

Traffic Signal Warrant Study

SH 5 (S Powell Pkwy) at Finley Blvd (Co Rd 422)

Anna, Texas



MALDONADO - BURKETT

ENGINEERS | CONTRACTORS

TBPE# 10258



12-17-21

Prepared for

City of Anna
3223 N. Powell Parkway
Anna, Texas 75409

December 17, 2021



Executive Summary

The City of Anna has requested Maldonado-Burkett (M-B) to perform a traffic signal warrant analysis at the intersection of SH 5 (S Powell Pkwy) and Finley Blvd (Co Rd 422), and to make a recommendation on whether a traffic signal should be considered at the study intersection. M-B engineers have analyzed all nine signal warrants from the Texas MUTCD (Revision 2 in 2014), using the collected traffic volume and historical crash data.

The analyses results are shown as below:

Warrant	Description	Analysis Result
1A	Eight Hour Volume – Minimum Vehicular Volume (70% & 56%)	Warrant 1, Condition A Met
1B	Eight Hour Volume – Interruption of Continuous Traffic (70% & 56%)	Condition B Not Evaluated as Condition A is Met
2	Four Hour Vehicular Volume	Warrant Met
3	Peak Hour	Warrant Met
4	Pedestrian Volume	Warrant Not Met
5	School Crossing	Warrant Not Met
6	Coordinated Signal System	Warrant Not Met
7	Crash Experience	Warrant Not Met
8	Roadway Network	Not Applicable
9	Intersection Near a RR Grade Crossing	Warrant Met

The eight-hour, four-hour and peak-hour traffic volumes met the MUTCD Warrants 1, 2 and 3. The geometry of the east leg of the intersection where the rail track exists, and the traffic volume at the peak hour when the train crosses the intersection met the requirements in Warrant 9.

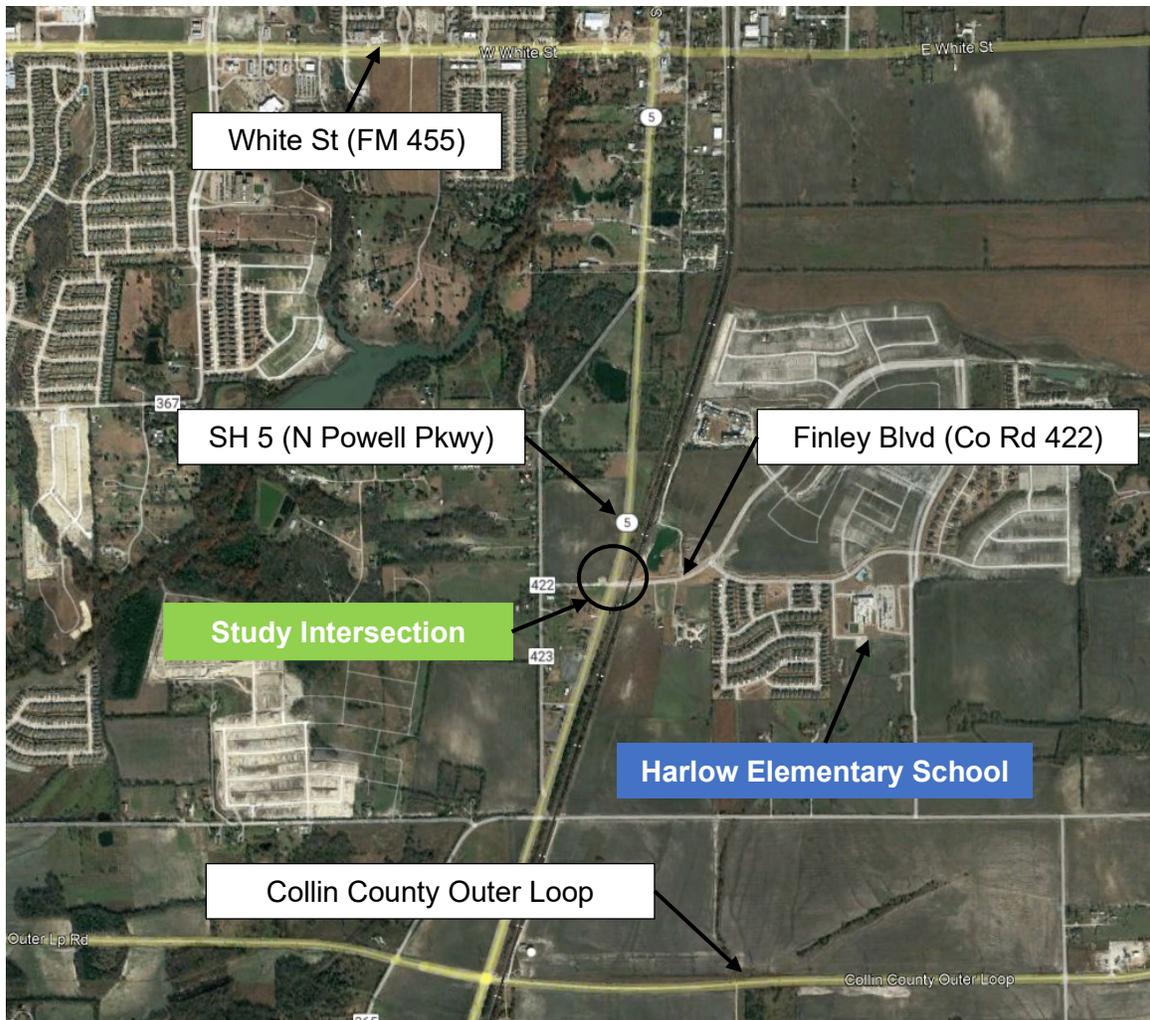
Based on the analysis result of each warrant, it is determined that the installation of a traffic control signal should be considered at the intersection of SH 5 (S Powell Pkwy) & Finley Blvd (Co Rd 422).



1. Introduction

The City of Anna has requested that Maldonado-Burkett (M-B) to perform a traffic signal warrant analysis at the intersection of SH 5 (N Powell Pkwy) and Finley Blvd (Co Rd 422), and to make a recommendation on whether a traffic signal is needed at the study intersection. SH 5, which is considered as the “major street” in this study, is a 2-lane, 2-way undivided roadway with 12-foot lanes and two 5-foot shoulders. The posted speed limit on SH 5 in the study area is 60 MPH. Finley Blvd, which is considered as the “minor street” in this study, has a 3-lane cross section design on the east leg, with two lanes (one Right-Turn Lane and one Left-Turn/Thru Option Lane) for the westbound approach. The west leg of this intersection is unpaved, and has a 2-lane undivided design. The posted speed limit on Finley Blvd is 30 MPH. Figure 1 shows the location of the study intersection.

Figure 1. Study Intersection Location



The analysis was performed in accordance with the Texas Manual on Uniform Traffic Control Devices (Texas MUTCD) 2014 Revision, Chapter 4C. The goal of this project is to analyze traffic volume data



and crash records to determine if the traffic signal warrants are met in accordance with the requirements listed in the Texas MUTCD.

2. Data Collection

A 24-hour turning movement volume was collected on Tuesday, November 16, 2021 at the study intersection by Gram Traffic North Texas. The traffic volume dataset includes the traffic modes of motor vehicle, bicyclist, pedestrian. Additionally, daily volume of train traffic near the study intersection was also collected on the same day and included in the dataset. The raw traffic data is available in **Appendix B**.

Crash history of the study intersection for the past 12 months dated back from the analysis date is obtained through TxDOT's Crash Records Information System (CRIS), and is included in **Appendix C**.

3. Study Approach

The 2014 Texas MUTCD contains nine traffic signal warrants, which address a variety of intersection conditions such as vehicular volume, pedestrian volume, crashes, progression, and delay; and establish minimum criteria for further evaluation of traffic signal installation. The investigation of the need for a traffic control signal shall include an analysis of the applicable factors contained in the traffic signal warrants and other factors related to existing operation and safety at the study location. The nine warrants are listed as below:

- Warrant 1, Eight-Hour Vehicular Volume
- Warrant 2, Four-Hour Vehicular Volume
- Warrant 3, Peak Hour
- Warrant 4, Pedestrian Volume
- Warrant 5, School Crossing
- Warrant 6, Coordinated Signal System
- Warrant 7, Crash Experience
- Warrant 8, Roadway Network
- Warrant 9, Intersection near a Grade Crossing

Section 3.1 through Section 3.9 in this chapter show the content of each of the nine warrants, and present the corresponding analyses results in general. Detailed analyses for each warrant are included in **Appendix A**.

3.1. Warrant 1, Eight-Hour Vehicular Volume

The purpose of Warrant 1 is to determine whether intersecting traffic from the minor approaches are the main reason to consider installing a traffic signal. This warrant includes two conditions:



- Condition A – the Minimum Vehicular Volume, is intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic control signal;
- Condition B – the Interruption of Continuous Traffic is intended for application at locations where Condition A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street.

