

November 5, 2020

Ms. Jennifer Staple-Clark  
7 Woodmere Circle  
North Haven, CT 06473

**RE: Traffic Study  
Slate Upper School  
5100 Outer Ridge Road  
North Haven, Connecticut  
MMI #6156-03-01**

Dear Ms. Staple-Clark:

At your request, we have undertaken this study to determine the traffic impact associated with the proposed Slate Upper School to be located at 5100 Outer Ridge Road in North Haven, Connecticut. The proposed school will be attended by approximately 90 students from Grade 7 to Grade 12, with the potential to add 10 students from the pre-Kindergarten program. The site is currently occupied by the former Mount Carmel Christian Church building, which will be removed as part of the development. The work comprising this study consisted of a number of tasks, including field reconnaissance, review of current roadway and traffic conditions, data collection, estimation of site-development-generated traffic volumes, and assessment of future traffic operations at and near the site. **Figure 1** shows the site location and area roadway network.

## **EXISTING CONDITIONS**

**Outer Ridge Road (Ridge Road)** runs approximately north/south adjacent to the site with one travel lane in each direction and no shoulders; sidewalks are currently not present along either side of Outer Ridge Road. North of the site, Outer Ridge Road intersects Mount Carmel Avenue at an unsignalized T intersection, at which traffic along Outer Ridge Road is stop controlled while traffic along Mount Carmel Avenue is free flowing. To the south of the site, Outer Ridge Road intersects with Blue Hills Road and Ridge Road.

**Mount Carmel Avenue** runs approximately east/west with one travel lane in each direction; the posted speed limit is 25 miles per hour (mph). Mount Carmel Avenue was repaved in the vicinity of the site within the past 2 years.

Land use near the site is primarily residential. Sleeping Giant State Park and Quinnipiac University are located approximately 1 mile west of the site. Further to the west, Mount Carmel Avenue intersects Whitney Avenue (State Route 10); east of the site, Mount Carmel Avenue provides access to the Hartford Turnpike. The site is located near the North Haven town boundary with Hamden.

**Crash Data Summary**

Data on traffic crashes near the site for the recent 3-year period of February 1, 2017, through January 31, 2020, was obtained via the Connecticut Crash Data Repository. This data is summarized in **Table 1** by location, crash severity, and collision type.

**TABLE 1**  
**Crash Data Summary**

LOCATION:	CRASH SEVERITY				COLLISION TYPE	
	SUSPECTED MINOR INJURY	POSSIBLE INJURY	PROPERTY DAMAGE ONLY	TOTAL	FIXED-OBJECT	TOTAL
Outer Ridge Road at Mount Carmel Avenue			2	<b>2</b>	2	<b>2</b>
Outer Ridge Road at Blue Hills Road						
Ridge Road between Blue Hills Road and Mansfield Road			1	<b>1</b>	1	<b>1</b>
Outer Ridge Road at Mansfield Road						
<b>TOTAL</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>

Source: University of Connecticut's Connecticut Crash Data Repository from February 1, 2017, to January 31, 2020

A total of three crashes were reported along Outer Ridge Road/Ridge Road in the vicinity of the site. No crashes occurred along Outer Ridge Road along the site frontage, although there was one crash on Ridge Road approximately 0.5 miles south of the site, which resulted in property damage only. The remaining two crashes took place at the intersection of Mount Carmel Avenue. All three of the crashes were fixed-object collisions. There do not appear to be any unusual trends in the crash data.

**Roadway Traffic**

Traffic monitoring data was collected on Outer Ridge Road along the site frontage for 48 hours on February 11, 2020, and February 12, 2020, via an Automatic Traffic Recorder (ATR). According to the data, traffic volumes along Outer Ridge Road peak from 8:00 a.m. to 9:00 a.m. and 3:00 p.m. to 4:00 p.m. Approximately 35 and 50 vehicles travel past the site in both directions along Outer Ridge Road during the morning and afternoon roadway peak hours, respectively.

Due to the anticipated school start and end times, the peak hours analyzed in this traffic analysis differ slightly from the peak hour for the roadway. The peak hours for school-related traffic are anticipated to occur from 8:00 a.m. to 9:00 a.m. and 2:30 p.m. to 3:30 p.m. Nevertheless, the roadway peak-hour volumes were used in further analysis since they align closely with the school's peak activity and represent conservative traffic conditions. **Figure 2** shows the existing morning and afternoon peak-hour traffic volumes near the site.

## **PROPOSED DEVELOPMENT**

The proposed school is to be located on a 3.3-acre parcel of land southwest of the intersection of Mount Carmel Avenue at Outer Ridge Road. The school will begin with enrollment of Grade 7 in 2024; each subsequent year, the next grade will be added as the students advance. It is anticipated that the school will have full enrollment from Grade 7 to Grade 12 in 2029. There will be approximately 90 students and 10 to 15 staff members when the school reaches full capacity.

The school hours will be somewhat flexible as students are encouraged to arrive any time between 8:00 a.m. and 9:00 a.m. and will be dismissed between 2:30 p.m. and 3:30 p.m. Generally, though, school will start around 8:00 a.m. and end around 2:30 p.m.; after-school programs will be limited. The morning and afternoon peak hours have been approximated according to our understanding of the school's future operations during the week.

Site access is to be provided to and from the site via a new stop-controlled driveway at Outer Ridge Road, approximately 40 feet north of the southern portion of the existing horseshoe driveway. Sight distances were reviewed for a motorist egressing the proposed driveway onto Outer Ridge Road. Looking to the left from the proposed driveway location, the sight line is ample, meeting the Connecticut Department of Transportation (CTDOT) requirement of 370 feet for the 85<sup>th</sup> percentile speed on Outer Ridge Road of 32 mph. Looking to the right, the sight distance for the 85<sup>th</sup> percentile speed is also achievable.

