DRAFT TECHNICAL MEMORANDUM #2: TRAFFIC ANALYSIS

TO: Sai Sarepalli, PE (CCRPC)

FROM: Corey Mack, PE
Roxanne Meuse, EIT

DATE: September 19, 2016

SUBJECT: Allen Martin Drive and VT-15 Intersection Scoping Study | Trip Generation and Distribution

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The Town of Essex and Chittenden County Regional Planning Commission (CCRPC) have contracted with RSG to conduct an intersection scoping study of VT Route 15 and Allen Martin Drive. This memorandum is Deliverable 4d of the scope of work submitted on March 21, 2016. This technical memorandum adds the currently permitted traffic to the adjusted observed traffic volumes, documents the 2036 projected traffic volumes, and conducts a turn lane warrant analysis and a signal warrant analysis for the study intersection for both current and future years.

SUMMARY OF KEY FINDINGS

- All movements at the study intersection currently meet the minimum required level-of-service (D) by the Vermont Agency of Transportation (VTrans) in the AM and PM peak hours.
- Northbound right and left turns from Allen Martin Drive onto VT Route 15 currently experience acceptable delay, but the proposed buildout of the Saxon Hill Industrial Park (SHIP) will bring these movements below the VTrans minimum required level-of-service.
- The northbound and westbound approaches to the study intersection currently experience queueing of no more than approximately 60 feet, but with the buildout of the SHIP, queues will significantly increase.
- A westbound left turn lane on VT-15 at the approach to Allen Martin Drive is currently warranted.
- A signal is not currently warranted at the study intersection, but will be as development within the SHIP continues.

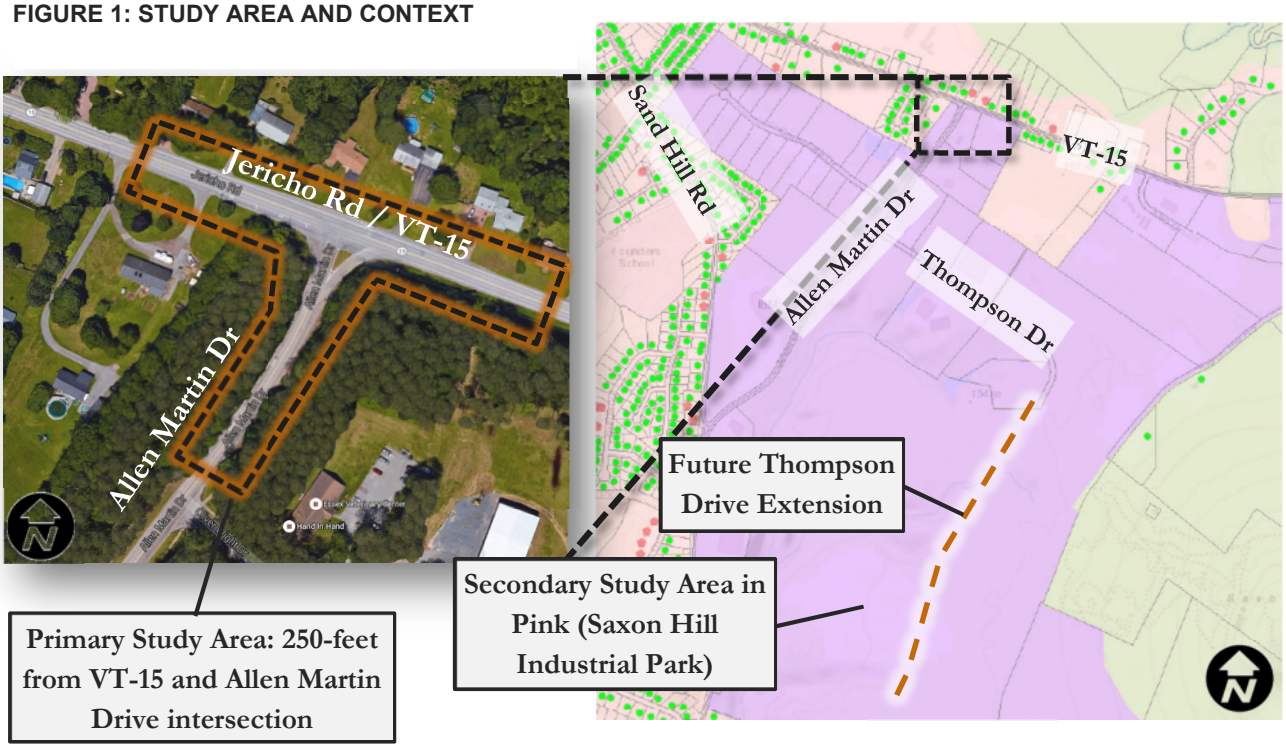
INTRODUCTION

PROJECT DESCRIPTION

Allen Martin Drive serves as the primary access to the Saxon Hill Industrial Park (SHIP). Continued development in the park has led to a concern of traffic congestion and left turn conflicts at the VT-15 and Allen Martin Drive intersection. Ultimate SHIP plans include a secondary access road to River Road / VT-117, but until this road is constructed, Allen Martin Drive is expected to remain the primary vehicle access route to the SHIP.

The primary and secondary study areas are shown in Figure 1.

FIGURE 1: STUDY AREA AND CONTEXT



SHIP BUILDOUT

The Town of Essex has designated the Saxon Hill Industrial Park (SHIP) as a Resource Preservation District – Industrial (RPD-I) zoning district. In an RPD-I district, 40% of the land can be developed for industrial/commercial purposes, and the remaining 60% of the land must be preserved as undeveloped open space. A 200-foot buffer is required between industrial uses and residential parcels. This buffer as well as the mountain biking trails in the SHIP are included in the 60% conservation land.

Within a given parcel, only 60% of the parcel may be developed with an impervious surface. The remaining 40% of the parcel includes the residential buffer, if applicable.

The land in the SHIP has either already been developed or has been designated for one of the two uses - Industrial or Conservation/Recreation. Of the lots designated for industrial purposes,