Table 4C-1 from Texas MUTCD that shows the minimum requirements of eight-hour traffic volumes for both conditions is presented as below:

Table 1. MUTCD Table 4C-1: Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (Total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%a	80%b	70%c	56%d	100%a	80%b	70%c	56%d
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (Total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%a	80%b	70%c	56%d	100%a	80%b	70%c	56%d
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

a - Basic minimum hourly volume;

b - Used for combination of Conditions A and B after adequate trial of other remedial measures;

c - May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000;

d - May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000.

Per the Texas MUTCD standards, the need for a traffic control signal shall be considered if an engineering study finds that one of the following conditions exist for each of any 8 hours of an average day:



A. The vehicles per hour given in both of the 100 percent columns of Condition A in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection; or

B. The vehicles per hour given in both of the 100 percent columns of Condition B in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to intersection.

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, the traffic volumes in the 70 percent columns in Table 4C-1 may be used in place of the 100 percent columns.

The posted speed limit on SH 5 adjacent to the study intersection is 60 MPH. Therefore, by comparing the traffic volumes of the eight highest hours of the study intersection with the volumes in the 70% columns in Table 4C-1, it is determined that Condition A of Warrant 1 is met. Per the Texas MUTCD, Warrant 1 is to be treated as a single warrant, if Condition A is satisfied, then Warrant 1 is satisfied and analyses of Condition B and the combination of Conditions A and B are not needed. Therefore, **Warrant 1 is met at the study intersection.**

The 24-hour traffic volume on November 16, 2021 is presented in Table 2 on next page. Detailed analyses process and the traffic volumes for the eight highest hours are included in **Appendix A.**



Table 2. Warrant 1 Analysis

Time	Major St.	Higher Volume Minor St.	Meet Condition A (70%)?	Meet Condition B (70%)?	Meet Condition A & B (56%)?
12:00 AM	34	9	No	N/A	N/A
1:00 AM	30	11	No		
2:00 AM	15	3	No		
3:00 AM	31	14	No		
4:00 AM	68	29	No		
5:00 AM	191	83	No		
6:00 AM	490	196	Yes		
7:00 AM	948	403	Yes		
8:00 AM	725	202	Yes		
9:00 AM	531	158	Yes		
10:00 AM	573	137	No		
11:00 AM	625	158	Yes		
12:00 PM	712	173	Yes		
1:00 PM	673	156	Yes		
2:00 PM	728	153	Yes		
3:00 PM	848	306	Yes		
4:00 PM	1153	208	Yes		
5:00 PM	1186	268	Yes		
6:00 PM	896	161	Yes		
7:00 PM	536	91	No		
8:00 PM	397	52	No		
9:00 PM	208	34	No		
10:00 PM	175	20	No		
11:00 PM	82	9	No		
No. of Hours Meeting Condition:			12	N/A	N/A
No. of Hours Required;			8	N/A	N/A
Meet Warrant 1:			Yes	N/A	N/A

3.2. Warrant 2, Four-Hour Vehicular Volume

Similar to Warrant 1, Warrant 2, Four-Hour Vehicular Volume is also intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal.

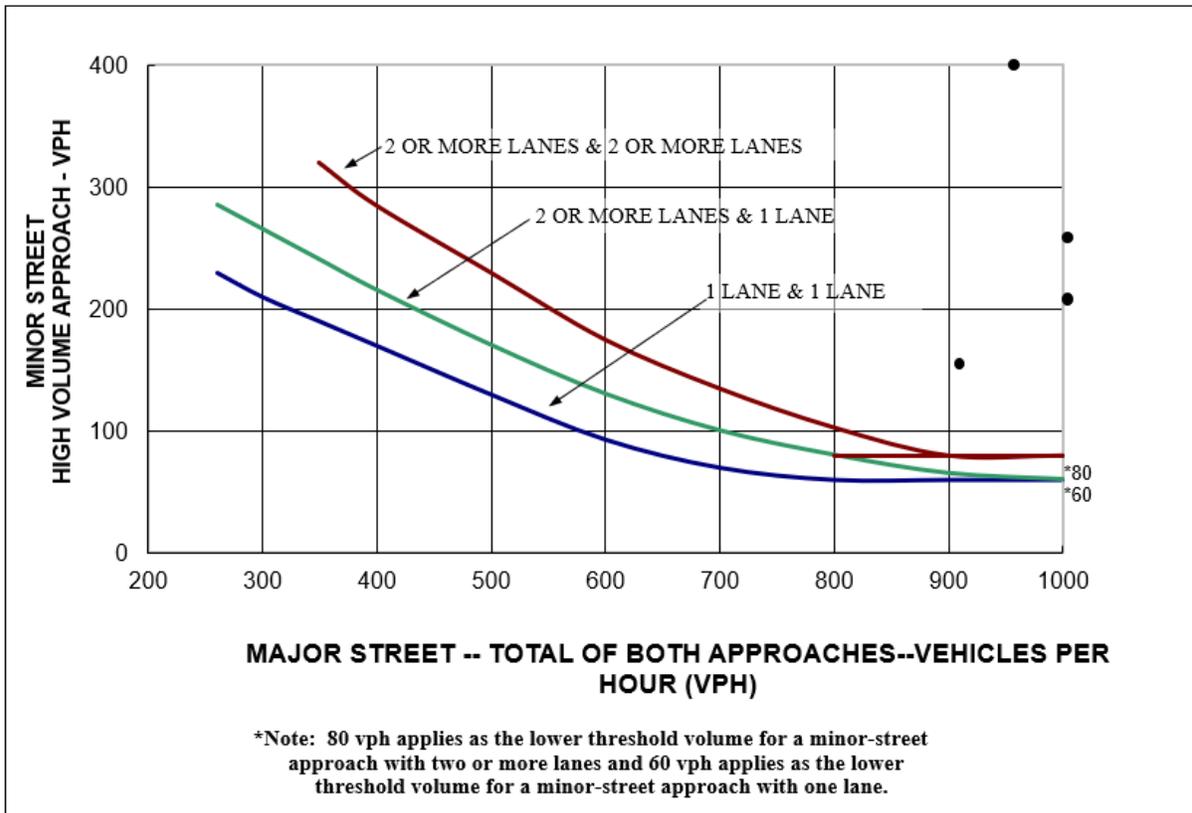
Per the Texas MUTCD standards, the need for a traffic control signal shall be considered if an engineering study finds that, for each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) all fall above the applicable curve in Figure 4C-1 for the existing combination of approach lanes. On the minor street, the higher volume shall not be required to be on the same approach during each of these 4 hours.



If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-2 may be used in place of Figure 4C-1.

As the posted speed limit on SH 5 is 60 MPH, Figure 4C-2 from Texas MUTCD that shows the minimum requirements of four-hour traffic volumes is used in the analysis and is presented on next page.

Figure 2. MUTCD Figure 4C-2 Warrant 2, Four-Hour Vehicular Volume (70% Factor)



By comparing the traffic volumes of the four highest hours of the study intersection with the volumes in Figure 4C-2, it is determined that **Warrant 2 is met at the study intersection**. Detailed analysis process is included in **Appendix A**.

3.3. Warrant 3, Peak Hour

The Peak Hour signal warrant is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street.

A traffic signal shall be considered if an engineering study finds that the criteria in either of the following two categories are met:



A. If all three of the following conditions exist for the same 1 hour (any four consecutive 15-minute periods) of an average day:

1. The total stopped time delay experienced by the traffic on one minor-street approach (one direction only) controlled by a STOP sign equals or exceeds: 4 vehicle-hours for a one-lane approach or 5 vehicle-hours for a two-lane approach; and
2. The volume on the same minor-street approach (one direction only) equals or exceeds 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes; and
3. The total entering volume serviced during the hour equals or exceeds 650 vehicles per hour for intersections with three approaches or 800 vehicles per hour for intersections with four or more approaches.