Generally, Outer Ridge Road is more than 22 feet in width near the site and on the approaches to the site except for two small sections close to the site. South of the driveway for about 200 feet, there is an outcropping on the west side of Outer Ridge Road that narrows the road width to around 18 to 20 feet. Some clearing of the brush, regrading of the shoulder, and widening of the road in this area to 22 feet are recommended to eliminate this bottleneck that exists close to the school driveway. North of the site driveway, a drainage area on the west side of Outer Ridge Road narrows the road width to around 18 feet. Some regrading of the shoulder and widening of the road to 22 feet, which will also require the relocation of an existing utility pole, are recommended. The widening concepts are depicted in **Figures 6 and 7** for the southern and northern locations, respectively.

## **Site-Generated Traffic**

Site-generated peak-hour trips from the proposed school were estimated based on the future profile of the school at full buildout, including the pre-Kindergarten program, with 100 students and 15 staff members. It is our understanding that the school will not be using bus services; therefore, all school-related traffic is expected to be generated by passenger cars of staff members and students being dropped off/picked up. It is estimated that all students will be dropped off/picked up through the year 2029. Starting in 2029, up to 15 percent of the students may drive themselves. For the purposes of this study, it was assumed that all students are dropped off and picked up. A vehicle occupancy rate of 1.25 students per vehicle was used,

although it could be higher, such as 1.33, based on Milone & MacBroom, Inc. (MMI) data from other schools in Connecticut. **Table 2** summarizes the site-generated traffic estimates for the proposed school at full enrollment with these assumptions in place.

**TABLE 2**  
**Site-Generated Traffic Estimates**

LAND USE	NUMBER OF VEHICLE TRIPS					
	WEEKDAY MORNING PEAK HOUR			WEEKDAY AFTERNOON PEAK HOUR		
	IN	OUT	TOTAL	IN	OUT	TOTAL
Upper School, 100 students (Pre-Kindergarten and Grades 7-12)	90	80	170	75	80	155

Some teachers are expected to arrive and depart outside of the peak-hour activity. Additionally, in the afternoon, peak-hour trips are expected to be slightly lower than during the morning peak hour due to some after-school programs and activities. Additionally, it is noted that not all students will be arriving or departing in a single 15-minute window as is typical for most schools since the Slate Upper School will have flexible start and end times for students. Arrival and departure will be spread somewhat evenly across the analysis peak hours.

The distribution of site-generated traffic was estimated based on review of the surrounding roadway network as well as expected student demographics. Students who will attend the school are expected to live throughout the surrounding towns within reasonable driving distance. It is estimated that 70 percent of the site-generated traffic would be oriented to/from the south via Outer Ridge Road, 10 percent to/from the west via Mount Carmel Avenue, and 20 percent to/from the east via Mount Carmel Avenue. **Figure 3** shows the estimated site-generated traffic routed through the site driveway based on this distribution for the weekday morning and afternoon peak hours.

### **Special Events**

Very infrequently, perhaps once or twice per year, there may be larger school events, such as graduation. These will require more parking than proposed on site. During these events, the school will utilize parking at the Lower Slate School, located at 124 Mansfield Road in North Haven. They anticipate that a shuttle or valet service between the two schools will be implemented to accomplish this.

### **FUTURE TRAFFIC VOLUMES**

Future roadway traffic volumes were estimated both with and without the proposed school in place in order to determine possible traffic impacts. The school is expected to open with full enrollment in 2029.

The background (no-build) traffic scenario is reflective of future conditions before the new development is built. The background volumes were estimated by expanding the baseline traffic volumes to the year of 2029 using an annual growth rate of 0.75 percent, per input from CTDOT. Correspondence with the Towns of North Haven and Hamden, as well as CTDOT, finds that there is currently no other upcoming development in the area that is expected to contribute future traffic volumes past the site. The resultant

estimated 2022 traffic volumes reflect conditions before the proposed development would open and can be seen in **Figure 4** as the background traffic volumes.

The estimated site-generated traffic volumes (**Figure 3**) were then added to the background traffic (**Figure 4**) to form the future combined traffic volumes. Combined traffic volumes are reflective of roadway traffic conditions with the proposed development in place and can be seen in **Figure 5** for the morning and afternoon study peak hours.

### **Intersection Capacity Analysis**

In this study, the future traffic conditions with the school in place were evaluated by means of capacity analysis techniques. These analyses were used to estimate the quality of operations at the future school driveway. The quality of operations is measured and expressed as a level of service (LOS). LOS is defined as a measure of inconvenience that motorists experience. The levels are expressed with letter designations of A through F. A more detailed explanation of LOS and the analysis worksheets is provided in the Appendix. Table 3 summarizes the results of the capacity analysis.

As can be seen, traffic conditions at the proposed school driveway are estimated to operate at LOS A during both peak hours. Traffic along this portion of Outer Ridge Road is light and is not expected to be significantly affected by, nor will it interfere with, future school-related traffic.

**TABLE 3**  
**Preliminary Capacity Analysis Summary**

<b>MOVEMENTS</b>	<b>WEEKDAY MORNING PEAK HOUR</b>	<b>WEEKDAY AFTERNOON PEAK HOUR</b>
<b>Outer Ridge Road at proposed school driveway</b>		
Eastbound Left/Right	A	A
Northbound Left	A	A

### **SUMMARY AND CONCLUSION**

This traffic study was conducted to assess the traffic impact of the proposed Slate Upper School to be located at 5100 Outer Ridge Road in North Haven, Connecticut. To determine a profile of existing conditions, detailed field reconnaissance and data assembly efforts were undertaken. Traffic that will be generated by the proposed development was estimated, and intersection capacity analyses were performed to analyze future conditions at the site. Analysis of the estimated traffic added to the adjacent roadway from the proposed school finds that the additional traffic can be accommodated with no perceptible impact. The LOS at the school driveway on Outer Ridge Road is expected to be excellent at LOS A.

