

To: Dr. James Hess, Superintendent
Independent School District 31

From: Jordan Schwarze, PE, Senior Engineer
Matt Pacyna, PE, Senior Associate

Date: March 21, 2016

Subject: Gene Dillon Elementary School Traffic Study – Division Street Site

Introduction

SRF has completed a traffic study for the proposed Gene Dillon Elementary School (GDES) located along the north side of Division Street at Becida Road immediately west of Bemidji, MN (see Figure 1: Project Location). The main objectives of this study are to review existing operations within the study area, evaluate the traffic impacts to the adjacent roadway network including the proposed access, circulation, and parking, and recommend any necessary improvements. The following information provides the assumptions, analysis, and recommendations offered for consideration.

Existing Conditions

The existing conditions were reviewed to establish a baseline in order to identify any future impacts associated with the proposed elementary school. The evaluation of existing conditions includes turning movement counts, field observations, and an intersection capacity analysis.

Data Collection

Traffic Volumes

Peak period turning movement counts were collected by SRF during the week of January 18, 2015 at the following study intersections:

- Division Street and Becida Road
- Division Street and Adams Avenue
- Division Street and Bemidji High School West Access
- Division Street and Bemidji High School East Access
- Division Street and US Highway 71 West Ramps
- Division Street and US Highway 71 East Ramps

Historical average daily traffic (ADT) volumes within the study area were provided by the Minnesota Department of Transportation (MnDOT).



H:\Projects\09000\09037\TS\Figures\9037-01\Fig01 Project Location.cdr



Project Location

Gene Dillon Elementary School Traffic Study - Division Street Site
Bemidji, MN

0159037.01
March 2016

Figure 1

Classroom hours for existing Bemidji area elementary schools are 8:05 a.m. to 2:50 p.m. Classroom hours for the nearby Bemidji High School (BHS) are currently 8:19 a.m. to 3:05 p.m. However, a change in classroom hours has been proposed to accommodate busing to/from GDES. Proposed classroom hours for GDES are 8:10 a.m. to 2:55 p.m. and the nearby BHS are 8:24 a.m. to 3:10 p.m. Therefore, school peak hours chosen for analysis were 7:30 to 8:30 a.m. and 2:30 to 3:30 p.m. to include the peak 15-minute traffic intervals for both GDES and BHS. Since the school and adjacent roadway network a.m. peak hours coincide, a single a.m. peak hour analysis was completed. It should be noted that the adjacent roadway network p.m. peak hour was observed to be 4:45 to 5:45 p.m.

Roadway Characteristics

In addition to intersection turning movement counts, observations were completed to identify roadway characteristics within the study area. Becida Road is a two-lane undivided roadway with a posted speed limit of 55 miles per hour (mph). Division Street is a two-lane undivided roadway with a posted speed limit of 45 mph west of Adams Avenue. East of Adams Avenue, Division Street is a three-lane undivided roadway with a continuous center two-way left-turn lane and a posted speed limit of 45 mph. Adams Avenue is a two-lane undivided roadway with a posted speed limit of 50 mph. It should be noted that Becida Road, Division Street, and Adams Avenue (north of Division Street) are functionally classified as collector roadways. All study intersections, with the exception of the Division Street/BHS East Access signalized intersection, are side-street stop controlled. Existing geometrics, traffic controls, and volumes in the study area are shown in Figure 2.

Existing Intersection Capacity Analysis

An existing intersection capacity analysis was completed for the a.m., school p.m., and p.m. peak hours to establish baseline conditions for comparison with future traffic operations. Study intersections were analyzed using Synchro/SimTraffic (V8) software. Capacity analysis results identify a Level of Service (LOS), which indicates the quality of traffic flow through an intersection. Intersections are given a ranking from LOS A through LOS F. The LOS results are based on average delay per vehicle, which correspond to the delay threshold values shown in Table 1. LOS A indicates the best traffic operation, with vehicles experiencing minimal delays. LOS F indicates an intersection where demand exceeds capacity, or a breakdown of traffic flow.

Table 1 Level of Service Criteria for Signalized and Unsignalized Intersections

LOS Designation	Signalized Intersection Average Delay/Vehicle (seconds)	Unsignalized Intersection Average Delay/Vehicle (seconds)
A	≤ 10	≤ 10
B	> 10 - 20	> 10 - 15
C	> 20 - 35	> 15 - 25
D	> 35 - 55	> 25 - 35
E	> 55 - 80	> 35 - 50
F	> 80	> 50

