Office of Highway Safety

Road Safety Audit Review

Town:	Cambridge	**Date Reviewed:**	June 26 2018
Route:	VT 15, VT 104 and Old RTE 15	**Mile points:**	VT 15: 1.75 – 1.88 VT 104: 0.00-0.08

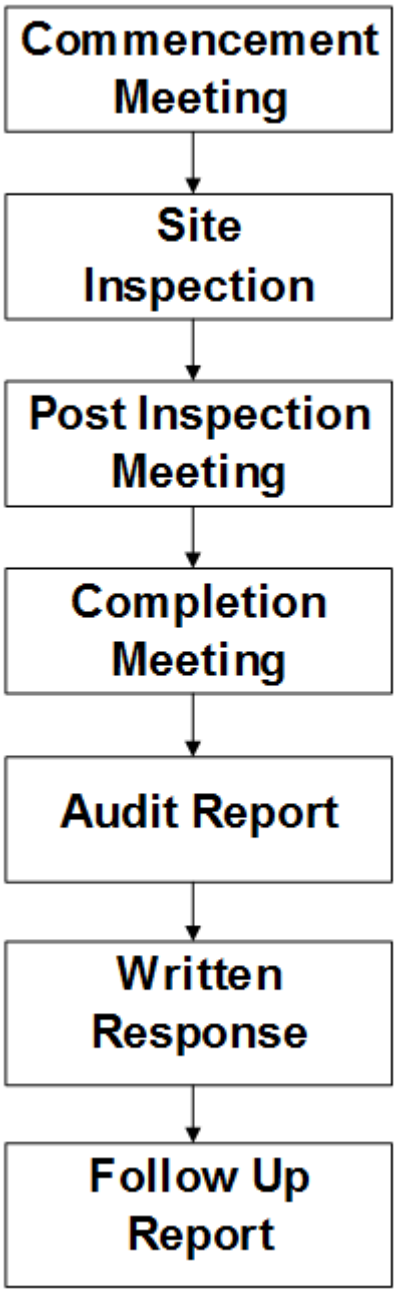
Location Map

RSAR Process

A Road Safety Audit Review (RSAR) is a formal examination of an existing road in which an independent, multi-discipline team (the Audit Team) reports on potential safety issues.

According to the Federal Highway Administration (FHWA), the purpose of a RSAR is to determine which elements of the road may present a safety concern, to what extent and under what circumstances as well as to identify opportunities to mitigate the identified safety concerns.

Figure 1 - Road Safety Audit Process



The RSAR process is composed of several steps as shown in Figure 1. The process starts with a Commencement Meeting during which the Audit Team reviews data and gathers community concerns. A Site Inspection is then performed by the Audit Team. The site visit involves the identification of safety deficiencies as seen in the field. The Audit Team will usually drive through the location of interest to “get a feel” for the area, traveling through each approach in the case of intersections. The team is to then drive at a slower speed to make observations. If needed, the team will also walk the location. Following the site inspection, the Audit Team holds a Post Inspection Meeting**.** It is during this meeting that the team members discuss their observations and identify safety issues. The team is to reach a consensus on the importance of each safety issue mentioned. Only those issues for which a consensus is reached are included in the RSAR findings. A RSAR report (Written Report) is prepared.

The Written Report identifies safety concerns and proposes guidance. These issues and solutions are presented in a tabular format associated to each Responsible Entity for ease of reporting. The Responsible Entities are any groups who own a roadway feature or who are responsible for making an improvement or for initiating further studies. These could include for example, the VTrans design section, the local town, the local police or the local RPC.

Location

The location of this RSAR is the intersection of VT 15, VT 114 and Old Route 15 in Cambridge and its approaches.

Purpose of the RSAR

This RSAR was conducted as part of the Highway Safety Improvement Program (HSIP).

The RSAR herein has sought to identify potential safety hazards and physical features which may affect road user safety. However, it is possible that not every deficiency has been identified. It should further be recognized that the implementation of the guidance in this report might contribute to improve the level of safety of the facility reviewed but not necessarily remove all the risks.

RSAR Participants

Mario Dupigny-Giroux from the Office of Highway Safety, VTrans, was the RSAR coordinator.

The other participants were:

Kyle Carpenter,	District 8, VTrans
Jim Cota,	District 8, VTrans
Ian Griffith,	Traffic Design, VTrans
Tyler Guazzoni,	TSMO, VTrans
Bill Jenkins,	GHSP, VTrans
Josh Plaksa,	Office of Highway Safety, VTrans
Taylor Sisson,	Traffic Design, VTrans
Robert Lucas,	Vermont State Police
Tara Thomas,	Vermont State Police
Bill Morey,	Town of Cambridge
George Putnam	Cambridge Selectboard
Dana Sweet,	Cambridge Selectboard
Rob Moore,	LCPC

Representatives from Boyden Valley Winery joined the group during the site visit.

Information Reviewed

Geometry

This is a four-way intersection that is controlled by stop signs on VT 104 and Old Route 15. VT 15 is considered a west-to-east road while VT 104 is considered a south-to-north road.

The roadway typical for both VT 15 and VT 104 is two elven-foot lanes with four-foot shoulders. In addition, there is an auxiliary right turn lane on VT 15 for westbound traffic to turn onto VT 104.

There is a 200-foot long farm access approximately 200 ft north of the intersection on VT 104 and approximately 170 ft west of the intersection on VT 15. This access forms a triangle with VT 15 and VT 104.

Farm Access Between VT 15 and VT 104

A 12-degree horizontal curve to the left is present on VT 15 while traveling westbound. There is also an eastbound vertical down grade on VT 15 west of VT 104 with a dip in the road.