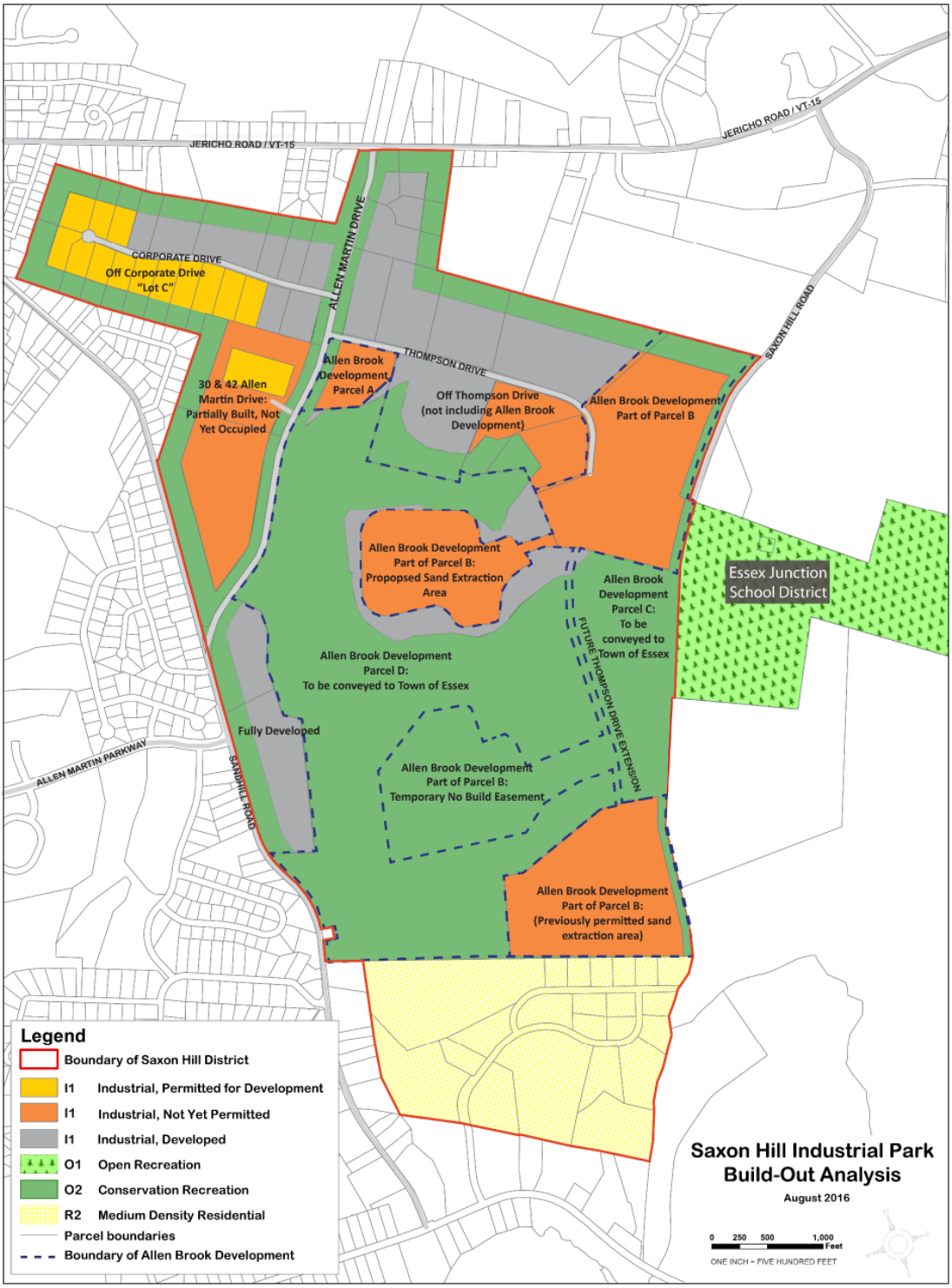
approximately 250 acres is currently undeveloped (approximately 200 acres not including residential buffers). A temporary no-build easement of 27.5 acres is not included in this area.

Remaining lots designated for industrial purposes include:

- **Lot C.** Lot C is the group of parcels along Corporate Drive, in the northwest section of the SHIP. Lot C was permitted by Land Use Permit #4C0329-17-EB in 1999. There are 12 undeveloped parcels remaining (consisting of 37 acres in total), which are permitted a certain number of peak hour trips according to the land use permit.
- **30 & 42 Allen Martin Drive.** This lot is located along the west side of Allen Martin Drive south of Corporate Drive. It is permitted to have two 180,000 SF buildings and one 60,000 SF buildings. One 180,000 SF building has already been built but is not yet occupied.
- **Allen Brook Development.** Allen Brook Development owns land designated for industrial uses in various areas east of Allen Martin Drive. The company has 116 acres of developable land, 27.5 acres designated only for sand extraction, and a temporary no-build easement of 27.5 acres. None of these land uses are currently permitted. According to the 2016 Traffic Impact Study for the sand extraction area, vehicles accessing this site will not use the study intersection of VT-15 and Allen Martin Drive, so it will not be analyzed as part of this report.
- **Other.** 17 acres off Thompson Drive that are not owned by Allen Brook Development have yet to be developed or permitted.

A map of the SHIP's designated uses, parcel/lot information, and developer information is shown in Figure 2.

FIGURE 2: SHIP BUILDOUT MAP



TRAFFIC VOLUMES ANALYSIS

PERMITTED TRAFFIC VOLUMES

RSG considers permitted traffic to include the remaining allowable trips associated with Lot C and projected trips from the existing but unoccupied building at 30-42 Allen Martin Drive.

Lot C (Corporate Drive)

Approximately half of the parcels in Lot C have been developed since 1999, when the Land Use Permit for Lot C was issued. This is in line with the number of peak hour trips remaining; approximately half of all permitted trips in Lot C have been generated.

Lot C has 184 approved trips remaining in the weekday morning peak hour and 137 approved trips remaining in the weekday evening peak hour. These numbers were found in the July 2015 traffic impact study for Saxon Hill Corporation's proposed warehouse building at 14 Corporate Drive; these numbers include projected trips from 14 Corporate Drive since the warehouse has not yet been constructed.

To determine enter and exit distribution of these trips, ITE Industrial Park Land Use (code 130) was used (Table 1). The trip generation and enter/exit distribution of Lot C is shown in

Table 2.

30-42 Allen Martin Drive (Existing, unoccupied building)

According to the 2013 Traffic Impact Assessment for 30-42 Allen Martin Drive, it is expected that the buildings on this Lot will consist of 50% manufacturing use and 50% warehousing use. Trip generation and enter/exit distribution of the existing, unoccupied 180,000 SF building at 30-42 Allen Martin Drive reflect this projection using the ITE Manufacturing Land Use (code 140) and the ITE Warehousing Land Use (code 150) (see Table 1). This building is expected to generate 93 weekday morning peak hour trips and 95 weekday evening peak hour trips. The trip generation and enter/exit distribution of 30-42 Allen Martin Drive are shown in

Table 2.

TABLE 1: ITE LAND USE TRIP GENERATION RATES

	AM			PM		
	Trip Rate	**Enter**	**Exit**	**Trip Rate**	**Enter**	**Exit**
ITE: Industrial Park (130)	8.55/acre	83%	17%	8.84/acre	21%	79%
ITE: Warehousing (150)	0.3/1000 SF	79%	21%	0.32/1000 SF	25%	75%

