Traffic Signal Warrant Analysis

Villa Maria Road at Autumn Lake Drive & Kingsgate Drive

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Prepared for:

W&B Development

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OVERVIEW

Alliance Transportation Group, Inc. has been retained to perform a traffic signal warrant analyses and turn lane analyses for two intersections in Bryan, Texas. The proposed Edgewater Subdivision (located north of the existing developments accessing Kingsgate Drive and Autumn Lake Drive) will be incorporated into the traffic warrant analysis for future build-out scenarios. A site plan of the proposed Edgewater Subdivision is shown in **Figure 1.** The following intersections were analyzed in this study:

- Villa Maria Road and Kingsgate Drive (minor-street stop controlled)
- Villa Maria Road and Autumn Lake Drive (minor-street stop controlled)

Villa Maria Road and Kingsgate Drive is a three leg intersection. Villa Maria Road is considered as the major street and Kingsgate Drive is considered as the minor street. Villa Maria Road is a two-lane undivided roadway with one lane in each direction. The posted speed limit of Villa Maria Road is 55 mph. At the intersection, Kingsgate Drive consists of two-lanes, one lane each for left- and right-turns.

Villa Maria Road and Autumn Lake Drive is a three leg intersection. Villa Maria Road is considered as the major street and Autumn Lake Drive is considered as the minor street. Villa Maria Road is a two-lane undivided roadway with one lane in each direction. The posted speed limit of Villa Maria Road is 55 mph. At the intersection, Kingsgate Drive consists of one shared lane for left- and right-turns.

This signal warrant study was conducted in accordance with chapter 4C of the Texas Manual on Uniform Traffic Control Devices (TMUTCD) [1]. As stated in the TMUTCD, traffic control signals should not be installed unless one or more of the signal warrants are met.

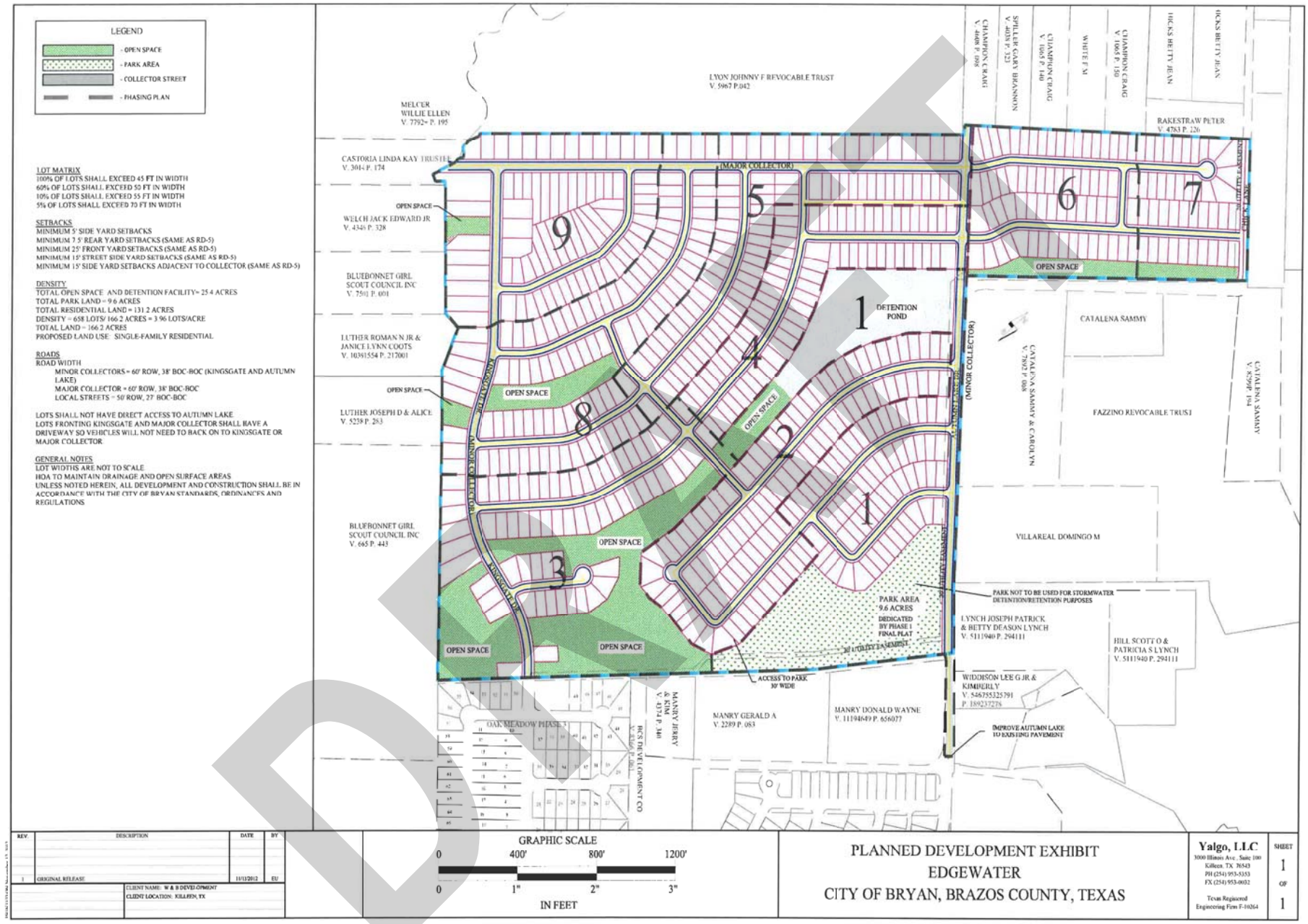


Figure 1. Edgewater Subdivision Proposed Site Plan

STUDY METHODOLOGY

Signal Warrant Analysis

As noted in Chapter 4C in the Texas Manual on Uniform Traffic Control Devices[1], a traffic control signal should not be installed unless one or more of the factors described in this Chapter are met. Further, a traffic control signal should not be installed unless an engineering study indicates that installing a traffic control signal will improve the overall safety and/or operation of the intersection. A traffic control signal should not be installed if it will seriously disrupt progressive traffic flow. A study to determine whether warrants are satisfied should consider the effects of the right-turn vehicles from the minor-street approaches. Engineering judgment should be used to determine what, if any, portion of the right-turn traffic is subtracted from the minor-street traffic count when evaluating the traffic data against the signal warrants.

Traffic data were collected at the study intersections in December 2012. This traffic data was then compared with the requirements set forth in the TMUTCD to determine whether traffic signals are warranted at the study intersections for existing conditions and build-out year scenarios.

Analysis is based on the nine Warrants set forth in the MUTCD. These warrants are shown below:

- Warrant 1: Eight Hour Vehicle Volumes
- Warrant 2: Four Hour Vehicle Volumes
- Warrant 3: Peak Hour Volume
- 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

The TMUTCD allows for reductions in the volumes required for satisfying warrants 1, 2, 3, and 4, if the 85th percentile speed of major street traffic is greater than 40 mph, or when the intersection lies within the built-up area of an isolated community having a population of less than 10,000. As the posted speed limit on Villa Maria Drive is greater than 40 mph, the reduced requirements have been applied at this study intersection. The following provides a description of each warrant and an assessment of its applicability to the study intersections.

Warrant 1, Eight-Hour Vehicle Volume

The Minimum Vehicular Volume, Condition A, is intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic control signal.

The Interruption of Continuous Traffic, Condition B, 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.

It is intended that Warrant 1 be treated as a single warrant. If Condition A is satisfied, then the criterion for Warrant 1 is satisfied and analyses of Condition B and the combination of Conditions A and B are not needed. Similarly, if Condition B is satisfied, then the criterion for Warrant 1 is satisfied and the combination of Conditions A and B is not needed.

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 the intersection.

In applying each condition the 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 these 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 70 percent columns in Table 4C-1 may be used in place of the 100 percent columns.

The combination of Conditions A and B is intended for application at locations where Condition A is not satisfied and Condition B is not satisfied and should be applied only after an adequate trial of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems.

The need for a traffic control signal shall be considered if an engineering study finds that both 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 80 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; and

B. The vehicles per hour given in both of the 80 percent columns of Condition B in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection.

These major-street and minor-street volumes shall be for the same 8 hours for each condition; however, the 8 hours satisfied in Condition A shall not be required to be the same 8 hours satisfied in Condition B. 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.

This warrant is applicable at both study intersections and will be discussed further in this report.

Figure 2: 4C-1 Warrant 1 Volumes [(1)]

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 St	Minor St	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 St	Minor St	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 combinations 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 major street exceeds 40 mph or in an isolated community with a population of less than 10,000

Warrant 2, Four-Hour Vehicle Volume

The Four-Hour Vehicular Volume signal warrant conditions are intended to be applied where the volume of intersecting traffic 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, 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.

This warrant is applicable at both study intersections and will be discussed further in this report.

Warrant 3, Peak Hour Volume

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.

This signal warrant shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.

The need for a traffic control 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 satisfy the criteria in the second category of the Standard.

This warrant is not applicable at any of the study intersections for existing conditions, but is applicable for build-out conditions.

Warrant 4, Pedestrian Volume

The Pedestrian Volume signal warrant is intended for 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 both 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 a 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.

The Pedestrian Volume signal warrant shall not be applied at locations where the distance to the nearest traffic control signal or STOP sign controlling the street that pedestrians desire to cross is less than 300 feet, unless the proposed traffic control signal will not restrict the progressive movement of traffic.

If this warrant is met and a traffic control signal is justified by an engineering study, the traffic control signal shall be equipped with pedestrian signal heads conforming to requirements set forth in Chapter 4E.