A rough estimate of available corner sight distance from VT 104 when looking to the left is about 650 ft, while a rough estimate when looking to the right is about 500 ft (the corner sight distance to the right is limited because of a dip in the road west of VT 104). The AASHTO corner sight distance guideline is 555 feet for a speed of 50 mph.

Looking West from VT 104,
Source Google Map, June 2012

When looking from Old Route 15, the corner sight distance was observed to be relatively poor in both directions (approximately less than 200 feet looking west and about 300 ft looking east).

Looking West from Old Rte 15

Traffic Control Devices

There is a modified advance warning horizontal curve sign with a side road displayed on the sign along with a 30-mph advisory speed plaque beneath the sign in both directions on VT 15. The eastbound sign is located at mile point 1.67 and the westbound sign is located at mile point 2.04. Chevrons facing both directions are also used to delineate the curve on the inside of the curve.

On VT 104, there is a Junction VT 15 sign and a VT 104 end sign at mile point 0.170. This is followed by a stop ahead sign at mile point 0.130 with flashing lights above the sign. VT 104 is controlled by gate posted stop signs (one on each side of the approach). In addition, there is a double arrow facing southbound traffic across from VT 15.

Markings at this intersection consist on white edgelines, white lane markings including for the right turn lane and double yellow center line markings and stop bars.

Pavement markings were faded at the time of this site visit as can be seen in the following picture.

Speed Limit

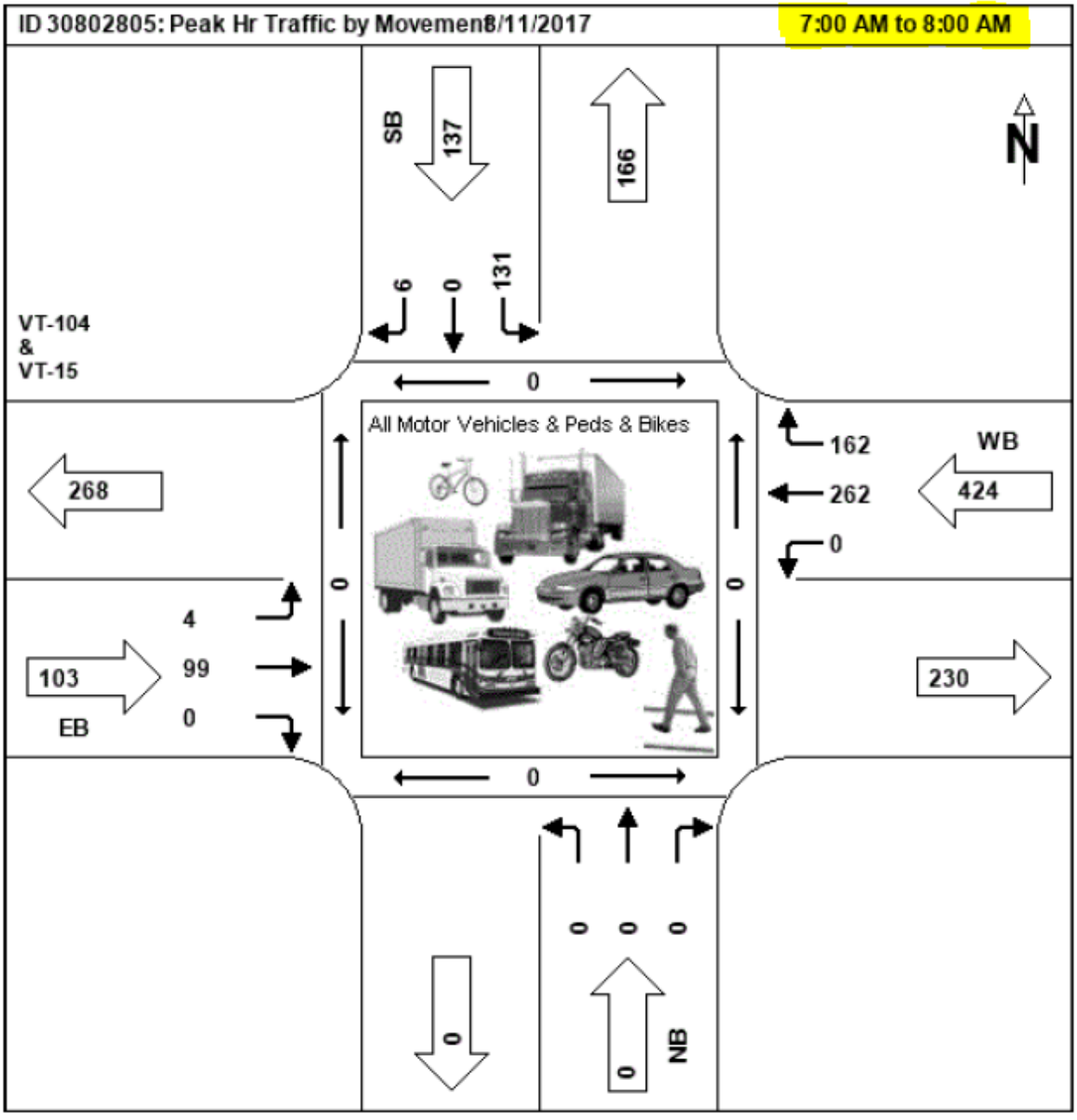
The speed limit on both VT 104 and VT 15 in the area of the intersection is 50 mph. The speed limit on Old VT 15 is 30 mph.

Traffic Volumes

The 2016 Average Annual Daily Traffic (AADT) east of the intersection on VT 15 was 8100 vehicles per day and west of the intersection, it was 5200 vehicles per day. On VT 104, the AADT was 4300 vehicles per day.

A 2017 turning movement count shows that the majority of the traffic that enters the intersection from VT 104 is making a left turn onto VT 15 east.

