US 2 Corridor Study
Final Report

Grand Forks, ND

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

KLJ

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Executive Summary

US Highway 2 is a highway providing regional mobility to tens of thousands of motorists each day. As a designated truck route it carries over half of North Dakota's 85 thousand tons of freight. The study area for this project extends five miles along US 2 from County Road 5/17th Street through the Interstate 29 (I-29) functional area, serving a diverse range of uses including the Grand Forks International Airport on the west end and commercial uses like Wal-Mart on the east end. The study highlighted improvements to six major focus areas: the Airport Drive intersection, I-29 functional area, traffic control, access management, the NPN site, turn lanes and bicycle and pedestrian facilities.

Airport Drive Intersection

The Airport Drive intersection is one of the most crash prone rural intersections in the entire state, one of only two high crash sites east of Bismarck, according to NDDOT databases. The crash tendencies at this intersection are common for rural signalized intersections on high speed corridors. Forty percent of crashes at the intersection are of the rear-end type where motorists decelerate very quickly. This is exacerbated by the fact that the 85th percentile speed along the corridor is 15 miles per hour above the posted speed limit; 30 percent of all crashes at the intersection involving speeding motorists. Furthermore, by 2040 the traffic signal operates deficiently according to local and state standards.

Based on technical analysis results and input from the Steering Committee and public, the Staggered T-Intersection Configuration scored highest in performance and support of the alternatives studied. The defining characteristic of this design is that the median and acceleration lane is used to convert far-side angle movements into merge movements. Intelligent transportation system (ITS) is also employed to reduce crash potential. This alternative provides the following benefits, impacts and costs:

- Safety: 67 percent reduction in crash potential
- Traffic Operations: 77 percent reduction to 2040 peak hour delays
- Environmental Impacts: No building impacts but property acquisition required
- Cost: $1,708,000
- Benefit/Cost Ratio: 19.6

This intersection is a prime candidate for Highway Safety Improvement Program (HSIP) funds. HSIP solicitation is sent out by NDDOT in October or November. Applications are reviewed between January and March and approval notices sent out in the fall. The timing of the HSIP funding cycle provides an opportunity for environmental documentation, right-of-way acquisition and design to occur before the first applicable HSIP cycle. It is recommended that HSIP be immediately pursued to lighten the financial burden of this project and be implemented as quickly as funds can be secured. It as additionally recommended that project development activities begin immediately to allow for a seamless transition into construction, if awarded in the first applicable HSIP cycle.

Interim Improvement Strategy

While project development occurs and funding is being secured for long-term improvements, it is recommended that dynamic speed display signs (DSDS) are installed to reduce speeds at the intersection. DSDS actively relay speed information to drivers and respond by flashing or changing colors of speeds that exceed predefined thresholds. It is also recommended that yellow and all-red clearance intervals are adjusted to reflect 70 miles per hour speeds. Both interim solutions are low cost and can be implemented immediately using local NDDOT funds.

Figure I: Study Area Map

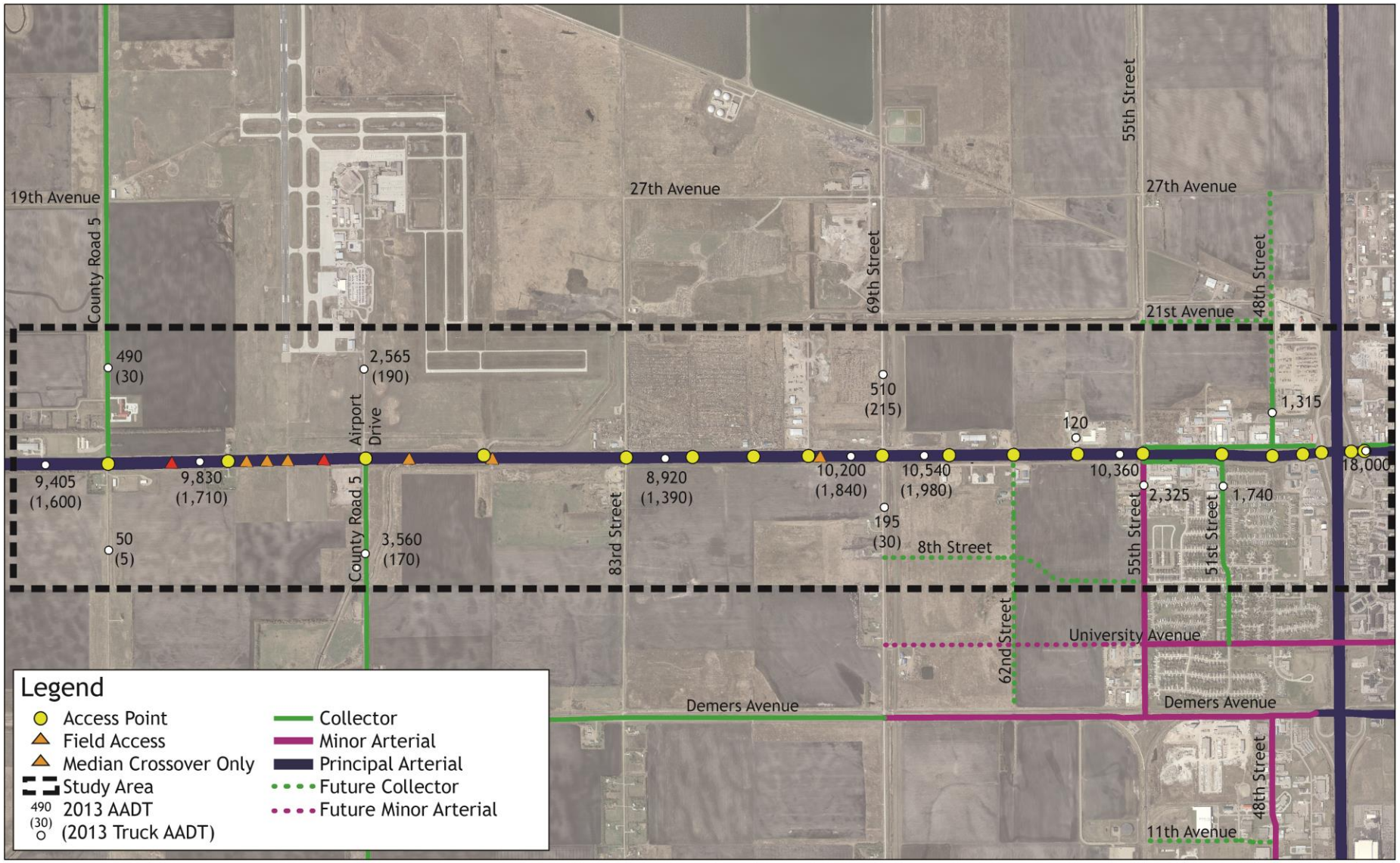
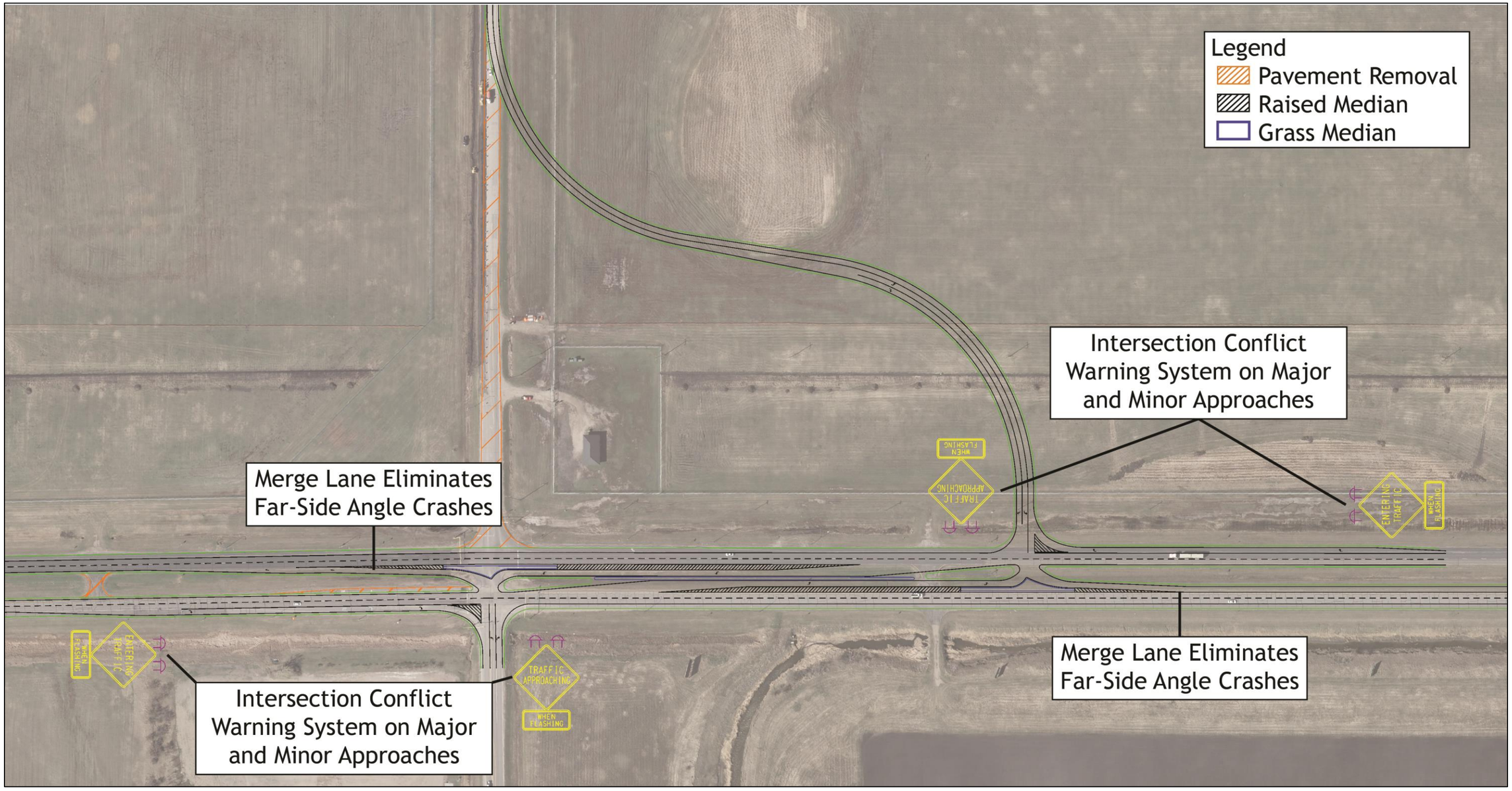


Figure II: Staggered T-Intersection Configuration Design



I-29 Interchange Influence Area

The I-29 interchange influence area refers to the section of US 2 between 43rd and 47th Streets that includes the I-29 interchange ramps. The I-29 East Ramp intersection creates a major bottleneck on US 2, operating at exceedingly deficient levels of service. Queuing from this intersection onto the interstate is common under existing conditions and unavoidable by 2040. The I-29 East Ramp intersection also generates queues across adjacent intersections, creating congestion and delay. Queueing on US 2 is a major challenge in the influence area due to proximity of four intersections located within a quarter mile. Congestion and queueing onto the interstate and across adjacent intersections contributes to an increased crash potential. Specifically, more than 40 percent of the crashes within the study area occur around the interchange, primarily during peak periods due to increased queues, delays and motorist frustration.

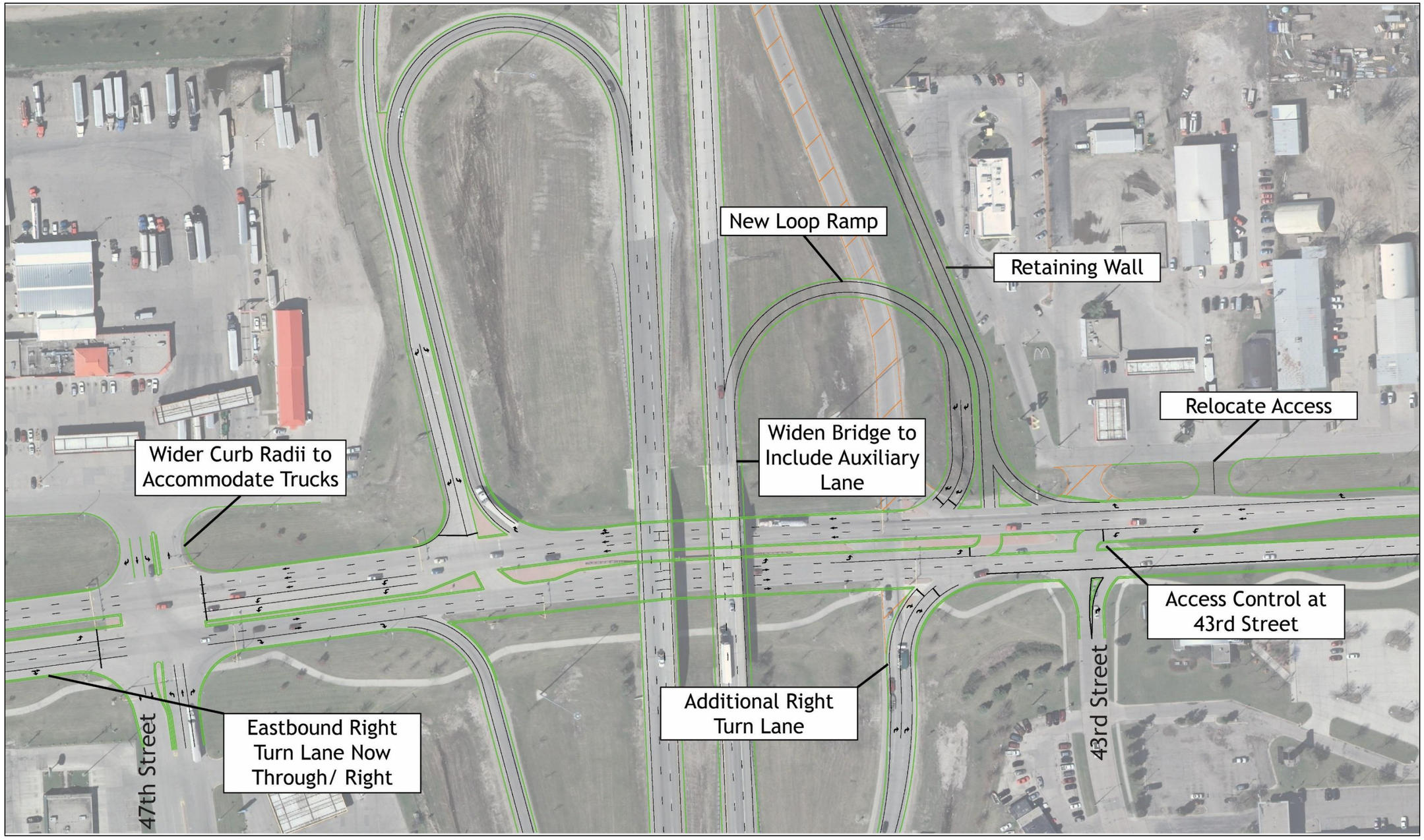
Based on technical analysis results and input from the Steering Committee and public, the highest scoring and most support alternative included a new loop ramp in the northeast quadrant along with a variety of turn lane additions and access restrictions at the East Ramp intersection and 43rd Street, respectively. Additionally, a retaining wall was designed for the I-29 northbound on ramp to separate the ramp from the McDonald's parking lot. The Northeast Loop alternative prevents northbound left-turns from conflicting with eastbound left-turn and through movements, effectively converting the traffic signal from three phases to two phases, increasing throughput. This alternative mitigates potential for queueing onto the interstate and across adjacent US 2 intersections, reducing conflict potential. Quantitatively stated, this alternative provides the following benefits, impacts and costs:

- Safety: 40 percent reduction in crash potential
- Traffic Operations: 20 percent reduction to 2040 peak hour delays
- Environmental Impacts: Minor wetland impacts with the new loop, access control at 43rd Street
- Cost: $6,342,000
- Benefit/Cost Ratio: 8.5

During the last Grand Forks – East Grand Forks Metropolitan Planning Organizations Long Range Transportation Planning (LRTP) process, it was determined that roadway needs far outweighed available funds. This produced a list of illustrative projects that did not fit into the fiscally constrained plan; North Dakota alone had $151,550,000 in unmet needs. It is unknown how this improvement ranks in terms of other local and state priorities. This project is not currently in the Transportation Improvement Program and will not likely be funded before the next LRTP cycle. It is recommended that this project be included in the universe of alternatives for the next LRTP and programmed based on this analysis.

Spillback from the east ramp intersection onto mainline interstate is common under existing conditions. However, capacity analysis using the calibrated simulation model indicates that optimizing signal timing should mitigate this deficiency for the near future. By 2025, it is unlikely that signal timing alone can resolve this issue. As an interim solution, it is recommended that the east ramp signal timing be revised to provide more green time for the northbound movements. Signal timing improvements are low cost and can be implemented immediately at the intersection level or during planned City-wide updates that occur approximately every five years.

Figure III: Northeast Loop Design



Traffic Control

The US 2 corridor has seen a spike in development interest in recent years, particularly between 55th and 69th Streets on the south side of US 2. This is highlighted by Wal-Mart, constructed in 2014 that already produces over nine thousand trips per day and the Adams Development, planned for future development with the potential for 26,000 new trips once fully built out. Access onto US 2 from this growth area is a major challenge during peak periods due to lack of traffic control. This results in deficient operations on the side streets with average vehicle delay increasing to several minutes by 2040, leading to motorist frustration and often risk taking behavior.

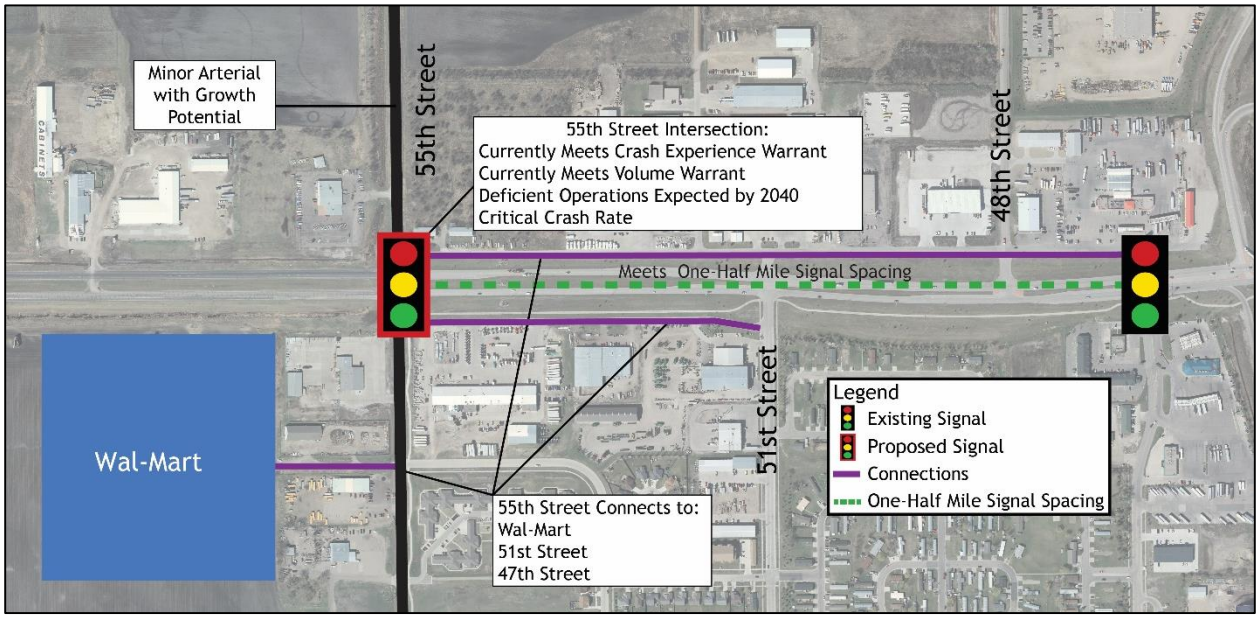
Currently, the intersections at 51st, Street, 55th Street and 58th Street meet traffic volume warrants for the installation of traffic signals. As illustrated by the congestion around the interchange, closely spaced signalized intersections often negatively impact traffic flow and safety. After technical analysis, discussion with the Steering Committee and the public, it was determined that 55th Street is the optimal location for a traffic signal, leaving 51st and 58th Street unsignalized.

A traffic signal at 55th Street will reduce congestion at not only 55th Street, a minor arterial with connectivity north and south, but also from adjacent congested intersections at 47th, 48th and 51st Streets due to the presence of frontage/backage roads. A signal at this intersection would also mitigate angle crashes, a problem that has made 55th Street the second highest crash rate location in the study area.

A new traffic signal would cost approximately $600,000. The relatively low cost of the new traffic signal at 55th Street allows this project to be funded in coming years. This project would be a joint venture by NDDOT and the City of Grand Forks. It is recommended this signal be considered as part of the next TIP development process and coordinated with NDDOT's Grand Forks District priorities for regional roads funding.

Furthermore, if planned development builds out by 2040 and expands west, it is likely that more traffic will utilize 62nd Street, potentially warranting a traffic signals at this location. While NDDOT prefers one mile signal spacing on rural corridors, as the corridor urbanizes, half-mile signal spacing will become acceptable. As development occurs and more is known about specific land uses and timing of development, a traffic impact study should be conducted to evaluate the impacts, which would include traffic control recommendations.

Figure IV: Benefits of 55th Street Signal



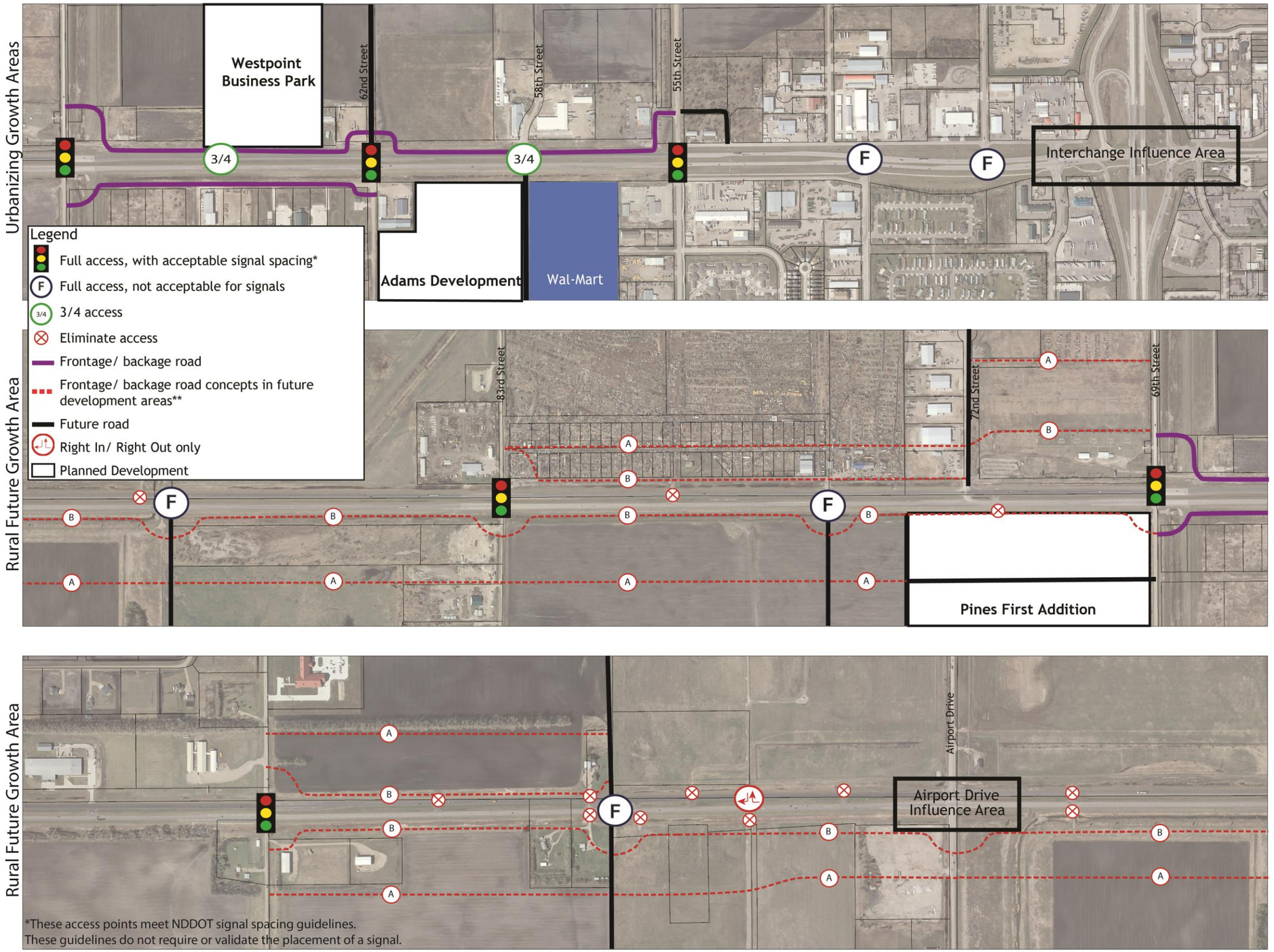
Access Management

Access density is directly correlated with crash potential and traffic progression. The recent reinvigoration of development along the corridor makes it critical to provide a proactive and thought-out access plan to balance development needs with the mobility and safety needs of the roadway. On review of technical findings, the Steering Committee and public agreed to implement a frontage/backage road configuration.

Once the access management framework was determined, a final alternative could be developed and refined. At this level of detail, decisions regarding specific access points could be made. To complete this task, the corridor was split into three segments:

- Built Out Urban Area. This area includes US 2 from the interchange influence area to 55th Street. Access in this area was studied when this roadway section was urbanized. No improvements were identified in this area.
- Urbanizing Growth Area. This area includes US 2 between 55th Street to 69th Street, the major growth area over the next 25 years. The frontage/backage road designs were developed to consider current parcel configurations and prepare the corridor to be urbanized in the future. Specifically, ¾ access points were included between full access points and signal spacing was reduced to one-half mile. The addition of ¾ access points and half-mile signal spacing would not be applicable until the corridor is urbanized; until that time the corridor should maintain a rural nature.
- Rural Future Growth Area. This area includes US 2 from 69th Street to the west study area limit (County Road 5/17th Street). This area is not forecasted to experience notable development until beyond 2040. Thus, specific alignments for frontage and backage roads were not defined. Rather, alignment alternatives for frontage and backage roads were presented to provide an understanding of access restrictions for developers interested in this land. This approach allows for a clear understanding of where access is permitted while allowing for flexibility in final frontage/backage road design for developers. Once developed, this section of US 2 should follow the one-half mile signal spacing and one-quarter mile ¾ access spacing as laid out in the Urbanizing Growth Area.

Figure V: Proposed Access Management Plan



NPN Fertilizer Production Site

Northern Plains Nitrogen (NPN) has plans to construct a nitrogen fertilizer plant northwest of Grand Forks. This development was not considered in the LRTP. Initial estimates show NPN generating 336 trucks per day during the peak season (April through May and October through November) and 250 passenger cars per weekday year round. Considering the magnitude of the NPN development, the trip generation is very modest on a square foot basis.

97 percent of traffic generated from the site would be attracted south toward US 2. Technical analysis, Steering Committee and public input all agreed that 69th Street is the optimal route to access NPN from US 2. This route would impact fewer properties in the event of an anhydrous ammonia spill, cost less to upgrade and has no railroad complications, unlike 55th Street. The only advantage to 55th Street is the proposed traffic signal at US 2. This advantage is nullified once future traffic from development warrants a signal at 69th Street. The three percent of trips attracted north would have minimal impacts to the transportation system due to low trip generation and existing traffic volumes in the area.

