Team Gushue Highway Connection Review and Options Report

Prepared for:

Newfoundland and Labrador Department of Transportation and Infrastructure

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Harbourside Transportation Consultants
8 Rowan Street, Suite 301
Terrace on the Square
St. John's, NL, Canada A1B 4J9
Tel: 709-579-6435
www.harboursidetransportation.com

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Prepared by:

Mark Stuckless, P.Eng.
Michael MacDonald, P.Eng.
Florence Allaire, MScE, P.Eng.

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8 Rowan Street, Suite 301
Terrace on the Square
St. John's, NL, Canada A1B 4J9
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1 Introduction

The Team Gushue Highway, formerly known as the East-West Arterial, was first envisioned in the early 1970s. The arterial highway is a major component of the regional road network. The first phase of the Team Gushue Highway, extending between the Outer Ring Road (Route 1) and Kenmount Road, opened in 2006. The second phase was completed in 2018, extending the highway from Kenmount Road to Topsail Road. The third and final phase of the Team Gushue Highway will extend the highway to the Commonwealth Avenue, Brookfield Road, Heavy Tree Road area and provide a connection to the Pitts Memorial Drive (Route 2) and Robert E. Howlett Memorial Drive (Route 3) interchange.

The alignment of the Team Gushue Highway and the connection to Pitts Memorial Drive and Robert E. Howlett Memorial Drive was developed approximately 30 years ago. In that time, there have been significant changes to the surrounding environment that will impact the Team Gushue Highway connection to Pitts Memorial Drive and Robert E. Howlett Memorial Drive:

1. Numerous residential developments in Mount Pearl and St. John's, including Castle Bridge, Brookside, Southlands and Galway have resulted in an increase in traffic volume in the area. Future phases of Southlands and Galway will cause further increases.
2. Residential and commercial development in the Towns of Conception Bay South and Paradise have and will continue to increase traffic volumes in the area.
3. Increased commuter traffic from the southern shore area utilizing the Team Gushue Highway as a means to access their work locations.
4. Commercial development in Galway has resulted in an increase in traffic volume in the area. Future phases of commercial and industrial development will cause further increases.
5. Accommodation of farming activity in the area.

The Newfoundland and Labrador Department of Transportation and Infrastructure (NLDTI) has undertaken a detailed study to review the impact of recent and future development on the Team Gushue Highway and the existing Pitts Memorial Drive and Robert E. Howlett Memorial Drive interchange. The study includes three components:

- **Part A:** Evaluate current traffic operations at the Pitts Memorial Drive and Robert E. Howlett Memorial Drive interchange and at the intersection of Commonwealth Avenue and Old Placentia Road/Brookfield Road. Evaluate traffic operations for the 2020, 2025 and 2035 timeframes of multiple at-grade and grade separated Team Gushue Highway infrastructure options for the connection to Commonwealth Avenue, Brookfield Road, Heavy Tree Road area
- **Part B:** Develop preliminary concepts for the at-grade and grade separated options to connect the Team Gushue Highway to Pitts Memorial Drive and Robert E. Howlett Memorial Drive. Select the top three preliminary options to complete a detailed evaluation from an operational, capacity, safety and geometric perspective.
- **Part C:** Review the existing Team Gushue Highway connection to Topsail Road and evaluate traffic operations under the fully operational configuration for the 2020, 2025 and 2035 timeframes. Identify if future improvements will be required at the connection from an operational, capacity, and safety perspective.

2 Study Context

2.1 Background Documents

Various documents were reviewed for background information. Relevant documents include:

- Glencrest Traffic Impact Study
- Southlands Traffic Impact Study
- Karwood Market Area Traffic Study
- Conception Bay South Integrated Transportation Plan
- Mount Pearl Kenmount Hill Traffic Impact Study
- Route 2 Traffic Study

2.2 Traffic Count Data Collection

Weekday traffic count data were collected at key locations using Miovision 'Scout' video data collection devices. The location, type of count, duration and date of each traffic count are summarized in Table 1; the detailed traffic count data can be found in Appendix A.

Traffic data were collected during the morning (7:00am to 9:00am) and afternoon (4:00pm to 6:00pm) peak periods of traffic on a typical weekday in October, 2019. Additional data were collected during the midday (11:00am to 1:00pm) peak periods of traffic at unsignalized intersections. Traffic volumes (categorized as 'light' and 'other' vehicles) and pedestrians were recorded in 15-minute intervals.

Table 1: Traffic Count Summary

Location	Count Type	Duration	Date
Team Gushue Highway SB Ramps & Kenmount Road EB	Intersection	6 hours	Oct-23-2019
Team Gushue Highway SB Ramps & Kenmount Road WB	Roadway	6 hours	Oct-23-2019
Team Gushue Highway NB Ramps & Kenmount Road EB	Intersection	6 hours	Oct-24-2019
Team Gushue Highway NB Ramps & Kenmount Road WB	Roadway	6 hours	Oct-24-2019
Team Gushue Highway Briar Avenue Ramps	Roadway	6 hours	Oct-24-2019
Redmond's Road & Team Gushue Highway SB Ramps	Intersection	6 hours	Oct-31-2019
Redmond's Road & Team Gushue Highway NB Ramps	Intersection	6 hours	Oct-31-2019
Topsail Road & Team Gushue Highway Ramps/Dunn's Road	Intersection	4 hours	Oct-29-2019
Commonwealth Avenue & Old Placentia Road/Brookfield Road	Intersection	4 hours	Oct-29-2019
Route 2 East of Commonwealth Avenue	Roadway	24 hours	Oct-28-2019
Route 2 WB Ramps & Commonwealth Avenue	Intersection	6 hours	Oct-28-2019
Route 2 EB Ramps & Robert E. Howlett Drive	Intersection	6 hours	Oct-28-2019
Route 2 EB Off-Ramp & Heavy Tree Road	Intersection	6 hours	Oct-29-2019

3 Stakeholder Consultation

As required by the RFP terms of reference, the City of St. John's and the City of Mount Pearl were consulted at start of this project in order to identify and gauge regional growth and development projections that could have an impact on the study area.

3.1 City of St. John's

A meeting was held with the City of St. John's on October 30, 2019. The City of St. John's was represented by various staff members from the departments of Planning and Development and Engineering. The Team Gushue Highway study was discussed with the City of St. John's, an overview of the scope of work and objectives was provided to inform the discussion with the City.

The City of St. John's provided an overview of development potential in St. John's. The majority of future growth is expected to occur in the Southlands and Galway developments.

- Dewcor projects approximately 100 residential dwelling units per year and 650,000 ft^2 of commercial retail development will be developed in Galway.
- Fairview Investments projects approximately 50 new residential dwelling units per year in Southlands.

There is potential for growth in the Kilbride and Goulds planning areas as municipal water and sanitary infrastructure is upgraded. There is currently no timeframe for municipal water and sanitary infrastructure in these areas.

The City of St. John's did not note any specific concerns with respect to the Team Gushue Highway. The City noted that the connection of Pitts Memorial Drive, Robert E. Howlett Memorial Drive and the Team Gushue Highway will be an important and heavily used junction of two major highways within the regional road network; the City stressed the importance to ensure that the final configuration is properly designed to accommodate growth in the study timeframes and beyond.

3.2 City of Mount Pearl

A meeting was held with the City of Mount Pearl on October 17, 2019. The City of Mount Pearl was represented by the Manager of Planning and Development. The Team Gushue Highway study was discussed with the City of Mount Pearl, an overview of the scope of work and objectives was provided to inform the discussion with the City.

The City of Mount Pearl provided an overview of development potential in Mount Pearl. There are two areas of current and future growth:

- Moffatt Road/Brant Drive: A residential development is currently under construction in the Moffatt Road/Brant Drive area, approximately 162 residential lots remain to be developed. The development is expected to be completed by 2025.
- Kenmount Hill: There are approximately 100 hectares of undeveloped lands above the 190-metre contour elevation in the Kenmount Hill area. Development in this area was previously restricted by the lack of municipal water and sanitary infrastructure. However, Provincial and municipal planning policies which restricted the expansion of municipal services to the area have since been amended to allow the development of these lands. Development in the area will include a mixture of residential (single-family detached housing, multifamily mid-rise housing and senior adult housing) and commercial land uses. The timeframes associated with the development of the Kenmount Hill area will be subject to the availability of municipal services.

The City indicated that the lands above the 190-metre contour are the only significant area of undeveloped lands remaining within Mount Pearl. All other future development in the City will involve redevelopment of lands that may result in higher densities; these are unlikely to have a significant impact on traffic volumes in the area.

The City of Mount Pearl noted that traffic volumes have increased throughout the City since the extension of the Team Gushue Highway to Topsail Road. Increased traffic volumes travelling to/from the Team Gushue Highway have caused backups to frequently occur at the intersection of Topsail Road, Dunn's Road and the Team Gushue Highway Ramps, Smallwood Drive and Park Avenue and Smallwood Drive and Commonwealth Avenue.

4 Travel Demand Forecasts

The City of St. John's PTV Visum 2025 Travel Demand Forecasting Model was used to establish travel demand forecasts. The regional model includes the City of St. John's, the City of Mount Pearl, the Town of Paradise, the Town of Conception Bay South and nine other communities: Portugal Cove-St. Philip's, Torbay, Logy Bay-Middle Cove-Outer Cove, Pouch Cove, Flatrock, Bay Bulls, Witless Bay, Petty Harbour-Maddox Cove and Bauline. The regional model was developed by the City of St. John's in 2011.

Visum is a transportation demand modelling software used to model transportation networks and travel demands to forecast traffic flows. The model uses zones as origins and destinations to distribute traffic to the study area road network, trips to and from each zone are determined by land use data. Model zones are coded with land use data (such as dwelling units and employment data or ITE trip generation rates) and multi point assignments (MPAs) which are used to define where traffic to and from a zone is assigned to the road network.

Trips are distributed between the zones using the Gravity Model based on Newton's universal law of gravitation. The Gravity Model is built on the theory that, all else being equal, the attraction between two masses will be proportional to the size of the masses and inversely proportional to the distance between the masses. Visum uses the number of trips to reflect the size of the mass and route travel time to reflect the distance between the masses.

The model was updated to reflect the current and future regional road network; major road network connections include:

- Team Gushue Highway
- Route 2 and Galway interchange
- Route 1 and Galway interchanges
- Southlands Boulevard Connection
- Octagon Pond/Karwood Market connection to Route 2

The regional model was also updated to reflect future development projections as discussed in the following sections.

4.1 2020: Redistribution of Existing Traffic

The Team Gushue Highway connection to Route 2 and Route 3 will have a significant impact on regional travel patterns. The regional model was used to estimate the redistribution of traffic that can potentially be realized once the highway is completed and this connection is made. Since the regional model was developed and calibrated for 2025, traffic volumes obtained from the model could not be used directly in the analysis. A full calibration of the model to 2020 conditions was outside the scope of this study. The regional model was used to obtain traffic volumes before and after the Team Gushue Highway connection and to derive changes in travel patterns throughout the study area.

To approximate base 2020 conditions, future development areas, the Team Gushue Highway (from Topsail Road to Commonwealth Avenue) and all other future regional road network connections were turned off in the model. The traffic volumes obtained from the base model were compared to traffic count data and calibrated to ensure the travel patterns observed in the model reflect current travel patterns.

Once the base volumes were established the model was run again, this time including the Team Gushue Highway connection, to obtain redistributed traffic volumes. The redistributed traffic volumes were compared to the base traffic volumes to establish changes in travel patterns and calculate percentages. The changes in travel patterns observed in the before/after comparison of model volumes were then applied to known traffic count data to obtain redistributed traffic volumes for the analysis. The 2020 traffic volumes can be found in Appendix B.

4.2 2025: Development Projections

To provide a complete outlook of future conditions for the study timeframes, significant developments in St. John's, Mount Pearl, Paradise and Conception Bay South were included in the development projections. Development projections for the region were developed based on the stakeholder consultation and background documents. The residential, commercial, and industrial development projections for the 0-5 year timeframe are summarized in Table 2.

Table 2: 0-5 year Development Projections

Development Projections (0-5 year timeframe)	Residential (units)	Commercial (sq. ft.)	Industrial (sq. ft.)
Galway Development	500	425,566	-
Southlands Development	250	-	-
H3 Development	-	314,830	-
Mount Pearl	519	156,139	-
Paradise	377	222,396	193,313
Conception Bay South	750	150,000	435,725
Development Projections (0-5 yr)	2,396	1,268,931	629,038

4.2.1 Trip Generation

The weekday morning and afternoon peak hour trip generation estimates for the projected developments are summarized in Table 3. The 0-5 year development projections are expected to generate 4701 trips during the morning peak hour and 8136 trips during the afternoon peak hour.

Table 3: Trip Generation Estimates – 0-5 year Development Projections

Development	Trips Generation Estimates (veh/hr)					
	Weekday AM Peak Hour			Weekday PM Peak Hour		
	Total	Entering	Exiting	Total	Entering	Exiting
St. John's						
Galway Development	1,365	695	670	2,439	1,293	1,146
Southlands Development	185	47	138	248	157	91
H3 Development	277	209	68	1,323	662	661
St. John's Estimated Trips	1,827	951	876	4,010	2,112	1,898
Mount Pearl						
Moffatt Road/Brant Drive Area	120	30	90	161	102	59
Kenmount Hill	554	268	286	1,134	614	521
Mount Pearl Estimated Trips	674	298	376	1,295	716	580
Paradise						
Karwood Market	412	284	129	595	254	341
Octagon Pond	258	144	114	347	152	195
Junior High School	493	266	227	145	71	74
Paradise Estimated Trips	1,163	694	470	1,087	477	610
Conception Bay South						
Active Subdivisions	555	139	416	743	468	275
CBS Gateway	176	121	55	725	363	362
CBS Industrial Park	255	224	31	229	30	199
Fowler's Road Industrial Park	51	45	6	46	6	40
Conception Bay South Estimated Trips	1,037	529	508	1,743	867	876
Regional Estimated Trips (0-5 yr)	**4,701**	**2,472**	**2,230**	**8,135**	**4,171**	**3,964**

4.2.2 Trip Assignment and Distribution

The trip estimates associated with the proposed residential, commercial and industrial development projections were assigned and distributed to the regional road network using the PTV Visum regional model. The “select zone analysis” feature of the software was used to distribute the trips associated with the development projections to the road network and obtain traffic volumes throughout the study area.

The following future regional road network connections were included in the 2025 distribution: the Team Gushue Highway and the Southlands Boulevard Connection. The traffic volumes for the 0-5 year development projections were superimposed onto the 2020 traffic volumes to produce 2025 traffic volumes for analysis. The 2025 traffic volumes can be found in Appendix B.

4.3 2035: Development Projections

To provide a complete outlook of future conditions for the study timeframes, significant developments in St. John’s, Mount Pearl, Paradise and Conception Bay South were included in the development projections. Development projections for the region were developed based on the stakeholder consultation and background documents. The residential, commercial, and industrial development projections for the 5-15 year timeframe are summarized in Table 4. The total development projections for the 15-year study horizon shown in Table 5; the 0-15 year development projections combine the 0-5 year development projections in Table 2 with the 5-15 year development projection in Table 4.

Table 4: 5-15 year Development Projections

Development Projections (5-15 year timeframe)	Residential (units)	Commercial (sq. ft.)	Industrial (sq. ft.)
Galway Development	4,017	1,428,905	3,246,080
Southlands Development	3,988	126,700	-
H3 Development	-	-	434,937
Mount Pearl	879	105,749	-
Paradise	421	258,500	342,935
Conception Bay South	900	200,000	356,360
Development Projections (5-15 yr)	10,205	2,119,854	4,380,312

Table 5: 0-15 year Total Development Projections

Timeframe	Residential (units)	Commercial (sq. ft.)	Industrial (sq. ft.)
Development Projections (0-5 yr)	2,396	1,268,931	629,038
Development Projections (5-15 yr)	10,205	2,119,854	4,380,312
Total Development Projections (0-15 yr)	**12,601**	**3,388,785**	**5,009,350**

4.3.1 Trip Generation

The weekday morning and afternoon peak hour trip generation estimates for the projected developments are summarized in Table 6. The 5-15 year development projections are expected to generate 12,756 trips during the morning peak hour and 19,417 trips during the afternoon peak hour. The total trip generation estimates for the 15-year study horizon are shown in Table 7; the 0-15 year trip generation estimates combine the 0-5 year trip generation estimates in Table 3 with the 5-15 year trip generation estimates in Table 6. The 15-year development projections are expected to generate 17,457 trips during the morning peak hour and 27,554 trips during the afternoon peak hour.

Table 6: Trip Generation Estimates– 5-15 year Development Projections

Development	Trips Generation Estimates (veh/hr)					
	Weekday AM Peak Hour			Weekday PM Peak Hour		
	Total	Entering	Exiting	Total	Entering	Exiting
St. John's						
Galway Development	6,616	3,900	2,716	11,395	5,336	6,059
Southlands Development	3,342	691	2,651	3,499	2,274	1,225
H3 Development	305	269	36	275	36	239
St. John's Estimated Trips	10,263	4,860	5,403	15,169	7,646	7,523
Mount Pearl						
Kenmount Hill	484	176	308	884	505	379
Mount Pearl Estimated Trips	484	176	308	884	505	379
Paradise						
Karwood Market	610	429	181	961	393	568
Octagon Pond	249	139	110	323	131	192
Paradise Estimated Trips	859	568	291	1,284	524	760
Conception Bay South						
Comprehensive Development Areas	666	167	499	891	561	330
CBS Gateway	234	161	73	966	483	483
Fowler's Road Industrial Park	250	220	30	225	29	196
Conception Bay South Estimated Trips	1,150	548	602	2,082	1,073	1,009
Regional Estimated Trips (5-15 yr)	**12,756**	**6,152**	**6,604**	**19,419**	**9,748**	**9,671**

Table 7: 0-15 year Total Trip Generation Estimates

Timeframe	Trips Generation Estimates (veh/hr)					
	Weekday AM Peak Hour			Weekday PM Peak Hour		
	Total	Entering	Exiting	Total	Entering	Exiting
Regional Estimated Trips (0-5 yr)	4,701	2,472	2,230	8,135	4,171	3,964
Regional Estimated Trips (5-15 yr)	12,756	6,152	6,604	19,419	9,748	9,671
Total Regional Estimated Trips (0-15 yr)	**17,457**	**8,624**	**8,834**	**27,554**	**13,919**	**13,635**

4.3.2 Trip Assignment and Distribution

The trip estimates associated with the proposed residential, commercial and industrial development projections were assigned and distributed to the regional road network using the PTV Visum regional model. The "select zone analysis" feature of the software was used to distribute the trips associated with the development projections to the road network and obtain traffic volumes throughout the study area.

The following future regional road network connections were included in the 2035 distribution:

- Team Gushue Highway
- Southlands Boulevard Connection
- Route 2 and Galway interchange
- The two Route 1 and Galway interchanges
- Octagon Pond/Karwood Market connection to Route 2

The traffic volumes for both the 0-5 year and 5-15 year development projections were superimposed onto the 2020 traffic volumes to produce 2035 traffic volumes for analysis. The 2035 traffic volumes can be found in Appendix B.

5 Method of Analysis

5.1 Intersection Capacity Analysis: Measures of Performance

The performance of an intersection can be evaluated using a number of measures of effectiveness (MOEs), including level of service (LOS), delay, volume-to-capacity ratio (v/c) and vehicle queuing.

Level of service is a qualitative measure used to describe the level of performance of an intersection in terms of traffic movement. Level of service for intersections is defined in terms of delay, which is a measure of driver discomfort, frustration and increased travel time. The quality of traffic movement is divided into six levels ranging from A to F. Level of service A represents the best quality of traffic where there are essentially free flow conditions, and level of service F represents the worst quality of traffic where the level of congestion is considered unacceptable to most drivers. The level of service criteria for intersections (Table 8) are stated in terms of average control delay per vehicle, where control delay is additional travel time experienced by a motor vehicle attributable to the presence of traffic control (unsignalized or signalized intersection) and conflicting traffic.

Table 8: LOS Criteria for Signalized and Unsignalized Intersections

Level of Service	Description	Signalized Control Delay	Unsignalized Control Delay
A	No congestion; most vehicles do not stop. (Excellent)	≤ 10 sec/veh	≤ 10 sec/veh
B	Very light congestion; some vehicles stop. (Very Good)	10-20 sec/veh	10-15 sec/veh
C	Light congestion; most vehicles stop. (Good)	20-35 sec/veh	15-25 sec/veh
D	Noticeable congestion; vehicles must sometimes wait through more than one red light. No long-standing queues. (Satisfactory)	35-55 sec/veh	25-35 sec/veh
E	Congestion; vehicles must sometimes wait through more than one red light. Long-standing queues are formed. (Unsatisfactory)	55-80 sec/veh	35-50 sec/veh
F	Severe congestion; demand exceeds the capacity of the intersection. (Unacceptable)	≥ 80 sec/veh	≥ 50 sec/veh

The volume-to-capacity (v/c) ratio is a measure of how the peak hour traffic volume on an approach to an intersection compares to the theoretical maximum volume that could be accommodated on that intersection approach. As the v/c ratio approaches 1.0, the movement has reduced ability to accommodate any additional volume of traffic.

The 95th percentile queue (95th% queue) is the estimated length, in metres, of the vehicles queued on an intersection approach which is only exceeded five percent of the time. The average vehicle occupies approximately seven metres of queue length so, for example, a 95th% queue of 14 metres on any particular approach indicates that less than five times of out 100 there may be more than two vehicles stopped on that approach. The 95th% queue is typically used to determine if sufficient vehicle storage is available to maintain efficient traffic flow.

The Synchro Studio (Version 10) software package was used to evaluate signalized and unsignalized (two-way and all-way stop control) intersections. Synchro, the analysis and optimization component of the software package, was used to analyze network intersections based on the methodology of the *Highway Capacity Manual* (6th edition) published by the Transportation Research Board. SimTraffic, the micro-simulation component of the software package, was also used in the course of the analysis to check delay, illustrate and identify interactions between individual driver types and to illustrate the effects of adjacent or closely spaced intersections. The combination of the two components within the software allows the analyst to review the intersections using two different approaches. Synchro models each intersection in isolation, while SimTraffic analyzes the network as a whole. SimTraffic will identify external influences on intersections such as spillbacks from upstream and/or downstream intersections included in the model.

Junctions 8 Arcady software was used to analyze roundabouts. Arcady uses an empirical model based on the application of statistical regression of a large data set of observed roundabout operations in the United Kingdom.

5.2 Highway Capacity Analysis: Measures of Performance

The performance of a highway can be evaluated using a number of measures of effectiveness. LOS, density and density-to-capacity ratio are the primary measure of effectiveness used in highway capacity analyses. Highway LOS for multilane highways is calculated based on density. Density is the number of vehicles occupying a given length of a lane at any particular point in time. Density is calculated as flow rate divided by speed. The level of service criteria for multilane highways are described in Table 9.

The Highway Capacity Software (Version 7) was used to evaluate highway segments based on the methodology of the *Highway Capacity Manual* (6th edition).

Table 9: LOS Criteria for Multilane Highways

Level of Service	Density (pc/mi/ln)		
	Basic Freeway Segments	Merge/Diverge Segments	Weaving Segments
A	≤ 11	≤ 10	≤ 10
B	> 11-18	> 10-20	> 10-20
C	> 18-26	> 20-28	> 20-28
D	> 26-35	> 28-35	> 28-35
E	> 35-45	> 35	> 35 -43
F	> 45 or v/c > 1.0	v/c > 1.0	> 43 or v/c > 1.0

6 Existing Infrastructure on Commonwealth Avenue

The proposed connection of the Team Gushue Highway to Commonwealth Avenue and Brookfield will impact travel patterns on Commonwealth Avenue. Existing intersections in the vicinity of the Team Gushue Highway connection include the Pitts Memorial Drive (Route 2) Interchange with Robert E. Howlett Memorial Drive (Route 3) and Commonwealth Avenue and the signalized intersection of Commonwealth Avenue and Old Placentia Road/Brookfield Road.

Traffic operations at these intersections were evaluated under existing traffic volumes and redistributed traffic volumes with the initial connection of the Team Gushue Highway to identify if future improvements will be required from an operational, capacity, and safety perspective.

6.1 Existing Operations (2020)

The existing traffic operations at the Pitts Memorial Drive (Route 2) Interchange with Robert E. Howlett Memorial Drive (Route 3) and Commonwealth Avenue and the intersection of Commonwealth Avenue and Old Placentia Road/Brookfield Road were evaluated. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 10. The detailed Synchro and SimTraffic reports can be found in Appendix C.

Under existing conditions, operational deficiencies are observed at both unsignalized intersections (ramp terminals) and at the signalized intersection of Commonwealth Avenue and Old Placentia Road/Brookfield Road during the morning and afternoon peak hours. The operations at each intersection are described below.

The Route 3 and Route 2 WB Ramps unsignalized intersection operates at LOS A during the morning peak hour. The westbound left and through movements (Route 2 Off-Ramp) operate at LOS F in Synchro; however, SimTraffic indicates that the westbound left and through movements operate at acceptable levels of service. During the afternoon peak hour, the westbound left and through movements operate at LOS F in Synchro and the traffic volumes exceed the capacity of this approach. However, SimTraffic indicates that the westbound left and through movements operate at acceptable levels of service. Overall, this intersection operates at LOS E.

The Route 3 and Route 2 EB Ramps unsignalized intersection operates at LOS A during the morning peak hour. The eastbound left and through movements (Route 2 Off-Ramp) operate at LOS F in Synchro;

however, SimTraffic indicates that the eastbound movements operate at acceptable levels of service. During the afternoon peak hour, the intersection operates at LOS A; all movements operate at acceptable levels of service.

The Commonwealth Avenue and Old Placentia Road/Brookfield Road signalized intersection operates at LOS C during the morning peak hour; all movements operate at acceptable levels of service. During the afternoon peak hour, the southbound through and right movements (Commonwealth Avenue) operate at LOS E in Synchro and the traffic volumes have almost reached the capacity of this approach. SimTraffic indicates that the southbound through and right movements operate at LOS F. Significant 95th% queue lengths are observed on this approach. The 95th% queue lengths for the westbound left and right movements (Brookfield Road) and the northbound left movement (Commonwealth Avenue) indicate that queues exceed the storage capacity of the left turn and right turn lanes during the afternoon peak hour.

Table 10: Existing Infrastructure Intersection Operations - Existing (2020)

Existing Infrastructure on Commonwealth Avenue															
2020		Weekday AM Peak Hour							Weekday PM Peak Hour						
Intersection		Synchro				SimTraffic			Synchro				SimTraffic		
		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)
Route 3 & Route 2 Westbound Ramps		**6.0**	**A**			**3.0**	**A**		**49.1**	**E**			**8.1**	**A**	
Route 2 Westbound Off-Ramp	WB-L	98.8	F	0.53	15.4	17.6	C	18.3	264.8	F	1.44	122.5	27.9	D	109.7
	WB-T					17.6	C						27.9	D	
	WB-R	11.2	B	0.12	2.8	2.8	A	10.9	13.8	B	0.48	18.2	11.1	B	34.9
Route 3	NB-L	9.9	A	0.35	11.2	5.2	A	26.1	8.9	A	0.16	4.2	3.9	A	17.6
	NB-T	0.0	A	0.00	-	2.1	A	-	0.0	A	0.00	-	1.2	A	-
	SB-T	0.0	A	0.00	-	0.7	A	-	0.0	A	0.00	-	1.1	A	-
	SB-R	0.0	A	0.00	-	2.4	A	14.4	0.0	A	0.00	-	2.1	A	12.1
Route 3 & Route 2 Eastbound Ramps		**7.0**	**A**			**4.4**	**A**		**3.5**	**A**			**2.6**	**A**	
Route 2 Eastbound Off-Ramp	EB-L	116.6	F	0.73	25.9	26.9	D	23.8	32.3	D	0.46	15.4	13.4	B	23.6
	EB-T					8.2	A						4.6	A	
	EB-R	0.0	A	0.00	-	3.6	A	9.2	0.0	A	0.00	-	3.4	A	11.8
Route 3	NB-T	0.0	A	0.00	-	0.8	A	0.8	0.0	A	0.00	-	0.4	A	-
	NB-R	0.0	A	0.00	-	5.2	A	44.0	0.0	A	0.00	-	1.9	A	-
	SB-L	11.8	B	0.40	13.3	8.5	A	32.5	8.1	A	0.06	1.4	3.3	A	10.9
	SB-T	0.0	A	0.00	-	2.5	A	14.8	0.0	A	0.00	-	1.7	A	-
	SB-R					3.2	A						2.8	A	
Route 2 Eastbound Off-Ramp & Heavy Tree		**0.8**	**A**			**0.9**	**A**		**0.5**	**A**			**0.7**	**A**	
Route 2 Eastbound Off-Ramp	EB-T	0.0	A	0.00	-	0.1	A	-	0.0	A	0.00	-	0.3	A	-
	EB-R	0.0	A	0.00	-	0.0	A		0.0	A	0.00	-	0.1	A	
Heavy Tree Road	WB-T	0.0	A	0.00	-	4.4	A	7.2	0.0	A	0.00	-	5.9	A	5.4
	NB-R	9.0	A	0.01	0.0	1.1	A	1.7	10.3	B	0.03	0.7	1.2	A	1.7
Commonwealth Ave & Old Placentia Rd		**22.1**	**C**			**17.5**	**B**		**34.2**	**C**			**47.0**	**D**	
Old Placentia Road	EB-L	18.6	B	0.27	23.9	21.6	C	35.5	18.2	B	0.26	18.7	21.4	C	33.7
	EB-T	35.1	D	0.60	73.3	26.1	C	65.9	35.0	D	0.56	58.2	27.6	C	58.8
	EB-R	5.8	A	0.37	15.7	2.6	A	-	0.7	A	0.16	0.0	2.1	A	-
Brookfield Road	WB-L	18.3	B	0.22	15.0	22.5	C	29.3	20.3	C	0.41	30.3	37.3	D	40.1
	WB-T	31.0	C	0.35	35.5	28.1	C	50.1	35.2	D	0.62	76.9	42.8	D	154.0
	WB-R	1.7	A	0.21	2.2	4.6	A	19.7	9.8	A	0.38	23.2	20.8	C	38.2
Commonwealth Avenue	NB-L	15.7	B	0.11	12.0	16.7	B	18.2	25.1	C	0.57	32.0	21.8	C	35.4
	NB-T	22.6	C	0.42	43.2	22.2	C	32.4	26.3	C	0.43	50.3	24.2	C	44.5
	NB-R					4.1	A	39.9					4.7	A	49.0
	SB-L	20.5	C	0.51	43.7	17.7	B	43.8	17.8	B	0.30	26.4	27.7	C	184.4
	SB-T	26.6	C	0.48	85.7	19.9	B	60.6	68.6	E	0.99	174.3	126.8	F	323.8
	SB-R					5.8	A						98.5	F	

6.2 Traffic Signal Warrant Analysis

The Transportation Association of Canada (TAC) developed the Canadian Traffic Signal Warrant Matrix Procedure in 2005 to provide a basis for making rational, defensible decisions on the installation of traffic signals. The matrix uses a "cumulative factors methodology" to evaluate vehicle to vehicle and vehicle to pedestrian interactions while considering local factors such as demographics and roadway characteristics. The procedure also incorporates collision prediction theory which anticipates the number of collisions based on traffic volume and intersection geometry. However, it should be noted that some of the data required for this warrant procedure is subjective in nature, such as the intersection being located "near a school". The matrix provides a final score for the intersection, in order for traffic signals to be considered an intersection must score 100 priority points or more. A traffic signal installation would be deemed unwarranted if the scoring is less than 100 points.