On VT 15, traveling east, the vast majority of the traffic is continuing east on VT 15 while traveling west, traffic is either continuing straight on VT 15 west or turning right onto VT 104 (the proportion of right-turns during the AM peak is 38%, it is 46% Midday and 54% during the PM peak).



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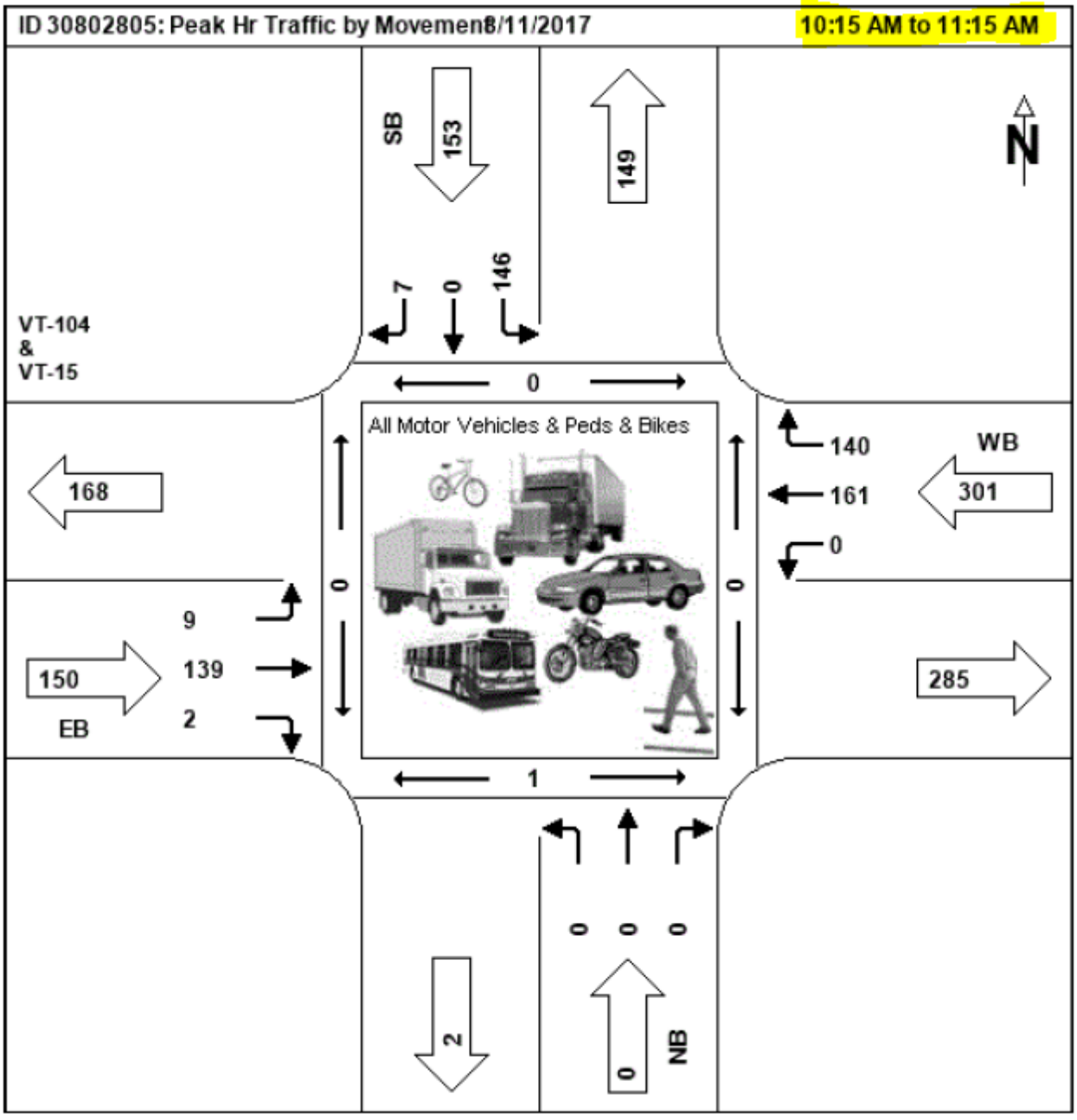

