Traffic Impact Study

WALDEN GROCERY STORE

WALDEN, TENNESSEE

Prepared for:

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This report presents the results of a traffic impact study prepared in support of a proposed grocery store and retail development at the northwest corner of Timesville Road and Taft Highway in Walden, Tennessee.

This report assesses projected traffic operations with and without the site in place and uses this comparison to determine whether the proposed development has a detrimental impact on the study area.

Proposed Development

The details of the proposed development are shown in Table 1.

Table 1: Proposed Development Program

Development	**Walden Grocery Store**			
Full-Build Year	2024			
Existing Lane Use(s)	Greenhouse			
Proposed Land Use(s)	43,987 sf Supermarket 4,500 sf Apparel Store 4,000 sf Variety Store 1,500 sf Office			
Access Point(s)	***Access #***	***At***	***Control***	***Movement***
	1	Taft Highway	Side Street Stop	Full
	2	Timesville Road	Side Street Stop	Full
Estimated Site Trips	***Weekday***	***AM***	***PM***	
	4,906	189 (new)	312 (new) 161 (pass-by)	

Projected Traffic Impacts

In order to assess the impacts of the proposed development, this study examined three traffic analysis scenarios:

- **2019 Existing Conditions**, based on current traffic volumes, lane configuration, and traffic control; discussed in Chapter 3
- **2024 Future No-Build Conditions**, which includes 5 years of background growth and any background developments; discussed in Chapter 4
- **2024 Future Full-Build,** which incorporates all projected future traffic passing through the study area, including future no-build growth as well as site-generated traffic; discussed in Chapter 6

These scenarios and their underlying assumptions are discussed in subsequent chapters as noted above. Intersection capacity and queuing analyses were conducted across peak hours and all analysis scenarios using HCM methodology.

Findings and Recommendations

This assessment finds that there are two turning movements that are negatively impacted by the development:

Eastbound Left Turn on Site Access 1 at Taft Highway, PM Peak hour

This turning movement is expected to operate at LOS F.

Eastbound Approach of Timesville Road at Taft Highway, PM Peak hour

This turning movement is expected to deteriorate from LOS C to LOS F. This development is expected to generate 61 vehicles at this approach in this peak hour, or 68.5% of the overall movement.

Inbound Turning Movements on Taft Highway at Site Access 1

According to NCHRP 457 analysis, a northbound left turn lane and southbound right tun lane are warranted on Taft Highway at Site Access 1 in both peak hours. Although operationally the proposed turns don't cause the intersection to fail, they do add delay to the mainline and are warranted for safety and operational concerns as outlined in NCHRP 457.

Poor LOS is expected at stop-controlled approaches to arterials such as Taft Highway.

As a result, the overall finding of this report is that the traffic impacts of the site are evident but can be addressed by the recommendations below.

The following recommendations are expected to ensure effective and safe traffic operations within the study area:

- Design all proposed internal and external roadways according to standards found within *A Policy on Geometric Design of Highways and Streets*, AASHTO, 7th Edition.
- Ensure adequate sight distance available for Site Accesses 1 and 2 according to methods found within *A Policy on Geometric Design of Highways and Streets*, AASHTO, 7th Edition, providing a minimum of 445 feet to the north of Site Access 1, 385 feet to the south of Site Access 1, 290 feet to the east of Site Access 2, and 335 feet to the west of Site Access 2.
- Install eastbound left turn lane with a minimum of 75 feet of storage at the intersection of Taft Highway and Timesville Road**.**
- Monitor potential pedestrian traffic crossing Taft Highway between the proposed development and retail on the east side of Taft Highway. Although negligible pedestrian traffic is expected, if noticeable pedestrian traffic is observed, a safe pedestrian crossing

needs to be installed, with shared responsibility between TDOT and the proposed development.

- Ensure internal circulation allows a minimum of 100 feet of storage space for the eastbound approach of Site Access 1 at Taft Highway before any internal intersection.
- Install inbound southbound right turn and northbound left turn lanes on Taft Highway at Site Access 1, providing a minimum of 50 feet of storage. Turn lanes to be designed according to standards found within *A Policy on Geometric Design of Highways and Streets*, AASHTO, 7th Edition.

1. INTRODUCTION

This chapter provides a description of the proposed project, the surrounding regional context, and discusses the analysis process that will be used to determine what impacts, if any, the proposed project will have on the surrounding roadway network.

The following study references the previous traffic impact study prepared by Meyer Transportation Consultants for the developer, Grant, Konvalinka & Harrison, P.C., sealed April 23, 2019. This previous study will be referred to as the reference study, and the methods within that study will be evaluated within the following report.

Proposed Development Program

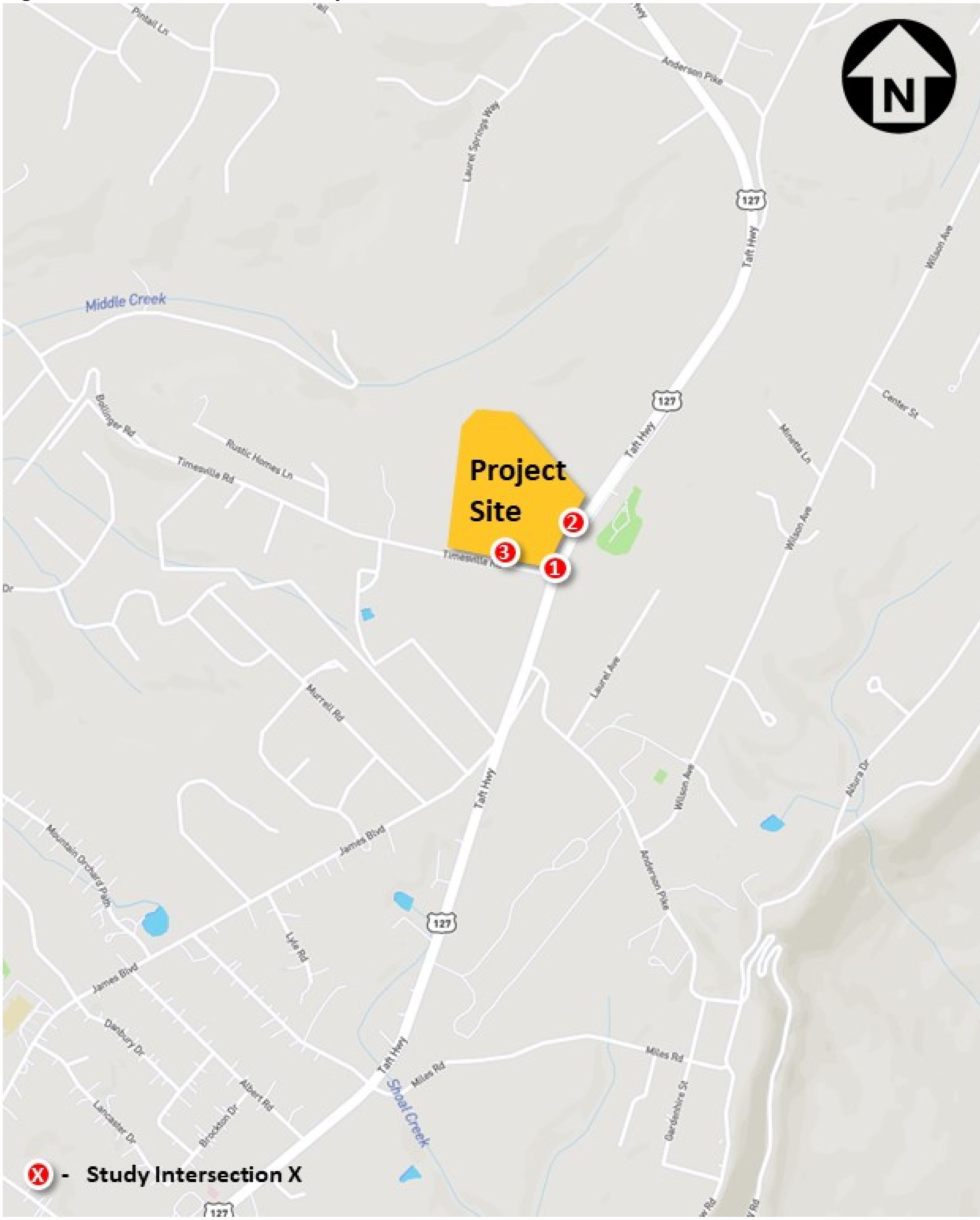
Location and details of the proposed development program as presented in the reference study are shown in Table 2.

Table 2: Proposed Development Program

Development	**Walden Grocery Store**			
Full-Build Year	2024			
Existing Lane Use(s)	Greenhouse			
Proposed Land Use(s)	43,987 sf Supermarket 4,500 sf Apparel Store 4,000 sf Variety Store 1,500 sf Office			
Access Point(s)	***Access #***	***At***	***Control***	***Movement***
	1	Taft Highway	Side Street Stop	Full
	2	Timesville Road	Side Street Stop	Full
Estimated Site Trips	***Weekday***	***AM***	***PM***	
	4,906	189 (new)	312 (new) 161 (pass-by)	

A map showing the location of the site is included as Figure 1. More information about the site, including the internal configuration and access, is included in Chapter 5.

Figure 1. Site Location and Study Area Intersections



Background Imagery: Openstreetmaps

Regional Context

The site is located along the Taft Highway corridor, in Signal Mountain, Tennessee. The development site will be configured to face Taft Highway and the site's primary access points will be on Taft Highway and Timesville Road. A detailed discussion of the existing roadway network serving the site is provided in Chapter 2.

Planned Transportation Improvement Projects

There were no planned changes to the vehicle network of public roadways in the study area identified by the reference study.

Nearby Background Development Projects

There were no background development projects provided in the reference study.

Analysis Goals and Approach

The purpose of this report is to determine what impacts, if any, the proposed project will have on traffic operations and roadway infrastructure in the vicinity of the project site.

This determination is conducted through a series of traffic impact analyses which will compare calculated traffic performance metrics between Future No-Build and Future Full-Build conditions with the development. Comparing these two scenarios allows for the impacts of the development to be identified independent of other traffic growth occurring around the study area or in the broader region.

Analysis Methodology

The impact of the site on traffic volumes throughout the study area is determined by calculating the number of new vehicle trips generated by the proposed development site using the *Trip Generation Manual*, 10th edition, published by the Institute of Transportation Engineers (ITE). This industry-standard reference provides a detailed catalog of trip generation rates for various land uses, collected at numerous sites across the country over the course of many decades.

These site-generated traffic volumes are then used in conjunction with traffic counts conducted within the study area to determine the projected volumes under existing, future no-build, and future full-build conditions. A series of traffic models are then built based on these volumes, along with the known roadway laneage and traffic control within the study area, in order to calculate expected intersection capacity and queuing performance metrics. These performance metrics are calculated using industry-standard methodology developed by the Transportation Research Board of the National Academies of Sciences and published in the HCM (Highway Capacity Manual). The analyses that follow are conducted using the HCM 6th Edition methodology, as implemented in Synchro version 11.

Determination of Impacts and Mitigations

If this assessment finds any site-specific impacts that require mitigation, this report will identify potential mitigation strategies that could bring the affected intersection or approach back into compliance with town standards. Possible mitigation strategies include but are not limited to:

- Modifications to traffic control;
- Alterations to traffic signal timings and/or phasing;
- Modifications to intersection geometry or site access configuration, including the addition of through lanes or auxiliary turn lanes; and/or
- Expansion of available queueing space.

Any mitigation strategies will be assessed to determine their feasibility and suitability for both the study area and the specific impact identified by the traffic analyses. Any strategies that pass this assessment will be highlighted as recommended mitigation strategies.

2. STUDY AREA EVALUATION

This chapter provides an overview of the major analysis assumptions for the study area and analysis scenarios.

