Highway 105 Port Hastings to South Haven

Road Safety Review

December 2016

NOVA SCOTIA

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1 Introduction

1.1 Background

Highway 105 from Port Hastings to South Haven is a rural, two lane arterial highway that travels through several growing communities which include the villages of Whycocomagh and Baddeck as well as Waycobah and Wagmatcook First Nations. This Road Safety Review was conducted by the Department of Transportation and Infrastructure Renewal (TIR) in response to concerns expressed by TIR District staff regarding road safety performance along Highway 105 from the Canso Causeway to Exit 11 at South Haven. Safety related concerns have been noted by members of the public, emergency service providers, local business owners as well Municipal and community representatives. Areas of particular concern are the Port Hastings Rotary, the area around the Baddeck Tim Horton's/Irving and Exit 11 at South Haven. There are also issues of traffic conflict between vehicles passing areas of roadside development where services are being provided and the road users accessing these services.

1.2 Review Scope

As part of Nova Scotia's Road Safety Strategy, safety reviews are conducted in an effort to improve overall road safety for all road users. The purpose of this Road Safety Review is to assess the safety performance of Highway 105 from the Canso Causeway to the South Haven and recommend appropriate and cost effective improvements for the study area that will reduce road safety risk. This review will aid in the development of a safety improvement plan aimed at improving safety performance levels. Mitigating measures presented in this report will be categorized by time frame.

1.3 Basis of Review

A Road Safety Review is a formal safety performance examination of an existing or future road or intersection by a Road Safety Review team. It recognizes and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.

Unless otherwise stated the information in this report is based on:

- Photographs and video recorded on December 3rd, 2015 and April 8th, 2016.
- Observations of the review team from December 3rd, 2015 and April 8th, 2016.
- Collision records from 2010-2014
- Safety concerns received by the Department from the public and media reporting.

1.4 Review Team

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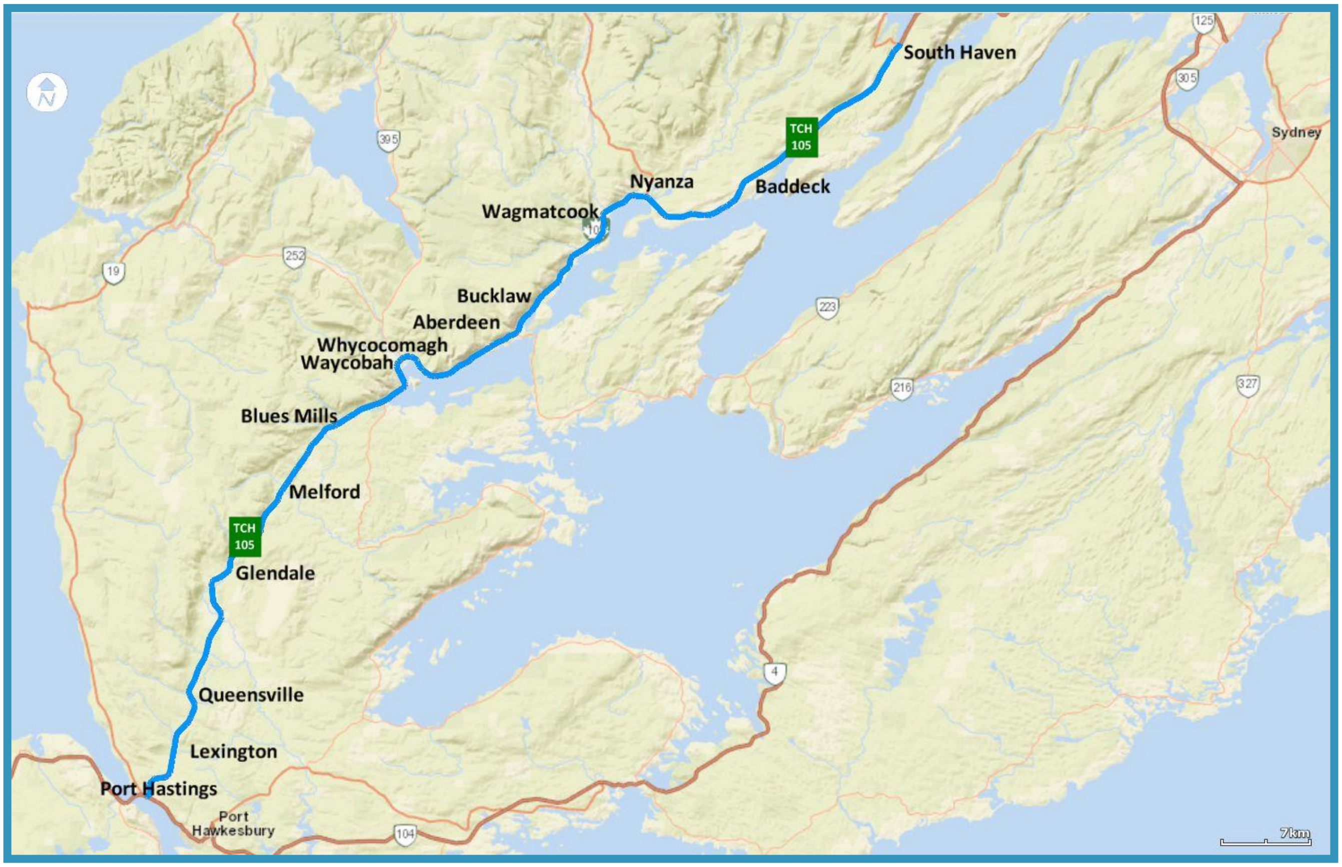
2 Site Description

This review looks at TransCanada Highway (TCH) 105 sections 10 through 80 from Port Hastings to Exit 11 at South Haven which is an approximately 103km long section of two-lane, mostly uncontrolled access, rural highway. Along these sections, access is controlled for less than a kilometer outside of Port Hastings and from Exit 8 at Baddeck to Exit 11 and beyond. Average annual daily traffic volumes range from 2,740 to 5,660 vehicles per day. The posted speed limit varies between 60 and 100 km/h. There are a large number of driveways and resource land accesses along this route as well as numerous local businesses and services including restaurants, gas stations, tourist attractions, community centers, volunteer fire departments, churches, and several school bus stops. There is also rural mail delivery and garbage collection along this section of Highway 105. Given these conditions, this section of Highway 105 serves as both a high-speed arterial highway and a local roadway for vehicle, cyclist and pedestrian activity.