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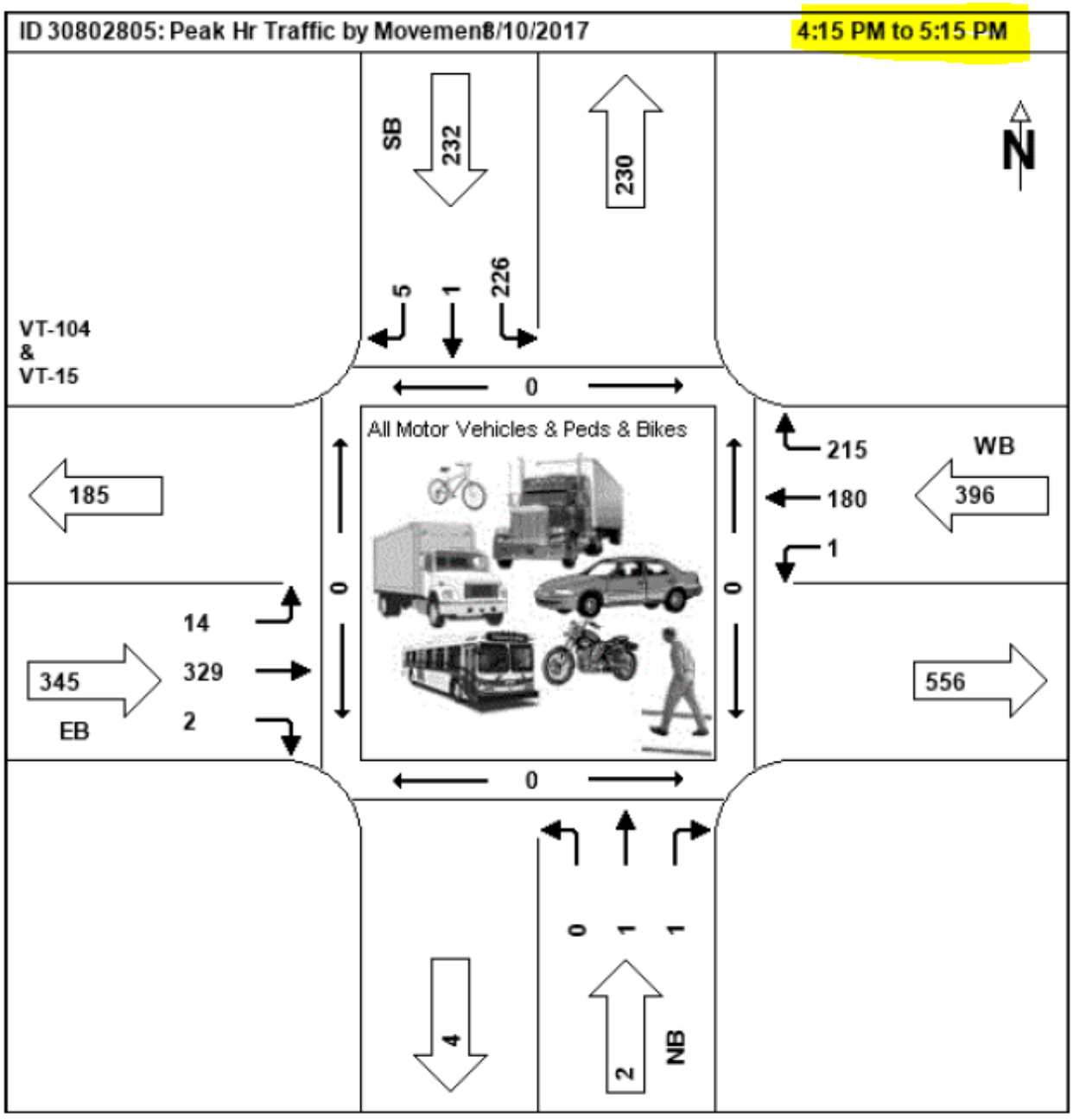


Pavement Condition

The surface condition on VT 15 is rated as poor with the date of last work being 2002. In contrast, the surface condition on VT 104 is rated as good with the date of last work being 2013 (VTransparency June 2018).

Past Projects

STATEWIDE-NORTHWEST STPG SIGN(58) was for the replacement of signs on VT 104. This project was substantially completed in November 2017.

WINOOSKI-CAMBRIDGE STPG SIGN(55) was for the replacement of signs on VT 15. This project was substantially completed in May 2017.

CAMBRIDGE – FAIRFAX STP 2713(1) was for the resurfacing of VT 104. This project was substantially completed in September 2012.

Future Projects

A VTrans paving project on VT 15 is two to three years out.

Crash History

The 2012 to 2017 crash data was reviewed for this intersection along with the January 2018 fatal crash. This intersection is a high crash location in the most recent available HCL report that covers the period 2012 to 2016 period.

Upon review of the crashes at this intersection, there are seventeen crashes listed at this intersection for the most recent six-year period. Of these, thirteen crashes are classified as non-reportable. A crash narrative is not available for these crashes and the manner of crash is also unknown for all of these thirteen crashes.

For the crashes with an available narrative (including the 2018 fatal crash), the manner of crash was some form of a right angle crash. For these crashes, a common factor was that the roads were snow covered.

For at least four crashes, the vehicle at fault skidded on the snow. For the three non-fatal crashes, the light conditions were dark.

The last crash review of this intersection considered the 2006-2008 period. There were nine crashes reported during this time. Of these, five crashes involved a vehicle that was making a left turn from VT 104 onto VT 15 and that collided with a westbound vehicle on VT 15. Of the nine crashes, only two took place on a wet road surface. None were reported to take place on a snow-covered road.

The crash characteristics from the 2006 to 2008 period are different than the ones from the 2012 to 2017 period. In the 2006 to 2008 period, there was a clear right angle crash pattern between a VT 104 vehicle and a VT 15 westbound vehicle. This pattern is not present in the 2012 to 2017 period. In addition, during the 2012 to 2017 for the crashes that have information available, dark conditions and a snow-covered road surface appeared to be present.

The collision diagrams from the 2006 to 2008 period and the one for the most recent five years can be found in Appendix A.

Current Local Concerns

A nearby resident explained, following the January 2018 fatal crash, that people on VT 104 thought that westbound vehicles on VT 15 were turning onto VT 104 and decided to make the left turn to realize that that car was continuing westbound on VT 15. According to this resident, the speed limit in the area up to Angelino's Restaurant should be 35 mph.

It was mentioned during the commencement meeting to this road safety audit that it was the impression that people on VT104 thought that they had enough time to go across but that, in reality, they did not. It was also reported that there was a dip on VT 15 west of the intersection and that vehicles were "getting out of view" for a moment.

It was also reported that many trucks were traveling 50 mph to 60 mph and turning onto VT 104. It was also stated that trucks were coming down the hill on VT 15 at excessive speeds (in the range of 60 mph).

They are non-authorized vehicles that use the farm access between VT 104 and VT 14. This access gets icy and vehicles that use this access are often sliding into VT 104.

A representative from Boyden Valley Winery indicated that they had a lot of visitors during their events and that traffic was backing up as it tries to enter their property.

