Route 1 Corridor Study

NB Department of Transportation & Infrastructure

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Prepared By:
Mark Gunter, P.Eng.
Don Good, P.Eng.
Steve Wetmore, P.Eng.
Jamie Copeland, P.Eng.
Danielle Sullivan, EIT

Reviewed By:
Serge Levesque, P.Eng.

exp Services Inc.
1133 Regent Street, Suite 300
Fredericton, NB, E3B 3Z2
T: +1.506.452.9000
www.exp.com

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Prepared By: *Mark Gunter, P.Eng.*	
Reviewed By: *Serge Levesque, P.Eng.*	

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1 Introduction

1.1 Project Rationale

With traffic volumes upwards of 35,000 vehicles per day on some segments, the 14 km stretch of NB Route 1 between Ashburn Lake Road and Quispamsis has the distinction of being New Brunswick's busiest stretch of highway. The road currently has a four lane rural arterial divided cross-section, with full access control via grade separated interchanges.

Although some capacity and safety improvements were recently implemented on this corridor as part of the Route 1 Gateway Project (most notably at the Route 111 interchange), it is unclear whether current infrastructure can adequately meet the needs of future traffic demands. As such, the New Brunswick Department of Transportation & Infrastructure (NBDTI) has pro-actively initiated this study with the goal of identifying a 25-year strategic plan for this corridor. The findings from this study will allow the Department to start planning now for the future by:

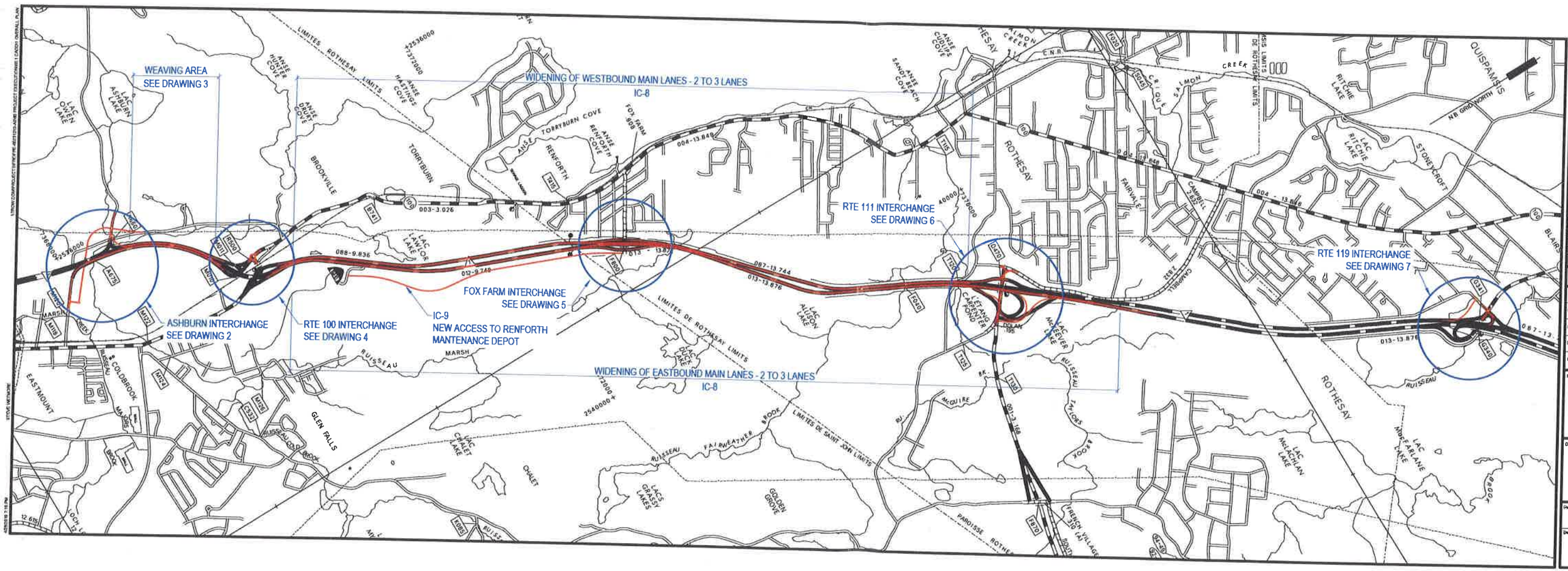
- Prioritizing capital investments based on current and projected needs;
- Identifying additional property which may be required to accommodate future infrastructure expansions; and
- Developing cost estimates for future budgeting purposes.

1.2 Study Area

As shown in Figure 1, the study area covers a 14 km stretch of the Route 1 main lanes between Ashburn Lake Road and Route 119 in Quispamsis, including the following access locations (from west to east):

- Ashburn Lake Road – on/off ramps (EB only)
- Foster Thurston Drive – on/off ramps (WB only)
- Route 100 (Rothesay Ave) – grade separated interchange
- Fox Farm Road – grade separated interchange
- Route 111 (Rothesay) – grade separated interchange
- Route 119 (Quispamsis) – grade separated interchange

The extent of the study area at each interchange was limited to the ramp terminals only.



exp. Services Inc.
T +1 506 462 9000 | F +1 506 460 3052
1133 Regent Street, Suite 300
Fredericton, NB, E3B 3Z2
CANADA
www.exp.com

exp.

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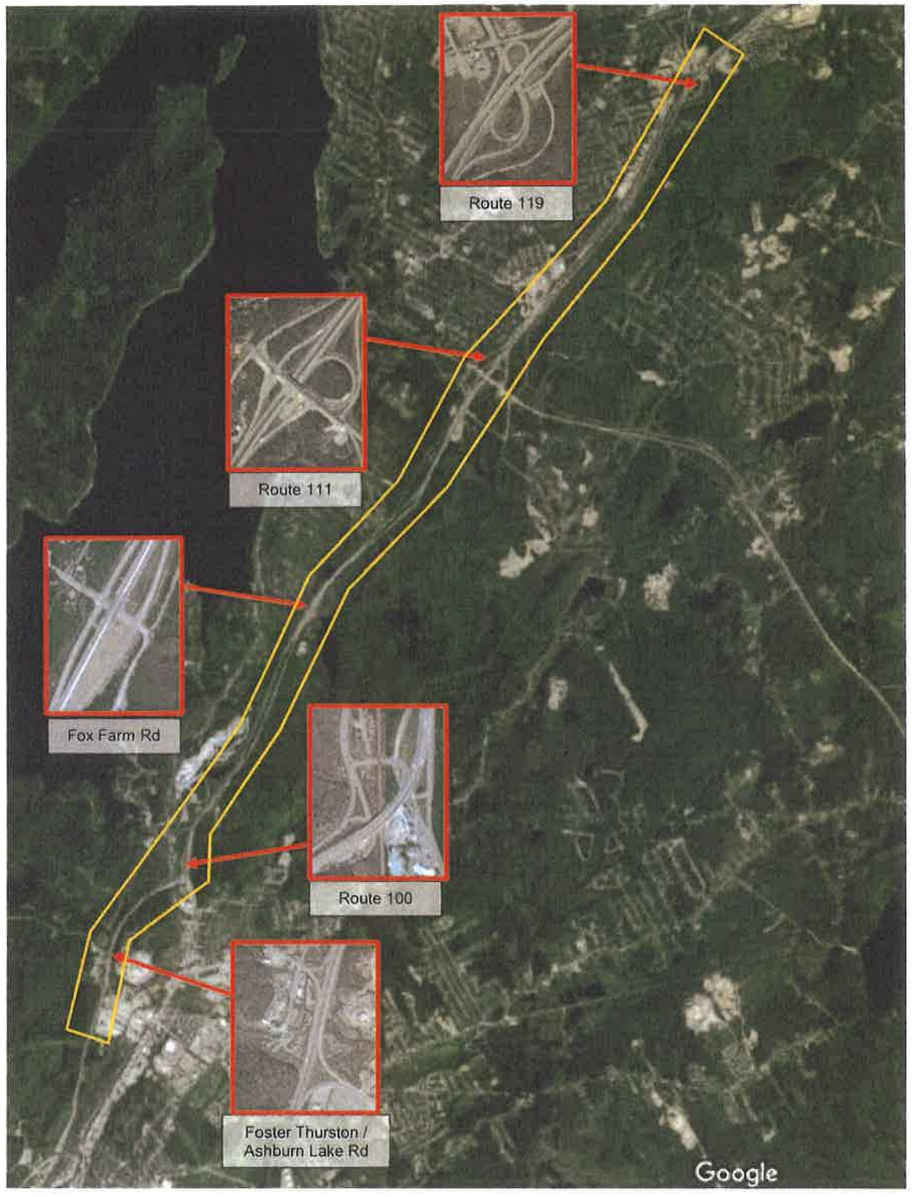

Figure 1: Map of Study Area

1.3 Scope Definition

The primary goal of this study was to identify and prioritize improvements to the Route 1 corridor (between Ashburn Lake Road and Route 119) that will be required to accommodate anticipated travel demand over the next 25 years. Section 1.4 describes the major tasks undertaken in achieving this goal. Meanwhile, the precise scope of work was further defined by the following:

1. Under the Route 1 Gateway P3 Project agreement, the independent operator is responsible for all routine maintenance and planned rehabilitation along the study area corridor until June 30th, 2040. Consequently, recommended improvements over the next 25 years were limited to infrastructure additions and/or modifications (i.e. roadway rehabilitation improvements were not considered).
2. Operational analysis was limited to the Route 1 main lanes, ramps, and ramp terminals only.
3. Given the associated complexity and cost, it was decided by NBDTI that no modifications would be made to the existing Route 100 overpass structure.
4. In-service safety reviews and collision analysis previously undertaken as part of the Route 1 Gateway Project identified a number of deficiencies which have since been addressed. Consequently, it was concluded that a comprehensive road safety audit was unlikely to offer significant value to the study and considered outside of scope.
5. Given the age of the most recent collision data (2012) and the number of improvements which have been made in recent years to address previous safety issues, limited emphasis was placed on analyzing historical collision data beyond what is described in Section 1.4.5. Instead the primary focus of the safety review was to assess how the overall safety performance of the study area corridor compares to other similar facilities.
6. Given the high level nature of this study, potential improvement options were assessed at a conceptual level only. It is expected that a more in-depth analysis would be required to confirm their feasibility.
7. An exhaustive options analysis was not undertaken to determine the "optimal" solution for each location. Rather, the study's intent was to identify at least one feasible solution to address each operational deficiency expected over the study horizon.