Figure 1 Study Area



2.1 Study Area Sections

The Department of Transportation and Infrastructure Renewal maintains traffic volume and collisions data organized by highway section. The Highway 105 sections included in this study are defined in Table 1.

Table 1 NSTIR Sections in Study Area

Section	Description	Length (km)	*AADT (2014)
10	PORT HASTINGS ROTARY TO MACMASTER RD (QUEENSVILLE)	10.85	3570
15	MACMASTER RD (QUEENSVILLE) TO EXIT 2 (RIVERSIDE RD)	7.06	3890
20	EXIT 2 (RIVERSIDE RD) TO EXIT 3 (RIVER DENYS RD) (MELFORD)	12.34	3970
25	EXIT 3 (RIVER DENYS RD-MELFORD)TO EXIT 4 (ORANGEDALE RD)	12.26	4510
30	EXIT 4 (ORANGEDALE RD) TO EXIT 5 (RTE 252) (WHYCOCOMAGH)	4.97	4750
40	EXIT 5 (RTE 252) (WHYCOCOMAGH) TO EXIT 6 (RTE 223)	11.08	2740
50	EXIT 6 (RTE 223) TO HUMES REAR RD	9.33	4120
55	HUMES REAR RD TO EXIT 7 (CABOT TRAIL) (NYANZA)	7.75	4720
60	EXIT 7 (CABOT TRAIL - NYANZA) TO EXIT 8 (RTE 205 WEST OF BADDECK)	7.76	5660
70	EXIT 8 (RTE 205 WEST OF BADDECK) TO EXIT 9 (BADDECK CEN INTER/C)	2.13	3930
75	EXIT 9 (BADDECK CEN INTER/C) TO EXIT 10 (RTE 205 EAST OF BADDECK)	9.01	3050
80	EXIT 10 (RTE 205 EAST OF BADDECK) TO EXIT 11 (CABOT TRAIL)	8.83	3640

* Annual Average Daily Traffic, abbreviated AADT, is a measure of the average number of vehicles passing a count location on a highway or road section in a 24 hour period, averaged on the basis of one year.

3 Collisions Data Analysis

Collisions data analysis looks at the number, contributing factors, and types of collisions that occur within an area using individual collision reports. This informs and can help identify current road safety issues which can guide road safety investment and work programs. Because collision are relatively rare and random occurrences, several years of collision data must be examined. NSTIR collisions data is compiled from reports filed by police. Data from 2010 to 2014 was used in this review. This collision data was analyzed to determine the number and specific types of collision that have occurred in the study area. See Figure 2.

There were 297 reported collisions along the 103 km study area of TCH 105 in the five years between 2010 and 2014. Of these, there have been 9 fatal collisions resulting in 10 deaths along this corridor during this time period. See Figure 3. These fatal collisions included 3 single vehicle collisions and 6 collisions involving two or more vehicles. 50% of the victims were drivers or passengers over the age of 60 and one was under the age of 45. Even though all but one of the fatal collisions occurred during clear weather, many other injury and property damage collisions occurred during rain, snow or fog conditions. In more than 55% of all collisions vehicles ran off the road. A significant number of these collisions involved wildlife in the roadway.

Driver behavior such as distraction or inattention, impairment by drugs or alcohol, fatigue or speeding has been identified as a contributed factor in each of the fatal collisions along the study area corridor. In two of these fatal collisions, the victims were not wearing a seatbelt.

Nearly 56% of reported collisions were run off road (ROR) where vehicles have left the travel lane and crossed over the shoulder ending in a collision. The reasons for these types of collisions are varied and include avoiding a vehicle, object, or animal in the travel lane; inattentive driving due to distraction, fatigue, sleep, or impairment by drugs or alcohol; the effects of weather on pavement conditions; or traveling too fast through a curve. The probability of a collision depends to some extent on the speed of the vehicle and the driver's experience and capabilities. Roadway design factors such as substandard curves, and unforgiving shoulders and roadsides can also increase the probability that a driver error will become an ROR collision.

Shoulder maintenance is intended to ensure an acceptable shoulder surface, proper slope, and to provide a smooth transition from the edge of pavement to the gravel shoulder. Roadway departure crashes that are most likely to be severe are those involving large pavement edge drop offs that exceed the desirable threshold of 100mm. These crashes may occur as the result of a vehicle leaving the paved surface and encroaching on an unpaved surface lower than the roadway.

A significant number of rear end collisions have occurred along the study area corridor during the five year timeframe looked at for this review. This may indicate issues with drivers unexpectedly stopping along the roadway to access services or driveways. Wildlife involvement was also noted in more than 15% of collision.

