

# REPORT

**TO:** Benjamin Avery, Black Rock Construction  
**FROM:** Mark Smith, P.E., Jonathan Slason, P.E.  
**DATE:** August 20, 2018 DRAFT  
**SUBJECT:** Haystack Crossing Traffic Impact Study – Preliminary Findings for Phase 1

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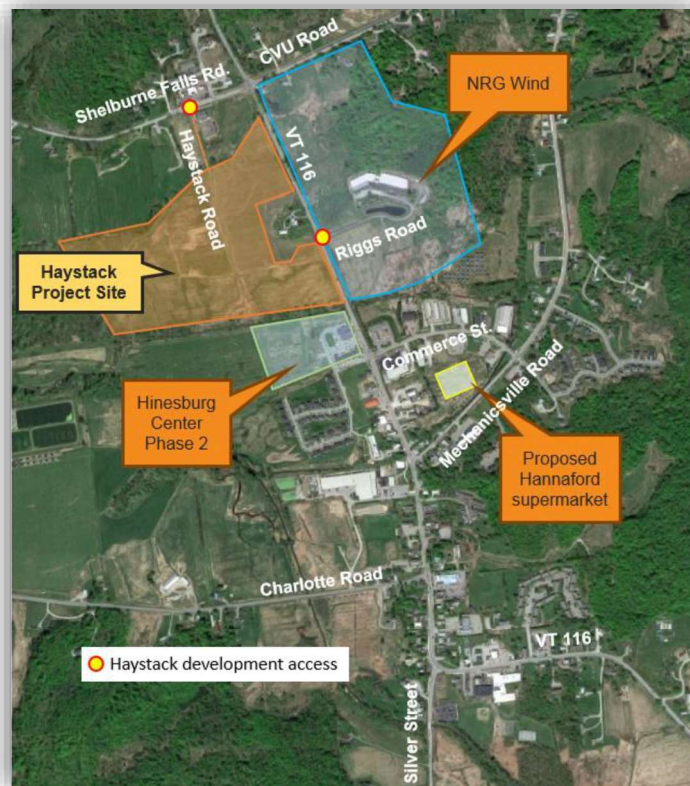
RSG has completed the following traffic analysis of the existing road network in Hinesburg surrounding the proposed Haystack development, along with an analysis of Phase 1 development traffic in the initial construction year (2021), both in the No-Build and Build condition.

## 1.0 GEOGRAPHIC SCOPE

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The location of the proposed project and several other planned but unbuilt developments in the area are shown below in Figure 1.

**FIGURE 1: PROJECT AREA AND OTHER NEARBY PLANNED DEVELOPMENTS**



## ACCESS ASSUMPTIONS

It is assumed that phase 1 of the development will have full access at Shelburne Falls Road via Haystack Road and a *right-in/right-out* access on VT116 at Riggs Road.

### 1.1 | PROJECT PARAMETERS AND TRAFFIC SCENARIOS

This report includes an analysis of existing traffic conditions in the project area, as well as Phase 1 of the Haystack development in its planned construction year (2021 No-build vs. Build). The 2021 scenarios include traffic from other planned but unbuilt developments in the area (including Hannaford, an initial phase of further development on the NRG site, and Hinesburg Center Phase 2), as indicated in Figure 1 above.

## 2.0 TRAFFIC VOLUMES

This study relies upon design standards and analysis procedures documented in the 2010 Highway Capacity Manual,<sup>1</sup> Trip Generation,<sup>2</sup> A Policy on Geometric Design of Highways and Streets,<sup>3</sup> Manual on Uniform Traffic Control Devices (MUTCD),<sup>4</sup> Traffic Impact Evaluation: Study and Review Guide,<sup>5</sup> and the Vermont State Design Standards,<sup>6</sup> which are the generally accepted traffic analysis references relied upon by traffic engineering professionals and VTrans for projects of this type in Vermont.

VTrans guidelines specify that a traffic study should be considered if the proposed development will generate 75 or more peak hour trips. The geographic scope of the study should also include the immediate access points and those intersections or highway segments receiving 75 or more project-generated peak hour trips.<sup>7</sup>

### 2.1 | TRAFFIC COUNTS

The study area includes seven intersections depicted in Figure 2, along with the source for each traffic count used in this study.

<sup>1</sup> Transportation Research Board, National Research Council, *Highway Capacity Manual* (Washington, DC: National Academy of Sciences, 2010).

<sup>2</sup> Institute of Transportation Engineers, *Trip Generation* 10<sup>th</sup> Edition (Washington, D.C.: Institute of Transportation Engineers, 2017).

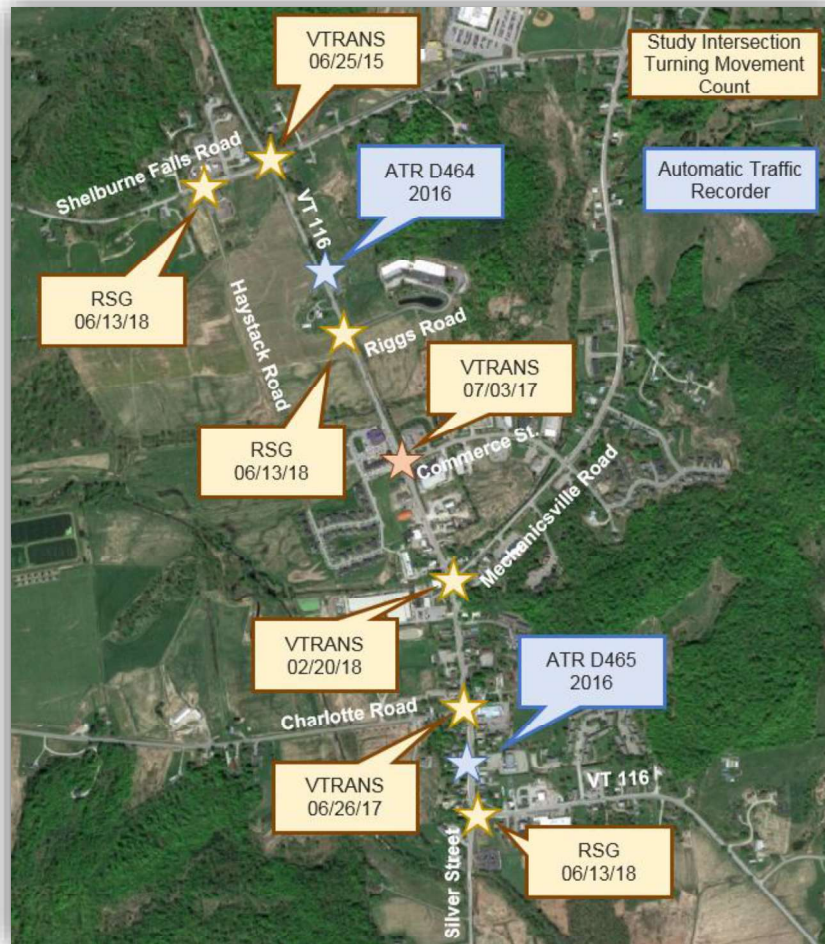
<sup>3</sup> American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets*, 6<sup>th</sup> Edition (Washington DC: AASHTO, 2011).

<sup>4</sup> American Traffic Safety Services Association (ATSSA), ITE, and AASHTO, *Manual on Uniform Traffic Control Devices*, 2009 Edition (Washington DC: FHWA, 2009).

<sup>5</sup> Vermont Agency of Transportation, Development Review Section, *Traffic Impact Evaluation Study and Review Guide* (October 2008).

<sup>6</sup> State of Vermont Agency of Transportation, *Vermont State Standards* (Montpelier: VTrans, 1 July 1997).

<sup>7</sup> Vermont Agency of Transportation, Development Review Section, *Traffic Impact Evaluation Study and Review Guide* (October 2008).

**FIGURE 2. STUDY INTERSECTIONS AND TRAFFIC COUNT INFORMATION**

## 2.2 | ADJUSTMENTS

### *Two Traffic Count Adjustments*

1. Design hour adjustment factors are based on VTrans ATR station D464 located between Riggs Road and Shelburne Falls/CVU Road. The 2016 DHV at this station was compared to the peak hour volumes of the turning movement count to formulate DHV adjustments. DHV adjustments change raw count volumes by +7%, and volumes were then balanced between adjacent intersections.
2. An annual adjustment factor, representing general background traffic growth, was assumed to be 1% at ATR station D464 by VTrans for the 2017 year. We continued to use this factor for the following year thus 2 years later (2018) the count would increase by 2%. The adjustment to 2021 follows VTrans long term growth projections for this type of facility, adding another 1%.

Figures 3 and 4 presents the existing (2018 adjusted) traffic volumes at the various study intersections for the AM and PM peak hours.

FIGURE 3. EXISTING TRAFFIC COUNTS AM PEAK HOUR

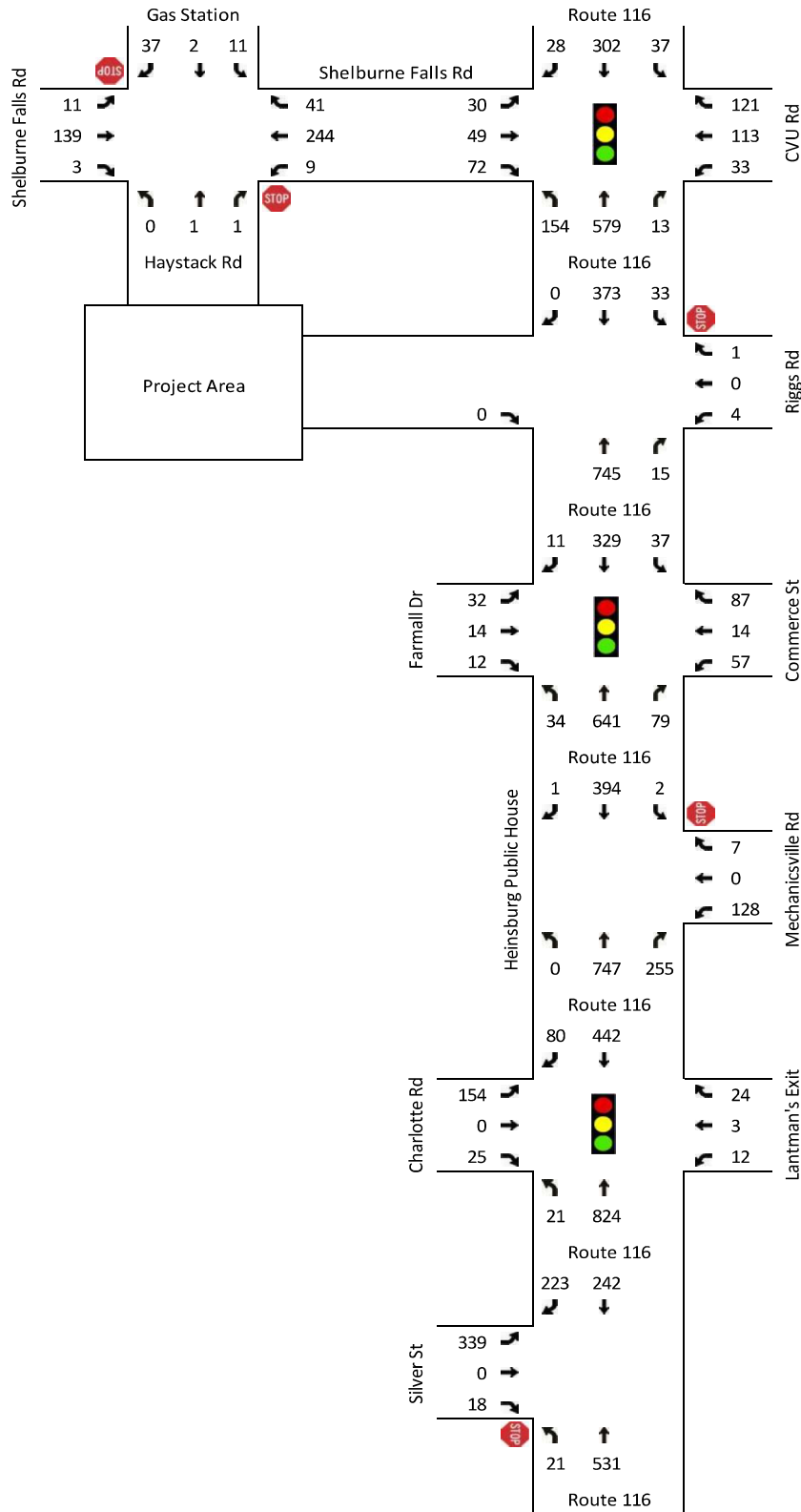
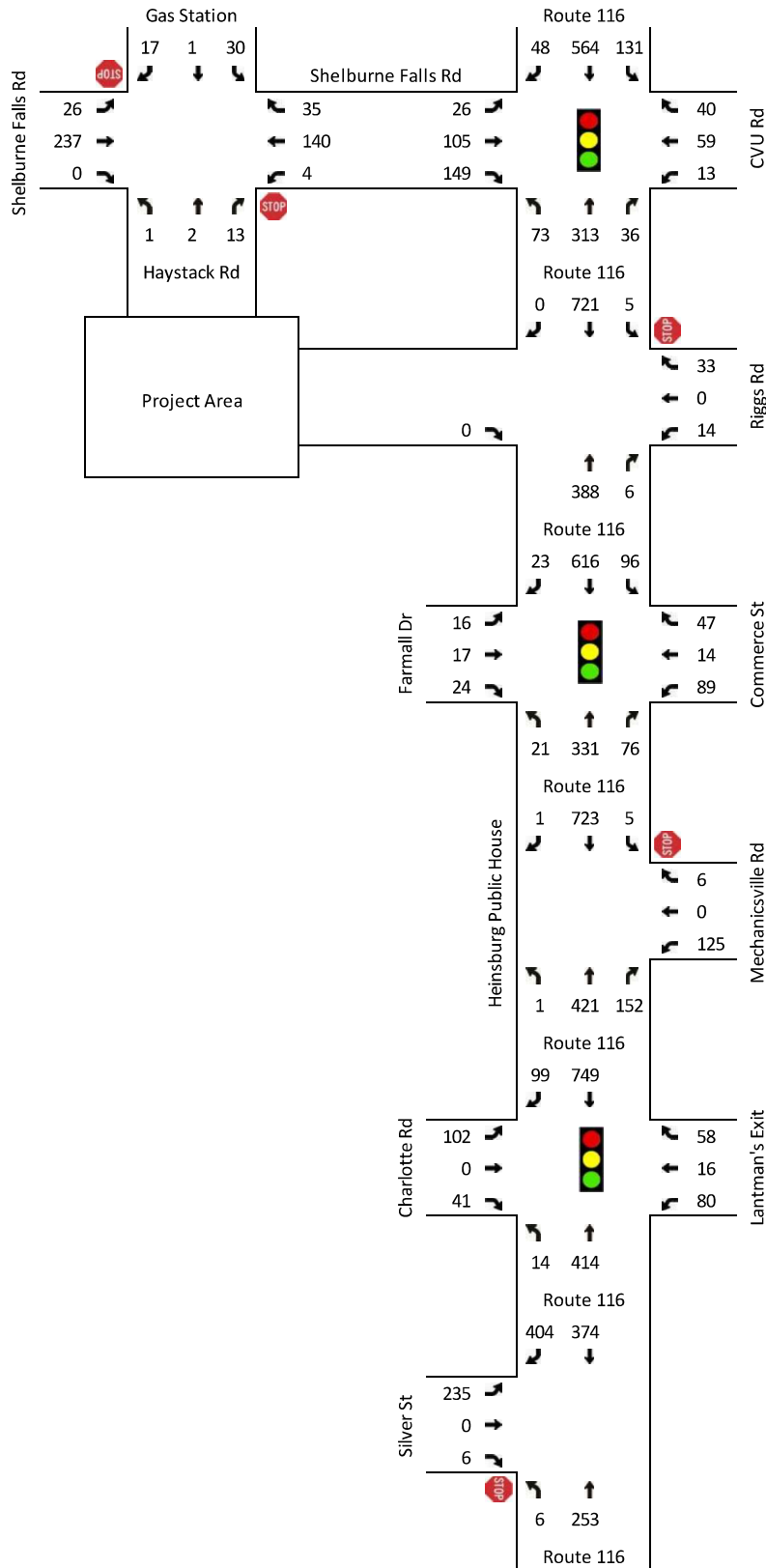


FIGURE 4. EXISTING TRAFFIC COUNTS PM PEAK HOUR



## 2.3 | FIELD OBSERVATIONS

Field observations were made on 13 June 2018, with local schools in session, at the same time as the RSG traffic counts, to ensure that modeling results were in line with the conditions observed, while also noting that the adjusted volumes are slightly higher than the observed counts (see previous section). Highlights of traffic observations include:

### AM Peak Observations

- Long queues northbound on VT116 from Charlotte Road, reaching Silver Street for the entire peak hour. Queues extended past the elementary school for much of the peak hour, briefly reaching Friendship Lane (1,500 ft south/east of Silver Street).
- Long queues northbound on the Silver Street approach to VT116, reaching one half mile or more, for the entire peak hour.
- Queued cars on VT116 were courteous to cars entering from Silver Street, allowing them to join the queue when possible.

### PM Peak Observations

- Long queues southbound on VT116 from Charlotte Road, past Commerce Street for much of the peak hour, sometimes reaching Riggs Road.
- Southbound left turns at the entrance to Lantman's Market, just south of Charlotte Road, often blocked southbound through traffic, further exacerbating queues at the signal.
- Queued cars on VT116 were courteous to cars entering from Mechanicsville Road., which kept delay and queues reasonable on Mechanicsville Road.

## 2.4 | TRIP GENERATION

Trip generation refers to the number of vehicle trips originating at or destined for a particular development. To estimate the number of vehicle trips generated by the subject project, and other planned developments in the area (see Figure 1), we examined trip generation rates for various land use types surveyed and published in the Institute of Transportation Engineer's *Trip Generation Manual*<sup>8</sup>.

### HAYSTACK PHASE 1

The land uses assumed for Haystack Phase 1 (and the corresponding ITE Land Use Code) include:

- 26 Single family units (LUC 210)
- 43 Apartment units (LUC 220)
- 29 Townhouses (LUC 220)
- 56 Senior housing units (LUC 252)
- 14,900 GSF<sup>9</sup> Commercial space (LUC varies - see below)
- 3,650 GSF Commercial space and 3,650 GSF Light industrial (LUC 110)

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<sup>8</sup> 10<sup>th</sup> Edition, 2017

<sup>9</sup> Gross Square Feet



We assume the Commercial space (14,900+3,650 =18,550 GSF) will be a mix of office/services (LUC 710), specialty retail (LUC 826), and restaurant (LUC 932), (50%, 30%, 20% respectively.)

Table 1 below presents the projected trip generation<sup>10</sup>. Primary trips (or new vehicle trips) are distinguished from passby trips, which are trips that are assumed already on the network but diverted to the new land use.

**TABLE 1. PEAK HOUR TRIP GENERATION - HAYSTACK PHASE 1**

ITE Code	ITE Land Use Name	Size	Weekday AM				Weekday PM			
			Primary		Passby		Primary		Passby	
			Enter	Exit	Enter	Exit	Enter	Exit	Enter	Exit
110	General Light Industrial	3,650 sq ft	2	0	0	0	0	2	0	0
210	Single-Family Detached Housing	26 units	5	14	0	0	16	10	0	0
220	Apartment	43 units	5	15	0	0	15	9	0	0
220	Apartment (townhouses)	29 units	3	10	0	0	10	6	0	0
252	Senior Adult Housing-Attached	56 Units	4	7	0	0	8	7	0	0
710	General Office Building	9,325 sq ft	9	2	0	0	2	9	0	0
814	Variety Store	5,595 sq ft	10	8	0	0	20	18	0	0
932	High-Turnover (Sit-Down) Restaurant	3,730 sq ft	20	17	0	0	13	8	10	6
	residential		16	47	0	0	50	31	0	0
	commercial		42	26	0	0	35	37	10	6
	Sub-totals		58	73	0	0	84	68	10	6
	Totals		132				168			

Maps of the distribution of project generated traffic volumes on the network are included in Appendix A.