1.4 Approach

In general, the study consisted of the following tasks as described below:

1.4.1 Traffic Data Collection

Ramps & Ramp Terminals

Current traffic volumes were collected at all ramps and ramp terminals within the study area using *Miovision* automated video detection equipment. As shown in Table 1, all counts were undertaken over a two-week period between February 2nd and 16th. Great care was taken to ensure these counts were representative of "typical" weekday conditions, to the extent that two counts had to be rescheduled on account of school closures. Given that counts were undertaken in February, a seasonality adjustment factor of 5% was subsequently applied based on permanent count station factors.

Table 1: Traffic Data Collection Schedule

Count Location	Date
Ashburn / Foster Thurston	February 2, 2016 (Tuesday)
Route 100	February 3, 2016 (Wednesday)
Fox Farm	February 10 (Wednesday)
Route 111	February 11, 2016 (Thursday)
Route 119	February 16, 2016 (Tuesday)

Main Lanes

Traffic volumes on the Route 1 main lanes were obtained from NBDTI's permanent count station (PC-001-12-9) located between the Fox Farm and Route 100 interchanges. The volumes at this location were then combined with collected ramp volumes from the *Miovision* counts to determine the remaining segment volumes along the Route 1 corridor.

1.4.2 Future Traffic Growth Projections

Annual traffic growth projections were developed for the 25-year study horizon based on:

- Consultations with staff from the Town of Quispamsis, Town or Rothesay, and the City of Saint John regarding future development potential;
- Municipal population projections;
- Trip generation estimates for proposed large-scale developments;
- Historical traffic volumes and growth trends (where available); and
- Study team experience.

Separate projections were completed for each interchange as well as for the Route 1 main lanes. The percentage increase at each interchange location was subsequently input into the VISSIM Model to generate a full set of future turning movements.

1.4.3 Identifying Existing & Future Operational Deficiencies

Using existing and projected traffic volumes, a variety of different tools and techniques were subsequently used to identify expected operational deficiencies within the study area over the next 25 years.

The primary analysis tool was a VISSIM microsimulation model developed for the entire study area corridor. Like other software packages, VISSIM provides a number of different metrics for assessing traffic operations such as vehicular delay, travel times, volume/capacity ratio, and queue lengths. However, one advantage of VISSIM is that it is widely considered to offer a more accurate representation of traffic operations at highway merge and diverge areas. It also produces a 3-D flyover video which serves as an extremely effective visual for presentation purposes.

For this study, the VISSIM model was supplemented by analysis in Synchro, Sidra, and HCM software as appropriate.

Finally, all of the above analysis was continuously validated by members of the project team who commute regularly through the study area and possess a strong first hand familiarity with prevailing traffic operations.

1.4.4 Developing & Evaluating Improvement Concepts

Members of the study team held internal brainstorming sessions to identify potential solutions for addressing existing and future operational deficiencies. In many cases, this involved "**dusting off**" previous concepts which have already been investigated in earlier studies. In other instances, brand new concepts were identified.

Concepts were developed in AutoCAD in sufficient detail to depict general lane configurations and approximate additional land requirements where applicable.

Once again, the effectiveness of each concept at addressing operational issues was evaluated using a combination of analysis tools and techniques including VISSIM, Synchro, Sidra, and HCM software as appropriate.

Class "D" cost estimates were identified for each improvement concept.

1.4.5 Collision Analysis

A Collision Prediction Model (CPM) tailored specifically for the study area segment of Route 1 was developed based on:

- standard CPM templates published in AASHTO's Highway Safety Manual,
- appropriate collision modification factors to account for geometric variations;
- historical Route 1 traffic volume data (provided by NBDTI); and
- AASHTO's prescribed calibration methodology to account for New Brunswick conditions.

This model was used to determine the expected collision frequencies along the study segment of the Route 1 corridor.

Expected collision frequencies were subsequently compared to actual collision frequencies observed between 2008-2012 as provided by NBDTI.

A high level of assessment of collision characteristics (i.e. configuration, severity, contributing factors) was also undertaken.

The results of the collision analysis are presented in Appendix A.

1.4.6 Report Structure

The remainder of this document summarizes the complete findings of the preceding tasks. For clarity purposes, it was decided to organize the findings according to the five existing interchange areas plus the mainline segments.

2 Ashburn Interchange

2.1 Existing Traffic Volumes

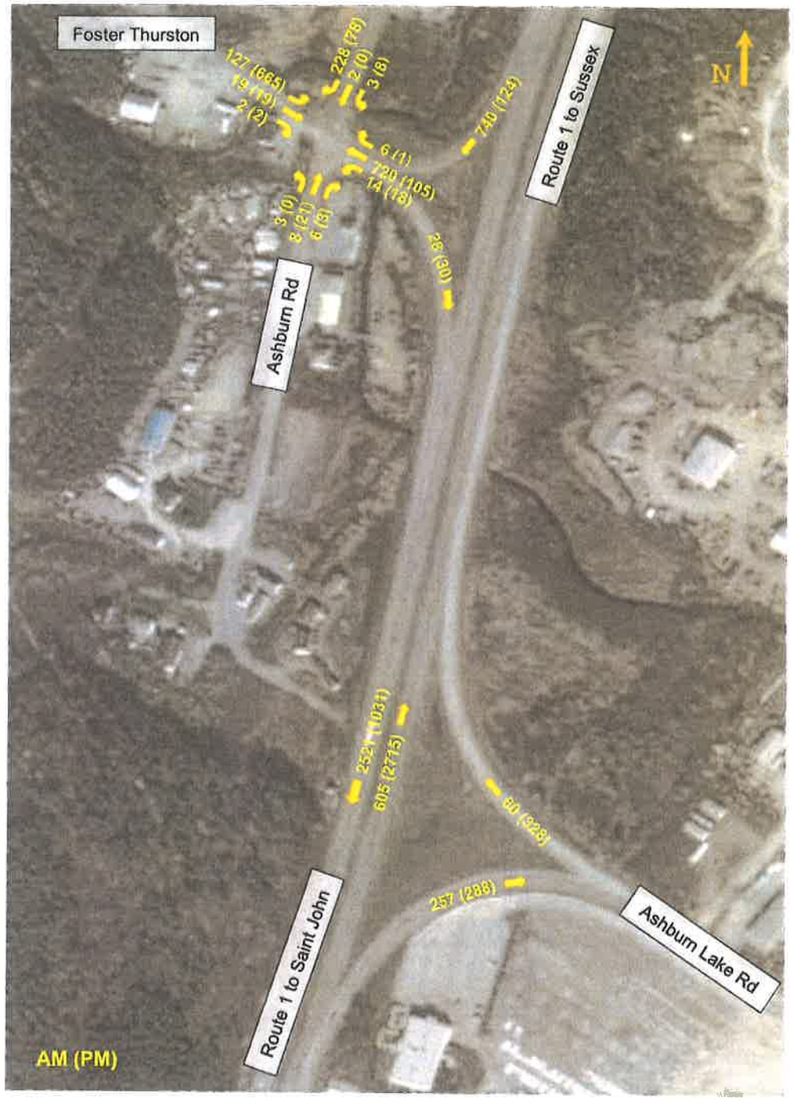

Figure 2: 2016 Peak Hour Volumes - Ashburn Interchange

2.2 Redistribution of Existing Traffic

Future traffic demand at the both the Ashburn and Route 100 interchanges is highly dependent on whether a new underpass structure is eventually built to connect the existing ramps at Foster Thurston Drive and Ashburn Lake Road. While the full ramp system is already in place at this location, there is currently no connection to permit the movement of traffic to and from the north and south side of Route 1. If and when this connection is made, a significant amount of existing traffic is expected to divert to the Ashburn Interchange from the Route 100 interchange, thus alleviating many of the operational issues currently experienced. Consequently, it was assumed (in consultation with the Department) that for the purposes of assessing future infrastructure requirements for both the Ashburn and Route 100 interchanges, that the underpass connection at Foster Thurston Rd / Ashburn Lake Rd will be made at some point over the study horizon.

Once the new underpass structure is built, there will be an immediate redistribution of traffic. For the purposes of this study, it was assumed the following redistribution will occur:

1. 30% of existing WB off-ramp traffic at Route 100 interchange will divert to the WB off ramp at the Ashburn interchange;
2. 80% of the existing left turn movement from Foster Thurston onto Ashburn Road will divert to the new EB on-ramp at Ashburn Interchange;
3. Existing traffic from Rothesay Road to Route 1 EB will also decrease by 80% (as a consequence of traffic being redistributed in *Assumption #2*);
4. 30% of existing through traffic from Rothesay Road to Rothesay Avenue will divert to the new Ashburn interchange
5. Existing traffic from Rothesay Avenue to Route 1 WB will decrease by 75%
6. Traffic from Ashburn Lake Road to Route 1 WB will increase by the inverse of the current AM/PM peak hour volumes at the EB off-ramp at Ashburn Lake Road;

The net redistribution of traffic based on the above assumptions is depicted graphically in Figure 3. This redistribution was reflected in the VISSIM model prior to assigning future traffic growth at the Ashburn and Route 100 interchanges.