If this warrant is met and a traffic control signal is justified by an engineering study, then:

A. If it is installed at an intersection or major driveway location, the traffic control signal should also control the minor-street or driveway traffic, should be traffic-actuated, and should include pedestrian detection.

B. If it is installed at a non-intersection crossing, the traffic control signal should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs, and should be pedestrian-actuated. If the traffic control signal is installed at a non-intersection crossing, at least one of the signal faces should be traveled way of approach, parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the crosswalk or site accommodations should be made through curb extensions or other techniques to provide adequate sight distance, and the installation should include suitable standard signs and pavement markings.

C. Furthermore, if it is installed within a signal system, the traffic control signal should be coordinated.

The criterion for the pedestrian volume crossing the major roadway may be reduced as much as 50 percent if the 15th-percentile crossing speed of pedestrians is less than 3.5 feet per second.

A traffic control signal may not be needed at the study location if adjacent coordinated traffic control signals consistently provide gaps of adequate length for pedestrians to cross the street.

This warrant is not applicable at any of the study intersections.

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 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 children are using the crossing is less than the number of minutes in the same period (see Section 7A.03) and there are a minimum of 20 students 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 ft., unless the proposed traffic control signal will not restrict the progressive movement of traffic.

If this warrant is met and a traffic control signal is justified by an engineering study, then:

A. If at an intersection, the traffic control signal should be traffic-actuated and should include pedestrian detectors.

B. If at a non-intersection crossing, the traffic control signal should be pedestrian-actuated, parking and other sight obstructions should be prohibited for at least 100 ft. in advance of and at least 20 ft. beyond the crosswalk, and the installation should include suitable standard signs and pavement markings.

C. Furthermore, if installed within a signal system, the traffic control signal should be coordinated.

This warrant is not applicable at any of the study intersections.

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.

The need for a traffic control 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 Coordinated Signal System signal warrant should not be applied where the resultant spacing of traffic control signals would be less than 1,000 ft.

This warrant is not applicable at any of the study intersections.

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 (see Section 4C.02), 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.

Collision data for the years 2011-2012 was provided by the City of Bryan. None of the study intersections had five reported crashes within a twelve month span over the last two years. Therefore, Warrant 7 is not satisfied at either of the intersections.

Warrant 8, Roadway Network

Installing a traffic control signal at some intersections might be justified to encourage concentration and organization of traffic flow on a 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).

A major route as used in this signal warrant shall have one or more of the following characteristics:

A. It is part of the street or highway system that serves as the principal roadway network for through traffic flow; or

B. It includes rural or suburban highways outside, entering, or traversing a City; or

C. It appears as a major route on an official plan, such as a major street plan in an urban area traffic and transportation study; or

D. It connects areas of principal traffic generation; or

E. It has surface street freeway or expressway ramp terminals.

This warrant is not applicable at any of the study intersections.

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.

This signal warrant should be applied only after adequate consideration has been given to other alternatives or after a trial of an alternative has failed to alleviate the safety concerns associated with the grade crossing. Among the alternatives that should be considered or tried are:

A. Providing additional pavement that would enable vehicles to clear the track or that would provide space for an evasive maneuver, or

B. Reassigning the stop controls at the intersection to make the approach across the track a non-stopping approach.

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 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 following considerations apply when plotting the traffic volume data on Figure 4C-9 or 4C-10:

A. Figure 4C-9 should be used if there is only one lane approaching the intersection at the track crossing location and Figure 4C-10 should be used if there are two or more lanes approaching the intersection at the track crossing location.

B. After determining the actual distance D, the curve for the distance D that is nearest to the actual distance D should be used. For example, if the actual distance D is 95 feet, the plotted point should be compared to the curve for D = 90 feet.

C. If the rail traffic arrival times are unknown, the highest traffic volume hour of the day should be used.

The minor-street approach volume may be multiplied by up to three adjustment factors as provided in the following paragraphs.

Because the curves are based on an average of four occurrences of rail traffic per day, the vehicles per hour on the minor-street approach may be multiplied by the adjustment factor shown in Table 4C-2 for the appropriate number of occurrences of rail traffic per day.

Because the curves are based on typical vehicle occupancy, if at least 2% of the vehicles crossing the track are buses carrying at least 20 people, the vehicles per hour on the minor-street approach may be multiplied by the adjustment factor shown in Table 4C-3 for the appropriate percentage of high-occupancy buses.

Because the curves are based on tractor-trailer trucks comprising 10% of the vehicles crossing the track, the vehicles per hour on the minor-street approach may be multiplied by the adjustment factor shown in Table 4C-4 for the appropriate distance and percentage of tractor-trailer trucks.

If this warrant is met and a traffic control signal at the intersection is justified by an engineering study, then:

A. The traffic control signal shall have actuation on the minor street;

B. Preemption control shall be provided in accordance with Sections 4D.27, 8C.09, and 8C.10; and

C. The grade crossing shall have flashing-light signals

This warrant is not applicable at any of the study intersections.

Turn Lane Analysis

As noted in the TXDOT Roadway Design Manual [(2)], left turn deceleration lanes should meet specified guidelines before being considered. Although left turn lanes on two-lane highways at intersecting crossroads are generally not economically justifiable, moderate to high volume highways with heavy left turn movements can be considered. Left turn lane

considerations for existing and future conditions at the intersections of Villa Maria Road and Kingsgate Drive and Villa Maria Road and Autumn Lake Drive will be assessed using Figure 3-11 from the Roadway Design Manual, Chapter 3, shown in **Figure 3**. Synchro™ version 8.0[3] will be used to determine the operational effects of left turn lanes at the intersections. Right turn deceleration lanes on two-lane highways at "tee" intersections are generally inappropriate, as it could result in the appearance of a three-lane highway and could cause driver confusion. Therefore, right turn deceleration lanes will not be considered at either study intersection.

Figure 3: Guidelines for Left Turn Lanes on Two-Lane Highways [2]

Opposing Volume (vph)	**Advancing Volume (vph)**			
-	5 % Left Turns	10 % Left Turns	20 % Left Turns	30 % Left Turns
40 mph [60 km/h] Design Speed				
800	330	240	180	160
600	410	305	225	200
400	510	380	275	245
200	640	470	350	305
100	720	515	390	340
50 mph [80 km/h] Design Speed				
800	280	210	165	135
600	350	260	195	170
400	430	320	240	210
200	550	400	300	270
100	615	445	335	295
60 mph [100 km/h] Design Speed				
800	230	170	125	115
600	290	210	160	140
400	365	270	200	175
200	450	330	250	215
100	505	370	275	240

ANALYSIS OF WARRANTS

Existing Conditions

As noted in the prior discussion, Warrants 1 and 2 are applicable at both intersections for existing conditions and will be discussed in more detail in the following paragraphs.

Villa Maria Road and Kingsgate Drive

Existing traffic data for the intersection of Villa Maria Road and Kingsgate Drive is summarized in **Table 1**. Due to the exclusive right turn lane on Kingsgate Drive, the right turn volume can be subtracted from the total volume of the southbound approach. Since turning movement counts were only conducted for the AM and PM peak periods, the right turn reduction is only applied from 7:00-9:00 AM and 4:00-6:00 PM. The turning movement counts were obtained in December of 2012 and are included in Appendix A.

Table 1: Approach Counts (2012) - Villa Maria Rd and Kingsgate Dr

End Hour	Villa Maria Rd (Total of Both Approaches)	Kingsgate Dr (Higher Volume Approach)
1:00	10	1
2:00	10	2
3:00	11	0
4:00	14	3
5:00	9	2
6:00	25	14
7:00	132	26
8:00	430	52*
9:00	265	15*
10:00	227	28
11:00	196	25
12:00	305	11
13:00	346	25
14:00	245	24
15:00	291	17
16:00	432	26
17:00	390	16*
18:00	330	22*
19:00	188	23
20:00	128	9
21:00	98	10
22:00	58	7
23:00	53	9
24:00	16	1

*Right turn volume subtracted from total volume on approach

Based on the speed limit on Villa Maria Road, the 70% values in the MUTCD are used as the criteria for determination of satisfying Condition A or B under Warrant 1.

To satisfy the criteria in Warrant 1 – Condition A, eight hours of an average day must have more than 420 vehicles per hour on the major street and 105 vehicles per hour on the minor

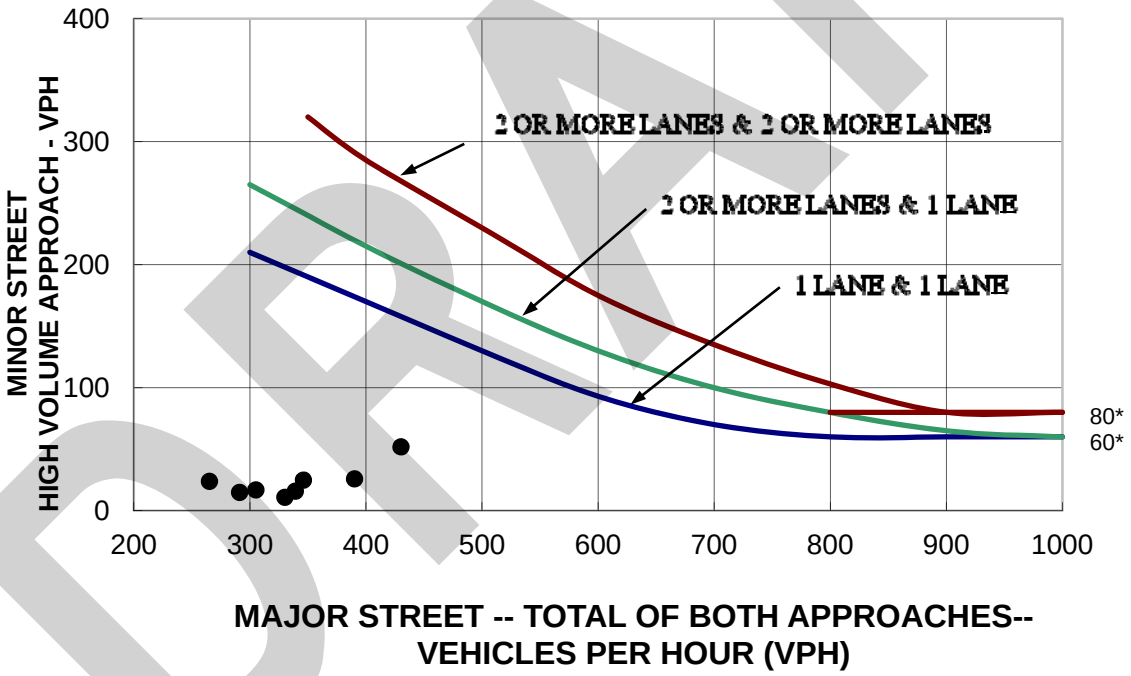
street. As noted in Table 1, there are two hours which satisfy the major street volume requirements and no hours which satisfy the minor street volume requirements.