We recommend that the outcropping on the west side of Outer Ridge Road, south of the site, and the drainage area north of the site be removed. The roadway should be widened approximately by 2 feet at both locations, within the town right-of-way. In order to maintain sight distances, overhanging branches and brush should be cleared within in the right-of-way and maintained as such.

We hope this report is useful to you and the Town of North Haven. If you have any questions or need anything further, please do not hesitate to contact either of the undersigned.

Very truly yours,

MILONE & MACBROOM, INC.



David G. Sullivan, PE  
Manager of Traffic Engineering



Neil C. Olinski, MS, PTP  
Lead Transportation Planner

Enclosures

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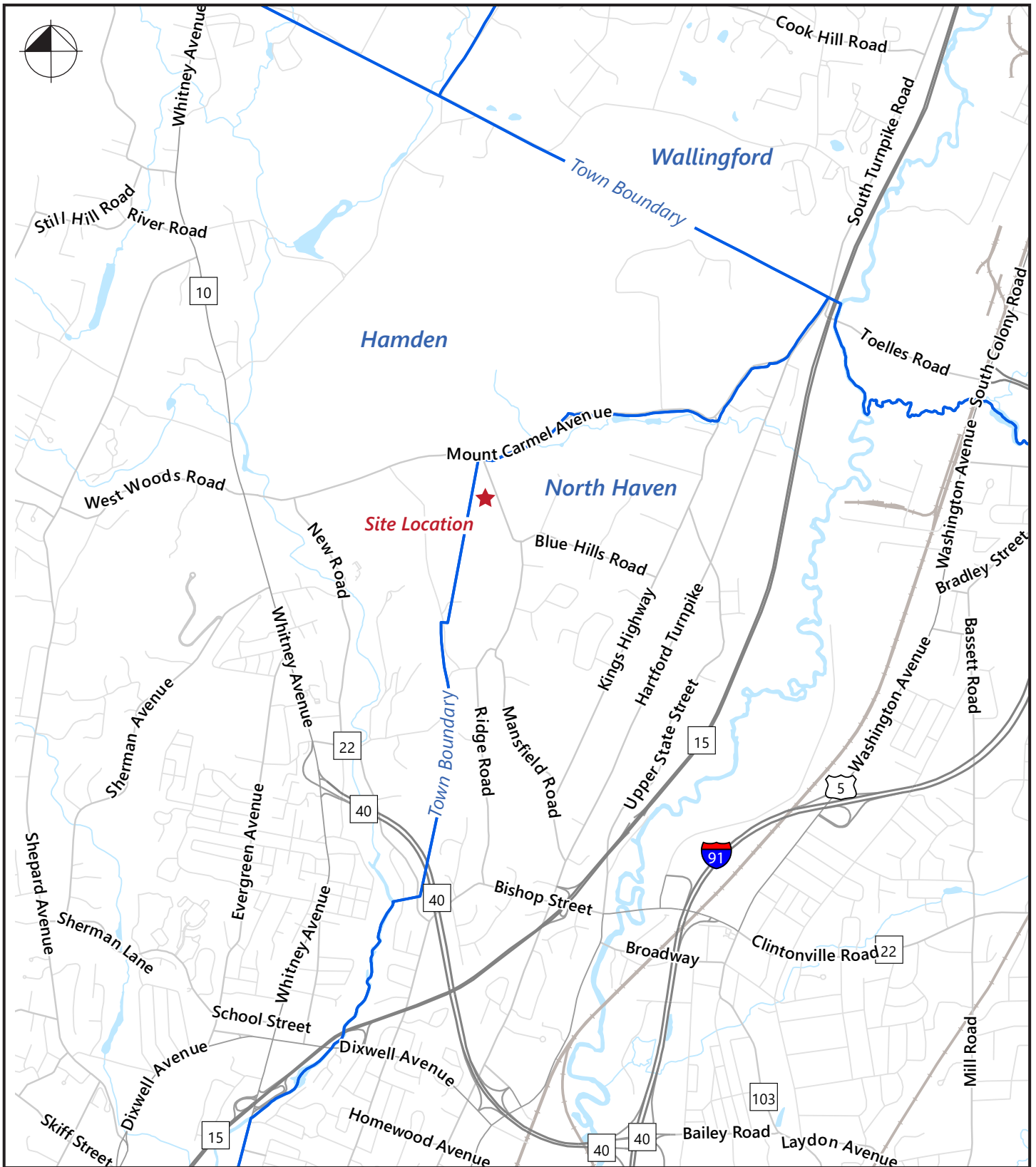