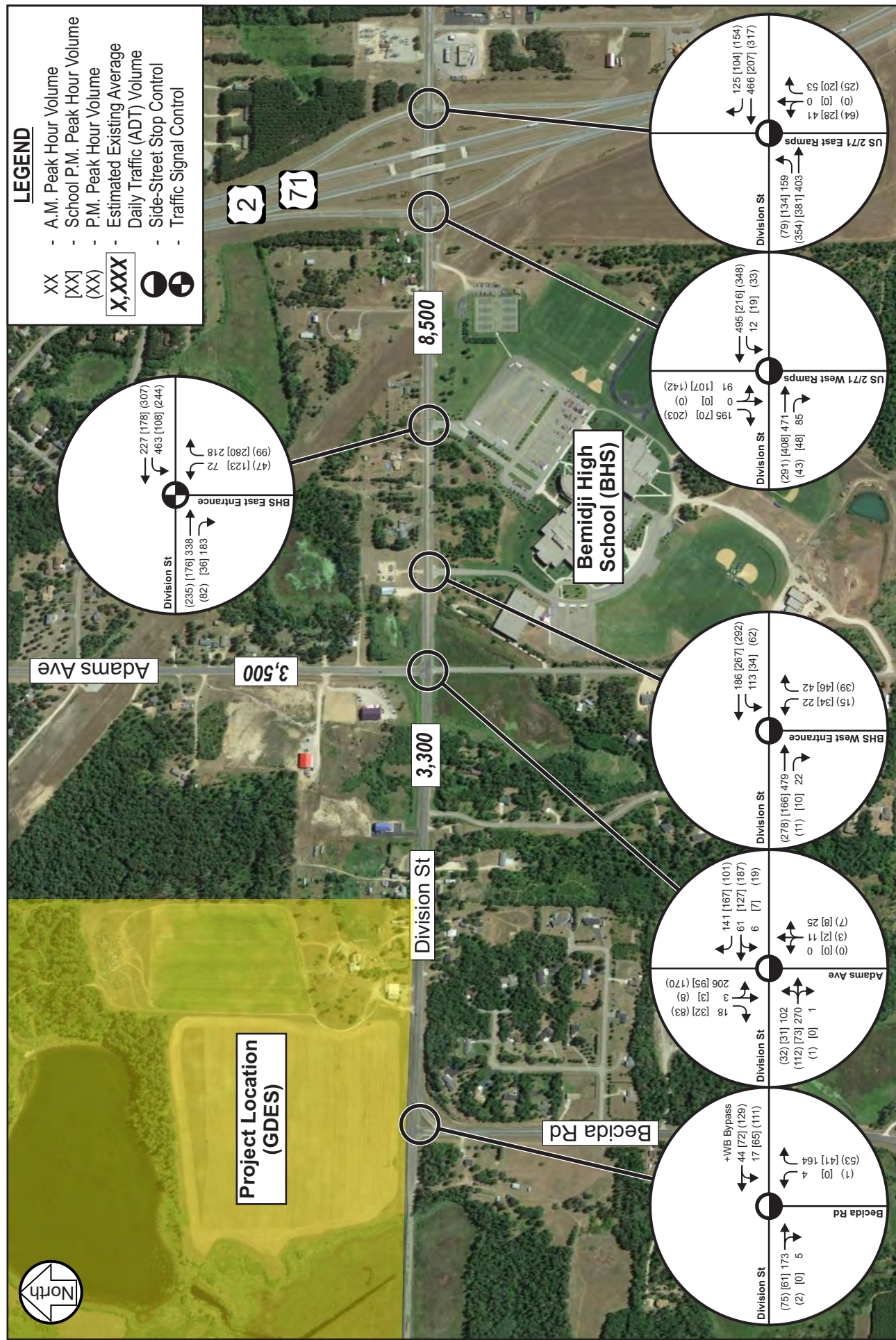


Figure 2

For side-street stop controlled intersections, special emphasis is given to providing an estimate for the level of service of the side-street approach. Traffic operations at an unsignalized intersection with side-street stop control can be described in two ways. First, consideration is given to the overall intersection level of service. This takes into account the total number of vehicles entering the intersection and the capability of the intersection to support these volumes. Second, it is important to consider the delay on the minor approach. Since the mainline does not have to stop, the majority of delay is attributed to the side-street approaches. It is typical of intersections with higher mainline traffic volumes to experience high levels of delay (i.e. poor levels of service) on the side-street approaches, but an acceptable overall intersection level of service during peak hour conditions.

Schools generally have condensed busy periods as compared to typical roadway network a.m. and p.m. peak periods (i.e. traffic on and near school grounds tends to be busy for a short period of time close to school start and end times). Therefore, traffic operations were analyzed over two different time intervals to better understand peak conditions. First, the entire peak hour (i.e. 60-minute interval) was analyzed, which is the traffic industry standard. Second, the peak 15-minute interval was analyzed, which provides an understanding of operations more closely related to the immediate school area.

Results of the existing intersection capacity analysis (60-minute interval) shown in Table 2 indicate that all study intersections currently operate at an overall LOS B or better during the school and adjacent roadway network p.m. peak hours. However, the Division Street/BHS East Access intersection currently operates at an overall LOS D during the a.m. peak hour, as a high volume of westbound left-turn maneuvers cause significant delays.

Table 2 Existing Intersection Capacity Analysis – 60 Minute Interval

Intersection	A.M. Peak Hour ⁽²⁾		School P.M. Peak Hour ⁽²⁾		P.M. Peak Hour	
	LOS	Delay	LOS	Delay	LOS	Delay
Division Street and Becida Road ⁽¹⁾	A/A	3 sec.	A/A	3 sec.	A/A	3 sec.
Division Street and Adams Avenue ⁽¹⁾	B/D	26 sec.	A/A	5 sec.	A/A	7 sec.
Division Street and BHS West Access ⁽¹⁾	A/B	12 sec.	A/A	6 sec.	A/A	4 sec.
Division Street and BHS East Access	D	41 sec.	B	11 sec.	A	7 sec.
Division Street and US 71 West Ramps ⁽¹⁾	B/E	37 sec.	A/C	18 sec.	A/B	12 sec.
Division Street and US 71 East Ramps ⁽¹⁾	A/B	10 sec.	A/A	6 sec.	A/A	7 sec.

(1) Indicates an unsignalized intersection with side-street stop control, where the overall LOS is shown followed by the worst approach LOS. The delay shown represents the worst side-street approach delay.

(2) The school a.m. and p.m. analysis peak hours are defined as 7:30 – 8:30 a.m. and 2:30 – 3:30 p.m. respectively. The school a.m. analysis peak hour coincides with the a.m. peak hour of the adjacent roadway network.

Results of the existing intersection capacity analysis (15-minute interval) shown in Table 3 indicate that all study intersections currently operate at an overall LOS B or better during the school and adjacent roadway network p.m. peak 15-minute intervals. In addition, no significant side-street delays or queuing issues were observed in the field or traffic simulation during these peak 15-minute intervals. However, significant operational/safety issues were observed during the a.m. peak 15-minute interval.

Table 3 Existing Intersection Capacity Analysis – 15 Minute Interval

Intersection	A.M. Peak Hour ⁽²⁾		School P.M. Peak Hour ⁽²⁾		P.M. Peak Hour	
	LOS	Delay	LOS	Delay	LOS	Delay
Division Street and Becida Road ⁽¹⁾	A/A	3 sec.	A/A	3 sec.	A/A	3 sec.
Division Street and Adams Avenue ⁽¹⁾	C/E	44 sec.	A/B	11 sec.	A/A	7 sec.
Division Street and BHS West Access ⁽¹⁾	A/C	15 sec.	A/A	8 sec.	A/A	5 sec.
Division Street and BHS East Access	E	64 sec.	B	16 sec.	A	9 sec.
Division Street and US 71 West Ramps ⁽¹⁾	C/F	56 sec.	A/D	34 sec.	A/C	15 sec.
Division Street and US 71 East Ramps ⁽¹⁾	A/B	11 sec.	A/B	10 sec.	A/A	9 sec.

(1) Indicates an unsignalized intersection with side-street stop control, where the overall LOS is shown followed by the worst approach LOS. The delay shown represents the worst side-street approach delay.

(2) The school a.m. and p.m. analysis peak hours are defined as 7:30 – 8:30 a.m. and 2:30 – 3:30 p.m. respectively. The school a.m. analysis peak hour coincides with the a.m. peak hour of the adjacent roadway network.

Division Street and Adams Avenue Intersection

- Moderate side-street delays and queues were observed.
- Limited gaps in Division Street traffic cause the southbound intersection approach to operate at LOS E.
- Southbound queues were observed to extend up to 300 feet.

Division Street and BHS East Access Intersection

- The intersection currently operates at an overall LOS E during the peak 15-minute interval.
- Westbound left-turn queues were observed to extend more than 1,200 feet through the adjacent Division Street/US Highway 71 West Ramps intersection.

Division Street and US Highway 71 West Ramps Intersection

- Significant side-street delays and queues were observed.
- A combination of westbound left-turn queues from the adjacent Division Street/BHS East Access intersection and limited gaps in eastbound/westbound through traffic cause the southbound intersection approach (i.e. US Highway 71 off-ramp) to operate at LOS F.
- Southbound intersection approach queues were observed to extend more than 800 feet along the US Highway 71 off-ramp, nearly reaching mainline southbound US Highway 71. This situation creates a safety issue, considering the limited distance available to complete a stopping maneuver from mainline highway speeds.

Division Street and US Highway 71 East Ramps Intersection

- Moderate side-street delays were observed.
- The observed side-street approach delays are likely an underrepresentation of actual delays, as a number of vehicles were observed to complete a northbound right-turn maneuver only to turn around downstream and ultimately proceed in the westbound direction.

Proposed Development

The proposed Gene Dillon Elementary School, shown in Figure 3, is located along the north side of Division Street at Becida Road approximately three-quarters of a mile west of BHS. Upon anticipated opening in the year 2017, GDES is expected to have an enrollment of approximately 850 students. However, the expected student capacity of the proposed elementary school is estimated at 900 students. Therefore, traffic operations analyses were completed at the proposed elementary school capacity to provide a conservative estimate of future year conditions. Access to GDES was preliminarily proposed at one location along Division Street, approximately 700 feet east of Becida Road

Year 2018 Conditions

To help determine the impacts associated with the proposed elementary school, traffic forecasts were developed for year 2018 conditions (i.e. one year after opening). The year 2018 conditions take into account general area background growth and traffic generated by the proposed elementary school. The following sections provide details on the background traffic forecasts, estimated school trip generation, and intersection capacity analysis for year 2018 conditions.