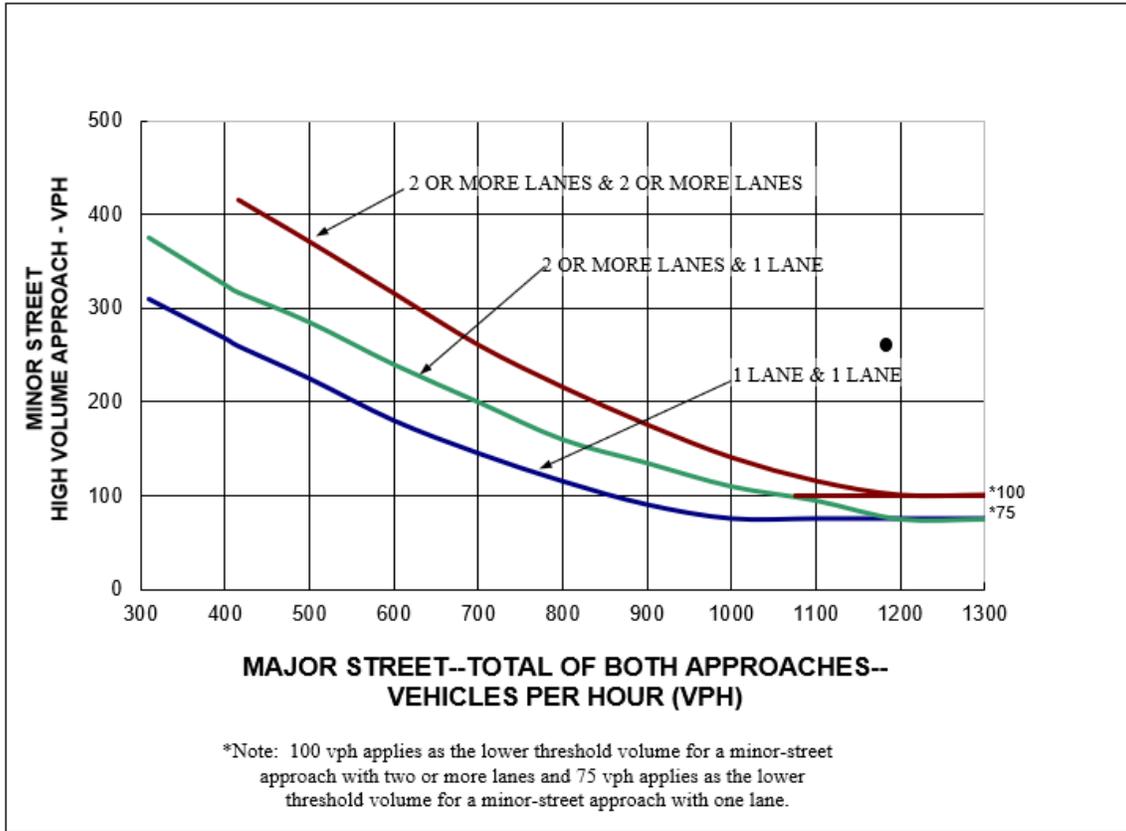
B. The plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4C-3 for the existing combination of approach lanes.

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-4 may be used in place of Figure 4C-3 to evaluate the criteria in the second category of the Standard.

Figure 4C-4 from the Texas MUTCD (presented on next page) is used in this study because the posted speed limit on SH 5 is 60 MPH.



Figure 3. MUTCD Figure 4C-4 Warrant 3, Peak Hour (70% Factor)



Through applying the highest hourly volume of the study intersection to Figure 4C-4, it can be seen that Category B is met for this Warrant.

Warrant 3 also has a requirement that the signal be near a facility that attracts or discharges large numbers of vehicles over a short time. The intersection is approximately 1/2 mile from Harlow Elementary School, and Finley Blvd serves as the primary access route to SH 5. The proximity to the school is considered to meet the Texas MUTCD requirements for this warrant.

Warrant 3 is met at the study intersection.

3.4. Warrant 4, Pedestrian Volume

This warrant is intended application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

The need for a traffic control signal at an intersection or midblock crossing shall be considered if an engineering study finds that one of the following criteria is met:

- A. For each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) all fall above the curve in Figure 4C-5; or



B. For 1 hour (any four consecutive 15-minute periods) of an average day, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) falls above the curve in Figure 4C-7.

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 35 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-6 may be used in place of Figure 4C-5 to evaluate Criterion A in Paragraph 2, and Figure 4C-8 may be used in place of Figure 4C-7 to evaluate Criterion B in Paragraph 2.

As SH 5 has a posted speed limit of 60 MPH adjacent to the study intersection, Figure 4C-6 and Figure 4C-8 were used in the analysis and are resented as below:

Figure 4. MUTCD Figure 4C-6 Warrant 4, Pedestrian Four-Hour Volume (70% Factor)

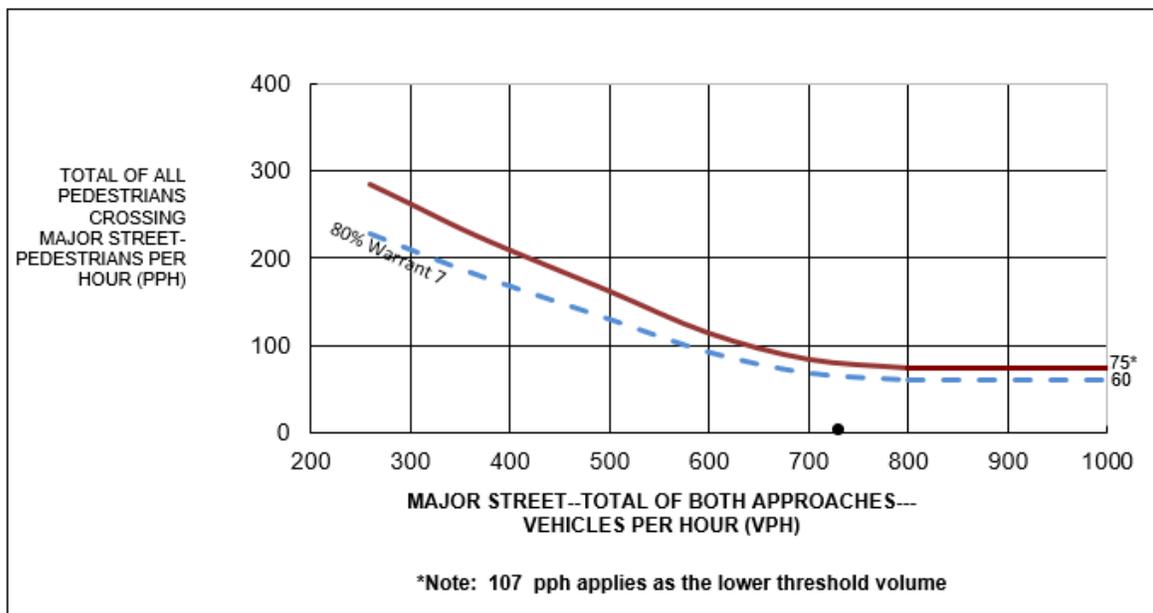
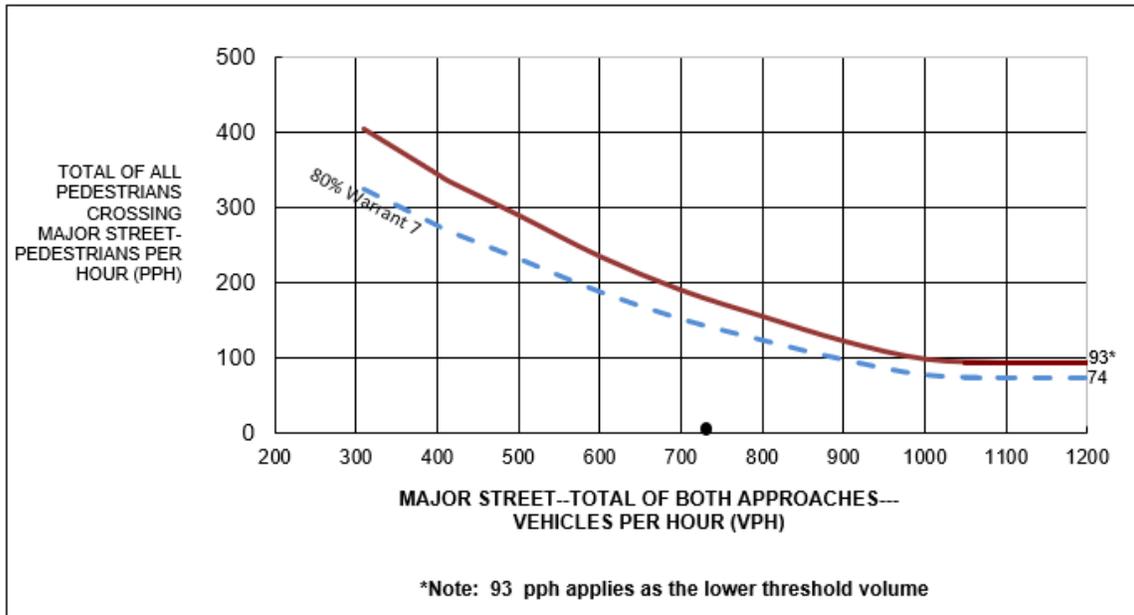




Figure 5. MUTCD Figure 4C-8 Warrant 4, Pedestrian Peak Hour (70% Factor)



According to the collected data, one pedestrian was counted for the entire 24-hour period at the study intersection. Therefore, **Warrant 4 is not met for the study intersection.**

3.5. Warrant 5, School Crossing

The School Crossing signal warrant is intended for application where the fact that school children cross the major street is the principal reason to consider installing a traffic control signal. For the purposes of this warrant, the word “school children” includes elementary through high school students.

The need for a traffic control signal shall be considered when an engineering study of the frequency and adequacy of gaps in the vehicular traffic stream as related to the number and size of groups of school children at an established school crossing across the major street shows that the number of adequate gaps in the traffic stream during the period when the school children are using the crossing is less than the number of minutes in the same period and there are a minimum of 20 school children during the highest crossing hour.

Before a decision is made to install a traffic control signal, consideration shall be given to the implementation of other remedial measures, such as warning signs and flashers, school speed zones, school crossing guards, or a grade-separated crossing.

The School Crossing signal warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 300 feet, unless the proposed traffic control signal will not restrict the progressive movement of traffic.