The traffic signal warrant matrix was used to evaluate if traffic signals should be considered at the two unsignalized intersections. The traffic signal warrant analysis worksheets can be found in Appendix D. The intersections scored the following priority points using existing traffic volumes:

- Route 3 & Route 2 EB Ramps = 78 points
- Route 3 & Route 2 WB Ramps = 99 points

The traffic signal warrant analysis indicates that the existing traffic volumes at the intersections do not warrant traffic signals. However, the Route 3 & Route 2 WB Ramps intersection is only one point short of the threshold for traffic signals.

6.3 Team Gushue Highway Connection (2020)

Future traffic operations at the Pitts Memorial Drive (Route 2) Interchange with Robert E. Howlett Memorial Drive (Route 3) and Commonwealth Avenue and the intersection of Commonwealth Avenue and Old Placentia Road/Brookfield Road with the initial connection of the Team Gushue Highway were evaluated. The signal timing plans at the signalized intersection of Commonwealth Avenue and Old Placentia Road/Brookfield Road were optimized. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 11. The detailed Synchro and SimTraffic reports can be found in Appendix C.

Under future conditions with the initial connection of the Team Gushue Highway, operational deficiencies are observed at both unsignalized intersections (ramp terminals) during the morning and afternoon peak hours. The operations at each intersection are described below.

The Route 3 and Route 2 WB Ramps unsignalized intersection operates at LOS B during the morning peak hour. The westbound left and through movements (Route 2 Off-Ramp) operate at LOS F in Synchro and the traffic volumes exceed the capacity of this approach. However, SimTraffic indicates that the westbound movements operate at acceptable levels of service. During the afternoon peak hour, the westbound left and through movements operate at LOS F in Synchro and the traffic volumes exceed the capacity of this approach. Overall, this intersection operates at LOS F. SimTraffic indicates that the westbound left and through movements operate at LOS F and that the westbound right movement operates at LOS E.

The Route 3 and Route 2 EB Ramps unsignalized intersection operates at LOS F during the morning peak hour. The eastbound left and through movements (Route 2 Off-Ramp) operate at LOS F in Synchro and the traffic volumes exceed the capacity of this approach. SimTraffic indicates that the eastbound left, through and right movements operate at LOS F. The 95th% queue lengths for the southbound left movement (Route 3) indicate that queues exceed the storage capacity of the left turn lane during the morning peak hour. During the afternoon peak hour, the unsignalized intersection operates at LOS F. The eastbound left and through movements (Route 2 Off-Ramp) operate at LOS F in Synchro and the traffic volumes exceed the capacity of this approach. SimTraffic indicates that the eastbound left, through and right movements operate at LOS F.

The Commonwealth Avenue and Old Placentia Road/Brookfield Road signalized intersection operates at LOS C during the morning peak hour; all movements operate at acceptable levels of service. The 95th% queue lengths for the northbound left movement (Commonwealth Avenue) indicate that queues exceed the storage capacity of the left turn lane during the morning peak hour. During the afternoon peak hour, the signalized intersection operates at LOS C; all movements operate at acceptable levels of service. The 95th% queue lengths for the northbound left movement (Commonwealth Avenue) indicate that queues exceed the storage capacity of the left turn lane during the afternoon peak hour.

Table 11: Existing Infrastructure Intersection Operations - TGH Connection (2020)

Existing Infrastructure on Commonwealth Avenue																
TGH Connection 2020		Weekday AM Peak Hour							Weekday PM Peak Hour							
Intersection		Synchro				SimTraffic			Synchro				SimTraffic			
		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)
Route 3 & Route 2 Westbound Ramps		**11.9**	**B**			**3.0**	**A**		**70.3**	**F**			**12.9**	**B**		
Route 2 Westbound Off-Ramp	WB-L	668.6	F	1.55	30.1	25.7	D	15.1	754.7	F	2.44	142.1	71.5	F	169.8
	WB-T					25.7	D						71.5	F	
	WB-R	25.6	D	0.28	7.7	2.6	A	6.3	22.6	C	0.58	25.2	35.6	E	38.7
Route 3	NB-L	10.3	B	0.38	12.6	5.4	A	21.7	9.7	A	0.18	4.9	5.4	A	17.6
	NB-T	0.0	A	0.00	-	2.4	A	10.8	0.0	A	0.00	-	1.2	A	0.7
	SB-T	0.0	A	0.00	-	1.1	A	18.4	0.0	A	0.00	-	1.4	A	0.9
	SB-R	0.0	A	0.00	-	2.9	A	19.7	0.0	A	0.00	-	4.9	A	39.7
Route 3 & Route 2 Eastbound Ramps		**973.2**	**F**			**33.7**	**D**		**146.6**	**F**			**26.5**	**D**		
Route 2 Eastbound Off-Ramp	EB-L	4991.5	F	11.6	366.1	479.5	F	100.6	615.0	F	2.24	226.1	111.0	F	99.1
	EB-T					479.5	F						102.2	F	
	EB-R	0.0	A	0.00	-	289.2	F	34.4	0.0	A	0.00	-	64.5	F	39.0
Route 3	NB-T	0.0	A	0.00	-	1.3	A	2.0	0.0	A	0.00	-	0.8	A	0.6
	NB-R	0.0	A	0.00	-	2.5	A	7.9	0.0	A	0.00	-	1.9	A	-
	SB-L	18.1	C	0.56	24.5	25.6	D	45.7	8.4	A	0.07	1.4	3.7	A	11.1
	SB-T	0.0	A	0.00	-	7.4	A	82.0	0.0	A	0.00	-	1.8	A	1.2
	SB-R					5.8	A						2.7	A	
Route 2 Eastbound Off-Ramp & Heavy Tree		**0.3**	**A**			**602.1**	**F**		**0.3**	**A**			**150.9**	**F**		
Route 2 Eastbound Off-Ramp	EB-T	0.0	A	0.00	-	764.6	F	156.3	0.0	A	0.00	-	162.4	F	178.4
	EB-R	0.0	A	0.00	-	764.6	F		0.0	A	0.00	-	158.1	F	
Heavy Tree Road	WB-T	0.0	A	0.00	-	5.5	A	1.9	0.0	A	0.00	-	5.8	A	4.0
	NB-R	11.3	B	0.02	0.7	10.9	B	9.6	12.2	B	0.03	0.7	1.5	A	5.0
Commonwealth Ave & Old Placentia Rd		**31.6**	**C**			**14.0**	**B**		**26.6**	**C**			**15.0**	**B**		
Old Placentia Road	EB-L	34.9	C	0.38	34.1	34.9	C	37.1	49.2	D	0.53	31.4	37.6	D	32.9
	EB-T	32.8	C	0.01	4.0	26.6	C	5.9	40.4	D	0.02	4.5	31.1	C	6.2
	EB-R	36.0	D	0.91	107.0	4.0	A	-	13.2	B	0.70	26.0	3.2	A	-
Brookfield Road	WB-L	33.4	C	0.02	3.4	39.5	D	6.4	36.2	D	0.03	3.9	40.8	D	6.5
	WB-T	37.4	D	0.02	4.0	49.8	D	6.9	40.4	D	0.02	4.5	54.4	D	6.6
	WB-R	0.0	A	0.02	0.0	2.0	A	1.3	0.0	A	0.01	0.0	2.1	A	0.7
Commonwealth Avenue	NB-L	46.4	D	0.82	69.7	14.9	B	28.8	41.1	D	0.87	163.2	14.8	B	37.5
	NB-T	9.7	A	0.18	37.0	4.1	A	29.1	7.7	A	0.34	80.7	6.0	A	89.8
	NB-R					2.1	A	17.8					2.9	A	49.2
	SB-L	8.6	A	0.01	2.0	7.0	A	4.8	8.6	A	0.01	1.8	11.4	B	5.7
	SB-T	35.8	D	0.89	266.3	21.2	C	152.2	43.9	D	0.90	238.5	31.6	C	144.6
	SB-R					14.6	B						19.0	B	

7 Part A: Team Gushue Highway Connection to Commonwealth Avenue/ Brookfield Road: At-Grade and Grade-Separated

Proposed at-grade and grade separated options for the connection of the Team Gushue Highway to Commonwealth Avenue and Brookfield were evaluated. The connection options identified by NLDTI include:

- At-Grade Signalized Intersection
- At-Grade Roundabout
- Grade-Separated Interchange

The Part A analysis of the Team Gushue Highway connections to Commonwealth Avenue/Brookfield Road are summarized in the following sections. The adjacent signalized intersection of Commonwealth Avenue and Old Placentia Road/Brookfield Road located in the City of Mount Pearl was included in the analysis to identify potential interactions between the closely spaced intersections.

7.1 At-Grade Signalized Intersection Connection

The conceptual drawing for the at-grade signalized intersection is shown in Figure 1. The signalized intersection will require:

- A protected dual left turn on the eastbound approach (Commonwealth Avenue).
- Split phasing on the minor street approaches.
- Free flow for the southbound right (Team Gushue Highway) with an added lane on Commonwealth Avenue.

7.1.1 Traffic Operations

Operations at the signalized intersection were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The intersection MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 12. The detailed Synchro and SimTraffic reports can be found in Appendix C.

In 2020, Synchro indicates that the Commonwealth Avenue and Team Gushue Highway signalized intersection will experience light congestion (LOS C) during the morning peak hour with all movements operating at acceptable levels of service. This intersection also experiences light congestion (LOS C) during the afternoon peak hour. The eastbound through movement (Commonwealth Avenue) and the westbound through and right movements (Brookfield Road) operate at LOS E in Synchro. SimTraffic indicates that the eastbound through and westbound through movements operate at LOS E.

Synchro indicates that the Commonwealth Avenue and Old Placentia Road signalized intersection will experience light congestion (LOS C) during the morning peak hour with all movements operating at acceptable levels of service. This intersection also experiences light congestion (LOS C) during the afternoon peak hour with all movements operating at acceptable levels of service. The 95th% queue lengths from Synchro indicate that queues will exceed the storage capacity of the left turn storage lane for the northbound left movement (Commonwealth Avenue) during both peak hours. The southbound through movement also experiences significant queue lengths during both peak hours.

Figure 1: At-Grade Signalized Intersection Connection - Concept Drawing

In 2025, Synchro Indicates that the Commonwealth Avenue and Team Gushue Highway signalized intersection will experience light congestion (LOS C) during the morning peak hour with the westbound through and right movements (Brookfield Road) operating at LOS E. SimTraffic shows the westbound movements to operate at acceptable levels of service, but the southbound left movement (Team Gushue Highway) operating at LOS E. This intersection also experiences light congestion (LOS C) during the afternoon peak hour with the eastbound through movement (Commonwealth Avenue) and northbound left movement (Team Gushue Highway) operating at LOS E; and westbound through and right movements (Brookfield Road) operating at LOS F in Synchro. SimTraffic shows the eastbound through and westbound left movements to operate at LOS E and the westbound through and right movements to operate at LOS F.

Synchro indicates that Commonwealth Avenue and Old Placentia Road signalized intersection will experience light congestion (LOS C) during the morning peak hour with the northbound left movement (Commonwealth Avenue) operating at LOS E. This intersection also experiences light congestion (LOS C) during the afternoon peak hour with the northbound left movement (Commonwealth Avenue) and eastbound left movement (Old Placentia Road) operating at LOS E in Synchro. SimTraffic shows the westbound through movement (former Brookfield Road Cul-de-Sac) to operate at LOS E. The northbound left movement queue lengths exceed the storage capacity of the left turn lane and the southbound through movement (Commonwealth Avenue) experience significant queue lengths during both peak hours.

In 2035, Synchro indicates that the Commonwealth Avenue and Team Gushue Highway signalized intersection will experience light congestion (LOS C) during the morning peak hour with the westbound through and right movements (Brookfield Road) operating at LOS F. SimTraffic shows the westbound through and the southbound left movements (Team Gushue Highway) to operate at LOS E. This intersection experiences noticeable congestion (LOS D) during the afternoon peak hour with the eastbound left (Commonwealth Avenue) and southbound through (Team Gushue Highway) movements operating at LOS E; the eastbound through, westbound through and right, and northbound left movements operating at LOS F in Synchro. The westbound through and right (Brookfield Road), and the northbound left (Team Gushue Highway) traffic volumes exceed capacity. SimTraffic indicates that the eastbound left, northbound left, and southbound left and through movements operate at LOS E and the eastbound through, the westbound left, through and right movements operate at LOS F. SimTraffic indicates that the intersection will experience congestion (LOS E).

Synchro indicates that the Commonwealth Avenue and Old Placentia Road signalized intersection will experience noticeable congestion (LOS D) during the morning peak hour with the northbound left movement (Commonwealth Avenue) operating at LOS E in Synchro. This intersection also experiences noticeable congestion (LOS D) during the afternoon peak hour with the northbound left movement (Commonwealth Avenue) operating at LOS F and eastbound left movement (Old Placentia Road), southbound through and right movements operating at LOS E in Synchro. In SimTraffic, the westbound left and through movements (former Brookfield Road Cul-de-Sac) and the southbound right movement (Commonwealth Avenue) operate at LOS E and the southbound through movement operates at LOS F.

The northbound left movement queue lengths exceed the storage capacity of the left turn lane and the southbound through movement experiences significant queue lengths during both peak hours.

Table 12: At-Grade Signalized Intersection Operations

Part A - At-Grade Signalized Intersection Connection																	
2020		Weekday AM Peak Hour							Weekday PM Peak Hour								
		Synchro				SimTraffic			Synchro				SimTraffic				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)		
Route 3 & Commonwealth Ave/Brookfield Rd		**21.9**	**C**			**19.8**	**B**		**28.0**	**C**			**27.2**	**C**			
Commonwealth Avenue	EB-L	33.0	C	0.73	62.5	30.8	C	73.0	45.5	D	0.64	35.3	44.9	D	39.6		
	EB-T	25.5	C	0.28	29.9	27.3	C	33.1	62.3	E	0.77	60.7	55.2	E	56.1		
	EB-R	7.1	A	0.67	23.4	9.3	A	7.6	13.1	B	0.73	26.5	9.4	A	32.3		
Brookfield Road	WB-L	33.5	C	0.17	13.9	34.3	C	17.7	31.8	C	0.08	10.6	41.8	D	44.5		
	WB-T	47.2	D	0.69	48.4	42.6	D	49.7	69.3	E	0.91	97.7	71.5	E	109.1		
	WB-R					12.6	B						39.9	D			
Route 3	NB-L	19.0	B	0.36	30.2	18.3	B	34.9	44.8	D	0.88	85.9	28.5	C	74.5		
	NB-T	24.2	C	0.72	91.2	19.1	B	72.2	13.5	B	0.28	35.7	12.4	B	40.7		
	NB-R	0.1	A	0.03	0.0	3.9	A	10.9	0.7	A	0.07	1.6	2.8	A	-		
	SB-L	25.8	C	0.04	3.4	46.6	D	6.5	24.8	C	0.02	3.3	34.8	C	18.5		
	SB-T	25.1	C	0.11	11.5	22.1	C	22.3	35.8	D	0.75	82.8	37.1	D	93.9		
	SB-R	0.2	A	0.18	0.0	3.5	A	-	1.0	A	0.46	0.0	6.5	A	-		
Commonwealth Ave & Old Placentia Rd		**31.6**	**C**			**13.5**	**B**		**26.6**	**C**			**16.0**	**B**			
Old Placentia Road	EB-L	34.9	C	0.38	34.1	37.2	D	38.7	49.2	D	0.53	31.4	37.7	D	33.2		
	EB-T	32.8	C	0.01	4.0	38.6	D	6.0	40.4	D	0.02	4.5	28.7	C	5.0		
	EB-R	36.0	D	0.91	107.0	3.9	A	-	13.2	B	0.70	26.0	3.0	A	-		
Former Brookfield Road Cul-de-Sac	WB-L	33.4	C	0.02	3.4	38.3	D	6.8	36.2	D	0.03	3.9	34.1	C	6.1		
	WB-T	37.4	D	0.02	4.0	49.8	D	7.1	40.4	D	0.02	4.5	54.5	D	5.7		
	WB-R	0.0	A	0.02	0.0	2.1	A	2.1	0.0	A	0.01	0.0	2.0	A	1.7		
Commonwealth Avenue	NB-L	46.4	D	0.82	69.7	15.8	B	27.7	41.1	D	0.87	163.2	17.2	B	36.6		
	NB-T	9.7	A	0.18	37.0	6.9	A	15.3	7.7	A	0.34	80.7	9.3	A	56.0		
	NB-R					5.2	A	22.0					6.9	A	41.9		
	SB-L	8.6	A	0.01	2.0	6.0	A	4.6	8.6	A	0.01	1.8	12.9	B	5.8		
	SB-T	35.8	D	0.89	266.3	18.8	B	120.4	43.9	D	0.90	238.5	30.0	C	139.2		
	SB-R					11.9	B						18.4	B			
2025		Weekday AM Peak Hour							Weekday PM Peak Hour								
		Synchro				SimTraffic			Synchro				SimTraffic				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)		
Route 3 & Commonwealth Ave/Brookfield Rd		**26.5**	**C**			**24.4**	**C**		**33.4**	**C**			**35.5**	**D**			
Commonwealth Avenue	EB-L	41.6	D	0.71	81.2	42.8	D	96.5	52.6	D	0.62	41.8	51.1	D	68.7		
	EB-T	33.4	C	0.28	38.6	37.5	D	38.4	73.6	E	0.82	75.3	76.3	E	116.5		
	EB-R	7.2	A	0.67	26.9	9.8	A	3.8	13.4	B	0.75	30.8	14.2	B	70.4		
Brookfield Road	WB-L	44.2	D	0.20	19.1	43.8	D	24.4	38.8	D	0.11	15.4	79.7	E	68.9		
	WB-T	59.6	E	0.72	55.1	51.6	D	56.4	81.2	F	0.94	121.5	122.0	F	170.5		
	WB-R					16.0	B						92.2	F			
Route 3	NB-L	22.0	C	0.33	41.6	20.2	C	41.0	58.8	E	0.93	117.3	33.8	C	85.9		
	NB-T	28.4	C	0.71	135.6	21.9	C	91.9	15.1	B	0.31	47.3	13.7	B	52.0		
	NB-R	0.1	A	0.03	0.0	5.7	A	19.8	2.6	A	0.09	6.0	3.2	A	7.7		
	SB-L	30.6	C	0.05	3.8	58.0	E	6.5	29.2	C	0.02	3.7	41.2	D	14.8		
	SB-T	28.6	C	0.10	15.8	23.5	C	25.9	43.0	D	0.79	110.4	41.5	D	111.0		
	SB-R	0.2	A	0.18	0.0	3.2	A	-	1.0	A	0.46	0.0	6.5	A	-		
Commonwealth Ave & Old Placentia Rd		**33.0**	**C**			**15.6**	**B**		**34.8**	**C**			**23.9**	**C**			
Old Placentia Road	EB-L	35.4	D	0.40	35.8	38.4	D	40.0	58.6	E	0.62	39.2	45.2	D	39.5		
	EB-T	32.8	C	0.01	4.0	36.4	D	12.7	43.8	D	0.03	5.9	40.5	D	7.4		
	EB-R	35.7	D	0.91	107.6	4.1	A	-	12.5	B	0.68	27.7	3.0	A	1.7		
Former Brookfield Road Cul-de-Sac	WB-L	33.7	C	0.03	4.3	35.9	D	7.5	38.6	D	0.03	4.4	39.8	D	5.4		
	WB-T	37.4	D	0.02	4.0	48.4	D	6.4	47.5	D	0.04	5.9	59.1	E	7.6		
	WB-R	0.0	A	0.02	0.0	2.3	A	0.9	0.0	A	0.02	0.0	2.3	A	-		
Commonwealth Avenue	NB-L	55.4	E	0.86	73.7	15.9	B	28.1	65.9	E	0.96	191.2	19.1	B	37.7		
	NB-T	9.8	A	0.18	38.7	7.1	A	17.7	8.2	A	0.36	87.2	10.0	A	93.9		
	NB-R					5.6	A	23.2					8.3	A	52.0		
	SB-L	8.6	A	0.01	2.0	6.6	A	6.3	9.2	A	0.01	1.9	18.0	B	61.7		
	SB-T	37.6	D	0.90	273.1	23.7	C	155.7	53.8	D	0.96	286.5	53.2	D	270.2		
	SB-R					16.7	B						38.8	D			

2035		Weekday AM Peak Hour							Weekday PM Peak Hour						
Intersection		Synchro				SimTraffic			Synchro				SimTraffic		
		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)
Route 3 & Commonwealth Ave/Brookfield Rd		**31.3**	**C**			**27.9**	**C**		**44.3**	**D**			**57.2**	**E**	
Commonwealth Avenue	EB-L	53.9	D	0.86	94.9	48.9	D	113.5	64.1	E	0.67	48.9	66.1	E	154.3
	EB-T	42.1	D	0.47	57.9	43.6	D	53.8	102.4	F	0.93	98.1	140.7	F	241.4
	EB-R	8.9	A	0.72	30.9	10.6	B	21.5	14.7	B	0.78	34.6	35.2	D	103.0
Brookfield Road	WB-L	50.6	D	0.34	26.1	44.6	D	36.6	44.3	D	0.10	16.8	140.6	F	83.8
	WB-T	80.8	F	0.86	71.9	66.5	E	66.7	106.9	F	1.03	163.1	182.8	F	186.4
	WB-R					30.0	C						157.8	F	
Route 3	NB-L	16.6	B	0.33	35.5	20.4	C	47.2	91.2	F	1.02	149.9	58.8	E	121.8
	NB-T	31.7	C	0.89	196.9	25.9	C	134.3	17.8	B	0.43	78.6	16.4	B	76.7
	NB-R	0.1	A	0.03	0.0	10.0	A	27.9	2.5	A	0.14	8.9	4.2	A	26.6
	SB-L	24.6	C	0.07	3.4	70.8	E	7.3	30.0	C	0.02	3.9	63.9	E	16.2
	SB-T	21.8	C	0.13	20.4	20.2	C	33.8	58.1	E	0.94	188.2	70.8	E	229.2
	SB-R	0.2	A	0.18	0.0	3.4	A	-	1.0	A	0.46	0.0	11.8	B	142.5
Commonwealth Ave & Old Placentia Rd		**43.3**	**D**			**15.4**	**B**		**42.4**	**D**			**35.3**	**D**	
Old Placentia Road	EB-L	36.9	D	0.34	40.9	43.6	D	42.5	58.7	E	0.62	39.5	47.1	D	41.7
	EB-T	35.2	D	0.02	6.4	36.7	D	9.4	44.0	D	0.04	7.5	43.4	D	8.5
	EB-R	47.2	D	0.94	165.3	4.5	A	2.4	12.5	B	0.69	28.1	3.6	A	18.3
Former Brookfield Road Cul-de-Sac	WB-L	33.7	C	0.03	4.6	44.0	D	7.2	38.6	D	0.03	4.4	56.9	E	6.1
	WB-T	41.3	D	0.03	5.4	50.6	D	7.0	47.7	D	0.05	7.5	56.9	E	9.3
	WB-R	0.0	A	0.02	0.0	2.2	A	-	0.0	A	0.02	0.0	2.4	A	2.1
Commonwealth Avenue	NB-L	75.4	E	0.92	85.5	16.8	B	27.7	89.3	F	1.06	218.6	21.3	C	37.6
	NB-T	12.5	B	0.20	45.4	7.2	A	24.0	8.2	A	0.36	88.4	11.3	B	98.6
	NB-R					5.7	A	27.6					10.7	B	68.4
	SB-L	10.6	B	0.01	2.4	7.7	A	21.5	9.4	A	0.01	1.9	22.3	C	290.6
	SB-T	50.4	D	0.95	314.5	22.4	C	151.5	62.0	E	0.99	304.2	87.0	F	393.4
	SB-R					15.0	B						75.3	E	

7.2 At-Grade Roundabout Connection

The conceptual drawing for the at-grade roundabout is shown in Figure 2. The roundabout will require:

- Two-lane entries on all approaches.
- A right turn by-pass on the southbound approach (Team Gushue Highway).
- A third entry lane on the northbound approach (Team Gushue Highway) in 2035.

7.2.1 Traffic Operations

Operations at the at-grade roundabout connection were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 13. The detailed Arcady reports can be found in Appendix C.

In 2020 and 2025, the Commonwealth Avenue and Team Gushue Highway roundabout operates at LOS A during the morning and afternoon peak hours with two lane entries on the Team Gushue Highway with all movements operating at acceptable levels of service.

In 2035, the Team Gushue Highway northbound approach will operate at LOS F and be over capacity with two entry lanes. A third northbound entry lane will be required in 2035 to maintain acceptable levels of service during the peak hours. With the additional lane, the Commonwealth Avenue and Team Gushue Highway roundabout will operate at LOS A during the morning and afternoon peak hours with all movements continuing to operate at acceptable levels of service.

Figure 2: At-Grade Roundabout Connection - Concept Drawing

Table 13: At-Grade Roundabout Operations

Part A - At -Grade Roundabout Connection										
2020		Weekday AM Peak Hour				Weekday PM Peak Hour				
		Arcady				Arcady				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Route 3 & Commonwealth Ave/Brookfield Rd		**4.3**	**A**			**3.2**	**A**		
Commonwealth Avenue	EB-L	3.7	A	0.58	7.0	3.6	A	0.46	7.0
	EB-T								
	EB-R								
Brookfield Road	WB-L	4.0	A	0.19	7.0	2.8	A	0.21	7.0
	WB-T								
	WB-R								
Route 3	NB-L	5.8	A	0.67	14.0	3.1	A	0.45	7.0
	NB-T								
	NB-R								
	SB-L	1.8	A	0.05	7.0	3.0	A	0.39	7.0
	SB-T								
	SB-R								
2025		Weekday AM Peak Hour				Weekday PM Peak Hour				
		Arcady				Arcady				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Route 3 & Commonwealth Ave/Brookfield Rd		**5.1**	**A**			**3.6**	**A**		
Commonwealth Avenue	EB-L	3.8	A	0.59	7.0	4.1	A	0.51	7.0
	EB-T								
	EB-R								
Brookfield Road	WB-L	4.4	A	0.21	7.0	3.1	A	0.24	7.0
	WB-T								
	WB-R								
Route 3	NB-L	7.4	A	0.74	28.0	3.6	A	0.52	7.0
	NB-T								
	NB-R								
	SB-L	1.8	A	0.05	7.0	3.4	A	0.44	7.0
	SB-T								
	SB-R								
2035		Weekday AM Peak Hour				Weekday PM Peak Hour				
		Arcady				Arcady				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Route 3 & Commonwealth Ave/Brookfield Rd		**46.5**	**E**			**5.1**	**A**		
Commonwealth Avenue	EB-L	4.5	A	0.64	14.0	5.6	A	0.59	7.0
	EB-T								
	EB-R								
Brookfield Road	WB-L	7.2	A	0.33	7.0	3.8	A	0.31	7.0
	WB-T								
	WB-R								
Route 3	NB-L	94.5	F	1.04	917.0	5.3	A	0.67	21.0
	NB-T								
	NB-R								
	SB-L	1.9	A	0.09	7.0	5.0	A	0.61	7.0
	SB-T								
	SB-R								
2035 - 3-lane Entry Northbound		Weekday AM Peak Hour				Weekday PM Peak Hour				
		Arcady				Arcady				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Route 3 & Commonwealth Ave/Brookfield Rd		**9.4**	**A**			**4.6**	**A**		
Commonwealth Avenue	EB-L	4.5	A	0.64	14.0	5.6	A	0.59	7.0
	EB-T								
	EB-R								
Brookfield Road	WB-L	8.1	A	0.35	7.0	3.8	A	0.31	7.0
	WB-T								
	WB-R								
Route 3	NB-L	15.1	C	0.89	189.0	3.6	A	0.58	7.0
	NB-T								
	NB-R								
	SB-L	1.9	A	0.09	7.0	5.0	A	0.61	7.0
	SB-T								
	SB-R								

7.3 Grade Separated Interchange Connection

The conceptual drawing for the grade separated interchange is shown in Figure 3. The interchange will require:

- Free flow for the southbound right on the Team Gushue Highway southbound ramp with an added lane on Commonwealth Avenue.

7.3.1 Traffic Operations

Operations at the unsignalized intersections were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The intersection MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 14. The detailed Synchro and SimTraffic reports can be found in Appendix C.

In 2020, the unsignalized intersection of Commonwealth Avenue and Team Gushue Highway SB Ramps operates at LOS A during the morning and afternoon peak hours and all movements operate at acceptable levels of service. The unsignalized intersection of Brookfield Road and Team Gushue Highway NB Ramps operate at LOS A during the morning peak hour. The eastbound left movement (Team Gushue Highway Off-Ramp) operates at LOS F in Synchro; however, SimTraffic indicates that the eastbound left movement operates at an acceptable level of service. This intersection operates at LOS A during the afternoon peak hour with all movements shown to operate at acceptable levels of service.

The Commonwealth Avenue and Old Placentia Road signalized intersection experiences light congestion (LOS C) during the morning peak hour with all movements operating at acceptable levels of service. This intersection also experiences light congestion (LOS C) during the afternoon peak hour with all movements operating at acceptable levels of service in Synchro. In SimTraffic, the westbound through movement (former Brookfield Road Cul-de-Sac) operates at LOS E. The 95th% queue lengths for the northbound left movement (Commonwealth Avenue) indicate that queues exceed the storage capacity of the left turn lane during both peak hours. The southbound through movement (Commonwealth Avenue) is also shown to experience significant queue lengths during both peak hours.

