MEMO

TO: Benjamin Avery, BlackRock Construction

FROM: Corey Mack, PE

DATE: May 18, 2020

SUBJECT: Haystack Crossing: Updated Traffic Impact Assessment

RSG has prepared the following update to the Traffic Impact Study for the proposed Haystack Crossing mixed use development in Hinesburg, VT. The proposed site is located on the west side of Vermont Route 116 (VT-116) south of Shelburne Falls Road (SFR), with full site access via Shelburne Falls Road and limited right-in / right-out access to VT-116.

This update to the previous traffic analysis is intended to address comments received from Town staff and technical review, dated April 3, 2020. Notably, this memo updates the following information as a result of the technical review:

1. **The geographic scope is reduced** to focus on the directly affected intersections, including the VT-116 / SFR / CVU Road intersection; the right-in / right-out drive access onto VT-116, and the full access Haystack Road intersection with SFR. This geographic scope is consistent with Vermont Agency of Transportation (VTrans) guidelines[1] for identifying impacted intersections for traffic analyses associated with a proposed development project. This is explained further in Section 1.
2. **Updated and documented the land use program, trip generation estimates, and adjustments to the trip generation estimates, with documentation,** for Phase 1A and Phase 1B, explored further in Section 1.
3. **Removed contributing volumes associated with the withdrawn Hannaford Bros.** grocery store development south of the project area. Other Development Volumes included in the analysis are documented in Section 2.
4. **Reviewed the improvements at VT-116 and SFR** with respect to the implementation of Phase 1A and total Phase 1 (1A and 1B) in Section 3.
5. **Intersection capacity analyses include Synchro / Highway Capacity Manual reports** for delay, Level of Service, and volume to capacity (v/c) performance measures, included in Section 4.

[1] https://vtrans.vermont.gov/sites/aot/files/planning/documents/trafficresearch/TISGuidelines.pdf

6. **Performed warrant analyses for left turn and right turn lanes** at both site access drive intersections, documented in Section 4.
7. **Additional crash review and analysis** was performed along VT-116 to better quantify and understand the cause of crashes in the vicinity of the proposed drives. This is explored in Section 5.
8. **Discussed access considerations for the southern driveway** on VT-116 leading to the right-in / right-out design in Section 1.

The following recommendations from the Town staff and technical review were not explored further:

1. **Lantman's entrance driveway** was not added into the traffic network for modeling. Given the reduction of the geographic scope, intersections receiving fewer than 75 trips in the peak hours were not analyzed as part of this study. As discussed in Section 1, VT-116 south of Riggs Road receives 37 and 32 vehicles in the AM and PM peak hours following full build out of Phase 1. All intersections south of Riggs Road were not considered in this analysis.
2. **No analysis was conducted for Phase 2.** The Phase 2 land use development program is incomplete. Furthermore, the timeline for implementation of Phase 2 is more uncertain. Phase 2 will be developed and approached as a separate project following buildout of Phase 1.

The results of this analysis are summarized in Section 7.

1.0 PROPOSED PHASED DEVELOPMENT PROGRAM

As documented in Haystack Crossing Phasing Plan L-101 dated 01/16/2020 by TJ Boyle and Associated and presented in Figure 1, the Haystack Crossing development program is proposed to be constructed in two phases, with the first phase being separated into an initial and a secondary phase:

- Phase 1A represents the capacity that can be accommodated by the existing Town of Hinesburg water supply system.
- Phase 1B represents the remaining scope that can be accommodated when the new well on the Haystack Crossing property comes online.
- Phase 2 represents the full build out potential of the property. As noted earlier, the development program for this phase is conditional based upon market demands. As such, the development program is neither documented nor estimated in this traffic analysis.

The proposed development program of Phase 1A and Phase 1B, with a total Phase 1 (sum of 1A and 1B, combined), is shown in Table 1.

FIGURE 1: EXCERPT OF L101, ILLUSTRATING PHASE 1A IN GREEN, 1B IN ORANGE, AND FUTURE PHASE 2 IN BLUE.

TABLE 1: PROPOSED DEVELOPMENT PROGRAM OF PHASE 1A AND PHASE 1B.

		Phase 1A					Phase 1B				
	Description	Single Family	Town-homes	Multi Fam Units	Cong. Care Units	Comm. GFA	Single Family	Town-homes	Multi Fam Units	Cong. Care Units	Comm. GFA
10-Plex									10		
A									5		3320
B				5		3040					
C				3		3000					
H	Congregate Care				50						
J									36		3500
K											7356
	Single Family	19					28				
	Townhomes							20			
		19	0	8	50	6040	28	20	51		14176
						Total Phase (1A+1B)	47	20	59	50	20216

1.1 PHASED TRIP GENERATION ESTIMATES

RSG estimated the new trip generation of the proposed development for Phase 1A and total Phase 1 (Phase 1A plus Phase 1B) using the following process.

1. Estimate the proposed *base* trip generation of the proposed land uses, using published trip generation rates available from the Institute of Transportation Engineers.
2. Estimate the internal capture rate based on the methodology provided by NCHRP Report 6841, and document *internal* and *external* trip generation.
3. Review ITE Trip Generation Handbook for pass-by rate information, documenting *primary external* and *pass-by external* trips.
4. Review the proposed site features and the VTrans Transportation Demand Management (TDM) Guidebook for potential reductions in *pass-by external* trips due to TDM features.

Phase 1A Trip Generation Estimate

Using established ITE trip generation estimation rates, RSG estimated Phase 1A of the proposed development will generate 40 trips in the AM peak hour, and 56 trips in the PM peak hour. The trip generation estimate by land use[2] is documented in Table 2.

TABLE 2: BASE TRIP GENERATION CALCULATION FOR PHASE 1A.

			Base Trips - Phase 1A							
					AM Peak			PM Peak		
ITE LUC	Description	Land Use	Variable	Unit	Total	Enter	Exit	Total	Enter	Exit
Residential										
210	Single Family Detached	Residential	19	D.U.	14	4	11	19	12	7
220	Multi-Family Low Rise	Residential	0	D.U.	0	0	0	0	0	0
220	Townhomes (Attached)	Residential	8	D.U.	4	1	3	4	3	2
253	Congregate Care	Residential	50	D.U.	4	2	1	9	5	4
Commercial										
110	Light Industrial	Office	0.99	KSF	1	1	0	1	0	1
710	General Office	Office	2.53	KSF	3	3	0	3	0	2
814	Variety Store	Retail	1.52	KSF	5	3	2	10	5	5
932	High Turnover Restaurant	Restaurant	1.01	KSF	10	6	5	10	6	4
					40	18	22	56	31	25

The proposed development consists of several different types of land uses, allowing trips originating from one land use to be destined for another land use within the development. For example, single family house resident may walk to the onsite retail store or restaurant. These trips are considered to be captured internally and are not

[2] The “commercial” land use was separated into a variety of potential land-uses intended to represent a variety of potential tenants. Actual commercial tenants will vary based on market conditions.

counted towards the number of trips generated by the development on the adjacent transportation network. The rate of internal capture depends on the scale of the various land uses and is documented in NCHRP Report 6841. We believe the development pattern proposed by Haystack Crossing Phase 1A (and total Phase 1) is consistent with a mixed use development subject to internally captured trip generation. The internally captured trips associated with the proposed Haystack Crossing development are documented in the attached worksheets.

External trips are calculated as the total base trips minus the internal trips. External site generated traffic can be differentiated between primary and pass-by trips. While primary trips represent people who leave their home, place of work, or other origin expressly to visit the site and who would not otherwise have gotten into their vehicle to make a trip, pass-by trips represent vehicles that currently pass by the site on the local road network and who, when the proposed development is present, turn into the site on their way to another destination. Pass-by trips are converted from through movements to turning movements into and out from the site at the development access point, but do not add new trips to intersections beyond the site access. The percentage of trips that are considered pass-by is based on estimates from the ITE Trip Generation Handbook, and only apply to vehicle-based external trips.

ITE has documented a pass-by trip rate for two potential land uses within Haystack: 814 Variety Store (34% pass-by) and 932 High Turnover Restaurant (43% pass-by).

Transportation demand management (TDM) is the practice of reducing the number of trips during peak hour travel times by providing or promoting alternative travel means. Physical TDM measures include being located near a bus stop with a shelter, having access to and providing continuity of sidewalks and transit near building entrances, and providing accommodations for bike storage on site (including both covered and uncovered bicycle parking areas).

The proposed development includes nearby access to Green Mountain Transit service along the Route 116 Commuter line, improvements to the pedestrian network, and bicycle racks at several locations within the development. Following VTrans TDM Guidance[3], these TDM accommodations may facilitate up to a 2.5%[4] reduction in external vehicle, non-pass-by trip generation. While we believe a TDM adjustment would be applicable to this site, TDM adjustments were not pursued to maintain a conservative analysis.

The resulting AM and PM peak hour trip generation adjustments for Phase 1A, including internal capture, pass-by trips, and TDM adjustments are documented in Table 3 and Table 4.

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[3] https://vtrans.vermont.gov/sites/aot/files/planning/documents/trafficresearch/VTrans%20TDM%20Guidance%20Feb%202017.pdf

[4] Table 4-1: bicycle racks only: 0.5%; sidewalk or shared-use path improvements in a mixed use / low transit environment: 2%; additive to 2.5%

TABLE 3: PHASE 1A AM PEAK HOUR TRIP GENERATION ADJUSTMENTS

	AM Peak Hour - Phase 1A										
	Base Trips		Internal Trips		External Trips		Pass-by Trips			Primary Trips	
Land Use Summary	Enter	Exit	Enter	Exit	Enter	Exit	Rate	Enter	Exit	Enter	Exit
Office	3	0	0	0	3	0				3	0
Retail	3	2	0	0	3	2				3	2
Restaurant	6	5	1	0	5	5				5	5
Residential	6	15	0	1	6	14				6	14
	18	22	1	1	17	21		0	0	17	21
							TDM Credit		0.0%	0	0
							Final AM Peak Hour External Primary Trips			17	21

TABLE 4: PHASE 1A PM PEAK HOUR TRIP GENERATION ADJUSTMENTS

	PM Peak Hour - Phase 1A										
	Base Trips		Internal Trips		External Trips		Pass-by Trips			Primary Trips	
Land Use Summary	Enter	Exit	Enter	Exit	Enter	Exit	Rate	Enter	Exit	Enter	Exit
Office	1	3	0	0	1	3				1	3
Retail	5	5	3	2	2	3	34%	1	1	2	2
Restaurant	6	4	2	3	4	1	43%	2	0	2	0
Residential	19	13	2	2	17	11				17	11
	31	25	7	7	24	18		3	1	22	16
							TDM Credit		0.0%	0	0
							Final PM Peak Hour External Primary Trips			22	16

Total Phase 1 (1A plus 1B) Trip Generation Estimate

Using the same ITE trip generation estimation rates as Phase 1A, RSG estimated the base trip generation of Phase 1 (1A plus 1B) to be 136 trips in the AM peak hour, and 179 trips in the PM peak hour. The trip generation estimate by land use is documented in Table 5.

TABLE 5: BASE TRIP GENERATION CALCULATION FOR PHASE 1 (1A PLUS 1B).

			Total Phase 1 (1A+1B)							
					AM Peak			PM Peak		
ITE LUC	Description	Land Use	Variable	Unit	Total (Avg Rate)	Enter	Exit	Total (Avg Rate)	Enter	Exit
Residential										
210	Single Family Detached	Residential	47	D.U.	35	9	26	47	29	17
220	Multi-Family Low Rise	Residential	51	D.U.	23	5	18	29	18	11
220	Townhomes (Attached)	Residential	28	D.U.	13	3	10	16	10	6
253	Congregate Care	Residential	50	D.U.	4	2	1	9	5	4
Commercial										
110	Light Industrial	Office	3.31	KSF	2	2	0	2	0	2
710	General Office	Office	8.45	KSF	10	8	1	10	2	8
814	Variety Store	Retail	5.07	KSF	16	9	7	35	18	17
932	High Turnover Restaurant	Restaurant	3.38	KSF	34	18	15	33	20	13
					136	57	79	179	102	77

Following the same trip generation adjustment procedures for Phase 1A, the resulting AM and PM peak hour trip generation adjustments for total Phase 1 (1A plus 1B), including internal capture, pass-by trips, and TDM adjustments, are documented in Table 6 and Table 7.

TABLE 6: PHASE 1 TOTAL (1A+1B) AM PEAK HOUR TRIP GENERATION ADJUSTMENTS

	AM Peak Hour - Total Phase 1 (1A+1B)										
	Base Trips		Internal Trips		External Trips		Pass-by Trips			Primary Trips	
Land Use Summary	Enter	Exit	Enter	Exit	Enter	Exit	Rate	Enter	Exit	Enter	Exit
Office	10	2	1	1	9	1				9	1
Retail	9	7	2	1	7	6				7	6
Restaurant	18	15	6	3	12	12				12	12
Residential	19	55	1	5	18	50				18	50
	57	79	10	10	47	69		0	0	47	69
								TDM Credit	0.0%	0	0
						Final AM Peak Hour External Primary Trips				47	69

TABLE 7: PHASE 1 TOTAL (1A+1B) PM PEAK HOUR TRIP GENERATION ADJUSTMENTS

	PM Peak Hour - Total Phase 1 (1A+1B)										
	Base Trips		Internal Trips		External Trips		Pass-by Trips			Primary Trips	
Land Use Summary	Enter	Exit	Enter	Exit	Enter	Exit	Rate	Enter	Exit	Enter	Exit
Office	2	10	1	1	1	9				1	9
Retail	18	17	8	9	10	8	34%	3	3	7	5
Restaurant	20	13	8	7	12	6	43%	5	2	7	3
Residential	62	38	6	6	56	32				56	32
	102	77	23	23	79	54		9	5	71	49
								TDM Credit	0.0%	0	0
						Final PM Peak Hour External Primary Trips				71	49

Trip Distribution

RSG distributed the external trip generation following the existing observed traffic patterns. The resulting traffic distribution of the total Phase 1 (1A plus 1B) external primary trip generation at the site driveways and the VT-116 / SFR / CVU Road intersections is shown in Figure 2 and Figure 3.

As shown in Figure 2 and Figure 3, the total trip generation of Haystack Crossing Total Phase 1 (1A and 1B combined) is expected to generate 37 and 34 new trips along VT-116 south of Riggs Road in the AM and PM peak hours, respectively; and 37 and 48 new trips along VT-116 north of Shelburne Falls Road in the AM and PM peak hours, respectively.

The total trip generation of Haystack Crossing Total Phase 1 (1A and 1B combined) is expected to generate 80 and 82 new trips through the intersection of VT-116 / Shelburne Falls Road / CVU Road in the AM and PM peak hours, respectively.

FIGURE 2: DISTRIBUTION OF PHASE 1 AM EXTERNAL PRIMARY TRIP GENERATION

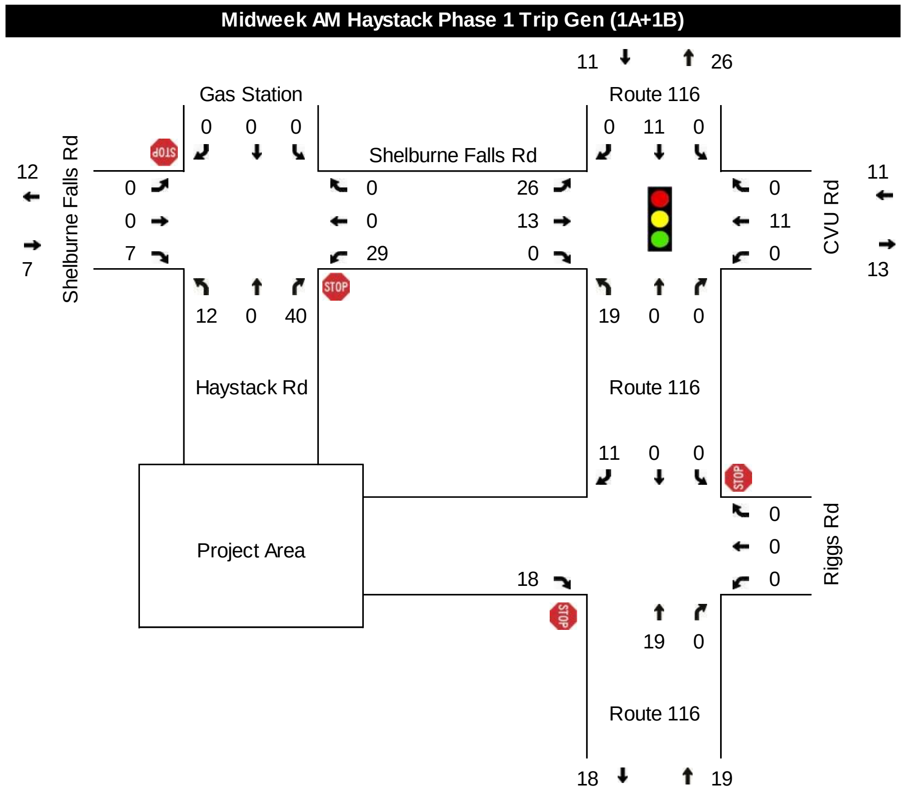
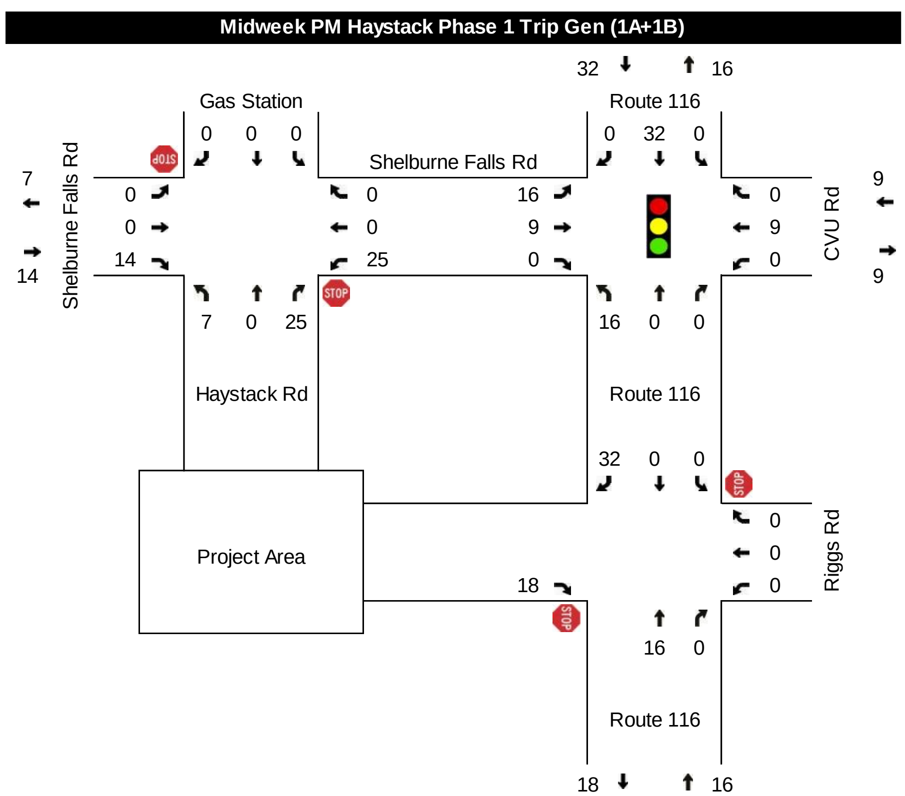


FIGURE 3: DISTRIBUTION OF PHASE 1 PM EXTERNAL PRIMARY TRIP GENERATION



1.2 GEOGRAPHIC SCOPE OF STUDY AREA

The VTrans Traffic Impact Study guidelines states:

> *VTrans normally expects that the geographic scope of the study includes the immediate access points, those intersections or highway segments receiving 75 or more project generated peak hour.*

South of Riggs Road, the proposed total Phase 1 project is expected to increased traffic by 37 and 32 vehicles in the AM and PM peak hours. This represents an increase of +3.0% and +2.7%, respectively, over the existing AM and PM peak hour traffic volumes.