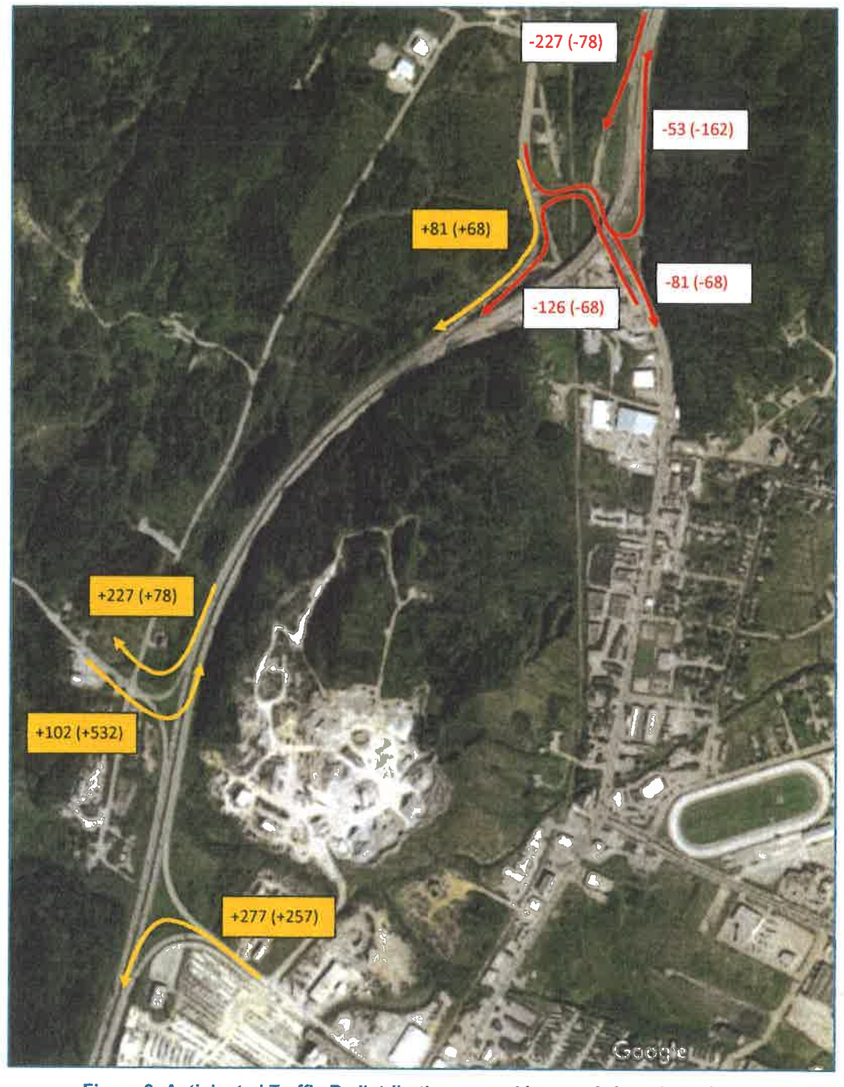

Figure 3: Anticipated Traffic Redistribution caused by new Asburn Interchange

2.3 Projected Traffic Growth

Once traffic is redistributed to the new Ashburn Interchange, other key considerations likely to impact future traffic demand at this location include:

- A large, mixed used development known as "The Crossing" is being proposed for the lands immediately west of the Route 100 interchange. Based on discussions with the developer, this area would contain approximately 500,000 square feet of floor space, including retail, residential, office, and services;
- The construction of an underpass at this location will make the land north of the interchange more desirable for development. Discussions with the City indicate that there is the future potential for development along Foster Thurston Drive in the vicinity of the hospital; and
- The underpass will provide a more direct link between the north and south sides of Route 1, resulting in increased travel demand between various types of land uses.

Based on the above, a 0.5 % annual growth rate on all movements was deemed to be appropriate for future traffic analysis. This is in addition to traffic expected to generated by "The Crossing" (assuming it proceeds), which was estimated separately as described below.

2.3.1 Impact of "The Crossing"

Based on discussions with the developer, an estimate of the trip potential for "The Crossing" was prepared using the *Institute of Transportation Engineers* standard trip rates. This estimate also reflects a 30 percent factor to account for internal synergy among the various development components. In the morning peak hour, it is estimated that 445 vehicles would enter the development, while 291 would exit. The evening peak hour would be busier with 614 vehicles entering and 705 exiting.

These trips to and from the proposed development would be comprised of new trips, diverted trips, and pass-by trips that are on the adjacent street system and make an intermediate stop at the development as part of an overall trip. This component is estimated at 25 percent. New and diverted trips would be new to the surrounding streets.

The assignment of these trips to the adjacent streets reflects the location of the various proposed access points and the streets used to get there. Traffic will be attracted from Route 1 east and west of the development and would use both the Ashburn and Route 100 interchanges. Rothesay Road would also be utilized. Traffic from the south would access via an extension of Rothesay Avenue at Rothesay Road as well as the new underpass at the Ashburn interchange. Traffic to and from the north would use Foster Thurston Drive.

Based on existing travel patterns and surrounding development, and allowing for a 25 percent pass-by factor, the estimated increases on the surrounding street network expressed in terms of vehicles is presented in Table 2.

Table 2: Estimated Traffic Distribution to and from "The Crossing"

Link	Morning Peak	Evening Peak
At Route 100 Interchange		
Rothesay Avenue In	83	116
Rothesay Avenue Out	55	132
Route 1 Westbound Off Ramp	50	69
Route 1 Eastbound On Ramp	33	80
Route 1 Eastbound Off Ramp	17	23
Route 1 Westbound On Ramp	11	26
At Ashburn Interchange		
Ashburn Lake Road In	67	92
Ashburn Lake Road Out	44	106
Foster Thurston Drive In	50	69
Foster Thurston Drive Out	33	80
Route 1 Westbound Off Ramp	17	23
Route 1 Eastbound On Ramp	11	26
Route 1 Eastbound Off Ramp	50	69
Route 1 Westbound On Ramp	33	80

Note: Numbers reflect a 25 percent pass-by component.

2.4 Existing / Future Traffic Operations

- The current lack of a full interchange connection at this location results in some very circuitous routing for some major traffic movements. Most notably, commuters travelling southbound on Foster Thurston Drive wishing to access Route 1 EB must currently make a left turn onto Ashburn Road and travel through the already congested Route 100 interchange. Approximately 665 vehicles make this trip during the PM peak hour.
- While the EB ramps to and from Ashburn Lake Road provide adequate capacity for existing and future traffic volumes, the demand for these movements are strongly influenced by:
    a) the nearby at-grade rail crossing that runs parallel to Rothesay Avenue. Rail traffic along this section has increased significantly in recent years, which has resulted in increased delays for motorists; and
    b) the existing intersection configuration at Ashburn Lake Road / Rothesay Avenue / Retail Drive which currently operates at a poor level of service.

  While both of these issues are located outside the study area, coordination with both the City of Saint John and CN Rail is recommended to identify a solution.

2.5 Potential Infrastructure Improvements

IC-1: Completion of Ashburn Interchange

This would involve building a new structure across Route 1 and realignment of ramps and access roads to connect the existing WB ramps at Foster Thurston Road with the EB ramps at Ashburn Lake Road. The biggest benefit of this improvement concept is that it will divert significant traffic away from the adjacent Route 100 interchange, which will otherwise experience operational issues in the future. Providing a more direct access to Route 1 would also eliminate the current circuitous routing for the heavy commuter movement from Foster Thurston to Route 1 EB during the PM peak hour.

Several different concepts have already been explored in previous studies with Figure 4 depicting the preferred concept identified from the most recent study.

Figure 4: Concept Sketch for IC-1 (Completion of Ashburn Interchange)

4 Fox Farm Interchange

4.1 Existing Traffic Volumes

Figure 8: 2016 Peak Hour Volumes - Fox Farm Road Interchange

3 Route 100 Interchange

3.1 Existing Traffic Volumes

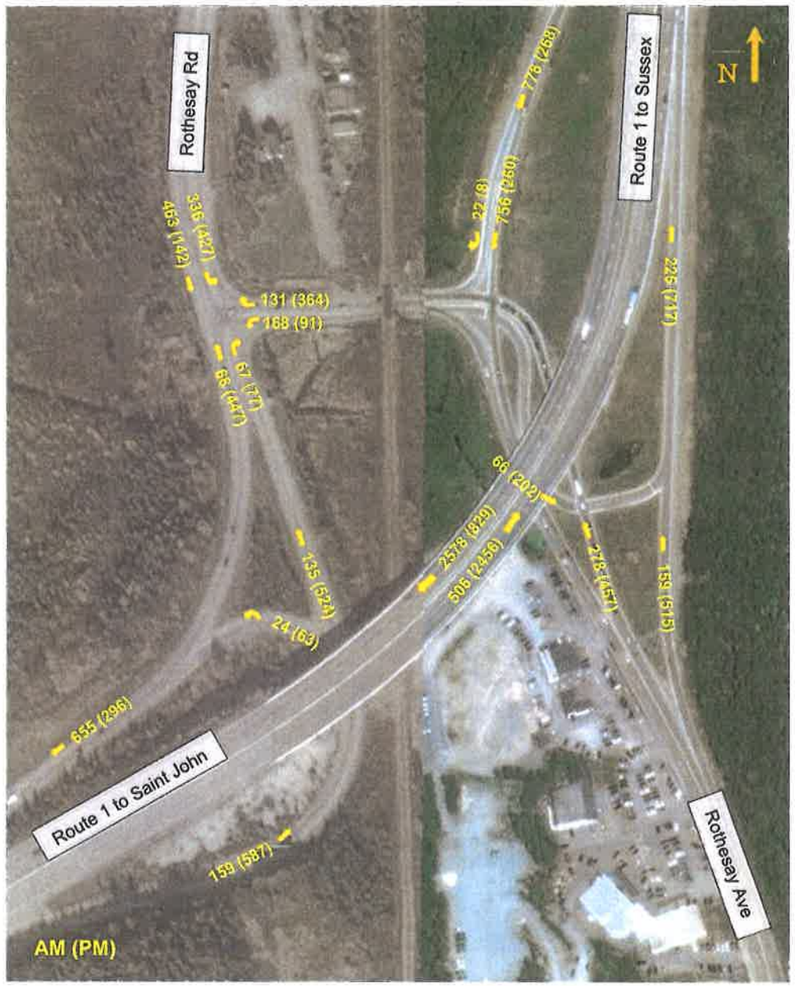

Figure 5: 2016 Peak Hour Volumes - Route 100 Interchange

3.2 Projected Traffic Growth

Once traffic is redistributed to the new Ashburn Interchange, other key considerations likely to impact future traffic demand for the Route 100 interchange include:

- New traffic generated by the proposed "Crossing" development as previously described in Section 2.3;
- With perhaps the exception of some low density residential development in Drury Cove, opportunity for future growth along Rothesay Road is limited; and
- Capacity for approximately 200,000 sq. ft. of additional commercial/retail development remains off Rothesay Avenue in the Eastpoint Shopping District.