In 2025, the unsignalized intersection of Commonwealth Avenue and Team Gushue Highway SB Ramps operates at LOS A during the morning and afternoon peak hours with all movements operating at acceptable levels of service. The unsignalized intersection of Brookfield Road and Team Gushue Highway NB Ramps operates at LOS A during the morning peak hour. The eastbound left movement (Team Gushue Highway Off-Ramp) is shown to operate at LOS F in Synchro, however SimTraffic indicates that the eastbound left movement will operate at an acceptable level of service. This intersection operates at LOS A during the afternoon peak hour. The eastbound left movement (Team Gushue Highway Off-Ramp) is shown to operate at LOS E in Synchro, however SimTraffic indicates that the eastbound left movement will operate at an acceptable level of service.

Figure 3: Grade Separated Interchange Connection - Concept Drawing

The Commonwealth Avenue and Old Placentia Road signalized intersection experiences light congestion (LOS C) during the morning peak hour with th northbound left movement (Commonwealth Avenue) shown to operate at LOS E in Synchro. This intesection also experiences light congestion (LOS C) during the afternoon peak hour with the northbound left movement (Commonwealth Avenue) and the eastbound left movement (Old Placentia Road) operating at LOS E in Synchro. The westbound through movement (former Brookfield Road Cul-de-Sac) is shown to operate at LOS E in SimTraffic. The northbound left movement queue lengths exceed the storage capacity of the left turn lane and the southbound through movement (Commonwealth Avenue) experiences significant queue lengths during both peak hours.

In 2035, the unsignalized intersection of Commonwealth Avenue and Team Gushue Highway SB Ramps operates at LOS A during the morning and afternoon peak hours with all movements operating at acceptable levels of service. The unsignalized intersection of Brookfield Road and Team Gushue Highway NB Ramps operates at LOS A during the morning peak hour. The eastbound left movement (Team Gushue Highway Off-Ramp) is shown to operate at LOS F in Synchro, however SimTraffic indicates that the eastbound left movement will operate at an acceptable level of service. This intersection will experience very light congestion (LOS B) during the afternoon peak hour. The eastbound left movement (Team Gushue Highway Off-Ramp) is shown to operate at LOS F in Synchro, however SimTraffic indicates that the eastbound left movement will operate at an acceptable level of service.

At the intersection of Brookfield Road and Team Gushue Highway NB Ramps, under the unsignalized configuration, the Synchro results show poor operations for the left turn movements on the ramp approaches, however SimTraffic shows those movements operating at acceptable levels of service. SimTraffic results tend to be more reflective of actual conditions. The installation of traffic signals or roundabout may improve operations should problems arise. A roundabout at the Brookfield Road ramp terminal would also aid in developing a suitable access to Tobin's Road.

The Commonwealth Avenue and Old Placentia Road signalized intersection experiences noticeable congestion (LOS D) during the morning peak hour with the northbound left movement (Commonwealth Avenue) operating at LOS E in Synchro. This intersection is also shown to experience noticeable congestion (LOS D) during the afternoon peak hour with the the northbound left movement (Commonwealth Avenue) operating at LOS F and the eastbound left movement (Old Placentia Road) and southbound through and right movements operating at LOS E in Synchro. In SimTraffic, the westbound through movement (former Brookfield Road Cul-de-Sac) and the southbound through and right movement (Commonwealth Avenue) operate at LOS E. The northbound left movement queue lengths exceed the storage capacity of the left turn lane and the southbound through movement experiences significant queue lengths during both peak hours.

Table 14: Grade Separated Interchange Operations

Part A - Grade Separated Interchange Connection																	
2020		Weekday AM Peak Hour							Weekday PM Peak Hour								
		Synchro				SimTraffic			Synchro				SimTraffic				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)		
Commonwealth Ave & TGH Southbound		**0.1**	**A**			**4.7**	**A**		**0.1**	**A**			**3.6**	**A**			
Commonwealth Ave	EB-T	0.0	A	0.00	-	6.1	A	35.0	0.0	A	0.00	-	5.1	A	-		
	EB-R	0.0	A	0.00	-	0.4	A	2.5	0.0	A	0.00	-	0.3	A	0.9		
	WB-T	0.0	A	0.00	-	0.8	A	-	0.0	A	0.00	-	1.0	A	-		
	WB-R	0.0	A	0.00	-	0.3	A	-	0.0	A	0.00	-	0.3	A	-		
TGH Southbound Off-Ramp	SB-L	18.5	C	0.02	0.7	21.6	C	7.2	20.5	C	0.02	0.7	16.5	C	5.4		
	SB-R					2.8	A						4.4	A			
Brookfield Rd & TGH Northbound Ramps		**8.0**	**A**			**5.0**	**A**		**7.7**	**A**			**4.4**	**A**			
TGH Northbound Off-Ramp	EB-L	84.3	F	0.29	7.0	17.3	C	11.4	30.3	D	0.30	8.4	11.9	B	17.5		
	EB-R	10.2	B	0.20	4.9	3.8	A	18.8	14.4	B	0.48	18.2	6.9	A	33.9		
Brookfield Rd	NB-L	9.7	A	0.45	16.8	6.3	A	40.1	8.7	A	0.22	5.6	4.5	A	23.3		
	NB-T	0.0	A	0.00	-	3.2	A	10.1	0.0	A	0.00	-	1.5	A	-		
	SB-T	0.0	A	0.00	-	2.4	A	16.1	0.0	A	0.00	-	1.5	A	8.9		
	SB-R	0.0	A	0.00	-	2.1	A		0.0	A	0.00	-	1.8	A			
Commonwealth Ave & Old Placentia Rd		**31.6**	**C**			**14.3**	**B**		**26.6**	**C**			**15.5**	**B**			
Old Placentia Road	EB-L	34.9	C	0.38	34.1	38.2	D	38.6	49.2	D	0.53	31.4	37.8	D	33.0		
	EB-T	32.8	C	0.01	4.0	38.1	D	5.8	40.4	D	0.02	4.5	30.5	C	5.8		
	EB-R	36.0	D	0.91	107.0	3.9	A	-	13.2	B	0.70	26.0	3.0	A	-		
Cul-de-Sac	WB-L	33.4	C	0.02	3.4	35.2	D	6.6	36.2	D	0.03	3.9	34.8	C	6.6		
	WB-T	37.4	D	0.02	4.0	48.8	D	7.0	40.4	D	0.02	4.5	56.5	E	7.1		
	WB-R	0.0	A	0.02	0.0	2.3	A	2.6	0.0	A	0.01	0.0	2.2	A	1.5		
Commonwealth Avenue	NB-L	46.4	D	0.82	69.7	16.9	B	29.1	41.1	D	0.87	163.2	16.6	B	36.9		
	NB-T	9.7	A	0.18	37.0	6.0	A	18.5	7.7	A	0.34	80.7	7.9	A	62.8		
	NB-R					5.1	A	25.6					6.7	A	44.4		
	SB-L	8.6	A	0.01	2.0	6.6	A	21.3	8.6	A	0.01	1.8	9.9	A	35.3		
	SB-T	35.8	D	0.89	266.3	20.7	C	133.4	43.9	D	0.90	238.5	30.6	C	139.4		
	SB-R					13.1	B						17.4	B			
2025		Weekday AM Peak Hour							Weekday PM Peak Hour								
		Synchro				SimTraffic			Synchro				SimTraffic				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)		
Commonwealth Ave & TGH Southbound		**0.1**	**A**			**4.7**	**A**		**0.1**	**A**			**3.8**	**A**			
Commonwealth Ave	EB-T	0.0	A	0.00	-	6.1	A	19.8	0.0	A	0.00	-	5.3	A	-		
	EB-R	0.0	A	0.00	-	0.4	A	1.8	0.0	A	0.00	-	0.3	A	1.7		
	WB-T	0.0	A	0.00	-	0.9	A	-	0.0	A	0.00	-	1.1	A	-		
	WB-R	0.0	A	0.00	-	0.3	A	-	0.0	A	0.00	-	0.4	A	-		
TGH Southbound Off-Ramp	SB-L	19.0	C	0.02	0.7	19.5	C	5.5	22.7	C	0.03	0.7	16.3	C	6.3		
	SB-R					2.5	A						4.8	A			
Brookfield Rd & TGH Northbound Ramps		**8.4**	**A**			**5.0**	**A**		**9.0**	**A**			**5.1**	**A**			
TGH Northbound Off-Ramp	EB-L	91.6	F	0.35	9.1	19.5	C	13.4	37.8	E	0.43	14.0	15.6	C	25.8		
	EB-R	10.4	B	0.22	5.6	3.9	A	18.8	16.3	C	0.55	23.8	8.2	A	42.3		
Brookfield Rd	NB-L	9.7	A	0.46	17.5	6.2	A	38.0	8.8	A	0.22	5.6	5.0	A	24.5		
	NB-T	0.0	A	0.00	-	3.1	A	10.0	0.0	A	0.00	-	1.6	A	-		
	SB-T	0.0	A	0.00	-	2.1	A	16.6	0.0	A	0.00	-	1.8	A	10.9		
	SB-R	0.0	A	0.00	-	2.1	A		0.0	A	0.00	-	2.0	A			
Commonwealth Ave & Old Placentia Rd		**33.0**	**C**			**13.9**	**B**		**34.8**	**C**			**17.0**	**B**			
Old Placentia Road	EB-L	35.4	D	0.40	35.8	38.7	D	42.0	58.6	E	0.62	39.2	46.6	D	41.5		
	EB-T	32.8	C	0.01	4.0	24.9	C	5.8	43.8	D	0.03	5.9	45.0	D	14.6		
	EB-R	35.7	D	0.91	107.6	3.9	A	-	12.5	B	0.68	27.7	3.0	A	-		
Cul-de-Sac	WB-L	33.7	C	0.03	4.3	38.0	D	6.6	38.6	D	0.03	4.4	50.7	D	6.1		
	WB-T	37.4	D	0.02	4.0	45.8	D	6.6	47.5	D	0.04	5.9	55.7	E	6.2		
	WB-R	0.0	A	0.02	0.0	2.1	A	1.3	0.0	A	0.02	0.0	1.9	A	1.7		
Commonwealth Avenue	NB-L	55.4	E	0.86	73.7	16.6	B	28.5	65.9	E	0.96	191.2	18.3	B	37.0		
	NB-T	9.8	A	0.18	38.7	5.9	A	19.6	8.2	A	0.36	87.2	7.9	A	70.0		
	NB-R					4.9	A	25.0					6.6	A	47.4		
	SB-L	8.6	A	0.01	2.0	9.8	A	5.6	9.2	A	0.01	1.9	12.7	B	28.4		
	SB-T	37.6	D	0.90	273.1	19.7	B	129.8	53.8	D	0.96	286.5	32.6	C	154.2		
	SB-R					12.1	B						18.8	B			

2035		Weekday AM Peak Hour							Weekday PM Peak Hour						
Intersection		Synchro				SimTraffic			Synchro				SimTraffic		
		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)
Commonwealth Ave & TGH Southbound		**0.1**	**A**			**5.1**	**A**		**0.1**	**A**			**3.8**	**A**	
Commonwealth Ave	EB-T	0.0	A	0.00	-	6.7	A	33.6	0.0	A	0.00	-	5.5	A	-
	EB-R	0.0	A	0.00	-	0.4	A	4.2	0.0	A	0.00	-	0.3	A	1.3
	WB-T	0.0	A	0.00	-	1.0	A	-	0.0	A	0.00	-	1.2	A	-
	WB-R	0.0	A	0.00	-	0.4	A	-	0.0	A	0.00	-	0.5	A	-
TGH Southbound Off-Ramp	SB-L	20.1	C	0.02	0.7	22.1	C	7.2	24.6	C	0.03	0.7	22.4	C	10.5
	SB-R					2.8	A						4.6	A	
Brookfield Rd & TGH Northbound Ramps		**9.0**	**A**			**5.3**	**A**		**14.5**	**B**			**6.0**	**A**	
TGH Northbound Off-Ramp	EB-L	122.8	F	0.48	12.6	25.7	D	14.0	80.4	F	0.81	37.8	17.5	C	29.8
	EB-R	10.8	B	0.24	6.3	4.3	A	21.9	18.2	C	0.59	27.3	9.2	A	43.7
Brookfield Rd	NB-L	9.9	A	0.47	18.2	6.7	A	39.0	9.0	A	0.23	6.3	5.2	A	26.2
	NB-T	0.0	A	0.00	-	3.4	A	7.6	0.0	A	0.00	-	1.6	A	-
	SB-T	0.0	A	0.00	-	2.2	A	16.4	0.0	A	0.00	-	1.7	A	9.6
	SB-R	0.0	A	0.00	-	2.3	A		0.0	A	0.00	-	1.9	A	
Commonwealth Ave & Old Placentia Rd		**43.3**	**D**			**14.2**	**B**		**42.4**	**D**			**29.8**	**C**	
Old Placentia Road	EB-L	36.9	D	0.34	40.9	44.7	D	44.0	58.7	E	0.62	39.5	49.5	D	42.6
	EB-T	35.2	D	0.02	6.4	34.6	C	8.8	44.0	D	0.04	7.5	44.0	D	11.8
	EB-R	47.2	D	0.94	165.3	4.4	A	-	12.5	B	0.69	28.1	3.1	A	-
Cul-de-Sac	WB-L	33.7	C	0.03	4.6	41.8	D	8.9	38.6	D	0.03	4.4	42.7	D	7.3
	WB-T	41.3	D	0.03	5.4	46.4	D	6.6	47.7	D	0.05	7.5	57.9	E	10.1
	WB-R	0.0	A	0.02	0.0	2.2	A	1.9	0.0	A	0.02	0.0	2.5	A	-
Commonwealth Avenue	NB-L	75.4	E	0.92	85.5	16.2	B	29.3	89.3	F	1.06	218.6	20.7	C	36.7
	NB-T	12.5	B	0.20	45.4	5.6	A	17.9	8.2	A	0.36	88.4	9.1	A	86.6
	NB-R					4.4	A	26.0					6.2	A	61.8
	SB-L	10.6	B	0.01	2.4	6.8	A	5.2	9.4	A	0.01	1.9	16.3	B	239.5
	SB-T	50.4	D	0.95	314.5	20.0	B	140.0	62.0	E	0.99	304.2	72.9	E	248.8
	SB-R					13.0	B						57.9	E	

8 Part B: Team Gushue Highway, Pitts Memorial Drive (Route 2) and Robert E. Howlett Memorial Drive (Route 3) Reconfiguration

Seven (7) preliminary options were developed for the reconfiguration of the Team Gushue Highway connection area including Pitts Memorial Drive (Route 2), Robert E. Howlett Memorial Drive (Route 3). The options include:

- Option 1 Signalized Corridor
- Option 2 Roundabout Corridor
- Option 3 Cloverleaf Interchange
- Option 4 Diverging Diamond Interchange
- Option 5 Route 2/Route 3 Interchange Flyover
- Option 6 Route 2 Flyover
- Option 7 Route 2 Underpass

8.1 Evaluation Criteria

The preliminary options were evaluated and ranked based on evaluation criteria developed for the context of this study and outlined in the RFP. The criteria include: driver comfort, land impact, utility impact, land acquisition, construction cost and traffic operations.

An evaluation matrix was developed to assess and compare the preliminary options, the matrix assigns a weighing factor to each criterion for a total of 100 points. Each criterion is rated using a poor/fair/good or high/medium/low scale, the rating translates to a specific number of points. For example, for a criterion with a weight of 10 points the poor/fair/good or high/medium/low scale translate to 0 points/5 points/10 points.

The preliminary options were evaluated based on the following criteria:

- **Driver Comfort (maximum 5 points):** considers the familiarity of the type of control and expected comfort for the average driver. Driver comfort is rated as poor/fair/good, where:
    - Poor (0 points): the option includes unconventional types of traffic, high level of complexity and violates driver expectations.
    - Fair (2.5 points): the option includes conventional types of control, introduces some level of complexity and can be unfamiliar/uncomfortable for some drivers.
    - Good (5 points): the option includes conventional and common types of control, meets driver expectations and is familiar/comfortable for the majority of drivers.
- **Land Impact (maximum 5 points):** considers disturbances to existing developed areas and environmental aspects associated with disturbance of wetlands and/or water bodies. The land impact of each option is rated as high/medium/low, where:
    - High (0 points): the option will cause disturbances to at least two of the following criteria: residential properties, agricultural uses and/or environmentally sensitive areas.

- Medium (2.5 points): the option will cause disturbances to at least one of the following criteria: residential properties, agricultural uses and/or environmentally sensitive areas.
- Low (5 points): no land impacts are anticipated.

- **Utility Impact (maximum 5 points):** considers the impact to utilities including water supply, sanitary sewer, high voltage transmission lines, and electrical/communications lines. The utility impact for each option is rated as high/medium/low, where:
  - High (0 points): the option requires the relocation of water supply, sanitary sewer and/or high voltage transmission lines.
  - Medium (2.5 points): the option requires the relocation of significant amounts of low voltage electrical and/or communications lines
  - Low (5 points): the option requires the relocation of minor amounts of low voltage electrical and/or communications lines or no utility impact is anticipated.
- **Land acquisition (maximum 10 points):** considers the area of land acquisition required to construct each option. The land acquisition for each option is rated as high/medium/low, where:
  - High (0 points): the option requires over 50 hectares of land acquisition.
  - Medium (5 points): the option requires between 25 and 50 hectares of land acquisition.
  - Low (10 points): the option requires less than 25 hectares of land acquisition.
- **Construction Cost (maximum 15 points):** considers cost to construction each option. The construction cost of each option is rated as high/medium/low, where:
  - High (0 points): the estimated cost to construct the option is over $50 million.
  - Medium (7.5 points): the estimated cost to construct the option is between $25 and $50 million.
  - Low (15 points): the estimated cost to construct the option is less than $25 million.
- **Traffic Operations (maximum 60 points):** considers future traffic operations with the completion of the Team Gushue Highway for the 2020, 2025 and 2035 timeframes. A maximum of 10 points is allotted for the 2020 timeframe, a maximum of 20 points is allotted for the 2025 timeframe and a maximum of 30 points is allotted for the 2035 timeframe, for a total maximum of 60 points. Traffic operations are rated as poor/fair/good for each timeframe, where:
  - Poor (0 points): intersections or highway segments experience LOS F and/or v/c > 1.
  - Fair (5 points for 2020, 10 points for 2025 and 15 points for 2035): intersections or highway segments experience LOS E.
  - Good (10 points for 2020, 20 points for 2025 and 30 points for 2035): intersections or highway segments experience LOS A-D.

The preliminary options and evaluation of the criteria are discussed in the following sections.

8.2 Option 1 Signalized Corridor

Option 1 is a traffic signals corridor with traffic signal control at the following intersections:

- Team Gushue Highway & Commonwealth Avenue/Brookfield Road
- Route 3/Commonwealth Avenue & Route 2 Westbound Ramps
- Route 3/Commonwealth Avenue & Route 2 Eastbound Ramps

The conceptual drawing for the signalized intersection corridor is shown in Figure 4; the full-size drawing has been included in Appendix E.

8.2.1 Driver Comfort

Traffic signals are a conventional form of traffic control and are commonly used in the metro region and throughout the Province. The majority of drivers are familiar and comfortable with traffic signals. Driver comfort is rated as "**Good**" for the signalized corridor option.

8.2.2 Land Impact

The signalized corridor does not cause disturbances to residential properties, agricultural uses and/or environmentally sensitive areas. Land impact is rated as "**Low**" for the signalized corridor option.

8.2.3 Utility Impact

The signalized corridor will require the relocation of some power and communications distribution infrastructure at the Brookfield Road crossing. The high-voltage transmission lines were previously raised in anticipation of the at-grade crossing of the Team Gushue Highway. Utility impact is rated as "**Low**" for the signalized corridor option.

8.2.4 Land Acquisition

Land acquisition areas were estimated based on the conceptual drawing, approximately 12.1 hectares of land is required to construct the signalized intersection corridor. The land acquisition includes approximately 12.1 hectares of rural residential infill (RRI) and rural (R) land. Land acquisition is rated as "**Low**" for the signalized corridor option.

8.2.5 Construction Cost

A Class 'D' opinion of probable construction cost was developed for this option. Costs do not include allowances for land acquisition, inflation, engineering, utility relocations, or harmonized sales tax (HST). The cost to construct the signalized intersection corridor is estimated to be approximately $20.1 million; the breakdown of the opinion of probable cost has been included in Appendix F. Construction cost is rated as "**Low**" for the signalized corridor option.

Figure 4: Option 1 Signalized Corridor

8.2.6 Traffic Operations

Operations at the signalized intersections and interchange were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The intersection MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 15. The detailed Synchro and SimTraffic reports can be found in Appendix G. The signalized intersections experience operational problems in 2020, 2025 and 2035. Overall, the signalized intersections operate at acceptable levels of service in 2020 and 2025 with some operational problems on the minor street approaches at the Team Gushue Highway and Commonwealth Avenue/Brookfield Road intersection caused by coordination along the Team Gushue Highway. In 2035, the Team Gushue Highway and Commonwealth Avenue/Brookfield Road and the Route 3 and Route 2 Eastbound Ramps intersections experience operational problems with movements over capacity on number of approaches during the peak hours.

The highway capacity analysis results including density, level of service and density-to-capacity ratio are summarized in Table 16. The detailed Highway Capacity Software reports can be found in Appendix G. The diamond interchange will operate at acceptable levels of service in 2020 and 2025. In 2035, the Route 2 eastbound segments before the off-ramp, at the off-ramp and after the on-ramp operate at LOS E during the morning peak hour. During the afternoon peak hour, the Route 2 westbound highway segment before the off-ramp operates at LOS E, all other segments operate at LOS F; and the highway segments at the on-ramp and after the on-ramp will be over capacity.

The poor levels of service on Route 2 eastbound in the morning peak hour and westbound in the afternoon peak hour are primarily caused by high through volumes at the interchange. It should be noted that the future proposed widening of Route 2 to three lanes in each direction west of the Route 2/Route 3 interchange will improve the 2035 traffic operations at the interchange to LOS E or better during the peak hours.

Traffic operations for the signalized corridor option are rated as "**Fair**" for 2020, "**Poor**" for 2025 and "**Poor**" for 2035.

Table 15: Signalized Corridor Intersection Operations

Part B - Signalized Intersection Corridor																
2020		Weekday AM Peak Hour							Weekday PM Peak Hour							
Intersection		Synchro				SimTraffic			Synchro				SimTraffic			
		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	
Route 3 & Commonwealth Ave/Brookfield Rd		**16.3**	**B**			**19.5**	**B**		**28.6**	**C**			**26.9**	**C**		
Commonwealth Avenue	EB-L	33.0	C	0.73	62.5	32.5	C	80.7	45.5	D	0.64	35.3	46.9	D	56.5	
	EB-T	25.5	C	0.28	29.9	25.9	C	51.2	62.3	E	0.77	60.7	47.2	D	51.8	
	EB-R	7.1	A	0.67	23.4	5.0	A	15.7	13.1	B	0.73	26.5	5.5	A	35.9	
Brookfield Road	WB-L	33.5	C	0.17	13.9	32.6	C	22.9	31.8	C	0.08	10.6	45.8	D	36.3	
	WB-T	47.2	D	0.69	48.4	42.6	D	50.8	69.3	E	0.91	97.7	67.0	E	108.4	
	WB-R					13.7	B						38.6	D		
Route 3	NB-L	6.7	A	0.36	10.6	19.6	B	31.6	52.7	D	0.89	85.7	28.8	C	71.3	
	NB-T	9.6	A	0.72	32.7	18.9	B	89.5	12.3	B	0.29	35.1	20.1	C	163.7	
	NB-R	0.1	A	0.03	0.0	7.0	A	13.6	2.9	A	0.07	3.6	7.9	A	18.5	
	SB-L	25.8	C	0.05	3.4	44.2	D	7.5	24.8	C	0.02	3.3	33.1	C	14.9	
	SB-T	25.1	C	0.11	11.5	21.9	C	19.8	35.8	D	0.75	82.8	34.5	C	79.9	
	SB-R	0.2	A	0.18	0.0	3.6	A	0.0	1.0	A	0.46	0.0	6.8	A	0.0	
Route 3 & Route 2 Westbound Ramps		**11.8**	**B**			**17.1**	**B**		**10.5**	**B**			**18.3**	**B**		
Route 2 Westbound Off-Ramp	WB-L	22.8	C	0.08	10.1	36.2	D	16.5	25.3	C	0.62	27.9	20.5	C	59.5	
	WB-T					0.0	A						0.0	A		
	WB-R	1.5	A	0.14	2.0	2.4	A	8.1	9.6	A	0.57	14.5	5.1	A	36.1	
Route 3	NB-L	10.0	B	0.52	21.7	14.5	B	51.5	11.7	B	0.31	26.9	28.5	C	49.2	
	NB-T	3.4	A	0.48	11.0	7.0	A	67.3	8.7	A	0.34	42.4	14.5	B	65.3	
	SB-T	36.0	D	0.67	61.7	47.6	D	101.6	12.8	B	0.57	39.4	28.2	C	198.9	
	SB-R	6.5	A	0.38	13.6	7.4	A	17.6	3.4	A	0.59	4.1	13.3	B	50.6	
Route 3 & Route 2 Eastbound Ramps		**28.7**	**C**			**26.9**	**C**		**16.4**	**B**			**22.8**	**C**		
Route 2 Eastbound Off-Ramp	EB-L	29.9	C	0.68	36.7	24.7	C	54.9	21.4	C	0.51	31.1	18.4	B	48.8	
	EB-T	30.1	C	0.68	37.1	16.4	B	44.4	21.6	C	0.52	31.7	7.8	A	36.9	
	EB-R	1.4	A	0.16	1.2	2.7	A	8.7	5.3	A	0.38	10.3	3.2	A	11.6	
Route 3	NB-T	36.5	D	0.90	121.9	28.0	C	104.8	40.1	D	0.66	50.8	31.0	C	57.3	
	NB-R	2.2	A	0.23	6.7	6.1	A	56.6	0.0	A	0.02	0.0	2.0	A	0.0	
	SB-L	32.2	C	0.89	80.2	47.0	D	68.5	5.3	A	0.11	9.3	29.0	C	52.4	
	SB-T	1.2	A	0.09	0.0	13.7	B	10.1	5.4	A	0.44	39.0	25.7	C	119.2	
	SB-R					4.9	A	10.1					7.6	A	101.2	
2025		Weekday AM Peak Hour							Weekday PM Peak Hour							
Intersection		Synchro				SimTraffic			Synchro				SimTraffic			
		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	
Route 3 & Commonwealth Ave/Brookfield Rd		**20.9**	**C**			**24.6**	**C**		**33.5**	**C**			**34.9**	**C**		
Commonwealth Avenue	EB-L	41.6	D	0.71	81.2	40.1	D	102.6	52.4	D	0.62	41.8	52.1	D	61.6	
	EB-T	33.4	C	0.28	38.6	35.6	D	40.6	73.3	E	0.81	75.3	65.2	E	92.1	
	EB-R	7.2	A	0.67	26.9	5.3	A	21.6	13.4	B	0.75	30.8	8.8	A	60.0	
Brookfield Road	WB-L	44.2	D	0.20	19.1	44.6	D	21.8	38.7	D	0.11	15.4	71.8	E	59.8	
	WB-T	59.6	E	0.72	55.1	53.1	D	54.6	80.8	F	0.94	121.5	98.6	F	154.5	
	WB-R					16.5	B						75.2	E		
Route 3	NB-L	11.6	B	0.33	22.3	23.1	C	51.5	60.3	E	0.94	118.8	41.1	D	102.3	
	NB-T	14.0	B	0.71	74.0	25.3	C	122.9	15.2	B	0.31	47.6	22.5	C	133.3	
	NB-R	0.1	A	0.03	0.1	11.9	B	22.1	2.6	A	0.09	6.0	8.3	A	26.3	
	SB-L	30.6	C	0.05	3.8	49.4	D	6.2	29.2	C	0.02	3.7	42.7	D	11.6	
	SB-T	28.6	C	0.10	15.8	25.6	C	23.9	43.4	D	0.80	110.4	42.6	D	104.0	
	SB-R	0.2	A	0.18	0.0	3.4	A	0.0	1.0	A	0.46	0.0	7.2	A	0.0	
Route 3 & Route 2 Westbound Ramps		**9.2**	**A**			**20.8**	**C**		**15.3**	**B**			**24.0**	**C**		
Route 2 Westbound Off-Ramp	WB-L	38.7	D	0.11	14.5	48.5	D	19.4	44.5	D	0.61	75.6	41.2	D	121.9	
	WB-T					0.0	A						0.0	A		
	WB-R	0.7	A	0.15	0.0	2.7	A	9.6	13.6	B	0.51	35.7	16.3	B	38.3	
Route 3	NB-L	4.1	A	0.47	15.2	20.0	B	57.3	3.4	A	0.30	10.2	32.9	C	56.4	
	NB-T	0.6	A	0.47	0.0	10.5	B	134.0	0.6	A	0.33	0.0	11.4	B	86.9	
	SB-T	36.6	D	0.56	62.7	54.3	D	121.9	31.7	C	0.58	87.3	38.0	D	225.6	
	SB-R	5.9	A	0.38	12.8	8.7	A	26.4	6.0	A	0.62	28.1	17.0	B	63.5	
Route 3 & Route 2 Eastbound Ramps		**33.3**	**C**			**33.9**	**C**		**21.7**	**C**			**31.3**	**C**		
Route 2 Eastbound Off-Ramp	EB-L	37.1	D	0.71	56.5	30.5	C	67.8	23.7	C	0.54	43.6	21.3	C	62.0	
	EB-T	36.3	D	0.70	54.6	23.6	C	56.2	23.9	C	0.55	44.4	12.2	B	51.0	
	EB-R	0.6	A	0.14	0.0	4.0	A	20.5	8.2	A	0.39	17.1	3.7	A	22.7	
Route 3	NB-T	41.7	D	0.90	170.6	34.9	C	137.7	49.2	D	0.72	69.8	40.1	D	71.3	
	NB-R	0.6	A	0.21	0.0	10.8	B	60.2	0.0	A	0.02	0.0	2.5	A	0.0	
	SB-L	35.3	D	0.89	103.9	60.8	E	61.4	6.4	A	0.13	8.1	41.8	D	63.5	
	SB-T	2.5	A	0.09	0.0	16.5	B	110.2	10.7	B	0.48	30.3	38.3	D	155.6	
	SB-R					5.1	A	25.3					11.9	B	139.7	