## 2.5 | 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 we assume they are already present on the road network in the analysis years.

### HANNAFORD

Hannaford supermarkets has proposed a 36,000 s.f. retail supermarket with access on Commerce Street (Figure 1). The original TIS for this development was published in 2013 and has since been updated (June 19, 2018). The actual size of the market was reduced from 36,783 s.f., however, the trip generation was not changed. The 2021 analysis presented in this report assumes Hannaford is open and operational, as expected by the TIS. Trip generation, as estimated by the Hannaford TIS, is presented in Table 2.

<sup>10</sup> No adjustments were made for internal capture or potential TDM measures, which could reduce trips as much as 30%

**TABLE 2. PEAK HOUR TRIP GENERATION - HANNAFORD SUPERMARKET**

ITE Code	ITE Land Use Name	Size	Weekday AM				Weekday PM			
			Primary		Passby		Primary		Passby	
			Enter	Exit	Enter	Exit	Enter	Exit	Enter	Exit
850	Supermarket	36,000 sq ft	51	33	30	18	126	121	71	68
Totals			132				386			

**NRG WIND ENERGY ASSOCIATES**

Several scenarios have been supposed for further development of this parcel, including new office space, light industrial space and housing. No formal applications have been submitted, however. For the purposes of this analysis we have assumed the latest information provided by the Town Planning staff, which supposes a new light industrial or office complex (ITE Land Use Code 715 – Single Tenant Office) with 150 employees. Note that trip generation for light industrial and office are very similar when estimated by employee. Expected trip generation from this development is presented in Table 3.

**TABLE 3. PEAK HOUR TRIP GENERATION - NRG WIND ASSOCIATES**

ITE Code	ITE Land Use Name	Size	Weekday AM				Weekday PM			
			Primary		Passby		Primary		Passby	
			Enter	Exit	Enter	Exit	Enter	Exit	Enter	Exit
715	Single Tenant Office Building	150 employees	71	9	0	0	11	65	0	0
Totals			80				77			

**HINESBURG CENTER PHASE 2**

The development plan includes 69 residential dwelling units as follows: 13 single family detached, 16 single family attached, one six-unit building, one mixed use building with 28 dwelling units, and two other mixed-use buildings each with three units (six total).

The non-residential part of the project includes the three mixed-use buildings for a total of 11,000 square feet of commercial space, as well as a stand-alone 2,400 square foot building intended for light industrial or commercial use.

Table 4 presents this expected ODV trip generation.

**TABLE 4. TRIP GENERATION - HINESBURG CENTER PHASE 2**

ITE Code	ITE Land Use Name	Size	Weekday AM				Weekday PM			
			Primary		Passby		Primary		Passby	
			Enter	Exit	Enter	Exit	Enter	Exit	Enter	Exit
110	General Light Industrial	2,400 sq ft	1	0	0	0	0	1	0	0
210	Single-Family Detached Housing	29 units	5	16	0	0	18	11	0	0
220	Apartment	6 units	1	2	0	0	2	1	0	0
220	Apartment (townhouses)	34 units	4	12	0	0	12	7	0	0
710	General Office Building	8,000 sq ft	8	1	0	0	1	8	0	0
820	Shopping Center	3,000 sq ft	2	1	0	0	4	4	2	2
residential			10	30	0	0	32	19	0	0
commercial			11	3	0	0	5	13	2	2
Sub-totals			21	33	0	0	37	32	2	2
Totals			54				73			





Maps of the distribution of Traffic volumes on the network from the ODV's are included in Appendix A.

## 3.0 CONGESTION ANALYSIS

### 3.1 | LEVEL-OF-SERVICE DEFINITION

Level-of-service (LOS) is a qualitative measure describing the operating conditions as perceived by motorists driving in a traffic stream. LOS is calculated using the procedures outlined in the 2000 and 2010 Highway Capacity Manuals.<sup>11</sup> In addition to traffic volumes, key inputs include the number of lanes at each intersection, traffic control type (signalized or unsignalized), and the traffic signal timing plans.

The 2010 Highway Capacity Manual defines six qualitative grades to describe the level of service at an intersection. Level-of-Service is based on the average control delay per vehicle. Table 5 shows the various LOS grades and descriptions for signalized and unsignalized intersections.

**TABLE 5. LEVEL-OF-SERVICE CRITERIA FOR SIGNALIZED AND UNSIGNALIZED INTERSECTIONS**

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

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

The VTrans policy on level of service 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.








<sup>11</sup> The HCM 2010 does not provide methodologies for calculating intersection delays at certain intersection types including signalized intersections with exclusive pedestrian phases and signalized intersections with non NEMA-standard phasing. Because of these limitations, HCM 2000 methodologies are employed where necessary.

- 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.

### EXISTING CONDITIONS

A Synchro / Simtraffic<sup>12</sup> model was built using the 2018 adjusted intersection volumes, with performance results shown in Table 6. These results assume existing traffic signal timings, as provided by VTrans<sup>13</sup>. Delay is reported in seconds per vehicle, queues are in feet. Note that yellow highlight indicates where queues exceed the link length (distance between intersections<sup>14</sup>). Red boxes indicate queues are attributed (fully or partially) to the spillover from the upstream intersection. Blue highlighting indicates where the Level of Service exceeds VTrans guidelines.

**TABLE 6. CONGESTION ANALYSIS RESULTS FOR EXISTING CONDITIONS (2018)**

Intersections	Link Length	AM Peak Hour			PM Peak Hour			
		LOS	Delay (sec)	95th% Queue	LOS	Delay (sec)	95th% Queue	
 <b>1: Haystack Rd/Gas Station &amp; Shelburne Falls Rd</b>	EB, along Shelburne Falls Rd	620+	B	13	156	A	1	25
	WB, along Shelburne Falls Rd	510	A	2	11	A	1	10
	NB, along Haystack Rd	~	A	3	14	A	4	34
	SB, Gas Station	~	C	20	101	A	5	51
	Overall		D	36		C	28	
 <b>2: VT 116 &amp; Shelburne Falls Rd/CVU Rd</b>	EB, along Shelburne Falls Rd	510	D	47	236	D	37	273
	WB, along CVU Rd	1200	D	54	473	D	37	139
	NB, along VT 116	1480	C	31	566	C	27	378
	SB, along VT 116	900+	C	27	389	C	24	488
	Overall		D	36		C	28	
 <b>3: VT 116 &amp; Haystack Development/Riggs Rd</b>	EB, along Haystack Rd	~	n/a			n/a		
	WB, along Riggs Rd	~	B	15	22	A	8	53
	NB, along VT 116	1084	A	3	4	A	2	0
	SB, along VT 116	1479	D	30	568	A	4	43
	Overall		C	27		B	20	
 <b>4: VT 116 &amp; Farmall Dr/Commerce St</b>	EB, along Famall Dr	275	E	67	127	D	35	75
	WB, along Commerce St	580+	E	63	277	D	47	184
	NB, along VT 116	951	B	12	339	B	11	217
	SB, along VT 116	1084	C	34	505	B	18	511
	Overall		C	27		B	20	
 <b>5: VT 116 &amp; Mechanicsville Rd</b>	WB, along Mechanicsville Rd	865+	F	172	539	F	85	298
	NB, along VT 116	987	A	8	6	A	4	5
	SB, along VT 116	951	D	26	426	D	31	747
	Overall		C	33		E	80	
 <b>6: VT 116 &amp; Charlotte Rd/Lantmans Exit</b>	EB, along Charlotte Rd	1300+	F	97	177	F	>100	230
	WB, exiting Lantmans	300+	F	>100	222	F	>100	437
	NB, along VT 116	728	E	76	932	D	39	573
	SB, along VT 116	1043	D	39	631	F	95	1299
	Overall		C	33		E	80	
 <b>8: VT 116 &amp; Silver St</b>	EB, along Silver St	2800+	F	373	2289	C	19	164
	NB, along VT 116	805+	E	37	625	A	3	92
	SB, along VT 116	672	A	2	12	A	2	18
	Overall		D	36		C	28	

<sup>12</sup> Synchro V9. Simtraffic microsimulation results are recommended (vs. Highway Capacity Manual model results) in congested corridors such as VT116 in Hinesburg because they better reflect the interaction of queues between intersection or spillover from adjacent lanes.

<sup>13</sup> Received 2/15/2018

<sup>14</sup> some links are actually longer as indicated with “+”


## 2021 NO-BUILD AND BUILD SCENARIO

RSG developed traffic volumes for the project area in the 2021 year, the planned construction completion date for Haystack Phase 1, which include development traffic from other planned developments (ODVs, see Section 2.4).

ODVs are included in every scenario (both No-Build and Build) because we assume they are already present on the road network in the analysis years. We also assume improvements to the network and to traffic timing plans that are proposed by Hannaford to reduce the queue lengths and improve system operations:

1. Phasing change at VT116/Charlotte Road (concurrent east/westbound movements).
2. At VT116/Commerce Street - extend the southbound left turn lane and westbound right turn lane.
3. Take signals (Commerce Street & Charlotte Road) off coordination and optimize the timings for each.

For the Build scenario, RSG added expected traffic from Haystack Phase 1 development to the No-build scenario volumes. The performance results for 2021 No-build and Build scenarios, along with existing conditions for comparison, are presented in Table 7 (AM peak hour) and Table 8 (PM peak hour) below.








Again, note that **yellow** highlight indicates where queues exceed the link length (distance between intersections<sup>15</sup>). Red boxes  indicate queues attributed to (fully or partially) the spillover from the upstream intersection. Delay is reported in seconds per vehicle, queues are in feet. **Blue** highlighting indicates where the Level of Service exceeds VTrans guidelines, assuming LOS D is acceptable.

Detailed Level of Service and queuing worksheets from Simtraffic are provided in Appendix B.

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<sup>15</sup> As modeled for practicality. Some links are longer and are thus noted with “+”

**TABLE 7. 2021 AM PEAK HOUR NO-BUILD AND BUILD CONGESTION ANALYSIS RESULTS**

Intersections	Link Length	Existing Conditions			2021 No Build			2021 Build			
		LOS	Delay (sec)	95th% Queue	LOS	Delay (sec)	95th% Queue	LOS	Delay (sec)	95th% Queue	
 <b>1: Haystack Rd/Gas Station &amp; Shelburne Falls Rd</b>	EB, along Shelburne Falls Rd	620+	A	1	22	A	0	18	A	1	22
	WB, along Shelburne Falls Rd	510	A	2	10	A	2	9	A	2	34
	NB, along Haystack Rd	~	A	3	15	A	4	15	A	5	51
	SB, Gas Station	~	A	4	53	A	4	51	A	5	50
	Overall										
 <b>2: VT 116 &amp; Shelburne Falls Rd/CVU Rd</b>	Overall		C	27		C	32		D	44	
	EB, along Shelburne Falls Rd	510	C	32	164	C	31	163	E	64	300
	WB, along CVU Rd	1200	C	34	241	D	35	251	D	42	298
	NB, along VT 116	1480	C	31	568	D	41	732	E	56	940
	SB, along VT 116	900+	B	12	195	B	15	239	B	16	248
 <b>3: VT 116 &amp; Haystack Development/Riggs Rd</b>	EB, along Haystack Rd	~	n/a			n/a			A	5	45
	WB, along Riggs Rd	~	B	12	23	C	22	39	C	19	37
	NB, along VT 116	1084	A	3	4	A	4	14	A	4	76
	SB, along VT 116	1479	A	4	95	A	7	182	A	7	168
	Overall										
 <b>4: VT 116 &amp; Farmall Dr/Commerce St</b>	Overall		B	15		B	17		B	18	
	EB, along Famall Dr	275	D	43	92	D	38	112	D	46	119
	WB, along Commerce St	580+	C	32	132	C	28	119	C	35	142
	NB, along VT 116	951	B	12	344	B	15	403	B	14	394
	SB, along VT 116	1084	A	9	180	B	11	180	A	10	190
 <b>5: VT 116 &amp; Mechanicsville Rd</b>	WB, along Mechanicsville Rd	865+	F	124	409	F	173	420	F	119	366
	NB, along VT 116	987	A	8	6	A	7	3	A	7	5
	SB, along VT 116	951	A	3	85	A	3	80	A	3	79
	Overall										
 <b>6: VT 116 &amp; Charlotte Rd/Lantmans Exit</b>	Overall		B	18		B	16		B	18	
	EB, along Charlotte Rd	1300+	D	45	173	E	59	183	D	45	181
	WB, exiting Lantmans	300+	D	54	79	D	43	78	D	55	81
	NB, along VT 116	728	E	68	917	D	43	828	E	60	876
	SB, along VT 116	1043	B	19	385	B	14	321	B	20	408
 <b>8: VT 116 &amp; Silver St</b>	EB, along Silver St	2800+	F	307	2005	F	472	2609	F	908	3462
	NB, along VT 116	805+	C	23	514	A	9	316	B	12	399
	SB, along VT 116	672	A	2	13	A	2	2	A	2	2
	Overall										

AM Peak Hour Comments:

- 2021 Scenarios include mitigation proposed by Hannaford at Commerce St. and Charlotte Rd.
- No displacement of left turns from Mechanicville Road to Commerce St. was assumed, however poor conditions could result in experienced drivers changing behavior, using Commerce St. to head south on VT 116.

**TABLE 8. 2021 PM PEAK HOUR NO-BUILD AND BUILD CONGESTION ANALYSIS RESULT**


Intersections	Link Length	Existing Conditions			2021 No Build			2021 Build			
		LOS	Delay (sec)	95th% Queue	LOS	Delay (sec)	95th% Queue	LOS	Delay (sec)	95th% Queue	
<b>1: Haystack Rd/Gas Station &amp; Shelburne Falls Rd</b>	EB, along Shelburne Falls Rd	620+	A	1	25	A	1	27	A	3	95
	WB, along Shelburne Falls Rd	510	A	1	10	A	1	10	A	2	41
	NB, along Haystack Rd	~	A	4	34	A	4	36	A	7	53
	SB, Gas Station	~	A	5	51	A	5	53	A	8	56
	Overall		C	28		D	49		F	92	
<b>2: VT 116 &amp; Shelburne Falls Rd/CVU Rd</b>	EB, along Shelburne Falls Rd	510	D	37	273	D	39	297	E	63	432
	WB, along CVU Rd	1200	D	37	139	D	41	154	D	38	145
	NB, along VT 116	1480	C	27	378	D	53	638	F	>100	1365
	SB, along VT 116	900+	C	24	488	D	51	895	E	75	1095
	Overall		C	28		D	49		F	92	
<b>3: VT 116 &amp; Haystack Development/Riggs Rd</b>	EB, along Haystack Rd	~	n/a			n/a			D	27	55
	WB, along Riggs Rd	~	A	8	53	C	20	130	E	39	177
	NB, along VT 116	1084	A	2	0	A	3	185	A	4	74
	SB, along VT 116	1479	A	4	43	A	6	0	C	16	553
	Overall		B	20		D	53		D	53	
<b>4: VT 116 &amp; Farnall Dr/Commerce St</b>	EB, along Farnall Dr	275	D	35	75	C	34	94	D	39	111
	WB, along Commerce St	580+	D	47	184	F	>100	712	F	>100	683
	NB, along VT 116	951	B	11	217	B	13	267	B	14	277
	SB, along VT 116	1084	B	18	511	C	34	786	D	39	844
	Overall		B	20		D	53		D	53	
<b>5: VT 116 &amp; Mechanicsville Rd</b>	WB, along Mechanicsville Rd	865+	F	85	298	F	115	311	F	144	417
	NB, along VT 116	987	A	4	5	A	4	6	A	4	3
	SB, along VT 116	951	D	31	747	F	58	1116	F	55	1064
	Overall		E	80		F	91		F	97	
<b>6: VT 116 &amp; Charlotte Rd/Lantmans Exit</b>	EB, along Charlotte Rd	1300+	F	>100	230	F	>100	639	F	>100	718
	WB, exiting Lantmans	300+	F	>100	437	F	>100	525	F	>100	556
	NB, along VT 116	730	D	39	573	D	50	751	D	40	678
	SB, along VT 116	1043	F	95	1299	F	91	1357	F	91	1344
	Overall		E	80		F	91		F	97	
<b>8: VT 116 &amp; Silver St</b>	EB, along Silver St	2800+	C	19	164	E	40	356	D	33	306
	NB, along VT 116	805+	A	3	92	A	10	240	A	9	211
	SB, along VT 116	820	A	2	18	A	2	9	A	2	12
	Overall		C	19		E	40		D	33	

PM Peak Hour Comments:

- 2021 Scenarios include mitigation proposed by Hannaford at Commerce St and Charlotte Rd.
- No displacement of left turns from Mechanicville Road to Commerce St. was assumed, however poor conditions could result in experienced drivers changing behavior, using Commerce St. to head south on VT 116.

Congestion at VT116 / Shelburne Falls / CVU Road would be mitigated by improvements planned by VTrans at that location, as shown in Table 9. Detailed Level of Service and queuing worksheets for this scenario are provided in Appendix C.

**TABLE 9. EFFECT OF PLANNED VTRANS IMPROVEMENTS AT SHELburnE FALLS RD / CVU RD**

	AM Peak Hour						PM Peak Hour					
	2021 No Build			2021 Build			2021 No Build			2021 Build		
	LOS	Delay (sec)	95th% Queue	LOS	Delay (sec)	95th% Queue	LOS	Delay (sec)	95th% Queue	LOS	Delay (sec)	95th% Queue
 <b>2: VT 116 &amp; Shelburne Falls Rd/CVU Rd</b>												
Overall	B	13		B	15		B	19		C	28	
EB, along Shelburne Falls Rd	B	13	79	B	16	99	C	28	159	C	31	196
WB, along CVU Rd	B	16	119	B	16	132	C	30	104	C	31	104
NB, along VT 116	B	13	231	B	14	245	B	13	225	B	14	227
SB, along VT 116	B	13	179	B	14	190	B	17	479	C	35	761

## 4.0 SAFETY

### SIGHT DISTANCE ANALYSIS

As defined in the 2011 publication *A Policy on Geometric Design of Highways and Streets*, from the American Association of State Highway and Transportation Officials (AASHTO), sight distance is the “the length of roadway ahead that is visible to the driver.”<sup>16</sup> Sight distances of sufficient length are necessary at all points along a roadway to ensure vehicles can safely stop or avoid colliding with potential obstructions or other vehicles on the roadway.

Standard practice in assessing intersection safety and operations involves measuring two separate sight distances – **stopping sight distance** and **intersection sight distance**.

**Stopping sight distance** is the visible distance along a roadway between an advancing motorist and a potential obstacle in the roadway. It is measured from a point representing the approaching driver’s eye and a point representing an obstacle in the roadway.<sup>17</sup> Stopping sight distances of adequate length are needed along all roadways, both at and away from intersections, so that drivers travelling at design speeds can react to potential obstacles and safely brake to avoid collisions. Design minimum stopping sight distances are calculated based on factors such as design speed, response times, and grades as reported in the *2011 Policy on Geometric Design of Highways and Streets*.<sup>18</sup>

Based on the posted speed limits of 40 MPH on VT116 at Riggs Road, the design minimum stopping sight distance for VT116 traffic at the site driveway is 305 feet.