Identified Safety Concerns

This section lists the areas of safety concern identified by the audit team during the site inspection and from the analysis of available data. This section also reports the potential safety enhancements suggested by the audit team. The concerns are not listed in order of importance.

Concern: There is confusion about the configuration of the lanes on the VT 15 westbound approach

The VT 15 westbound approach has a through lane and an auxiliary right turn lane. However, the markings are faded and the right turn lane is not visible.

Safety Enhancements:

Immediate to Short Term

- Refresh the lane markings at this intersection.

Mid to Long Term

- Consider using recessed markings.

Concern: Drivers could potentially be unaware of the need to stop at the VT 104 approach

It was observed that the yellow flashing lights above the stop ahead sign were not conspicuous. It was also observed that although the stop signs are gate posted, the left hand stop sign is ineffective as a supplemental sign since it is too far out to be properly seen by drivers. In addition, at the time of the site visit, the right hand stop sign was slightly at an angle.

Immediate to Short Term

- Check the beacons over the stop ahead sign and fix them as needed.
- Adjust the right-hand stop sign (which is twisted).
- Add reflective post panels to the gate posted stop signs to increase night time conspicuity

Short to Mid Term

- Install an overhead beacon at this intersection with red lenses facing VT 104/Old Route 15 and yellow lenses facing VT 15.

Concern: VT 104 drivers could be misjudging gaps when entering VT 15

There is a dip in the road on VT 15 west of the intersection. This causes eastbound vehicles to disappear for a few seconds from the view of motorists waiting on VT 104. Vehicles on VT 15 are perceived to be traveling above the 50 mph speed limit and above the 30 mph advisory speed for this area. Motorists on VT 104 are said to have less time than they expect when entering VT 15. Motorists on VT 104 were also reported to misjudge whether a westbound vehicle on VT 15 was turning right or continuing westbound on VT 15.

Short Term

- Review the speed limit on VT 15 from the Angelino's Restaurant to a point west of the intersection. Review the speed limit on VT 104 approaching the intersection. Town to request

via letter to the Traffic Committee Coordinator, Ian Degustis[1], that these speed limits between the mentioned boundaries be studied.

Short to Mid Term

- Install an overhead beacon at this intersection with yellow lenses facing VT 15 and red lenses facing VT 104/Old Route 15.

Mid to Long Term

- Evaluate the possibility of removing the dip in the road on VT 15.
- Evaluate the possibility of relocating the intersection to provide better corner sight distance.
- Evaluate the possibility of converting the existing right turn lane to an offset right turn lane[2].

Concern: Corner sight distance on Old Route 15 is poor

Entering VT 15 from Old Route 15 at this intersection is difficult due to the poor corner sight distance in either direction.

Short to Mid Term

- Consider making Old Route 15 one-way eastbound (towards Angelino's).

Mid to Long Term

- Evaluate closing off Old Route 15 at the VT 104 intersection.

[1] Ian Degustis, Vermont Traffic Committee Coordinator, VTrans, Highway Division, Maintenance & Operations Bureau, Technical Services Section, 2178 Airport Road Barre, VT 05641

[2] An offset right turn lane is a right turn lane that is constructed outside of the intersection sight distance triangle for minor road traffic. This concept is illustrated in the figure shown in **Appendix B**. The top intersection shows a conventional right turn lane and how the right turning car prevents the motorist on the minor road to see the through vehicle on the main road. The second intersection shows an offset right turn lane and how its design provides the motorist on the minor road a clear view of the oncoming through vehicle.

Concern: The farm access between VT 15 and VT 104 creates potential conflicts

It was explained that the farm access between VT 15 and VT 104 was being used at times by motorists and that this created conflicts with the normal traffic on these two roads.

Immediate

- Research if this access is permitted, suggest that it be closed off at the VT 15 end or gated.

Summary of Safety Enhancements

The safety concerns and potential actions that were identified in the previous sections are further summarized in the next table. These potential enhancements will be presented to respective parties for further consideration. The entities listed under the column called “Potential Responsibility” are suggested groups that could possibly implement some of the countermeasures.

In this table, time frames and costs are qualified as follows: short term, < 1 year; mid-term 1-3 years; long term > 3 years; low cost, < $15,000; medium cost, $15,001 - $75,000; high cost, > $ 75,001.

The safety concerns discussed previously are referred to in the table by the numbers shown here:

1 There is confusion about the configuration of the lanes on the VT 15 westbound approach

2 Drivers could potentially be unaware of the need to stop at the VT 104 approach

3 VT 104 drivers could be misjudging gaps when entering VT 15

4 Corner sight distance on Old Route 15 is poor

5 The farm access between VT 15 and VT 104 creates potential conflicts

Potential Safety Enhancements Summary Table										
	Safety Concerns						**Potential Responsibility**	**Safety Payoff[3]**	**Time Frame**	**Cost**
Safety Enhancement	1	2	3	4	5					
Refresh the lane markings at this intersection	X						VTrans -District		Now (done 7/19/18)	Med
Consider using recessed markings	X						VTrans – Pavement Management		Mid to Long	Med
Check the beacons over the stop ahead sign		X					VTrans – TSMO		Now (done[4] 6/27/18)	Low
Adjust the right-hand stop sign		X					VTrans – TSMO		Now	Low
Add red retroreflective strips on the stop sign posts		X					VTrans – TSMO		Now	Low

[3] The CMF Clearinghouse explains that the star quality rating indicates the quality or confidence in the results of the study producing the CMF. The star rating is based on a scale (1 to 5), where a 5 indicates the highest or most reliable rating. The review process considers five categories for each study: study design, sample size, standard error, potential bias, and data source.