Study Area

The study area for this assessment was taken from the reference study. The study area for this analysis will include the following intersections:

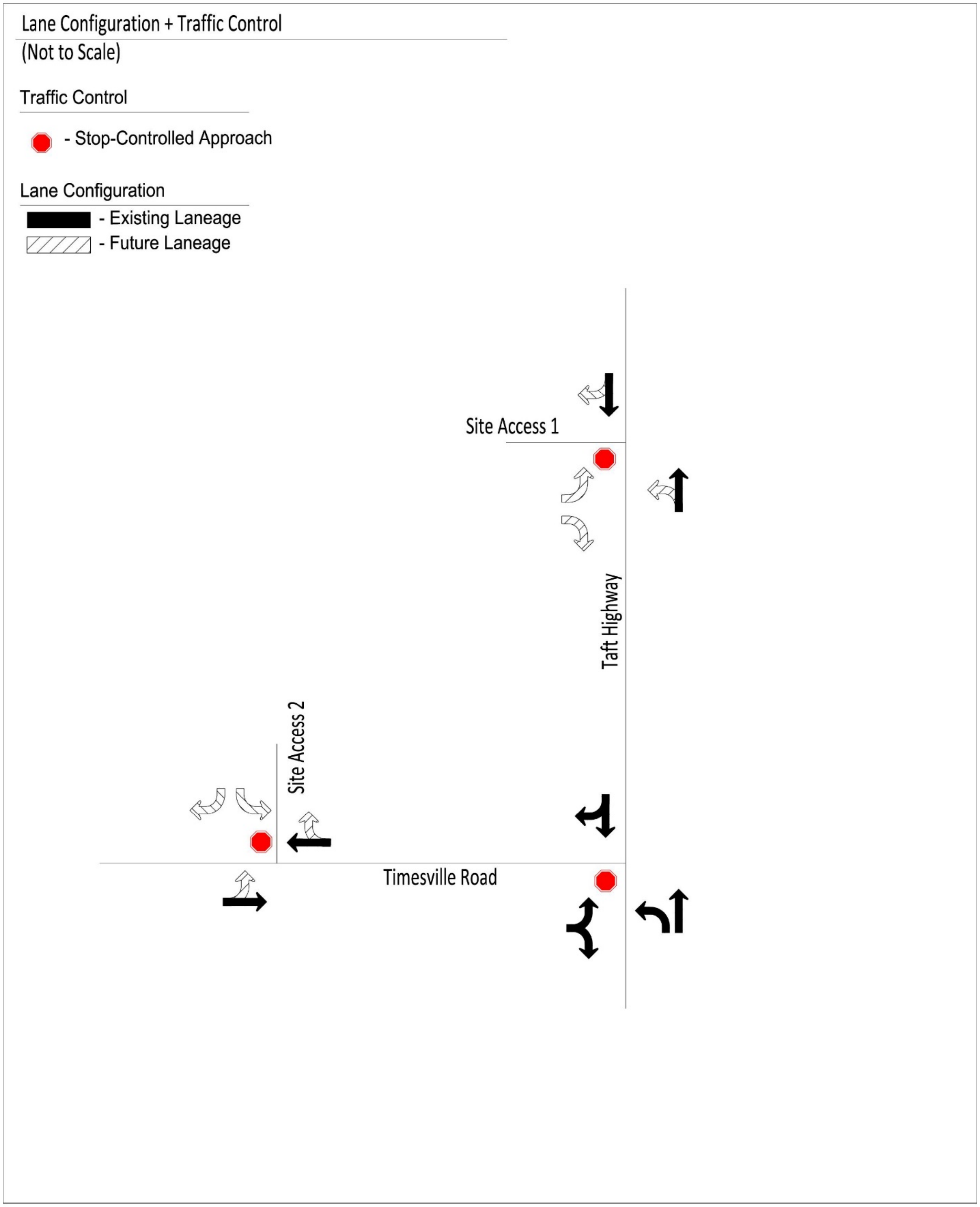
1. Taft Highway & Timesville Road
2. Taft Highway & Site Access 1 *(future intersection)*
3. Timesville Road & Site Access 2 *(future intersection)*

The study area intersections, as well as the location of the proposed development, are shown in Figure 1 in Chapter 1. An annotated site plan showing the planned site layout, internal circulation, and site access points is included as Figure 5 in Chapter 5.

Existing Intersection Geometry and Traffic Control

An inventory of roadway geometry within the study area was conducted in order to determine the laneage and traffic control present at the study area intersections. Figure 2 shows a summary of the existing conditions present within the study area, including the proposed configuration of the development site's access points. This roadway configuration is used as the basis for the intersection analyses that will be conducted in the following chapters. Note that the site plan shows a northbound left turn lane on Taft Highway, but the approach was considered a shared through/left to evaluate the need for a left turn lane.

Figure 2. Existing Lane Configuration and Traffic Control



Roadway Configuration

Descriptions of the roadways within the study area are as follows:

Taft Highway | US 127 | SR 8		
Direction		Two-Way North/South
Lane(s) Each Direction		One (1)
Median		None
Classification		Minor Arterial
Posted Speed Limit		40 MPH
Connects	***North***	Walden, TN
	South	Signal Mountain Road/US 27
Local Transit Stops		None
Bike Facilities		None
On-Street Parking		Angled parking on east side at Timesville Road
Pedestrian Service		None
Notes		Becomes Signal Mountain Road to the south, the primary road down Signal Mountain and leads to the major arterial US 27.

Taft Highway, looking south
(development site to right)

Timesville Road		
Direction		Two-Way East-West
Lane(s) Each Direction		One (1)
Median		None
Classification		Local Street
Posted Speed Limit		30 MPH
Connects	***East***	Taft Highway
	West	Residential
Local Transit Stops		None
Bike Facilities		None
On-Street Parking		None
Pedestrian Service		None
Notes		Dead end residential street

Timesville Road, looking east
(development site to north)

Traffic Control

A description of the intersection within the study area is as follows:

Taft Highway & Timesville Road								
				Speed	Pedestrian Service			
Street	**Approach**	**Laneage [storage]**	**Traffic Control**	**Limit**	**Leg**	**Ramp**	**Crosswalk**	**Signal**
Taft Highway	*Northbound*	1 x LT [55 ft to TWLTL] 1 x Thru	None	40 mph	*South*	--	--	--
Taft Highway	*Southbound*	1 x Thru/RT	None	40 mph	*North*	--	--	--
Timesville Road	*Eastbound*	1 x LT/Thru/RT	Stop	30 mph	*West*	--	--	--
Notes	East side of intersection is angled parking for retail							
RT: Right-Turn Lane		*LT: Left-Turn Lane*		*Thru: Through Lane*		*TWLTL: Two-Way Left-Turn Lane*		

Lane configuration and traffic control within the study area are shown in Figure 2.

Study Area Traffic Characteristics

Peak Hours	8:00 – 9:00 AM 5:00– 6:00 PM
TDOT Count Stations	000445 – Taft Highway
Observed Traffic Growth 2009 - 2018	+2.02%
Report Year	2019
Full-Build Year	2024

An understanding of travel patterns and traffic growth is an important element of this traffic assessment. These items will be discussed in more detail later in this report, but this section provides a contextual overview.

Existing Multimodal Facilities

As expected in a suburban mountainous area like this, the streets within the study area have no sidewalk facilities, except for storefronts. There are no nearby bicycle facilities or transit services.

Future Multimodal Facilities

No multimodal facilities are planned in the area.

3. EXISTING TRAFFIC CONDITIONS

This chapter provides a review of existing traffic conditions within the study area, building upon the discussion of the existing study area contained in Chapter 2. This includes the results of collected data quantifying existing traffic volumes. This data is then incorporated into a traffic model in order to calculate expected intersection delay and queuing as part of the existing conditions capacity analysis.

Existing Traffic Volumes

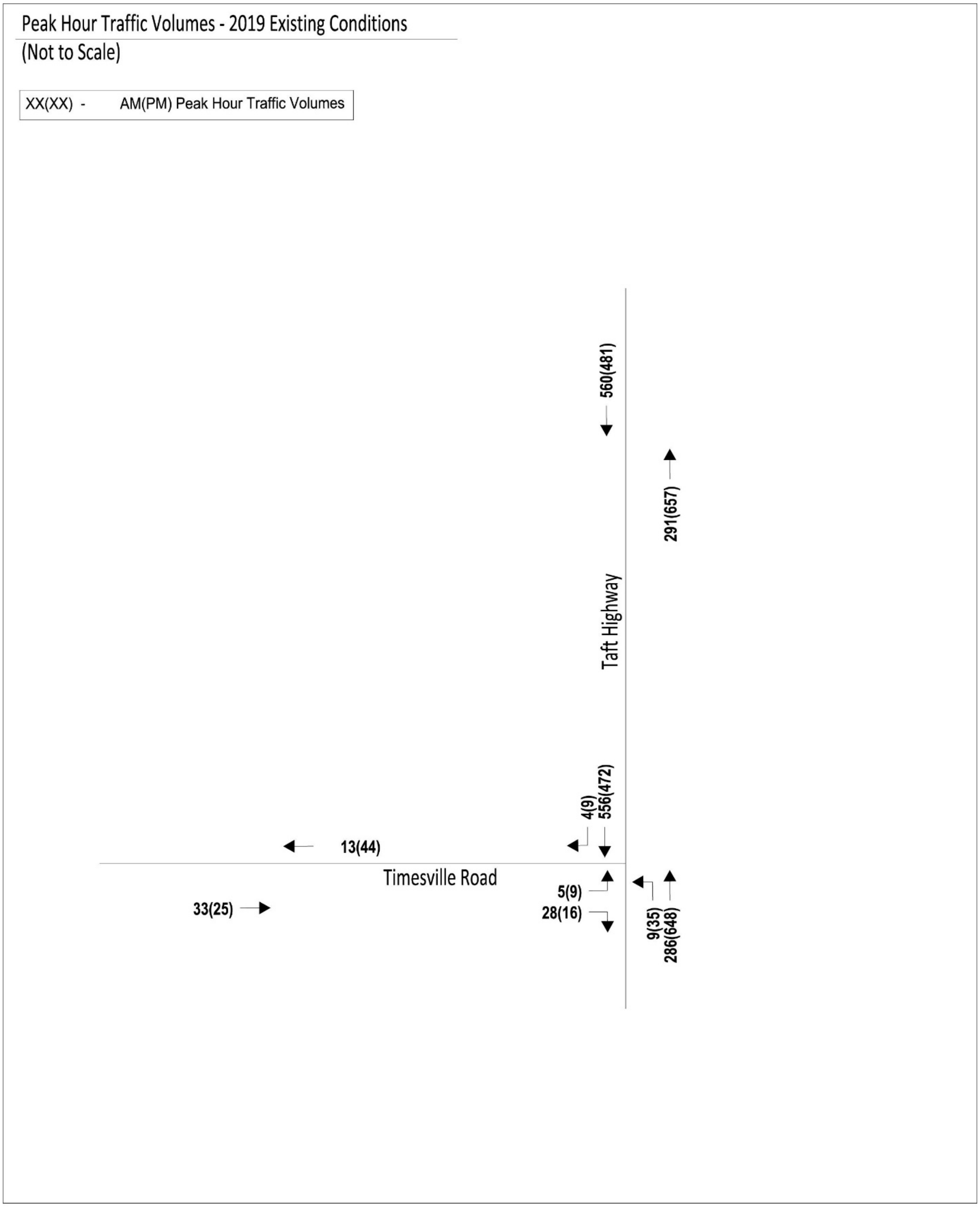
Traffic data was received from the reference study for the existing study area intersection conducted on April 11, 2019. Vehicle turning movement and classification counts were conducted during a morning rush period from 7:00 - 9:00 AM and an evening rush from 4:00 - 6:00 PM. A figure of the 2019 data is included in Figure 3.

Due to the ongoing effects of the COVID-19 pandemic quarantine, at the time of writing this study existing traffic counts are not considered reliable. However, traffic counts were conducted on July 22, 2020, when local schools were closed, and the state had enacted quarantine guidelines. Peak hour traffic volumes were substantially lower than 2019 volumes, approximately a 20% decrease. This is not surprising, and not radically different to invalidate 2019 volumes. For purposes in this study, the 2019 volumes were used.

Raw data from the counts are included as Appendix A.

All study intersections will be analyzed during the peak hour of each individual intersection within the AM and PM peak periods. For this reason, the traffic volumes presented in Figure 3 do not balance between adjacent intersections.

Figure 3. Peak Hour Traffic Volumes: 2019 Existing Conditions



Intersection Capacity Analysis

The study intersections were analyzed to determine how they operate in existing conditions. Traffic studies typically assess automobile traffic service quality in terms of capacity impact, which can be calculated qualitatively using industry-standard methodologies and models. This section discusses the performance metrics used in this report before presenting the results of the existing conditions capacity analysis.

Traffic Impact Thresholds

Delay and LOS (Level of Service)

The primary service quality measure used in traffic analysis is the average delay, in seconds, experienced by a vehicle at a given intersection. For two-way stop-controlled intersections, delays can be calculated for all minor street lane groups as well as non-free-flow movements on the major street which may experience delay, such as left-turning movements. At all other intersection types, delay can be calculated for all lane groups as well as for the overall intersection.

Delay can further be summarized in terms of LOS, a letter grade based on the calculated delay that ranges from A, being the best, to F, being the worst. The relationship between control delay and LOS for signalized and unsignalized intersections is summarized in Table 3.

Table 3. Level of Service Criteria

Level of Service	Description	Average Control Delay (seconds per vehicle)	
		Signalized Intersections	Unsignalized Intersections
A	*Free flow*	≤ 10	≤ 10
B	*Stable flow, slight delay*	> 10 - 20	> 10 - 15
C	*Stable flow, acceptable delay*	> 20 - 35	> 15 - 25
D	*Near-unstable flow, tolerable delay*	> 35 - 55	> 25 - 35
E	*Unstable flow, intolerable delay*	> 55 - 80	> 35 - 50
F	*Forced flow, failure*	> 80	> 50

Source: Highway Capacity Manual (HCM 6th Edition), Exhibits 18-4 and 19-1

Queue Length

Vehicle queues are not a direct intersection capacity measure themselves but rather give an indication of when capacity issues may exist. Queues are typically expressed in terms of the 95th percentile queue length, which represents a worst-case situation that is expected to be exceeded no more than 5% of the time during the analysis period.