Furthermore, as the Hannaford Bros. project has been withdrawn, the associated trip generation has been removed from the analysis. In the PM peak hour, this removed traffic (46 trips) is greater than the proposed Haystack Phase 1 additional traffic. The results of previous study south of Riggs Road would likely improve with the removal of the Hannaford Bros. development.

RSG believes the traffic impact associated with the Haystack Phase 1 project will be most evident at the VT-116 / SFR / CVU Rd intersection. This intersection received 80 and 82 new trips in the AM and PM peak hours, respectively, as a result of the total development. No other intersections meet the 75-trip threshold typically used by VTrans to determine the geographic scope for analysis. The increase in traffic associated with the Haystack project is relatively modest given the existing traffic volumes.

RSG recommends the geographic scope for further analysis is focused on the following intersections:

1. Shelburne Falls Road and Haystack Road (full site access)
2. VT-116 and Shelburne Falls Road and CVU Road
3. VT-116 and Riggs Road (right-in / right-out site access)

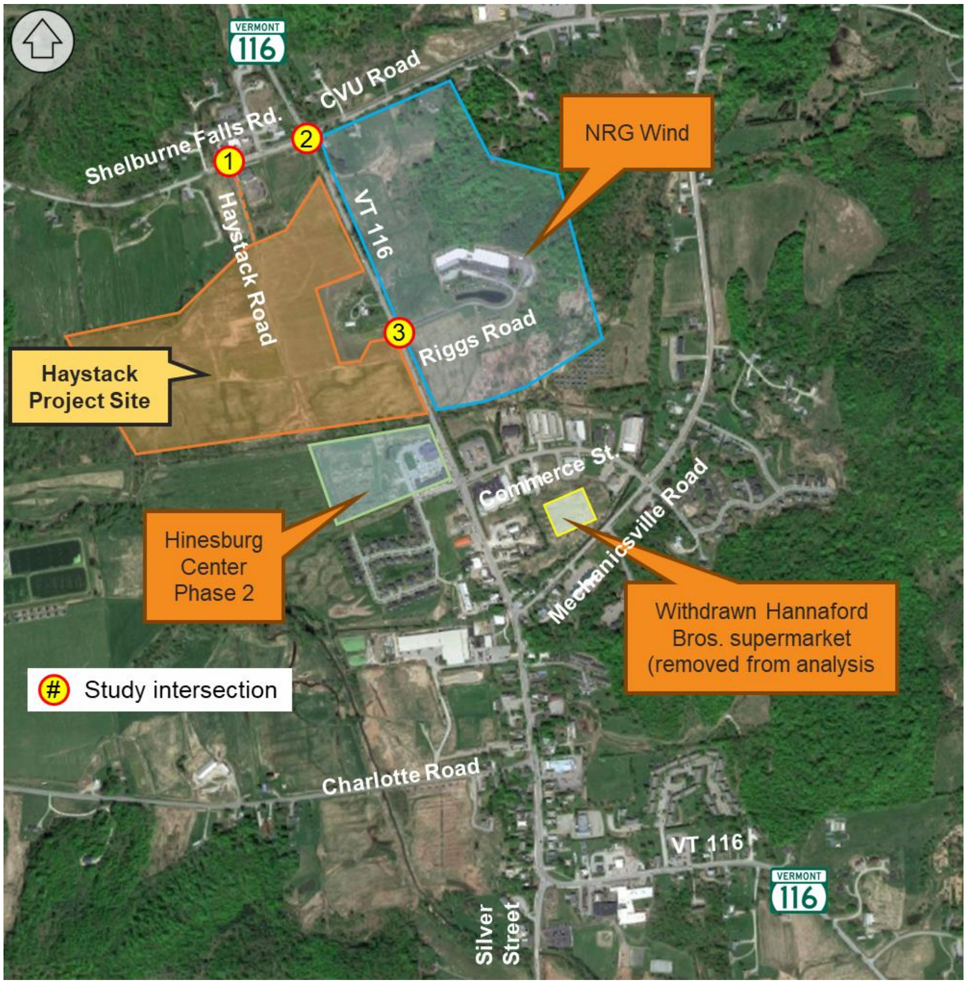
These intersections are illustrated in Figure 4, along with the proposed site location and adjacent other development volumes to be discussed in the following sections.

1.3 SITE ACCESS CONSIDERATIONS ALONG VT-116

The proposed Haystack Crossing development is planned to have two[5] site access points: Haystack Road from Shelburne Falls Road and Riggs Road on VT-116. Initially, both access intersections were proposed with full access. However, VTrans has exercised their right-of-way access control to restrict turning movements along VT-116. In addition VTrans has generally discouraged crosswalks across state highways without a documented demand. VTrans has declined to allow full vehicle access or pedestrian crossing infrastructure on the state highway at this location.

[5] A third access point is proposed contingent upon completion of both the Haystack Crossing Master Plan and development of Hinesburg Center Phase 2 to the south.

FIGURE 4: PROJECT AREA, STUDY INTERSECTIONS, AND OTHER NEARBY PLANNED DEVELOPMENTS



1.4 OVERALL SITE CIRCULATION REVIEW

RSG reviewed the overall Haystack Crossing site development master plan for circulation, congestion, and safety issues. The master plan includes several connected neighborhood streets with all way stop controlled intersections. Most internal streets offer continuous circulation routes; Hailey Lane is a non-continuous dead-end street (although turnaround is possible without a reversing maneuver through the Phase 2 parking area). The Phase 2 plan will integrate efficiently into Phase 1. The master plan site layout, with appropriate wayfinding signs, should provide safe and efficient bicycle, pedestrian, and vehicle circulation routes through the proposed development.

Potential minor modifications to ensure safe and efficient circulation may include:

- Hailey Lane ends without an outlet; confirm adequate circulation to turnaround for appropriate design vehicle (in interim Phase 1 and ultimate Phase 2 sites).
- Several trees are shown near intersection corners and crosswalks; recommend minor revisions to landscaping plan to maintain sight lines at critical locations.

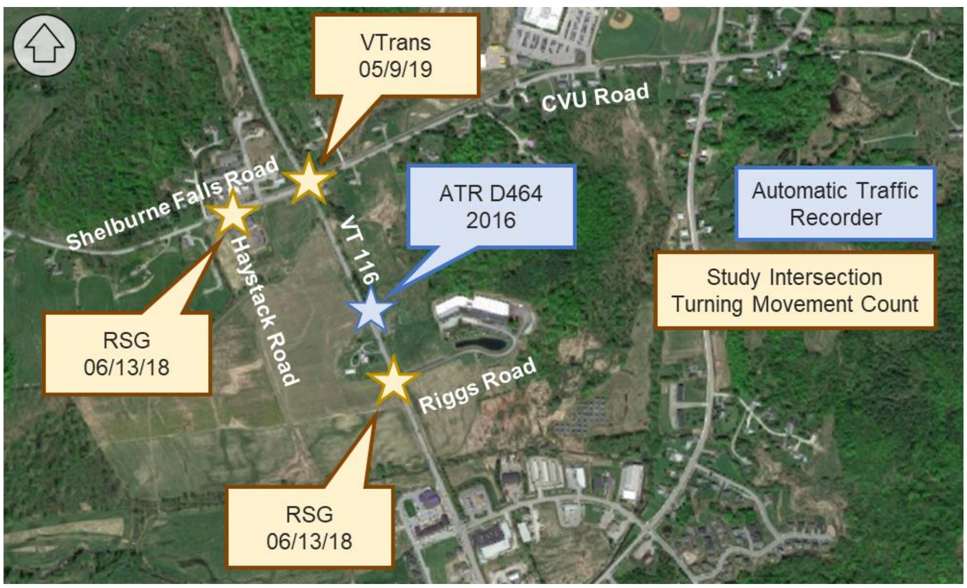
2.0 TRAFFIC VOLUMES

This study relies upon design standards and analysis procedures documented in the Highway Capacity Manual 6th Edition,[6] Trip Generation,[7] A Policy on Geometric Design of Highways and Streets,[8] Manual on Uniform Traffic Control Devices (MUTCD),[9] Traffic Impact Evaluation: Study and Review Guide,[10] and the Vermont State Design Standards,[11] which are the generally accepted traffic analysis references relied upon by traffic engineering professionals and VTrans for projects of this type in Vermont.

2.1 TRAFFIC COUNTS

RSG updated the traffic count at VT-116 and SFR to reflect the latest available data from the online Transportation Data Management System. The original traffic observations from the two site drives continue to be used in the analysis. Figure 5 illustrates the three study area intersections and the source and date of the traffic count used in this study.

FIGURE 5: STUDY INTERSECTIONS AND TRAFFIC COUNT SOURCES



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[6] Transportation Research Board, National Research Council, *Highway Capacity Manual* (Washington, DC: National Academy of Sciences, 2016).
[7] Institute of Transportation Engineers, *Trip Generation* 10th Edition (Washington, D.C.: Institute of Transportation Engineers, 2017).
[8] American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets*, 7th Edition (Washington DC: AASHTO, 2018).
[9] American Traffic Safety Services Association (ATSSA), ITE, and AASHTO, *Manual on Uniform Traffic Control Devices*, 2009 Edition (Washington DC: FHWA, 2009).
[10] Vermont Agency of Transportation, Development Review Section, *Traffic Impact Evaluation Study and Review Guide* (October 2008).
[11] State of Vermont Agency of Transportation, *Vermont State Standards* (Montpelier: VTrans, 1 July 1997).

2.2 ADJUSTMENTS

Two volume adjustment factors were used to represent design conditions in the build years:

Design Hour Adjustment

Design hour adjustment factors are based on VTrans ATR station D464 located between Riggs Road and SFR / CVU Road. The 2016 design hour volume (DHV) at this station[12] was compared to the peak hour volumes of the turning movement count to formulate DHV adjustments. DHV adjustments change raw count volumes by +2%, and volumes were then balanced between adjacent intersections.

Annual Growth Factor Adjustment

RSG applied growth factors documented in the 2018 Continuous Traffic Counter Report[13] (Redbook) to adjust the 2016 DHV to represent 2021 traffic volumes. The 2016 to 2018 annual adjustment factor for urban sites is 0.996 (Redbook page 19); the 2018 to 2021 annual adjustment factor is 1.020 (Redbook page 20). The total 2016 to 2021 annual adjustment factor is 1.016.

The annual adjustment factor from 2021 to 2026 is 1.020.

2.3 OTHER DEVELOPMENT VOLUMES

Other development volumes (ODVs) represent trips generated by anticipated developments in the study area. Trips generated by ODVs are included in every scenario (both No Build and Build) because it is assumed they are already present on the road network in the analysis years.

This updated traffic analysis includes trips associated with development of office space at the NRG Wind Associates campus and the development of Hinesburg Center Phase 2. The Hannaford Bros. grocery store development and all associated roadway modifications are no longer part of this analysis. Trip generation calculations for each of these ODVs are presented in the previous analysis, and ODV distribution for the AM and PM peak hours is illustrated in the attachments.

2.4 SCENARIO VOLUMES

The following figures represent AM and PM peak hour Build and No Build scenario volumes. 2021 Build volumes include Haystack Crossing Phase 1A trip generation; 2026 Build volumes includes both total Phase 1A and Phase 1B, representing total Phase 1.

[12] ATR DHV based on highest observed hour during the five day count in 2016.
[13] https://vtrans.vermont.gov/sites/aot/files/planning/documents/trafficresearch/Redbook2018.pdf