Figure 2 Collision History

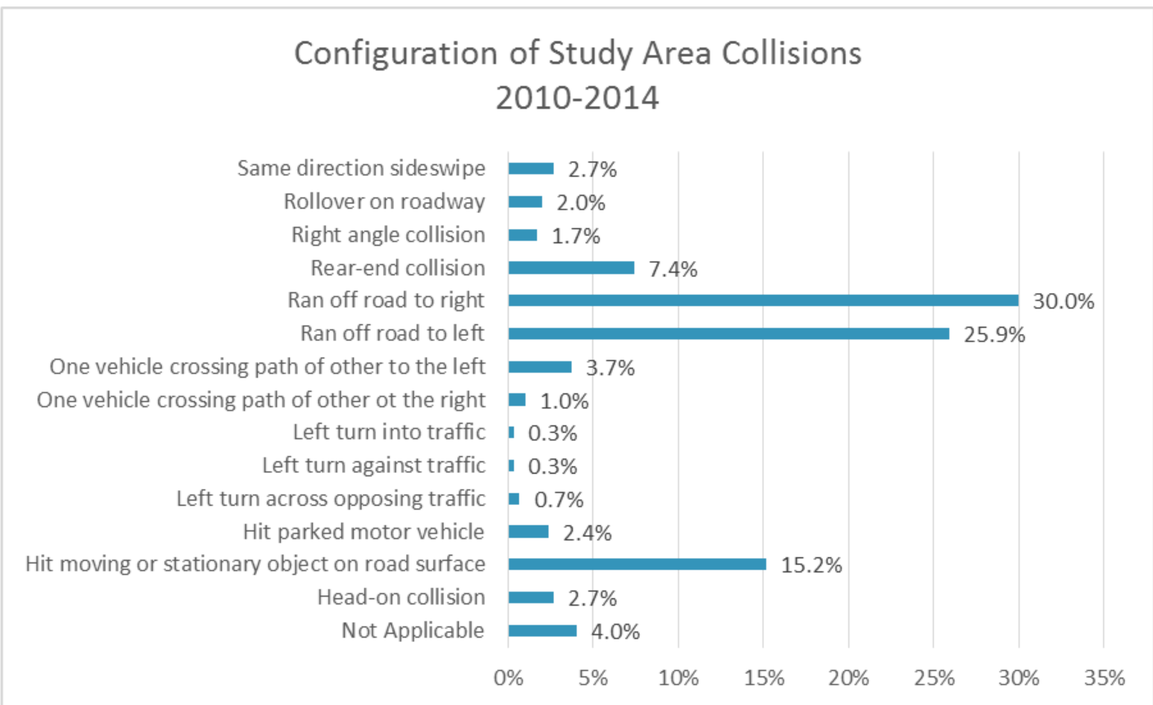
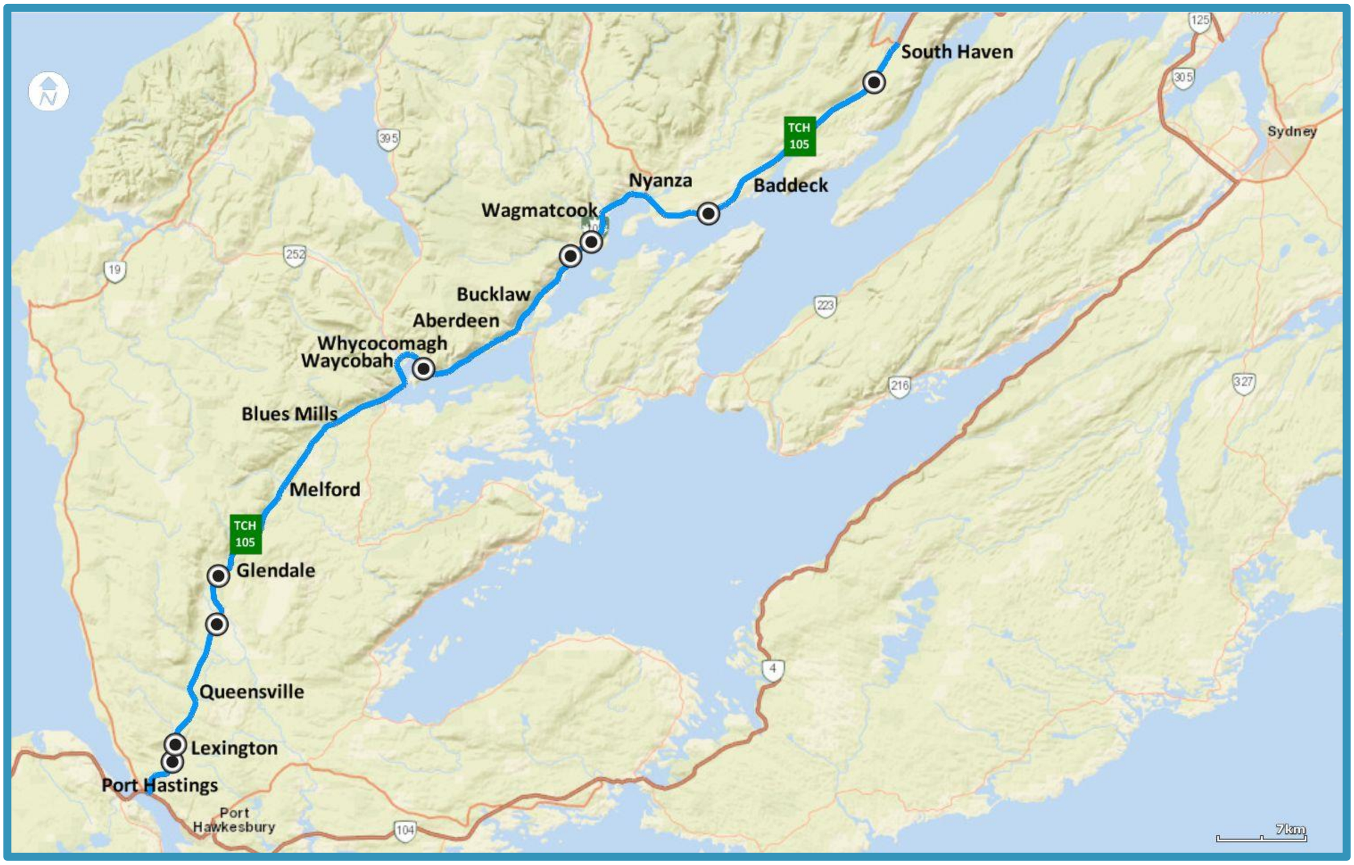


Figure 3 Fatal Collision Locations



4 Community Input

4.1 Background

The Review Team distributed contact information and solicited input from municipal leaders, community members, emergency service providers and the public requesting that anyone who wished to express their safety concerns do so via telephone or email discussion. District staff also provided information about their observations and any concerns they have been made aware of. After receiving numerous submissions, the review team noted a number of common concerns.