Traffic Analysis Methodology

As discussed in Chapter 1, the performance measures noted above are calculated using industry-standard methodology developed by the Transportation Research Board of the National Academies of Sciences and published in the HCM (Highway Capacity Manual). The analyses that follow are conducted using the HCM 6th Edition methodology, as implemented in Synchro version 11. Note that the reference study implemented HCM 2010 methodology, which may have subtly difference results, but still will be consistent with 6th Edition results.

Traffic analysis models were built in Synchro based on the lane use and traffic controls outlined in Figure 2 in conjunction with the existing peak hour traffic volumes presented in Figure 3. The results of these analyses are summarized in the following sections, with detailed traffic analysis worksheets included in Appendix B.

Intersection Capacity Analysis Results

Table 4 summarizes the delay, LOS, and queue results of the traffic analyses in the existing scenario. As shown in Table 5, all approaches at Timesville Road operate at acceptable levels of service.

Full capacity analysis reports are included in Appendix B.

Table 4. Intersection Capacity and Queueing Results: Existing Conditions

Average Delay (in seconds), Level of Service (letter grade, A-F), and 95th Percentile Queue Length (# of vehicles)

Intersection	Control	Approach	Available Storage	Existing Delay	Existing LOS	Existing Queue
AM Peak Hour						
1. Taft Highway & Timesville Road	**TWSC**	NB Left	75' *(3 veh)*	8.7	A	0.0
		EB Shared	375' *(15 veh)*	13.7	B	0.3
2. Taft Highway & Site Access 1	**TWSC**	NB Shared	250' *(10 veh)*	--	--	--
		EB Left	25' *(1 veh)*	--	--	--
		EB Right	25' *(1 veh)*	--	--	--
3. Timesville Road & Site Access 2	**TWSC**	EB Shared	650' *(26 veh)*	--	--	--
		SB Left	25' *(1 veh)*	--	--	--
		SB Right	25' *(1 veh)*	--	--	--
PM Peak Hour						
1. Taft Highway & Timesville Road	**TWSC**	NB Left	75' *(3 veh)*	8.6	A	0.1
		EB Shared	375' *(15 veh)*	17.8	C	0.3
2. Taft Highway & Site Access 1	**TWSC**	NB Shared	250' *(10 veh)*	--	--	--
		EB Left	25' *(1 veh)*	--	--	--
		EB Right	25' *(1 veh)*	--	--	--
3. Timesville Road & Site Access 2	**TWSC**	EB Shared	650' *(26 veh)*	--	--	--
		SB Left	25' *(1 veh)*	--	--	--
		SB Right	25' *(1 veh)*	--	--	--

4. FUTURE NO-BUILD TRAFFIC CONDITIONS

This chapter provides projections of the additional vehicle traffic volume that will be added to the study area roadways by the expected full build-out year of the development, assuming the development is not built. This assessment of conditions without the project is based on additional traffic from off-site, or “background”, sources. This chapter assesses conditions during a scenario under future no-build traffic conditions to assess the impacts when the project is included in subsequent chapters.

Background Traffic Development and Growth Calculations

In order to determine the level of impact of the site, an estimate of traffic volumes without the site for the full build-out year must be determined. This allows for a direct comparison of future conditions with and without the development. Background traffic volumes come from two sources:

- **Background developments**, namely specifically approved developments within the study area.
- **Background growth**, the increase in traffic passing through the study area due to regional development and general population growth.

Background Growth

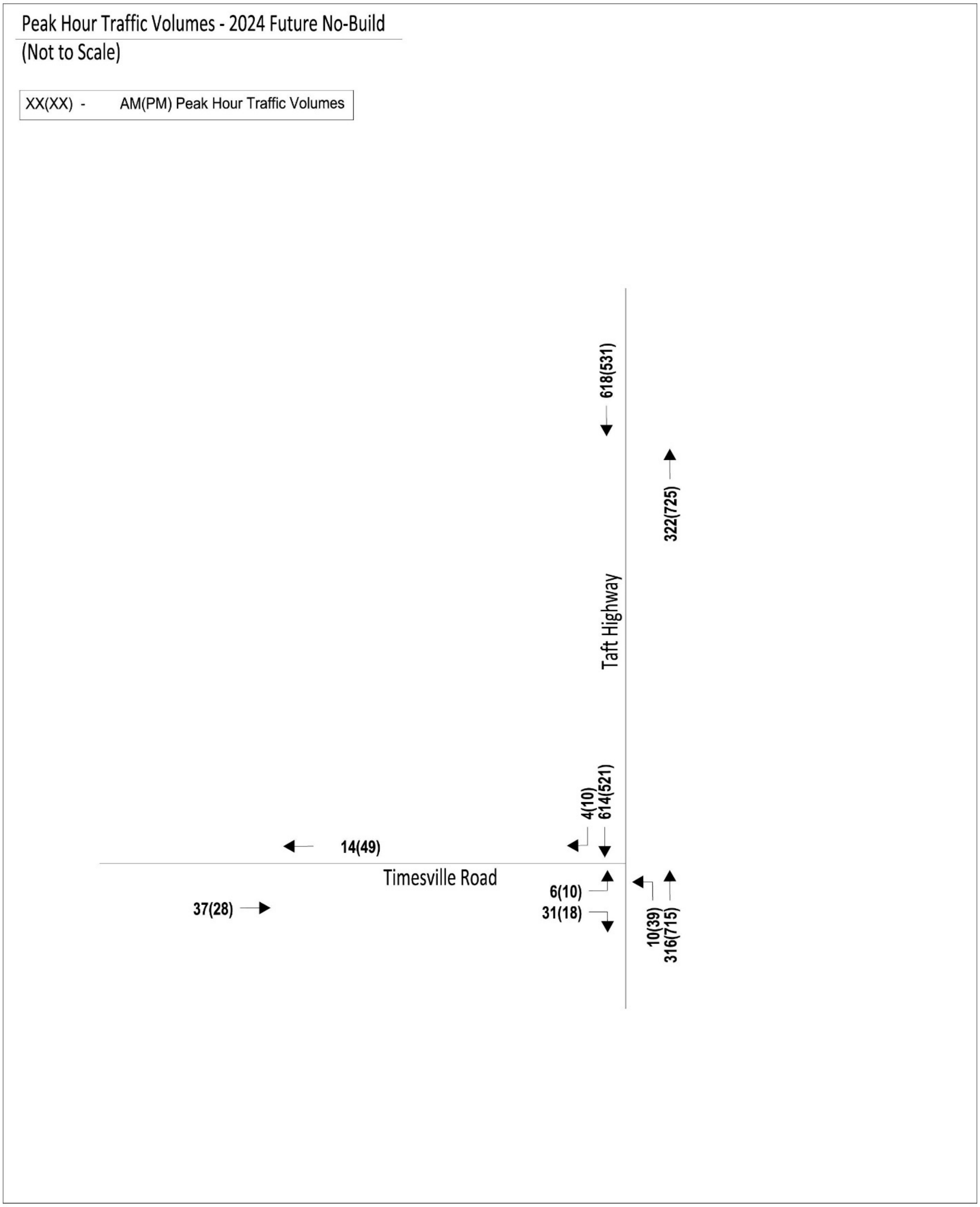
Background growth is generally calculated based on observed growth rates at nearby TDOT-collected count stations. This data, included in Appendix A, was previously discussed in Chapter 1. As was seen in that chapter, the nearby TDOT count station shows a growth rate within the study area of +2.02% annually since 2009. The reference study used a 2% growth rate, so a 2% growth rate was applied to existing traffic volumes.

Background Developments

No background projects were identified in the reference study.

Calculated background volumes are shown in Figure 4.

Figure 4. Peak Hour Traffic Volumes: Future No-Build Conditions



Intersection Capacity Analysis

Capacity and queueing analyses were performed using the projected Future No-Build volumes from Figure 4, with the same assumed laneage and traffic control as in the Existing conditions analysis from Chapter 3.

The study intersection maintained similar operations as existing conditions.

Table 5. Intersection Capacity and Queueing Results: Future No-Build Conditions

Average Delay (in seconds), Level of Service (letter grade, A-F), and 95th Percentile Queue Length (# of vehicles)

Intersection	Control	Approach	Available Storage	Existing			Future No-Build		
				Delay	LOS	Queue	Delay	LOS	Queue
AM Peak Hour									
1. Taft Highway & Timesville Road	**TWSC**	NB Left	75' *(3 veh)*	8.7	A	0.0	9.0	A	0.0
		EB Shared	375' *(15 veh)*	13.7	B	0.3	14.9	B	0.3
2. Taft Highway & Site Access 1	**TWSC**	NB Shared	250' *(10 veh)*	--	--	--	--	--	--
		EB Left	25' *(1 veh)*	--	--	--	--	--	--
		EB Right	25' *(1 veh)*	--	--	--	--	--	--
3. Timesville Road & Site Access 2	**TWSC**	EB Shared	650' *(26 veh)*	--	--	--	--	--	--
		SB Left	25' *(1 veh)*	--	--	--	--	--	--
		SB Right	25' *(1 veh)*	--	--	--	--	--	--
PM Peak Hour									
1. Taft Highway & Timesville Road	**TWSC**	NB Left	75' *(3 veh)*	8.6	A	0.1	8.8	A	0.1
		EB Shared	375' *(15 veh)*	17.8	C	0.3	20.2	C	0.4
2. Taft Highway & Site Access 1	**TWSC**	NB Shared	250' *(10 veh)*	--	--	--	--	--	--
		EB Left	25' *(1 veh)*	--	--	--	--	--	--
		EB Right	25' *(1 veh)*	--	--	--	--	--	--
3. Timesville Road & Site Access 2	**TWSC**	EB Shared	650' *(26 veh)*	--	--	--	--	--	--
		SB Left	25' *(1 veh)*	--	--	--	--	--	--
		SB Right	25' *(1 veh)*	--	--	--	--	--	--

5. SITE TRAFFIC CONDITIONS

This chapter provides a review of the proposed development program and discusses the expected number of trips that the proposed site is expected to generate at full build-out.

Proposed Development Program

The details of the proposed development are shown in Table 6.

Table 6: Proposed Development Program

Development	**Walden Grocery Store**			
Full-Build Year	2024			
Existing Lane Use(s)	Greenhouse			
Proposed Land Use(s)	43,987 sf Supermarket 4,500 sf Apparel Store 4,000 sf Variety Store 1,500 sf Office			
Access Point(s)	***Access #***	***At***	***Control***	***Movement***
	1	Taft Highway	Side Street Stop	Full
	2	Timesville Road	Side Street Stop	Full
Estimated Site Trips	***Weekday***	***AM***	***PM***	
	4,906	189 (new)	312 (new) 161 (pass-by)	

A site plan of the proposed development and its site access points is included in Figure 5. The proposed development's location was previously shown in Figure 1 in Chapter 1.

Site Access Points

The site is served by two access points, outlined above in Table 6 and shown in Figure 5. Intersection sight distance is the length of roadway visible to a driver stopped at an intersection to see oncoming vehicles to safely make a turn. Required sight distance was calculated using methods outlined in *A Policy on Geometric Design of Highways and Streets*, the American Association of State Highway and Transportation Officials (AASHTO), 7th Edition. The results of sight distance calculations are shown in Table 7.

