

Road Safety Audit Review

VT 15 & I-89 Exit 15 NB City of Winooski

April 6, 2006



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VT 15 & I-89 Exit 15 NB Ramp

Road Safety Audit Review Review Report

Definitions

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. "Independent" means that the members of the team will not be directly involved with the location being audited.

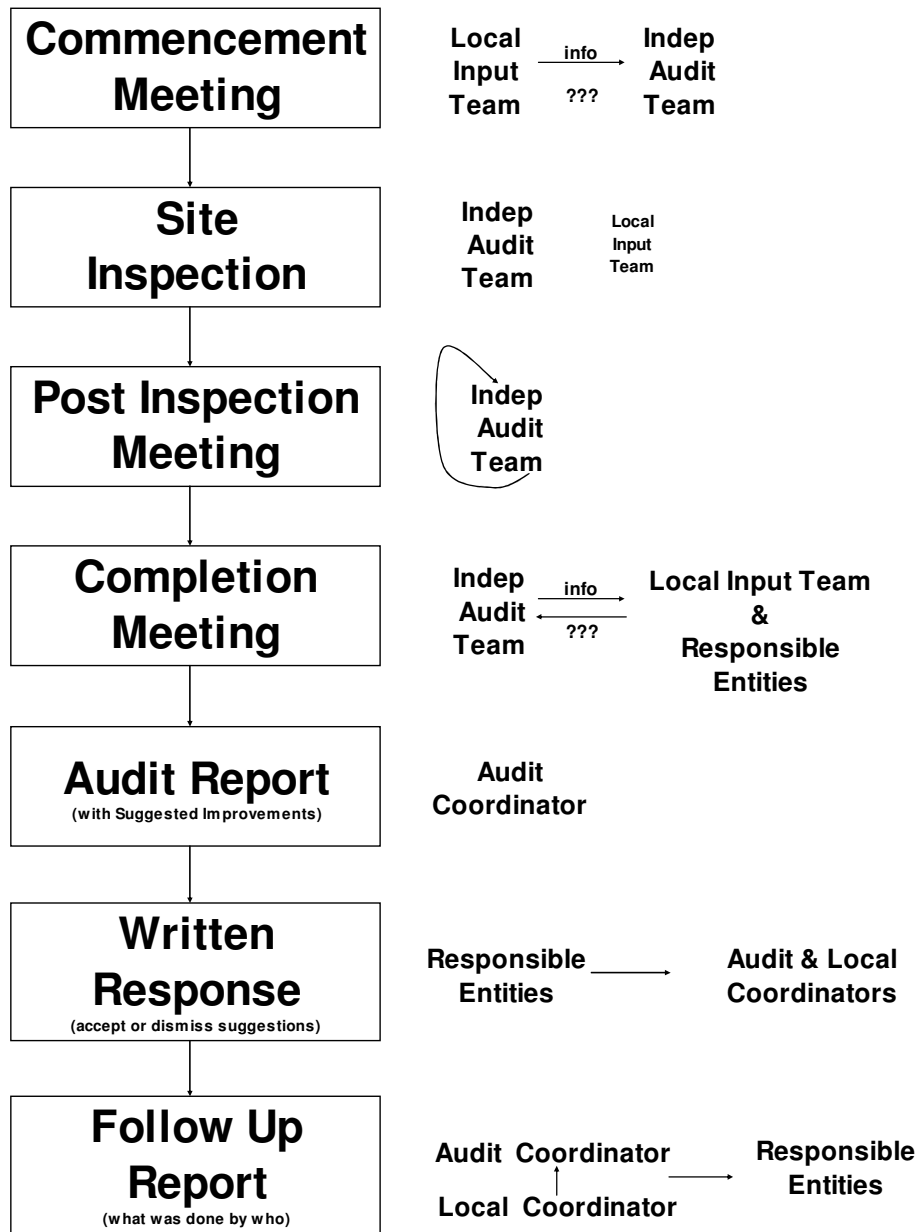
In addition to the Audit Team, a RSAR involves the following key players: Local Coordinator, Local Input Team and Responsible Entities.

The **Local Coordinator** is either a representative of the Town/City or the local regional planning commission. His/her role is to put a Local Input Team together, aggregate traffic and safety information, lead the commencement meeting and follow-up with local responsible entities. The role of the **Local Input Team** is to provide a local perspective at the commencement meeting. It is composed of representatives from the community such as Selectboard Members, Police, EMT, VTrans District, and Other Local People. The **Audit Team** is responsible for performing a site visit, identifying safety issues and coming to a consensus with respect to possible guidance. **Responsible Entities** are any groups who own a roadway feature or who are responsible for making an improvement or initiating further studies. These could include for example, the VTRANS Design Section, the Local Town, the Police or the Local RPC/MPO. The role of the Responsible Entities is to assess the viability of the suggestions provided by the Audit Team and provide a written response to the Audit Coordinator, to schedule and/or perform the improvements if deemed necessary and to follow-up with the audit or local coordinator when the project is completed. Finally, the **Audit Coordinator** is the person responsible for setting up the audit and other meeting dates, to put the audit team together, to facilitate the post inspection meeting and the completion meeting, and to prepare the audit report.

