

Traffic Operations Analysis

4H Road & Desoto Road – Intersection Study

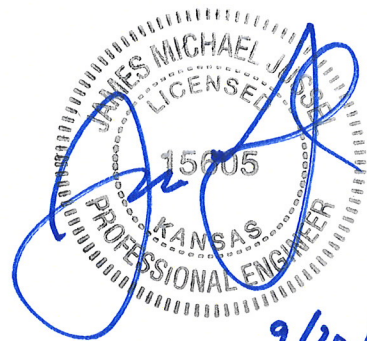
PREPARED FOR

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Alfred Benesch & Company (Benesch) has completed a traffic operations and safety study of the intersection of 4H Road & Desoto Road in Lansing, Kansas. Purpose of this study is to evaluate the intersection to determine alternatives to improve the overall safety and traffic operations of the intersection.

1.0 Existing Conditions

Situated on the western edge of Lansing, Kansas, the intersection of 4H Road and Desoto Road is currently an all-way stop controlled intersection. **Figure 1** displays the project location. The newly-constructed Lansing High School is approximately 3/4 mile south of the intersection.

Desoto Road is currently a two-lane rural roadway. The roadway is approximately 24 feet in width with ditches and has a 35 mph posted speed limit. 4H Road is a two-lane rural roadway, approximately 22 feet wide, with a posted speed limit of 45 mph west of Desoto Road and 40 mph east of Desoto Road. According to Transportation Map in Lansing’s 2030 Comprehensive Plan, 4H Road is classified a collector roadway and Desoto Road is classified as a minor arterial.

Other than red reflective posts for the stop signs, there are no additional safety signs or signals present on the approaches to the intersection from any direction.

Prior to Year 2015, 4H Road was the main roadway with two-way stop control for the Desoto Road approaches. With the addition of the high school, the traffic volumes along Desoto Road have increased. The amount of volume along Desoto Road has shifted to be higher than 4H Road.