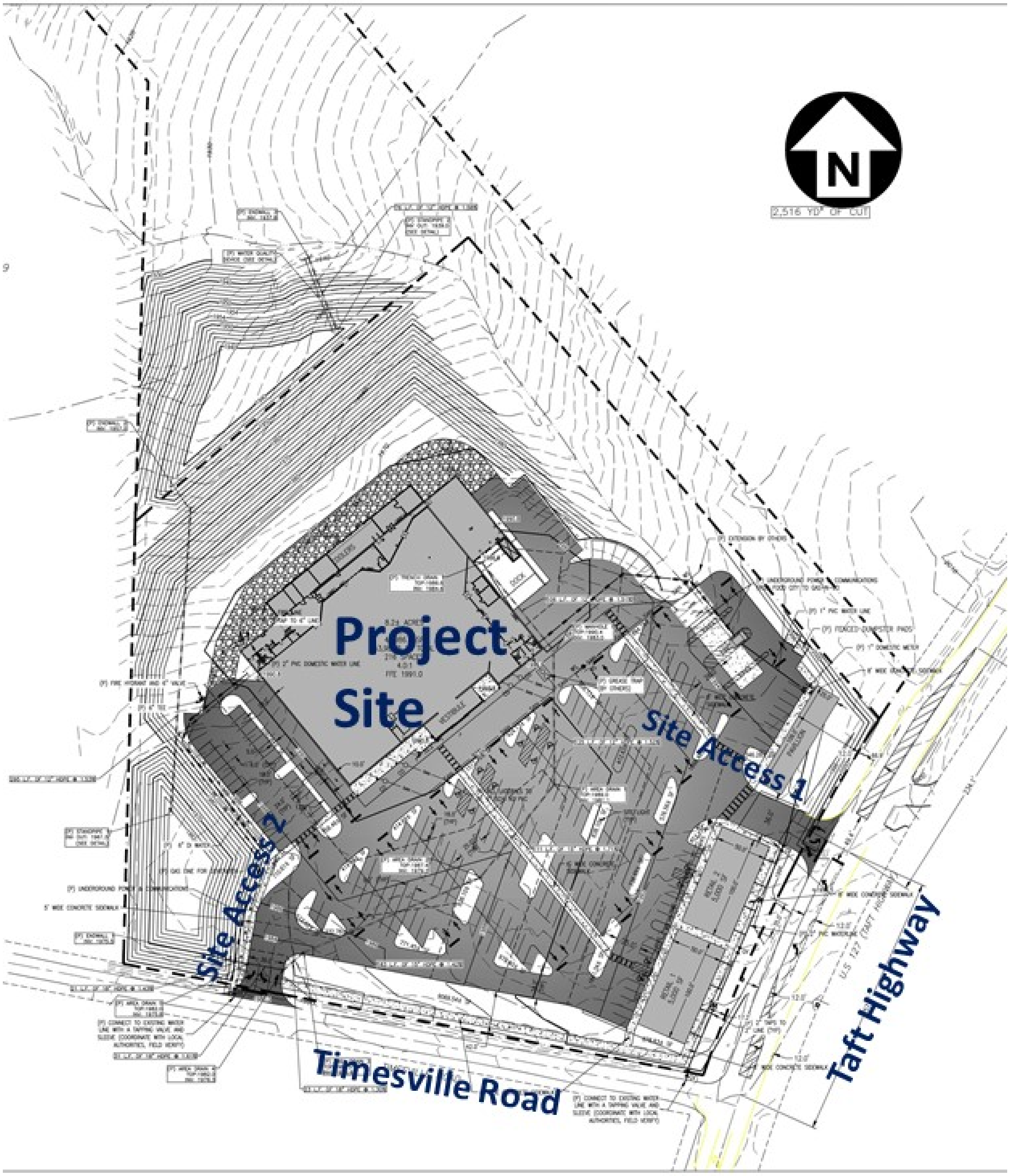
Table 7. Required Sight Distance

From	To	On	Turn	Speed Limit	Stopping Sight Distance (feet)	Intersection Sight Distance Required (feet)
Site Access 1	North	Taft Highway	Left	40 mph	305	445
	South		Right			385
Site Access 2	West	Timesville Road	Left	30 mph	200	335
	East		Right			290

Internal Circulation

Internal circulation within the site will be provided by circulation lanes throughout the parking lot. Several crosswalks and sidewalks allow pedestrian circulation within the site.

Figure 5. Site Plan



Proposed Development Traffic

Next, trips directly attributable to the proposed development must be computed. Projected site-generated trips are calculated using industry-standard trip generation rates applied over the amount of development that is expected on the site. These trips are then applied across the study area roadways based on expected routing patterns.

Trip Generation

The trips generated by the proposed development were forecasted using *Trip Generation*, 10th Edition, published by ITE (Institute of Transportation Engineers).

Pass-by trips were also forecasted using methods and factors in ITE's *Trip Generation Handbook*, 3rd Edition. Pass-by trips represent vehicles that do not have the project site as the final destination but are stopping at the project site on the way to a pre-existing destination. Because of this, pass-by trips are subtracted from the mainline through volumes.

The expected trip generation is summarized in Table 8.

Table 8. Summary of Site Trip Generation

						AM			PM	
ITE CODE	**LAND USE**	**# UNITS**	**UNIT TYPE**	**Weekday/ADT**	**Enter**	**Exit**	**Total**	**Enter**	**Exit**	**Total**
850	Supermarket	43,987	sf	4330	101	67	168	216	207	423
712	Office	1,500	sf	24	2	1	3	1	3	4
876	Apparel Store	4,500	sf	299	4	1	5	9	10	19
814	Variety Store	4000	sf	254	7	6	13	14	13	27
	ITE Pass-By Rate		*Total Trips*	*4907*	*114*	*75*	*189*	*240*	*233*	*473*
850	36% (PM only)			1559	36	24	60	78	75	152
814	34% (PM only)			86	2	2	4	5	4	9
			Pass-By Trips	1645	38	26	**64**	83	79	**161**

Trip Distribution

A distribution of the trips generated by the project site was based on the distribution in the reference study, which in turn was based on the existing traffic directional split. However, this study modified the distribution in the reference study in two ways. First, the reference study distributing 13% of PM exiting trips west on Timesville Road and 7% east via Site Access 2, a minor adjustment. These distributions were switched to better reflect the small number of residential homes on Timesville Road. More crucially, the reference study assigns all exiting trips destined for northbound Taft Highway through the eastbound left turn at Site Access 1. This is normally a reasonable assumption; however, the reference study found that eastbound left turn lane to operate at LOS F in the PM peak hour with a substantial queue of 9 vehicles. In this situation, it would be expected a portion of those eastbound left turns would instead exit south at Site Access

2 and proceed to the eastbound left turn on Timesville Road at Taft Highway. Therefore, approximately a fourth of the trips distributed through Site Access 2 rather than Site Access 1, or 7% of the AM and 13% of the total generated trips. The expected distribution of new trips is shown in Figure 6. The distribution of Pass-By Trips is shown in Figure 7.

Traffic Assignment

The generated trips were assigned to the roadway network using the expected distributions from the previous section. The expected assignment of new site-generated trips is shown in Figure 8.

Figure 6. Site-Generated Trip Distribution

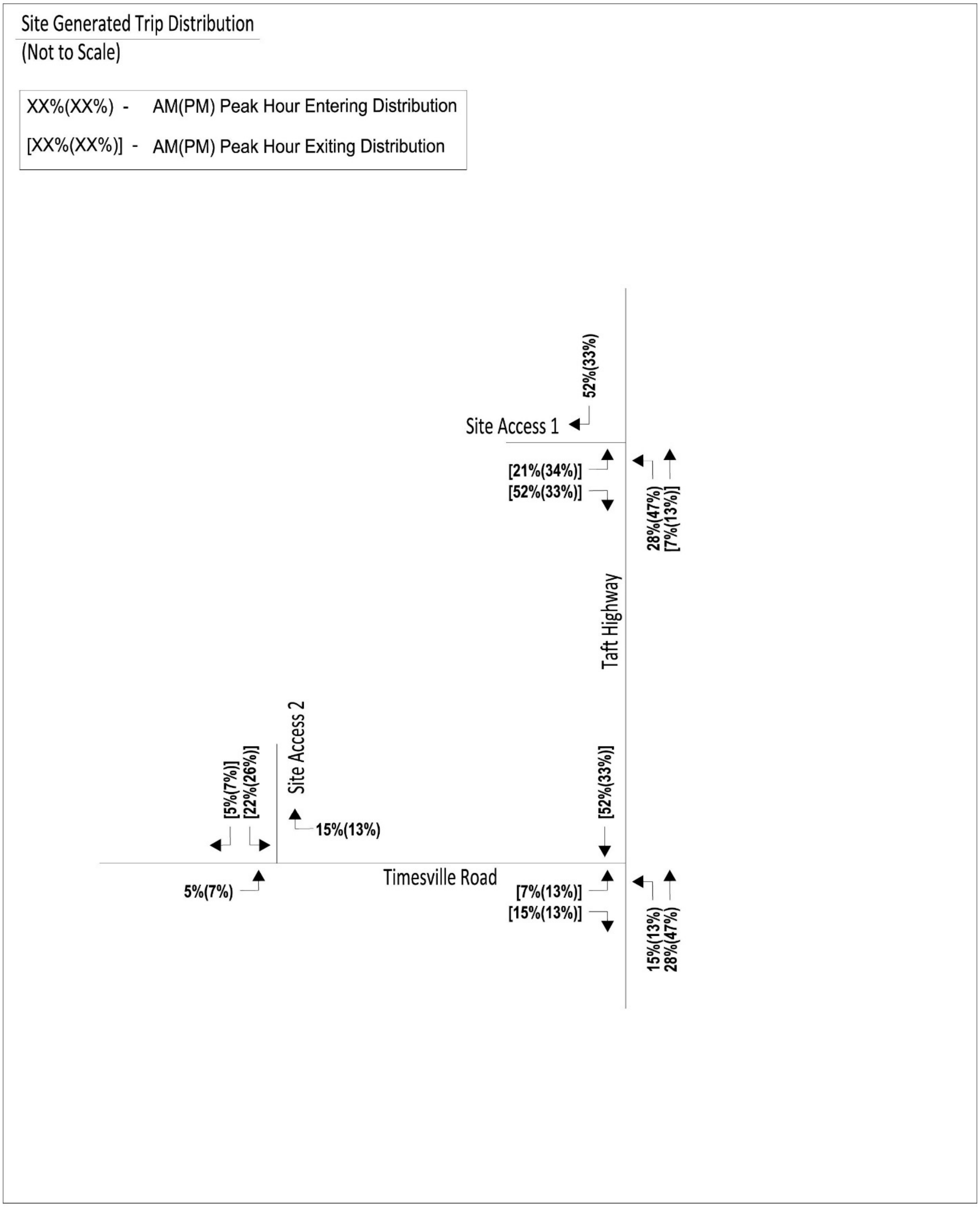


Figure 7. Pass-by Trip Distribution

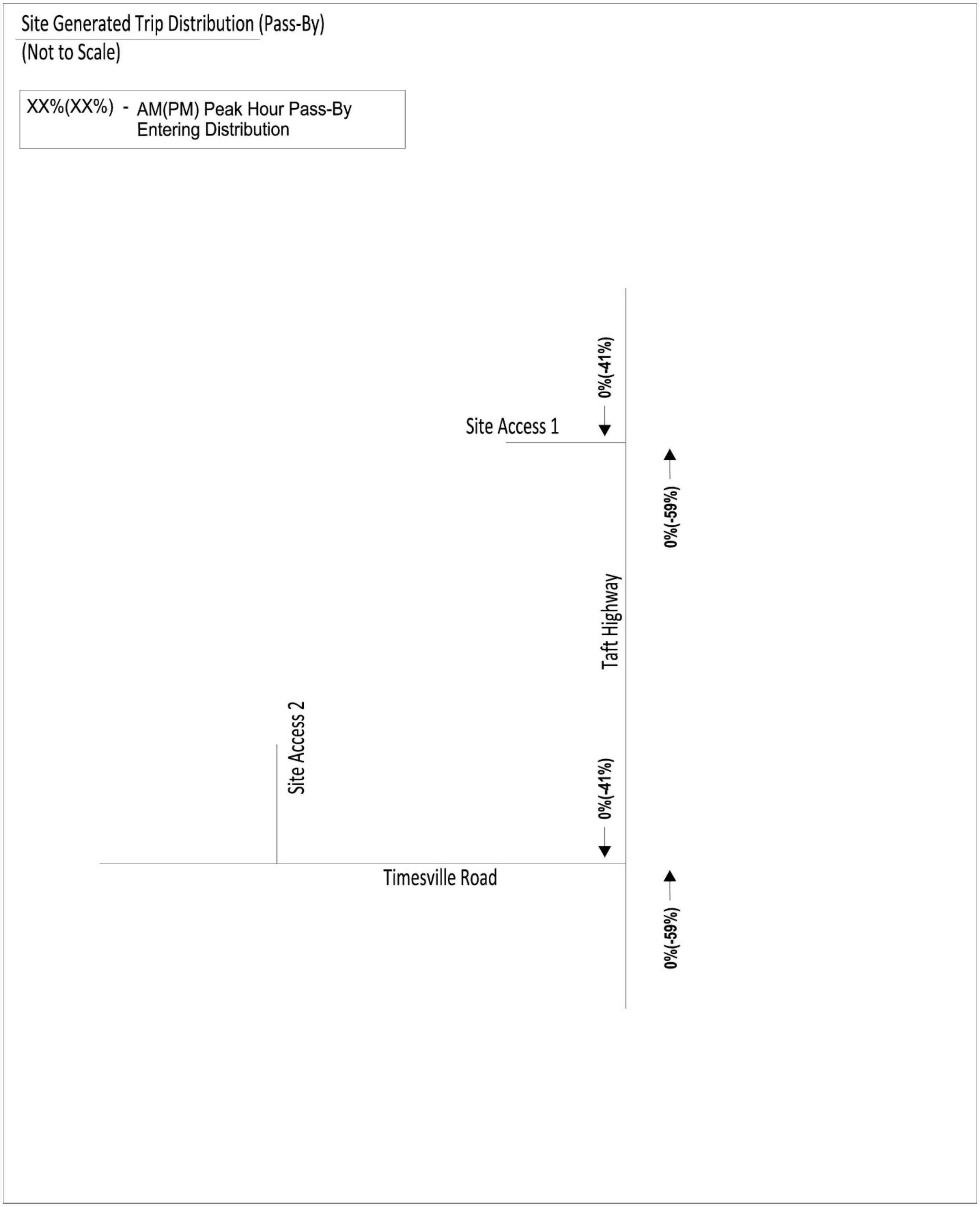
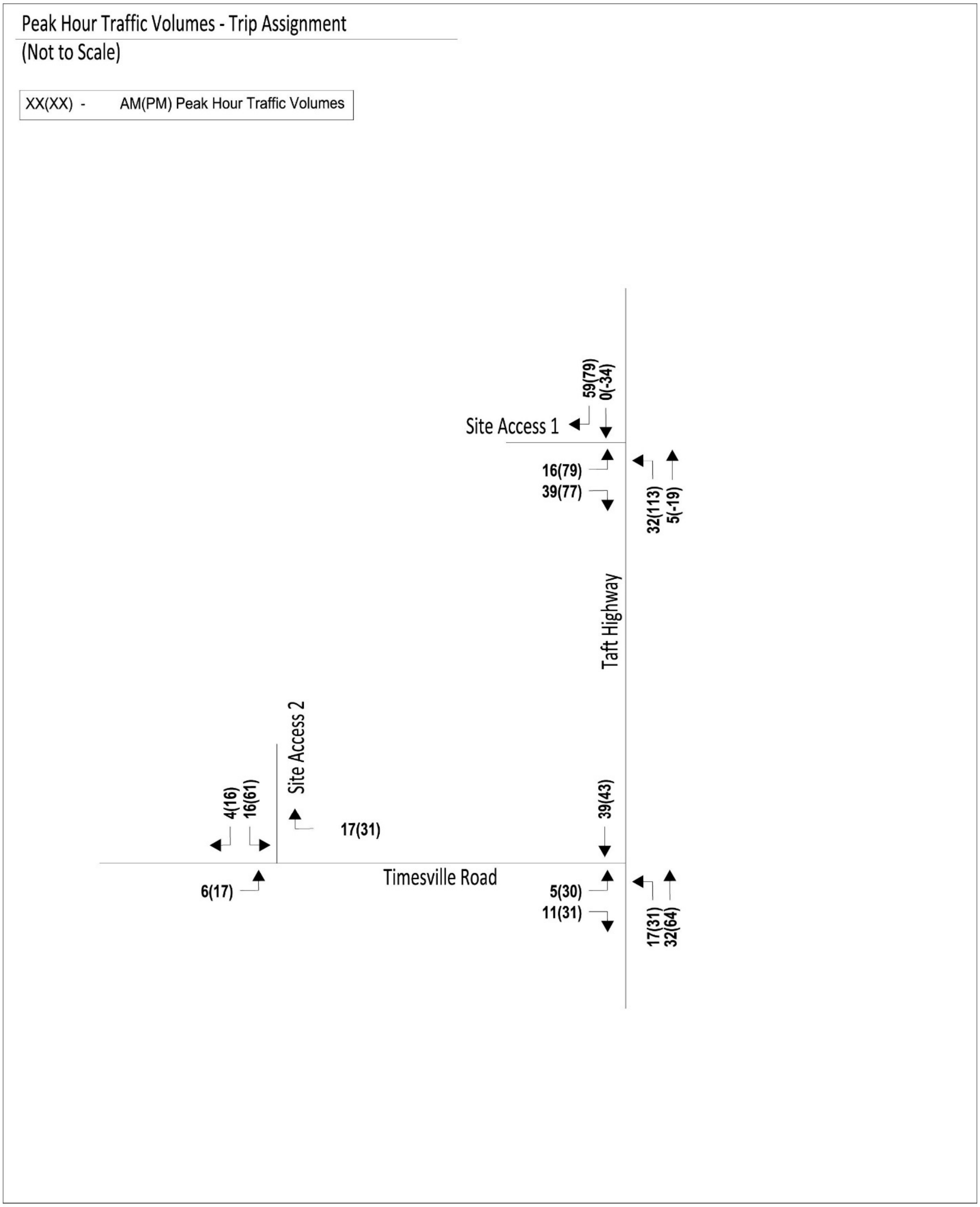


