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US 2/US 81 SKEWED INTERSECTION STUDY

Existing and Future Conditions Report

Grand Forks, ND

February 2019

Overcoming Barriers Strengthening Connections

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

Grand Forks - East Grand Forks
Metropolitan Planning Organization

Ensuring Opportunities Planning One Community

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INTRODUCTION

The purpose of this report is to evaluate the existing and future conditions of a segment of US 2/Gateway Drive and US 81/Washington Street in Grand Forks, North Dakota. This report will identify issues and opportunities that will be used to develop solutions to improve the transportation options.

STUDY AREA

The study area consists of one-half mile of US 2/Gateway Drive in Grand Forks, North Dakota. This study area includes five intersections with US 2/Gateway Drive that will be evaluated in this report:

- 20th Street
- US 81/Washington Street
- Mill Road/5th Street
- 4th Street
- 3rd Street/11th Avenue

US 2/Gateway Drive and US 81/Washington Street serve as Level One Freight Systems for the State of North Dakota, as defined in the *North Dakota State Freight Plan*. This means they serve as critical freight corridors, with International and Interstate connections. Between the US 2/Gateway Drive intersections of US 81/Washington Street and Mill Rd/ 5th Street is the Burlington Northern Santa Fe (BNSF) Mill Spur that serves the North Dakota State Mill and Elevator (NDSM) to the north.

Figure 1 shows the study area intersections, current traffic control, overall average daily traffic (ADT), truck ADT, and functional classification of study area roadways. Further information obtained from a field review and desktop review of the current infrastructure are summarized in subsequent sections.

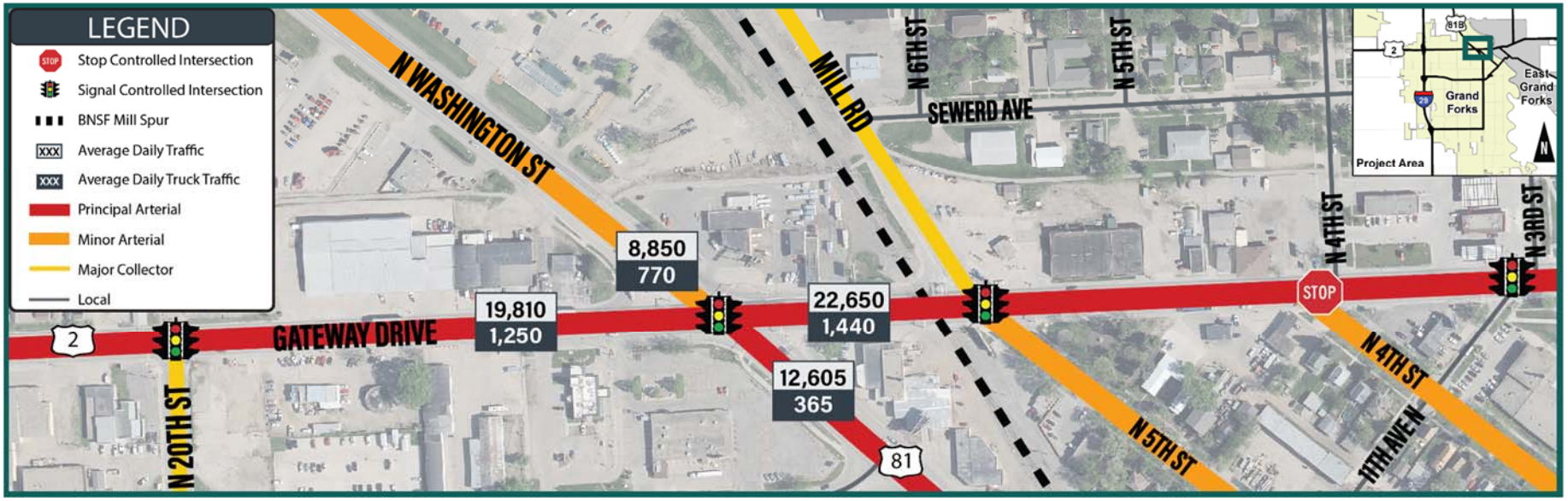


Figure 1: Study Area Infrastructure

Functional Classification

Functional classification is a uniform way of classifying roadways based on the mobility and access of the roadway. Core classifications are arterials, collectors, and local which encompass all roadways and provide a range of higher mobility/lower access to lower mobility/higher access, respectively. Characteristics also vary depending on whether they are in an urban or rural environment. Functional classifications for study area roads are shown in **Figure 1**.

- US 2/Gateway Drive and US 81/Washington Street south of the intersection with US 2/Gateway Drive are classified as Principal Arterials. Principal Arterials in the urban environment, are defined as roadways that serve major areas with the high traffic volumes. These roadways should have the smallest access density according to the Federal Highway Administration (FHWA). US 2/Gateway Drive is also listed on the National Highway System, which includes roads important to the nation's economy, defense, and mobility.
- US 81/Washington Street north of the intersection with US 2/Gateway Drive, 5th Street and 4th Street south of US 2/Gateway Drive are classified as Minor Arterials. Urban Minor Arterials provide connection to Principal Arterial roads from other lower classifications. Minor Arterials also have a higher access density than a Principal Arterial, but also smaller than Collectors and Local roads. US 81/Washington Street south of US 2/Gateway Drive is also listed on the National Highway System.
- Mill Road and 20th Street are classified as Collectors. The main purpose of collectors is to provide access to arterials from Local roads.
- All other roads in the study are classified as local streets. Local roads are intended for short trips and primarily serve as direct land access.

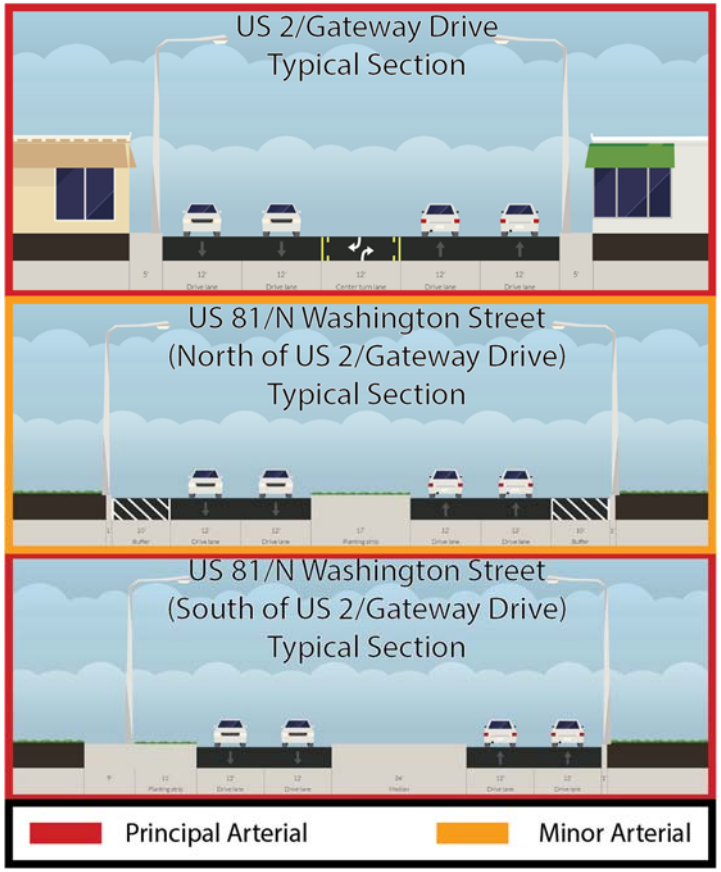
Typical Sections

Typical sections show the general configuration of a roadway, with typical sections for the study area are shown in **Figure 2**. Within the study area US 2/Gateway Drive is a five-lane section with additional right-turn lanes at intersections as necessary. Sidewalks are available for pedestrians.

US 81/Washington Street north of US 2/Gateway Drive is a four-lane section with a grass median approximately 17' feet wide, and 10' shoulders on either side of the road. Left-turn lanes are provided approximately every 200 feet, and additional turn lanes are provided at the intersection with US 2/Gateway Drive. Pedestrian facilities are limited to directly adjacent to the intersection of US 2/Gateway Drive and US 81/Washington Street on US 81/Washington Street.

US 81/Washington Street south of US 2/Gateway Drive is a four-lane section with a center median and a shared use path for pedestrians on the west side of the roadway.

Figure 2: Typical Sections



Right-Of-Way

Right-of-way refers to the land available adjacent to a corridor for the expansion or modification of roads, pedestrian facilities, or utilities.

Existing right-of-way information was obtained from the City of Grand Forks GIS Services Map. US 2/Gateway Drive is limited to the roadway and current sidewalks, with limited utility easements available for streetlights. The approximate width is 70 feet.

Businesses and parking lots occupy the space adjacent to the right-of-way making the acquisition of additional right-of-way difficult. Examples of this in the study area can be seen in **Figure 3:**

- The University Storage Building is immediately adjacent to the sidewalk
- Facilities/parking at U-Haul of Grand Forks are also adjacent to the sidewalk.

US 81/Washington street has approximately 20' on the east side of the road and 60' on the west side of the roadway, allowing for more flexibility.

Pavement Conditions

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 $515 to the annual cost of car ownership due to damaged tires, suspensions, reduced fuel efficiency, and accelerated vehicle depreciation.

The Grand Forks-East Grand Forks MPO derived a pavement conditions map for the 2045 Long Range Transportation Plan update that combined NDDOT and City of Grand Forks pavement data into one pavement map, this information is shown in **Figure 4**. Based on this information, US 2/Gateway Drive pavement is in good condition, US 81/Washington Street pavement is in satisfactory condition, and Mill Road/5th street is in fair condition.

Figure 3: Right of Way Limitations

Utilities

Existing utilities and locations were also obtained from the City of Grand Forks GIS Services map. These utilities include buried water lines, sanitary sewer, storm sewer, electrical and fiber optic; and are shown in **Figure 4**.

US 2/Gateway Drive and US 81/Washington Street both have overhead street lights on either side of the roadway.

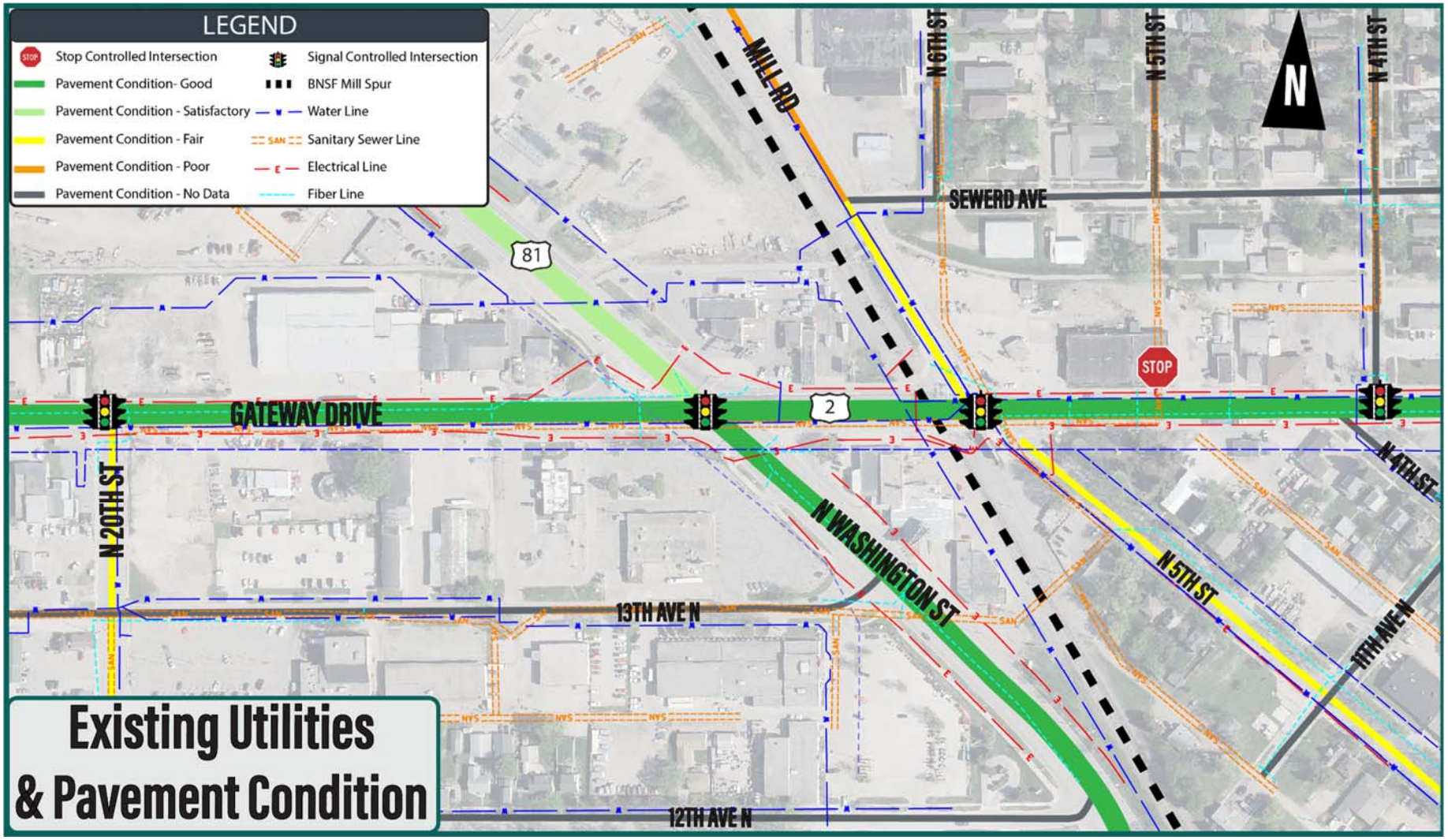


Figure 4: Utilities and Pavement Condition

Access Management

Access management is the process of balancing the competing needs of traffic movement and land access. Accesses introduce conflict and friction into the traffic stream. Allowing dense, uncontrolled access spacing results in safety, operational and aesthetic deficiencies for all users.

- According to NCHRP Report 420: Impact of Access Management Techniques, every unsignalized driveway increases the corridor crash rate by approximately two percent and decreases corridor travel speeds by 0.25 miles per hour.
- 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.

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 access management configurations locally and statewide.

The study corridor is a principal arterial classified by the Grand Forks Land Development Code as a Level 4 Access Controlled Street. The desired access spacing is 660 feet, or eight accesses per mile per side including crossing arterial routes. There were 33 accesses including roadways, private residential driveways, and commercial business driveways inventoried on the half-mile study corridor. This equates to 66 access points per mile, which is more than eight times the recommended spacings for a principal arterial. **Figure 5** shows the existing accesses in the study area.

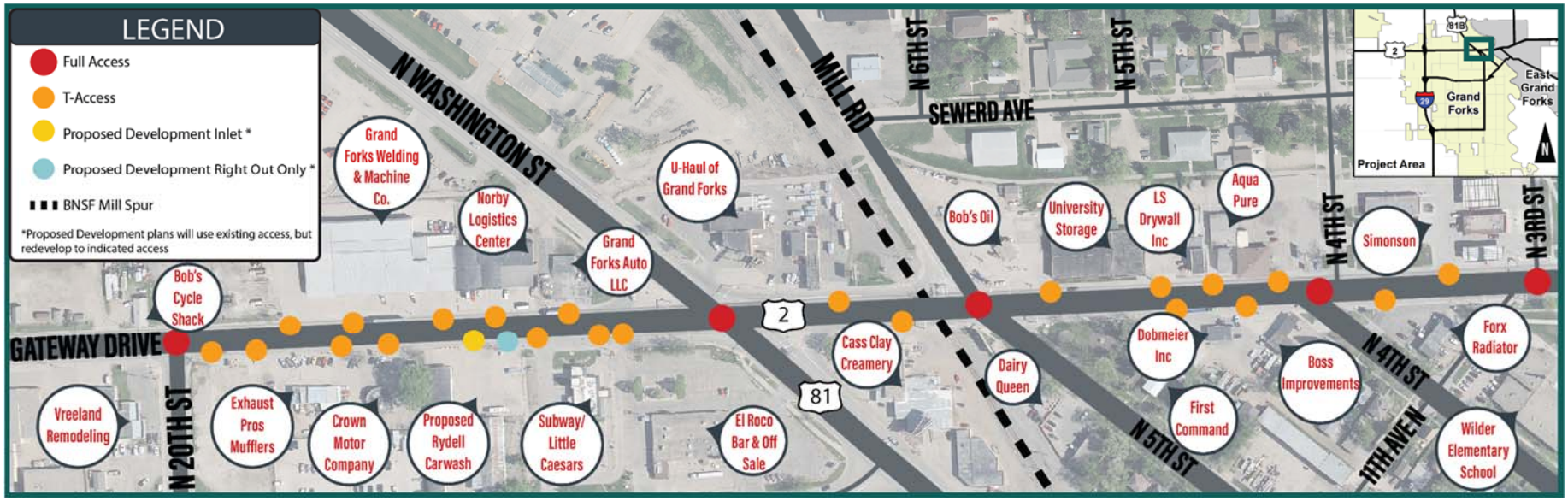


Figure 5: Existing Accesses

TRAIN ACTIVITY

The Burlington Northern Santa Fe (BNSF) railroad line runs parallel to Mill Road/5th Street on the west side. Preemption data obtained from the City of Grand Forks shows that the average number of train blockages daily is between 4 and 5 trains. Data from the Federal Railroad Administration (FRA) is consistent with this, showing 4 trains or switching maneuvers per day. The maximum train speed is 20 miles per hour, with common train speeds between five and 10 miles per hour.