Based on the above, annual growth rates of 0% and 1% were deemed appropriate for traffic approaching the interchange from Rothesay Road and Rothesay Avenue, respectively. This does not take into account new traffic that would be generated by "The Crossing" development (assuming it proceeds as planned), which was estimated separately in Section 2.3.1.

3.3 Existing / Future Traffic Operations

- Completion of the Ashburn Interchange (and the resulting redistribution of traffic) would have an immediate positive impact on operations at the Route 100 interchange. All movements are expected to operate at an acceptable level of service under existing traffic conditions.
- Future operations at this interchange will be greatly influenced by the development of "The Crossing". Assuming the development proceeds as planned, it has the potential to add significant traffic volumes to the interchange over the study horizon. Based on the trip generation assumptions utilized for this study, the left turn movement from Rothesay Ave toward the WB Route 1 on-ramp is expected to reach LOS F during the PM peak hour within the study horizon. The exact timing depends on the rate of development.
- The Route 1 WB on-ramp is also expected to operate near capacity in the future during the AM peak hour. Based on the VISSIM model, the high ramp volumes at this location will experience considerable turbulence as they attempt to merge with traffic on the main lanes (which is projected to increase with the opening of the new Ashburn interchange). This is due to the high volumes in the two WB main lanes providing very few gaps for the high on-ramp volumes to merge within the existing acceleration lane length.
- The through movement from Rothesay Avenue toward Rothesay Road is also projected to experience considerable delays at the stop controlled intersection at the end on the WB off-ramp. However the magnitude of this issue will depend on how the development of "The Crossing" unfolds, which is an unknown at this point.

3.4 Potential Infrastructure Improvements

IC-2: Introduce Weaving Area between Route 100 and Ashburn Interchanges

This option involves extending the Route 1 WB acceleration lane at Route 100 to connect with the adjacent deceleration lane at Foster Thurston Drive, thus forming a weaving lane between the two interchanges. This would effectively alleviate some of the expected merging issues expected at the end of the WB on ramp. Constructing a similar weaving lane in the EB direction would also offer some operational benefit, although it is not considered to be as critical as in the WB direction. This concept is depicted in Figure 6.

Figure 6: Concept Sketch for IC-2: (Weaving Area between Route 100 and Ashburn Interchanges)

IC-3: New Roundabout at Rothesay Road / Rothesay Avenue Intersection

This option involves installing a single lane roundabout at the existing tee intersection of Rothesay Avenue and Rothesay Road as shown in Figure 7. As a result, the overall intersection delay is expected to improve significantly from 30 seconds per vehicle (LOS C) to 7 seconds per vehicle (LOS A). Most importantly, delays for the critical left turn movement from Rothesay Avenue toward the Route 1 WB on-ramp is expected to improve from LOS F to LOS B.

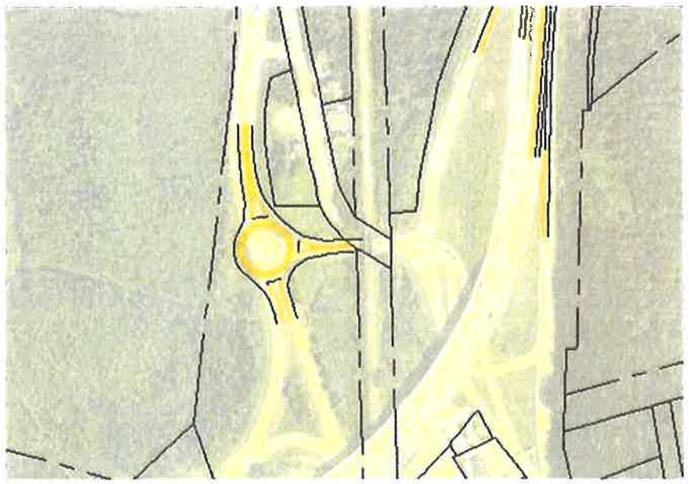

Figure 7: Concept Sketch for IC-3 (Roundabout at Rothesay Rd / Rothesay Ave Intersection)

4.2 Projected Traffic Growth

Key considerations likely to impact future traffic demand for the Fox Farm Road interchange include:

- The Town of Rothesay is exploring possibilities to open up residential development to the northwest of Route 1 between Grove Avenue and Fox Farm Road. As many as 600 – 800 new residential units could be built in this area over the study horizon. The distribution of how this traffic will access Route 1 will ultimately be dependant on the development phasing. That said, assuming a complete arterial connection is made between Grove Avenue and Fox Farm Road, the majority of commuter traffic generated by this new development is expected to access Route 1 at the Fox Farm Road interchange.
- No further development is planned south of Route 1, as much of this area is either designated watershed or difficult to service.

At full buildout, the residential development is estimated to generate an additional 300-400 vehicles during both the AM and PM peak hours (based on typical ITE Trip Generation rates). Assuming 50% of this newly generated traffic would commute westbound to/from Saint John via Fox Farm Road, this represents an additional 150- 200 vehicles using the interchange during the peak hours over the study horizon, or an average annual growth rate of 2.5% per year.

4.3 Existing / Future Traffic Operations

The existing interchange configuration at Fox Farm Road has more than adequate capacity to accommodate both current and future traffic volumes without any anticipated operational issues. However, similarly to Routes 119 and 111, vehicles at the end of the WB on ramp do experience some turbulence while attempting to merge into the heavy main lane traffic stream (approx. 3,200 vehicles per hour) during the AM peak hour.

4.4 Potential Infrastructure Improvements

Even with the likely potential for increased travel demand, no major infrastructure enhancements are anticipated to be required at the Fox Farm Interchange over the study horizon to accommodate traffic entering and exiting Route 1. However, widening of the existing Fox Farm Road structure and realignment of the ramps would be required if and when Route 1 eventually expands to six lanes (see Section 7.4 for further details).

5 Route 111 Interchange

5.1 Existing Traffic Volumes

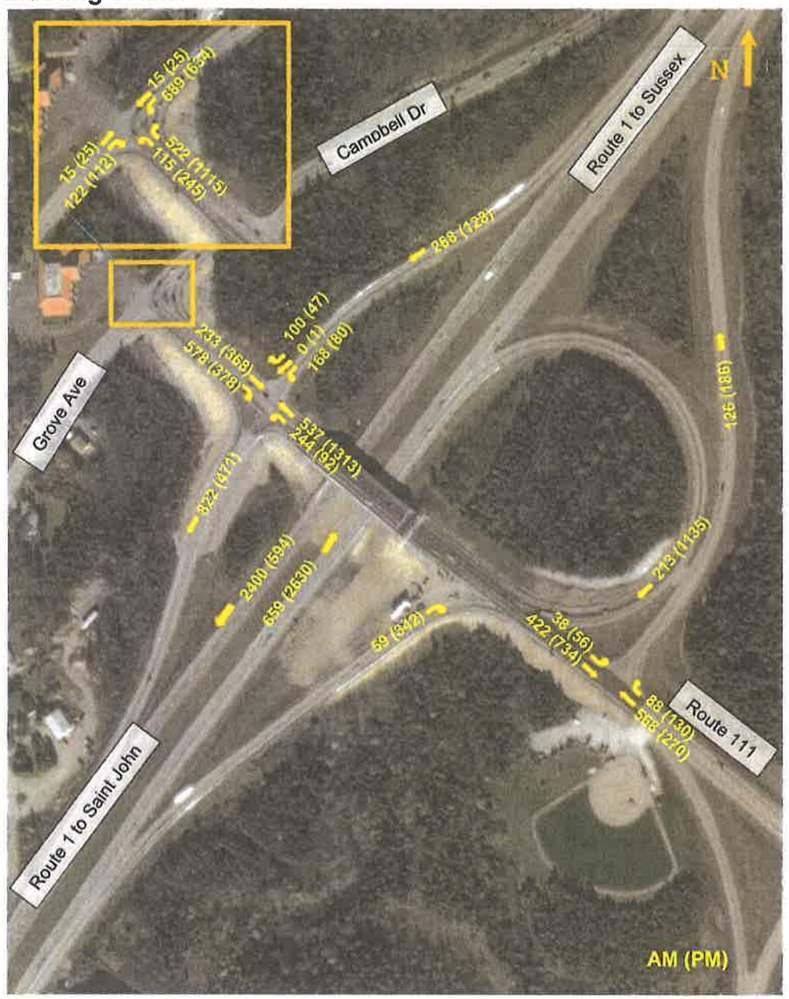

Figure 9: 2016 Peak Hour Volumes - Route 111 Interchange

5.2 Projected Traffic Growth

Key considerations likely to impact future traffic demand for the Route 111 interchange include:

- The areas to the north and east of the of the interchange that use Marr Road and Campbell Drive to access Route 1 are nearly fully developed and future growth opportunities are limited.
- As discussed in Section 4.2, the residential development to the northwest of Route 1 between Grove Avenue and Fox Farm Road would impact traffic demand on Grove Avenue (assuming it proceeds as planned). As many as 600 – 800 new residential units could be built in this area over the study horizon. The distribution of how this traffic will access Route 1 will ultimately be dependant on the development phasing. That said, assuming a complete arterial connection is made between Grove Avenue and Fox Farm Road, the majority of commuter traffic generated by this new development is expected to access Route 1 at the Fox Farm Road interchange.
- One more major commercial development is expected in Rothesay within the next 5 years on a parcel of land bounded by Campbell Drive, Millennium Drive, and Route 1. While this development would almost certainly impact the surrounding the local street network, the expected impact on the Route 111 interchange is not significant.
- No further development is planned south of Route 1, as much of this area is designated watershed with the remaining areas being extremely difficult to service.
- Significant growth is not expected in the French Village Subdivision.