4.2 Operational Concerns

The Chief of Wagmatcook First Nation has expressed concerns about road safety in his community. In a 2015 letter to the Minister of Transportation and Infrastructure Renewal, Chief Bernard requested that the existing 70 km/h posted speed limit on TCH 105 through Wagmatcook be reduced. A review was conducted by the Department District Traffic Supervisor. This review concluded that the existing speed limit should be retained at 70 km/h and that the 70 km/h speed zone be extended approximately 600 m westerly to a point approximately 100 m beyond the west end of MacLellans Loop. Extending the zone to this point would include all residential development within Wagmatcook in the 70 km/h zone. In addition, this would place the advance transition and start of the eastbound zone on a positive grade rather than on the downhill grade as it is now.

Residents along the study corridor have reported excessive speed and an increase in vehicle traffic, particularly commercial transport, over the past number of decades. There are conflicts between local use of the roadway i.e. pedestrian and cyclist activity, motorists accessing driveways and local services with commercial truck traffic at locations where access onto TCH 105 is unrestricted. Feedback from local residents noted particular locations of safety concern along curves, particularly a sharp curve near the church at Glendale where residents have noted that adverse weather can create a hazard for motorists. The Municipality of Victoria County has expressed concerns about traffic access/egress, internal layout and traffic flow issues at the existing Tim Horton's/Irving commercial operation on TCH 105. Concerns were also raised about proposed developments that have access frontage on TCH 105 and their impact on traffic.

Residents of the Village of Whycocomagh have asked that the study team look at road safety issues at the intersection of TCH 105 and Main Street, Route 252 and MacInnis Road. They indicated that the skewed alignment of the intersection creates sight distance issues particularly coming out of Main Street. The presence of school buses traveling on and crossing TCH 105 as well as heavy pedestrian use in the area, particularly by seniors, is also a concern.

The CEO of the Gaelic College at St Ann's requested the Department do a safety review of Exit 11. With more and more vehicles visiting the College each year, many being seniors, it was noted that wayfinding is an issue for older drivers and visitors who are unfamiliar with the local environment. In addition, traffic coming from the Newfoundland ferry means a number of large trucks in a short amount of time travel along TCH 105 passing Exit 11 at a high rate of speed in an effort to make up time after coming down from Kelly's mountain. There was also concern expressed about traffic turning at Exit 11 during winter conditions. It was noted that turning in to access the Cabot Trail can become dangerous depending on how much snow has been left after plowing. The intersection may appear to be clear of snow but after beginning a turning maneuver, drivers may encounter snow part way through the turn.

In 2015, an evaluation of safety concerns at the Port Hastings Rotary was conducted by the District Traffic Supervisor for Eastern District with respect to the need for additional signage to address vehicles entering the rotary in the wrong direction at various access points. This evaluation resulted in recommendations for improved signing, markings and traffic control devices. These improvements have been carried out and at the time of this report, no safety issues were observed at the Rotary.

5 Safety Issues (see Appendix A for photos)

5.1 Background

The study team identified 16 safety issues along the Port Hastings to South Haven section of TCH 105. An on-site review was conducted on a rainy day and again on a clear day. No noticeable weather impacts were observed. Traffic was relatively heavy for mid-day on a rural roadway with a significant amount of turning traffic at commercial business locations. The study team also observed the roadway at night. The safety issues noted should not be considered deficiencies but could present an increased risk of collision and a higher level severity should a collision occur. While many issues are inter-related and carry over into multiple areas of concern, field observations were generally categorized into the following areas of investigation:

5.2 Accesses

5.2.1 General

Access management is the management of entrances onto provincial highways, at interchanges and intersections, and onto municipal roads in the vicinity of a provincial highway. Access management techniques help to reduce conflict points, preserve mobility, and maintain safety by controlling the location, spacing, design, and operation of driveways, median openings and street connections. Managing the number of locations where vehicles enter and exit the roadway reduces the number of conflict points where vehicles' paths can either cross, merge, or diverge thereby reducing the potential for collisions. Access management is important for both highway safety and traffic mobility as it also provides appropriate access for land development. Unexpected turning movements impact safety due to incorrect decisions or delayed reaction times of drivers. It is important to provide drivers with clear clues about what is expected of them on a particular roadway.

5.2.2 Observations

Traffic conflicts are a concern at various locations along the study area corridor where commercial development with limited controls on access contribute to driver confusion and unexpected vehicle movements. In 2014, NSTIR staff conducted a review at the Tim Horton's/Irving location near Baddeck which recommended the owner/operators have a traffic study conducted to look at the noted issues. (see Photo 11) Based on this review NSTIR renewed and replaced regulatory signing in the area. A request was made of the RCMP to increase enforcement of existing parking restrictions along TCH 105 in the area of the Tim Horton's/Irving. This location was analysed for traffic signals and left turn lanes in 2015. While it was determined that traffic signal are not warranted, the warrant was met for left turn lanes at this location.

The study area also has a large number of driveways and intersections which cause conflict with traffic traveling along the corridor and can lead to angle type collisions that can be of a higher severity in terms of injury. Collision data shows a number of collisions along the study area sections involve turning movements or are rear end collisions which indicate drivers are not anticipating turning traffic or vehicles stopped on the roadway to make a turn into a driveway or intersecting road. There are a large number of driveway locations along the controlled access portion of Hwy 105 that service resource land. (see Photo 12) These entrances appear to range greatly in use some being almost completely overgrown with vegetation. There is currently an unmaintained scenic lookoff where vehicles can stop adjacent to the climbing lane near the 90 kilometer marker. (see Photo 17) The pavement at this location is crumbling and roadside trees have not been cut in decades and are blocking the view. It has been reported that truck operators use this location as a rest area. NSTIR should review the need for suitable rest area locations along the corridor and should contact Tourism Nova Scotia to discuss future plans for use of this lookoff and consider closing it off, either by regrading the ditch/sideslope or with guard rail. A detailed list of access issues is provided at the end of this report in Appendix B.