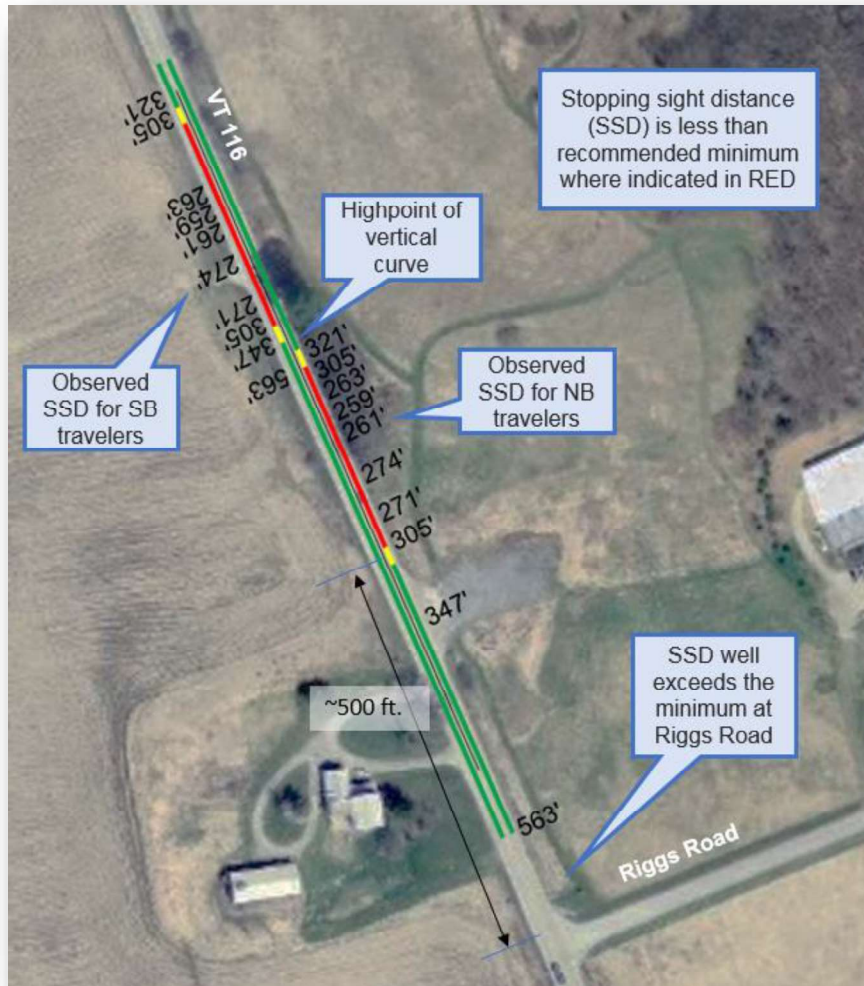
Sight distances were observed in the field in June of 2018 and are summarized in Figure 7.

<sup>16</sup> American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, Fifth Edition (Washington D.C.: American Association of State Highway and Transportation Officials, 2011). Page 3-2.

<sup>17</sup> As noted in the 2011 *Policy on Geometric Design of Highways and Streets* (page 3-14 to 3-15), the height of the driver’s eye is assumed to be 3.5’ above the road surface and the height of a potential obstacle is 2.0’ above the road surface.

<sup>18</sup> American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, Fifth Edition (Washington D.C.: American Association of State Highway and Transportation Officials, 2011). Page 3-5.

FIGURE 5. OBSERVED STOPPING SIGHT DISTANCES ON VT116



The recommended minimum SSD at 35 mph is 250 feet. This value is exceeded throughout the vertical curve by 9 feet northbound, at its most restricted spot, and 11 feet southbound.

**Intersection sight distance** is the distance available along the major road travelled way corresponding with the maximum visibility between an advancing motorist on the major road and an entering motorist on an intersecting minor road. It is measured between a point representing the advancing driver's eye above the major road and the entering driver's eye above the intersecting road.<sup>19</sup>

<sup>19</sup> As noted in the 2011 Policy on Geometric Design of Highways and Streets (page 3-14 to 3-15), the height of the driver's eye of the approaching vehicle is assumed to be 3.5' above the road surface of the major road and the height of the driver's eye of the entering vehicle is assumed to be 3.5' above the minor road surface and 14.5' back from the edge of the major road travelled way.

The 2011 Policy on Geometric Design of Highways and Streets states that the available intersection sight distance should be at least equal to the required stopping sight distance along the major road, which in this case is 305 feet along VT116.

*“Sight distance is also provided at intersections to allow the drivers of stopped vehicles a sufficient view of the intersecting highway to decide when to enter the intersecting highway or to cross it. If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions.”*

However, when possible it is desirable to have intersection sight distances that exceed the design minimum stopping sight distances in order to offer improved operations, such that major road traffic need not decelerate to accommodate entering traffic.

*“However, in some cases a major-road vehicle may need to stop or slow to accommodate the maneuver by a minor road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road.”*

Desirable target intersection sight distances are based on design speeds.<sup>20</sup> On VT116 the target intersection sight distance is 445 feet.

In the field, available intersection sight distance was observed to exceed 600 feet in either direction thus exceeds the design standard and the desired targets prescribed by AASHTO.

## CRASH ANALYSIS

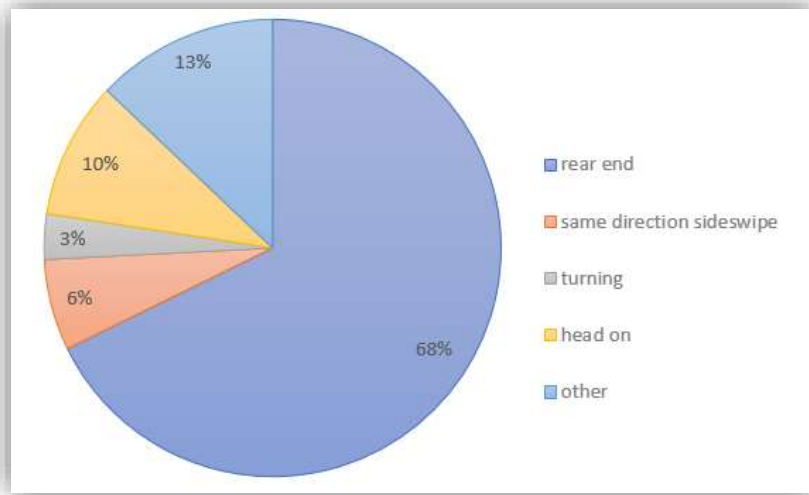
RSG reviewed the latest crash data (2012-2017) on the existing road network adjacent to the development. Of particular interest is the designated High Crash Location (HCL) road segment that leads from just north of Mechanicville Road (near the fire station) through Commerce Street, to just north of (and including) Riggs Road. Crashes associated with this HCL have been sorted by direction type (Figure 8) and year (Figure 9).

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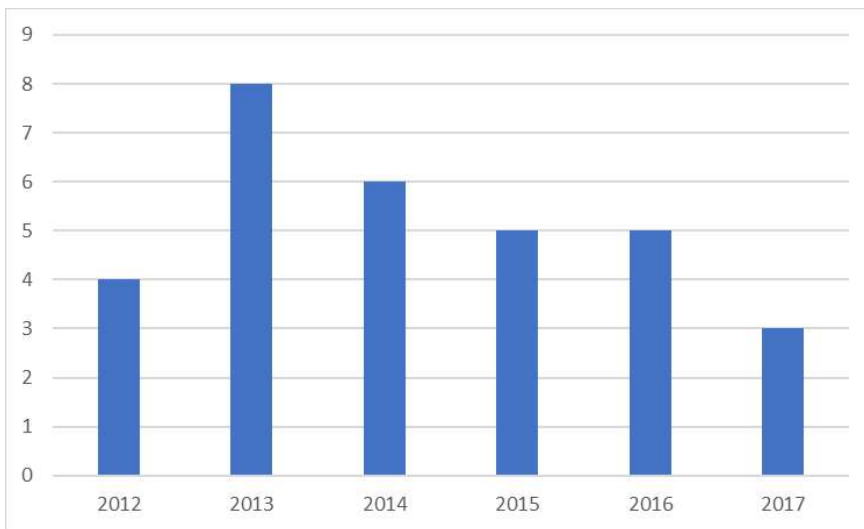
<sup>20</sup> As noted in the 2011 Policy on Geometric Design of Highways and Streets (page 9-38) grade is not factored into target intersection sight distances because “both the major- and minor-road vehicle will be on the same grade when departing from the intersection.”



**FIGURE 6. HCL COLLISIONS BY DIRECTION (2012-2017)**



**FIGURE 7. HCL CRASHES BY YEAR**



Furthermore:

- Only 4 crashes (of 31 in the HCL) occurred during rain or freezing rain events.
- The high proportion of rear end crashes in the HCL suggests that congestion plays a significant factor in these crashes.
- There was one crash on Shelburne Falls Road within stopping sight distance of Haystack Road.
- There were 15 crashes within stopping sight distance of Riggs Road, 5 resulting in injury. (Note: not all of these crashes are considered part of the HCL).
- The intersection of Shelburne Falls Rd./CVU Rd./VT116 has also been determined to be an HCL intersection. Proposed improvements at that location are expected to improve safety.

## 5.0 FINDINGS AND CONCLUSIONS

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### 5.1 | EXISTING CONDITION

Observed and modeled conditions were generally in agreement, and show:

- In the morning peak: long queues northbound on VT116 approaching Charlotte Road, as well as on the Silver Street approach to VT116. Delays are substandard (LOS F) for the Silver Street approach.
- In the afternoon peak: results show long queues southbound, extending north past Mechanicsville road and even Commerce St.

### 5.2 | CHANGE IN 2021 NO-BUILD

Changes from existing conditions to the 2021 project No-build condition include additional traffic expected from three significant developments: expansion of an existing multi-use project - Hinesburg Center *Phase 2*, a new Hannaford supermarket, and a new light industrial/office complex at the NRG site. Despite improvements proposed by Hannaford, traffic is expected to deteriorate at several key locations:

In the AM peak hour:

1. Delay at the Riggs Rd. approach to VT116 increases due to further development of the NRG parcel.
2. Average delay increases significantly at both the Mechanicsville Rd. and Silver St. approaches to VT116.

In the PM peak hour:

1. At Shelburne Falls Rd./CVU Rd./VT116 the overall LOS drops from C to D.
2. Westbound delay at Commerce St./VT116 increases significantly.
3. At Charlotte Rd./VT116 overall LOS drops from E to F.
4. Average delay increases significantly at the Mechanicsville Rd. approach to VT116.

### 5.3 | CHANGE IN 2021 DUE TO HAYSTACK DEVELOPMENT

In the AM peak hour:

1. No significant delay is expected at either project access point.
2. At Shelburne Falls Rd./CVU Rd./VT116 - LOS, delay and queues increase modestly in the AM peak. These conditions would be mitigated by the proposed VTrans project.
3. Conditions at Farmall/Commerce, Mechanicsville and Charlotte Rd remain poor with little change due to the project.

In the PM peak hour:

1. No significant delay is expected at either project access point.
2. At Shelburne Falls Rd./ CVU Rd./VT116, LOS and delay and queues increase significantly. These conditions would be mitigated by the VTrans project.
3. Conditions at Farmall/Commerce, Mechanicsville and Charlotte Rd remain poor with little change due to the project.

Overall effects due to the development are modest, and do not include the positive effects of internal capture (trips made between uses within the development) or potential measures that increase the use of biking, walking, transit use, etc.

## **5.4 | SAFETY**

### **CRASH HISTORY**

No significant crash history was found at the Shelburne Falls Road access point, however the access point on VT116 opposite Riggs Road is within a High Crash Location segment, and a significant number of crashes, as well as crashes with injuries, occurred at or near this access location.

### **SIGHT DISTANCE**

Stopping sight distance (SSD) and corner sight distance (CSD) meet the required minimums at both proposed development access points. Stopping sight distance diminished to the north of Riggs Road however, causing concern that if vehicles are stopped in a queue on VT116, they may be at risk. Reducing the speed limit to 35 mph relieves this concern.

END OF MEMO



## APPENDICES

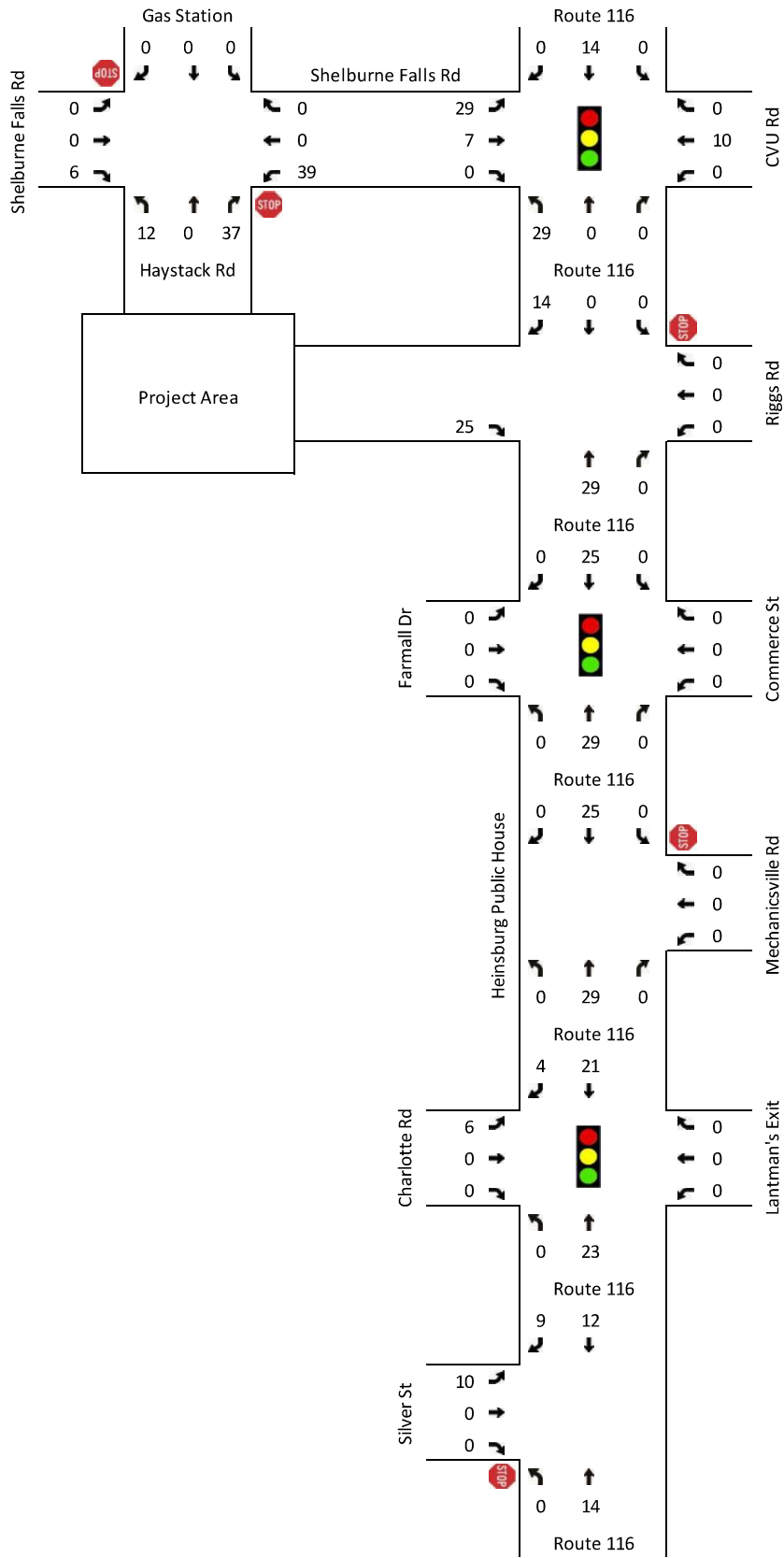
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- A- Trip Distribution Network Maps
  - a. Project development
  - b. Other Developments
- B- Level of Service and Queuing Worksheets
  - a. Existing Condition – AM Peak
  - b. Existing Condition – PM Peak
  - c. 2021 No-Build – AM Peak
  - d. 2021 No-Build – PM Peak
  - e. 2021 Build – AM Peak
  - f. 2021 Build – PM Peak
- C- Result Worksheets with VTrans improvements at VT116/Shelburne Falls/CVU Road
  - a. 2021 No-Build – AM Peak
  - b. 2021 No-Build – PM Peak
  - c. 2021 Build – AM Peak
  - d. 2021 Build – PM Peak