FIGURE 1

SLATE UPPER SCHOOL  
5100 OUTER RIDGE ROAD  
NORTH HAVEN, CT

EXISTING TRAFFIC VOLUMES

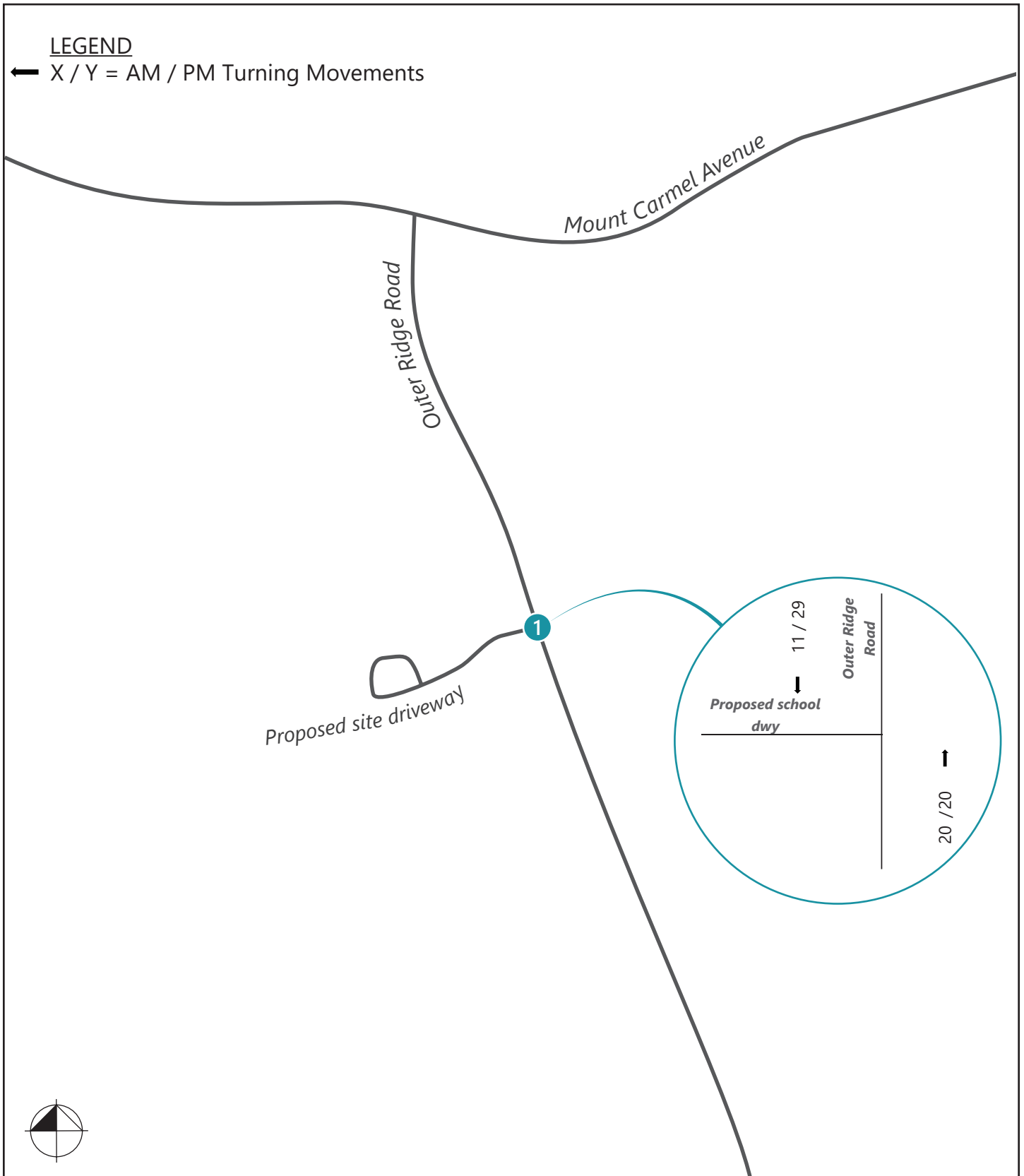


FIGURE 2



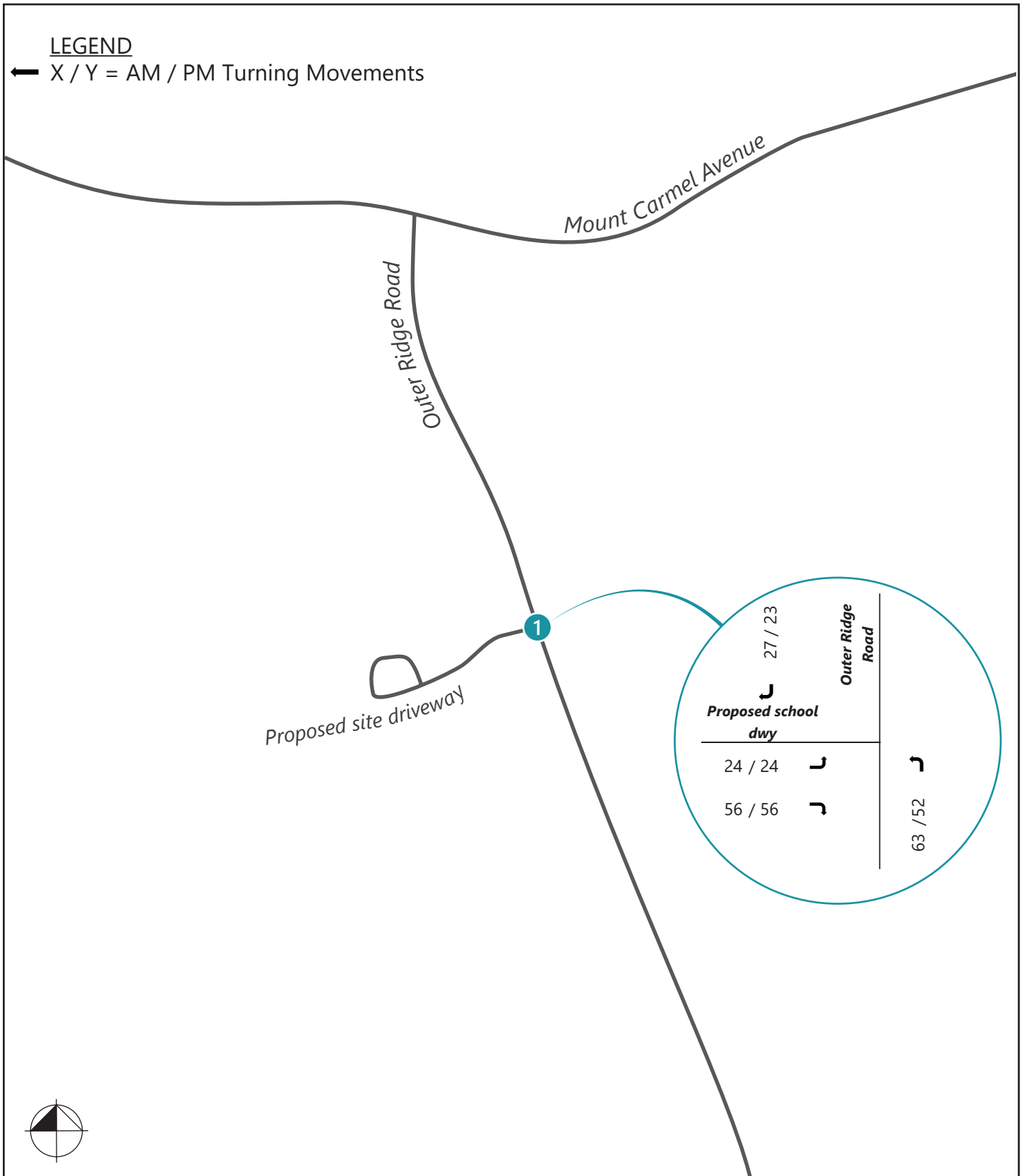


FIGURE 3

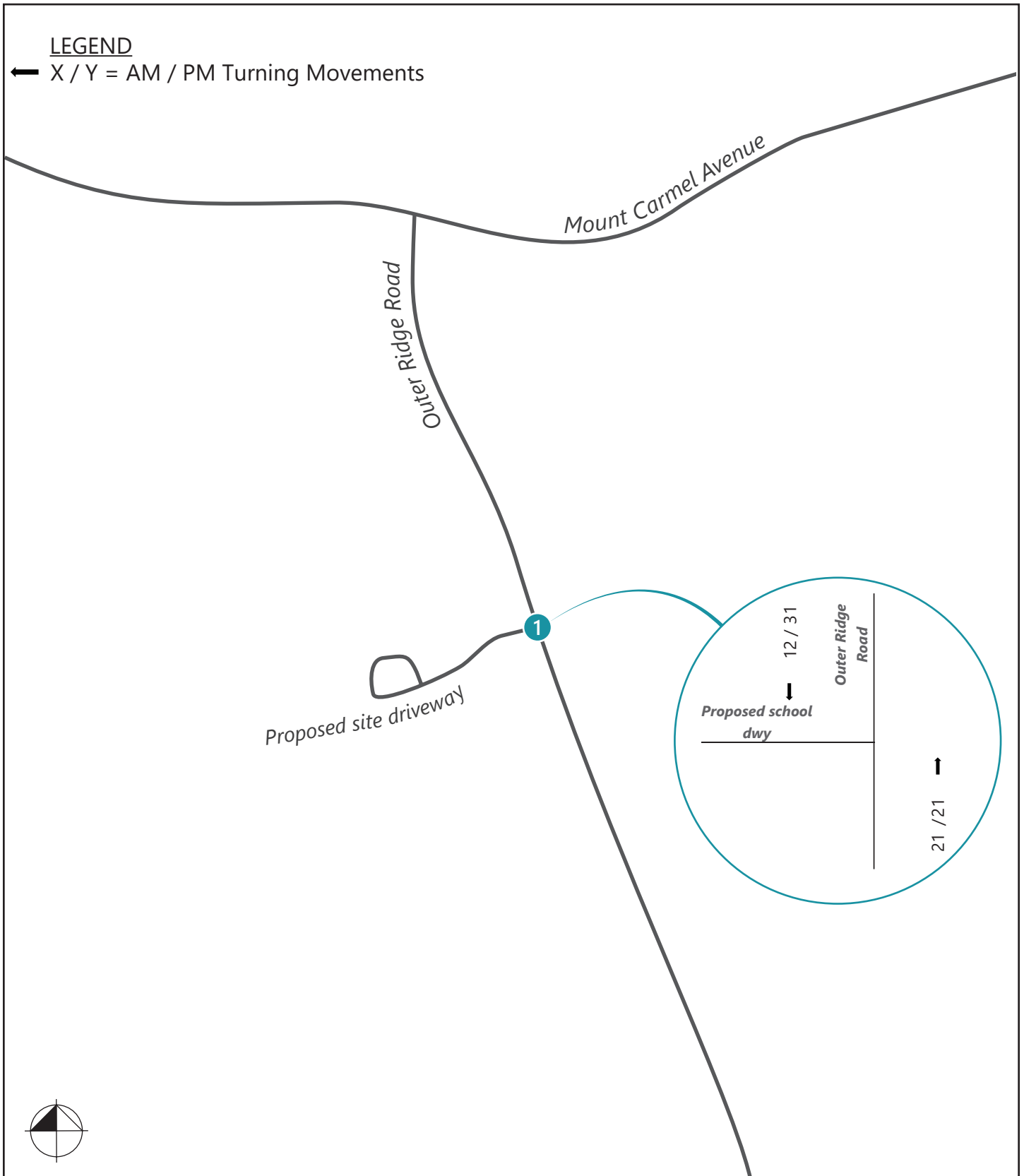