[4] TSMO signal crew replaced the bulbs and reported the beacons to be "brighter"

Potential Safety Enhancements Summary Table

	Safety Concerns						Potential Responsibility	Safety Payoff[3]	Time Frame	Cost
Safety Enhancement	1	2	3	4	5					
Install an overhead beacon at this intersection		X	X				VTrans – OHS[5] or Pavement Management	40% reduction in sever crashes (NCDOT[6])	Mid to Long	Med
Request, via letter, a review of the speed limit on VT 15 and VT 104			X				Town of Cambridge		Now to Short	Low
Evaluate the possibility of removing the dip on VT 15			X				VTrans – AMP or Pavement Management		Mid to Long	Mid to High
Evaluate the possibility of relocating the intersection to provide better corner sight distance			X				VTrans – AMP or Pavement Management		Mid to Long	Mid to High

[5] Could use HSIP small project funding via work order if below $25,000
[6] https://connect.ncdot.gov/resources/safety/Safety%20Evaluation%20Completed%20Projects/FlasherCRF.pdf

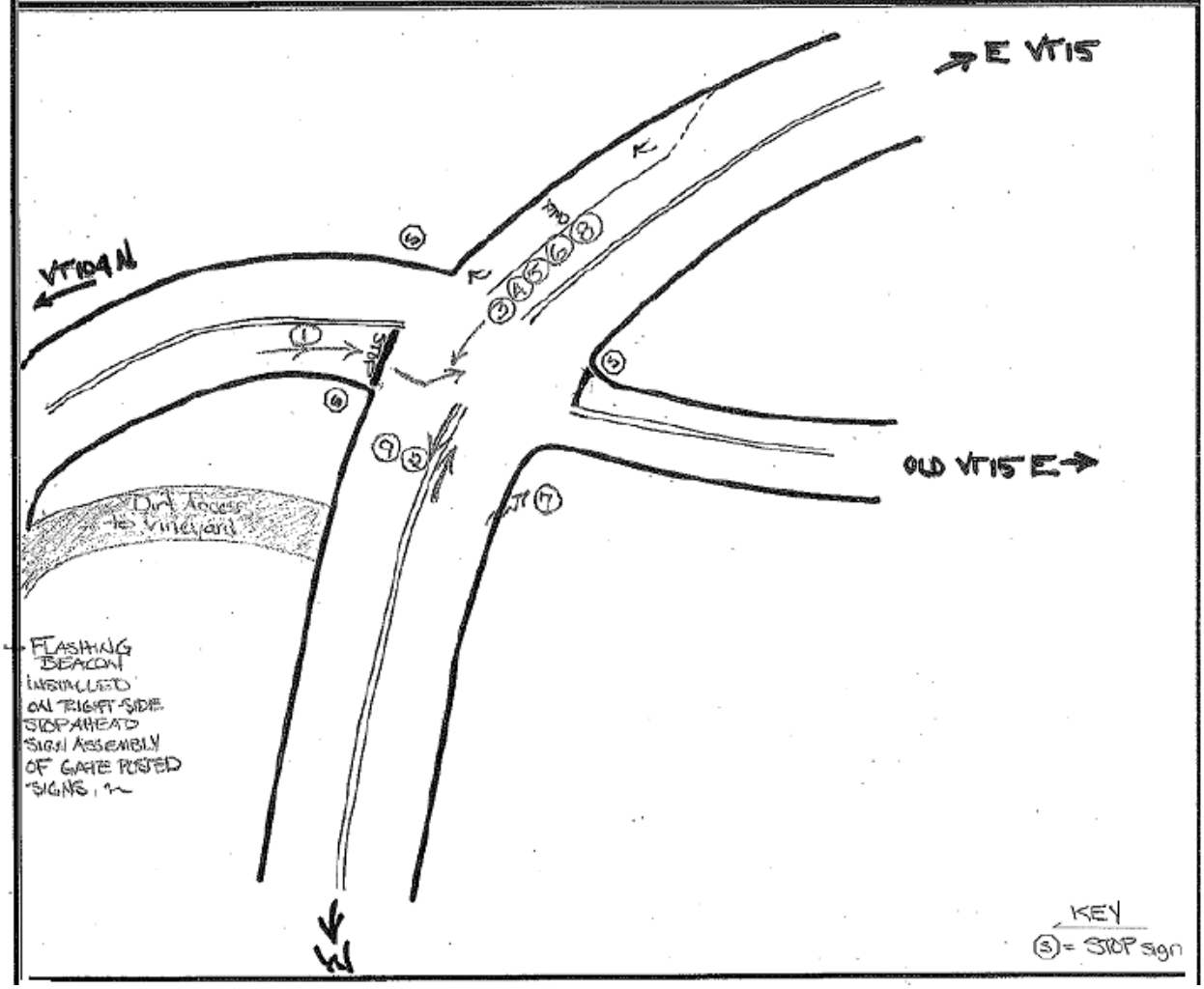
Potential Safety Enhancements Summary Table

	Safety Concerns						Potential Responsibility	Safety Payoff[3]	Time Frame	Cost
Safety Enhancement	1	2	3	4	5					
Evaluate the possibility of converting the existing right turn lane to an offset right turn lane				X			VTrans – AMP or Pavement Management		Mid to Long	Mid to High
Evaluate closing off Old Route 15 at the VT 104 intersection				X			Town of Cambridge & LCPC		Mid to Long	Low to Mid
Research if this access is permitted, suggest that it be closed off or gated					X		VTrans – Permitting		Now	Low

Appendix A
Collision Diagrams

COLLISION DIAGRAM

LOCATION ID: HSIP # 09-23	*MILE MARKER:* 1.750 - 1.880
DISTRICT: 8	*TOWN:* CAMBRIDGE
PERIOD: 2006-2008	*PREPARED BY :* NLA