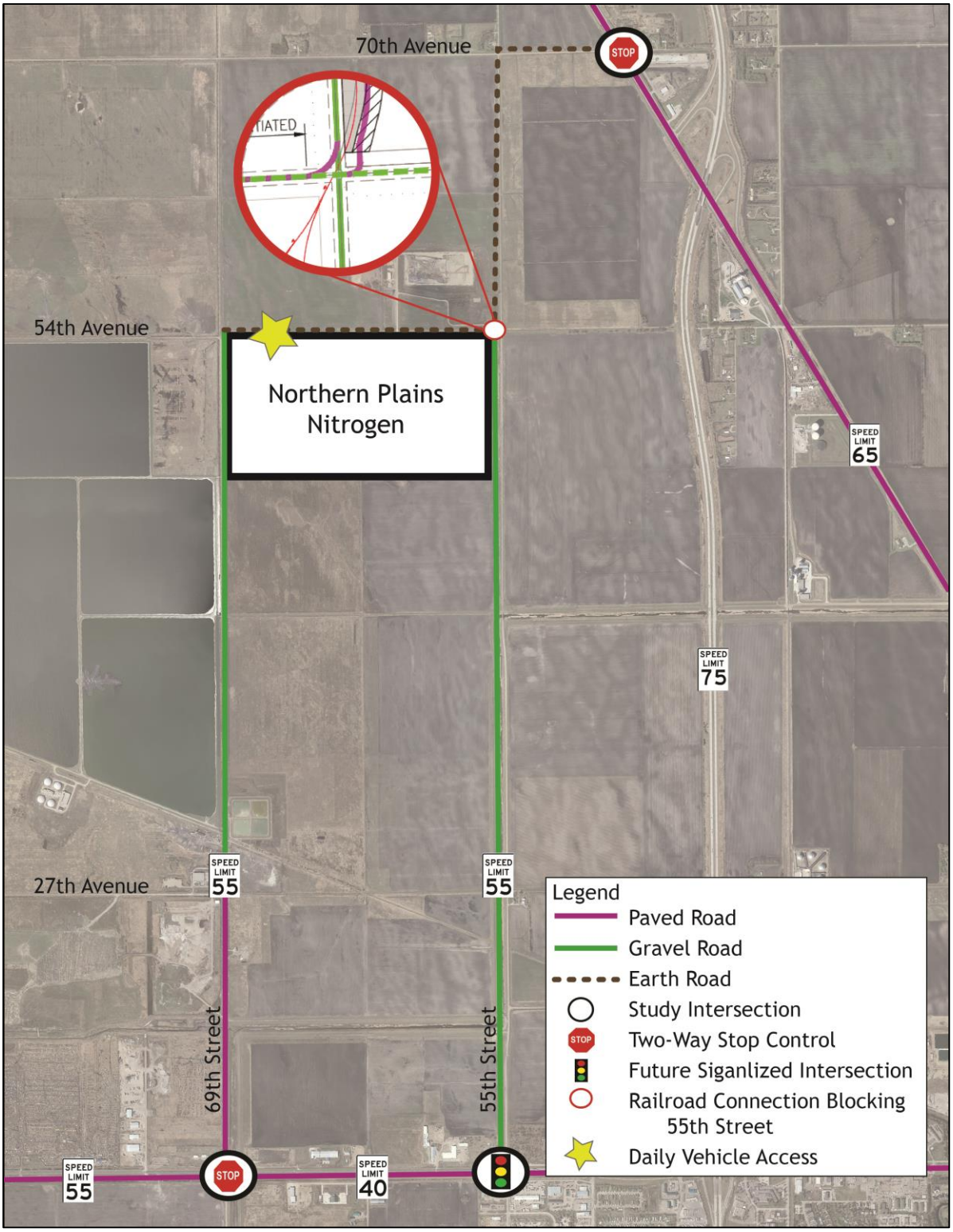
Improvements to 69th Street to accommodate the NPN development would cost approximately $2.67 million, including pavement of 69th Street and 54th Avenue as well as constructing a southbound right turn lane from 69th Street onto US 2. This would be a joint venture between City of Grand Forks and NPN. Detailing the specific cost participation of each party will require negotiation and is outside the scope of this study. These improvements will be required prior to completion of the NPN development. This schedule was not known at the time this study was completed.

Turn Lanes

The addition of turn lanes adds capacity and improves safety by clearing slowed or stopped vehicles making turning movements out of the through lanes. To identify where turn lanes can provide the greatest benefit to the study area, recommendations are provided on two different analysis. The first using volume and crash criteria from guidelines provided by NDDOT. For the urban section of the corridor, where speeds were lower than 50 miles per hour, and on side streets, Synchro software was used to identify locations where turn lanes could improve level of service. Turn lane recommendations at the Airport Drive/ County Road 5 intersection and the interchange influence area can be found in their respective chapters of the reports. Turn lanes should be considered at

- 51st Street ($15,000). Northbound and southbound right turn lanes can fit within the existing roadway footprint and are warranted under existing traffic volumes. These turn lanes should be implemented during the next cycle of roadway striping.
- 55th Street ($327,500). Currently a westbound and northbound right turn lane is warranted under existing traffic volumes and an eastbound left turn lane will be warranted by 2025. These turn lanes should be implemented during the NDDOT Turn Lane project or traffic signal project, whichever comes first.
- 58th Street and 64th Street ($750,000). Left turn lanes to accommodate a ¾ access should only be implemented once the corridor has urbanized and frontage road access has been established to allow for restricted access at these locations.
- 69th Street ($70,000). A southbound right turn lane should be implemented as part of the NPN roadway project improving 69th Street.

Figure VI: NPN Site



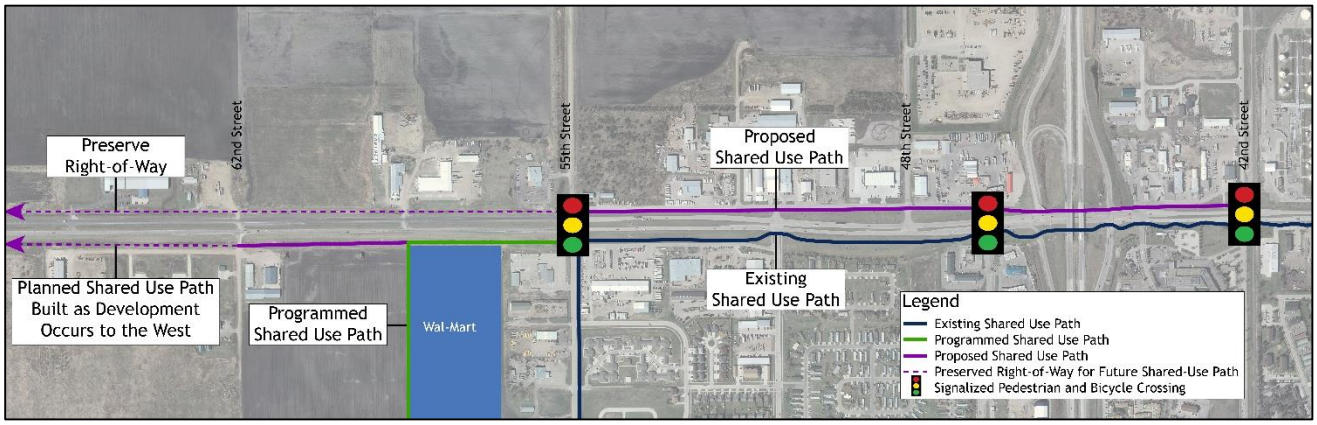
Pedestrian and Bicycle Improvements

The onset of recent commercial and residential development increases the necessity to provide pedestrian and bicycle facilities to major existing and future generators. Currently, only 10 percent of the corridor has pedestrian and bicycle specific facilities (counting both sides of the corridor). Additionally, there are no pedestrian and bicycle crossings across US 2 within the study area.

There was no clear preference on the provision of bicycle and pedestrian facilities on the corridor. The Steering Committee preferred facilities on both sides, while the public preferred facilities only on the south side. Land owners primarily rejected shared use paths on the north side because they opposed potential assessments. AASHTO guidance discourages shared use paths on only one side because it is counter to driver expectancy. Furthermore, the 2040 LRTP has extensive goals and objectives for the bicycle and pedestrian network in the Grand Forks metro area. For these reasons, the proposed alternative:

- Provides facilities on the south side of US 2, constructing paths as development occurs to the west.
- Could provide facilities on the north side of US 2 between 42nd Street and 55th Street, in coordination with the roadway rehabilitation projects planned in 2026 (I-29 to Columbia Drive) and 2029 (55th Street to I-29).
- Preserves enough right-of-way along the north side of the corridor west of 55th Street that future provision of facilities could occur or when financial assistance could increase support.
- Provides signalized crossings at existing and planned signals located at 42nd Street, 47th Street and 55th Street. All future signals along the corridor would facilitate signalized pedestrian crossings.

Figure VII: Proposed Bicycle and Pedestrian Facilities



Introduction

Background

US Highway 2 (US 2) is a principal arterial providing regional mobility to tens of thousands of motorists, connecting the west coast to as far east as Michigan. It is a designated truck route, helping to carry over half of North Dakota's 85 thousand tons of freight (2040 GF-EGF LRTP). The corridor is incredibly diverse. Beginning in the westernmost section of the corridor at 17th Street Northeast/County Road 5, US 2 is a four lane divided highway with a posted speed of 70 miles per hour and limited access points. US 2 transitions to an urban corridor with curb and gutter, densely spaced access points with traffic control signals and a posted speed of 35 miles per hour. The corridor serves the Grand Forks Regional Airport on the west side and industrial and commercial uses like Wal-Mart on the east side.

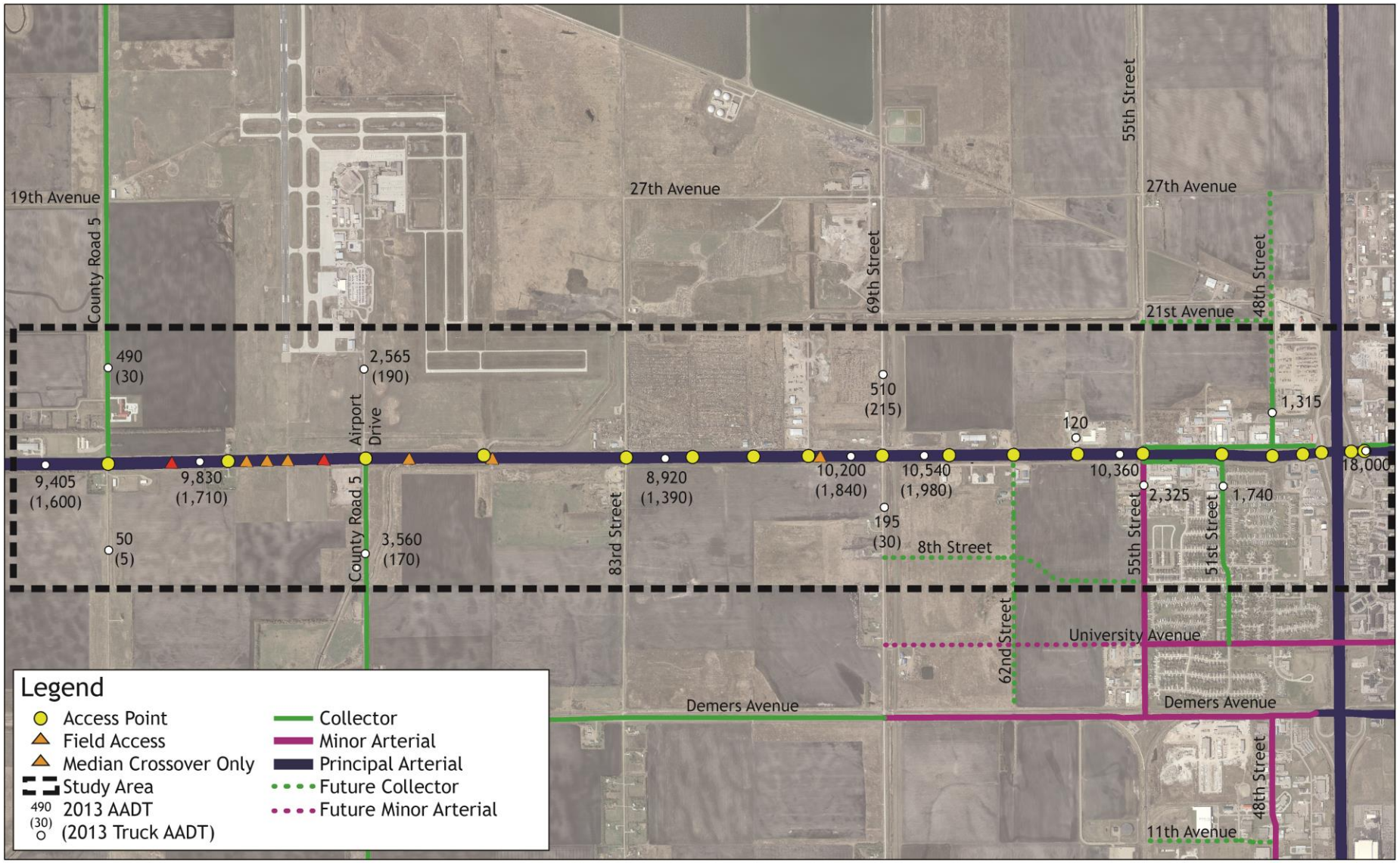
Figure 1: On the Corridor. Airport Drive (Top), Wal-Mart (Middle) and 47th Street Intersection (Bottom)

The corridor's diverse personality produces deficiencies rarely seen in such a compact area. On one end of the corridor, the most prevalent deficiency is crash susceptibility related to the high-speed interstate-like design of the corridor. On the other end of the corridor, congestion caused by closely spaced traffic signals, dense access spacing and development is the primary issue.

New and proposed development is placing new demands on this corridor. The new Wal-Mart, completed in early 2014, already produces over nine thousand trips per day. Wal-Mart is spurring development along the corridor and each new site requires access. Development of an access management plan is critical to provide a thought-out and logical access plan to balance development access needs with the mobility needs of the roadway. Beyond access, the increased traffic from new developments has the potential to lead to congestion, with implications to safety and efficiency.

The purpose of this study is to evaluate existing and future conditions of the corridor to identify the strengths of the corridor as well as opportunities for improvements in the areas of access management, safety and efficiency. The technical analysis will be supplemented by stakeholder input occurring early and often throughout the process. A diverse Steering Committee, comprised of local government officials and business owners, will be asked for comments and ideas to guide the final recommendations.

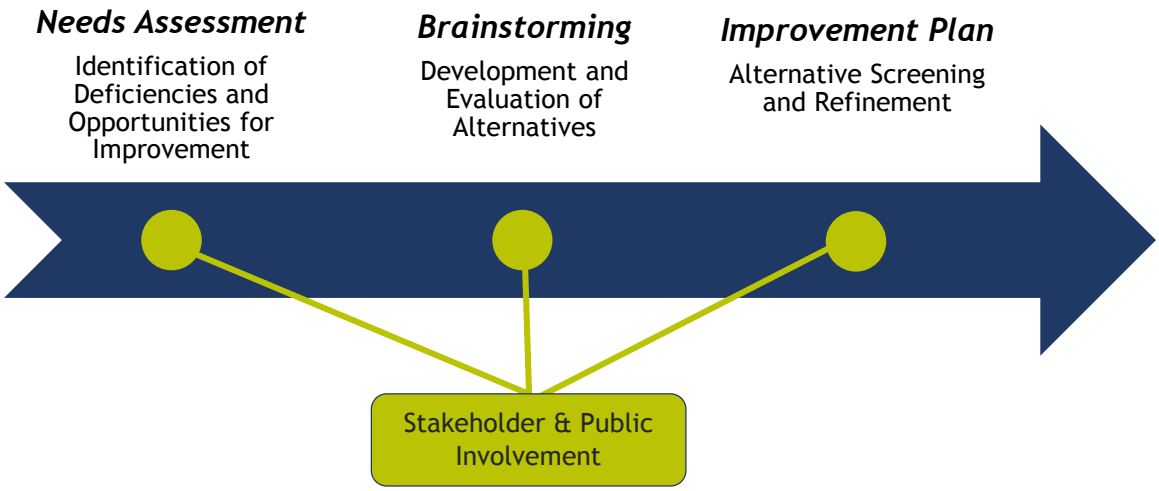
Figure 2: Study Area Map



Study Approach

The study approach is simple, with many levels of complexity engrained within each step. Each step will be detailed within its respective chapter or associated appendix. Figure 3 below highlights the process.

Figure 3: Public Involvement Process



Every step in the study approach included a Steering Committee and public input meeting. Details regarding the Steering Committee and public input meetings, including dates, locations, minutes, attendees, presentation materials and comments received can be found in Appendix H.

Steering Committee

The Steering Committee was a diverse group of stakeholders with varying interests along the corridor. Each of the three Steering Committee meetings began with a presentation, often including technical details of analysis and discussion. The Steering Committee was given the opportunity to identify additional deficiencies and provide feedback on technical analysis during the needs assessment and discard alternatives, suggest refinements and recommend alternatives during the brainstorming phase. Comments received from these meetings have been embedded into the corresponding sections of the report. Members of the Steering Committee included:

- FHWA North Dakota
- NDDOT Grand Forks District
- NDDOT Local Government
- GF-EGF Metropolitan Planning Organization
- Grand Forks Airport Authority
- Grand Forks County Engineering
- Grand Forks County Planning and Zoning
- Grand Forks Region Economic Development Corporation
- City of Grand Forks Engineering
- City of Grand Forks Planning and Community Development
- RDO Equipment, business representative
- New Vision Truck, business representative
- Northern Plains Nitrogen

STEERING COMMITTEE MEETING 1

The first Steering Committee meeting was an overview of the study and public input process, identification of major study areas, issues and a discussion of the members' biggest concerns along the corridor.

STEERING COMMITTEE MEETING 2

The second Steering Committee meeting was a value planning workshop. Improvement alternatives were developed for focus areas, including the Airport Drive/County Road 5 intersection, the US 2/I-29 interchange, access management, traffic control and bicycle and pedestrian facilities. The Steering Committee was then asked to weight planning factors for the Airport Drive/County Road 5 intersection and the US 2/I-29 interchange, including cost, safety, environmental impacts and traffic operations. These weights were applied to technical analysis and the alternatives were ranked. For the other study areas, the committee was asked to rank the alternatives.

Refinements suggested by the committee were then made to the top ranked alternatives.

STEERING COMMITTEE MEETING 3

The third Steering Committee meeting included a summary of recommendations made for each of the focus areas. Refinements made based on Steering Committee meeting two and public input meeting two were presented and discussed. This meeting also included presentation and discussion of implementation and funding strategies for each alternative.

Figure 4: Presentation at Public Input Meeting

Public Input Meetings

Each of the three public input meetings were held after the Steering Committee meeting for that part of the process. The public input meetings were purposefully less technical and designed to be shorter. Each public input meeting included an open house element, where attendees could review materials and leave comments, and a formal presentation with opportunities for discussion. Comments received at public input meetings have been incorporated into recommendations and embedded throughout the report.

PUBLIC INPUT MEETING 1

Public input meeting one was a two part process. The first part was one-on-one meetings with property owners along the corridor. Flyers were sent to all property owners, and then phone calls were made to follow up and schedule meetings with those owners who were interested. The second part of the process was an open house and formal presentation. Major issues along the corridor were highlighted and the public was given the opportunity to identify specific deficiencies.

PUBLIC INPUT MEETING 2

Similar to Steering Committee meeting two, improvement alternatives to the focus areas were presented and the public was given the opportunity to rank alternatives and discuss refinements. Input and refinements were incorporated into the final recommendations.

PUBLIC INPUT MEETING 3

Final recommendations including comments and refinements were presented. This was the public's final opportunity to comment on alternatives before the plan was sent for approval. This meeting also included presentation and discussion of implementation and funding strategies for each alternative.

EXISTING AND FUTURE CONDITIONS

Existing and Future Land Use

The US 2 corridor is currently zoned primarily for agricultural and industrial uses with some residential zones south of US 2. Since the opening of Wal-Mart at 58th Street, the area has seen increased interest in development. Existing and future development will have direct impacts on the operations of US 2 and the roads that feed into it.

Future Land Use

The City of Grand Forks' 2040 Future Land Use Plan converts much of the agricultural land directly adjacent to the corridor between 55th Street and 83rd Street, north and south of US 2, to industrial uses. As this transition occurs, the corridor will continue to see heavy truck traffic and growing passenger vehicle traffic.

The 2040 Future Land Use Plan identified the US 2 corridor between 55th Street to Airport Drive/ County Road 5 as "Pilot Area 3". This area was selected because it is an older industrial corridor with existing mixed uses and an active business community already pursuing corridor beautification. The results of the pilot planning initiative was corridor appropriate plans considering land use, infrastructure and open space.

- Land Use. All new developments must comply with Grand Forks International Airport regulations and be compatible with the existing mixed uses along the corridor. To update older properties and facilitate more cohesive designs for new properties, building design, placement and landscaping recommendations were made.
- Infrastructure. With strict access guidelines throughout the corridor, new and existing sites will be required to use frontage and backage road approaches for building design. Additional stormwater management facilities will be designed to be an open space amenity.
- Open Space. Realigning the diversion channel along 69th Street can create a community green space.

PLANNED DEVELOPMENTS

Proposed development, planned for construction in coming years, along and adjacent to the corridor includes a major mixed-use development and an industrial development.

- Adams Development. The Adams Development is a major mixed-use development that will include a mix of single and multi-family homes, a commercial and light industrial area. This land would require utilities to allow for development.
- Westpoint Business Park. The Westpoint Business Park, including Steffes Corporation, is seeking to rezone the parcels north of US 2 between 62nd Street and 69th Street to Heavy Industrial to facilitate the expansion of Steffes Corporation. This subdivision will require additional infrastructure including paved roads at 62nd Street and new stormwater ponds and conveyance.

Figure 5: Growth Areas

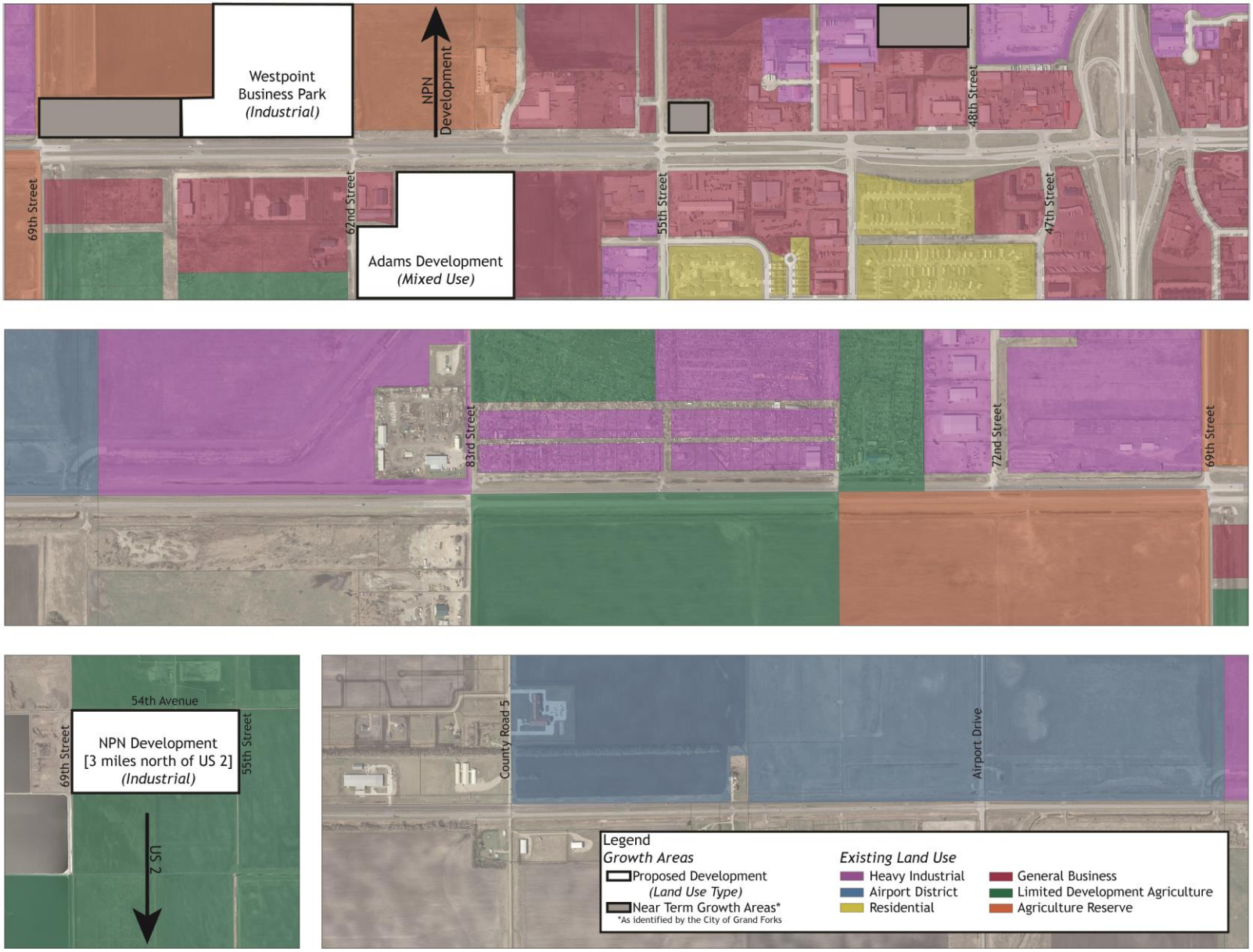


Figure 6: Employment and Housing Growth

The Long Range Transportation Plan (LRTP) includes new trip generation in the areas noted above. The growth area with the greatest traffic production and US 2 impact potential is the Adams Development. The LRTP forecasts 7,810 new trips for this site. Developing assumptions for commercial, residential and industrial land use densities by reviewing surrounding developments, a trip generation value of 26,500 was determined. The LRTP forecasted that the Adams Development will only build out to approximately 30 percent of its potential by 2040.

This trip generation determined for the Adams Development could greatly deviate based on specific land uses, which produce varied pass-by rates and internal capture rates. For example, a gas station relies primarily on trips already on the network passing by the development, while a sit-down restaurant draws largely from the adjacent land uses.

As these developments progress and more is known regarding specific land uses and timing of development, traffic impact studies should be conducted to evaluate the impacts they will have on traffic along US 2.

NORTHERN PLAINS NITROGEN

Northern Plains Nitrogen (NPN) has plans to construct a nitrogen fertilizer plant northwest of Grand Forks between 40th Avenue North and 54th Avenue North and 55th Street North and 69th Street North. This location is near the City of Grand Forks' Sewage Disposal Ponds and the Municipal Solid Waste Landfill. This development is unique in that it was not included in the LRTP Travel Demand Model (TDM). For this reason, this site was evaluated much closer than the previous developments as a supplement to LRTP generated traffic forecasts.

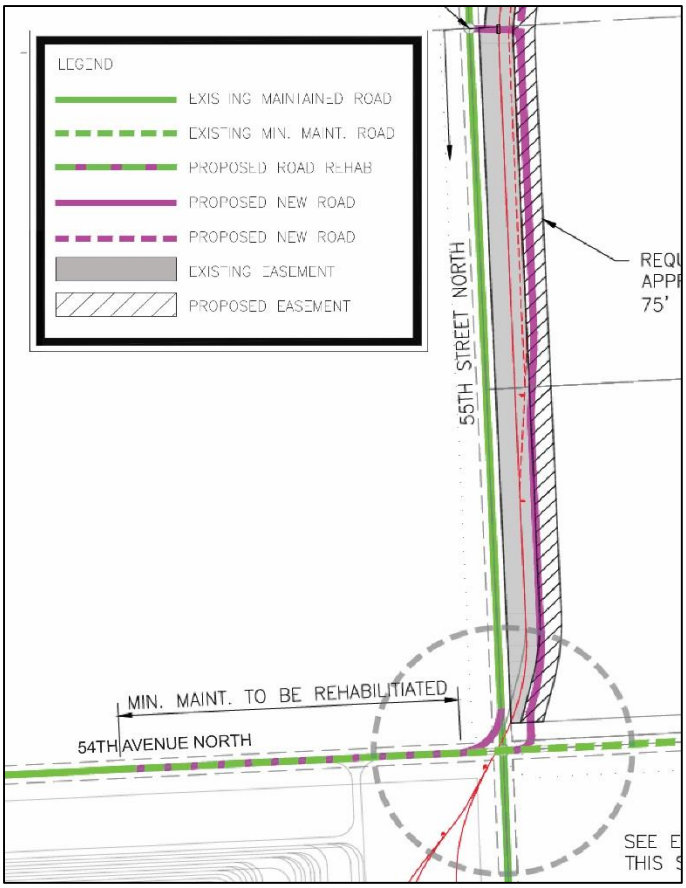
NPN has the capacity to produce more than 1.5 million tons of fertilizer each year, shipping it on a combination of rail and trucks. This results in 60,000 truck trips annually, and just over 330 daily with seasonal operations. They also expect to employ up to 172 people from shift workers to administrative office staff. Based on their expected operations, NPN will add more than 130 trips to both the A.M. and P.M. peak hours.