2035		Weekday AM Peak Hour							Weekday PM Peak Hour						
Intersection		Synchro				SimTraffic			Synchro				SimTraffic		
		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	95th% Queue (m)
Route 3 & Commonwealth Ave/Brookfield Rd		**26.6**	**C**			**25.3**	**C**		**45.0**	**D**			**63.7**	**E**	
Commonwealth Avenue	EB-L	63.0	E	0.87	109.5	55.2	E	101.8	64.1	E	0.67	48.9	64.2	E	77.9
	EB-T	49.4	D	0.48	66.9	47.2	D	63.1	102.4	F	0.93	98.1	108.4	F	168.6
	EB-R	9.3	A	0.72	33.2	6.2	A	38.5	14.7	B	0.78	34.6	20.3	C	93.0
Brookfield Road	WB-L	57.8	E	0.32	29.6	57.1	E	43.4	44.3	D	0.10	16.8	126.7	F	74.3
	WB-T	85.2	F	0.84	78.4	83.2	F	83.4	106.9	F	1.03	163.1	163.4	F	192.6
	WB-R					41.7	D						141.0	F	
Route 3	NB-L	8.0	A	0.31	19.7	16.9	B	30.5	110.5	F	1.03	154.3	72.0	E	127.7
	NB-T	15.9	B	0.85	139.2	16.5	B	79.8	13.1	B	0.43	49.8	23.8	C	171.3
	NB-R	0.2	A	0.03	0.0	8.5	A	16.9	2.8	A	0.14	7.5	10.9	B	39.2
	SB-L	26.8	C	0.09	3.8	85.8	F	7.7	30.0	C	0.02	3.9	86.0	F	15.9
	SB-T	22.3	C	0.12	22.0	21.0	C	28.6	58.1	E	0.94	188.2	94.1	F	340.1
	SB-R	0.2	A	0.18	0.0	3.5	A	0.0	1.0	A	0.46	0.0	31.1	C	222.8
Route 3 & Route 2 Westbound Ramps		**10.9**	**B**			**29.0**	**C**		**13.4**	**B**			**36.4**	**D**	
Route 2 Westbound Off-Ramp	WB-L	49.1	D	0.14	18.9	54.4	D	23.5	62.5	E	0.71	93.1	74.6	E	191.1
	WB-T					0.0	A						0.0	A	
	WB-R	0.9	A	0.17	0.0	2.9	A	13.4	24.2	C	0.62	52.7	44.0	D	36.0
Route 3	NB-L	6.9	A	0.55	13.5	14.6	B	55.0	6.2	A	0.42	20.6	41.8	D	61.6
	NB-T	0.8	A	0.62	0.0	5.8	A	37.4	1.1	A	0.43	0.0	13.8	B	149.6
	SB-T	52.2	D	0.73	88.9	133.7	F	230.5	11.1	B	0.57	27.0	45.6	D	335.5
	SB-R	8.3	A	0.57	33.6	15.4	B	54.9	16.0	B	0.85	66.7	40.9	D	64.8
Route 3 & Route 2 Eastbound Ramps		**71.1**	**E**			**64.3**	**E**		**34.6**	**C**			**41.9**	**D**	
Route 2 Eastbound Off-Ramp	EB-L	108.0	F	1.10	198.8	78.3	E	92.0	59.3	E	0.83	154.4	43.7	D	103.3
	EB-T	101.1	F	1.08	190.0	78.5	E	103.7	58.2	E	0.82	151.6	43.9	D	108.8
	EB-R	0.5	A	0.12	0.0	52.3	D	44.7	23.5	C	0.59	68.3	17.8	B	46.7
Route 3	NB-T	69.2	E	1.02	240.0	55.7	E	156.9	63.6	E	0.85	105.7	57.3	E	93.7
	NB-R	1.3	A	0.21	2.7	28.7	C	68.0	0.0	A	0.02	0.0	6.5	A	19.6
	SB-L	61.2	E	1.01	133.3	95.3	F	60.0	1.3	A	0.12	0.0	45.2	D	65.9
	SB-T	2.4	A	0.10	0.0	27.8	C	165.3	2.1	A	0.41	0.0	40.2	D	185.9
	SB-R					7.9	A	79.9					11.3	B	165.3

Table 16: Diamond Interchange Operations

Part B - Diamond Interchange								
2020		Weekday AM Peak Hour			Weekday PM Peak Hour		
Highway Segment		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**21.9**	**C**		**7.3**	**B**	
Basic	Freeway	22.3	C	0.56	11.1	B	0.28
Diverge	Freeway	24.5	C	0.56	12.2	B	0.28
	Ramp	24.1		0.25	13.0		0.30
Basic	Freeway	18.0	B	0.46	5.9	A	0.15
Merge	Freeway	23.6	C	0.56	7.0	A	0.17
	Ramp	24.0		0.26	10.0		0.05
Basic	Freeway	22.5	C	0.57	6.8	A	0.17
Route 2 Westbound		**6.1**	**B**		**21.7**	**C**	
Basic	Freeway	5.6	A	0.14	22.0	C	0.56
Diverge	Freeway	6.0	A	0.14	24.1	C	0.55
	Ramp	8.0		0.05	24.2		0.25
Basic	Freeway	4.7	A	0.12	17.6	B	0.44
Merge	Freeway	10.3	B	0.25	24.8	C	0.59
	Ramp	13.0		0.30	25.1		0.34
Basic	Freeway	10.0	A	0.25	23.6	C	0.60

2025		Weekday AM Peak Hour			Weekday PM Peak Hour		
Highway Segment		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**23.8**	**D**		**9.3**	**B**	
Basic	Freeway	24.5	C	0.62	13.7	B	0.35
Diverge	Freeway	26.9	C	0.61	15.1	B	0.34
	Ramp	26.2		0.28	15.6		0.35
Basic	Freeway	19.6	C	0.50	7.7	A	0.19
Merge	Freeway	25.8	C	0.61	8.8	B	0.21
	Ramp	25.7		0.28	11.6		0.05
Basic	Freeway	24.5	C	0.62	8.6	A	0.22
Route 2 Westbound		**7.6**	**B**		**24.4**	**D**	
Basic	Freeway	7.0	A	0.18	24.7	C	0.62
Diverge	Freeway	7.6	A	0.18	27.1	C	0.62
	Ramp	9.4		0.05	26.9		0.27
Basic	Freeway	6.1	A	0.15	20.0	C	0.51
Merge	Freeway	12.4	B	0.30	28.3	C	0.67
	Ramp	14.7		0.34	27.9		0.39
Basic	Freeway	12.0	B	0.30	26.7	D	0.68
2035		**Weekday AM Peak Hour**			**Weekday PM Peak Hour**		
Highway Segment		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**35.9**	**E**		**16.0**	**C**	
Basic	Freeway	43.9	E	0.99	23.8	C	0.60
Diverge	Freeway	43.6	E	0.98	26.6	C	0.60
	Ramp	40.6		0.54	25.5		0.58
Basic	Freeway	29.6	D	0.75	13.8	B	0.35
Merge	Freeway	38.2	D	0.86	15.3	B	0.37
	Ramp	34.6		0.28	17.2		0.06
Basic	Freeway	35.5	E	0.87	14.7	B	0.37
Route 2 Westbound		**12.6**	**B**		**51.6**	**F**	
Basic	Freeway	11.6	B	0.29	39.4	E	0.93
Diverge	Freeway	12.5	B	0.29	63.0	F	0.92
	Ramp	13.9		0.05	38.9		0.26
Basic	Freeway	10.7	A	0.27	81.2	F	0.81
Merge	Freeway	19.5	C	0.47	56.4	F	1.06
	Ramp	20.7		0.46	41.8		0.59
Basic	Freeway	18.7	C	0.47	39.4	F	1.07

8.2.7 Evaluation Summary

The evaluation of Option 1 Signalized Corridor is detailed in Table 17. The signalized corridor option scores a total of 45 points out of 100 points.

Table 17: Option 1 Evaluation

Criteria		Max Points	Option 1 Signalized Corridor		
			Evaluation	Rating	Score
Driver Comfort		**5**	Common type of control; meets driver expectations.	Good	5
Land Impact		**5**	No disturbances to developed areas.	Low	5
Utility Impact		**5**	Minor electrical/communications relocations.	Low	5
Land Acquisition		**10**	Less than 25 hectares.	Low	10
Construction Cost		**15**	Less than $25 million.	Low	15
Traffic Operations	**2020**	**10**	Intersection LOS E; highway LOS A-D.	Fair	5
	2025	**20**	Intersection LOS F; highway LOS A-D.	Poor	0
	2035	**30**	Intersection LOS F; highway LOS E with Route 2 widening.	Poor	0
Max Score		**100**	**Total Score**	**45**	

8.3 Option 2 Roundabout Corridor

Option 2 is a roundabout corridor with roundabout control at the following intersections:

- Team Gushue Highway & Commonwealth Avenue/Brookfield Road
- Route 3/Commonwealth Avenue & Route 2 Westbound Ramps
- Route 3/Commonwealth Avenue & Route 2 Eastbound Ramps

The conceptual drawing for the roundabout corridor is shown in Figure 5; the full-size drawing has been included in Appendix E.

8.3.1 Driver Comfort

Roundabouts are a conventional form of traffic control and are commonly used in the metro region as well as some other areas in the Province. The majority of drivers are familiar and comfortable with roundabouts. Driver comfort is rated as "**Good**" for the roundabout corridor option.

8.3.2 Land Impact

The roundabout corridor will cause disturbances to agricultural uses. Land impact is rated as "**Medium**" for the roundabout corridor option. There will also be some minor impacts on the existing alignment of South Brook on the south side of Route 2.

8.3.3 Utility Impact

The roundabout corridor will require the relocation of some power and communications distribution infrastructure at the Brookfield Road crossing. The high-voltage transmission lines were previously raised in anticipation of the at-grade crossing of the Team Gushue Highway. Utility impact is rated as "**Low**" for the roundabout corridor option.

8.3.4 Land Acquisition

Land acquisition areas were estimated based on the conceptual drawing, approximately 20.5 hectares of land is required to construct the roundabout corridor. The land acquisition includes approximately 12.1 hectares of rural residential infill (RRI) and rural (R) land and approximately 8.4 hectares of agricultural land (AG). Land acquisition is rated as "**Low**" for the roundabout corridor option.

8.3.5 Construction Cost

A Class 'D' opinion of probable construction cost was developed for the option. Costs do not include allowances for land acquisition, inflation, engineering, utility relocations, or harmonized sales tax (HST). The cost to construct the roundabout corridor is estimated to be approximately $18.9 million; the breakdown of the opinion of probable cost has been included in Appendix F. Construction cost is rated as "**Low**" for the roundabout corridor option.

Figure 5: Option 2 Roundabout Corridor

8.3.6 Traffic Operations

Operations at the roundabout intersections were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 18. The detailed Arcady reports can be found in Appendix G. The roundabouts operate at acceptable levels of service in 2020, 2025 and 2035.

The highway capacity analysis results including density, level of service and density-to-capacity ratio are summarized in Table 19. The detailed Highway Capacity Software reports can be found in Appendix G. The diamond interchange operates at acceptable levels of service in 2020 and 2025. In 2035, the Route 2 eastbound segments before the off-ramp, at the off-ramp and after the on-ramp operate at LOS E during the morning peak hour. During the afternoon peak hour, the Route 2 westbound highway segment before the off-ramp operate at LOS E, all other segments operate at LOS F; the highway segments at the on-ramp and after the on ramp will be over capacity.

The poor levels of service on Route 2 eastbound in the morning peak hour and westbound in the afternoon peak hour are primarily caused by high through volumes at the interchange. It should be noted that the future proposed widening of Route 2 to three lanes in each direction west of the Route 2/Route 3 interchange will improve the 2035 traffic operations at the interchange to LOS E or better during the peak hours.

Traffic operations for the roundabout corridor option are rated as "**Good**" for 2020, "**Good**" for 2025 and "**Fair**" for 2035.

Table 18: Roundabout Corridor Intersection Operations

Part B - Roundabout Corridor										
2020		Weekday AM Peak Hour				Weekday PM Peak Hour				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	
Route 3 & Commonwealth Ave/Brookfield Rd		**3.6**	**A**			**3.0**	**A**			
Commonwealth Avenue	EB-L	3.7	A	0.58	7.0	3.6	A	0.46	7.0	
	EB-T									
	EB-R									
Brookfield Road	WB-L	4.0	A	0.19	7.0	2.8	A	0.21	7.0	
	WB-T									
	WB-R									
Route 3	NB-L	3.9	A	0.57	7.0	2.4	A	0.39	7.0	
	NB-T									
	NB-R									
	SB-L	1.8	A	0.05	7.0	3.0	A	0.39	7.0	
	SB-T									
	SB-R									
Route 3 & Route 2 Westbound Ramps		**2.9**	**A**			**3.0**	**A**			
Route 2 Westbound Off-Ramp	WB-L	3.0	A	0.08	7.0	2.7	A	0.27	7.0	
	WB-T									
	WB-R									
Route 3	NB-L	3.1	A	0.58	7.0	1.9	A	0.30	7.0	
	NB-T									
	SB-T	2.6	A	0.32	7.0	3.8	A	0.55	7.0	
	SB-R									
Route 3 & Route 2 Eastbound Ramps		**3.3**	**A**			**2.5**	**A**			
Route 2 Eastbound Off-Ramp	EB-L	2.3	A	0.24	7.0	3.0	A	0.32	7.0	
	EB-T									
	EB-R									
Heavy Tree Road	NE-L	5.0	A	0.02	7.0	7.2	A	0.03	7.0	
	NE-T									
	NE-R									
Route 3	NB-L	4.2	A	0.61	14.0	1.8	A	0.18	7.0	
	NB-T									
	NB-R									
	SB-L	1.9	A	0.22	7.0	2.4	A	0.37	7.0	
	SB-T									
	SB-R									

2025		Weekday AM Peak Hour				Weekday PM Peak Hour			
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Route 3 & Commonwealth Ave/Brookfield Rd		**3.9**	**A**			**3.4**	**A**		
Commonwealth Avenue	EB-L	3.8	A	0.59	7.0	4.1	A	0.51	7.0
	EB-T								
	EB-R								
Brookfield Road	WB-L	4.4	A	0.21	7.0	3.1	A	0.24	7.0
	WB-T								
	WB-R								
Route 3	NB-L	4.5	A	0.63	14.0	2.7	A	0.45	7.0
	NB-T								
	NB-R								
	SB-L	1.8	A	0.05	7.0	3.4	A	0.44	7.0
	SB-T								
	SB-R								
Route 3 & Route 2 Westbound Ramps		**3.4**	**A**			**3.5**	**A**		
Route 2 Westbound Off-Ramp	WB-L	3.3	A	0.08	7.0	3.0	A	0.31	7.0
	WB-T								
	WB-R								
Route 3	NB-L	3.6	A	0.64	21.0	2.0	A	0.36	7.0
	NB-T								
	SB-T	2.7	A	0.35	7.0	4.7	A	0.63	14.0
	SB-R								
Route 3 & Route 2 Eastbound Ramps		**4.0**	**A**			**2.8**	**A**		
Route 2 Eastbound Off-Ramp	EB-L	2.5	A	0.27	7.0	3.5	A	0.40	7.0
	EB-T								
	EB-R								
Heavy Tree Road	NE-L	5.6	A	0.07	7.0	9.2	A	0.04	7.0
	NE-T								
	NE-R								
Route 3	NB-L	5.4	A	0.68	21.0	2.0	A	0.21	7.0
	NB-T								
	NB-R								
	SB-L	1.9	A	0.22	7.0	2.6	A	0.42	7.0
	SB-T								
	SB-R								

2035		Weekday AM Peak Hour				Weekday PM Peak Hour			
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Route 3 & Commonwealth Ave/Brookfield Rd		**9.4**	**A**			**4.6**	**A**		
Commonwealth Avenue	EB-L	4.5	A	0.64	14.0	5.6	A	0.59	7.0
	EB-T								
	EB-R								
Brookfield Road	WB-L	8.1	A	0.35	7.0	3.8	A	0.31	7.0
	WB-T								
	WB-R								
Route 3	NB-L	15.1	C	0.89	189.0	3.6	A	0.58	7.0
	NB-T								
	NB-R								
	SB-L	1.9	A	0.09	7.0	5.0	A	0.61	7.0
	SB-T								
	SB-R								
Route 3 & Route 2 Westbound Ramps		**8.8**	**A**			**5.9**	**A**		
Route 2 Westbound Off-Ramp	WB-L	5.7	A	0.14	7.0	4.0	A	0.37	7.0
	WB-T								
	WB-R								
Route 3	NB-L	10.8	B	0.88	161.0	2.7	A	0.51	7.0
	NB-T								
	SB-T	3.2	A	0.42	7.0	9.3	A	0.81	70.0
	SB-R								
Route 3 & Route 2 Eastbound Ramps		**13.3**	**B**			**4.3**	**A**		
Route 2 Eastbound Off-Ramp	EB-L	3.8	A	0.53	7.0	6.5	A	0.67	14.0
	EB-T								
	EB-R								
Heavy Tree Road	NE-L	8.9	A	0.10	7.0	21.8	C	0.12	7.0
	NE-T								
	NE-R								
Route 3	NB-L	23.7	C	0.92	259.0	2.5	A	0.29	7.0
	NB-T								
	NB-R								
	SB-L	1.9	A	0.23	7.0	2.6	A	0.42	7.0
	SB-T								
	SB-R								

Table 19: Diamond Interchange Operations

Part B - Diamond Interchange								
2020		Weekday AM Peak Hour			Weekday PM Peak Hour		
Highway Segment		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**21.9**	**C**		**7.3**	**B**	
Basic	Freeway	22.3	C	0.56	11.1	B	0.28
Diverge	Freeway	24.5	C	0.56	12.2	B	0.28
	Ramp	24.1		0.25	13.0		0.30
Basic	Freeway	18.0	B	0.46	5.9	A	0.15
Merge	Freeway	23.6	C	0.56	7.0	A	0.17
	Ramp	24.0		0.26	10.0		0.05
Basic	Freeway	22.5	C	0.57	6.8	A	0.17
Route 2 Westbound		**6.1**	**B**		**21.7**	**C**	
Basic	Freeway	5.6	A	0.14	22.0	C	0.56
Diverge	Freeway	6.0	A	0.14	24.1	C	0.55
	Ramp	8.0		0.05	24.2		0.25
Basic	Freeway	4.7	A	0.12	17.6	B	0.44
Merge	Freeway	10.3	B	0.25	24.8	C	0.59
	Ramp	13.0		0.30	25.1		0.34
Basic	Freeway	10.0	A	0.25	23.6	C	0.60
2025		Weekday AM Peak Hour			Weekday PM Peak Hour		
Highway Segment		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**23.8**	**D**		**9.3**	**B**	
Basic	Freeway	24.5	C	0.62	13.7	B	0.35
Diverge	Freeway	26.9	C	0.61	15.1	B	0.34
	Ramp	26.2		0.28	15.6		0.35
Basic	Freeway	19.6	C	0.50	7.7	A	0.19
Merge	Freeway	25.8	C	0.61	8.8	B	0.21
	Ramp	25.7		0.28	11.6		0.05
Basic	Freeway	24.5	C	0.62	8.6	A	0.22
Route 2 Westbound		**7.6**	**B**		**24.4**	**D**	
Basic	Freeway	7.0	A	0.18	24.7	C	0.62
Diverge	Freeway	7.6	A	0.18	27.1	C	0.62
	Ramp	9.4		0.05	26.9		0.27
Basic	Freeway	6.1	A	0.15	20.0	C	0.51
Merge	Freeway	12.4	B	0.30	28.3	C	0.67
	Ramp	14.7		0.34	27.9		0.39
Basic	Freeway	12.0	B	0.30	26.7	D	0.68
2035		Weekday AM Peak Hour			Weekday PM Peak Hour		
Highway Segment		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**35.9**	**E**		**16.0**	**C**	
Basic	Freeway	43.9	E	0.99	23.8	C	0.60
Diverge	Freeway	43.6	E	0.98	26.6	C	0.60
	Ramp	40.6		0.54	25.5		0.58
Basic	Freeway	29.6	D	0.75	13.8	B	0.35
Merge	Freeway	38.2	D	0.86	15.3	B	0.37
	Ramp	34.6		0.28	17.2		0.06
Basic	Freeway	35.5	E	0.87	14.7	B	0.37
Route 2 Westbound		**12.6**	**B**		**51.6**	**F**	
Basic	Freeway	11.6	B	0.29	39.4	E	0.93
Diverge	Freeway	12.5	B	0.29	63.0	F	0.92
	Ramp	13.9		0.05	38.9		0.26
Basic	Freeway	10.7	A	0.27	81.2	F	0.81
Merge	Freeway	19.5	C	0.47	56.4	F	1.06
	Ramp	20.7		0.46	41.8		0.59
Basic	Freeway	18.7	C	0.47	39.4	F	1.07

8.3.7 Evaluation Summary

The evaluation of Option 2 Roundabout Corridor is detailed in Table 20. The roundabout corridor option scores a total of 82.5 points out of 100 points.

Table 20: Option 2 Evaluation

Criteria		Max Points	Option 2 Roundabout Corridor		
			Evaluation	Rating	Score
Driver Comfort		**5**	Common type of control; meets driver expectations.	Good	5
Land Impact		**5**	Impacts to agricultural uses.	Medium	2.5
Utility Impact		**5**	Minor electrical/communications relocations.	Low	5
Land Acquisition		**10**	Less than 25 hectares.	Low	10
Construction Cost		**15**	Less than $25 million.	Low	15
Traffic Operations	**2020**	**10**	Intersection LOS A-D; highway LOS A-D.	Good	10
	2025	**20**	Intersection LOS A-D; highway LOS A-D.	Good	20
	2035	**30**	Intersection LOS A-D; highway LOS E with Route 2 widening.	Fair	15
Max Score		**100**	**Total Score**	**82.5**	

8.4 Option 3 Cloverleaf Interchange

Option 3 is a cloverleaf interchange between Route 2 and Route 3 with a roundabout on Route 3 to maintain access to Commonwealth Avenue and Heavy Tree Road. The conceptual drawing for the cloverleaf interchange is shown in Figure 6; the full-size drawing has been included in Appendix E.

8.4.1 Driver Comfort

Cloverleaf interchanges and roundabouts are conventional forms of traffic control. There is an existing cloverleaf interchange on Route 2 where it connects to Route 1 approximately 6 kilometres to the west. The majority of drivers are familiar with and comfortable navigating a cloverleaf interchange. Driver comfort is rated as "**Good**" for the cloverleaf interchange option.

8.4.2 Land Impact

The cloverleaf interchange will place the Team Gushue Highway closer to some existing residential dwellings which may ultimately have to be acquired. There is a significant impact on land currently used for agricultural, particularly on the south side of Route 2. There will also be impacts on the existing alignment of South Brook on the south side of Route 2. The proposed plan is conceptual only and it is worth noting that the elimination of some low volume movements (e.g. TGH southbound off ramp to Route 2 eastbound), could potentially reduce the land impacts somewhat while also improving the alignment. In any case, however, land impact is rated as "**High**" for the cloverleaf interchange option.

8.4.3 Utility Impact

The cloverleaf interchange option will require the relocation of some power and communications distribution infrastructure along Brookfield Road. The grade separated crossing at Brookfield Road will likely require the relocation of high voltage electrical transmission lines as well. Utility impact is rated as "**High**" for the cloverleaf interchange option.

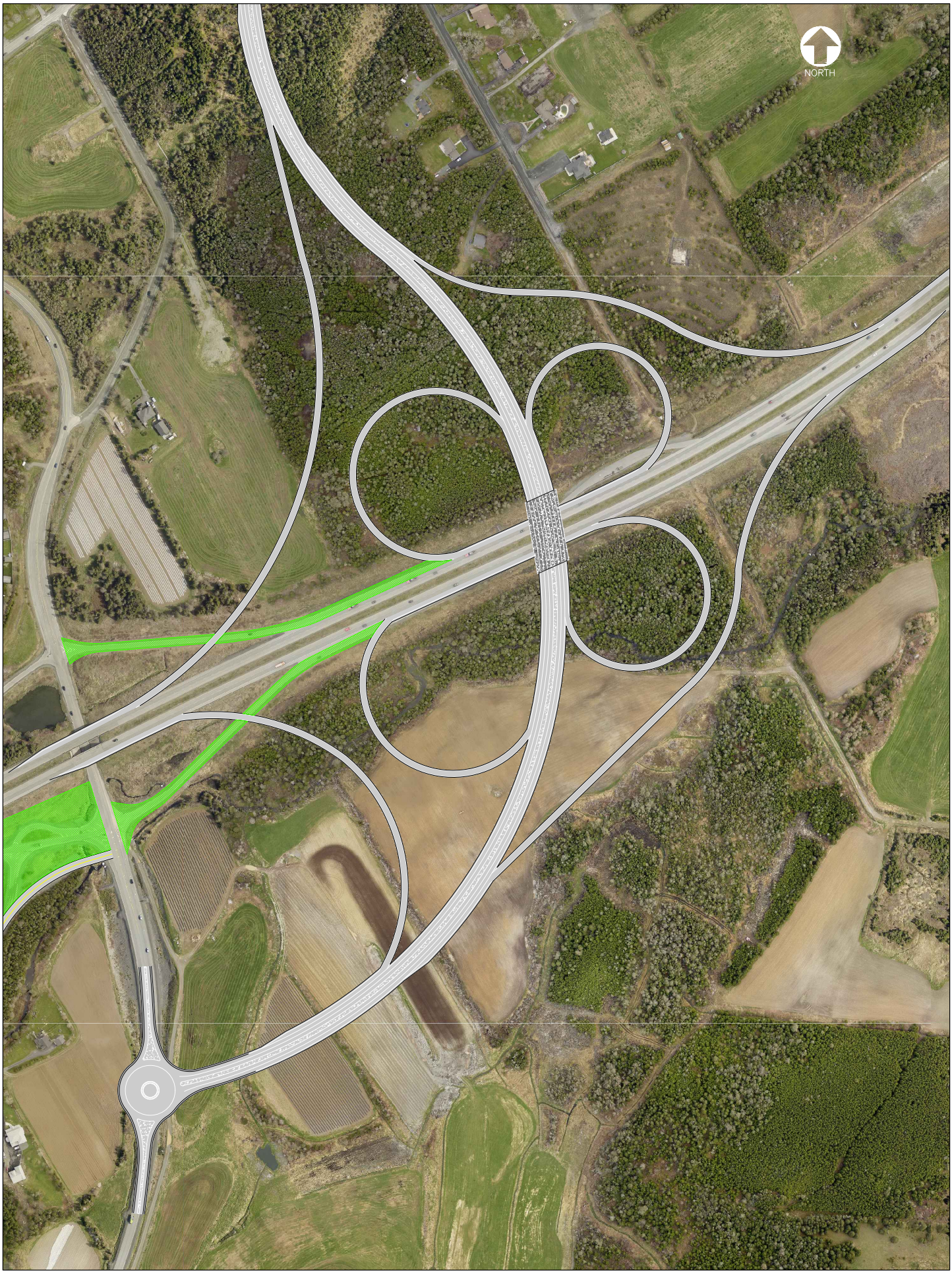

Figure 6: Option 3 Cloverleaf Interchange

8.4.4 Land Acquisition

Land acquisition areas were estimated based on the conceptual drawing, approximately 71.3 hectares of land is required to construct the cloverleaf interchange. The land acquisition includes approximately 25.9 hectares of rural residential infill (RRI) and rural (R) land and approximately 45.4 hectares of agricultural land (AG). Land acquisition is rated as "**High**" for the cloverleaf interchange option.

8.4.5 Construction Cost

A Class 'D' opinion of probable construction cost was developed for the option. Costs do not include allowances for land acquisition, inflation, engineering, utility relocations, or harmonized sales tax (HST). The cost to construct the cloverleaf interchange is estimated to be approximately $41.7 million; the breakdown of the opinion of probable cost has been included in Appendix F. Construction cost is rated as "**Medium**" for the cloverleaf interchange option.

8.4.6 Traffic Operations

Operations at the roundabout intersection were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 21. The detailed Arcady reports can be found in Appendix G. The roundabout will operate at acceptable levels of service in 2020, 2025 and 2035.

The highway capacity analysis results including density, level of service and density-to-capacity ratio are summarized in Table 22. The detailed Highway Capacity Software reports can be found in Appendix G. The cloverleaf interchange operates at acceptable levels of service in 2020 and 2025. In 2035, the Route 2 eastbound segments before the off-ramp, at the off-ramp, between the off-ramp and weave section and after the on-ramp operate at LOS E during the morning peak hour. During the afternoon peak hour, the Route 2 westbound highway segment before the off-ramp operate at LOS E, all other segments operate at LOS F; the highway segment at the on-ramp and after the on ramp will be over capacity.

The poor levels of service on Route 2 eastbound in the morning peak hour and westbound in the afternoon peak hour are primarily caused by high through volumes at the interchange. It should be noted that the future widening of Route 2 to three lanes in each direction west of the Route 2/Route 3 interchange will improve the 2035 traffic operations at the interchange to LOS E or better during the peak hours.

Traffic operations for the cloverleaf interchange option are rated as "**Good**" for 2020, "**Good**" for 2025 and "**Fair**" for 2035.