RSAR Process

The RSAR process is composed of several steps as shown in the diagram below. The process starts with a **Commencement Meeting** between the Local Input Team and the Audit Team. The purpose of the meeting is for the Local Input Team to present community concerns to the Audit Team. A **Site Inspection** is then performed by the Audit Team. Members from the Local Input Team can accompany the Audit Team to further explain concerns. 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

Figure 1. ROAD SAFETY AUDIT PROCESS



“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. The final RSAR report (Written Report) is finalized following the Completion Meeting during which the issues identified by the audit team are discussed with the Local Input Team and Responsible Entities. The meeting is to be constructive and foster dialogue between the parties involved. The *Written Report* identifies safety

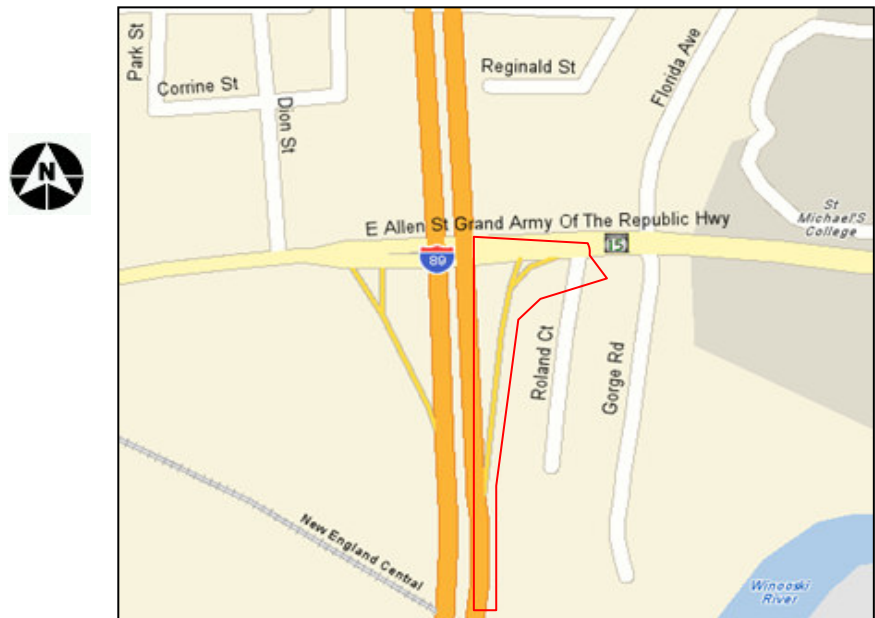
concerns and proposes guidance. These issues and solutions are presented in a tabular format associated to each Responsible Entity for ease of reporting. The Responsible Entities are to provide a Written Response on every finding of the Written Report as to its implementation. The Responsible Entity is not obliged to implement the findings in the Written Report. However, the reasons for not implementing a finding should be documented (e.g. physical constraints, excessive cost, environmental constraints, etc.).

The RSAR herein covers physical features which may affect road user safety and it has sought to identify potential safety hazards. However, the Audit Team points out that no guarantee is made that every deficiency has been identified. Further, it should also be understood that the adoption of the guidance in this report should improve the level of safety of the facility but not necessarily remove all the risks.

Location

The area of concern of this RSAR comprises the intersection of VT 15 with the I-89 northbound off-ramp, the intersection of VT 15 with Roland Court and the deceleration lane of Exit 15 on I-89 NB. The speed limit on VT 15 is 25 mph and it is 55 mph on the interstate. The deceleration lane has no advisory speed. While the intersection with the I-89 off-ramp is signalized for most of the movements through the intersection, it has a slip lane that is stop controlled for the I-89 exiting traffic going eastbound on VT 15. Roland Court is a dead-end residential street with 19 dwellings located approximately 80 feet east of the Exit 15 slip lane and that is also controlled by a stop sign. The deceleration lane on I-89 extends from the bridge over the Winooski River for a distance of about 1,800 feet. The average annual daily traffic on VT 15 east of the off-ramp is estimated at 27,200 vehicles and that of the off-ramp traffic at 8,700 vehicles per day. Traffic in and out of Roland Court would total about 225 vehicles per day with 16 and 8 vehicles coming out of Roland Court between 7:00 – 9:00 am and 4:00 -6:00 pm respectively (ITE Trip Generation).