None of the roads accessing this site are fully paved, which will be troublesome when trucks are loaded to 40 tons and the plant is fully operational during peak seasons. A traffic operations study, found in Appendix A, has been completed to select a primary route to and from the site that considered:

- Impacts to site generated vehicle miles traveled and vehicle hours of delay
- Impacts to traffic operations on US 2
- Varying roadway improvement needs to accommodate new truck traffic
- Impacts to adjacent land uses due to the hazardous materials being routed to and from the site

Access north of the NPN site is complicated by BNSF rail accommodations, as illustrated in Figure 7. The rail connection to the BNSF mainline intersects 55th Street at an angle. When product is being loaded onto a unit train (85 cars of approximately one mile in length), the 55th Street railroad crossing would be blocked for six to eight hours, maximum 12 hours. To facilitate traffic during this period, BNSF will require NPN to build a new roadway that parallels the track and reconnects to 55th Street, where the unit train would not be queued. Although this provides an alternative route, this new route is quite circuitous if traffic has an origin or destination at NPN. It is forecasted that one unit train would arrive at the NPN site per week on average, blocking 55th Street for six to 12 hours once a week.

Figure 7: North Access to NPN Site



Existing and Future Traffic Volumes

The Grand Forks-East Grand Forks Metropolitan Planning Organization (GF-EGF MPO) collected turning movement counts at 14 major intersections and driveways during spring 2014. This data was supplemented with turning movement counts at four additional locations, as well as a speed study west of Airport Drive/County Road 5. These counts were extrapolated to provide average daily traffic (ADT) and can be seen in Figure 8.

Existing Traffic Data

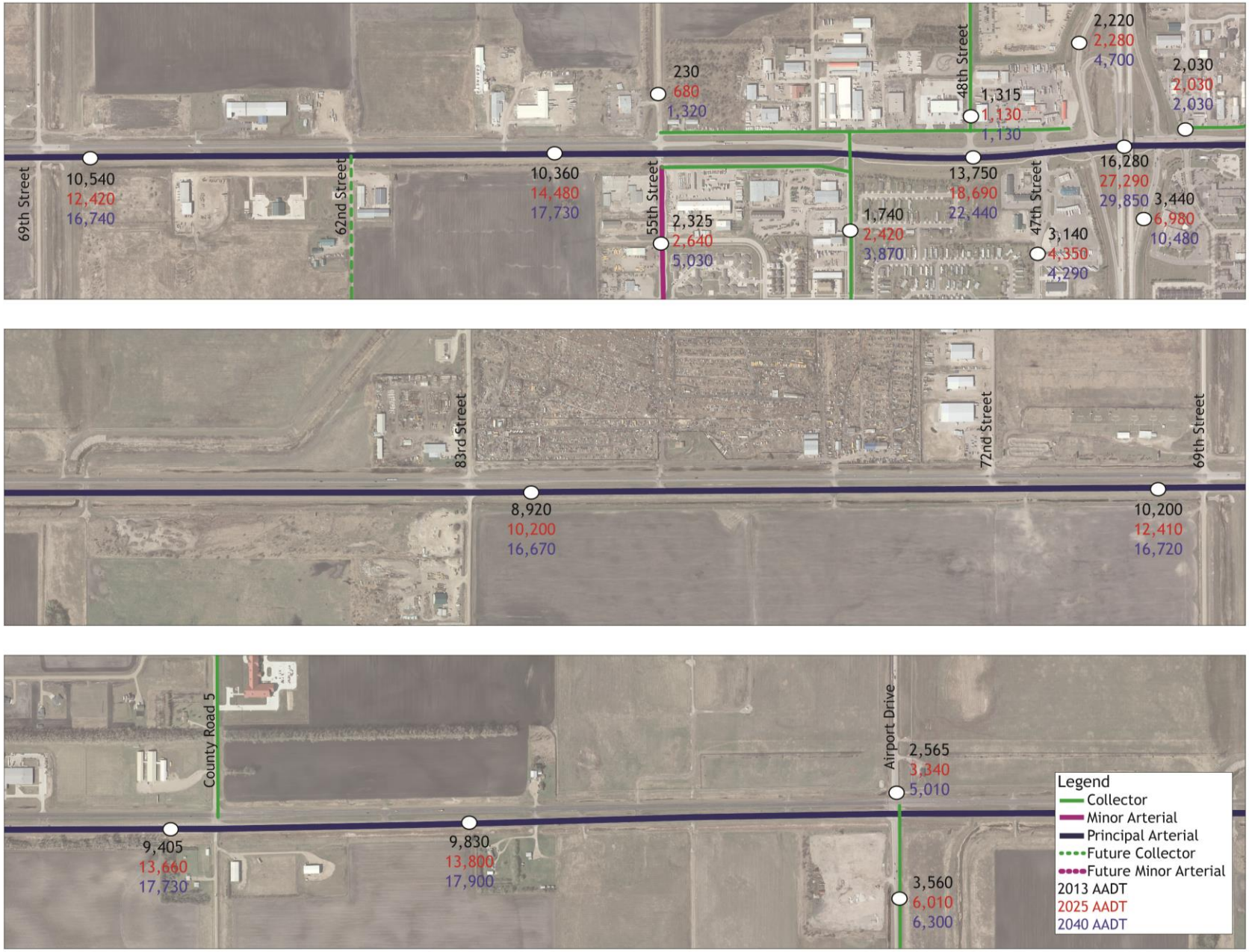
Using the data collected, it was observed that the traffic volumes nearly double from the west end of the corridor at 9,405 ADT to the east end of the corridor at 16,000 ADT. US 2 is a National Highway System route and is designated as a "Super Haul-Expanded Envelope Corridor". This corridor serves as an important gateway for international trade from Canada via Interstate 29. This produces heavy truck traffic, approximately 10 percent, throughout the corridor.

Forecasted Traffic Data

The TDM for the GF-EGF MPO was updated as part of the 2040 LRTP development process. The TDM incorporates existing and expected socioeconomic data and existing and expected roadway facilities to forecast traffic volumes. This model provides traffic forecasts for the study corridor for years 2025 and 2040.

TDMs often under-produce forecasts on the fringes of a metropolitan area, similar to the US 2 corridor, due to uncertainty of traffic volumes to and from external origins and destinations. Since 1990, the Grand Forks Air Force Base has had a declining population, something that has contributed to the decline in traffic volumes to and from the external origins and destinations. However, a major new development is planned for the Base that will include 18 new buildings and employ 3,000 people.

Figure 8: Existing and Future Forecasted Traffic Volumes in Study Area



Refer to Appendix C for a full description of the traffic forecast adjustments. Construction of the development will occur in phases, to be completed by 2030. If, for some reason, these plans stagnate, 2040 forecasted volumes could be overstated up to 34 percent. At the time of this report, it is fully anticipated that this development will occur and including it provides a conservative look into forecasted traffic volumes. Additional socioeconomic and traffic information from new developments unknown during the development process, like NPN, was also added to the TDM. Adjustments to the TDM outside of the study area was beyond the scope of this study and not evaluated.

Traffic Operations

Corridor capacity was gauged via bottleneck analysis at each existing or forecasted high volume intersection along the corridor (15 total). Intersection capacity analysis was evaluated in terms of delay and level of service (LOS). Level of service is a term used to describe the operational performance of transportation infrastructure elements. Essentially, LOS is a grade value that corresponds to specific traffic characteristics within a given system. 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, an LOS "A" or "B" is desirable, with LOS "C" being the minimum acceptable threshold value. The GF-EGF MPO accepts LOS "D" as the minimum acceptable value, but strives for LOS "C". To be conservative, LOS "D" was considered deficient, only acceptable when other alternatives were not available or cost effective.

Table 1: HCM Level of Service

Control Delay (sec/veh)		Volume < Capacity	Volume > Capacity
Unsignalized	Signalized		
≤ 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
> 10 - 15	> 80	F	F

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 Highway Capacity Manual (HCM). HCM capacity analysis is an industry and NDDOT standard. Improvement alternatives that involve potential merging, diverging, weaving and queueing complications were evaluated using Vissim microsimulation models. Vissim is a more comprehensive microsimulation tool that requires substantially more effort to develop and calibrate. Specifically, improvement strategies at the US 2/I-29 interchange and the US 2 and Airport Drive/County Road 5 intersection required this level of analysis.
- Signal Timing. Where available, existing signal timing information was used. This provides a more accurate representation of the existing traffic operations. Where unavailable, signal timing plans were optimized using standard industry practice. Future timing plans were optimized to account for variations in traffic.

Capacity Analysis

Under existing conditions, the corridor has little congestion. All intersections operate at LOS "B" or better during both the A.M. and P.M. peak. There are some deficient approach levels of service, which is common at stop controlled approaches on arterials with heavy through traffic, like US 2.

By 2025, the corridor begins to operate deficiently with intersections at LOS "E". Both minor approaches at the intersection of US 2 and 55th Street, US 2 and County Road 5/17th Street and US 2 and 58th Street operate at LOS "E" or "F" during the P.M. peak. Deficient approach levels of service is common at stop controlled approaches on arterials with heavy through traffic like at US 2 and County Road 5/17th Street. Queueing begins to become an issue by 2025. US 2 and 55th Street, US 2 and 51st Street and US 2 and 47th Street have queues that block the frontage road. Additionally, queues at the westbound approach at the US 2 and I-29 intersection extend into the intersection at 43rd Street during both the A.M. and P.M. peak hours. These intersections are only about 250 feet apart.

Figure 9: Queues Blocking Adjacent Intersections

By 2040, the operations along the corridor fail at four intersections during the P.M. peak: US 2 and 55th Street, US 2 and 51st Street, US 2 and I-29 East Ramps and US 2 and 43rd Street. The average per vehicle delay at these intersections exceeds three minutes, sometimes approaching nine minutes. Queues at these intersections exceed 200 feet at all locations and 500 feet at US 2 and 55th Street. Queues on the I-29 East Ramp extend onto I-29 creating major safety deficiencies (Figure 9). Beyond these three intersections, queues at US 2 and 47th Street, US 2 and the I-29 East Ramps and US 2 and 42nd Street block turn lanes, limiting the overall capacity potential of the intersection.

To prevent queues backing up onto I-29, signal timing was adjusted to give more green time to vehicles exiting the interstate. This caused backups throughout the network, extending past 42nd Street on the east side and 47th Street on the west side of the US 2 and I-29 East Ramp intersection. Westbound queues at 43rd Street extend for more than one-third mile with vehicle delay exceeding six minutes per vehicle, while eastbound queues at 47th Street also extend for more than one-third mile with vehicle delay exceeding five minutes per vehicle.

Refer to Figures 10, 11 and 12 for traffic operations for existing and years 2025 and 2040.

Turn Lanes

The addition of turn lanes adds capacity and improves safety by clearing slowed or stopped vehicles making turning movements out of the through lanes. NDDOT provides warrants for the installation of turn lanes based on three criteria: volume, crash and engineering judgment. For roadways with speeds 50 miles per hour or greater, turn lanes are generally considered warranted when turning volumes exceed 75 passenger car equivalence. This equivalence factor puts a greater weight on trucks making turning movements because they may have a more difficult time crossing conflicting traffic.

NDDOT recently completed a traffic operations study for a nearly 60 mile stretch of US 2, which included the majority of high-volume study area intersections. Recommendations generated by the NDDOT study included new turn lanes as well as turn lane extensions. This study was to be used for a turn lane construction project planned for 2016; this project has since been abandoned in favor of a safety project outside the Grand Forks area.

The information provided in the NDDOT study only accounted for mainline US 2 turn lanes. This information will be updated with current assumptions developed as part of this corridor study and also include analyses and recommendations on the side streets. Turn lane needs are contingent upon context and control. For example, the turn lane needs at a full access signalized intersection is different than an unsignalized ¾ access point. Thus, turn lane warrants and analyses were considered once baseline recommendations were established. This can be found in the Turn Lanes Focus Area chapter of the report.

Figure 10: Existing Traffic Operations

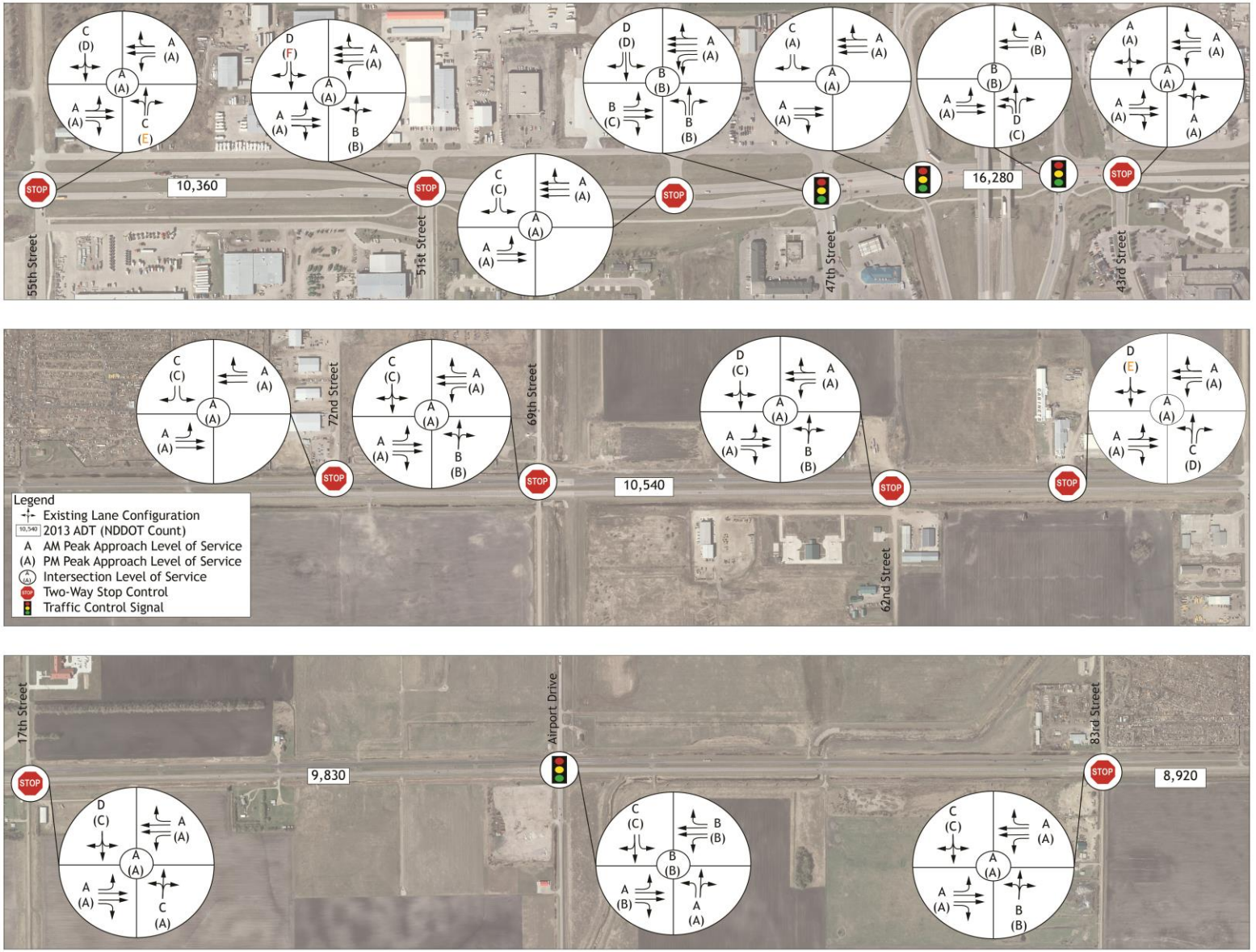


Figure 11: 2025 Traffic Operations

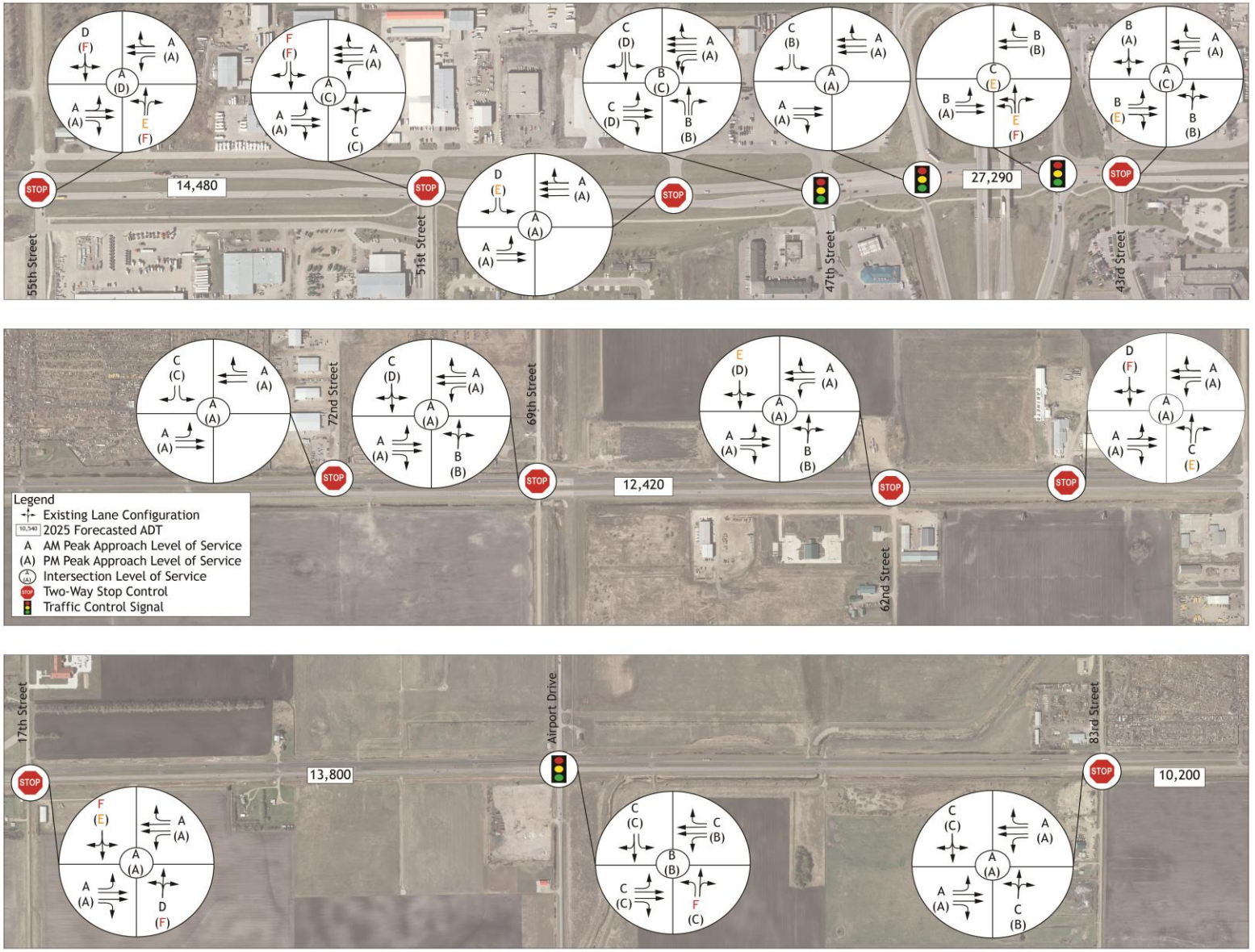
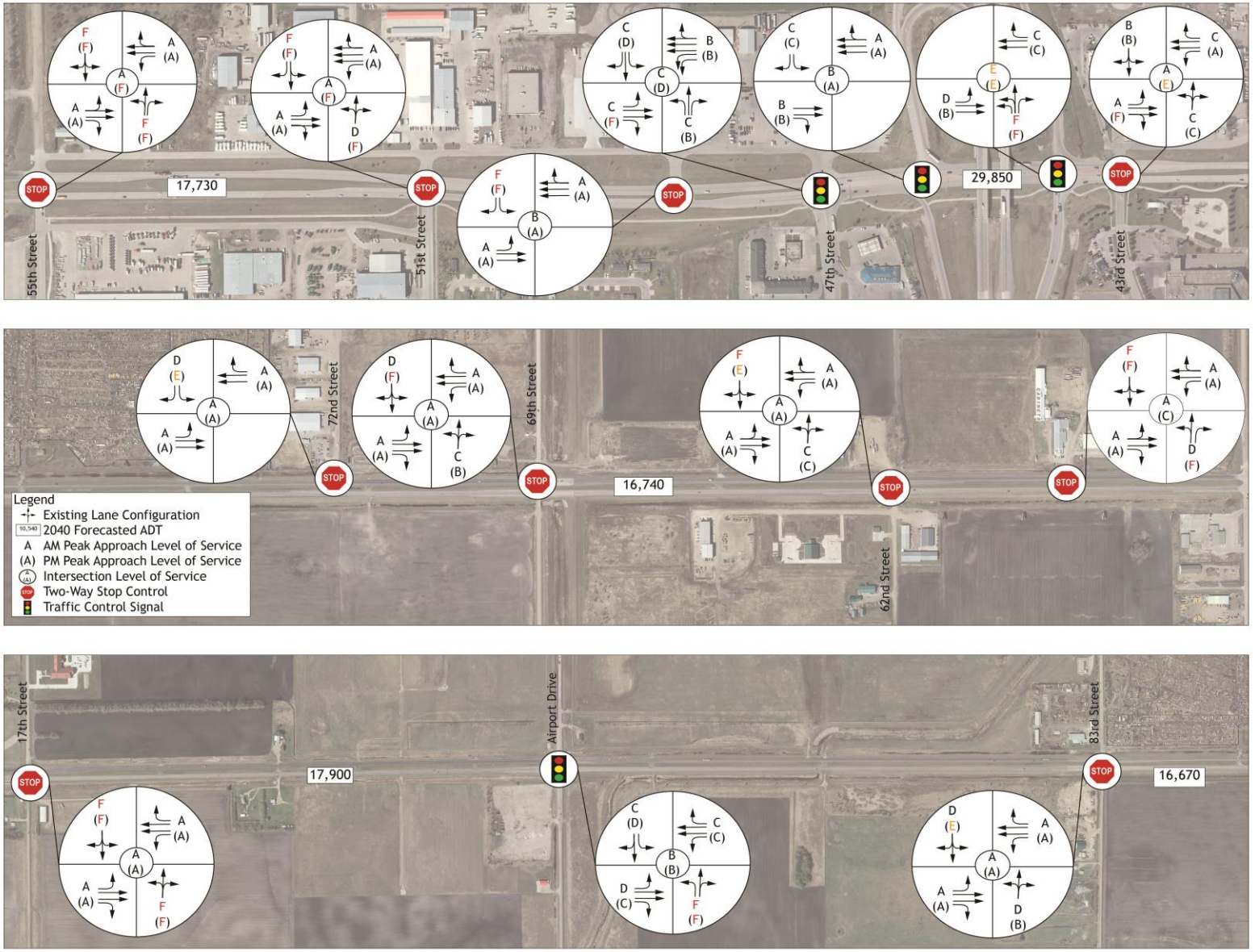


Figure 12: 2040 Traffic Operations



Traffic Control

Figure 13: Traffic Signal at US 2 and 47th Street Intersection

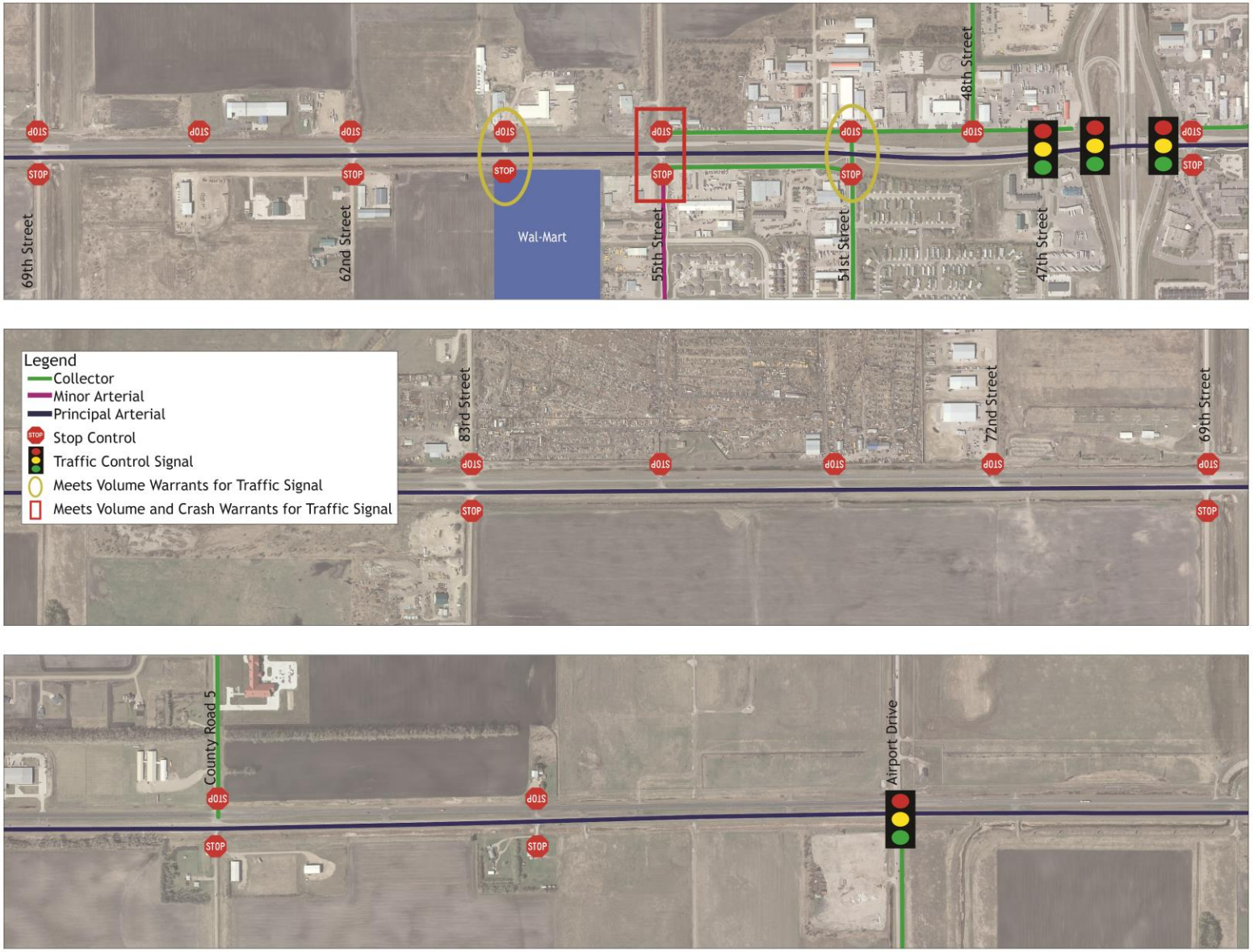
Appropriate traffic control is essential for efficient traffic operations and crash mitigation. The US 2 corridor includes two types of traffic control: traffic signals and stop control on minor approaches. Figure 14 illustrates the existing traffic control within the study area.

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

Collected turning movement counts were used to evaluate traffic control. The following is a summary of the traffic control analysis under 2014 and 2040 traffic conditions:

- All-way stop control was not studied in this corridor due to the poor operations and progression induced by this traffic control type along the corridor.
- All local roads (excluding driveways) that meet two-way stop control warrants have stop control on the minor approaches.
- There are traffic control signals at four intersections along the corridor; all are warranted with existing traffic volumes.
- The intersections of US 2 and 51st Street, US 2 and 55th Street and US 2 and 58th Street are warranted for traffic signals based on existing traffic volumes. However, installation of traffic signals at all of these locations will have negative impacts on traffic flow, as well as violate NDDOT signal spacing guidelines. In the alternatives section of the report, the appropriate configuration of traffic control at these locations will be studied in greater detail.
- The intersection of US 2 and 55th Street also meets the crash experience warrant for traffic control installation. The crash experience warrant requires five or more reported crashes, susceptible to correction by a traffic control signal, occurring with a 12 month period.
- No other intersections meet warrants under existing or future traffic volumes.