FIGURE 4

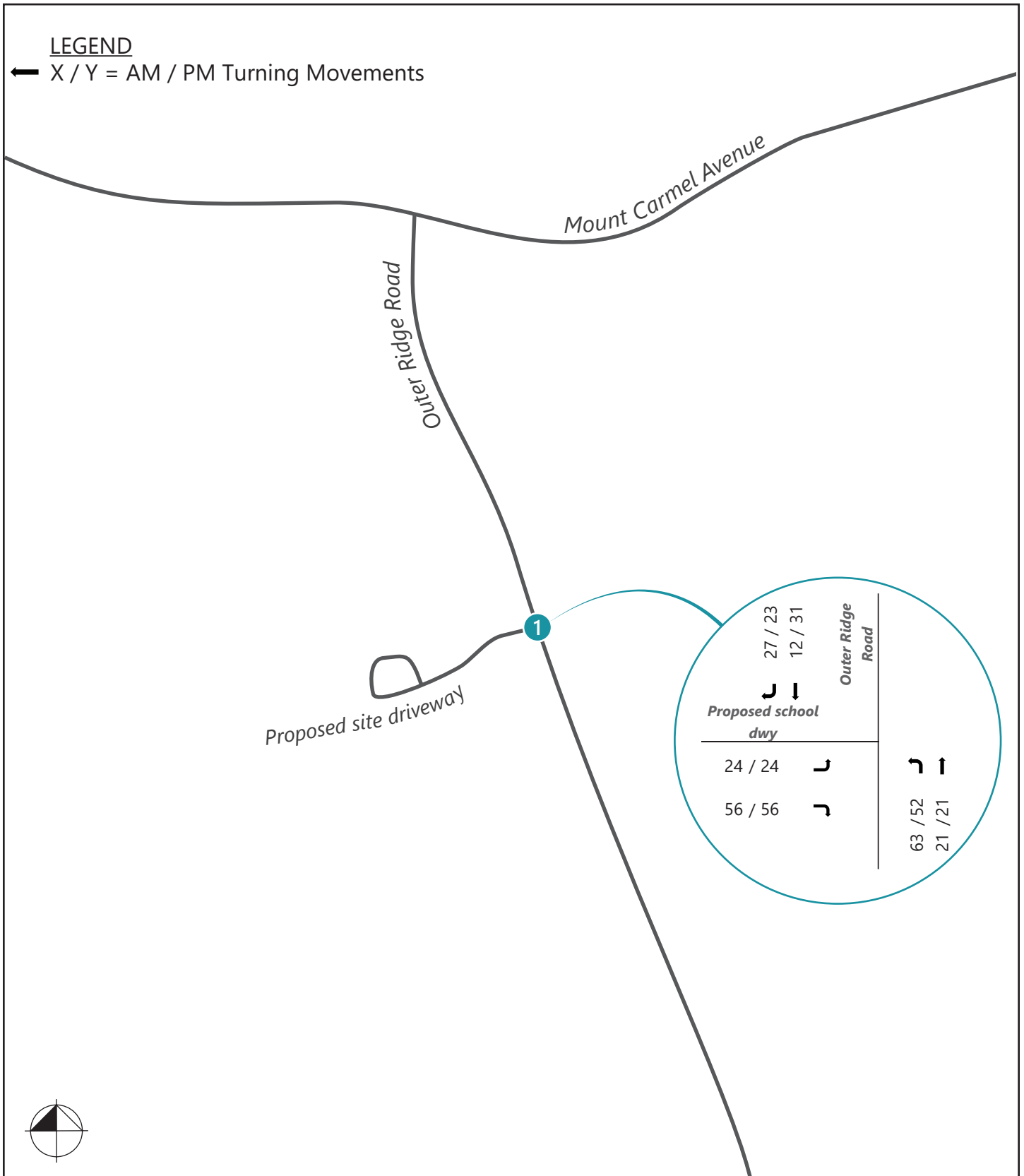
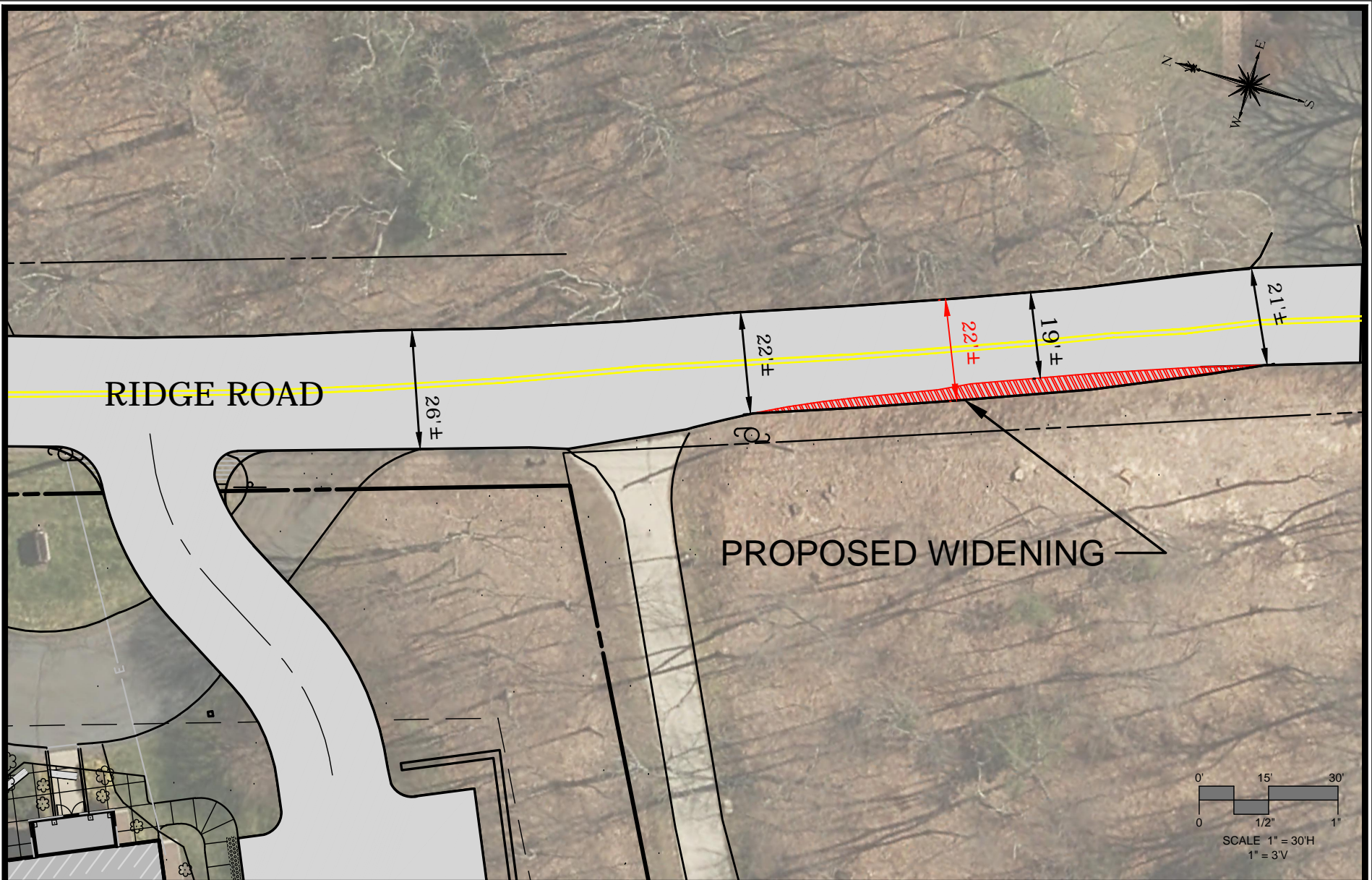