Per the collected traffic data, no school children crossing had been discovered or recorded at the study intersection. It is required in this warrant that there are a minimum of 20 school children crossing the major street during the highest hour. Therefore, it is determined in this study that Warrant 5 is not met



due to the absence of crossing actions. However, if this intersection is to accommodate student crossing in the future, it is recommended that a gap study on the major street traffic stream be performed prior to a traffic signal warrant study.

Warrant 5 is not met for the study intersection.

3.6. Warrant 6, Coordinated Signal System

Progressive movement in a coordinated signal system sometimes necessitates installing traffic control signals at intersections where they would not otherwise be needed in order to maintain proper platooning of vehicles.

A traffic signal shall be considered if an engineering study finds that one of the following criteria is met:

- A. On a one-way street or a street that has traffic predominantly in one direction, the adjacent traffic control signals are so far apart that they do not provide the necessary degree of vehicular platooning.
- B. On a two-way street, adjacent traffic control signals do not provide the necessary degree of platooning and the proposed and adjacent traffic control signals will collectively provide a progressive operation.

The study intersection is not contained in a coordinated traffic signal system, and doesn't need to provide a necessary degree of vehicle platooning. As a result, **Warrant 6 is not met for the study intersection.**

3.7. Warrant 7, Crash Experience

The Crash Experience signal warrant conditions are intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal.

The need for a traffic control signal shall be considered if an engineering study finds that all of the following criteria are met:

- A. Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency; and
- B. Five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a 12-month period, each crash involving personal injury or property damage apparently exceeding the applicable requirements for a reportable crash; and
- C. For each of any 8 hours of an average day, the vehicles per hour (vph) given in both of the 80 percent columns of Condition A in Table 4C-1, or the vph in both of the 80 percent columns of Condition B in Table 4C-1 exists on the major-street and the higher volume minor-street approach, respectively, to the intersection, or the volume of pedestrian traffic is not less than 80 percent of the requirements specified in the Pedestrian Volume warrant. These major-street and minor-street volumes shall be for the same 8 hours. On the minor street, the higher volume shall not be required to be on the same approach during each of the 8 hours.

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less



than 10,000, the traffic volumes in the 56 percent columns in Table 4C-1 may be used in place of the 80 percent columns. In this study, the 56 percent columns in Table 4C-1 were used as the posted speed limit on SH 5 is 60 MPH. A crash report at the intersection for the past 12 month was obtained through TxDOT's Crash Records Information System (CRIS) and is included in **Appendix C**. By analyzing the traffic volume and crash data, it is determined that **Warrant 7 is not met**.

3.8. Warrant 8, Roadway Network

The need for a traffic control signal shall be considered if an engineering study finds that the common intersection of two or more major routes meets one or both of the following criteria:

- A. The intersection has a total existing, or immediately projected, entering volume of at least 1,000 vehicles per hour during the peak hour of a typical weekday and has 5-year projected traffic volumes, based on an engineering study, that meet one or more of Warrants 1, 2, and 3 during an average weekday; or
- B. The intersection has a total existing or immediately projected entering volume of at least 1,000 vehicles per hour for each of any 5 hours of a non-normal business day (Saturday or Sunday).

The study intersection does not serve as a common intersection of two major routes, therefore, **Warrant 8 does not apply** to this study.

3.9. Warrant 9, Intersection Near a Grade Crossing

The Intersection Near a Grade Crossing signal warrant is intended for use at a location where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic control signal.

The need for a traffic control signal shall be considered if an engineering study finds that both of the following criteria are met:

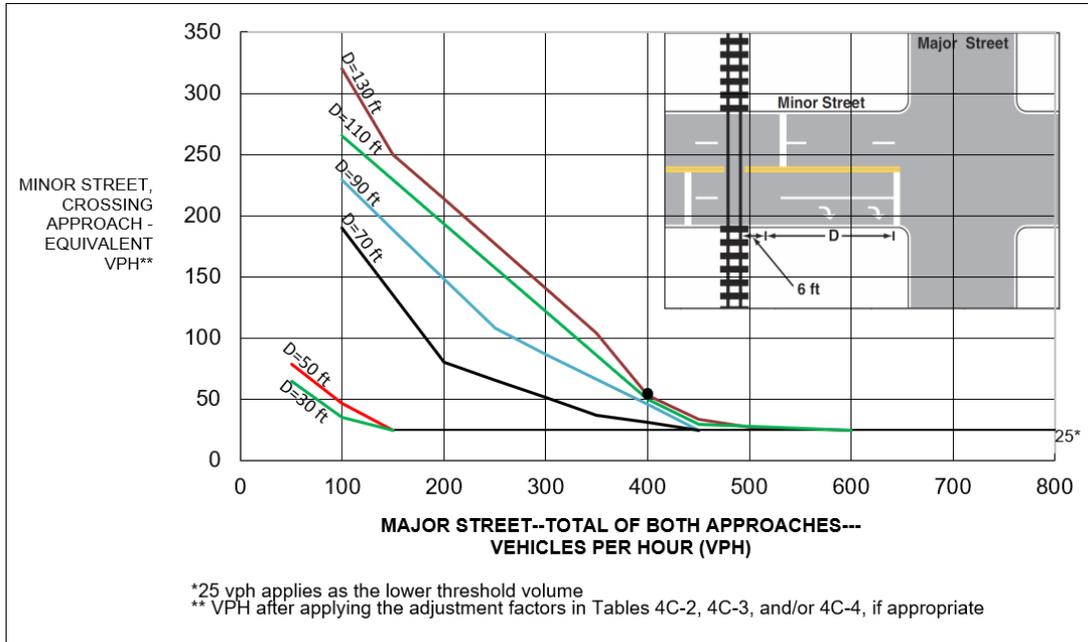
- A. A grade crossing exists on an approach controlled by a STOP or YIELD sign and the center of the track nearest to the intersection is within 140 feet of the stop line or yield line on the approach; and
- B. During the highest traffic volume hour during which rail traffic uses the crossing, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the minor-street approach that crosses the track (one direction only, approaching the intersection) falls above the applicable curve in Figure 4C-9 (shown as below) or 4C-10 for the existing combination of approach lanes over the track and the distance D, which is the clear storage distance as defined in Section 1A.13.

The distance between the center of the railroad track is approximately 132 feet from the stop line of the westbound approach at the study intersection. Therefore, criteria A is met. Per the collected daily train volumes and arrival time data, the traffic volumes are 397 vph on the major street and 52 vph on the



minor street. The clear storage distance D is measured to be approximate 121 feet. Based on the plot on in Figure 6, Criteria B is met. Therefore, Warrant 9 is met for this intersection.

Figure 6. MUTCD Figure 4C-10 Warrant 9, Intersection Near a Grade Crossing



3.10. Results and Conclusions.

The results of the warrant analysis are summarized in Table 3. The intersection was analyzed with SH 5 (major street) being a 1-lane approach in both directions, and with Finley Blvd (minor street) being a 2-lane approach in the westbound direction.

Table 3. Signal Warrant Analysis Results

Warrant	Description	Analysis Result
1A	Eight Hour Volume – Minimum Vehicular Volume (70% & 56%)	Warrant 1, Condition A Met
1B	Eight Hour Volume – Interruption of Continuous Traffic (70% & 56%)	Condition B Not Evaluated as Condition A is Met
2	Four Hour Vehicular Volume	Warrant Met
3	Peak Hour	Warrant Met
4	Pedestrian Volume	Warrant Not Met
5	School Crossing	Warrant Not Met
6	Coordinated Signal System	Warrant Not Met
7	Crash Experience	Warrant Not Met
8	Roadway Network	Not Applicable
9	Intersection Near a RR Grade Crossing	Warrant Met



In summary, four (Warrant 1, 2, 3 & 9) of the total nine signal warrants are met in this study. As a result, **the installation of a traffic control signal should be considered at the intersection of SH 5 (S Powell Pkwy) & Finley Blvd (Co Rd 422).**



Appendix A. Traffic Signal Warrant Analysis



Traffic Survey — Count Analysis

2014 TXMUTCD Warrants

County: Collin District: Dallas
 City: Anna Population: 13,052 Survey Date: 12/6/2021

	Name	Control	Section	85% Speed
Major	SH 5			60 MPH
Minor	Finley Blvd			30 MPH

Eight Highest Hours: Include the same 8 hours for the Major and Minor St. volumes.

Time Ends	Major St. - Both App.		Minor St. - Hi. Vol. App.		Comments:
	Veh. Total	Ped. Total	Veh. Total	Ped. Total	
5:00 PM	1,186		268		
4:00 PM	1,153		208		
7:00 AM	948		403		
6:00 PM	896		161		
3:00 PM	848		306		
2:00 PM	728		153		
8:00 AM	725		202		
12:00 PM	712		173	1	

Warrant 1. Eight Hour Vehicular Volume

Yes No Meets 70%^c (and major-street speed exceeds 40 mph or population less than 10,000) *or* 100%^a (regardless of speed) of Condition A.
 – *or* –
 Yes No Meets 70%^c (and major-street speed exceeds 40 mph or population less than 10,000) *or* 100%^a (regardless of speed) of Condition B.
 – *or* –
 Yes No Meets 80%^b of Conditions A and B.
 – *or* –
 Yes No Meets 56%^d of Conditions A and B (and major-street speed exceeds 40 mph or population less than 10,000).

