

Date: 7 February 2022
To: Ben Avery, Project Manager
From: Corey Mack, PE
Subject: Haystack Transportation Support – Queue Assessment

WCG has been requested to address Conditions of Approval Order 19 of Preliminary Approval for the Haystack project in Hinesburg VT. Order 19 reads:

“The traffic studies shall be updated to evaluate traffic generation to the 95% percentile standard. The updated study will be reviewed at final.”

Order 19 is related to Conclusion 12:

“The Applicant’s traffic review uses average queue and does not provide an analysis for areas south of Riggs Road on VT Route 116. The Board agrees with the Applicant that no additional review to the south of Riggs Road is required. Per the Town’s independent traffic engineer’s recommendation, the traffic review should be updated to include the 95th percentile standard queue in order to better address conformance with Section 5.1.6 of the HSR for phase 1. Concerns regarding access and egress from this development on to Shelburne Falls Road need to be explored. Improvements (e.g., Haystack Crossing turn lanes, intersection striping/signage on Shelburne Falls Road) may be warranted given observed queuing during peak times. The Applicant should discuss possible improvements with the Town Highway Foreman and the Selectboard.”

This memo reports and evaluates the 95th percentile queues as originally presented in the traffic analyses.

BACKGROUND

RSG prepared an Updated Traffic Impact Assessment, dated 18 May 2020. The assessment included updated trip generation estimates, trip distribution, and traffic modeling for the study area. The traffic modeling scenarios included phased development of the Haystack project and the adjacent VT-116 & Shelburne Falls Road / CVU Road intersection, with 2021 scenarios including for phase 1A of Haystack and no intersection improvements, 2026 scenarios including Haystack phases 1A plus 1B and improvements to the VT-116 & Shelburne Falls Road / CVU Road intersection in place.

The traffic modeling included microsimulation queue analysis in SimTraffic software. The microsimulation software models a peak hour of traffic movements, recording spot queues to every intersection approach at two-minute intervals. The arithmetic mean of the recorded queue data is reported as the average queue length; the longest recorded queue is reported as the maximum queue, and the 95th percentile queue is reported as the average queue multiplied by 1.65 standard deviations of the average queue data set. The 95th percentile queue is often used to represent the peak queue to be expected that may occur once during the analysis hour.

The 95th percentile queue may also be estimated from formulas contained in the Highway Capacity Manual using derived values, including capacity, demand, incremental delay, number of lanes, duration of unmet demand, effective green, and other variables.

QUEUE RESULTS

As reported in the 18 May 2020 Memo Appendices, the average and 95th percentile queues from the SimTraffic Queue Analysis are presented in Table 1. This analysis was prepared using information from a May 2019 traffic count at VT-116 & Shelburne Falls Road / CVU Road, prior to the traffic signal intersection upgrades.

TABLE 1: 2026 AVERAGE AND 95TH QUEUES AS REPORTED IN THE 18 MAY 2020 TRAFFIC ANALYSIS; HIGHLIGHTED CELLS INDICATE QUEUE LENGTH EXCEEDS STORAGE CAPACITY

	Storage Length (ft)	Average Queue Length (ft)				95th Percentile Queue Length (ft)			
		AM		PM		AM		PM	
		No Build	Build	No Build	Build	No Build	Build	No Build	Build
EB Thru / Left Shel. Falls Rd	-	135	232	112	109	244	433	186	167
EB Right Shel. Falls Rd	220	40	89	62	71	122	252	114	140
WB Thru / Left CVU Rd	-	192	265	78	81	388	533	149	144
WB Right CVU Rd	120	108	124	40	39	179	180	95	102
NB Left VT-116	175	114	128	46	64	241	247	121	152
NB Thru / Right VT-116	-	360	467	146	172	649	877	263	306
SB Left VT-116	200	64	60	101	118	137	120	227	257
SB Thru / Right	-	129	116	218	323	252	212	378	580

As noted in the 18 May 2020 analysis, the largest increase in queue length is associated with the VT-116 through movements. This is associated with the additional green time assigned to the eastbound and westbound approaches, resulting in a longer red phase for the VT-116 approaches. The longer red phase allows the queue to grow longer in each cycle. However, queues consistently cleared and vehicles progressed through the network.

Reviewing the instances in which the estimated 95th percentile queues exceed the storage capacity, the estimated 95th percentile queue lengths exceed storage capacity in the existing, no-build condition by as much as 65 feet, or around 2-3 vehicle lengths. The 95th percentile queues are not expected to change significantly from the no build to build conditions, except for the eastbound Shelburne Falls Road right turn lane.

- The westbound CVU Road right turn lane and northbound VT-116 left turn lane queues are expected to change by less than 25 feet, or less than the equivalent of one vehicle.
- The southbound VT-116 left turn lane queue is expected to increase by 30 feet, or approximately one vehicle.
- The eastbound Shelburne Falls Road approach queues are estimated to increase from the no build to build condition in the AM peak hour. While no new eastbound rights are

expected at this intersection in the build condition¹, the new eastbound left turn and through demand consumes more of the approach capacity, adding to the overall queues to be expected on this approach. The longer 95th percentile queues are estimated to grow through the Haystack Road intersection, and the right turn lane queue is estimated to exceed the storage capacity by approximately 32 feet, or a little over one vehicle length.

These queues are not expected to significantly impact vehicle operations or safety. As 95th percentile queues, this length of queue would be expected to occur only once in the design hour. In this peak queue condition that is expected to occur once in the peak hour, the proposed build condition queues are not expected to increase significantly. The queue that increases the most in the build condition is the eastbound Shelburne Falls Road approach.

The average queues are more likely to be representative of the queue length that would be expected at any point during the design hour. SimTraffic modeling indicated that the peak turn lane queues would dissipate quickly.

If excessive eastbound queueing is persistent due to left turning vehicles, through vehicles may use the right turn lane to bypass the stopped / waiting left turning vehicles. This may create conflict within this approach with unexpected lane changes or through movements from the dedicated right turn lane. We recommend that this condition is evaluated five years after build to consider if approach lane reconfiguration is warranted.

ATTACHEMENTS

Excerpt Traffic Reports from RSG Updated Traffic Impact Assessment, 5/18/2020

¹ May 18, 2020 Updated Traffic Impact Assessment, Figure 3

Queuing and Blocking Report Baseline

05/15/2020

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

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

Intersection: 6: VT-116 & Riggs Rd

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

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

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

Network Summary

Network wide Queuing Penalty: 107

Queuing and Blocking Report Baseline

05/15/2020

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

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

Intersection: 6: VT-116 & Riggs Rd

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

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

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

Network Summary

Network wide Queuing Penalty: 199

Queuing and Blocking Report Baseline

05/15/2020

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

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

Intersection: 6: VT-116 & Riggs Rd

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

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

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

Network Summary

Network wide Queuing Penalty: 26

Queuing and Blocking Report Baseline

05/15/2020

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

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

Intersection: 6: VT-116 & Riggs Rd

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

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

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

Network Summary

Network wide Queuing Penalty: 52