Based on the above, a 1.0 % annual growth rate is projected on all movements over the next 10 years, followed by nominal growth of 0.5 % per year for the remainder of the study horizon.

5.3 Existing / Future Traffic Operations

- Operations at the Route 111 interchange have improved significantly since the recent widening of the underpass structure - which now allows the EB exit loop ramp to normally operate under free-flow conditions. Queues which regularly extended the entire length of the ramp onto the main lanes during the PM peak hour have now been alleviated. That said, this movement continues to handle a very high volume of traffic which can sometimes give the perception that vehicles are queuing when in fact they are just travelling at a reduced speed.
- The recent installion of traffic signals at intersections of Route 111 / Campbell Drive and Route 111 / WB ramps have also improved operations compared to what they used to be – particularly for left turning vehicles from the WB off-ramp.
- With the recent improvements, the most prominent issue remaining at the Route 111 interchange is the considerable amount of "turbulence" experienced by drivers as they attempt to merge onto the WB Route 1 main lanes during the AM peak hour. A Level of Service analysis undertaken using HCM methodology revealed that the WB on-ramp is currently operating at LOS E during this period. This is expected to worsen to LOS F without any improvements over the study horizon.

  While the length of the WB acceleration lane was recently lengthened in an attempt to improve operations, many drivers may not be taking advantage of this longer merge opportunity. Instead, some choose to come to a near stop at the end of the ramp and wait for an acceptable gap in traffic, which causes traffic to queue back on the ramp.

- During the site visits, traffic was also observed to queue back along Campbell Drive during the AM peak hour at the signalized intersection in front of the fire station. While this queuing is not fully reflected in the VISSIM model, it is suspected that that this is at least partially attributed to the aforementioned downstream traffic turbulence at the Route 1 WB on-ramp and/or signal timing/ phasing issues at the signalized intersection at the WB ramp terminals.
- The existing signalized intersection in front of the fire station is expected to reach LOS F without any improvements over the study horizon.
- The VISSIM model also indicated that the northbound left turn movement from Route 111 onto Grove Avenue will experience considerable delays and queuing during the PM peak hour under future traffic volume scenarios. Queues for this movement are shown to spill back into the signalized intersection at the WB ramp terminals.
- The other major operational issue for this interchange is the close proximity of the Dolan Road Irving access to the Route 1 EB off ramps. This short weaving area (400 m) creates a very turbulent situation - particularly during the PM peak hour - as *accelerating* vehicles entering Route 1 from the Irving must merge with decelerating vehicles exiting at the off-ramp. Between 2008 and 2012 (the most recent collision data available), there were a total of 8 reported collisions in the immediate vicinity of the Irving access.

5.4 Potential Infrastructure Improvements

IC-4: Realign Campbell Drive

This improvement involves realigning Campbell Drive to make the predominant traffic flow to/from Route 111 the continuous movement. Grove Avenue would then tee into the newly aligned roadway under stop-controlled conditions to the east of the fire station. This concept is illustrated in Figure 10.

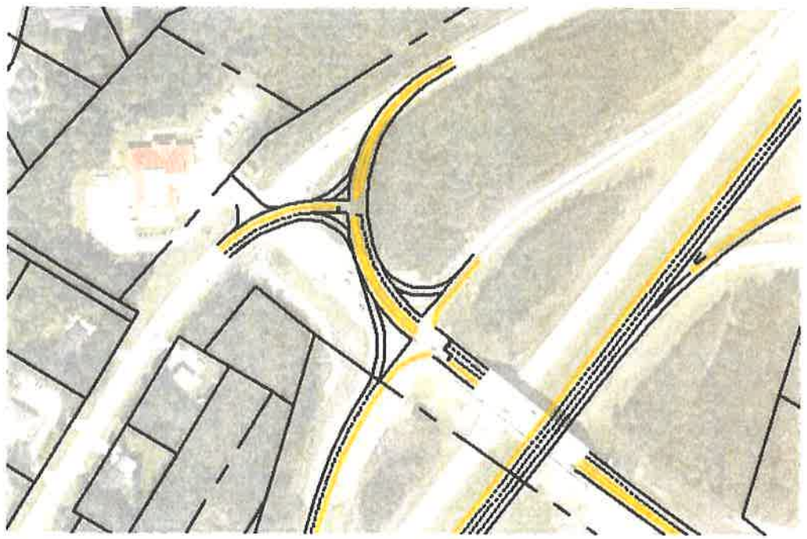

Figure 10: Concept Sketch of IC-4 (Realignment of Campbell Drive)

This improvement is expected to offer a significant operational benefit over existing conditions. Based on the Synchro analysis, the existing signalized intersection in front of the fire station is expected to reach LOS F within the study horizon, with an average delay of 80 seconds / vehicle. However, by realigning Campbell Drive as shown, the overall intersection delay improves to 25 seconds / vehicle (LOS C).

It is worth noting that under the proposed stop-controlled condition, the left turn movement from Grove Avenue to Campbell Drive will experience a very poor LOS F. However, demand for this movement is very low during the peak hour (less than 15 vehicles per hour), and therefore doesn't represent a significant concern.

IC-5: Realign EB Exit Loop Ramp

This improvement would involve upgrading the existing EB loop off-ramp from its existing 100 m radius to a new 130 m radius to comply with minimum TAC design speed guidelines for this classification of highway (refer to Figure 11 below). In addition to reducing the speed differential between the main lanes and the ramp, it would also provide for extra storage on the ramp itself (which would further reduce the risk of traffic queuing back onto Route 1).

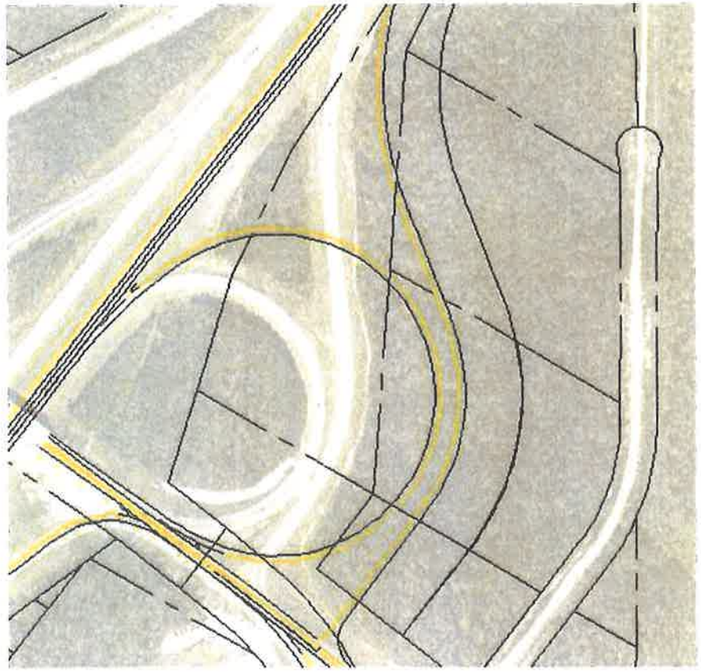

Figure 11: Concept Sketch of IC-5 (Realignment of EB Exit loop Ramp)

This improvement was also previously planned as part of the Route 1 Gateway project, but was temporarily shelved for financial considerations.

IC-6: Elimination / Relocation of Service Station Access

This would involve eliminating the existing service station access onto Route 1 by either a) providing an alternative access from the minor street network, or b) relocating the service station altogether. Given the sensitivities surrounding this topic, specific alternatives were not considered as part of this study. Assuming that a mutually agreeable solution can be identified, eliminating this access would have an overall positive impact on safety and operations.

New Interchange between Route 111 and Route 119

The Department has previously considered the need for constructing a new interchange between Route 111 and Route 119 to alleviate existing congestion at those two adjacent locations. However, it is expected that the improvements identified in this study, combined with those already implemented as part of the Route 1 Gateway project, will be sufficient to accommodate both existing and future travel demand with acceptable levels of service. Consequently, based on our current understanding of future development potential, a new interchange is unlikely to be *required* within the study horizon. That said, it may be prudent for Department to continue to reserve land for the eventual construction of a new interchange at Millennium Drive over the longer term.