Condition A - Minimum Vehicle Volume

Number of Lanes for Moving Traffic on Each Approach		Vehicles per hour on Major St (Total of Both Approaches)				Vehicles per hour on higher-volume Minor St approach (One Direction Only)					
Major Street	Minor Street	Required				Existing	Required				Existing
		100% ^a	80% ^b	70% ^c	56% ^d		100% ^a	80% ^b	70% ^c	56% ^d	
1	1	500	400	350	280		150	120	105	84	
2 or more	1	600	480	420	336		150	120	105	84	
2 or more	2 or more	600	480	420	336		200	160	140	112	
1	2 or more	500	400	350	280		200	160	140	112	

Condition B - Interruption of Continuous Traffic

Number of Lanes for Moving Traffic on Each Approach		Vehicles per hour on Major St (Total of Both Approaches)				Vehicles per hour on higher-volume Minor St approach (One Direction Only)					
Major Street	Minor Street	Required				Existing	Required				Existing
		100% ^a	80% ^b	70% ^c	56% ^d		100% ^a	80% ^b	70% ^c	56% ^d	
1	1	750	600	525	420		75	60	53	42	
2 or more	1	900	720	630	504		75	60	53	42	
2 or more	2 or more	900	720	630	504		100	80	70	56	
1	2 or more	750	600	525	420		100	80	70	56	

^aBasic minimum hourly volume.

^bUsed for combination of Conditions A and B after adequate trial of other remedial measures.

^cMay be used when the major-street speed exceeds 40 mph or in a community with a population of less than 10,000.

^dMay be used for combination of Conditions A and B after adequate trial of other remedial measures when major street exceeds 40 mph or in an isolated community with a population of less than 10,000.

Warrant 2. Four Hour Volumes (70% Factor)

<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Meets each of 4 Highest Hours (Warrant 2 — see Figure 1).
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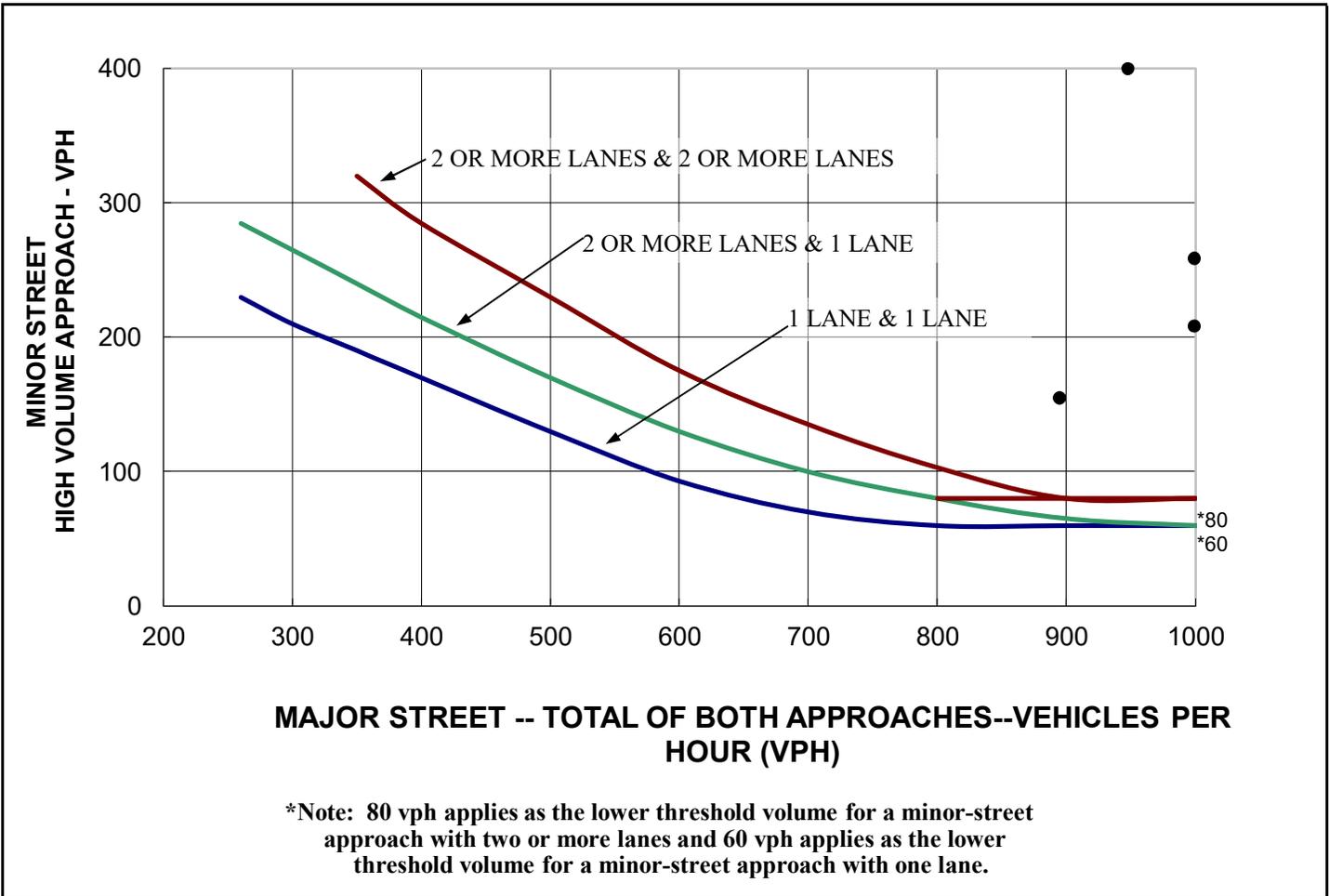


Figure 1. Four-hour volume warrant (community less than 10,000 population or above 40 MPH on major street). (Warrant 2.)

Warrant 3. Peak Hour (70% Factor)

<input type="checkbox"/> Yes <input type="checkbox"/> No	Are all of the following conditions true for any four consecutive 15 minute periods? 1. The total stopped time delay experienced by the traffic on one minor street approach (one direction only) controlled by a stop sign equals or exceeds 4 vehicle-hours for a one-lane approach and 5 vehicle-hours for a two-lane approach, <i>and</i> 2. The volume of the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic or 150 vph for two moving lanes, <i>and</i> 3. The total entering volume serviced during the hour equals or exceeds 650 vph for intersections with three approaches or 800 vph for intersections with four (or more) approaches.
– <i>or</i> –	
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Meets one High Hour (Warrant 3 — see Figure 2).