Background Traffic Growth

To account for general background growth in the area, an annual growth rate of one (1) percent was applied to the existing peak hour traffic volumes to develop year 2018 background traffic forecasts. This growth rate is consistent with historical growth rates in the study area.

Trip Generation

To account for traffic impacts associated with GDES, trip generation estimates for the a.m., school p.m., and p.m. peak hours as well as a daily basis were developed. These trip generation estimates were developed using the *ITE Trip Generation Manual, Ninth Edition*, transportation modal information provided by the school district, and by reviewing the observed trip generation rates of Bemidji Middle School (BMS) from March 2015 turning movement counts:

- Observed entering/exiting middle school a.m. peak hour trips were approximately 40 percent higher than corresponding ITE forecasted trips. Therefore, a 40 percent increase from ITE forecasted trips was utilized to forecast GDES a.m. peak hour trips.
- Observed entering/exiting middle school p.m. peak hour trips were approximately 85 percent higher than corresponding ITE forecasted trips.
 - During the school p.m. peak hour, BMS is used as a transfer point for approximately 40 school buses for students from BMS, BHS, and a number of charter schools. The bus transfer is estimated to increase school p.m. peak hour trips by approximately 15 percent as compared to ITE forecasted trips. Therefore, a 70 percent increase from ITE forecasted trips was utilized to forecast GDES p.m. peak hour trips.



Figure 3

- Observed entering/exiting roadway p.m. peak hour trips were similar to corresponding ITE forecasted trips. Therefore, no increase from ITE forecasted trips was utilized to forecast the adjacent roadway network p.m. peak hour trips.
- School a.m. and p.m. peak hour trips generally comprise 50 to 60 percent of daily site trips. Given increased observed middle school peak hour trips and similar observed adjacent roadway network p.m. peak hour trips compared to ITE forecasted trips, school peak hour trips likely comprise at least 60 percent of daily site trips at BMS. Therefore, GDES peak hour trips were conservatively estimated to comprise 60 percent of daily site trips.

Results of the trip generation estimates, shown in Table 4, indicate the proposed elementary school is expected to generate approximately 567 school a.m. peak hour, 429 school p.m. peak hour, 135 p.m. peak hour, and 1,660 daily trips. Given the school district estimates that nearly 80 percent of proposed elementary students will utilize school buses, approximately 25 entering/exiting buses were conservatively assumed to serve GDES during the school peak hours.

Table 4 Trip Generation Estimates

Land Use Type (ITE Code)	Size	School A.M. Peak Hour Trips		School P.M. Peak Hour Trips		P.M. Peak Hour Trips		Daily Trips
		In	Out	In	Out	In	Out	
Existing Bemidji Middle School								
Middle School (522)	1,064 Students ⁽¹⁾	316	259	144	176	83	87	1,724
Middle School (Observed) ⁽²⁾	1,064 Students ⁽¹⁾	450	358	261	332	85	86	N/A
Proposed Gene Dillon Elementary School								
Elementary School (520)	900 Students	223	182	113	139	66	69	1,161
Elementary School (Observed Rate) ⁽³⁾	900 Students	312	255	193	236	66	69	1,660

(1) 2014-2015 BMS enrollment provided by the Minnesota Department of Education.

(2) Entering/exiting trips based on turning movement counts collected by Karvakko Engineering/Traffic Impact Group in March 2015.

(3) Proposed GDES trip generation based on observed BMS trip generation rate.

The anticipated allocation of GDES trips over the school peak hours was developed based on the observed allocation of BMS trips. The resulting GDES trip allocation is shown in Table 5.

Table 5 Generation Allocation – Proposed Elementary School

School A.M. Peak Hour			Anticipated GDES Trip Allocation (Percent of GDES Peak Hour)	
15-Minute Interval			In	Out
Anticipated GDES A.M. Peak Hour	7:15 to 7:30 a.m.	School ⁽¹⁾ A.M. Peak Hour Chosen for Analysis	62 (20%)	38 (15%)
	7:30 to 7:45 a.m.		109 (35%)	77 (30%)
	7:45 to 8:00 a.m.		94 (30%)	89 (35%)
	8:00 to 8:15 a.m.		47 (15%)	51 (20%)
	8:15 to 8:30 a.m.		9 (N/A)	13 (N/A)
School P.M. Peak Hour				
15-Minute Interval			In	Out
Anticipated GDES P.M. Peak Hour	2:30 to 2:45 p.m.	School ⁽¹⁾ P.M. Peak Hour Chosen for Analysis	48 (25%)	12 (5%)
	2:45 to 3:00 p.m.		68 (35%)	35 (15%)
	3:00 to 3:15 p.m.		48 (25%)	106 (45%)
	3:15 to 3:30 p.m.		29 (15%)	83 (35%)

(1) School peak hours beginning at 7:30 a.m. and 2:30 p.m. were analyzed to include peak 15-minute traffic intervals for both GDES and the nearby BHS.

The GDES trips were distributed throughout the area based on the directional distribution shown in Figure 4, which was developed based on geographical enrollment information provided by the school district, existing travel patterns, and engineering judgment. The resultant year 2018 traffic forecasts, which include general background growth and trips generated by the proposed elementary school, are shown in Figure 5.

Year 2018 Intersection Capacity Analysis

To determine if the existing roadway network can accommodate the year 2018 traffic forecasts, a detailed traffic capacity analysis was completed using Synchro/SimTraffic software. Once again, both the 60-minute and 15-minute peak intervals were reviewed.

Results of the year 2018 intersection capacity analysis (60-minute interval) shown in Table 6 indicate that all study intersections are expected to continue operating at an overall LOS B or better during the school and adjacent roadway network p.m. peak hours under the existing roadway geometry and traffic control. However, study intersections along Division Street from Adams Avenue through US Highway 71 are expected to have significant delays during the majority of the a.m. peak hour.