FIGURE 6: 2021 AM PEAK HOUR NO BUILD SCENARIO VOLUMES

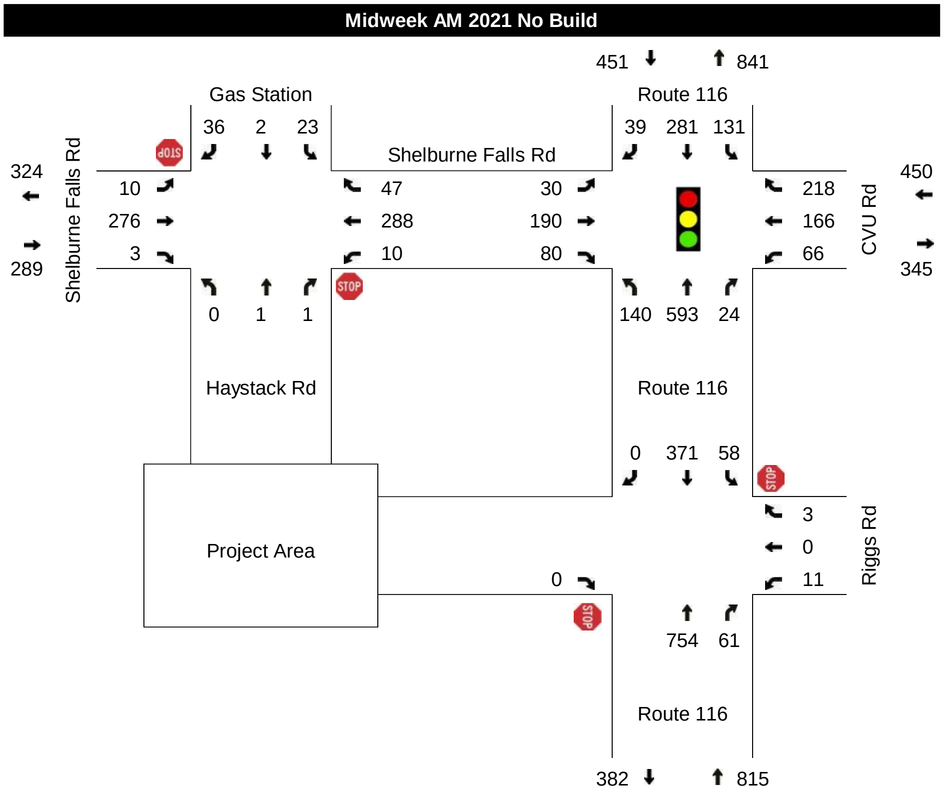


FIGURE 7: 2021 PM PEAK HOUR NO BUILD SCENARIO VOLUMES

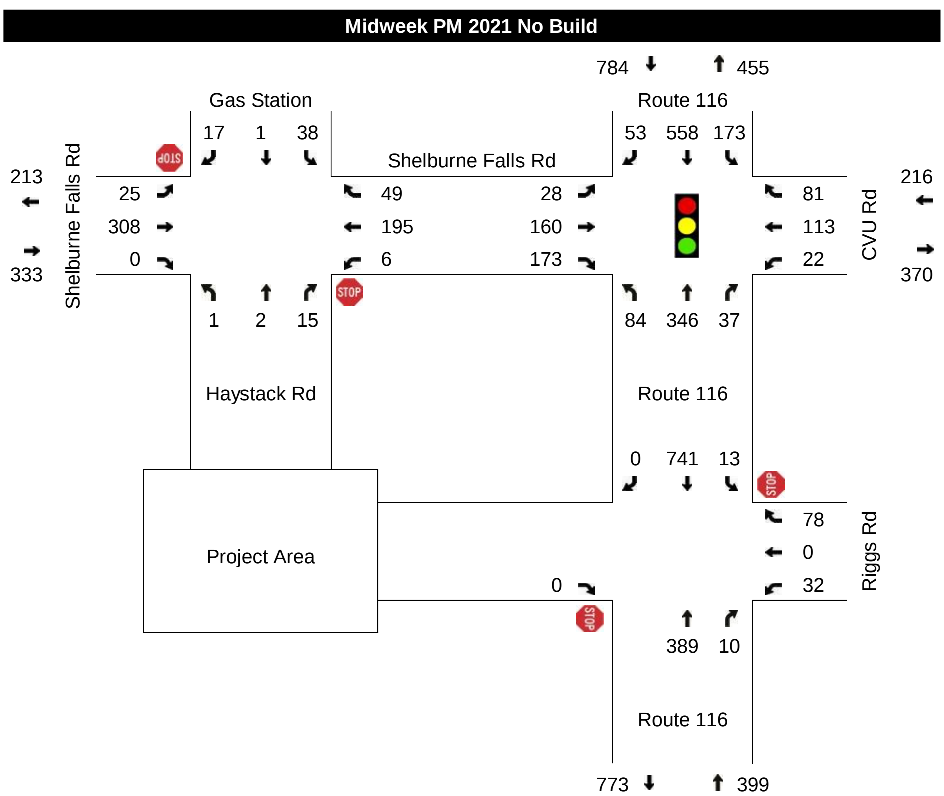


FIGURE 8: 2021 AM PEAK HOUR PHASE 1A BUILD SCENARIO VOLUMES

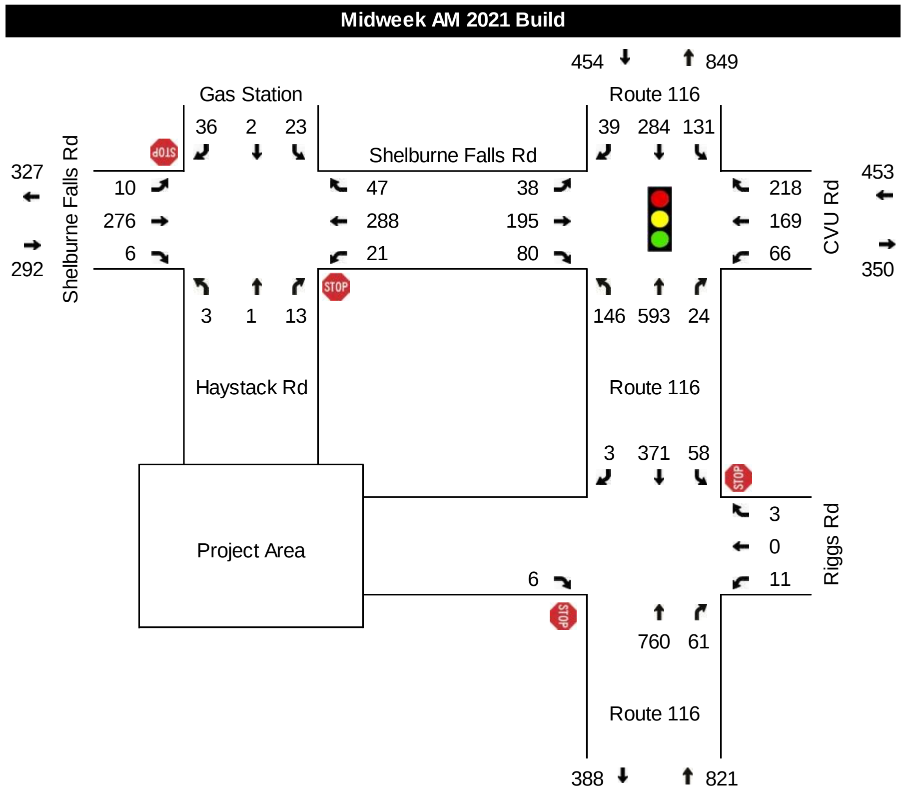


FIGURE 9: 2021 PM PEAK HOUR PHASE 1A BUILD SCENARIO VOLUMES

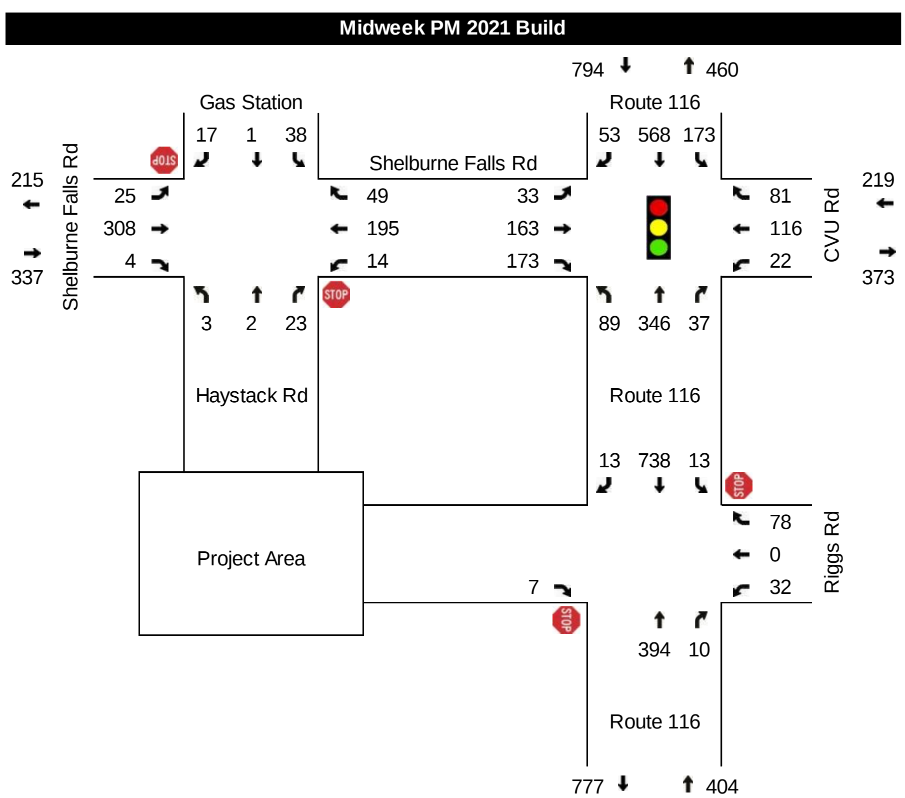


FIGURE 10: 2026 AM PEAK HOUR NO BUILD SCENARIO VOLUMES

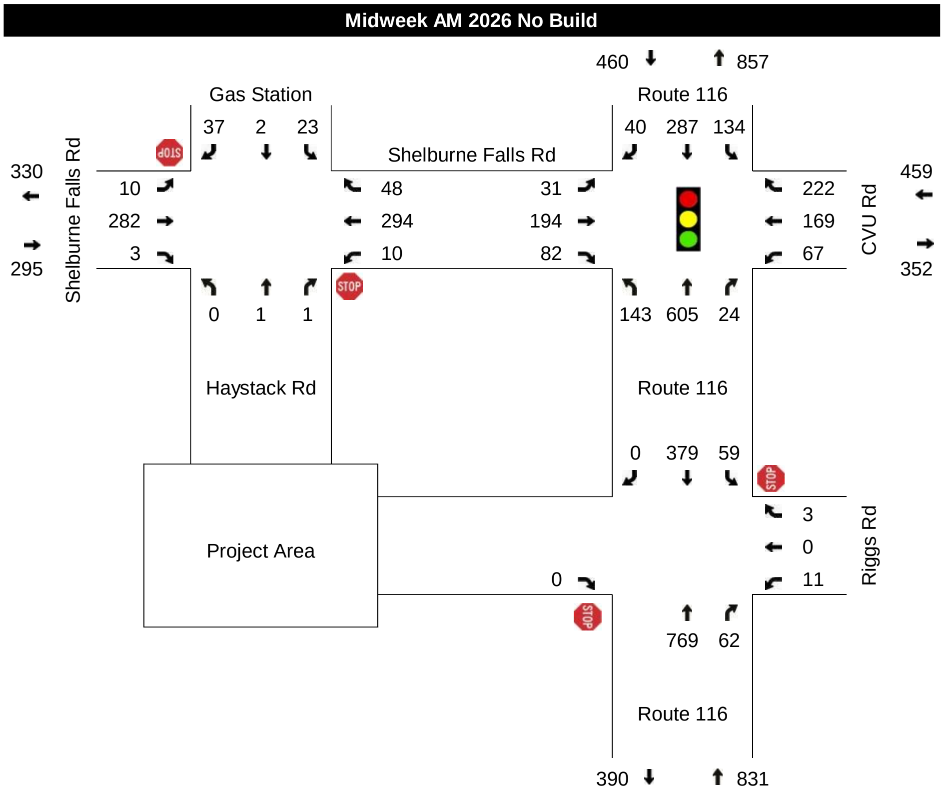


FIGURE 11: 2026 PM PEAK HOUR NO BUILD SCENARIO VOLUMES

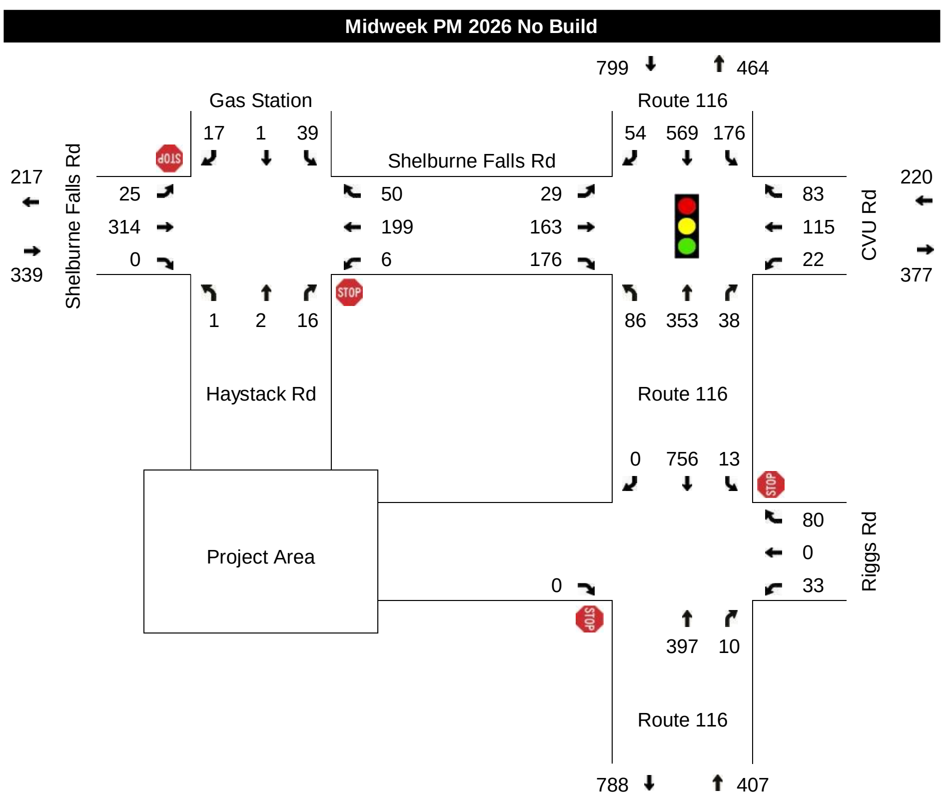


FIGURE 12: 2026 AM PEAK HOUR PHASE 1 (1A+1B) BUILD SCENARIO VOLUMES

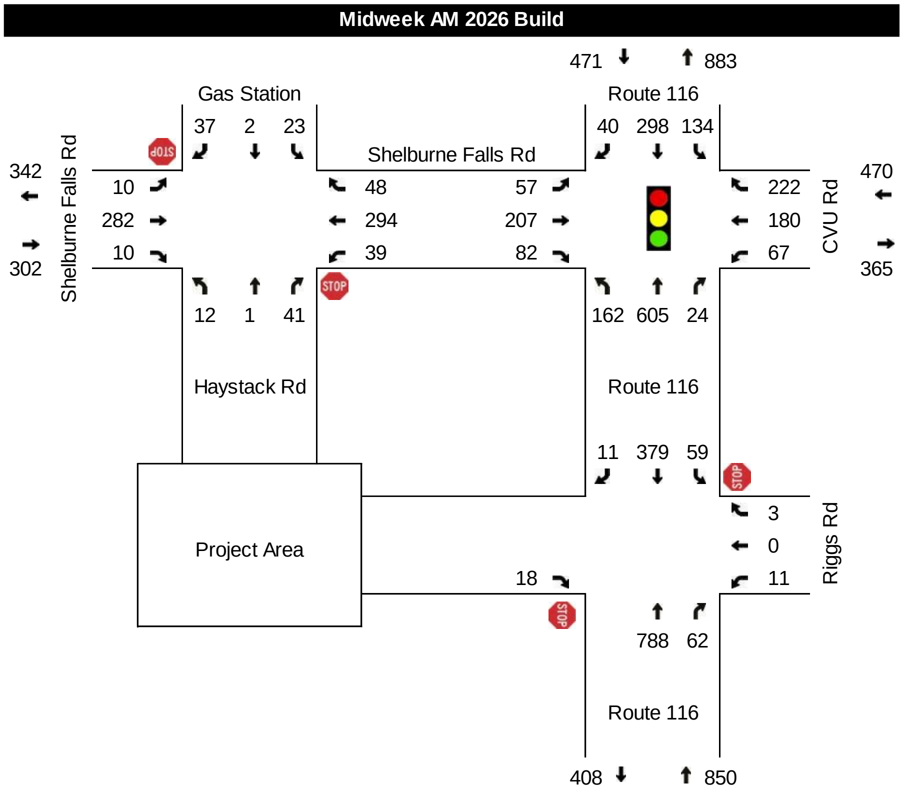
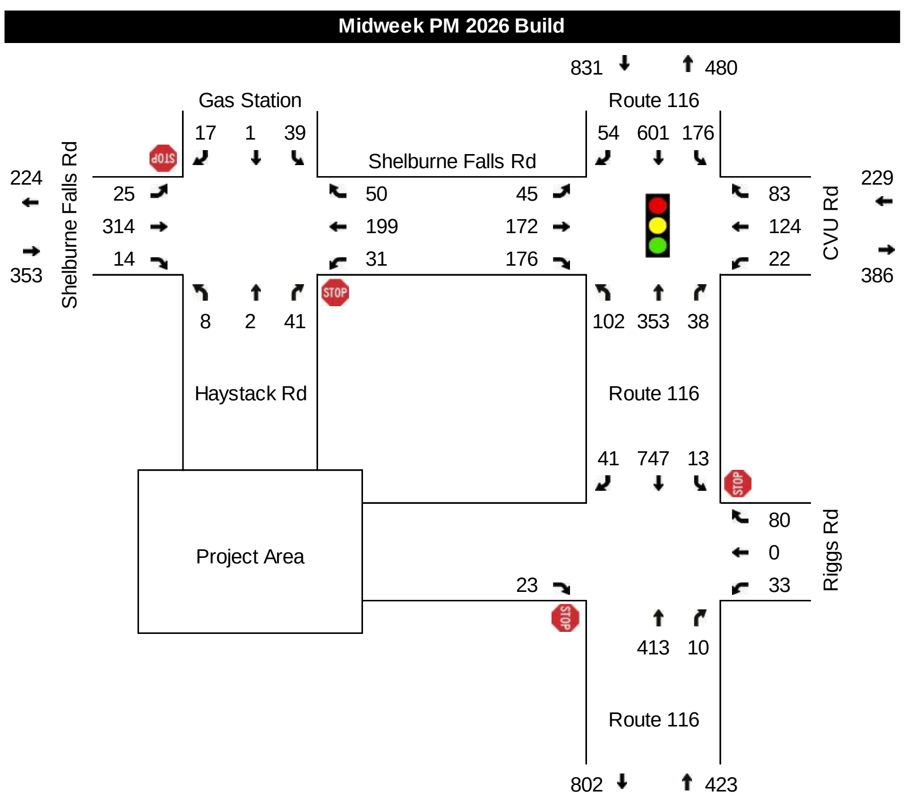


FIGURE 13: 2026 PM PEAK HOUR PHASE 1 (1A+1B) BUILD SCENARIO VOLUMES



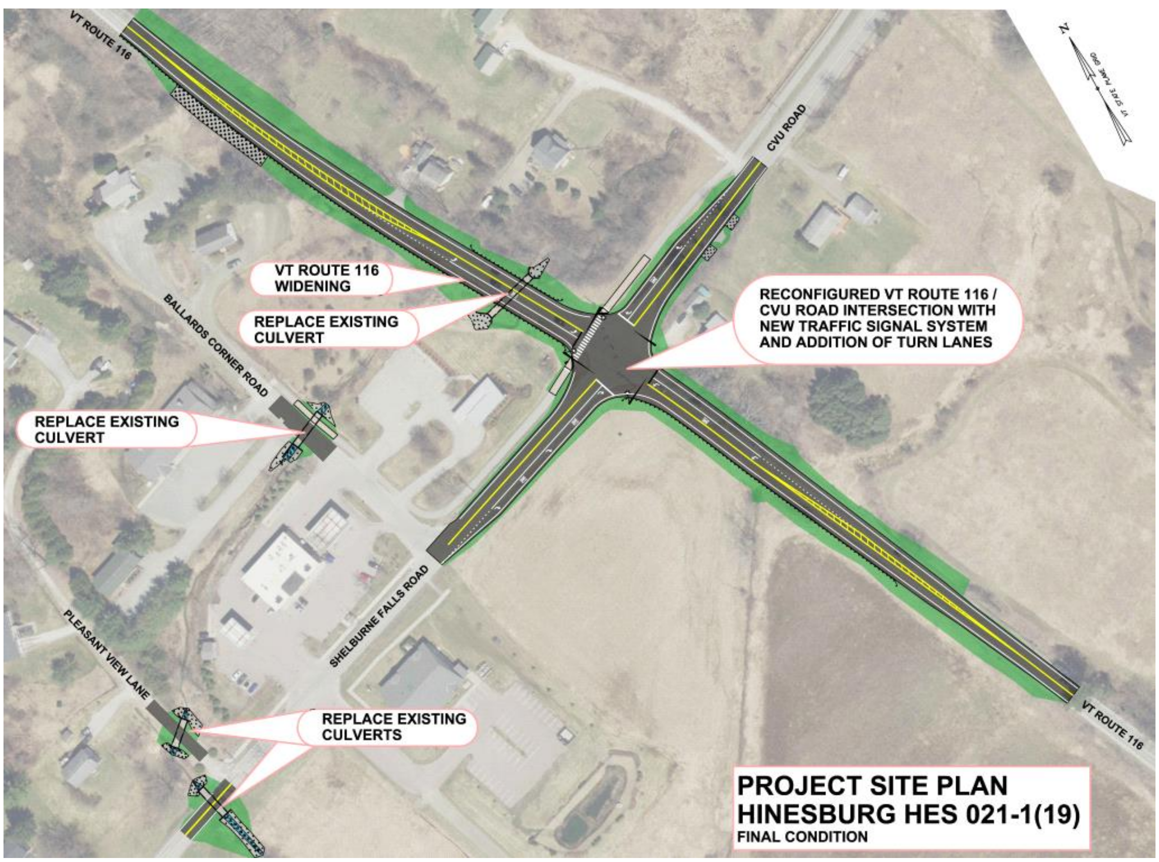
3.0 COMMITTED VTRANS HIGHWAY IMPROVEMENTS

The intersection of VT-116 / Shelburne Falls Road / CVU Road is programmed for reconstruction under VTrans project HINESBURG HES 021-1(19). Improvements under this project include:

- Left turn lanes and protected / permitted left turn phasing along northbound (approx. 175-feet) and southbound (approx. 200-feet) VT-116.
- Right-turn lanes with right-turn phase overlap on eastbound Shelburne Falls Road (approx. 220-feet) and westbound CVU Road (approx. 120-feet).
- New overhead mast arm strain pole signal supports and other associated improvements.