To satisfy the criteria in Warrant 1 – Condition B, eight hours of an average day must have more than 630 vehicles per hour on the major street and 53 vehicles per hour on the minor street. As noted in Table 1, there are no hours which satisfy the major street volume requirements and no hours which satisfy the minor street volume requirements.

Thus, Warrant 1 is not satisfied at this intersection for existing conditions (2012).

The evaluation of Warrant 2 (Four Hour Volumes) for this intersection utilizes Figure 4C-2 from the MUTCD. Data points showing the combination of major street and minor street volumes are shown in **Figure 4.**

Figure 4: Warrant 2 (2012) - Villa Maria Road and Kingsgate Drive



As indicated in the above figure, no points are above the applicable curve, therefore, Warrant 2 is not satisfied at this intersection for existing conditions (2012).

Villa Maria Road and Autumn Lake Drive

Existing traffic data for the intersection of Villa Maria Road and Autumn Lake Drive is summarized in **Table 2**. Since Autumn Lake Drive consists of a single approach lane for all movements, there was no reduction in volume for right-turning vehicles. The approach counts are shown in **Table 2**.

Table 2: Approach Counts (2012) - Villa Maria Rd and Autumn Lake Dr

End Hour	Villa Maria Rd (Total of Both Approaches)	Autumn Lake Dr (Higher Volume Approach)
1:00	9	4
2:00	16	1
3:00	12	3
4:00	17	4
5:00	11	3
6:00	35	5
7:00	153	21
8:00	481	77
9:00	286	29
10:00	262	23
11:00	226	18
12:00	463	31
13:00	767	56
14:00	288	19
15:00	329	24
16:00	443	32
17:00	435	19
18:00	388	23
19:00	236	25
20:00	159	20
21:00	121	30
22:00	73	8
23:00	66	19
24:00	36	7

Based on the speed limit on Villa Maria Road, the 70% values in the MUTCD are used as the criteria for determination of satisfying Condition A or B under Warrant 1.

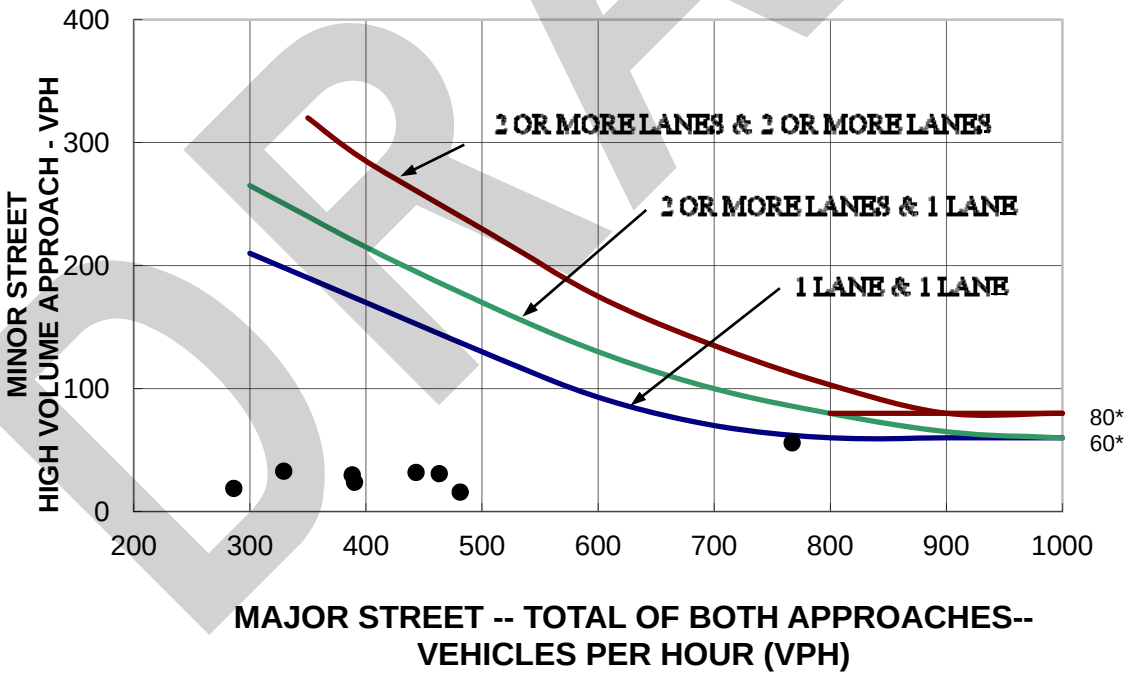
To satisfy the criteria in Warrant 1 – Condition A, eight hours of an average day must have more than 420 vehicles per hour on the major street and 105 vehicles per hour on the minor street. As noted in Table 1, there are five hours which satisfy the major street volume requirements and no hours which satisfy the minor street volume requirements.

To satisfy the criteria in Warrant 1 – Condition B, eight hours of an average day must have more than 630 vehicles per hour on the major street and 53 vehicles per hour on the minor street. As noted in Table 1, there is one hour which satisfies the major street volume requirements and two hours which satisfy the minor street volume requirements.

Thus, Warrant 1 is not satisfied at this intersection for existing conditions (2012).

The evaluation of Warrant 2 (Four Hour Volumes) for this intersection utilizes Figure 4C-2 from the MUTCD. Data points showing the combination of major street and minor street volumes are shown in **Figure 5.**

Figure 5: Warrant 2 (2012) - Villa Maria Road and Autumn Lake Dr



As indicated in the above figure, no points are above the applicable curve, therefore, Warrant 2 is not satisfied at this intersection for existing conditions (2012).

Build-Out Conditions

Warrants 1, 2, and 3 are anticipated to be applicable at both intersections for the proposed build-out of the Edgewater Subdivision and will be discussed in more detail in the following paragraphs. If any study intersections satisfy signal warrants for the full build-out (2018) of the Edgewater Subdivision, the level of development of the property which will be required to satisfy signal warrants will be assessed.

Existing and projected traffic volumes using the roadway system without the proposed project are commonly called background traffic. For this study, background traffic is based upon traffic counts collected in December 2012. Based on a recent traffic study done in the area, a growth rate of 5% per year will be used for Villa Maria Road. The Edgewater Subdivision is anticipated to be fully built out by the year 2018. Therefore, existing traffic was grown over a five year period for the full build-out condition. Subsequent intermediate build-out scenarios used the same growth rate, but existing traffic was grown over proportionally fewer years, i.e. 80% of the development will be assumed to be built by 2017. Increases in volume on Kingsgate Drive and Autumn Lake Drive were assumed to be incorporated into the estimated site traffic produced by the Edgewater Subdivision. Therefore, no growth rate was applied to existing volumes on Kingsgate Drive and Autumn Lake Drive.

For the Edgewater Subdivision, entering and exiting volumes were calculated using information from *ITE's Trip Generation, 9th Edition* [4] and are shown in **Table 3.** The reported volumes are for the peak generation during the peak hour of the adjacent street. The AM Peak of Villa Maria Road is assumed to be 7:00 AM - 8:00 AM and the PM Peak is assumed to be 4:00 PM - 5:00 PM. Site trips were added only to the AM and PM peak hours for build-out analyses. Site trip distribution is shown in **Table 4.** Lastly, it was assumed that 60% of the residents of the Edgewater Subdivision will take access from Villa Maria Road at Autumn Lake Drive and 40% of residents will take access at Kingsgate Drive.

TABLE 3: ITE Trip Generation

ITE Code	Description	Quantity	ADT	AM Peak		PM Peak	
				Enter	Exit	Enter	Exit
210	Single Family Housing	658 DU	5,884	118	353	361	212

TABLE 4: Site Distribution

Roadway	Outbound	Inbound
EB Villa Maria Rd	75%	25%
WB Villa Maria Rd	25%	75%

Villa Maria Road and Kingsgate Drive

Traffic data of intersection of Villa Maria Road and Kingsgate Drive for the full build-out (2018) of the Edgewater Subdivision is summarized in **Table 5**. Due to the exclusive right turn lane on Kingsgate Drive, the right turn volume can be subtracted from the total volume of the southbound approach during the peak periods. The approach counts are shown in **Table 5**.

Table 5: Approach Counts (2018) - Villa Maria Rd and Kingsgate Dr

End Hour	Villa Maria Rd (Total of Both Approaches)	Kingsgate Dr (Higher Volume Approach)
1:00	13	1
2:00	13	2
3:00	14	0
4:00	18	3
5:00	11	2
6:00	32	14
7:00	168	26
8:00	617$^{\Delta}$	130*$^{\Delta}$
9:00	338	15*
10:00	290	28
11:00	250	25
12:00	389	11
13:00	442	25
14:00	313	24
15:00	371	17
16:00	551	26
17:00	751$^{\Delta}$	91*$^{\Delta}$
18:00	421	22*
19:00	240	23
20:00	163	9
21:00	125	10
22:00	74	7
23:00	68	9
24:00	20	1

*Right turn volume subtracted from total volume on approach
$^{\Delta}$Peak hour site trips included

Based on the speed limit on Villa Maria Road, the 70% values in the MUTCD are used as the criteria for determination of satisfying Condition A or B under Warrant 1.