Figure 4

H:\Projects\09000\9037\TS\Figures\9037-01\Fig04_Directional Distribution.cdr

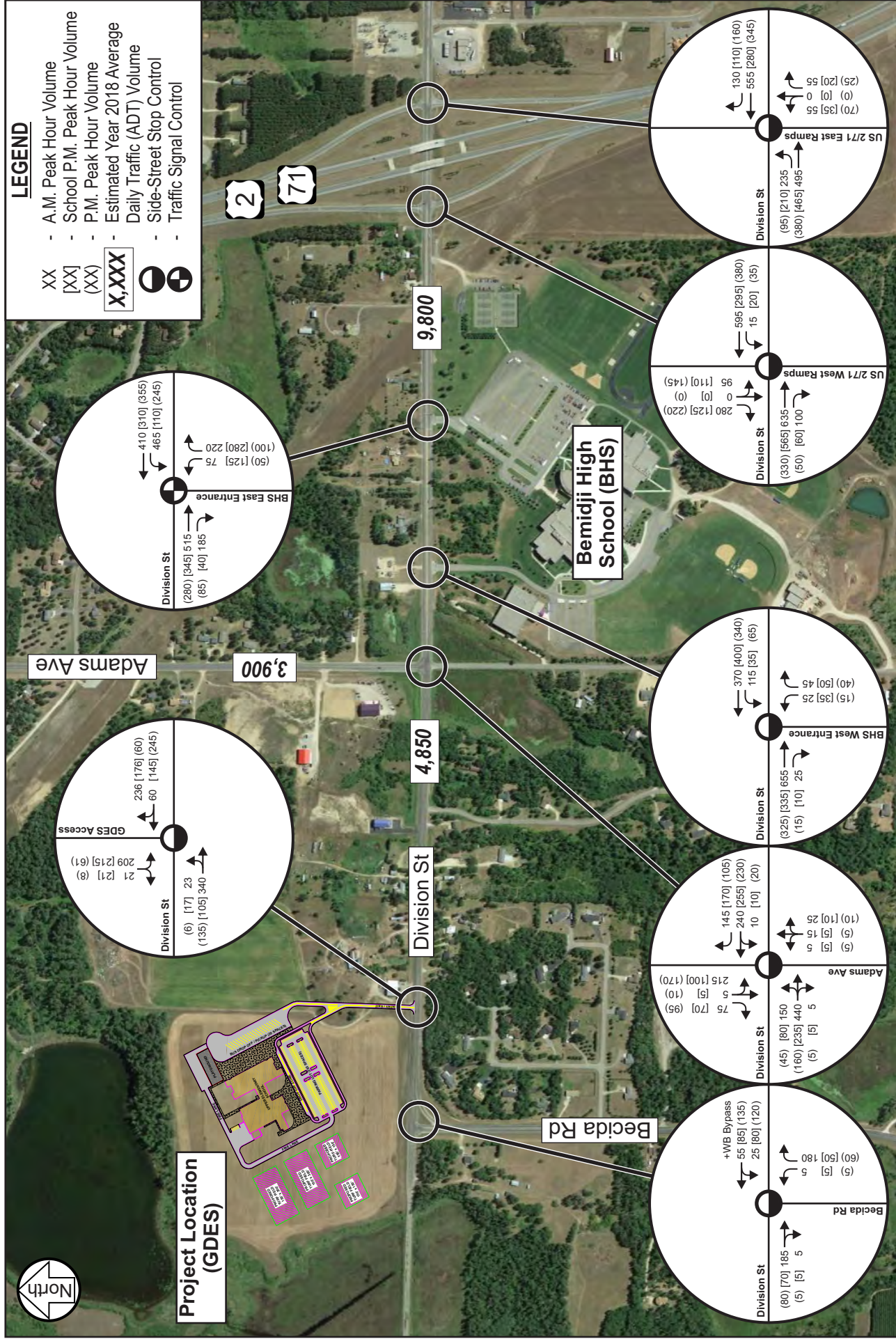


Table 6 Year 2018 Intersection Capacity Analysis – 60 Minute Interval

Intersection	A.M. Peak Hour ⁽²⁾		School P.M. Peak Hour ⁽²⁾		P.M. Peak Hour	
	LOS	Delay	LOS	Delay	LOS	Delay
Division Street and Becida Road ⁽¹⁾	A/A	3 sec.	A/A	3 sec.	A/A	3 sec.
Division Street and GDES Access ⁽¹⁾	B/D	34 sec.	A/B	12 sec.	A/A	6 sec.
Division Street and Adams Avenue ⁽¹⁾	F/F	> 3 min.	A/A	9 sec.	A/A	8 sec.
Division Street and BHS West Access ⁽¹⁾	B/F	85 sec.	A/B	11 sec.	A/A	5 sec.
Division Street and BHS East Access	E	70 sec.	B	19 sec.	A	8 sec.
Division Street and US 71 West Ramps ⁽¹⁾	E/F	> 3 min.	A/E	39 sec.	A/C	16 sec.
Division Street and US 71 East Ramps ⁽¹⁾	A/D	25 sec.	A/B	11 sec.	A/A	9 sec.

(1) Indicates an unsignalized intersection with side-street stop control, where the overall LOS is shown followed by the worst approach LOS. The delay shown represents the worst side-street approach delay.

(2) The school a.m. and p.m. analysis peak hours are defined as 7:30 – 8:30 a.m. and 2:30 – 3:30 p.m. respectively. The school a.m. analysis peak hour coincides with the a.m. peak hour of the adjacent roadway network.

Results of the year 2018 intersection capacity analysis (15-minute interval) shown in Table 7 indicate that all study intersections are expected to operate at an overall LOS C or better during the school and adjacent roadway network p.m. peak hours under the existing roadway geometry and traffic control. In addition, only the Division Street/US Highway 71 West Ramps intersection is expected to experience significant side-street delays/queuing issues outside the a.m. peak 15-minute interval. However, significant operational/safety issues were observed during the a.m. peak 15-minute interval.

Table 7 Year 2018 Intersection Capacity Analysis – 15 Minute Interval

Intersection	A.M. Peak Hour ⁽²⁾		School P.M. Peak Hour ⁽²⁾		P.M. Peak Hour	
	LOS	Delay	LOS	Delay	LOS	Delay
Division Street and Becida Road ⁽¹⁾	A/A	3 sec.	A/A	3 sec.	A/A	3 sec.
Division Street and GDES Access ⁽¹⁾	C/E	45 sec.	A/B	14 sec.	A/A	7 sec.
Division Street and Adams Avenue ⁽¹⁾	F/F	> 3 min.	A/C	15 sec.	A/B	10 sec.
Division Street and BHS West Access ⁽¹⁾	C/F	121 sec.	A/B	14 sec.	A/A	5 sec.
Division Street and BHS East Access	F	101 sec.	C	30 sec.	A	9 sec.
Division Street and US 71 West Ramps ⁽¹⁾	F/F	> 3 min.	C/F	104 sec.	A/C	20 sec.
Division Street and US 71 East Ramps ⁽¹⁾	A/D	33 sec.	A/C	15 sec.	A/A	9 sec.

(1) Indicates an unsignalized intersection with side-street stop control, where the overall LOS is shown followed by the worst approach LOS. The delay shown represents the worst side-street approach delay.

(2) The school a.m. and p.m. analysis peak hours are defined as 7:30 – 8:30 a.m. and 2:30 – 3:30 p.m. respectively. The school a.m. analysis peak hour coincides with the a.m. peak hour of the adjacent roadway network.