TABLE 2: PERMITTED TRIP GENERATION AND DISTRIBUTION

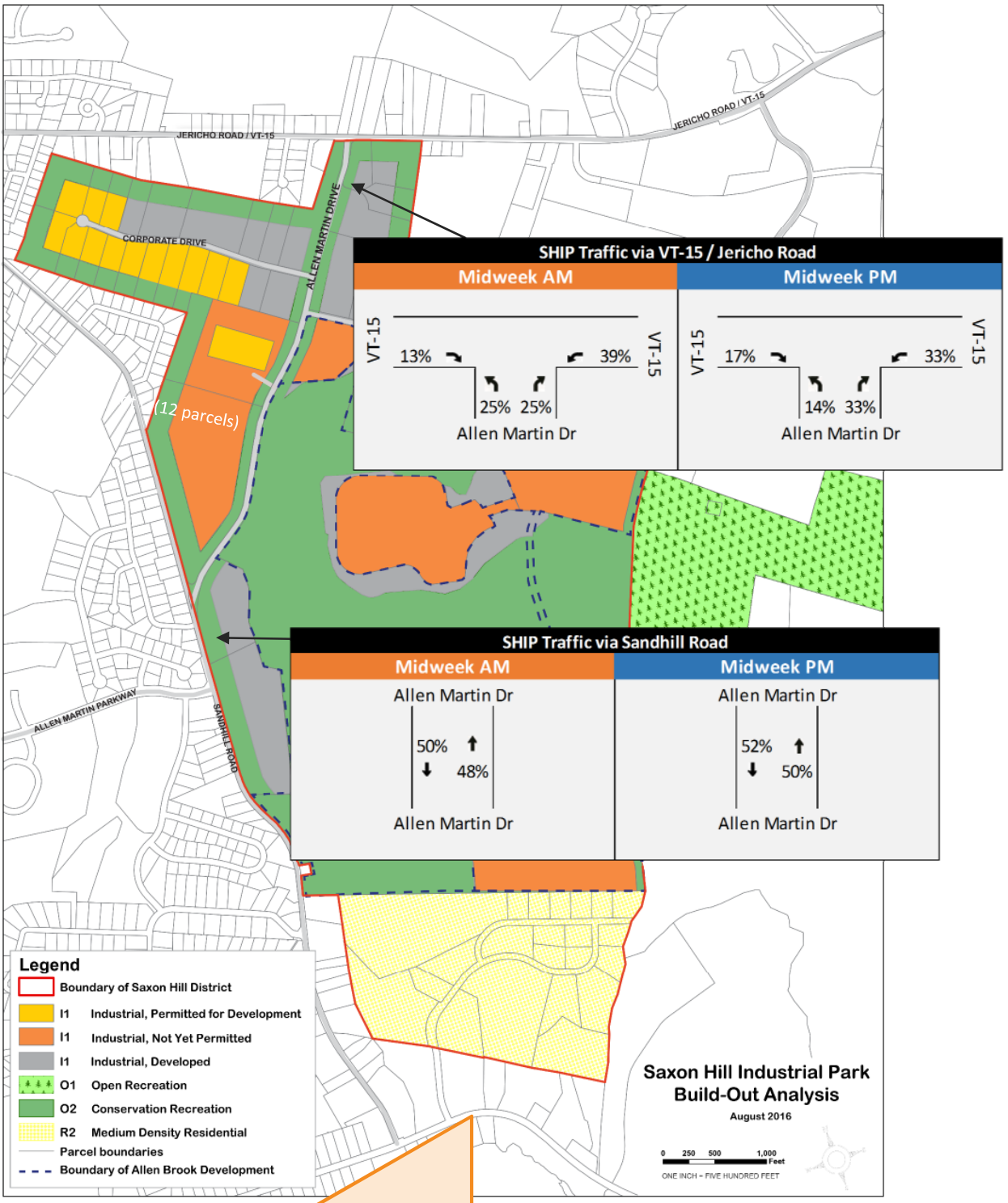
Permitted Developments	Parcel Information		Trip Generation						
	Total Acreage of Undeveloped Parcels (including residential buffer)	Building Square Footage	Basis of Trip Generation	AM			PM		
				Enter	Exit	*Total*	Enter	Exit	*Total*
Lot C (Corporate Drive)	36.9	N/A	**Trips:** Land Use Permit **Enter/Exit:** ITE: Industrial Park (130) based on acreage	153	31	*184*	29	108	*137*
30-42 Allen Martin Drive existing building	20	180,000	ITE: 50% Manufacturing (140) and 50% Warehousing (150) based on square footage	73	20	*93*	31	64	*95*
TOTAL				**225**	**51**	***277***	**60**	**172**	***232***

Trip Distribution of the SHIP Permitted Trips

The currently permitted trips were distributed proportionally using the same methodology used for the 2012 traffic impact study (TIS) for the Reinhart Food Service warehouse, located on Thompson Drive in the SHIP. The distribution percentage and the study area distribution of the permitted trips is illustrated in

Figure 3 and Figure 4, respectively.

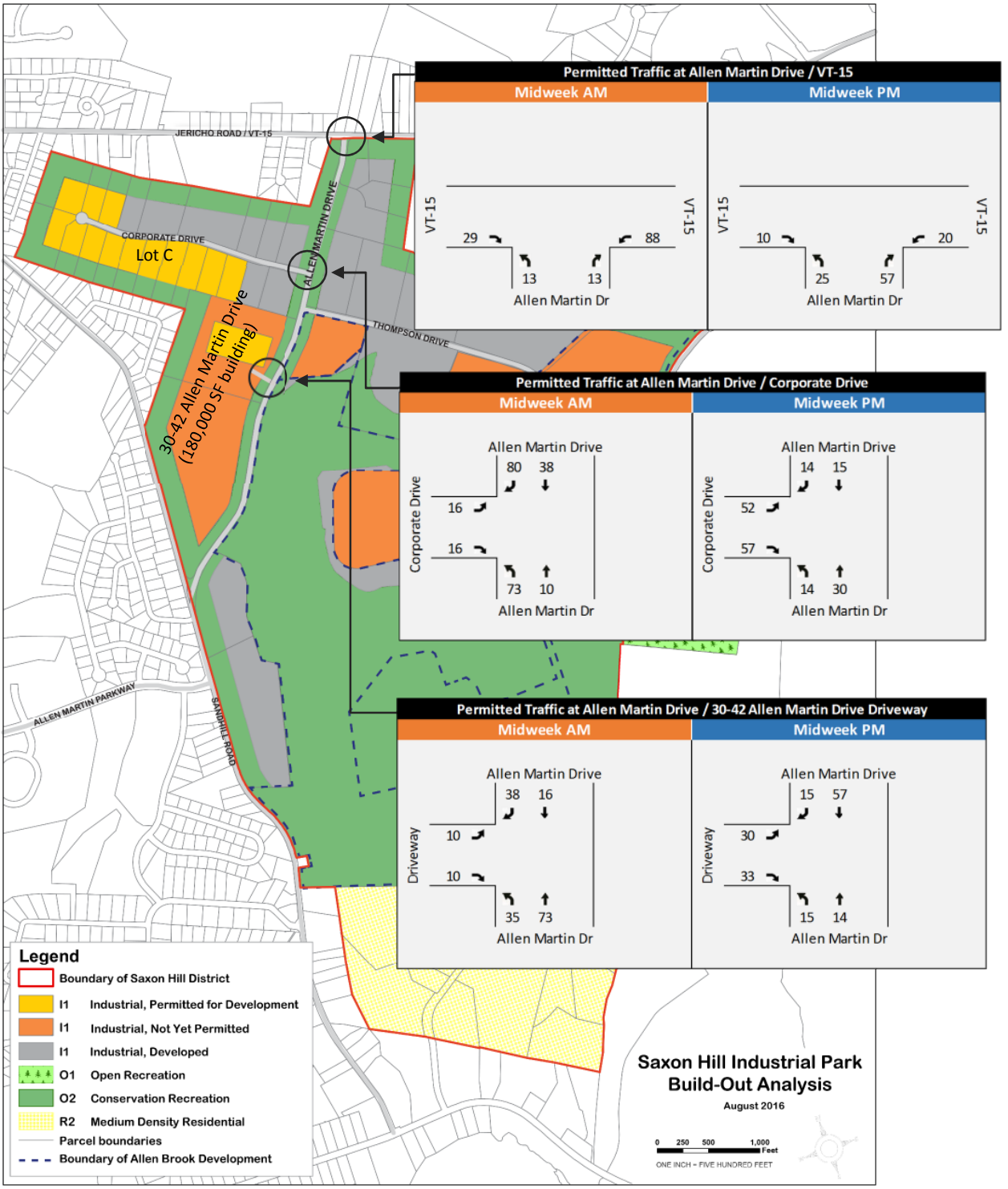
FIGURE 3: TRIP DISTRIBUTION VIA VT-15 AND SANDHILL ROAD (BASED ON REINHART TIS)



The **entering movements** are percentages of **all trips entering** the development (via VT-15 or Sandhill Road).