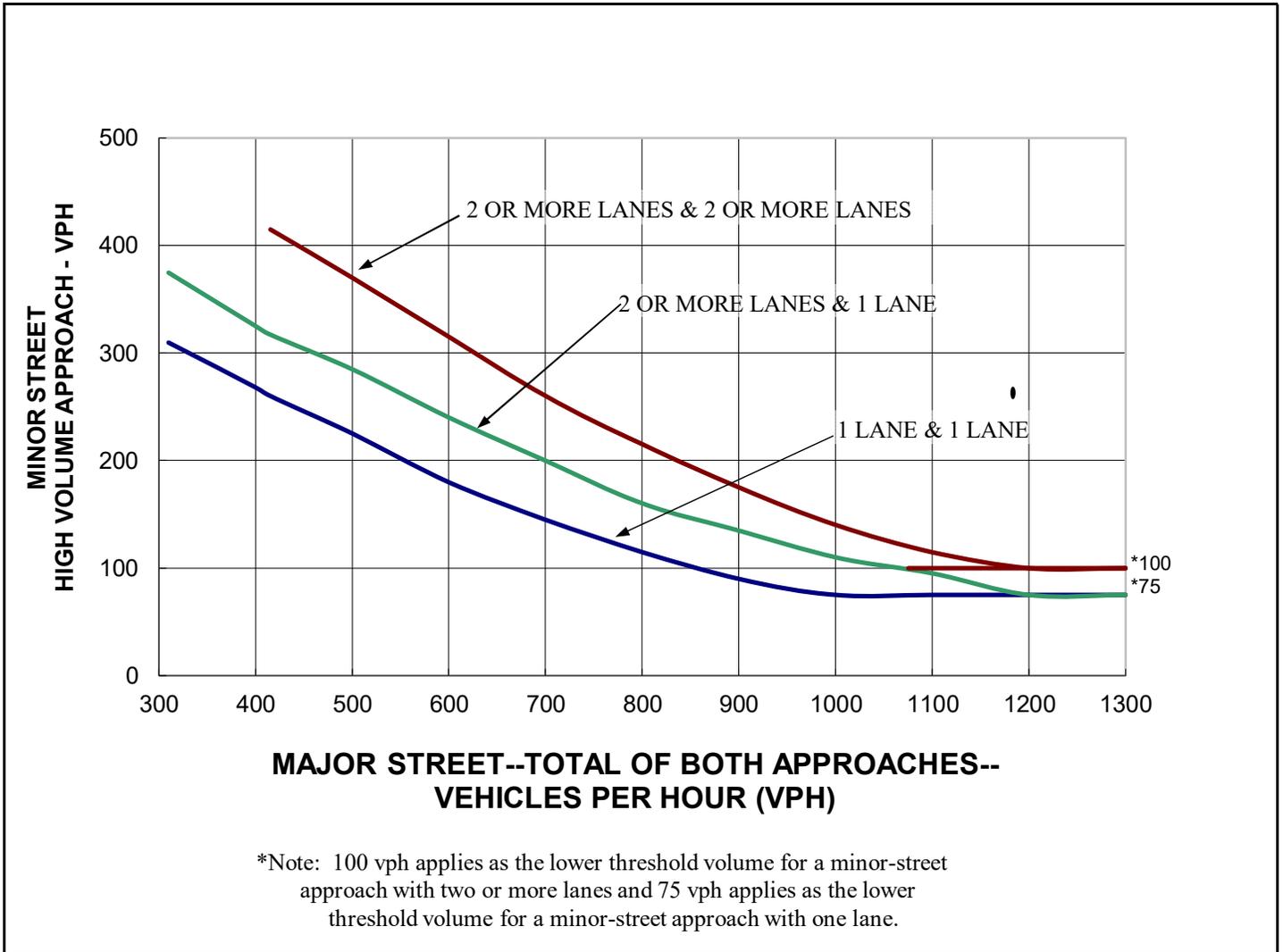


Figure 2. Peak hour volume warrant (community less than 10,000 population or above 40 MPH on major street). (Warrant 3.)

Warrant 4. Four Hour Pedestrian Volumes (70% Factor)

<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Meets each of 4 Highest Hours (Warrant4 — see Figure 3).
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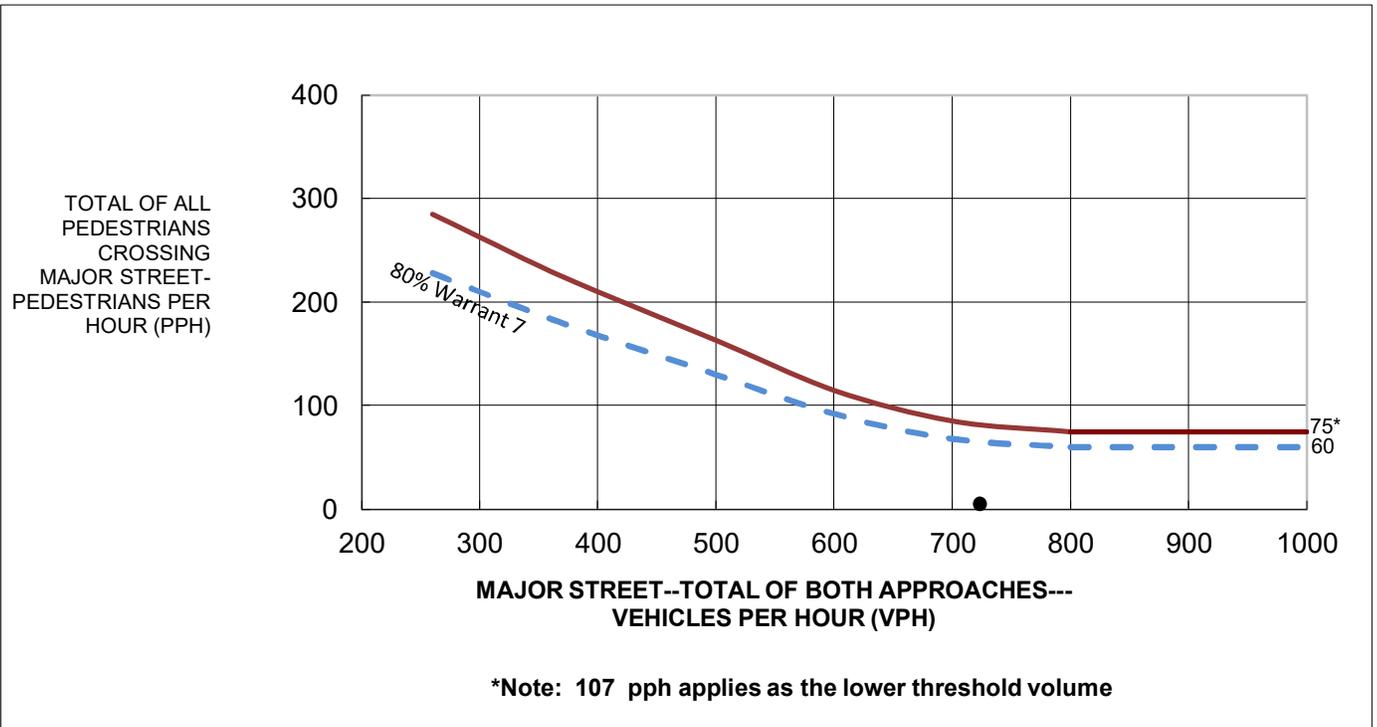


Figure 3. Four-hour pedestrian warrant (community less than 10,000 population or above 35 MPH on major street). (Warrant 4.)

Warrant 4. Peak Hour Pedestrian Volumes (70% Factor)

<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Meets Peak Hour Pedestrian (Warrant4 — see Figure 4).
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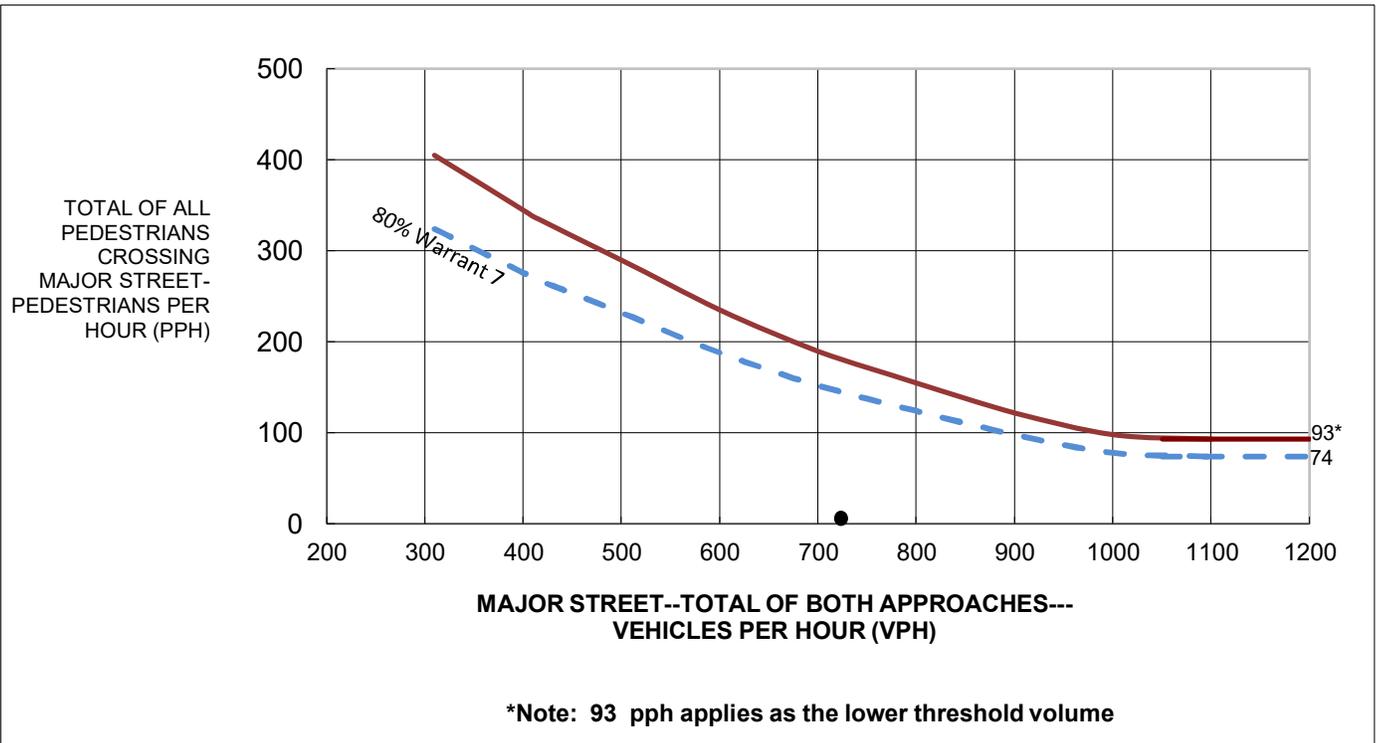


Figure 4. Peak hour pedestrian warrant (community less than 10,000 population or above 35 MPH on major street). (Warrant 4.)

Warrant 5. School Crossing

<input type="checkbox"/> Yes	<input type="checkbox"/> No	Is the number of adequate gaps in traffic stream during the period when the children are using the crossing less than the number of minutes in the same period? – <i>and</i> –
N/A		
<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Is there a minimum of 20 students during the highest crossing hour? – <i>and</i> –
<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	Is the nearest signal located more than 300 feet away? (This warrant may be applied, if the proposed signal is less than 300 feet and does not restrict the progressive movement of traffic.)