COLLISION DIAGRAM

Key Number = 1

MUNICIPALITY: Cambridge COUNTY: Lamoille

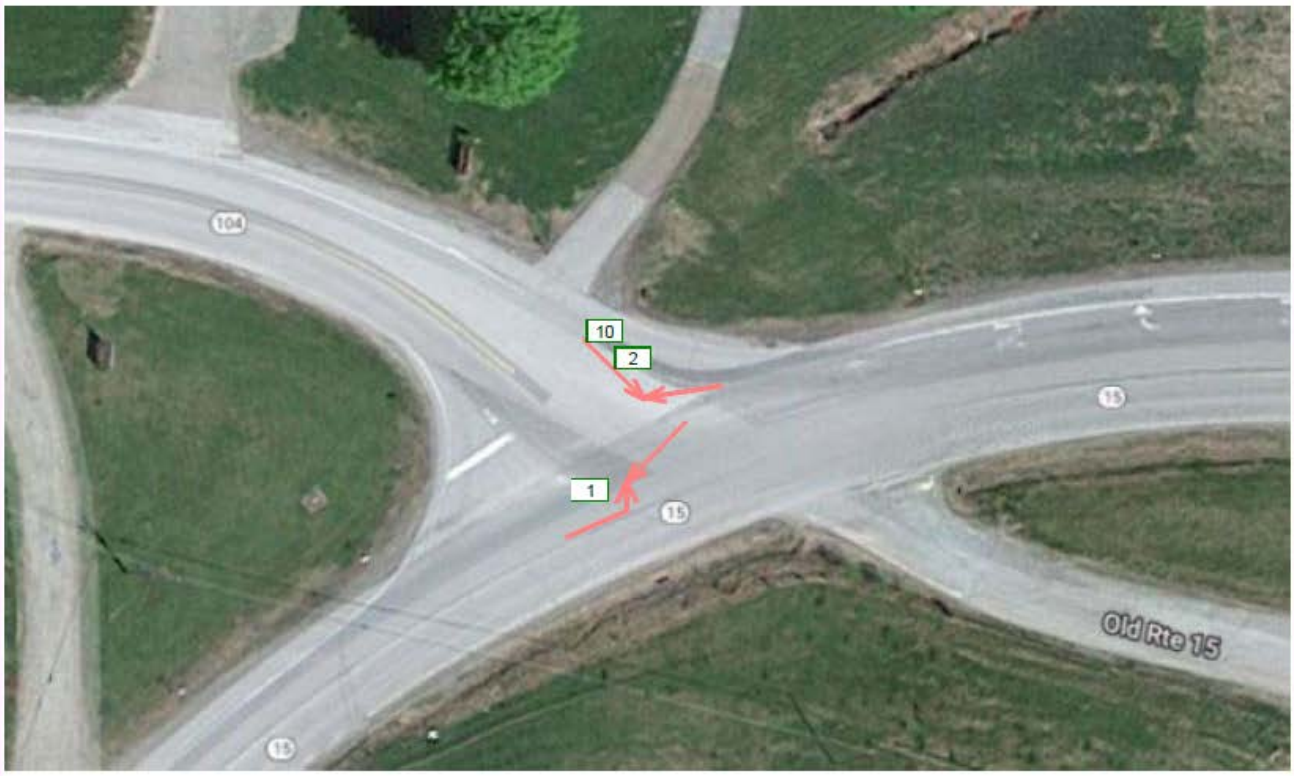
INTERSECTION: VT 15

PERIOD: 6 YEARS 0 MONTHS FROM 1/1/2012 TO 12/31/2017

FILE: vt15vt104

CASE # :

BY: DATE: 5/11/2018



SYMBOLS			
MOVING VEHICLE	P	PEDESTRIAN
TURNING VEHICLE	B	BICYCLIST
BACKING VEHICLE	A	ANIMAL
PARKED VEHICLE		FIXED OBJECT
999 RECORD NUMBER		Fatal

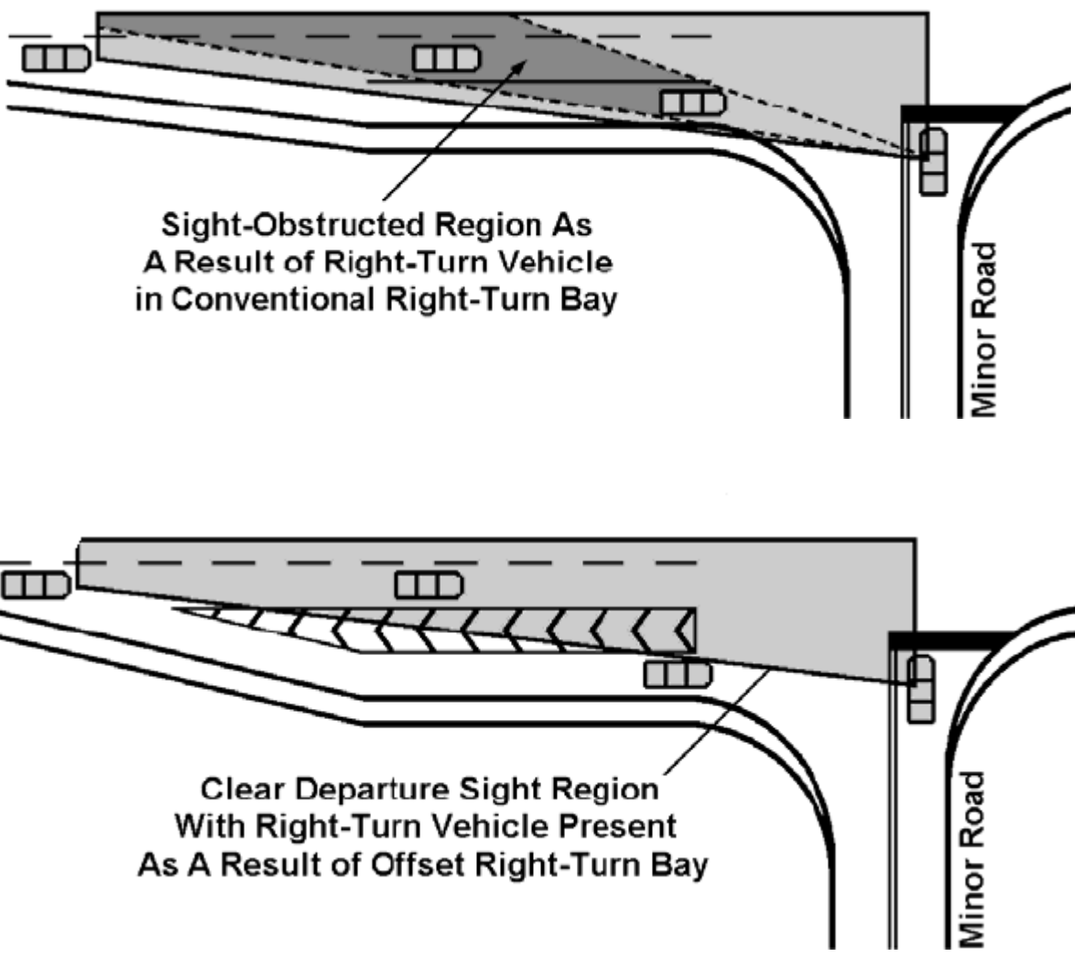
MANNER OF COLLISION	
REAR END	HEAD ON
LEFT TURN	RIGHT TURN
LEFT TURN	RIGHT TURN
OVERTAKE	RIGHT ANGLE
OUT OF CONTROL	SIDE SWIPE