Figure 1. Project Location

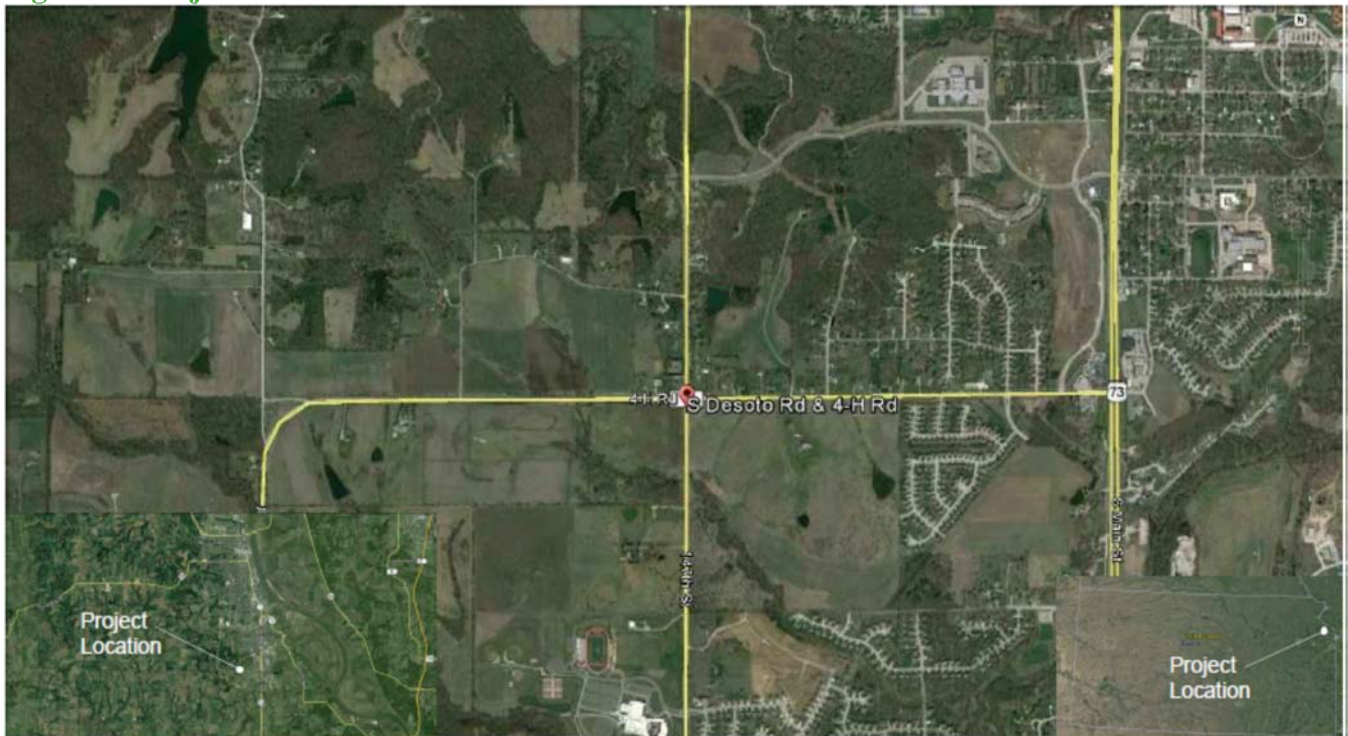


Image: Google Earth

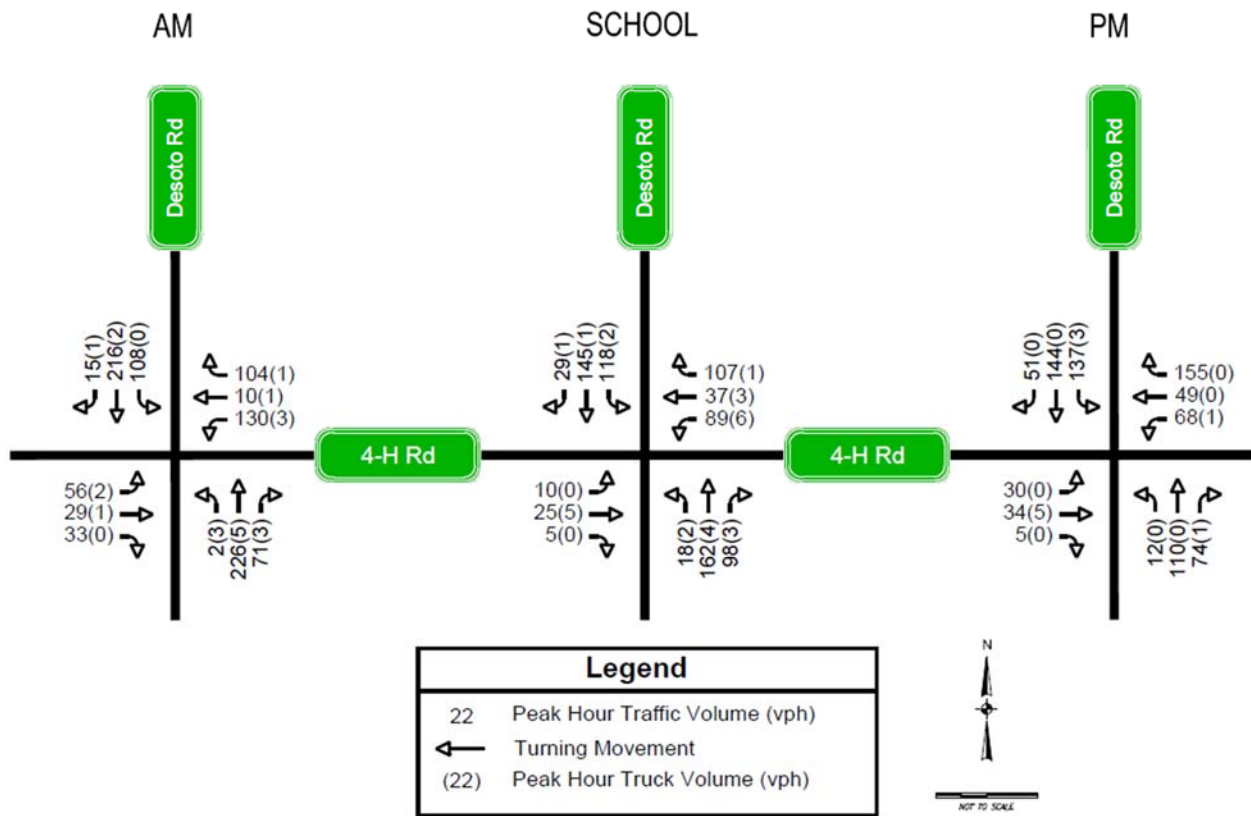
1.1 Existing Traffic Conditions

Benesch conducted turning movement counts on Thursday, May 5, 2016, from 7:00 AM to 6:00 PM utilizing Miovision video cameras.

1.1.1 Existing Traffic Volumes

The AM peak hour was identified as 7:00 AM to 8:00 AM. The PM peak period for commuters is typically between 5:00 PM and 7:00 PM; however, for this intersection, the school traffic from Lansing High School generates more traffic volume than the typical afternoon commuter peak period. As a result, the PM peak hour of this intersection was identified as 4:45 PM to 5:45 PM, and a separate School peak hour was analyzed from 3:15 PM to 4:15 PM. The existing 2016 peak hour volumes are displayed in **Figure 2**.

Figure 2. Existing Traffic Volumes



1.2 Existing Capacity Analysis

Unsignalized intersection capacity analyses were completed for the AM, School, and PM peak hours to determine the current traffic operation of the intersection. Highway Capacity Software 2010 (HCS) was used to analyze the intersection. Levels of service for the study intersections were determined as described in the *Highway Capacity Manual, 2010 Edition* (HCM). Level of service is a system of ranking intersection performance using average stop delay per vehicle as the evaluation criteria (expressed as seconds of delay per vehicle, or sec/veh). A summary of the HCM level of service criteria is displayed in **Table 1**.