Table 21: Cloverleaf Interchange Roundabout Operations

Part B - Cloverleaf Interchange Roundabout										
2020		Weekday AM Peak Hour				Weekday PM Peak Hour				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	
Route 3 & Route 3A/Commonwealth Ave		**2.7**	**A**			**5.8**	**A**			
Team Gushue Highway (Route 3A)	WB-L	2.0	A	0.21	7.0	7.7	A	0.79	49.0	
	WB-R									
Route 3	NB-T	2.4	A	0.07	7.0	2.0	A	0.09	7.0	
	NB-R									
Commonwealth Avenue	SB-L	3.4	A	0.54	7.0	3.2	A	0.38	7.0	
	SB-T									
2025		Weekday AM Peak Hour				Weekday PM Peak Hour				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	
Route 3 & Route 3A/Commonwealth Ave		**2.8**	**A**			**8.6**	**A**			
Team Gushue Highway (Route 3A)	WB-L	2.0	A	0.22	7.0	12.2	B	0.87	154.0	
	WB-R									
Route 3	NB-T	2.5	A	0.07	7.0	2.0	A	0.09	7.0	
	NB-R									
Commonwealth Avenue	SB-L	3.6	A	0.56	7.0	3.6	A	0.43	7.0	
	SB-T									
2035		Weekday AM Peak Hour				Weekday PM Peak Hour				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	
Route 3 & Route 3A/Commonwealth Ave		**2.9**	**A**			**21.0**	**C**			
Team Gushue Highway (Route 3A)	WB-L	2.0	A	0.22	7.0	32.3	D	0.96	539.0	
	WB-R									
Route 3	NB-T	2.5	A	0.07	7.0	2.0	A	0.09	7.0	
	NB-R									
Commonwealth Avenue	SB-L	3.7	A	0.57	7.0	4.2	A	0.48	7.0	
	SB-T									

Table 22: Cloverleaf Interchange Operations

Part B - Cloverleaf Interchange													
Highway Segment		2020						2025					
		Weekday AM Peak Hour			Weekday PM Peak Hour			Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**21.2**	**C**		**7.3**	**B**		**23.1**	**D**		**9.1**	**B**	
Basic	Freeway	22.3	C	0.56	11.1	B	0.28	24.5	C	0.62	13.7	B	0.35
Diverge	Freeway	24.1	C	0.56	12.1	B	0.28	26.5	C	0.61	15.0	B	0.34
	Ramp	21.9		0.07	10.8		0.15	24.0		0.08	13.4		0.19
Basic	Freeway	21.2	C	0.54	8.4	A	0.21	23.2	C	0.59	10.4	A	0.26
Weave	Freeway	14.8	B	0.39	5.6	A	0.17	16.4	B	0.43	7.0	A	0.20
Basic	Freeway	18.1	C	0.46	6.0	A	0.15	19.7	C	0.50	7.7	A	0.20
Merge	Freeway	23.5	C	0.56	7.0	A	0.17	25.6	C	0.61	8.8	B	0.22
	Ramp	22.5		0.26	8.5		0.05	24.2		0.28	10.1		0.05
Basic	Freeway	22.6	C	0.57	6.8	A	0.17	24.5	C	0.62	8.6	A	0.22
Route 2 Westbound		**6.6**	**B**		**21.5**	**C**		**8.1**	**B**		**24.2**	**D**	
Basic	Freeway	5.6	A	0.14	22.0	C	0.56	7.0	A	0.18	24.7	C	0.62
Diverge	Freeway	6.0	A	0.14	23.8	C	0.55	7.6	A	0.18	26.7	C	0.62
	Ramp	5.6		0.03	21.9		0.08	7.0		0.03	24.6		0.08
Basic	Freeway	5.1	A	0.13	20.6	C	0.52	6.5	A	0.16	23.3	C	0.59
Weave	Freeway	6.8	A	0.24	17.3	B	0.46	8.1	A	0.26	19.9	B	0.51
Basic	Freeway	9.3	A	0.23	20.6	C	0.52	11.1	B	0.28	23.3	C	0.59
Merge	Freeway	10.2	B	0.25	24.6	C	0.59	12.3	B	0.30	28.2	C	0.67
	Ramp	11.4		0.04	23.4		0.17	13.2		0.05	26.2		0.20
Basic	Freeway	10.0	A	0.25	23.6	C	0.60	12.0	B	0.30	26.7	D	0.68
Route 3 Northbound		**19.8**	**C**		**8.6**	**B**		**21.2**	**C**		**9.4**	**B**	
Basic	Freeway	26.1	D	0.54	8.9	A	0.18	27.7	D	0.57	10.0	A	0.21
Diverge	Freeway	25.7	C	0.53	8.7	A	0.18	27.3	C	0.56	9.7	A	0.20
	Ramp	20.5		0.26	7.1		0.05	21.8		0.28	7.9		0.05
Basic	Freeway	20.4	C	0.42	7.9	A	0.16	21.6	C	0.45	8.8	A	0.18
Weave	Freeway	18.2	B	0.42	7.7	A	0.26	19.9	B	0.46	8.7	A	0.29
Basic	Freeway	18.5	C	0.38	7.3	A	0.15	19.8	C	0.41	8.1	A	0.17
Merge	Freeway	18.4	B	0.39	8.6	A	0.18	19.5	B	0.41	9.4	A	0.20
	Ramp	16.5		0.03	9.2		0.08	17.3		0.03	9.8		0.08
Basic	Freeway	19.2	C	0.40	9.0	A	0.19	20.4	C	0.42	9.8	A	0.20
Route 3 Southbound		**3.8**	**A**		**15.0**	**C**		**3.8**	**A**		**15.8**	**C**	
Basic	Freeway	4.4	A	0.09	16.7	B	0.35	4.5	A	0.09	17.6	B	0.37
Diverge	Freeway	4.3	A	0.09	16.4	B	0.34	4.4	A	0.09	17.3	B	0.36
	Ramp	3.8		0.04	13.5		0.17	4.0		0.05	14.2		0.20
Basic	Freeway	3.5	A	0.07	12.9	B	0.27	3.4	A	0.07	13.3	B	0.28
Weave	Freeway	2.5	A	0.06	11.3	B	0.27	2.4	A	0.06	11.9	B	0.28
Basic	Freeway	3.9	A	0.08	16.7	B	0.35	3.8	A	0.08	17.5	B	0.36
Merge	Freeway	5.1	A	0.11	19.2	B	0.41	5.3	A	0.11	20.8	B	0.44
	Ramp	6.2		0.07	16.6		0.15	6.3		0.08	17.7		0.19
Basic	Freeway	5.4	A	0.11	20.1	C	0.42	5.5	A	0.11	21.7	C	0.45

Highway Segment		2035					
		Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**35.7**	**E**		**16.0**	**C**	
Basic	Freeway	43.9	E	0.99	23.8	C	0.60
Diverge	Freeway	42.3	E	0.98	26.1	C	0.60
	Ramp	38.4		0.08	23.3		0.29
Basic	Freeway	40.8	E	0.95	18.8	C	0.47
Weave	Freeway	29.7	D	0.71	13.4	B	0.36
Basic	Freeway	29.7	D	0.75	13.8	B	0.35
Merge	Freeway	38.1	D	0.86	15.3	B	0.37
	Ramp	33.1		0.28	15.7		0.06
Basic	Freeway	35.6	E	0.87	14.8	B	0.37
Route 2 Westbound		**13.1**	**B**		**46.3**	**F**	
Basic	Freeway	11.6	B	0.29	39.4	E	0.93
Diverge	Freeway	12.5	B	0.29	57.9	F	0.92
	Ramp	11.6		0.03	36.5		0.08
Basic	Freeway	11.1	B	0.28	60.0	F	0.90
Weave	Freeway	12.7	B	0.36	79.7	F	0.75
Basic	Freeway	17.0	B	0.43	75.3	F	0.92
Merge	Freeway	19.4	B	0.47	56.4	F	1.06
	Ramp	19.2		0.10	40.2		0.34
Basic	Freeway	18.7	C	0.47	39.4	F	1.07
Route 3 Northbound		**26.9**	**D**		**12.3**	**B**	
Basic	Freeway	29.5	D	0.61	11.4	B	0.24
Diverge	Freeway	29.0	C	0.60	11.2	A	0.23
	Ramp	23.2		0.28	9.0		0.06
Basic	Freeway	23.4	C	0.48	10.2	A	0.21
Weave	Freeway	28.3	D	0.68	12.3	B	0.45
Basic	Freeway	25.4	C	0.52	11.0	A	0.23
Merge	Freeway	25.0	C	0.53	12.1	B	0.26
	Ramp	21.3		0.03	11.8		0.08
Basic	Freeway	26.0	C	0.54	12.7	B	0.26
Route 3 Southbound		**4.3**	**A**		**17.7**	**C**	
Basic	Freeway	5.4	A	0.11	20.9	C	0.43
Diverge	Freeway	5.3	A	0.11	20.6	B	0.42
	Ramp	4.6		0.10	16.8		0.34
Basic	Freeway	3.2	A	0.07	13.5	B	0.28
Weave	Freeway	2.3	A	0.06	11.9	B	0.28
Basic	Freeway	3.7	A	0.08	17.5	B	0.36
Merge	Freeway	5.3	A	0.11	22.9	B	0.48
	Ramp	6.3		0.08	19.2		0.29
Basic	Freeway	5.5	A	0.11	23.9	C	0.49

8.4.7 Evaluation Summary

The evaluation of Option 3 Cloverleaf Interchange is detailed in Table 23. The cloverleaf interchange option scores a total of 57.5 points out of 100 points.

Table 23: Option 3 Evaluation

Criteria		Max Points	Option 3 Cloverleaf Interchange		
			Evaluation	Rating	Score
Driver Comfort		**5**	Common type of control; meets driver expectations.	Good	5
Land Impact		**5**	Impacts to residential and agricultural uses.	High	0
Utility Impact		**5**	Relocation of high voltage transmission lines.	High	0
Land Acquisition		**10**	Greater than 50 hectares.	High	0
Construction Cost		**15**	Betweem $25 to $50 million.	Medium	7.5
Traffic Operations	**2020**	**10**	Intersection LOS A-D; highway LOS A-D.	Good	10
	2025	**20**	Intersection LOS A-D; highway LOS A-D.	Good	20
	2035	**30**	Intersection LOS A-D; highway LOS E with Route 2 widening.	Fair	15
Max Score		**100**	**Total Score**	**57.5**	

8.5 Option 4 Diverging Diamond Interchange

Option 4 is a diverging diamond interchange between Route 2 and Route 3 with a roundabout on Route 3 to maintain access to Commonwealth Avenue and Heavy Tree Road. The conceptual drawing for the diverging diamond interchange is shown in Figure 7; the full-size drawing has been included in Appendix E.

8.5.1 Driver Comfort

The diverging diamond interchange is an unconventional form of traffic control. Traffic signals are required as part of the installation where the through movements “criss-cross” one another. The majority of drivers will not be familiar with this type of interchange and may be uncomfortable navigating the same, particularly in the early stages of its implementation. Driver comfort is rated as “**Poor**” for the diverging diamond interchange option.

8.5.2 Land Impact

The diverging diamond interchange will cause disturbances to residential and agricultural uses. There will also be impacts on the existing alignment of South Brook on the south side of Route 2. Land impact is rated as “**High**” for the diverging diamond interchange option.

8.5.3 Utility Impact

The diverging diamond interchange option will require the relocation of some power and communications distribution infrastructure along Brookfield Road. The grade separated crossing at Brookfield Road will likely require the relocation of high voltage electrical transmission lines as well. Utility impact is rated as “**High**” for the diverging diamond interchange option.

8.5.4 Land Acquisition

Land acquisition areas were estimated based on the conceptual drawing, approximately 37.9 hectares of land is required to construct the diverging diamond interchange. The land acquisition includes approximately 12.1 hectares of rural residential infill (RRI) and rural (R) land and approximately 25.8 hectares of agricultural land (AG). Land acquisition is rated as “**Medium**” for the diverging diamond interchange option.

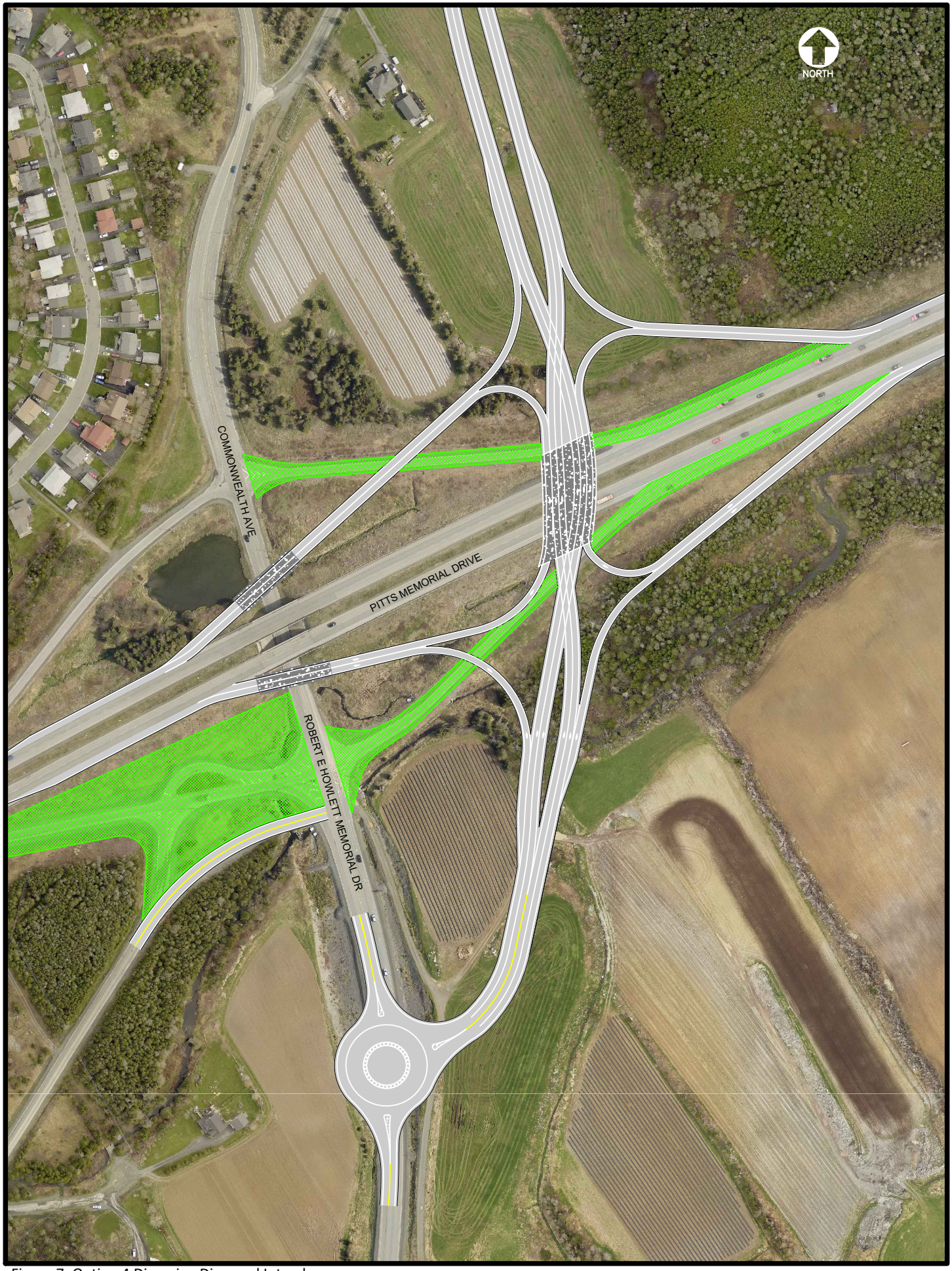

Figure 7: Option 4 Diverging Diamond Interchange

8.5.5 Construction Cost

A Class 'D' opinion of probable construction cost was developed for the option. Costs do not include allowances for land acquisition, inflation, engineering, utility relocations, or harmonized sales tax (HST). The cost to construct the diverging diamond interchange is estimated to be approximately $43.0 million; the breakdown of the opinion of probable cost has been included in Appendix F. Construction cost is rated as "**Medium**" for the diverging diamond interchange option.

8.5.6 Traffic Operations

Operations at the signalized and roundabout intersections were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 24. The detailed Synchro, SimTraffic and Arcady reports can be found in Appendix G.

Overall, the signalized intersections are shown to operate at acceptable levels of service in 2020 and 2025. In 2025, SimTraffic indicates that the eastbound left movement on the Route 2 eastbound off ramp will operate at LOS E during the morning peak hour.

In 2035, during the morning peak hour the southbound through movement (Route 3) at the north intersection and the eastbound left movement on the Route 2 eastbound off ramp operates at LOS E in Synchro. SimTraffic indicates that only the eastbound left movement will operate at LOS E. The signalized intersections operate at acceptable levels of service during the afternoon peak hour.

The highway capacity analysis results including density, level of service and density-to-capacity ratio are summarized in Table 25. The detailed Highway Capacity Software reports can be found in Appendix G. The diverging diamond interchange is shown to operate at acceptable levels of service in 2020 and 2025. In 2035, the Route 2 eastbound segments before the off-ramp, at the off-ramp and after the on-ramp operate at LOS E during the morning peak hour. During the afternoon peak hour, the Route 2 westbound highway segment before the off-ramp operates at LOS E, all other segments operate at LOS F; the highway segments at the on-ramp and after the on ramp will be over capacity.

The poor levels of service on Route 2 eastbound in the morning peak hour and westbound in the afternoon peak hour are primarily caused by high through volumes at the interchange. It should be noted that the future widening of Route 2 to three lanes in each direction west of the Route 2/Route 3 interchange will improve the 2035 traffic operations at the interchange to LOS E or better during the peak hours.

Traffic operations for the diverging diamond interchange option are rated as "**Good**" for 2020, "**Fair**" for 2025 and "**Fair**" for 2035.

Table 24: Diverging Diamond Signalized Intersection Operations

Part B - Diverging Diamond Interchange																	
2020		**Weekday AM Peak Hour**							**Weekday PM Peak Hour**								
Intersection		**Synchro**				**SimTraffic**			**Synchro**				**SimTraffic**				
		Delay (s/veh)	**LOS**	**v/c**	**95th% Queue (m)**	**Delay (s/veh)**	**LOS**	**95th% Queue (m)**	**Delay (s/veh)**	**LOS**	**v/c**	**95th% Queue (m)**	**Delay (s/veh)**	**LOS**	**95th% Queue (m)**		
Route 3 North Intersection		**13.8**	**B**			**11.0**	**B**		**14.8**	**B**			**13.0**	**B**			
Route 3	NB-T	10.0	A	0.76	36.5	7.3	A	44.6	10.1	B	0.53	17.9	12.3	B	38.2		
	SB-T	33.8	C	0.31	44.7	30.8	C	52.9	17.4	B	0.62	99.4	13.4	B	53.5		
Route 3 & Route 2 Westbound Ramps		**2.9**	**A**			**6.0**	**A**		**8.6**	**A**			**11.0**	**B**			
Route 2 Westbound Off-Ramp	WB-L	0.1	A	0.04	0.0	15.2	B	16.0	28.7	C	0.70	59.6	33.2	C	80.0		
Route 3	SB-T	3.3	A	0.31	1.5	4.7	A	9.5	2.7	A	0.62	4.8	4.2	A	19.8		
Route 3 & Route 2 Eastbound Ramps		**7.7**	**A**			**14.7**	**B**		**3.4**	**A**			**10.2**	**B**			
Route 2 Eastbound Off-Ramp	EB-L	33.7	C	0.64	37.5	54.1	D	78.8	1.9	A	0.18	5.8	17.9	B	48.3		
Route 3	NB-T	2.4	A	0.74	7.0	6.6	A	35.1	4.1	A	0.60	3.1	7.1	A	22.8		
Route 3 South Intersection		**14.3**	**B**			**10.3**	**B**		**15.1**	**B**			**11.2**	**B**			
Route 3	NB-T	14.8	B	0.74	173.1	9.1	A	42.6	29.0	C	0.60	72.8	18.6	B	41.7		
	SB-T	11.9	B	0.46	7.4	16.5	B	28.4	8.6	A	0.76	43.5	7.7	A	39.9		
2025		**Weekday AM Peak Hour**							**Weekday PM Peak Hour**								
Intersection		**Synchro**				**SimTraffic**			**Synchro**				**SimTraffic**				
		Delay (s/veh)	**LOS**	**v/c**	**95th% Queue (m)**	**Delay (s/veh)**	**LOS**	**95th% Queue (m)**	**Delay (s/veh)**	**LOS**	**v/c**	**95th% Queue (m)**	**Delay (s/veh)**	**LOS**	**95th% Queue (m)**		
Route 3 North Intersection		**14.2**	**B**			**11.4**	**B**		**16.1**	**B**			**13.5**	**B**			
Route 3	NB-T	9.8	A	0.77	48.4	7.0	A	41.8	10.2	B	0.56	22.7	11.9	B	39.4		
	SB-T	38.7	D	0.34	49.5	35.5	D	53.7	19.6	B	0.67	109.8	14.4	B	56.0		
Route 3 & Route 2 Westbound Ramps		**3.1**	**A**			**6.3**	**A**		**9.4**	**A**			**11.4**	**B**			
Route 2 Westbound Off-Ramp	WB-L	0.1	A	0.04	0.0	13.8	B	17.4	30.0	C	0.72	69.0	31.8	C	82.8		
Route 3	SB-T	3.5	A	0.34	1.5	5.2	A	11.0	3.1	A	0.67	5.0	5.2	A	23.5		
Route 3 & Route 2 Eastbound Ramps		**9.5**	**A**			**16.2**	**B**		**5.1**	**A**			**11.5**	**B**			
Route 2 Eastbound Off-Ramp	EB-L	41.9	D	0.71	49.6	63.9	E	83.8	3.4	A	0.19	9.2	16.9	B	51.5		
Route 3	NB-T	2.6	A	0.78	7.4	6.3	A	33.9	5.8	A	0.72	8.1	9.4	A	27.3		
Route 3 South Intersection		**15.5**	**B**			**9.5**	**A**		**16.6**	**B**			**11.8**	**B**			
Route 3	NB-T	16.4	B	0.78	196.0	8.5	A	42.6	32.4	C	0.72	86.5	20.7	C	42.8		
	SB-T	10.8	B	0.47	7.6	14.6	B	26.6	8.7	A	0.80	51.5	7.3	A	40.6		
2035		**Weekday AM Peak Hour**							**Weekday PM Peak Hour**								
Intersection		**Synchro**				**SimTraffic**			**Synchro**				**SimTraffic**				
		Delay (s/veh)	**LOS**	**v/c**	**95th% Queue (m)**	**Delay (s/veh)**	**LOS**	**95th% Queue (m)**	**Delay (s/veh)**	**LOS**	**v/c**	**95th% Queue (m)**	**Delay (s/veh)**	**LOS**	**95th% Queue (m)**		
Route 3 North Intersection		**14.1**	**B**			**10.3**	**B**		**21.3**	**C**			**15.5**	**B**			
Route 3	NB-T	8.1	A	0.83	107.1	4.5	A	43.9	17.9	B	0.69	59.7	15.3	B	42.9		
	SB-T	59.5	E	0.55	56.8	52.1	D	54.6	24.0	C	0.72	127.1	15.6	B	54.4		
Route 3 & Route 2 Westbound Ramps		**5.2**	**A**			**10.0**	**A**		**8.6**	**A**			**10.2**	**B**			
Route 2 Westbound Off-Ramp	WB-L	0.1	A	0.04	0.0	7.6	A	14.8	26.1	C	0.61	70.4	28.2	C	79.4		
Route 3	SB-T	6.0	A	0.55	1.4	10.4	B	15.5	3.4	A	0.72	5.1	4.8	A	20.4		
Route 3 & Route 2 Eastbound Ramps		**30.0**	**C**			**27.9**	**C**		**7.8**	**A**			**13.2**	**B**			
Route 2 Eastbound Off-Ramp	EB-L	75.5	E	0.99	163.2	79.6	E	80.2	11.4	B	0.35	32.6	19.8	B	77.7		
Route 3	NB-T	10.2	B	0.96	12.9	7.2	A	30.6	5.5	A	0.77	7.5	9.2	A	27.0		
Route 3 South Intersection		**33.8**	**C**			**9.8**	**A**		**18.7**	**B**			**11.1**	**B**			
Route 3	NB-T	38.5	D	0.96	343.0	10.0	A	40.5	34.4	C	0.77	108.2	19.5	B	42.2		
	SB-T	5.5	A	0.31	6.4	8.3	A	16.5	9.4	A	0.83	44.8	6.1	A	38.9		

Table 25: Diverging Diamond Interchange Operations

Part B - Diverging Diamond Interchange								
2020		Weekday AM Peak Hour			Weekday PM Peak Hour		
Highway Segment		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**22.1**	**D**		**7.4**	**B**	
Basic	Freeway	22.3	C	0.56	11.1	B	0.28
Diverge	Freeway	24.5	B	0.56	12.2	A	0.28
	Ramp	18.7		0.12	7.6		0.15
Basic	Freeway	18.0	B	0.46	5.9	A	0.15
Merge	Freeway	23.3	C	0.56	6.9	A	0.17
	Ramp	20.2		0.13	6.2		0.02
Basic	Freeway	22.5	C	0.57	6.8	A	0.17
Route 2 Westbound		**6.3**	**B**		**21.9**	**C**	
Basic	Freeway	5.6	A	0.14	22.0	C	0.56
Diverge	Freeway	6.0	A	0.14	24.1	B	0.55
	Ramp	2.1		0.03	18.3		0.13
Basic	Freeway	4.7	A	0.12	17.6	B	0.44
Merge	Freeway	10.2	A	0.25	24.4	C	0.59
	Ramp	8.9		0.15	21.0		0.17
Basic	Freeway	10.0	A	0.25	23.6	C	0.60
2025		Weekday AM Peak Hour			Weekday PM Peak Hour		
Highway Segment		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**24.1**	**D**		**9.4**	**B**	
Basic	Freeway	24.5	C	0.62	13.7	B	0.35
Diverge	Freeway	26.9	C	0.61	15.1	B	0.34
	Ramp	20.8		0.14	10.2		0.17
Basic	Freeway	19.6	C	0.50	7.7	A	0.19
Merge	Freeway	25.4	C	0.61	8.7	A	0.21
	Ramp	21.9		0.14	7.8		0.03
Basic	Freeway	24.5	C	0.62	8.6	A	0.22
Route 2 Westbound		**7.8**	**B**		**24.6**	**D**	
Basic	Freeway	7.0	A	0.18	24.7	C	0.62
Diverge	Freeway	7.6	A	0.18	27.1	C	0.62
	Ramp	3.5		0.03	21.1		0.14
Basic	Freeway	6.1	A	0.15	20.0	C	0.51
Merge	Freeway	12.2	B	0.30	27.9	C	0.67
	Ramp	10.7		0.17	23.8		0.19
Basic	Freeway	12.0	B	0.30	26.7	D	0.68
2035		Weekday AM Peak Hour			Weekday PM Peak Hour		
Highway Segment		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**36.3**	**E**		**16.2**	**C**	
Basic	Freeway	43.9	E	0.99	23.8	C	0.60
Diverge	Freeway	43.6	E	0.98	26.6	C	0.60
	Ramp	35.2		0.27	20.1		0.29
Basic	Freeway	29.6	D	0.75	13.8	B	0.35
Merge	Freeway	37.6	D	0.86	15.1	B	0.37
	Ramp	30.9		0.14	13.4		0.03
Basic	Freeway	35.5	E	0.87	14.7	B	0.37
Route 2 Westbound		**12.7**	**B**		**54.0**	**F**	
Basic	Freeway	11.6	B	0.29	39.4	E	0.93
Diverge	Freeway	12.5	A	0.29	67.5	F	0.92
	Ramp	8.1		0.03	33.0		0.13
Basic	Freeway	10.7	A	0.27	84.9	F	0.81
Merge	Freeway	19.2	B	0.47	56.4	F	1.06
	Ramp	16.6		0.23	37.8		0.29
Basic	Freeway	18.7	C	0.47	39.4	F	1.07

8.5.7 Evaluation Summary

The evaluation of Option 4 Diverging Diamond Interchange is detailed in Table 26. The diverging diamond interchange option scores a total of 47.5 points out of 100 points.

Table 26: Option 4 Evaluation

Criteria		Max Points	Option 4 Diverging Diamond Interchange		
			Evaluation	Rating	Score
Driver Comfort		**5**	Unconventional type of control.	Poor	0
Land Impact		**5**	Impacts to residential and agricultural uses.	High	0
Utility Impact		**5**	Relocation of high voltage transmission lines.	High	0
Land Acquisition		**10**	Between 25 and 50 hectares.	Medium	5
Construction Cost		**15**	Betweem $25 to $50 million.	Medium	7.5
Traffic Operations	**2020**	**10**	Intersection LOS A-D; highway LOS A-D.	Good	10
	2025	**20**	Intersection LOS E; highway LOS A-D.	Fair	10
	2035	**30**	Intersection LOS E; highway LOS E with Route 2 widening.	Fair	15
Max Score		**100**	**Total Score**	**47.5**	

8.6 Option 5 Route 2/Route 3 Interchange Flyover

Option 5 is a new interchange between Route 2 and Route 3 with roundabout control at the ramps and a flyover from Route 2 eastbound to the Team Gushue Highway. The conceptual drawing for the Route 2/3 interchange flyover is shown in Figure 8; the full-size drawing has been included in Appendix E.

8.6.1 Driver Comfort

The Route 2/Route 3 interchange flyover is a conventional form of traffic control. However, in combination with the roundabouts required for the Commonwealth Avenue connection, this option introduces a level of complexity that may not be expected by drivers. Driver comfort is rated as "**Fair**" for the Route 2/Route 3 interchange flyover option.

8.6.2 Land Impact

The Route 2/Route 3 interchange flyover will place the Team Gushue Highway closer to some existing residential dwellings which may ultimately have to be acquired. There is some impact on land currently used for agricultural, and there will also be impacts on the existing alignment of South Brook on the south side of Route 2. Land impact is rated as "**High**" for the Route 2/Route 3 interchange flyover option.

8.6.3 Utility Impact

The Route 2/Route 3 interchange flyover option will require the relocation of some power and communications distribution infrastructure along Brookfield Road. The grade separated crossing at Brookfield Road will likely require the relocation of high voltage electrical transmission lines as well. Utility impact is rated as "**High**" for the Route 2/Route 3 interchange flyover option.