Figure 14: Traffic Control in Study Area



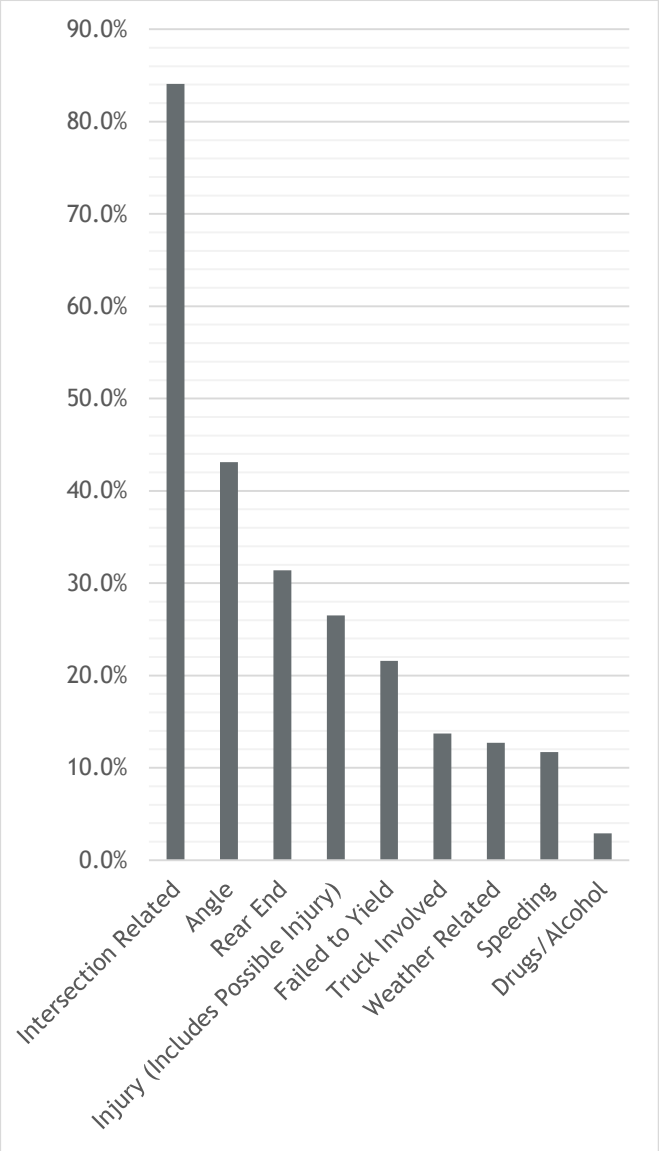
Crash History

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 34 crashes per year in the study area. There were no fatalities reported in the three-year period, but it does include nine crashes per year resulting in an injury (including the possible injury classification).

An evaluation of crash trends (Figure 15) highlights intersection related crashes, making up 84 percent of crashes in the study corridor. Angle crashes, almost exclusively related to intersections and access management, make up 43 percent of crashes in the study area. This is particularly worrisome since national data has shown almost 45 percent of angle crashes result in injuries or fatalities (NHTSA, 2012). Stricter access management, as a complete set of engineering techniques, can help mitigate intersection and angle related crashes.

The National Safety Council (NSC) estimates the economic impact 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 in the study area were more than $352,000 per year.

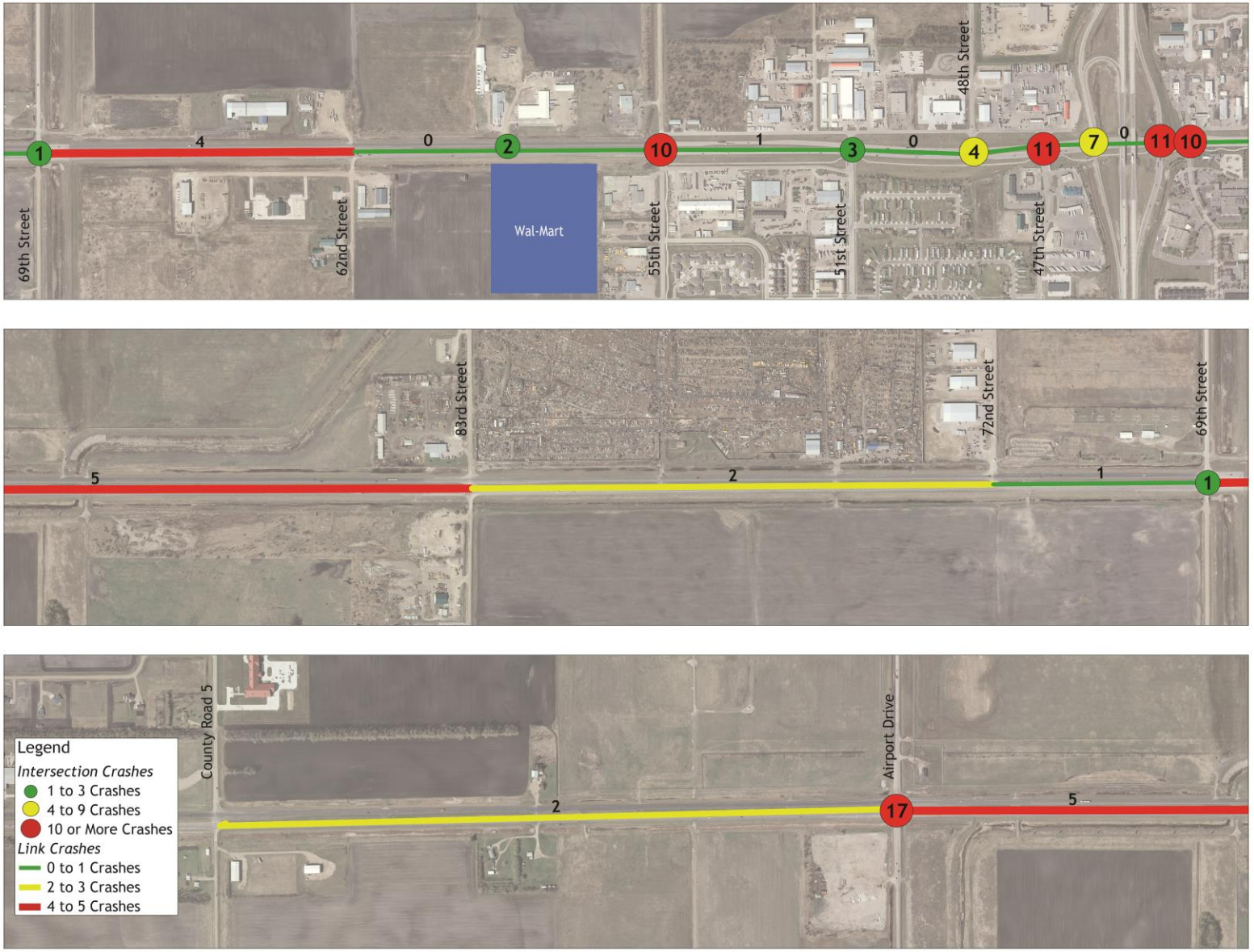
Figure 15: Crash Trends



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 16). 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.

Figure 16: Crashes in Study Area



To identify statistically significant crash rates, the critical crash rate method 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 analysis methodology, intersections with crash rates above the critical rate are considered overrepresented and in need of further review; there is a high probability that conditions at the site are contributing to the higher crash rate. Various filters were used during the analysis to allow intersections and links to be compared similar facilities. For intersections, this included rural and urban characteristics and traffic control. For links, this included the urban and rural cross-section context.

After evaluating each scenario, two intersections were considered overrepresented according to the critical crash methodology:

- US 2 and Airport Drive/County Road 5
- US 2 and 55th Street

With the exception of two intersections, US 2 and I-29 East Ramps and US 2 and I-29 West Ramps, none of the study intersections were analyzed in the 2040 LRTP due to a minimum crash threshold of 10 crashes between January 1, 2009 and December 31, 2011 or because the intersection was outside the urban boundary. These two intersections were found to be under the critical crash rate calculated for the entire Grand Forks-East Grand Forks metropolitan area. The critical crash rate analysis presented in this report used a crash threshold of one per year in an effort to filter out random events. The purposed of this analysis was to identify all crash-prone locations within the study area.

Trend Analysis

AIRPORT DRIVE

Seventeen crashes occurred at the US 2 and Airport Drive/County Road 5 from March 1, 2011 to February 28, 2014. Of these crashes, nine were of the rear-end crash type attributable to a red light, including six eastbound rear-end crashes. Four additional crashes were angle type crashes attributable to red light running. The 1991 LRTP recommended to not install a traffic signal at this intersection due to the high-speed rural environment and sparse signal spacing in the area that potentially interferes with motorist expectance, attributing to rear-end crash potential. This is common at rural intersections.

Based on historical data, it is possible that removing the traffic signal in favor of two-way stop control could result in a lower crash rate. Before the signal was installed, the crash rate per million entering vehicles was 0.77; after the traffic signal installation, the crash rate per million entering vehicles increased to 1.24. However, the two-way stop control increases the potential for angle crashes and could have adverse effects on traffic operations. Other alternatives will be considered in later chapters of this report.

55TH STREET

Ten crashes occurred at the US 2 and 55th Street intersection from March 1, 2011 to February 28, 2014. Eighty percent of crashes at this intersection were angle crashes. Of these angle crashes, four occurred when northbound to westbound vehicles failed to yield to oncoming traffic while making left turns. The installation of a traffic signal would help reduce delay for vehicles on the minor approach and reduce the potential for angled crashes. Additionally, four crashes at this intersection involved trucks. This is 28.6 percent of all truck-involved crashes in the corridor.

INTERCHANGE FUNCTIONAL AREA

The interchange functional area refers to the section of US 2 surrounding the I-29 interchange. This includes the two ramp intersections and 43rd and 47th Streets. As described above, there is a bottleneck during peak periods with high volumes of traffic circulating between the two principal arterials, I-29 and US 2. A review of crash data in this area points to a direct correlation between operations and safety. Forty percent of all crashes in this area occurred during the peak periods, even though just more than 20 percent of the daily traffic occurs during this period. During casual observations of this intersection, it was noted that delays fueled motorist frustration and led to risk-taking driver behaviors.

The following trends were noted in this area:

- Access to the north frontage road at 43rd Street. 89 percent (8/9) of crashes at the US 2 and 43rd Street intersection were angle or left-turn crashes in to or out of the side street. 56 percent (5/9) of crashes occurred when motorists either made a left-turn onto the north frontage road or attempted to make a movement out of the frontage road.
- Yield controlled right-turn at I-29 East Ramp. 45 percent (5/11) of crashes occurred when motorists attempted to make a right turn at the northbound ramp. The root of the problem was that most motorists were looking upstream to the left for gaps in traffic and not forward and collided with an adjacent lane.
- Tight double-left turn lanes at I-29 East Ramp. 18 percent (2/11) of crashes occurred when a truck attempted to make a left-turn in the double-left turn lane, off-tracked and hit a vehicle in the adjacent lane.
- Red light running at I-29 West Ramp. 57 percent (4/7) of crashes occurred when a westbound motorist failed to stop at a red light. This could be fueled by motorist frustration due to long delays or shorter than anticipated clearance intervals at the intersection.
- Rear-end crashes at 47th Street and I-29 West Ramp. 50 percent (9/18) of crashes at US 2 and 47th Street and US 2 and I-29 West Ramps were rear-end crashes. These intersections experience heavy queueing between the two intersections that produce frequent stop-and-go traffic conditions which often leads to increased rear-end crash potential.

ANGLE CRASHES

There were 44 angle crashes (43.1 percent of total crashes) in the study area. More than 25 percent of these crashes occurred when drivers failed to yield to oncoming traffic while making left turns. Nearly 40 percent of all angle crashes occurred during the A.M. or P.M. peak period.

Of angle crashes, 43.2 percent occurred at signalized intersections. 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 as motorists tend to become frustrated and more likely to take chances. Adjustments to signal timing, including longer all-red clearance intervals, may help alleviate conflicting traffic and improve traffic operations.

SPEED

Twelve crashes in the study area had contributing factors of speed or going too fast for the conditions. Eight of these occurred between County Road 5/17th Street Northeast and 83rd Street, including the Airport Drive/County Road 5 intersection. It is important to note it is often difficult to confirm speed was a contributing factor for crashes. This is particularly true when both parties are speeding. Thus, speeding is often underrepresented.

In the speed limit transition area, west of Airport Drive/County Road 5, significant speeding occurs. The posted speed limit is 55 miles per hour. For westbound vehicles, the 85th percentile speed was 72

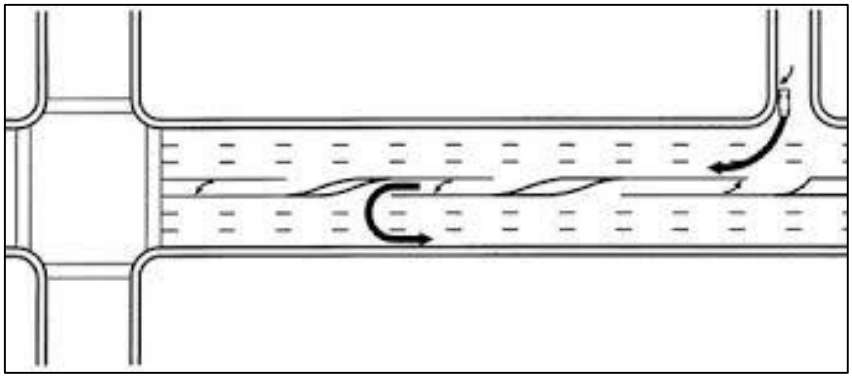
miles per hour. For eastbound vehicles, the 85th percentile was 69 miles per hour. Research has shown that roadway design, not posted speed limit, is the biggest determinant of speed, thus changing the posted speed and not the design, context or congestion will not produce reductions in speed. Wide roads, multiple lanes and lack of development encourage higher speeds (FHWA-RD-98-154).

Local Road Safety Program

The Local Road Safety Program (LRSP) is part of North Dakota's statewide Highway Safety Improvement Plan. The goal of this program is to "identify and implement specific safety strategies at specific locations and to link these projects directly with the contributing factors associated with the majority of serious crashes on the local roads." The LRSP for Grand Forks County was completed in June 2014 and identified the following locations and recommended improvements:

- The intersection of US 2 and Airport Drive/County Road 5 was identified as a high priority location for safety improvements and a directional median was recommended.
- The intersection of US 2 and County Road 5/17th Street Northeast was identified as a medium priority location for safety improvements; streetlights, signs and new pavement markings were recommended.

Figure 17: Directional Median



Source: Federal Highways Administration

Although the LRSP was recently completed, the recommendations in this corridor study will supersede any made in the LRSP. Early in the study process, several key stakeholders opposed the proposed recommendation in the LRSP and particularly opposed the fact they were not involved in the alternative review, refinement and selection process. NDDOT acknowledged that this study would be used to further expand on information in the LRSP and will be used in the final decision making for the Airport Drive/County Road 5 intersection.

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, operation 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 Highway Capacity Manual found that roadway speeds were reduced an average of 2.5 miles per hour for every 10 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 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.

The traditional method of counting the number of access points along a corridor and comparing it to the minimum 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 (RIRO) driveway with only three conflict points or a T-intersection with nine conflict points equal to a driveway with full access that has 32 conflict points (Figure 18).

Figure 18: Conflict Points

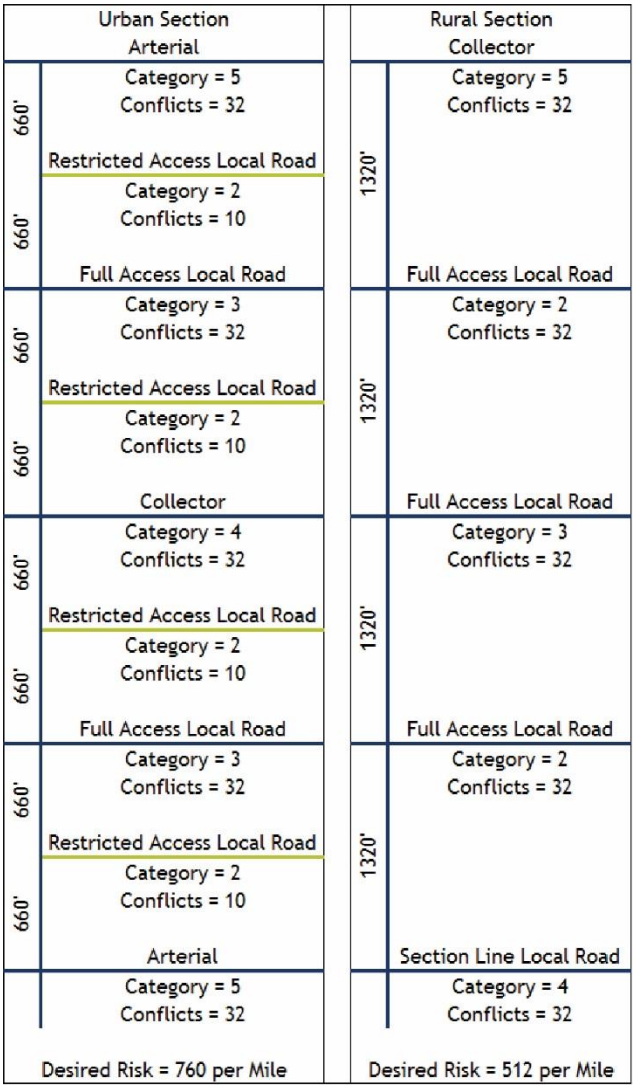
To account for those flaws, the access risk approach was developed by KLJ and detailed below.

1. Segment Roadway. For this corridor, the roadway was segmented into a rural section (west of 55th Street) and an urban section (east of 55th Street).
2. Translate access points into *conflict points* (Figure 18).
3. Categorize existing and future access points by traffic volumes for *conflict potential*. Assign the *conflict potential* criteria to each access.
    a. Category 1: Driveway or non-section line local road with less than 100 vehicles per day.
    b. Category 2: Driveway or non-section line local road with 100 to 1,000 vehicles per day.
    c. Category 3: Driveway or non-section line local road with more than 1,000 vehicles per day.
    d. Category 4: Rural section line local road or urban collector.
    e. Category 5: Rural collector or urban arterial.
4. Multiply *conflict points* by *conflict potential* to get *access risk*.

In built-out urban areas, conflict potential is typically only calculated using traffic volumes. Within the study area, there is a lot of undeveloped land so existing traffic volumes do not represent volume potential. As a result, the conflict potential approach for this corridor considered the roadway hierarchy as well as traffic volumes to assess the potential for increased volumes. This produced an increased weight for any roadway with increased connectivity and regional significance.

The methodology described above will be used to compare existing access management alternatives developed later. Desirable access risk considers the spacing guidelines set forth in the City of Grand Forks ordinances, NDDOT Design Manual, FHWA Functional Classification Guidelines and effective

Figure 19: Desired Access Risk



access management configurations locally and statewide. However, access spacing between 69th Street and 83rd Street has spacing access at 2,640 feet, instead of the traditional 1,320 feet found in most rural sections. This creates a unique problem. The corridor transitions from 660 feet access spacing from I-29 to 69th Street to 2,640 feet between 69th Street and 83rd Street and then 1,054 feet from 83rd Street west. Although the corridor becomes less urbanized as you move west, the transfer of jurisdictional control allows for less stringent access management. After reviewing typical access control along US 2 and within the urbanized area of Grand Forks, it was determined that the 1,054 feet access spacing was more likely to occur along the corridor as development moves west. This was used for the desired access risk and illustrated in Figure 19. However, the more stringent layout will be considered during alternative analysis.

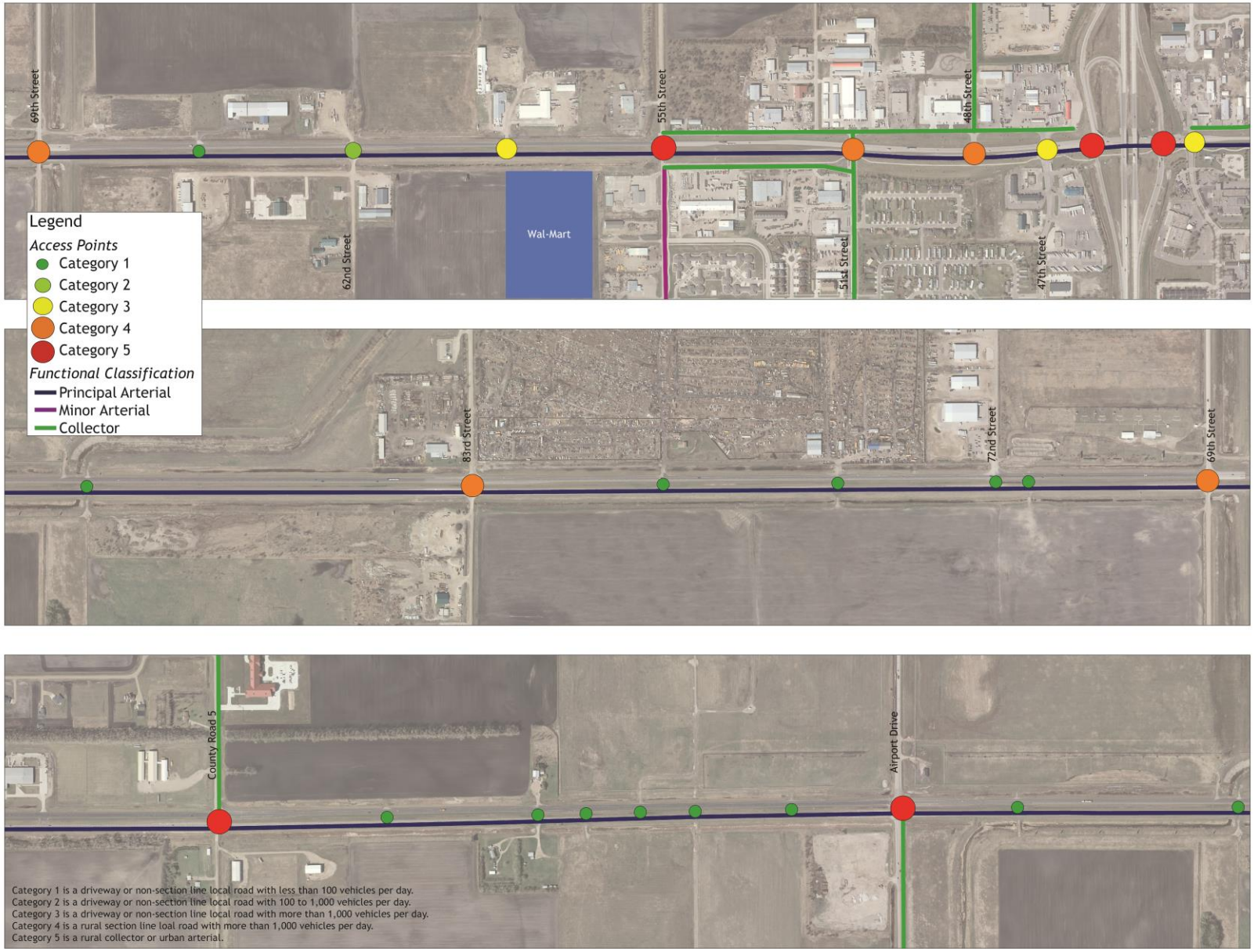
Access Risk in Study Corridor

Access onto the US 2 corridor is a joint agreement between the City of Grand Forks and NDDOT east of 83rd Street and determined solely by NDDOT west of 83rd Street. Table 2 shows the access points on both the north and south side used to calculate access risk. For the purpose of the access risk calculation, a full access is considered an access on the north and south side of US 2. Based on the methodology described above, the only segment with an existing access risk higher than the desired access risk is between 42nd Street and 55th Street. However, one goal of this study is to proactively develop an access management plan using the methodology described above. This will ensure that poor operations and safety deficiencies caused by access points are well managed as the corridor develops. Access alternatives, developed in later chapters will consider access risk, access spacing, roadway design (i.e. is an access within a turn lane storage bay) and corridor operations (i.e. do intersection queues block the access). Access management along developing or developed corridors is more an art than a strict science. A map of the access points and their risk can be found in Figure 20.

Table 2: Access Points and Access Risk in Study Area

Termini	Access Points			Access Risk		
	Permitted Per Side	North Side	South Side	Desired Risk	Existing Risk	Factor Over
42nd Street & 55th Street	7	7	6	760	776	1.08
55th Street & 69th Street	8	5	4	512	457	0.89
69th Street & 83rd Street	2	5	4	512	315	0.62
83rd Street & Airport Drive	5	4	4	512	352	0.69
Airport Drive & County Road 5	5	6	5	512	397	0.77

Figure 20: Access Points in Study Area



Bicycle and Pedestrian Facilities

Designing roadways to accommodate all types of users is commonly referred to as “complete streets”. This type of roadway design approach offers safety, health and community benefits. While a complete street in a university or downtown setting might include dedicated bike lanes and streetscaping, a context sensitive complete street on a high-speed divided highway may only have wide shoulders for bicyclists and pedestrians. Any future “complete streets” designs for US 2 will consider pedestrian destinations and safety as well as the needs of vehicular traffic.

Figure 21: Shared Use Path Terminates at 55th Street

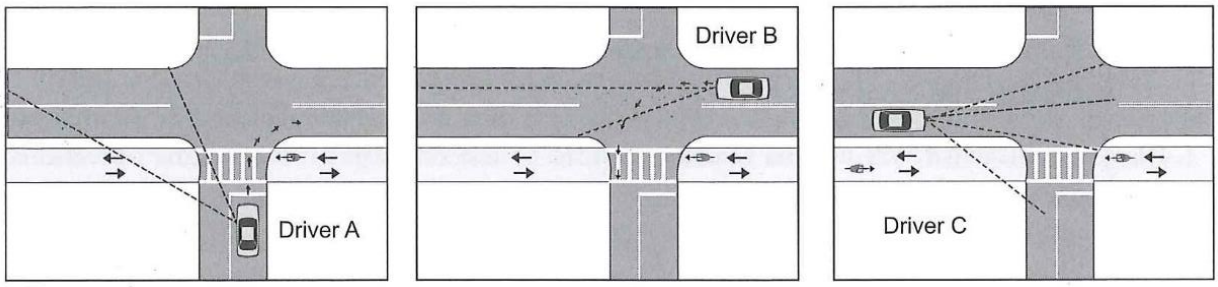
Existing Facilities

Currently, there is a shared use path on the south side of US 2 that runs between Columbia Road and 55th Street. At 55th Street this shared use path turns south and runs along 55th Street until University Avenue.

West of 55th Street, most locations along the corridor meet AASHTO design guidelines for wide shoulders. However, the high-speeds and heavy truck traffic discourage even advanced cyclists. Additionally, at intersections with right turn lanes, shoulders are narrowed, forcing bicyclists into the driving lane.

Recent design guidance presented by AASHTO has discouraged the use of shared use paths on only one side of the street as it interferes with motorist expectancy.

Figure 22: Driver Expectancy



Source: AASHTO

Bicycle and Pedestrian Generators

Historically, the corridor has primarily been made up of industrial land uses, but the onset of recent commercial and residential development increases the necessity to provide pedestrian and bicycle facilities to major existing and future generators. Two of the largest trip generators in the metro area (Wal-Mart and Grand Forks International Airport) are located on the corridor. Additionally, the Red River BMX bike track is on the corridor with no connecting bicycle facilities.

The Grand Forks Planning department has seen increased interest in residential developments south of US 2 near the new Wal-Mart. New residential development would increase the pedestrian facility needs in the area.

TURTLE RIVER STATE PARK

Turtle River State Park is located in Arvilla, North Dakota, approximately 15 miles west of the Grand Forks International Airport. The railroad bed west of 55th Street is no longer active; discussions in the

past have indicated some interest in providing a recreational trail along the old railroad bed, although no plans have been established. Providing pedestrian and bicycle access across and along US 2 could increase access to this potential trail.

Barriers

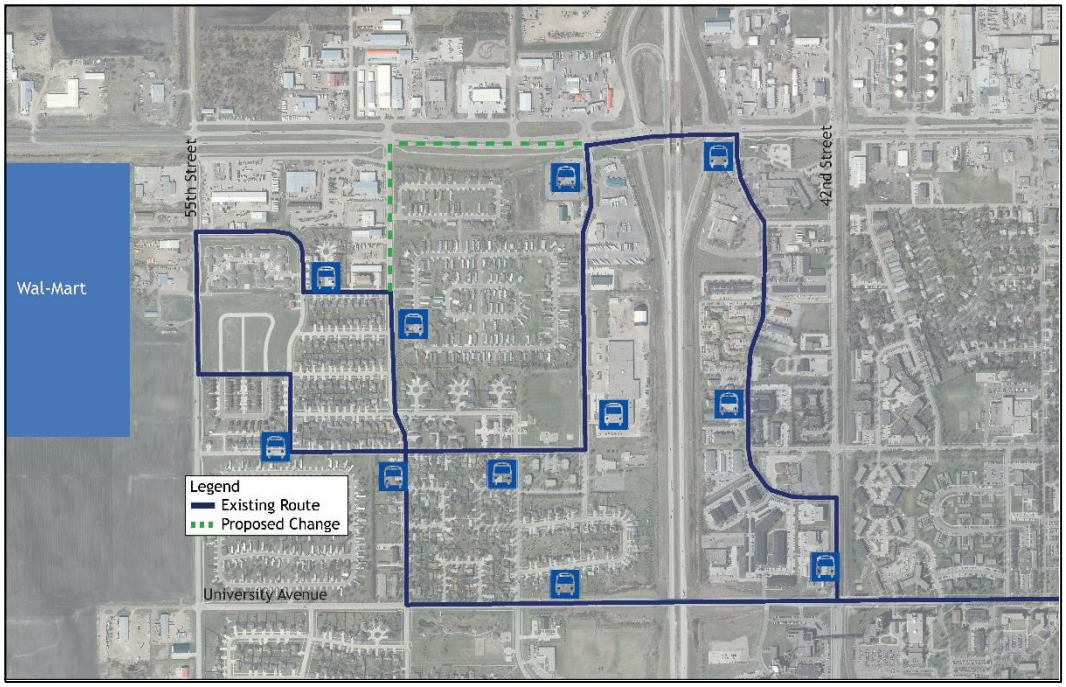
The industrial nature of the corridor, paired with high speeds and traffic volumes make this corridor difficult for pedestrian and bicycle users. US 2/Gateway Drive is exempt from the ordinance requiring sidewalks on both sides of the street and the shared use path currently ends on the east side of 55th Street. This leaves many potential destinations without facilities for bicycles and pedestrians. The current shared use path on the south side does not service any facilities on the north side, nor are there any designated pedestrian crossings that would permit a pedestrian or bicyclist to access those destinations safely. Additionally, the lack of pedestrian facilities across US 2 requires that traffic signals are timed to allow a pedestrian to cross the corridor during each cycle regardless of whether a pedestrian is present or not. The wide corridor requires a long pedestrian clearance interval required unnecessary delay at the intersection.