Table 1. HCM Level of Service Ranges

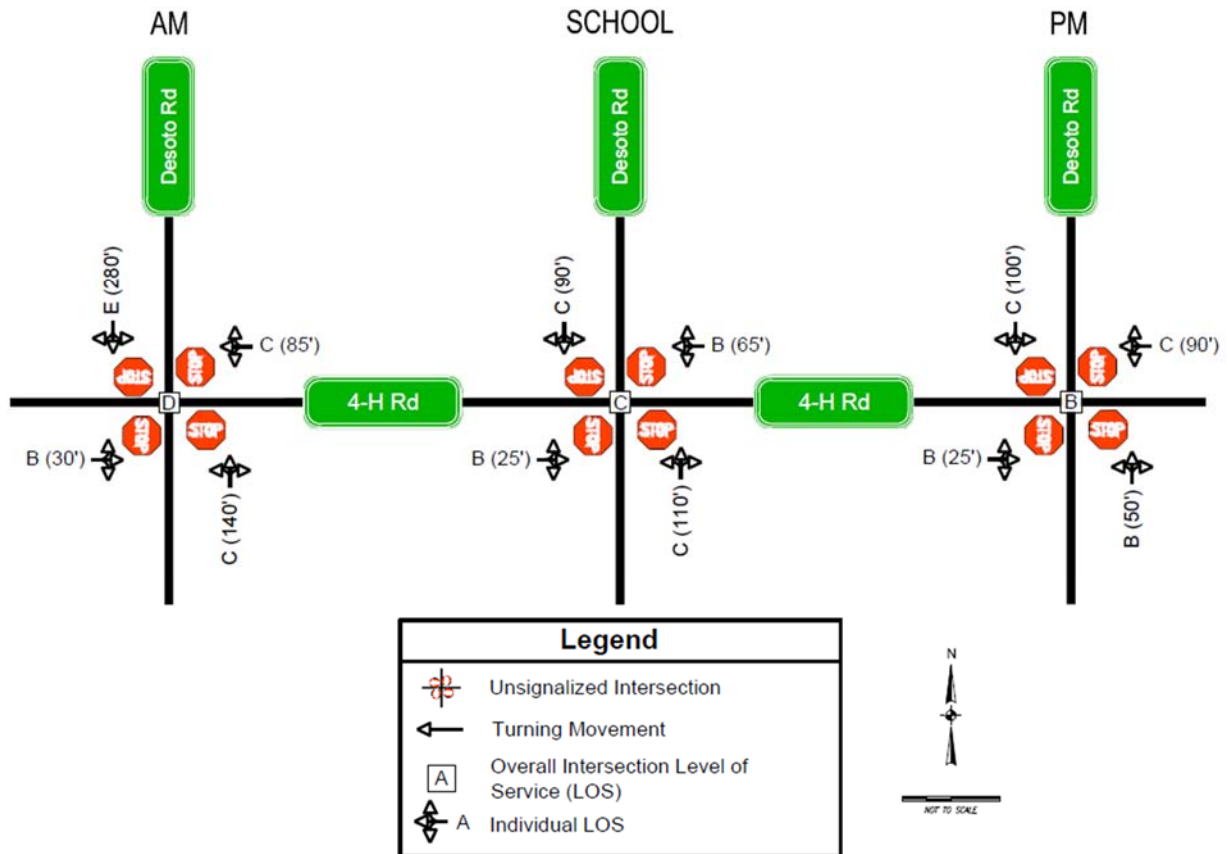
LOS	Average Delay [sec/veh]	
	Signalized	Unsignalized
A	≤10	≤10
B	>10-20	>10-15
C	>20-35	>15-25
D	>35-55	>25-35
E	>55-80	>35-50
F	>80	>50

For this report, acceptable levels of service were considered LOS D or better for the overall intersection and LOS E or better for individual movements.

Based on the unsignalized capacity analysis, the overall intersection is currently operating with a LOS D during the morning peak period, as shown in **Figure 3**. The eastbound and westbound approaches currently operate with a LOS B and C and the northbound and southbound approaches are operating with a LOS C and E, respectively. The southbound approach has an estimated 95th percentile queue length of 280 feet during the morning peak period.

The overall intersection is currently operating with a LOS C during the school peak period. The individual approaches are operating with a LOS C or better, depicted in **Figure 3**. Similarly, the overall intersection is currently operating with a LOS B during the afternoon peak commuter period with the individual approaches operating with a LOS C or better.