Figure 2. Location Map and Area of Concern





**Figure 3.
VT 15,
Looking
West (Roland
Court is first
on the left
hand side
followed by
the I-89 slip
lane)**

**Figure 4. Roland
Court, Looking
North towards
VT 15**



Purpose of the RSAR

This RSAR was conducted at the request of the Agency of Transportation's Roadway, Traffic & Safety Program Manager pursuant to prior discussions between the Agency of Transportation and the City of Winooski with the primary intent of assessing the situation and identifying short term solutions.

RSAR Team

The Road Safety Audit Review Team included the following representatives from the Vermont Agency of Transportation (VAOT), and from the Chittenden County Metropolitan Planning Organization (CCMPO):

Tom Anderson,	Operations (VAOT District 6)
Stew Menard,	Roadway Design (VAOT)
Marcos Miller,	Traffic Operations (VAOT)
Bruce Nyquist,	Traffic Design (VAOT)
Susan Smichenko,	Planning (CCMPO)

RSAR Team Coordinator

The road safety audit review coordinator was:

Mario Dupigny-Giroux,	Traffic Operations (VAOT)
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Local Coordinator

The local coordinator was:

Gerry Myers,	City of Winooski
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Local Input Team

The following people from the local community were present at the Commencement Meeting:

Dave Blackmore,	Operations (VAOT District 5)
Steve McQueen,	Winooski PD
William O'Leary,	VT State Police

Information Reviewed in the Completion of the Audit Review

- (1) VAOT Work Order 03-444
- (2) Roland Court – Exit 15 Alternatives Analysis, November 2004
- (3) Collision diagram for the 2001-2004 reporting period
- (4) Traffic videos taken on March 30, 2006, during the pm peak hour.

→ *VAOT Work Order 03-444*

This work order was generated at the request of the Winooski PD to investigate the chronic disregard of the stop condition at the slip ramp. The major outcome of this work order was the installation of larger stop signs (from 30" to 36") on both sides of the slip lane at the off-ramp. A new lane assignment sign that showed the two left turn lanes as well as the slip lane for right turns was also installed to replace the sign that was only showing, at the time, the two left turn lanes.

→ *Roland Court – Exit 15 Alternatives Analysis, November 2004*

This study was prepared by Resource Systems Group, for the City of Winooski and CCMPO. The study evaluated the following four alternative designs to the VT 15 intersections with the Exit 15 off-ramp and Roland Ct:

Alternative 1- Included a left-turn lane pocket in the median of VT 15 for traffic coming out of Roland Ct and going westbound on VT 15.

Alternative 2- Included the Roland Ct left-turn pocket along with the elimination of the slip lane at the off-ramp and the provision of a dual left-turn lane and an exclusive right-turn lane controlled by a traffic signal.

Alternative 3- Included the left-turn pocket and the elimination of the slip lane with a traffic signal controlling one left-turn lane and a dual right-turn lane.

Alternative 4- Included the left-turn pocket, the elimination of the slip lane and the provision of one left-turn lane, one right turn lane and one shared left and right turn lane controlled by a traffic signal.

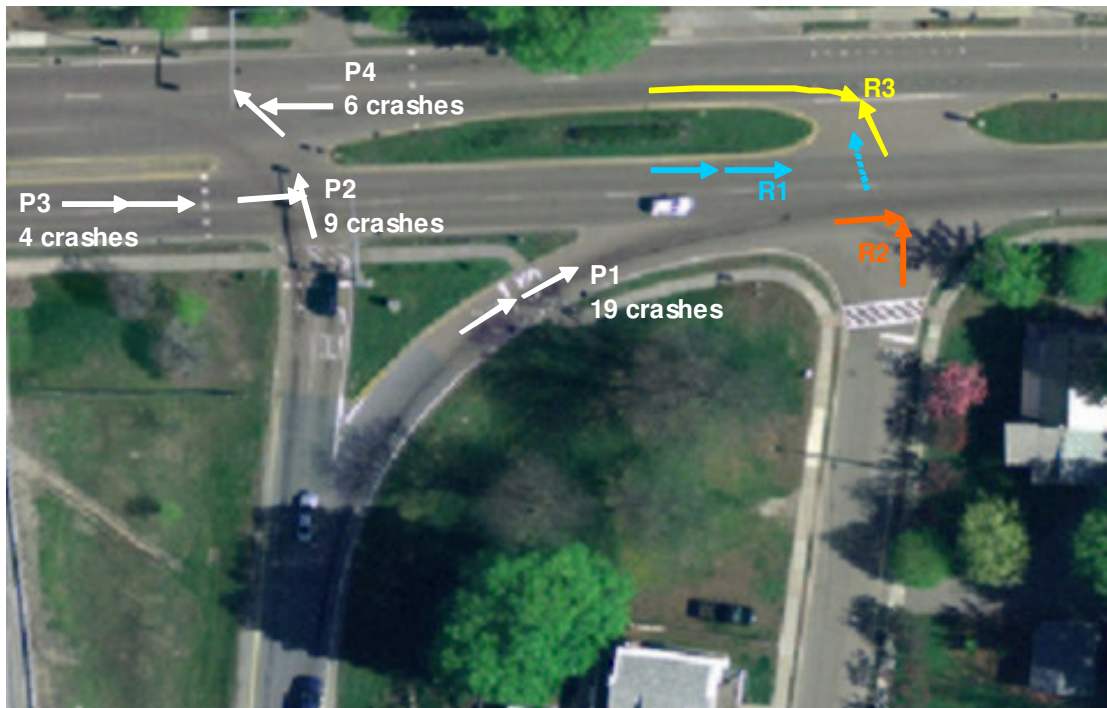
The study considered traffic projections to 2010 during the am and pm peak hours and included traffic estimates from the Winooski Redevelopment Project. Based on the operational and safety benefits evaluated, the study recommended that Alternative 1 be implemented immediately and that Alternative 4 be considered for long term improvement.