The **exiting movements** are percentages of **all trips exiting** the development (via VT-15 or Sandhill Road).

FIGURE 4: PERMITTED TRIP GENERATION AND DISTRIBUTION, 2016



FUTURE YEAR VOLUMES

RSG projected traffic volumes to 2036 - 20 years from now - when the SHIP will likely be fully developed. In addition to the permitted trips (Lot C and the building currently at 30-42 Allen Martin Drive), RSG considered the following remaining parcels as projected future trip generators:

- **30-42 Allen Martin Drive:** Future second 180,000 SF building and future 60,000 SF building
- **Allen Brook Development:** 116 developable acres
- **Thompson Drive:** 17 developable acres

Projected trips for each of these is shown in Table 3. Because future building square footage of most of these properties is unknown, acreage was used as a variable with the ITE land use Industrial Park (130) to determine trip generation (see Table 1 for the ITE rates). The zoning regulations of the Town of Essex limit development to 60% of a property; trips are based on 60% of the total available acreage.

TABLE 3: PROJECTED TRIP GENERATION AND DISTRIBUTION

Potential Developments	Parcel Information			Trip Generation						
	Total Acreage of Undeveloped Parcels (including residential buffer)	60% of Developable Acreage (residential buffer included in remaining 40%)	Building Square Footage	Basis of Trip Generation	AM			PM		
					Enter	Exit	*Total*	Enter	Exit	*Total*
30-42 Allen Martin Drive remaining space	33	20	240,000	ITE: 50% Manufacturing (140) and 50% Warehousing (150) based on square footage	97	27	*124*	41	85	*126*
Allen Brook Development (not including sand extraction area)	116	70	N/A	ITE: Industrial Park (130) based on acreage	494	101	*595*	129	486	*615*
Remaining Thompson Drive space	17	10	N/A	ITE: Industrial Park (130) based on acreage	73	15	*88*	19	72	*91*
TOTAL					**664**	**143**	***806***	**189**	**643**	***832***

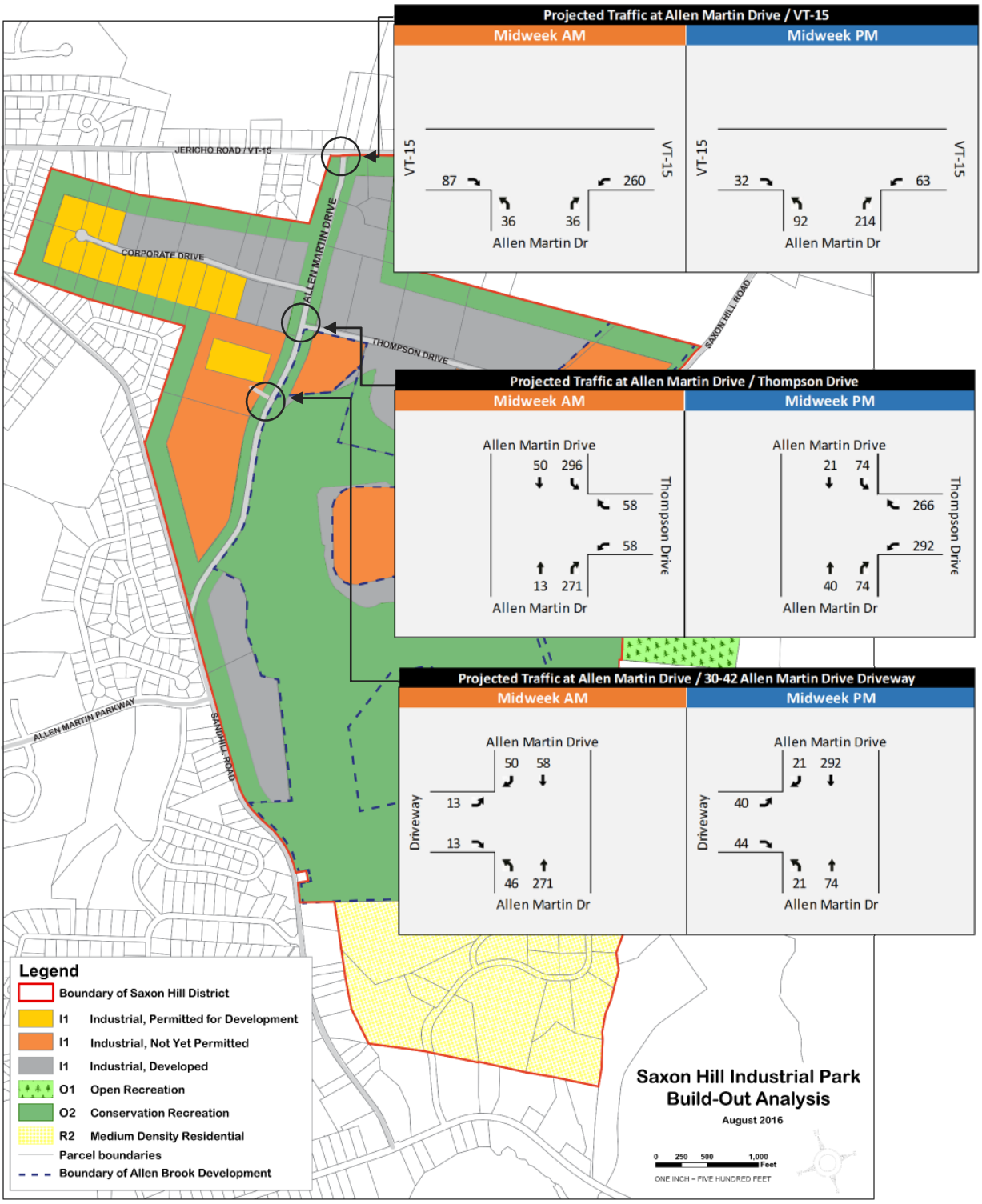
Potential Trips at VT-15 and Allen Martin Drive Intersection

To determine the number of generated trips associated with the full build-out that pass through the intersection of VT-15 and Allen Martin Drive, as well as the approach and exit directions of those trips, RSG used the same methodology used for permitted trips; projected turning movements from the Reinhart TIS were used to split the trips proportionally (see

Figure 3).

A map of the study area showing all potential (not including permitted) trips and their enter and exit distributions is shown in Figure 5.