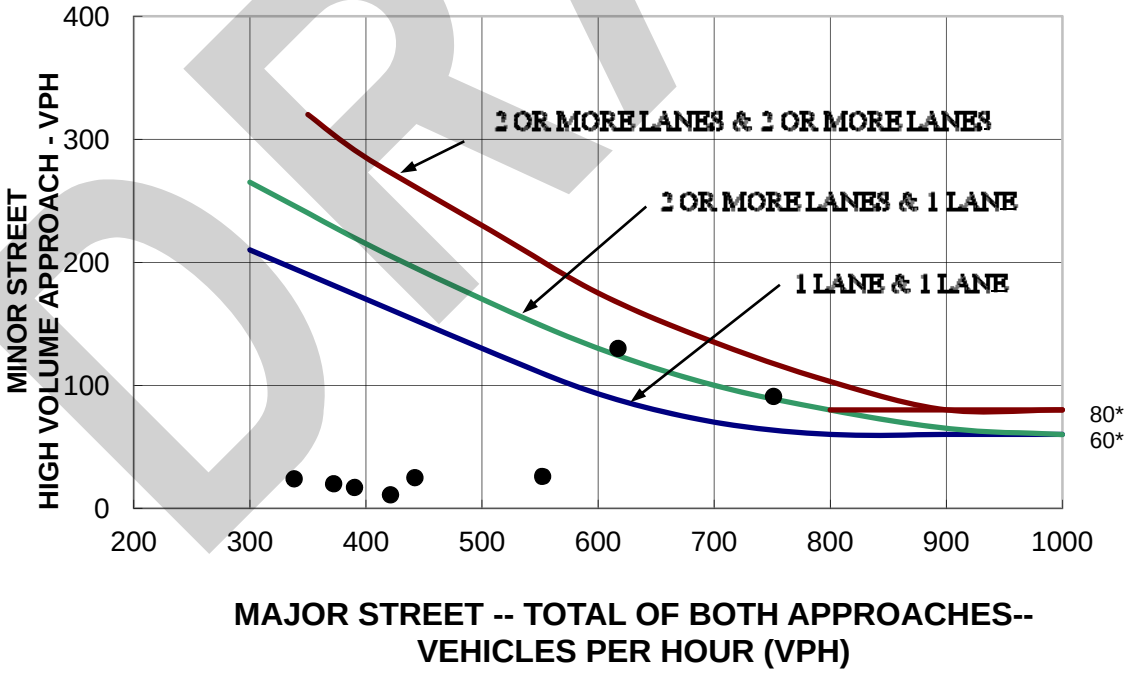
To satisfy the criteria in Warrant 1 – Condition A, eight hours of an average day must have more than 420 vehicles per hour on the major street and 105 vehicles per hour on the minor street. As noted in Table 5, there are five hours which satisfy the major street volume requirements and one hour which satisfies the minor street volume requirements.

To satisfy the criteria in Warrant 1 – Condition B, eight hours of an average day must have more than 630 vehicles per hour on the major street and 53 vehicles per hour on the minor street. As noted in Table 5, there is one hour which satisfies the major street volume requirements and two hours which satisfy the minor street volume requirements.

Thus, Warrant 1 is not satisfied at this intersection with the full build-out of the Edgewater Subdivision (2018).

The evaluation of Warrant 2 (Four Hour Volumes) for this intersection utilizes Figure 4C-2 from the MUTCD. Data points showing the combination of major street and minor street volumes are shown in **Figure 6.**

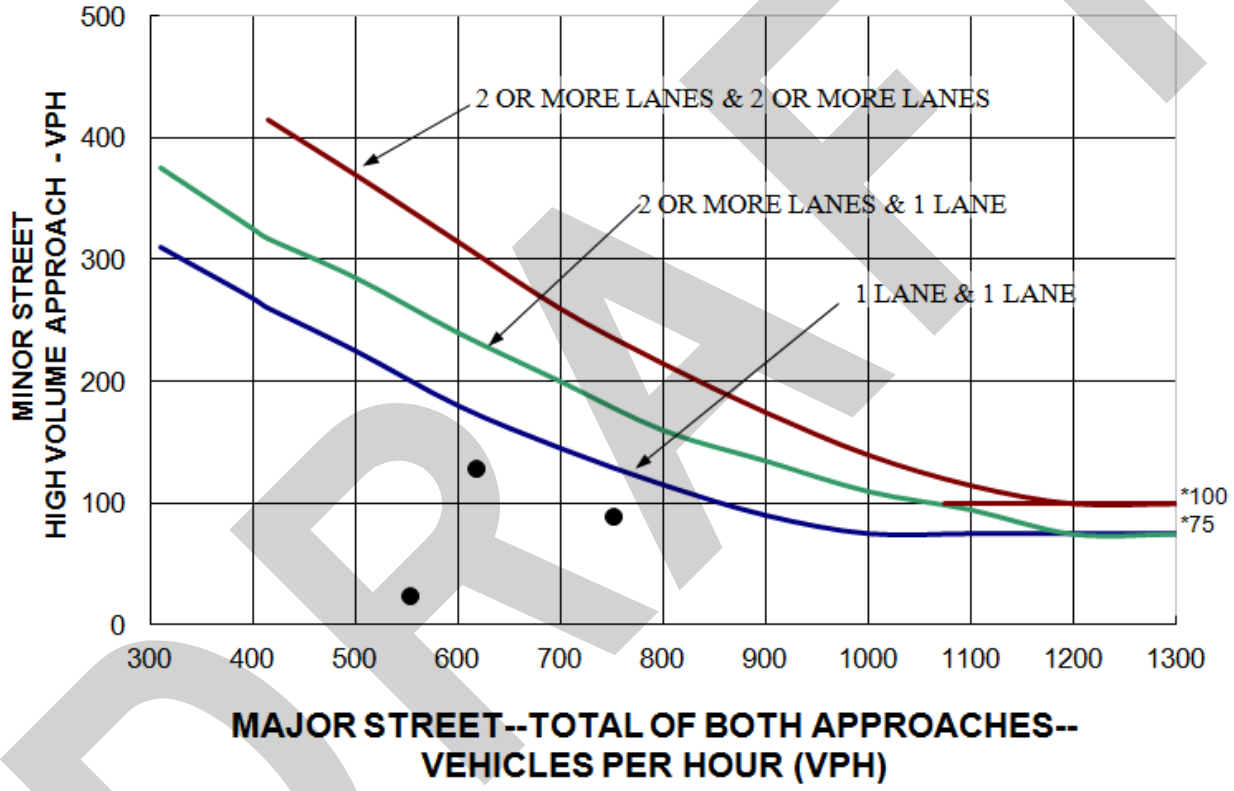
Figure 6: Warrant 2 (2018) - Villa Maria Road and Kingsgate Drive



As indicated in the above figure, two points are above the applicable curve, therefore, Warrant 2 is not satisfied at this intersection with the full build-out of the Edgewater Subdivision (2018).

The evaluation of Warrant 3 (Peak Hour) for this intersection utilizes Figure 4C-4 from the MUTCD. Data points showing the combination of major street and minor street volumes are shown in **Figure 7.**

Figure 7: Warrant 3 (2018) - Villa Maria Road and Kingsgate Drive



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

As indicated in the above figure, no points are above the applicable curve, therefore, Warrant 3 is not satisfied at this intersection with the full build-out of the Edgewater Subdivision (2018).

Villa Maria Road and Autumn Lake Drive

Traffic data for the intersection of Villa Maria Road and Autumn Lake Drive is summarized in **Table 6**. Since Autumn Lake Drive consists of a single approach lane for all movements, there was no reduction in volume for right-turning vehicles. The approach counts are shown in **Table 6**.

Table 6: Approach Counts (2018) - Villa Maria Rd and Autumn Lake Dr

End Hour	Villa Maria Rd (Total of Both Approaches)	Autumn Lake Dr (Higher Volume Approach)
1:00	11	4
2:00	20	1
3:00	15	3
4:00	22	4
5:00	14	3
6:00	45	5
7:00	195	21
8:00	724[Δ]	289[Δ]
9:00	365	33
10:00	334	23
11:00	288	18
12:00	591	31
13:00	979	56
14:00	368	19
15:00	419	24
16:00	565	32
17:00	958[Δ]	157[Δ]
18:00	495	36
19:00	301	25
20:00	203	20
21:00	154	30
22:00	93	8
23:00	84	19
24:00	46	7

[Δ]Peak hour site trips included

Based on the speed limit on Villa Maria Road, the 70% values in the MUTCD are used as the criteria for determination of satisfying Condition A or B under Warrant 1.