6 Route 119 Interchange

6.1 Existing Traffic Volumes

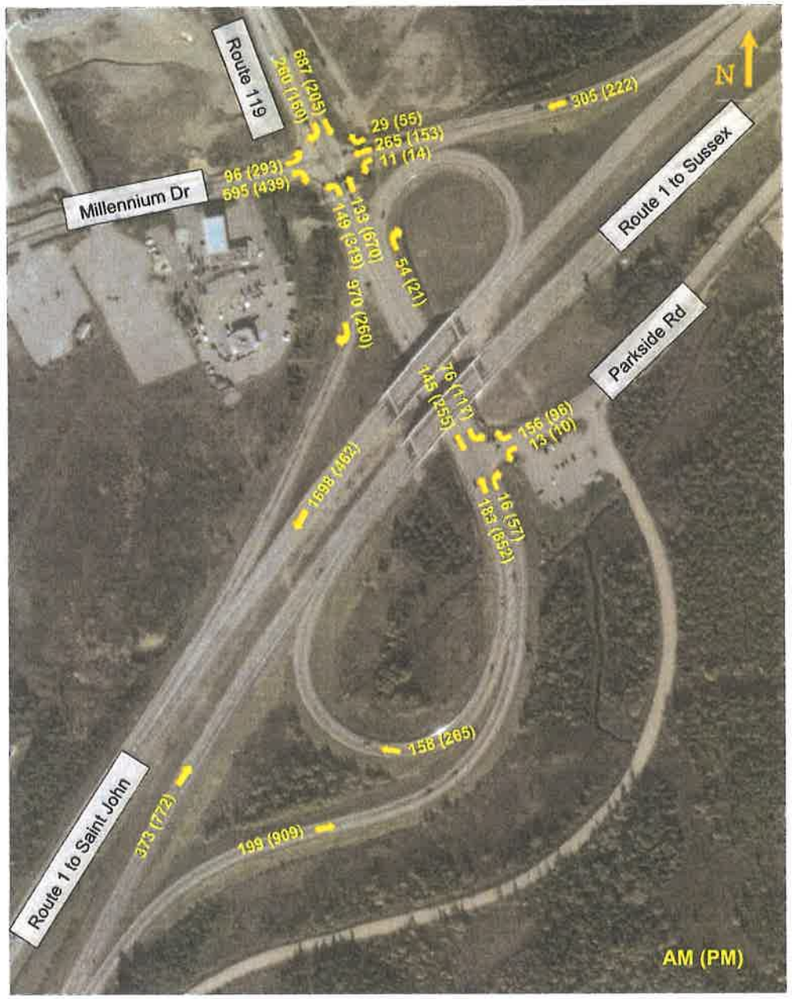

Figure 12: 2016 Peak Hour Volumes - Route 119 Interchange

6.2 Projected Traffic Growth

Key considerations likely to impact future traffic demand for the Route 119 interchange include:

- The Town of Quispamsis is projecting annual population increases of approximately 2.5% over the next ten years. The majority of this growth will occur on scattered parcels of land within the Town's existing core residential footprint.
- Development within the Town is gradually expected to migrate further east, which may eventually be better serviced by a new interchange connection in the vicinity of Stock Farm Road / Elliot Road.
- No further development is planned to the south of Route 1 in Quispamsis, as much of this area is designated watershed with the remaining areas being extremely difficult to service.
- Unless a permanent bridge structure eventually replaces the ferries at Gondola Point, significant growth is not expected on the Kingston Peninsula.

Based on the above, a 1.5 % annual growth rate is projected on all movements over the next 10 years, followed by nominal growth of 0.5 % per year for the remainder of the study horizon.

6.3 Existing / Future Traffic Operations

Overall, the Route 119 interchange provides an acceptable level of service for most existing traffic movements. Key observations include:

- The largest delays are currently experienced during the AM peak hour on the Gondola Point Arterial (Route 119) approaching the signalized intersection at Millennium Drive and the Route 1 WB off-ramp. Based on model results from *Synchro*, the average vehicular delay for the southbound through movement on this approach is currently **40 sec/vehicle (or LOS D)**. This is expected to increase to **81 sec/vehicle (or LOS F)** without any improvements over the study horizon as traffic volumes increase.
- All other movements are expected to operate at acceptable levels of services both under existing and future travel demand in the AM and PM peak periods.

6.4 Potential Infrastructure Improvements

IC-7: Realign and Reconfigure both WB On-Ramps

This improvement would involve realigning the WB East on-ramp to tee into the signalized intersection directly across from Millennium Drive. At the same time, the other existing WB Weston-ramp would be relocated from Route 119 to Millennium Drive. A concept of this configuration is depicted in Figure 14.

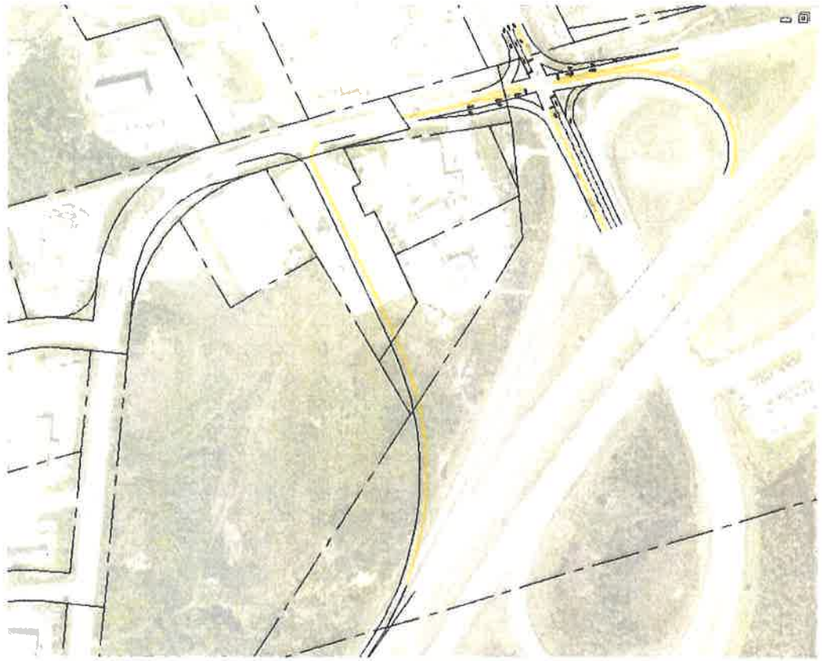

Figure 14: Concept Sketch of IC-6: Realignment of WB On-Ramps

Under the new configuration, southbound commuter traffic on Route 119 will access Route 1 WB by turning left at the Millennium Drive intersection and using the reconfigured WB East on-ramp. Meanwhile, commuter traffic approaching from Millennium Drive will access Route 1 WB using the relocated on-ramp. Splitting the heavy WB traffic volume into two parts is expected to greatly alleviate existing and future congestion along the WB west on-ramp. At the same time, this configuration also takes advantage of reserve capacity on the WB East on-ramp, which has a high level of reserve capacity.

Implementing the above improvements is expected to reduce the overall delay at the Millennium Drive / Route 119 intersection by more than 10 seconds per vehicle during the peak periods compared to existing conditions. Based on projected 2040 traffic volumes, the intersection is expected to operate with an average delay of 27 seconds per vehicle during the AM peak hour (which equates to LOS C). The improvements will also provide acceptable operations during the PM peak hour.

7 Route 1 Freeway Segments

7.1 Existing Traffic Volumes

Table 3 below depicts existing main lane volumes for the study area segments of Route 1, As previously mentioned, these volumes were determined by combining data from NBDTI's permanent count station (PC-001-12-9) with ramp volumes obtained as part of this study.

Table 3: Existing Route 1 Main Lane Volumes (2016)

Highway Segment		Peak Hour Volumes AM (PM)
East of	EB	530 **(1,040)**
Route 119	WB	**1,950** (660)
Route 119	EB	570 **(1,680)**
to Route 111	WB	**2,670** (720)
Route 111	EB	720 **(2,970)**
to Fox Farm	WB	**3,220** (1,070)
Fox Farm	EB	730 **(3,170)**
To Route 100	WB	**3,360** (1,100)
Route 100 to	EB	670 **(3,040)**
Ashburn / Foster Thurston	WB	**3,230** (1,130)
West of	EB	860 **(3,000)**
Ashburn / Foster Thurston	WB	**2,520** (1,030)

7.2 Projected Traffic Growth

Future travel demand on the Route 1 mainlines will influenced by traffic growth at the various interchanges along the study area corridor (as described in previous sections), as well by through traffic originating from and destined to locations outside of the study area. For the purposes of the study, an annual growth rate of 1% per year was deemed appropriate for this through traffic movement. Based on these assumptions, Table 4 presents the projected Route 1 volumes for the study horizon year of 2040.

Table 4: Projected Route 1 Main lane Volumes (2040)

Highway Segment		Peak Hour Volumes AM (PM)
East of	EB	620 **(1,310)**
Route 119	WB	**2,490** (825)
Route 119	EB	660 **(2,005)**
to Route 111	WB	**3,380** (930)
Route 111	EB	820 **(3,440)**
to Fox Farm	WB	**4,030** (1,320)
Fox Farm	EB	805 **(3,620)**
To Route 100	WB	**4,300** (1,410)
Route 100 to	EB	815 **(3,680)**
Ashburn / Foster Thurston	WB	**4,180** (1,470)
West of	EB	920 **(3,100)**
Ashburn / Foster Thurston	WB	**3,280** (1,470)

7.3 Existing / Future Traffic Operations

In an effort to quantify existing and future operations on the main lanes, a level of service (LOS) analysis was undertaken based on methodology contained in the *Highway Capacity Manual (2010)* for basic freeway segments. This methodology defines LOS on a basic freeway segment in terms of density, which describes the proximity to other vehicles and is related to the freedom to maneuver within the traffic streams. There are 6 LOS defined for basic freeway segments.

LOS A describes free flow operations. Free flow speed (FFS) prevails on the freeway and vehicles are almost completely unimpeded in their ability to maneuver in the traffic stream. Density is less than or equal to 11 passenger cars per mile per lane.

LOS B represents reasonable free-flow operations, and FFS on the freeway is maintained. The ability to maneuver in the traffic stream is only slightly restricted. The effects of minor incidents and point breakdowns are easily absorbed. Density ranges between >11 and 18 passenger cars per mile per lane.

LOS C provides for flows with speeds near the FFS of the freeway. Freedom to maneuver within the traffic stream is noticeable restricted and lane changes require more care. Minor incidents may still be absorbed, but the local deterioration in service quality will be significant. Density ranges between >18 and 26 passenger cars per mile per lane.

LOS D is the level at which speeds begin to decline with increasing flows, with density increasing more quickly. Freedom to maneuverer within the traffic stream is seriously limited and drivers experience reduced physical and psychological comfort levels. Even minor incidents can be expected to create queuing. Density ranges between >26 and 35 passenger cars per mile per lane.

LOS E describes operation at capacity. Any disruption to the traffic stream can establish a disruption wave that propagates throughout the upstream traffic flow. At capacity the traffic stream has no ability to dissipate even the most minor disruptions and any incident can be expected to produce a serious breakdown and substantial queuing. Density ranges between >35 and 45 passenger cars per mile per lane.