Warrant 6. Coordinated Signal System

<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	On a one-way street or a street with traffic predominantly in one direction, are the adjacent signals far enough apart that the necessary degree of vehicle platooning does not occur? – <i>or</i> –
<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	On a two-way street, are the adjacent signals far enough apart that the necessary degree of vehicle platooning does not occur and would the proposed and adjacent traffic control signal provide a progressive operation?

Warrant 7. Crash Experience

<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	Is one of the following conditions met?: <ul style="list-style-type: none"> ◆ 80% of Condition A or Condition B in Warrant 1 ◆ 56% of Condition A or B in Warrant 1 (major-street speed exceeding 40 mph or population less than 10,000) ◆ 80 % or more of Warrant 4 met? – <i>and</i> –
<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Have there been 5 or more reportable crashes susceptible to correction by a traffic signal within a 12 month period?

Warrant 8. Roadway Network

<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Is the total existing, or immediately projected, entering volume on all approaches greater than 1000 vehicles for each of any 5 hours of a Saturday and/or Sunday. – <i>or</i> –
<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Is the total existing, or immediately projected, entering volume greater than 1000 vehicles for the peak hour of a typical weekday, and do the 5 year projected traffic volumes meet one or more of Warrants 1, 2, and 3 during an average weekday?

Check applicable characteristics of each route:

<u>Major Street</u>	<u>Minor Street</u>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	It is part of street or highway system that serves as the principal roadway network for through traffic flow.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	It includes rural or suburban highways outside, entering, or traversing a city.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	It appears as a major route on an official plan such as a major street plan in an urban area traffic and transportation study.

Remarks:

Warrant 9. Intersection Near a Grade Crossing (Two or More Approach Lanes at the Track Crossing)

<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	Meets one High Hour (Warrant 9 — see Figure 5).
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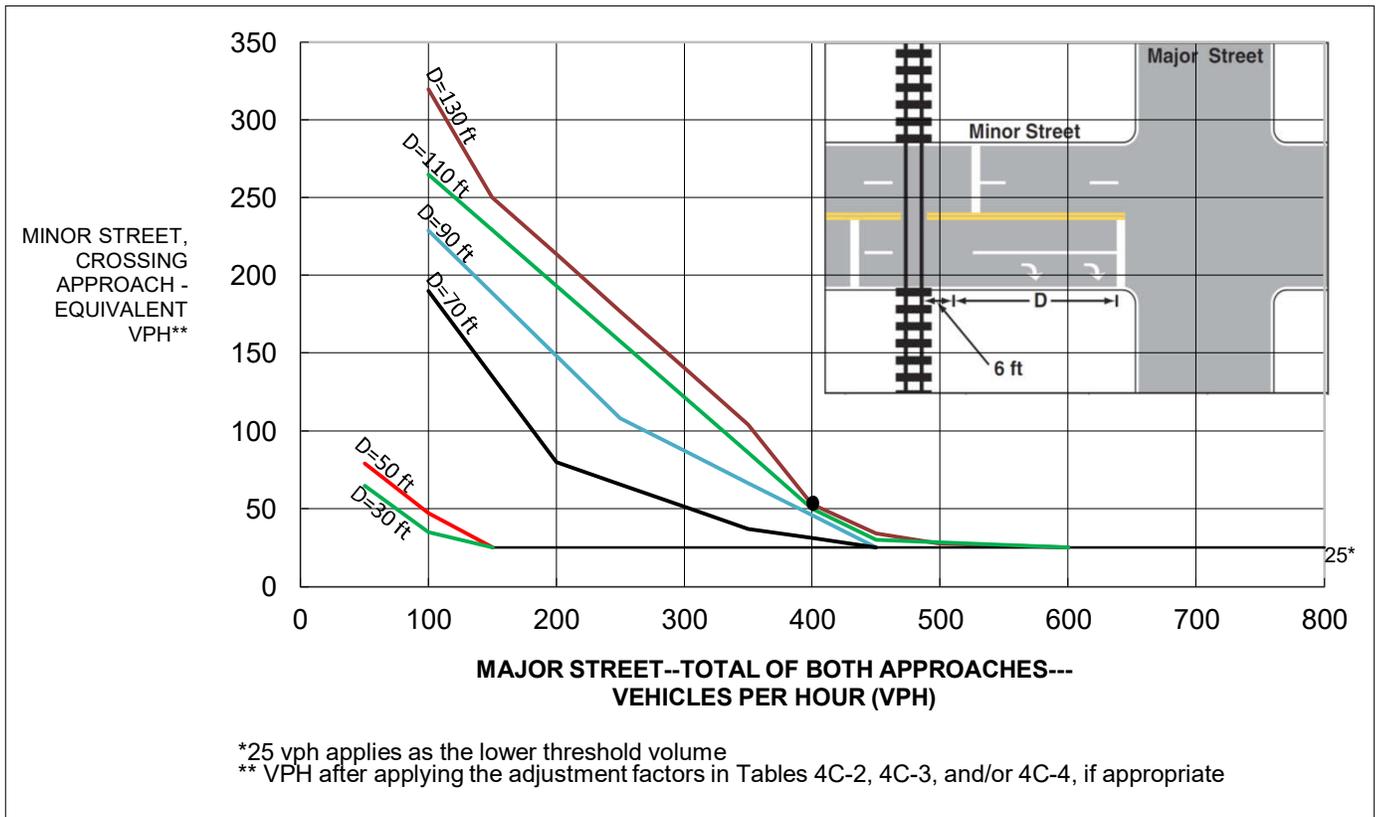


Figure 5. Railroad Grade Crossing (Two or More Approach Lanes at the Track Crossing). (Warrant 9.)



Appendix B. 24-Hour Traffic Volume Data

Study Name: SH 5 @ FINLEY Traffic Volume Collection
Start Date: 11/16/2021
Start Time: 12:00 AM
Duration: 24 Hr

Start Time	SH 5 Southbound					FINLEY BLVD Westbound					SH 5 Northbound					FINLEY BLVD Eastbound				
	Left	Thru	Right	U-Turn	Ped	Left	Thru	Right	U-Turn	Ped	Left	Thru	Right	U-Turn	Ped	Left	Thru	Right	U-Turn	Ped
12:00 AM	2	5	0	0	0	0	0	1	0	0	0	5	3	0	0	0	1	0	0	0
12:15 AM	1	2	0	0	0	2	0	1	0	0	0	1	3	0	0	0	0	0	0	0
12:30 AM	0	5	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0
12:45 AM	0	2	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0
1:00 AM	0	1	0	0	0	1	0	3	0	0	0	2	1	0	0	0	0	0	0	0
1:15 AM	2	1	0	0	0	2	0	0	0	0	0	3	1	0	0	0	0	0	0	0
1:30 AM	3	3	0	0	0	1	0	1	0	0	0	1	2	0	0	0	0	0	0	0
1:45 AM	1	2	0	0	0	3	0	0	0	0	0	6	1	0	0	0	0	0	0	0
2:00 AM	1	3	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0
2:15 AM	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2:30 AM	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 AM	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
3:00 AM	0	3	0	0	0	2	0	2	0	0	0	3	0	0	0	0	0	0	0	0
3:15 AM	1	6	0	0	0	3	0	1	0	0	0	1	1	0	0	0	0	0	0	0
3:30 AM	1	4	0	0	0	0	0	3	0	0	0	2	1	0	0	0	0	0	0	0
3:45 AM	1	4	0	0	0	3	0	0	0	0	0	2	1	0	0	0	0	0	0	0
4:00 AM	1	7	0	0	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0
4:15 AM	0	8	0	0	0	3	1	2	0	0	0	3	1	0	0	0	0	0	0	0
4:30 AM	0	8	0	0	0	9	0	0	0	0	0	7	2	0	0	0	0	0	0	0
4:45 AM	2	16	0	0	0	6	0	5	0	0	0	9	0	0	0	0	0	0	0	0
5:00 AM	1	18	0	0	0	8	0	1	0	0	0	6	2	0	0	0	0	0	0	0
5:15 AM	1	22	0	0	0	19	0	1	0	0	0	7	1	0	0	0	0	0	0	0
5:30 AM	0	38	0	0	0	20	1	5	0	0	0	16	0	0	0	0	0	0	0	0
5:45 AM	3	62	0	0	0	23	0	5	0	0	0	14	0	0	0	0	0	0	0	0
6:00 AM	3	59	1	0	0	20	0	10	0	0	0	17	3	0	0	0	0	0	0	0
6:15 AM	6	63	0	0	0	41	0	5	0	0	0	14	5	0	0	0	0	0	0	0
6:30 AM	18	80	0	0	0	36	1	17	0	0	0	35	11	0	0	0	0	1	0	0
6:45 AM	38	83	0	0	0	43	1	22	0	0	0	40	14	0	0	0	0	0	0	0
7:00 AM	85	104	0	0	0	39	0	58	0	0	0	32	22	0	0	0	0	1	0	0
7:15 AM	84	97	0	0	0	36	1	102	0	0	0	54	28	0	0	0	0	1	0	0
7:30 AM	24	97	0	0	0	32	0	62	0	0	0	82	18	0	0	1	0	0	0	0
7:45 AM	21	115	0	0	0	34	0	39	0	0	0	68	17	0	0	0	0	0	0	0
8:00 AM	25	95	0	0	0	29	0	27	0	0	0	69	12	0	0	0	1	0	0	0
8:15 AM	29	105	0	0	0	27	1	17	0	0	0	66	16	0	0	0	0	0	0	0
8:30 AM	22	75	0	0	0	36	0	16	0	0	1	50	19	0	0	0	0	1	0	0
8:45 AM	9	67	0	0	0	27	0	22	0	0	0	54	11	0	0	0	0	0	0	0