Crash #	Report Number	Town	Route	Mile Marker	Date	Time	Weather	Contributing Circumstances	Manner of Collision	Injuries	Fatalities	Untimely Deaths
1	VTVSP0100/14A105663	Cambridge	VT 15	1.78	12/12/2014	17:49	Snow	Failed to yield right of way	Left Turn and Thru, Angle Broadside -->v--	0	0	0
2	VTVSP0100/13A104746	Cambridge	VT 15	1.83	11/24/2013	05:01	Snow	Driving too fast for conditions	No Turns, Thru moves	0	0	0
3	VTVSP0100/14A101193	Cambridge	VT 15	1.83	03/13/2014	11:45	[No Weather]		[No Direction of Collision]	0	0	0
4	VTVSP0100/15A100526	Cambridge	VT 15	1.83	01/30/2015	16:12	[No Weather]		[No Direction of Collision]	0	0	0
5	VTVSP0100/15A100911	Cambridge	VT 15	1.83	02/15/2015	20:58	[No Weather]		[No Direction of Collision]	0	0	0
6	VTVSP0100/15A105258	Cambridge	VT 15	1.83	10/10/2015	12:28	[No Weather]		[No Direction of Collision]	0	0	0
7	VTVSP0100/15A105504	Cambridge	VT 15	1.83	10/24/2015	19:57	[No Weather]		[No Direction of Collision]	0	0	0
8	VTVSP0100/16A100996	Cambridge	VT 15	1.83	02/26/2016	01:18	[No Weather]		[No Direction of Collision]	0	0	0
9	VTVSP0100/16A100483	Cambridge	VT 15	1.84 Not at intersection but near the Park and Ride	01/29/2016	13:57	Sleet, Hail (Freezing Rain	Followed too closely, Inattention, No	Rear End	0	0	0

Crash #	Report Number	Town	Route	Mile Marker	Date	Time	Weather	Contributing Circumstances	Manner of Collision	Injuries	Fatalities	Untimely Deaths
10	VTVSP0100/13A105309	Cambridge	VT 104	0	12/24/2013	23:23	Snow	Driving too fast for conditions, Failure to	Opp Direction Sideswipe	0	0	0
11	VTVSP0100/13A105320	Cambridge	VT 104	0	12/26/2013	06:55	[No Weather]		[No Direction of Collision]	0	0	0
12	VTVSP0100/15A101032	Cambridge	VT 104	0	02/21/2015	16:19	[No Weather]		[No Direction of Collision]	0	0	0
13	VTVSP0100/15A103506	Cambridge	VT 104	0	07/07/2015	20:21	[No Weather]		[No Direction of Collision]	0	0	0
14	VTVSP0100/15A103803	Cambridge	VT 104	0	07/24/2015	07:06	[No Weather]		[No Direction of Collision]	0	0	0
15	VTVSP0100/15A104966	Cambridge	VT 104	0	09/23/2015	12:29	[No Weather]		[No Direction of Collision]	0	0	0
16	VTVSP0100/13A105365	Cambridge	VT 104	0.02	12/27/2013	16:34	[No Weather]		[No Direction of Collision]	0	0	0
17	VTVSP0100/13A102969	Cambridge	VT 104	0.04	07/30/2013	16:22	Clear	Failed to yield right of way	Other - Explain in	1	0	0

Appendix B
Offset Right Turn Lane Concept

An offset right turn lane is a right turn lane that is constructed outside of the intersection sight distance triangle for minor road traffic. This concept is illustrated in the figure[7] below. The top intersection shows a conventional right turn lane and how the right turning car prevents the motorist on the minor road to see the through vehicle on the main road. The second intersection shows an offset right turn lane and how its design provides the motorist on the minor road a clear view of the oncoming through vehicle.



[7] Source: Safety Effects of Offset Right-Turn Lanes at Rural Expressway Intersections, Proceedings of the 2007 Mid-Continent Transportation Research Symposium, Ames, Iowa, August 2007