FIGURE 5

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Plotted by: FLYNN On this date: Wed, 2020 November 4 - 12:57pm



**MILONE & MACBROOM**  
 NOW PART OF **SLR**  
 99 REALTY DRIVE  
 CHESHIRE, CT 06410  
 203.271.1773  
 WWW.MMINC.COM

DATE	9/23/2020
SCALE	1"=30'
PROJ. NO.	6156-03
DESIGNED	---
DRAWN	FMF
CHECKED	DGS

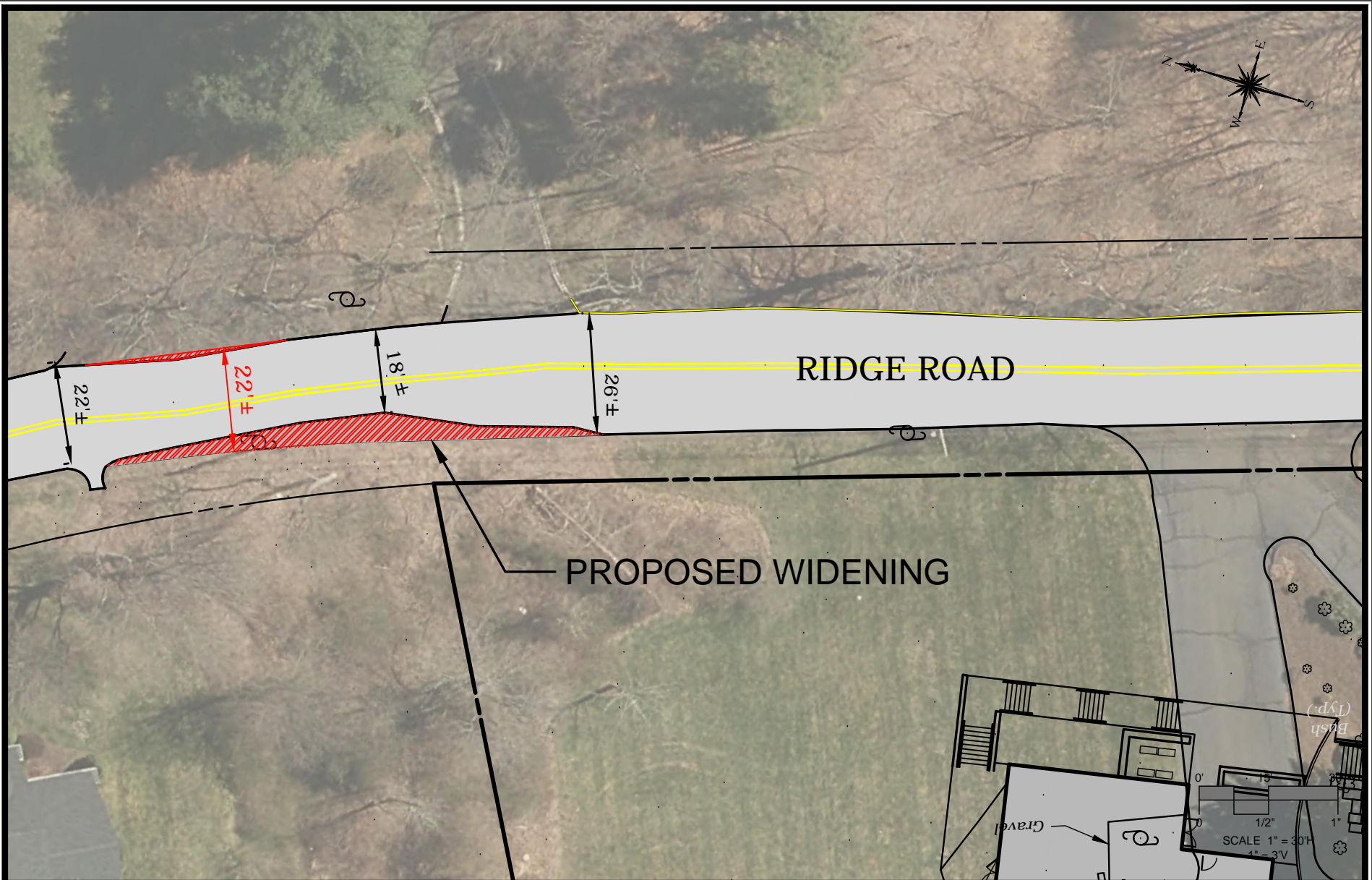
**WIDENING CONCEPT SOUTH OF SITE DRIVEWAY**  
**SLATE UPPER SCHOOL**  
 5100 OUTER RIDGE ROAD  
 NORTH HAVEN, CONNECTICUT