Division Street and Adams Avenue Intersection

- The intersection is expected to operate at an overall LOS F.
- GDES added traffic along Division Street is expected to minimize the gaps needed to complete through and left-turn maneuvers from the side-street, causing significant delays and queues on the southbound intersection approach.
- Without improved traffic control, southbound queues beyond 1,000 feet are expected.
 - *While either a traffic signal or roundabout would be appropriate operational mitigation, a traffic signal is recommended for the Division Street/Adams Avenue intersection to minimize the footprint of the intersection and limit impacts on surrounding wetlands. The addition of eastbound/westbound dedicated left-turn lanes is also recommended and could potentially be implemented without widening Division Street.*

Division Street and BHS West Access Intersection

- Significant side-street delays are expected.
- Although the northbound intersection approach is expected to operate at LOS F, relatively few vehicles are expected to be affected.
 - It should be noted that the BHS West Access serves as the primary bus entrance/exit as well as access for the Bemidji Community Arena.
 - *No turn-lane or traffic control improvements are recommended for the Division Street/BHS West Access intersection. However, installing access directly to Adams Avenue from the Bemidji Community Arena/ West side of BHS may be considered to utilize improved traffic control at the Division Street/Adams Avenue intersection.*

Division Street and BHS East Access Intersection

- The intersection is expected to operate at an overall LOS F.
- GDES added traffic along Division Street is expected to increase the likelihood of eastbound queues extending through the adjacent Division Street/BHS West Access intersection.
 - *The implementation of dual westbound left-turn lanes is recommended for the Division Street/BHS East Access intersection.*
 - *The east leg of the Division Street/BHS East Access intersection appears to have enough width to accommodate dual westbound left-turn lanes. However, the west leg of the Division Street/BHS East Access intersection will require widening to the south to provide proper eastbound through lane continuity and replace the existing eastbound right-turn lane.*
 - *Eastbound and northbound right-turn overlap signal phasing is also recommended.*
 - *Recommended improvements at the Division Street/BHS East Access intersection may necessitate partial or full replacement of the existing traffic signal system.*

Division Street and US Highway 71 West Ramps Intersection

- The intersection is expected to operate at an overall LOS F.
- GDES added traffic along Division Street is expected to increase the likelihood of southbound queues extending onto mainline southbound US Highway 71.
 - *Traffic signal or roundabout control is recommended for the Division Street/US Highway 71 West Ramps intersection.*

Division Street and US Highway 71 East Ramps Intersection

- Moderate side-street delays are expected.
 - *The desired traffic control at the Division Street/US Highway 71 West Ramps intersection may also be similarly implemented at the US Highway 71 East Ramps intersection.*

Signal Warrant Analysis

Due to significant anticipated traffic volumes along Division Street, left-turn and through maneuvers from Adams Avenue and the southbound US Highway 71 off-ramp are expected to be difficult during school peak hours under the forecast year 2018 conditions with the current side-street stop control. Turn-lane improvements alone would not provide the gaps necessary for vehicles to safely and efficiently perform these maneuvers. Therefore, a traffic control improvement would be necessary to improve intersection operations to acceptable levels of service.

Consequently, a preliminary traffic signal warrant analysis was performed based on anticipated year 2018 traffic volumes at the Division Street/Adams Avenue and Division Street/US Highway 71 West Ramps intersections. Results of the preliminary traffic signal warrant analysis indicate that the Division Street/Adams Avenue and Division Street/US Highway 71 West Ramps intersections are expected to meet a peak hour warrant during the a.m. peak hour.

Bemidji High School Improvements

The implementation of dual westbound left-turn lanes at the Division Street/BHS East Access intersection will necessitate improvements to the BHS East Access driveway. In order to accommodate dual inbound lanes in the southbound direction, the south leg of the Division Street/BHS East Access intersection will require widening to the west. Furthermore, additional driveway improvements, including a raised median near the Division Street/BHS East Access intersection, should be considered to minimize potential vehicle conflicts and enhance traffic flow into the site. Short- and long-term BHS conceptual layouts illustrating potential driveway and parking lot improvements are shown in Figures 6 and 7.



BHS Conceptual Layout - Short-Term Improvements

Gene Dillon Elementary School Traffic Study - Division Street Site
 Bemidji, MN

Figure 6



BHS Conceptual Layout - Long-Term Improvements

Gene Dillon Elementary School Traffic Study - Division Street Site
 Bemidji, MN

Figure 7

Site Plan/Access Review

A review of the proposed site plan was completed to identify any issues and recommend potential improvements with regard to site access, parking, drop-off/pick-up zones, and pedestrian/bicyclist connectivity. In general, traffic controls, signing, and striping should be based on guidelines established in the *Minnesota Manual on Uniform Traffic Control Devices* (MN MUTCD).

Site Access

As preliminarily proposed, access to GDES along Division Street was planned approximately 700 feet east of Becida Road. This location lies on a crest vertical curve that would limit sight distance for motorists attempting to exit the proposed elementary school to Division Street. Although minimum sight distance guidelines for a 45 mph roadway are met at this location, sight distance is significantly improved further west along Division Street. Therefore, locating the GDES main access at a new north leg of the Division Street/Becida Road intersection is recommended.

It should be noted that Beltrami County has discussed making improvements to the Division Street/Becida Road intersection apart from the proposed development, including potentially modifying geometry and traffic control. Given a large existing intersection footprint and the potential safety benefits of roundabout control, reconstructing the Division Street/Becida Road intersection to include the GDES main access in a four-leg roundabout is recommended. The anticipated year 2018 traffic volumes at the Division Street/Becida Road intersection are not expected to meet a traffic signal warrant.

Although the GDES main access could shift to the Division Street/Becida Road intersection, the preliminary site access located approximately 700 feet to the east along Division Street could remain as a bus/delivery truck access. Given the higher profile of these vehicle types, sight distance is expected to be less of a concern for their drivers. It should be noted that *Transportation Research Board (TRB) Access Management Manual* guidelines for spacing along a rural collector roadway such as Division Street recommend a minimum of 660 feet between access locations. The potential GDES dual access scenario, described above and shown in Figure 8, would meet this access spacing guideline.

Parking

Parking generation estimates were completed using the *ITE Parking Generation Manual, Fourth Edition* (shown in Table 8). Based on the 85th percentile and maximum ITE peak parking demand rates, the proposed elementary school would be expected to generate a peak parking demand of approximately 189 to 216 vehicles. The preliminary site plan proposal had shown more than 290 parking spaces (excluding 20 proposed bus parking spaces). It should be noted that the main parking lot and perimeter drive aisle improvements shown in Figure 8 could potentially reduce available parking to approximately 270 spaces. At this capacity, a surplus of at least 50 parking spaces is anticipated.