The proposed project is illustrated in Figure 14: Illustration of improvements associated with HINESBURG HES 021-1(19) (Illustration by VTrans).

FIGURE 14: ILLUSTRATION OF IMPROVEMENTS ASSOCIATED WITH HINESBURG HES 021-1(19) (ILLUSTRATION BY VTRANS)



A contractor has been selected to begin work this year. The contract end date has been extended into 2021 as a result of the Covid-19 health crisis. As a result, the existing signal system is modeled for the 2021 AM and PM peak hour build and no-build scenarios, and the proposed signal system as shown in HINESBURG HES 021-1(19) with turn lanes and protected phasing is modeled for the 2026 AM and PM peak hour build and no-build scenarios.

4.0 CONGESTION ANALYSIS

4.1 DEFINITION OF PERFORMANCE MEASURES

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, and 6th Edition Highway Capacity Manuals.[14] 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 Highway Capacity Manual, 6th Edition 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 8 shows the various LOS grades and descriptions for signalized and unsignalized intersections.

TABLE 8: LOS 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

[14] The 2010 and 6th Editions of the HCM do 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; the overlapped right turn phase in the proposed 2026 VT-116 / Shelburne Farms Road / CVU Road is not consistent with NEMA standard phasing. Because of these limitations, HCM 2000 methodologies are employed for consistent analysis between all scenarios.

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 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 resulting from improvements necessary to achieve LOS C.
- 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.

The volume to capacity ratio (v/c) represents the sufficiency of an approach leg to accommodate the vehicular demand. According to FHWA:

> *"As the v/c ratio approaches 1.0, traffic flow may become unstable, and delay and queuing conditions may occur. Once the demand exceeds the capacity (a v/c ratio greater than 1.0), traffic flow is unstable and excessive delay and queuing is expected."*[15]

A queue analysis was conducted for the 2026 scenarios using SimTraffic microsimulation software at the VT-116 / Shelburne Farms Road / CVU Road intersection to ensure the proposed design and layout of HINESBURG HES 021-1(19) can adequately serve the proposed development with potential capacity for additional development in the future.

4.2 TRAFFIC MODELING SCENARIOS

RSG built a traffic model using Synchro version 10 software for the No Build and Build scenarios in the AM and PM peak hours. Two analysis years were used with different Haystack Crossing build phases and intersection facilities at the VT-116 / Shelburne Falls Road / CVU Road intersection.

Traffic modeling result worksheets are provided in Attachment 5.

2021 Scenarios

The 2021 Scenarios included the Haystack Crossing Phase 1A development program in the "Build" condition, and the VT-116 / Shelburne Falls Road / CVU Road intersection is modeled in its existing alignment (no dedicated turn lanes or VT-116 signal phasing). The performance results for the 2021 Build and No-Build AM and PM peak hours are shown in Table 9.

[15] Federal Highway Administration (FHWA), *Signalized Intersections: Informational Guide*, 2004

TABLE 9: CONGESTION ANALYSIS PERFORMANCE MEASURES FOR THE 2021 SCENARIOS

	2021 Scenarios											
	AM No Build			AM Build			PM No Build			PM Build		
Intersections	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
VT-116 / Shelburne Falls Road / CVU Road												
Overall	D	35	0.91	D	37	0.93	C	29	0.85	C	32	0.86
EB Shelburne Falls Road	C	31	0.54	C	33	0.59	E	58	0.85	E	56	0.81
WB CVU Road	D	47	0.85	D	48	0.85	D	40	0.54	D	42	0.49
NB VT-116	D	35	0.91	D	39	0.93	B	11	0.50	B	13	0.53
SB VT-116	C	25	0.72	C	26	0.73	C	24	0.83	C	29	0.86
VT-116 / Haystack Road / Gas Station												
EB Shelburne Falls Road	A	0	0.01	A	<1	0.01	A	<1	0.02	A	<1	0.02
WB Shelburne Falls Road	A	0	0.01	A	<1	0.02	A	<1	0.00	A	<1	0.01
NB Haystack Road	B	12	0.00	B	11	0.03	B	11	0.03	B	11	0.04
SB Gas Station Drive	B	13	0.11	B	13	0.12	B	14	0.12	B	14	0.13
VT-116 / Riggs Road												
EB Riggs Road	-	-	-	B	10	0.01	-	-	-	B	14	0.02
WB Riggs Road	D	30	0.09	D	31	0.09	C	19	0.31	C	20	0.32
NB VT-116	A	0	0.48	A	<1	0.48	A	<1	0.23	A	<1	0.24
SB VT-116	A	2	0.07	A	2	0.07	A	<1	0.01	A	<1	0.01

As shown in Table 9, the additional traffic associated with the Haystack Crossing Phase 1A development generally increases average delay throughout the analyzed network. However, in no case does the additional delay result in a change in Level of Service. The volume to capacity ratio on VT-116 increases for all scenarios, yet remains below the threshold of 1.0 indicating unstable flow, excessive delay, and lengthy queuing.

Several anomalies are present in the Table 9:

- Delay and v/c *decreases* along Shelburne Falls Road and CVU Road in the PM peak hour build condition. This is due to traffic signal controller programming and actuation. Using the existing signal timings, the eastbound and westbound approaches do not use all assigned green time in their respective phase within the cycle, meaning the red light turns on early (the approach "gaps out"). With more traffic on these legs, the green time cycle serving these legs is extended, allowing for more vehicles to be processed within the cycle, increasing the capacity of the approach and reducing the approach delay.

- Delay *decreases* along the Haystack Road approach to Shelburne Falls Road in the AM peak hour build condition. Delay, as reported, is an average number of seconds per vehicle. The northbound Haystack Road traffic increases from 2 vehicles in the AM peak hour (50% turning right) to 18 vehicles in the build condition (14, or 78%, turning right). A right turn experiences less delay than a through or left-turn maneuver. The higher proportion of right turning vehicles decreases the overall delay *per vehicle*.

2026 Scenarios

The 2026 Scenarios included the Haystack Crossing Phase 1A and 1B development program in the "Build" condition representing Total Phase 1; the No-build scenario did not include Phase 1A or any other development on the Haystack Crossing project site.

The VT-116 / Shelburne Falls Road / CVU Road intersection is modeled in its proposed alignment (with dedicated turn lanes and signal phasing as described in Section 3).

The performance results for the 2026 Build and No-Build AM and PM peak hours are shown in Table 10.

TABLE 10: CONGESTION ANALYSIS PERFORMANCE MEASURES FOR THE 2026 SCENARIOS

	2026 Scenarios											
	AM No Build			AM Build			PM No Build			PM Build		
Intersections	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
VT-116 / Shelburne Falls Road / CVU Road												
Overall	C	25	0.81	C	28	0.84	C	20	0.67	C	22	0.72
EB Thru / Left Shelburne Falls Road	C	33	0.60	D	43	0.78	D	37	0.64	D	38	0.69
EB Right Shelburne Falls Road	C	21	0.04	B	20	0.04	C	24	0.12	C	23	0.14
WB Thru / Left CVU Road	D	48	0.81	D	52	0.84	C	32	0.46	C	32	0.46
WB Right CVU Road	C	22	0.22	C	21	0.22	C	22	0.04	C	21	0.04
NB Left VT-116	A	10	0.24	B	11	0.28	A	10	0.21	B	11	0.27
NB Thru / Right VT-116	C	26	0.75	C	29	0.77	B	16	0.44	B	17	0.45
SB Left VT-116	B	13	0.37	B	14	0.39	A	8	0.29	A	8	0.30
SB Thru / Right VT-116	B	18	0.39	B	19	0.42	B	19	0.67	C	22	0.72
VT-116 / Haystack Road / Gas Station												
EB Shelburne Falls Road	A	0	0.01	A	<1	0.01	A	<1	0.02	A	<1	0.02
WB Shelburne Falls Road	A	0	0.01	A	1	0.03	A	<1	0.00	A	1	0.03
NB Haystack Road	B	12	0.00	B	12	0.10	B	11	0.03	B	12	0.09
SB Gas Station Drive	B	12	0.11	B	14	0.13	B	14	0.12	C	16	0.14
VT-116 / Riggs Road												
EB Riggs Road	-	-	-	B	11	0.03	-	-	-	B	15	0.06
WB Riggs Road	D	31	0.09	D	34	0.10	C	20	0.32	C	23	0.36
NB VT-116	A	0	0.49	A	<1	0.50	A	<1	0.24	A	<1	0.25
SB VT-116	A	2	0.07	A	2	0.07	A	<1	0.01	A	<1	0.01

As shown in Table 10, the additional traffic associated with the Haystack Crossing total Phase 1 development (Phase 1A and Phase 1B) generally increases average delay throughout the analyzed network. The overall operation of the VT-116 / Shelburne Falls Road / CVU Road intersection remains at LOS C in all scenarios. While the volume to capacity ratio on VT-116 increases for all scenarios, the highest v/c on VT-116 is 0.77, indicating stable vehicle flow along VT-116. The highest v/c along Shelburne Falls Road 0.84 in the AM peak hour build condition, indicating the intersection has additional capacity to support additional vehicle trips from the Haystack development in the future.

Several anomalies are present in the Table 10:

- Delay and v/c *decreases* for several of the lane groups along Shelburne Falls Road and CVU Road in the PM peak hour build condition. This is due to traffic signal controller programming and actuation. Using the existing signal timings, the eastbound and westbound approaches do not use all assigned green time in their respective phase within the cycle, meaning the red light turns on early (the approach "gaps out"). With more traffic on these legs, the green time cycle serving these legs is extended, allowing for more vehicles to be processed within the cycle, increasing the capacity of the approach and reducing the approach delay.

RSG prepared a SimTraffic microsimulation model to evaluate the queues associated with the 2026 No Build and Build scenarios. The resulting average queues length, in feet, is shown in Table 11.

TABLE 11: AVERAGE QUEUE LENGTHS IN THE 2026 BUILD AND NO BUILD SCENARIOS

	Storage Length (ft)	Average Queue Length (ft) 2026 Scenario AM No Build	AM Build	PM No Build	PM Build
VT-116 / Shelburne Falls Raod / CVU Road					
EB Thru / Left Shelburne Falls Road	-	135	232	112	109
EB Right Shelburne Falls Road	220	40	89	62	71
WB Thru / Left CVU Road	-	192	265	78	81
WB Right CVU Road	120	108	124	40	39
NB Left VT-116	175	114	128	46	64
NB Thru / Right VT-116	-	360	467	146	172
SB Left VT-116	200	64	60	101	118
SB Thru / Right VT-116	-	129	116	218	323

Differences in queue length of 20-feet or less between no build or build scenarios are negligible given the stochastic nature of the microsimulation models. Queues did not approach the storage length capacity along the approaches most impacted by the proposed Haystack development: eastbound Shelburne Falls Road or northbound VT-116. The largest increase in queue length is associated with the VT-116 through movements. This is associated with the additional green time assigned to the eastbound and westbound approaches, resulting in a longer red phase for the VT-116 approaches. The longer red phase allows the queue to grow longer in each cycle. However, queues consistently cleared and vehicles progressed through the network.

4.3 TURN LANE WARRANT ANALYSIS

Using the 2026 Build scenario volumes, RSG conducted turn lane warrant analyses at the following locations:

- Westbound Shelburne Falls Road left turn lane into Haystack Crossing
- Eastbound Shelburne Falls Road right turn lane into Haystack Crossing
- Southbound VT-116 right turn lane into Haystack Crossing
- Southbound VT-116 left turn lane into Riggs Road

Left Turn Lane Warrant

VTrans has identified the Kikuchi and Chakroborty (K&C) model as the preferred turn lane warrant analysis model using 85% of the DHV[16]. The K&C model predicts the probability of a queue forming due to a left turning vehicle stopped in the travel way. Inputs in the model include turning movement traffic volumes and the speed limit.

[16] https://vtrans.vermont.gov/sites/aot/files/planning/documents/trafficresearch/TISGuidelines.pdf

Table 12 summarizes the results of the turn lane warrant analysis. A southbound left turn lane along VT-116 at Riggs Road is warranted in the AM peak hour. This movement accesses a property outside of the Haystack Crossing project area, and the associated volumes do not change between build and no-build scenarios. The warrant for this left turn lane is met in both the build and no-build scenarios. All other left turn lane warrants are not met. The calculations for the turn lane warrant for each scenario is included in Attachment 4.

TABLE 12: RESULTS OF LEFT TURN LANE WARRANT ANALYSES

	WB SHELBURNE FALLS RD LTL		SB VT-116 LTL	
	AM	**PM**	**AM**	**PM**
Warrant Met?	No	No	Yes	No
Warranting Turn Volume (increase from build volume)[17]	86 (+47)	115 (+84)	n/a	25 (+11)

However, the K&C documentation further recommends that the volume guidelines presented in the model should serve as logical starting points for an engineering determination of the appropriateness of a left turn lane. Other considerations should include site characteristics, crash history, congestion, and other site-specific considerations.

Given the state highway context, directional traffic volume, and potential for congestion, RSG recommends construction of a southbound left turn lane into Riggs Road from VT-116. However, this recommendation is independent of the proposed Haystack Crossing development. The southbound left turn lane is not warranted due to an identified crash history, congestion, or any operational issue associated with the Haystack Crossing development. The Haystack Crossing development does not contribute to the southbound left turn demand. RSG recommends that the Haystack Crossing project identify and allocate the necessary rights of way for a southbound (and potentially northbound) left turn lane for future construction as part of the NRG Wind Systems development.

Right Turn Lane Warrant

VTrans documents a methodology for a right turn lane warrant analysis in Appendix I of the VTrans Traffic Impact Study Guidelines. Inputs in the model include turning movement traffic volumes and the speed limit. Using the formula provided by the model and documented traffic volumes, right turn lanes into the Haystack Crossing

[17] Assuming all other traffic volumes remain the same, this is the volume of left turning vehicles required to warrant a dedicated turn lane. The increase in the turning volume compared to the build volume is indicated in parenthesis "(+##)".

development are not warranted on either eastbound Shelburne Falls Road or southbound VT-116.

The results of the right turn lane warrant analyses are summarized in Table 13. The calculation for the warranting advancing volumes is included in Attachment 4.

TABLE 13: RESULTS OF RIGHT TURN LANE WARRANT ANALYSES

	EB SHELBURNE FALLS RD RTL		SB VT-116 RTL	
	AM	PM	AM	PM
Warrant Met?	No	No	No	No
Warranting Turn Volume[18]	153 (+143)	119 (+105)	79 (+68)	53 (+12)

Right turn lanes can be a challenge for bicycles to navigate. VT-116 is designated by VTrans as a High Use / Priority statewide bicycle corridor. Since the warrant is not met and the likely presence of bicyclists, a right turn lane is not recommended in this location.

5.0 EXPANDED CRASH REVIEW

The proposed project site is near two state-designated High Crash Locations based on data between 2012-2016:

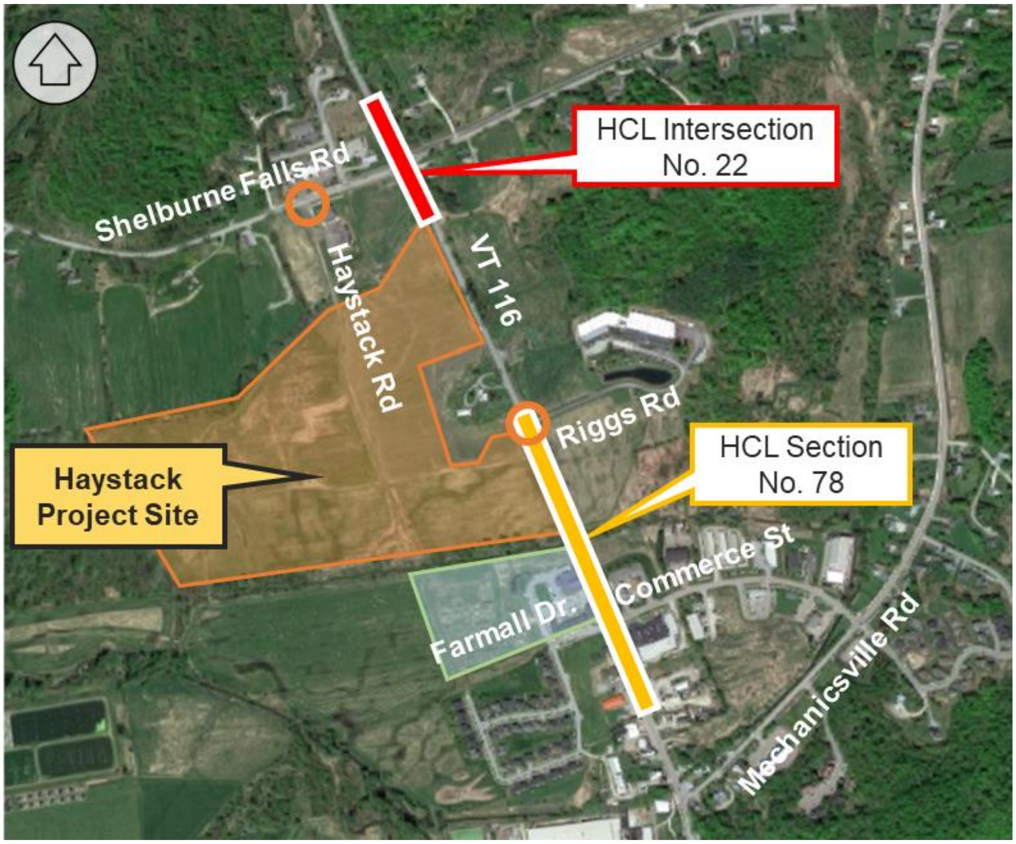
- High Crash Location Intersection at VT-116 / Shelburne Falls Road / CVU Road
  HCL Intersection No. 22; actual: critical 1.69, 35 crashes in 5 years
- High Crash Location Segment along VT-116 from the Hinesburg Fire Station through Commerce Street to Riggs Road (MM 4.878 – MM 5.178)
  HCL Segment No. 78; actual: critical 2.335, 27 crashes in 5 years

These two high crash locations, relative to the project area, are shown in Figure 15.

RSG reviewed all reported crashes near the site access drives and the VT-116 / Shelburne Falls Rad / CVU Road intersection in the five-year period from January 1, 2015 to January 1, 2020 available from the online crash query tool.

[18] Assuming all other traffic volumes remain the same, this is the volume of right turning vehicles required to warrant a dedicated turn lane.