→ *Collision diagram for the 2001-2004 reporting period*

The crash reports for the 2001 to 2004 reporting period were reviewed in order to identify prominent crash patterns within the area of concern. Four crash patterns were recognized as illustrated in Figure 5.

The pattern with the most crashes (P1 in Figure 5) took place at the slip lane. In this case, motorists rear-ended each other as a result of the first car stopped at the stop sign moving and stopping again and the motorist behind thinking that the car in front was gone.

Figure 5. Major Crash Patterns for the 2001-2004 Reporting Period



Roland Court Crashes

R1: Rear-end; Time 0715; VT 15 vehicle stopped to let a car out of Roland Ct.

R2: Right-angle; Time 0559; Motorist out of Roland Ct did not observe any traffic on VT 15, made left turn.

R3: Head-on; Time 0715; Resident came out of drive at 363 E, went EB in WB lane to reach the median opening.

See the text for comments on P1 through P 5



* Includes one crash entered so far for 2005 in the VAOT crash database

The second pattern with the most crashes (P2) took place on the eastbound approach on VT 15. On this approach, people were involved in right-angle crashes due to red light running on VT 15. In the crash report narratives, some of the motorists involved said that the sun was shining on the signal lenses and that they could not tell the color of the traffic lights. Some others simply stated that the lights went from green to yellow.

Still on the eastbound approach, a less important pattern (P3) consists of rear-end crashes in which the front vehicle stopped for the change of lights.

In the westbound direction, right-angle crashes at the intersection are also taking place (P4). As was the case for pattern P2, these crashes are due to red light running. In the narratives of the crash reports, a couple of motorists indicated that they had failed to notice the color of the light or that it was red. For the other crashes, the reason was not stated.

Another somewhat recognizable pattern is the one with rear-end crashes in the deceleration lane (P5). In this instance, somebody was usually rear-ending another vehicle as a result of the vehicle at fault driving too fast to stop in time. There were two such crashes during the four-year period (at least another one was recorded for 2005).

In terms of time-of-day, one third of the crashes in pattern P1 occurred between 5:00 pm and 6:00 pm. The other crashes in this pattern took place mostly during the afternoon with some others in the evening. Similarly, most crashes under pattern P2 took place during the afternoon or the evening with only one in the 5:00 pm and 6:00 pm period. While pattern P3 does not show any trends with respect to time of occurrence, pattern P4 had most crashes in the afternoon, and two between 5:00 pm and 6:00 pm. In contrast, crashes under pattern P5 took place only in the 5:00 pm and 6:00 pm period.

In addition to the five patterns described above, a review of the crash data near the intersection of Roland Court indicated that three crashes had taken place at this intersection during the four-year period (referred to as R1, R2 and R3 in Figure 5). All three crashes took place before 7:30 am and all three crashes involved or were caused by a left turning vehicle out of Roland Court.

→ *Traffic videos taken on March 30, 2006, during the pm peak hour*

Videos of the traffic on the off-ramp were taken on March 30, 2006, between 16:55 pm and 15:30 pm. The weather at that time was sunny. During the first 15 minutes of observation, queues of right turning traffic were seen forming on the off-ramp and dissipating. During the same 15-minute period, left turning traffic was observed to be light. During the next 15-minute period, the queue of right turning traffic started to get longer and traffic eventually started backing up past the gore area on I-89. The left turning traffic started to get heavier as well and formed a queue that extended a few cars past the beginning of the slip lane.