LOS F describes breakdown or unstable flow. Such conditions exist within queues forming behind bottlenecks. The ratio of demand to capacity is greater than 1. Density is greater than 45 passenger cars per mile per lane.

Table 5 depicts the results of this analysis. As shown, the critical segment is between Fox Farm Road and Route 100, which operates at LOS E under existing conditions. Meanwhile, the two adjacent segments (i.e. Route 111 to Fox Farm and Route 100 to Ashburn interchange) both operate at LOS D today.

The above level of service analysis was repeated using projected future volumes based on anticipated growth percentages for the 25-year study horizon (as well as traffic redistribution associated with the new Ashburn interchange). The results of this analysis (presented in Table 6) indicate that three of the segments are projected to reach LOS F over this timeframe. The anticipated timing for these segments to reach LOS F is as follows:

- Fox Farm Rd to Route 100 – within 10 years
- Route 111 to Fox Farm Rd - within 15 years
- Route 100 to Foster Thurston – within 15 years

Table 5: Existing Levels of Service on Route 1 Main Lane Segments

Freeway Segment	Volume	Morning Peak LOS	Morning Peak Density (pc/km/ln)	Evening Peak LOS	Evening Peak Density (pc/km/ln)
East of Route 119 (WB)	1,950	C	19.3		
East of Route 119 (EB)	1,040			A	10.8
Route 119 to Route 111 (WB)	2,670	D	27.6		
Route 119 to Route 111 (EB)	1,680			B	17.4
Route 111 to Fox Farm Road (WB)	3,220	D	34.2		
Route 111 to Fox Farm Road (EB)	2,970			D	31.0
Fox Farm Road to Route 100 (WB)	3,360	E	36.3		
Fox Farm Road to Route 100 (EB)	3,170			E	33.5
Route 100 to Foster Thurston (WB)	3,230	D	35.0		
Route 100 to Foster Thurston (EB)	3,040			D	31.8
West of Foster Thurston (WB)	2,520	C	26.5		
West of Foster Thurston (EB)	3,000			D	31.3

Table 6: Projected Levels of Service on Route 1 Main Lane Segments (2040)

Freeway Segment	Volume	Morning Peak LOS	Morning Peak Density (pc/km/ln)	Evening Peak LOS	Evening Peak Density (pc/km/ln)
East of Route 119 (WB)	2,490	C	25.8		
East of Route 119 (EB)	1,310			B	13.6
Route 119 to Route 111 (WB)	3,380	E	36.9		
Route 119 to Route 111 (EB)	2,005			C	20.8
Route 111 to Fox Farm Road (WB)	4,030	F	NA		
Route 111 to Fox Farm Road (EB)	3,440			E	37.9
Fox Farm Road to Route 100 (WB)	4,300	F	NA		
Fox Farm Road to Route 100 (EB)	3,620			E	41.8
Route 100 to Foster Thurston (WB)	4,180	F	NA		
Route 100 to Foster Thurston (EB)	3,680			E	43.2
West of Foster Thurston (WB)	3,280	E	35.1		
West of Foster Thurston (EB)	3,100			D	32.2

7.4 Potential Infrastructure Improvements

IC-8: Widen Route 1 to Six Lanes between Route 111 and Route 100

This improvement, which involves adding an additional lane of capacity in each direction of Route 1 between Route 111 and Route 100, was originally planned to be implemented as part of the Route 1 Gateway project. However, it was ultimately shelved due to financial considerations at the time.

The level of service analysis presented in Section 7.3 indicates that a 6-lane cross section is likely to be required over the 9 km stretch between Route 111 and the new Ashburn Interchange. Unfortunately, the existing structure at Route 100 (which was deemed to be outside the scope of this study) is not wide enough to accommodate a 6-lane cross section, meaning that the widening must terminate at this location.

With an estimated price tag of $23 million (excluding ROW), it is likely that this solution will be implemented in phases. Assuming this is the case, widening of the WB lanes commencing at Route 111 should be the priority.

IC-9: Relocate Access to NBDTI Renforth Maintenance Depot

NBDTI's Renforth Maintenance Depot currently has direct access onto the eastbound lanes of Route 1 just east of the Route 100 interchange. This is one of two direct accesses within the study area (the other being to a service station as previously mentioned). This access does represent a moderate safety concern, and under ideal circumstances would be eliminated. A concept was previously developed to build a new service road to access the depot from the Fox Farm Interchange.

8 Summary of Improvement Concepts

In total, this study identified eight (8) distinct improvement concepts that, collectively, are expected to provide acceptable traffic operations on Route 1 for the next 25 years. The recommended timing for many of these concepts are closely tied to how future development unfolds, as well as the availability of funding.

The following sections present a brief summary of each improvement concept, including operational benefits, property requirements, timing / phasing considerations, and cost estimates. It is expected that this information can then be used by the Department to undertake subsequent analysis to developed a prioritized ranking.

8.1 IC-1: Completion of Ashburn Interchange

Criteria	Key Considerations
Location	• Existing On and Off Ramps at Ashburn Lake Road and Foster Thurston Drive.
Description	• Construction of new underpass and connector roadways to allow for full movements at this interchange.
Project Benefits	• Relieves existing and future congestion at the Route 100 interchange. • Eliminates circuitous routing for heavy movement from Foster Thurston to Route 1 EB during PM peak hour (currently 660 vehicles per hour). • Promotes future development.
Property Requirements	• Depending on the final configuration, property impacts could be significant as business are likely to be impacted.
Timing / Phasing	• The project would provide immediate benefit as soon as funding becomes available. • Ideally this project would proceed prior to making significant investments at the Route 100 interchange, given the expected positive impact on operations at that location.
Other Considerations	• Existing property access needs to be reviewed. • Alternatives could be explored to reduce property impacts. • Reconfiguration of the existing Ashburn Lake Road / Rothesay Avenue / Retail Drive intersection should also be coordinated with the City of Saint John in conjunction with this improvement to enhance traffic operations • If possible, elimination of the at-grade rail crossing across Ashburn Lake Road (through grade separation) should also be explored.
Class "D" Construction Estimate ($2016)	• $9.5M (excluding ROW acquisition and property access).

8.2 IC-2: Introduce Weaving Area between Route 100 and Ashburn Interchange

Criteria	Key Considerations
Location	• The westbound lanes between the Route 100 WB On-ramp and the Foster Thurston WB Off-ramp. • The eastbound lanes between the Ashburn Lake Road on-ramp and the Route 100 WB off-ramp.
Description	• Extend the acceleration lane from the Route 100 WB on-ramp to the start of the deceleration lane for the Foster Thurston WB off-ramp, introducing a weaving area. The same can be repeated for the eastbound lanes
Project Benefits	• Reduces congestion for WB On-ramp at Route 100. • Reduction of flow interruptions on the WB lanes.
Property Requirements	• Narrow right of way likely requires additional property.
Timing / Phasing	• Westbound lanes are the critical direction. • Timing dependent on development of "The Crossing". • Improvement may be implemented in conjunction with new Ashburn interchange.
Other Considerations	• Large rock cut and fills required for widening.
Class "D" Construction Estimate ($2016)	• $1.0M (excluding ROW acquisition).

8.3 IC-3: Install Roundabout at Rothesay Rd / Rothesay Ave

Criteria	Key Considerations
Location	• Intersection of Rothesay Road and Rothesay Avenue (Route 100 Interchange)
Description	• Upgrade existing unsignalized intersection to a single lane roundabout.
Project Benefits	• Reduces overall intersection delay from 30 sec / vehicle (LOS C) to 7 sec / vehicle (LOS A). • Operations for critical left turn movement from Rothesay Avenue toward Route 1 WB on-ramp improve from LOS F to LOS B. • Single lane roundabouts are generally safer for motorists than equivalent signalized intersections.
Property Requirements	• Potential impact at the corner of one property. • Potential impact on large property to the west of the proposed roundabout.
Timing / Phasing	• Improvement should be implemented in conjunction with establishment of new access to "The Crossing".
Other Considerations	• Developers of "The Crossing" have indicated they are opposed to a roundabout at this location.

	• The installation of signals would also improve operations at this location.
Class "D" Construction Estimate ($2016)	• $1.5M (excluding ROW acquisition).

8.4 IC-4: Realign Campbell Drive

Criteria	Key Considerations
Location	• Route 111 interchange (North side).
Description	• Make Route 111 and Campbell Drive continuous. • Grove Avenue tees into Campbell Drive under stop controlled conditions.
Project Benefits	• Predominant AM movement from Campbell Drive to Route 1 WB On-ramp changes from a left turn to a more efficient through movement. • Predominant PM movement from Route 1 EB Off-ramp toward Rothesay changes from a right turn movement to a more efficient through movement. • Reduces future intersection delay in front of fire station from 80 sec / vehicle (LOS F) to 25 sec / vehicle (LOS C).
Property Requirements	• No impact on Right of Way
Timing / Phasing	• The project would provide immediate benefit as soon as funding becomes available, however it is projected to be required within 10-15 years.
Other Considerations	• Fire Station has less direct access to Campbell Drive and Route 111. • The new horizontal curve maximum design speed is 50 km/h. • The existing signalized intersections on Route 111 at Campbell Drive and the WB Ramps have recently been upgraded • Under the proposed stop-controlled condition, the left turn movement from Grove Avenue to Campbell Drive will experience a very poor LOS F. However, demand for this movement is very low during the peak hour (less than 15 vehicles per hour), and therefore doesn't represent a significant concern
Class "D" Construction Estimate ($2016)	• $1.5M

8.5 IC-5: Upgrade EB Exit Loop Ramp (Route 111 Interchange)

Criteria	Key Considerations
Location	• Route 111 interchange (South side).
Description	• Upgrade existing EB loop off-ramp to a higher design speed to comply with minimum TAC guidelines. • Relocation of EB on-ramp to accommodate the new EB loop off-ramp.
Project Benefits	• Reduced potential for queuing back onto Route 1. • Design speed differential between main lanes and ramp complies with TAC guidelines.
Property Requirements	• Partial impact on five wooded properties.
Timing / Phasing	• Improvement may be undertaken in conjunction with main lane widening (IC-8) to minimize potential duplication in construction efforts.
Other Considerations	• n/a
Class "D" Construction Estimate ($2016)	• $3.5M (excluding ROW acquisition).