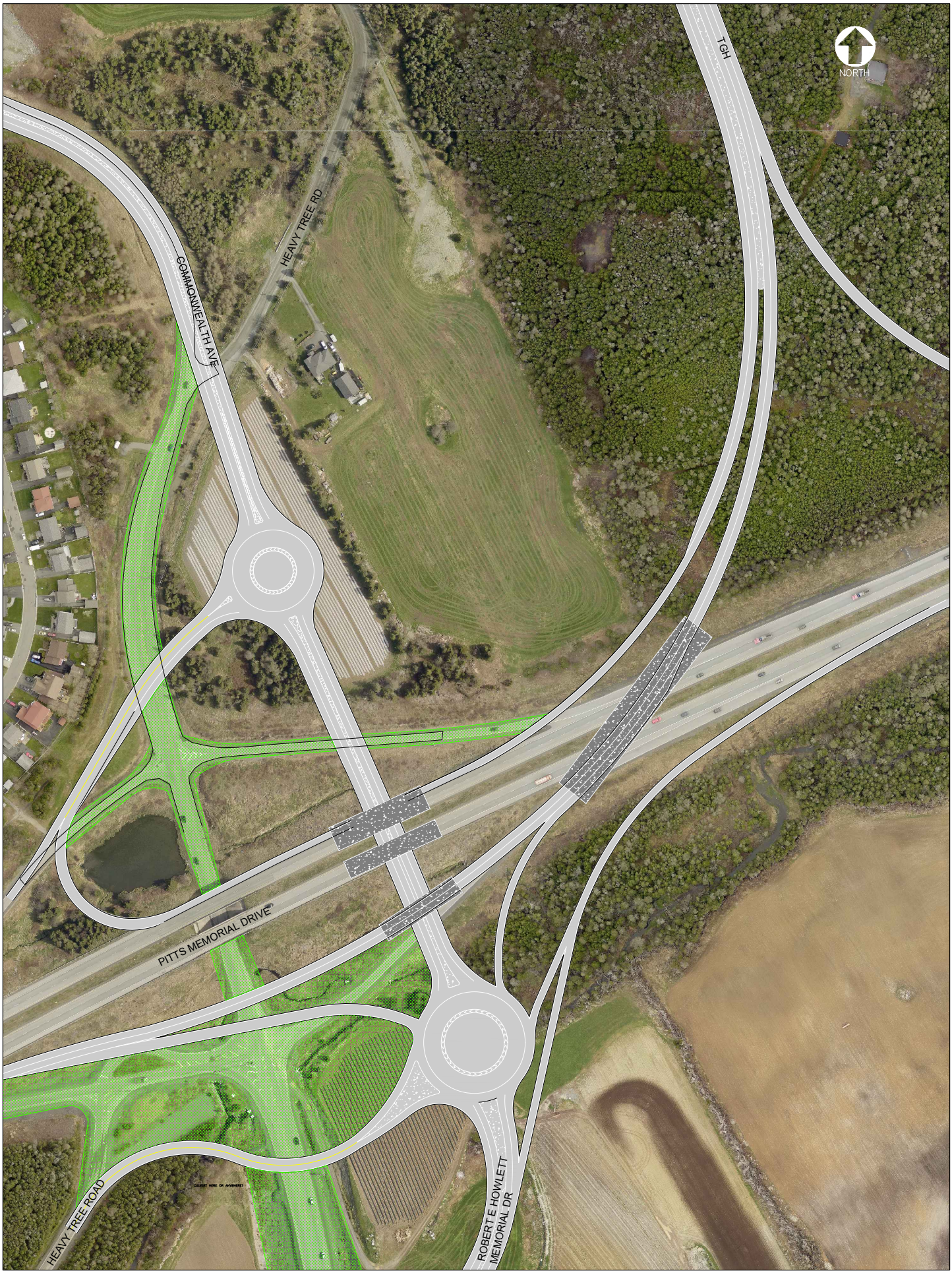

Figure 8: Option 5 Route 2/Route 3 Interchange Flyover

8.6.4 Land Acquisition

Land acquisition areas were estimated based on the conceptual drawing, approximately 49.6 hectares of land is required to construct the Route 2/3 interchange flyover. The land acquisition includes approximately 32.3 hectares of rural residential infill (RRI) and rural (R) land and approximately 17.3 hectares of agricultural land (AG). Land acquisition is rated as "**Medium**" for the Route 2/Route 3 interchange flyover option.

8.6.5 Construction Cost

A Class 'D' opinion of probable construction cost was developed for the option. Costs do not include allowances for land acquisition, inflation, engineering, utility relocations, or harmonized sales tax (HST). The cost to construct the Route 2/3 interchange flyover is estimated to be approximately $51.4 million; the breakdown of the opinion of probable cost has been included in Appendix F. Construction cost is rated as "**High**" for the Route 2/Route 3 interchange flyover option.

8.6.6 Traffic Operations

Operations at the roundabout intersection were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 27. The detailed Arcady reports can be found in Appendix G. The roundabouts will operate at acceptable levels of service in 2020, 2025, 2035.

The highway capacity analysis results including density, level of service and density-to-capacity ratio are summarized in Table 28. The detailed Highway Capacity Software reports can be found in Appendix G. The Route 2/Route 3 interchange and flyover operates at acceptable levels of service in 2020 and 2025. In 2035, the Route 2 eastbound segments before the off-ramp, at the off-ramp and after the on-ramp operate at LOS E during the morning peak hour. During the afternoon peak hour, the Route 2 westbound highway segments before the off-ramp, at the off-ramp and between the off-ramp and weave section operate at LOS E. All other segments operate at LOS F; the highway segments at the on-ramp and after the on ramp will be over capacity.

The poor levels of service on Route 2 eastbound in the morning peak hour and westbound in the afternoon peak hour are primarily caused by high through volumes at the interchange. It should be noted that the future widening of Route 2 to three lanes in each direction west of the Route 2/Route 3 interchange will improve the 2035 traffic operations at the interchange to LOS E or better during the peak hours.

Traffic operations for the Route 2/3 interchange flyover option are rated as "**Good**" for 2020, "**Good**" for 2025 and "**Fair**" for 2035.

Table 27: Route 2/3 Flyover Roundabout Operations

Part B - Route 2/3 Flyover Roundabouts										
2020		Weekday AM Peak Hour				Weekday PM Peak Hour				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	
Route 3 & Route 2 Westbound Ramps		**3.6**	**A**			**5.4**	**A**			
Route 2 Westbound Off-Ramp	EB-L	3.1	A	0.23	7.0	7.6	A	0.76	28.0	
	EB-R									
Route 3	NB-L	2.3	A	0.27	7.0	2.8	A	0.26	7.0	
	NB-T									
	SB-T	4.4	A	0.61	14.0	2.3	A	0.32	7.0	
	SB-R									
Route 3 & Route 2 Eastbound Ramps		**5.2**	**A**			**2.8**	**A**			
Route 2 Eastbound Off-Ramp	EB-L	2.5	A	0.08	7.0	2.8	A	0.19	7.0	
	EB-R									
	EB-HR									
Heavy Tree Road	NE-L	6.4	A	0.02	7.0	7.3	A	0.03	7.0	
	NE-T									
	NE-R									
Route 3	NB-T	7.4	A	0.70	21.0	2.2	A	0.21	7.0	
	NB-R									
	NB-R									
	SB-HL	3.0	A	0.50	7.0	3.0	A	0.49	7.0	
	SB-L									
	SB-T									
	SB-R									
2025		Weekday AM Peak Hour				Weekday PM Peak Hour				
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)	
Route 3 & Route 2 Westbound Ramps		**3.8**	**A**			**6.4**	**A**			
Route 2 Westbound Off-Ramp	EB-L	3.1	A	0.23	7.0	9.5	A	0.81	70.0	
	EB-R									
Route 3	NB-L	2.4	A	0.30	7.0	3.0	A	0.31	7.0	
	NB-T									
	SB-T	4.7	A	0.63	14.0	2.4	A	0.34	7.0	
	SB-R									
Route 3 & Route 2 Eastbound Ramps		**6.9**	**A**			**3.3**	**A**			
Route 2 Eastbound Off-Ramp	EB-L	2.6	A	0.10	7.0	3.2	A	0.25	7.0	
	EB-R									
	EB-HR									
Heavy Tree Road	NE-L	7.0	A	0.08	7.0	8.9	A	0.04	7.0	
	NE-T									
	NE-R									
Route 3	NB-T	10.7	B	0.79	63.0	2.4	A	0.24	7.0	
	NB-R									
	NB-R									
	SB-HL	3.1	A	0.51	7.0	3.6	A	0.58	14.0	
	SB-L									
	SB-T									
	SB-R									

2035		Weekday AM Peak Hour				Weekday PM Peak Hour			
Intersection		Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Route 3 & Route 2 Westbound Ramps		**4.4**	**A**			**6.3**	**A**		
Route 2 Westbound Off-Ramp	EB-L	3.1	A	0.22	7.0	9.4	A	0.80	70.0
	EB-R								
Route 3	NB-L	2.7	A	0.38	7.0	3.5	A	0.41	7.0
	NB-T								
	SB-T	5.8	A	0.68	21.0	2.6	A	0.37	7.0
	SB-R								
Route 3 & Route 2 Eastbound Ramps		**11.6**	**B**			**3.4**	**A**		
Route 2 Eastbound Off-Ramp	EB-L	2.6	A	0.11	7.0	3.9	A	0.38	7.0
	EB-R								
	EB-HR								
Heavy Tree Road	NE-L	7.1	A	0.08	7.0	12.1	B	0.07	7.0
	NE-T								
	NE-R								
Route 3	NB-T	19.2	C	0.89	182.0	2.7	A	0.31	7.0
	NB-R								
	NB-R								
	SB-HL	3.1	A	0.51	7.0	3.3	A	0.54	7.0
	SB-L								
	SB-T								
	SB-R								

Table 28: Route 2/3 Interchange Flyover Operations

Part B - Route 2/3 Interchange Flyover													
Highway Segment		2020						2025					
		Weekday AM Peak Hour			Weekday PM Peak Hour			Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**21.9**	**C**		**7.4**	**B**		**23.9**	**D**		**9.3**	**B**	
Basic	Freeway	22.3	C	0.56	11.1	B	0.28	24.5	C	0.62	13.7	B	0.35
Diverge	Freeway	24.5	C	0.56	12.2	B	0.28	26.9	C	0.61	15.1	B	0.34
	Ramp	22.1		0.25	11.0		0.30	24.2		0.28	13.6		0.35
Basic	Freeway	18.0	B	0.46	5.9	A	0.15	19.6	C	0.50	7.7	A	0.19
Merge	Freeway	23.5	C	0.56	6.9	A	0.17	25.6	C	0.61	8.8	B	0.21
	Ramp	22.6		0.26	8.7		0.05	24.4		0.28	10.3		0.05
Basic	Freeway	22.5	C	0.57	6.8	A	0.17	24.5	C	0.62	8.6	A	0.22
Route 2 Westbound		**6.2**	**B**		**22.7**	**D**		**7.6**	**B**		**25.6**	**D**	
Basic	Freeway	5.6	A	0.14	22.0	C	0.56	7.0	A	0.18	24.7	C	0.62
Diverge	Freeway	6.0	A	0.14	23.8	C	0.55	7.6	A	0.18	26.7	C	0.62
	Ramp	4.6		0.03	20.8		0.08	6.0		0.03	23.5		0.08
Basic	Freeway	5.1	A	0.13	20.6	C	0.52	6.5	A	0.16	23.3	C	0.59
Weave	Freeway	5.5	A	0.16	25.6	C	0.63	6.5	A	0.18	28.9	D	0.70
Basic	Freeway	5.4	A	0.14	20.6	C	0.52	6.9	A	0.17	23.2	C	0.59
Merge	Freeway	10.2	B	0.25	24.6	C	0.59	12.3	B	0.30	28.1	C	0.67
	Ramp	11.1		0.26	23.4		0.17	12.9		0.29	26.2		0.20
Basic	Freeway	10.0	A	0.25	23.6	C	0.60	12.0	B	0.30	26.7	D	0.68
Route 3 Northbound		**13.2**	**B**		**6.3**	**B**		**14.0**	**B**		**7.0**	**B**	
Basic	Freeway	4.3	A	0.11	5.1	A	0.13	4.9	A	0.12	6.1	A	0.15
Diverge	Freeway	4.7	A	0.11	5.6	A	0.13	5.3	A	0.12	6.6	A	0.15
	Ramp	6.0		0.06	6.8		0.15	6.6		0.07	7.7		0.19
Basic	Freeway	3.2	A	0.08	2.6	A	0.07	3.6	A	0.09	2.8	A	0.07
Merge	Freeway	15.1	B	0.37	5.9	A	0.14	16.1	B	0.39	6.6	A	0.16
	Ramp	15.4		0.66	7.9		0.18	16.3		0.69	8.5		0.21
Basic	Freeway	14.7	B	0.37	5.7	A	0.15	15.6	B	0.40	6.4	A	0.16
Merge	Freeway	15.7	B	0.38	7.3	A	0.18	16.7	B	0.40	8.0	A	0.20
	Ramp	16.5		0.03	9.2		0.08	17.3		0.03	9.8		0.08
Basic	Freeway	15.2	B	0.38	7.1	A	0.18	16.1	B	0.41	7.8	A	0.20
Route 3 Southbound		**3.4**	**A**		**13.2**	**B**		**3.5**	**A**		**13.9**	**B**	
Basic	Freeway	3.4	A	0.09	13.2	B	0.33	3.5	A	0.09	13.9	B	0.35

Highway Segment		2035					
		Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**36.0**	**E**		**16.1**	**C**	
Basic	Freeway	43.9	E	0.99	23.8	C	0.60
Diverge	Freeway	43.6	E	0.98	26.6	C	0.60
	Ramp	38.6		0.54	23.5		0.58
Basic	Freeway	29.6	D	0.75	13.8	B	0.35
Merge	Freeway	38.0	D	0.86	15.2	B	0.37
	Ramp	33.3		0.28	15.8		0.06
Basic	Freeway	35.5	E	0.87	14.7	B	0.37
Route 2 Westbound		**12.4**	**B**		**41.3**	**F**	
Basic	Freeway	11.6	B	0.29	39.4	E	0.93
Diverge	Freeway	12.5	B	0.29	39.8	E	0.92
	Ramp	10.5		0.03	35.5		0.08
Basic	Freeway	11.1	B	0.28	37.0	E	0.90
Weave	Freeway	10.2	B	0.28	47.2	F	0.97
Basic	Freeway	12.2	B	0.31	63.4	F	0.95
Merge	Freeway	19.4	B	0.47	54.1	F	1.06
	Ramp	18.9		0.37	40.2		0.27
Basic	Freeway	18.7	C	0.47	39.2	F	1.07
Route 3 Northbound		**18.5**	**C**		**9.4**	**B**	
Basic	Freeway	9.4	A	0.24	10.0	A	0.25
Diverge	Freeway	10.2	B	0.24	11.0	B	0.25
	Ramp	11.0		0.08	11.6		0.28
Basic	Freeway	8.0	A	0.20	5.1	A	0.13
Merge	Freeway	20.8	C	0.50	8.9	B	0.22
	Ramp	20.2		0.69	10.5		0.21
Basic	Freeway	20.1	C	0.51	8.7	A	0.22
Merge	Freeway	21.4	C	0.51	10.3	B	0.25
	Ramp	21.3		0.03	11.8		0.08
Basic	Freeway	20.6	C	0.52	10.1	A	0.25
Route 3 Southbound		**4.2**	**A**		**16.5**	**C**	
Basic	Freeway	4.2	A	0.11	16.5	B	0.42

8.6.7 Evaluation Summary

The evaluation of Option 5 Route 2/Route 3 Interchange Flyover is detailed in Table 29. The Route 2/Route 3 interchange flyover option scores a total of 52.5 points out of 100 points.

Table 29: Option 5 Evaluation

Criteria		Max Points	Option 5 Route 2/Route 3 Interchange Flyover		
			Evaluation	Rating	Score
Driver Comfort		**5**	Conventional control; introduces some level of complexity.	Fair	2.5
Land Impact		**5**	Impacts to residential and agricultural uses.	High	0
Utility Impact		**5**	Relocation of high voltage transmission lines.	High	0
Land Acquisition		**10**	Between 25 and 50 hectares.	Medium	5
Construction Cost		**15**	Greater than $50 million.	High	0
Traffic Operations	**2020**	**10**	Intersection LOS A-D; highway LOS A-D.	Good	10
	2025	**20**	Intersection LOS A-D; highway LOS A-D.	Good	20
	2035	**30**	Intersection LOS A-D; highway LOS F with Route 2 widening.	Fair	15
Max Score		**100**	**Total Score**	**52.5**	

8.7 Option 6 Route 2 Flyover

Option 6 is a realignment of the Team Gushue Highway, crossing Brookfield Road just over 1 kilometre to the east of the originally proposed crossing location and connecting to Route 2 approximately 1.8 kilometres east of the Route 2 interchange at Commonwealth Avenue. The new interchange between Route 2 the Team Gushue Highway is a flyover from Route 2 eastbound to the Team Gushue Highway. It is worth noting that the concept plan does not accommodate a Team Gushue Highway southbound to Route 2 eastbound movement. This is a relatively low volume movement and will require two additional structures, significantly increasing construction costs. The conceptual drawing for the Route 2 flyover is shown in Figure 9; the full-size drawing has been included in Appendix E.

8.7.1 Driver Comfort

The flyover is a conventional form of traffic control and the majority of drivers are familiar and comfortable with this type of control. Driver comfort is rated as "**Good**" for the Route 2 underpass.

8.7.2 Land Impact

The Route 2 flyover will cause disturbances to land currently used for agricultural. South Brook is in very close proximity to the Route 2 eastbound off ramp, which will likely require realignment of the Brook, and/or a combination of bank stabilization and retaining walls. Land impact is rated as "**High**" for the Route 2 flyover option.

8.7.3 Utility Impact

The Route 2 flyover option will require the relocation of some power and communications distribution infrastructure near the grade-separated crossing of the Team Gushue Highway on Brookfield Road. Utility impact is rated as "**Medium**" for the Route 2 flyover option.

8.7.4 Land Acquisition

Land acquisition areas were estimated based on the conceptual drawing, approximately 43.8 hectares of agricultural land (AG) is required to construct the Route 2 flyover. Land acquisition is rated as "**Medium**" for the Route 2 flyover option.

8.7.5 Construction Cost

A Class 'D' opinion of probable construction cost was developed for the option. Costs do not include allowances for land acquisition, inflation, engineering, utility relocations, or harmonized sales tax (HST). The cost to construct the Route 2 flyover is estimated to be approximately $21.3 million; the breakdown of the opinion of probable cost has been included in Appendix F. Construction cost is rated as "**Low**" for the Route 2 flyover option.

Figure 9: Option 6 Route 2 Flyover

8.7.6 Traffic Operations

Operations at the interchange were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The highway capacity analysis results including density, level of service and density-to-capacity ratio are summarized in Table 30. The detailed Highway Capacity Software reports can be found in Appendix G. The Route 2 interchange and flyover will experience operational problems in 2020, 2025 and 2035.

In 2020, the Route 2 eastbound highway segments from the Commonwealth Avenue on-ramp to the flyover operate at LOS E during the morning peak hour. During the afternoon peak hour, the Route 2 westbound highway segment at the Commonwealth Avenue off-ramp operates at LOS E.

In 2025, the Route 2 eastbound highway segments from the Commonwealth Avenue on-ramp to the flyover operate at LOS F during the morning peak hour; with these segments shown to be over capacity. During the afternoon peak hour, the Route 2 westbound highway segment from the Team Gushue Highway on-ramp to the Commonwealth Avenue off-ramp operates at LOS E.

In 2035, the Route 2 eastbound highway segments before the Commonwealth Avenue off-ramp operate at LOS E and the highway segments from the Commonwealth Avenue off-ramp to the flyover operate at LOS F during the morning peak hour. The segments between the Commonwealth Avenue on-ramp and the flyover are shown to be over capacity. During the afternoon peak hour, the Route 2 westbound highway segments before the Team Gushue Highway off-ramp operate at LOS E. The highway segments from the Team Gushue Highway off-ramp to the Commonwealth Avenue off-ramp, at the Commonwealth Avenue off-ramp and after the off-ramp operate at LOS F. Highway segments from the Team Gushue Highway on-ramp to the Commonwealth Avenue off-ramp and at/after the Commonwealth Avenue on-ramp are shown to be over capacity

Option 6 is not considered to be a viable alternative from a traffic operations perspective given the poor levels of service along Route 2. While Option 6 utilizes a form of flyover structure very similar to Option 5, the difference in traffic operations can be attributed to the traffic volumes on Route 2. In Option 5, the connection to the Team Gushue Highway is located at the Commonwealth Avenue interchange and the traffic volumes that are heading to/from the Team Gushue Highway do not mix with the traffic volumes that are heading between (to/from) Commonwealth Avenue and downtown St. John's. In Option 6 the traffic volumes that are heading to/from the Team Gushue Highway converge with the traffic volumes that are heading to/from downtown on Route 2. As such, Option 6 results in a significant increase in traffic volumes on Route 2 between the Commonwealth Avenue interchange and the proposed Team Gushue Highway connection. Option 6 would require the addition of one lane in each direction along the segment of Route 2 between the Commonwealth Avenue interchange and the proposed Team Gushue Highway connection to improve traffic operations to LOS E or better.

Traffic operations for the Route 2 flyover option are rated as "**Fair**" for 2020, "**Poor**" for 2025 and "**Poor**" for 2035.

Table 30: Route 2 Flyover Interchange Operations

Part B - Route 2 Flyover													
Highway Segment		2020						2025					
		Weekday AM Peak Hour			Weekday PM Peak Hour			Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**26.6**	**D**		**9.1**	**B**		**26.5**	**F**		**11.2**	**B**	
Basic	Freeway	22.3	C	0.56	11.1	B	0.28	24.5	C	0.62	13.7	B	0.35
Diverge	Freeway	24.1	C	0.56	12.1	B	0.28	26.5	C	0.61	15.0	B	0.34
	Ramp	22.1		0.06	11.0		0.15	24.2		0.07	13.6		0.19
Basic	Freeway	21.3	C	0.54	8.5	A	0.22	23.2	C	0.59	10.5	A	0.27
Merge	Freeway	42.3	E	0.93	12.9	B	0.31	48.5	F	1.00	15.4	B	0.37
	Ramp	35.2		0.92	13.7		0.23	37.7		0.97	15.9		0.26
Basic	Freeway	40.1	E	0.94	12.5	B	0.32	39.0	F	1.01	15.0	B	0.38
Diverge	Freeway	42.5	E	0.93	13.7	B	0.31	42.0	F	1.00	16.5	B	0.37
	Ramp	36.6		0.42	12.1		0.17	36.0		0.45	14.6		0.19
Basic	Freeway	22.5	C	0.57	6.8	A	0.17	21.0	C	0.62	8.6	A	0.22
Route 2 Westbound		**6.8**	**B**		**24.9**	**D**		**8.4**	**B**		**28.3**	**D**	
Basic	Freeway	5.6	A	0.14	22.0	C	0.56	7.0	A	0.18	24.7	C	0.62
Diverge	Freeway	6.0	A	0.14	23.8	C	0.55	7.6	A	0.18	26.7	C	0.62
	Ramp	5.3		0.03	21.5		0.08	6.7		0.03	24.2		0.08
Basic	Freeway	5.1	A	0.13	20.6	C	0.52	6.5	A	0.16	23.3	C	0.59
Merge	Freeway	8.7	B	0.21	37.1	D	0.84	10.3	B	0.25	42.3	E	0.93
	Ramp	10.1		0.20	32.3		0.76	11.5		0.20	35.4		0.80
Basic	Freeway	8.5	A	0.21	34.5	D	0.85	10.1	A	0.25	40.1	E	0.94
Diverge	Freeway	9.2	B	0.21	38.3	E	0.84	10.9	B	0.25	42.4	E	0.93
	Ramp	10.8		0.18	35.9		0.76	12.4		0.18	39.3		0.81
Basic	Freeway	5.4	A	0.14	20.6	C	0.52	6.9	A	0.17	23.2	C	0.59
Merge	Freeway	10.3	B	0.25	24.8	C	0.59	12.4	B	0.30	28.3	D	0.67
	Ramp	13.0		0.26	25.3		0.17	14.8		0.29	28.1		0.20
Basic	Freeway	10.0	A	0.25	23.6	C	0.60	12.0	B	0.30	26.7	D	0.68
Route 3 Northbound		**15.1**	**C**		**6.8**	**B**		**16.0**	**C**		**7.5**	**B**	
Basic	Freeway	14.7	B	0.37	5.7	A	0.15	15.6	B	0.40	6.4	A	0.16
Merge	Freeway	15.7	B	0.38	7.3	A	0.18	16.7	B	0.40	8.0	B	0.20
	Ramp	17.1		0.03	9.8		0.08	18.0		0.03	10.4		0.08
Basic	Freeway	15.2	B	0.38	7.1	A	0.18	16.1	B	0.41	7.8	A	0.20
Route 3 Southbound		**3.4**	**A**		**13.2**	**B**		**3.5**	**A**		**13.9**	**B**	
Basic	Freeway	3.4	A	0.09	13.2	B	0.33	3.5	A	0.09	13.9	B	0.35

Highway Segment		2035					
		Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**41.9**	**F**		**18.9**	**C**	
Basic	Freeway	43.9	E	0.99	23.8	C	0.60
Diverge	Freeway	78.8	F	0.98	26.1	C	0.60
	Ramp	38.6		0.08	23.5		0.28
Basic	Freeway	85.7	F	0.95	18.9	C	0.48
Merge	Freeway	42.1	F	1.36	24.5	C	0.59
	Ramp	35.0		0.97	23.4		0.26
Basic	Freeway	39.8	F	1.38	23.4	C	0.59
Diverge	Freeway	43.3	F	1.36	26.1	C	0.59
	Ramp	36.4		0.58	22.9		0.25
Basic	Freeway	17.0	B	0.87	14.7	B	0.37
Route 2 Westbound		**13.5**	**B**		**53.7**	**F**	
Basic	Freeway	11.6	B	0.29	39.4	E	0.93
Diverge	Freeway	12.5	B	0.29	78.3	F	0.92
	Ramp	11.2		0.03	36.2		0.08
Basic	Freeway	11.1	B	0.28	85.6	F	0.90
Merge	Freeway	15.8	B	0.38	42.1	F	1.30
	Ramp	16.2		0.24	35.1		0.95
Basic	Freeway	15.3	B	0.39	39.8	F	1.31
Diverge	Freeway	16.6	B	0.38	42.2	F	1.30
	Ramp	17.6		0.17	39.1		0.82
Basic	Freeway	12.2	B	0.31	22.9	C	0.95
Merge	Freeway	19.5	C	0.47	29.4	F	1.06
	Ramp	20.8		0.37	28.8		0.27
Basic	Freeway	18.7	C	0.47	27.6	F	1.07
Route 3 Northbound		**20.5**	**C**		**9.8**	**B**	
Basic	Freeway	20.1	C	0.51	8.7	A	0.22
Merge	Freeway	21.4	C	0.51	10.4	B	0.25
	Ramp	21.9		0.03	12.5		0.08
Basic	Freeway	20.6	C	0.52	10.1	A	0.25
Route 3 Southbound		**4.2**	**A**		**16.5**	**C**	
Basic	Freeway	4.2	A	0.11	16.5	B	0.42

8.7.7 Evaluation Summary

The evaluation of Option 6 Route 2 Flyover is detailed in Table 31. The Route 2 flyover option scores a total of 32.5 points out of 100 points.

Table 31: Option 6 Evaluation

Criteria		Max Points	Option 6 Route 2 Flyover		
			Evaluation	Rating	Score
Driver Comfort		**5**	Common type of control; meets driver expectations.	Good	5
Land Impact		**5**	Impact to agricultural uses, environmentally sensitive area.	High	0
Utility Impact		**5**	Signigicant electrical/communications relocations.	Medium	2.5
Land Acquisition		**10**	Between 25 and 50 hectares.	Medium	5
Construction Cost		**15**	Less than $25 million.	Low	15
Traffic Operations	**2020**	**10**	Highway LOS E.	Fair	5
	2025	**20**	Highway LOS F.	Poor	0
	2035	**30**	Highway LOS F with Route 2 widening.	Poor	0
Max Score		**100**	**Total Score**	**32.5**	

8.8 Option 7 Route 2 Underpass

Option 7 is a realignment of the Team Gushue Highway, crossing Brookfield Road just over 1 kilometre to the east of the originally proposed crossing location and connecting to Route 2 approximately 1.8 kilometres east of the Route 2 interchange at Commonwealth Avenue. The new interchange between Route 2 the Team Gushue Highway includes a roundabout control at the Route 2 eastbound ramp terminal. This option does accommodate all movements, but at lower speeds than Option 6. The conceptual drawing for the interchange is shown in Figure 10; the full-size drawing has been included in Appendix E.

8.8.1 Driver Comfort

Diamond interchanges and roundabouts are conventional forms of traffic control and are commonly used in the area. The majority of drivers are familiar and comfortable with both. Driver comfort is rated as "**Good**" for the Route 2 underpass.

8.8.2 Land Impact

The Route 2 underpass will cause disturbances to land currently used for agricultural uses and environmentally sensitive areas. South Brook is in very close proximity to the Route 2 eastbound off ramp, which will likely require realignment of the Brook, and/or a combination of bank stabilization and retaining walls. The proposed roundabout will also be located within the existing floodplain for South Brook. Land impact is rated as "**High**" for the Route 2 underpass option.

8.8.3 Utility Impact

The Route 2 underpass option will require the relocation of some power and communications distribution infrastructure near the grade-separated crossing of the Team Gushue Highway on Brookfield Road. Utility impact is rated as "**Medium**" for the Route 2 underpass option.

8.8.4 Land Acquisition

Land acquisition areas were estimated based on the conceptual drawing, approximately 43.8 hectares of agricultural land (AG) is required to construct the Route 2 underpass. Land acquisition is rated as "**Medium**" for the Route 2 underpass option.

8.8.5 Construction Cost

A Class 'D' opinion of probable construction cost was developed for the option. Costs do not include allowances for land acquisition, inflation, engineering, utility relocations, or harmonized sales tax (HST). The cost to construct the Route 2 underpass is estimated to be approximately $20.5 million; the breakdown of the opinion of probable cost has been included in Appendix F. Construction cost is rated as "**Low**" for the Route 2 underpass option.

Figure 10: Option 7 Route 2 Underpass

8.8.6 Traffic Operations

Operations at the interchange were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The highway capacity analysis results including density, level of service and density-to-capacity ratio are summarized in Table 32. The detailed Highway Capacity Software reports can be found in Appendix G. The Route 2 underpass is shown to experience operational problems in 2020, 2025 and 2035.

In 2020, the Route 2 eastbound highway segments from the Commonwealth Avenue on-ramp to the flyover operate at LOS E during the morning peak hour. During the afternoon peak hour, the Route 2 westbound highway segment at the Commonwealth Avenue off-ramp operates at LOS E.

In 2025, the Route 2 eastbound highway segments from the Commonwealth Avenue on-ramp to the flyover operate at LOS F during the morning peak hour with these segments shown to be over capacity. During the afternoon peak hour, the Route 2 westbound highway segments from the Team Gushue Highway on-ramp to the Commonwealth Avenue off-ramp operate at LOS E.

In 2035, the Route 2 eastbound highway segments before the Commonwealth Avenue off-ramp operate at LOS E and the highway segments from the Commonwealth Avenue off-ramp to the flyover operate at LOS F during the morning peak hour. The segments between the Commonwealth Avenue on-ramp and flyover will be over capacity. During the afternoon peak hour, the Route 2 westbound highway segment before the Team Gushue Highway off-ramp operates at LOS E. The highway segments from the Team Gushue Highway off-ramp to the Commonwealth Avenue off-ramp, at the Commonwealth Avenue off-ramp and after the off-ramp operate at LOS F. The highway segments are shown to be over capacity from the Team Gushue Highway on-ramp to the Commonwealth Avenue off-ramp and at/after the Commonwealth Avenue on-ramp.