FIGURE 5: PROJECTED TRIP GENERATION FROM NOT YET PERMITTED LAND USES WITHIN THE SHIP



SUMMARY OF VT ROUTE 15 / ALLEN MARTIN DRIVE TRAFFIC VOLUMES

FIGURE 6: 2016 EXISTING TRAFFIC VOLUMES (NO BUILD)

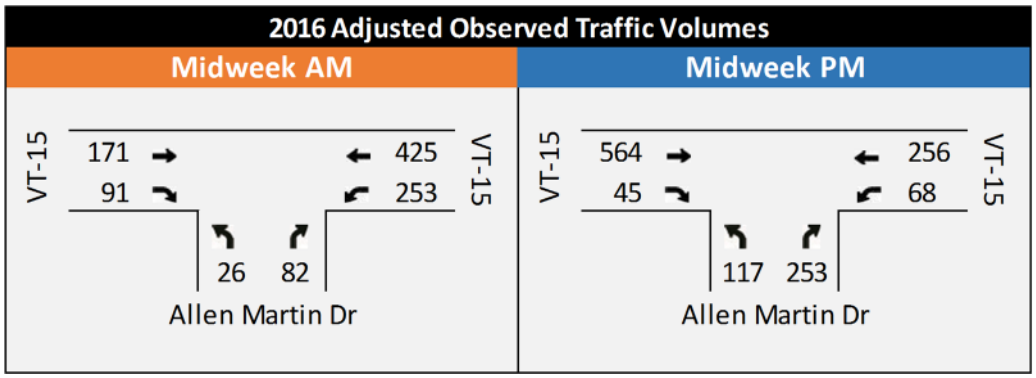
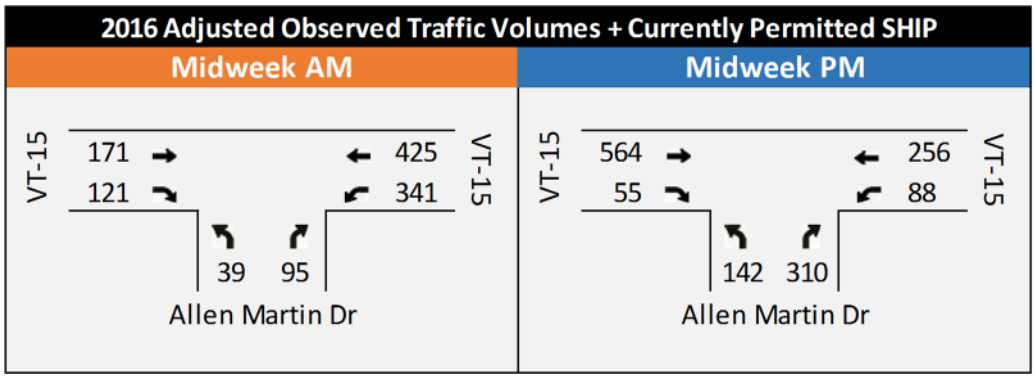


FIGURE 7: 2016 PERMITTED TRAFFIC VOLUMES (BUILD)



Projecting to 2036, RSG applied a growth factor of 0.5% per year, for a total growth factor of +10.5%, to the adjusted observed traffic volumes. Figure 8 and Figure 9 show the Permitted and Projected volumes of the VT-15 and Allen Martin Drive intersection in 2036 with this growth factor applied to the adjusted observed volumes.

FIGURE 8: 2036 PERMITTED TRAFFIC VOLUMES (NO BUILD)

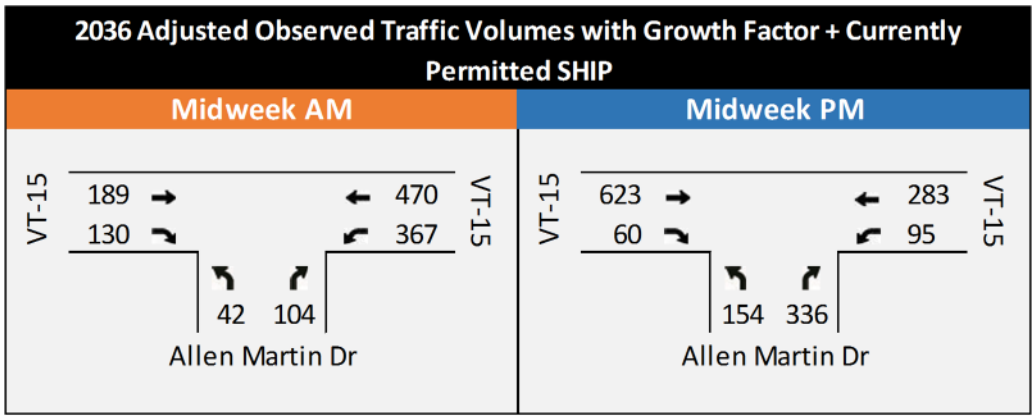
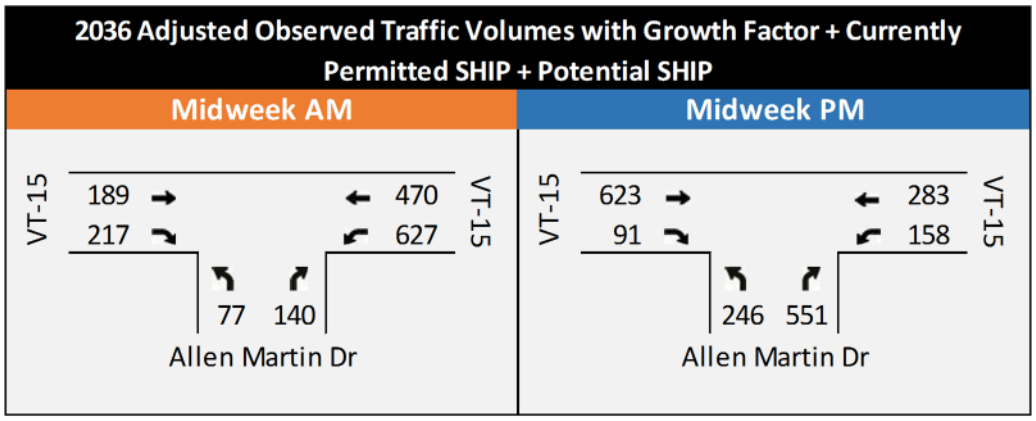


FIGURE 9: 2036 PROJECTED TRAFFIC VOLUMES (BUILD)



CONGESTION ANALYSIS

LEVEL-OF-SERVICE DEFINITION

Level-of-service (LOS) is a qualitative measure describing the operating conditions as perceived by motorists driving in a traffic stream. LOS is calculated using the procedures outlined in the 2000 and 2010 Highway Capacity Manuals.[1] In addition to traffic volumes, key inputs include the number of lanes at each intersection, traffic control type (signalized or unsignalized), and the traffic signal timing plans.

The 2010 Highway Capacity Manual defines six qualitative grades to describe the level of service at an intersection. Level-of-Service is based on the average control delay per vehicle. Table 4 shows the various LOS grades and descriptions for signalized and unsignalized intersections.