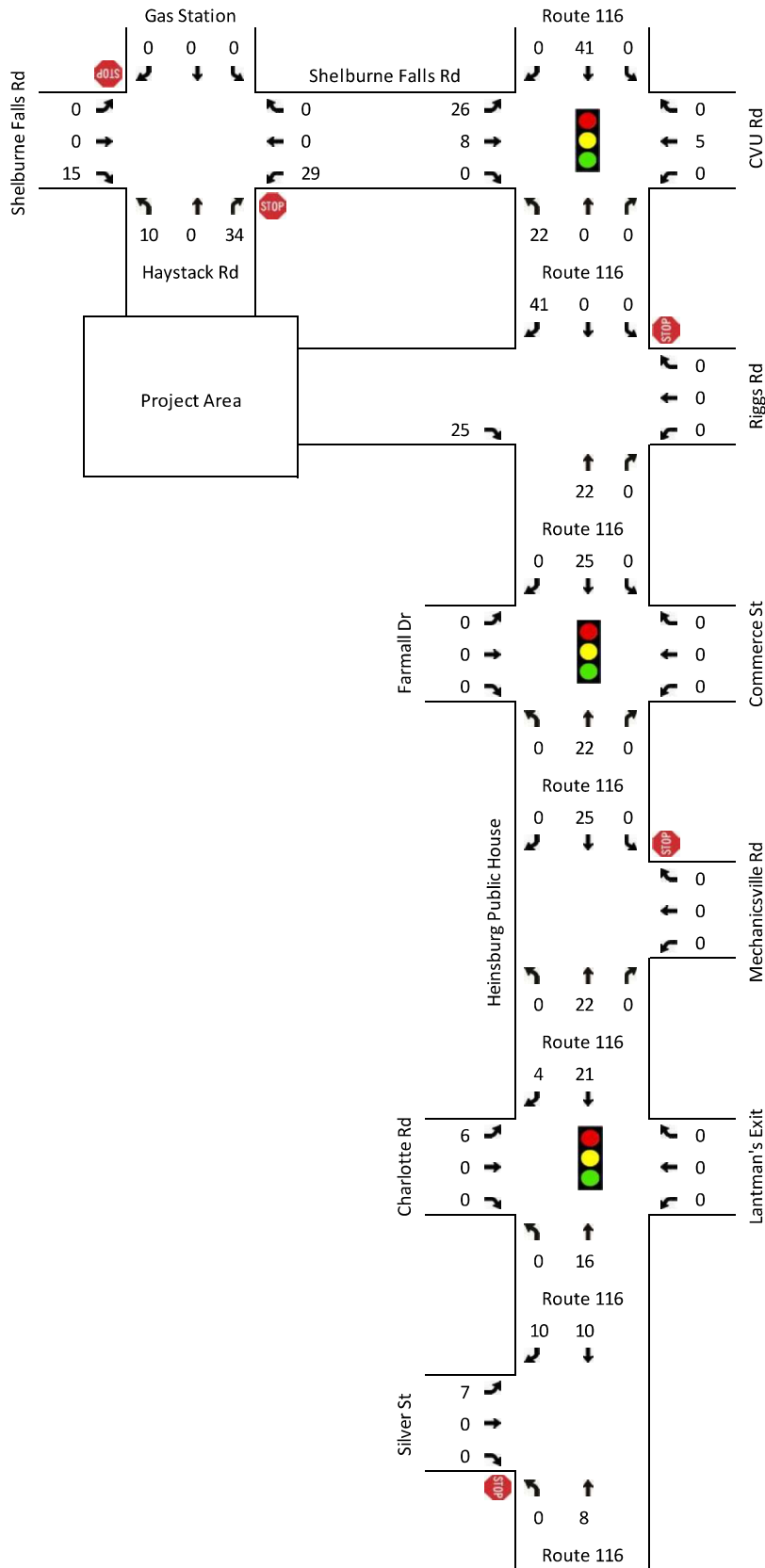
# APPENDIX A



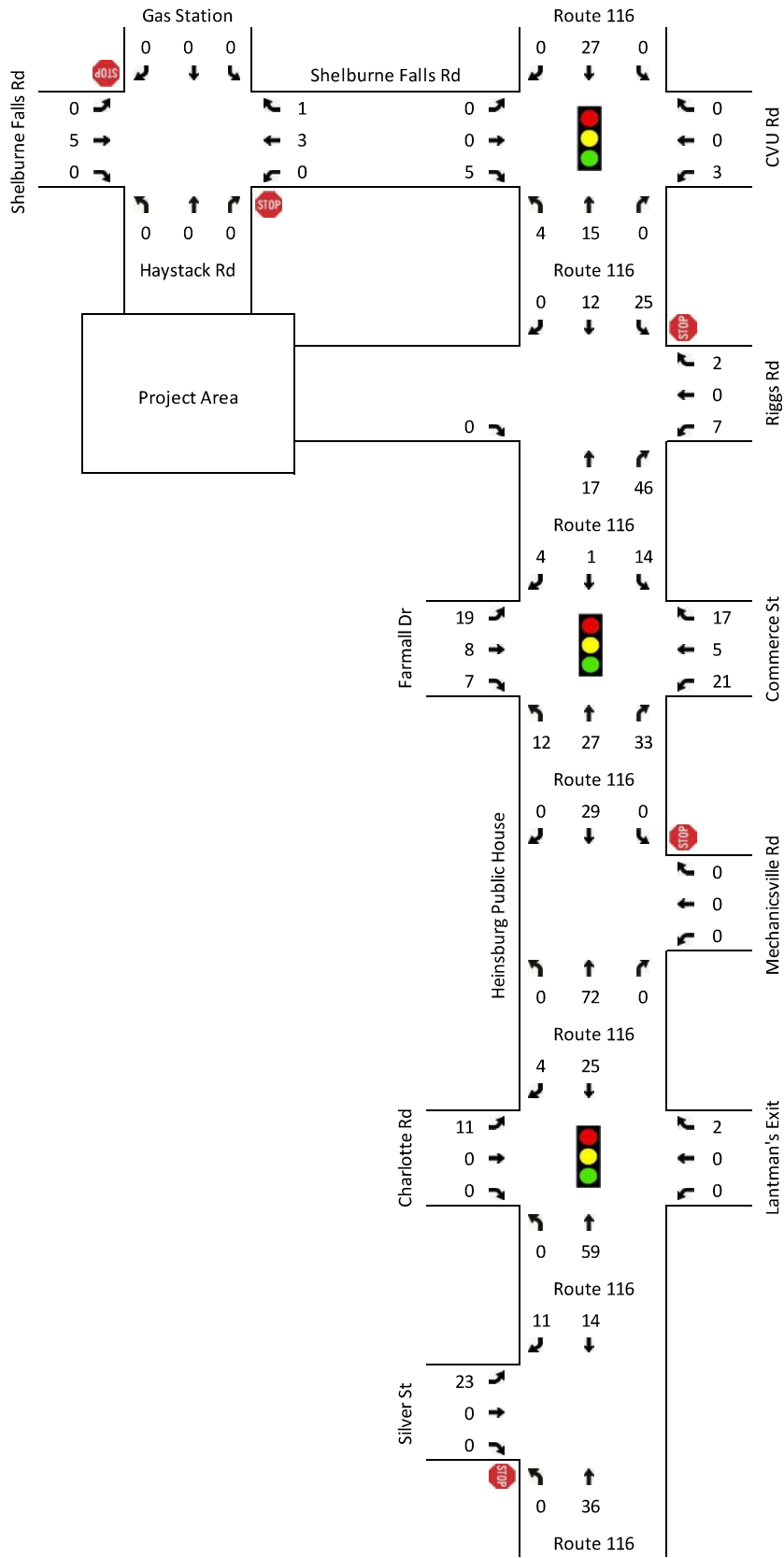
Haystack Phase 1 Trip Generation – AM Peak Hour



Haystack Phase 1 Trip Generation –PM Peak Hour

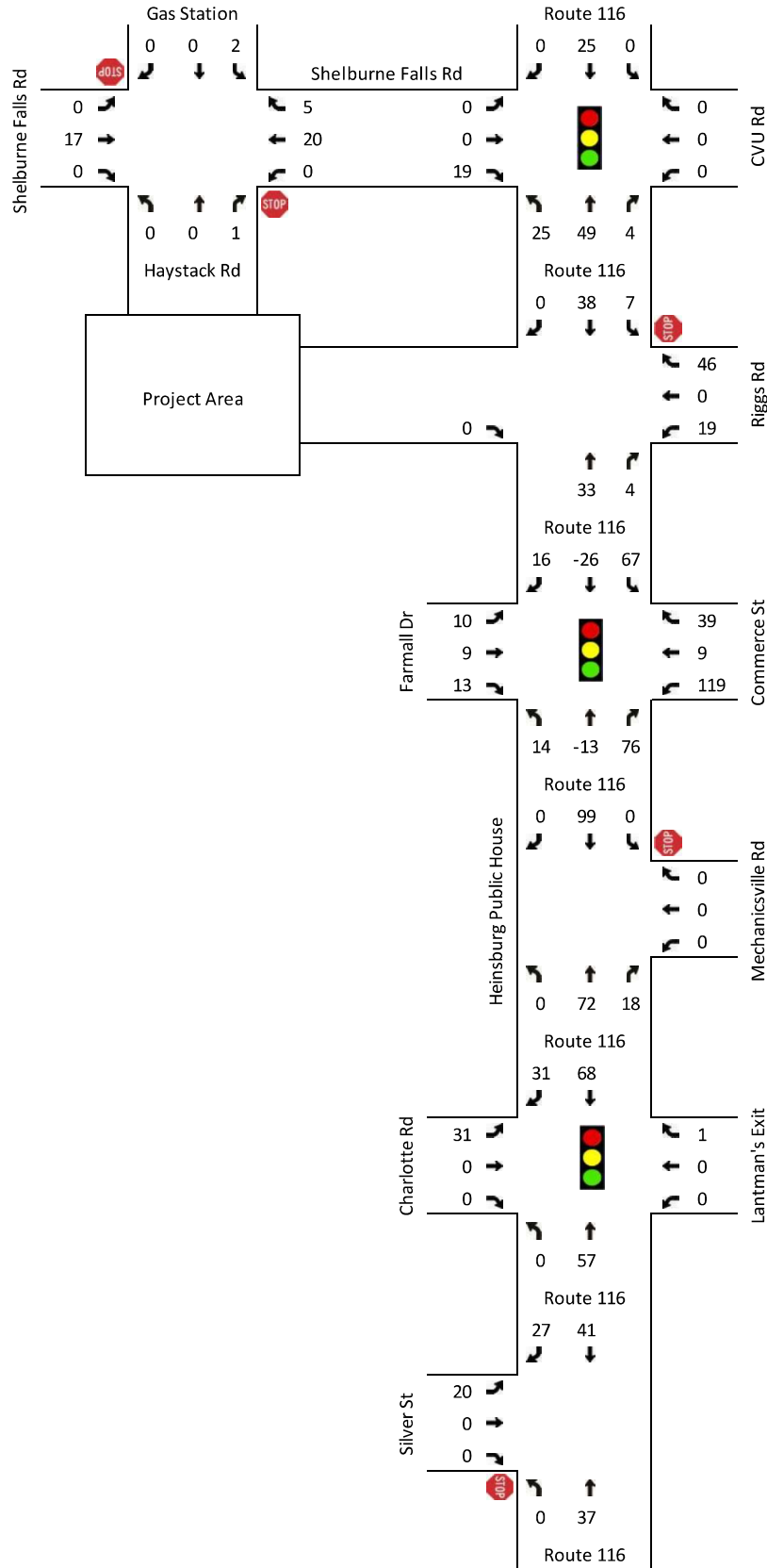


ODV Trip Generation - AM Peak Hour

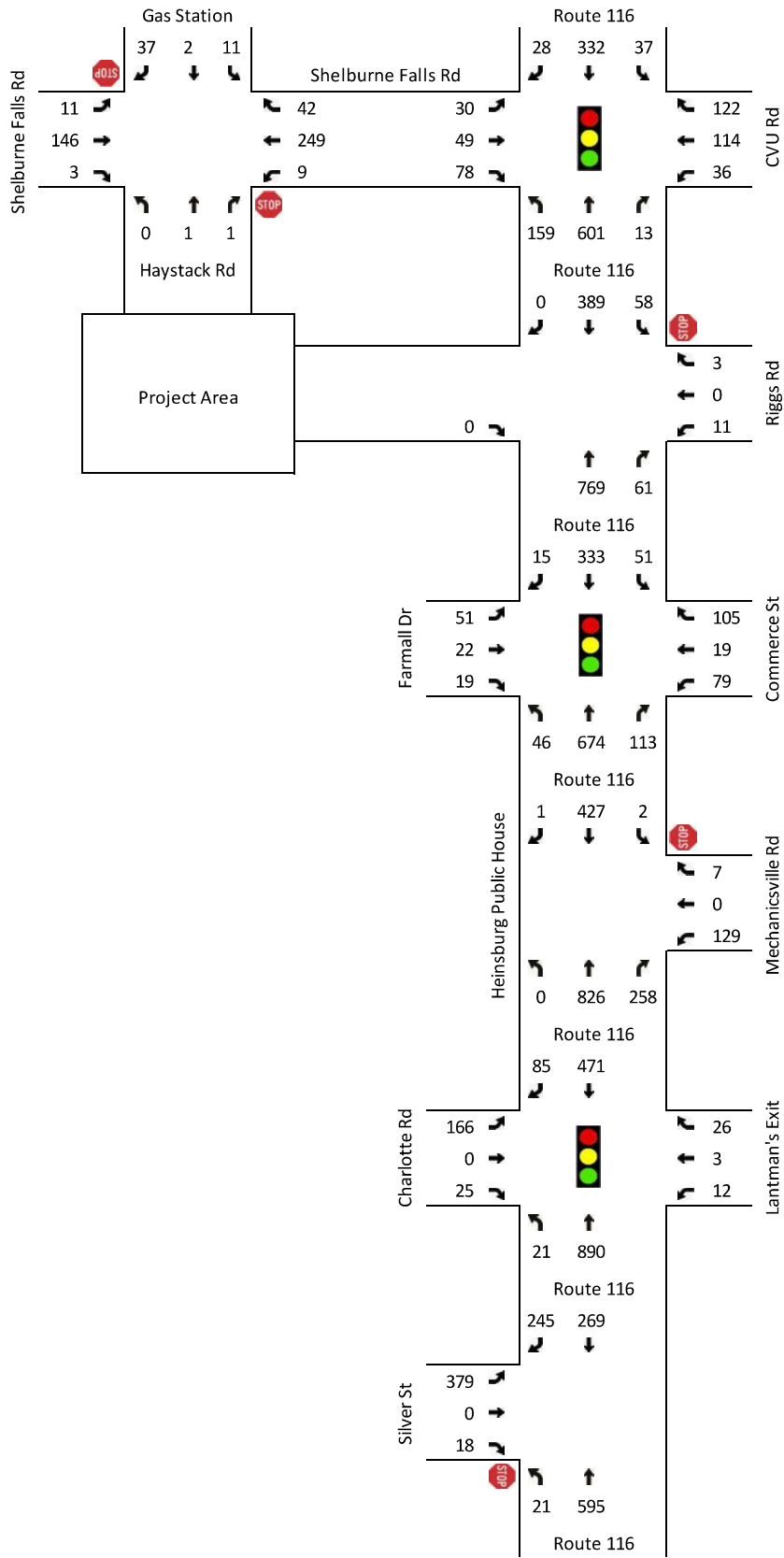




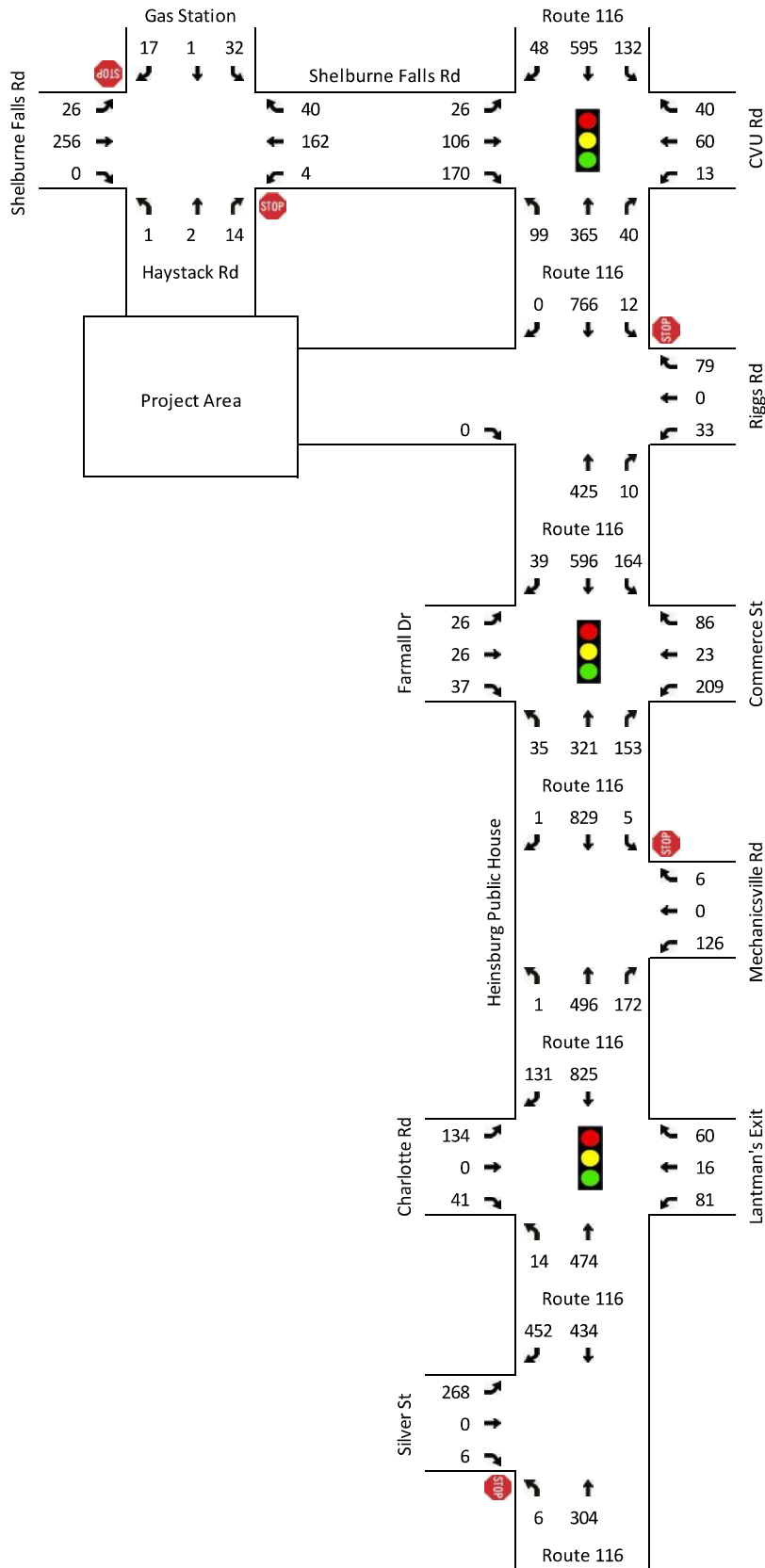
# ODV Trip Generation - PM Peak Hour



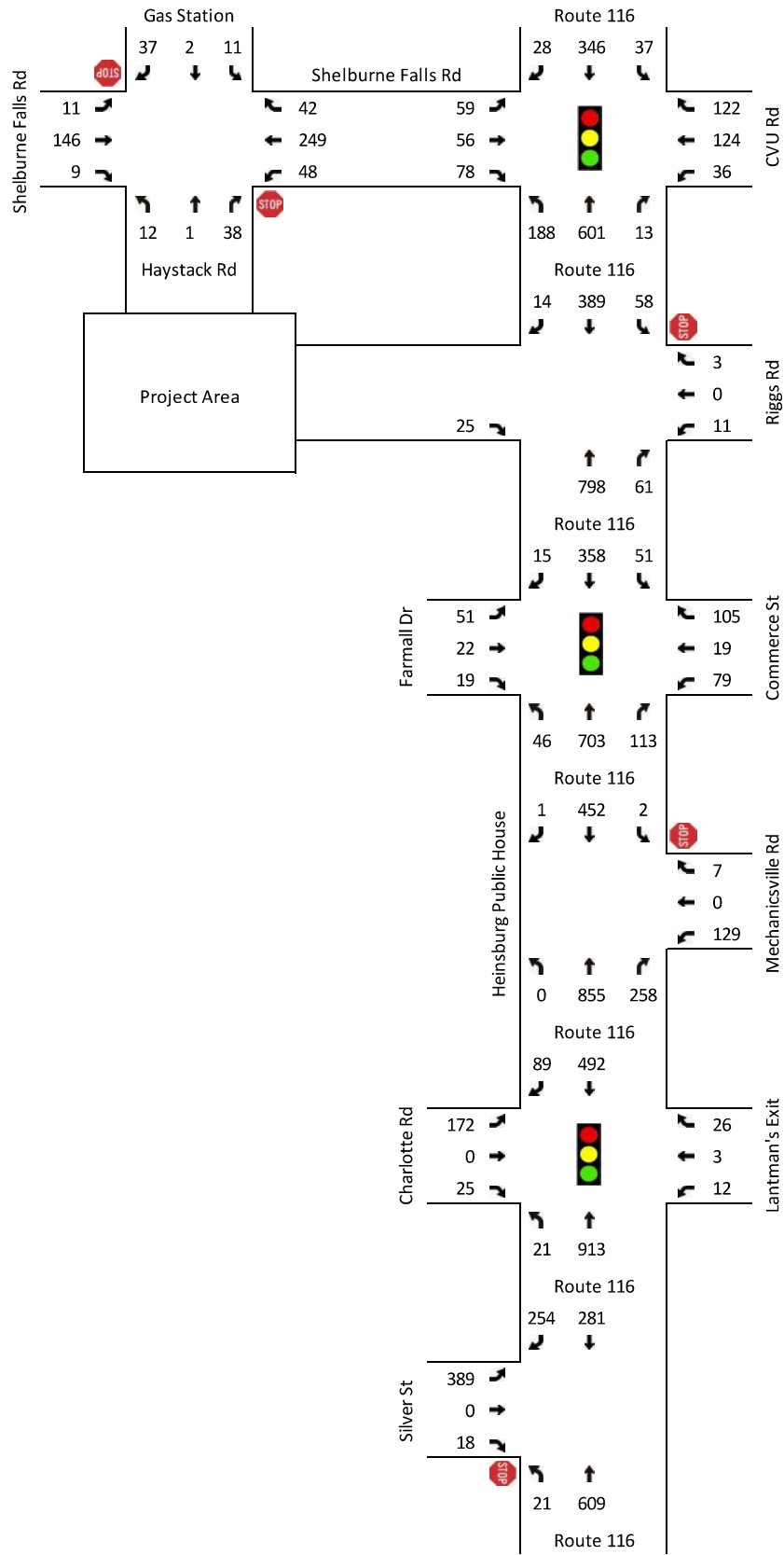
No Build Traffic Volumes – 2021 AM Peak Hour