Option 7 is not considered to be a viable alternative from a traffic operations perspective given the poor levels of service along Route 2. Similar to Option 6, Option 7 combines the traffic volumes that are heading to/from the Team Gushue Highway with the traffic volumes that are heading to/from downtown resulting in a significant increase in traffic volumes and poor operations on the segment of Route 2 between the Commonwealth Avenue interchange and the proposed Team Gushue Highway connection.

Option 7 would also require the addition of one lane in each direction along the segment of Route 2 between the Commonwealth Avenue interchange and the proposed Team Gushue Highway connection to improve traffic operations to LOS E or better.

The roundabout was not modelled to obtain level of service conditions as this would have little bearing on the overall traffic operation for this option. Traffic operations for the Route 2 underpass option are rated as “**Fair**” for 2020, “**Poor**” for 2025 and “**Poor**” for 2035.

Table 32: Route 2 Underpass Interchange Operations

Part B - Route 2 Underpass													
Highway Segment		2020						2025					
		Weekday AM Peak Hour			Weekday PM Peak Hour			Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**26.7**	**D**		**9.1**	**B**		**26.6**	**F**		**11.3**	**B**	
Basic	Freeway	22.3	C	0.56	11.1	B	0.28	24.5	C	0.62	13.7	B	0.35
Diverge	Freeway	24.1	C	0.56	12.1	B	0.28	26.5	C	0.61	15.0	B	0.34
	Ramp	22.1		0.06	11.0		0.15	24.2		0.07	13.6		0.19
Basic	Freeway	21.3	C	0.54	8.5	A	0.22	23.2	C	0.59	10.5	A	0.27
Merge	Freeway	42.3	E	0.93	12.9	B	0.31	48.5	F	1.00	15.4	B	0.37
	Ramp	35.2		0.92	13.7		0.23	37.7		0.97	15.9		0.26
Basic	Freeway	40.1	E	0.94	12.5	B	0.32	39.0	F	1.01	15.0	B	0.38
Diverge	Freeway	42.5	E	0.93	13.7	B	0.31	42.0	F	1.00	16.5	B	0.37
	Ramp	36.6		0.42	12.1		0.17	36.0		0.45	14.6		0.19
Basic	Freeway	22.5	C	0.57	6.8	A	0.17	21.0	C	0.62	8.6	A	0.22
Merge	Freeway	23.5	C	0.56	7.0	A	0.17	21.9	C	0.61	8.8	B	0.22
	Ramp	22.7		0.00	8.5		0.00	21.3		0.00	10.1		0.00
Basic	Freeway	22.6	C	0.57	6.8	A	0.17	21.1	C	0.62	8.6	A	0.22
Route 2 Westbound		**6.8**	**B**		**24.9**	**D**		**8.4**	**B**		**28.3**	**D**	
Basic	Freeway	5.6	A	0.14	22.0	C	0.56	7.0	A	0.18	24.7	C	0.62
Diverge	Freeway	6.0	A	0.14	23.8	C	0.55	7.6	A	0.18	26.7	C	0.62
	Ramp	5.3		0.03	21.5		0.08	6.7		0.03	24.2		0.08
Basic	Freeway	5.1	A	0.13	20.6	C	0.52	6.5	A	0.16	23.3	C	0.59
Merge	Freeway	8.7	B	0.21	37.1	D	0.84	10.3	B	0.25	42.3	E	0.93
	Ramp	10.1		0.20	32.3		0.76	11.5		0.20	35.4		0.80
Basic	Freeway	8.5	A	0.21	34.5	D	0.85	10.1	A	0.25	40.1	E	0.94
Diverge	Freeway	9.2	B	0.21	38.3	E	0.84	10.9	B	0.25	42.4	E	0.93
	Ramp	10.8		0.18	35.9		0.76	12.4		0.18	39.3		0.81
Basic	Freeway	5.4	A	0.14	20.6	C	0.52	6.9	A	0.17	23.2	C	0.59
Merge	Freeway	10.3	B	0.25	24.8	C	0.59	12.4	B	0.30	28.3	D	0.67
	Ramp	13.0		0.26	25.3		0.17	14.8		0.29	28.1		0.20
Basic	Freeway	10.0	A	0.25	23.6	C	0.60	12.0	B	0.30	26.7	D	0.68
Route 3 Northbound		**15.1**	**C**		**6.8**	**B**		**16.0**	**C**		**7.5**	**B**	
Basic	Freeway	14.7	B	0.37	5.7	A	0.15	15.6	B	0.40	6.4	A	0.16
Merge	Freeway	15.7	B	0.38	7.3	A	0.18	16.7	B	0.40	8.0	B	0.20
	Ramp	17.1		0.03	9.8		0.08	18.0		0.03	10.4		0.08
Basic	Freeway	15.2	B	0.38	7.1	A	0.18	16.1	B	0.41	7.8	A	0.20
Route 3 Southbound		**3.1**	**A**		**12.1**	**B**		**3.3**	**A**		**12.8**	**B**	
Basic	Freeway	3.4	A	0.09	13.2	B	0.33	3.6	A	0.09	14.0	B	0.35
Diverge	Freeway	3.8	A	0.09	15.0	B	0.33	3.9	A	0.09	15.9	B	0.35
	Ramp	3.2		0.20	12.8		0.76	3.3		0.20	13.6		0.80
Basic	Freeway	0.1	A	0.00	0.1	A	0.00	0.1	A	0.00	0.1	A	0.00

Highway Segment		2035					
		Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**42.0**	**F**		**19.0**	**C**	
Basic	Freeway	43.9	E	0.99	23.8	C	0.60
Diverge	Freeway	78.8	F	0.98	26.1	C	0.60
	Ramp	38.6		0.08	23.5		0.28
Basic	Freeway	85.7	F	0.95	18.9	C	0.48
Merge	Freeway	42.1	F	1.36	24.5	C	0.59
	Ramp	35.0		0.97	23.4		0.26
Basic	Freeway	39.8	F	1.38	23.4	C	0.59
Diverge	Freeway	43.3	F	1.36	26.1	C	0.59
	Ramp	36.4		0.58	22.9		0.25
Basic	Freeway	17.0	B	0.87	14.7	B	0.37
Merge	Freeway	17.6	B	0.86	15.2	B	0.37
	Ramp	17.7		0.00	15.7		0.00
Basic	Freeway	17.1	B	0.87	14.8	B	0.37
Route 2 Westbound		**13.5**	**B**		**53.7**	**F**	
Basic	Freeway	11.6	B	0.29	39.4	E	0.93
Diverge	Freeway	12.5	B	0.29	78.3	F	0.92
	Ramp	11.2		0.03	36.2		0.08
Basic	Freeway	11.1	B	0.28	85.6	F	0.90
Merge	Freeway	15.8	B	0.38	42.1	F	1.30
	Ramp	16.2		0.24	35.1		0.95
Basic	Freeway	15.3	B	0.39	39.8	F	1.31
Diverge	Freeway	16.6	B	0.38	42.2	F	1.30
	Ramp	17.6		0.17	39.1		0.82
Basic	Freeway	12.2	B	0.31	22.9	C	0.95
Merge	Freeway	19.5	C	0.47	29.4	F	1.06
	Ramp	20.8		0.37	28.8		0.27
Basic	Freeway	18.7	C	0.47	27.6	F	1.07
Route 3 Northbound		**20.5**	**C**		**9.8**	**B**	
Basic	Freeway	20.1	C	0.51	8.7	A	0.22
Merge	Freeway	21.4	C	0.51	10.4	B	0.25
	Ramp	21.9		0.03	12.5		0.08
Basic	Freeway	20.6	C	0.52	10.1	A	0.25
Route 3 Southbound		**3.9**	**A**		**15.2**	**C**	
Basic	Freeway	4.2	A	0.11	16.5	B	0.42
Diverge	Freeway	4.6	A	0.11	19.0	B	0.41
	Ramp	3.9		0.24	16.1		0.95
Basic	Freeway	0.1	A	0.00	0.1	A	0.00

8.8.7 Evaluation Summary

The evaluation of Option 7 Route 2 Underpass is detailed in Table 33. The Route 2 underpass option scores a total of 32.5 points out of 100 points.

Table 33: Option 7 Evaluation

Criteria		Max Points	Option 7 Route 2 Underpass		
			Evaluation	Rating	Score
Driver Comfort		**5**	Common type of control; meets driver expectations.	Good	5
Land Impact		**5**	Impact to agricultural uses, environmentally sensitive area.	High	0
Utility Impact		**5**	Signigicant electrical/communications relocations.	Medium	2.5
Land Acquisition		**10**	Between 25 and 50 hectares.	Medium	5
Construction Cost		**15**	Less than $25 million.	Low	15
Traffic Operations	**2020**	**10**	Highway LOS E.	Fair	5
	2025	**20**	Highway LOS F.	Poor	0
	2035	**30**	Highway LOS F with Route 2 widening.	Poor	0
Max Score		**100**	**Total Score**	**32.5**	

8.9 Preliminary Options Evaluation

The preliminary options were evaluated and ranked based on evaluation criteria including: driver comfort, land impact, utility impact, land acquisition, construction cost and traffic operations, as described in Section 8.1. The matrix developed to assess and compare the preliminary options is detailed in Table 34. Each option was rated and given a total score out of 100 points as described throughout Sections 8.2 to 8.8. The total score was used to rank the preliminary options and identify the top three options. The three options recommended to proceed to more detailed concept layouts, opinions of probable cost and comprehensive analysis are:

1. **Option 2 Roundabout Corridor**
2. **Option 3 Cloverleaf Interchange**
3. **Option 5 Route 2/2 Interchange Flyover**

Table 34: Preliminary Option Evaluation Matrix

Criteria		Max Points	Option 1 Signalized Corridor		Option 2 Roundabout Corridor		Option 3 Cloverleaf Interchange		Option 4 Diverging Diamond Interchange		Option 5 Route 2/3 Interchange Flyover		Option 6 Route 2 Interchange Flyover		Option 7 Route 2 Underpass	
																
			Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Driver Comfort		5	Good	5	Good	5	Good	5	Poor	0	Fair	2.5	Good	5	Good	5
Land Impact		5	Low	5	Medium	2.5	High	0	High	0	High	0	High	0	High	0
Utility Impact		5	Low	5	Low	5	High	0	High	0	High	0	Medium	2.5	Medium	2.5
Land Acquisition		10	Low	10	Low	10	High	0	Medium	5	Medium	5	Medium	5	Medium	5
Construction Cost		15	Low	15	Low	15	Medium	7.5	Medium	7.5	High	0	Low	15	Low	15
Traffic Operations	2020	10	Fair	5	Good	10	Good	10	Good	10	Good	10	Fair	5	Fair	5
	2025	20	Poor	0	Good	20	Good	20	Fair	10	Good	20	Poor	0	Poor	0
	2035	30	Poor	0	Fair	15	Fair	15	Fair	15	Fair	15	Poor	0	Poor	0
Total		100	45		82.5		57.5		47.5		52.5		32.5		32.5	
Rank			5		1		2		4		3		6 (Tie)		6 (Tie)	

9 Part B: Comprehensive Options Review and Concept Analysis

The conceptual drawings for the top three options were refined, the detailed concept drawings reflect a level of design completion of approximately 33 percent required to develop Class 'C' opinions of probable construction cost as defined "*Guide to Cost Predictability in Construction: An Analysis of Issues Affecting the Accuracy of Construction Cost Estimates"* prepared by the Joint Federal Government/Industry Cost predictability taskforce.

9.1 Evaluation Criteria

A comprehensive analysis of the significant design and decision parameters was completed to inform the selection of the appropriate design connection for the Team Gushue Highway. The following factors were considered in the evaluation:

- Level of service and capacity
- Traffic conflict points
- Construction staging sequence, duration and traffic impacts
- Land/property requirements
- Interface/access points with private property owners
- Ability to accommodate farming operations
- Environmental considerations
- Drainage and storm water detention requirements
- Structures, overpass and bridge requirements
- Unique operational considerations
- Project development costs

An evaluation matrix was developed to assess and compare the three detailed options, the matrix assigns a weighing factor to each criterion for a total of 100 points. Each criterion is rated using a poor/fair/good or high/medium/low scale, the rating translates to a specific number of points. For example, for a criterion with a weight of 10 points the poor/fair/good or high/medium/low scale translate to 0 points/5 points/10 points.

The detailed options were evaluated based on the following criteria:

- **Level of Service and Capacity (maximum 10 points):** considers future traffic operations with the completion of the Team Gushue Highway for the 2035 timeframe. The preliminary options analysis established that all three options would operate at acceptable levels of service in the 2020 and 2025 timeframes, but would experience poor levels of service in 2035 with the current four-lane cross section on Route 2. Therefore, the detailed analysis evaluates highway traffic operations for the 2035 timeframe with the proposed widening to a six-lane cross section west of Commonwealth Avenue. Level of service and capacity is rated as poor/fair/good.
    - Poor (0 points): highway segments experience LOS F and/or v/c > 1.
    - Fair (5 points): highway segments experience LOS E.
    - Good (10 points): all highway segments experience LOS A-D.

- **Traffic Conflict Points (maximum 10 points):** considers the number of intersection and highway conflict points. Traffic conflict points for each option is rated as high/medium/low, where:
    - High (0 points): the option has more than 50 conflict points.
    - Medium (5 points): the option has between 25 and 50 conflict points.
    - Low (10 points): the option has less than 25 conflict points.
- **Construction Sequence and Traffic Impacts (maximum 10 points):** considers the complexity of the construction staging sequence, duration and the traffic impacts during construction. The construction impacts for each option is rated as high/medium/low, where:
    - High (0 points): the construction staging sequence is very complex. Construction will have significant traffic impacts over a longer duration.
    - Medium (5 points): the construction staging sequence is complex. Construction will have moderate traffic impacts over a longer duration.
    - Low (10 points): the construction staging sequence is not complex. Construction will have moderate traffic impacts over a shorter duration.
- **Land/Property Requirements (maximum 10 points):** considers the area of land/property acquisition required to construct each option. The land acquisition for each option is rated as high/medium/low, where:
    - High (0 points): the option requires over 50 hectares of land acquisition.
    - Medium (5 points): the option requires between 25 and 50 hectares of land acquisition.
    - Low (10 points): the option requires less than 25 hectares of land acquisition.
- **Access to Private Property Impacts (maximum 5 points):** consider the interface/access points with private property owners. The impact to access of each option is rated as high/medium/low, where:
    - High (0 points): the option does not accommodate access to private property.
    - Medium (2.5 points): special considerations will be required to accommodate access to private property.
    - Low (5 points): the option can accommodate access to private property.
- **Agricultural Operations Impacts (maximum 5 points):** considers the ability to accommodate farming operations, farm equipment access and movements. The impact to agricultural operations of each option is rated as high/medium/low, where:
    - High (0 points): the option will cause significant disturbances to farming operations, farm equipment access and movements. The option does not accommodate current agricultural operations.

  - Medium (2.5 points): the option will cause moderate disturbances to farming operations, farm equipment access and movements. The option does not accommodate current agricultural operations. Special considerations will be required to accommodate farming operations.
  - Low (5 points): the option will not cause disturbances to farming operations, farm equipment access and movements. The option can accommodate farming operations.

- **Environmental Impacts (maximum 10 points):** considers disturbances to environmental aspects associated with disturbance of wetlands and/or water bodies. The land impact of each option is rated as high/medium/low, where:
  - High (0 points): the option will cause significant disturbances to environmentally sensitive areas.
  - Medium (5 points): the option will cause moderate disturbances to environmentally sensitive areas.
  - Low (10 points): no disturbances to environmentally sensitive areas are anticipated.
- **Drainage/Stormwater Requirements (maximum 10 points):** The City of St. John's has enacted a Stormwater Detention Policy, the objective of which is to ensure that new developments provide stormwater detention that temporarily stores the difference in stormwater runoff volumes that can result from changes to permeable surface areas between the pre- and post-development conditions. Replacing existing permeable surfaces such as wooded areas, grassed areas, planted fields, etc. with an impermeable surface such as asphalt, or a less permeable surface such as compacted granular, theoretically results in greater volumes of storm water runoff, and generally higher runoff rates. The proposed detention system must limit the post-development runoff rate from the development for each return period/duration to the respective pre-development runoff rate for the same return period/duration. The City requires detailed computer modeling of the proposed stormwater detention system using a specific storm water modelling package called XPSWMM. Such modelling is beyond the scope of this project, however an estimate of the change in permeable surface area is provided and a high-level assessment of the options for storm water detention are discussed. Scoring for this category is as follows:
  - High (0 points): The option requires large volumes of water to be stored and/or proposed geometry limits available storage options
  - Medium (5 points): The option requires moderate to large volumes of water to be stored; however proposed geometry provides suitable storage options.
  - Low (10 points): The option minimizes volume of water to be stored and proposed geometry provides suitable storage options.
- **Structures Requirements (maximum 5 points):** considers the area of structures required to construct each option. The land acquisition for each option is rated as high/medium/low, where:
  - High (0 points): the option requires over 5,000 square metres of structures.

- Medium (2.5 points): the option requires between 2,500 and 5,000 square metres of structures.
- Low (5 points): the option requires less than 2,500 square metres of structures.

- **Operational Considerations (maximum 5 points):** considers the type of control and any unique operation consideration that would exceed the expectations of the average driver. Operational considerations are rated as poor/fair/good, where:
  - Poor (0 points): the option includes unconventional types of control, high level of complexity and violates driver expectations.
  - Fair (2.5 points): the option includes conventional types of control, but introduces some level of complexity and can be unfamiliar/uncomfortable for some drivers.
  - Good (5 points): the option includes conventional types of control and meets driver expectations.
- **Project Development Costs (maximum 20 points):** considers the total project development costs including engineering design, land/property acquisitions, materials, construction, and construction management, utility relocation costs (assumed) and stakeholder interfacing. With respect to storm water detention costs, it is anticipated that the costs associated with a detailed storm water detention analysis will be covered in the engineering design component and incorporation of the selected storage option within the road design is not expected to result in any significant changes to engineering costs. Construction costs associated with storm water detention can vary widely depending on the selected storage options and costs are assumed for this component. It is not anticipated that the options for storage will vary widely between the roundabout, cloverleaf or flyover options. The construction cost of each option is rated as high/medium/low, where:
  - High (0 points): the estimated cost to construct the option greater than $60.0 million.
  - Medium (10 points): the estimated cost to construct the option between $30.0 and $60.0 million.
  - Low (20 points): the estimated cost to construct the option less than $30.0 million.

The evaluation of the criteria for each of the top three options are discussed in the following sections.

9.2 Option 2 Roundabout Corridor

The detailed concept drawing for the roundabout corridor is shown in Figure 11; the full-size drawing has been included in Appendix H. No significant changes were made to the roundabout corridor concept.

Figure 11: Option 2 Roundabout Corridor – Detailed Concept

9.2.1 Level of Service and Capacity

Operations on Route 2 and the Team Gushue Highway segments were evaluated under the projected 2035 traffic volumes with the current four-lane cross section on Route 2 and with the proposed widening of Route 2 to three lanes in each direction west of the Route 2/Route 3 interchange. The highway capacity analysis results including density, level of service and density-to-capacity ratio are summarized in Table 35. The detailed Highway Capacity Software reports can be found in Appendix I.

In 2035, the Route 2 eastbound segments before the off-ramp, at the off-ramp and after the on-ramp will operate at LOS E during the morning peak hour. During the afternoon peak hour, the Route 2 westbound highway segment before the off-ramp will operate at LOS E, all other segments will operate at LOS F; the highway segments at the on-ramp and after the on ramp will be over capacity.

The proposed widening to a six-lane cross section west of the interchange will improve traffic operations at the interchange, the widening was modelled with the additional eastbound lane terminating at the off-ramp, and the additional westbound lane beginning as an added lane at the on-ramp. During the morning peak hour, only the Route 2 eastbound segments after the on-ramp will operate at LOS E. During the afternoon peak hour, the Route 2 westbound highway segments before the off-ramp and at the off ramp will operate at LOS E, highway segments will no longer be over capacity. Traffic operations for the roundabout corridor option are rated as "**Fair**" for 2035 with the proposed widening.

The highway segments that continue to operate at LOS E during the peak hours are the highway segments and east of the interchange. These highway segments experience high traffic volumes travelling to/from St. Johns that would be expected without the Team Gushue Highway. It should be noted that extending the widening of Route 2 to three lanes in each direction east throughout the interchange would improve the traffic operations at the interchange to acceptable levels of service during the morning and afternoon peak hours.

9.2.2 Traffic Conflict Points

The roundabout corridor option has a total of 64 conflict points, broken down as follows:

- The Team Gushue Highway and Commonwealth Avenue/Brookfield Road roundabout has a total of 24 conflict points (9 merging, 8 diverging and 7 crossing).
- The Route 3 and Route 2 WB Ramps roundabout has a total of 16 conflict points (6 merging, 5 diverging and 5 crossing).
- The Route 3 and Route 2 EB Ramps roundabout has a total of 20 conflict points (8 merging, 7 diverging and 5 crossing).
- The diamond interchange ramps have a total of 4 conflict points (2 merging and 2 diverging).

Traffic conflicts are rated as "**High**" for the roundabout corridor option.

Table 35: Roundabout Corridor Diamond Interchange Operations – Detailed Analysis

Part B - Diamond Interchange													
Highway Segment		2035						2035 - Widening					
		Weekday AM Peak Hour			Weekday PM Peak Hour			Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**35.9**	**E**		**16.0**	**C**		**32.6**	**E**		**14.8**	**C**	
Basic	Freeway	43.9	E	0.99	23.8	C	0.60	26.0	C	0.66	15.9	B	0.40
Diverge	Freeway	43.6	E	0.98	26.6	C	0.60	24.1	C	0.65	14.7	B	0.39
	Ramp	40.6		0.54	25.5		0.58	-		0.51	-		0.58
Basic	Freeway	29.6	D	0.75	13.8	B	0.35	29.6	D	0.75	13.8	B	0.35
Merge	Freeway	38.2	D	0.86	15.3	B	0.37	38.2	D	0.86	15.3	B	0.37
	Ramp	34.6		0.28	17.2		0.06	34.6		0.28	17.2		0.06
Basic	Freeway	35.5	E	0.87	14.7	B	0.37	35.5	E	0.87	14.7	B	0.37
Route 2 Westbound		**12.6**	**B**		**51.6**	**F**		**11.4**	**B**		**35.8**	**E**	
Basic	Freeway	11.6	B	0.29	39.4	E	0.93	11.6	B	0.29	39.4	E	0.93
Diverge	Freeway	12.5	B	0.29	63.0	F	0.92	12.5	B	0.29	40.3	E	0.92
	Ramp	13.9		0.05	38.9		0.26	13.9		0.05	38.9		0.26
Basic	Freeway	10.7	A	0.27	81.2	F	0.81	10.7	A	0.27	32.5	D	0.81
Merge	Freeway	19.5	C	0.47	56.4	F	1.06	6.6	A	0.18	19.9	C	0.53
	Ramp	20.7		0.46	41.8		0.59	-		0.46	-		0.59
Basic	Freeway	18.7	C	0.47	39.4	F	1.07	12.5	B	0.32	28.3	D	0.72

9.2.3 Construction Sequence and Traffic Impacts

The following general construction staging sequence should be used to construct the roundabout corridor:

1. Team Gushue Highway and Commonwealth Avenue/Brookfield Road roundabout
2. Construct the two roundabouts at the Commonwealth Avenue interchange, detour ramp traffic to Southlands Boulevard interchange.
3. Construct retaining walls under existing Route 2 bridge structures to accommodate the new cross section.

The proposed construction staging sequence will minimize traffic impacts. During the first stage, normal operations will continue on Route 2 and Commonwealth Avenue while the Team Gushue Highway roundabout is constructed.

Stage two will have the most significant impacts on traffic, for a shorter construction duration a detour for Route 2 on and off-ramp traffic is recommended. Traffic should be diverted to the Southlands Boulevard interchange. The roundabout construction will then only need to accommodate through traffic between Commonwealth Avenue and Robert E. Howlett Memorial Drive. The roundabout construction should be staged to maintain one lane in each direction. Construction impacts are rated as "**Low**" for the roundabout corridor option.

9.2.4 Land/Property Requirements

The land acquisition estimates were refined based on the detailed concept drawing, approximately 13 hectares of land is required to construct the roundabout corridor. The land acquisition includes approximately 11.2 hectares of rural residential infill (RRI) and rural (R) land and approximately 1.2 hectares of agricultural land (AG). Land acquisition is rated as "**Low**" for the roundabout corridor option.

9.2.5 Private Property Access Impacts

The roundabout corridor can accommodate the existing access to agricultural fields south of Route 2 located at the Route 3/Commonwealth Avenue and Route 2 Eastbound Ramps intersection. The roundabout corridor will not impact access to private properties north of Route 2. All accesses can be maintained on the remaining segment of Heavy Tree Road. Impacts to access are rated as "**Low**" for the roundabout corridor option.

9.2.6 Agricultural Operations Impacts

The roundabout corridor will have a minor impact on land currently used for agricultural. The roundabout corridor will accommodate farming operations, farm equipment access and movement. Impacts to agricultural operations are rated as "**Low**" for the roundabout corridor option.

9.2.7 Environmental Impacts

The roundabout corridor will impact the existing alignment of South Brook on the south side of Route 2. Environmental impacts are rated as "**Medium**" for the roundabout corridor option.

9.2.8 Drainage and Storm Water Detention Requirements

The roundabout option results in the lowest increase of impermeable surface area (~6 ha), and as such will require the lowest volume of water to be stored. There should be ample opportunity to provide storage in new ditches to be constructed along the corridor via check dams (similar to what has been completed along other segments of the TGH). There may also be opportunity to provide some storage in existing water bodies near the existing Pitt's Memorial Drive/Commonwealth Avenue overpass. While a detailed storm water detention analysis is beyond the scope of this project, a quick check using the rational method indicates that this option would require storage volumes in the vicinity of 5,400 m^3. Drainage features other than the stormwater detention will be limited to typical infrastructure including, ditches, culverts, catch basins, ditch inlets, etc. The roundabout option is rated as **"Low"** with respect to storm water detention.

9.2.9 Structures, Overpass and Bridge Requirements

The roundabout corridor does not require the construction of new structures. Retaining walls will be required to accommodate four lanes under the existing structure at the Route 2 interchange. Structure requirements are rated as "**Low**" for the roundabout corridor option.

9.2.10 Operational Considerations

The roundabout corridor does not include any unique operational considerations. Operational considerations are rated as "**Good**" for the roundabout corridor option.

9.2.11 Project Development Costs

The opinion of probable construction cost for the roundabout corridor was refined to a Class 'C' estimate based on the detailed concept drawings. Costs do not include allowances for inflation or harmonized sales tax (HST). The cost to construct the roundabout corridor is estimated to be approximately $15.9 million; the breakdown of the opinion of probable cost has been included in Appendix J. Project Development Costs are rated as "**Low**" for the roundabout corridor option.

9.3 Option 3 Cloverleaf Interchange

The detailed concept drawing for the cloverleaf interchange is shown in Figure 12; the full-size drawing has been included in Appendix H.

In the process of refining the cloverleaf interchange option, the ramp from the Team Gushue Highway southbound to Route 2 eastbound was eliminated to improve the alignment. This particular movement can still be accommodated by travelling to the roundabout and completing a U-turn maneuver (via circulating the roundabout) to access the ramp from the Team Gushue Highway northbound to Route 2 eastbound. The traffic volumes for the movement are expected to be relatively low since travelling southbound on Team Gushue Highway to Route 2 eastbound would be considered backtracking. There are a number of routes of shorter route that are more attractive.

9.3.1 Level of Service and Capacity

Operations on Route 2 and the Team Gushue Highway segments were evaluated under the projected 2035 traffic volumes with the current four-lane cross section on Route 2 and with the proposed widening of Route 2 to three lanes in each direction west of the Route 2/Route 3 interchange. The highway capacity analysis results including density, level of service and density-to-capacity ratio are summarized in Table 36. The detailed Highway Capacity Software reports can be found in Appendix I.

In 2035, the Route 2 eastbound segments before the first off-ramp, at the first off-ramp, between the first and second off-ramp, at the second off ramp and after the on-ramp operate at LOS E during the morning peak hour. During the afternoon peak hour, the Route 2 westbound highway segments before the off-ramp operate at LOS E, all other segments operate at LOS F; the highway segment at the on-ramp and after the on ramp is shown to be over capacity.

The proposed widening to a six-lane cross section west of the interchange improves traffic operations at the interchange. During the morning peak hour, only the Route 2 eastbound segments after the on-ramp operates at LOS E. During the afternoon peak hour, the Route 2 westbound highway segments before the off-ramp, at the off-ramp, between the off ramp and the weave ramp, and after the weave operate at LOS E; highway segments are no longer shown to be over capacity. The weave highway segment operates at acceptable levels of service. Traffic operations for the cloverleaf interchange option are rated as "**Fair**" for 2035 with the proposed widening.

The highway segments that continue to operate at LOS E during the peak hours are the highway segments east of the interchange. These highway segments experience high traffic volumes travelling to/from St. Johns that would be expected without the Team Gushue Highway. It should be noted that extending the widening of Route 2 to three lanes in each direction east throughout the interchange would improve the traffic operations at the interchange to acceptable levels of service during the morning and afternoon peak hours.