Figure 23: Pedestrian and Bicycle Facilities in Study Area

Transit

Cities Area Transit (CAT) provides public transportation for the Grand Forks-East Grand Forks metropolitan area. CAT operates thirteen routes. Currently, Route 8 extends to the residential development at 53rd Street with additional stops at Sta-Mart and the Howard Johnson along the

Figure 24: Cities Area Transit Route 8



corridor. This route is an hourly service that also serves the UND campus and Altru Hospital. CAT provides no service west of 55th Street.

In the January 2014 update to the Transit Development Plan (TDP), it was recommended that Route 8 be shortened by four minutes to improve on-time arrival percentages. The proposed route is shown in Figure 24. Additionally, the plan identified Grand Forks International Airport as a potential generator for transit service but did not recommend any specific route revisions to access this generator.

Lighting

Studies have found that roadway lighting reduces roadway fatalities up to 50 percent. Lighting design and spacing is required to meet AASHTO standards according to the NDDOT Design Manual. Lighting analysis was split into two segments: east of 55th Street (urban) and west of 55th Street (rural).

Figure 25: Corridor Lighting

East of 55th Street

Existing lights consist of standard, non-decorative davit type poles with cobra head type luminaries on both sides of US 2. The traffic control signal at the US 2 and 47th Street intersection has lighting mounted to the pole; the other two traffic control signals at the US 2 and I-29 East Ramp intersection and the US 2 and I-29 West Ramp intersection have no mounted lights. Existing lights at the interchange consist of high mast light towers located in each quadrant within the I-29 right-of-way. The Traffic Operations Report prepared for the US 2 Turn Lane project included four intersections between 55th Street and 47th Street and did not recommend any additional lighting at these intersections.

West of 55th Street

West of 55th Street is primarily a rural roadway with limited lighting. There is transitional lighting at the turn lanes and mast mounted lighting on the traffic control signals at the intersection of US 2 and Airport Drive/County Road 5.

NDDOT LIGHTING WARRANTS

NDDOT provides warrants for the lighting of rural intersections on US numbered highways under certain conditions:

- Channelized intersections
- Where locations have a ratio of night-to-day crashes of 1.5 or higher or six nighttime crashes in three years
- Where engineering judgment indicates that lighting may be expected to result in a significant benefit to the public
- Where the installation of lighting will add sufficient benefit in the form of convenience, safety, policing, community promotions, public relations or otherwise and the local government will pay 50 percent of the cost of installation and all the costs of maintenance and operation

Based on these warrants, no location west of 55th Street requires lighting unless the governmental entity with jurisdiction is willing to pay 50 percent of the total cost.

Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) is the application of advanced technology to solve transportation problems. ITS encompasses a broad range of communications 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.

Figure 26: Video Detection System on US 2

Signals are coordinated on US 2 between 47th Street and 3rd Street, containing three intersections in the study area (US 2 and 47th Street, US 2 and I-29 West Ramp and US 2 and I-29 East Ramp). Coordination of signals results in improved traffic flow.

Video detection systems are present at the four signalized intersections on the corridor. Video detection cameras are mounted on some part of the signal structure and are used primarily to detect traffic for signal phasing purposes. Video detection cameras also provide live video feed for engineers needing to view intersection operations and can count traffic automatically.

Dependent on the deficiencies identified along the corridor, applicable ITS solutions will be evaluated and incorporated in later chapters. ITS solutions may provide operational and/or safety benefits. Potential ITS applications applicable for the US 2 corridor context include dynamic message signs, dynamic speed display signs, vehicle detection and/or intersection conflict warning systems.

Maintenance and Operations

Studies have found timely pavement rehabilitation has the potential to be six to 14 times more cost effective than rebuilding a deteriorated road. Another study found that rough roads add an average of $335 to the annual cost of owning a car due to damaged tires, suspensions, reduced fuel efficiency and accelerated vehicle depreciation. The 2040 LRTP has identified two "State of Good Repair" project with the goal of preserving and maintaining the existing roadways in the corridor: a mill and overlay project from 55th Street to the I-29 and I-29 to Columbia road to be completed between 2025 and 2030.

NDDOT uses the International Roughness Index (IRI). The IRI is a measure of pavement smoothness that is calculated from the longitudinal profile of the roadway surface. The higher the IRI, the worse the condition of the pavement. The rural section of the study area from County Road 5/17th Street Northeast to 55th Street had an IRI that fell under the "Good" category. The section of 55th Street to the I-29 East Ramp had an IRI that fell under the "Fair" category. The section of I-29 East Ramp to 43rd Street also had a "Fair" rating.

Figure 27: Pavement Conditions in Study Area

Stakeholder Meetings

To understand the specific needs, current and future, along the corridor, one-on-one stakeholder meetings and a public open house were held during the needs assessment and issues identification phase of the study.

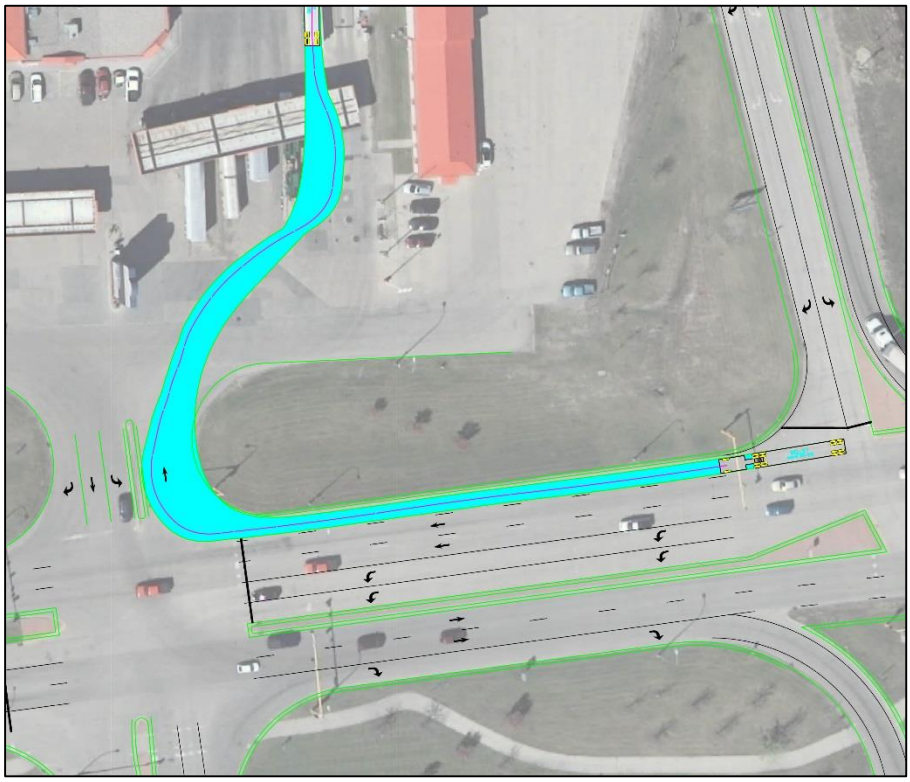
Invitation to participate in the stakeholder meeting and open house were sent to every property owner along the corridor and then followed up with a personal phone call to inform them of the public input opportunities. One meeting with nine businesses and organizations at the Grand Forks International Airport, and two meetings with private businesses along the corridor were held. Organizations at the airport stated ease in accessing the airport, combined with safety, is a top priority for them. They urged direct access to reduce emergency vehicle response times, should an incident occur. The meetings with the private businesses identified speeding on the frontage road, consistent signage and accommodating access with growing truck traffic as main issues.

Through the public open house, where several additional land owners were present as well as members of the public, and subsequent public comments generated from this meeting the following additional issues were identified:

- Roadway capacity on US 2 to serve the businesses along the corridor
- Concerns with funding the most effective solutions
- Safety in regards to large truck traffic percentages
- Merging the commercial and residential nature south of US 2 with the industrial character north of US 2
- The turning radii on the northeast quadrant of 47th street is not conducive for truck traffic, often resulting in off-tracking, breaking the curb and gutter and hitting the traffic signal.

Figure 28 below illustrates that a westbound truck making a right turn can just narrowly make this turn if driven perfectly.

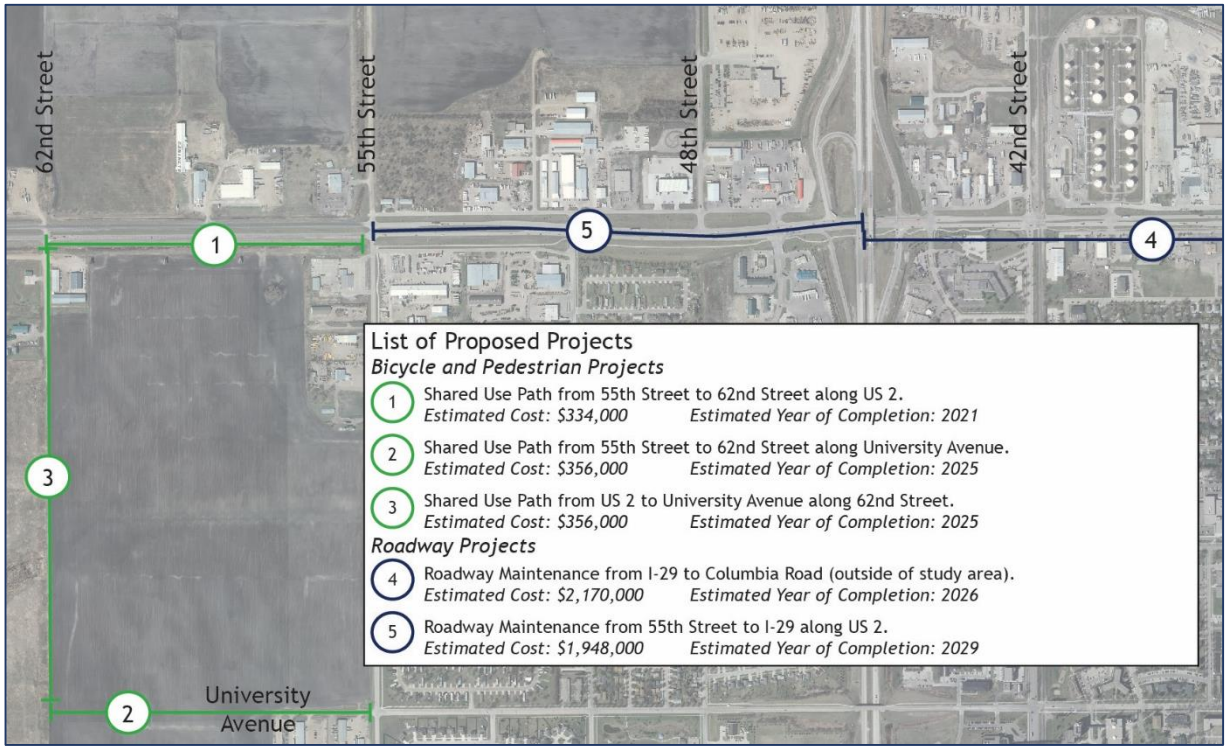
Figure 28: Turning Radius at 47th Street



Planned Improvements

The GF-EGF MPO recently completed their 2040 LRTP that identified a series of roadway and multimodal improvements in the study area. In this fiscally constrained plan, expected funding revenues were forecasted and compared against maintenance and rehabilitation needs and then later expansion needs (i.e. capacity enhancement projects). During this exercise, it was determined that needs far outweighed the available funds, producing a list of illustrative projects, including $151,550,000 in unmet needs in North Dakota alone. The major projects planned through 2040 is the shared use path construction from 55th Street to 62nd Street in 2021 and roadway maintenance projects from I-29 to Columbia Road in 2026 and 55th Street to I-29 in 2029. Refer to Figure 29 for a list of projects in the study area.

Figure 29: Planned Improvements in Study Area



Summary of Needs

Key Deficiencies

Based on technical analysis, comments received at Steering Committee meeting 1 and the corresponding public input meeting, focus areas were developed to concentrate effort and resources. The remainder of this report will be dedicated to resolving these deficiencies.

- Safety and operational deficiencies at the Airport Drive. This intersection is one of the highest crash locations in the state and is projected to operate at a deficient level of service by 2040.
- Safety and operational deficiencies at the interchange influence area, including the four intersections between 47th Street and 43rd Street. Specifically, the I-29 East Ramp intersection creates spillback onto I-29 and across adjacent US 2 intersections. This creates not only operational deficiencies but increases crash potential.
- Proper traffic control throughout the corridor. Densely spaced signals impact safety and traffic flow efficiency. Identifying the proper type and location will improve traffic flow into the future.
- Access management throughout the corridor. Densely spaced access points increase friction and reduce the efficiency of the corridor. While adjusting existing access spacing will be difficult, developing a proactive access management plan will allow efficient spacing while providing access to all parcels along the corridor into the future.
- Northern Plains Nitrogen site. The routing decisions to access this site required consideration to mitigate impacts to the traffic network as well as the public health risk associated with transporting anhydrous ammonia.
- Turn lanes throughout the corridor. As traffic increases throughout the corridor, the addition of turn lanes will reduce crash potential and increase traffic flow efficiency.

- Bicycle and Pedestrian Facilities. Only 10 percent of the corridor has bicycle and pedestrian facilities and there are no protected crossings.

Corridor Strengths

During the existing and future conditions analysis, a number of corridor strengths or non-issues were uncovered. The following items were studied and determined to not require additional attention.

- Roadway conditions. Currently the corridor is in good to fair condition. The areas in fair conditions are planned for roadway maintenance before 2040.
- Lighting. Based on a review of NDDOT lighting standards, the current lighting configuration along the corridor appears adequate for the foreseeable future.
- Transit. The recent Transit Development Plan looked into transit needs and opportunities along the corridor in great detail. No further analyses were considered.
- ITS. No obvious ITS deficiencies or gaps were uncovered. However, ITS were considered during alternative development phases of the project.

Focus Area 1: Airport Drive Intersection

The Airport Drive/County Road 5 intersection is one of the most crash-prone rural intersections in the entire state, one of only two high crash sites east of Bismarck, according to NDDOT databases. Over the past five years, this intersection has experienced nearly six crashes per year and 1.6 injuries or fatalities per year. In the context of the US 2 corridor, this intersection is responsible for 20 percent of the total crashes along the expansive five mile corridor and has a crash rate more than double the next highest intersection.

The crash tendencies at this intersection are common for rural signalized intersections on high speed corridors. Forty percent of crashes at the intersection are the rear-end type where motorists decelerate very quickly. This is exacerbated by the fact that the 85th percentile speed along the corridor is 15 miles per hour above the speed limit, highlighted by 30 percent of all crashes at the intersection involving speeding motorists. Before the signal was installed in 1992, two-way stop control was in place on the north and south approaches. Stop control experienced a 30 percent lower crash rate; however, this included a 150 percent increase in angle crash potential, the crash type most prone to serious injuries.

By 2040, the traffic signal operates at a LOS "E", deficient according to local and state standards. Although the sheer volumes of the intersection do not force noticeable congestion, the delay induced by forcing a stop to the nearly 20,000 vehicles traveling 70 miles per hour on US 2 results in a major hindrance to traffic flow.

Evaluation Criteria

The following two approaches were used to evaluate alternatives at Airport Drive/County Road 5.

Value Planning Criteria

Value planning criteria involves safety, operations, cost and environmental impacts as detailed below. This criteria was weighted by the Steering Committee to replicate the values of stakeholders and responsible agencies as it pertains to this intersection. The weights are noted in the description below.

SAFETY

Safety is quantified in terms of crash potential. Crashes are converted into dollar values using National Safety Council data for associated crash costs as following:

- Property damage only crash = $8,900
- Nonfatal disabling injury crash = $78,000 (equivalent to 8.7 property damage only crashes)
- Crash resulting in a fatality = $1,410,000 (equivalent to 158.4 property damage only crashes)

Table 3: Safety Scoring

Rating	Label	Description
0	Very Poor	Alternative with the highest total crash related costs
1 – 9	Poor – Very Good	Score is relative to alternative's performance versus the alternative with the highest and lowest total crash related cost
10	Excellent	Alternative with the lowest total crash related costs

Improvements were evaluated using crash modification factors (CMF) from the Highway Safety Manual and the Crash Modification Factor Clearinghouse. The most recent five years of crash data and the 5.4 years of crash data prior to signal installation were used to fully understand the implications of specific signalized and unsignalized alternatives.

Steering Committee Weight: 44.4 percent

TRAFFIC OPERATIONS

Traffic operations was gauged using traffic simulation models that estimate delay per vehicle; delay per vehicle was then translated to LOS. The following approach was used to evaluate differing configurations:

- For a traffic signal, the average intersection delay was used to estimate LOS using the table below. Motorists naturally accept longer delays at signalized intersections where right-of-way is guaranteed compared to stop control.
- For two-way stop control, the controlled approach with the highest delay was used as is standard in the HCM. The unsignalized control criteria was used.
- For alternatives that were not signal controlled and required circuitous routing behavior, the aggregated total intersection delay was used in combination with the unsignalized delay criteria.

Table 4: Airport Drive Traffic Operations Scoring

Rating	Label	Level of Service	Motorist Delay (sec)	
			Unsignalized	Signalized
Discard Alternative	Overcapacity; Breakdown of Flow	F	> 70	> 100
			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

Steering Committee Weight: 25.0 percent

COST, CONSTRUCTION IMPACTS AND SCHEDULE

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

Table 5: Cost, Construction Impacts and Schedule Scoring

Rating	Label	Description
0	Very Poor	Alternative with 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 cost, construction impact and duration
10	Excellent	Alternative with lowest combination of cost, construction impacts and construction duration

Steering Committee Weight: 20.3 percent

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 attribute are drainage and hydraulic issues.

Table 6: Environmental Impacts Scoring

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 environment impacts

Steering Committee Weight: 10.4 percent

Benefit-Cost Ratio

Using guidance from the "User Benefit Analysis for Highways" developed by AASHTO, a benefit-cost analysis (B/C) was conducted to provide a systematic evaluation of the economic advantages (benefits) and disadvantages (costs) of each Airport Drive/County Road 5 alternative. This analysis was conducted using the following additional sources:

- US DOT's "Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis" published July 9th, 2014 was used to quantify 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 Grand Forks 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 detailed above.

This analysis was used to illustrate whether an alternative is a cost-effective expenditure. B/C resulted in a poor alternative comparison tool for Airport Drive/County Road 5 for the following reasons:

- Significant discrepancy between high cost and low cost alternatives. For example, alternatives with minimal costs often return exceptional B/C results, even if the benefits did not achieve desired study goals (crash reduction or operational requirements).
- The aggregation of total delay ignores varying driver delay acceptance thresholds at specific traffic control devices (i.e. drivers become frustrated by delays faster at stop control intersections versus signal control).

Alternative Assessment

Six build alternatives and a do-nothing alternative were analyzed. The alternatives were ranked by combining technical analysis and input from the Steering Committee and the public. Table 7 at the end of this section illustrates the weighted scoring of each alternative. Additional detail pertaining to each alternative and larger figures are available for review in Appendix G.

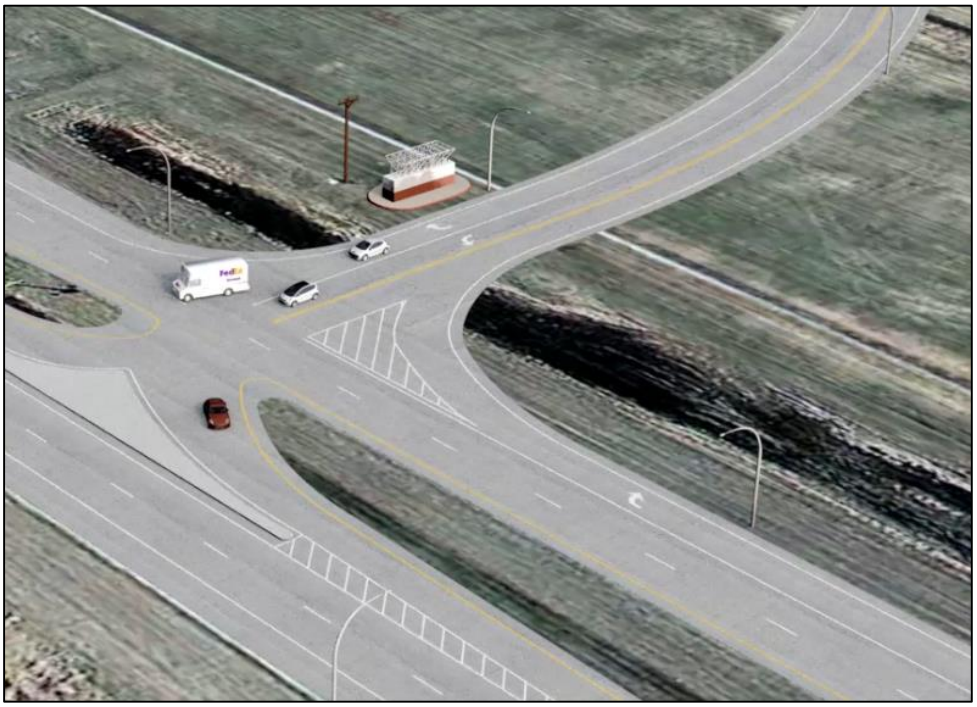
Most Technically Feasible and Locally Supported Alternative

Based on technical analysis results and input from the Steering Committee and the public, a Staggered T-Intersection Configuration (STIC) should be considered at this intersection. This would involve shifting Airport Drive to the east 1,100 feet.

This design would involve the following defining characteristics:

- Elimination of signal control. As noted earlier, the rural context of the traffic signal affects motorist expectancy and US 2 drivers moving at 70 miles per hour or more struggle to effectively stop in time for the signal. Eliminating the traffic signal for two-way stop control has the potential to reduce total crashes by 30 percent according to historic data. Additionally, eliminating stops for mainline traffic is anticipated to reduce average intersection delay by 77 percent during the peak hour.
- Elimination of far-side crashes. Left-turns will be funneled through a new auxiliary lane and merged over. This eliminates the potential for far-side angle crashes, the movement most prone to serious crashes. The merge introduces a potential sideswipe conflict point, however these types of crashes are statistically less likely to result in serious injuries. This is a major improvement as 71 percent of crashes were angle crashes according to data prior to signal installation.

Figure 30: Auxiliary Lane for Left Turning Vehicles



- Reduction to near-side crashes. An intersection conflict warning system (ICWS) will be implemented to warn drivers on the mainline and side streets of a potential conflict. Using vehicle detection, the ICWS advises drivers on major roads with flashing lights and the language "Entering Traffic When Flashing". Motorists on minor approaches will see the flashing lights and the message "Traffic Approaching When Flashing". MnDOT studies have found these configurations reduce conflicts by 54 percent and crashes by 30 percent when compared to traditional two-way stop control. Although sight distance is not a concern at this intersection, the high speeds along this corridor can be difficult to judge.

Figure 31: Intersection Conflict Warning System

- Rerouting. This alternative requires through movements to perform a circuitous movement to get from Airport Drive, the north approach, to County Road 5, the south approach, and vice versa. However, this movement only represents five percent of the total intersection volume. The major movements between the Airport and the City of Grand Forks actually see an improvement in travel time.

The defining characteristics of this alternative have been found to significantly increase safety. Historic data at this intersection suggests that removing the traffic signal would reduce crashes by 30 percent, but increase total angle crashes by 150 percent. The Federal Highway Administration (FHWA) found that converting a four-leg intersection into two three-leg intersections can reduce crashes up to 30 percent. FHWA also found that the conversion of a signalized T-intersection into a Continuous Green T-Intersection reduced total crashes by 60 percent, eliminating 97 percent of the angled crashes. Finally, the Minnesota Department of Transportation found that the installation of intersection conflict warning systems can reduce crashes up to 30 percent.

EVALUATION RESULTS

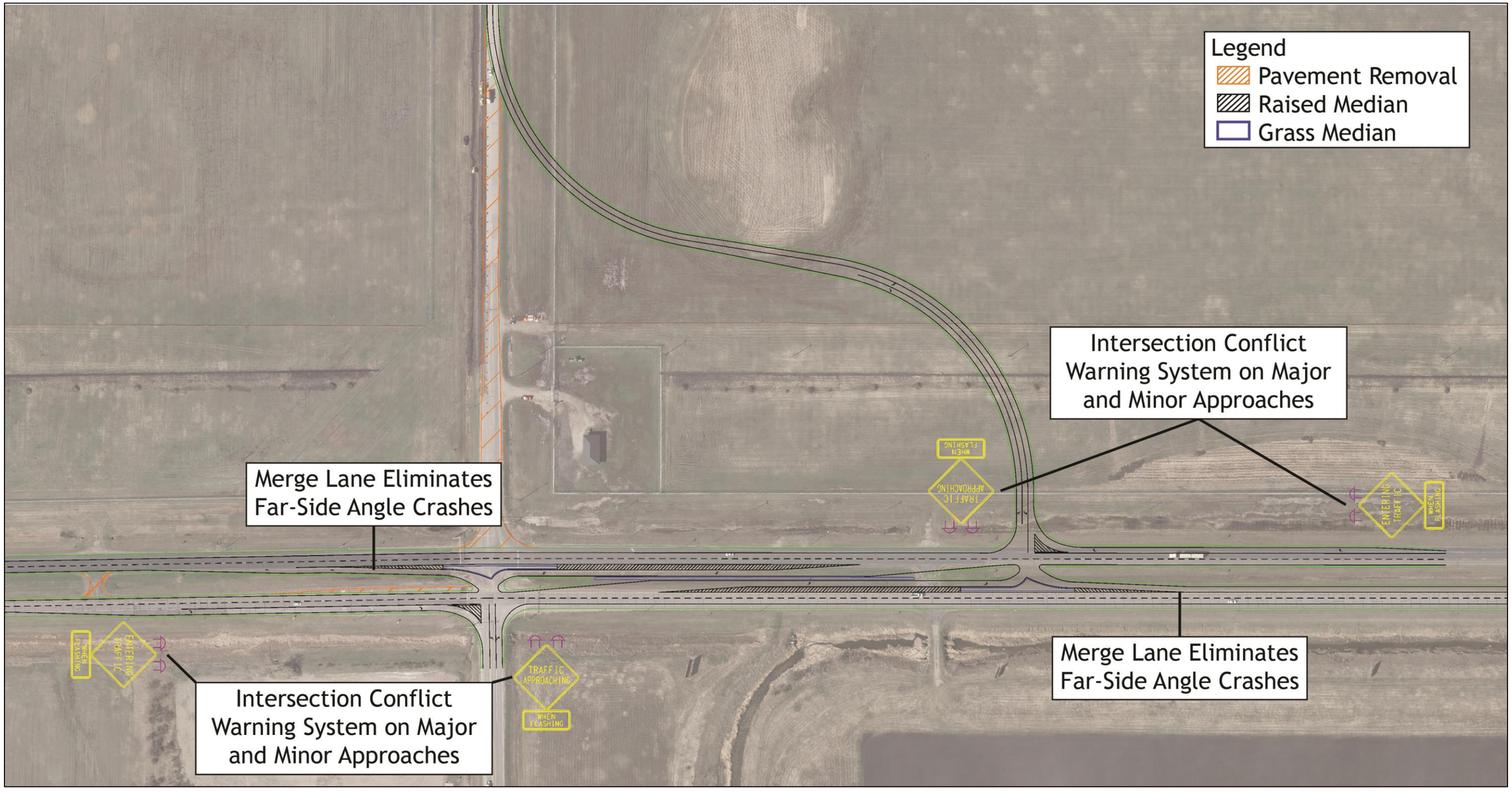
Technical analysis, Steering Committee and public input were used to evaluate the alternatives. Based on technical analysis, the Staggered T-Intersection Configuration (STIC) performed exceptionally well in the following categories:

- Safety: 67 percent reduction in crash potential (Score 10/10)
- Traffic Operations: 77 percent reduction in 2040 peak hour delays (Score 8/10)
- Environmental Impacts: No building impacts but property acquisition required (Scored 6/10)
- Cost: $1,708,000 (Score 10/10)
- Benefit/Cost Ratio: 19.6
- Unweighted Rank: 1 (of 7)

The STIC was presented to the Steering Committee for input. Based on weights assigned to the above categories by the Steering Committee, the STIC was ranked first of seven presented alternatives based on technical analysis. When asked for their recommendation, the Steering Committee ranked the STIC first.