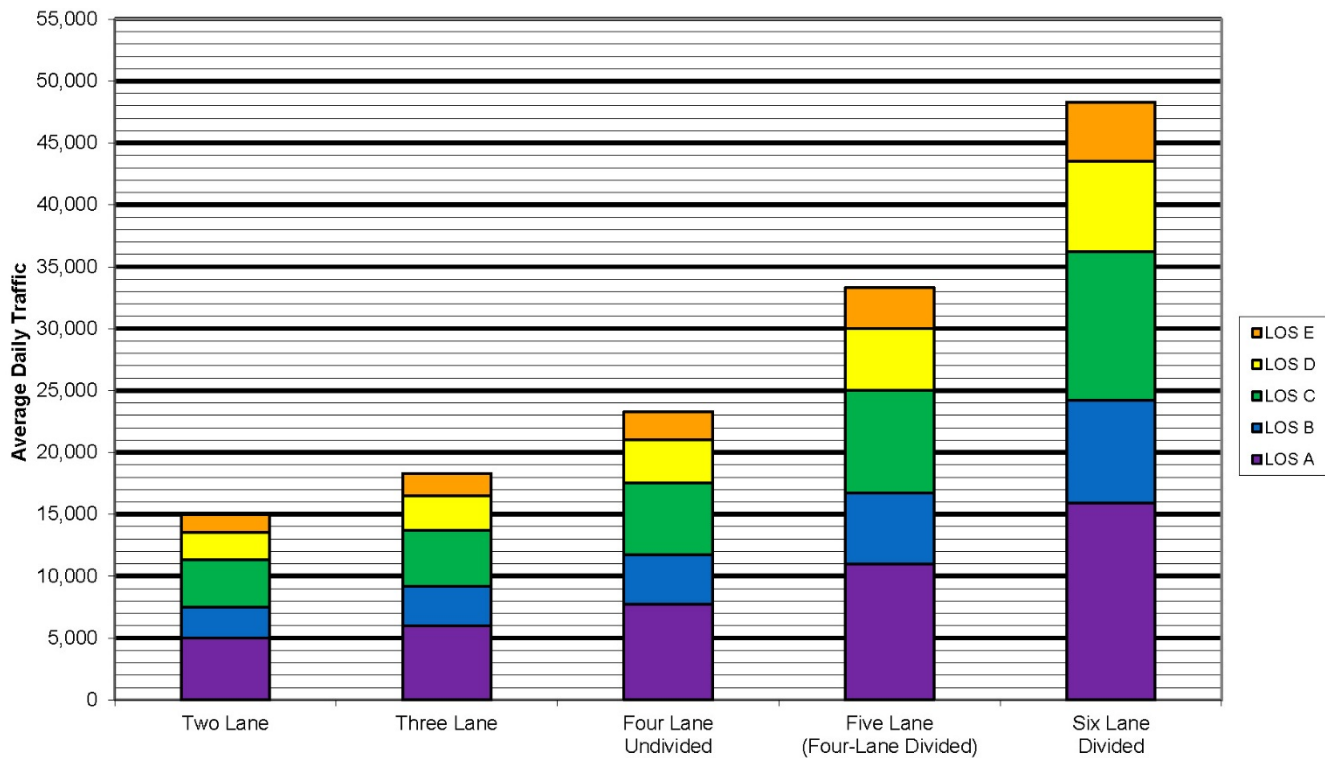
Figure 3. Existing Level of Service



Based on the KDOT traffic volume maps, 4H Road has an AADT of 3,650 vehicles per day (vpd). Desoto Road AADT is approximately 4,400 vpd. Assuming a two percent growth rate, an estimated 2016 AADT was calculated to be about 4,450 vpd for 4H Road and 5,400 vpd. Using the estimated 2016 AADT, the roadway level of service was determined by comparing the AADT on each segment to the capacities described in National Cooperative Highway Research Program (NCHRP) *Report 365: Travel Estimation Techniques for Urban Planning*, displayed in

Exhibit 1. Both 4H Road and Desoto Road are currently operating with a LOS A and are expected to operate with a LOS A in twenty years. The level of service for intersection nodes will be lower than the roadway segment level of service.

Exhibit 1. Typical Roadway Capacities



1.3 Crash Analysis

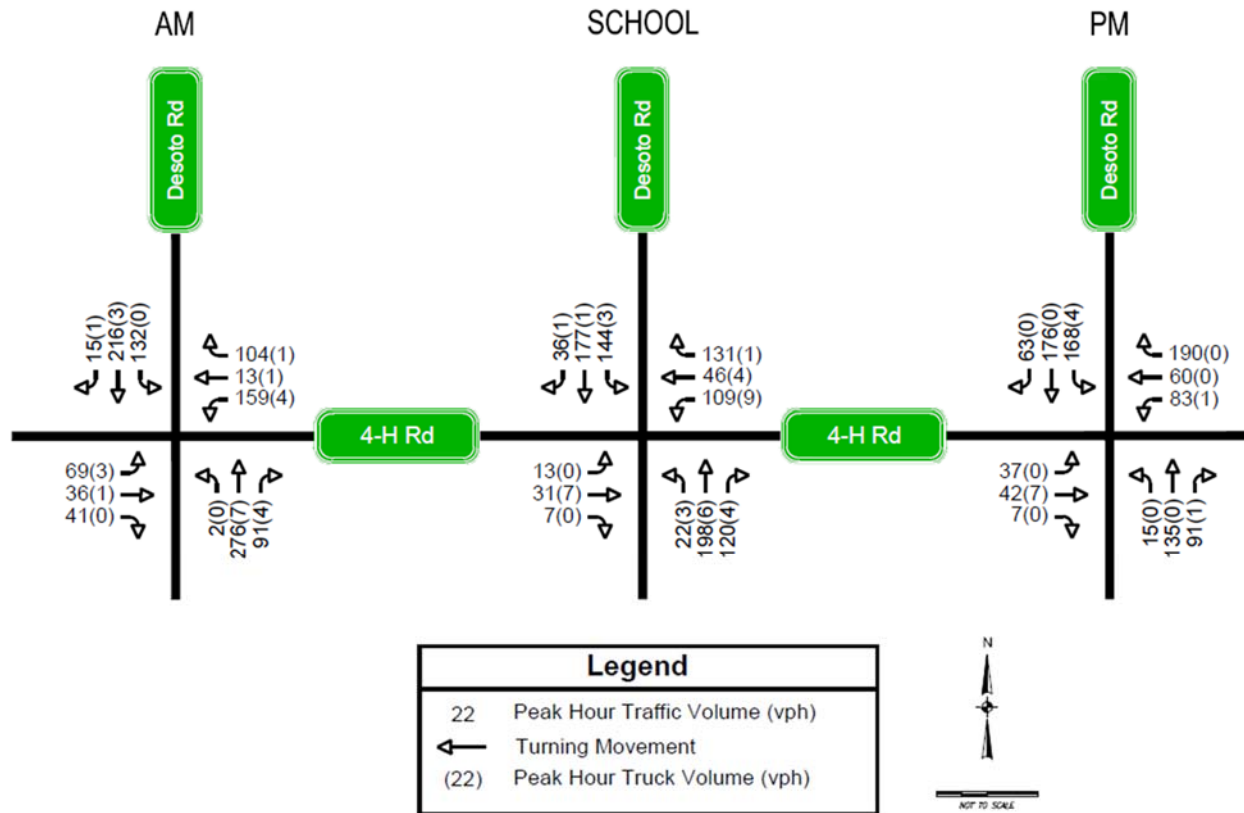
City of Lansing provided crash data for the intersection. Majority of the crashes occurred prior to 2015. The City installed all-way stop control devices to the intersection in the summer of 2015 to help reduce the number of vehicle crashes and to improve traffic operation for the new high school. By adding stop signs to 4H Road, and therefore controlling east- and westbound traffic, only one crash has been reported since 2015. The other crash data was when the intersection was a two-way stop controlled intersection therefore additional crash analysis was not completed.

2.0 Future Conditions

2.1 Future Traffic Volumes

To determine the historic growth rate in the area, Benesch reviewed traffic volumes from the City of Lansing and Kansas Department of Transportation. The comparison of the historical ADT (including the 2016 ADT count) showed zero or declining traffic growth on both 4H Road and Desoto Road. For these reasons, a conservative growth was assumed for the traffic (i.e., a growth rate of 1%) through the projected Year 2035. The future traffic volumes with no intersection modifications are the shown in **Figure 4**.