Given the low train volumes and low train operating speeds, the existing overhead flashers meet FRA guidelines for active crossing safety devices. While no crashes involving a train have been reported since 1994, 12 crashes had occurred previously between 1975 and 1994.

In 2010, the Grand Forks – East Grand Forks MPO completed the *Mill Spur Feasibility Study* to identify railroad crossing improvements that would improve safety and aesthetics of the corridor, improve traffic operations, and plan for improvements that would accommodate a future train whistle quiet zone. This study recommended installing an active warning system (railroad gate arms and constant warning time), 8-inch high concrete median, pedestrian gates, and other geometric improvements that will increase crossing safety for vehicles and pedestrians.

Conflicts are not only limited to vehicles, with sidewalks crossing the tracks on each side of US 2/Gateway Drive, and a multi-use path crossing the tracks 250 feet north of the corridor.

The North Dakota State Mill is also working to accommodate unit train access. Unit trains are trains that carry one single commodity to reduce costs of switching out train cars at multiple locations. They typically exceed 110 cars and are approximately 7,000 feet in length. These trains can be longer and have more cars that will need to be loaded at the NDSM which can have a more significant impact to traffic flow during train events. According to analysis completed as part of the Mill Spur Feasibility Study Completed in 2010, one Unit Train will block each individual crossing between 8.67 and 16.57 minutes depending on the speed. A unit train would block all of the crossings along the Mill Spur from 2nd Avenue to Gateway Drive between 2.97 and 5.17 minutes depending on speed.

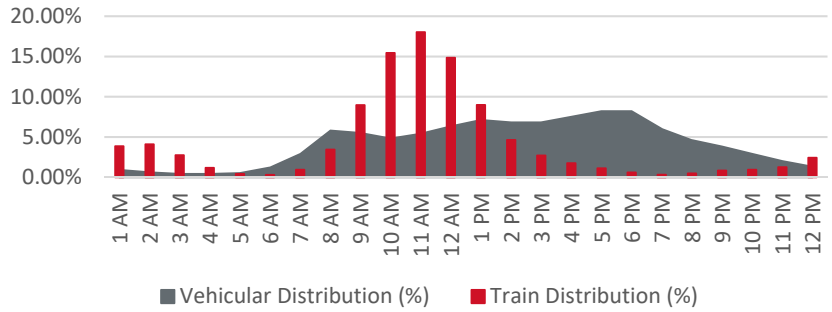
According to the ND Mill, the Mill would typically receive 2 unit trains per month with a minimum of 3 and a minimum of zero unit trains. This would be in replacement of other trains and not in addition to. The Mill also expects most of these trains to come on the weekends and at night. While the evenings and weekends limits the impact to traffic delays, this does increase the noise impacts to surrounding neighborhoods.

Current Train Events

The City of Grand Forks provided railroad preemption data from the traffic signals for the periods between 2016 and 2018. This data shows date, time, and duration of train events on the Mill Spur rail line. Only 4.5 months of data were analyzed due to most data files not showing the type of preemption (train vs. emergency vehicle), this data was not used in the analysis, to prevent skew from shorter duration emergency vehicle preemption events. Further information on types of preemption, as well as, providing data for the full year of 2018 would provide the most accurate analysis of current traffic conditions.

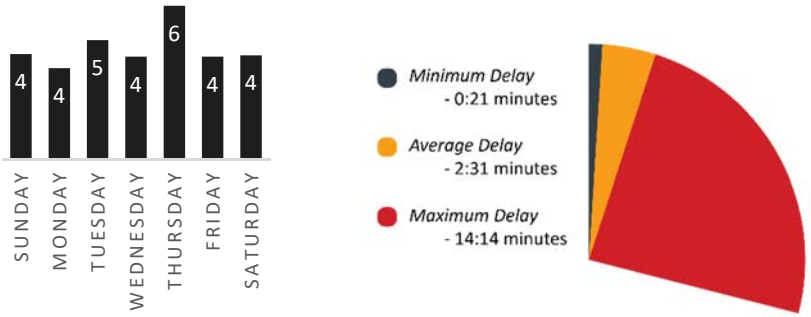
The following analysis was based on the 4.5 months of useable data. The months analyzed included March, April, October, November, and half of December. These numbers likely do not reflect the highest or lowest number of trains throughout the year. Figure 6 shows the daily distribution of trains per intersection, based on this data, as well as, the typical daily distribution of traffic. This distribution shows how trains and vehicles are spread out throughout the day. The peak hour for trains occurs between 11am and noon, while the peak hour for vehicles is 4pm to 6pm.

Figure 6: Train and Traffic Distribution



As illustrated by the duration of these blockages, this crossing accommodates train movements and switching maneuvers. **Figure 7** shows the average number of blockages per day of the week based on the data provided and the duration of train blockages. Average, maximum, and minimum duration of train blockings at the US 2/Gateway Drive crossing were found to be 2:31, 14:14, and 0:21 minutes respectively. When considering the total delay to all vehicles it adds up to 89 hours per day, 2,670 hours per month, and 32,396 hours a year. This does not consider seasonal variances due to the limited amount of data.

Figure 7: Average Daily Trains and Delay Duration



Crossing Exposure and Crash Prediction

Data from the *National Highway Traffic Safety Administration* (NHTSA) indicates that a motorist is 20 times more likely to die in a crash involving a train than in a collision involving another motor vehicle. Therefore, it is imperative that the risk for vehicle-train collisions is minimized while working to achieve other goals such as reducing traffic delays and minimizing the impacts that train activity has on surrounding homes and businesses.

The Federal Railroad Administration (FRA) has a crash prediction model, according to this model, this intersection will have 0.02808 crashes per year with a train. This is the 5th highest rate in Grand Forks, and the 7th highest rate in Grand Forks County.

FHWA has guidelines for determining if grade separation should be considered at locations.

Grade Separation Guidelines:

- Highway designated in National Highway System
- Highway access is designed for partial controlled access
- Highway speed exceeds 55 mph
- Train speed exceeds 100 mph
- AADT exceeds 50,000 in urban areas
- Average number of trains per day exceeds 75 (or 50 passenger trains)
- Crossing exposure (product of vehicular crossing ADT and number of trains) exceeds 500,000 (or 400,000 for passenger train crossing exposure)
- Accident frequency exceeds 0.2
- Vehicle delay per day exceeds 30 vehicle hours per day
- An engineering study indicates lack of grade separation would cause the highway to perform below design level of service more than 10 percent of the time.

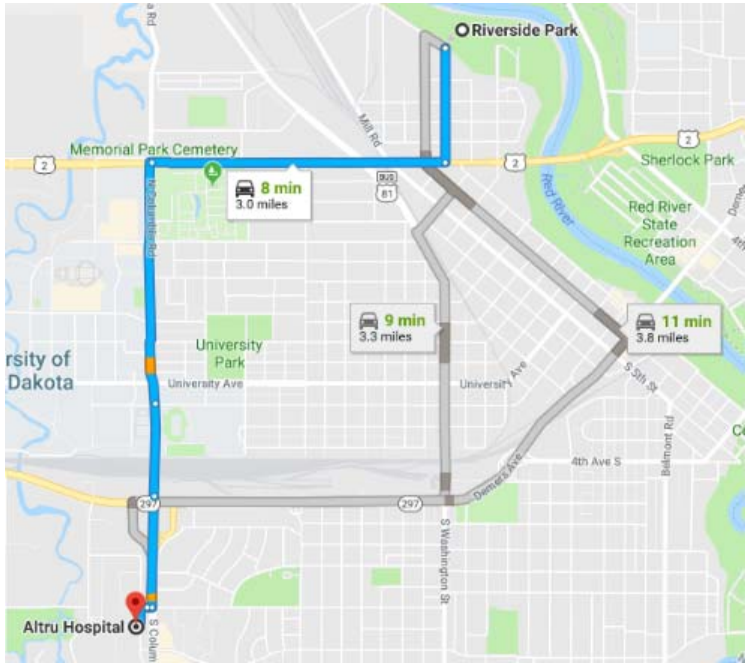
Under current conditions, the only guideline that this intersection meets for grade separation is for vehicle delay. The threshold for vehicle delay is 30 vehicle hours per day, and currently vehicle delay is almost three times that at 89 hours per day.

Emergency Operations

Grand Forks Fire, Police, and Ambulance service regularly cross the Mill Spur rail line for emergency service, especially to provide service to East Grand Forks and rural Minnesota. During a train event the crossing is blocked on average 2 minutes and 31 seconds. This delay impacts the response time of these emergency services.

- For emergencies involving loss of oxygen to the brain, brain damage is possible within four to six minutes, expected from six to 10 minutes, and death is most likely to occur after 10 minutes, making ambulance and medical first responders time critical.
- Effective fire-fighting is also impacted with each minute of delay: typical residential fires double in size every 60 seconds so response time to fires is critically important.

Figure 8: Google Maps Travel Time Estimate from Riverside Park to Altru Hospital



Altru Hospital is the primary healthcare provider for the city and region including East Grand Forks and surrounding areas. The impacts of a train event on the Mill Spur line, for a medical first responder is shown in **Figure 8**. To travel from Riverside Park to Altru Hospital during a train event adds three additional minutes, assuming no additional congestion through downtown.

The Grand Forks Fire department has five fire stations, which are placed to allow them to respond to any address in city limits within four minutes. Station 2 serves approximately the northern third of the city and is located on the corner of North Columbia Road and 10th Avenue North. Any train delays would impact the department's capability to respond to the northeast corner of the city. **Figure 9** shows the response area for Station 2 from the Grand Forks Fire Department and the location of the rail crossings.

Figure 9: Grand Forks Fire Station 2 Response Area

PEDESTRIAN, BICYCLE, AND TRANSIT FACILITIES ANALYSIS

Pedestrian Facilities and Amenities

The industrial nature of the corridor and high truck traffic can conflict with the ability to provide pedestrian and bicyclist comfortability. There are four-foot sidewalks adjacent to the curb line throughout the study area, excluding the north side of US 2/Gateway Drive from 20th Street to US 81/Washington Street. The only marked intersection across US 2/Gateway Drive is located at the 3rd Street/11th Avenue signalized intersection; there are also pedestrian push buttons, countdown timers, and truncated domes. There are no other marked crosswalks across US 2/Gateway Drive in the study area. There are marked crosswalks and truncated domes across the minor approaches at 20th Street, Us 81/Washington Street, and Mill Road/5th Street. There are no pedestrian push buttons or countdown timers at these locations. The high volume of traffic and the crossing distance of about 75 feet makes it a challenge for pedestrians to cross on US 81/Washington Street without pedestrian signal phasing. The presence of right-turn slip lanes on the north approaches of US 81/Washington Street and the Mill Road can reduce pedestrian comfort and safety as it permits right-turning vehicles to make fast, uncontrolled right-turns.

In addition to the sidewalks along US 2/Gateway Drive, there is a multi-use path that runs along the back of the commercial properties north of US 2/Gateway Drive. East of 3rd Street/11th Avenue, there is an underpass beneath US 2/Gateway Drive which connects the path to 3rd Street and ultimately the Red River Greenway and Riverside Pool. There is also a multi-use path that runs along the west side of US 81/Washington Street south of US 2/Gateway Drive that continues to 8th Avenue N, where it transitions to sidewalks and continues south through the City of Grand Forks.

Pedestrian facilities in the study area are shown in **Figure 10.**

Safe Routes to School

The Wilder Elementary School is located on the south-east quadrant of US 2/N 3rd Street/11th Avenue intersection. The existing surface crossing and tunnel on the east side of the N 3rd Street and 11th Avenue crossing US 2/Gateway Drive is a designated safe route to the school for pedestrians and bicyclists.

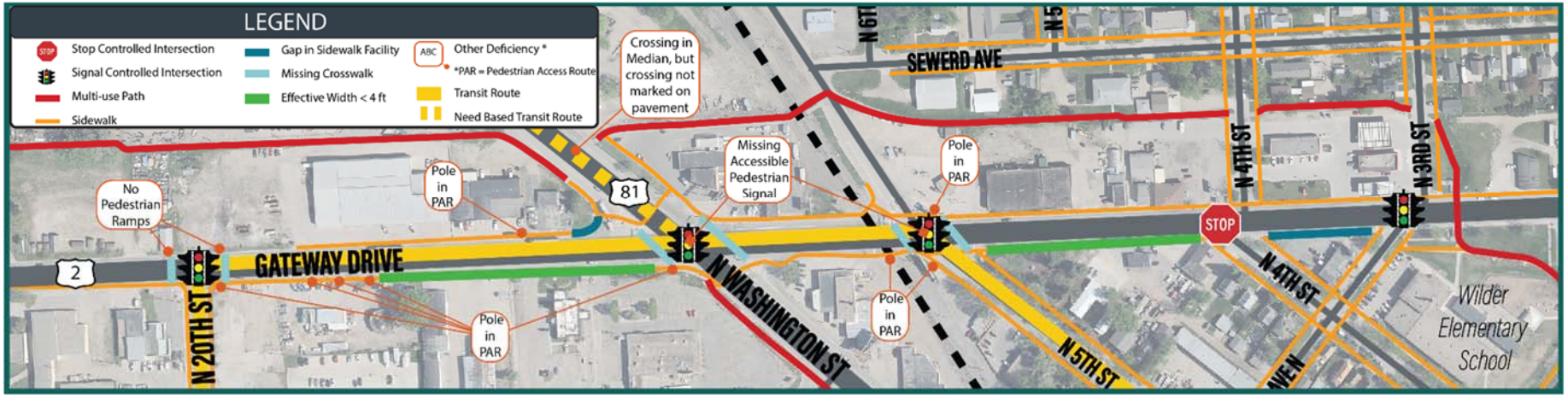


Figure 10: Pedestrian, Bicycle, and Transit Facilities

Americans with Disabilities Act

The Americans with Disabilities Act (ADA) provides design standards for pedestrian paths and curb ramps in the *2010 ADA Standards for Accessible Design*. The basic requirements address width, condition, surfaces, curb ramps and flares, location, placement of pedestrian push buttons, slopes for pedestrian paths, and curb ramps. Beyond the federal law that requires ADA compliance, meeting standards improves accessibility and comfort for all users. A full evaluation of ADA compliance is outside the scope of the study. However, during the field review, multiple locations were noted with narrow, broken, or overgrown sidewalks. Signs, light poles, and debris often block pedestrian paths which could be dangerous to pedestrians with visual impairments and make traversing the sidewalk difficult for pedestrians in wheelchairs. Detectable warning panels are present at all marked crosswalks.

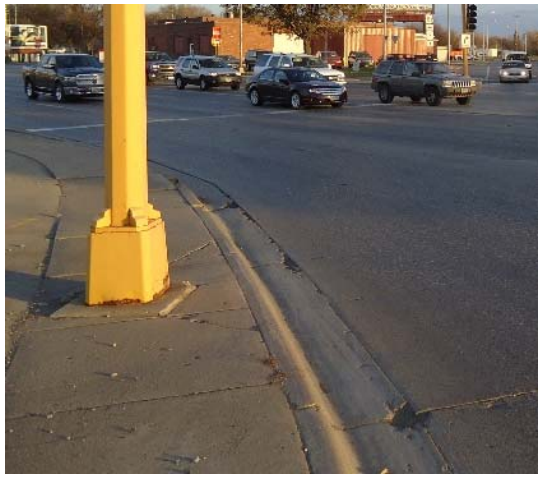
The existing non-compliant ADA pedestrian facilities in the study area are shown in **Figure 10**.