Commencement Meeting

The Commencement Meeting was held at the Winooski City Hall on April 6, 2006.

Following the introductions of those present, Gerry Myers of the City of Winooski explained that, due to the heavy off-ramp traffic during the peak hours, it was very difficult for motorists to come out of Roland Ct. He stated that this had been an issue for more than 10 years and that it had become very emotional in the eye of the public. He reported that those living on Roland Ct felt that they were endangering themselves each time they were trying to make a left turn. He related that, at one point, the slip ramp was controlled with a yield sign. From his observations, going to the stop control condition has not made a difference.

Susan Smichenko of CCMPO discussed briefly the Alternatives Analysis Study done by Resource Systems Group. She mentioned that four alternatives were looked at and that the scope of this study was different from the evaluation that had been done by Lamoureux and Dickinson back in 2002 in that the 2002 study focused more on traffic calming.

Lt. William O'Leary of the State Police mentioned that traffic was backing up on the bridge in the northbound direction during the afternoon rush hour. He suggested that the Exit 16 northbound off-ramp was a good example that could be applied here. He further expressed his concern about how truck traveling east could be impacting traffic if the off-ramp was eliminated and replaced by a 90-degree turn lane. Dave Blackmore of District 5 concurred with this concern and added that during winter, trucks would have difficult times going up the hill. In his opinion, he did not believe that the current design could be ruled out.

Steve McQueen of the Winooski PD explained that the crash problem at the ramp was due to motorists looking west for traffic and rear-ending the vehicle stopped at the stop sign. According to Chief McQueen, vehicles traveling on the left hand side of the ramp (as to make a left turn) and trying to cut back in the slip lane to turn right has not been an issue.

Mr. Myers also mentioned during the commencement meeting that the master plan of the Champlain Valley Exposition included the development of a multi-purpose arena that could seat about 7,000 people. According to Mr. Myers, this multi-purpose arena (civic center) could generate 200 to 250 events per year and increase the level of traffic at the off-ramp. For his part, Lt. O'Leary anticipated that a new arena could produce longer queues on the interstate during the afternoon peak hour time if no improvements were made.

Field Visit

Following the Commencement Meeting, the Audit Team performed the site review of the area of concern. Mr. Myers was on hand to answer questions and further explain the concerns of the City and residents. The field visit was conducted mid-morning and traffic was light in all directions. At this time of the day, the slip lane traffic was observed to treat the stop condition mostly as a yield condition. The Audit Team discussed with Mr. Myers the usage of the sidewalk. Mr. Myers indicated that pedestrians usually traveled on the north sidewalk on the other side of VT 15.

Post Inspection Meeting

The Audit Team met at the District 5 garage following the field inspection to discuss their observations. At this meeting, the Audit Team reviewed the collision diagram and the videos of the ramp traffic that were taken previously during part of an afternoon peak hour. The Audit Team discussed, as a short term solution to providing adequate gaps for Roland Ct traffic, the possibility of signaling the slip lane. It was determined during the field visit that mounting the signal heads on pedestal posts would be best.

Due to field conditions, the pedestal posts will have to be located approximately in line with where the current stop bar is. Because at least one of the signal heads has to be not less than 40 feet behind the stop bar, the stop bar will have to be relocated further back and away from VT 15. The Audit Team felt that this would likely prevent most motorists from making a right-turn on red. In addition, the total length of the yellow and all red interval will have to be adjusted to ensure that eastbound traffic going through the intersection at the onset of the yellow light can clear past the slip lane. To assess the impact of signaling the slip lane on the queue of traffic on I-89 during the afternoon peak hour, the Audit Team suggested that VAOT model this scenario using the Synchro timing files developed by Resource Systems Group during the preparation of the 2004 Alternatives Analysis. A discussion of the results of this analysis can be found in Appendix A.

The Audit Team further discussed, via emails, the possibility of closing off the median in front of Roland Court, which would have for effect to eliminate left turns in and out of Roland Court (this is an alternative that was reviewed as part of the 2002 Lamoureux and Dickinson report). The issues with this option were identified by the Audit Team as being the inconvenience to those living on Roland Court and whether there was a safe place to turn around in either direction. With respect to turning around, going east on VT 15, U-turns are currently prohibited with a regulatory sign at the intersection with Florida St (just east of Roland Court). Motorists could still make a left turn into Florida St. to then turn around. The next place to turn around on VT 15 eastbound would be at the traffic signal at the St Michael's College entrance which is approximately ¼ mile away and which has a left turn lane. Another possible place to turn around eastbound would be by using the jughandle at the Camp Johnson traffic signal located slightly more than ½ mile away. Going westbound to come into Roland Court, one possible place to turn around would be at the traffic signal of the on-ramp to the interstate using the left turn lane. It is believed that the current available width on VT 15 in the eastbound direction could make this movement difficult. In addition, because the U-turn traffic would be light, there would be the possibility of rear-end crashes due to the drivers' expectancy of those going on the interstate being violated. One could also anticipate that somebody could turn around in one of the two gas stations east of the on-ramp. Finally, driving to the roundabout at the intersection of Main Street would be another possibility for the westbound direction (this is slightly less than ¾ mile from Roland Court). From the above review, locations to safely turn around are available but these are located more than ½ mile from Roland Court.