At the public input meeting, 96 percent of attendees supported this alternative.

Figure 32: Staggered T-Intersection Configuration Design



INTERIM IMPROVEMENT STRATEGY

Depending on funding constraints, the STIC may not be constructed for a number of years. The following low cost improvements are proposed in the interim to reduce crash potential and severity. These improvements will only produce a fraction of the total safety benefits offered by the STIC and none of the operational benefits.

Update Design to 85th Percentile Speed

Minor tweaks to yellow and red clearance intervals that reflect 85th percentile speeds versus signed speeds has the potential to decrease crash potential. These improvements translate to 1.3 seconds of additional yellow and all red time, limiting the overall impact to safety at the intersection. However, the benefits of this improvement far exceed the minimal cost and effort required for implementation.

The relocation of existing advanced warning signs and flashing beacons are anticipated to provide nominal benefits as the current placement provides more than ample stopping sight distance under 70 miles per hour conditions.

Figure 33: Dynamic Speed Display Sign

Install Dynamic Speed Display Signs

A multitude of studies have found that drivers will drive the speed at which a roadway is designed, not the posted speed limit. Effectively reducing speeds throughout the corridor for prolonged distances and duration is likely infeasible without costly design revisions. However, dynamic speed display signs (DSDS) offer the potential to reduce speeds for the short duration approaching the Airport Drive/ County Road 5 intersection. Lower speeds may reduce the potential for rear-end and speeding crashes and reduce the severity of crashes that do occur.

DSDS actively relay speed information to drivers and respond by flashing or changing colors of speeds that exceed predefined thresholds (i.e. five or 10 miles per hour over the limit). DSDS have been found to reduce excessive speeds (greater than 10 miles per hour over the speed limit) by 32 percent in urban settings and reduce 85th percentile speeds by 19 percent for rural arterials.

DSDS will not fully solve the crash issue at this intersection. However, DSDS can serve as an interim solution until funding can be secured for the STIC. DSDS cost $14,000 and have no environmental impacts. This solution could effectively be installed as quickly as it could be ordered.

CONTINGENCY PLANNING

Seventy-two percent of regional traffic growth is attributed to the major Air Force Base (AFB) development discussed in earlier chapters. Although this is in later stages of approval, assuming this development reaches its full potential is still not entirely certain. To safeguard against the scenario where the AFB development doesn't reach full potential, an evaluation of traffic operations with 50 percent AFB development was studied. The results of this analysis shuffled the technical ranking of alternatives, but still resulted in the STIC ranked first in both weighted and unweighted rankings.

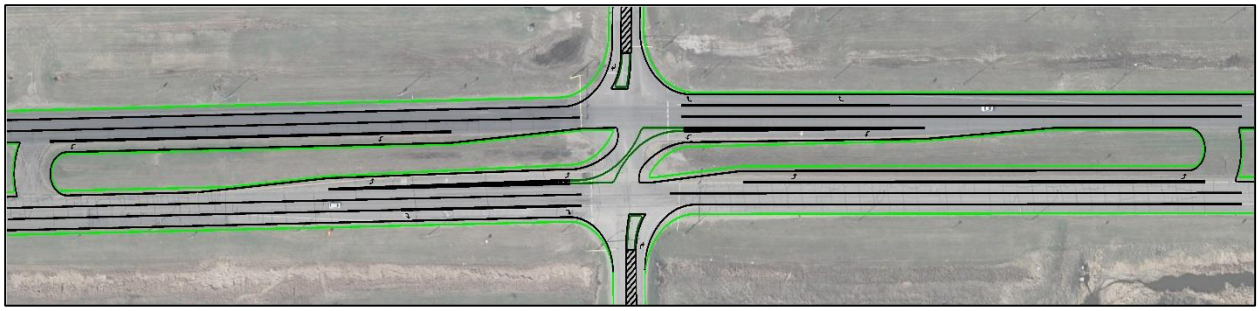
Other Technically Feasible Alternatives

Below is a very brief summary of two other technically feasible build alternatives. As project development is initiated, these alternatives may be carried forward into environmental analysis. The information provided in this report can then act as project prioritization to guide analysis.

RESTRICTED CROSSING U-TURN INTERSECTION

This alternative, also known as a J-turn intersection, superstreet, restricted crossing intersection and median intersection, converts through and left-turn maneuvers from the minor approaches to U-turn maneuvers located downstream of the central intersection. This alternative would provide proven safety benefits but operate at deficient levels by 2040. This alternative also received strong opposition from the Airport Authority and tenants.

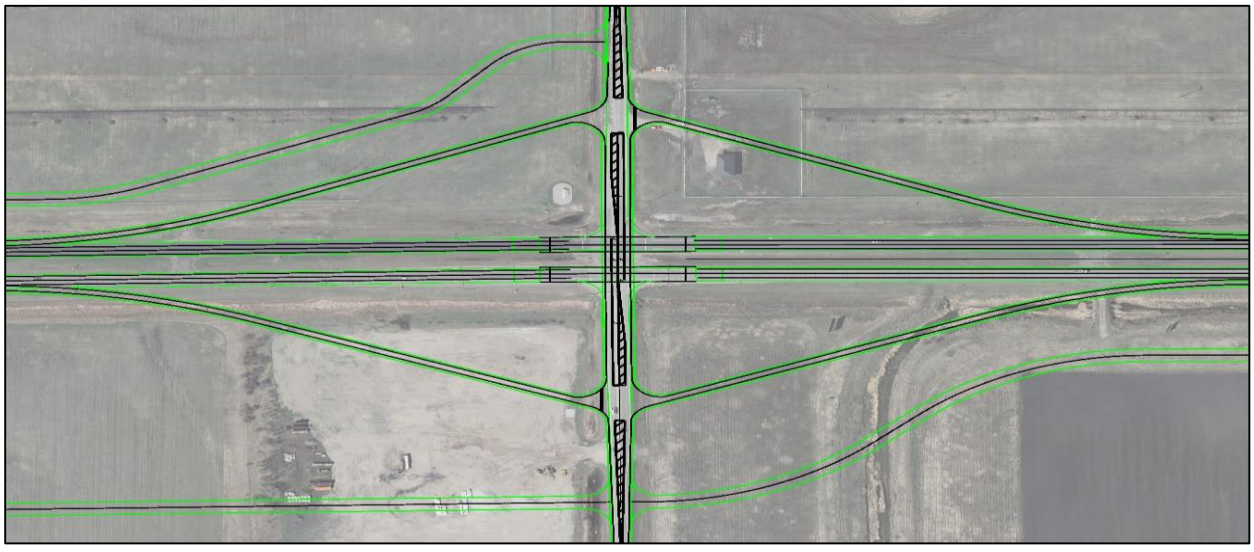
Figure 34: Restricted Crossing U-Turn intersection Alternative



DIAMOND INTERCHANGE

An interchange design would require a bridge separating Airport Drive/ County Road 5 traffic from US 2 traffic. Turning movements would be facilitated using on and off ramps. Frontage/backage roads would be required according to NDDOT guidance to restrict access onto US 2 one mile east and west of the interchange. This alternative provides safety and operational benefits, however the cost is nearly 11 times greater than the next most expensive alternative, significantly disproportionate to its benefits. Furthermore, the cost of this alternative prohibits the potential for this alternative to be implemented anytime in the near future, allowing crashes to compound.

Figure 35: Diamond Interchange Alternative



Technically Infeasible Alternatives

These alternatives operate deficiently or do not provide safety benefits sufficient to be carried forward into environmental analysis.

CHANGES TO POSTED SPEED LIMITS

This alternative would reduce the posted speed limit on the mainline to reduce speeds. Because general compliance with speed limits is poor in this area, it is unlikely that reducing the posted speed limit would have any impact on safety at the intersection. FHWA research supports this assertion.

SPEED REDUCTION MEASURES ONLY

This alternative would install Dynamic Speed Display Signs (DSDS) on the mainline to reduce speeds. A description and figure is included on Page 39. The reduced speeds provided by this alternative are not expected to reduce crash frequency to desired levels. NCHRP Report 613 found that the installation of DSDS at high speed locations would likely reduce speeds by three to four miles per hour initially, but that this impact diminishes as time goes on, limiting its overall effectiveness. Additionally, a traffic signal will operate deficiently by 2040.

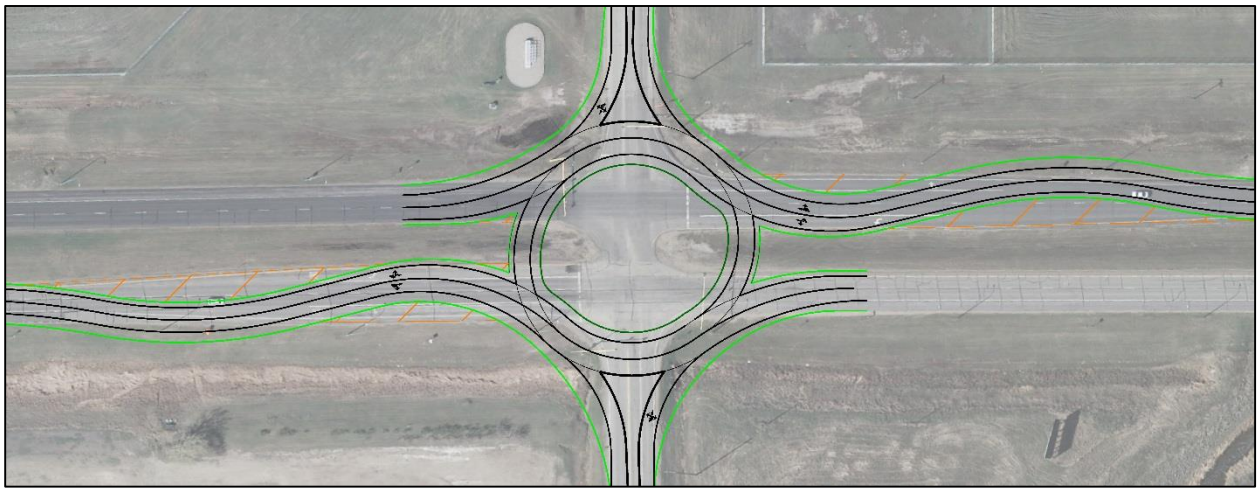
INTERSECTION CONFLICT WARNING SYSTEM ONLY

This alternative would remove the traffic signal and install Intersection Conflict Warning Systems (ICWS) on all major and minor approaches at the intersection. This alternative is anticipated to improve safety at the intersection but operate deficiently under 2040 traffic conditions.

ROUNDABOUT

A roundabout is a type of circular intersection in which traffic flows clockwise around a central island with approaching traffic yielding to circulating traffic. This alternative would provide safety benefits but operate deficiently by the year 2040.

Figure 36: Roundabout Alternative



Summary of Alternatives

Summary, figures, scoring and analysis of discarded alternatives can be found in Appendix G. The proposed solution was determined by combining technical analysis and input from the Steering Committee and public. The table below illustrates the scoring of the various alternatives.

Table 7: Airport Drive Alternative Comparison

Alternative	Value Planning Parameters with Steering Committee Weights								Rank		Benefit/Cost Ratio
	Safety	Weight	Traffic Operations	Weight	Environmental	Weight	Cost	Weight	Weighted	Steering Committee	
Do Nothing	1	44.4%	3	25.0%	8	10.4%	10	20.3%	6	**6**	-
Dynamic Speed Display Sign	3		3		8		10		5	2	121.7
Intersection Conflict Warning System	8		3		8		10		2	4	74.6
Restricted Crossing U-Turn Intersection	8		3		8		10		2	5	17.2
Staggered T-Intersection Configuration	10		8		6		10		1	1	19.6
Diamond Interchange	9		10		4		1		4	2	2.4
Roundabout	Discarded for poor operations during 2040 A.M. and P.M. peak hours.										

Stakeholder Involvement

The Airport was very involved in the development of this study. They had two members on the Study Review Committee which met three times and was invited to the three public input meetings. Additionally, KLJ and/or the MPO participated in three Airport Authority Meetings and 2 presentations to the Airport tenants. In total, the Airport was engaged 11 times as a part of this project.

The position of the airport has evolved as the study has progressed. By the end of the study, they made the following three comments regarding the draft report and alternatives;

- Acknowledged there is a safety issue at Airport Drive and improvements are needed, including removal of the traffic signal.
- Acknowledged that an interchange is not warranted through the 2040 study horizon but believe it will eventually be warranted beyond this timeframe.
- Desire to maintain direct access between Airport Drive and CR 5. This contradicts the configuration of the STIC and RCUT.

Implementation Plan

Interim Improvement

Improvement: Dynamic Speed Display Signs and adjust clearance intervals to reflect 70 miles per hour design speed.

2015 Cost: $14,000

Implementation Strategy: Recommended interim improvements are low-cost strategies that can be implemented by NDDOT as early as the 2015 construction season using NDDOT funds.

Near-Term Improvement

Improvement: Staggered T-Intersection Configuration

Lead Agency: NDDOT

2015 Cost: $1,708,000

Implementation Strategy: As one of only two identified rural high crash locations in eastern North Dakota, this intersection has already been identified as a prime candidate for Highway Safety Improvement Program (HSIP) funds. The original submittal, however, only included funding for $900,000. As lead agency, it is recommended that NDDOT immediately pursue HSIP funds to lighten the financial burden of this project and be implemented as quickly as funds can be secured.

HSIP solicitation is sent out by NDDOT in October or November, reviewed by NDDOT from January through March with approval notices sent out the following fall. The timing of HSIP funding awards provides an opportunity for environmental documentation, right-of-way acquisition and design to occur during the solicitation and review process. It is recommended that these project development activities begin immediately to allow for a seamless transition into construction, if the project were to be awarded in the first applicable HSIP funding cycle.

Focus Area 2: Interchange Influence Area

The I-29 interchange influence area refers to the section of US 2 between 43rd and 47th Streets that includes the I-29 interchange ramps. The I-29 East Ramp intersection creates a major bottleneck on US 2, operating at exceedingly deficient levels of service. Queueing from this intersection on to the interstate is common under existing conditions and unavoidable by 2040. Queued vehicles on the interstate creates major speed differentials with motorists traveling at 70 miles per hour or more. The East Ramp intersection also generates queues across adjacent intersections creating congestion and delay. US 2 queueing is a major challenge in the I-29 influence area due to the proximity of four intersections located within a quarter mile.

Operations at this interchange are exacerbated by the fact that US 2 and I-29 are the two largest freight corridors in the area. Two truck stops are located at the signalized intersection of 47th Street, just 350 feet west of the I-29 West Ramp. The three consecutive signals on US 2 within 900 feet make traffic progression challenging and spillback common.

The congestion surrounding the interchange has already produced negative safety consequences. 43 percent of the corridor's crashes occur within the interchange functional area. A review of crash data in this area points to a direct correlation between operations and safety. Forty percent of all crashes in this area occurred during the peak periods even though just more than 20 percent of the daily traffic occurs during this period. During casual observations of this intersection, it was noted that delays fueled motorist frustration and led to risk-taking driver behaviors, further highlighting the connection between safety and operations.

Evaluation Criteria

The following two approaches were used to evaluate alternatives at the interchange influence area.

Value Planning Criteria

Value planning criteria involves safety, traffic operations, cost and environmental impacts. This criteria was weighted by the Steering Committee to replicate the values of stakeholders and responsible agencies as it pertained to this specific location. The weights are noted in the description below.

SAFETY

The safety scoring criteria mirrors the Airport Drive criteria found on Page 33. 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 conflict points at the interchange.
- Rear-end crashes were adjusted based on a comparison of total delay and congestion.
- Sideswipe crashes were adjusted based on the total length of adjacent lane miles.

Steering Committee Weight: 35.8 percent

TRAFFIC OPERATIONS

The interchange influence area includes the two interchange ramp intersections, the 43rd Street intersection and the 47th Street intersection. The interchange influence area operates as one cohesive unit and was evaluated as such. The total delay of each alternative was reported and evaluated as follows.

Table 8: Interchange Influence Area Traffic Operations Scoring

Rating	Label	Description
0	Very Poor	Alternative with the highest aggregated delay per vehicle
1 – 9	Poor – Very Good	Score is relative to alternative's performance versus the alternative with the highest and lowest aggregated delay per vehicle
10	Excellent	Alternative with the lowest aggregated delay per vehicle

Steering Committee Weight: 29.8 percent

COST, CONSTRUCTION IMPACTS AND SCHEDULE

The cost, construction impacts and schedule scoring criteria mirrors the airport drive criteria found on Page 34.

Steering Committee Weight: 24.3 percent

ENVIRONMENTAL IMPACTS

The environmental impacts scoring criteria mirrors the Airport Drive criteria found on Page 35.

Steering Committee Weight: 10.1 percent

Benefit-Cost Ratio

Benefit-cost ratio (B/C) analysis is detailed on Page 35. Unlike Airport Drive, B/C analysis was an extremely effective comparison tool due to the similarities of the various alternatives.

Alternative Assessment

Five build alternatives and a do-nothing alternative were analyzed. The proposed solution was determined by combining technical analysis and input from the Steering Committee and the public. Table 9 at the end of this section illustrates the weighted scoring of each alternative. Additional detail pertaining to each alternative and larger figures are available for review in Appendix G.

Most Technically Feasibly and Locally Supported Alternative

Based on technical analysis results and input from the Steering Committee and public, a new loop ramp constructed in the northeast quadrant should be considered. The improvement includes the following revisions as illustrated in Figure 38.

- Widen the east I-29 bridge to include a new auxiliary lane for the northeast loop.
- Provide additional right-turn lane at I-29 East Ramp for improved operations.
- Convert eastbound right-turn lane at 47th Street to a through/right turn lane to improve flow onto the I-29 on-ramp.
- Relocate the north approach of 43rd Street and convert to RIRO. Restrict left-out of the south access of 43rd Street. These access improvements will reduce conflict potential between this intersection and the I-29 East Ramp intersection. The exact location of the driveway to the north would be determined in later stages of project development.
- Retaining wall to separate the I-29 northbound on-ramp from the existing McDonald's parking lot. It may be determined during project development that it is more advantageous to

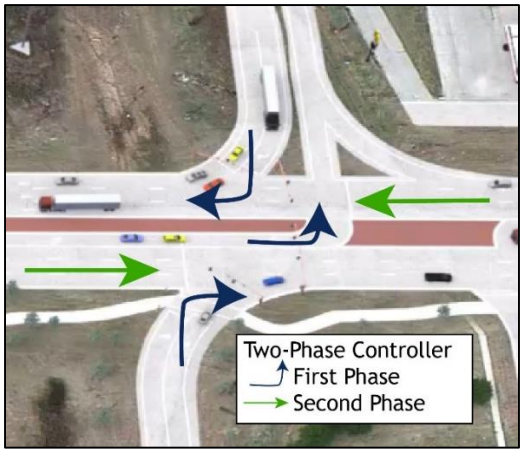
completely remove the McDonalds to widen out the loop. However, based upon preliminary engineering, this is not required.

- Wider turning radius for westbound right turns into the north approach at 47th Street. This will better accommodate truck traffic entering the Simonson Travel Center and should eliminate trucks broaching the curb and hitting the traffic signal pole.

The Northeast Loop alternative prevents northbound left-turns from conflicting with eastbound left-turn and through movements, effectively converting the traffic signal from three phases to two phases, increasing throughput. In addition to operations, the major reduction to delays and queues provides the following safety benefits:

- Increased throughput mitigates potential for queueing onto the interstate.
- Increased throughput mitigates potential for queueing across adjacent US 2 intersections, reducing conflict potential.
- Reduced stop-and-go traffic reduces potential for peak hour rear-end crashes on US 2.
- Minimizing the number of crossing movements reduces potential for angled crashes.

Figure 37: Two Phase Signal Controller on I-29 East Ramp



EVALUATION RESULTS

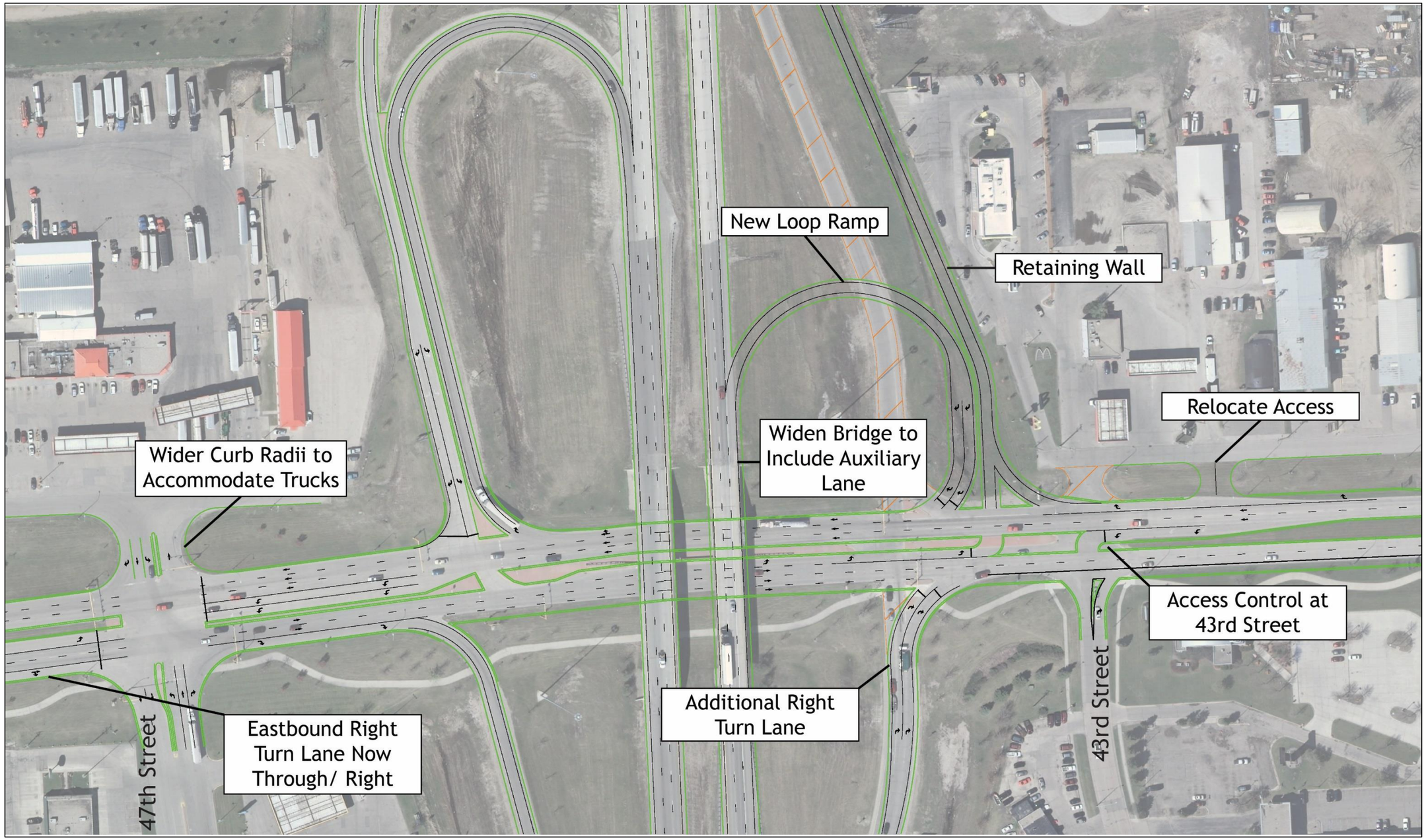
Technical analysis, Steering Committee and public input were used to evaluate the interchange influence area alternatives. Based on technical analysis, the Northeast Loop alternative performed exceptionally well:

- Safety: 40 percent reduction in crash potential (Score 10/10)
- Traffic Operations: 20 percent reduction to 2040 vehicle hours traveled (Score 10/10)
- Environmental Impacts: Minor wetland impacts with the new loop. Access control to 43rd Street (Score 6/10)
- Cost: $6,342,000 (Score 7/10)
- Benefit Cost Ratio: 8.5
- Unweighted Rank: 1 (of 7)

The Northeast Loop alternative was presented to the Steering Committee for input. Based on weights assigned to the value planning categories, the Northeast Loop was ranked first of six presented alternatives based on technical analysis. When asked for their recommendation, the Steering Committee ranked the Northeast Loop first.

At the public input meeting, the Northeast Loop received unanimous support from attendees.

Figure 38: Northeast Loop Design



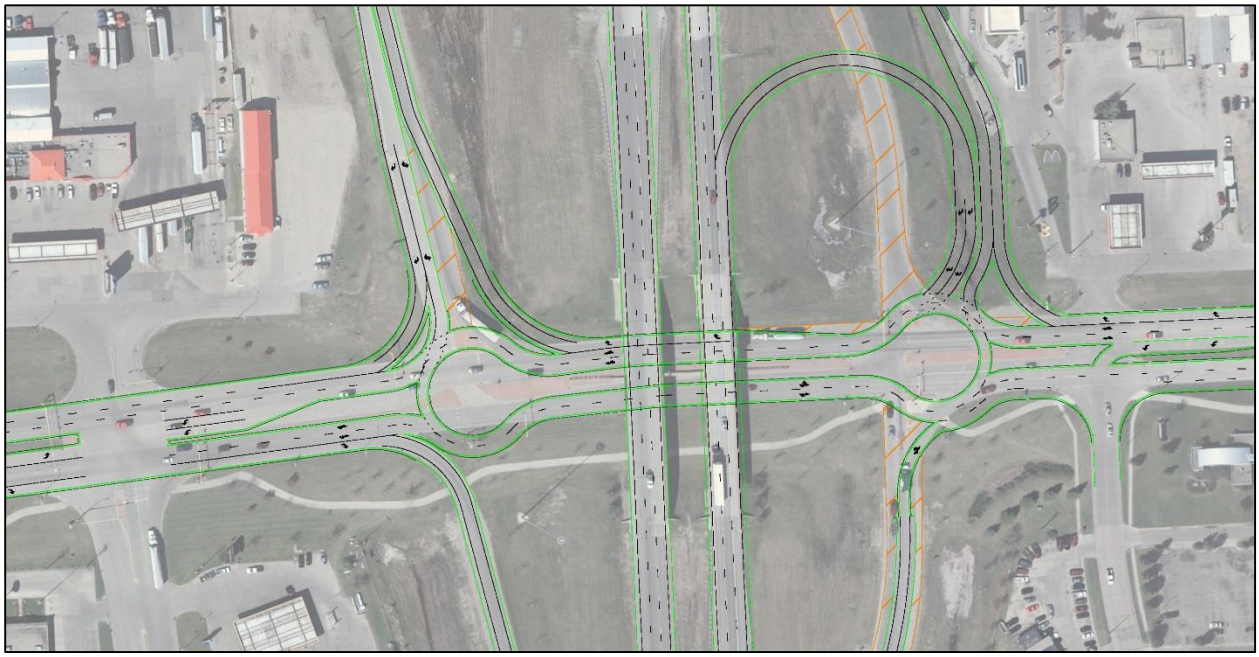
Other Technically Feasible Alternatives

Below is a very brief summary of the four discarded build alternatives. As project development is initiated, some of these alternatives may be carried forward into environmental analysis. The information provided in this report can then act as project prioritization to guide analysis.

ROUNDABOUTS WITH NORTHEAST LOOP

This alternative includes a northeast loop ramp and converts the I-29 East and West Ramp intersections into roundabouts, instead of signalized intersections. This alternative is expected to create the greatest delays of any of the build alternatives.