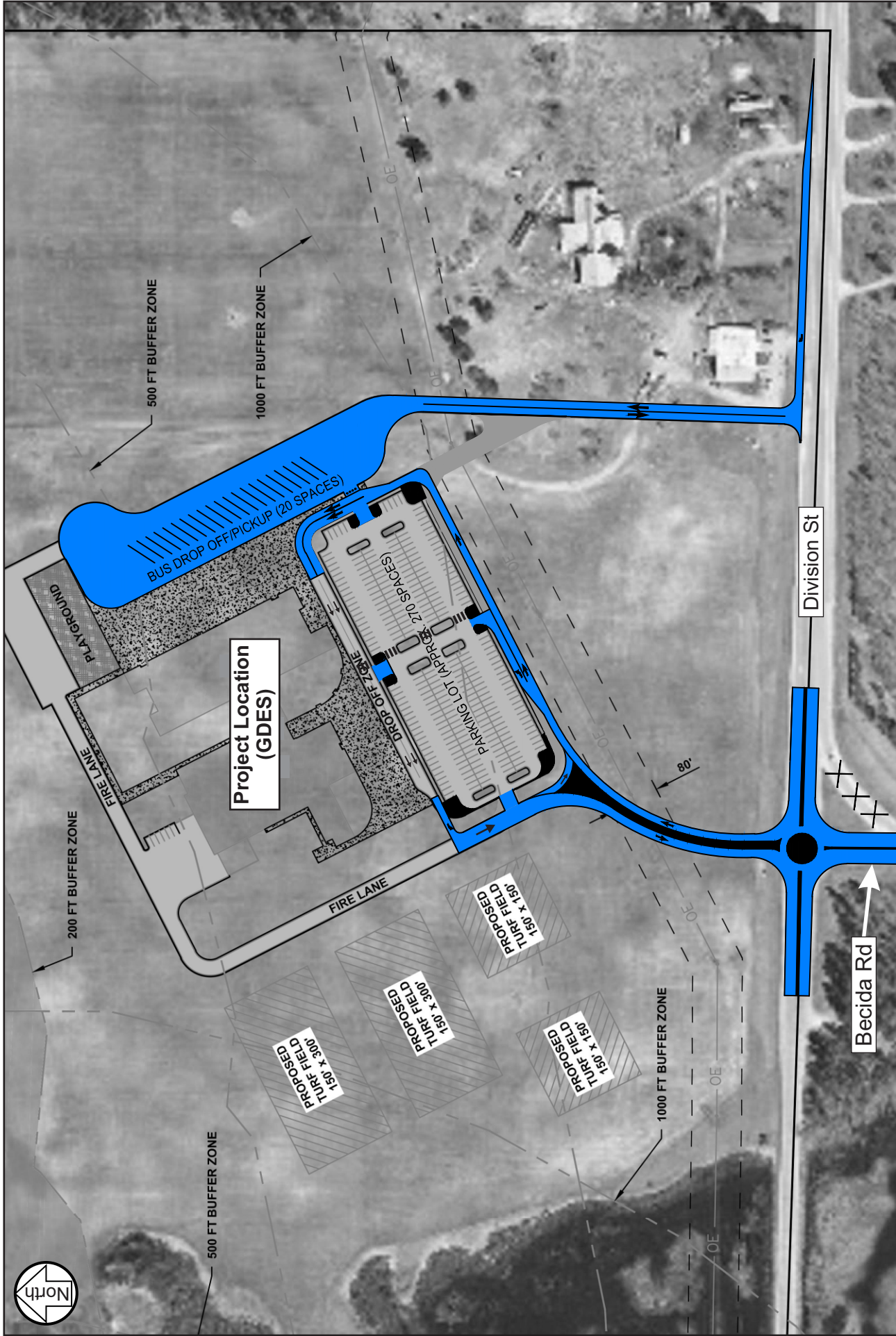


Figure 8

Table 8 Parking Generation Estimates

Land Use Type (<i>ITE Code</i>)	Size	ITE 85th Percentile Peak Parking Demand	ITE Maximum Peak Parking Demand
Elementary School (520)	900 Students	189	216

Drop-off/Pick-up Zones

Two separate drop-off/pick-up zones (i.e. bus and parent) were shown on the preliminary site plan. However, their access was combined at the single site access located along Division Street approximately 700 feet east of the Division Street/Becida Road intersection. The following improvements to the drop-off/pick-up zones and main parking lot should be considered to provide orderly traffic flow and minimize vehicle and pedestrian conflicts:

Parent Drop-off/Pick-up Zone

- Consider modifying the parent drop-off/pick-up zone and main parking lot as illustrated previously in Figure 8. Key modifications include:
 - Provide access to the parent drop-off/pick-up zone and main parking lot from a new north leg of the Division Street/Becida Road intersection.
 - Extend the parent drop-off/pick-up zone to maximize vehicle stacking area.
 - The proposed parent drop-off/pick-up zone as illustrated is expected to accommodate approximately 28 general passenger vehicles (i.e. approximately 560 feet of storage).
 - Considering the expected parking surplus, additional storage of parent vehicles during drop-off/pick-up operations can be accommodated in the main parking lot if needed.
 - Provide pedestrian crosswalks within the main parking lot as well as between the main parking lot and the school.

Bus Drop-off/Pick-up Zone

- Consider modifying the bus drop-off/pick-up zone as illustrated previously in Figure 8. Key modifications include:
 - Provide access to the bus drop-off/pick-up zone from the previously proposed site access located approximately 700 feet east of the Division Street/Becida Road intersection.
 - Install signing prohibiting general purpose vehicle traffic within the bus drop-off/pick-up zone to minimize potential vehicle conflicts with buses.
 - Review turning movements to ensure that buses (and delivery trucks) have adequate accommodations to negotiate internal driveways and the bus drop-off/pick-up zone.
 - Provide a gated roadway connection between the bus drop-off/pick-up zone and the main parking lot/perimeter drive aisle.

Pedestrian/Bicyclist Connectivity

Limited pedestrian/bicyclist connectivity currently exists within the study area. Appropriate internal pedestrian connections are shown between drop-off/pick-up zones and the proposed elementary school as well as between the proposed onsite playground and the elementary school. Pedestrian connections should also be considered between the proposed elementary school and onsite athletic fields.

Roadway Improvements Summary

To provide the study area and proposed elementary school with acceptable levels of service and safe operations, the following geometric and traffic control improvements are recommended for consideration:

Division Street and Becida Road

- Reconstruct the Division Street/Becida Road intersection to include the GDES main access in a four-leg roundabout.

Division Street and GDES Bus Access

- The preliminary GDES site access located approximately 700 feet east of the Division Street/Becida Road intersection could remain as a bus/delivery truck access. Assuming this scenario, the installation of a westbound right-turn lane is recommended to minimize potential conflicts with entering vehicles.

Division Street and Adams Avenue

- The installation of a traffic signal is recommended for the Division Street/Adams Avenue intersection.
 - The addition of eastbound/westbound dedicated left-turn lanes is also recommended and could potentially be implemented without widening Division Street.

Division Street and BHS West Access

- No turn-lane or traffic control improvements are recommended for the Division Street/BHS West Access intersection. However, the installation of access directly to Adams Avenue from the Bemidji Community Arena/West side of BHS may be considered to utilize improved traffic control at the Division Street/Adams Avenue intersection.

Division Street and BHS East Access

- The implementation of dual westbound left-turn lanes is recommended for the Division Street/BHS East Access intersection.
 - The west leg of the Division Street/BHS East Access intersection will require widening to the south to provide proper eastbound through lane continuity and replace the existing eastbound right-turn lane.
 - Eastbound and northbound right-turn overlap signal phasing is also recommended.
- Recommended improvements at the Division Street/BHS East Access intersection will necessitate dual inbound lanes on the BHS East Access driveway in the southbound direction. Recommended improvements may also necessitate partial or full replacement of the existing traffic signal system.

Division Street and US Highway 71 West Ramps

- Traffic signal or roundabout control is recommended for the Division Street/US Highway 71 West Ramps intersection.

Division Street and US Highway 71 East Ramps

- The desired traffic control at the Division Street/US Highway 71 West Ramps intersection may also be similarly implemented at the US Highway 71 East Ramps intersection.

An illustration of recommended roadway improvements is shown in Figure 9.