TABLE 4: LEVEL-OF-SERVICE CRITERIA FOR SIGNALIZED AND UNSIGNALIZED INTERSECTIONS

LOS	CHARACTERISTICS	UNSIGNALIZED TOTAL DELAY (SEC)	SIGNALIZED TOTAL DELAY (SEC)
A	Little or no delay	≤ 10.0	≤ 10.0
B	Short delays	10.1-15.0	10.1-20.0
C	Average delays	15.1-25.0	20.1-35.0
D	Long delays	25.1-35.0	35.1-55.0
E	Very long delays	35.1-50.0	55.1-80.0
F	Extreme delays	> 50.0	> 80.0

The delay thresholds for LOS at signalized and unsignalized intersections differ because of the driver's expectations of the operating efficiency for the respective traffic control conditions. According to HCM procedures, an overall LOS cannot be calculated for two-way stop-controlled intersections because not all movements experience delay. In signalized and all-way stop-controlled intersections, all movements experience delay and an overall LOS can be calculated.

The VTrans policy on level of service for **Signalized and All-Way Stop Intersections** is:

- Overall LOS C should be maintained for state-maintained highways and other streets accessing the state's facilities
- Reduced LOS may be acceptable on a case-by-case basis when considering, at minimum, current and future traffic volumes, delays, volume to capacity ratios, crash rates, and negative impacts as a result of improvement necessary to achieve LOS C.

The VTrans policy on level of service for **Two-Way and One-Way Stop Intersections** is:

- LOS D should be maintained for side roads with volumes exceeding 100 vehicles/hour for a single lane approach (150 vehicles/hour for a two-lane approach) at two-way stop-controlled intersections. No LOS criteria are in effect for volumes less than these.

[1] The HCM 2010 does not provide methodologies for calculating intersection delays at certain intersection types including signalized intersections with exclusive pedestrian phases and signalized intersections with non NEMA-standard phasing. Because of these limitations, HCM 2000 methodologies are employed where necessary.

LEVEL-OF-SERVICE RESULTS

The Highway Capacity Manual congestion reports within Synchro (version 9), a traffic analysis software package from Trafficware that is routinely relied upon by transportation engineering professionals, were used to assess traffic congestion at the study intersection. Table 5 and Table 6 present the LOS results during the weekday AM and PM peak hours, respectively.

TABLE 5: AM PEAK HOUR CONGESTION RESULTS

Movement	2016 Existing (No Build)			2016 Permitted (Build)			2036 Permitted (No Build)			2036 Projected (Build)		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
NB Left	D	28	0.14	E	47	0.32	F	66	0.42	F	>100	2.66
NB Right	A	10	0.09	A	10	0.11	A	10	0.12	B	10	0.17
WB Left	A	8	0.18	A	8	0.24	A	9	0.27	A	10	0.45

TABLE 6: PM PEAK HOUR CONGESTION RESULTS

Movement	2016 Existing (No Build)			2016 Permitted (Build)			2036 Permitted (No Build)			2036 Projected (Build)		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
NB Left	D	29	0.44	E	38	0.58	F	58	0.73	F	>100	1.53
NB Right	C	18	0.48	C	21	0.59	D	27	0.69	F	>100	1.12
WB Left	A	9	0.07	A	9	0.09	A	9	0.10	A	10	0.16

Detailed Synchro LOS worksheets are available in Appendix A.

Discussion

Existing Conditions: A-D. All turning movements in both the AM and PM peak hours currently meet the VTrans minimum LOS of D for one-way stop intersections.

Northbound Left Movements: D, E, and F. For AM and PM peak hours in the 2016 Permitted scenarios, northbound left turns do not meet the VTrans minimum LOS of D. This is primarily due to the lack of sufficient gaps in through traffic on VT-15, and also partially due to westbound left turns onto Allen Martin Drive. In the 2036 Permitted scenario, the northbound left turn movement worsens to an F in both AM and PM peak hours due to the increase in through traffic due to 20-year growth. In the 2036 Projected scenario, the northbound left turn movement is an F with delay and v/c numbers well over the minimum necessary to be rated as an F.

Northbound Right Movements: A - F. In the AM peak hour for all scenarios, northbound right turns experience negligible delays as most through traffic heads west (not conflicting with northbound right turns). In the PM peak hour, when most through traffic heads east and when there are significantly more northbound right movements than in the AM peak hour as vehicles exit the SHIP, LOS's range from C to F. Vehicles taking this right turn do not need to cross traffic and experience delay that comes from that, but they must wait behind northbound vehicles waiting to turn left. A greater delay for northbound left turns results in a greater delay for northbound right turns. In the 2016 and 2036 Permitted scenarios, the northbound right movement meets the VTrans minimum LOS of D. This movement worsens to a failing F in the 2036 Projected scenario.

Westbound Left Movements: A. In all scenarios, for both the AM and PM peak hours, westbound left turns experience negligible delays despite crossing eastbound through traffic.

QUEUING ANALYSIS

In addition to the congestion analysis, estimated average maximum queues were evaluated using SimTraffic. Five one-hour-long simulations were averaged together to estimate queue lengths,[2] shown in Table 7.

TABLE 7: AVERAGE MAXIMUM QUEUE LENGTHS (IN FEET)

	AM Peak Hour				PM Peak Hour			
	2016		2036		2016		2036	
Approach	Existing (No Build)	Permitted (Build)	Permitted (No Build)	Projected (Build)	Existing (No Build)	Permitted (Build)	Permitted (No Build)	Projected (Build)
EB	1	3	3	12	0	0	0	1
WB	53	79	92	421	22	27	50	76
NB	13	15	18	467	41	71	174	776

Detailed SimTraffic queuing worksheets are available in Appendix B.

Discussion

2016 Existing and Permitted queue lengths are generally acceptable; the highest estimated queue length is of approximately 80 feet in the AM Permitted westbound approach. Westbound queues are likely most often a result of westbound through vehicles being blocked from continuing past the intersection due to one westbound left-turning vehicle waiting for a sufficient gap in eastbound traffic to turn onto Allen Martin Drive.

Queue lengths in the westbound and northbound approaches are expected to experience minimal increases due to growth in through traffic between the 2016 and 2036 Permitted scenarios. The northbound PM approach is one exception; its queues are expected to double from 71 feet to 174 feet between these two scenarios.

Queue lengths in the westbound and northbound approaches are expected to significantly increase due to the buildout of the SHIP. The northbound approach will experience a greater increase compared to the westbound approach in both the AM and PM peak hours between the 2036 Permitted and Projected scenarios - from 18 feet to 467 feet in the AM peak and from 174 feet to 776 feet in the PM peak. The westbound approach will experience a much greater increase in queue length in the AM peak hour than the PM peak hour - from 92 feet to 421 feet in the AM peak and from 50 feet to 76 feet in the PM peak. This is due to a much greater number of vehicles due to the SHIP buildout approaching from the west in the morning than in the afternoon.

[2] Five one-hour-long simulations were averaged together to estimate queue lengths. As each run is different, a difference of less than 50 feet should not be seen as significant.

TURN LANE WARRANT ANALYSIS

In assessing the SHIP access via VT-15, a turn lane warrant analysis was conducted for westbound left turns and eastbound right turns onto Allen Martin Drive from VT-15. Dedicated turn lanes have the safety and capacity benefits of removing turning traffic from the through volume traffic stream but also promote higher vehicle speeds and require increased pavement widths.

LEFT TURN LANE

Using Harmelink's methodology for unsignalized intersections, it was found that volume warrants necessary for construction of a dedicated westbound left-turn lane **are met** during the weekday AM and PM peak hours at this site, based on existing traffic conditions and roadway characteristics (40 mph posted speed limit). This method is shown graphically in Figure 10, with supporting numbers in

Table 8.