Figure 8. Site-Generated Trip Assignment



6. FUTURE FULL-BUILD TRAFFIC CONDITIONS

This chapter provides projections of the additional vehicle traffic volume that will be added to the study area roadways by the expected full build-out year of the development, 2024, and the additional traffic generated by the development. This assessment of conditions with the project is based on trip generation, distribution, and assignment performed in the previous chapter. This chapter assesses conditions during a scenario under future traffic conditions with the project in place in order to assess the impacts compared to Future No-Build Traffic conditions.

Projected Total Future Traffic Volumes

The expected trip assignments from Figure 8 were added to the future no-build traffic volumes from Figure 4 to find the total projected traffic volumes. The projected traffic volumes represent the expected traffic in the study area after the opening of the proposed development. The total projected volumes are shown in Figure 9.

Intersection Capacity Analysis

Capacity and queueing analyses were performed using the projected Future Full-Build volumes from Figure 9, with the same assumed laneage and traffic control as in the existing conditions analysis. The results of this analysis are shown in Table 9. As shown in Table 9, two approaches suffer poor delay. The eastbound approach Timesville Road at Taft Highway experiences LOS E in the PM peak hour. The eastbound left turn of Site Access 1 at Taft Highway experiences LOS F in the PM peak.

These identified impacts will be discussed further in Chapter 7.

Figure 9. Peak Hour Traffic Volumes: Future Full-Build Conditions

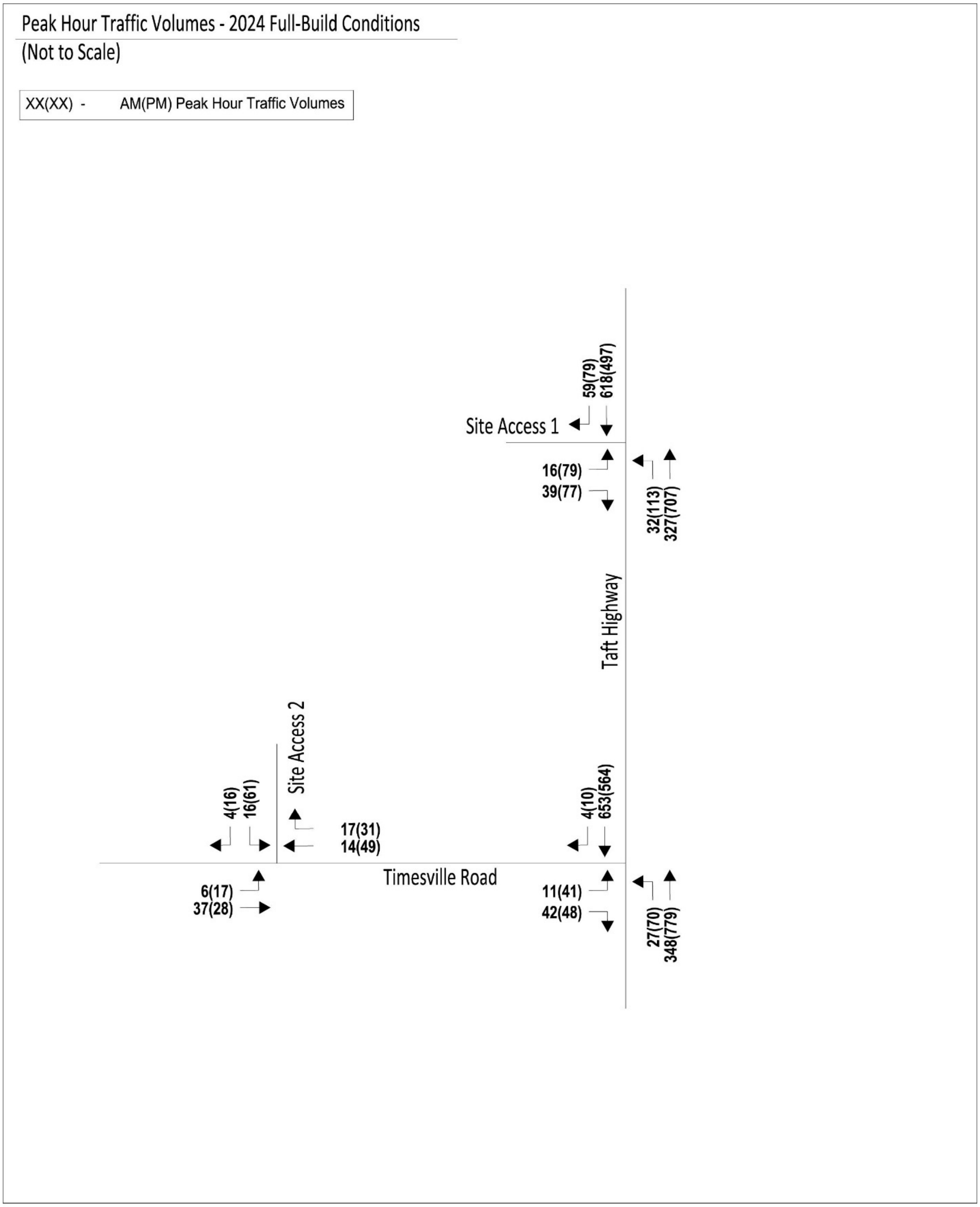


Table 9. Complete Intersection Capacity and Queueing Results

Average Delay (in seconds), Level of Service (letter grade, A-F), and 95th Percentile Queue Length (# of vehicles)

Intersection	Control	Approach	Available Storage	Existing			Future No-Build			Future Full-Build		
				Delay	LOS	Queue	Delay	LOS	Queue	Delay	LOS	Queue
AM Peak Hour												
1. Taft Highway & Timesville Road	**TWSC**	NB Left	75' *(3 veh)*	8.7	A	0.0	9.0	A	0.0	9.2	A	0.1
		EB Shared	375' *(15 veh)*	13.7	B	0.3	14.9	B	0.3	17.1	C	0.6
2. Taft Highway & Site Access 1	**TWSC**	NB Shared	250' *(10 veh)*	--	--	--	--	--	--	9.3	A	0.1
		EB Left	25' *(1 veh)*	--	--	--	--	--	--	23.2	C	0.3
		EB Right	25' *(1 veh)*	--	--	--	--	--	--	14.1	B	0.3
3. Timesville Road & Site Access 2	**TWSC**	EB Shared	650' *(26 veh)*	--	--	--	--	--	--	7.3	A	0.0
		SB Left	25' *(1 veh)*	--	--	--	--	--	--	9.0	A	0.1
		SB Right	25' *(1 veh)*	--	--	--	--	--	--	8.4	A	0.0
PM Peak Hour												
1. Taft Highway & Timesville Road	**TWSC**	NB Left	75' *(3 veh)*	8.6	A	0.1	8.8	A	0.1	9.1	A	0.3
		EB Shared	375' *(15 veh)*	17.8	C	0.3	20.2	C	0.4	**45.2**	**E**	2.7
2. Taft Highway & Site Access 1	**TWSC**	NB Shared	250' *(10 veh)*	--	--	--	--	--	--	9.3	A	0.4
		EB Left	25' *(1 veh)*	--	--	--	--	--	--	**162.1**	**F**	**5.4**
		EB Right	25' *(1 veh)*	--	--	--	--	--	--	13.4	B	0.6
3. Timesville Road & Site Access 2	**TWSC**	EB Shared	650' *(26 veh)*	--	--	--	--	--	--	7.4	A	0.0
		SB Left	25' *(1 veh)*	--	--	--	--	--	--	9.6	A	0.3
		SB Right	25' *(1 veh)*	--	--	--	--	--	--	8.7	A	0.1

Turn Lane Warrants

The site accesses were analyzed for the need for turn lanes based on the methodology outlined in National Cooperative Highway Research Program Report 457: *Evaluating Intersection Improvements: An Engineering Study Guide*, Transportation Research Board (2001), which is the national standard for this type of evaluation. Using future full-build volumes and methods outlined in the NCHRP report, the site accesses were evaluated for the need to install turn lanes. The results of the analysis are presented in Table 10.

Table 10. Turn Lane Warrant Results

Approach to	Left-turn Warranted?		Right-turn Warranted?	
	AM	PM	AM	PM
Site Access 1	✓	✓	✓	✓
Site Access 2	X	X	X	X

As Shown in Table 10, Site Access 1 warrants both right and left turn lanes in both peak hours. Turn lanes will not only improve operations but prevent dangerous rear end crashes for turning vehicles. Full turn lane warrant data included in Appendix C.

7. SUMMARY OF FINDINGS

This chapter compares the forecast roadway conditions without and with the proposed development in order to identify any adverse impacts.

Comparison of Capacity and Queuing Results

Table 9 in Chapter 6 presents a comparison of all intersection capacity and queueing results side-by-side for the 2019 Existing, 2024 Future No-Build, and 2024 Future Full-Build conditions. The latter two scenarios represent roadway conditions without and with the proposed development, respectively.

Identified Impacts

Based on the evaluation criteria listed in the previous section, this comparison identified a total of three areas that is projected to experience a deterioration in service quality after the opening of the proposed development:

<u>Eastbound Left Turn on Site Access 1 at Taft Highway, PM Peak hour</u>

This turning movement is expected to operate at LOS F.

<u>Eastbound Approach of Timesville Road at Taft Highway, PM Peak hour</u>

This turning movement is expected to deteriorate from LOS C to LOS F. This development is expected to generate 61 vehicles at this approach in this peak hour, or 68.5% of the overall movement.