The safety impacts on driver behavior caused by the possible inconvenience of having to travel ½ mile away from Roland Court to come back in the opposite direction can only be speculated. One could think that at the beginning, some motorists could drive more

aggressively through the corridor and maybe that, as people get use to the close off, more normal driving behavior would take place.

The next section lists the safety concerns identified by the Audit Team and subsequently provides a summary of the recommendations made by the Audit Team in Table 1.

Potential Safety Concerns

This section describes the areas of safety concern identified by the Audit Team. The concerns are not listed in order of importance. Responsible entities are identified in the summary table at the end of this section (Table 1). The safety concerns are also reported on the observation tables that are specific to each entity responsible for the improvements. These tables are found at the end of the report.

- ✓ Traffic out of Roland Court has difficulties finding adequate gaps in VT 15 traffic to enter VT 15 in both morning and afternoon peak hour periods but more particularly during the afternoon peak hour when VT 15 traffic is heavier. The problem is more accentuated for left turning traffic.
- ✓ Rear-end crashes at the end of the slip lane by the stop signs and the stop bar are very common.
- ✓ Traffic queues up on the off-ramp past the gore area into the deceleration lane (sometimes as far as the bridge) on I-89 during the afternoon peak hour. Some rear-end crashes have been reported.
- ✓ Right-angle crashes are common on both eastbound and westbound approaches of the intersection on VT 15 as a result of running the red light on VT 15.
- ✓ Rear-end crashes on the eastbound approach have been occurring due to the change of lights from green to yellow or yellow to red.

Some of the safety concerns listed above are illustrated in Figures 6 and 7.

**Figure 6.
Right
Turning
Traffic
Queues-up on
the Off-
Ramp during
the PM Peak**



**Figure 7.
The Queue
Extends Past
the Gore
Area into the
Deceleration
Lane on I-89
NB during
the PM Peak
(View is from
the on ramp)**



Table 1. Possible Countermeasures and Responsible Parties

Observations & Possible Countermeasures	Responsible Entities (√: primary, T: technical assistance)								Strategy	
	City of Winooski	VAOT District 5	VAOT Traffic Design	VAOT Traffic Ops	VAOT Roadway Design	CCMPO				
<p>1) Traffic out of Roland Court has difficulties finding adequate gaps in VT 15 especially during the PM peak.</p> <p>Immediate Action: Assess the desirability of closing off the median to reduce conflicts.</p> <p>Short Term: If the results of the immediate actions are negative, create gaps in EB traffic and provide provisions for the Roland Court left turning traffic to complete the movement in sequences.</p> <p>Long Term: Based on the outcomes of the short term actions and based on future traffic demand, reconfigure the ramp.</p>	√					T				<p>Immediate Action: Update turning movement counts at Roland Court and determine if closing the median is a feasible cost effective solution. From the safety side, there exist safe turn around locations.</p> <p>Short Term/Low Cost: a) Consider installing a left turn pocket on VT 15 as suggested in the RSG report. b) Consider adding pedestal signals at the slip lane as per the MUTCD.</p> <p>Long Term/High Cost: a) Analyze the functionality of the off-ramp in light of future high traffic generators such as the proposed CVE civic center. b) Assuming no civic center and given the traffic conditions forecasted by RSG, and after the evaluation of the outcomes of the short term actions, consider the scoping and construction of Alt. 4 of the RSG report. See 2) below.</p>
<p>2) Rear-End crashes at the end of the slip lane by the two stop signs are very common.</p> <p>Short Term: Reduce the need for motorists to constantly look to the left at an angle for on-coming traffic.</p> <p>Long Term: Possibly eliminate the slip lane.</p>	√				√					<p>Short Term/Low Cost: Consider the signalization of the slip lane as suggested in 1) above.</p> <p>Long Term/High Cost: Consider reconfiguring the ramp and give considerations for right turning trucks.</p>
<p>3) Traffic queues up on the off-ramp past the gore area into the deceleration lane during the PM peak hour.</p> <p>Better inform motorists that this is a deceleration lane.</p>			√							<p>a) The deceleration lane should be marked according to Figure 3B-8 a of the MUTCD. Accordingly, the dotted white lane would extend for ½ length of the full width of the deceleration lane (≈ 900 ft) with the other half being the regular white lane line markings.</p>