8.6 IC-6: Eliminate Service Station Access

Criteria	Key Considerations
Location	• Existing service station on the eastbound lanes immediately upstream of the Route 111 interchange.
Description	• Decommission existing on and off ramps to the service station. • Relocate service station to a location near the existing interchange on Route 111.
Project Benefits	• Elimination of independent on and off ramps and speed change lanes. • Relocation would increase exposure of the facility to traffic in both directions.
Property Requirements	• Land purchase for new location required.
Timing / Phasing	• In conjunction or following construction of Route 111 interchange EB Ramps.
Other Considerations	• Disruption of operations. • Requires agreement with business owner.
Class "D" Construction Estimate ($2016)	• $0.5M (decommissioning of ramps and speed change lanes only).

8.7 IC-7: Realign WB On-Ramps (Route 119 Interchange)

Criteria	Key Considerations
Location	• Route 119 interchange
Description	• Relocation of existing Westbound West On-ramp from Route 119 to Millennium Drive. • Additional left turn pocket from Route 119 Southbound, additional connection to Westbound East On-ramp, and re-alignment of right slip lane to Westbound East On-ramp.
Project Benefits	• Takes advantage of reserve capacity at Westbound East On-ramp. • Relieves congestion for Westbound West On-ramp. • Reduces overall delay at Millennium Drive / Route 119 intersection by more than 10 seconds compared to existing conditions.
Property Requirements	• Two or three properties impacted for new Westbound West On-ramp. One existing gravel parking lot (whole parcel), and two cleared and empty parcels (portions) impacted.
Timing / Phasing	• The project would provide immediate benefit as soon as funding becomes available.
Other Considerations	• Conversion of existing through movement at intersection to left turn movement. • All new guide signage for Westbound side of interchange.
Class "D" Construction Estimate ($2016)	• $1.5M (excluding ROW acquisition).

8.8 IC-8: Widen Route 1 to Six Lanes (Route 111 to Route 100)

Criteria	Key Considerations
Location	• Route 1 from Route 100 interchange to Route 111 interchange.
Description	• Widening Eastbound Lanes from 2 to 3 lanes, from Route 100 interchange On-ramp to a point beyond Route 111 interchange (approx. 8.5 km). • Widening Westbound Lanes from 2 to 3 lanes, from Route 100 interchange Off-ramp to Route 111 interchange On-ramp (approx. 7.0 km). • Widening of each main lane structure at Fox Farm interchange from 2 lanes to 3 lanes. • Realignment of all ramps at the Fox Farm interchange.
Project Benefits	• Additional capacity for the most congested freeway portion of Route 1 in the study area. • Reduced potential for queuing at Route 111 Westbound On-ramp.

	• Reduced driver frustration, which can be a factor in collisions.
Property Requirements	• Numerous additional properties required along the corridor.
Timing / Phasing	• Projected to be required within 10-15 years • Widening of the WB lanes commencing at Route 111 should be the priority.
Other Considerations	• Detailed review of widening on median side in some areas may reduce the need for large rock cuts. • Enhanced investment and promotion of regional public transit initiatives may be a preferred alternative to adding roadway capacity.
Class "D" Construction Estimate ($2016)	• $23.0M (excluding ROW acquisition and Service Road).

8.9 IC-9: Eliminate / Relocate Access to NBDTI Maintenance Depot

Criteria	Key Considerations
Location	• Eastbound lanes immediately east of the Route 1 on-ramp from Route 100.
Description	• Decommission existing access to the maintenance depot • Construct new 2.8 km service road to access the facility from Fox Farm Road.
Project Benefits	• Improved safety by eliminating direct access on high speed facility.
Property Requirements	• Property has already been acquired.
Timing / Phasing	• As soon as possible or in conjunction with widening of EB Route 1 main lanes.
Other Considerations	• Relocation of Maintenance Depot may represent a viable alternative.
Class "D" Construction Estimate ($2016)	• $4.5 M (excluding ROW acquisition)

Appendix A – Supplementary Safety Assessment

Route 1 Corridor Study – Supplementary Safety Assessment

Tables 1 and **2** summarize the reported collision data analysis completed as part of the overall study of the Route 1 corridor. Five years (2008-2012) of reported collision data for each control section were provided by NBDTI for use during this study. It should be noted that the study period for this safety analysis does not take into account recent highway upgrades made to these segments during the Route 1 Gateway Project.

In addition to the collision data analysis, predicted collision frequencies were calculated using the AASHTO 2014 Highway Safety Manual (HSM), which provides Safety Performance Functions (SPFs), Collision Modification Factors (CMFs), and calibration methodologies for freeways similar to Route 1 facility. The results produced using the 2014 HSM methodology found that Route 1, in its current geometric configuration, has been experiencing collision frequencies within the expected ranges produced using the SPFs, CMFs, and calibration factors. This indicates that the current facility is performing adequately based on the 4 to 5 years of recent collision data provided by the Province. It is interesting to note, based on the results presented in **Tables 1** and **2**, that there have been several instances where single vehicles have been running off the road to the left and right of the existing facility. A common mitigation strategy for these types of collisions is to install longitudinal rumble strips on both sides of the roadway. Currently, there are rumble strips installed in several sections of the existing facility on the right-hand side of the road; however, no rumble strips are currently installed on the left side of either the eastbound and westbound lanes. It is likely that adding rumble strips to the left sides of these lanes will decrease the frequency of run-off-road collisions on the left sides of the lanes.

Table 7 – Collisions per Year by Characteristic

	Collision Characteristics						
Control Section	Single Vehicle	Multi Vehicle	PDO	Injury	Fatality	ROR Left	ROR Right
Ashburn Lake Rd to Rothesay Town Limit (EB)	5	3.5	6.75	1.75	0	1	2
Rothesay Town Limit to Route 119 Interchange (EB)	13.8	8.2	18.2	3.8	0	2.6	3.2
Route 119 Interchange to Rothesay Town Limit (WB)	18.2	9.8	23.8	4.2	0	7.2	6.2
Rothesay Town Limit to Foster Thurston Drive (WB)	7.75	4.5	10	2	0.25	1.75	3.5

Table 8 – Collisions per year by Characteristic per km

Control Section	Collision Characteristics						
	Single Vehicle	**Multi Vehicle**	**PDO**	**Injury**	**Fatality**	**ROR Left**	**ROR Right**
Ashburn Lake Rd to Rothesay Town Limit (EB)	0.94	0.66	1.27	0.33	0.00	0.19	0.38
Rothesay Town Limit to Route 119 Interchange (EB)	1.54	0.91	2.03	0.42	0.00	0.29	0.36
Route 119 Interchange to Rothesay Town Limit (WB)	1.92	1.03	2.51	0.44	0.00	0.76	0.65
Rothesay Town Limit to Foster Thurston Drive (WB)	1.56	0.91	2.01	0.40	0.05	0.35	0.70

Tables 3 and **4** summarize the Major Contributing Factors (MCFs) attributable to the collisions experienced on the Route. 1 facility within the project areas based on 2008 to 2012 collision data. An analysis of these data indicates a significant number of collision that have recently occurred on this facility involved single vehicles colliding with wildlife. A possible remedial measure that would significantly reduce these collision frequencies would be to install wildlife fencing on both sides of the facility. This countermeasure would not completely eliminate wildlife-related collisions as animals may enter the facility at either end of the fencelines and ultimately be trapped within the fences. Proper placement of the wildlife fencing, as well as installing corralling gates at the ends and along the lengths of the fencelines, should limit the number of animals entering the facility, with the gates corralling the wildlife out of the facility, if required.

The data presented in **Tables 3** and **4** also indicate that driver condition, impairment, and behaviour have contributed significantly to the frequency of collisions on the facility. Increased surveillance by law enforcement along this route could significantly reduce these collision frequencies, with individuals being fined by the authorities for illegal manoeuvers, and the public, overall becoming more aware that there driving behaviour, and level of intoxication will put them at risk of being fined or incarcerated for their condition/behaviour.

It is interesting to note that there have been several reported collision events which involved construction vehicles, personnel, and temporary infrastructure. This may further reinforce the point that additional surveillance by law enforcement may increase driver vigilance within construction zones, ultimately reducing the frequency of collisions within these areas.

Table 9 – Collision Frequency per Year by Category

	Major Contributing Factor (MCF)					
CS	Wildlife	Weather	Impaired	Driver Condition/ Error	Pedestrian	Construction Zone
Ashburn Lake Rd to Rothesay Town Limit (EB)	3	5	0.25	7.75	0	0.25
Rothesay Town Limit to Route 119 Interchange (EB)	7.6	7.4	0.8	9.6	0	0.4
Route 119 Interchange to Rothesay Town Limit (WB)	7.4	15.8	0.8	17	0	0.6
Rothesay Town Limit to Foster Thurston Drive (WB)	2.4	6	0.6	6.8	0.2	0.4

Table 10 – Collision Frequency per Year by Category per km

	Major Contributing Factor (MCF)					
CS	Wildlife	Weather	Impaired	Driver Condition/ Error	Pedestrian	Construction Zone
Ashburn Lake Rd to Rothesay Town Limit (EB)	0.56	0.94	0.05	1.46	0.00	0.05
Rothesay Town Limit to Route 119 Interchange (EB)	0.85	0.82	0.09	1.07	0.00	0.04
Route 119 Interchange to Rothesay Town Limit (WB)	0.78	1.66	0.08	1.79	0.00	0.06
Rothesay Town Limit to Foster Thurston Drive (WB)	0.48	1.21	0.12	1.37	0.04	0.08