FIGURE 10: LEFT TURN LANE HARMELINK WARRANT FOR 2016 EXISTING CONDITIONS

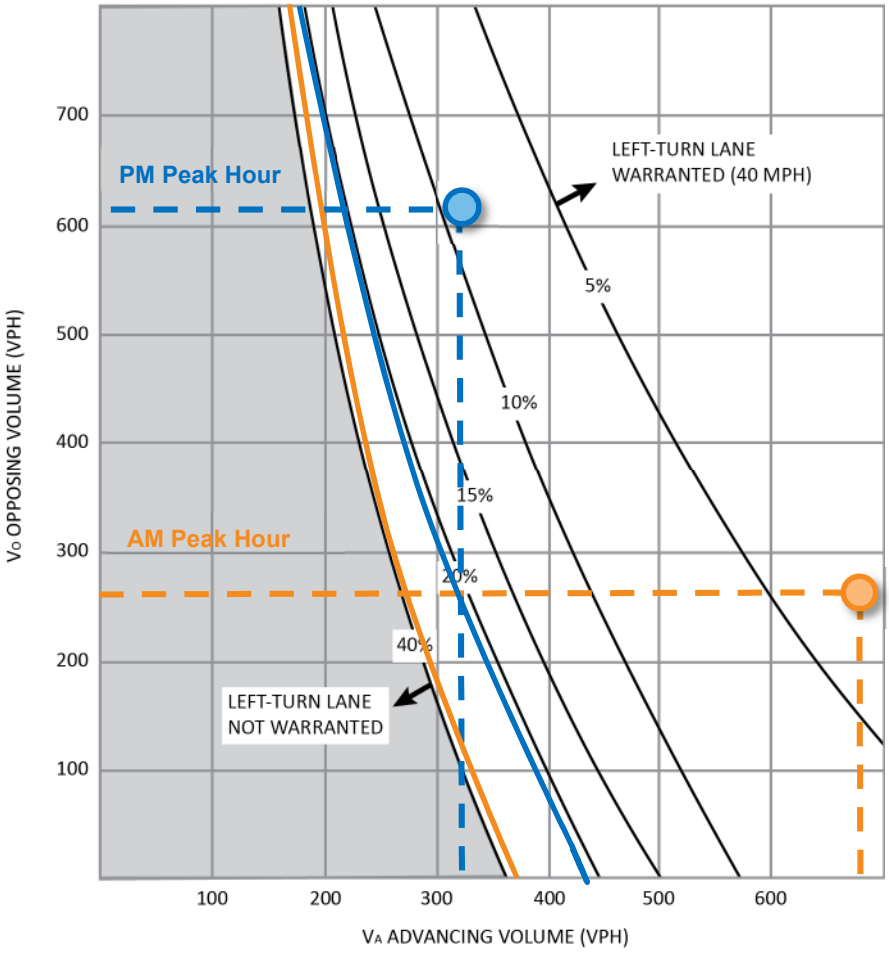


TABLE 8: LEFT TURN LANE HARMELINK WARRANT FOR 2016 EXISTING CONDITIONS

	AM Peak Hour	PM Peak Hour
Advancing (WB) Volume (V_A)	678	324
Opposing (EB) Volume (V_O)	263	609
% Left Turns	37%	21%
Warranted?	Yes	Yes

Because a left turn lane is warranted at the study intersection for existing observed traffic conditions, a left turn lane will continue to be warranted, and by greater amounts, as the SHIP continues to be developed.

RIGHT TURN LANE

A warrant analysis was conducted for the existing right turn lane from VT-15 onto Allen Martin Drive using the VTrans Right Turn Auxiliary Lanes Traffic Volume Warrants. According to this methodology, a right turn lane is **not warranted** under the existing traffic conditions in AM or PM peak hours (see Figure 11). **A right turn lane is only warranted at the study intersection for 2036 Projected volumes in the PM peak hour** (see Table 9).

FIGURE 11: RIGHT TURN LANE VTRANS WARRANT FOR 2016 EXISTING CONDITIONS

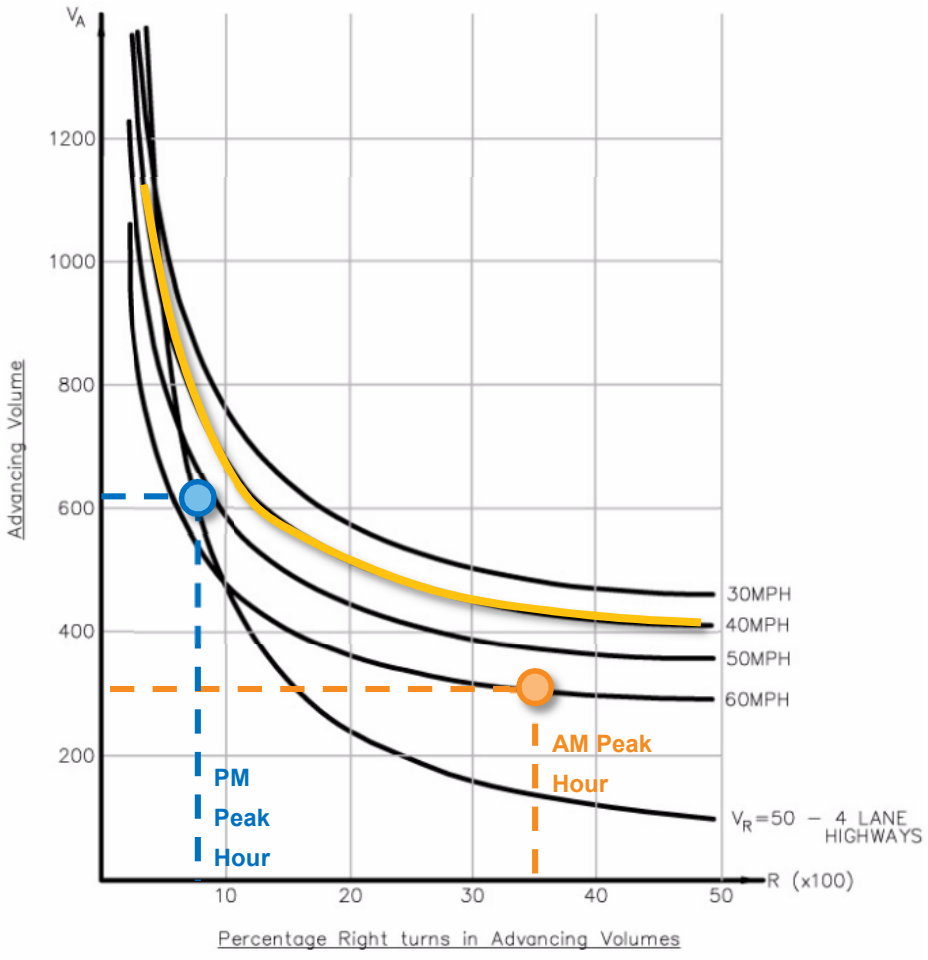


TABLE 9: RIGHT TURN LANE VTRANS WARRANT FOR ALL SCENARIOS

AM Peak Hour	2016 Existing	2016 Permitted	2036 Permitted	2036 Projected
Advancing (EB) Volume	263	292	320	406
% Right Turns	35%	41%	41%	53%
Warranted?	**No**	**No**	**No**	**No**
PM Peak Hour	2016 Existing	2016 Permitted	2036 Permitted	2036 Projected
Advancing (EB) Volume	609	619	683	714
% Right Turns	7%	9%	9%	13%
Warranted?	**No**	**No**	**No**	**Yes**

Although a right turn lane is not currently warranted according to existing traffic volumes, the turn lane serves the operational characteristics of large vehicles traveling through the intersection accessing the industrial park. Large vehicles account for approximately 7% of the vehicle volume in the AM Peak Hour. Eastbound trucks turning right onto Allen Martin Drive may first decelerate in the turn lane. To accomplish the turning maneuver, trucks may be required to overturn, or encroach on either the eastbound through or northbound left turn lane to avoid off-tracking of the trailer outside the pavement (Figure 12).