Observations & Possible Countermeasures	Responsible Entities (√: primary, T: technical assistance)								Strategy	
	City of Winooski	VAOT District 5	VAOT Traffic Design	VAOT Traffic Ops	VAOT Roadway Design	CCMPO				
3) continued - Traffic queues up on the off-ramp past the gore area into the deceleration lane during the PM peak hour.			√							b) Install a yellow Exit Only sign (E11-a) below the E-61 guide sign.
4) Right-angle crashes are common on both EB and WB approaches as a result of running the red light on VT 15. Immediate Action: Reduce conflicts within the intersection. Short Term: Make the signal indications more visible.	√									Immediate Action: Consider adding an extra second of all red time (for a total of 2 seconds) to provide more time for vehicles to clear. Short Term: Consider replacing all-non LED signal indications with LED lenses. The LED lenses will be brighter and more visible, especially in sunny conditions.
5) Rear-end crashes on the eastbound approach have been occurring due to the change of lights from green to yellow or yellow to red.	√									Improving the visibility of the lenses as per the short term action from 4) above might help with this issue.

Road Safety Audit Review Observations

Instruction

The next section of the RSAR Written Report contains tables that display observations and guidance. The safety issues in bold in the first column have been identified through this road safety audit review. For each observation, the Audit Team suggests the guidance listed below the observation as a possible remedial solution. Each Responsible Entity was mailed their respective tables. Please indicate in the second column if you agree to implement this measure and if not, support your decision by writing a reason in the last column. Responsible Entities are not obliged to follow the findings of this Written Report. However, the reasons for not implementing a finding should be documented (e.g. physical constraints, excessive cost, environmental constraints, etc.). A written response should be submitted to the Audit Coordinator within three weeks of receipt of the Written Report.

Road Safety Audit Review Observations
VT 15/I-89 Off Ramp/Roland Ct

City's Response (1 of 2)

Observations and Possible Countermeasures	Beg. MM	End MM	<u>Decision</u> Agree/Reject	Planned Completion Date	Reason for Dismissal/Comments
<p>1) Traffic out of Roland Court has difficulties finding adequate gaps in VT 15 especially during the PM peak.</p> <p>a) Updated turning movement counts at Roland Court and determine if closing off the median is a feasible cost effective option to reduce conflicts through the intersection.</p> <p>b) If a) is found to be not feasible, consider installing a left turn pocket on VT 15 as suggested in the RSG report, and</p> <p>c) Consider adding pedestal signals at the slip lane as per the MUTCD.</p>					
<p>2) Rear-End crashes at the end of the slip lane by the two stop signs are very common.</p> <p>Consider adding pedestal signals at the slip lane as per the MUTCD.</p>					

Road Safety Audit Review Observations
VT 15/I-89 Off Ramp/Roland Ct

City's Response (2 of 2)

Observations and Possible Countermeasures	Beg. MM	End MM	<u>Decision</u> Agree/Reject	Planned Completion Date	Reason for Dismissal/Comments
<p>3) Right-angle crashes are common on both EB and WB approaches as a result of running the red light on VT 15.</p> <p>a) Consider adding an extra second of all red time (for a total of 2 seconds) to provide more time for vehicles to clear.</p> <p>b) Consider replacing all-non LED signal indications with LED lenses. The LED lenses will be brighter and more visible, especially in sunny conditions.</p>					
<p>4) Rear-end crashes on the eastbound approach have been occurring due to the change of lights from green to yellow or yellow to red.</p> <p>Consider replacing all-non LED signal indications with LED lenses. The LED lenses will be brighter and more visible, especially in sunny conditions. Improving the visibility of the lenses might help with this issue.</p>					

Road Safety Audit Review Observations
VT 15/I-89 Off Ramp/Roland Ct

VAOT Traffic Operations' Response (1 of 1)

Observations and Possible Countermeasures	Beg. MM	End MM	<u>Decision</u> Agree/Reject	Planned Completion Date	Reason for Dismissal/Comments
<p>1) Traffic queues up on the off-ramp past the gore area into the deceleration lane during the PM peak hour.</p> <p>a) The deceleration lane should be marked according to Figure 3B-8 a of the MUTCD. Accordingly, the dotted white lane would extend for ½ length of the full width of the deceleration lane (≈ 900 ft) with the other half being the regular white lane line markings.</p> <p>b) Install a yellow Exit Only sign (E11-a) below the E-61guide sign.</p>					

Road Safety Audit Review Observations
VT 15/I-89 Off Ramp/Roland Ct

VAOT District 5's Response (1 of 1)