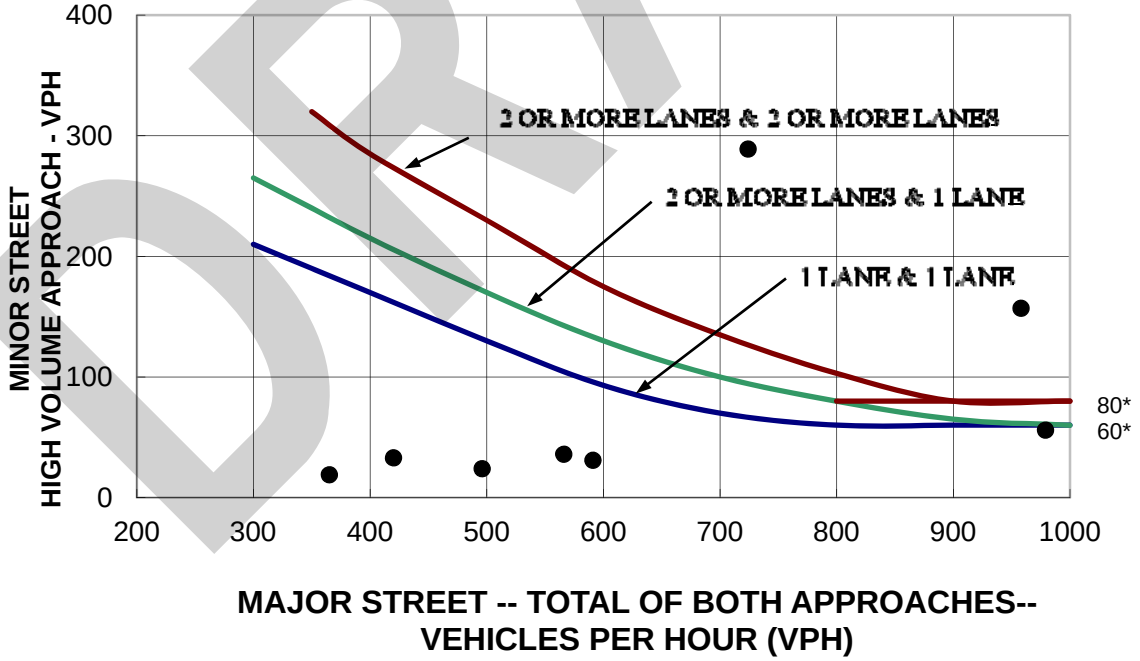
To satisfy the criteria in Warrant 1 – Condition A, eight hours of an average day must have more than 420 vehicles per hour on the major street and 105 vehicles per hour on the minor street. As noted in Table 6, there are six hours which satisfy the major street volume requirements and two hours which satisfy the minor street volume requirements.

To satisfy the criteria in Warrant 1 – Condition B, eight hours of an average day must have more than 630 vehicles per hour on the major street and 53 vehicles per hour on the minor street. As noted in Table 6, there are three hours which satisfy the major street volume requirements and three hours which satisfy the minor street volume requirements.

Thus, Warrant 1 is not satisfied at this intersection with the full build-out of the Edgewater Subdivision (2018).

The evaluation of Warrant 2 (Four Hour Volumes) for this intersection utilizes Figure 4C-2 from the MUTCD. Data points showing the combination of major street and minor street volumes are shown in **Figure 8.**

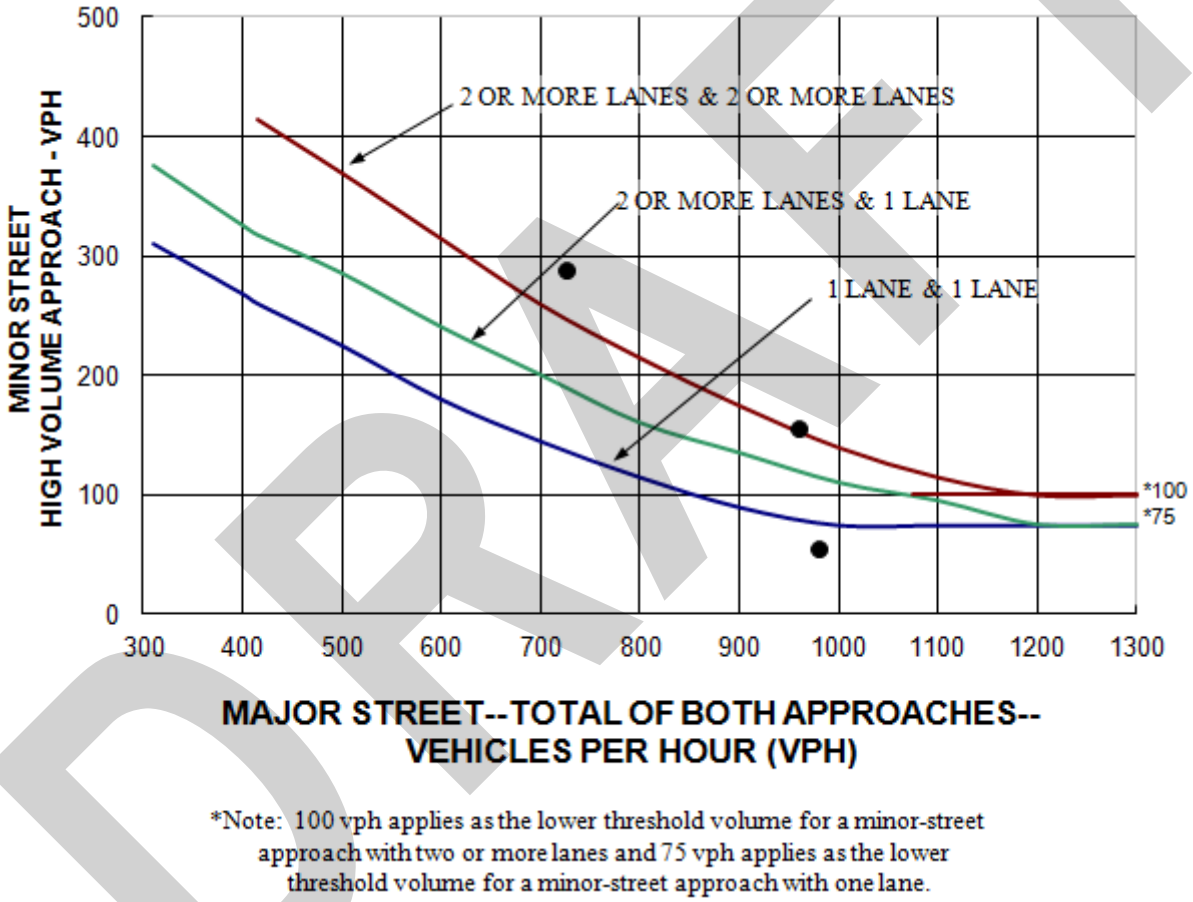
Figure 8: Warrant 2 (2018) - Villa Maria Road and Autumn Lake Drive



As indicated in the above figure, two points are above the applicable curve, therefore, Warrant 2 is not satisfied at this intersection with the full build-out of the Edgewater Subdivision (2018).

The evaluation of Warrant 3 (Peak Hour) for this intersection utilizes Figure 4C-4 from the MUTCD. Data points showing the combination of major street and minor street volumes are shown in **Figure 9.**

Figure 9: Warrant 3 (2018) - Villa Maria Road and Autumn Lake Drive

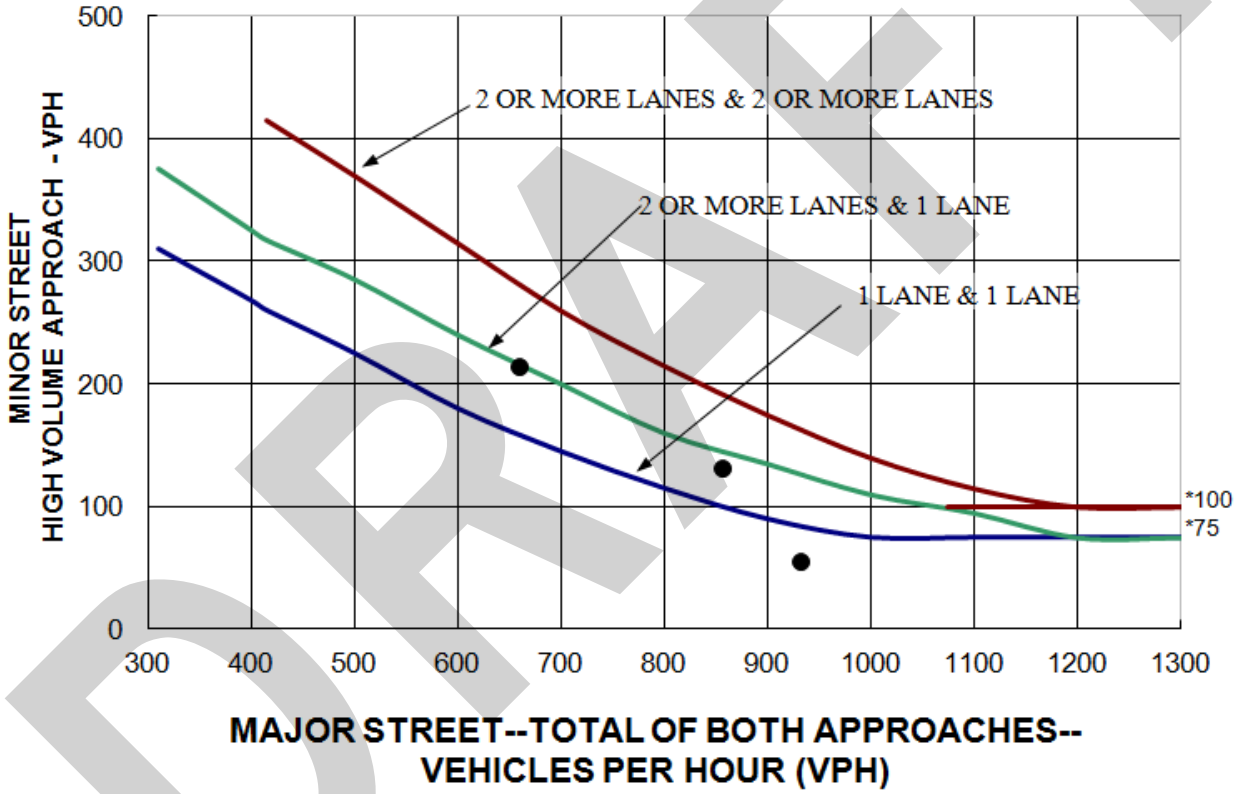


As indicated in the above figure, two points are above the applicable curve, therefore, Warrant 3 is satisfied at this intersection with the full build-out of the Edgewater Subdivision (2018).