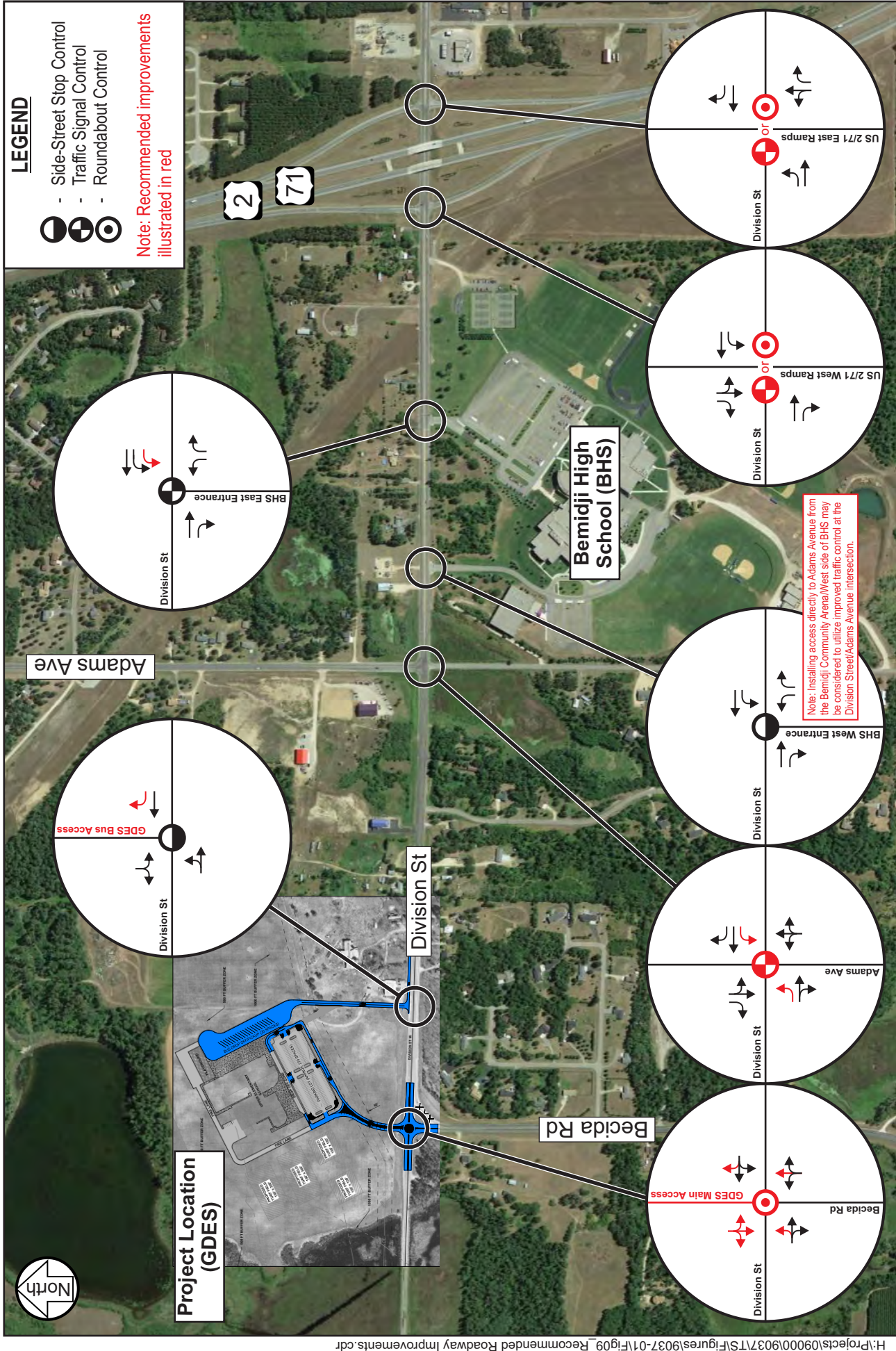
Year 2036 Conditions with Improvements

To help determine impacts associated with long-term general background growth, an evaluation of horizon year 2036 conditions was completed. An annual growth rate of one (1) percent was again applied to the existing peak hour traffic volumes to develop year 2036 background traffic forecasts. The resultant year 2036 conditions, which include general background growth and trips generated by the proposed elementary school, are shown in Figure 10.

Year 2036 Intersection Capacity Analysis – With Improvements

To determine if the improved roadway network can accommodate the year 2036 traffic forecasts, a detailed traffic capacity analysis was completed using Synchro/SimTraffic software. Once again, both the 60-minute and 15-minute peak intervals were reviewed.

Results of the year 2036 intersection capacity analysis (60-minute interval) shown in Table 9 indicate that all study intersections are expected to operate at an overall LOS C or better during the a.m., school p.m., and adjacent roadway network p.m. peak hours under the improved roadway geometry and traffic control. In addition, only moderate side-street delays and queuing were observed in the traffic simulation at the Division Street/GDES Bus Access and Division Street/BHS West Access intersections during the a.m. peak hour.