PROJECT PHASE:	CONCEPT
DRAWING NAME:	<b>FIG. 6</b>
REVISED:	---

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Plotted by: FLYNN

On this date: Wed, 2020 November 4 - 4:44pm



**MILONE & MACBROOM**  
 NOW PART OF **SLR**  
 99 REALTY DRIVE  
 CHESHIRE, CT 06410  
 203.271.1773  
 WWW.MMINC.COM

DATE	11/3/2020
SCALE	1"=30'
PROJ. NO.	6156-03
DESIGNED	---
DRAWN	FMF
CHECKED	DGS

**WIDENING CONCEPT NORTH OF SITE DRIVEWAY**  
**SLATE UPPER SCHOOL**  
 5100 OUTER RIDGE ROAD  
 NORTH HAVEN, CONNECTICUT

PROJECT PHASE: CONCEPT
DRAWING NAME: <b>FIG. 7</b>
REVISED: ---

# **APPENDIX**

# LEVEL OF SERVICE FOR UNSIGNALIZED INTERSECTIONS ALL-WAY STOP-CONTROL (AWSC)

The criteria for AWSC intersections have different threshold values than do those for signalized intersections primarily because drivers expect different levels of performance from distinct types of transportation facilities. The expectation is that a signalized intersection is designed to carry higher traffic volumes than an AWSC intersection. Thus a higher level of control delay is acceptable at a signalized intersection for the same LOS. The level-of-service criteria are given below.

<b>LEVEL-OF SERVICE CRITERIA FOR AWSC INTERSECTIONS</b>	
<b>LOS<sup>1</sup></b>	<b>CONTROL DELAY (s/veh)</b>
<b>A</b>	<b><math>\leq 10</math></b>
<b>B</b>	<b><math>&gt; 10 \text{ AND } \leq 15</math></b>
<b>C</b>	<b><math>&gt; 15 \text{ AND } \leq 25</math></b>
<b>D</b>	<b><math>&gt; 25 \text{ AND } \leq 35</math></b>
<b>E</b>	<b><math>&gt; 35 \text{ AND } \leq 50</math></b>
<b>F</b>	<b><math>&gt; 50</math></b>

<sup>1</sup> For approaches and intersection-wide assessment, LOS is defined solely by control delay.

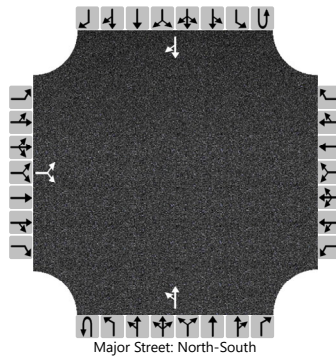
Note: LOS F is assigned to a movement if the volume-to-capacity ratio exceeds 1.0, regardless of the control delay.

Reference: Highway Capacity Manual Version 6.0, Transportation Research Board, 2016.

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	FMF			Intersection	Ridge Rd at school dwy		
Agency/Co.	MMI			Jurisdiction			
Date Performed	9/4/2020			East/West Street	Proposed school dwy		
Analysis Year	2029			North/South Street	Outer Ridge Rd		
Time Analyzed	AM			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Combined - AM Peak Hour						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume (veh/h)		24		56						63	21				12	27
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized																
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		6.43		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

## Delay, Queue Length, and Level of Service

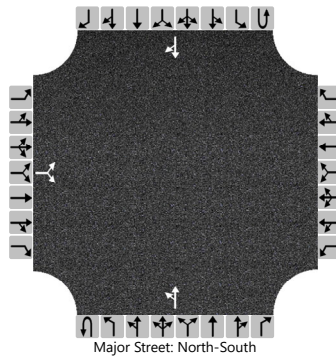
Flow Rate, v (veh/h)			87							68						
Capacity, c (veh/h)			941							1560						
v/c Ratio			0.09							0.04						
95% Queue Length, Q <sub>95</sub> (veh)			0.3							0.1						
Control Delay (s/veh)			9.2							7.4						
Level of Service (LOS)			A							A						
Approach Delay (s/veh)	9.2								5.6							
Approach LOS	A															



# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	FMF			Intersection	Ridge Rd at school dwy		
Agency/Co.	MMI			Jurisdiction			
Date Performed	9/4/2020			East/West Street	Proposed school dwy		
Analysis Year	2029			North/South Street	Outer Ridge Rd		
Time Analyzed	PM			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Combined - PM Peak Hour						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume (veh/h)		24		56						52	21				31	23
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized																
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		6.43		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			87							57						
Capacity, c (veh/h)			932							1539						
v/c Ratio			0.09							0.04						
95% Queue Length, Q <sub>95</sub> (veh)			0.3							0.1						
Control Delay (s/veh)			9.3							7.4						
Level of Service (LOS)			A							A						
Approach Delay (s/veh)	9.3								5.4							
Approach LOS	A															