Effective Walkway Width

Effective walkway widths ensure a minimum accessible route of passage within a sidewalk or other walkway that may not comprise the full width of the route. Research presented in the *Highway Capacity Manual* (HCM) found that pedestrians generally keep 18 inches between themselves and adjacent walls, curbs, and other obstructions, resulting in sidewalks that have less usable space than their design space. This is especially true when pedestrian routes are directly adjacent to a vehicular travel lane. Along US 2/Gateway Drive, the effective walkway width does not follow the recommended four-feet of clear width. There are several obstructions including presence of utility structures and advertisement poles within the pedestrian access route (PAR) along the corridor, examples of which can be seen in **Figure 11**.

The non-compliant effective width and obstructions within the PAR in the study area are shown in **Figure 10**.

Figure 11: Obstructions in Walkways



Bicycle Facilities and Amenities

The City of Grand Forks is a Bronze level Bicycle Friendly Community as designated by the League of American Bicyclists. The city has an extensive network of bicycle facilities and amenities due to City Ordinances prohibiting bicycles on sidewalks, except in residential districts. Along US 2/Gateway Drive, the multi-use path that runs along the back of commercial properties north of US 2/Gateway Drive connects cyclists to 3rd Street and the Red River Greenway to the east and to the Columbia Road and 55th Street multi-use paths and the 42nd Street multi-use path to the west. However, when this path crosses US 81/Washington Street there are no protections available for bikes and pedestrians.

Bicycle facilities in the study area are shown in **Figure 10**.

Transit Service and Operations

Cities Area Transit (CAT) provides fixed-route transit service in the Grand Forks – East Grand Forks CAT Route 2 runs along US 2/Gateway Drive, with hourly service. It has designated stops at 5th Street and 10th Avenue and Hugo's on 20th Street, two blocks south of US 2/Gateway Drive. CAT will also stop at Home of Economy on US 81/Washington Street, north of US 2/Gateway Drive when scheduled in advance.

Transit service in the study area is shown in **Figure 10**. Reliability information was not readily available for the route, however, according to CAT no delay issues have been reported due to the Mill Spur at this location.

EXISTING TRAFFIC CONDITIONS

To analyze existing, and forecast future conditions, the 85th Percentile of five days of data from the Upper Great Plans Transportation Institute Advanced Traffic Analysis Center (ATAC) was taken for each intersection in the study area. The days selected were from May, June, July, August and October of 2018. The Grand Forks – East Grand Forks MPO also provided data on 12-hour turning movement counts that were collected in October 2018. After reviewing the data, provided by the MPO, the counts were much lower than those in ATAC and were determined did not accurately depict existing conditions in the study area. The morning peak was identified between 7:15 AM and 8:15 AM, while the evening peak was identified between 4:15 PM and 5:15 PM, based upon this turning movement data. Turning movements were adjusted to balance the observed volume differences between intersections.

The existing average annual daily traffic (AADT) was obtained from the North Dakota Depart of Transportation (NDDOT)*Transportation Information Map* for the corridor segments. The 2015 count data was used due to construction on the Kennedy bridge causing skewed data in 2018. 2018 data showed a reduction in overall traffic but an average increase in truck traffic of 32 percent. Operations at the Mill, which expanded in the summer of 2016, may be contributing to the increase in truck traffic. They are now producing up to 25 percent more trucks each day than before the expansion. All analysis was based on peak hour turning movement counts.

Figure 13 shows the existing morning and evening peak hour turning movement counts, AADT, and lane configurations of the intersections along the corridor.

Traffic Volumes

US 2/Gateway Drive is a major east-west principal arterial and a business corridor. The corridor is a thoroughfare to and from Grand Forks International airport, Grand Forks Air Force Base and East Grand Forks, Minnesota. The corridor carries between 20,000 and 23,000 vehicles per day.

The US 2/Gateway Drive and US 81/Washington Street intersection is a major intersection along the corridor. US 81/Washington Street is an important north-south arterial route, serving as the business route for US 81, carrying between

9,000 and 12,500 vehicles per day. 5th Street serves as the US 2 business route and is a major entry point into downtown Grand Forks, carrying around 3,200 vehicles per day.

Truck Volumes

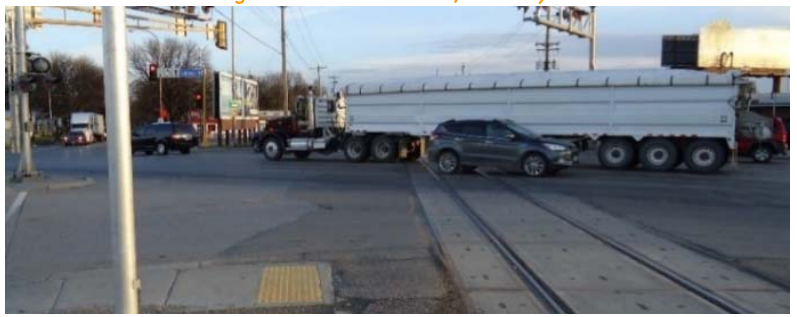
The US 2/Gateway Drive corridor is designated as a major truck route by the *NDDOT Freight Plan 2015*. The corridor carries between 1,250 and 1,500 trucks per day.

During the annual sugar beet harvest between September and October of each year, the truck volumes can far exceed 1,500 trucks per day. Grand Forks County produces over 800,00 tons of sugar beets, which must make their way to the processing plant in East Grand Forks, located off the US 2 business loop.

The North Dakota State Mill (NDSM), northwest of US 2/Gateway Drive and Mill Road intersection is a major truck generator in the region. Trucks bring commodities to NDSM and after processing, the outputs are shipped on the BNSF Mill Spur. NDSM currently processes and ships almost 5 million pounds of product daily according to their website. There are plans for improvement at NDSM with the anticipated increase in grain processing in the future. This is expected to have an impact on the roadway network due to increased truck traffic and additional activity at the railroad crossing.

The geometrics of the corridor intersections need to support the critical truck movements in the corridor. The skew characteristic makes observing cross traffic much more difficult than a typical intersection, as drivers must turn their head at a much greater angle to view the cross traffic. It can also make negotiating the turns much more difficult. US 81/Washington Street intersects US 2/Gateway Drive at a 42-degree angle and Mill Road intersects US 2/Gateway drive at a 55-degree angle.

Figure 12: Trucks on US 2/Gateway Drive



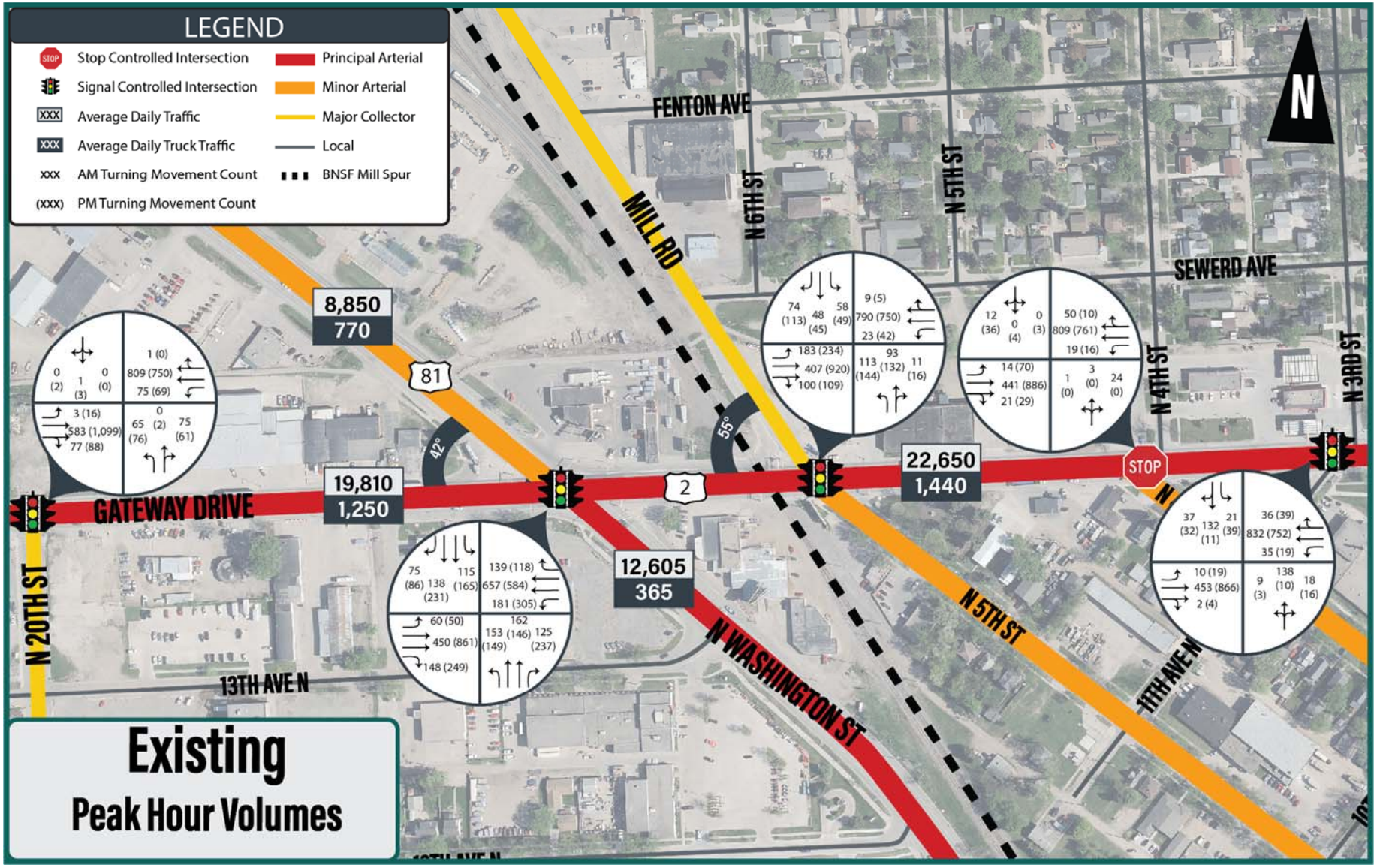


Figure 13: Existing Peak Hour Turning Movements

Traffic Control Warrant Analysis

Selecting the appropriate traffic control device requires consideration of traffic patterns and volumes, roadway geometry, lane configurations and multimodal aspects. The *Manual of Uniform Traffic Control Device* (MUTCD) provides guidance and standards on the installation of traffic control methods which considers vehicular volume, pedestrian volumes, and crash frequency thresholds for multiple roadway contexts. Warrant analysis does not require signals to be built. However, the analysis highlights the locations that may benefit from traffic control upgraded or removed. Research conducted by FHWA found that that removing unwarranted signals may result in a 24 percent decrease in all crashes, a 53 percent decrease in injury crashes, a 24 percent decrease in right-angle crashes, and a 29 percent decrease in rear-end crashes. Specific traffic control alternatives will be analyzed in the *Alternatives Development and Assessment Report*, to be developed later.

Warrant analysis was conducted at the five study intersections. In accordance with NDDOT guidance for warrant analysis, minor street right-turn volumes were excluded for dedicated right-turn lanes and included at 50 percent for shared right-turn lanes. **Figure 14** shows existing traffic control at each of the study intersections. Only the 4th Street intersection is two-way stop controlled; the remaining study intersections are currently signalized. Below is a summary of the findings from the traffic control analysis.

Table 1 shows required hours of specified volumes to meet each warrant and how many hours are being fulfilled with the current volume of traffic:

- The US 81/Washington Street and Mill Road/5th Street intersections meet traffic volume warrants 1, 2, and 3 currently.
- The 20th Street and 3rd Street/11th Avenue intersections do not meet signal warrants under current conditions. These intersections are currently signalized.
- The 4th Street intersection does not meet any signal warrants under current conditions.

Table 1: Existing Traffic Control Warrants Analysis

Intersection	Existing Traffic Control	Warrants Met (Hours Met/Required)			
		1A	1B	2	3
20th Street	Signal	0/8	0/8	0/4	0/1
US 81/ Washington Street	Signal	**8/8**	**8/8**	**4/4**	**1/1**
Mill Road/5th Street	Signal	0/8	**8/8**	**4/4**	**1/1**
4th Street	Thru/Stop	0/8	0/8	0/4	0/1
3rd Street/11th Ave	Signal	0/8	1/8	1/4	0/1

Warrant 1a: Minimum Vehicular Volume
Warrant 1b: Interruption of Continuous Traffic
Warrant 2: Four-Hour Vehicular Volume
Warrant 3: Peak Hour Vehicular Volume
Warrant 9: Intersection Near a Grade Crossing

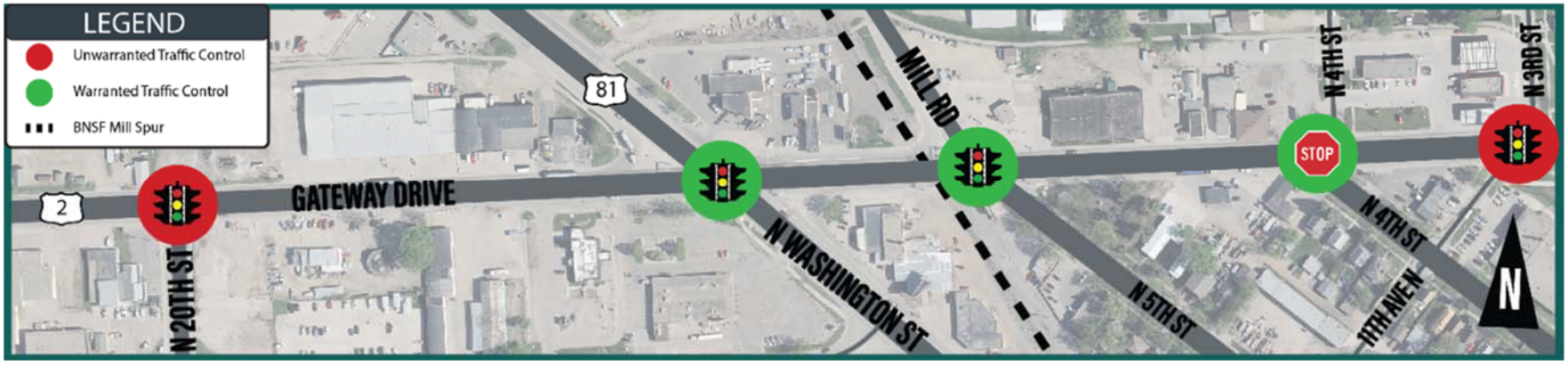


Figure 14: Existing Traffic Control Warrant Analysis

Traffic Operations

Methodology

Existing traffic operations were analyzed using PTV VISSIM Version 9 that utilizes the Level of Service (LOS) methodologies documented in the *Highway Capacity Manual* (HCM). VISSIM simulates the movement of every vehicle through an intersection and then collects information for associated performance measures like delay, queue lengths, travel times, and density. The models included in-place geometry such as number of thru lanes and turn lanes, storage length for turn lanes, distances between traffic control (link distance), speed limits. The model also includes signal timing parameters such as phasing, cycle length, maximum greens, yellow, all red intervals. The primary results that are used in the study are delay/LOS and queuing analysis. Operational analysis results are described in terms of LOS ranging from A to F with A operating with the least delay and F operating with the most delay. Intersection delay and corresponding LOS for signalized and unsignalized intersections, as defined by HCM are presented in **Table 2**.

Based on NDDOT guidance and standard practice in traffic engineering, the threshold for acceptable intersection operations is commonly the border between LOS D and LOS E. LOS D is considered acceptable and LOS E is considered unacceptable.