FIGURE 12: TRUCK TURNING RADIUS (WB-67)

SIGNAL WARRANT ANALYSIS

RSG conducted a signal warrant analysis using PC Warrants, a software from Ridge Engineering, which performs signal warrants according to the MUTCD. The analysis of the study intersection is based on RSG's 12-hour turning movement count on April 14, 2016[3].

A signal warrant analysis is a set of tests that are run to determine whether a traffic signal would significantly improve operations, mobility, and safety at an intersection. There is a total of 8 warrants. The warrants are described below, and with each one is a discussion of how the study intersection does or does not meet the warrant. The PC Warrants signal warrant analysis report is in Appendix C. Calculations used to determine the increase in developed acres required to meet the warrant are in Appendix D.

1) ***Eight-Hour Vehicular Traffic Warrant:*** **when a large amount of intersecting traffic occurring over an 8-hour period is the principal reason for installing a traffic signal, or where excessive delays occur on minor approaches to an intersection.**

    - There are three conditions that can be applied to meet this warrant, only one of which must be satisfied to meet the warrant. Each of the three conditions require a minimum volume on the major street and a minimum volume on the minor street for any 8 hours of an average day. Because the study intersection meets these volume requirements for only 3 hours of the day, **this warrant is not met.**
    - Allen Martin Drive's total enter and exit volumes would need to increase by approximately **40%** between 6AM and 6PM to meet this warrant. This is equivalent to an increase of approximately 1170 trips across 12 hours, or **70 developed acres.**

2) ***Four-Hour Vehicular Traffic Warrant:*** **when a large amount of intersecting traffic occurring over a 4-hour period is the principal reason for installing a traffic signal.**

    - To meet this warrant, an intersection must have a minimum volume on the major street and a minimum volume on the minor street for any 4 hours of an average day. Because the study intersection meets the requirements for only 2 hours of the day, **this warrant is not met.**
    - Allen Martin Drive's approach volumes would need to increase by approximately **45%** between 6AM and 6PM to meet this warrant. This is equivalent to an increase of approximately 1,320 trips across 12 hours, or **80 developed acres**.

3) ***Peak Hour Warrant:*** **when the minor-street traffic suffers unduly delay when entering or crossing the major-street during the average peak hour is the principal reason for installing a traffic signal.**

    - There are two conditions that can be applied to meet this warrant, only one of which must be satisfied to meet the warrant. Both conditions require a minimum

[3] Raw counts were multiplied by a daily adjustment factor of 0.92 to adjust the data to an average day, as recommended by the MUTCD for signal warrants. The adjustment factor was found in the 2014 VTrans Red Book using continuous traffic counter P6D531 on the second Thursday in April 2014 - April 10 - to match RSG's data collected on the second Thursday in 2016.

volume on the major street and a minimum volume on the minor street for 1 hour (any four consecutive 15-minute periods) of an average day. Because the study intersection meets the required volumes for 1 hour, **this warrant is met.**

4) ***Pedestrian Volume Warrant:*** **when the traffic volumes on a major street are so heavy that pedestrians experience excessive delays.**

   - Because the number of pedestrians crossing the study intersection is an order of magnitude beneath the necessary threshold to meet this warrant, **this warrant is not applicable.**

5) ***School Crossing Warrant:*** **when school children crossing a major street are the principal reason for installing a traffic signal.**

   - Because there is no school in the vicinity of the study intersection, **this warrant is not applicable.**

6) ***Coordinated Signal System Warrant:*** **when maintaining proper platooning of vehicles is the principal reason for installing a traffic signal.**

   - Because the study intersection is not along a road with frequent traffic signals, **this warrant is not applicable.**

7) ***Crash Experience Warrant:*** **when the severity and frequency of accidents is the principal reason for installing a traffic signal.**

   - Because the study intersection experienced less than five crashes in the past 12 months, and the type of crashes experienced at the intersection would not expected to be reduced by a signal, **this warrant is not met.**

8) ***Roadway Network Warrant:*** **when the concentration and organization of traffic flow at the intersection of two or more major routes is the principal reason for installing a traffic signal.**

   - Because the SHIP buildout will not make Allen Martin Drive a "major route", **this warrant is not applicable.**

9) ***Intersection Near a Grade Crossing:*** **when the proximity to a railroad crossing is the principal reason for installing a traffic signal.**

   - Because there is no proximate railroad crossing, **this warrant is not applicable.**

A signal warrant analysis is considered advisory only. This means that simply meeting any warrant may not be sufficient cause for installing a traffic signal. For example, meeting the peak hour warrant is usually not sufficient in and of itself to warrant installing a traffic signal. The rationale for this is that one hour (or less) of congestion in a day is probably not severe enough to justify the investment in the traffic signal controller and related equipment and software. Experience in Vermont suggests that meeting at least two other warrants is needed to justify investment in a traffic signal. **RSG found only one of the eight signal warrants were met; thus, a traffic signal is <u>not</u> currently warranted at the VT-15 / Allen Martin Drive intersection.**

ALTERNATIVES FOR FURTHER CONSIDERATION

Based on the purpose and needs developed and documented at previous stages of this project, and further informed by the traffic analysis presented in this technical memorandum, the following alternatives may be pursued to mitigate the identified issues.

		Identified Issues ("X" indicates the proposed alternative may partially address the issue)					
		Rear-end crashes on VT-15	Congestion on Allen Martin Drive	Congestion on VT Route 15	Speeding vehicles along VT-15	Engine braking noise from vehicles entering speed zone	Uncomfortable environment for pedestrians
Short Term							
S1	Restrict Engine Braking				X	X	X
S2	Extend 35 mph speed zone						X
S3	Striped shoulder on VT-15 adjacent to turn lane island		X				
S4	Intersection warning sign on approach to Allen Martin Drive on VT-15	X					
Mid-Term							
M1	Extend green space into VT-15 near turn lane island (permanent S3)		X				
M2	Add a WB left turn lane	X		X			
M3	Extend sidewalk along VT-15 from Sandhill Rd				X		X
M4	Add / extend separate NB right- and left-turn lanes		X				
M5	Widen eastbound right turn curve radius			X			
Long Term							
L1	Construct Allen Martin Parkway exit from VT-289		X				
L2	Construct Thompson Drive extension to VT-117		X				
L3	Intersection Control Modification: Signal	X	X				X
L4	Intersection Control Modification: Roundabout	X	X				X
L5	Construct connection to Saxon Hill Road		X				