Figure 39: Roundabouts with Northeast Loop Alternative

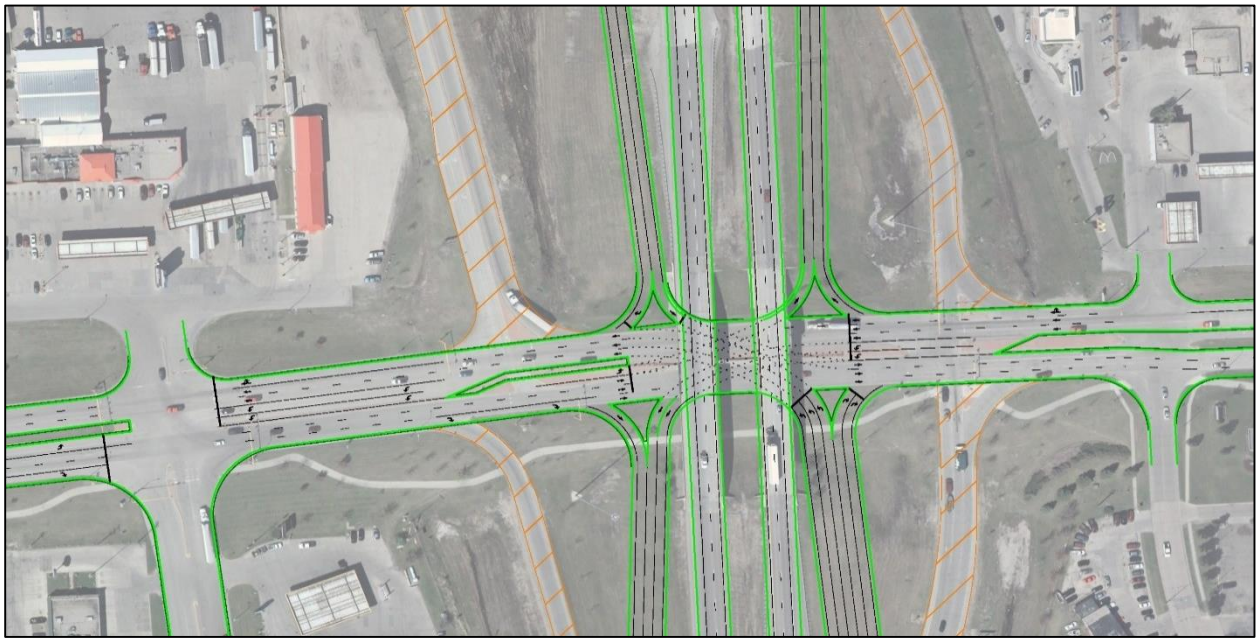


SINGLE POINT URBAN INTERCHANGE

A single point urban interchange (SPUI) consolidates the two intersections into one central location under the two bridges. This type of interchange effectively separates the ramp intersections from 43rd and 47th Streets, although queues from the ramp intersection would still queue across 43rd Street forcing this intersection to be right-in/right-out (RIRO) only.

This alternative would require an entirely new bridge and new ramps which creates cost challenges. This also requires a three lane merge to get southbound traffic onto the interstate and triple left-turn lane from I-29 onto US 2, two configurations that are complicated for drivers to navigate through.

Figure 40: Single Point Urban Interchange Alternative

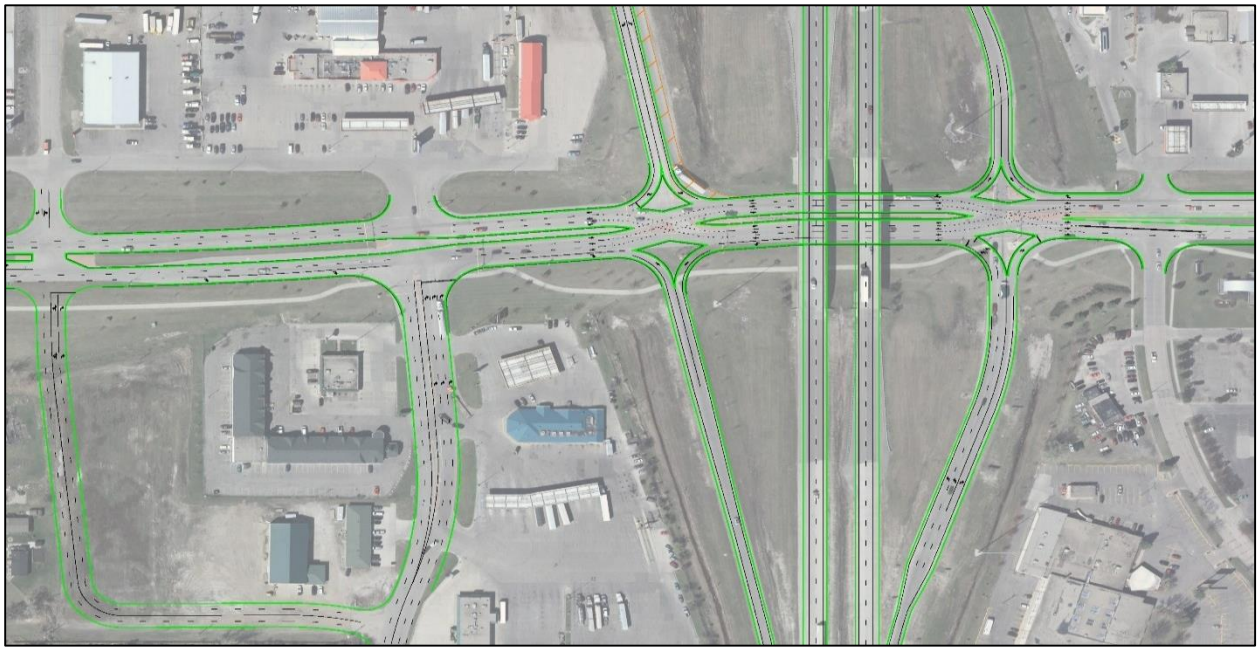


DIVERGING DIAMOND INTERCHANGE

A diverging diamond interchange (DDI) requires the two directions of traffic on US 2 road to cross to the opposite side of the road under the I-29 bridge. This allows left-turning and right-turning traffic to perform a free flow movement onto the interstate on-ramp. The free-flowing movements reduce the signal phases to two at each intersection, significantly reducing delays.

This alternative would not significantly reduce US 2 queues. Major access revisions would be required at both 43rd Street and 47th Street for this configuration to operate effectively. Both intersections would be converted to RIRO operations only. To allow access to 47th Street, a backage road would be required at 48th Street south of US 2.

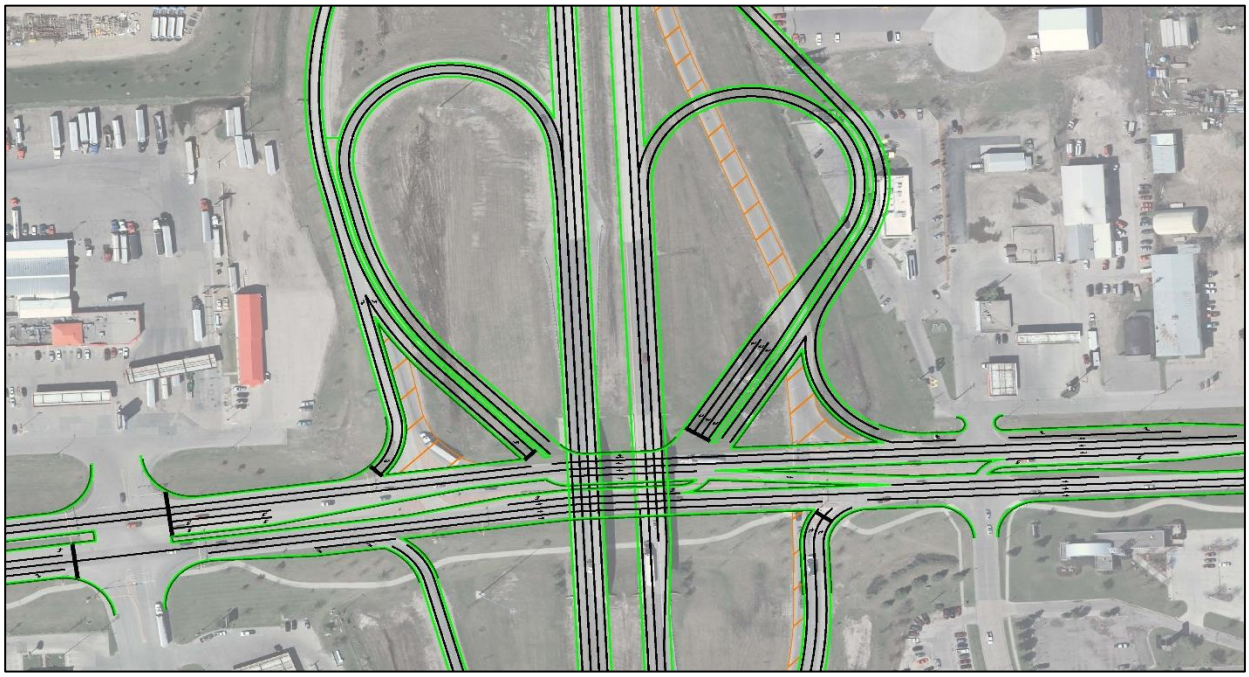
Figure 41: Diverging Diamond Interchange Alternative



MODIFIED SINGLE POINT URBAN INTERCHANGE

The modified SPUI consolidates the two ramp intersections like the regular SPUI, except this design utilizes the existing bridges and maintains the northeast loop ramp and includes a new northwest loop ramp. This configuration requires unique routing for the southbound ramp left-turn maneuver as this merges into traffic. This alternative provides the similar operational and safety benefits as the northeast loop configuration with the same spacing benefits of the SPUI. This alternative would require a property acquisition to properly fit the northeast loop ramp.

Figure 42: Modified Single Point Urban Interchange Alternative



OTHER ITEMS

During the public input process, a connection, either a frontage road or connecting 12th Avenue North, from 51st Street to 47th Street was requested to make it easier for trucks moving between the different truck services along the corridor. While this would reduce the number of slow-moving trucks traveling between the two intersections, low volumes on 51st Street and property impacts between the two streets make this technically unfeasible.

Summary of Alternatives

Summary, figures, scoring and analysis of discarded alternatives can be found in Appendix G. The table below illustrates the scoring of the various alternatives.

Table 9: Interchange Influence Area Alternative Comparison

Alternative	Value Planning Parameters with Steering Committee Weights								Rank		Benefit/Cost Ratio
	Safety	Weight	Traffic Operations	Weight	Environmental	Weight	Cost	Weight	Weighted	Steering Committee	
Do Nothing	1	29.8%	1	35.8%	10	24.3%	8	10.1%	6	**6**	-
Northeast Loop	10		10		8		6		1	1	8.2
Roundabouts with Northeast Loop	5		7		7		6		4	4	0.6
Single Point Urban Interchange	9		4		1		5		5	5	1.8
Diverging Diamond Interchange	7		7		7		5		3	2	1.9
Modified Single Point Urban Interchange	9		10		5		4		2	3	2.4

Interim Improvements

Spillback from the east ramp intersection onto mainline interstate is common under existing conditions. However, capacity analysis using the calibrated simulation model indicates that optimizing signal timing should mitigate this deficiency for the near future. By 2025, it is unlikely that signal timing alone can resolve this issue. It is recommended that the east ramp signal timing be revised to provide more green time for the northbound movements. Signal timing improvements are low cost improvements depending upon the scope of improvements; i.e. intersection or corridor-wide.

If signal timing improvements alone cannot resolve this issue under existing volumes, another interim solution is to implement special ramp detection that can alert the traffic signal controller when spillback onto mainline interstate is about to occur. Once alerted, the controller can respond with special phasing and timing designed to clear out the ramp to avoid queues on the mainline. It is estimated that this setup would cost approximately $6,500 to $8,500.

Future Analysis

At the time this report was being finalized, there were plans for a detailed I-29 Corridor Study, which included this interchange, and the Glasston Railroad Crossing study which included the at-grade rail crossing east of 42nd Street. The following items are recommended for inclusion in these studies:

- Review mainline traffic patterns. The extremely heavy traffic forecasts on the northbound off-ramp dictates design of the interchange. This ramp already experiences queue spillback onto the interstate and forecasted traffic volume increases from the TDM is estimated at over 200 percent. Taking a global look at traffic on I-29 will help confirm this growth assumption.
- Detailed analysis of US 2 intersection with 42nd Street and Glasston Subdivision Railroad Line. This intersection was tangentially analyzed as part of this study, but was not scoped for detailed development of alternatives. During train events, long delays are experienced on US 2 that often result in queues that stretch to the interchange. This can result in gridlock and queues onto the interstate. A grade separation between the roadway and railroad may be required to mitigate this deficiency.

Implementation Plan

Interim Improvement

Improvement: Revise signal timing at the east ramp intersection to provide more green time for northbound movements.

2015 Cost: Dependent upon scope of project; intersection of corridor-wide improvements. Regardless, each are relatively low-cost when compared to the infrastructure improvements in this study.

Implementation Plan: Timing plans are regularly updated every five years in Grand Forks with the most recent coming as part of the LRTP completed nearly 2 years ago. Timing plans can be updated as part of the next iteration of city-wide timing plan improvements to account for the entire corridor or implemented immediately at the intersection level.

Long-Term Improvement

Improvement: Northeast Loop Alternative

Lead Agency: NDDOT

2015 Cost: $6,342,000

Implementation Strategy: There are a variety of funding sources that could be pursued for this project including Regional/National Highway Performance Program funds and HSIP funds. What is unknown, is how this improvement ranks in terms of other local and state priorities. The 2040 LRTP does not include a technical scoring methodology, so it is not possible to compare this project against the long list of planned and illustrative projects. This project is not currently in the Transportation Improvement Program (TIP) and will not likely be funded before the next LRTP cycle. It is recommended that this project be included in the universe of alternatives for the next LRTP and programmed based on this analysis.

Focus Area 3: Traffic Control

The US 2 corridor has seen a spike in development interest in recent years, particularly between 55th and 69th Streets on the south side of US 2. This is highlighted by Wal-Mart, constructed in 2014, which already produces over 9,000 trips per day and the Adams Development, a planned future development with the potential for 26,000 new trips once fully built out. Access onto US 2 from this growth area is a major challenge during peak periods due to the lack of traffic control. This results in deficient operations on the side streets, which increases average vehicle delay to several minutes by 2040. Long delays at two-way stop control intersections often lead to motorist frustration and risk taking behavior. This behavior may explain why 55th Street is above the critical crash rate threshold, primarily experiencing angle crashes between motorists on the side street and mainline traffic.

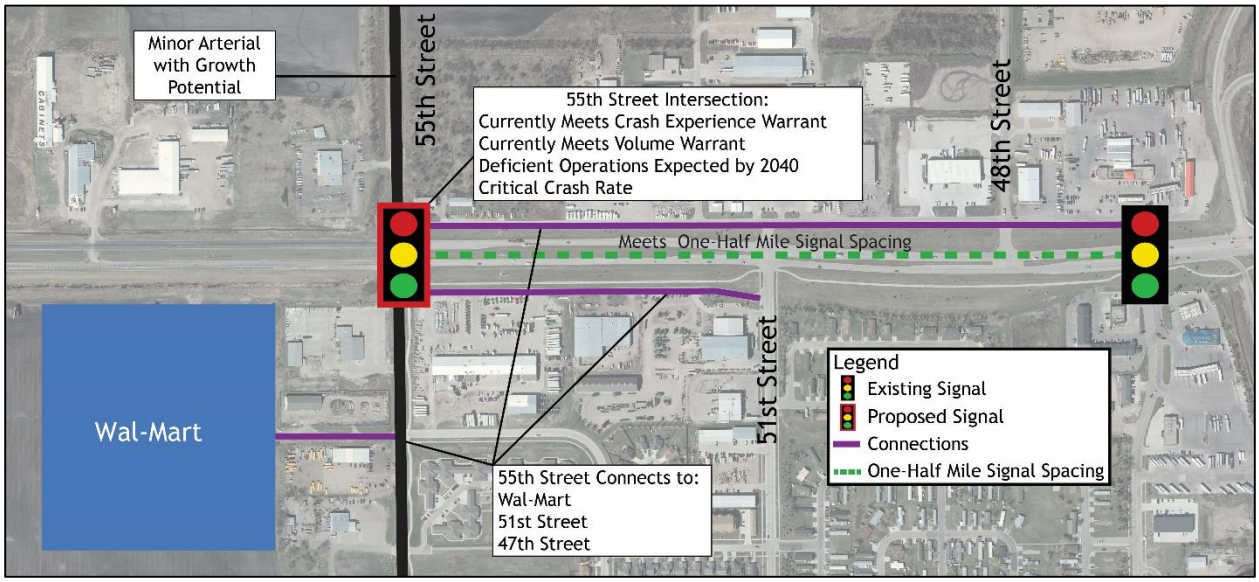
Currently, the intersections at 51st Street, 55th Street and 58th Street meet warrants for traffic signals based on existing traffic volumes. As illustrated by the congestion around the interchange, closely spaced signalized intersections often negatively impact traffic flow and safety. A thought-out, long-term strategy for traffic control implementation needs to be developed to ensure US 2 continues to be a safe and efficient corridor for travel, while also being conducive for development.

Alternative Assessment

After technical analysis, discussion with the Steering Committee and the public, it was determined that 55th Street is the optimal location for a traffic signal, leaving 51st and 58th Streets unsignalized. Signalizing the 55th Street intersection provided the following benefits that the other locations either did not or not as well:

- Intersection Operations: 55th Street experiences the highest volumes and longest delays of the three locations under existing and future conditions.
- Growth Potential: 55th Street is a minor arterial with connectivity north and south. This increases the potential for increased future traffic beyond what is included in the TDM.
- Accessibility: The current configuration of frontage and backage roads allow Wal-Mart traffic, 48th Street and 51st Street traffic to utilize the signal at 55th Street. The frontage road on the north side of US 2 may also reroute traffic from the 47th Avenue signal which would help alleviate congestion in the interchange influence area.
- Safety: 55th Street has the second highest crash rate along the corridor due to angle crash susceptibility. Effectively alternating the right-of-way will reduce the potential for these types of crashes. Crash warrants for signal installation are also met at the 55th Street intersection.

Figure 43: Benefits of 55th Street Signal



Contingency Planning

As noted earlier in the study, planned development between 55th Street and 69th Street north and south of US 2 has the potential to introduce a substantial increase in traffic along the corridor, particularly if housing is provided in a timely fashion to capitalize on the planned Air Force Base development. The current LRTP forecasts this development to build out to approximately 30 percent of its potential, with the majority of the development occurring close to 55th Street and University Avenue.

If the planned development builds out to a greater potential by 2040 and expands west, it is likely that more traffic will utilize 62nd Street, potentially warranting a traffic signal at this location. While NDDOT prefers one mile signal spacing on rural corridors, as the corridor urbanizes, half-mile signal spacing will become acceptable, permitting signals at 55th Street, 62nd Street and 69th Street, assuming all locations meet warrants.

As development occurs and more is known regarding specific land uses and timing of development, it is recommended that a traffic impact study be conducted to evaluate the impacts. This includes additional traffic control recommendations. At this time, it appears unlikely a traffic signal will be warranted in the next five years at either 62nd Street or 69th Street, meaning there is no need to implement traffic control improvements until development progresses.

Implementation Plan

Improvement: Install a traffic signal at the US 2 and 55th Street intersection with eastbound left, westbound right and northbound right turn lanes.

Lead Agency: NDDOT

Cost: $927,500 ($600,000 for traffic signal, $327,500 for turn lanes)

Implementation Strategy: The relatively low cost of the new traffic signal at 55th Street allows this project to be funded in coming years. This project would be a joint venture by NDDOT and the City of Grand Forks. It is recommended this signal be considered as part of the next Transportation Improvement Plan development process and coordinated with NDDOT's Grand Forks District priorities for Regional Roads funding (STP/U or NHPP).

Focus Area 4: Access Management

Access density is directly correlated with crash potential and traffic progression. Currently, access spacing along the corridor is in compliance with current standards, with the exception of the interchange influence area. The recent reinvigoration of development along the corridor makes it critical to provide a proactive and thought-out access plan to balance development access needs with the mobility and safety needs of the roadway.

Evaluation Criteria

The primary considerations for the access management plan:

- Accessibility. Each property along the corridor was carefully studied to ensure that some form of access was provided. This may be via full or restricted access from US 2 or access from a frontage or backage road. Since all parcels are accessible under all scenarios, accessibility was not used to compare alternatives.
- Safety and Operations. This was evaluated using the access risk criteria established on Page 22. This methodology considers conflict points and traffic volumes to determine the potential for congestion and crashes related to access points.
- Cost. The cost not only included access revisions and frontage/backage roads but also included turn-lanes necessary to accommodate the various alternatives. Cost estimates were developed for a hypothetical mile that currently did not have any turn lanes or frontage/backage roads. This permitted for a consistent evaluation of the alternatives.

Alternative Assessment

The table below details the three corridor-wide alternatives studied. Once the alternative was selected, the strategy was refined to accommodate corridor-specific needs.

Table 10: Access Management Alternatives Comparison

Alternative	Description[1]	Access Risk per Mile	Cost per Mile[2]
Frontage/Backage Road	Frontage or backage roads implemented throughout the corridor. Full access spacing restricted to every one-half mile.	480	$2.9 Million
Context Specific Improvements	Full access points are located every one-half mile, ¾ access points are located in between (one-quarter mile). Frontage/backage roads used only where necessary.	580	$1.9 Million
Restricted Crossing Corridor	¾ access spacing located every one-quarter mile. Left-turn and through movements are facilitated via U-turn maneuvers at the ¾ access. ¾ access points on each side of a major intersection would include acceleration lanes to accommodate high volume U-turn maneuvers.	230	$2.5 Million

[1]Right-in/Right-out permitted at locations where access cannot be removed (i.e. emergency access to Grand Forks International Airport

[2]Hypothetical cost for completely undeveloped stretch of US 2. Hypothetical analysis helps compare each alternative without bias from existing infrastructure (i.e. turn lanes, frontage roads, etc.).

Access management was the only scenario where technical analysis did not provide a clear optimal solution as access risk was not directly correlated to cost. Also, access risk did not account for the circuitous routing required necessary to account for the restricted crossing corridor. The Steering Committee and public were required to make a decision based on qualitative information; they selected the frontage/backage road for the following reasons:

- Safety and Operations. The frontage/backage road configuration provided half-mile access spacing that would provide an efficient and safe corridor into the future. Although the access risk for this alternative was not as low as the restricted crossing corridor, the circuitous routing requirements of the restricted crossing was considered to be a hindrance to operations by stakeholders and decision makers.
- Consistent and Desired Design. Frontage/backage road design is consistent with US 2 design along the corridor. This also matches the desired design as outlined in the 2040 Land Use Plan for US 2 development and redevelopment.

Proposed Access Management

Once the access management framework was determined, an alternative could be developed and refined. At this level of detail, decisions regarding specific access points could be made. To complete this task, the corridor was split into the following three segments:

- Built-Out Urban Area. This area includes US 2 from the interchange influence area to 55th Street. Access in this area was studied when this roadway section was urbanized. No improvements were identified in this area.
- Urbanizing Growth Area. This area includes US 2 between 55th Street to 69th Street, the major growth area over the next 25 years. The frontage/backage road designs were developed to consider current parcel configurations and prepare the corridor to be urbanized in the future. Specifically, ¾ access points were included between full access points and signal spacing was reduced to one-half mile. The addition of ¾ access points and half-mile signal spacing would not be applicable until the corridor is urbanized; until that time the corridor should maintain rural in nature.
- Rural Future Growth Area. This area includes US 2 from 69th Street to the west study area limit (County Road 5/17th Street). This area is not forecasted to experience notable development until beyond 2040. Thus, specific alignments for frontage and backage roads were not defined. Rather, alignment alternatives for frontage and backage roads were presented to provide an understanding of access restrictions for developers interested in this land. This approach allows for a clear understanding of where access is permitted while allowing for flexibility in final frontage/backage road design for developers. Once developed, this section of US 2 should follow the one-half mile signal spacing and one-quarter mile ¾ access spacing as laid out in the Urbanizing Growth Area.

Refer to Figure 44 for an illustration of the frontage/backage road configuration. In the proposed access management plan, a ¾ access was recommended at 58th Street. This access revision is only feasible once the frontage road system is implemented on the north side to allow for reasonable egress out of the property. The ¾ access is required on the north side due to the lack of frontage road setbacks caused by existing building footprints. The ¾ access was opposed by the adjacent land owner.

The proposed access management plan specifies restricted access between designated access points. However, it is not uncommon for developers to request right-in/right-out (RIRO) access points. It is recommended that RIRO access be restricted, particularly within the functional area of the intersection. Current design standards defines the upstream functional area of an intersection as a variable distance, influenced by the distance traveled during perception-reaction time, deceleration distance while the driver maneuvers to a stop and the amount of queueing at the intersection. The downstream functional area includes the same factors without queueing considerations.

Figure 44: Proposed Access Management Plan

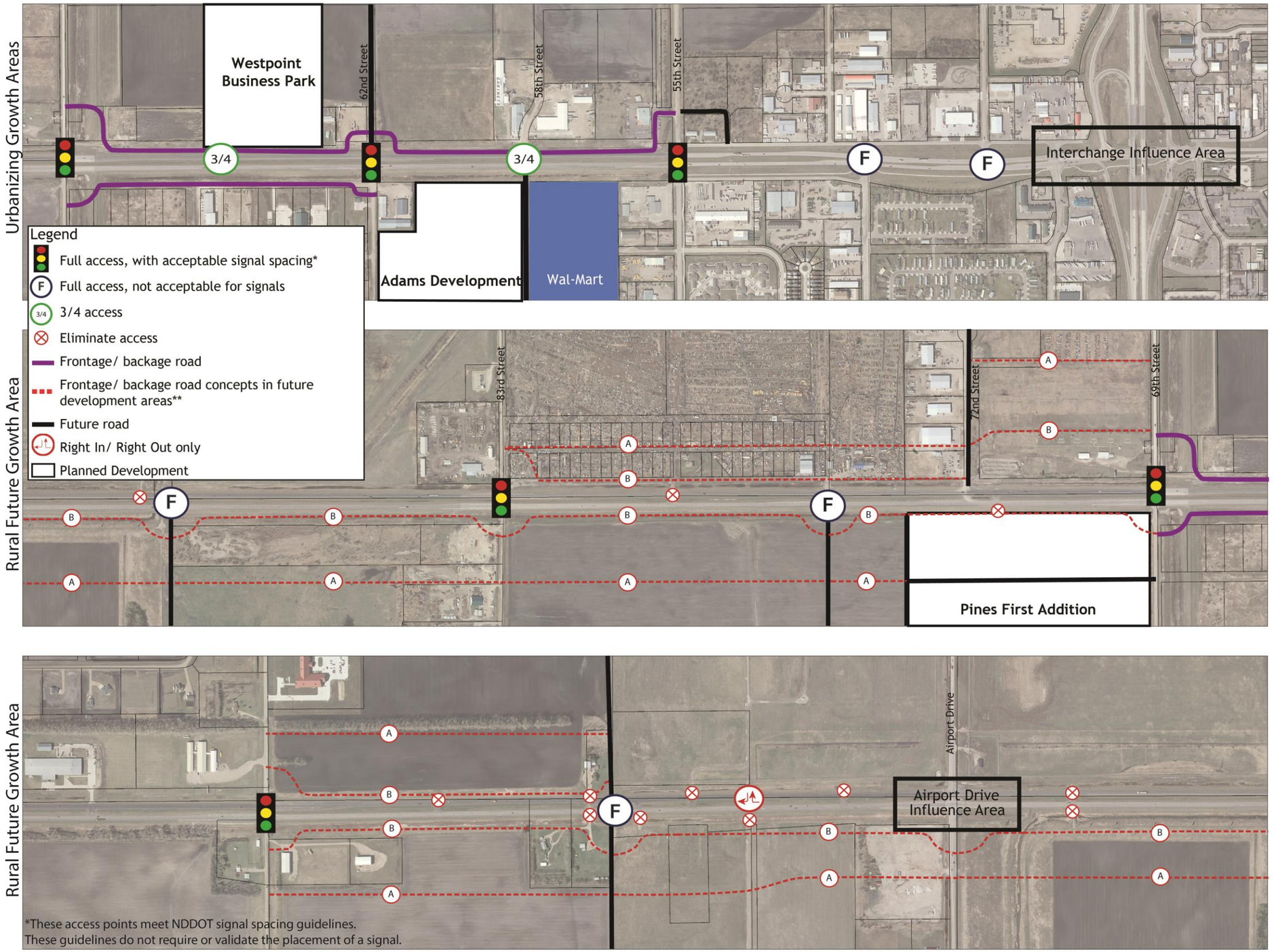
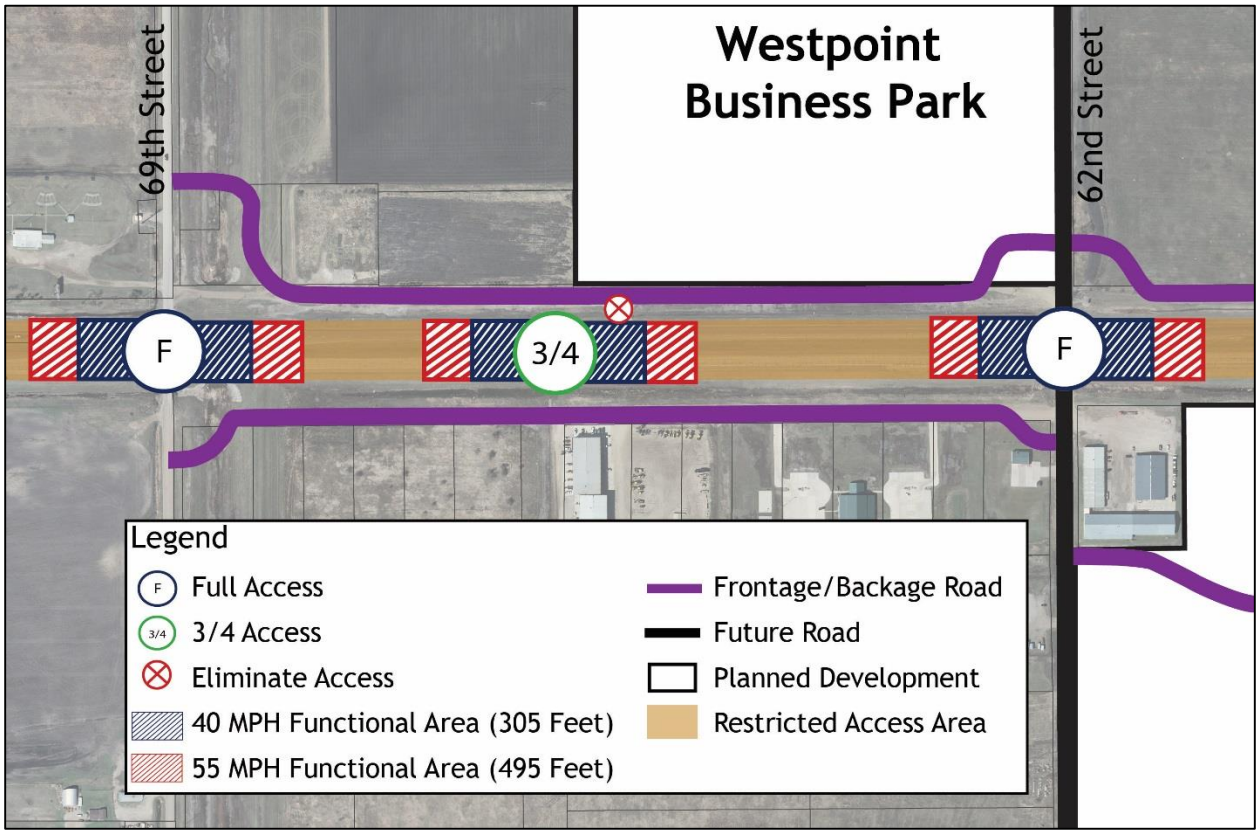


Figure 45 below illustrates the functional area surrounding a small section of the corridor. This illustrates both a 55 miles per hour functional area to reflect the current speed limit, and a 40 miles per hour to reflect the conditions of the urbanized corridor to the east. If an appropriate access management plan is implemented, higher speeds can be maintained, benefiting traffic flow through the study area. Since none of the intersections in this figure have mainline traffic control, there is no queueing forecasted, making upstream and downstream functional areas equal.