Table 2: Intersection Delay and Level of Service Thresholds

Control Delay (sec/veh)		Level of Service (LOS) Thresholds
Signalized	Unsignalized	
≤ 10	≤ 10	A
10 - 20	10 - 15	B
20 - 35	15 - 25	C
35 - 55	25 - 35	D
55 - 80	35 - 50	E
> 80	> 50	F

Queuing of vehicles at intersections can have serious traffic safety implications, as well as contributing to excessive delay due to blocked lanes impeding the flow of traffic. Queue analysis was completed in addition to level of service analysis. Queuing values were analyzed for the average and 95th percentile modeled queue lengths based on the average of five 60-minute simulation runs during peak hours. A queuing issue was identified if any of the five conditions were met:

- Condition 1: 95th percentile queue length exceeds storage length and the movement operates worse than LOS D.
- Condition 2: Average queue length exceeds storage length.
- Condition 3: 95th percentile queue length blocks upstream full access intersection.
- Condition 4: 95th percentile through lane queue blocks access to the turn lane bay.
- Condition 5: 95th percentile queue length exceeds 500 feet on a stop-controlled approach.

Traffic Operations Results

Traffic operations analysis was completed for three scenarios: morning peak, evening peak, and a train event. The traffic signal timing parameters were provided by the City. The traffic models maintained the cycle lengths at each intersection and traffic operations were evaluated after optimizing the signal timing splits. For the train event, the peak was chosen between 11 AM and noon based on the 4.5 months of preemption data provided by the city. This time period has the highest frequency of a train event occurring according to the data. The average train blockage of 2 minutes and 31 seconds was used for the analysis.

Figure 15 and **Figure 16** summarize the morning, evening, and train event operations. The reported approach and intersection delays were derived from PTV VISSIM 9 and is based on the average of five 60-minute simulation runs. The operations and queuing analysis are discussed below.

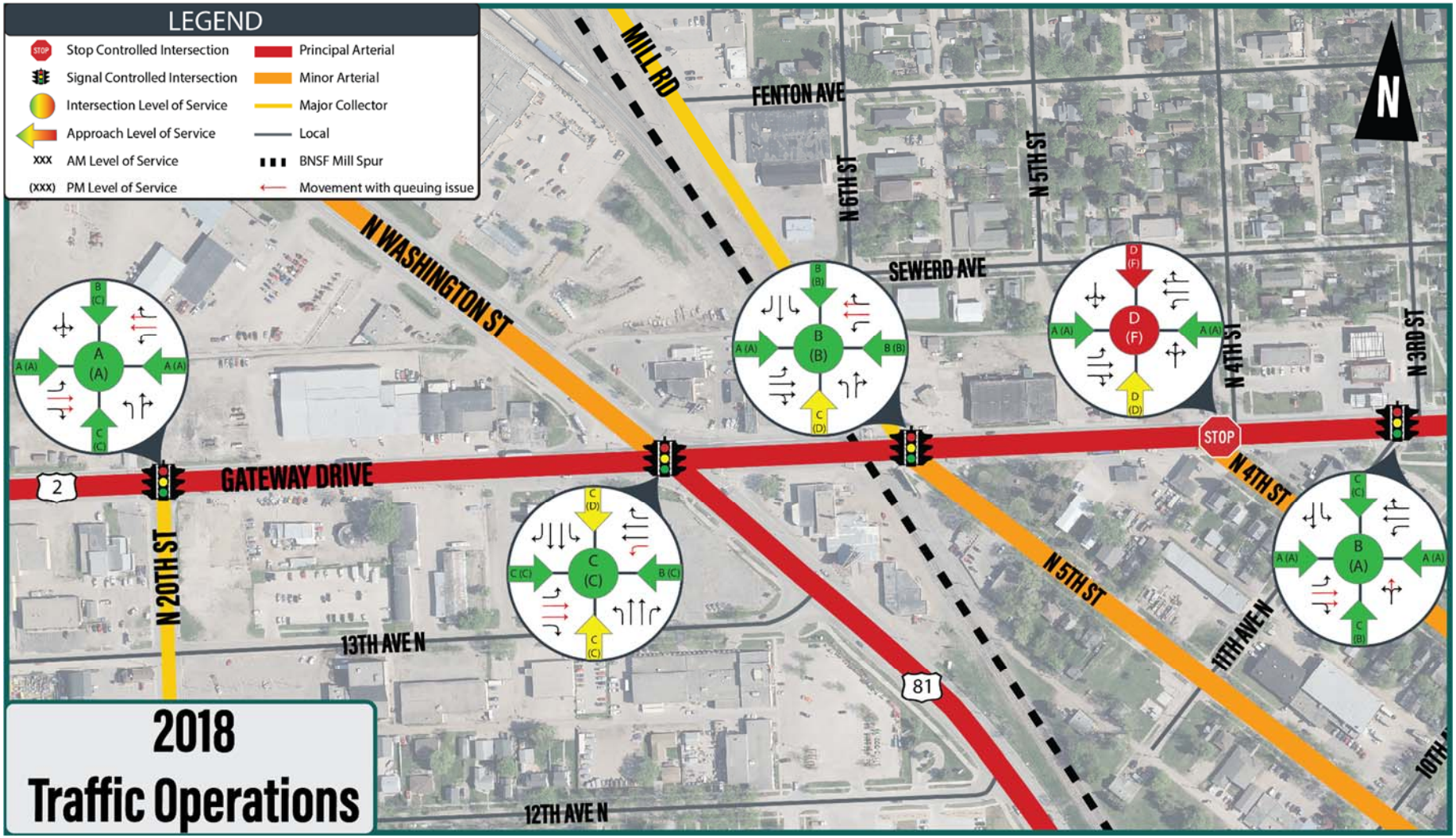


Figure 15: Existing Peak Hour Operations

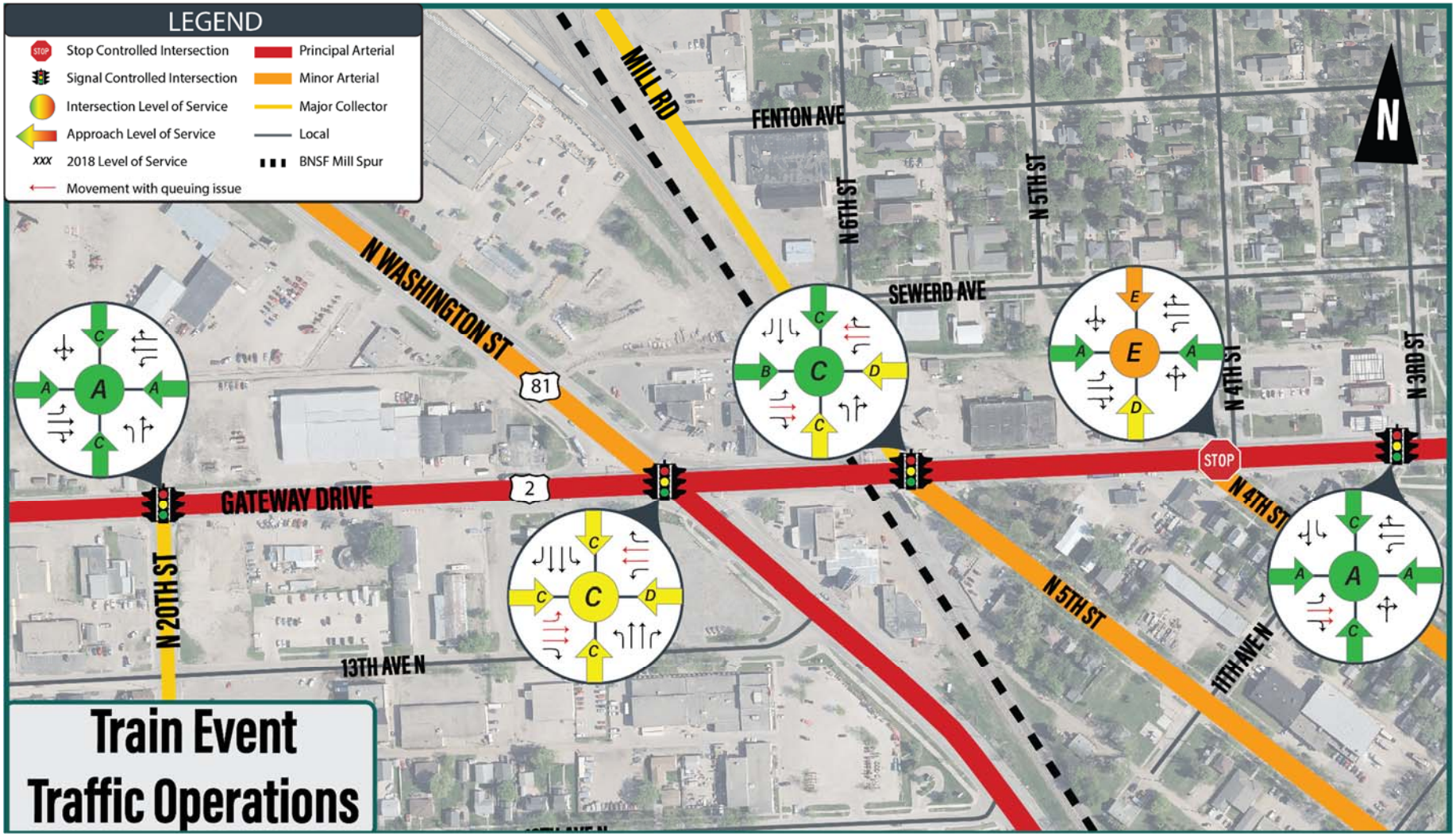


Figure 16: Train Event Operations (Average of Full Hour)

Morning Peak Hour

During the morning peak, intersections and their corresponding approaches operate at an acceptable delay and LOS, with their overall intersection and individual approaches operating no worse than LOS D.

Multiple queuing deficiencies were identified.

- Mill Road/5th Street
  - Block access to turn lanes: westbound thru and right turn queues
- 3rd Street intersection
  - Exceed Storage Length: thru/right turn lane queues on the westbound approaches
  - Block Access to Turn Lanes: westbound thru/right lane queue.

All these deficiencies contribute to the approach and intersection delay, however, currently these intersections are still operating at an acceptable level of delay.

The free flow travel time for the corridor from 20th Street to 3rd Street is 65 seconds, which is the scenario where no delays are encountered. **Figure 17** shows the comparison of travel time for each model analyzed. During the morning peak hour drivers experience, on average, an additional travel time of 30 seconds for eastbound travel and 29 seconds for westbound travel.

Evening Peak Hour

During the evening peak, most intersections and their approaches operate at acceptable delay and LOS. However, delays at the minor approaches of the two-way stop-controlled intersection of US 2/Gateway Drive and 4th street result in an intersection LOS F.

The following queuing issues are present in the evening peak hour.

- 20th Street
  - Block Access to Turn Lanes: eastbound and westbound thru queue.
- US 81/Washington Street,
  - Block access to turn lanes: eastbound thru queues
- Mill Road/5th Street
  - Block access to turn lanes: westbound thru queue
- 3rd Street intersection
  - Block Access to Turn Lanes: eastbound thru queue

Queueing delay can be a contributing factor to the poor LOS at the 4th street intersection, and poor approach delay on the westbound approach of the Mill Road/5th Street intersection.

During the evening peak hour drivers experience an average additional travel time of 51 seconds for eastbound travel and 31 seconds for westbound travel, when compared to free flow conditions.

Train Event

During a train event, each intersection and their approaches operate at acceptable delay and LOS of C or better, except for the 4th Street intersection which operates at a LOS E, as shown in **Figure 16**. The unacceptable delays at 4th Street intersection are caused by high volume of mainline traffic on US 2/Gateway Drive that limits the gaps for these minor street traffic to enter the intersection. However, the minor approaches have relatively low volumes at this intersection and no significant queuing issues were identified at the minor approaches.

The following queuing issues are present in the hour surrounding a train event.

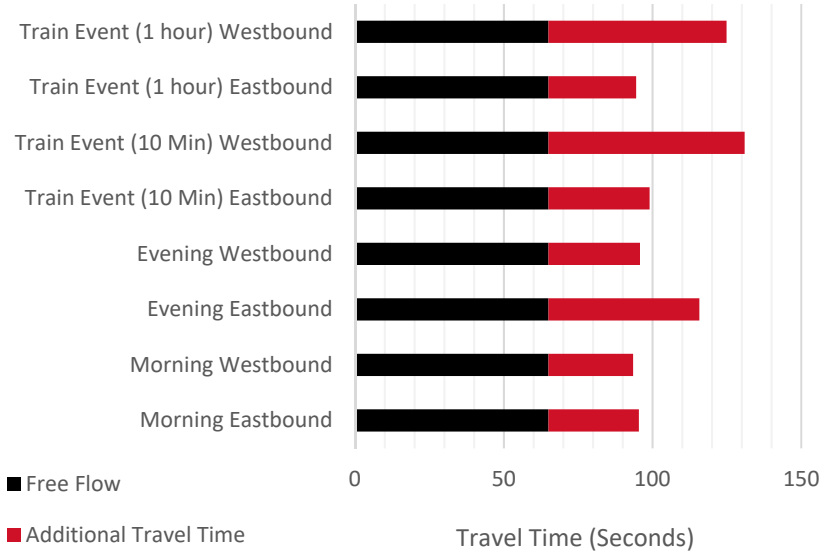
- US 81/Washington Street,
  - Exceed Storage Length: westbound left turn and thru queues
  - Block access to turn lanes: westbound thru queue
- Mill Road/5th Street
  - Exceed Storage Length: eastbound and westbound thru queues
  - Block access to turn lanes: eastbound and westbound thru queue

Queues at US 81/Washington Street and Mill Road/5th Street extend into upstream intersections causing additional delay at those intersections.

Travel time during the peak 10 minutes around a train results in an additional 41 second delay for eastbound travel, and 29 second delay for westbound travel. These results are shown graphically in **Figure 17**.

The average travel time, for the hour surrounding a train event, eastbound travel is 30 seconds longer than free flow (95 seconds total) and westbound travel is 28.5 seconds longer than free flow (93.5 seconds total). Vehicles are not delayed by the entire 2 and ½ minute train event is due to when vehicles arrive. Not all vehicles will arrive right as the train event starts, thus all experience different length delays, which are averaged in the model over the time period analyzed.

Figure 17: Travel Time Comparison

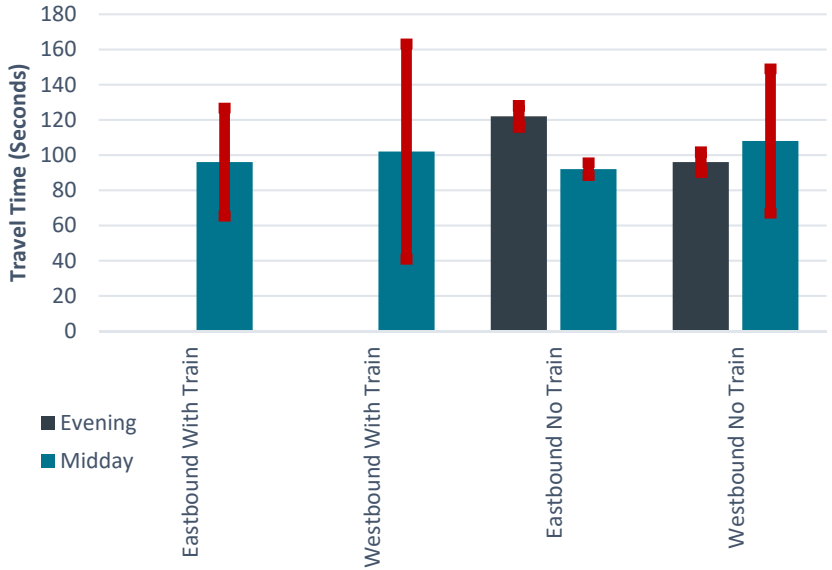


Travel Time Reliability

Travel time reliability is a measure of consistency to indicate day-to-day travel times on a given roadway. Most travelers are less tolerant of unexpected delays because they cannot be incorporated into planned travel time, resulting in late arrivals; alternatively budgeting twice as long as needed for a trip also can result in wasted time. Train events impact reliability on US 2/Gateway Drive and US 81/Washington Street, both which are listed on the NHS, and require high levels of reliability.

Train events and congestion contribute to poor reliability. Travel times and reliability for Existing models are shown in **Figure 18.** This figure shows travel times for the midday and evening peaks. Travel time reliability is shown by the red bars. This represents how much travel time fluctuates for each scenario. There are extreme reliability issues during train events, and westbound traffic has the worst reliability, both when a train event has occurred and also without a train event.