<u>Inbound Turning Movements on Taft Highway at Site Access 1</u>

According to NCHRP 457 analysis, a northbound left turn lane and southbound right tun lane are warranted on Taft Highway at Site Access 1 in both peak hours. Although operationally the proposed turns don’t cause the intersection to fail, they do add delay to the mainline and are warranted for safety and operational concerns as outlined in NCHRP 457.

Potential Mitigation Measures

This review focused on identifying potential mitigation measures at the impacted intersection. Potential strategies that were investigated as part of this assessment are shown in Table 11.

Table 11. Potential Mitigation Measures

Mitigation Measure	Site Access 1 Eastbound Left Turn	Timesville Road Eastbound Approach
Upgrades to Intersection Traffic Control	The intersection turning volumes will not warrant a signal. **Does not address issue.**	The intersection turning volumes will not warrant a signal. However, a roundabout would mitigate delay issues. However, a roundabout cannot accommodate street parking on east side of Taft Highway at Timesville Road. **Not applicable.**
Adjustments to signal phasing and/or cycle length	The intersection is not signalized. **Not applicable.**	The intersection is not signalized. **Not applicable.**
Reallocating traffic signal green time split lengths	The intersection is not signalized. **Not applicable.**	The intersection is not signalized. **Not applicable.**
Corridor widening	Any more involved measures are not possible due to restricted right-of-way and are disproportionate to the impact of the proposed development. **Not applicable.**	Any more involved measures are not possible due to restricted right-of-way and are disproportionate to the impact of the proposed development. **Not applicable.**
Additional queue space	As included in the recommendations, reconfiguring site circulation allows adequate queue space. **Addresses issue.**	A new eastbound left turn lane will alleviate delays for eastbound right turns, although delay remains high for eastbound left turns. **Partially addresses issue.**

Mitigation Measures Analysis

Analysis of the potential mitigation measures for the intersection were conducted using HCM 6th Edition methodology for stop-controlled intersection and with Sidra analysis for roundabouts using the same future full build volumes. A comparison of the results of mitigation are shown in Table 12. As shown in Table 12, A left turn lane provides lower delay for eastbound right turns, but would only provide the left turns LOS F. A roundabout at the intersection would provide excellent service but would introduce minimal delay to mainline through volumes. Also, the east side of the intersection does include street parking, which would be difficult to incorporate into a roundabout. Therefore a roundabout is not recommended.

Table 12. Mitigation Measures Analysis for Taft Highway & Timesville Road

Intersection	Control	Approach	Available Storage	Future Full-Build			Left Turn Lane			Roundabout		
				Delay	LOS	Queue	Delay	LOS	Queue	Delay	LOS	Queue
AM Peak Hour												
1. Taft Highway & Timesville Road	**TWSC**	*NB Shared*	999' *(40 veh)*	0.0	A	0.0	0.0	A	0.0	5.4	A	0.1
		NB Left	75' *(3 veh)*	9.2	A	0.1	9.2	A	0.1	--	--	--
		EB Left	75' *(3 veh)*	--	--	--	22.9	C	0.2	--	--	--
		EB Shared	375' *(15 veh)*	17.1	C	0.6	14.3	B	0.4	6.6	A	0.0
		SB Shared	999' *(40 veh)*	0.0	A	0.0	0.0	A	0.0	8.7	A	0.2
PM Peak Hour												
1. Taft Highway & Timesville Road	**TWSC**	*NB Shared*	999' *(40 veh)*	0.0	A	0.0	0.0	A	0.0	13.0	B	0.4
		NB Left	75' *(3 veh)*	9.1	A	0.3	9.1	A	0.3	--	--	--
		EB Left	75' *(3 veh)*	--	--	--	62.5	F	1.8	--	--	--
		EB Shared	375' *(15 veh)*	45.2	E	2.7	13.2	B	0.4	6.5	A	0.5
		SB Shared	999' *(40 veh)*	0.0	A	0.0	0.0	A	0.0	8.2	A	3.8

8. RECOMMENDATIONS

This assessment finds that there are two turning movements that are negatively impacted by the development:

Eastbound Left Turn on Site Access 1 at Taft Highway, PM Peak hour

Eastbound Approach of Timesville Road at Taft Highway, PM Peak hour

Inbound Turning Movements on Taft Highway at Site Access 1

As a result, the overall finding of this report is that the traffic impacts of the site are evident but can be addressed by the recommendations below.

The following recommendations are expected to ensure effective and safe traffic operations within the study area:

- Design all proposed internal and external roadways according to standards found within *A Policy on Geometric Design of Highways and Streets*, AASHTO, 7th Edition.
- Ensure adequate sight distance available for Site Accesses 1 and 2 according to methods found within *A Policy on Geometric Design of Highways and Streets*, AASHTO, 7th Edition, providing a minimum of 445 feet to the north of Site Access 1, 385 feet to the south of Site Access 1, 290 feet to the east of Site Access 2, and 335 feet to the west of Site Access 2.
- Install eastbound left turn lane with a minimum of 75 feet of storage at the intersection of Taft Highway and Timesville Road.
- Monitor potential pedestrian traffic crossing Taft Highway between the proposed development and retail on the east side of Taft Highway. Although negligible pedestrian traffic is expected, if noticeable pedestrian traffic is observed, a safe pedestrian crossing needs to be installed, with shared responsibility between TDOT and the proposed development.
- Ensure internal circulation allows a minimum of 100 feet of storage space for the eastbound approach of Site Access 1 at Taft Highway before any internal intersection.
- Install inbound southbound right turn and northbound left turn lanes on Taft Highway at Site Access 1, providing a minimum of 50 feet of storage. Turn lanes to be designed according to standards found within *A Policy on Geometric Design of Highways and Streets*, AASHTO, 7th Edition.

APPENDIX A – COUNT DATA

3.1 EXISTING CONDITIONS

3.2 Existing Traffic Volume

On Thursday, April 11, 2019, 15-minute turning movement counts (TMCs) were collected at the unsignalized intersection of SR 8 (Taft Highway) and Timesville Road. **Table 2** and **Table 3** illustrate the sum of the AM and PM peak 15-minute approach volumes. Traffic data was collected for two (2) hours during the AM peak (7:00-9:00am) and two (2) hours during the PM peak (4:00-6:00pm). All data collection can be found in the appendix.

TABLE 2
AM Peak Hour TMCs

Time Period	Eastbound		Northbound		Southbound		**Intersection Total**
	Left	Right	Left	Thru	Thru	Right	
8:00 AM	2	4	4	64	142	1	**217**
8:15 AM	1	9	0	58	132	1	**201**
8:30 AM	2	6	1	78	135	0	**222**
8:45 AM	0	9	4	86	147	2	**248**
Hourly Total	**5**	**28**	**9**	**286**	**556**	**4**	**888**

TABLE 3
PM Peak Hour TMCs

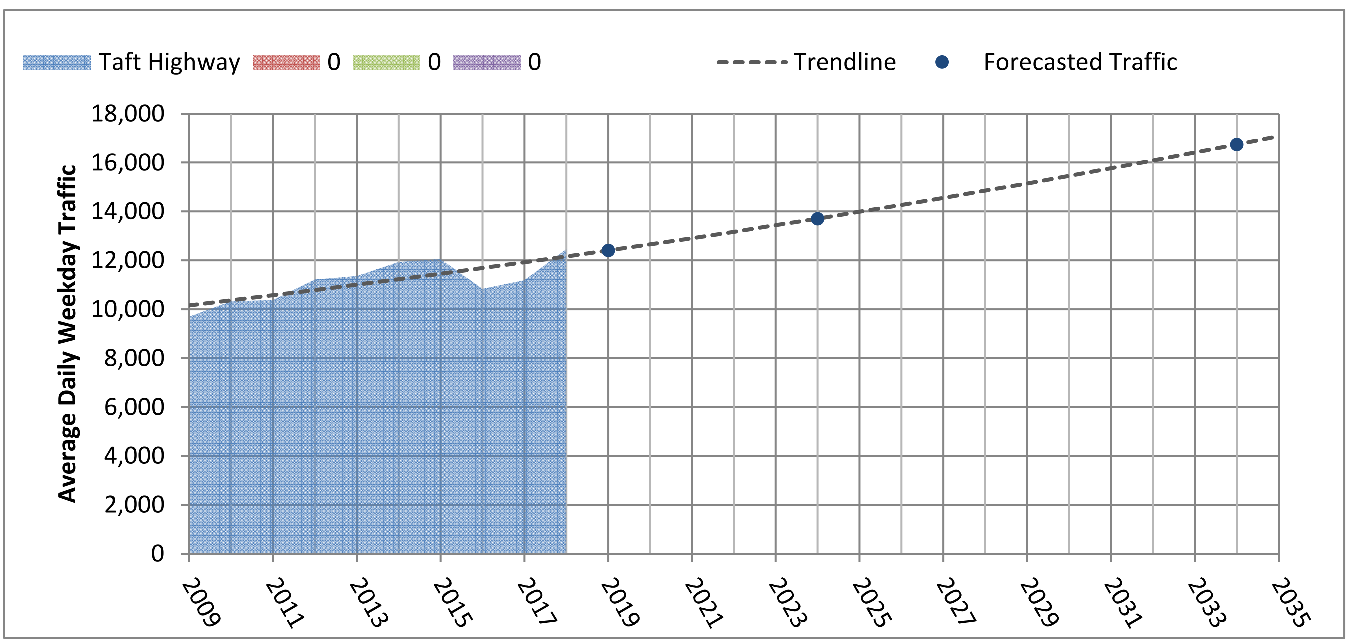
Time Period	Eastbound		Northbound		Southbound		**Intersection Total**
	Left	Right	Left	Thru	Thru	Right	
5:00 PM	3	3	10	164	123	5	**308**
5:15 PM	1	6	10	186	120	1	**324**
5:30 PM	3	5	7	143	123	1	**282**
5:45 PM	2	2	8	155	106	2	**275**
Hourly Total	**9**	**16**	**35**	**648**	**472**	**9**	**1189**

The peak hour traffic volumes are shown in **Figure 4**.

Growth Rate Worksheet

Year	Maury Co. Sta 000445	Maury Co.			Total Area Traffic
	Taft Highway				
2009	9,693				9,693
2010	10,325				10,325
2011	10,369				10,369
2012	11,208				11,208
2013	11,351				11,351
2014	11,927				11,927
2015	12,046				12,046
2016	10,830				10,830
2017	11,183				11,183
2018	12,456				12,456

Current Year	2019	12,400
Short-Term Future Forecasted Traffic	2024	13,704
Horizon Future Forecasted Traffic	2034	16,737
Percent Yearly Traffic Increase (compounded) for Site		**+2.02%**



APPENDIX B – CAPACITY ANALYSIS REPORTS

Intersection						
Int Delay, s/veh	0.6					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	28	9	286	556	4
Future Vol, veh/h	5	28	9	286	556	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	30	10	311	604	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	937	606	608	0	-	0
Stage 1	606	-	-	-	-	-
Stage 2	331	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	294	497	970	-	-	-
Stage 1	545	-	-	-	-	-
Stage 2	728	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	291	497	970	-	-	-
Mov Cap-2 Maneuver	291	-	-	-	-	-
Stage 1	540	-	-	-	-	-
Stage 2	728	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.7	0.3	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	970	-	449	-	-
HCM Lane V/C Ratio	0.01	-	0.08	-	-
HCM Control Delay (s)	8.7	-	13.7	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	9	16	35	648	472	9
Future Vol, veh/h	9	16	35	648	472	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	10	17	38	704	513	10

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1298	518	523	0	-	0
Stage 1	518	-	-	-	-	-
Stage 2	780	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	178	558	1043	-	-	-
Stage 1	598	-	-	-	-	-
Stage 2	452	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	172	558	1043	-	-	-
Mov Cap-2 Maneuver	172	-	-	-	-	-
Stage 1	576	-	-	-	-	-
Stage 2	452	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	17.8	0.4	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1043	-	309	-	-
HCM Lane V/C Ratio	0.036	-	0.088	-	-
HCM Control Delay (s)	8.6	-	17.8	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.3	-	-

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	6	31	10	316	614	4
Future Vol, veh/h	6	31	10	316	614	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	34	11	343	667	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1034	669	671	0	-	0
Stage 1	669	-	-	-	-	-
Stage 2	365	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	257	458	919	-	-	-
Stage 1	509	-	-	-	-	-
Stage 2	702	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	254	458	919	-	-	-
Mov Cap-2 Maneuver	254	-	-	-	-	-
Stage 1	503	-	-	-	-	-
Stage 2	702	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	14.9	0.3	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	919	-	405	-	-
HCM Lane V/C Ratio	0.012	-	0.099	-	-
HCM Control Delay (s)	9	-	14.9	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Intersection						
Int Delay, s/veh	0.7					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	18	39	715	521	10
Future Vol, veh/h	10	18	39	715	521	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	20	42	777	566	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1433	572	577	0	-	0
Stage 1	572	-	-	-	-	-
Stage 2	861	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	148	520	996	-	-	-
Stage 1	565	-	-	-	-	-
Stage 2	414	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	142	520	996	-	-	-
Mov Cap-2 Maneuver	142	-	-	-	-	-
Stage 1	541	-	-	-	-	-
Stage 2	414	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	20.2	0.5	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	996	-	267	-	-
HCM Lane V/C Ratio	0.043	-	0.114	-	-
HCM Control Delay (s)	8.8	-	20.2	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.4	-	-