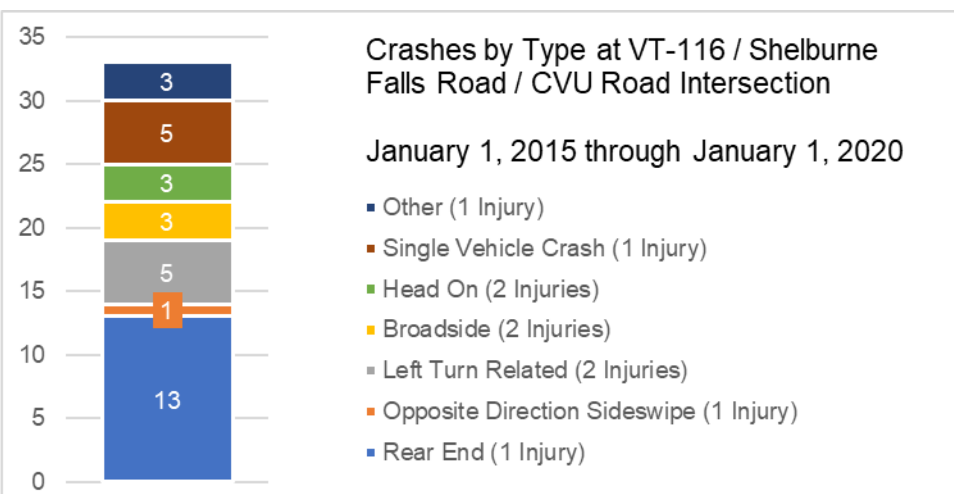
FIGURE 15: HIGH CRASH LOCATIONS NEAR THE HAYSTACK CROSSING PROJECT SITE



5.1 VT-116 / SHELBURNE FALLS ROAD / CVU ROAD

RSG compiled all reported crashes within 250 feet of the VT-116 / Shelburne Falls Road / CVU Road intersection from January 1, 2015 through January 1, 2020. In this five-year period, 33 crashes were reported in the vicinity of the intersection.

FIGURE 16: CRASHES BY TYPE AT THE VT-116 / SHELBURNE FALLS ROAD / CVU ROAD INTERSECTION, 1/1/15 THROUGH 1/1/20



Of the 33 reported crashes, 13 crashes were rear end and 3 were through-move broadsides. Rear end crashes are common at signalized and stop controlled intersections with changes in speed. Both rear end crashes and broadside crashes may indicate poor visibility to the signals. These types of crashes may be reduced following the completion of the signal reconstruction project in which the traffic signals will be mounted on mast arms on the far side of the intersection with improved signal alignment and backplates, improving visibility of the signal lenses. In addition, northbound and southbound turning traffic will be removed from the through lane, reducing the likelihood of unexpected stopped or slowing traffic in the through lane.

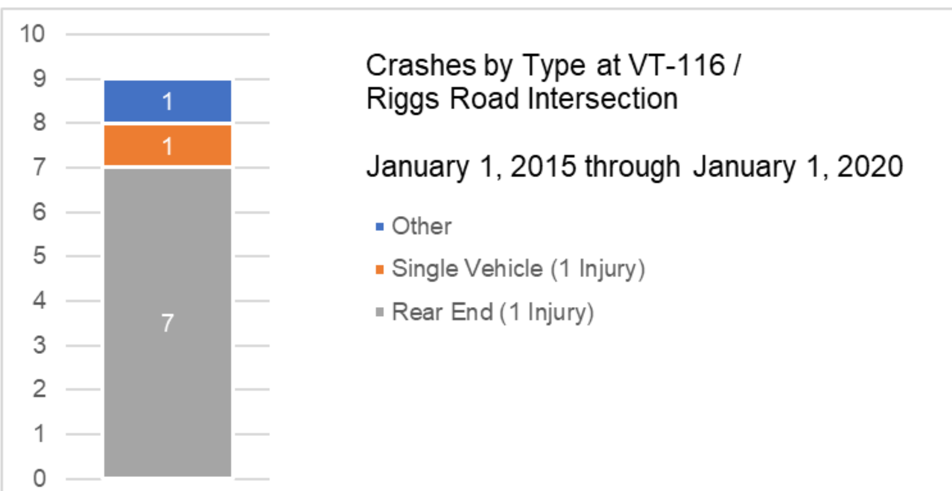
Five of the crashes were related to left turn movements. These types of crashes may be reduced following the completion of the signal reconstruction project in which the northbound and southbound left turns traffic signals will have a protected phase and dedicated turn lanes.

The planned improvements to signal hardware and roadway layout as part of HINESBURG HES 021-1(19) is expected to improve congestion and reduce the number of crashes at this location.

5.2 VT-116 / RIGGS ROAD

RSG compiled all reported crashes within 250 feet of the VT-116 / Riggs Road intersection from January 1, 2015 through January 1, 2020. In this five-year period, nine crashes were reported in the vicinity of the intersection.

FIGURE 17: CRASHES BY TYPE AT THE VT-116 / RIGGS ROAD INTERSECTION, 1/1/15 THROUGH 1/1/20



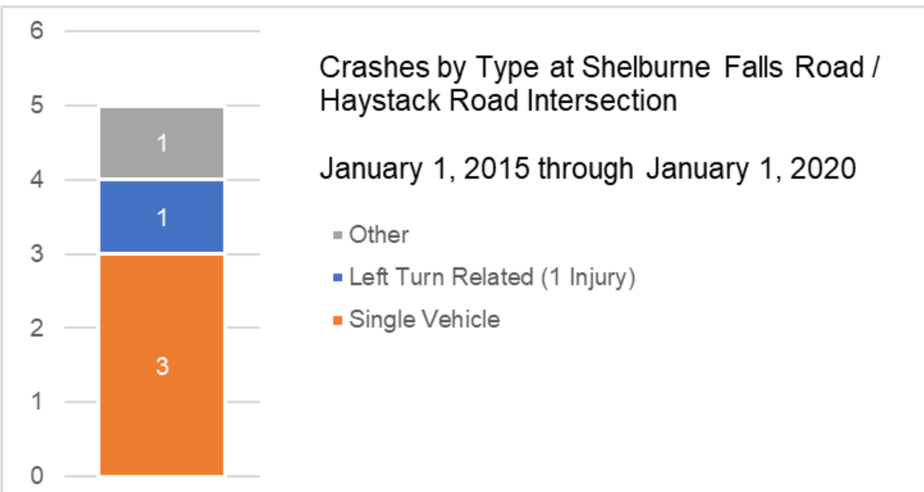
Of the nine reported crashes, seven crashes are rear end. As noted earlier, rear end crashes are common at locations of stopped and slowing traffic. Reviewing the recorded time of the seven rear end crashes, four of the rear end crashes occurred during the PM peak periods, one occurred in the AM peak period, and two occurred off peak. Since the traffic flow in the PM peak period is significantly southbound and there are few left turns into Riggs Road, this indicates the source of the congestion causing slowing or stopped conditions is likely the result of the downstream signal and associated southbound queue from Commerce Street.

With the proposed right-in / right-out access at the Riggs Road intersection, the existing southbound queueing behavior is unlikely to exacerbate the existing rear end crash pattern.

5.3 SHELBURNE FALLS ROAD / HAYSTACK ROAD

RSG compiled all reported crashes within 250 feet of the Shelburne Falls Road / Haystack Road intersection from January 1, 2015 through January 1, 2020. In this five-year period, five crashes were reported in the vicinity of the intersection; four of these intersections were also included in the crash review for the VT-116 / Shelburne Falls Road / CVU Road intersection.

FIGURE 18: CRASHES BY TYPE AT THE SHELBURNE FALLS ROAD / HAYSTACK ROAD INTERSECTION, 1/1/15 THROUGH 1/1/20



No discernable crash pattern is evident from the reported crashes. As noted earlier, four of the 5 crashes near the site are most likely associated with the adjacent signalized VT-116 intersection. The one crash identified at the Haystack Road intersection does not indicate the presence of an unsafe or hazardous condition. The proposed site access to Shelburne Farms Road from Haystack Road is unlikely to create or exacerbate a hazardous condition.

6.0 TRANSPORTATION IMPACT FEE CALCULATION

The State of Vermont, under Act 145, is likely to assess traffic impact fees associated with the signal and roadway improvements proposed at VT-116 / Shelburne Falls Road / CVU Road (HINESBURG HES 021-1(19)). This project has a base fee of $1,109 per PM trip.

As shown in Figure 3, the total Phase 1 (1A and 1B combined) trip generation routes 79 PM peak hour trips through the VT-116 / Shelburne Falls Road / CVU Road intersection. This results in a base fee of $1,109 per trip x 82 trips, or $90,938.

The base impact fee may be reduced due to several TDM strategies employed at the site. The project will construct bicycle racks and walkways throughout the site. In addition, the applicant is constructing improvements to the bicycle and pedestrian network along VT-116. These improvements warrant a 10% reduction in the base fee according to Table 1 of the Act 145 Impact Fee Guidance,[19] for an **adjusted Act 145 Transportation Impact Fee of $81,844**.

Lastly, if an Act 145 impact fee is assessed, an applicant may seek to offset the Act 145 Impact Fee based on the construction cost of other transportation projects constructed as a result of this project. From the Act 145 Guidance:

> *"An applicant may construct a portion, or the entirety of, a transportation project that would have otherwise been constructed by VTrans or a municipality. In these cases, the Act 145 fee will be adjusted to reflect the value of the work completed by the applicant. In most cases, the adjustment would more than offset the Act 145 fee."*

7.0 FINDINGS AND CONCLUSIONS

Based on the analysis, RSG estimates the proposed project will not cause or exacerbate any unreasonable congestion or unsafe conditions on the local roadway network and will not unnecessarily or unreasonably endanger the public's investment in any local roads, highways, or related infrastructure.

The proposed Phase 1A project will not have a significant impact on *existing* traffic operations at the adjacent signalized VT-116 / Shelburne Falls Road / CVU Road intersection, and the proposed overall Phase 1 (1A and 1B combined) project will not have a significant impact on the *proposed reconstructed* operations at the VT-116 / Shelburne Falls Road / CVU Road intersection. Site driveways are expected to operate safely and efficiently.

The total new external primary trip generation for overall Phase 1 was estimated at +71 entrances and +49 exits in the PM peak hour, for a total of +120 peak hour trips. When distributed, this trip generation falls below the +75-trip threshold generally used by VTrans to justify a Traffic Impact Study south of the project area. This small number of new external primary trip generation is not expected to significantly impact the near-capacity performance of the VT-116 corridor south of Riggs Road.

[19] https://vtrans.vermont.gov/sites/aot/files/planning/documents/trafficresearch/Act%20145%20Guidance%20Revision%202%20-%20January%202020.pdf

The proposed master plan, with appropriate wayfinding signs, generally offers safe and efficient bicycle, pedestrian, and vehicle circulation routes through the overall planned use development.

The site access drive on VT-116 is proposed as a right-in / right-out onto VT-116. While this is not a traditional access, this is the only intersection alternative allowed by VTrans onto VT-116. The access is designed to reinforce directional movements and is expected to operate safely and efficiently.

RSG recommends construction of a southbound left turn lane into Riggs Road from VT-116. However, this recommendation is independent of the proposed Haystack Crossing development. The southbound left turn lane is not warranted due to an identified crash history or congestion associated with the Haystack Crossing development. The Haystack Crossing development does not contribute to the southbound left turn demand. RSG recommends that the Haystack Crossing project identify and allocate the necessary rights of way for a southbound (and potentially northbound) left turn lane for future construction as part of the NRG Wind Systems development.

RSG has calculated a total Act 145 impact fee of $78,850 (subject to adjustment based on transportation project construction or local tax payments).

ATTACHMENTS:

1. NCHRP Report 6841 – Internal Capture Worksheets: Phase 1A
2. NCHRP Report 6841 – Internal Capture Worksheets: Phase 1 (1A + 1B)
3. Other Development Volumes: AM and PM Peak Hour Distributions
4. Turn Lane Warrant Spreadsheets
5. Synchro and SimTraffic Worksheets

NCHRP 8-51 Internal Trip Capture Estimation Tool				
Project Name:	Haystack Phase 1A		**Organization:**	RSG
Project Location:	Hinesburg, VT		**Performed By:**	CDM
Scenario Description:			**Date:**	5/15/2020
Analysis Year:	2021		**Checked By:**	
Analysis Period:	**AM Street Peak Hour**		**Date:**	

Table 1-A: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)				Estimated Vehicle-Trips		
	ITE LUCs[1]	Quantity	Units		Total	Entering	Exiting
Office					3	3	0
Retail					5	3	2
Restaurant					11	6	5
Cinema/Entertainment					0	0	0
Residential					21	6	15
Hotel					0	0	0
All Other Land Uses[2]					0	0	0
Total					40	18	22

Table 2-A: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips				Exiting Trips		
	Veh. Occ.	% Transit	% Non-Motorized		Veh. Occ.	% Transit	% Non-Motorized
Office							
Retail							
Restaurant							
Cinema/Entertainment							
Residential							
Hotel							
All Other Land Uses[2]							

Table 3-A: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-A: Internal Person-Trip Origin-Destination Matrix*

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	0		0	0	0	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	0	1	0		0
Hotel	0	0	0	0	0	

Table 5-A: Computations Summary

	Total	Entering	Exiting
All Person-Trips	40	18	22
Internal Capture Percentage	5%	6%	5%
External Vehicle-Trips[3]	38	17	21
External Transit-Trips[4]	0	0	0
External Non-Motorized Trips[4]	0	0	0

Table 6-A: Internal Trip Capture Percentages by Land Use

Land Use	Entering Trips	Exiting Trips
Office	0%	N/A
Retail	0%	0%
Restaurant	17%	0%
Cinema/Entertainment	N/A	N/A
Residential	0%	7%
Hotel	N/A	N/A

[1]Land Use Codes (LUCs) from *Trip Generation Informational Report*, published by the Institute of Transportation Engineers.
[2]Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
[3]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A
[4]Person-Trips
*Indicates computation that has been rounded to the nearest whole number.
Estimation Tool Developed by the Texas Transportation Institute

Project Name:	Haystack Phase 1A
Analysis Period:	**AM Street Peak Hour**

Table 7-A: Conversion of Vehicle-Trip Ends to Person-Trip Ends

Land Use	Table 7-A (D): Entering Trips				Table 7-A (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*		Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	3	3		1.00	0	0
Retail	1.00	3	3		1.00	2	2
Restaurant	1.00	6	6		1.00	5	5
Cinema/Entertainment	1.00	0	0		1.00	0	0
Residential	1.00	6	6		1.00	15	15
Hotel	1.00	0	0		1.00	0	0

Table 8-A (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	1		0	0	0	0
Restaurant	2	1		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	0	3	0		0
Hotel	0	0	0	0	0	

Table 8-A (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		1	1	0	0	0
Retail	0		3	0	0	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	1	1	0		0
Hotel	0	0	0	0	0	

Table 9-A (D): Internal and External Trips Summary (Entering Trips)

Destination Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	3	3		3	0	0
Retail	0	3	3		3	0	0
Restaurant	1	5	6		5	0	0
Cinema/Entertainment	0	0	0		0	0	0
Residential	0	6	6		6	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	0	0		0	0	0

Table 9-A (O): Internal and External Trips Summary (Exiting Trips)

Origin Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	0	0		0	0	0
Retail	0	2	2		2	0	0
Restaurant	0	5	5		5	0	0
Cinema/Entertainment	0	0	0		0	0	0
Residential	1	14	15		14	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	0	0		0	0	0

[1]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A
[2]Person-Trips
[3]Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
*Indicates computation that has been rounded to the nearest whole number.

NCHRP 8-51 Internal Trip Capture Estimation Tool			
Project Name:	Haystack Phase 1A	**Organization:**	RSG
Project Location:	Hinesburg, VT	**Performed By:**	CDM
Scenario Description:		**Date:**	5/15/2020
Analysis Year:	2021	**Checked By:**	
Analysis Period:	**PM Street Peak Hour**	**Date:**	

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)			Estimated Vehicle-Trips		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				4	1	3
Retail				10	5	5
Restaurant				10	6	4
Cinema/Entertainment				0	0	0
Residential				32	19	13
Hotel				0	0	0
All Other Land Uses[2]				0	0	0
Total				56	31	25

Table 2-P: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.	% Transit	% Non-Motorized	Veh. Occ.	% Transit	% Non-Motorized
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses[2]						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-P: Internal Person-Trip Origin-Destination Matrix*

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	0		1	0	1	0
Restaurant	0	2		0	1	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	1	1	0		0
Hotel	0	0	0	0	0	

Table 5-P: Computations Summary

	Total	Entering	Exiting
All Person-Trips	56	31	25
Internal Capture Percentage	25%	23%	28%
External Vehicle-Trips[3]	42	24	18
External Transit-Trips[4]	0	0	0
External Non-Motorized Trips[4]	0	0	0

Table 6-P: Internal Trip Capture Percentages by Land Use

Land Use	Entering Trips	Exiting Trips
Office	0%	0%
Retail	60%	40%
Restaurant	33%	75%
Cinema/Entertainment	N/A	N/A
Residential	11%	15%
Hotel	N/A	N/A

[1]Land Use Codes (LUCs) from *Trip Generation Informational Report*, published by the Institute of Transportation Engineers.
[2]Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
[3]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P
[4]Person-Trips
*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas Transportation Institute

Project Name:	Haystack Phase 1A
Analysis Period:	**PM Street Peak Hour**

Table 7-P: Conversion of Vehicle-Trip Ends to Person-Trip Ends

Land Use	Table 7-P (D): Entering Trips				Table 7-P (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*		Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	1	1		1.00	3	3
Retail	1.00	5	5		1.00	5	5
Restaurant	1.00	6	6		1.00	4	4
Cinema/Entertainment	1.00	0	0		1.00	0	0
Residential	1.00	19	19		1.00	13	13
Hotel	1.00	0	0		1.00	0	0

Table 8-P (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		1	0	0	0	0
Retail	0		1	0	1	0
Restaurant	0	2		0	1	0
Cinema/Entertainment	0	0	0		0	0
Residential	1	5	3	0		0
Hotel	0	0	0	0	0	

Table 8-P (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	1	0
Retail	0		2	0	9	0
Restaurant	0	3		0	3	0
Cinema/Entertainment	0	0	0		1	0
Residential	1	1	1	0		0
Hotel	0	0	0	0	0	

Table 9-P (D): Internal and External Trips Summary (Entering Trips)

Destination Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	1	1		1	0	0
Retail	3	2	5		2	0	0
Restaurant	2	4	6		4	0	0
Cinema/Entertainment	0	0	0		0	0	0
Residential	2	17	19		17	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	0	0		0	0	0

Table 9-P (O): Internal and External Trips Summary (Exiting Trips)

Origin Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	3	3		3	0	0
Retail	2	3	5		3	0	0
Restaurant	3	1	4		1	0	0
Cinema/Entertainment	0	0	0		0	0	0
Residential	2	11	13		11	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	0	0		0	0	0

[1]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P
[2]Person-Trips
[3]Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
*Indicates computation that has been rounded to the nearest whole number.