Figure 4. 20-Year No Build Traffic Volumes

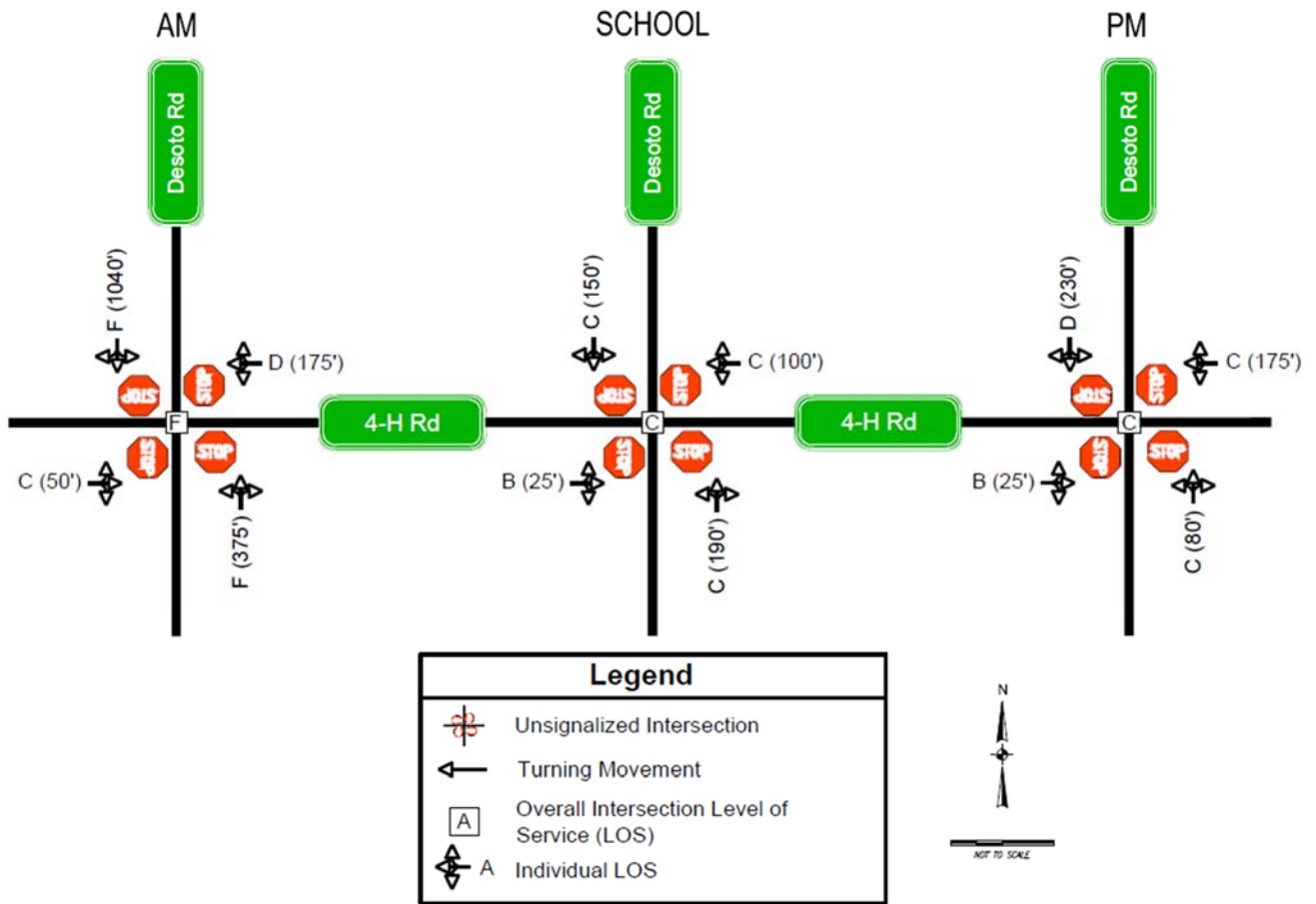


2.2 Future Traffic Condition Capacity Analysis

The capacity analyses for the All-Way stop controlled intersection during projected 20-year volume condition indicate the overall intersection would be expected to operate F during the AM peak period with the northbound and southbound approaches operating with a LOS F, as shown in **Figure 5**. The 95th percentile queue length for the northbound approach is estimated to be about 375 feet and 1,040 feet for the southbound approach. The eastbound and westbound approaches would be expected to operate with LOS C and D.

During school, the overall intersection would be expected to operate with a LOS C. The individual turning approaches would be expected to operate with a LOS C or better, as depicted in **Figure 5**. Similarly, the overall intersection would be expected to operate with a LOS C during the afternoon peak period. The eastbound and westbound approaches would be expected to operate with a LOS B and C, respectively. The northbound and southbound approaches would be expected to operate with a LOS C and D, respectively. The 95th percentile queue length for the southbound approach is estimated to be about 230 feet during the PM peak period.

Figure 5. 20-Year Future No Build Traffic Level of Service



3.0 Alternatives Analysis

As described in the existing conditions section, the existing All-way stop controlled intersection is currently experiencing a LOS D during the AM peak period. With conservative growth projections in the area, operations are expected to worsen for future conditions and are summarized in Section 2.0. To address the anticipated poor traffic operations by the Year 2035, alternatives have been developed to improve the overall traffic operation.

3.1 Geometric Modification

An alternative for Desoto Road involving re-constructing the roadway by adding a northbound right turn lane was investigated. This alternative would alleviate some of the queue length, especially during the large after-school traffic volumes.

3.1.1 Widening for Right Turn Lane

Widening Desoto Road to allow for a northbound right-turn lane would have the benefit of reducing queue lengths for northbound traffic from Lansing High School. Operationally, the overall level of service would be expected to improve to a LOS C during the morning peak hour, as shown in **Figure 6**, and the northbound approach movement would improve to LOS B during the school peak period.

However, the overall intersection would still be expected to operate with a poor level of service, LOS F during the AM peak period, in the 20-year projected volume condition, as illustrated in **Figure 7**. The right turn lane did reduce the 95th percentile vehicle for the northbound approach but the southbound approach would operate with a LOS F.