5.3 Pedestrian and Cyclist Activity

5.3.1 General

Collisions in general are uncommon events and this is especially true for pedestrian impacts. Pedestrians however are extremely vulnerable in collisions with fast moving vehicles. When traffic speeds are high, pedestrians and bicyclists may feel particularly vulnerable using the roadway. Enhanced safety education programs for all road users, speed limit enforcement, increased lighting and sidewalks in areas of heavy pedestrian use can improve safety. Lighting and pedestrian facilities including sidewalks are the responsibility of Municipalities.

5.3.2 Observations

There is a high level of pedestrian activity in a number of communities bisected by TCH 105. Pedestrians were observed walking along the edge of the highway and on the shoulder on the sections of TCH 105 that run through the communities of Wagmatcook and Waycobah. There are currently no sidewalks through these communities. There is limited lighting along these sections of roadway. Field work for this study was carried out in December and April so cycling activity would not be expected and none was observed. No collisions involving bicycles have been reported on the review roadway sections. There is currently no cycling infrastructure i.e. bike lanes or trails and there are currently no plans for Provincial Active Transportation Blue Route links from Port Hastings to Whycocomagh. A portion of the corridor from Whycocomagh to Baddeck is under review as potential Blue Route.

5.4 **Older Drivers**

5.4.1 General

Studies have found that seniors are disproportionately involved in collisions which involve making a turn across opposing traffic at intersections, merging from a yield lane, or changing lanes on a highway. One of the requirements for safe driving is the ability to scan the visual field for objects and take appropriate action. Using larger advance street name signs, increasing the text size to enhance readability is a potentially effective countermeasure for older adults. A number of other countermeasures have the potential to address the difficulties older drivers face when driving at night. These include internally lit street signs, improved roadway illumination, larger text sizes and highly reflective road signs can result in increased readability, especially for older adults who are more likely to suffer from degraded perceptual abilities.

5.4.2 Observations

Road name signs are too small. (see Photo 19) Analysis of collisions data has revealed a majority of collisions along the study area sections of TCH 105 involve drivers 45 years of age and older.

5.5 Roadside

5.5.1 General

The clear zone is considered to be the total, fixed-object-free roadside border area on a slope that is 3:1 or flatter at the edge of the roadway available for safe use by vehicles that may travel outside of the travel way. The wider the clear zone, the less the frequency and severity of collisions with fixed objects. This clear zone distance varies based on travel speed and the classification of a roadway. The travel way is the portion of the roadway for the movement of vehicles, exclusive of shoulders. In order to provide for adequate safety in roadside conditions, hazardous elements such as fixed obstacles or slopes steeper than 3:1 should be placed outside of the clear zone in order to reduce or eliminate the need for roadside protection. If this is not possible, steep slopes or fixed obstacles should be protected by barriers, removed, or delineated.

5.5.2 Observations

There are utility boxes and poles, large trees, numerous other fixed objects and driveway culverts within the clear zone that could present a hazard if struck by a vehicle. (see Photos 1 -5)

5.6 Maintenance

5.6.1 General

A non-paved shoulder is that portion of the roadway which is adjacent to and runs parallel to the pavement or traveled portion of the road. Roadway departure collisions involving large pavement edge drop offs (exceeding the desirable threshold of 100mm) are more likely to result in injury. These collisions may occur as the result of a vehicle leaving the paved surface and encroaching on an unpaved surface lower than the roadway. Low gravel shoulders can lead to a loss of control should a vehicle leave the roadway transitioning from a high friction surface to a low friction surface. Shoulders give lateral support to the road structure, allow run-off of surface water, and may provide an area for emergency refuge off the traveled portion of the roadway.

Shoulder maintenance is an important factor along sections of the road where there are increased numbers of driveways, accesses and intersections and is intended to ensure an acceptable shoulder surface, proper slope, and to provide a smooth transition from the edge of pavement to the gravel shoulder. This maintenance should include repairing or restoring washouts and low shoulders on non-paved shoulders by adding new gravel or recycled asphalt or using existing material.

Ditches should be maintained in a condition such that surface runoff water is collected and carried along and away from the highway without erosion of road section, damage to the adjacent properties, degradation of the environment or saturation of subgrade. Paving shoulders wide enough to accommodate edge line rumble strips should be considered as part of maintenance activities.

5.6.2 Observations

While it was observed that the pavement along this corridor was in good condition without any observable wheel rutting, polished surfaces, transverse cracks across the lanes or alligator cracking, there are a number of locations where large potholes were observed. (see photos 6 &

7) Bumps significant enough to warrant warning signs are also present and some asphalt overlays are worn out. Paved shoulder widths, which should be 2 metres wide to accommodate edge line rumble strips, are not consistently wide enough. Throughout the corridor there are shoulders with significant pavement edge drop-offs which present a hazard. In some locations there is deterioration of adjacent pavement, which may indicate poorly drained subgrade. (see Photo 8)

5.7 Barriers and Guideposts

5.7.1 General

Roadside barriers (guard rail, cable barrier, concrete barrier etc.) should be designed, installed, and maintained along the roadside of 100 series highways in a manner that improves overall road safety conditions. Installation and maintenance of roadside barrier is intended to reduce the severity of roadside collisions.