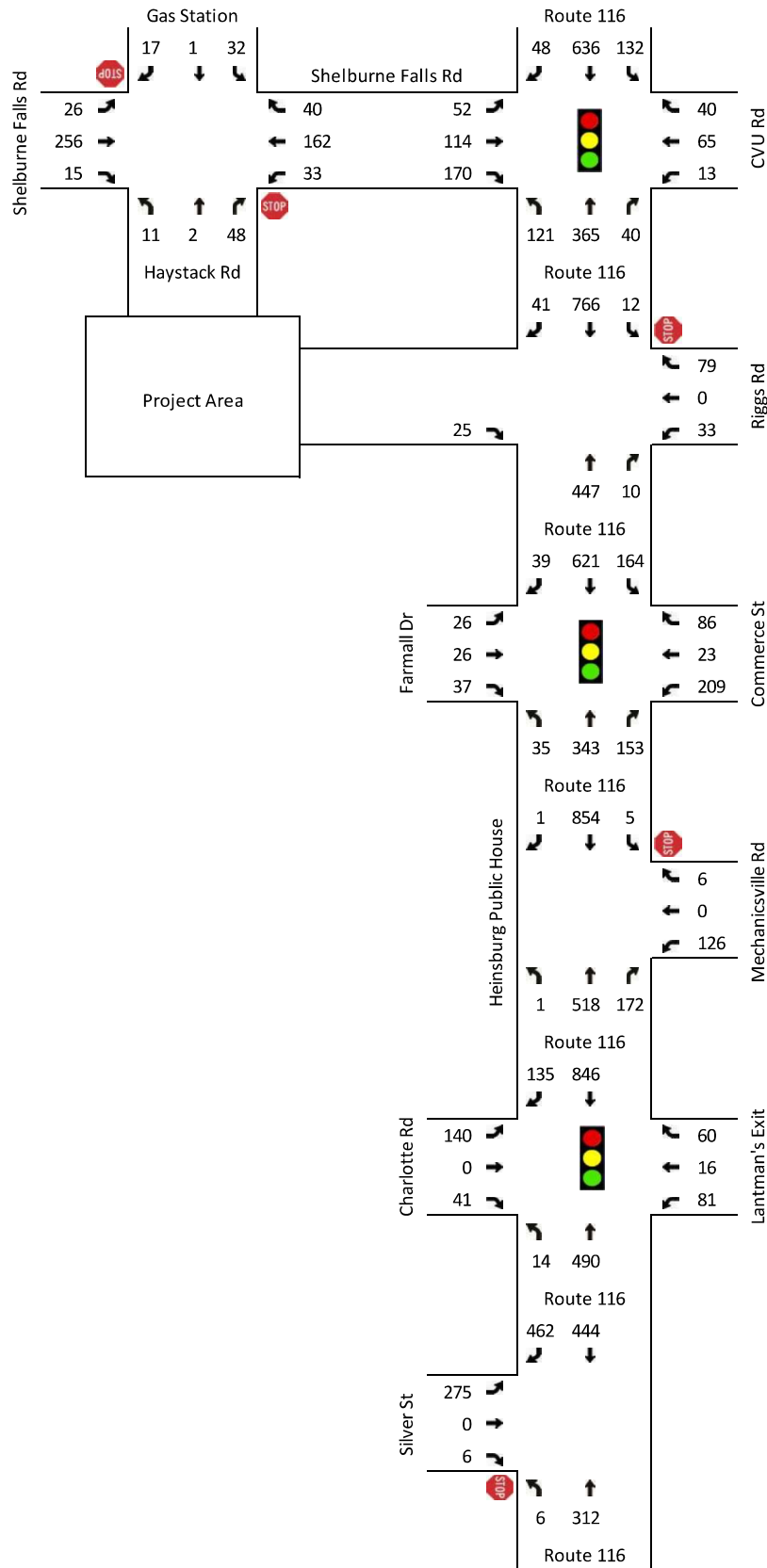
No Build Traffic Volumes – 2021 PM Peak Hour



Build Traffic Volumes – 2021 AM Peak Hour



Build Traffic Volumes – 2021 PM Peak Hour



# APPENDIX B



1: Haystack Rd/Gas Station & Shelburne Falls Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.1	0.1	0.1
Total Delay (hr)	0.0	0.1	0.0	0.1	0.2
Total Del/Veh (s)	0.5	1.6	2.7	4.3	1.6
Stop Delay (hr)	0.0	0.0	0.0	0.0	0.1
Stop Del/Veh (s)	0.1	0.2	2.2	3.4	0.5
Total Stops	4	1	3	53	61
Stop/Veh	0.03	0.00	1.00	1.00	0.12
Travel Dist (mi)	18.1	30.6	0.2	4.5	53.4
Travel Time (hr)	0.6	1.3	0.0	0.3	2.2
Avg Speed (mph)	28	23	20	18	24
Vehicles Entered	154	287	3	53	497
Vehicles Exited	153	287	3	53	496
Hourly Exit Rate	153	287	3	53	496
Input Volume	153	295	2	50	500
% of Volume	100	97	150	106	99
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

2: VT 116 & Shelburne Falls Rd/CVU Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	0.0	0.2	0.0	0.3	0.1
Total Delay (hr)	1.4	2.5	6.3	1.2	11.4
Total Del/Veh (s)	31.7	33.5	31.3	12.0	27.1
Stop Delay (hr)	1.3	2.2	4.1	0.9	8.4
Stop Del/Veh (s)	29.3	29.2	20.2	8.7	20.0
Total Stops	132	231	563	169	1095
Stop/Veh	0.86	0.85	0.78	0.47	0.73
Travel Dist (mi)	16.3	61.5	207.2	62.0	346.9
Travel Time (hr)	2.0	4.7	13.3	3.4	23.4
Avg Speed (mph)	8	13	16	19	15
Vehicles Entered	153	267	713	358	1491
Vehicles Exited	153	268	711	358	1490
Hourly Exit Rate	153	268	711	358	1490
Input Volume	151	267	746	367	1531
% of Volume	101	100	95	98	97
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

3: VT 116 & Haystack Development/Riggs Rd Performance by approach

Approach	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.6	0.4	1.0
Total Del/Veh (s)	12.4	3.0	3.8	3.3
Stop Delay (hr)	0.0	0.0	0.1	0.1
Stop Del/Veh (s)	11.1	0.1	0.9	0.5
Total Stops	5	0	32	37
Stop/Veh	1.00	0.00	0.08	0.03
Travel Dist (mi)	0.5	158.6	115.8	274.9
Travel Time (hr)	0.0	6.1	4.4	10.5
Avg Speed (mph)	14	26	26	26
Vehicles Entered	5	731	400	1136
Vehicles Exited	5	728	399	1132
Hourly Exit Rate	5	728	399	1132
Input Volume	5	761	407	1173
% of Volume	100	96	98	97
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

4: VT 116 & Farmall Dr/Commerce St Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.0	0.0	0.1
Denied Del/Veh (s)	1.0	2.4	0.0	0.0	0.3
Total Delay (hr)	0.7	1.4	2.4	0.9	5.4
Total Del/Veh (s)	43.4	32.3	11.6	8.9	14.7
Stop Delay (hr)	0.7	1.3	1.2	0.6	3.8
Stop Del/Veh (s)	40.8	29.8	6.1	5.5	10.2
Total Stops	55	146	232	117	550
Stop/Veh	0.93	0.95	0.32	0.31	0.42
Travel Dist (mi)	3.3	17.1	138.6	80.9	239.9
Travel Time (hr)	0.9	2.2	7.1	3.7	13.8
Avg Speed (mph)	4	8	20	22	18
Vehicles Entered	58	154	720	372	1304
Vehicles Exited	57	152	723	376	1308
Hourly Exit Rate	57	152	723	376	1308
Input Volume	58	158	755	378	1349
% of Volume	98	96	96	99	97
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0



5: VT 116 & Mechanicsville Rd Performance by approach

Approach	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	0.0
Total Delay (hr)	5.0	2.1	0.3	7.4
Total Del/Veh (s)	123.7	7.9	3.1	17.8
Stop Delay (hr)	5.0	0.0	0.1	5.1
Stop Del/Veh (s)	123.1	0.1	0.9	12.1
Total Stops	141	0	8	149
Stop/Veh	0.97	0.00	0.02	0.10
Travel Dist (mi)	23.1	188.4	75.9	287.4
Travel Time (hr)	5.8	8.7	2.9	17.5
Avg Speed (mph)	4	22	26	16
Vehicles Entered	140	956	394	1490
Vehicles Exited	139	959	395	1493
Hourly Exit Rate	139	959	395	1493
Input Volume	135	1003	398	1536
% of Volume	103	96	99	97
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

6: VT 116 & Charlotte Rd/Lantmans Exit Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	2.8	0.1	0.0	0.0	0.3
Total Delay (hr)	2.3	0.6	1.8	2.8	7.6
Total Del/Veh (s)	44.7	53.7	8.2	19.3	17.6
Stop Delay (hr)	2.2	0.6	1.4	2.0	6.1
Stop Del/Veh (s)	41.4	51.6	6.2	13.3	14.1
Total Stops	172	41	122	247	582
Stop/Veh	0.91	0.95	0.15	0.47	0.37
Travel Dist (mi)	46.2	11.0	17.5	103.0	177.7
Travel Time (hr)	4.1	1.0	2.4	6.5	14.0
Avg Speed (mph)	12	11	7	16	13
Vehicles Entered	186	42	794	522	1544
Vehicles Exited	185	43	794	521	1543
Hourly Exit Rate	185	43	794	521	1543
Input Volume	179	39	846	522	1586
% of Volume	103	110	94	100	97
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

7: VT 116 & Lantman Enter Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	13.9	0.3	14.2
Total Del/Veh (s)	59.5	2.1	38.7
Stop Delay (hr)	10.6	0.1	10.7
Stop Del/Veh (s)	45.5	0.8	29.3
Total Stops	794	11	805
Stop/Veh	0.94	0.02	0.61
Travel Dist (mi)	114.0	11.1	125.1
Travel Time (hr)	17.9	0.7	18.6
Avg Speed (mph)	6	16	7
Vehicles Entered	821	477	1298
Vehicles Exited	817	477	1294
Hourly Exit Rate	817	477	1294
Input Volume	870	480	1350
% of Volume	94	99	96
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

8: VT 116 & Silver St Performance by approach

Approach	EB	NB	SB	All
Denied Delay (hr)	0.1	0.2	0.0	0.3
Denied Del/Veh (s)	1.1	1.3	0.0	0.8
Total Delay (hr)	31.6	3.6	0.2	35.4
Total Del/Veh (s)	307.1	23.2	1.6	91.8
Stop Delay (hr)	32.5	2.8	0.0	35.3
Stop Del/Veh (s)	315.7	18.3	0.0	91.6
Total Stops	369	187	2	558
Stop/Veh	0.99	0.34	0.00	0.40
Travel Dist (mi)	181.1	84.5	62.9	328.6
Travel Time (hr)	38.0	6.6	2.5	47.1
Avg Speed (mph)	5	13	25	7
Vehicles Entered	357	554	463	1374
Vehicles Exited	306	551	463	1320
Hourly Exit Rate	306	551	463	1320
Input Volume	357	552	465	1374
% of Volume	86	100	100	96
Denied Entry Before	0	0	0	0
Denied Entry After	1	0	0	1

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 1: Haystack Rd/Gas Station & Shelburne Falls Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	36	20	26	65
Average Queue (ft)	4	1	2	28
95th Queue (ft)	22	10	15	53
Link Distance (ft)	620	510	572	442
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: VT 116 & Shelburne Falls Rd/CVU Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	199	286	618	248
Average Queue (ft)	84	141	305	102
95th Queue (ft)	164	241	568	195
Link Distance (ft)	510	1214	1479	912
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: VT 116 & Haystack Development/Riggs Rd

Movement	WB	NB	SB
Directions Served	LTR	TR	LTR
Maximum Queue (ft)	31	4	154
Average Queue (ft)	5	0	26
95th Queue (ft)	23	4	95
Link Distance (ft)	518	1084	1479
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 4: VT 116 & Farmall Dr/Commerce St

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	L	T	R	L	TR
Maximum Queue (ft)	116	69	172	94	106	464	125	96	238
Average Queue (ft)	42	11	60	44	19	156	23	20	73
95th Queue (ft)	92	42	132	94	73	344	90	58	180
Link Distance (ft)	295		582			951			1084
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)		75		70	100		100	100	
Storage Blk Time (%)	6	0	12	1	0	11	0	0	4
Queuing Penalty (veh)	1	0	11	1	0	13	0	0	2

Intersection: 5: VT 116 & Mechanicsville Rd

Movement	WB	NB	SB
Directions Served	LR	TR	LT
Maximum Queue (ft)	390	7	146
Average Queue (ft)	166	0	9
95th Queue (ft)	409	6	85
Link Distance (ft)	865	987	951
Upstream Blk Time (%)	0		
Queuing Penalty (veh)	0		
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 6: VT 116 & Charlotte Rd/Lantmans Exit

Movement	EB	EB	WB	NB	SB
Directions Served	L	R	LTR	LT	TR
Maximum Queue (ft)	172	190	93	87	448
Average Queue (ft)	110	29	40	62	177
95th Queue (ft)	173	107	79	76	357
Link Distance (ft)		1313	1358	56	987
Upstream Blk Time (%)				42	
Queuing Penalty (veh)				358	
Storage Bay Dist (ft)	150				
Storage Blk Time (%)	5	0			
Queuing Penalty (veh)	1	0			

## Queuing and Blocking Report Baseline

08/21/2018

### Intersection: 7: VT 116 & Lantman Enter

Movement	NB	SB	SB
Directions Served	TR	L	T
Maximum Queue (ft)	709	33	50
Average Queue (ft)	547	10	3
95th Queue (ft)	841	33	28
Link Distance (ft)	672		56
Upstream Blk Time (%)	16		1
Queuing Penalty (veh)	141		4
Storage Bay Dist (ft)		10	
Storage Blk Time (%)		7	0
Queuing Penalty (veh)		35	0

### Intersection: 8: VT 116 & Silver St

Movement	EB	EB	NB	SB
Directions Served	L	R	LT	R
Maximum Queue (ft)	1602	275	627	24
Average Queue (ft)	825	77	156	1
95th Queue (ft)	2005	276	514	13
Link Distance (ft)	2827		805	
Upstream Blk Time (%)	1		2	
Queuing Penalty (veh)	0		0	
Storage Bay Dist (ft)		250		150
Storage Blk Time (%)	72	0		
Queuing Penalty (veh)	13	0		

### Network Summary

Network wide Queuing Penalty: 579

1: Haystack Rd/Gas Station & Shelburne Falls Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.1	0.1	0.1
Total Delay (hr)	0.0	0.1	0.0	0.1	0.2
Total Del/Veh (s)	0.6	1.4	4.0	4.9	1.4
Stop Delay (hr)	0.0	0.0	0.0	0.1	0.1
Stop Del/Veh (s)	0.1	0.3	3.3	4.0	0.6
Total Stops	5	1	13	46	65
Stop/Veh	0.02	0.01	1.00	1.00	0.13
Travel Dist (mi)	31.7	18.3	1.5	1.2	52.6
Travel Time (hr)	1.1	0.8	0.1	0.1	2.1
Avg Speed (mph)	28	23	20	9	25
Vehicles Entered	269	174	13	46	502
Vehicles Exited	269	174	13	46	502
Hourly Exit Rate	269	174	13	46	502
Input Volume	263	181	16	48	508
% of Volume	102	96	81	96	99
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

2: VT 116 & Shelburne Falls Rd/CVU Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.1	0.1
Denied Del/Veh (s)	0.0	0.2	0.0	0.7	0.3
Total Delay (hr)	3.0	1.2	3.2	5.0	12.3
Total Del/Veh (s)	37.3	37.1	26.5	24.3	28.2
Stop Delay (hr)	2.7	1.1	2.4	3.4	9.4
Stop Del/Veh (s)	33.1	34.1	19.9	16.2	21.6
Total Stops	242	91	279	488	1100
Stop/Veh	0.84	0.81	0.65	0.65	0.70
Travel Dist (mi)	30.2	25.0	120.7	127.8	303.6
Travel Time (hr)	4.2	2.0	7.3	9.6	23.0
Avg Speed (mph)	7	12	17	14	13
Vehicles Entered	282	109	418	739	1548
Vehicles Exited	283	110	419	738	1550
Hourly Exit Rate	283	110	419	738	1550
Input Volume	280	112	423	743	1558
% of Volume	101	98	99	99	99
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

3: VT 116 & Haystack Development/Riggs Rd Performance by approach

Approach	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.1	0.3	0.8	1.1
Total Del/Veh (s)	8.1	2.3	3.7	3.4
Stop Delay (hr)	0.1	0.0	0.0	0.2
Stop Del/Veh (s)	7.2	0.1	0.2	0.5
Total Stops	47	0	7	54
Stop/Veh	1.02	0.00	0.01	0.05
Travel Dist (mi)	4.6	85.4	212.2	302.3
Travel Time (hr)	0.3	3.2	8.0	11.5
Avg Speed (mph)	16	27	26	26
Vehicles Entered	47	394	727	1168
Vehicles Exited	46	389	728	1163
Hourly Exit Rate	46	389	728	1163
Input Volume	47	394	726	1167
% of Volume	98	99	100	100
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

4: VT 116 & Farmall Dr/Commerce St Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.0	0.0	0.1
Denied Del/Veh (s)	1.9	1.5	0.0	0.0	0.2
Total Delay (hr)	0.6	1.9	1.3	3.8	7.6
Total Del/Veh (s)	35.1	47.4	10.5	18.2	19.7
Stop Delay (hr)	0.5	1.8	0.8	2.5	5.6
Stop Del/Veh (s)	32.9	44.0	6.7	11.8	14.6
Total Stops	54	148	153	337	692
Stop/Veh	0.90	1.01	0.36	0.45	0.50
Travel Dist (mi)	3.4	16.3	81.8	158.7	260.2
Travel Time (hr)	0.8	2.6	4.1	9.2	16.7
Avg Speed (mph)	5	6	20	17	16
Vehicles Entered	60	146	424	739	1369
Vehicles Exited	60	145	427	736	1368
Hourly Exit Rate	60	145	427	736	1368
Input Volume	57	150	428	735	1370
% of Volume	105	97	100	100	100
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

5: VT 116 & Mechanicsville Rd Performance by approach

Approach	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	0.0
Total Delay (hr)	2.9	0.6	6.3	9.9
Total Del/Veh (s)	84.9	4.0	30.8	24.7
Stop Delay (hr)	2.9	0.0	4.8	7.7
Stop Del/Veh (s)	83.5	0.1	23.4	19.2
Total Stops	123	0	274	397
Stop/Veh	0.99	0.00	0.37	0.28
Travel Dist (mi)	20.1	113.1	139.9	273.1
Travel Time (hr)	3.7	4.7	11.1	19.4
Avg Speed (mph)	6	24	13	14
Vehicles Entered	123	578	733	1434
Vehicles Exited	121	573	715	1409
Hourly Exit Rate	121	573	715	1409
Input Volume	131	574	729	1434
% of Volume	92	100	98	98
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

6: Charlotte Rd/Lantmans Exit & VT 116 Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	2.3	0.2	0.0	0.0	0.2
Total Delay (hr)	4.3	7.5	1.3	22.3	35.4
Total Del/Veh (s)	102.3	160.4	10.7	95.3	79.7
Stop Delay (hr)	4.1	7.3	1.1	16.9	29.4
Stop Del/Veh (s)	99.1	155.4	9.1	72.2	66.3
Total Stops	159	174	96	1046	1475
Stop/Veh	1.06	1.04	0.22	1.24	0.92
Travel Dist (mi)	35.9	41.4	9.6	161.8	248.6
Travel Time (hr)	5.6	9.0	1.6	27.9	44.1
Avg Speed (mph)	6	5	6	6	6
Vehicles Entered	145	161	435	825	1566
Vehicles Exited	143	159	434	817	1553
Hourly Exit Rate	143	159	434	817	1553
Input Volume	143	154	429	848	1574
% of Volume	100	103	101	96	99
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0



7: VT 116 & Lantman Enter Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	4.0	0.6	4.6
Total Del/Veh (s)	28.3	2.7	12.2
Stop Delay (hr)	3.2	0.2	3.4
Stop Del/Veh (s)	22.9	0.8	9.0
Total Stops	241	60	301
Stop/Veh	0.48	0.07	0.22
Travel Dist (mi)	69.3	20.1	89.4
Travel Time (hr)	6.5	1.4	7.9
Avg Speed (mph)	11	14	11
Vehicles Entered	498	853	1351
Vehicles Exited	499	853	1352
Hourly Exit Rate	499	853	1352
Input Volume	488	870	1358
% of Volume	102	98	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