9:00 AM	15	67	0	0	0	18	0	11	0	0	0	44	14	0	0	0	0	0	0
9:15 AM	8	61	1	0	0	25	0	21	0	0	0	45	17	0	0	0	0	0	0
9:30 AM	15	51	0	0	0	24	0	12	0	0	0	48	12	0	0	0	0	0	0
9:45 AM	24	51	0	0	0	18	0	29	0	0	0	45	13	0	0	0	0	0	0
10:00 AM	18	56	0	0	0	21	0	18	0	0	0	53	12	0	0	1	0	0	0
10:15 AM	16	63	1	0	0	17	0	12	0	0	0	56	12	0	0	0	2	0	0
10:30 AM	20	59	0	0	0	23	0	15	0	0	0	49	10	0	0	0	0	0	0
10:45 AM	17	57	0	0	0	14	0	17	0	0	0	57	17	0	0	0	0	0	0
11:00 AM	11	62	0	0	0	20	0	18	0	0	1	40	19	0	0	0	0	1	0
11:15 AM	16	80	0	0	0	18	0	22	0	0	0	74	13	0	0	0	1	0	0
11:30 AM	16	72	0	0	0	17	0	20	1	0	0	46	18	0	0	0	0	0	0
11:45 AM	28	63	0	0	0	18	0	24	0	0	0	50	16	0	0	0	1	0	0
12:00 PM	19	71	0	0	0	16	0	20	0	0	0	69	24	0	0	0	0	0	0
12:15 PM	16	76	0	0	0	25	1	22	0	0	0	65	17	0	0	1	0	0	0
12:30 PM	16	73	0	0	0	22	0	18	0	0	0	53	24	0	0	0	0	0	0
12:45 PM	21	80	0	0	0	29	1	19	0	0	0	66	22	0	0	1	0	0	1
1:00 PM	17	63	0	0	0	18	0	17	0	0	1	70	23	0	0	0	0	0	0
1:15 PM	27	63	0	0	0	23	0	19	0	0	0	73	24	0	0	0	0	0	0
1:30 PM	20	65	0	0	0	24	0	11	0	0	0	42	19	0	0	0	0	0	0
1:45 PM	22	74	0	0	0	20	0	24	0	0	0	55	15	0	0	1	1	0	0
2:00 PM	33	69	0	0	0	16	0	20	1	0	0	54	17	0	0	0	0	0	0
2:15 PM	25	47	1	0	0	13	0	23	0	0	0	59	24	0	0	1	1	0	0
2:30 PM	45	63	0	0	0	21	0	21	0	0	0	78	23	0	0	0	0	0	0
2:45 PM	38	60	0	0	0	13	0	25	0	0	0	63	29	0	0	0	0	0	0
3:00 PM	49	64	0	0	0	22	0	64	0	0	0	65	20	0	0	0	0	0	0
3:15 PM	40	55	0	0	0	22	2	71	0	0	0	56	27	0	0	0	0	0	0
3:30 PM	28	71	0	0	0	30	2	39	0	0	0	107	25	0	0	0	0	0	0
3:45 PM	26	83	0	0	0	20	1	33	0	0	0	108	24	0	0	0	0	0	0
4:00 PM	29	86	0	0	0	14	0	37	0	0	0	120	41	0	0	1	1	0	0
4:15 PM	43	91	1	0	0	19	1	28	0	0	0	100	38	0	0	1	0	0	0
4:30 PM	55	111	0	0	0	23	1	33	0	0	0	112	39	0	0	0	0	0	0
4:45 PM	39	102	0	0	0	15	1	36	0	0	0	107	39	0	0	1	0	0	0
5:00 PM	41	106	0	0	0	25	0	45	0	0	0	122	46	0	0	0	0	1	0
5:15 PM	35	98	0	0	0	26	0	32	0	0	0	117	51	0	0	0	0	0	0
5:30 PM	32	107	0	0	0	31	0	48	0	0	0	110	46	0	0	0	1	0	0
5:45 PM	36	104	0	0	0	28	1	32	0	0	0	88	47	0	0	0	0	0	0
6:00 PM	41	91	0	0	0	22	0	27	0	0	0	87	44	0	0	0	0	0	0
6:15 PM	24	75	0	0	0	23	0	26	0	0	0	83	42	0	0	0	0	0	0
6:30 PM	29	70	0	0	0	16	1	24	0	0	0	68	27	0	0	1	0	0	0
6:45 PM	31	64	0	0	0	16	1	5	0	0	0	72	48	0	0	0	0	0	0
7:00 PM	17	63	0	0	0	12	0	14	0	0	0	47	19	0	0	0	0	0	0
7:15 PM	19	49	0	0	0	3	0	17	0	0	0	62	13	0	0	0	0	0	0
7:30 PM	24	34	0	0	0	8	0	15	0	0	0	40	26	0	0	0	0	0	0
7:45 PM	25	42	0	0	0	8	0	14	0	0	0	41	15	0	0	0	0	0	0

8:00 PM	25	43	0	0	0	3	0	11	0	0	0	36	21	0	0	0	0	0	0	0
8:15 PM	14	34	0	0	0	7	0	5	0	0	0	24	17	0	0	0	0	0	0	0
8:30 PM	16	29	0	0	0	4	0	9	0	0	0	41	13	0	0	0	0	0	0	0
8:45 PM	14	27	0	0	0	8	0	5	0	0	0	28	15	0	0	0	0	0	0	0
9:00 PM	4	20	0	0	0	7	0	6	0	0	0	6	15	0	0	0	0	0	0	0
9:15 PM	6	20	0	0	0	4	0	0	0	0	0	12	13	0	0	0	0	0	0	0
9:30 PM	7	17	0	0	0	2	1	9	0	0	0	21	12	0	0	0	0	0	0	0
9:45 PM	8	14	0	0	0	3	0	2	0	0	0	16	17	0	0	0	0	0	0	0
10:00 PM	4	17	0	0	0	1	0	5	0	0	0	23	10	0	0	0	0	0	0	0
10:15 PM	3	12	0	0	0	5	0	4	0	0	0	21	11	0	0	0	0	0	0	0
10:30 PM	3	12	0	0	0	0	0	2	0	0	0	15	13	0	0	0	0	0	0	0
10:45 PM	5	12	0	0	0	0	0	3	0	0	0	9	5	0	0	0	0	0	0	0
11:00 PM	3	12	0	0	0	0	0	3	0	0	0	9	4	0	0	0	0	0	0	0
11:15 PM	2	11	0	0	0	1	0	2	0	0	0	7	5	0	0	0	0	0	0	0
11:30 PM	3	4	0	0	0	2	0	0	0	0	0	12	4	0	0	0	0	0	0	0
11:45 PM	1	1	0	0	0	0	0	1	0	0	0	0	4	0	0	0	0	0	0	0



Appendix C. Crash Records from CRIS for the Past 12 Months

Query Result Counts:

Your query returned a total of 5 Crashes containing 11 Units and 14 Persons

Filters Applied to current Query:

Crash Date Is Between 2020-12-06 00:00 and 2021-12-06 09:48

Crash ID	City	Street Name	Crash Date	Manner of Collision	Crash Severity	Crash Death Count	Railroad Company	Railroad Flag	Surface Condition
18175708	ANNA	SH0005	3/30/2021	SAME DIRECTION - ONE STRAIGHT-ONE STOPPED	N - NOT INJURED	0	No Data	No	1 - DRY
18391527	ANNA	COUNTY ROAD 422	7/26/2021	ONE MOTOR VEHICLE - GOING STRAIGHT	N - NOT INJURED	0	No Data	No	1 - DRY
18424432	ANNA	SH0005	8/12/2021	SAME DIRECTION - BOTH GOING STRAIGHT-REAR END	N - NOT INJURED	0	No Data	No	1 - DRY
18530916	ANNA	SH0005	10/13/2021	OPPOSITE DIRECTION - ONE STRAIGHT-ONE LEFT TURN	B - SUSPECTED MINOR INJURY	0	No Data	No	2 - WET
18534502	ANNA	SH0005	10/16/2021	SAME DIRECTION - ONE STRAIGHT-ONE STOPPED	N - NOT INJURED	0	No Data	No	1 - DRY