Prohibiting or eliminating driveways within the functional area of an intersection (upstream and downstream) helps reduce the number of decisions motorists must make while traveling through an intersection and improves safety in the vicinity of an intersection. A recent study evaluating crashes in the vicinity of signalized intersections in suburban areas completed by the Utah Department of Transportation provides one illustration of the correlation between driveways in the functional area of intersections and decreased safety; the study found that the existence of accesses within the upstream functional area of the intersection correlated to increased crashes and crash severity costs.

Figure 45: Intersection Functional Areas



Implementation Plan

The proposed access management plan is a gradual process that is to be implemented as development occurs. Building frontage roads for development that may not come for several decades is not cost effective in any environment, especially not a challenging financial environment.

NDDOT regulates access onto US 2 by permit. However, only the City of Grand Forks and Grand Forks County can regulate development adjacent to the highway system. Successful access management requires a partnership between NDDOT and the City of Grand Forks and Grand Forks County. If land use and development is not regulated to ensure a connected local street network and frontage/backage

road system, it will be impossible to implement the proposed access management plan. NDDOT and the City of Grand Forks will need to work together to implement this plan. However, NDDOT would lead any urbanization project where major access management improvements such as restricted access points or frontage roads.

According to Grand Forks City Code, the section of US 2 between 55th Street and 69th Street is classified as level 4 access control where access is allowed every 660 feet. The area from 69th Street to 83rd Street is classified as a Level 2 access controlled roadway with 2,640 feet access spacing. It is clear that the level of access control between 55th Street and 69th Street needs to be changed. The closest access management level is 3, which restricts access to every quarter mile. According to the Land Development Code, access spacing deviating from these standards may be authorized based on a traffic study demonstrating acceptable operations.

This corridor study acts as a surrogate for independent traffic studies for each potential access point. By adopting this corridor study and corresponding access management plan, the City of Grand Forks could accept the proposed access management plan as the current access standard for the study area. While any new access point onto US 2 requires a traffic impact study, those that follow the proposed access management plan would likely be supported by NDDOT and the City of Grand Forks. If deviations to the access plan were approved by NDDOT and the City, an amendment to the corridor study would be required to incorporate the revised access configuration.

Focus Area 5. NPN Site

Northern Plains Nitrogen (NPN) has plans to construct a nitrogen fertilizer plan northwest of Grand Forks. This development was not considered in the LRTP. Initial estimates show NPN generating 336 trucks per day during the peak season (April through May and October through November) and 250 passenger cars per weekday year round. Considering the magnitude of the NPN development, the trip generation is very modest on a square foot basis. The 60,000 annual truck trips, however, will take a toll on the existing roadway system, thus making the preferred access route a critical consideration.

Alternative Assessment

The NPN site can reasonably be accessed from either 55th Street or 69th Street from US 2. Roadway conditions, site layout and access efficiency onto US 2 will influence driver behavior regarding which route is utilized. These factors are within the control of NPN, City of Grand Forks and the Rye and Falconer Townships. To select the preferred NPN route to and from US 2, the following characteristics were studied.

Hazardous Materials Routing

When considering hazardous materials routes, minimizing the impact of any potential incidents is the goal. 55th Street is nearer to more existing and proposed commercial and residential developments, while 69th Street has limited development surrounding it and serves the Grand Forks Sewage Disposal Ponds and the Grand Forks Municipal Solid Waste Landfill. The City of Grand Forks has begun to prepare the US 2 corridor, specifically between 58th Street and 48th Street for private redevelopment.

The Centers for Disease Control has guidelines for emergency response for anhydrous ammonia spills. In the event an incident were to occur, emergency responders would need to evacuate everyone for one-mile in all directions. If that incident were to occur on 55th Street, 1,394 parcels could be impacted, including 697 residential properties, whereas the total impact that could occur from a spill on 69th Street is limited to a potential 539 parcels, including only six residential properties.

Advantage: 69th Street

Roadway Improvement Needs

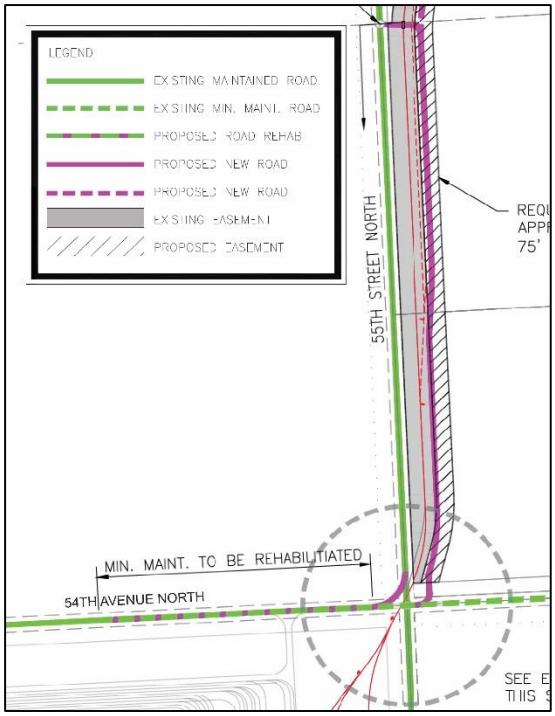
In terms of cost effectiveness, both 69th Street and 55th Street would need to be improved to a paved road that could support NPN related truck traffic. From US 2 to 54th Avenue, 55th Street is entirely gravel, while the first mile north of US 2 on 69th Street is paved. Currently, City of Grand Forks Sanitation uses 55th Street and maintains this route for their vehicles, but Countrywide Sanitation and other private sanitation trucks are encouraged to use 69th Street per the City of Grand Forks' "Good Neighbor Policy" for access to the landfill. Trucks that travel on 69th Street are commonly loaded to 25 tons so it is likely this mile of pavement would need improvements to accommodate NPN truck traffic, expected to be loaded to 40 tons. However, the already paved corridor would likely require fewer improvements than 55th Street.

- Selecting 69th Street would require approximately 3.33 miles total of new or rehabilitated pavement, including three miles on 69th Street and approximately one-third mile on 54th Avenue. According to NDDOT per mile project cost history, improving this route with a mill and HBP overlay and an HBP overlay would cost approximately $2.6 million.

- Selecting 55th Street as the primary access road would require 3.67 miles of total new pavement, including the three miles from US 2 to 54th Avenue and two-thirds mile on 54th Avenue to the access point. According to NDDOT per mile project cost history, improving this route with an HBP overlay for the entire 3.67 miles would cost almost $3.4 million.

Advantage: 69th Street

Figure 46: Proposed Rail Connection to NPN Site



Accessibility

Accessing NPN from 55th Street would provide a minor reduction in vehicle miles traveled (VMT), albeit fewer than 100 VMT for the entire year due to forecasted routing behavior. However, during train load operations at the NPN site, 55th Street would be blocked for six to 12 hours, once every week forcing motorists to reroute through a bypass roadway that reconnects north of 55th Street beyond the rail blockage (refer to Figure 46). This requires a circuitous route for vehicles accessing NPN from the south (or vice versa). If 55th Street is improved, there is the potential to increase traffic along this corridor for traffic not generated by NPN, making this conflict more prevalent.

Advantage: 69th Street

Traffic Operations

As noted in the earlier sections, a traffic signal is warranted and proposed at 55th Street. This mitigates delay as trucks and motorists egress the site as 55th Street traffic would experience 14 seconds of delay per vehicle at 55th Street versus 42 seconds of delay per vehicle at 69th Street. This also provides safety advantages as well, by limiting the potential angle crash exposure of trucks filled with ammonia. However, as development progresses west of 55th Street, the potential for a signal at 69th Street increases. This is not anticipated in the near future.

Advantage: 55th Street in the interim, equal once development warrants traffic signal at 69th Street

Proposed Alternative

In summary, technical analysis, Steering Committee and public input all agreed that 69th Street is the optimal route to access NPN. This route would impact fewer properties in the event of an anhydrous ammonia spill, cost less and require no railroad complications. The only advantage 55th Street has is the proposed traffic signal at US 2, which is mitigated if additional development triggers a traffic signal in the future at 69th Street.

Additionally, NPN requested an acceleration lane from 69th Street onto westbound US 2. Despite extremely low volumes making this movement, the volatility of the product may make an acceleration lane viable. However, NDDOT would be willing to consider an acceleration lane at this location if a proper agreement on cost, design and maintenance could be made.

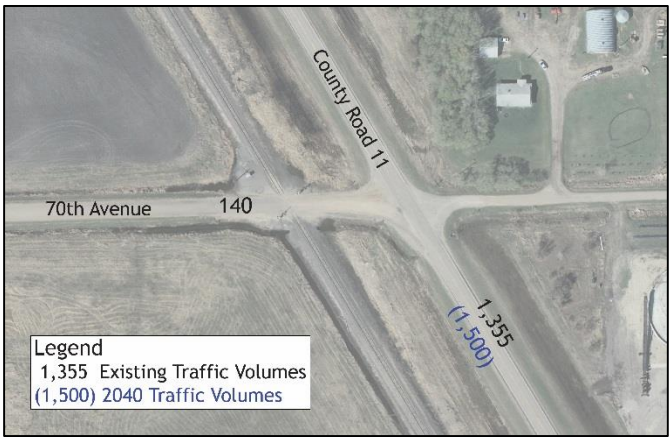
North Access

Truck trips were distributed and assigned throughout the transportation network based on conversations with NPN and analysis of VMT and vehicle hours traveled (VHT) for each potential route.

Passenger car trips were distributed based on existing traffic patterns using Average Daily Traffic (ADT) and the location of regional housing and then assigned to the network based on the shortest trip.

According to trip distribution and assignment analysis, 97 percent of traffic to and from the NPN site would be attracted south toward US 2 and the remaining three percent would be attracted north toward 70th Avenue to County Road 11 to access the interstate. The minimal amount of traffic generated north would not result in any deficiencies to the operations of these roadways. 70th avenue and County Road 11 currently carry 140 and 1,355 vehicles per day respectively. This means that even if the planned trip distribution and assignment completely changes, there is ample capacity along these corridors before any major deficiencies occur.

Figure 47: Traffic Volumes at 70th Avenue and County Road 11



Implementation Plan

Improvement: Roadway improvements on 69th Street from US 2 to 54th Avenue and on 54th Avenue from 69th Street to the NPN access and southbound right turn lane from 69th Street onto US 2.

Lead Agency: City of Grand Forks

Cost: $2,670,000

Implementation Strategy: Improvements to 69th Street to accommodate the NPN development would be a joint venture between the City of Grand Forks and NPN. Detailing the specific cost participation of each party will require negotiation and is outside the scope of this study. These improvements will be required prior to completion of the NPN development. The schedule was not known at the time this report was completed.

Focus Area 6: Turn Lanes

The addition of turn lanes adds capacity and improves safety by clearing slowed or stopped vehicles making turning movements out of the through lanes. To identify where turn lanes can provide the greatest benefit to the study area, recommendations are provided based on two different analyses. The first was for the rural part of the corridor where speeds are greater than 50 miles per hour. Turn lanes for this section of the corridor were proposed based on the volume and crash criteria provided by NDDOT. For the urban section of the corridor where speeds were lower than 50 miles per hour, and on side streets, Synchro software was used to identify locations where approach LOS was at "D" or below. At these locations, turn lanes were evaluated to improve LOS to "C" or above. Turn lane recommendations at the Airport Drive/County Road 5 intersection or the interchange influence area can be found in previous chapters. Turn lanes should be considered at these intersections:

- 51st Street: Turn lanes for the northbound and southbound approaches can fit within the existing roadway footprint and are warranted under existing traffic volumes.
- 55th Street: Currently westbound right and northbound right turn lanes are warranted under existing traffic volumes. An eastbound left will be warranted by 2025.
- 58th Street: A ¾ access configuration is recommended at 58th Street. Construction of an eastbound left turn will be necessary to accommodate this configuration.
- 64th Street: A ¾ access configuration is also recommended at this intersection. Construction of an eastbound and westbound left turn lane will be necessary to accommodate this configuration.
- 69th Street. When NPN is fully operational, a southbound right turn lane will be warranted.

Proposed turn lanes can be seen in Figure 48.

Implementation Plan

The following is an implementation plan for turn lanes to be considered.

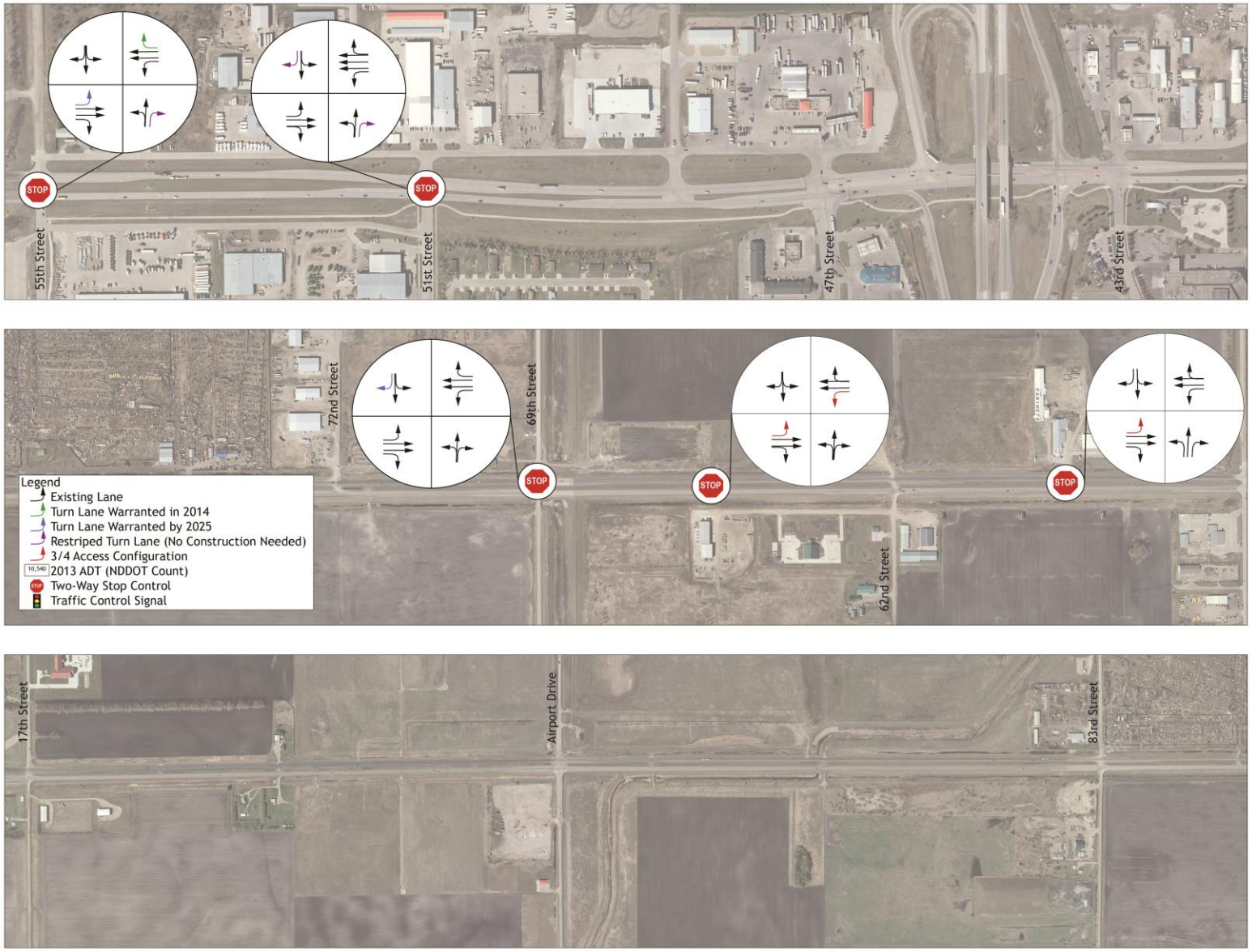
NDDOT would be lead agency for the following turn lane projects:

- 51st Street Turn Lanes ($15,000). Northbound and southbound right turn lanes should be implemented during the next cycle of roadway striping costs.
- 55th Street Turn Lanes ($327,500). These turn lanes should be implemented during the traffic signal project.
- 58th and 64th Street Turn Lanes for Access Restrictions ($750,000). Turn lanes to accommodate a ¾ access should only be implemented once the corridor has urbanized and frontage road access has been established to allow for restricted access at these locations.

The City of Grand Forks would be lead agency for the following turn lane project:

- 69th Street Turn Lanes ($70,000). This turn lane should be implemented as part of the NPN roadway project improving 69th Street.

Figure 48: Proposed Turn Lanes



Focus Area 7. Bicycle and Pedestrian Facilities

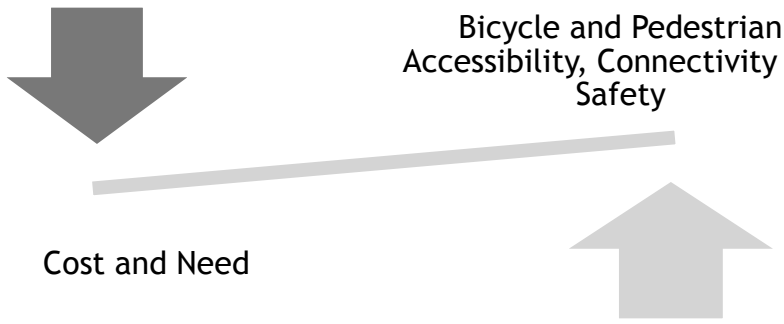
Historically, the corridor has primarily been made up of industrial land uses, but the onset of recent commercial and residential development increases the necessity to provide bicycle and pedestrian facilities to major existing and future generators. Currently only 10 percent of the corridor has bicycle and pedestrian specific facilities (counting both sides of the corridor). Recent development, such as Wal-Mart, did not incorporate bicycle and pedestrian facilities.

The high-speeds, volumes and truck activity make on-street bicycle activity unappealing to even advanced riders. Additionally, there are no signalized bicycle and pedestrian crossings across US 2 within the study area. This means that the traffic signals must be timed to allow pedestrians to cross the entire intersection without stopping on each phase. This requires very long green periods for the sidestreets, even when traffic is minimal, resulting I unnecessary delay and worsened operations due to the limited amount of pedestrian activity across US 2. To make US 2 conducive to non-motorized traffic, it is vital that bicycle and pedestrian facilities be planned and preserved as development occurs.

Evaluation Criteria

The decision for increased bicycle and pedestrian activity can be graphically illustrated in the figure below. The lack of existing facilities along US 2 makes it difficult to gauge demand. However, not providing bicycle and pedestrian facilities or accessibility to the north side of the corridor has obvious impacts to multimodal activity and safety, and may even limit the types of development attracted to the area.

Figure 49: Balancing Bicycle and Pedestrian Facilities Cost and Need



Proposed Alternative

The Steering Committee and public were provided two alternatives. The first continued the design of the corridor with a shared use path exclusively on the south side of the corridor. The second alternative included a shared use path on both the north and south side. This would connect with plans to include the shared use path on 55th Street north of US 2, provide access to new developments on the

north side of the corridor and allow for safe and efficient crossing of US 2 at signalized locations of 42nd Street and 47th Street and the future signal at 55th Street.

There was no clear preference on the provision of bicycle and pedestrian facilities on the corridor. The Steering Committee preferred facilities on both sides (45.5 percent voted for facilities on both sides, 36.3 percent voted for facilities only on the south side and 18.2 percent voted to do nothing), while the public preferred facilities only on the south side (84.2 percent voted for facilities only on the south side and 15.8 percent voted for facilities on both sides). Land owners primarily opposed shared use paths on the north side because they opposed potential assessments.

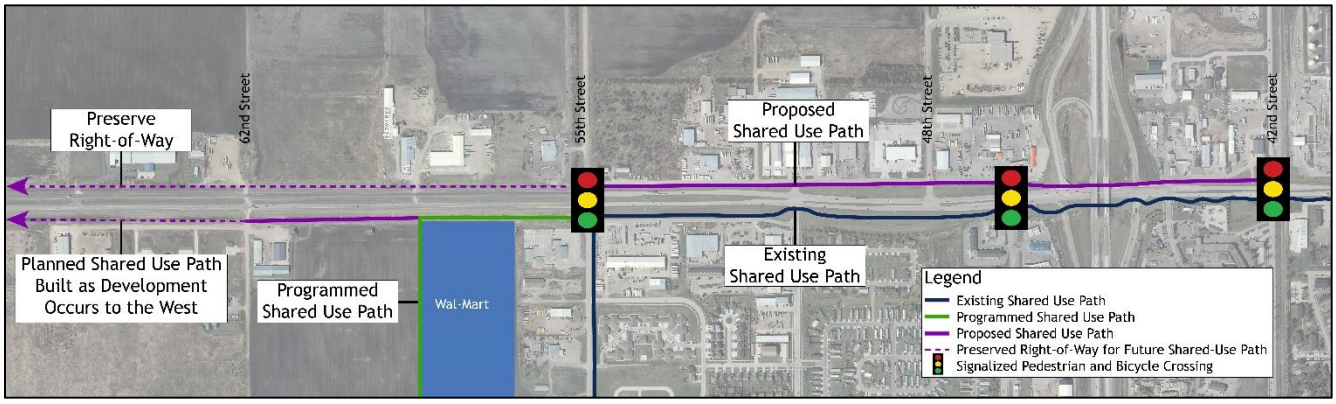
AASHTO guidance discourages shared use paths on only one side because it is counter to driver expectancy. Furthermore, the 2040 LRTP has extensive goals and objectives for the bicycle and pedestrian network:

- Reduce excessive travel delays by using the bike network
- Increase non-motorized mode split by 10 percent
- Promote the off-road network
- Increase miles of bikeway network by 63 percent
- Encourage installation of bicycle and pedestrian facilities during street repair, renovation and construction to reduce costs

For these reasons, the proposed alternative

- Provides facilities on the south side of US 2, constructing paths as development occurs to the west.
- Could provide facilities on the north side of US 2 between 42nd Street and 55th Street, in coordination with the roadway maintenance projects planned for 2026 and 2029.
- Preserves enough right-of-way along the north side of the corridor west of 55th Street that future provision of facilities could occur when redevelopment occurs or when financial assistance could increase support.
- Provides signalized crossings at existing and planned signals located at 42nd Street, 47th Street and 55th Street. All future signals along the corridor will facilitate signalized pedestrian crossings.

Figure 50: Bicycle and Pedestrian Facilities Recommendations



Implementation Plan

Similar to access management, the bicycle and pedestrian improvement plan would not be to build shared use paths along the entirety of the corridor immediately, but rather to preserve the corridor for when development occurs and place the onus of constructing paths along the corridor on the

developer. That way, new developments, like Wal-Mart for example, are not constructed without bicycle and pedestrian connectivity.

There are several locations where redevelopment is unlikely but facilities may be desirable. This includes the north side of US 2 east of 55th Street and the south side of US 2 between 55th Street and 58th Street. The 2040 LRTP proposed a shared use path on the south side of US 2 between 55th Street and 58th Street that would wrap around Wal-Mart and connect to the shared use path and bike lane on University Avenue. This project was estimated for completion in 2021.

For the north side of US 2 east of 55th Street, a variety of funding and project phasing alternatives are available. The 2040 LRTP has identified a series of roadway maintenance projects scheduled for estimated completion between 2026 and 2029 that would stretch from 55th Street east to the Red River. The construction of shared use paths could be completed in tandem with these projects. Alternatively, these projects could be added to the universe of improvements evaluated and prioritized in the next Bicycle and Pedestrian Plan update, making them eligible for TAP funds. Finally, assessments could be considered to implement the desired facilities, allowing for a connected network as facilities are constructed in developing areas.

Summary of Proposed Improvements

Infrastructure Improvements

Airport Drive Intersection

The Staggered T-Intersection Configuration eliminates signal control and far-side crashes. This configuration will reduce total crash potential by 67 percent and 2040 peak hour delays by 77 percent. The design minimizes the environmental impacts.

Interchange Influence Area

The Northeast Loop alternative adds a loop ramp in the northeast quadrant and another turn lane on the northbound to eastbound off-ramp. By preventing northbound left-turns from conflicting with eastbound left turns and through movements, the traffic signal was reduced to only two phases, increasing throughput and reducing queues across adjacent US 2 intersections. This alternative reduces crash potential by 40 percent and 2040 vehicle hours traveled by 20 percent.

55th Street Improvements

55th Street was selected as the optimal location for a traffic signal because of its connectivity north and south, accessibility to adjacent intersections because of the frontage road configuration and the potential to reduce angle crashes. This intersection also requires eastbound left, westbound right and northbound right turn lanes.

69th Street Improvements

The planned NPN site will require improved roadways to access their site three miles north of US 2. 69th Street was selected for improvement because of limited potential impacts in the event of an anhydrous ammonia spill, less roadway improvement needs and no railroad impacts. 69th Street will need to be paved and southbound right turn lane from 69th Street onto US 2 should be constructed.

Turn Lanes

Additional turn lanes are proposed at 51st Street, 58th Street and 64th Street. The timeframe for implementation on these projects varies and is correlated with development growth on the corridor.

Policy Improvements

Access Management Plan

The proposed access management plan was designed to be a gradual process, implemented as development occurs. This plan provides refined solutions for the urbanizing growth area and flexibility for the rural growth areas, where development is not imminent.

Bicycle and Pedestrian Facilities Plan

The bicycle and pedestrian facilities plan also provides phasing for the provision of bicycle and pedestrian facilities. This plan will implement facilities on the north side of US 2 with the planned roadway projects and preserve right-of-way to the west on both sides of the corridor.

Figure 51: Proposed Infrastructure Improvements