Figure 18: Existing Travel Time Reliability



Safety Analysis

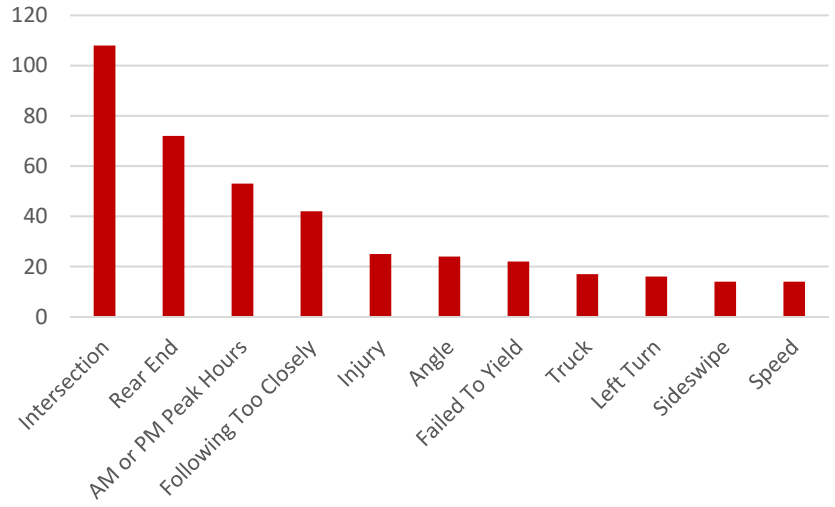
Reviewing historic crash information can help identify existing deficiencies. Five years of crash records (December 1, 2013 to November 30, 2018) were obtained from NDDOT that showed an average of 28 crashes per year in the study area. This includes five crashes per year resulting in an injury, including the possible injury classification. There were no fatalities reported in the study area.

An evaluation of crash trends, shown in **Figure 20**, identifies intersection related crashes were 78 percent of all crashes in the study area; 52 percent of all crashes were rear end crashes and 38 percent occurred during the morning or evening peak hours. **Figure 19** shows the location and distribution of crashes in the study area.

Vehicle-Rail Crashes

BNSF has not reported a vehicle-rail crash at the Mill Spur at-grade crossing since 1994. However, the segment between US 81/Washington Street and Mill Road/5th Street reported two rear-ends that occurred when the overhead warning flashers were active.

Figure 20: Crash Trends



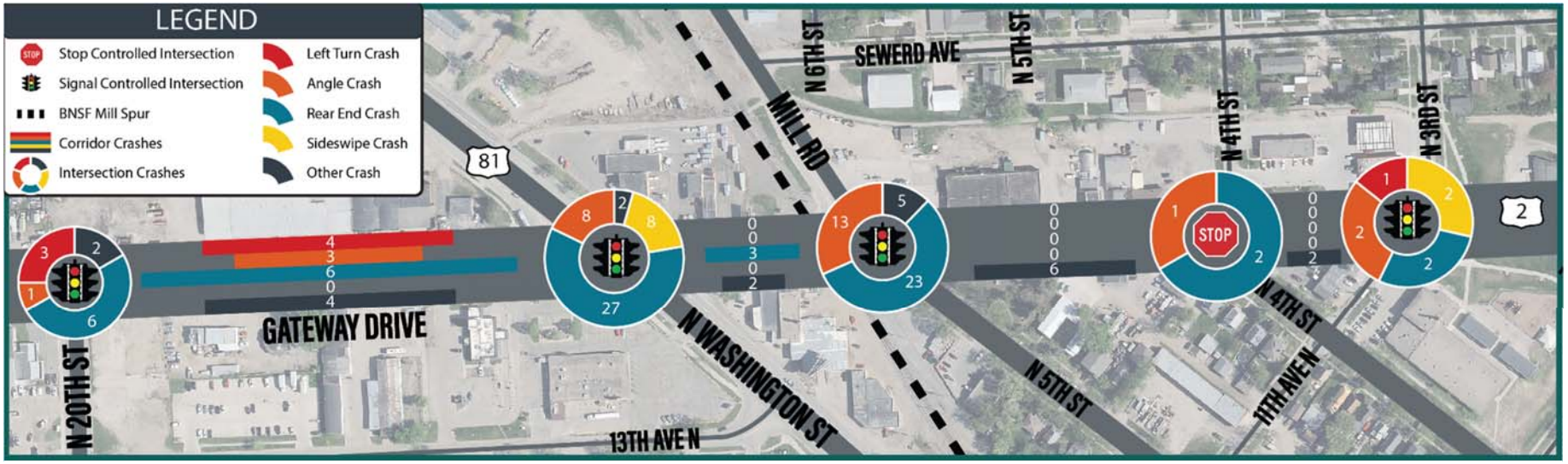


Figure 19: Crash Types

Crash Hot Spots

To identify overrepresented crash locations within the study area, a two-phase approach was used. 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. 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.

Critical Crash Rates

To identify statistically significant crash rates, the critical crash rate method was used, which 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 and links with crash rates above the critical rate are considered overrepresented and in need for further review; there is a high probability that conditions at the site are contributing to the higher crash rate. Based on this analysis, the following locations were found to be overrepresented.

- The Mill Road/5th Street intersection with US 2/Gateway Drive
- The segment of US 2/Gateway Drive between 20th Street and US 81/Washington Street

The Mill Road/5th Street intersection was also identified in the 2045 Long Range Transportation Plan (LRTP) as an intersection with a crash rate above the expected crash rate. This is based on the average crash rate for all major intersections in Grand Forks and East Grand Forks.

Trend Analysis

US 2/Gateway Drive and 20th Street Intersection

Over the past five years, there were 12 crashes at this intersection, half of which were rear end crashes. Four rear end crashes were on the eastbound approach. No time of day trends were identified for rear end crashes. In addition to the rear end crashes, there were three left-turn crashes which occurred with the westbound to southbound movement; two occurred during the morning peak. The unwarranted signal control at the intersection may be a contributing factor for the crashes as they increase vehicular delay from stopping at a light with minimal minor approach traffic. A study conducted by *FHWA* indicate that unwarranted signal controls increase right angle and rear-end crashes by 24 percent and 29 percent.

US 2/Gateway Drive and US 81/Washington Street Intersection

Over the past five years, there were 45 crashes at this intersection, 60 percent of which were rear end crashes. There were no discernable directional trends for rear end crashes. Thirty percent of rear end crashes occurred during the morning or evening peak hours, thirty percent occurred between 11 AM and 1 PM. These time periods correspond with peak traffic and low train periods. Rear end crashes were nearly identically split between eastbound and westbound traffic. Long queues, which are common at this intersection, and dense access spacing on US 2/Gateway Drive may have been the predominant circumstance during which rear end crashes occurred. The high crash rate around the noon hour when trains are frequent may be due to motorists abruptly changing their routing to go around a train.

US 2/Gateway Drive and Mill Road/5th Street Intersection

Over the past five years, there were 41 crashes at this intersection. More than half (23 of 41) were rear end crashes; 65 percent of all rear end crashes occurred during the morning or evening peak hours and 52 percent of all rear end crashes occurred on the east approach. Long queues, which are common at this intersection, and dense access spacing on the east approach may have been the predominant circumstance during which rear-end crashes occurred.

US 2/Gateway Drive between 20th Street and US 81/Washington Street

There were 17 crashes along this segment in the last five years, including six rear end crashes. Four of the six rear end crashes occurred during the morning or evening peak hour, with three occurring in the eastbound direction. This may be a result of high volume of mainline traffic and dense access spacings causing vehicles to decelerate or stop.

Figure 21: Intersection Functional Area

Further, there were four left-turning crashes. Three occurred during the evening peak hour. Two factors may be contributing to this crash trend. First, vehicles waiting to make a left-turn into a business along this corridor may become impatient during heavy traffic, accepting smaller gaps to make their movement. They may misjudge the gap, resulting in a left-turning crash.

Second, there are more than ten uncontrolled accesses along this segment, including four within the functional area of the intersection, which means drivers need to pay attention to oncoming traffic and vehicles making movements to and from the different access points. **Figure 21** shows the functional area of 20th Street and US 81/Washington Street intersections, as well as the access points along the corridor. During times of heavy traffic, eastbound queues may block the sight lines for westbound to southbound traffic using these driveways.

FUTURE TRAFFIC CONDITIONS

Traffic demand and growth is likely to be impacted by more than just growth in the study area, but new growth in both metro cities. East Grand Forks anticipates mid and long-term growth in commercial and residential developments along US 2 and Grand Forks anticipates short and mid-term growth in all land use types (commercial, industrial, and residential) along US 2/Gateway Drive. As this development occurs, traffic demand will continue to increase on US 2/Gateway Drive.

FUTURE TRAFFIC PROJECTIONS

Future traffic projections were based on the current Grand Forks MPO travel demand model, approved in 2018. The existing balanced volumes were scaled up based on the future projection factors along the corridor using the iterative directional volume estimation methodology developed and documented in the *NCHRP Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design.* **Figure 22** and **Figure 23** show the projected 2030 and 2045 turning movement counts, AADT, and current lane-configuration of the intersections along the study corridor.

FUTURE TRAIN CONDITIONS

No growth in the number or the duration of train blockages was incorporated into the train event models. At this time there is not sufficient data to be able to estimate how any growth at the Mill would impact train blockages

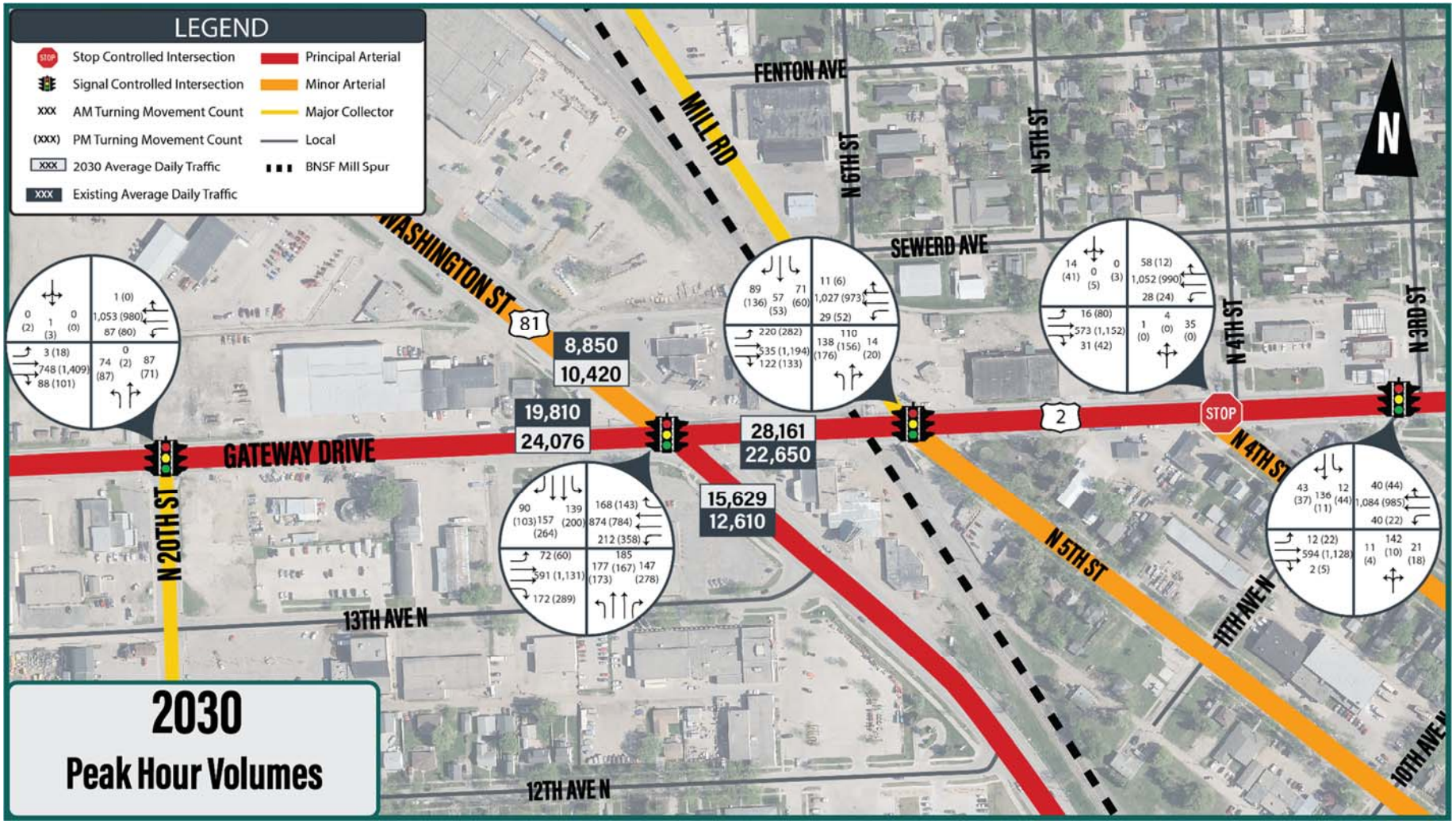


Figure 22: 2030 Peak Hour Turning Movements

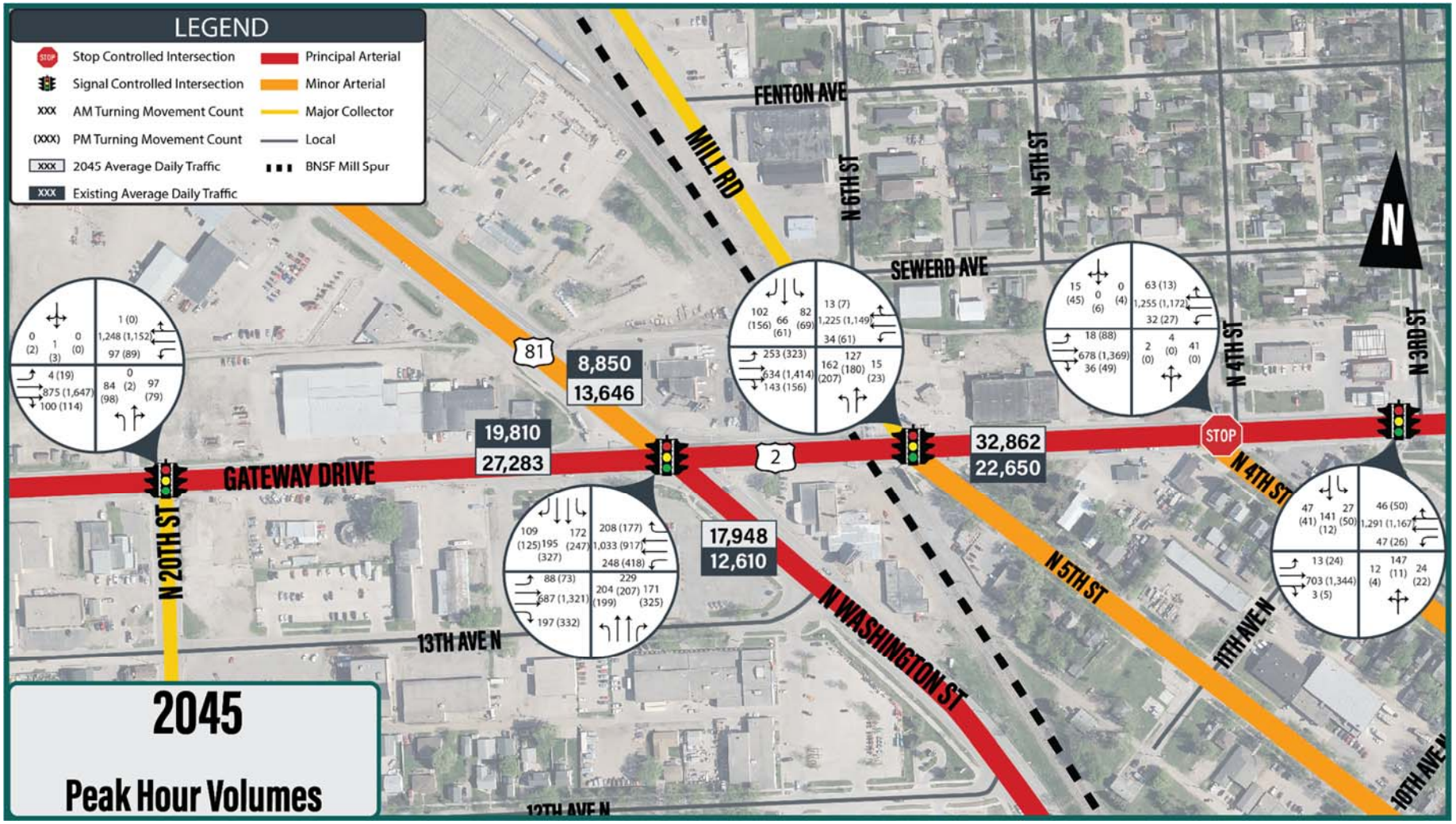


Figure 23: 2045 Peak Hour Turning Movements

2030 Traffic Control Warrant Analysis

Warrant analysis was conducted at the five study intersections with projected 2030 volumes. In accordance with NDDOT guidance for warrant analysis, minor street right-turn volumes were excluded for dedicated right-turn lanes and included at 50 percent for shared right-turn lanes. **Figure 24** shows existing traffic control at each of the study intersections. Only the 4th Street intersection is two-way stop controlled; the remaining study intersections are currently signalized.