8: VT 116 & Silver St Performance by approach

Approach	EB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.3	0.2	0.0	0.1
Total Delay (hr)	1.3	0.2	0.4	2.0
Total Del/Veh (s)	18.8	3.2	2.0	5.5
Stop Delay (hr)	1.1	0.2	0.0	1.3
Stop Del/Veh (s)	16.0	2.3	0.1	3.6
Total Stops	242	15	3	260
Stop/Veh	0.98	0.05	0.00	0.20
Travel Dist (mi)	99.7	46.3	104.4	250.4
Travel Time (hr)	4.8	1.8	4.2	10.8
Avg Speed (mph)	21	26	25	23
Vehicles Entered	242	272	765	1279
Vehicles Exited	241	270	766	1277
Hourly Exit Rate	241	270	766	1277
Input Volume	241	259	779	1279
% of Volume	100	104	98	100
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 1: Haystack Rd/Gas Station & Shelburne Falls Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	40	23	32	56
Average Queue (ft)	4	1	10	25
95th Queue (ft)	25	10	34	51
Link Distance (ft)	619	508	571	133
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: VT 116 & Shelburne Falls Rd/CVU Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	324	172	465	560
Average Queue (ft)	160	70	178	267
95th Queue (ft)	273	139	378	488
Link Distance (ft)	508	1212	1479	911
Upstream Blk Time (%)				0
Queuing Penalty (veh)				0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: VT 116 & Haystack Development/Riggs Rd

Movement	WB	SB
Directions Served	LTR	LT
Maximum Queue (ft)	61	83
Average Queue (ft)	27	4
95th Queue (ft)	53	43
Link Distance (ft)	516	1479
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 4: VT 116 & Farmall Dr/Commerce St

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	L	T	R	L	TR
Maximum Queue (ft)	93	63	205	95	74	295	125	123	545
Average Queue (ft)	32	18	92	40	11	90	23	47	211
95th Queue (ft)	75	47	184	100	45	217	85	116	511
Link Distance (ft)	294		581			948			1080
Upstream Blk Time (%)									0
Queuing Penalty (veh)									2
Storage Bay Dist (ft)		75		70	100		100	100	
Storage Blk Time (%)	2	0	26	0		6	0	0	15
Queuing Penalty (veh)	1	0	12	0		6	0	1	15

Intersection: 5: VT 116 & Mechanicsville Rd

Movement	WB	NB	SB
Directions Served	LR	TR	LT
Maximum Queue (ft)	260	8	668
Average Queue (ft)	109	0	233
95th Queue (ft)	298	5	747
Link Distance (ft)	864	984	948
Upstream Blk Time (%)			1
Queuing Penalty (veh)			11
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 6: Charlotte Rd/Lantmans Exit & VT 116

Movement	EB	EB	WB	NB	SB
Directions Served	L	R	LTR	LT	TR
Maximum Queue (ft)	166	230	407	69	1006
Average Queue (ft)	109	82	237	56	782
95th Queue (ft)	183	230	437	71	1220
Link Distance (ft)		1313	1358	54	984
Upstream Blk Time (%)				32	13
Queuing Penalty (veh)				138	110
Storage Bay Dist (ft)	150				
Storage Blk Time (%)	15	1			
Queuing Penalty (veh)	6	1			

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 7: VT 116 & Lantman Enter

Movement	NB	SB	SB
Directions Served	TR	L	T
Maximum Queue (ft)	577	40	76
Average Queue (ft)	195	27	27
95th Queue (ft)	502	47	79
Link Distance (ft)	674		54
Upstream Blk Time (%)	3	0	3
Queuing Penalty (veh)	12	0	28
Storage Bay Dist (ft)		10	
Storage Blk Time (%)		11	0
Queuing Penalty (veh)		83	0

Intersection: 8: VT 116 & Silver St

Movement	EB	EB	NB	SB	SB
Directions Served	L	R	LT	T	R
Maximum Queue (ft)	193	52	152	23	33
Average Queue (ft)	84	6	15	1	1
95th Queue (ft)	164	37	92	18	19
Link Distance (ft)	2174		900	674	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)		250			150
Storage Blk Time (%)	0			0	0
Queuing Penalty (veh)	0			1	0

Network Summary

Network wide Queuing Penalty: 428
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1: Haystack Rd/Gas Station & Shelburne Falls Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.1	0.1	0.1
Total Delay (hr)	0.0	0.1	0.0	0.1	0.2
Total Del/Veh (s)	0.4	1.6	4.0	4.3	1.5
Stop Delay (hr)	0.0	0.0	0.0	0.0	0.1
Stop Del/Veh (s)	0.1	0.2	3.2	3.4	0.5
Total Stops	3	1	2	51	57
Stop/Veh	0.02	0.00	1.00	1.00	0.11
Travel Dist (mi)	18.6	30.7	0.2	4.3	53.9
Travel Time (hr)	0.7	1.3	0.0	0.2	2.2
Avg Speed (mph)	28	23	20	18	24
Vehicles Entered	158	288	2	51	499
Vehicles Exited	158	288	2	51	499
Hourly Exit Rate	158	288	2	51	499
Input Volume	160	301	2	50	513
% of Volume	99	96	100	102	97
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

2: VT 116 & Shelburne Falls Rd/CVU Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	0.0	0.3	0.0	0.3	0.1
Total Delay (hr)	1.4	2.7	8.5	1.7	14.2
Total Del/Veh (s)	30.8	35.2	40.6	14.9	32.1
Stop Delay (hr)	1.3	2.4	5.8	1.2	10.7
Stop Del/Veh (s)	28.5	30.8	28.1	11.1	24.3
Total Stops	131	241	663	205	1240
Stop/Veh	0.81	0.86	0.88	0.51	0.78
Travel Dist (mi)	16.8	62.7	213.9	69.6	363.1
Travel Time (hr)	2.0	5.0	15.7	4.1	26.8
Avg Speed (mph)	8	13	14	17	14
Vehicles Entered	158	272	735	402	1567
Vehicles Exited	159	272	735	401	1567
Hourly Exit Rate	159	272	735	401	1567
Input Volume	159	272	773	397	1601
% of Volume	100	100	95	101	98
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

3: VT 116 & Haystack Development/Riggs Rd Performance by approach

Approach	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.1	0.9	0.9	1.9
Total Del/Veh (s)	21.6	3.9	7.0	5.3
Stop Delay (hr)	0.1	0.0	0.4	0.5
Stop Del/Veh (s)	20.2	0.2	3.0	1.4
Total Stops	14	2	93	109
Stop/Veh	1.00	0.00	0.20	0.09
Travel Dist (mi)	1.4	172.6	130.8	304.8
Travel Time (hr)	0.1	6.9	5.4	12.4
Avg Speed (mph)	10	25	24	25
Vehicles Entered	14	793	451	1258
Vehicles Exited	14	792	453	1259
Hourly Exit Rate	14	792	453	1259
Input Volume	14	830	448	1292
% of Volume	100	95	101	97
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

4: VT 116 & Farmall Dr/Commerce St Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.0	0.0	0.2
Denied Del/Veh (s)	1.0	2.3	0.0	0.0	0.4
Total Delay (hr)	1.0	1.5	3.3	1.2	7.1
Total Del/Veh (s)	37.9	27.5	15.1	10.5	17.0
Stop Delay (hr)	0.9	1.4	1.9	0.8	5.0
Stop Del/Veh (s)	35.0	25.3	8.4	6.7	11.9
Total Stops	88	176	344	149	757
Stop/Veh	0.93	0.87	0.43	0.36	0.50
Travel Dist (mi)	5.3	22.3	151.2	87.9	266.7
Travel Time (hr)	1.2	2.5	8.5	4.2	16.5
Avg Speed (mph)	4	9	18	21	16
Vehicles Entered	94	200	786	406	1486
Vehicles Exited	94	200	783	406	1483
Hourly Exit Rate	94	200	783	406	1483
Input Volume	92	203	834	400	1529
% of Volume	102	99	94	102	97
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

5: VT 116 & Mechanicsville Rd Performance by approach

Approach	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	0.0
Total Delay (hr)	6.6	2.0	0.4	8.9
Total Del/Veh (s)	172.5	6.9	3.0	20.1
Stop Delay (hr)	6.6	0.0	0.1	6.7
Stop Del/Veh (s)	172.6	0.1	0.8	15.2
Total Stops	133	0	8	141
Stop/Veh	0.96	0.00	0.02	0.09
Travel Dist (mi)	21.8	200.0	83.2	305.0
Travel Time (hr)	7.4	9.0	3.2	19.6
Avg Speed (mph)	3	22	26	16
Vehicles Entered	134	1016	433	1583
Vehicles Exited	129	1017	432	1578
Hourly Exit Rate	129	1017	432	1578
Input Volume	136	1084	431	1651
% of Volume	95	94	100	96
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

6: VT 116 & Charlotte Rd/Lantmans Exit Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	2.8	0.1	0.0	0.0	0.3
Total Delay (hr)	3.1	0.5	1.6	2.2	7.3
Total Del/Veh (s)	59.4	42.7	6.4	14.0	15.8
Stop Delay (hr)	2.9	0.5	1.1	1.4	5.8
Stop Del/Veh (s)	56.0	41.0	4.5	8.8	12.6
Total Stops	190	39	145	229	603
Stop/Veh	1.03	0.95	0.17	0.41	0.36
Travel Dist (mi)	45.1	10.8	19.1	108.8	183.8
Travel Time (hr)	4.8	0.9	2.2	6.0	13.9
Avg Speed (mph)	10	12	9	18	13
Vehicles Entered	181	42	877	551	1651
Vehicles Exited	182	41	876	553	1652
Hourly Exit Rate	182	41	876	553	1652
Input Volume	191	41	946	557	1735
% of Volume	95	100	93	99	95
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

7: VT 116 & Lantman Enter Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	9.3	0.3	9.6
Total Del/Veh (s)	36.8	1.8	24.1
Stop Delay (hr)	6.4	0.1	6.5
Stop Del/Veh (s)	25.4	0.6	16.4
Total Stops	717	12	729
Stop/Veh	0.78	0.02	0.51
Travel Dist (mi)	125.5	11.7	137.3
Travel Time (hr)	13.8	0.7	14.5
Avg Speed (mph)	9	17	9
Vehicles Entered	900	518	1418
Vehicles Exited	902	518	1420
Hourly Exit Rate	902	518	1420
Input Volume	974	527	1501
% of Volume	93	98	95
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

8: VT 116 & Silver St Performance by approach

Approach	EB	NB	SB	All
Denied Delay (hr)	0.2	0.1	0.0	0.2
Denied Del/Veh (s)	1.4	0.6	0.0	0.6
Total Delay (hr)	54.2	1.5	0.2	55.9
Total Del/Veh (s)	472.4	8.5	1.7	130.5
Stop Delay (hr)	56.3	0.9	0.0	57.3
Stop Del/Veh (s)	490.9	5.5	0.0	133.7
Total Stops	397	88	2	487
Stop/Veh	0.96	0.14	0.00	0.32
Travel Dist (mi)	191.7	94.1	68.8	354.6
Travel Time (hr)	61.0	4.7	2.7	68.4
Avg Speed (mph)	3	20	25	5
Vehicles Entered	393	615	507	1515
Vehicles Exited	318	616	506	1440
Hourly Exit Rate	318	616	506	1440
Input Volume	397	616	514	1527
% of Volume	80	100	98	94
Denied Entry Before	0	0	0	0
Denied Entry After	2	0	0	2



# Queuing and Blocking Report

## Baseline

08/21/2018

### Intersection: 1: Haystack Rd/Gas Station & Shelburne Falls Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	35	16	28	62
Average Queue (ft)	3	1	2	26
95th Queue (ft)	18	9	15	51
Link Distance (ft)	620	510	572	442
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

### Intersection: 2: VT 116 & Shelburne Falls Rd/CVU Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	195	302	745	308
Average Queue (ft)	84	147	370	123
95th Queue (ft)	163	251	732	239
Link Distance (ft)	510	1214	1479	912
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

### Intersection: 3: VT 116 & Haystack Development/Riggs Rd

Movement	WB	NB	SB
Directions Served	LTR	TR	LTR
Maximum Queue (ft)	46	25	287
Average Queue (ft)	13	2	64
95th Queue (ft)	39	14	182
Link Distance (ft)	518	1084	1479
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 4: VT 116 & Farmall Dr/Commerce St

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	L	T	R	L	TR
Maximum Queue (ft)	138	82	149	96	118	472	125	121	233
Average Queue (ft)	57	16	64	38	27	204	39	29	78
95th Queue (ft)	112	53	119	74	86	403	119	76	180
Link Distance (ft)	295		582			951			1084
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)		75		400	100		100	180	
Storage Blk Time (%)	11	0			0	16	0		1
Queuing Penalty (veh)	2	0			0	26	0		0

Intersection: 5: VT 116 & Mechanicsville Rd

Movement	WB	NB	SB
Directions Served	LR	TR	LT
Maximum Queue (ft)	408	4	135
Average Queue (ft)	202	0	8
95th Queue (ft)	420	3	80
Link Distance (ft)	865	987	951
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 6: VT 116 & Charlotte Rd/Lantmans Exit

Movement	EB	EB	WB	NB	SB
Directions Served	L	R	LTR	LT	TR
Maximum Queue (ft)	169	213	102	86	358
Average Queue (ft)	116	44	36	63	151
95th Queue (ft)	183	175	78	78	290
Link Distance (ft)		1313	1358	56	987
Upstream Blk Time (%)				33	
Queuing Penalty (veh)				314	
Storage Bay Dist (ft)	150				
Storage Blk Time (%)	11	0			
Queuing Penalty (veh)	3	0			

## Queuing and Blocking Report Baseline

08/21/2018

### Intersection: 7: VT 116 & Lantman Enter

Movement	NB	SB	SB
Directions Served	TR	L	T
Maximum Queue (ft)	692	34	68
Average Queue (ft)	413	9	5
95th Queue (ft)	750	32	31
Link Distance (ft)	672		56
Upstream Blk Time (%)	5		1
Queuing Penalty (veh)	53		4
Storage Bay Dist (ft)		10	
Storage Blk Time (%)		5	0
Queuing Penalty (veh)		26	0

### Intersection: 8: VT 116 & Silver St

Movement	EB	EB	NB	SB	SB
Directions Served	L	R	LT	T	R
Maximum Queue (ft)	2257	275	375	1	27
Average Queue (ft)	1370	90	72	0	1
95th Queue (ft)	2609	301	316	2	13
Link Distance (ft)	2827		805	672	
Upstream Blk Time (%)	3		0		
Queuing Penalty (veh)	0		0		
Storage Bay Dist (ft)		250			150
Storage Blk Time (%)	92	0			
Queuing Penalty (veh)	16	0			

### Network Summary

Network wide Queuing Penalty: 444

1: Haystack Rd/Gas Station & Shelburne Falls Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.3	0.0	0.1	0.1	0.2
Total Delay (hr)	0.1	0.1	0.0	0.1	0.2
Total Del/Veh (s)	0.7	1.4	3.8	5.1	1.4
Stop Delay (hr)	0.0	0.0	0.0	0.1	0.1
Stop Del/Veh (s)	0.1	0.3	3.3	4.2	0.6
Total Stops	6	1	16	50	73
Stop/Veh	0.02	0.01	1.00	1.00	0.13
Travel Dist (mi)	33.1	20.9	1.7	1.3	57.0
Travel Time (hr)	1.2	0.9	0.1	0.1	2.3
Avg Speed (mph)	28	23	20	9	25
Vehicles Entered	280	197	16	50	543
Vehicles Exited	281	198	16	50	545
Hourly Exit Rate	281	198	16	50	545
Input Volume	282	207	17	50	556
% of Volume	100	96	94	100	98
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

2: VT 116 & Shelburne Falls Rd/CVU Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.8	0.8
Denied Del/Veh (s)	0.0	0.2	0.0	3.6	1.7
Total Delay (hr)	3.4	1.3	7.4	11.1	23.1
Total Del/Veh (s)	39.1	41.4	52.5	51.0	48.7
Stop Delay (hr)	3.0	1.2	6.1	8.5	18.8
Stop Del/Veh (s)	34.7	38.2	43.7	39.0	39.6
Total Stops	266	92	440	705	1503
Stop/Veh	0.86	0.84	0.87	0.90	0.88
Travel Dist (mi)	32.4	25.1	143.1	133.0	333.6
Travel Time (hr)	4.6	2.1	12.3	16.4	35.5
Avg Speed (mph)	7	12	12	9	10
Vehicles Entered	303	110	496	771	1680
Vehicles Exited	303	109	491	765	1668
Hourly Exit Rate	303	109	491	765	1668
Input Volume	302	113	505	775	1695
% of Volume	100	96	97	99	98
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	1	1

3: VT 116 & Haystack Development/Riggs Rd Performance by approach

Approach	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	0.0
Total Delay (hr)	0.6	0.3	1.3	2.2
Total Del/Veh (s)	20.1	2.6	6.0	6.1
Stop Delay (hr)	0.6	0.0	0.4	1.0
Stop Del/Veh (s)	18.8	0.2	1.7	2.7
Total Stops	114	0	46	160
Stop/Veh	1.00	0.00	0.06	0.12
Travel Dist (mi)	11.2	92.1	224.8	328.1
Travel Time (hr)	1.1	3.5	9.0	13.6
Avg Speed (mph)	10	26	25	24
Vehicles Entered	114	424	770	1308
Vehicles Exited	113	424	770	1307
Hourly Exit Rate	113	424	770	1307
Input Volume	112	435	778	1325
% of Volume	101	97	99	99
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

4: VT 116 & Farmall Dr/Commerce St Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	7.1	0.0	0.0	7.2
Denied Del/Veh (s)	1.8	80.1	0.0	0.0	15.1
Total Delay (hr)	0.9	14.8	1.9	7.5	25.1
Total Del/Veh (s)	34.3	173.8	13.4	33.8	53.0
Stop Delay (hr)	0.8	14.5	1.2	5.6	22.2
Stop Del/Veh (s)	31.8	170.2	8.7	25.4	46.9
Total Stops	82	313	244	528	1167
Stop/Veh	0.90	1.02	0.48	0.66	0.69
Travel Dist (mi)	5.1	32.7	95.5	169.5	302.8
Travel Time (hr)	1.1	23.2	5.2	13.3	42.9
Avg Speed (mph)	5	2	18	13	8
Vehicles Entered	91	299	499	791	1680
Vehicles Exited	91	288	499	779	1657
Hourly Exit Rate	91	288	499	779	1657
Input Volume	89	318	509	799	1715
% of Volume	102	91	98	97	97
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	20	0	0	20

5: VT 116 & Mechanicsville Rd Performance by approach

Approach	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	0.0
Total Delay (hr)	4.5	0.8	13.2	18.5
Total Del/Veh (s)	114.7	4.4	58.1	41.3
Stop Delay (hr)	4.5	0.0	10.8	15.3
Stop Del/Veh (s)	113.8	0.1	47.6	34.1
Total Stops	138	0	477	615
Stop/Veh	0.98	0.00	0.59	0.38
Travel Dist (mi)	22.6	127.7	153.4	303.7
Travel Time (hr)	5.3	5.3	18.5	29.1
Avg Speed (mph)	4	24	8	10
Vehicles Entered	138	648	807	1593
Vehicles Exited	135	648	788	1571
Hourly Exit Rate	135	648	788	1571
Input Volume	132	668	842	1642
% of Volume	102	97	94	96
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