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	11	42	27	348	653	4
Future Vol, veh/h	11	42	27	348	653	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	46	29	378	710	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1148	712	714	0	-	0
Stage 1	712	-	-	-	-	-
Stage 2	436	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	220	432	886	-	-	-
Stage 1	486	-	-	-	-	-
Stage 2	652	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	213	432	886	-	-	-
Mov Cap-2 Maneuver	213	-	-	-	-	-
Stage 1	470	-	-	-	-	-
Stage 2	652	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	17.1	0.7	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	886	-	356	-	-
HCM Lane V/C Ratio	0.033	-	0.162	-	-
HCM Control Delay (s)	9.2	-	17.1	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.6	-	-

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	16	39	32	327	618	59
Future Vol, veh/h	16	39	32	327	618	59
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	17	42	35	355	672	64

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1129	704	736	0	-	0
Stage 1	704	-	-	-	-	-
Stage 2	425	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	226	437	870	-	-	-
Stage 1	490	-	-	-	-	-
Stage 2	659	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	215	437	870	-	-	-
Mov Cap-2 Maneuver	215	-	-	-	-	-
Stage 1	466	-	-	-	-	-
Stage 2	659	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.7	0.8	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	870	-	215	437	-	-
HCM Lane V/C Ratio	0.04	-	0.081	0.097	-	-
HCM Control Delay (s)	9.3	0	23.2	14.1	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.3	0.3	-	-

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	6	37	14	17	16	4
Future Vol, veh/h	6	37	14	17	16	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	40	15	18	17	4

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	33	0	-	0	78	24
Stage 1	-	-	-	-	24	-
Stage 2	-	-	-	-	54	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1579	-	-	-	925	1052
Stage 1	-	-	-	-	999	-
Stage 2	-	-	-	-	969	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1579	-	-	-	920	1052
Mov Cap-2 Maneuver	-	-	-	-	920	-
Stage 1	-	-	-	-	994	-
Stage 2	-	-	-	-	969	-

Approach	EB	WB	SB
HCM Control Delay, s	1	0	8.9
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1579	-	-	-	920	1052
HCM Lane V/C Ratio	0.004	-	-	-	0.019	0.004
HCM Control Delay (s)	7.3	0	-	-	9	8.4
HCM Lane LOS	A	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1	0

Intersection	
Int Delay, s/veh	3.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	41	48	70	779	564	10
Future Vol, veh/h	41	48	70	779	564	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	45	52	76	847	613	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1618	619	624	0	-	0
Stage 1	619	-	-	-	-	-
Stage 2	999	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	114	489	957	-	-	-
Stage 1	537	-	-	-	-	-
Stage 2	356	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	105	489	957	-	-	-
Mov Cap-2 Maneuver	105	-	-	-	-	-
Stage 1	495	-	-	-	-	-
Stage 2	356	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	45.2	0.7	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	957	-	182	-	-
HCM Lane V/C Ratio	0.08	-	0.532	-	-
HCM Control Delay (s)	9.1	-	45.2	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0.3	-	2.7	-	-

Intersection	
Int Delay, s/veh	9.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	79	77	113	707	497	79
Future Vol, veh/h	79	77	113	707	497	79
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	86	84	123	768	540	86

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1597	583	626	0	-	0
Stage 1	583	-	-	-	-	-
Stage 2	1014	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	117	512	956	-	-	-
Stage 1	558	-	-	-	-	-
Stage 2	350	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	91	512	956	-	-	-
Mov Cap-2 Maneuver	91	-	-	-	-	-
Stage 1	432	-	-	-	-	-
Stage 2	350	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	88.7	1.3	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	956	-	91	512	-	-
HCM Lane V/C Ratio	0.128	-	0.944	0.163	-	-
HCM Control Delay (s)	9.3	0	162.1	13.4	-	-
HCM Lane LOS	A	A	F	B	-	-
HCM 95th %tile Q(veh)	0.4	-	5.4	0.6	-	-

Intersection	
Int Delay, s/veh	4.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	17	28	49	31	61	16
Future Vol, veh/h	17	28	49	31	61	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	30	53	34	66	17

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	87	0	-	0	136	70
Stage 1	-	-	-	-	70	-
Stage 2	-	-	-	-	66	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1509	-	-	-	857	993
Stage 1	-	-	-	-	953	-
Stage 2	-	-	-	-	957	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1509	-	-	-	847	993
Mov Cap-2 Maneuver	-	-	-	-	847	-
Stage 1	-	-	-	-	942	-
Stage 2	-	-	-	-	957	-

Approach	EB	WB	SB
HCM Control Delay, s	2.8	0	9.4
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1509	-	-	-	847	993
HCM Lane V/C Ratio	0.012	-	-	-	0.078	0.018
HCM Control Delay (s)	7.4	0	-	-	9.6	8.7
HCM Lane LOS	A	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	-	0.3	0.1

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	11	42	27	348	653	4
Future Vol, veh/h	11	42	27	348	653	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	75	0	60	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	46	29	378	710	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1148	712	714	0	-	0
Stage 1	712	-	-	-	-	-
Stage 2	436	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	220	432	886	-	-	-
Stage 1	486	-	-	-	-	-
Stage 2	652	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	213	432	886	-	-	-
Mov Cap-2 Maneuver	213	-	-	-	-	-
Stage 1	470	-	-	-	-	-
Stage 2	652	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.1	0.7	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	886	-	213	432	-	-
HCM Lane V/C Ratio	0.033	-	0.056	0.106	-	-
HCM Control Delay (s)	9.2	-	22.9	14.3	-	-
HCM Lane LOS	A	-	C	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.2	0.4	-	-

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	16	39	32	327	618	59
Future Vol, veh/h	16	39	32	327	618	59
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	17	42	35	355	672	64

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1129	704	736	0	-	0
Stage 1	704	-	-	-	-	-
Stage 2	425	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	226	437	870	-	-	-
Stage 1	490	-	-	-	-	-
Stage 2	659	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	215	437	870	-	-	-
Mov Cap-2 Maneuver	215	-	-	-	-	-
Stage 1	466	-	-	-	-	-
Stage 2	659	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.7	0.8	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	870	-	215	437	-	-
HCM Lane V/C Ratio	0.04	-	0.081	0.097	-	-
HCM Control Delay (s)	9.3	0	23.2	14.1	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.3	0.3	-	-

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	6	37	14	17	16	4
Future Vol, veh/h	6	37	14	17	16	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	40	15	18	17	4

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	33	0	-	0	78	24
Stage 1	-	-	-	-	24	-
Stage 2	-	-	-	-	54	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1579	-	-	-	925	1052
Stage 1	-	-	-	-	999	-
Stage 2	-	-	-	-	969	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1579	-	-	-	920	1052
Mov Cap-2 Maneuver	-	-	-	-	920	-
Stage 1	-	-	-	-	994	-
Stage 2	-	-	-	-	969	-

Approach	EB	WB	SB
HCM Control Delay, s	1	0	8.9
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1579	-	-	-	920	1052
HCM Lane V/C Ratio	0.004	-	-	-	0.019	0.004
HCM Control Delay (s)	7.3	0	-	-	9	8.4
HCM Lane LOS	A	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1	0

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	41	48	70	779	564	10
Future Vol, veh/h	41	48	70	779	564	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	75	0	60	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	45	52	76	847	613	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1618	619	624	0	-	0
Stage 1	619	-	-	-	-	-
Stage 2	999	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	114	489	957	-	-	-
Stage 1	537	-	-	-	-	-
Stage 2	356	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	105	489	957	-	-	-
Mov Cap-2 Maneuver	105	-	-	-	-	-
Stage 1	495	-	-	-	-	-
Stage 2	356	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	35.9	0.7	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	957	-	105	489	-	-
HCM Lane V/C Ratio	0.08	-	0.424	0.107	-	-
HCM Control Delay (s)	9.1	-	62.5	13.2	-	-
HCM Lane LOS	A	-	F	B	-	-
HCM 95th %tile Q(veh)	0.3	-	1.8	0.4	-	-

Intersection	
Int Delay, s/veh	9.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	79	77	113	707	497	79
Future Vol, veh/h	79	77	113	707	497	79
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	86	84	123	768	540	86

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1597	583	626	0	-	0
Stage 1	583	-	-	-	-	-
Stage 2	1014	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	117	512	956	-	-	-
Stage 1	558	-	-	-	-	-
Stage 2	350	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	91	512	956	-	-	-
Mov Cap-2 Maneuver	91	-	-	-	-	-
Stage 1	432	-	-	-	-	-
Stage 2	350	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	88.7	1.3	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	956	-	91	512	-	-
HCM Lane V/C Ratio	0.128	-	0.944	0.163	-	-
HCM Control Delay (s)	9.3	0	162.1	13.4	-	-
HCM Lane LOS	A	A	F	B	-	-
HCM 95th %tile Q(veh)	0.4	-	5.4	0.6	-	-

Intersection	
Int Delay, s/veh	4.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	17	28	49	31	61	16
Future Vol, veh/h	17	28	49	31	61	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	30	53	34	66	17

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	87	0	-	0	136	70
Stage 1	-	-	-	-	70	-
Stage 2	-	-	-	-	66	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1509	-	-	-	857	993
Stage 1	-	-	-	-	953	-
Stage 2	-	-	-	-	957	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1509	-	-	-	847	993
Mov Cap-2 Maneuver	-	-	-	-	847	-
Stage 1	-	-	-	-	942	-
Stage 2	-	-	-	-	957	-

Approach	EB	WB	SB
HCM Control Delay, s	2.8	0	9.4
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1509	-	-	-	847	993
HCM Lane V/C Ratio	0.012	-	-	-	0.078	0.018
HCM Control Delay (s)	7.4	0	-	-	9.6	8.7
HCM Lane LOS	A	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	-	0.3	0.1

APPENDIX C – TURN LANE WARRANTS

Figure 2 - 6. Guideline for determining the need for a major-road right-turn bay at a two-way stop-controlled intersection.

INPUT

Roadway geometry:	2-lane roadw ay

Variable	Value
Major-road speed, mph:	40
Major-road volume (one direction), veh/h:	677
Right-turn volume, veh/h:	59

OUTPUT

Variable	Value
Limiting right-turn volume, veh/h:	39
Guidance for determining the need for a major-road right-turn bay for a 2-lane roadway:	
Add right-turn bay.	

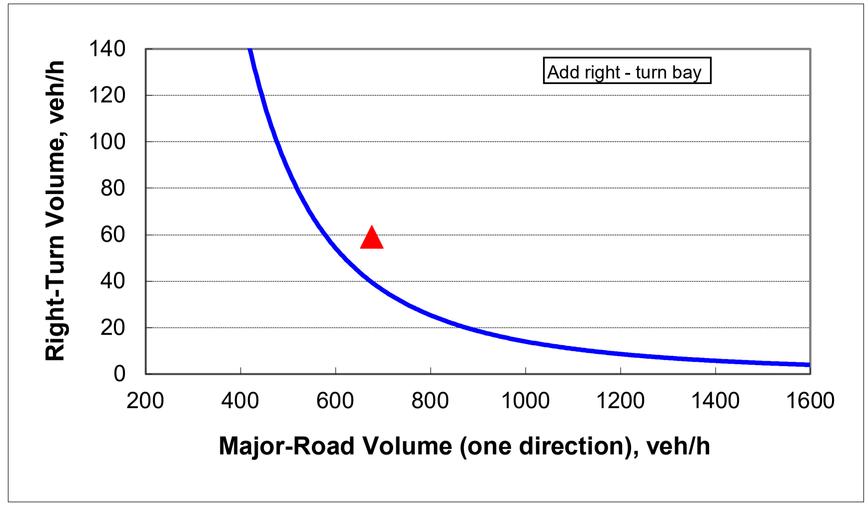


Figure 2 - 6. Guideline for determining the need for a major-road right-turn bay at a two-way stop-controlled intersection.

INPUT

Roadway geometry:	2-lane roadw ay

Variable	Value
Major-road speed, mph:	40
Major-road volume (one direction), veh/h:	576
Right-turn volume, veh/h:	79

OUTPUT

Variable	Value
Limiting right-turn volume, veh/h:	61
Guidance for determining the need for a major-road right-turn bay for a 2-lane roadway:	
Add right-turn bay.	