NCHRP 8-51 Internal Trip Capture Estimation Tool			
Project Name:	Haystack Phase 1	**Organization:**	RSG
Project Location:	Hinesburg, VT	**Performed By:**	CDM
Scenario Description:		**Date:**	5/8/2020
Analysis Year:	2026	**Checked By:**	
Analysis Period:	**AM Street Peak Hour**	**Date:**	

Table 1-A: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)			Estimated Vehicle-Trips		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				12	10	2
Retail				16	9	7
Restaurant				33	18	15
Cinema/Entertainment				0	0	0
Residential				74	19	55
Hotel				0	0	0
All Other Land Uses[2]				0	0	0
Total				135	56	79

Table 2-A: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.	% Transit	% Non-Motorized	Veh. Occ.	% Transit	% Non-Motorized
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses[2]						

Table 3-A: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-A: Internal Person-Trip Origin-Destination Matrix*

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	1	0	0	0
Retail	0		1	0	0	0
Restaurant	1	1		0	1	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	1	4	0		0
Hotel	0	0	0	0	0	

Table 5-A: Computations Summary

	Total	Entering	Exiting
All Person-Trips	135	56	79
Internal Capture Percentage	15%	18%	13%
External Vehicle-Trips[3]	115	46	69
External Transit-Trips[4]	0	0	0
External Non-Motorized Trips[4]	0	0	0

Table 6-A: Internal Trip Capture Percentages by Land Use

Land Use	Entering Trips	Exiting Trips
Office	10%	50%
Retail	22%	14%
Restaurant	33%	20%
Cinema/Entertainment	N/A	N/A
Residential	5%	9%
Hotel	N/A	N/A

[1]Land Use Codes (LUCs) from *Trip Generation Informational Report*, published by the Institute of Transportation Engineers.
[2]Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
[3]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A
[4]Person-Trips
*Indicates computation that has been rounded to the nearest whole number.
Estimation Tool Developed by the Texas Transportation Institute

Project Name:	Haystack Phase 1
Analysis Period:	**AM Street Peak Hour**

Table 7-A: Conversion of Vehicle-Trip Ends to Person-Trip Ends

Land Use	Table 7-A (D): Entering Trips			Table 7-A (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	10	10	1.00	2	2
Retail	1.00	9	9	1.00	7	7
Restaurant	1.00	18	18	1.00	15	15
Cinema/Entertainment	1.00	0	0	1.00	0	0
Residential	1.00	19	19	1.00	55	55
Hotel	1.00	0	0	1.00	0	0

Table 8-A (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		1	1	0	0	0
Retail	2		1	0	1	0
Restaurant	5	2		0	1	0
Cinema/Entertainment	0	0	0		0	0
Residential	1	1	11	0		0
Hotel	0	0	0	0	0	

Table 8-A (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		3	4	0	0	0
Retail	0		9	0	0	0
Restaurant	1	1		0	1	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	2	4	0		0
Hotel	0	0	1	0	0	

Table 9-A (D): Internal and External Trips Summary (Entering Trips)

Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	1	9	10	9	0	0
Retail	2	7	9	7	0	0
Restaurant	6	12	18	12	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	1	18	19	18	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses[3]	0	0	0	0	0	0

Table 9-A (O): Internal and External Trips Summary (Exiting Trips)

Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	1	1	2	1	0	0
Retail	1	6	7	6	0	0
Restaurant	3	12	15	12	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	5	50	55	50	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses[3]	0	0	0	0	0	0

[1]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A
[2]Person-Trips
[3]Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
*Indicates computation that has been rounded to the nearest whole number.

NCHRP 8-51 Internal Trip Capture Estimation Tool			
Project Name:	Haystack Phase 1	**Organization:**	RSG
Project Location:	Hinesburg, VT	**Performed By:**	CDM
Scenario Description:		**Date:**	5/15/2020
Analysis Year:	2026	**Checked By:**	
Analysis Period:	**PM Street Peak Hour**	**Date:**	

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)			Estimated Vehicle-Trips		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				12	2	10
Retail				35	18	17
Restaurant				33	20	13
Cinema/Entertainment				0	0	0
Residential				100	62	38
Hotel				0	0	0
All Other Land Uses[2]				0	0	0
Total				180	102	78

Table 2-P: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.	% Transit	% Non-Motorized	Veh. Occ.	% Transit	% Non-Motorized
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses[2]						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-P: Internal Person-Trip Origin-Destination Matrix*

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		1	0	0	0	0
Retail	0		5	0	4	0
Restaurant	0	5		0	2	0
Cinema/Entertainment	0	0	0		0	0
Residential	1	2	3	0		0
Hotel	0	0	0	0	0	

Table 5-P: Computations Summary

	Total	Entering	Exiting
All Person-Trips	180	102	78
Internal Capture Percentage	26%	23%	29%
External Vehicle-Trips[3]	134	79	55
External Transit-Trips[4]	0	0	0
External Non-Motorized Trips[4]	0	0	0

Table 6-P: Internal Trip Capture Percentages by Land Use

Land Use	Entering Trips	Exiting Trips
Office	50%	10%
Retail	44%	53%
Restaurant	40%	54%
Cinema/Entertainment	N/A	N/A
Residential	10%	16%
Hotel	N/A	N/A

[1]Land Use Codes (LUCs) from *Trip Generation Informational Report*, published by the Institute of Transportation Engineers.
[2]Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
[3]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P
[4]Person-Trips
*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas Transportation Institute

Project Name:	Haystack Phase 1
Analysis Period:	**PM Street Peak Hour**

Table 7-P: Conversion of Vehicle-Trip Ends to Person-Trip Ends

Land Use	Table 7-P (D): Entering Trips				Table 7-P (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*		Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	2	2		1.00	10	10
Retail	1.00	18	18		1.00	17	17
Restaurant	1.00	20	20		1.00	13	13
Cinema/Entertainment	1.00	0	0		1.00	0	0
Residential	1.00	62	62		1.00	38	38
Hotel	1.00	0	0		1.00	0	0

Table 8-P (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		2	0	0	0	0
Retail	0		5	1	4	1
Restaurant	0	5		1	2	1
Cinema/Entertainment	0	0	0		0	0
Residential	2	16	8	0		1
Hotel	0	0	0	0	0	

Table 8-P (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		1	0	0	2	0
Retail	1		6	0	29	0
Restaurant	1	9		0	10	0
Cinema/Entertainment	0	1	1		2	0
Residential	1	2	3	0		0
Hotel	0	0	1	0	0	

Table 9-P (D): Internal and External Trips Summary (Entering Trips)

Destination Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	1	1	2		1	0	0
Retail	8	10	18		10	0	0
Restaurant	8	12	20		12	0	0
Cinema/Entertainment	0	0	0		0	0	0
Residential	6	56	62		56	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	0	0		0	0	0

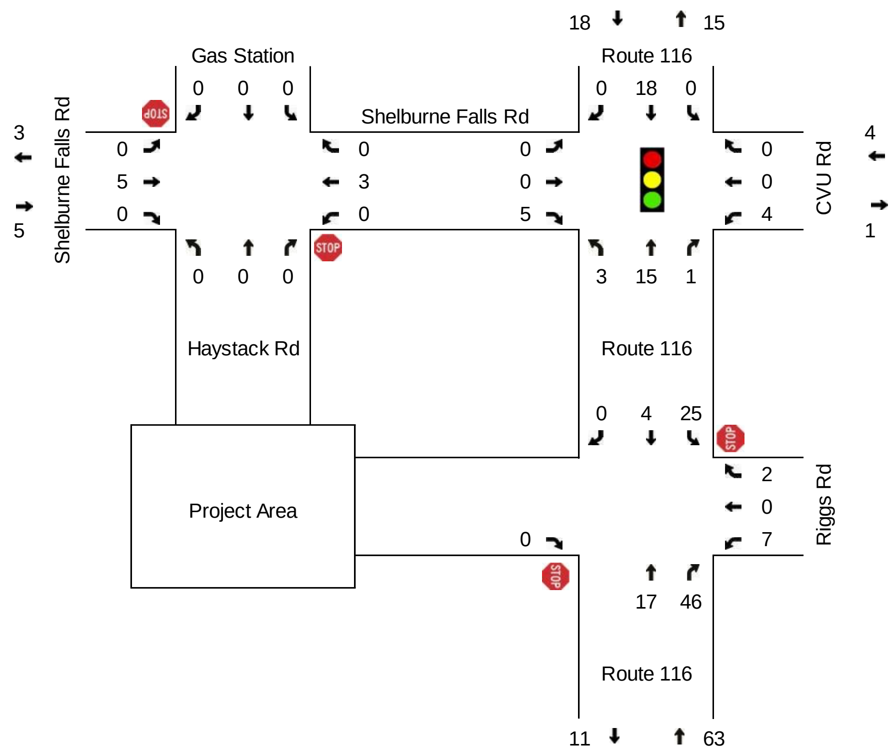
Table 9-P (O): Internal and External Trips Summary (Exiting Trips)

Origin Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	1	9	10		9	0	0
Retail	9	8	17		8	0	0
Restaurant	7	6	13		6	0	0
Cinema/Entertainment	0	0	0		0	0	0
Residential	6	32	38		32	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	0	0		0	0	0

[1]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P
[2]Person-Trips
[3]Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
*Indicates computation that has been rounded to the nearest whole number.

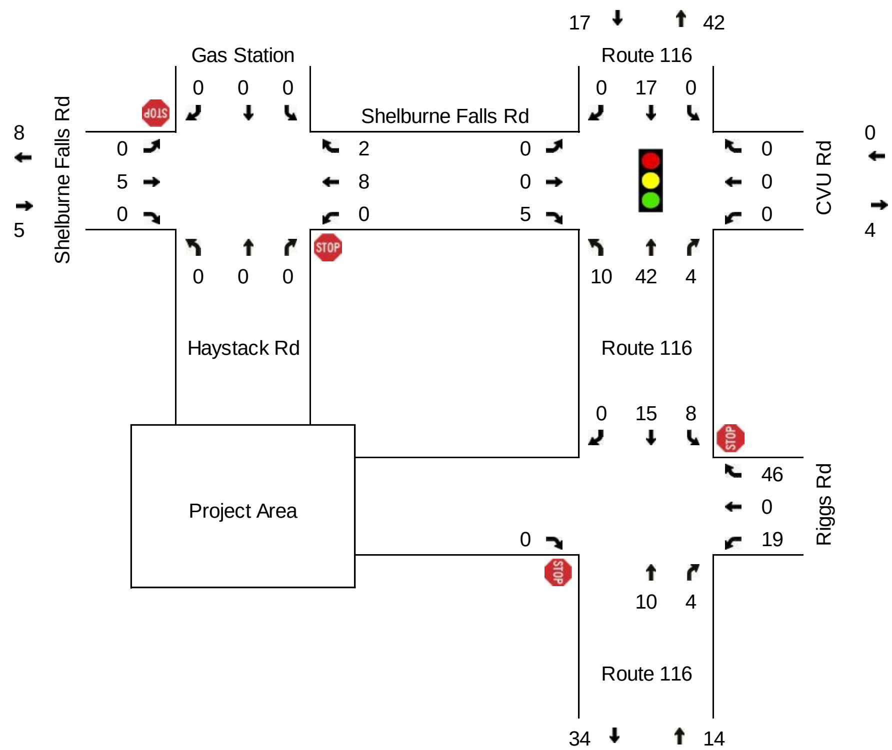
ATTACHMENT 3, FIGURE 1: AM PEAK HOUR ODVS

Midweek AM All ODVs



ATTACHMENT 3, FIGURE 2: PM PEAK HOUR ODVS

Midweek PM All ODVs



TURN LANE WARRANT ANALYSIS

PROJECT: Haystack Crossing
LOCATION: Shelburne Falls Road / Haystack Road
Hinesburg, VT

BY: CDM / RSG
DATE: 15-May-20
SCENARIO: 2026 AM Build

Source: Kikuchi and Chakroborty's "Modified Harmelink/AASHTO Model" from Method for Prioritizing Intersection Improvements, Washington State Transportation Center Research Report, January 1997

YEAR: 2025
TIME: PM Peak Hour
SPEED: 35 mph

Exclusive right-turn lane in the Va direction (Y/N)? N
Exclusive left-turn lane in the Vo direction (Y/N)? N

ENTER TRAFFIC VOLUMES (vph):

	Vadv.	Vopp.
Left-Turn =	39	10
Thru =	294	282
Right-Turn =	48	10

Va = 381 vph
Vo = 302 vph
L = 10.2%
R = 3.5%

Left Turn Lane

Va = exp(6.9017-0.001151*Vo+(exp(0.383-0.118*L)-0.01816*SP)) (Eq. 3.3)

Warranting Va = 576 vph

Va = 381 < 576

THEREFORE, WB LEFT-TURN LANE NOT WARRANTED

Opposing Right Turn Lane

Va = 33 x squareroot ((80-S) / (R x (1-R)))

Warranting Va = 1196.97 vph

Va = 302 < 1,197

THEREFORE, EB RIGHT-TURN LANE NOT WARRANTED

TURN LANE WARRANT ANALYSIS

PROJECT: Haystack Crossing
LOCATION: Shelburne Falls Road / Haystack Road
Hinesburg, VT

BY: CDM / RSG
DATE: 15-May-20
SCENARIO: 2026 PM Build

Source: Kikuchi and Chakroborty's "Modified Harmelink/AASHTO Model" from Method for Prioritizing Intersection Improvements, Washington State Transportation Center Research Report, January 1997

YEAR: 2025
TIME: PM Peak Hour
SPEED: 35 mph

Exclusive right-turn lane in the Va direction (Y/N)? N
Exclusive left-turn lane in the Vo direction (Y/N)? N

ENTER TRAFFIC VOLUMES (vph):

	Vadv.	Vopp.
Left-Turn =	31	25
Thru =	199	314
Right-Turn =	50	14

Va = 280 vph
Vo = 353 vph
L = 11.1%
R = 4.5%

Left Turn Lane

Va = exp(6.9017-0.001151*Vo+(exp(0.383-0.118*L)-0.01816*SP)) (Eq. 3.3)

Warranting Va = 522 vph

Va = 280 < 522

THEREFORE, WB LEFT-TURN LANE NOT WARRANTED

Opposing Right Turn Lane

Va = 33 x squareroot ((80-S) / (R x (1-R)))

Warranting Va = 1072.57 vph

Va = 353 < 1,073

THEREFORE, EB RIGHT-TURN LANE NOT WARRANTED

TURN LANE WARRANT ANALYSIS

PROJECT:	Haystack Crossing	BY:	CDM / RSG
LOCATION:	VT-116 / Riggs Road	DATE:	15-May-20
	Hinesburg, VT	SCENARIO:	2026 AM Build

Source: Kikuchi and Chakroborty's "Modified Harmelink/AASHTO Model" from Method for Prioritizing Intersection Improvements, Washington State Transportation Center Research Report, January 1997

YEAR: 2025
TIME: PM Peak Hour
SPEED: 40 mph

Exclusive right-turn lane in the Va direction (Y/N)? N
Exclusive left-turn lane in the Vo direction (Y/N)? N

ENTER TRAFFIC VOLUMES (vph):

	Vadv.	Vopp.
Left-Turn =	0	59
Thru =	768	379
Right-Turn =	62	11

Va = 830 vph
Vo = 449 vph
L = 0.0%
R = 2.9%

Left Turn Lane

Va = exp(6.9017-0.001151*Vo+(exp(0.383-0.118*L)-0.01816*SP)) (Eq. 3.3)

Warranting Va = 0 vph

Va = 0 => 0

THEREFORE, NB LEFT-TURN LANE NOT WARRANTED

Opposing Right Turn Lane

Va = 33 x squareroot ((80-S) / (R x (1-R)))

Warranting Va = 1243.26 vph

Va = 449 < 1,243

THEREFORE, SB RIGHT-TURN LANE NOT WARRANTED

TURN LANE WARRANT ANALYSIS

PROJECT: Haystack Crossing
LOCATION: VT-116 / Riggs Road
Hinesburg, VT

BY: CDM / RSG
DATE: 15-May-20
SCENARIO: 2026 PM Build

Source: Kikuchi and Chakroborty's "Modified Harmelink/AASHTO Model" from Method for Prioritizing Intersection Improvements, Washington State Transportation Center Research Report, January 1997

YEAR: 2025
TIME: PM Peak Hour
SPEED: 40 mph

Exclusive right-turn lane in the Va direction (Y/N)? N
Exclusive left-turn lane in the Vo direction (Y/N)? N

ENTER TRAFFIC VOLUMES (vph):

	Vadv.	Vopp.
Left-Turn =	0	13
Thru =	413	747
Right-Turn =	10	41

Va = 423 vph
Vo = 801 vph
L = 0.0%
R = 5.5%

Left Turn Lane

Va = exp(6.9017-0.001151*Vo+(exp(0.383-0.118*L)-0.01816*SP)) (Eq. 3.3)

Warranting Va = 0 vph

Va = 0 => 0

THEREFORE, NB LEFT-TURN LANE NOT WARRANTED

Opposing Right Turn Lane

Va = 33 x squareroot ((80-S) / (R x (1-R)))

Warranting Va = 916.369 vph

Va = 801 < 916

THEREFORE, SB RIGHT-TURN LANE NOT WARRANTED

TURN LANE WARRANT ANALYSIS

PROJECT: Haystack Crossing
LOCATION: VT-116 / Riggs Road (NRG)
Hinesburg, VT

BY: CDM / RSG
DATE: 15-May-20
SCENARIO: 2026 AM Build

Source: Kikuchi and Chakroborty's "Modified Harmelink/AASHTO Model" from Method for Prioritizing Intersection Improvements, Washington State Transportation Center Research Report, January 1997