Table 3: 2030 Traffic Control Warrants Analysis

Intersection	Existing Traffic Control	Warrants Met (Hours Met/Required)			
		1A	1B	2	3
20th Street	Signal	0/8	1/8	0/4	0/1
US 81/ Washington Street	Signal	**8/8**	**8/8**	**4/4**	**1/1**
Mill Road/5th Street	Signal	**8/8**	**8/8**	**4/4**	**1/1**
4th Street	Thru/Stop	0/8	0/8	0/4	0/1
3rd Street/11th Ave	Signal	0/8	1/8	1/4	**1/1**

Warrant 1a: Minimum Vehicular Volume
Warrant 1b: Interruption of Continuous Traffic
Warrant 2: Four-Hour Vehicular Volume
Warrant 3: Peak Hour Vehicular Volume
Warrant 9: Intersection Near a Grade Crossing

Below is a summary of the findings from the traffic control analysis. **Table 3** shows required hours of specified volumes to meet each warrant and how many hours are being fulfilled with the 2030 traffic volumes.

- The US 81/Washington Street intersection meets traffic volume warrants 1A, 1B, 2, and 3.
- The Mill Road/5th Street intersection meets traffic volume warrant 1A, 1B, 2, and 3.
- The 3rd Street/11th Avenue intersection meets warrant 3, however it is uncommon to use this warrant as justification for installation of a signal.
- The 20th Street intersection does not meet signal warrants in 2030. This intersection is currently signalized.
- The 4th Street intersection does not meet any signal warrants under 2030 conditions.

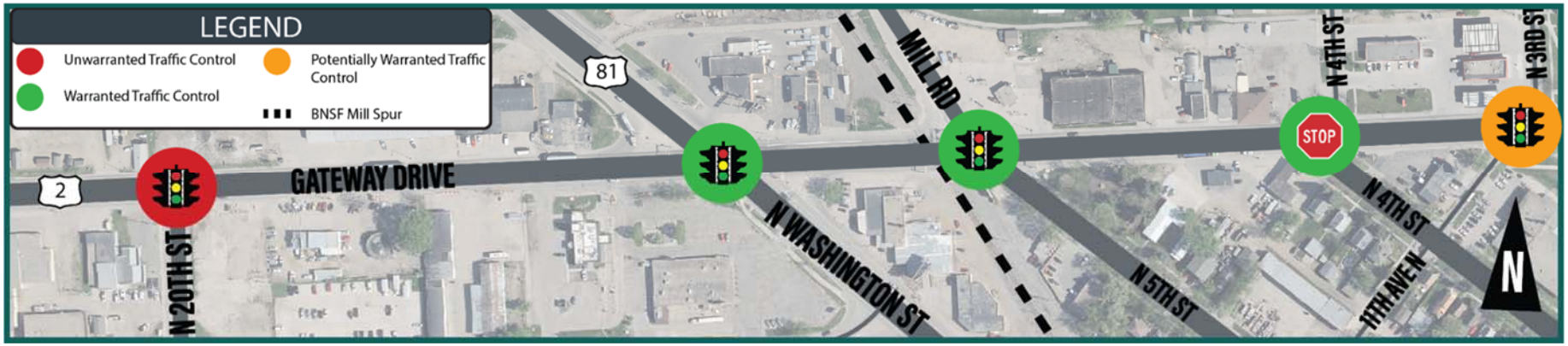


Figure 24: 2030 Traffic Control Warrant Analysis

2045 Traffic Control Warrant Analysis

Warrant analysis was conducted at the five study intersections with projected 2045 volumes. In accordance with NDDOT guidance for warrant analysis, minor street right-turn volumes were excluded for dedicated right-turn lanes and included at 50 percent for shared right-turn lanes. **Figure 25** shows existing traffic control at each of the study intersections. Only the 4th Street intersection is two-way stop controlled; the remaining study intersections are currently signalized.

Table 4: 2045 Traffic Control Warrants Analysis

Intersection	Existing Traffic Control	Warrants Met (Hours Met/Required)			
		1A	1B	2	3
20th Street	Signal	0/8	6/8	0/4	0/1
US 81/ Washington Street	Signal	**8/8**	**8/8**	**4/4**	**1/1**
Mill Road/5th Street	Signal	**8/8**	**8/8**	**4/4**	**1/1**
4th Street	Thru/Stop	0/8	0/8	0/4	0/1
3rd Street/11th Ave	Signal	0/8	1/8	1/4	**1/1**

Warrant 1a: Minimum Vehicular Volume
Warrant 1b: Interruption of Continuous Traffic
Warrant 2: Four-Hour Vehicular Volume
Warrant 3: Peak Hour Vehicular Volume
Warrant 9: Intersection Near a Grade Crossing

Below is a summary of the findings from the traffic control analysis. **Table 4** shows required hours of specified volumes to meet each warrant and how many hours are being fulfilled with the 2045 traffic volumes.

- The US 81/Washington Street intersection meets traffic volume warrants 1A, 1B, 2, and 3.
- The Mill Road/5th Street intersection meets traffic volume warrant 1A, 1B, 2, and 3.
- The 20th Street intersection does not meet signal warrants in 2045. This intersection is currently signalized.
- The 4th Street intersection does not meet any signal warrants under 2045 conditions.
- 3rd Street/11th Avenue intersection meets warrant 3, however it is uncommon to use this warrant as justification for installation of a signal.

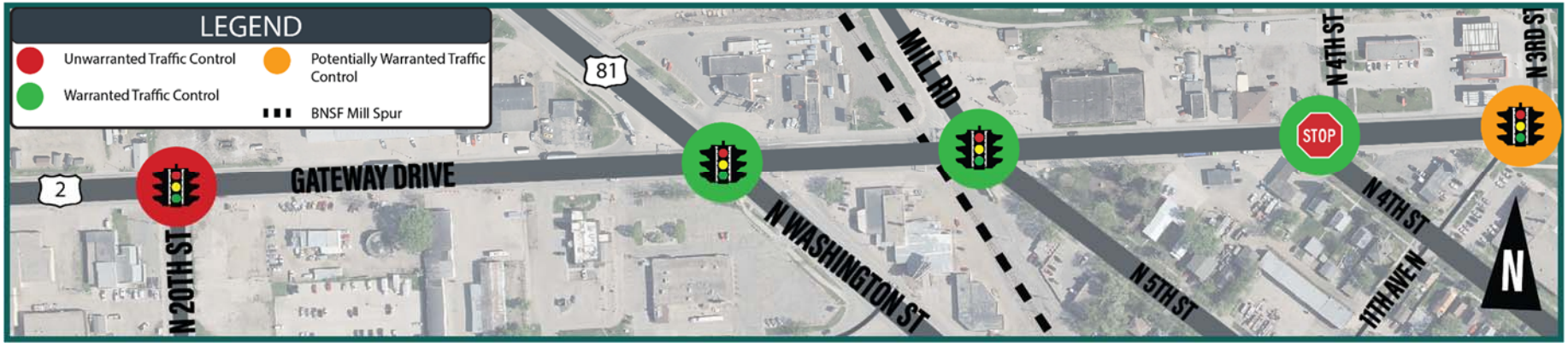


Figure 25: 2045 Traffic Control Warrant Analysis

2030 Traffic Operations

The 2030 traffic operations analysis reflects the existing infrastructure with increased travel demand. The operations analysis was completed using PTV VISSIM 9 microsimulation and is based on the average of five 60-minute simulation runs. The existing signal cycle lengths were maintained but the splits were optimized to 2030 travel demand.

Figure 26 shows the 2030 traffic operations for the morning and evening peak hour, as well as movements with queuing issues.

Figure 27 shows the operations during the hour surrounding a train event in 2030 and 2045. This figure also shows movements with queuing issues.

Travel time results for 2030 scenarios are shown in Figure 28.

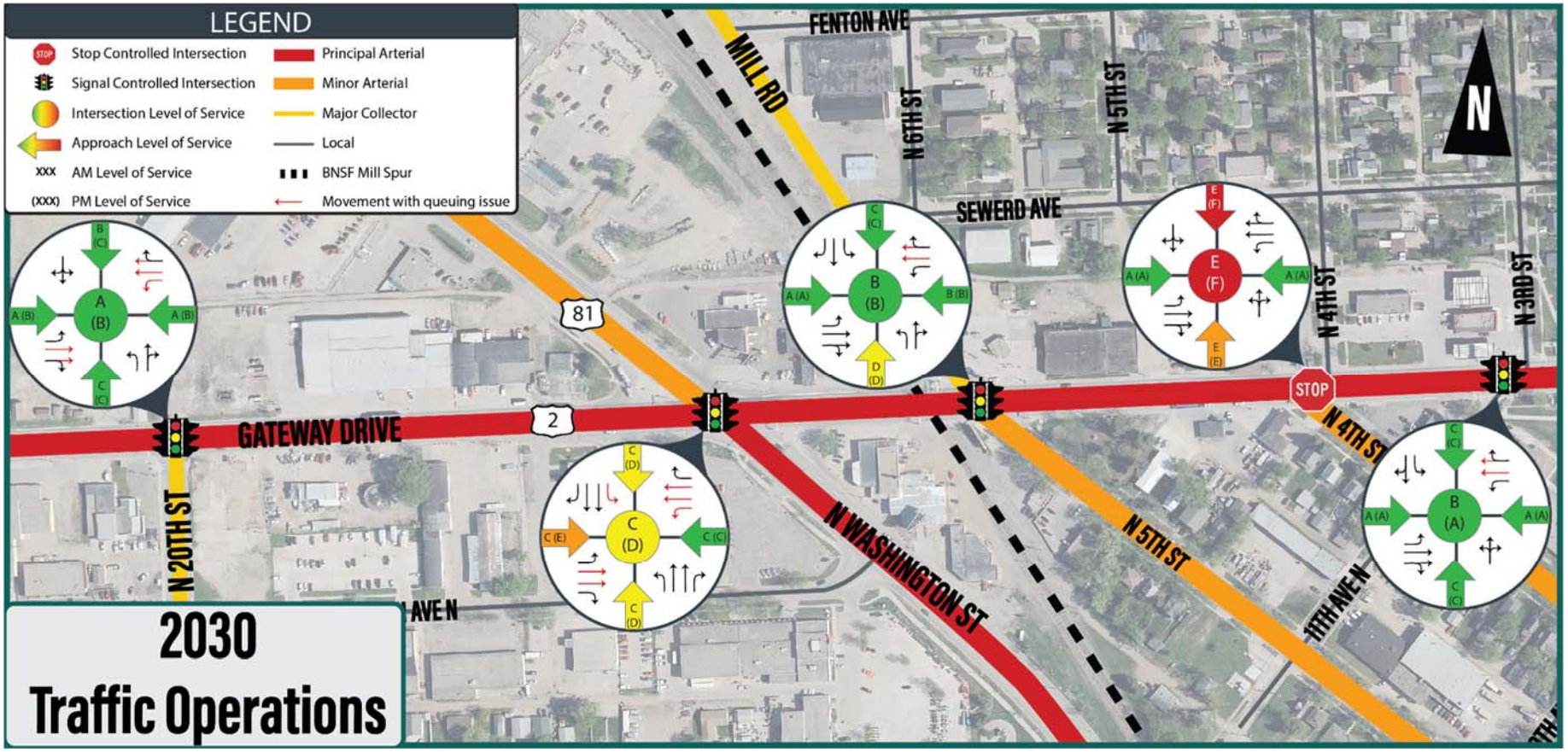


Figure 26: 2030 Traffic Operations

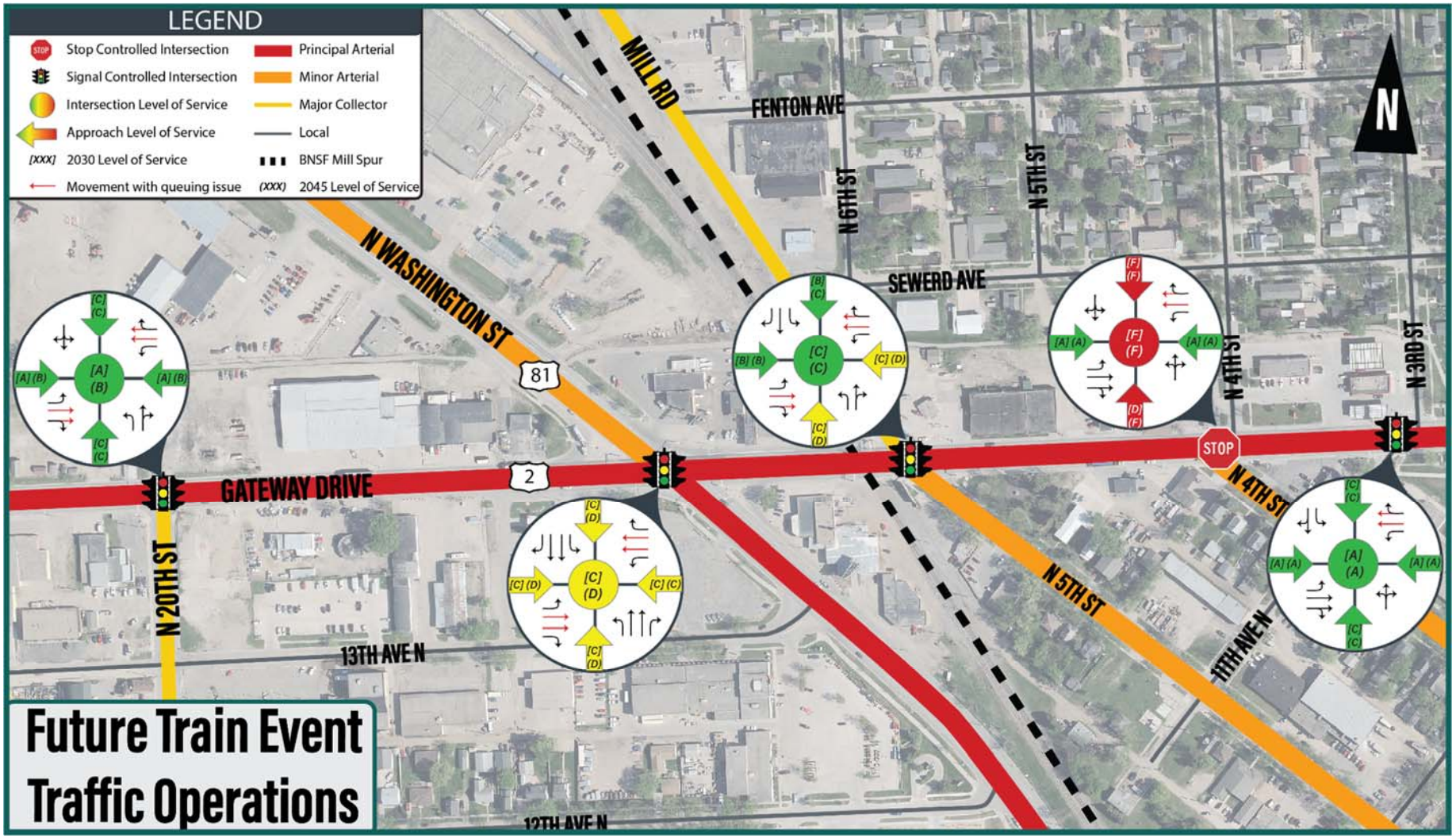


Figure 27: Future Train Event Operations

Morning Peak Hour

During the morning peak hour, each intersection and their corresponding approaches operate at acceptable delay and LOS, with the exception of the 4th Street intersection which operates at a LOS E.