6: Charlotte Rd/Lantmans Exit & VT 116 Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.1	0.0	0.0	0.2	0.3
Denied Del/Veh (s)	2.5	0.2	0.0	0.9	0.7
Total Delay (hr)	11.3	8.5	1.4	23.4	44.6
Total Del/Veh (s)	223.8	195.3	9.8	91.1	90.8
Stop Delay (hr)	11.1	8.4	1.1	17.3	38.0
Stop Del/Veh (s)	220.8	192.6	8.2	67.2	77.3
Total Stops	221	157	108	1223	1709
Stop/Veh	1.22	1.00	0.21	1.32	0.97
Travel Dist (mi)	42.6	38.1	10.9	177.0	268.6
Travel Time (hr)	12.9	9.9	1.7	29.8	54.3
Avg Speed (mph)	3	4	6	6	5
Vehicles Entered	174	150	501	905	1730
Vehicles Exited	166	141	502	892	1701
Hourly Exit Rate	166	141	502	892	1701
Input Volume	175	157	506	956	1794
% of Volume	95	90	99	93	95
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

7: VT 116 & Lantman Enter Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.1	0.0
Total Delay (hr)	6.5	0.7	7.3
Total Del/Veh (s)	40.6	2.9	17.5
Stop Delay (hr)	5.4	0.3	5.7
Stop Del/Veh (s)	33.6	1.0	13.6
Total Stops	315	65	380
Stop/Veh	0.54	0.07	0.25
Travel Dist (mi)	79.4	20.9	100.3
Travel Time (hr)	9.4	1.6	11.0
Avg Speed (mph)	8	13	9
Vehicles Entered	574	916	1490
Vehicles Exited	571	916	1487
Hourly Exit Rate	571	916	1487
Input Volume	572	978	1550
% of Volume	100	94	96
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

8: VT 116 & Silver St Performance by approach

Approach	EB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.3	0.3	0.0	0.1
Total Delay (hr)	3.1	0.9	0.5	4.5
Total Del/Veh (s)	39.6	10.0	2.2	11.2
Stop Delay (hr)	2.9	0.7	0.0	3.6
Stop Del/Veh (s)	37.5	8.4	0.0	9.1
Total Stops	274	37	1	312
Stop/Veh	0.99	0.12	0.00	0.22
Travel Dist (mi)	112.5	54.5	113.9	280.9
Travel Time (hr)	7.0	2.8	4.7	14.4
Avg Speed (mph)	16	20	24	20
Vehicles Entered	272	319	833	1424
Vehicles Exited	269	317	832	1418
Hourly Exit Rate	269	317	832	1418
Input Volume	274	310	886	1470
% of Volume	98	102	94	96
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 1: Haystack Rd/Gas Station & Shelburne Falls Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	46	18	34	59
Average Queue (ft)	5	1	12	28
95th Queue (ft)	27	10	36	53
Link Distance (ft)	620	510	572	134
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: VT 116 & Shelburne Falls Rd/CVU Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	338	196	708	835
Average Queue (ft)	173	75	313	461
95th Queue (ft)	297	154	638	895
Link Distance (ft)	510	1214	1481	912
Upstream Blk Time (%)				7
Queuing Penalty (veh)				0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: VT 116 & Haystack Development/Riggs Rd

Movement	WB	SB
Directions Served	LTR	LT
Maximum Queue (ft)	160	230
Average Queue (ft)	54	27
95th Queue (ft)	130	185
Link Distance (ft)	518	1481
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		



Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 4: VT 116 & Farmall Dr/Commerce St

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	L	T	R	L	TR
Maximum Queue (ft)	113	95	559	359	111	362	125	205	700
Average Queue (ft)	44	28	403	187	22	119	48	102	311
95th Queue (ft)	94	72	712	510	70	267	123	224	786
Link Distance (ft)	295		582			951			1083
Upstream Blk Time (%)			33						2
Queuing Penalty (veh)			0						15
Storage Bay Dist (ft)		75		400	100		100	180	
Storage Blk Time (%)	5	1	42	0	0	9	0	0	19
Queuing Penalty (veh)	2	0	36	0	0	16	0	0	31

Intersection: 5: VT 116 & Mechanicsville Rd

Movement	WB	NB	SB
Directions Served	LR	TR	LT
Maximum Queue (ft)	329	10	904
Average Queue (ft)	150	0	442
95th Queue (ft)	311	6	1116
Link Distance (ft)	865	987	951
Upstream Blk Time (%)			4
Queuing Penalty (veh)			36
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 6: Charlotte Rd/Lantmans Exit & VT 116

Movement	EB	EB	WB	NB	SB
Directions Served	L	R	LTR	LT	TR
Maximum Queue (ft)	174	568	520	77	1029
Average Queue (ft)	154	266	255	56	830
95th Queue (ft)	212	639	525	77	1266
Link Distance (ft)		1313	1358	56	987
Upstream Blk Time (%)				34	16
Queuing Penalty (veh)				170	150
Storage Bay Dist (ft)	150				
Storage Blk Time (%)	63	0			
Queuing Penalty (veh)	26	1			

## Queuing and Blocking Report Baseline

08/21/2018

### Intersection: 7: VT 116 & Lantman Enter

Movement	NB	SB	SB
Directions Served	TR	L	T
Maximum Queue (ft)	655	40	96
Average Queue (ft)	275	25	33
95th Queue (ft)	674	47	91
Link Distance (ft)	676		56
Upstream Blk Time (%)	6	0	5
Queuing Penalty (veh)	34	0	49
Storage Bay Dist (ft)		10	
Storage Blk Time (%)		12	0
Queuing Penalty (veh)		110	0

### Intersection: 8: VT 116 & Silver St

Movement	EB	EB	NB	SB
Directions Served	L	R	LT	R
Maximum Queue (ft)	347	106	306	19
Average Queue (ft)	132	11	41	1
95th Queue (ft)	356	73	240	9
Link Distance (ft)	2175		901	
Upstream Blk Time (%)			0	
Queuing Penalty (veh)			0	
Storage Bay Dist (ft)		250		150
Storage Blk Time (%)	6			
Queuing Penalty (veh)	0			

### Network Summary

Network wide Queuing Penalty: 677

1: Haystack Rd/Gas Station & Shelburne Falls Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.1	0.1	0.1
Total Delay (hr)	0.0	0.2	0.1	0.1	0.3
Total Del/Veh (s)	0.6	2.0	4.6	4.6	2.0
Stop Delay (hr)	0.0	0.0	0.1	0.1	0.1
Stop Del/Veh (s)	0.1	0.3	3.8	3.7	0.8
Total Stops	3	8	53	49	113
Stop/Veh	0.02	0.02	1.00	1.00	0.19
Travel Dist (mi)	19.5	34.9	5.8	4.1	64.3
Travel Time (hr)	0.7	1.5	0.3	0.2	2.8
Avg Speed (mph)	28	23	19	18	23
Vehicles Entered	166	328	53	49	596
Vehicles Exited	166	328	53	49	596
Hourly Exit Rate	166	328	53	49	596
Input Volume	166	340	51	50	607
% of Volume	100	96	104	98	98
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

2: VT 116 & Shelburne Falls Rd/CVU Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	0.0	0.3	0.0	0.3	0.1
Total Delay (hr)	3.5	3.5	11.4	1.8	20.2
Total Del/Veh (s)	63.6	42.3	55.7	15.8	44.4
Stop Delay (hr)	3.3	3.1	8.6	1.3	16.4
Stop Del/Veh (s)	60.7	37.4	42.3	11.9	36.1
Total Stops	180	260	760	204	1404
Stop/Veh	0.91	0.87	1.03	0.51	0.86
Travel Dist (mi)	20.4	66.9	209.1	69.3	365.8
Travel Time (hr)	4.3	5.9	18.5	4.2	32.9
Avg Speed (mph)	5	11	11	17	11
Vehicles Entered	194	291	721	400	1606
Vehicles Exited	194	292	718	400	1604
Hourly Exit Rate	194	292	718	400	1604
Input Volume	195	282	802	411	1690
% of Volume	99	104	90	97	95
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

3: VT 116 & Haystack Development/Riggs Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.1	0.9	0.9	1.8
Total Del/Veh (s)	4.6	18.7	4.0	6.8	5.1
Stop Delay (hr)	0.0	0.1	0.1	0.3	0.5
Stop Del/Veh (s)	4.4	17.2	0.4	2.8	1.5
Total Stops	28	13	6	81	128
Stop/Veh	1.00	1.00	0.01	0.18	0.10
Travel Dist (mi)	1.1	1.3	168.5	129.5	300.5
Travel Time (hr)	0.1	0.1	6.7	5.3	12.2
Avg Speed (mph)	12	11	25	24	25
Vehicles Entered	28	13	777	447	1265
Vehicles Exited	28	13	772	448	1261
Hourly Exit Rate	28	13	772	448	1261
Input Volume	25	14	859	462	1360
% of Volume	112	93	90	97	93
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

4: VT 116 & Farmall Dr/Commerce St Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.0	0.0	0.1
Denied Del/Veh (s)	1.0	2.2	0.0	0.0	0.4
Total Delay (hr)	1.2	1.9	3.0	1.2	7.2
Total Del/Veh (s)	45.7	34.6	13.8	10.0	17.5
Stop Delay (hr)	1.1	1.8	1.6	0.7	5.2
Stop Del/Veh (s)	42.6	32.3	7.5	6.4	12.7
Total Stops	85	183	293	141	702
Stop/Veh	0.92	0.92	0.38	0.33	0.47
Travel Dist (mi)	5.1	22.1	147.5	90.3	265.0
Travel Time (hr)	1.4	2.9	8.1	4.3	16.6
Avg Speed (mph)	4	8	18	21	16
Vehicles Entered	91	199	764	417	1471
Vehicles Exited	90	197	770	418	1475
Hourly Exit Rate	90	197	770	418	1475
Input Volume	92	203	862	425	1582
% of Volume	98	97	89	98	93
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

5: VT 116 & Mechanicsville Rd Performance by approach

Approach	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	0.0
Total Delay (hr)	4.7	1.9	0.4	7.0
Total Del/Veh (s)	119.4	7.1	3.0	16.0
Stop Delay (hr)	4.7	0.0	0.1	4.8
Stop Del/Veh (s)	118.7	0.1	0.8	10.9
Total Stops	137	0	9	146
Stop/Veh	0.96	0.00	0.02	0.09
Travel Dist (mi)	22.4	193.0	85.5	300.8
Travel Time (hr)	5.5	8.7	3.3	17.6
Avg Speed (mph)	4	22	26	17
Vehicles Entered	137	980	446	1563
Vehicles Exited	136	982	444	1562
Hourly Exit Rate	136	982	444	1562
Input Volume	136	1113	456	1705
% of Volume	100	88	97	92
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

6: VT 116 & Charlotte Rd/Lantmans Exit Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.2	0.0	0.0	0.0	0.2
Denied Del/Veh (s)	2.8	0.1	0.0	0.0	0.3
Total Delay (hr)	2.5	0.6	1.7	3.1	8.0
Total Del/Veh (s)	44.5	54.6	7.6	19.6	17.5
Stop Delay (hr)	2.3	0.6	1.3	2.1	6.3
Stop Del/Veh (s)	41.0	52.6	5.7	13.3	13.8
Total Stops	184	38	117	275	614
Stop/Veh	0.91	0.95	0.14	0.48	0.37
Travel Dist (mi)	49.8	10.3	18.1	111.8	190.1
Travel Time (hr)	4.4	1.0	2.4	7.0	14.8
Avg Speed (mph)	12	11	8	16	13
Vehicles Entered	201	40	826	566	1633
Vehicles Exited	200	40	827	566	1633
Hourly Exit Rate	200	40	827	566	1633
Input Volume	197	41	969	581	1788
% of Volume	102	98	85	97	91
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

7: VT 116 & Lantman Enter Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	12.6	0.3	12.9
Total Del/Veh (s)	51.9	1.9	33.0
Stop Delay (hr)	9.4	0.1	9.5
Stop Del/Veh (s)	38.7	0.6	24.2
Total Stops	782	13	795
Stop/Veh	0.89	0.02	0.56
Travel Dist (mi)	118.8	12.3	131.1
Travel Time (hr)	16.8	0.7	17.5
Avg Speed (mph)	7	17	7
Vehicles Entered	853	534	1387
Vehicles Exited	852	534	1386
Hourly Exit Rate	852	534	1386
Input Volume	998	548	1546
% of Volume	85	97	90
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

8: VT 116 & Silver St Performance by approach

Approach	EB	NB	SB	All
Denied Delay (hr)	16.5	0.2	0.0	16.7
Denied Del/Veh (s)	149.9	1.0	0.0	38.4
Total Delay (hr)	92.1	2.2	0.2	94.5
Total Del/Veh (s)	908.3	12.1	1.7	221.1
Stop Delay (hr)	95.0	1.6	0.0	96.6
Stop Del/Veh (s)	937.0	8.7	0.0	225.9
Total Stops	239	133	3	375
Stop/Veh	0.65	0.20	0.01	0.24
Travel Dist (mi)	145.7	98.4	70.8	315.0
Travel Time (hr)	113.6	5.7	2.8	122.1
Avg Speed (mph)	2	18	25	3
Vehicles Entered	324	645	523	1492
Vehicles Exited	240	645	521	1406
Hourly Exit Rate	240	645	521	1406
Input Volume	407	630	535	1572
% of Volume	59	102	97	89
Denied Entry Before	0	0	0	0
Denied Entry After	72	0	0	72

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 1: Haystack Rd/Gas Station & Shelburne Falls Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	39	58	62	54
Average Queue (ft)	4	8	28	26
95th Queue (ft)	22	34	51	50
Link Distance (ft)	619	507	571	441
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: VT 116 & Shelburne Falls Rd/CVU Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	351	355	882	324
Average Queue (ft)	146	171	459	126
95th Queue (ft)	300	298	940	248
Link Distance (ft)	507	1212	1477	911
Upstream Blk Time (%)	0		0	
Queuing Penalty (veh)	0		1	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: VT 116 & Haystack Development/Riggs Rd

Movement	EB	WB	NB	SB
Directions Served	R	LTR	TR	LTR
Maximum Queue (ft)	50	40	56	239
Average Queue (ft)	19	12	4	58
95th Queue (ft)	45	37	76	168
Link Distance (ft)	206	516	1081	1477
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 4: VT 116 & Farmall Dr/Commerce St

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	L	T	R	L	TR
Maximum Queue (ft)	151	98	167	85	115	470	125	137	260
Average Queue (ft)	62	18	76	37	23	186	33	29	80
95th Queue (ft)	119	62	142	70	78	394	108	84	190
Link Distance (ft)	294		581			948			1081
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)		75		400	100		100	180	
Storage Blk Time (%)	14	0			0	14	0		1
Queuing Penalty (veh)	3	0			0	22	0		1

Intersection: 5: VT 116 & Mechanicsville Rd

Movement	WB	NB	SB
Directions Served	LR	TR	LT
Maximum Queue (ft)	357	9	159
Average Queue (ft)	160	0	8
95th Queue (ft)	366	5	79
Link Distance (ft)	864	984	948
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 6: VT 116 & Charlotte Rd/Lantmans Exit

Movement	EB	EB	WB	NB	SB
Directions Served	L	R	LTR	LT	TR
Maximum Queue (ft)	174	218	97	84	444
Average Queue (ft)	117	38	38	61	196
95th Queue (ft)	181	143	81	75	374
Link Distance (ft)		1311	1357	55	984
Upstream Blk Time (%)				41	
Queuing Penalty (veh)				397	
Storage Bay Dist (ft)	150				
Storage Blk Time (%)	6				
Queuing Penalty (veh)	2				



Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 7: VT 116 & Lantman Enter

Movement	NB	SB	SB
Directions Served	TR	L	T
Maximum Queue (ft)	683	38	64
Average Queue (ft)	518	10	6
95th Queue (ft)	801	34	34
Link Distance (ft)	670		55
Upstream Blk Time (%)	8	1	0
Queuing Penalty (veh)	77	0	1
Storage Bay Dist (ft)		20	
Storage Blk Time (%)		6	0
Queuing Penalty (veh)		34	0

Intersection: 8: VT 116 & Silver St

Movement	EB	EB	NB	SB	SB
Directions Served	L	R	LT	T	R
Maximum Queue (ft)	2844	275	525	1	31
Average Queue (ft)	2203	77	105	0	2
95th Queue (ft)	3462	280	399	2	15
Link Distance (ft)	2825		804	670	
Upstream Blk Time (%)	43		1		
Queuing Penalty (veh)	0		0		
Storage Bay Dist (ft)		250			150
Storage Blk Time (%)	100	0			
Queuing Penalty (veh)	18	0			

Network Summary

Network wide Queuing Penalty: 555
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1: Haystack Rd/Gas Station & Shelburne Falls Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.3	0.0	0.1	0.1	0.2
Total Delay (hr)	0.2	0.1	0.1	0.1	0.6
Total Del/Veh (s)	2.9	1.9	6.6	8.1	3.3
Stop Delay (hr)	0.2	0.0	0.1	0.1	0.4
Stop Del/Veh (s)	2.0	0.4	5.8	7.2	2.2
Total Stops	13	12	61	47	133
Stop/Veh	0.04	0.05	1.00	1.00	0.21
Travel Dist (mi)	35.8	24.0	6.5	1.2	67.5
Travel Time (hr)	1.5	1.1	0.4	0.2	3.1
Avg Speed (mph)	24	22	17	7	22
Vehicles Entered	305	226	60	47	638
Vehicles Exited	303	227	60	47	637
Hourly Exit Rate	303	227	60	47	637
Input Volume	297	235	61	50	643
% of Volume	102	97	98	94	99
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

2: VT 116 & Shelburne Falls Rd/CVU Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	5.6	5.6
Denied Del/Veh (s)	0.1	0.2	0.2	24.5	11.4
Total Delay (hr)	6.1	1.3	21.7	16.8	45.8
Total Del/Veh (s)	62.5	37.9	153.2	74.5	92.1
Stop Delay (hr)	5.5	1.2	20.3	13.5	40.6
Stop Del/Veh (s)	57.0	34.8	143.9	60.0	81.6
Total Stops	322	95	581	791	1789
Stop/Veh	0.92	0.80	1.14	0.98	1.00
Travel Dist (mi)	36.2	26.6	142.2	136.6	341.6
Travel Time (hr)	7.5	2.2	26.6	27.0	63.4
Avg Speed (mph)	5	12	5	6	6
Vehicles Entered	341	116	495	797	1749
Vehicles Exited	341	116	486	781	1724
Hourly Exit Rate	341	116	486	781	1724
Input Volume	337	118	527	816	1798
% of Volume	101	98	92	96	96
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	23	23

3: VT 116 & Haystack Development/Riggs Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.2	0.0	0.0	0.0
Total Delay (hr)	0.2	1.2	0.5	3.7	5.5
Total Del/Veh (s)	26.6	39.1	3.8	16.2	14.3
Stop Delay (hr)	0.2	1.1	0.2	2.5	4.0
Stop Del/Veh (s)	26.3	37.9	1.4	11.1	10.5
Total Stops	27	105	10	67	209
Stop/Veh	1.00	0.98	0.02	0.08	0.15
Travel Dist (mi)	1.1	10.3	92.9	230.9	335.1
Travel Time (hr)	0.3	1.6	3.7	11.6	17.1
Avg Speed (mph)	4	7	25	20	20
Vehicles Entered	27	105	428	799	1359
Vehicles Exited	26	103	430	791	1350
Hourly Exit Rate	26	103	430	791	1350
Input Volume	25	112	458	819	1414
% of Volume	104	92	94	97	95
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

4: VT 116 & Farmall Dr/Commerce St Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.1	4.6	0.0	0.0	4.7
Denied Del/Veh (s)	2.9	51.5	0.0	0.1	9.8
Total Delay (hr)	1.0	13.7	1.9	8.6	25.3
Total Del/Veh (s)	38.5	161.3	13.8	38.5	53.2
Stop Delay (hr)	0.9	13.4	1.3	6.7	22.3
Stop Del/Veh (s)	36.1	157.2	9.2	29.9	46.9
Total Stops	82	321	243	543	1189
Stop/Veh	0.88	1.05	0.48	0.67	0.69
Travel Dist (mi)	5.0	32.4	96.1	170.7	304.3
Travel Time (hr)	1.3	19.5	5.3	14.5	40.7
Avg Speed (mph)	4	2	18	12	8
Vehicles Entered	90	299	502	795	1686
Vehicles Exited	90	286	502	780	1658
Hourly Exit Rate	90	286	502	780	1658
Input Volume	89	318	531	825	1763
% of Volume	101	90	95	95	94
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	20	0	0	20