Figure 6. Existing Traffic Levels of Service with Northbound Right Turn Lane

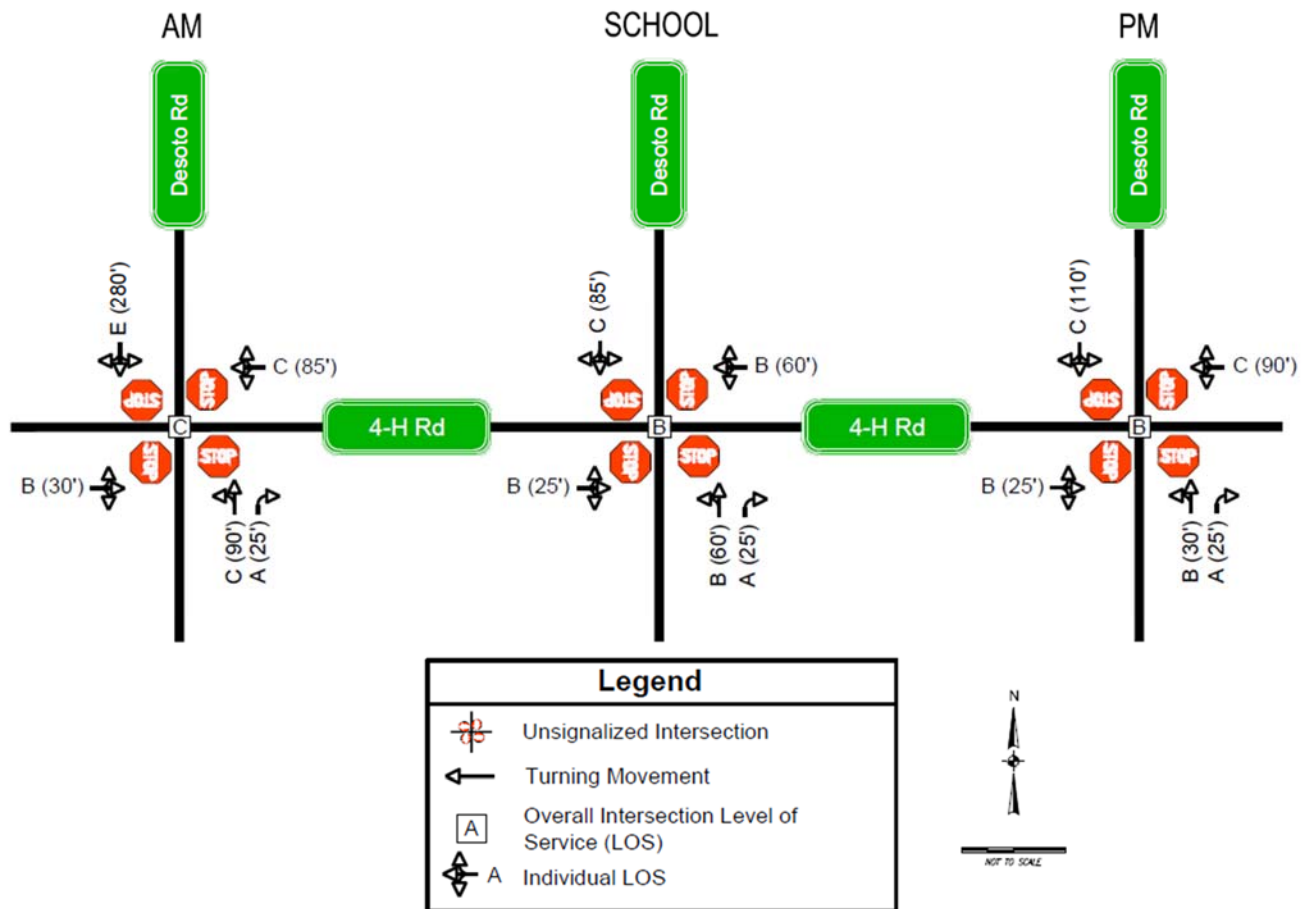
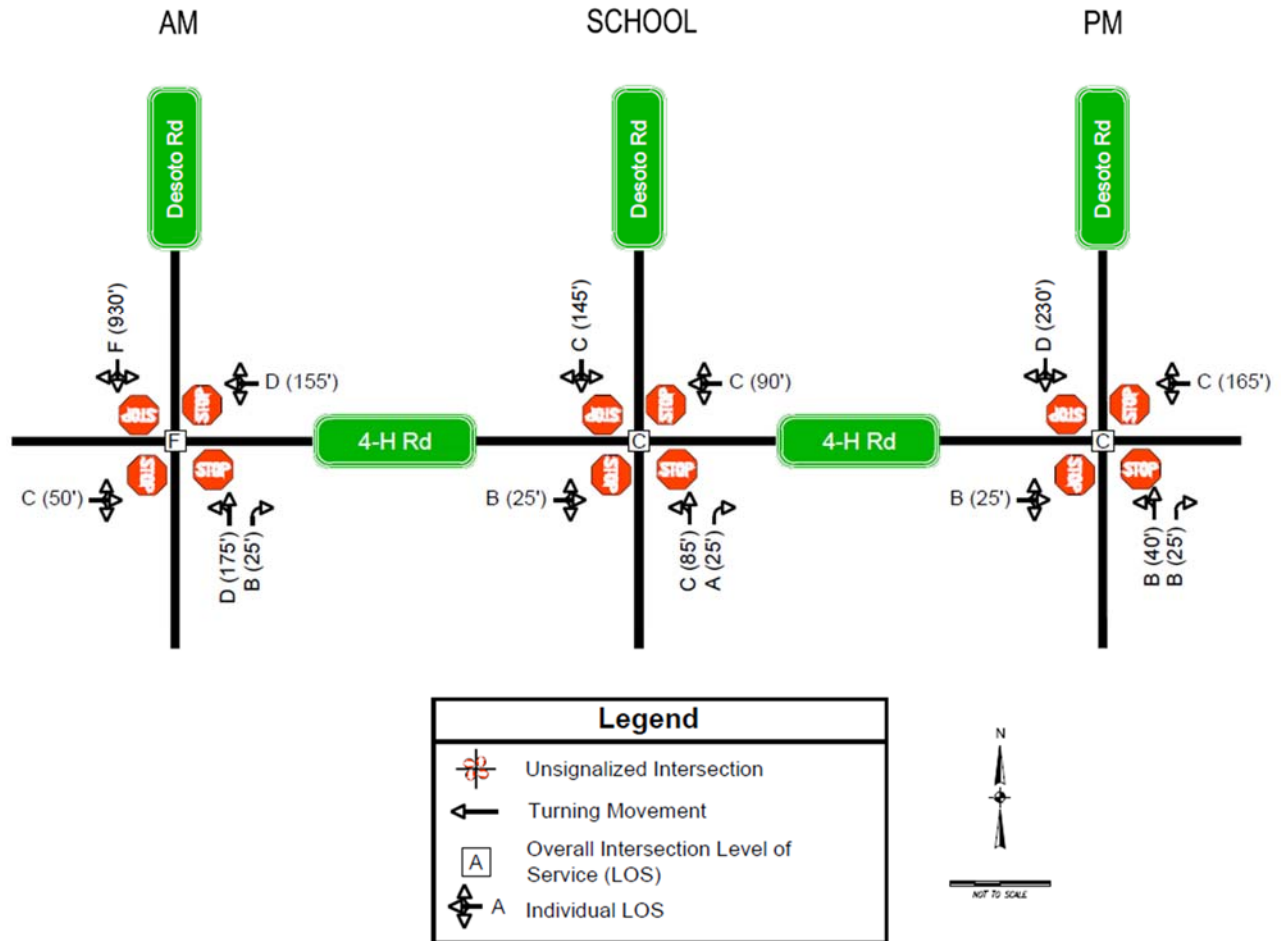