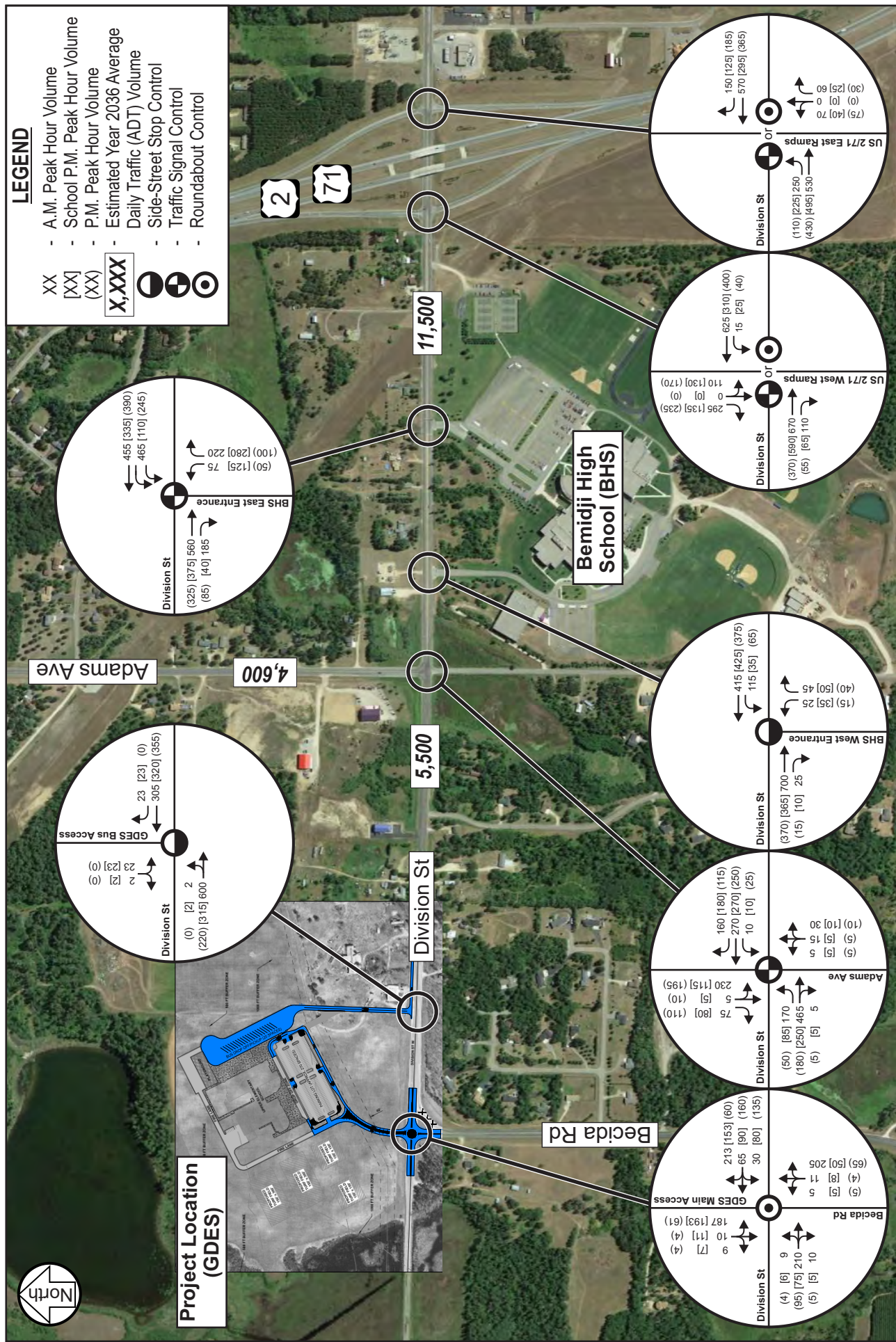


Figure 10

Table 9 Year 2036 Intersection Capacity Analysis – 60 Minute Interval

Intersection	A.M. Peak Hour ⁽³⁾		School P.M. Peak Hour ⁽³⁾		P.M. Peak Hour	
	LOS	Delay	LOS	Delay	LOS	Delay
Division Street and Becida Road/GDES Main Access	A	5 sec.	A	4 sec.	A	4 sec.
Division Street and GDES Bus Access ⁽¹⁾	A/D	29 sec.	A/B	14 sec.	A/A	3 sec.
Division Street and Adams Avenue	B	15 sec.	A	9 sec.	A	8 sec.
Division Street and BHS West Access ⁽¹⁾	A/E	47 sec.	A/B	12 sec.	A/A	6 sec.
Division Street and BHS East Access	C	23 sec.	C	22 sec.	B	12 sec.
Division Street and US 71 West Ramps ⁽²⁾	B	18 sec.	B	15 sec.	B	11 sec.
Division Street and US 71 East Ramps ⁽²⁾	B	19 sec.	B	10 sec.	A	9 sec.

(1) Indicates an unsignalized intersection with side-street stop control, where the overall LOS is shown followed by the worst approach LOS. The delay shown represents the worst side-street approach delay.

(2) Intersections modeled with traffic signal control for the year 2036 capacity analysis. Expect similar results with a multilane roundabout.

(3) The school a.m. and p.m. analysis peak hours are defined as 7:30 – 8:30 a.m. and 2:30 – 3:30 p.m. respectively. The school a.m. analysis peak hour coincides with the a.m. peak hour of the adjacent roadway network.

Results of the year 2036 intersection capacity analysis (15-minute interval) shown in Table 10 indicate that all study intersections are expected to operate at an overall LOS C or better during the a.m., school p.m., and adjacent roadway network p.m. peak hours under the improved roadway geometry and traffic control. Significant side-street delays and queuing were observed in the traffic simulation at the Division Street/BHS West Access intersection during the a.m. peak hour. However, as noted previously, installing access directly to Adams Avenue from the Bemidji Community Arena/ West side of BHS may be considered as mitigation. Moderate side-street delays and queuing were observed in the traffic simulation at the Division Street/GDES Bus Access intersection during the a.m. and school p.m. peak hours. It should be noted that routing buses through the recommended roundabout at the Division Street/Becida Road intersection could be considered as mitigation.

Table 10 Year 2036 Intersection Capacity Analysis – 15 Minute Interval

Intersection	A.M. Peak Hour ⁽³⁾		School P.M. Peak Hour ⁽³⁾		P.M. Peak Hour	
	LOS	Delay	LOS	LOS	Delay	LOS
Division Street and Becida Road/GDES Main Access	A	6 sec.	A	5 sec.	A	5 sec.
Division Street and GDES Bus Access ⁽¹⁾	A/E	38 sec.	A/E	39 sec.	A/A	3 sec.
Division Street and Adams Avenue	B	17 sec.	A	9 sec.	A	9 sec.
Division Street and BHS West Access ⁽¹⁾	A/F	70 sec.	A/C	17 sec.	A/A	8 sec.
Division Street and BHS East Access	C	26 sec.	C	32 sec.	B	13 sec.
Division Street and US 71 West Ramps ⁽²⁾	C	22 sec.	C	20 sec.	B	12 sec.
Division Street and US 71 East Ramps ⁽²⁾	C	24 sec.	B	13 sec.	B	10 sec.

(1) Indicates an unsignalized intersection with side-street stop control, where the overall LOS is shown followed by the worst approach LOS. The delay shown represents the worst side-street approach delay.

(2) Intersections modeled with traffic signal control for the year 2036 capacity analysis. Expect similar results with a multilane roundabout.

(3) The school a.m. and p.m. analysis peak hours are defined as 7:30 – 8:30 a.m. and 2:30 – 3:30 p.m. respectively. The school a.m. analysis peak hour coincides with the a.m. peak hour of the adjacent roadway network.

Summary and Conclusions

The following study summary and conclusions are offered for your consideration:

- Results of the existing intersection capacity analysis indicate that all study intersections currently operate at an overall LOS B or better during the school and adjacent roadway network p.m. peak hours and peak 15-minute intervals. However, the Division Street/Bemidji High School (BHS) East Access intersection currently operates at an overall LOS D during the a.m. peak hour, as a high volume of westbound left-turn maneuvers cause significant delays.
 - Significant operational issues were observed at a number of study intersections during the a.m. peak 15-minute interval.
- Upon anticipated opening in the year 2017, the proposed Gene Dillon Elementary School (GDES) is expected to have an enrollment of approximately 850 students. However, the school capacity is expected to be 900 students. Access to GDES was preliminarily proposed at one location along Division Street, approximately 700 feet east of Becida Road.
 - At capacity, GDES is expected to generate approximately 567 school a.m. peak hour, 429 school p.m. peak hour, 135 p.m. peak hour, and 1,660 daily trips.
 - Proposed classroom hours for GDES are 8:10 a.m. to 2:55 p.m. and the nearby BHS are 8:24 a.m. to 3:10 p.m. Therefore, school peak hours chosen for analysis were 7:30 to 8:30 a.m. and 2:30 to 3:30 p.m. to include the peak 15-minute traffic intervals for both GDES and BHS. Since the school and adjacent roadway network a.m. peak hours coincide, a single a.m. peak hour analysis was completed. It should be noted that the adjacent roadway network p.m. peak hour was observed to be 4:45 to 5:45 p.m.
- Results of the year 2018 intersection capacity analysis indicate that all study intersections are expected to continue operating at an overall LOS C or better during the school and adjacent roadway network p.m. peak hours and peak 15-minute intervals under the existing roadway geometry and traffic control. However, study intersections along Division Street from Adams Avenue through US Highway 71 are expected to have significant delays during the majority of the a.m. peak hour.
 - To address operational, safety, and access issues, the improvements recommended in the [Roadway Improvements Summary](#) should be considered.
- A review of the proposed site plan was completed to identify any issues and recommend potential improvements with regard to site access, parking, drop-off/pick-up zones, and pedestrian/bicyclist connectivity. Improvements recommended for consideration are listed in the [Site Plan/Access Review](#) section.
- Results of the horizon year 2036 intersection capacity analysis indicate that all study intersections are expected to operate at an overall LOS C or better during the a.m., school p.m., and adjacent roadway network p.m. peak hours and peak 15-minute intervals under the improved roadway geometry and traffic control.

H:\Projects\09000\9037\TS\Report\9037-01\9037-01_Gene Dillon Elementary TS_Division St Site_160321.docx