Observations and Possible Countermeasures	Beg. MM	End MM	<u>Decision</u> Agree/Reject	Planned Completion Date	Reason for Dismissal/Comments
<p>1) Traffic out of Roland Court has difficulties finding adequate gaps in VT 15 especially during the PM peak.</p> <p>Short Term: The City may look at creating gaps in EB traffic by installing a signal at the ramp. Assist the City with construction if requested.</p>					

Road Safety Audit Review Observations
VT 15/I-89 Off Ramp/Roland Ct

VAOT Roadway Design's Response (1 of 1)

Observations and Possible Countermeasures	Beg. MM	End MM	<u>Decision</u> Agree/Reject	Planned Completion Date	Reason for Dismissal/Comments
<p>1) Traffic out of Roland Court has difficulties finding adequate gaps in VT 15 especially during the PM peak.</p> <p>Long Term: Assuming no civic center and given the traffic conditions forecasted by RSG, and after the evaluation of the outcomes of the signalization of the slip lane, consider the scoping and construction of Alt. 4 of the RSG report.</p>					
<p>2) Rear-End crashes at the end of the slip lane by the two stop signs are very common.</p> <p>Consider reconfiguring the ramp and give considerations for right turning trucks.</p>					

**Road Safety Audit Review Observations
VT 15/I-89 Off Ramp/Roland Ct**

VAOT Traffic Design's Response (1 of 1)

Observations and Possible Countermeasures	Beg. MM	End MM	<u>Decision</u> Agree/Reject	Planned Completion Date	Reason for Dismissal/Comments
<p>1) Traffic out of Roland Court has difficulties finding adequate gaps in VT 15 especially during the PM peak.</p> <p>Short Term: The City may look at creating gaps in EB traffic by installing a signal at the ramp. Assist the City with a quick design if requested.</p>					

Appendix A

Synchro Analysis of Signalizing the Slip Lane

The Audit Team suggested assessing the impact of signalizing the I-89 Exit 15 off-ramp slip lane on the ramp traffic. To perform this analysis, the relevant Synchro files prepared by Resource Systems Group for the Roland Court - VT 15 Alternative Analysis were modified to replicate signalization at the slip lane. Two scenarios were investigated for both the 2004 and 2010 timelines. These two scenarios were 1) the signalization of the slip lane assuming right turns on red and 2) the signalization of the slip lane with no right turns on red anticipated. The second scenario was evaluated as the Audit Team believed that the relocation of the stop bar at the slip lane to accommodate the new signal might make it more difficult for motorists to turn on red.

For this analysis, a cycle length of 70 seconds was used. The total yellow and all red clearance interval for the eastbound VT 15 traffic to go from the stop bar at the existing signal and pass the slip lane was calculated to be 8 seconds.

The right turning queues of traffic for the four cases were estimated using the Synchro methodology by generating the maximum back of queue for the 95th busiest signal cycle. The results of the analysis are summarized in the table below.

	Scenarios	Right Turning Movement	Left Turning Movement
2004 PM Peak	Signal at Slip Lane	452	123
	Signal at Slip Lane with NO ROR	539	123
2010 PM Peak	Signal at Right Slip	579	154
	Signal at Slip Lane with NO ROR	619	154

The table shows that for 2004 traffic conditions, the queue of right turning vehicles under the right turns on red scenario would have been approximately 19% shorter than the queue under the no turns on red scenario. For the 2010 traffic volume conditions estimated by Resource Systems Group, the difference between the two scenarios would be smaller, as the queue under the right turns on red scenario would be only 6% shorter than the queue under more stringent operations.

In comparison, for 2010, Resource Systems Group had estimated in the Roland Court - VT 15 Alternative Analysis that Alternative 2 (adding a right turn lane and removing the slip lane) would generate queues of about 586 feet. This estimated queue is in the range of what was estimated here for the 2010 cases. In contrast, the observed queue of traffic under the current stop condition at the slip lane during the afternoon peak hour of March 30, 2006, was determined to extend at least 600 feet.

For the same scenarios, the queues for the left turning movement were also estimated as shown in the table. These queues would vary between 125 feet and 155 feet. Again in contrast, the longer queue of left turning traffic observed on March 30, 2006, was approximately 230 feet.

In discussing queuing, it is important to take into account available storage. From the observations made, it is evident that motorists make two lanes of traffic from about the Exit 15 sign at mile marker 0.080 on the off-ramp at which point, the width of the ramp is approximately 24 feet. From that point, the ramp varies in widths that are sufficient to accommodate two lanes of traffic all the way up to the beginning of the slip lane (approximately 500 ft). Starting at the slip lane, the available storage for the left turning traffic is approximately 80 feet. The length of the slip lane is also approximately 80 to 100 feet. From the Exit 15 sign down towards the interstate, the width of the ramp narrows down to about 12 ft at the gore area on I-89 (for a distance of about 300 ft).