Since Warrant 3 is met for the intersection of Villa Maria Road and Autumn Lake Drive for the full build-out conditions (2018), the level of development of the Edgewater Subdivision which would be required to satisfy signal warrants at this intersection will be assessed. No intermediate build-out conditions will be assessed for the intersection of Villa Maria Road and Kingsgate Drive as it is not projected to meet signal warrants for the full build-out of the Edgewater Subdivision.

Data points showing the combination of major street and minor street volumes are shown in **Figure 10** that correspond to the level of development (80%) and intermediate build-out year (2017) of the Edgewater Subdivision that meet Warrant 3.

Figure 10: Warrant 3 (2017) - Villa Maria Road and Autumn Lake Drive



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

An estimated 80% of development of the Edgewater Subdivision (approximately 525 dwelling units), assumed to be built by year 2017, will meet the requirement of a signal warrant.

ANALYSIS OF TURN LANES

The left turn lane analyses performed for this study are based on the TXDOT Roadway Design Manual [2] guidelines for left turn lanes. **Table 7** shows the existing and proposed volumes and left turn percentages for the two study intersections with the corresponding advancing volume from Table 3-11 in the Roadway Design Manual. For existing conditions, neither intersection meets the requirements for a left turn deceleration lane. For full build-out (2018) of the Edgewater Subdivision, the projected advancing volume will exceed the corresponding table value for advancing volume during the PM peak at Kingsgate Drive and during the AM and PM peak at Autumn Lake Drive. Therefore, both intersections can be considered for left turn deceleration lanes.

TABLE 7: Left Turn Lane Considerations

Turning Movement	Condition	Opposing Volume (vph)		% Left Turns		Advancing Volume (vph)		Table Value for Advancing Volume (vph)		Left Turn Considered?	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Eastbound Left at Villa Maria Rd & Kingsgate Drive	Existing (2012)	241	170	3%	3%	201	220	450	450	No	No
	Build-Out (2018)	367	370	8%	13%	229	330	330	270	No	Yes
Eastbound Left at Villa Maria Rd & Autumn Lake Drive	Existing (2012)	244	203	2%	2%	248	232	450	450	No	No
	Build-Out (2018)	362	540	7%	18%	336	344	270	160	Yes	Yes

In order to determine the operational effects of a left turn lane at the two study intersections, intersection measures of effectiveness (MOEs) were found using Synchro™ version 8.0. As shown in **Table 8**, the full build-out of the Edgewater Subdivision will result in very little queuing for vehicles turning left onto Kingsgate Drive or Autumn Lake Drive from Villa Maria Road. The intersection of Villa Maria Road and Autumn Lake Drive operates at a level of service 'F' for the PM peak in the build-out year, which is caused mostly by the delay experienced by the southbound traffic. The addition of an eastbound left turn lane has a very small impact on the overall operation of each intersection. Based on the projected volumes, neither intersection is expected to need a left turn lane for operational purposes. Analysis worksheets for existing and future conditions can be found in Appendix B and Appendix C, respectively.

TABLE 8: Left Turn Lane Operational Analysis

Turning Movement	MOEs	Existing (2012)		Build-Out (2018)		Build-Out w/ Left Turn Lanes (2018)	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Villa Maria Rd & Kingsgate Drive	LOS	A	A	C	A	C	A
	Delay (s)	1.7	0.6	24.1	5.5	23.9	5.3
	% Queue Free*	100%	100%	96%	95%	96%	95%
	95% Queue (ft)*	0	0	3	4	3	4
Villa Maria Rd & Autumn Lake Drive	LOS	A	A	F	B	F	B
	Delay (s)	1.8	0.5	150.5	10.8	150.2	10.5
	% Queue Free*	100%	100%	95%	91%	95%	91%
	95% Queue (veh)*	0	0	4	7	4	7

*For eastbound left turn movement only

CONCLUSIONS

The intersections of Villa Maria Road and Kingsgate Drive and Villa Maria Road and Autumn Lake Drive have been evaluated against the criteria contained in the Texas Manual on Uniform Control Devices to determine if traffic signal would be warranted at any of these intersections. The impacts of adding turn lanes to Villa Maria Road at the two intersections have also been assessed using the TXDOT Roadway Design Manual.

Based on the analysis of the traffic data collected in 2012, neither of these intersections satisfies the warrant criteria for signalization based on existing conditions. Left turn deceleration lanes do not need to be considered for existing conditions.

Using *ITE's Trip Generation, 9th Edition*, site trips were generated for the full build-out (2018) of the Edgewater Subdivision. Signal warrant analysis was then performed for the full build-out conditions. The intersection of Villa Maria Road and Autumn Lake Drive met Warrant 3 (Peak Hour Warrant), while the intersection of Villa Maria Road and Kingsgate did not meet signal warrants for the full build-out condition. Approximately 80% of the Edgewater Subdivision could be developed by 2017 before the intersection of Villa Maria Road and Autumn Lake Drive would meet signal warrants.

Although both study intersections meet the criteria for a left turn lane based on the TXDOT Roadway Design Manual, operationally a left turn deceleration lane is not necessary based on the delay and percent queue free expected for full build-out conditions. Since Villa Maria Road is a two-lane highway, a right turn deceleration lane is not considered at either intersection based on Roadway Design Manual recommendations.

REFERENCES

1. “Texas Manual on Uniform Traffic Control Devices,” Texas Department of Transportation, Austin, Texas, 2011.
2. "Roadway Design Manual," Texas Department of Transportation, Austin, Texas, 2010.
3. “Synchro”, Trafficware Corporation, Sugarland, Texas 2005.
4. Trip Generation, an Informal Report. 9th Edition, Institute of Transportation Engineers, Washington D.C., 2012.

APPENDIX A | Existing Traffic Counts

ALLIANCE TRANSPORTATION GROUP
11500 Metric Blvd, Bldg, M-1, Suite 150
Austin, TX 78758
(512) 821 - 2081

File Name: 101 -Kingsgate Dr & Villa Maria Rd

Start Date: Tuesday, December 04, 2012

	Kingsgate Dr					Villa Maria Rd					Kingsgate Dr					Villa Maria Rd					
	From North					From East					From South					From West					
Start Time	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Int Total
7:00 AM 7:15 AM	13	0	6	0	19	0	35	1	0	36	0	0	0	0	0	1	18	0	0	19	74
7:15 AM 7:30 AM	9	0	4	0	13	0	41	0	0	41	0	0	0	0	0	1	40	0	0	41	95
7:30 AM 7:45 AM	19	0	4	0	23	0	70	2	0	72	0	0	0	0	0	1	63	0	0	64	159
7:45 AM 8:00 AM	11	0	3	0	14	0	90	2	0	92	0	0	0	0	0	2	75	0	0	77	183
Total	52	0	17	0	69	0	236	5	0	241	0	0	0	0	0	5	196	0	0	201	511
8:00 AM 8:15 AM	10	0	2	0	12	0	50	1	0	51	0	0	0	0	0	3	43	0	0	46	109
8:15 AM 8:30 AM	2	0	0	0	2	0	29	1	0	30	0	0	0	0	0	0	26	0	0	26	58
8:30 AM 8:45 AM	1	0	0	0	1	0	36	2	0	38	0	0	0	0	0	0	19	0	0	19	58
8:45 AM 9:00 AM	5	0	1	0	6	0	32	3	0	35	0	0	0	0	0	0	18	0	0	18	59
Total	18	0	3	0	21	0	147	7	0	154	0	0	0	0	0	3	106	0	0	109	284
Grand Total	70	0	20	0	90	0	383	12	0	395	0	0	0	0	0	8	302	0	0	310	795
Apprch %	77.8	0.0	22.2			0.0	97.0	3.0			0.0	0.0	0.0			2.6	97.4	0.0			
Total %	8.8	0.0	2.5		11.3	0.0	48.2	1.5		49.7	0.0	0.0	0.0		0.0	1.0	38.0	0.0		39.0	

Peak Hour	Kingsgate Dr					Villa Maria Rd					Kingsgate Dr					Villa Maria Rd					
	From North					From East					From South					From West					
Start Time	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Int Total
7:00 AM 7:15 AM	13	0	6	0	19	0	35	1	0	36	0	0	0	0	0	1	18	0	0	19	74
7:15 AM 7:30 AM	9	0	4	0	13	0	41	0	0	41	0	0	0	0	0	1	40	0	0	41	95
7:30 AM 7:45 AM	19	0	4	0	23	0	70	2	0	72	0	0	0	0	0	1	63	0	0	64	159
7:45 AM 8:00 AM	11	0	3	0	14	0	90	2	0	92	0	0	0	0	0	2	75	0	0	77	183
Total	52	0	17	0	69	0	236	5	0	241	0	0	0	0	0	5	196	0	0	201	511
Apprch %	75.4	0.0	24.6			0.0	97.9	2.1			0.0	0.0	0.0			2.5	97.5	0.0			
PHF	0.68	0.00	0.71	0.00	0.75	0.00	0.66	0.63	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.63	0.65	0.00	0.00	0.65	0.70

ALLIANCE TRANSPORTATION GROUP
11500 Metric Blvd, Bldg, M-1, Suite 150
Austin, TX 78758
(512) 821 - 2081