YEAR: 2025
TIME: PM Peak Hour
SPEED: 40 mph

Exclusive right-turn lane in the Va direction (Y/N)? N
Exclusive left-turn lane in the Vo direction (Y/N)? N

ENTER TRAFFIC VOLUMES (vph):

	Vadv.	Vopp.
Left-Turn =	59	0
Thru =	379	788
Right-Turn =	11	62

Va = 449 vph
Vo = 850 vph
L = 13.1%
R = 7.9%

Left Turn Lane

Va = exp(6.9017-0.001151*Vo+(exp(0.383-0.118*L)-0.01816*SP)) (Eq. 3.3)

Warranting Va = 247 vph

Va = 449 => 247

THEREFORE, SB LEFT-TURN LANE IS WARRANTED

Opposing Right Turn Lane

Va = 33 x squareroot ((80-S) / (R x (1-R)))

Warranting Va = 775.186 vph

Va = 850 => 775

THEREFORE, NB RIGHT-TURN LANE IS WARRANTED

TURN LANE WARRANT ANALYSIS

PROJECT: Haystack Crossing
LOCATION: VT-116 / Riggs Road (NRG)
Hinesburg, VT

BY: CDM / RSG
DATE: 15-May-20
SCENARIO: 2026 PM Build

Source: Kikuchi and Chakroborty's "Modified Harmelink/AASHTO Model" from Method for Prioritizing Intersection Improvements, Washington State Transportation Center Research Report, January 1997

YEAR: 2025
TIME: PM Peak Hour
SPEED: 40 mph

Exclusive right-turn lane in the Va direction (Y/N)? N
Exclusive left-turn lane in the Vo direction (Y/N)? N

ENTER TRAFFIC VOLUMES (vph):

	Vadv.	Vopp.
Left-Turn =	13	0
Thru =	747	413
Right-Turn =	41	10

Va = 801 vph
Vo = 423 vph
L = 1.6%
R = 2.4%

Left Turn Lane

Va = exp(6.9017-0.001151*Vo+(exp(0.383-0.118*L)-0.01816*SP)) (Eq. 3.3)

Warranting Va = 0 vph

Va = 0 => 0

THEREFORE, SB LEFT-TURN LANE NOT WARRANTED

Opposing Right Turn Lane

Va = 33 x squareroot ((80-S) / (R x (1-R)))

Warranting Va = 1357.82 vph

Va = 423 < 1,358

THEREFORE, NB RIGHT-TURN LANE NOT WARRANTED

HCM Signalized Intersection Capacity Analysis
3: VT-116 & Shelburne Falls Rd/CVU Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	190	80	66	166	218	140	593	24	131	281	39
Future Volume (vph)	30	190	80	66	166	218	140	593	24	131	281	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.5			6.5			6.5			6.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.96			0.93			1.00			0.99	
Flt Protected		1.00			0.99			0.99			0.99	
Satd. Flow (prot)		1787			1728			1838			1815	
Flt Permitted		0.91			0.86			0.81			0.61	
Satd. Flow (perm)		1628			1500			1510			1129	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	30	190	80	66	166	218	140	593	24	131	281	39
RTOR Reduction (vph)	0	10	0	0	31	0	0	1	0	0	2	0
Lane Group Flow (vph)	0	290	0	0	419	0	0	756	0	0	449	0
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA		Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		36.5			36.5			61.3			61.3	
Effective Green, g (s)		36.5			36.5			61.3			61.3	
Actuated g/C Ratio		0.33			0.33			0.55			0.55	
Clearance Time (s)		6.5			6.5			6.5			6.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		536			494			835			624	
v/s Ratio Prot												
v/s Ratio Perm		0.18			c0.28			c0.50			0.40	
v/c Ratio		0.54			0.85			0.91			0.72	
Uniform Delay, d1		30.3			34.6			22.2			18.4	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.1			12.8			13.2			7.0	
Delay (s)		31.4			47.4			35.4			25.4	
Level of Service		C			D			D			C	
Approach Delay (s)		31.4			47.4			35.4			25.4	
Approach LOS		C			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	35.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	110.8	Sum of lost time (s)	21.0
Intersection Capacity Utilization	96.8%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: VT-116 & Riggs Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	11	0	3	0	754	61	58	371	0
Future Volume (Veh/h)	0	0	0	11	0	3	0	754	61	58	371	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	0	11	0	3	0	754	61	58	371	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1274	1302	371	1272	1272	784	371			815		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1274	1302	371	1272	1272	784	371			815		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	92	100	99	100			93		
cM capacity (veh/h)	135	149	675	137	156	393	1188			812		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	14	815	429
Volume Left	0	11	0	58
Volume Right	0	3	61	0
cSH	1700	159	1700	812
Volume to Capacity	0.00	0.09	0.48	0.07
Queue Length 95th (ft)	0	7	0	6
Control Delay (s)	0.0	29.8	0.0	2.1
Lane LOS	A	D		A
Approach Delay (s)	0.0	29.8	0.0	2.1
Approach LOS	A	D		

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Haystack Rd/Gas Station & Shelburne Falls Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	276	3	10	288	47	0	1	1	23	2	36
Future Volume (Veh/h)	10	276	3	10	288	47	0	1	1	23	2	36
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	10	276	3	10	288	47	0	1	1	23	2	36
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					482							
pX, platoon unblocked												
vC, conflicting volume	335			279			666	652	278	630	630	312
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	335			279			666	652	278	630	630	312
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			99			100	100	100	94	99	95
cM capacity (veh/h)	1224			1284			349	381	761	388	392	729

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	289	345	2	61
Volume Left	10	10	0	23
Volume Right	3	47	1	36
cSH	1224	1284	508	536
Volume to Capacity	0.01	0.01	0.00	0.11
Queue Length 95th (ft)	1	1	0	10
Control Delay (s)	0.4	0.3	12.1	12.6
Lane LOS	A	A	B	B
Approach Delay (s)	0.4	0.3	12.1	12.6
Approach LOS			B	B

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	39.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: VT-116 & Shelburne Falls Rd/CVU Rd

05/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	38	195	80	66	169	218	146	593	24	131	284	39
Future Volume (vph)	38	195	80	66	169	218	146	593	24	131	284	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.5			6.5			6.5			6.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.97			0.94			1.00			0.99	
Flt Protected		0.99			0.99			0.99			0.99	
Satd. Flow (prot)		1788			1729			1837			1815	
Flt Permitted		0.87			0.86			0.80			0.61	
Satd. Flow (perm)		1561			1495			1493			1130	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	38	195	80	66	169	218	146	593	24	131	284	39
RTOR Reduction (vph)	0	9	0	0	30	0	0	1	0	0	2	0
Lane Group Flow (vph)	0	304	0	0	423	0	0	762	0	0	452	0
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA		Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		36.8			36.8			61.2			61.2	
Effective Green, g (s)		36.8			36.8			61.2			61.2	
Actuated g/C Ratio		0.33			0.33			0.55			0.55	
Clearance Time (s)		6.5			6.5			6.5			6.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		517			495			823			623	
v/s Ratio Prot												
v/s Ratio Perm		0.19			c0.28			c0.51			0.40	
v/c Ratio		0.59			0.85			0.93			0.73	
Uniform Delay, d1		30.8			34.6			22.8			18.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.7			13.5			16.1			7.2	
Delay (s)		32.5			48.1			38.9			25.8	
Level of Service		C			D			D			C	
Approach Delay (s)		32.5			48.1			38.9			25.8	
Approach LOS		C			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	37.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	111.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	95.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: VT-116 & Riggs Rd

05/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	6	11	0	3	0	760	61	58	371	3
Future Volume (Veh/h)	0	0	6	11	0	3	0	760	61	58	371	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	6	11	0	3	0	760	61	58	371	3
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1282	1310	372	1285	1280	790	374			821		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1282	1310	372	1285	1280	790	374			821		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	99	92	100	99	100			93		
cM capacity (veh/h)	133	148	673	133	154	390	1184			808		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	6	14	821	432
Volume Left	0	11	0	58
Volume Right	6	3	61	3
cSH	673	154	1700	808
Volume to Capacity	0.01	0.09	0.48	0.07
Queue Length 95th (ft)	1	7	0	6
Control Delay (s)	10.4	30.6	0.0	2.1
Lane LOS	B	D		A
Approach Delay (s)	10.4	30.6	0.0	2.1
Approach LOS	B	D		

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Haystack Rd/Gas Station & Shelburne Falls Rd

05/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	276	6	21	288	47	3	1	13	23	2	36
Future Volume (Veh/h)	10	276	6	21	288	47	3	1	13	23	2	36
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	10	276	6	21	288	47	3	1	13	23	2	36
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					482							
pX, platoon unblocked												
vC, conflicting volume	335			282			690	676	279	666	656	312
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	335			282			690	676	279	666	656	312
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			98			99	100	98	94	99	95
cM capacity (veh/h)	1224			1280			334	366	760	359	376	729

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	292	356	17	61
Volume Left	10	21	3	23
Volume Right	6	47	13	36
cSH	1224	1280	590	513
Volume to Capacity	0.01	0.02	0.03	0.12
Queue Length 95th (ft)	1	1	2	10
Control Delay (s)	0.3	0.6	11.3	13.0
Lane LOS	A	A	B	B
Approach Delay (s)	0.3	0.6	11.3	13.0
Approach LOS			B	B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	40.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: VT-116 & Shelburne Falls Rd/CVU Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	28	160	173	22	113	81	84	346	37	173	558	53
Future Volume (vph)	28	160	173	22	113	81	84	346	37	173	558	53
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.5			6.5			6.5			6.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.94			0.95			0.99			0.99	
Flt Protected		1.00			0.99			0.99			0.99	
Satd. Flow (prot)		1736			1759			1826			1826	
Flt Permitted		0.96			0.87			0.77			0.78	
Satd. Flow (perm)		1666			1539			1420			1446	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	28	160	173	22	113	81	84	346	37	173	558	53
RTOR Reduction (vph)	0	25	0	0	19	0	0	2	0	0	1	0
Lane Group Flow (vph)	0	336	0	0	197	0	0	465	0	0	783	0
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA		Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		27.3			27.3			75.1			75.1	
Effective Green, g (s)		27.3			27.3			75.1			75.1	
Actuated g/C Ratio		0.24			0.24			0.65			0.65	
Clearance Time (s)		6.5			6.5			6.5			6.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		394			364			924			941	
v/s Ratio Prot												
v/s Ratio Perm		c0.20			0.13			0.33			c0.54	
v/c Ratio		0.85			0.54			0.50			0.83	
Uniform Delay, d1		42.1			38.6			10.5			15.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		16.1			1.6			0.4			8.5	
Delay (s)		58.2			40.2			10.9			23.8	
Level of Service		E			D			B			C	
Approach Delay (s)		58.2			40.2			10.9			23.8	
Approach LOS		E			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	29.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	115.4	Sum of lost time (s)	21.0
Intersection Capacity Utilization	97.0%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: VT-116 & Riggs Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	32	0	78	0	389	10	13	741	0
Future Volume (Veh/h)	0	0	0	32	0	78	0	389	10	13	741	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	0	32	0	78	0	389	10	13	741	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1239	1166	741	1161	1161	394	741			399		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1239	1166	741	1161	1161	394	741			399		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	81	100	88	100			99		
cM capacity (veh/h)	133	192	416	171	193	655	866			1160		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	110	399	754
Volume Left	0	32	0	13
Volume Right	0	78	10	0
cSH	1700	359	1700	1160
Volume to Capacity	0.00	0.31	0.23	0.01
Queue Length 95th (ft)	0	32	0	1
Control Delay (s)	0.0	19.4	0.0	0.3
Lane LOS	A	C		A
Approach Delay (s)	0.0	19.4	0.0	0.3
Approach LOS	A	C		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Haystack Rd/Gas Station & Shelburne Falls Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	308	0	6	195	49	1	2	15	38	1	17
Future Volume (Veh/h)	25	308	0	6	195	49	1	2	15	38	1	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	25	308	0	6	195	49	1	2	15	38	1	17
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					482							
pX, platoon unblocked												
vC, conflicting volume	244			308			607	614	308	606	590	220
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	244			308			607	614	308	606	590	220
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			100			100	99	98	90	100	98
cM capacity (veh/h)	1322			1253			392	397	732	392	410	820

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	333	250	18	56
Volume Left	25	6	1	38
Volume Right	0	49	15	17
cSH	1322	1253	641	466
Volume to Capacity	0.02	0.00	0.03	0.12
Queue Length 95th (ft)	1	0	2	10
Control Delay (s)	0.7	0.2	10.8	13.8
Lane LOS	A	A	B	B
Approach Delay (s)	0.7	0.2	10.8	13.8
Approach LOS			B	B

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: VT-116 & Shelburne Falls Rd/CVU Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	33	163	173	22	116	81	89	346	37	173	568	53
Future Volume (vph)	33	163	173	22	116	81	89	346	37	173	568	53
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.5			6.5			6.5			6.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.94			0.95			0.99			0.99	
Flt Protected		1.00			1.00			0.99			0.99	
Satd. Flow (prot)		1737			1761			1826			1826	
Flt Permitted		0.95			0.89			0.75			0.78	
Satd. Flow (perm)		1651			1576			1377			1438	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	33	163	173	22	116	81	89	346	37	173	568	53
RTOR Reduction (vph)	0	24	0	0	18	0	0	2	0	0	1	0
Lane Group Flow (vph)	0	345	0	0	201	0	0	470	0	0	793	0
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA		Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		33.7			33.7			83.3			83.3	
Effective Green, g (s)		33.7			33.7			83.3			83.3	
Actuated g/C Ratio		0.26			0.26			0.64			0.64	
Clearance Time (s)		6.5			6.5			6.5			6.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		427			408			882			921	
v/s Ratio Prot												
v/s Ratio Perm		c0.21			0.13			0.34			c0.55	
v/c Ratio		0.81			0.49			0.53			0.86	
Uniform Delay, d1		45.1			40.9			12.7			18.7	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		10.8			0.9			0.6			10.4	
Delay (s)		55.9			41.8			13.4			29.1	
Level of Service		E			D			B			C	
Approach Delay (s)		55.9			41.8			13.4			29.1	
Approach LOS		E			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	31.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	97.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: VT-116 & Riggs Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	7	32	0	78	0	394	10	13	738	13
Future Volume (Veh/h)	0	0	7	32	0	78	0	394	10	13	738	13
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	7	32	0	78	0	394	10	13	738	13
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1248	1174	744	1176	1176	399	751			404		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1248	1174	744	1176	1176	399	751			404		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	98	80	100	88	100			99		
cM capacity (veh/h)	131	189	414	164	189	651	858			1155		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	7	110	404	764
Volume Left	0	32	0	13
Volume Right	7	78	10	13
cSH	414	349	1700	1155
Volume to Capacity	0.02	0.32	0.24	0.01
Queue Length 95th (ft)	1	33	0	1
Control Delay (s)	13.8	20.0	0.0	0.3
Lane LOS	B	C		A
Approach Delay (s)	13.8	20.0	0.0	0.3
Approach LOS	B	C		

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Haystack Rd/Gas Station & Shelburne Falls Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	25	308	4	14	195	49	3	2	23	38	1	17
Future Volume (Veh/h)	25	308	4	14	195	49	3	2	23	38	1	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	25	308	4	14	195	49	3	2	23	38	1	17
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					482							
pX, platoon unblocked												
vC, conflicting volume	244			312			625	632	310	632	610	220
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	244			312			625	632	310	632	610	220
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			99			99	99	97	90	100	98
cM capacity (veh/h)	1322			1248			379	386	730	371	397	820

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	337	258	28	56
Volume Left	25	14	3	38
Volume Right	4	49	23	17
cSH	1322	1248	628	445
Volume to Capacity	0.02	0.01	0.04	0.13
Queue Length 95th (ft)	1	1	3	11
Control Delay (s)	0.7	0.5	11.0	14.2
Lane LOS	A	A	B	B
Approach Delay (s)	0.7	0.5	11.0	14.2
Approach LOS			B	B

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	41.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: VT-116 & Shelburne Falls Rd/CVU Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	31	194	82	67	169	222	143	605	24	134	287	40
Future Volume (vph)	31	194	82	67	169	222	143	605	24	134	287	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.5	6.5		6.5	6.5	6.5	6.5		6.5	6.5	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	0.99		1.00	0.98	
Flt Protected		0.99	1.00		0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1850	1583		1837	1583	1770	1852		1770	1829	
Flt Permitted		0.89	1.00		0.69	1.00	0.50	1.00		0.22	1.00	
Satd. Flow (perm)		1665	1583		1285	1583	940	1852		407	1829	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	31	194	82	67	169	222	143	605	24	134	287	40
RTOR Reduction (vph)	0	0	55	0	0	82	0	1	0	0	4	0
Lane Group Flow (vph)	0	225	27	0	236	140	143	628	0	134	323	0
Turn Type	Perm	NA	pm+ov	Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4	5		8	1	5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		20.3	29.1		20.3	29.2	49.3	40.5		49.5	40.6	
Effective Green, g (s)		20.3	29.1		20.3	29.2	49.3	40.5		49.5	40.6	
Actuated g/C Ratio		0.23	0.33		0.23	0.33	0.55	0.45		0.55	0.46	
Clearance Time (s)		6.5	6.5		6.5	6.5	6.5	6.5		6.5	6.5	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		378	631		292	633	601	840		361	832	
v/s Ratio Prot			0.00			0.02	0.02	c0.34		c0.04	0.18	
v/s Ratio Perm		0.14	0.01		c0.18	0.07	0.11			0.17		
v/c Ratio		0.60	0.04		0.81	0.22	0.24	0.75		0.37	0.39	
Uniform Delay, d1		30.8	20.5		32.6	21.8	9.8	20.1		12.2	16.1	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.5	0.0		15.0	0.2	0.2	6.0		0.6	1.4	
Delay (s)		33.3	20.6		47.7	21.9	10.0	26.1		12.8	17.5	
Level of Service		C	C		D	C	B	C		B	B	
Approach Delay (s)		29.9			35.2			23.2			16.1	
Approach LOS		C			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	25.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	89.2	Sum of lost time (s)	19.5
Intersection Capacity Utilization	86.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: VT-116 & Riggs Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	11	0	3	0	769	62	59	379	0
Future Volume (Veh/h)	0	0	0	11	0	3	0	769	62	59	379	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	0	11	0	3	0	769	62	59	379	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1300	1328	379	1297	1297	800	379			831		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1300	1328	379	1297	1297	800	379			831		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	92	100	99	100			93		
cM capacity (veh/h)	129	144	668	131	150	385	1179			801		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	14	831	438
Volume Left	0	11	0	59
Volume Right	0	3	62	0
cSH	1700	153	1700	801
Volume to Capacity	0.00	0.09	0.49	0.07
Queue Length 95th (ft)	0	7	0	6
Control Delay (s)	0.0	31.0	0.0	2.1
Lane LOS	A	D		A
Approach Delay (s)	0.0	31.0	0.0	2.1
Approach LOS	A	D		