5.7.2 Observations

There are locations throughout the study area where 6 x 6 wooden posts serve as roadside or intersection delineators. (see Photo 10) These posts present a hazard to off tracking vehicles and should be replaced with flexible guide posts in areas where additional road-edge delineation is found to be required or with guard rail where it is warranted. There are a number of locations where barrier installations are not consistent with NSTIR's new draft 100 Series Highway Roadside Barrier Policy. At some locations, barrier meant to protect does not appear to properly shield the vehicle from the hazard. Some roadside hazards located in the area are not protected by barriers. Where adequate guard rail does exist, proper end treatments are not in place. Only proprietary Energy-Absorbing Guard Rail Terminal (EAGRT) systems are acceptable on high speed sections. Buried or blunt guard rail ends should be replaced. (see Photo 9) Reflectors on most of the existing guard rails are missing. Brush along the roadway makes it difficult to see the existing reflectors as well as the guard rails in some places.

5.8 Visibility/Sight Lines

5.8.1 General

Insufficient sight distance and limited forward visibility can adversely affect safety and increases the risk of a collision by reducing reaction times and stopping distances. Adequate sight distance provides drivers with sufficient time to identify and appropriately react to all elements of the road environment, including other road users and hazards. Improved sight distances on the approaches to intersections and through curves can reduce collisions at these high-risk locations. Rear end collisions can be reduced with improved forward visibility.

5.8.2 Observations

In several driveway and intersection locations along the TCH 105 corridor, stopping sight distances appear to be insufficient. Parking on the roadside near accesses was observed. Sight lines are also restricted by roadside vegetation in some areas. There are several skew intersections along the corridor. Skew intersections like those at River Denys Rd, McIntyre Rd, South Haven Loop near the church property and others may present a hazard to vehicles turning onto Highway 105.

5.9 Signs, Markings, Lighting, Delineation

5.9.1
General
Wayfinding enables drivers to navigate from one location to another. Wayfinding abilities decline as individuals age, which may increase older driver reliance on directional cues i.e. signs. Familiarity with an environment can facilitate wayfinding due to previous knowledge of the route. The study area roadway is used by a large number of older drivers as well as drivers who are visitors to the area who may be unfamiliar with the environment. Readability of guide signing, particularly for older drivers, is improved when larger text sizes are used. Guide, warning and regulatory information signs should be placed at locations that have unobstructed visibility and minimum background clutter. To ensure the integrity of signs, to inform highway users of traffic regulations, to warn of roadway characteristics and hazards, and to provide necessary information, signs and markings should be repaired and maintained as outlined in NSTIR's Highway Maintenance Standards Manual.

5.9.2
Observations
There are several roads that intersect Highway 105 in the study area that lack advance road name signage i.e. the east end of Main Street in Whycocomagh. Although there were no observed deficiencies in pavement markings on the main roadway throughout the corridor, some intersections lack pavement markings and delineation to indicate to the driver that a road intersects TCH 105. Regulatory and warning signs are in poor condition and need upgrading throughout the corridor. Missing guide signs should be replaced. Existing lighting appears to meet Department standards. (see Photos 18-20)

6 Speed Review

6.1 Background
A key indicator of potential collision risk is the speed at which vehicles travel through the study area. Research shows that as speed increases, the severity of collisions increases and that as the variability of speeds increase, the likelihood of a collision increases. Prior to this review, several speed studies had been conducted at various locations throughout the corridor to determine if the speed limits should be reduced. These studies recommended that the existing speed zones be maintained.

6.2 Speed Study
Generally speeding was not observed to be a significant issue along the study area corridor except in those communities where the proliferation of roadside services conflicts with mainline traffic. The most recent speed study conducted in October of 2015 for the community of Wagmatcook looked at a 2 kilometer long section of TCH 105 with uncontrolled access and a posted speed limit of 70 km/h. Speed samples were taken at three locations. On March 26, 2015 the intersection of Humes Rear Road and near the Ultramar service station samples showed that the 85th percentile speed, at 78.4 km/h and 69.2km/h in the 70 km zone. During the period of September 1st to 4th, 2015 the third location, 50m west of the east end of Humes Rear East Loop showed the 85th percentile speed to be 81km/hr or 11 km over the posted speed limit. These results indicate there is a low level of compliance with the posted speed limit. At the request of

the Minister of Transportation and Infrastructure Renewal, there is currently a pilot project being implemented for a speed reduction to 60 km/hr through the communities of Wagmatcook and Waycobah. This will be a one year pilot to determine the effectiveness of this lower speed limit.

6.3 Analysis

In cases where compliance with posted speed limits is low, studies show that lowering posted speed limits does not reduce vehicle speeds or collisions. Also, lowering speed limits well below the 85th percentile speed can increase speed variability and the likelihood and severity of collisions. Some drivers will obey the new lower posted speed limit while others will continue traveling at a speed much higher than the posted speed limit. This greater speed differential increases the likelihood of collision. Lowering the speed limit in the study area may not be an effective countermeasure and could actually increase the safety risk. Speed was noted as a contributing factor in one of the fatalities that occurred on the study area roadway. This collision occurred in the community of Lexington during rainy weather conditions.

7 Identifying and Rating Safety Issues

After identifying safety issues, the Review Team's observations were given a Risk Rating. This rating is based on how often the issue is likely to lead to a collision or it's "frequency", and what the likely severity of the collision would be. The ratings are applied as follows:

Table 2 Safety Issue Ratings

Frequency	Severity			
	Negligible	Low	Medium	High
Frequent	C	D	E	F
Occasional	B	C	D	E
Infrequent	A	B	C	D
Rare	A	A	B	C

A = Lowest Priority F = Highest Priority

Table 3 Safety Issues

Issue		Location	Frequency	Severity	Rating
1	Trees, utility poles and rigid obstacles in clear zone. Roadside hazards not sufficiently protected including steep slopes.	Throughout	Occasional	High	E
2	Guard rail in poor condition. Energy-Absorbing Guard Rail Terminal (EAGRT) systems end treatments not in place.	Throughout	Frequent	High	F