File Name: 101 -Kingsgate Dr & Villa Maria Rd

Start Date: Tuesday, December 04, 2012

	Kingsgate Dr					Villa Maria Rd					Kingsgate Dr					Villa Maria Rd					
	From North					From East					From South					From West					
Start Time	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Int Total
4:00 PM 4:15 PM	3	0	2	0	5	0	32	8	0	40	0	0	0	0	0	3	72	0	0	75	120
4:15 PM 4:30 PM	4	0	1	0	5	0	31	9	0	40	0	0	0	0	0	0	58	0	0	58	103
4:30 PM 4:45 PM	4	0	0	0	4	0	45	7	0	52	0	0	0	0	0	3	42	0	0	45	101
4:45 PM 5:00 PM	5	0	0	0	5	0	33	5	0	38	0	0	0	0	0	0	42	0	0	42	85
Total	16	0	3	0	19	0	141	29	0	170	0	0	0	0	0	6	214	0	0	220	409
5:00 PM 5:15 PM	5	0	0	0	5	0	33	16	0	49	0	0	0	0	0	3	73	0	0	76	130
5:15 PM 5:30 PM	6	0	0	0	6	0	47	3	0	50	0	0	0	0	0	1	50	0	0	51	107
5:30 PM 5:45 PM	9	0	4	0	13	0	34	10	0	44	0	0	0	0	0	2	43	0	0	45	102
5:45 PM 6:00 PM	2	0	1	0	3	0	35	10	0	45	0	0	0	0	0	3	21	0	0	24	72
Total	22	0	5	0	27	0	149	39	0	188	0	0	0	0	0	9	187	0	0	196	411
Grand Total	38	0	8	0	46	0	290	68	0	358	0	0	0	0	0	15	401	0	0	416	820
Apprch %	82.6	0.0	17.4			0.0	81.0	19.0			0.0	0.0	0.0			3.6	96.4	0.0			
Total %	4.6	0.0	1.0		5.6	0.0	35.4	8.3		43.7	0.0	0.0	0.0		0.0	1.8	48.9	0.0		50.7	

Peak Hour	Kingsgate Dr					Villa Maria Rd					Kingsgate Dr					Villa Maria Rd					
	From North					From East					From South					From West					
Start Time	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Int Total
4:00 PM 4:15 PM	3	0	2	0	5	0	32	8	0	40	0	0	0	0	0	3	72	0	0	75	120
4:15 PM 4:30 PM	4	0	1	0	5	0	31	9	0	40	0	0	0	0	0	0	58	0	0	58	103
4:30 PM 4:45 PM	4	0	0	0	4	0	45	7	0	52	0	0	0	0	0	3	42	0	0	45	101
4:45 PM 5:00 PM	5	0	0	0	5	0	33	5	0	38	0	0	0	0	0	0	42	0	0	42	85
Total	16	0	3	0	19	0	141	29	0	170	0	0	0	0	0	6	214	0	0	220	409
Apprch %	84.2	0.0	15.8			0.0	82.9	17.1			0.0	0.0	0.0			2.7	97.3	0.0			
PHF	0.80	0.00	0.38	0.00	0.95	0.00	0.78	0.81	0.00	0.82	0.00	0.00	0.00	0.00	0.00	0.50	0.74	0.00	0.00	0.73	0.85

ALLIANCE TRANSPORTATION GROUP
11500 Metric Blvd, Bldg, M-1, Suite 150
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(512) 821 - 2081

File Name: 102 -Autumn Lake Dr & Villa Maria Rd

Start Date: Tuesday, December 04, 2012

	Autumn Lake Dr					Villa Maria Rd					Autumn Lake Dr					Villa Maria Rd					
	From North					From East					From South					From West					
Start Time	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Int Total
7:00 AM 7:15 AM	13	0	1	0	14	0	38	1	0	39	0	0	0	0	0	1	29	0	0	30	83
7:15 AM 7:30 AM	21	0	3	0	24	0	36	3	0	39	0	0	0	0	0	0	50	0	0	50	113
7:30 AM 7:45 AM	19	0	3	0	22	0	70	5	0	75	0	0	0	0	0	3	80	0	0	83	180
7:45 AM 8:00 AM	15	0	2	0	17	0	87	4	0	91	0	0	0	0	0	0	85	0	0	85	193
Total	68	0	9	0	77	0	231	13	0	244	0	0	0	0	0	4	244	0	0	248	569
8:00 AM 8:15 AM	10	0	3	0	13	0	46	4	0	50	0	0	0	0	0	0	52	0	0	52	115
8:15 AM 8:30 AM	3	0	0	0	3	0	32	7	0	39	0	0	0	0	0	0	28	0	0	28	70
8:30 AM 8:45 AM	2	0	2	0	4	0	39	0	0	39	0	0	0	0	0	0	21	0	0	21	64
8:45 AM 9:00 AM	9	0	0	0	9	0	37	2	0	39	0	0	0	0	0	0	19	0	0	19	67
Total	24	0	5	0	29	0	154	13	0	167	0	0	0	0	0	0	120	0	0	120	316
Grand Total	92	0	14	0	106	0	385	26	0	411	0	0	0	0	0	4	364	0	0	368	885
Apprch %	86.8	0.0	13.2			0.0	93.7	6.3			0.0	0.0	0.0			1.1	98.9	0.0			
Total %	10.4	0.0	1.6		12.0	0.0	43.5	2.9		46.4	0.0	0.0	0.0		0.0	0.5	41.1	0.0		41.6	

Peak Hour	Autumn Lake Dr					Villa Maria Rd					Autumn Lake Dr					Villa Maria Rd					
	From North					From East					From South					From West					
Start Time	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Int Total
7:00 AM 7:15 AM	13	0	1	0	14	0	38	1	0	39	0	0	0	0	0	1	29	0	0	30	83
7:15 AM 7:30 AM	21	0	3	0	24	0	36	3	0	39	0	0	0	0	0	0	50	0	0	50	113
7:30 AM 7:45 AM	19	0	3	0	22	0	70	5	0	75	0	0	0	0	0	3	80	0	0	83	180
7:45 AM 8:00 AM	15	0	2	0	17	0	87	4	0	91	0	0	0	0	0	0	85	0	0	85	193
Total	68	0	9	0	77	0	231	13	0	244	0	0	0	0	0	4	244	0	0	248	569
Apprch %	88.3	0.0	11.7			0.0	94.7	5.3			0.0	0.0	0.0			1.6	98.4	0.0			
PHF	0.81	0.00	0.75	0.00	0.80	0.00	0.66	0.65	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.33	0.72	0.00	0.00	0.73	0.74

ALLIANCE TRANSPORTATION GROUP
11500 Metric Blvd, Bldg, M-1, Suite 150
Austin, TX 78758
(512) 821 - 2081

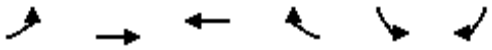
File Name: 102 -Autumn Lake Dr & Villa Maria Rd

Start Date: Tuesday, December 04, 2012

	Autumn Lake Dr					Villa Maria Rd					Autumn Lake Dr					Villa Maria Rd					
	From North					From East					From South					From West					
Start Time	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Int Total
4:00 PM 4:15 PM	4	0	1	0	5	0	36	8	0	44	0	0	0	0	0	3	73	0	0	76	125
4:15 PM 4:30 PM	1	0	1	0	2	0	41	10	0	51	0	0	0	0	0	0	63	0	0	63	116
4:30 PM 4:45 PM	5	0	2	0	7	0	47	9	0	56	0	0	0	0	0	0	45	0	0	45	108
4:45 PM 5:00 PM	4	0	1	0	5	0	38	14	0	52	0	0	0	0	0	1	47	0	0	48	105
Total	14	0	5	0	19	0	162	41	0	203	0	0	0	0	0	4	228	0	0	232	454
5:00 PM 5:15 PM	8	0	0	0	8	0	46	6	0	52	0	0	0	0	0	3	72	0	0	75	135
5:15 PM 5:30 PM	4	0	0	0	4	0	51	16	0	67	0	0	0	0	0	1	54	0	0	55	126
5:30 PM 5:45 PM	6	0	0	0	6	0	42	12	0	54	0	0	0	0	0	2	50	0	0	52	112
5:45 PM 6:00 PM	5	0	0	0	5	0	44	8	0	52	0	0	0	0	0	0	22	0	0	22	79
Total	23	0	0	0	23	0	183	42	0	225	0	0	0	0	0	6	198	0	0	204	452
Grand Total	37	0	5	0	42	0	345	83	0	428	0	0	0	0	0	10	426	0	0	436	906
Apprch %	88.1	0.0	11.9			0.0	80.6	19.4			0.0	0.0	0.0			2.3	97.7	0.0			
Total %	4.1	0.0	0.6		4.6	0.0	38.1	9.2		47.2	0.0	0.0	0.0		0.0	1.1	47.0	0.0		48.1	

Peak Hour	Autumn Lake Dr					Villa Maria Rd					Autumn Lake Dr					Villa Maria Rd					
	From North					From East					From South					From West					
Start Time	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Left	Thru	Right	U-turns	App Total	Int Total
4:00 PM 4:15 PM	4	0	1	0	5	0	36	8	0	44	0	0	0	0	0	3	73	0	0	76	125
4:15 PM 4:30 PM	1	0	1	0	2	0	41	10	0	51	0	0	0	0	0	0	63	0	0	63	116
4:30 PM 4:45 PM	5	0	2	0	7	0	47	9	0	56	0	0	0	0	0	0	45	0	0	45	108
4:45 PM 5:00 PM	4	0	1	0	5	0	38	14	0	52	0	0	0	0	0	1	47	0	0	48	105
Total	14	0	5	0	19	0	162	41	0	203	0	0	0	0	0	4	228	0	0	232	454
Apprch %	73.7	0.0	26.3			0.0	79.8	20.2			0.0	0.0	0.0			1.7	98.3	0.0			
PHF	0.70	0.00	0.63	0.00	0.68	0.00	0.86	0.73	0.00	0.91	0.00	0.00	0.00	0.00	0.00	0.33	0.78	0.00	0.00	0.76	0.91