Figure 7. 20-Year Future Traffic Levels of Service with Northbound Right Turn Lane



3.2 Traffic Signal

In addition to changing the configuration of the roadways, alterations to the intersection traffic control were investigated. The two options that were considered were a traffic signal and a single lane roundabout.

3.2.1 Signal Warrant Analysis

A traffic signal is a possible solution to improving functionality by mechanically controlling the movement of drivers. The existing and future traffic volumes were compared to the signal warrant criteria in the MUTCD to determine if a traffic signal should be considered at the intersection. Currently, 4H Road is considered the “major road” at this intersection, but with the large increase of volume stemming from Lansing High School to the south, Desoto Road was identified as the “major road” for this analysis. Although there are eight traffic signal warrants associated with at intersection, the available data was limited to vehicular volume and peak hour conditions. Therefore, the following warrants were analyzed:

- Warrant 1: Eight-Hour Vehicular Volume
- Warrant 2: Four-Hour Vehicular Volume
- Warrant 3: Peak Hour

Note, Warrant 3 is not commonly used as the sole justification to consider a signal; Warrant 1 and/or Warrant 2 must usually be satisfied before a signal is considered.

As shown in **Table 2**, the 2016 existing traffic volumes do not satisfy any of the traffic signal warrants. Therefore, a traffic signal is not recommended.

Table 2. Year 2015 Signal Warrant Analyses (Desoto Road – Major Road)

2015	Warrant 1 Four-Hour Volume	Warrant 2 Four-Hour Volume	Warrant 3 Peak Hour Volume
4H Rd and Desoto Rd	Not met	Not met	Not met

3.3 Roundabout

A roundabout was considered because the roundabout would provide the necessary traffic control to manage the traffic volumes. Roundabouts eliminate right-angle crashes and will accommodate growing traffic volumes. The roundabout was analyzed using HCS software.

3.3.1 Roundabout Capacity Analysis

A single-lane roundabout with single-lane approaches and single-lane departures was analyzed. Based on the capacity analysis of the single-lane roundabout, the overall intersection would be expected to operate with LOS A for each of the peak volume conditions for the existing traffic volume condition. In addition to the very good level of service, vehicle queues would be significantly reduced, as shown in **Figure 8**.

For the 20-year volume condition, the proposed roundabout would be expected to provide an overall intersection LOS B during the morning peak and LOS A during the school and afternoon peak periods, as displayed in **Figure 9**.