Queues at US 81/Washington extend into the Mill Road/5th Street contributing to queues at that intersection and extra delay. This queue can be especially dangerous due to the potential of vehicles stopping on the railroad between US 81/Washington Street and Mill Road/5th Street. The following additional queuing issues were identified in the 2030 morning peak hour:

- 20th Street
  - Block access to turn lane: westbound thru queue
- US 81/Washington Street
  - Exceed storage length: westbound left turn and thru queues
  - Block access to turn lanes: westbound and eastbound thru queues
- Mill Road/5th Street
  - Block access to turn lanes: westbound thru queue
- 3rd Street
  - Exceed storage length: westbound thru queue
  - Block access to turn lanes: westbound thru queue

During the morning peak hour drivers experience an additional travel time of 40 seconds for eastbound travel and 44 seconds for westbound travel when compared to free flow speeds, (105 and 109 seconds respectively), as shown in Figure 28.

Evening Peak Hour

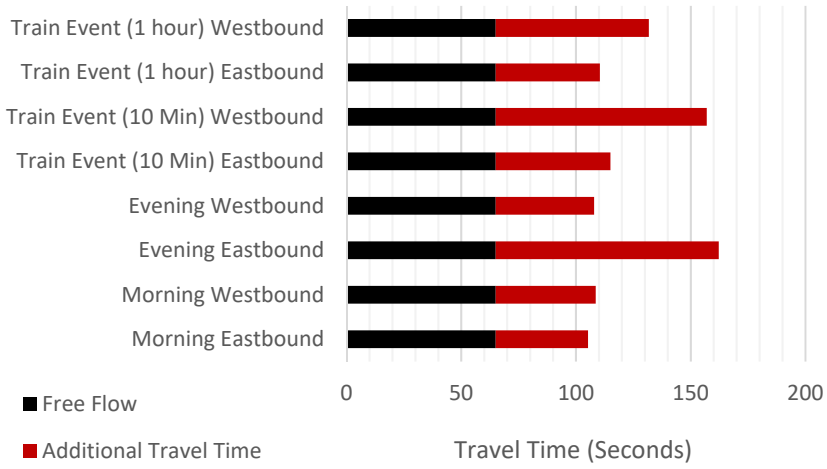
During the evening peak hour, the intersection at 4th Street operates at LOS F with its minor approaches experiencing unacceptable delays. The vehicles along the minor approaches find insufficient gaps to enter the mainline due to high frequency of uninterrupted traffic flow along the mainline. This type of operation is typical for a low volume two-way stop-controlled intersection intersecting a principal arterial. All the other intersections operate at acceptable delay and LOS D or better. The US 81/Washington Street Eastbound approach operates at a LOS E in this scenario.

Queuing issues at US 81/Washington Street cause extra delay and queuing issues to develop at the downstream intersections of Mill Road/5th Street and 20th Street. The queue extending into the Mill Road/5th Street intersection can cause additional complications if vehicles stop on the railroad between the intersections. The following queuing issues were also identified in the 2030 evening peak hour:

- 20th Street
  - Exceed storage length: Westbound left turn queue
  - Block access to turn lanes: eastbound and westbound thru queue
- US 81/Washington Street
  - Exceed storage length: Eastbound and westbound thru queues
  - Block access to turn lane: Eastbound and westbound thru queues
- Mill Road/5th Street
  - Block access to turn lanes: westbound thru queue

During the evening peak hour drivers experience an additional travel time of 97 seconds for eastbound travel and 43seconds for westbound travel (162 and 108 seconds total respectively), as shown in Figure 28.

Figure 28: 2030 Travel Times



Train Event

During a train event in 2030, all intersections and approaches except 4th Street operate at an acceptable LOS, 4th Street continues to operate at a LOS F. These can operations can be seen in **Figure 27.**

Westbound thru queues at US 81/Washington Street extend into the Mill Road/5th Street intersection, which cause Mill Road/5th Street westbound thru queues to extend into the 4th Street intersection. Eastbound queues at Mill Road/5th Street also extend into the US 81/Washington Street intersection. The following additional queuing issues were identified in the hour surrounding a train event in 2030:

- 20th Street
  - Block access to turn lanes: westbound thru queue
- US 81/Washington Street
  - Exceed Storage Length: westbound thru queue
  - Block access to turn lane: westbound thru queue
- Mill Road/5th Street
  - Exceed storage length: westbound and eastbound thru queues
  - Block access to turn lanes: westbound and east bound thru queues
- 3rd Street/11th Avenue
  - Block access to turn lane: westbound thru queue

The travel time during the peak 10 minutes following a train event results in an additional travel time of 50 seconds for eastbound travel, and 92 seconds for westbound travel when compared to free flow conditions (115 and 157 seconds respectively). The average travel time for the hour surrounding a train event for eastbound travel is increased by 45 seconds and for westbound travel is increased by 67 seconds (110 and 132 seconds respectively), as shown in **Figure 28.**

Figure 29: Vehicles on Railroad

2045 Traffic Operations

The 2045 traffic operations analysis reflects the existing infrastructure with increased travel demand. The operations analysis was completed using PTV VISSIM 9 microsimulation and is based on the average of five 60-minute simulation runs. The existing signal cycle lengths were maintained but the splits were optimized to 2045 travel demand.

Figure 30 shows the 2045 traffic operations for the morning and evening peak hour, as well as, the movements with queuing deficiencies.

Figure 31 depicts the travel time comparison for 2045 scenarios.

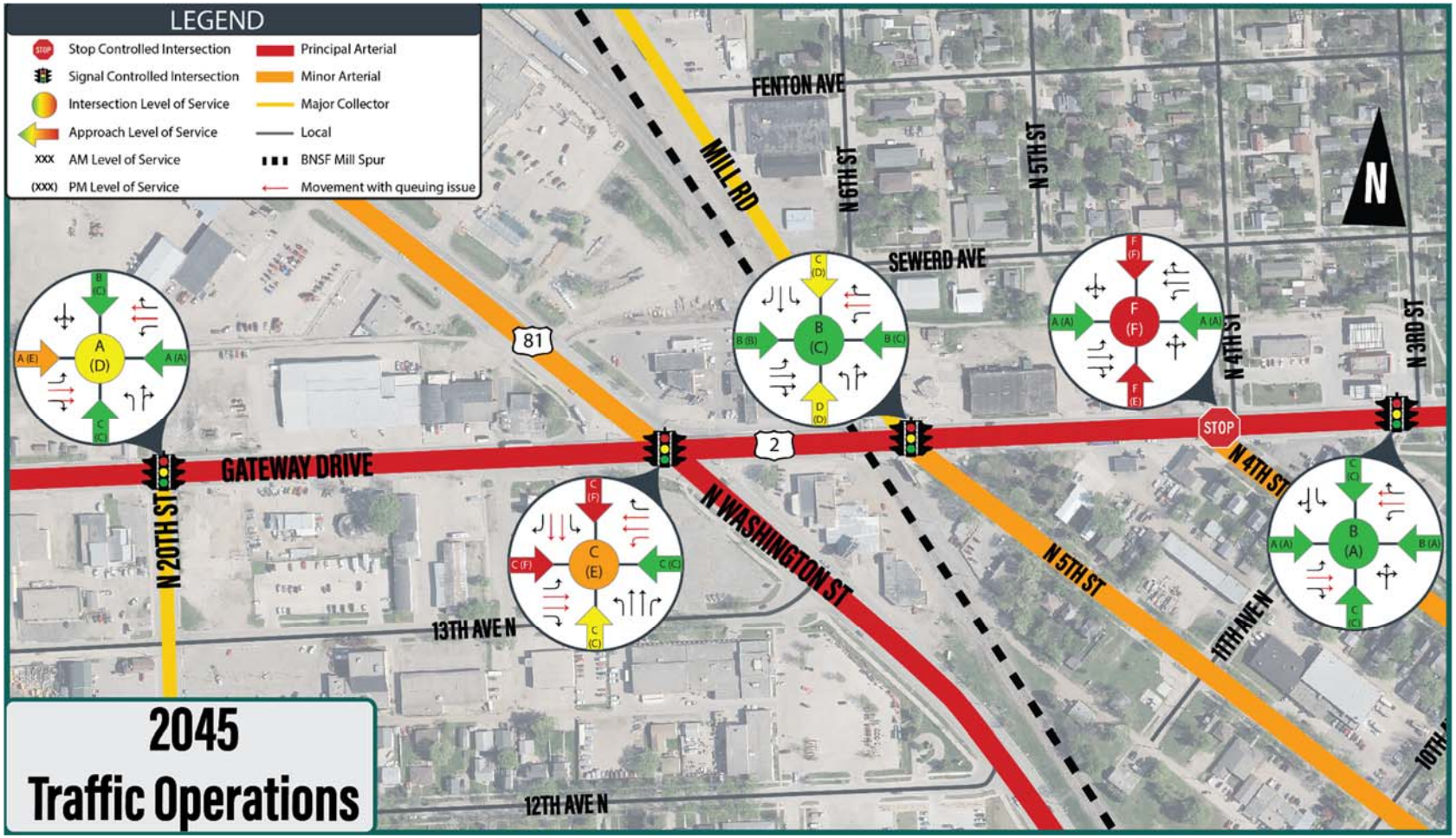


Figure 30: 2045 Traffic Operations

Morning Peak Hour

The intersection at 4th Street operates at LOS F with its minor approach experiencing unacceptable delays. This type of operation is typical for a low volume two-way stop-controlled intersection intersecting a principal arterial. All the other intersections and their corresponding approaches operate at acceptable delay and LOS.

Queues at US 81/Washington extend into the Mill Road/5th Street contributing to queues at that intersection and extra delay. This queue can be especially dangerous due to the potential of vehicles stopping on the railroad between US 81/Washington Street and Mill Road/5th Street. The eastbound thru queue at 3rd Street/11th Avenue extend to the upstream intersection of 4th Street. The following additional queuing issues were identified in the 2045 morning peak hour:

- 20th Street
  - Block Access to Turn Lane: westbound thru queue
- US 81/Washington Street
  - Exceed Storage Length: westbound left turn and thru queues
  - Block access to turn lanes: westbound and eastbound thru queues
- Mill Road/5th Street
  - Block access to turn lanes: westbound thru queue
- 3rd Street/11th Avenue
  - Exceed Storage Length: eastbound and westbound thru queue
  - Block Access to Turn Lanes: westbound thru queue

Travel times during the morning peak hours are 115 seconds for eastbound travel and 128 seconds for westbound travel.

Evening Peak Hour

The intersection at US 81/Washington Street operates at an unacceptable LOS E in 2045 evening peak hour with the southbound and eastbound approaches operating at a LOS F. The 4th Street intersection operates at LOS F with its minor approaches experiencing unacceptable delays. The 20th Street intersection operates at an acceptable LOS however the eastbound approach operates at a LOS E. All other intersections and their corresponding approaches operate at acceptable delay and LOS.

Queuing issues at US 81/Washington Street cause extra delay and queuing issues to develop at the downstream intersections of Mill Road/5th Street and 20th Street. The queue extending into the Mill Road/5th Street intersection can cause additional complications if vehicles stop on the railroad between the intersections. The eastbound thru queue at 3rd Street/11th Avenue extend to the upstream intersection of 4th Street. The following queuing issues were also identified in the 2045 evening peak hour:

- 20th Street
  - Block access to turn lane: westbound and eastbound thru queue
- US 81/Washington Street
  - Exceed storage length: westbound and eastbound thru queues
  - Block access to turn lanes: southbound, westbound and eastbound thru queues
- Mill Road/5th Street
  - Block access to turn lanes: westbound thru queue
- 3rd Street/11th Avenue
  - Exceed storage length: eastbound thru queue
  - Block access to turn lanes: westbound and eastbound thru queues

Evening peak hour drivers experience an eastbound travel time of 239 seconds and a westbound travel time of 126 seconds.

Train Event

During an average train event in 2045 all intersections except 4th Street operate at an acceptable LOS and can be seen in Figure 27.

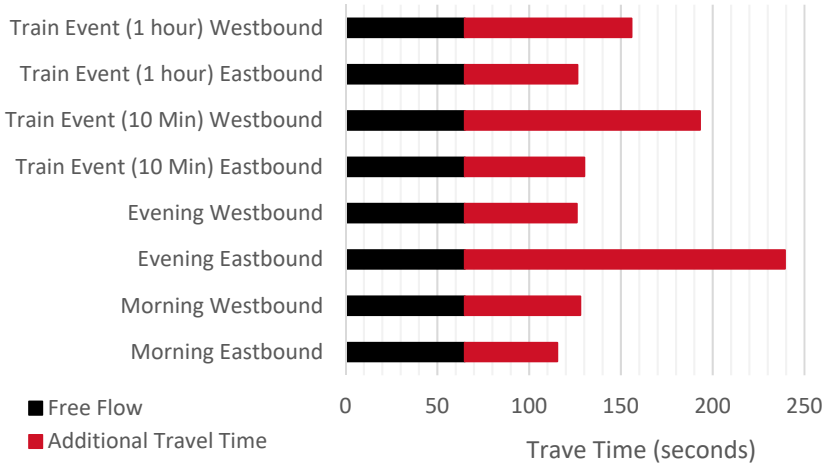
During a train event in 2045 all intersections experience queuing issues. Westbound thru queues at US 81/Washington Street extend into the Mill Road/5th Street intersection, which cause Mill Road/5th Street westbound thru queues to extend into the 4th Street intersection, which in turns extends to 3rd Street/11th Avenue. Eastbound queues at Mill Road/5th Street also extend into

the US 81/Washington Street intersection. The following additional queuing issues were identified in the hour surrounding a train event in 2045:

- 20th Street
  - Block access to turn lanes: westbound and eastbound thru queues
- US 81/Washington Street
  - Exceed storage length: westbound thru queue
  - Block access to turn lane: westbound and eastbound thru queues
- Mill Road/5th Street
  - Exceed storage length: westbound and eastbound thru queues
  - Block access to turn lane: westbound and east bound thru queues
- 4th Street
  - Block access to turn lane: westbound thru queue
- 3rd Street/11th Avenue
  - Block access to turn lane: westbound thru queue

The travel time during the peak 10 minutes following a train event results in a travel time of 130 seconds for eastbound travel, and 193 seconds for westbound travel. The average travel time for the hour surrounding a train event for eastbound travel is 126 seconds and for westbound travel is 156 seconds, as shown in **Figure 31**.

Figure 31: 2045 Travel Times

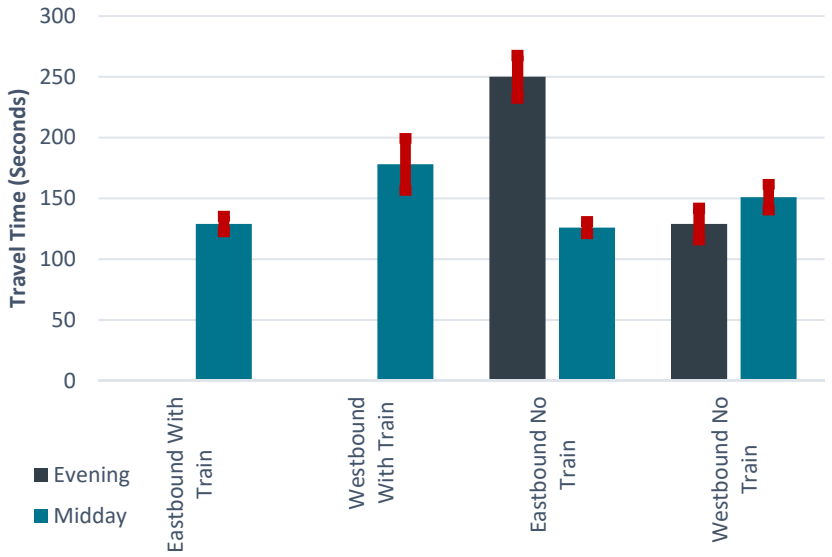


Travel Time Reliability

Travel time reliability is a measure of consistency to indicate day-to-day travel times on a given roadway. Most travelers are less tolerant of unexpected delays because they cannot be incorporated into planned travel time, resulting in late arrivals; alternatively budgeting twice as long as needed for a trip also can result in wasted time. Train events impact reliability on US 2/Gateway Drive and US 81/Washington Street, both which are listed on the NHS, and require high levels of reliability.