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Haystack Rd/Gas Station & Shelburne Falls Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	282	3	10	294	48	0	1	1	23	2	37
Future Volume (Veh/h)	10	282	3	10	294	48	0	1	1	23	2	37
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	10	282	3	10	294	48	0	1	1	23	2	37
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					482							
pX, platoon unblocked	0.91						0.91	0.91		0.91	0.91	0.91
vC, conflicting volume	342			285			680	666	284	643	643	318
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	228			285			599	583	284	558	558	201
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			99			100	100	100	94	99	95
cM capacity (veh/h)	1220			1277			353	380	755	394	392	764

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	295	352	2	62
Volume Left	10	10	0	23
Volume Right	3	48	1	37
cSH	1220	1277	505	554
Volume to Capacity	0.01	0.01	0.00	0.11
Queue Length 95th (ft)	1	1	0	9
Control Delay (s)	0.3	0.3	12.2	12.3
Lane LOS	A	A	B	B
Approach Delay (s)	0.3	0.3	12.2	12.3
Approach LOS			B	B

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	39.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: VT-116 & Shelburne Falls Rd/CVU Rd

05/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	57	207	82	67	180	222	162	605	24	134	298	40
Future Volume (vph)	57	207	82	67	180	222	162	605	24	134	298	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.5	6.5		6.5	6.5	6.5	6.5		6.5	6.5	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	0.99		1.00	0.98	
Flt Protected		0.99	1.00		0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1843	1583		1838	1583	1770	1852		1770	1830	
Flt Permitted		0.74	1.00		0.64	1.00	0.48	1.00		0.21	1.00	
Satd. Flow (perm)		1373	1583		1190	1583	891	1852		384	1830	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	57	207	82	67	180	222	162	605	24	134	298	40
RTOR Reduction (vph)	0	0	53	0	0	80	0	1	0	0	4	0
Lane Group Flow (vph)	0	264	29	0	247	142	162	628	0	134	334	0
Turn Type	Perm	NA	pm+ov	Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4	5		8	1	5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		22.9	32.4		22.9	32.1	50.3	40.8		49.7	40.5	
Effective Green, g (s)		22.9	32.4		22.9	32.1	50.3	40.8		49.7	40.5	
Actuated g/C Ratio		0.25	0.35		0.25	0.35	0.54	0.44		0.54	0.44	
Clearance Time (s)		6.5	6.5		6.5	6.5	6.5	6.5		6.5	6.5	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		340	666		294	661	575	817		344	802	
v/s Ratio Prot			0.00			0.02	0.03	c0.34		c0.04	0.18	
v/s Ratio Perm		0.19	0.01		c0.21	0.07	0.12			0.17		
v/c Ratio		0.78	0.04		0.84	0.22	0.28	0.77		0.39	0.42	
Uniform Delay, d1		32.4	19.8		33.0	21.3	10.8	21.8		13.5	17.8	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		10.6	0.0		18.9	0.2	0.3	6.9		0.7	1.6	
Delay (s)		43.0	19.8		52.0	21.4	11.0	28.7		14.3	19.4	
Level of Service		D	B		D	C	B	C		B	B	
Approach Delay (s)		37.5			37.5			25.1			18.0	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	28.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	92.4	Sum of lost time (s)	19.5
Intersection Capacity Utilization	89.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: VT-116 & Riggs Rd

05/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	18	11	0	3	0	788	62	59	379	11
Future Volume (Veh/h)	0	0	18	11	0	3	0	788	62	59	379	11
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	18	11	0	3	0	788	62	59	379	11
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1324	1352	384	1340	1327	819	390			850		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1324	1352	384	1340	1327	819	390			850		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	97	91	100	99	100			93		
cM capacity (veh/h)	124	139	663	119	144	375	1169			788		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	18	14	850	449
Volume Left	0	11	0	59
Volume Right	18	3	62	11
cSH	663	139	1700	788
Volume to Capacity	0.03	0.10	0.50	0.07
Queue Length 95th (ft)	2	8	0	6
Control Delay (s)	10.6	33.7	0.0	2.1
Lane LOS	B	D		A
Approach Delay (s)	10.6	33.7	0.0	2.1
Approach LOS	B	D		

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Haystack Rd/Gas Station & Shelburne Falls Rd

05/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	282	10	39	294	48	12	1	41	23	2	37
Future Volume (Veh/h)	10	282	10	39	294	48	12	1	41	23	2	37
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	10	282	10	39	294	48	12	1	41	23	2	37
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					482							
pX, platoon unblocked	0.89						0.89	0.89		0.89	0.89	0.89
vC, conflicting volume	342			292			741	727	287	744	708	318
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	198			292			646	631	287	650	609	171
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			97			96	100	95	93	99	95
cM capacity (veh/h)	1223			1270			315	340	752	311	350	776

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	302	381	54	62
Volume Left	10	39	12	23
Volume Right	10	48	41	37
cSH	1223	1270	565	487
Volume to Capacity	0.01	0.03	0.10	0.13
Queue Length 95th (ft)	1	2	8	11
Control Delay (s)	0.3	1.1	12.0	13.5
Lane LOS	A	A	B	B
Approach Delay (s)	0.3	1.1	12.0	13.5
Approach LOS			B	B

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	48.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: VT-116 & Shelburne Falls Rd/CVU Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	163	176	22	115	83	86	353	38	176	569	54
Future Volume (vph)	29	163	176	22	115	83	86	353	38	176	569	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.5	6.5		6.5	6.5	6.5	6.5		6.5	6.5	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	0.99		1.00	0.99	
Flt Protected		0.99	1.00		0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1849	1583		1848	1583	1770	1836		1770	1839	
Flt Permitted		0.92	1.00		0.91	1.00	0.28	1.00		0.44	1.00	
Satd. Flow (perm)		1720	1583		1700	1583	530	1836		822	1839	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	29	163	176	22	115	83	86	353	38	176	569	54
RTOR Reduction (vph)	0	0	114	0	0	60	0	3	0	0	2	0
Lane Group Flow (vph)	0	192	62	0	137	23	86	388	0	176	621	0
Turn Type	Perm	NA	pm+ov	Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4	5		8	1	5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		14.4	21.5		14.4	23.2	47.3	40.2		50.7	41.9	
Effective Green, g (s)		14.4	21.5		14.4	23.2	47.3	40.2		50.7	41.9	
Actuated g/C Ratio		0.17	0.26		0.17	0.28	0.57	0.48		0.61	0.51	
Clearance Time (s)		6.5	6.5		6.5	6.5	6.5	6.5		6.5	6.5	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		298	534		295	567	408	890		603	929	
v/s Ratio Prot			0.01			0.00	0.02	0.21		c0.03	c0.34	
v/s Ratio Perm		c0.11	0.03		0.08	0.01	0.10			0.15		
v/c Ratio		0.64	0.12		0.46	0.04	0.21	0.44		0.29	0.67	
Uniform Delay, d1		31.9	23.4		30.8	21.7	9.3	13.9		7.3	15.3	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		4.7	0.1		1.2	0.0	0.3	1.6		0.3	3.8	
Delay (s)		36.6	23.5		31.9	21.8	9.5	15.5		7.6	19.1	
Level of Service		D	C		C	C	A	B		A	B	
Approach Delay (s)		30.3			28.1			14.4			16.6	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	20.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	82.9	Sum of lost time (s)	19.5
Intersection Capacity Utilization	77.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: VT-116 & Riggs Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	33	0	80	0	397	10	13	756	0
Future Volume (Veh/h)	0	0	0	33	0	80	0	397	10	13	756	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	0	33	0	80	0	397	10	13	756	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1264	1189	756	1184	1184	402	756			407		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1264	1189	756	1184	1184	402	756			407		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	80	100	88	100			99		
cM capacity (veh/h)	127	186	408	165	187	648	855			1152		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	113	407	769
Volume Left	0	33	0	13
Volume Right	0	80	10	0
cSH	1700	349	1700	1152
Volume to Capacity	0.00	0.32	0.24	0.01
Queue Length 95th (ft)	0	34	0	1
Control Delay (s)	0.0	20.2	0.0	0.3
Lane LOS	A	C		A
Approach Delay (s)	0.0	20.2	0.0	0.3
Approach LOS	A	C		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Haystack Rd/Gas Station & Shelburne Falls Rd

05/13/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	314	0	6	199	50	1	2	16	39	1	17
Future Volume (Veh/h)	25	314	0	6	199	50	1	2	16	39	1	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	25	314	0	6	199	50	1	2	16	39	1	17
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					482							
pX, platoon unblocked	0.97						0.97	0.97		0.97	0.97	0.97
vC, conflicting volume	249			314			618	625	314	617	600	224
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	210			314			590	598	314	589	572	184
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			100			100	99	98	90	100	98
cM capacity (veh/h)	1320			1246			390	394	726	389	407	832

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	339	255	19	57
Volume Left	25	6	1	39
Volume Right	0	50	16	17
cSH	1320	1246	640	463
Volume to Capacity	0.02	0.00	0.03	0.12
Queue Length 95th (ft)	1	0	2	10
Control Delay (s)	0.7	0.2	10.8	13.9
Lane LOS	A	A	B	B
Approach Delay (s)	0.7	0.2	10.8	13.9
Approach LOS			B	B

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	45.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: VT-116 & Shelburne Falls Rd/CVU Rd

05/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	45	172	176	22	124	83	102	353	38	176	601	54
Future Volume (vph)	45	172	176	22	124	83	102	353	38	176	601	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.5	6.5		6.5	6.5	6.5	6.5		6.5	6.5	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	0.99		1.00	0.99	
Flt Protected		0.99	1.00		0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1844	1583		1849	1583	1770	1836		1770	1840	
Flt Permitted		0.89	1.00		0.90	1.00	0.24	1.00		0.44	1.00	
Satd. Flow (perm)		1657	1583		1681	1583	447	1836		818	1840	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	45	172	176	22	124	83	102	353	38	176	601	54
RTOR Reduction (vph)	0	0	99	0	0	58	0	3	0	0	3	0
Lane Group Flow (vph)	0	217	77	0	146	25	102	388	0	176	652	0
Turn Type	Perm	NA	pm+ov	Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4	5		8	1	5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		16.2	23.9		16.2	25.2	48.0	40.3		50.6	41.6	
Effective Green, g (s)		16.2	23.9		16.2	25.2	48.0	40.3		50.6	41.6	
Actuated g/C Ratio		0.19	0.28		0.19	0.30	0.56	0.47		0.60	0.49	
Clearance Time (s)		6.5	6.5		6.5	6.5	6.5	6.5		6.5	6.5	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		315	566		320	590	372	870		587	900	
v/s Ratio Prot			0.01			0.00	0.02	0.21		c0.03	c0.35	
v/s Ratio Perm		c0.13	0.04		0.09	0.01	0.13			0.15		
v/c Ratio		0.69	0.14		0.46	0.04	0.27	0.45		0.30	0.72	
Uniform Delay, d1		32.1	22.8		30.5	21.3	10.5	14.9		8.1	17.2	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		6.2	0.1		1.0	0.0	0.4	1.7		0.3	5.1	
Delay (s)		38.2	22.9		31.5	21.3	10.9	16.6		8.4	22.2	
Level of Service		D	C		C	C	B	B		A	C	
Approach Delay (s)		31.4			27.8			15.4			19.3	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	21.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	19.5
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: VT-116 & Riggs Rd

05/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	23	33	0	80	0	413	10	13	747	41
Future Volume (Veh/h)	0	0	23	33	0	80	0	413	10	13	747	41
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	23	33	0	80	0	413	10	13	747	41
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1292	1216	768	1234	1232	418	788			423		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1292	1216	768	1234	1232	418	788			423		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	94	77	100	87	100			99		
cM capacity (veh/h)	121	179	402	143	175	635	831			1136		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	23	113	423	801
Volume Left	0	33	0	13
Volume Right	23	80	10	41
cSH	402	317	1700	1136
Volume to Capacity	0.06	0.36	0.25	0.01
Queue Length 95th (ft)	5	39	0	1
Control Delay (s)	14.5	22.5	0.0	0.3
Lane LOS	B	C		A
Approach Delay (s)	14.5	22.5	0.0	0.3
Approach LOS	B	C		

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	65.7%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Haystack Rd/Gas Station & Shelburne Falls Rd

05/15/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	25	314	14	31	199	50	8	2	41	39	1	17
Future Volume (Veh/h)	25	314	14	31	199	50	8	2	41	39	1	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	25	314	14	31	199	50	8	2	41	39	1	17
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					482							
pX, platoon unblocked	0.96						0.96	0.96		0.96	0.96	0.96
vC, conflicting volume	249			328			674	682	321	699	664	224
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	200			328			642	650	321	668	631	174
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			97			98	99	94	88	100	98
cM capacity (veh/h)	1320			1232			352	357	720	325	366	836

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	353	280	51	57
Volume Left	25	31	8	39
Volume Right	14	50	41	17
cSH	1320	1232	598	398
Volume to Capacity	0.02	0.03	0.09	0.14
Queue Length 95th (ft)	1	2	7	12
Control Delay (s)	0.7	1.1	11.6	15.5
Lane LOS	A	A	B	C
Approach Delay (s)	0.7	1.1	11.6	15.5
Approach LOS			B	C

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	39.3%	ICU Level of Service	A
Analysis Period (min)	15		

Queuing and Blocking Report
Baseline 05/15/2020

Intersection: 3: VT-116 & Shelburne Falls Rd/CVU Rd

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	L	TR	L	TR
Maximum Queue (ft)	182	184	184	145	199	383	225	608
Average Queue (ft)	109	71	81	39	64	172	118	323
95th Queue (ft)	167	140	144	102	152	306	257	580
Link Distance (ft)	420		1445			1522		1282
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)		220		120	175		200	
Storage Blk Time (%)			3	0		9	0	22
Queuing Penalty (veh)			3	0		9	0	39

Intersection: 6: VT-116 & Riggs Rd

Movement	EB	WB	SB
Directions Served	R	LTR	LTR
Maximum Queue (ft)	50	114	76
Average Queue (ft)	16	47	10
95th Queue (ft)	42	77	45
Link Distance (ft)	759	834	1522
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 9: Haystack Rd/Gas Station & Shelburne Falls Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	74	134	98	74
Average Queue (ft)	8	14	28	34
95th Queue (ft)	39	60	62	54
Link Distance (ft)	1123	420	728	344
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 52

Queuing and Blocking Report
Baseline

05/15/2020

Intersection: 3: VT-116 & Shelburne Falls Rd/CVU Rd

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	L	TR	L	TR
Maximum Queue (ft)	289	160	510	145	200	715	224	342
Average Queue (ft)	135	40	192	108	114	359	64	129
95th Queue (ft)	244	122	388	179	241	649	137	252
Link Distance (ft)	420		1445			1522		1282
Upstream Blk Time (%)	0							
Queuing Penalty (veh)	0							
Storage Bay Dist (ft)		220		120	175		200	
Storage Blk Time (%)	2	0	24	2	0	29		3
Queuing Penalty (veh)	1	0	54	5	1	41		4

Intersection: 6: VT-116 & Riggs Rd

Movement	WB	NB	SB
Directions Served	LTR	TR	LTR
Maximum Queue (ft)	47	31	208
Average Queue (ft)	14	2	61
95th Queue (ft)	40	14	156
Link Distance (ft)	834	1552	1522
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 9: Haystack Rd/Gas Station & Shelburne Falls Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	52	42	22	70
Average Queue (ft)	3	4	2	31
95th Queue (ft)	23	23	13	57
Link Distance (ft)	1123	420	728	344
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 107

Queuing and Blocking Report
Baseline

05/15/2020

Intersection: 3: VT-116 & Shelburne Falls Rd/CVU Rd

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	L	TR	L	TR
Maximum Queue (ft)	429	245	566	145	200	889	168	239
Average Queue (ft)	232	89	265	124	128	467	60	116
95th Queue (ft)	433	252	533	180	247	877	120	212
Link Distance (ft)	420		1445			1522		1282
Upstream Blk Time (%)	7							
Queuing Penalty (veh)	24							
Storage Bay Dist (ft)		220		120	175		200	
Storage Blk Time (%)	22	0	40	2	0	37		2
Queuing Penalty (veh)	18	0	88	5	2	60		2

Intersection: 6: VT-116 & Riggs Rd

Movement	EB	WB	NB	SB
Directions Served	R	LTR	TR	LTR
Maximum Queue (ft)	31	42	20	213
Average Queue (ft)	10	12	1	54
95th Queue (ft)	34	38	10	140
Link Distance (ft)	759	834	1552	1522
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 9: Haystack Rd/Gas Station & Shelburne Falls Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	140	129	97	82
Average Queue (ft)	26	18	36	31
95th Queue (ft)	141	70	83	64
Link Distance (ft)	1123	420	728	344
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 199

Queuing and Blocking Report
Baseline

05/15/2020

Intersection: 3: VT-116 & Shelburne Falls Rd/CVU Rd

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	L	TR	L	TR
Maximum Queue (ft)	211	143	183	127	170	327	225	449
Average Queue (ft)	112	62	78	40	46	146	101	218
95th Queue (ft)	186	114	149	95	121	263	227	378
Link Distance (ft)	420		1445			1522		1282
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)		220		120	175		200	
Storage Blk Time (%)	0		4	0	0	6	0	10
Queuing Penalty (veh)	0		3	0	0	5	0	17

Intersection: 6: VT-116 & Riggs Rd

Movement	WB	SB
Directions Served	LTR	LTR
Maximum Queue (ft)	111	101
Average Queue (ft)	46	8
95th Queue (ft)	83	46
Link Distance (ft)	834	1522
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 9: Haystack Rd/Gas Station & Shelburne Falls Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	65	31	42	60
Average Queue (ft)	7	2	14	30
95th Queue (ft)	35	14	40	55
Link Distance (ft)	1123	420	728	344
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 26