5: VT 116 & Mechanicsville Rd Performance by approach

Approach	WB	NB	SB	All
Denied Delay (hr)	0.2	0.0	0.0	0.2
Denied Del/Veh (s)	4.8	0.0	0.0	0.4
Total Delay (hr)	5.4	0.8	12.3	18.5
Total Del/Veh (s)	144.4	4.3	54.7	41.6
Stop Delay (hr)	5.4	0.0	10.1	15.5
Stop Del/Veh (s)	143.5	0.1	45.1	34.9
Total Stops	132	0	400	532
Stop/Veh	0.98	0.00	0.49	0.33
Travel Dist (mi)	21.4	128.2	152.7	302.3
Travel Time (hr)	6.4	5.4	17.6	29.3
Avg Speed (mph)	3	24	9	10
Vehicles Entered	132	652	803	1587
Vehicles Exited	127	653	783	1563
Hourly Exit Rate	127	653	783	1563
Input Volume	132	691	867	1690
% of Volume	96	95	90	92
Denied Entry Before	0	0	0	0
Denied Entry After	2	0	0	2

6: Charlotte Rd/Lantmans Exit & VT 116 Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.1	0.0	0.0	0.4	0.6
Denied Del/Veh (s)	2.5	0.2	0.0	1.7	1.2
Total Delay (hr)	14.0	9.3	1.2	23.1	47.5
Total Del/Veh (s)	266.4	206.8	8.4	90.9	96.7
Stop Delay (hr)	13.9	9.2	1.0	17.2	41.2
Stop Del/Veh (s)	263.9	204.2	6.9	67.8	83.8
Total Stops	232	162	106	1143	1643
Stop/Veh	1.23	1.00	0.21	1.25	0.93
Travel Dist (mi)	43.8	39.2	10.9	174.3	268.3
Travel Time (hr)	15.7	10.7	1.6	29.5	57.5
Avg Speed (mph)	3	4	7	6	5
Vehicles Entered	181	155	503	893	1732
Vehicles Exited	166	143	503	878	1690
Hourly Exit Rate	166	143	503	878	1690
Input Volume	181	157	522	981	1841
% of Volume	92	91	96	90	92
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	1	1

7: VT 116 & Lantman Enter Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.1
Denied Del/Veh (s)	0.2	0.3	0.2
Total Delay (hr)	5.1	0.7	5.9
Total Del/Veh (s)	31.8	3.0	14.3
Stop Delay (hr)	4.2	0.3	4.4
Stop Del/Veh (s)	25.9	1.1	10.8
Total Stops	266	60	326
Stop/Veh	0.46	0.07	0.22
Travel Dist (mi)	79.0	20.5	99.5
Travel Time (hr)	8.0	1.6	9.6
Avg Speed (mph)	10	13	10
Vehicles Entered	573	902	1475
Vehicles Exited	569	903	1472
Hourly Exit Rate	569	903	1472
Input Volume	589	999	1588
% of Volume	97	90	93
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

8: VT 116 & Silver St Performance by approach

Approach	EB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	0.3	0.5	0.0	0.2
Total Delay (hr)	2.6	0.8	0.5	3.9
Total Del/Veh (s)	32.8	9.4	2.2	10.0
Stop Delay (hr)	2.4	0.7	0.0	3.1
Stop Del/Veh (s)	30.1	8.1	0.0	7.8
Total Stops	281	27	2	310
Stop/Veh	0.98	0.09	0.00	0.22
Travel Dist (mi)	115.3	53.2	112.1	280.6
Travel Time (hr)	6.6	2.7	4.6	13.9
Avg Speed (mph)	17	20	24	20
Vehicles Entered	281	313	820	1414
Vehicles Exited	276	309	819	1404
Hourly Exit Rate	276	309	819	1404
Input Volume	281	318	906	1505
% of Volume	98	97	90	93
Denied Entry Before	0	0	0	0
Denied Entry After	0	1	0	1

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 1: Haystack Rd/Gas Station & Shelburne Falls Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	128	65	66	68
Average Queue (ft)	13	10	28	28
95th Queue (ft)	95	41	53	56
Link Distance (ft)	620	510	572	134
Upstream Blk Time (%)	0			
Queuing Penalty (veh)	0			
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: VT 116 & Shelburne Falls Rd/CVU Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	454	180	1268	954
Average Queue (ft)	246	74	696	618
95th Queue (ft)	432	145	1365	1095
Link Distance (ft)	510	1214	1479	912
Upstream Blk Time (%)	2		1	22
Queuing Penalty (veh)	6		6	0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: VT 116 & Haystack Development/Riggs Rd

Movement	EB	WB	NB	SB
Directions Served	R	LTR	TR	LTR
Maximum Queue (ft)	66	214	69	433
Average Queue (ft)	22	65	6	85
95th Queue (ft)	55	177	74	553
Link Distance (ft)	208	518	1084	1479
Upstream Blk Time (%)		0		1
Queuing Penalty (veh)		0		11
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 4: VT 116 & Farmall Dr/Commerce St

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	L	T	R	L	TR
Maximum Queue (ft)	139	97	576	392	112	364	125	204	750
Average Queue (ft)	46	33	379	152	26	121	44	96	338
95th Queue (ft)	111	77	683	460	75	277	117	217	844
Link Distance (ft)	295		582			951			1084
Upstream Blk Time (%)	1		26						3
Queuing Penalty (veh)	0		0						29
Storage Bay Dist (ft)		75		400	100		100	180	
Storage Blk Time (%)	5	2	37	0	0	9	0	0	20
Queuing Penalty (veh)	2	1	31	0	0	16	0	0	34

Intersection: 5: VT 116 & Mechanicsville Rd

Movement	WB	NB	SB
Directions Served	LR	TR	LT
Maximum Queue (ft)	368	4	817
Average Queue (ft)	171	0	395
95th Queue (ft)	417	3	1064
Link Distance (ft)	865	987	951
Upstream Blk Time (%)	1		6
Queuing Penalty (veh)	0		49
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 6: Charlotte Rd/Lantmans Exit & VT 116

Movement	EB	EB	WB	NB	SB
Directions Served	L	R	LTR	LT	TR
Maximum Queue (ft)	174	636	523	80	1024
Average Queue (ft)	159	341	274	56	805
95th Queue (ft)	215	718	556	79	1259
Link Distance (ft)		1313	1358	56	987
Upstream Blk Time (%)				28	16
Queuing Penalty (veh)				144	154
Storage Bay Dist (ft)	150				
Storage Blk Time (%)	72	2			
Queuing Penalty (veh)	29	3			

## Queuing and Blocking Report Baseline

08/21/2018

### Intersection: 7: VT 116 & Lantman Enter

Movement	NB	SB	SB
Directions Served	TR	L	T
Maximum Queue (ft)	692	46	86
Average Queue (ft)	229	25	30
95th Queue (ft)	599	48	85
Link Distance (ft)	676		56
Upstream Blk Time (%)	5	0	6
Queuing Penalty (veh)	30	0	57
Storage Bay Dist (ft)		10	
Storage Blk Time (%)		13	0
Queuing Penalty (veh)		117	0

### Intersection: 8: VT 116 & Silver St

Movement	EB	EB	NB	SB
Directions Served	L	R	LT	R
Maximum Queue (ft)	346	74	272	27
Average Queue (ft)	123	8	34	1
95th Queue (ft)	306	54	211	12
Link Distance (ft)	2175		901	
Upstream Blk Time (%)			0	
Queuing Penalty (veh)			0	
Storage Bay Dist (ft)		250		150
Storage Blk Time (%)	3	0		
Queuing Penalty (veh)	0	0		

### Network Summary

Network wide Queuing Penalty: 721



# APPENDIX C



2: VT 116 & Shelburne Falls Rd/CVU Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.0	0.1	0.2
Denied Del/Veh (s)	0.0	1.6	0.0	0.7	0.5
Total Delay (hr)	0.6	1.2	2.5	1.5	5.8
Total Del/Veh (s)	13.0	15.6	12.5	13.0	13.2
Stop Delay (hr)	0.5	1.0	1.1	1.0	3.7
Stop Del/Veh (s)	11.4	12.6	5.7	9.1	8.4
Total Stops	122	209	343	229	903
Stop/Veh	0.74	0.77	0.47	0.56	0.57
Travel Dist (mi)	17.0	61.6	207.1	70.6	356.3
Travel Time (hr)	1.2	3.5	9.6	4.0	18.3
Avg Speed (mph)	14	18	22	18	20
Vehicles Entered	161	268	715	409	1553
Vehicles Exited	163	268	716	409	1556
Hourly Exit Rate	163	268	716	409	1556
Input Volume	159	272	773	397	1601
% of Volume	103	99	93	103	97
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 2: 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)	90	71	146	122	176	283	93	212
Average Queue (ft)	41	29	68	49	57	127	23	100
95th Queue (ft)	79	56	119	96	126	231	61	179
Link Distance (ft)	504		1208			1469		906
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)		210		100	175		150	
Storage Blk Time (%)			2	0		2		2
Queuing Penalty (veh)			3	0		3		1

2: VT 116 & Shelburne Falls Rd/CVU Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	0.3	0.4
Denied Del/Veh (s)	0.0	1.5	0.0	1.6	0.9
Total Delay (hr)	2.3	0.9	1.7	3.7	8.6
Total Del/Veh (s)	27.6	30.1	12.8	17.1	18.6
Stop Delay (hr)	2.1	0.8	1.0	2.5	6.5
Stop Del/Veh (s)	25.3	27.3	7.7	11.7	14.0
Total Stops	248	89	210	354	901
Stop/Veh	0.83	0.82	0.43	0.45	0.54
Travel Dist (mi)	31.2	24.2	137.4	132.6	325.4
Travel Time (hr)	3.5	1.8	6.5	8.6	20.4
Avg Speed (mph)	9	14	21	16	16
Vehicles Entered	295	106	476	773	1650
Vehicles Exited	293	107	477	763	1640
Hourly Exit Rate	293	107	477	763	1640
Input Volume	302	113	505	775	1695
% of Volume	97	95	94	98	97
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	1	1

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 2: 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)	185	162	134	87	166	282	174	552
Average Queue (ft)	91	60	51	24	44	97	62	199
95th Queue (ft)	159	119	104	59	104	225	152	479
Link Distance (ft)	505		1208			1469		906
Upstream Blk Time (%)								1
Queuing Penalty (veh)								0
Storage Bay Dist (ft)		210		100	175		150	
Storage Blk Time (%)	0	0	2	0		2	0	12
Queuing Penalty (veh)	0	0	1	0		2	0	15

2: VT 116 & Shelburne Falls Rd/CVU Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.1	0.0	0.1	0.2
Denied Del/Veh (s)	0.0	1.6	0.0	0.7	0.4
Total Delay (hr)	0.9	1.3	3.0	1.7	6.8
Total Del/Veh (s)	15.9	15.9	13.8	14.2	14.5
Stop Delay (hr)	0.8	1.0	1.4	1.2	4.4
Stop Del/Veh (s)	14.1	12.9	6.5	10.2	9.4
Total Stops	153	217	405	246	1021
Stop/Veh	0.78	0.76	0.52	0.59	0.61
Travel Dist (mi)	20.3	64.5	221.8	71.6	378.1
Travel Time (hr)	1.7	3.7	10.5	4.2	20.1
Avg Speed (mph)	12	18	21	17	19
Vehicles Entered	193	282	765	415	1655
Vehicles Exited	193	280	767	415	1655
Hourly Exit Rate	193	280	767	415	1655
Input Volume	195	282	802	411	1690
% of Volume	99	99	96	101	98
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 2: 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)	120	70	168	123	182	299	92	240
Average Queue (ft)	54	31	73	50	68	136	24	107
95th Queue (ft)	99	58	132	98	146	245	63	190
Link Distance (ft)	504		1208			1469		906
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)		210		100	175		150	
Storage Blk Time (%)			3	0	0	2		2
Queuing Penalty (veh)			3	1	0	5		1

2: VT 116 & Shelburne Falls Rd/CVU Rd Performance by approach

Approach	EB	WB	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0	6.9	7.0
Denied Del/Veh (s)	0.0	1.5	0.0	30.2	14.1
Total Delay (hr)	2.9	1.0	2.0	7.7	13.6
Total Del/Veh (s)	31.3	31.3	14.0	34.5	27.7
Stop Delay (hr)	2.7	0.9	1.3	6.2	11.0
Stop Del/Veh (s)	28.8	28.4	8.9	27.7	22.5
Total Stops	280	91	226	447	1044
Stop/Veh	0.83	0.82	0.44	0.56	0.59
Travel Dist (mi)	35.3	25.3	146.7	136.5	343.9
Travel Time (hr)	4.3	1.9	7.1	19.3	32.7
Avg Speed (mph)	8	14	21	11	13
Vehicles Entered	335	110	507	796	1748
Vehicles Exited	333	110	507	784	1734
Hourly Exit Rate	333	110	507	784	1734
Input Volume	337	118	527	816	1798
% of Volume	99	93	96	96	96
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	33	33



Queuing and Blocking Report  
Baseline

08/21/2018

Intersection: 2: 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)	242	198	124	81	185	294	174	665
Average Queue (ft)	111	71	53	24	60	96	79	319
95th Queue (ft)	196	145	104	58	134	227	182	761
Link Distance (ft)	505		1208			1469		906
Upstream Blk Time (%)								10
Queuing Penalty (veh)								0
Storage Bay Dist (ft)		210		100	175		150	
Storage Blk Time (%)	1	0	2	0	0	3	0	22
Queuing Penalty (veh)	1	1	1	0	1	3	0	30

# MEMO

**TO:** Benjamin Avery, Black Rock Construction, LLC  
**FROM:** Mark Smith, PE  
**DATE:** April 22, 2019  
**SUBJECT:** Haystack Crossing Traffic Impact Study – Update

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RSG recently completed a traffic analysis of the proposed Haystack Crossing development – Phase 1, dated 8-20-18.

This memo provides additional information to reflect recent changes to the development program, and addresses comments received from the Town staff and VTrans.

## 1.0 NEW DEVELOPMENT PROGRAM

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The 8-20-18 traffic analysis assumed Phase 1 of the development would create 131 trips in the AM Peak Hour and 153 trips in the PM Peak Hour (plus 16 pass-by trips). As a conservative measure, no accounting for Transportation Demand Management or Internal Trips was made in that analysis.

Transportation Demand Management (TDM) measures include the provision of features that encourage the use of alternate modes of transportation, thus reducing the expected trip generation. These measures include building connections to the network of bicycle and pedestrian facilities or making transit available to the residents/occupants of the development. A typical reduction in trip generation ranges from 4-20%, depending on the degree of accommodations. Guidance from VTrans<sup>1</sup> suggest that the modest measures proposed would be eligible for the minimum 4% reduction. These measures include:

- Designing the site to support walking and transit access
- Sidewalk and shared use path improvements

Internal Trips are trips made between uses in a mixed-use development such as Haystack – Phase 1. For instance, an office employee may choose to live in nearby housing, or a resident patronizes the restaurant. As part of the ITE Trip Generation Manual, a tool is provided to estimate internal trips<sup>2</sup> (referred to as Internal Capture).

The latest iteration of the development program, and the expected trip generation, including reductions for TDM and Internal Capture are provided in Table 1. These results show a modest

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<sup>1</sup> VT Agency of Transportation, TDM Guidance, March 2016

<sup>2</sup> Based on NCHRP Report 684: *Enhancing Internal Trip Capture Estimation for Mixed Use Developments*

reduction in expected trips compared to the 8-20-18 Traffic Impact Analysis. The use of access points and trip distribution onto the adjacent public road network are also expected to be similar to the assumptions in the previous analysis.

**FIGURE 1. UPDATED DEVELOPMENT PROGRAM AND ESTIMATED TRIP GENERATION<sup>3</sup>**

	LUC	units	AM Peak Hour		PM Peak Hour		
			enter	exit	enter	exit	
<b>RESIDENTIAL</b>							
Single family detached housing	210	47	9	29	29	17	
Multi-family (apt) - low-rise	220	54	11	35	36	21	
Townhomes (attached)	220	42	<i>&lt;= included above =&gt;</i>				
Senior housing (attached)	252	50	3	7	8	6	
		193	23	71	73	44	
<b>COMMERICAL</b>							
light industrial	110	3,274	3	1	0	4	
General office	710	8,363	8	2	2	8	
Retail	814	5,018	3	2	9	10	
Restaurant	932	3,345	18	15	12	7	
		16,726	32	20	23	29	
			subtotal	55	90	96	73
			less TDM reductions	2	4	4	3
			less Internal Capture	8	8	15	15
			subtotal	45	78	77	55
			Total	124		132	
						plus 14 passby	

<sup>3</sup> LUC-ITE Land Use Code



## 2.0 COMMENTS FROM TOWN STAFF

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RSG, Blackrock and CEA met with VTrans staff<sup>4</sup> in October of 2018 to review the Draft Traffic Impact Study, and then met separately with Town of Hinesburg planning staff in November of 2018. Additional information requested and questions raised include:

1. Address/describe the project's accommodations for bicyclists and pedestrians:

At a minimum, sidewalks are proposed throughout the project adjacent to all roadways. The final cross-section of the roadways are still under development, but the intent is to safely accommodate all modes of transportation. A shared use path is also proposed along VT116 (west side) from the Riggs Road intersection connecting to the existing sidewalk network near Kinney Drug. Please see detailed site plan by TJBoyle Associates.

2. Was the entrance to Lantman's store (just south of Charlotte Road) included in the analysis?

This intersection was part of the microsimulation traffic model used to determine network performance in all scenarios.

3. What are the peak traffic times?

The peak hours of analysis (determined by the actual traffic counts) are 7:30-8:30 AM and 4:45-5:45 PM<sup>5</sup>.

4. Describe the methods used to distribute traffic onto the public road network:

A gravity model was used to determine the origins and destinations of new trips based on existing traffic patterns. New traffic was assumed to gravitate to the following nodes surrounding the project area:

- Charlotte Road
- VT116 (to north)
- CVU Road
- Commerce St
- Charlotte Road (west)
- Silver Street
- VT116 (to south)

New residential traffic followed the proportion of existing traffic flowing in/out of each node for the given time period (AM/PM). Commercial trips (i.e. to/from places of employment) are assumed to flow in the opposite direction of existing traffic.

5. Are any turning lanes warranted at the Shelburne Falls / Haystack Road access?

No additional lanes are warranted in Phase 1 of the development. A westbound left turn lane is anticipated in future phases.

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<sup>4</sup> Utilities / Permitting Services and District 5.

<sup>5</sup> Some minor variations occurred at some intersection. The actual peak volume at each intersection was used in the analysis.



6. Discuss queues eastbound on Shelburne Falls at VT116:
  - Available queuing distance is ~520 ft.
  - AM peak build maximum queue (95 percentile) is 300 ft. (assuming existing road configuration and signal operation, see TIS Table 7).
  - PM build maximum queue is 432 ft. (existing road configuration and signal operation, see TIS Table 8).
  - Queues are expected to be substantially reduced with the improvements planned by VTrans at this intersection (AM 99 ft., PM 196 ft., see Table 9).

7. Discuss the suitability of the development access points in more detail:

The traffic analysis shows that much of the traffic in the peak hours gravitates to and from the north and northwest. The access at Shelburne Falls Road serves this traffic well. The connection at Riggs Road / VT116 is developed as much as practicable at this time (i.e. right turns only), given safety concerns associated with the high crash location.

If/when the development builds future phases it is expected that more traffic will travel to and from the village area, and the intersection of Riggs Road and VT116 may support full access (i.e. allow all turning movements).

Additional access to the south (connecting to Hinesburg Center Phase 2) has been anticipated and accommodated to the southern property line at Patrick Brook.

END OF MEMO