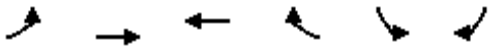
APPENDIX B | Left Turn Lane Analysis- Existing Conditions (2012)



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	5	196	236	5	52	17
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	213	257	5	57	18
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						12
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	262				483	259
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	262				483	259
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				90	98
cM capacity (veh/h)	1302				540	779

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	218	262	75
Volume Left	5	0	57
Volume Right	0	5	18
cSH	1302	1700	717
Volume to Capacity	0.00	0.15	0.10
Queue Length 95th (ft)	0	0	9
Control Delay (s)	0.2	0.0	11.8
Lane LOS	A		B
Approach Delay (s)	0.2	0.0	11.8
Approach LOS			B

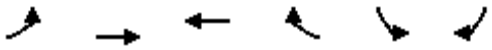
Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	24.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	4	244	231	13	68	9
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	265	251	14	74	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	265				532	258
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	265				532	258
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				85	99
cM capacity (veh/h)	1299				506	780

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	270	265	84
Volume Left	4	0	74
Volume Right	0	14	10
cSH	1299	1700	528
Volume to Capacity	0.00	0.16	0.16
Queue Length 95th (ft)	0	0	14
Control Delay (s)	0.2	0.0	13.1
Lane LOS	A		B
Approach Delay (s)	0.2	0.0	13.1
Approach LOS			B

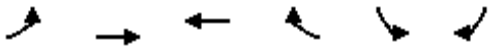
Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	27.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	6	214	141	29	16	3
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	233	153	32	17	3
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	185				415	169
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	185				415	169
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				97	100
cM capacity (veh/h)	1390				591	875

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	239	185	17	3
Volume Left	7	0	17	0
Volume Right	0	32	0	3
cSH	1390	1700	591	875
Volume to Capacity	0.00	0.11	0.03	0.00
Queue Length 95th (ft)	0	0	2	0
Control Delay (s)	0.2	0.0	11.3	9.1
Lane LOS	A		B	A
Approach Delay (s)	0.2	0.0	10.9	
Approach LOS			B	

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	26.1%	ICU Level of Service	A
Analysis Period (min)	15		

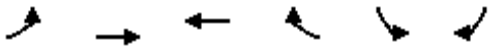


Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	4	228	162	41	14	5
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	248	176	45	15	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	221				455	198
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	221				455	198
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				97	99
cM capacity (veh/h)	1349				561	843

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	252	221	21
Volume Left	4	0	15
Volume Right	0	45	5
cSH	1349	1700	615
Volume to Capacity	0.00	0.13	0.03
Queue Length 95th (ft)	0	0	3
Control Delay (s)	0.2	0.0	11.1
Lane LOS	A		B
Approach Delay (s)	0.2	0.0	11.1
Approach LOS			B

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	25.2%	ICU Level of Service	A
Analysis Period (min)	15		

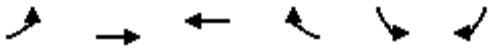
APPENDIX C | Left Turn Lane Analysis- Future Conditions (2018)



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	20	229	326	41	130	48
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.56	0.56	0.57	0.57	0.52	0.52
Hourly flow rate (vph)	36	409	572	72	250	92
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	644				1088	608
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	644				1088	608
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				0	81
cM capacity (veh/h)	941				230	496

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	445	644	250	92
Volume Left	36	0	250	0
Volume Right	0	72	0	92
cSH	941	1700	230	496
Volume to Capacity	0.04	0.38	1.09	0.19
Queue Length 95th (ft)	3	0	276	17
Control Delay (s)	1.1	0.0	130.5	13.9
Lane LOS	A		F	B
Approach Delay (s)	1.1	0.0	99.1	
Approach LOS			F	

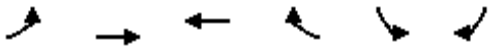
Intersection Summary			
Average Delay	24.1		
Intersection Capacity Utilization	42.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	26	336	293	69	186	73
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.57	0.57	0.60	0.60	0.54	0.54
Hourly flow rate (vph)	46	589	488	115	344	135
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	603				1227	546
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	603				1227	546
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	95				0	75
cM capacity (veh/h)	974				188	538

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	635	603	480
Volume Left	46	0	344
Volume Right	0	115	135
cSH	974	1700	230
Volume to Capacity	0.05	0.35	2.08
Queue Length 95th (ft)	4	0	904
Control Delay (s)	1.2	0.0	537.3
Lane LOS	A		F
Approach Delay (s)	1.2	0.0	537.3
Approach LOS			F

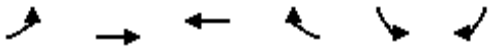
Intersection Summary			
Average Delay	150.5		
Intersection Capacity Utilization	60.5%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	51	330	226	144	91	31
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.82	0.82	0.91	0.91	0.56	0.56
Hourly flow rate (vph)	62	402	248	158	162	55
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	407				854	327
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	407				854	327
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	95				48	92
cM capacity (veh/h)	1152				311	714

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	465	407	162	55
Volume Left	62	0	162	0
Volume Right	0	158	0	55
cSH	1152	1700	311	714
Volume to Capacity	0.05	0.24	0.52	0.08
Queue Length 95th (ft)	4	0	71	6
Control Delay (s)	1.6	0.0	28.5	10.5
Lane LOS	A		D	B
Approach Delay (s)	1.6	0.0	24.0	
Approach LOS			C	

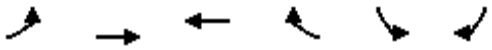
Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	55.9%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	74	344	327	213	117	39
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.89	0.89	0.84	0.84	0.72	0.72
Hourly flow rate (vph)	83	387	389	254	162	54
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	643				1069	516
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	643				1069	516
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	91				27	90
cM capacity (veh/h)	942				224	559

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	470	643	217
Volume Left	83	0	162
Volume Right	0	254	54
cSH	942	1700	263
Volume to Capacity	0.09	0.38	0.82
Queue Length 95th (ft)	7	0	164
Control Delay (s)	2.5	0.0	60.6
Lane LOS	A		F
Approach Delay (s)	2.5	0.0	60.6
Approach LOS			F

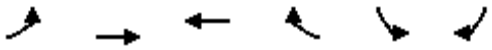
Intersection Summary			
Average Delay	10.8		
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	20	229	326	41	130	48
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.56	0.56	0.57	0.57	0.52	0.52
Hourly flow rate (vph)	36	409	572	72	250	92
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	644				1088	608
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	644				1088	608
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				0	81
cM capacity (veh/h)	941				230	496

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	36	409	644	250	92
Volume Left	36	0	0	250	0
Volume Right	0	0	72	0	92
cSH	941	1700	1700	230	496
Volume to Capacity	0.04	0.24	0.38	1.09	0.19
Queue Length 95th (ft)	3	0	0	276	17
Control Delay (s)	9.0	0.0	0.0	130.5	13.9
Lane LOS	A			F	B
Approach Delay (s)	0.7		0.0	99.1	
Approach LOS				F	

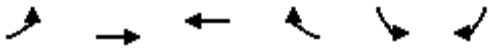
Intersection Summary			
Average Delay	23.9		
Intersection Capacity Utilization	33.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	26	336	293	69	186	73
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.57	0.57	0.60	0.60	0.54	0.54
Hourly flow rate (vph)	46	589	488	115	344	135
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	603				1227	546
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	603				1227	546
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	95				0	75
cM capacity (veh/h)	974				188	538

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	46	589	603	480
Volume Left	46	0	0	344
Volume Right	0	0	115	135
cSH	974	1700	1700	230
Volume to Capacity	0.05	0.35	0.35	2.08
Queue Length 95th (ft)	4	0	0	904
Control Delay (s)	8.9	0.0	0.0	537.3
Lane LOS	A			F
Approach Delay (s)	0.6		0.0	537.3
Approach LOS				F

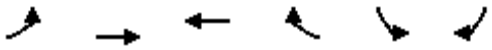
Intersection Summary			
Average Delay	150.2		
Intersection Capacity Utilization	43.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	51	330	226	144	91	31
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.82	0.82	0.91	0.91	0.56	0.56
Hourly flow rate (vph)	62	402	248	158	162	55
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	407				854	327
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	407				854	327
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	95				48	92
cM capacity (veh/h)	1152				311	714

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	62	402	407	162	55
Volume Left	62	0	0	162	0
Volume Right	0	0	158	0	55
cSH	1152	1700	1700	311	714
Volume to Capacity	0.05	0.24	0.24	0.52	0.08
Queue Length 95th (ft)	4	0	0	71	6
Control Delay (s)	8.3	0.0	0.0	28.5	10.5
Lane LOS	A			D	B
Approach Delay (s)	1.1		0.0	24.0	
Approach LOS				C	

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	39.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	74	344	327	213	117	39
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.89	0.89	0.84	0.84	0.72	0.72
Hourly flow rate (vph)	83	387	389	254	162	54
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	643				1069	516
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	643				1069	516
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	91				27	90
cM capacity (veh/h)	942				224	559

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	83	387	643	217
Volume Left	83	0	0	162
Volume Right	0	0	254	54
cSH	942	1700	1700	263
Volume to Capacity	0.09	0.23	0.38	0.82
Queue Length 95th (ft)	7	0	0	164
Control Delay (s)	9.2	0.0	0.0	60.6
Lane LOS	A			F
Approach Delay (s)	1.6		0.0	60.6
Approach LOS				F

Intersection Summary			
Average Delay	10.5		
Intersection Capacity Utilization	53.2%	ICU Level of Service	A
Analysis Period (min)	15		