Issue		Location	Frequency	Severity	Rating
3	Existing 6 x 6 guideposts present a hazard to vehicles leaving the road.	Various locations	Occasional	Medium	D
4	Pavement edge drop off greater than the desirable threshold of 100mm.	Throughout	Frequent	Medium	E
5	Paved shoulder width less than 2m needed for continuous shoulder rumble strips; lack of centerline rumble strips.	Throughout	Frequent	Medium	E
6	Washouts along roadway preventing water from getting into ditch. Gravel and soil build up along roadside. (see photo 6)	Various locations	Occasional	Medium	D
7	Numerous private access locations servicing resource land at locations with poor sight distances and close to intersections. (see photos 12-16)	Throughout	Frequent	High	F
8	Driveways a hazard to off tracking vehicles. i.e. vertical culvert walls. (see photos 4 & 5)	Various locations	Frequent	Medium	E
9	Parking on roadside. (see appendix B, item 6 & 7)	Various locations	Infrequent	Medium	C
10	Skew intersections may present a hazard to vehicles turning to/from Highway 105.	River Denys Rd, McIntyre Rd, Old Mill Rd, east end of Main St at Baddeck, South Haven Loop near the church property	Infrequent	Medium	C
11	Road name signs not located in advance of intersections.	Various locations	Occasional	Medium	D
12	Missing guide, warning and regulatory signs (see photo 20)	Various locations	Infrequent	Low	D
13	Low compliance with posted speed limit.	Waycobah and Wagmatcook First Nations	Frequent	High	F
14	Presence of wildlife (deer)	All sections; highest between Exits 9 and 10.	Frequent	Medium	E

Issue		Location	Frequency	Severity	Rating
15	Limited lighting and lack of sidewalks along the sections of roadway where there is pedestrian activity in high speed traffic areas	Wagmatcook First Nation, Village of Whycocomagh, Waycobah First Nation	Frequent	High	F
16	Traffic conflicts at commercial developments. Irregular turning movements by motorists leaving the highway to access services or driveways.	Vi's restaurant, Baddeck Tim Horton, Auld Brass Door Restaurant	Infrequent	Medium	C

8 Evaluating Countermeasures and Determining Priorities

Once these safety issues were rated, the study team looked at safety countermeasures and their potential effectiveness if implemented along this corridor.

One of the descriptors of a countermeasure's effectiveness is called a collision modification factor (CMF) and these have been developed through before-and-after research projects. Collision Modification Factor (CMF) is a multiplicative factor used to compute the expected number of collision after implementing a given countermeasure at a specific site. Collision Reduction Factor (CRF) is an estimate of the percentage reduction in collisions due to a particular countermeasure. Mathematically stated, CMF = 1 - (CRF/100). For example, if a particular countermeasure is expected to reduce the number of collisions by 23% (i.e., the CRF is 23), the CMF will be 1 - (23/100) = 0.77. On the other hand, if the treatment is expected to increase the number of collision by 23% (i.e., the CRF is -23), the CMF will be = 1 - (-23/100) = 1.23. Countermeasures were prioritized using both the estimated cost of implementation and the effectiveness rating for each countermeasure.

Table 4 Determining Priorities

Cost	Effectiveness		
	Low	Moderate	High
$ - Low	2	1	1
$$- Mid	3	2	1
$$$- High	3	3	2

* Effectiveness is a ranking based on the documented CMF for a particular countermeasure.

Effectiveness: <0.5 = Low   0.7-0.5 = Moderate   1.0-0.7 = High

$ - $0-$50,000 $$ - $50,000 - $250,000 $$$ - $250,000+

Table 5 Countermeasures Evaluation

Countermeasure *Related Safety Issue in brackets		Cost Category	Target Collisions	Documented CMF	Effectiveness	Priority
1	Clear trees and vegetation; relocate or protect utility poles; remove, delineate or protect fixed objects within clear zone. (1,2)	$$	Run off road Hit moveable object (deer)	0.62	0.7-0.5	2
2	Review all barriers to ensure that they are properly protecting the roadside hazard. - Replace with new barriers using appropriate end treatments as per NSTIR's Draft 100 Series Highway Roadside Barrier Policy . - Apply NSTIR's Flexible Guide Posts Policy where appropriate. - Lengthen existing barriers. - Enhance barrier delineation. (2,3)	$$	Run off road	0.53	0.7-0.5	2
3	Maintain the vertical drop between the paved edge of travelled way and the adjacent gravel shoulder not to exceed NSTIR's desirable safe threshold of 100 mm. Conduct frequent and regular reviews to identify pavement edge drop off locations. Implement regular grading program in the corridor as per NSTIR maintenance standard. (4,6)	$$$	Head on, Run off road, Sideswipe	0.21	<0.5	3
4	Install centerline and shoulder rumble strips as per NSTIR's Continuous Shoulder & Centre Line Rumble Strip Policy. (5)	$$	Run off road	0.46	0.7-0.5	2
5	Remove or relocate accesses where appropriate - see Appendix B. (7)	$$$	All	0.75-0.25	1.0-0.7	2
6	Install 3:1 sloped culvert walls 3:1 on new or upgraded driveway entrances where roadway speeds are 70km/hr and above as outlined in current NSTIR draft procedure for driveway entrances, PR-5000. (8)	$$$	Run off road	Not enough data available	Unknown	3
7	Restrict roadside parking near business accesses with signage. (9)	$	Rear-end Hit Parked Vehicle	No CMF available	Unknown	1

Countermeasure *Related Safety Issue in brackets		Cost Category	Target Collisions	Documented CMF	Effectiveness	Priority
8	Review and develop a plan for improved access considering an offset T intersection at TCH 105, Main Street and Route 252. (10)	$$$	All	0.64	0.7-0.5	3
9	Conduct left turn lanes warrant analysis at intersections and driveways with high turning volumes and install left turn lanes where warranted. (10,16)	$$$	Vehicle crossing path of other	.65	0.7-0.5	3
10	Review all warning, regulatory and guide signs to ensure consistent and appropriate signage is used throughout the corridor. Replace and erect new signage as needed. (11,12)	$	All	0.69	0.7-0.5	1
11	Review signing on all curves and install chevrons on substandard horizontal curves if warranted under NSTIR's Curve Warning Signs Policy i.e. Glendale. (12)	$	All	0.84	1.0-0.7	1
12	Where highway lighting exists, review to ensure adequacy. Encourage Community Councils to evaluate need for improved lighting and pedestrian sidewalks. (15)	$$	All	Not enough data available	Unknown	3
13	Improve wayfinding signage with increased text size. Assess the retroreflective properties of all existing guide signage and replace with "High Intensity" sheeting. Remove obsolete signs and replace missing signs. (16)	$$	All	Not enough data available.	Unknown	3