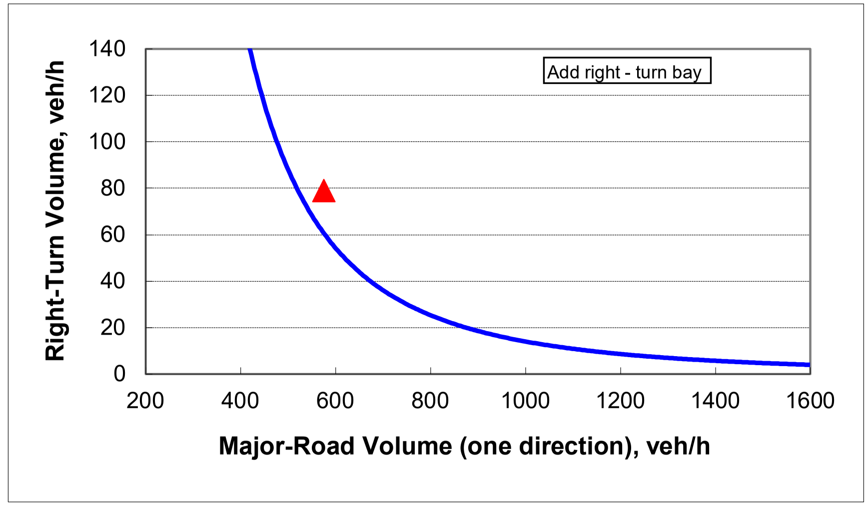


Figure 2 - 6. Guideline for determining the need for a major-road right-turn bay at a two-way stop-controlled intersection.

INPUT

Roadway geometry:	2-lane roadw ay
Variable	**Value**
Major-road speed, mph:	30
Major-road volume (one direction), veh/h:	31
Right-turn volume, veh/h:	17

OUTPUT

Variable	Value
Limiting right-turn volume, veh/h:	39
Guidance for determining the need for a major-road right-turn bay for a 2-lane roadway:	
Do NOT add right-turn bay.	

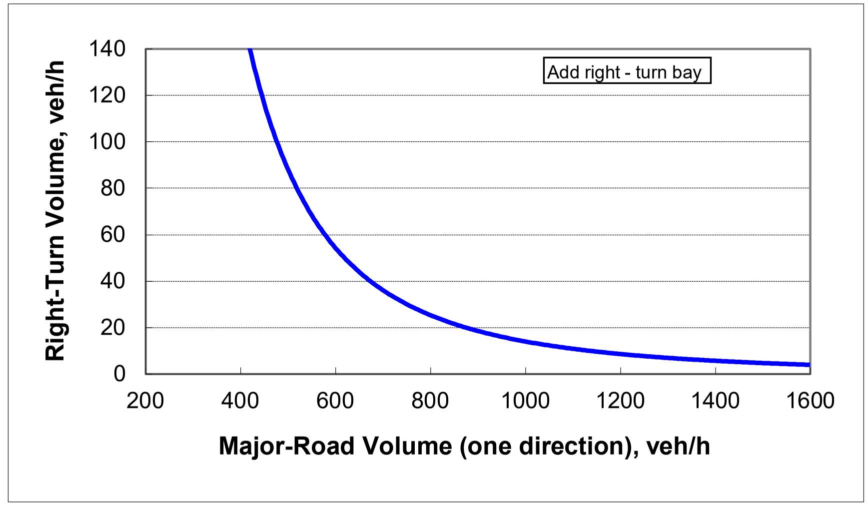


Figure 2 - 6. Guideline for determining the need for a major-road right-turn bay at a two-way stop-controlled intersection.

INPUT

Variable	Value
Roadway geometry:	2-lane roadw ay
Major-road speed, mph:	30
Major-road volume (one direction), veh/h:	80
Right-turn volume, veh/h:	31

OUTPUT

Variable	Value
Limiting right-turn volume, veh/h:	3775115
Guidance for determining the need for a major-road right-turn bay for a 2-lane roadway:	
Do NOT add right-turn bay.	

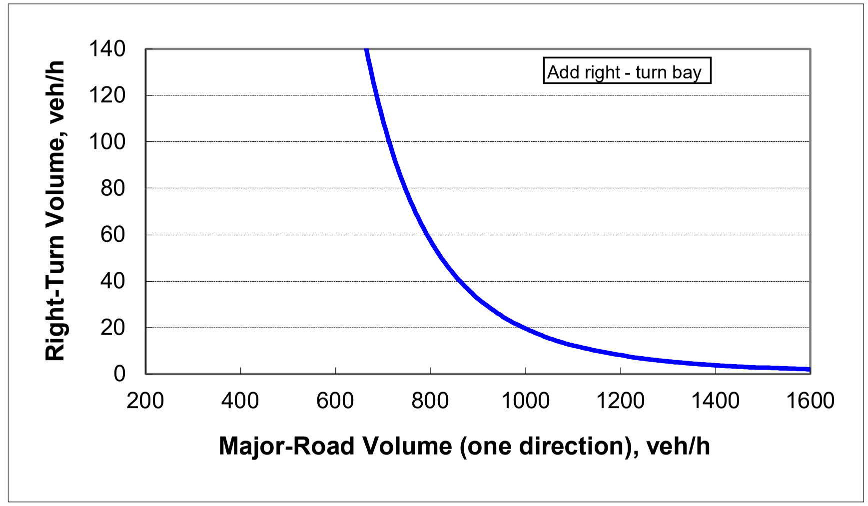


Figure 2 - 5. Guideline for determining the need for a major-road left-turn bay at a two-way stop-controlled intersection.

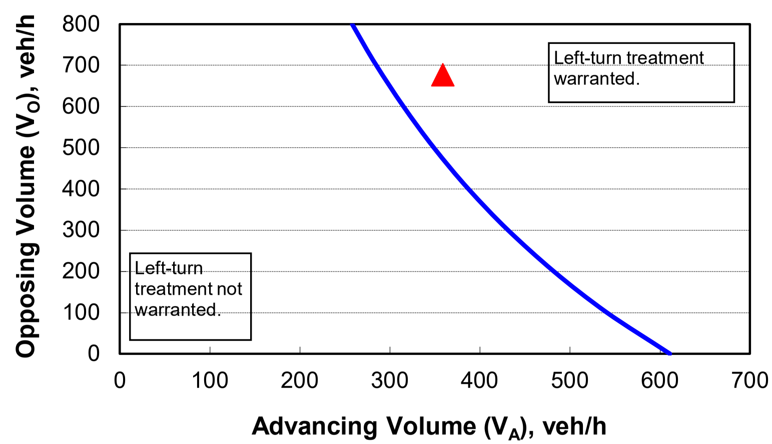
2-lane roadway (English)

INPUT

Variable	Value
85^{th} percentile speed, mph:	40
Percent of left-turns in advancing volume (V_A), %:	9%
Advancing volume (V_A), veh/h:	359
Opposing volume (V_O), veh/h:	677

OUTPUT

Variable	Value
Limiting advancing volume (V_A), veh/h:	291
Guidance for determining the need for a major-road left-turn bay:	
Left-turn treatment warranted.	



CALIBRATION CONSTANTS

Variable	Value
Average time for making left-turn, s:	3.0
Critical headway, s:	5.0
Average time for left-turn vehicle to clear the advancing lane, s:	1.9

Figure 2 - 5. Guideline for determining the need for a major-road left-turn bay at a two-way stop-controlled intersection.

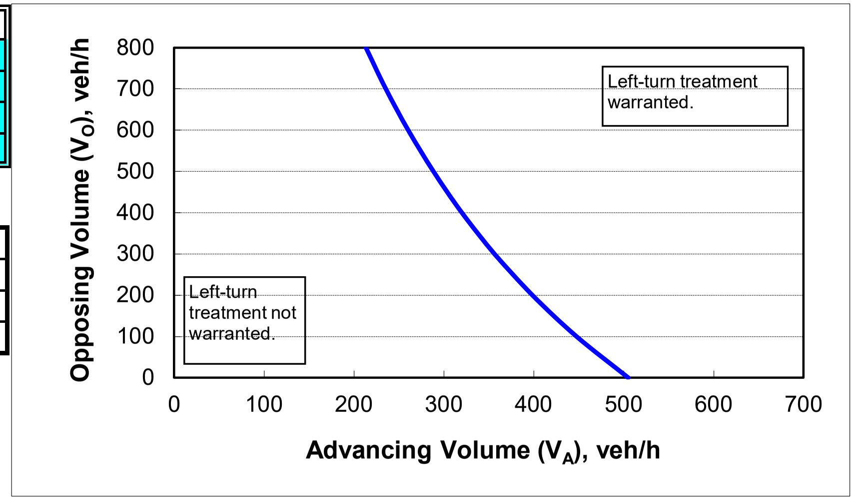
2-lane roadway (English)

INPUT

Variable	Value
85th percentile speed, mph:	40
Percent of left-turns in advancing volume (V_A), %:	14%
Advancing volume (V_A), veh/h:	820
Opposing volume (V_O), veh/h:	576

OUTPUT

Variable	Value
Limiting advancing volume (V_A), veh/h:	267
Guidance for determining the need for a major-road left-turn bay:	
Left-turn treatment warranted.	



CALIBRATION CONSTANTS

Variable	Value
Average time for making left-turn, s:	3.0
Critical headway, s:	5.0
Average time for left-turn vehicle to clear the advancing lane, s:	1.9

Figure 2 - 5. Guideline for determining the need for a major-road left-turn bay at a two-way stop-controlled intersection.

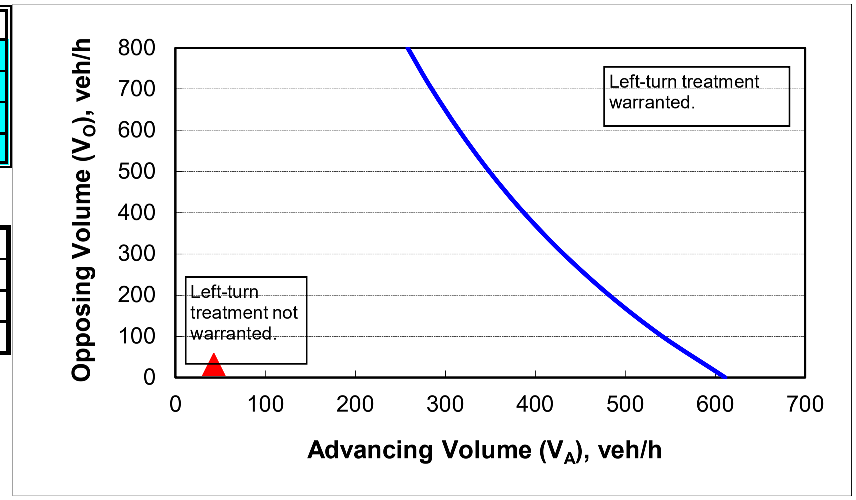
2-lane roadway (English)

INPUT

Variable	Value
85^{th} percentile speed, mph:	30
Percent of left-turns in advancing volume (V_A), %:	14%
Advancing volume (V_A), veh/h:	43
Opposing volume (V_O), veh/h:	31

OUTPUT

Variable	Value
Limiting advancing volume (V_A), veh/h:	291
Guidance for determining the need for a major-road left-turn bay:	
Left-turn treatment NOT warranted.	



CALIBRATION CONSTANTS

Variable	Value
Average time for making left-turn, s:	3.0
Critical headway, s:	5.0
Average time for left-turn vehicle to clear the advancing lane, s:	1.9

Figure 2 - 5. Guideline for determining the need for a major-road left-turn bay at a two-way stop-controlled intersection.

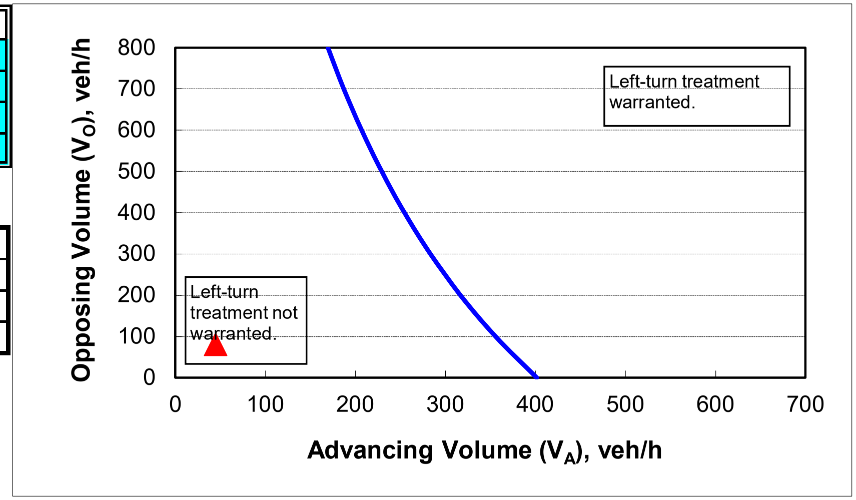
2-lane roadway (English)

INPUT

Variable	Value
85^{th} percentile speed, mph:	30
Percent of left-turns in advancing volume (V_A), %:	38%
Advancing volume (V_A), veh/h:	45
Opposing volume (V_O), veh/h:	80

OUTPUT

Variable	Value
Limiting advancing volume (V_A), veh/h:	364
Guidance for determining the need for a major-road left-turn bay:	
Left-turn treatment NOT warranted.	



CALIBRATION CONSTANTS

Variable	Value
Average time for making left-turn, s:	3.0
Critical headway, s:	5.0
Average time for left-turn vehicle to clear the advancing lane, s:	1.9