Train events and congestion contribute to poor reliability. Travel times and reliability for 2045 models are shown in **Figure 32.** This figure shows extreme travel times, due to the corridor being over capacity. Travel time reliability is shown by the red bars. This represents how much travel time fluctuates for each scenario. From the figure it appears reliability has improved, however due to the over capacity of the system, the models cannot accurately depict the unreliable nature of congestion.

Figure 32: 2045 Travel Time Reliability



ENVIRONMENTAL CONDITIONS

Introduction

The existing environmental conditions, or affected environment, are the baseline conditions in a given area. Environmental conditions have the potential to constrain the development of build alternatives and/or be impacted by build alternatives. Development of build alternatives for a given project is based on the purpose and need for the project and environmental constraints associated with the alternatives. This section contains an overview of the purpose and need as well as pertinent environmental conditions that could affect alternatives development associated with the US 2 and US 81 skewed intersection assessment.

The assessment corridor defines the extent within which project alternatives would be developed at the planning level and potentially transitioned into an environmental document pursuant to the National Environmental Policy Act (NEPA) (42 U.S.C. §4321 et seq.). For the purposes of the environmental conditions report for the US 2 and US 81 Skewed Intersection Study, the assessment corridor includes US 2/Gateway Drive from 20th Street to 3rd Street/11th Avenue as well as adjacent properties within 500 feet of US 2/Gateway Drive and the study intersections.

Purpose and Need

A purpose and need statement outline the problem(s) that project alternatives are intended to solve. The assessment corridors area heavily used roadways that pass through commercial and industrial areas important to the economic wellbeing of the community and the region. The corridors are important for local traffic and commuters. In general, the needs associated with the US 2 and US 81 skewed intersection include:

- Capacity: Existing and projected (2030 and 2045) delays at the minor approaches of the two-way stop-controlled intersection of US 2/Gateway Drive and 4th Street result in LOS F during the evening peak hour. This intersection is projected to operate at LOS E by 2030 and LOS F by 2045 during the morning peak hour as well. In addition, during the evening peak hours the US 81/Washington Street eastbound approach is projected to operate at a LOS E by 2030 and the eastbound approach to the 20th Street is projected to operate at LOS E by 2045. During a train event, the 4th Street intersection currently operates at LOS E and is projected to operate at LOS F by 2030/2045. In addition, existing and projected peak traffic and train delays block access to turn lanes and exceed storage length. Warrants for signal traffic control are currently met at US 81/Washington Street and Mill Road/5th Street intersections. By 2045, the intersection of 3rd Street/11th Avenue is projected to meet a warrant for signal control.
- Social demands and economic development: The NDSM is currently a major truck generator in the region and there are plans to increase operations in the future. This is expected to have an impact on the roadway network due to increased truck traffic and additional activity at the railroad crossing. The geometrics of the corridor intersections need to support the critical truck movements in the corridor. The skew characteristic can reduce visibility for drivers and make negotiating the turns much more difficult. These deficiencies impact regional, national and international economic activity associated with the NDSM.
- Roadway deficiencies: High traffic rail lies between two signalized intersections that are less than 500 feet apart. US 2/Gateway Drive pavement is in good condition, US 81/Washington Street pavement is in satisfactory condition, and Mill Road/5th street is in fair condition. There are currently more than eight times the recommended number of access points along the corridor for a principal arterial.
- Modal interrelationships: Lack of adequate pedestrian features, as well as, pedestrian and bicycle safety features at rail crossing.
- Safety: Crash rates are above the critical rate at intersection of Mill Road/5th Street with US 2/Gateway Drive and the segment of US 2/Gateway Drive between 20th Street and US 81/Washington Street. At-grade railroad crossings introduce the risk for vehicle-trail collisions. Current vehicle delay caused by train blockages along the corridor meets FHWA's grade separation threshold. Delays negatively impact response times for emergency responders that regularly cross the Mill Spur rail line.

The purpose of any projects associated with this assessment would be to address the aforementioned needs., with the overall goal of providing for the safe and efficient movement of people and goods.

The purpose and need for the project have been developed under guidance pursuant to 23 CFR 450 Appendix A (Linking the Transportation Planning and NEPA Processes). Identifying project needs and developing a project purpose at the corridor planning level aids in the development, evaluation, prioritization, and elimination of alternatives.

Affected Environment

The affected environment consists of the baseline resources that could constrain alternatives development or be impacted by a project. A desktop assessment of the corridor was completed using a variety of federal, state, and local resources to identify potential environmental constraints and impacts that projects along the corridor could encounter. As project alternatives are developed and refined, this assessment of impacts will also become more refined. Some of the resources discussed in the subsections below are shown in **Figure 33.**

Land Use

Land use can have many implications on the characteristics of a neighborhood and the efficiency of its transportation network. For example, a primarily industrial neighborhood will have peak traffic flows often associated with shift work and must accommodate heavy truck movements whereas a residential neighborhood will have strong peaking and directional characteristics as people leave to and return from work.

The assessment corridor is primarily characterized by heavy commercial and light industrial uses with areas behind this development as primarily residential. The 2045 Future Land Use Plan projects limited new commercial growth in this area.

Figure 33: Environmental Constraints

Hazardous Waste Sites

The Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act regulate hazardous waste sites. Hazardous materials/waste could be present along the assessment corridor (e.g., industrial areas, gas and service stations).

Improvements to the corridor would have the potential to encounter regulated materials/waste and/or contaminated properties. Surveys should be conducted to identify regulated materials/waste in structures that would be impacted so that any identified regulated materials/waste can be handled and disposed of according to state and federal law. Prior to right-of-way acquisition, large scale earthwork, groundwater dewatering, or work in commercial or industrial areas, surveys (e.g., Phase I and/or Phase II Environmental Site Assessment) should be conducted to identify contaminated properties so that liability and cost risk can be assessed.

Social and Economic Impacts

All transportation projects have some level of associated social and economic impacts. In general, projects aimed at improving transportation corridors have beneficial overall social and economic impacts. Temporary social and economic impacts could occur during construction activities as a result of reduced mobility through construction zones. Existing roadway right-of-way varies along the corridor and is generally constrained by existing development. Improvements along the corridor may require acquisition of right-of-way and/or temporary easements. Coordination with landowners and/or residents would be required for any acquisitions, access changes, or relocations in accordance with state and federal law, including the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

Environmental Justice

Consistent with Executive Order (EO) 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, measures must be taken to avoid disproportionately high, adverse impacts on minority or low-income communities. Minority populations, as defined by the Grand Forks – East Grand Forks MPO's Title VI Non-Discrimination Plan, include any block group with minority populations (American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic) equaling or exceeding 21.2 percent or greater of the total block group population. Low-income populations include those who have an income 1.84 times the US poverty guidelines equaling or exceeding 50 percent or greater of the total block group population.

Figure 34: Commercial and Non-Residential Land Uses in the Corridor

A low-income population has been identified within the assessment corridor to the southeast of the study area. Should impacts during construction activities along the corridor happen to be limited to the area where the identified environmental justice population is located, this population has the potential to experience disproportional impacts on a temporary basis. Permanent impacts of projects along the corridor are intended to improve the transportation corridor for all users; however, the following potential impacts would need to be assessed: splitting existing neighborhoods, promoting social isolation of a particular population, reduction of neighborhood community access or mobility, or promotion the separation of residences or sections of a neighborhood from community facilities or services.

Pedestrians and Bicyclists

The assessment corridor includes several pedestrian and bicyclist generators, such as a park, school, commercial areas, and residential areas. Existing sidewalks extend along the entire assessment area on one or both sides of US 2/Gateway Drive. In addition, multi-use paths extend along the back of the commercial properties north of US 2/Gateway Drive and along the west side of US 81/Washington Street south of US 2/Gateway Drive.

Improvements to the corridor would have the potential improve the pedestrian and bicyclist network within the assessment corridor.

Surface Water

Surface water resources generally include lakes, rivers, streams, floodplains, and wetlands. Water resources were desktop-evaluated using US Department of Agriculture (USDA) National Aerial Imagery Program (NAIP) aerial imagery, US Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps, FEMA FIRMs, US Geological Survey (USGS) National Hydrography Dataset (NHD), and various mapping tools.

No surface water resources were identified within the assessment corridor. Therefore, projects within the corridor are not anticipated to directly impact surface water. Potential indirect impacts on surface water during any project construction activities should be minimized by implementing erosion and stormwater best management practices.

Floodplains

Floodplains constitute land situated along rivers and their tributaries that are subject to periodic flooding with a one percent chance of being flooded in any given year, on the average interval of 100 years or less. EO 11988 - Floodplain Management requires federal agencies to take actions to reduce the risk of flood losses and flood impacts on human safety, health, and welfare, whenever possible. Pursuant to EO 11988, potential effects on floodplains must be evaluated and alternatives that avoid adverse effects and incompatible development in floodplains must be evaluated. If it is found that the only practicable alternatives require siting in a floodplain, it is necessary to design or modify the project to minimize potential harm to or within the floodplain. The North Dakota Floodplain Management Act of 1981 stipulates that the 100-year base flood elevations cannot be increased because of the proposed project. These flood protection measures are to be applied to new construction or rehabilitation. Projects within Floodways or Special Flood Hazard Areas identified on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) are required to obtain permits from local floodplain administrators.

The assessment corridor is located within an area with reduced flood risk due to levee (Zone X) on the FEMA FIRM. As such, projects within the assessment corridor are not anticipated impact floodplains nor require floodplain permitting.

Noise

Noise is generally defined as unwanted sound, and can be intermittent or continuous, steady or impulsive, stationary or transient. Noise levels discernible by humans and animals are dependent on several variables, including distance and ground cover between the source and receiver and atmospheric conditions. Perception of noise is affected by intensity, frequency, pitch and duration. Noise levels corresponding to human hearing are quantified by A-weighted decibels (dBA).

Any transportation project within the assessment corridor having Federal Highway Administration (FHWA) involvement would require a noise analysis in accordance with Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR 772) for "Type 1" projects. These projects include new construction, substantial alteration of horizontal and/or vertical alignment, addition of through-traffic lanes (including restriping). The first step in a noise analysis is assigning each land use an activity category and identifying sensitive noise receptors (i.e., areas of frequent human use). A computer model is then used to determine whether traffic noise impacts are anticipated and if noise abatement (e.g., implementation of noise barriers) is necessary.

Activity categories within the assessment corridor include:

- Residential (Category B)
- Non-residential land uses such as Wilder Elementary and Triangle Park (Category C or D, depending on whether frequent human use occurs outside or inside, respectively)
- Restaurants, offices, etc. (Category E)
- Retail, utilities, etc. (Category F)
- Presumably undeveloped lands that are not permitted for development (Category G).

If improvements to the corridor would be considered Type I projects, a noise analysis would be required for areas with activity categories B through E.

Historic and Archeological Preservation

Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108) requires that federal agencies consider the effects of their undertakings on historic properties. A historic property is any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on, the National Register of Historic Places (NRHP). The Section 106 review process is defined in regulations promulgated by the Advisory Council on Historic Preservation (ACHP), "Protection of Historic Properties" (36 CFR Part 800).

There is one publicly listed historic property on the NRHP within the assessment corridor, the Grand Forks Riverside Neighborhood Historic District, located northeast of the study intersections. Confidential historic properties or historic properties that have yet to be identified may also be present along the corridor. Projects along the corridor should include a records search at the State Historic Preservation Office (SHPO) records, field cultural resources inventory, and coordination with the SHPO to ensure all historic properties are identified and properly handled.

Figure 35: Grand Forks Historic District

Section 4(f) Resources

Section 4(f) of the Department of Transportation Act (23 U.S.C. 138) prohibits federal transportation agencies from approving the use of significant public parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites unless no feasible and practicable avoidance alternative exists. If such an avoidance alternative is not available, only the alternative with the least harm, including all possible planning to minimize harm, can be approved.

Section 4(f) is likely applicable to Gateway Triangle Park, the grounds of Wilder Elementary, multi-use paths, and Grand Forks Riverside Neighborhood Historic

District. In addition, sites determined to be on or e*ligible* for listing on the NRHP that may be identified during project-specific surveys and coordination would be protected by Section 4(f).

Should projects along the corridor include FHWA involvement, the FHWA would need to determine which properties Section 4(f) applies to and can only approve the project alternative(s) that avoid Section 4(f) resources if any such alternatives exist. If no feasible and prudent avoidance alternative exists, coordination with the official(s) with jurisdiction over the affected Section 4(f) resource(s) would be required to minimize and mitigate for impacts and identify the alternative(s) with least harm. Any Section 4(f) approval by the FHWA would require the appropriate coordination and documentation (e.g., Section 4(f) evaluation) efforts.

Section 6(f) Resources

Section 6(f) of the Land and Water Conservation Act requires that the conversion of lands or facilities acquired with Land and Water Conservation Funds (LWCF) be coordinated with the Department of Interior through the North Dakota Parks and Recreation Department (NDPRD). When such a conversion occurs, replacement in-kind is typically required.

According to the NDPRD's North Dakota LWCF Project and Grant Listing (1965-2015), several projects within Grand Forks have received a total of over $1 million in LWCF funding. It is not anticipated that any of these facilities are within the assessment corridor as such, projects associated with this assessment are not anticipated to require Section 6(f) coordination.

SUMMARY OF EXISTING AND FUTURE CONDITIONS

The Existing and Future Conditions report identified the following safety and operations deficiencies. These will be used to asses potential alternatives for the study area. Findings for each intersection are listed below.

US 2/Gateway Drive and 20th Street

- Signal is unwarranted with current and projected traffic volumes. This can result in more crashes, and unnecessary mainline delays.
- Queuing issues for the west approach develop by 2030 and continue to worsen by 2045.
- There were 12 crashes in the past five years, half of which were rear end. The unwarranted signal control at the intersection may be among the contributing factors for the crashes.

US 2/Gateway Drive and US 81/Washington Street

- Queuing issues exist under current conditions, these will continue to worsen through 2045. These queuing issues extend into upstream intersections causing operational issues at those intersections.
- Queuing issues occur during train events.
- The long queues and dense access spacing may be among the contributing factors for the more than 45 crashes in the last 5 years.

US 2/Gateway Drive and Mill Road/5th Street

- Queuing issues are present under existing conditions for the east approach.
- During train events queuing issues exist for west and east approaches.
- Queueing issues worsen as traffic increases
- More than half of the 41 crashes that occurred over the last five years were rear end crashes.
- The long queues and dense access spacing may be among the contributing factors for the intersection exceeding the critical crash rate.

US 2/Gateway Drive and 4th Street

- Currently operates deficiently, due to poor operations at the north approach and minimal gaps in traffic during peak hours.

US 2/Gateway Drive and 3rd Street

- Currently experiences queuing issues on the east approach that continues to degrade into 2045.
- Does not meet daily volume signal warrants currently or in the future and may impact safety in the corridor.

Train Events

- Currently the overall delay for drivers is almost 90 hours a day. This accumulates to over 32,000 hours a year in delay for drivers of the corridor. This delay will continue to worsen due to increased traffic.

Trucks

- The corridor carries between 1,250 and 1,500 trucks per day. These volumes can increase dramatically during times of harvest and can worsen queueing issues and operations.
- The skewed intersections at US 81/Washington and Mill Road/5th Street make turning especially difficult for larger trucks.

Pedestrians and Bicycles

- The study area lacks pedestrian accommodations at most intersections
- Multiple instances of objects in the middle of sidewalks
- Only one controlled crossing of US 2/Gateway Drive, even at signalized intersections
- The multi-use path that crosses US 81/Washington Street provides no protections for bikes and pedestrians crossing the road.

Transit

- The CAT Route 2 runs along US 2/Gateway Drive, with hourly service.
- The designated stops include 5th Street and 10th Avenue and Hugo's on 20th Street, two blocks south of US 2/Gateway Drive.
- CAT also stops at Home of Economy on US 81/Washington Street when scheduled in advance.
- No train related delays because of Mill Spur have been reported by CAT.

ROW Constraints

- The corridor is highly developed along US 2/Gateway Drive, making additional ROW acquisition difficult.

Environmental Constraints

- Noise Analysis is likely necessary
- Section (4(f) is likely applicable to Gateway Triangle Park, Wilder Elementary, multi-use paths, and Grand Forks Riverside Neighborhood Historic District