Figure 8. Existing Traffic Roundabout Levels of Service

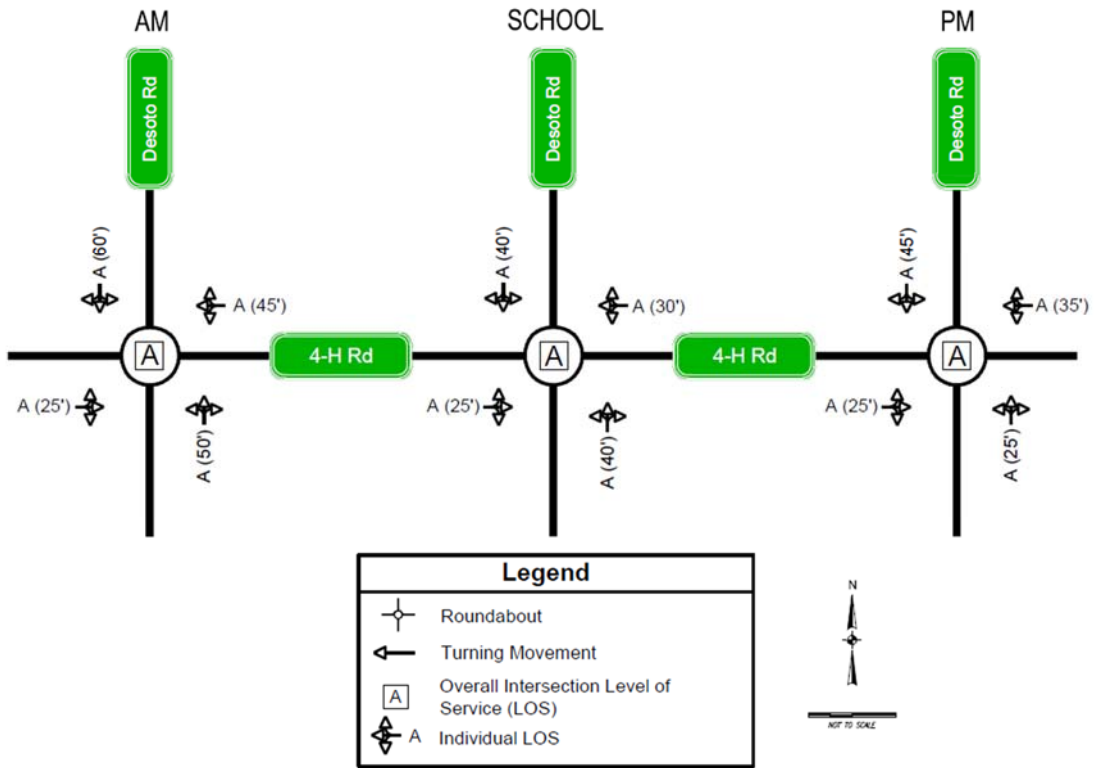
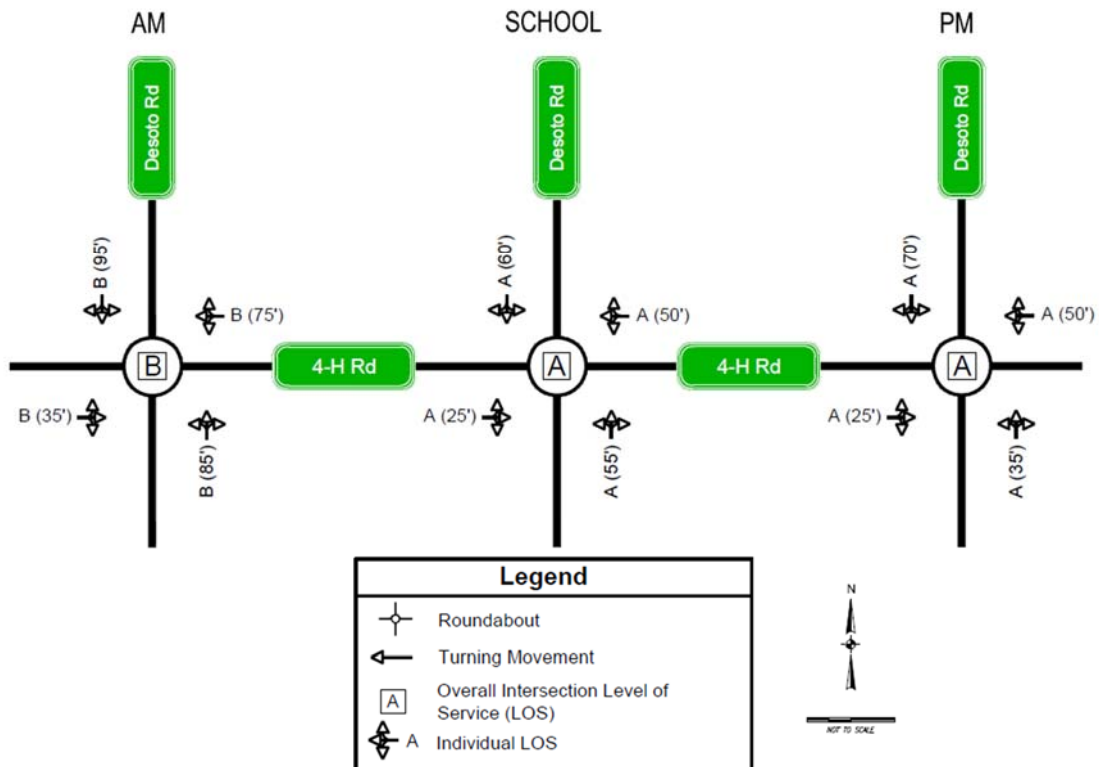


Figure 9. 20-Year Future Traffic Roundabout Levels of Service



4.0 Conclusions

The intersection currently operates adequately with the current All-way stop condition but does experience significant vehicle queues during the peak periods. The intersection was previously only two-way stop controlled, until stop signs were installed in 2015 which has greatly reduced the number of right-angle crashes. While historical trends don't illustrate any traffic growth in this area, a conservative growth rate of 1% was considered for future projections which will not aid in naturally improving the safety of the intersection. Traffic volume patterns have also changed with the addition of the new high school on Desoto Road, located approximately $\frac{3}{4}$ mile south of 4H Road.

Alternatives were developed and analyzed to address traffic operation concerns. Geometric modifications included adding a northbound right-turn lane to accommodate the northbound school traffic. However, based on the traffic analysis, the southbound approach is experiencing poor traffic operation during the morning peak period. The intersection is expected to experience poor traffic conditions within 20 years. To improve traffic operation, traffic signal warrant analysis was completed but none of the MUTCD warrants were met. As a result, a traffic signal is not recommended.

To improve the current and long term traffic operation, a roundabout was evaluated. A single-lane roundabout with single-lane approaches and single-lane departures should function with very good levels of service and vehicle queue lengths for both the existing and 20-year volume conditions. For these reasons, a roundabout should be considered to improve the current and long term conditions. Roundabouts can accommodate additional growth from the area and will provide additional safety benefits by reducing severe right-angle crashes. Roundabouts tend to have negative public perception, and therefore public involvement will be an integral component of the intersection improvements.