9 Recommendations

Using this report as a guide, the Department should prepare a detailed Road Safety Improvement Plan for short term (1-2 years), mid-term (2-4 years) and long term (4-6 years) implementation schedule of appropriate countermeasures. Because fully implementing all safety countermeasures is likely to exceed the Government's fiscal constraints and some countermeasures will not provide sufficient improvements in road safety to warrant funding, the plan should assess which countermeasures would be most easily implemented and be most cost effective. Some of the recommended countermeasures could be implemented as part of capital projects such as repaving and others are standard maintenance practices.

The Department should require a Traffic Impact Analysis for any proposed development, redevelopment, or other land use change as outlined in NSTIR policy PO1018, Traffic Impact Analysis and procedure PR5066, Traffic Impact Analysis Process. This process will identify the impact of additional traffic on the adjacent roadway, and any transportation infrastructure upgrading requirements.

This report recommends that guide and warning signs and the number and configuration of accesses be reviewed. Because the majority of reported collisions were run off road collisions requirements for roadside barriers should be reviewed along the entire length of the corridor in conjunction with upcoming repaving or upgrading projects. This should include a review of need where no barrier exists, the proper barrier technology application, and the existing barrier length of need. A significant number of collisions involved wildlife in the roadway. Brush cutting is necessary in some areas to preserve driver sight distances and visibility of signage, control roadside growth to deter wildlife, and ensure proper drainage. Maintenance should be evaluated to ensure the level of service is being met.

While the impact on traffic of slower moving trucks traveling from the Newfoundland Ferry was not identified as a safety issue for this study, it is recommended that a separate analysis be carried out to determine if additional passing lanes are warranted and to identify suitable locations.

Many older drivers use this roadway as well as a large number of visitors who may be unfamiliar with the local environment. A significant number of roadside land uses in the study area are service and tourism industry based. It is recommended that the Department consider a standard tourism signing plan specific to this unique area of the Province. This plan should be developed in consultation with local stakeholders with the aim of enhancing wayfinding throughout the corridor. The Department should also consider a Control of Access designation for the entire corridor.

10 Summary and Conclusion

This review identified numerous countermeasures which are expected to provide improvements in safety performance for this roadway. While it is unrealistic to expect the Department to implement all of the countermeasures immediately, many can be completed in the short term at a relatively low cost. It is also recommended that in an effort to lower the number of collisions and lessen collision severity along this route, the Department invest in consistent and proactive maintenance and develop a signage improvement plan to increasing safety for all road users.

Appendix A – Photos of Safety Issues

Examples of Objects in Clear Zone

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Examples of Shoulder and Pavement Issues

Photo 6

Photo 7

Photo 8

Examples of Access Issues

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

Photo 15

Photo 16

Photo 17

Signage Issues

Photo 18

Photo 19

Photo 20

Appendix B – Access Management Review Notes

Hwy 105 Exit 5 to 11 – Access Management Review
D. Cross, Access Management Engineer, NSTIR Traffic Engineering and Road Safety
May 13, 2016

General comments:
There are a multitude of driveway locations along the controlled access portion of Hwy 105 that service resource land, and they appear to range greatly in use (free of vegetation due to regular travel, to overgrown from the absence of use). I recommend as many of these as possible get closed. Western District have initiated a project with this goal in mind. Enhanced definition and improvement of driveway widths should be explored throughout the corridor.

Location specific comments:

1. Improvements should be considered at Old South Haven Road and the Church property. Review during Church arrivals/departures might be beneficial.

2. Eliminate access point on right side opposite civic number 4489.

3. Consider eliminating driveway to old TIR ROW at kilometer marker 98.

4. Eliminate wide open frontage and reduce to typical driveway width just ahead of kilometer marker 97 westbound.

5. Driveway near the end of a climbing lane should be closed just past kilometer marker 94.

6. A paved area where vehicles can stop just past kilometer marker 91 which exceeds 200 metres in length and is adjacent to the climbing lane should be closed off, either by regrading the ditch/sideslope of the highway, or with guard rail.

7. Ultramar access is too wide, and should be reduced. Shoulder parking on left side should be corrected just past kilometer marker 83.

8. Elimination/width reduction of access on left side at Bras d'Or Lakes campground.

9. Herring Choker Café has perpendicular parking stalls and wide open frontage on a curve. Reassignment of parking and access management should be pursued.

10. Presently there is no access management at the Ultramar in Wagmatcook First Nation and the access is 50 metres wide. Reduction to two access points with appropriate widths is recommended.

11. Intersection at MacLellan Loop appears to be excessively wide.

12. Wide frontages on both sides should be reduced and defined at the 70 kilometer marker.

13. Additional “permanent” narrowing of this frontage be conducted? See photo.

14. Access management required on left side at the 50 km marker westbound.

15. Close the west driveway. East access would remain. A second access exists on adjacent public road near back of building.

16. Westbound on left side at Milford Road, easterly looping driveway is very close to road intersection. Elimination of access to Hwy 105 or realignment of driveway to local road should be considered.

17. Redevelopment of shuttered gas station site across from the Co-op should be mindful of future access(es). A single driveway is adequate for most land uses.

18. Route 252 intersection has a history of reviews and recommendations. An access management plan should be adopted and implemented in this area.

19. Access management deficiencies along both sides of Hwy 105 study area corridor. A complete corrective plan should be developed.