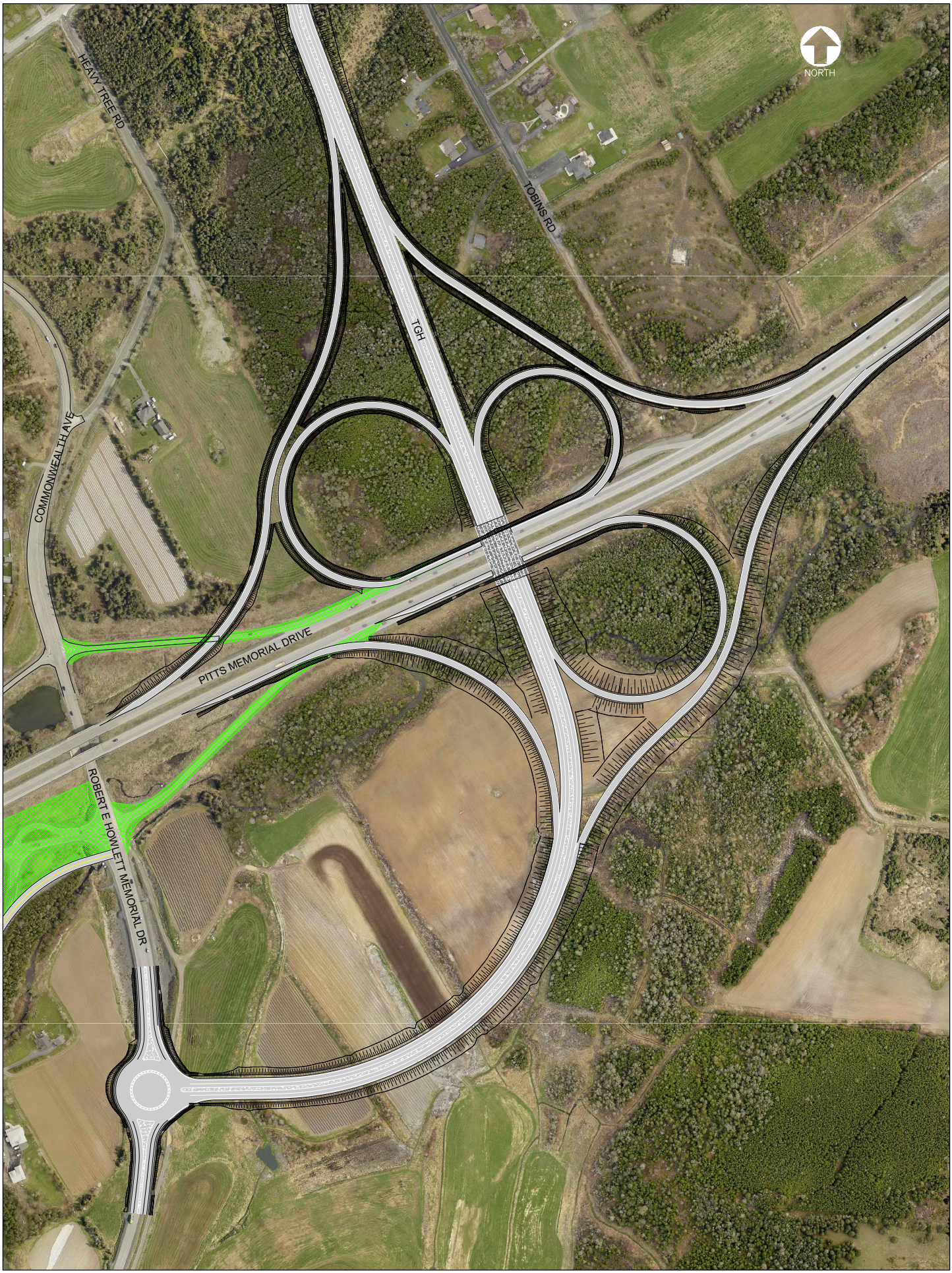

Figure 12: Option 3 Cloverleaf Interchange – Detailed Concept

Table 36: Cloverleaf Interchange Operations – Detailed Analysis

Part B - Cloverleaf Interchange													
Highway Segment		2035						2035 - Widening					
		Weekday AM Peak Hour			Weekday PM Peak Hour			Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**37.5**	**E**		**16.9**	**C**		**31.7**	**E**		**14.6**	**C**	
Basic	Freeway	43.9	E	0.99	23.8	C	0.60	26.0	C	0.66	15.9	B	0.40
Diverge	Freeway	42.3	E	0.98	26.1	C	0.60	26.3	C	0.65	16.4	B	0.40
	Ramp	38.4		0.08	23.3		0.29	25.0		0.08	17.1		0.29
Basic	Freeway	40.8	E	0.95	18.8	C	0.47	25.1	C	0.63	12.5	B	0.32
Diverge	Freeway	41.7	E	0.94	20.6	B	0.47	23.2	C	0.62	11.6	B	0.31
	Ramp	36.9		0.46	18.3		0.29	-		0.46	-		0.29
Basic	Freeway	29.6	D	0.75	13.8	B	0.35	29.6	D	0.75	13.8	B	0.35
Merge	Freeway	38.1	D	0.86	15.3	B	0.37	38.1	D	0.86	15.3	B	0.37
	Ramp	33.1		0.28	15.7		0.06	33.1		0.28	15.7		0.06
Basic	Freeway	35.6	E	0.87	14.8	B	0.37	35.6	E	0.87	14.8	B	0.37
Route 2 Westbound		**13.1**	**B**		**46.3**	**F**		**12.1**	**B**		**35.6**	**E**	
Basic	Freeway	11.6	B	0.29	39.4	E	0.93	11.6	B	0.29	39.4	E	0.93
Diverge	Freeway	12.5	B	0.29	57.9	F	0.92	12.5	B	0.29	39.8	E	0.92
	Ramp	11.6		0.03	36.5		0.08	11.6		0.03	36.5		0.08
Basic	Freeway	11.1	B	0.28	60.0	F	0.90	11.1	B	0.28	37.0	E	0.90
Weave	Freeway	12.7	B	0.36	79.7	F	0.75	12.7	B	0.36	31.6	D	0.75
Basic	Freeway	17.0	B	0.43	75.3	F	0.92	17.0	B	0.43	38.9	E	0.92
Merge	Freeway	19.4	B	0.47	56.4	F	1.06	10.5	A	0.28	22.6	C	0.60
	Ramp	19.2		0.10	40.2		0.34	-		0.10	-		0.34
Basic	Freeway	18.7	C	0.47	39.4	F	1.07	12.5	B	0.32	28.3	D	0.72
Route 3 Northbound		**26.9**	**D**		**12.3**	**B**		**26.9**	**D**		**12.3**	**B**	
Basic	Freeway	29.5	D	0.61	11.5	B	0.24	29.5	D	0.61	11.5	B	0.24
Diverge	Freeway	29.1	C	0.60	11.2	A	0.23	29.1	C	0.60	11.2	A	0.23
	Ramp	23.2		0.28	9.1		0.06	23.2		0.28	9.1		0.06
Basic	Freeway	23.4	C	0.48	10.2	A	0.21	23.4	C	0.48	10.2	A	0.21
Weave	Freeway	28.3	D	0.68	12.3	B	0.45	28.3	D	0.68	12.3	B	0.45
Basic	Freeway	25.4	C	0.52	11.0	A	0.23	25.4	C	0.52	11.0	A	0.23
Merge	Freeway	25.0	C	0.53	12.1	B	0.26	25.0	C	0.53	12.1	B	0.26
	Ramp	21.3		0.03	11.8		0.08	21.3		0.03	11.8		0.08
Basic	Freeway	26.0	C	0.54	12.7	B	0.26	26.0	C	0.54	12.7	B	0.26
Route 3 Southbound		**4.8**	**A**		**19.5**	**C**		**4.8**	**A**		**19.5**	**C**	
Basic	Freeway	5.4	A	0.11	20.9	C	0.43	5.4	A	0.11	20.9	C	0.43
Diverge	Freeway	5.3	A	0.11	20.6	B	0.42	5.3	A	0.11	20.6	B	0.42
	Ramp	4.6		0.10	16.8		0.34	4.6		0.10	16.8		0.34
Basic	Freeway	3.2	A	0.07	13.5	B	0.28	3.2	A	0.07	13.5	B	0.28
Merge	Freeway	3.6	A	0.08	16.8	B	0.36	3.6	A	0.08	16.8	B	0.36
	Ramp	5.1		0.03	14.7		0.19	5.1		0.03	14.7		0.19
Basic	Freeway	3.8	A	0.08	17.5	B	0.36	3.8	A	0.08	17.5	B	0.36
Merge	Freeway	5.4	A	0.11	23.0	B	0.48	5.4	A	0.11	23.0	B	0.48
	Ramp	6.4		0.08	19.2		0.29	6.4		0.08	19.2		0.29
Basic	Freeway	5.6	A	0.12	23.9	C	0.49	5.6	A	0.12	23.9	C	0.49

9.3.2 Traffic Conflict Points

The cloverleaf interchange option has a total of 47 conflict points, broken down as follows:

- The Team Gushue Highway has a total of 8 conflict points (4 merging, 3 diverging and 1 weaving).
- Route 2 has a total of 8 conflict points (3 merging, 4 diverging and 1 weaving).
- The Route 3 and Team Gushue Highway roundabout has a total of 18 conflict points (6 merging, 6 diverging and 6 crossing).
- The intersection of Commonwealth Avenue and the Route 2 WB On-Ramp has a total of 4 conflict points (1 merging, 2 diverging and 1 crossing).
- The intersection of Heavy Tree Road has a total of 9 conflict points (3 merging, 3 diverging and 3 crossing).

Traffic conflicts are rated as "**Medium**" for the cloverleaf interchange option.

9.3.3 Construction Sequence and Traffic Impacts

The following general construction staging sequence should be used to construct the cloverleaf interchange:

1. Construct ramps and cloverleaf segments north and south of Route 2
2. Construct the roundabout
3. Construct new structure over Route 2 and ramp connections
4. Remove obsolete ramps at the Route 2 and Commonwealth Avenue interchange

The proposed construction staging sequence will minimize traffic impacts. During the first stage, normal operations will continue on Route 2 while the cloverleaf segments north and south of Route 2 two are completed. Stage two will only impact traffic on Robert E. Howlett Memorial Drive while the roundabout is constructed, the roundabout construction should be stage to maintain one lane in each direction. Stage three will require the closure of Route 2 and have the most significant impacts on traffic, during this stage all Route 2 traffic will need to be diverted using temporary route connections that utilize existing ramps, the roundabout and the new cloverleaf ramps. During stage four the cloverleaf interchange should be fully operational, the removal of obsolete ramps will not have a significant impact of traffic. Construction impacts are rated as "**Medium**" for the cloverleaf interchange option.

9.3.4 Land/Property Requirements

The land acquisition estimates were refined based on the detailed concept drawing, approximately 74.4 hectares of land is required to construct the cloverleaf interchange. The land acquisition includes approximately 19.1 hectares of rural residential infill (RRI) and rural (R) land and approximately 55.3 hectares of agricultural land (AG). Land acquisition is rated as "**High**" for the cloverleaf interchange option.

9.3.5 Private Property Access Impacts

The cloverleaf interchange will eliminate the existing access to agricultural fields south of the Route 2 located that the Route 3/Commonwealth Avenue and Route 2 Eastbound Ramps intersection. However, the fields accessed from this location are included in the cloverleaf interchange footprint and are included in the land acquisition. The remaining fields are accessed through other existing locations including Ruby

Place and Silas Road. The cloverleaf interchange will not impact access to private properties north of Route 2. Impacts to access are rated as "**Low**" for the cloverleaf interchange option.

9.3.6 Agricultural Operations Impacts

The cloverleaf interchange will have a significant impact on land currently used for agricultural, particularly on the south side of Route 2. However, the cloverleaf interchange will accommodate remaining farming operations, farm equipment access and movement. Impacts to agricultural operations are rated as "**Medium**" for the cloverleaf interchange option.

9.3.7 Environmental Impacts

The cloverleaf interchange will impact the existing alignment of South Brook on the south side of Route 2. Environmental impacts are rated as "**Medium**" for the cloverleaf interchange option.

9.3.8 Drainage and Storm Water Detention Requirements

The cloverleaf option results in the highest increase of impermeable surface area (~8.4 ha), and as such will require the highest volume of water to be stored. There should be ample opportunity, however to provide storage in new ditches to be constructed along the corridor via check dams (similar to what has been completed along other segments of the TGH). There may also be opportunity to provide some storage in existing water bodies near the existing Pitt's Memorial Drive/Commonwealth Avenue overpass. While a detailed storm water detention analysis is beyond the scope of this project, a quick check using the rational method indicates that this option would require storage volumes in the vicinity of 7,500 m^3. Drainage features other that the stormwater detention will be limited to typical infrastructure including, ditches, culverts, catch basins, ditch inlets, etc. The cloverleaf option is rated as **"Medium"** with respect to storm water detention.

9.3.9 Structures, Overpass and Bridge Requirements

The cloverleaf interchange will require the construction of two new structures including:

- a structure over Route 2, and
- a structure over Brookfield Road.

In addition, cloverleaf interchange will require maintaining the existing structure on Route 2 to accommodate access to/from Mount Pearl. Structures requirements are rated as "**Medium**" for the cloverleaf interchange option.

9.3.10 Operational Considerations

The cloverleaf interchange does not reflect a traditional cloverleaf structure. When refining the option, the ramp from the Team Gushue Highway southbound to Route 2 eastbound was eliminated to improve the alignment. The movement can still be accommodated by travelling to the roundabout and completing a U-turn maneuver to access the ramp from the Team Gushue Highway northbound to Route 2 eastbound. Operational considerations are rated as "**Fair**" for the cloverleaf interchange option.

9.3.11 Project Development Costs

The opinion of probable construction cost for the cloverleaf interchange was refined to a Class 'C' estimate based on the detailed concept drawings. Costs do not include allowances for inflation or harmonized sales tax (HST). The cost to construct the cloverleaf interchange is estimated to be approximately $57.1 million; the breakdown of the opinion of probable cost has been included in Appendix J. Project development costs are rated as "**Medium**" for the cloverleaf interchange option.

9.4 Option 5 Route 2/3 Interchange Flyover

The detailed concept drawing for the Route 2/3 interchange flyover is shown in Figure 13; the full-size drawing has been included in Appendix H.

When refining the Route 2/3 interchange flyover option, a new off-ramp was added from the Team Gushue Highway southbound to the Route 3 and Route 2 WB Ramps roundabout. The new ramp eliminates the high volumes of traffic travelling to Commonwealth Avenue from the weave segment. This also reduces the complexity of the interchange configuration.

9.4.1 Level of Service and Capacity

Operations on Route 2 and the Team Gushue Highway segments were evaluated under the projected 2035 traffic volumes with the current four-lane cross section on Route 2 and with the proposed widening of Route 2 to three lanes in each direction west of the Route 2/Route 3 interchange. The highway capacity analysis results including density, level of service and density-to-capacity ratio are summarized in Table 37. The detailed Highway Capacity Software reports can be found in Appendix I.

In 2035, the Route 2 eastbound segments before the off-ramp, at the off-ramp and after the on-ramp operate at LOS E during the morning peak hour. During the afternoon peak hour, the Route 2 westbound highway segment before the off-ramp operate at LOS E, all other segments operate at LOS F; the highway segments at the on-ramp and after the on ramp are shown to be over capacity.

The proposed widening to a six-lane cross section west of the interchange improves traffic operations at the interchange. During the morning peak hour, only the Route 2 eastbound segments after the on-ramp operate at LOS E. During the afternoon peak hour, the Route 2 westbound highway segments before the off-ramp, at the off-ramp, between the off ramp and the weave ramp, and after the weave operate at LOS E; highway segments are no longer shown to be over capacity. The weave highway segments operate at acceptable levels of service. Traffic operations for the Route 2/3 interchange flyover option are rated as "**Fair**" for 2035 with the proposed widening.

The highway segments that continue to operate at LOS E during the peak hours are the highway segments and east of the interchange. These highway segments experience high traffic volumes travelling to/from St. Johns that would be expected without the Team Gushue Highway. It should be noted that extending the widening of Route 2 to three lanes in each direction east throughout the interchange would improve the traffic operations at the interchange to acceptable levels of service during the morning and afternoon peak hours.

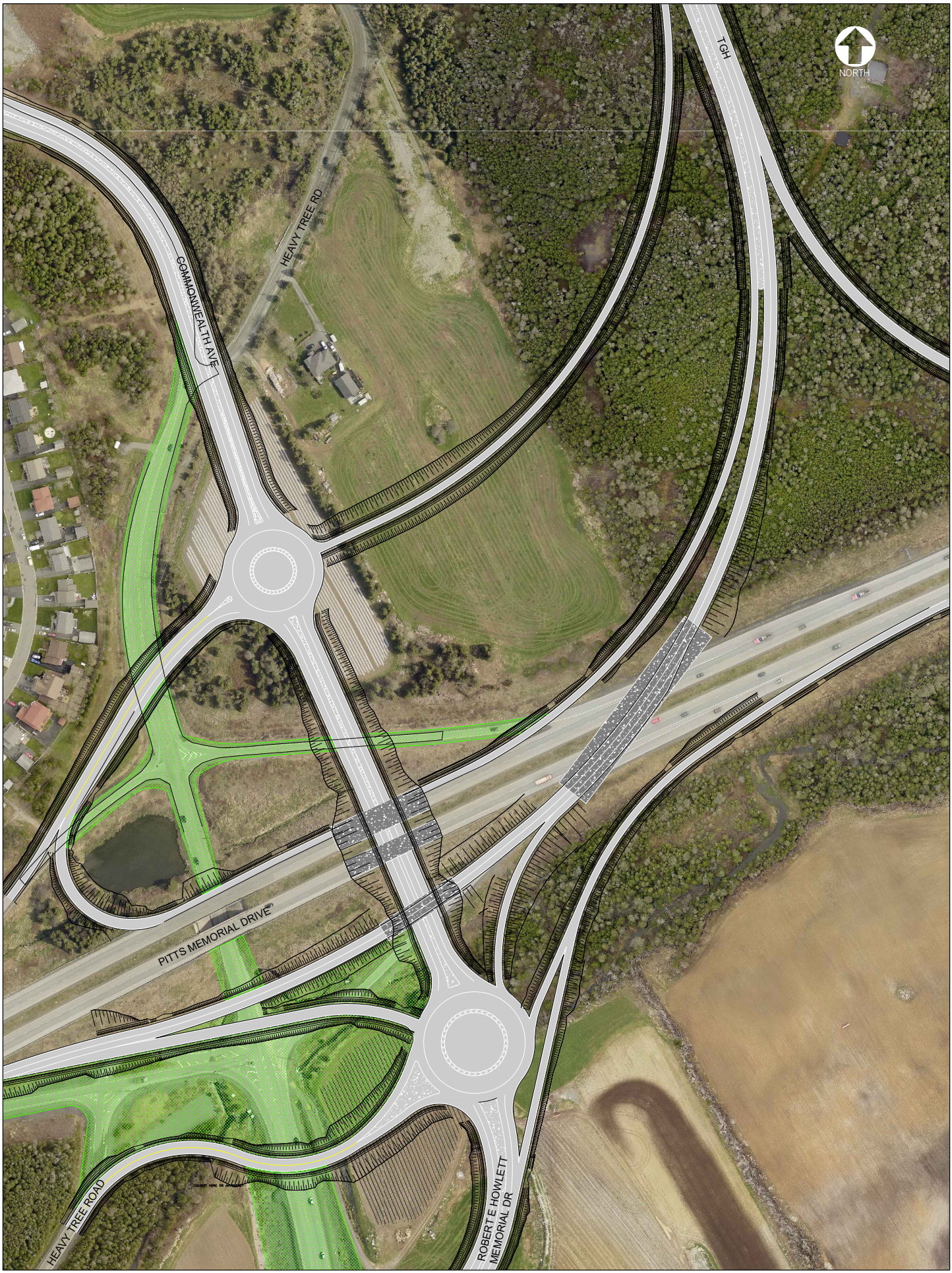

Figure 13: Option 5 Route 2/Route 3 Interchange Flyover – Detailed Concept

Table 37: Route 2/3 Interchange Flyover Operations – Detailed Analysis

Part B - Route 2/3 Interchange Flyover													
Highway Segment		2035						2035 - Widening					
		Weekday AM Peak Hour			Weekday PM Peak Hour			Weekday AM Peak Hour			Weekday PM Peak Hour		
		Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c	Density (pc/mi/ln)	LOS	d/c
Route 2 Eastbound		**36.0**	**E**		**16.1**	**C**		**32.6**	**E**		**14.8**	**C**	
Basic	Freeway	43.9	E	0.99	23.8	C	0.60	26.0	C	0.66	15.9	B	0.40
Diverge	Freeway	43.6	E	0.98	26.6	C	0.60	24.1	C	0.65	14.7	B	0.39
	Ramp	38.6		0.54	23.5		0.58	-		0.54	-		0.58
Basic	Freeway	29.6	D	0.75	13.8	B	0.35	29.6	D	0.75	13.8	B	0.35
Merge	Freeway	38.0	D	0.86	15.2	B	0.37	38.0	D	0.86	15.3	B	0.37
	Ramp	33.3		0.28	15.8		0.06	33.3		0.28	17.2		0.06
Basic	Freeway	35.5	E	0.87	14.7	B	0.37	35.5	E	0.87	14.7	B	0.37
Route 2 Westbound		**12.2**	**B**		**46.7**	**F**		**11.1**	**B**		**36.0**	**E**	
Basic	Freeway	11.6	B	0.29	39.4	E	0.93	11.6	B	0.29	39.4	E	0.93
Diverge	Freeway	12.5	B	0.29	57.0	F	0.92	12.5	B	0.29	39.8	E	0.92
	Ramp	10.5		0.03	35.5		0.08	10.5		0.03	35.5		0.08
Basic	Freeway	11.1	B	0.28	61.3	F	0.90	11.1	B	0.28	37.0	E	0.90
Weave	Freeway	8.4	A	0.24	80.1	F	0.78	8.4	A	0.24	33.3	D	0.78
Basic	Freeway	12.2	B	0.31	71.8	F	0.95	12.2	B	0.31	41.0	E	0.95
Merge	Freeway	19.4	B	0.47	56.4	F	1.06	7.6	A	0.20	23.3	C	0.62
	Ramp	18.9		0.37	40.2		0.27	-		0.37	-		0.27
Basic	Freeway	18.7	C	0.47	39.2	F	1.07	12.5	B	0.32	28.3	D	0.72
Route 3 Northbound		**18.5**	**C**		**9.4**	**B**		**18.5**	**C**		**9.4**	**B**	
Basic	Freeway	9.4	A	0.24	10.0	A	0.25	9.4	A	0.24	10.0	A	0.25
Diverge	Freeway	10.2	B	0.24	11.0	B	0.25	10.2	B	0.24	11.0	B	0.25
	Ramp	11.0		0.08	11.6		0.28	11.0		0.08	11.6		0.28
Basic	Freeway	8.0	A	0.20	5.1	A	0.13	8.0	A	0.20	5.1	A	0.13
Merge	Freeway	20.8	C	0.50	8.9	B	0.22	20.8	C	0.50	8.9	B	0.22
	Ramp	20.2		0.69	10.5		0.21	20.2		0.69	10.5		0.21
Basic	Freeway	20.1	C	0.51	8.7	A	0.22	20.1	C	0.51	8.7	A	0.22
Merge	Freeway	21.4	C	0.51	10.3	B	0.25	21.4	C	0.51	10.3	B	0.25
	Ramp	21.3		0.03	11.8		0.08	21.3		0.03	11.8		0.08
Basic	Freeway	20.6	C	0.52	10.1	A	0.25	20.6	C	0.52	10.1	A	0.25
Route 3 Southbound		**4.7**	**A**		**18.2**	**C**		**4.7**	**A**		**18.2**	**C**	
Basic	Freeway	5.3	A	0.11	20.8	C	0.43	5.3	A	0.11	20.8	C	0.43
Diverge	Freeway	5.2	A	0.11	20.8	B	0.42	5.2	A	0.11	20.8	B	0.42
	Ramp	1.2		0.15	13.4		0.63	1.2		0.15	13.4		0.63
Basic	Freeway	2.0	A	0.04	7.0	A	0.14	2.0	A	0.04	7.0	A	0.14

9.4.2 Traffic Conflict Points

The interchange flyover option has a total of 47 conflict points, broken down as follows:

- The Team Gushue Highway has a total of 4 conflict points (2 merging and 2 diverging).
- Route 2 has a total of 7 conflict points (3 merging, 3 diverging and 1 weaving).
- The Route 3 and Route 2 WB/Team Gushue Highway SB roundabout has a total of 17 conflict points (7 merging, 5 diverging and 5 crossing).
- The Route 3 and Route 2 EB/Team Gushue Highway NB roundabout has a total of 19 conflict points (7 merging, 8 diverging and 4 crossing).

Traffic conflicts are rated as "**Medium**" for the flyover interchange option.

9.4.3 Construction Impacts

The following general construction staging sequence should be used to construct the cloverleaf interchange:

1. Construct roundabout, ramp and flyover segments north and south of Route 2 that do not affect existing interchange operations.
2. Construct new Commonwealth Avenue alignment and structure over Route 2
3. Construct new flyover structure over Route 2

The proposed construction staging sequence will minimize traffic impacts. During the first stage, normal operations will continue on Route 2 and Commonwealth Avenue while ramp and flyover segments north and south of Route 2 two are completed. This will include partial construction of the roundabouts, with no connections to Commonwealth Avenue and Robert E. Howlett Memorial Drive.

Stages two and three will require the closure of Route 2 and have the most significant impacts on traffic during construction. During these stage all Route 2 traffic will need to be diverted using temporary route connections that utilize both existing and new ramps. Construction impacts are rated as "**High**" for the flyover interchange option.

9.4.4 Land/Property Requirements

The land acquisition estimates were refined based on the detailed concept drawing, approximately 25.6 hectares of land is required to construct the Route 2/3 interchange flyover. The land acquisition includes approximately 20.3 hectares of rural residential infill (RRI) and rural (R) land and approximately 5.3 hectares of agricultural land (AG). Land acquisition is rated as "**Medium**" for the flyover interchange option.

9.4.5 Private Property Access Impacts

The flyover interchange will eliminate the existing access to agricultural fields south of the Route 2 located that the Route 3/Commonwealth Avenue and Route 2 Eastbound Ramps intersection. A portion of the fields accessed from this location are included in the flyover interchange footprint and are included in the land acquisition. A new access similar to the existing access along Robert E. Howlett Memorial Drive could be accommodated along the new alignment. The flyover interchange will not impact access to private

properties north of Route 2. All accesses can be maintained on the remaining segment of Heavy Tree Road. Impacts to access are rated as "**Low**" for the flyover interchange option.

9.4.6 Agricultural Operations Impacts

The flyover interchange will have a moderate impact on land currently used for agricultural, particularly on the south side of Route 2. However, the flyover interchange will accommodate remaining farming operations, farm equipment access and movement. Impacts to agricultural operations are rated as "**Low**" for the flyover interchange option.

9.4.7 Environmental Impacts

The flyover interchange will impact the existing alignment of South Brook on the south side of Route 2. Environmental impacts are rated as "**Medium**" for the flyover interchange option.

9.4.8 Drainage and Storm Water Detention Requirements

The flyover interchange option results in a net increase of impermeable surface area of approximately ~6.3 ha. There should be ample opportunity to provide storage in new ditches to be constructed along the corridor via check dams (similar to what has been completed along other segments of the TGH). There may also be opportunity to provide some storage in existing water bodies near the existing Pitt's Memorial Drive/Commonwealth Avenue overpass. While a detailed storm water detention analysis is beyond the scope of this project, a quick check using the rational method indicates that this option would require storage volumes in the vicinity of 6,500 m^3. Drainage features other that the stormwater detention will be limited to typical infrastructure including, ditches, culverts, catch basins, ditch inlets, etc. The flyover interchange option is rated as **"Medium"** with respect to storm water detention.

9.4.9 Structures, Overpass and Bridge Requirements

The flyover interchange will require the construction of two new structures including:

- two structures over Route 2,
- a structure over the new alignment of Commonwealth Avenue, and
- a structure over Brookfield Road.

The flyover interchange will not require maintaining the existing structure on Route 2. Structures requirements are rated as "**High**" for the flyover interchange option.

9.4.10 Operational Considerations

The flyover interchange does not include any unique operational considerations. However, in the interchange configuration introduces a level of complexity that may not be expected by drivers. Operational considerations are rated as "**Fair**" for the flyover interchange option.

9.4.11 Project Development Costs

The opinion of probable construction cost for the Route 2/3 interchange flyover was refined to a Class 'C' estimate based on the detailed concept drawings. Costs do not include allowances for inflation or harmonized sales tax (HST). The cost to construct the Route 2/3 interchange flyover is estimated to be

approximately $71.4 million; the breakdown of the opinion of probable cost has been included in Appendix J. Project development costs are rated as "**High**" for the flyover interchange option.

9.5 Comprehensive Options Evaluation

The top three options were evaluated and ranked based on evaluation criteria described in Section 9.1, including:

- Level of service and capacity
- Traffic conflict points
- Construction staging sequence, duration and traffic impacts
- Land/property requirements
- Interface/access points with private property owners
- Ability to accommodate farming operations
- Environmental considerations
- Drainage and storm water detention requirements
- Structures, overpass and bridge requirements
- Unique operational considerations
- Project development costs

The matrix developed to assess and compare the options is detailed in Table 38. Each option was rated as described in Section 9.2 to 9.4 and given a total score out of 100 points. The total score was used to rank the preliminary options and identify the preferred option for the reconfiguration of the Team Gushue Highway connection to Route 2. **Option 2 Roundabout Corridor was identified as the preferred option.**

Table 38: Comprehensive Options Evaluation Matrix

							
Criteria	**Max Points**	**Option 2 Roundabout Corridor**		**Option 3 Cloverleaf Interchange**		**Option 5 Route 2/3 Interchange Flyover**	
		Rating	**Score**	**Rating**	**Score**	**Rating**	**Score**
Level of Service and Capacity	**10**	Fair	5	Fair	5	Fair	5
Traffic Conflict Points	**10**	High	0	Medium	5	Medium	5
Construction Sequence and Traffic Impacts	**10**	Low	10	Medium	5	High	0
Land/Property Requirements	**10**	Low	10	High	0	Medium	5
Private Property Access Impacts	**5**	Low	5	Low	5	Low	5
Agricultural Operations Impacts	**5**	Low	5	Medium	2.5	Low	5
Environmental Impacts	**10**	Medium	5	Medium	5	Medium	5
Drainage/Stormwater Requirements	**10**	Low	10	Medium	5	Medium	5
Structures Requirements	**5**	Low	5	Medium	2.5	High	0
Operational Considerations	**5**	Good	5	Fair	2.5	Fair	2.5
Project Development Costs	**20**	Low	20	Medium	10	High	0
Total	**100**	**80**		**47.5**		**37.5**	
Rank		**1**		**2**		**3**	

9.5.1 Roundabout Traffic Conflict Points

Traffic conflict points was one of 11 criteria used in the comprehensive options evaluation matrix and while the total score for the roundabout corridor option far exceeded the cloverleaf and flyover options, the roundabout corridor option scored 0 traffic conflict points in the comprehensive options evaluation due to the highest number of conflicts points. Safety is of course, a critical consideration and the recommended solution must be acceptable from a safety perspective. None of these options will eliminate collisions, however, one of the advantages that roundabouts have is that collisions which do occur, occur at lower speeds and are of a type that are less conducive to serious injury and/or fatality.

As outlined in Section 9.1, the traffic conflict points evaluation criterion considered the number of intersection and highway conflict points:

> *Traffic Conflict Points (maximum 10 points): considers the number of intersection and highway conflict points. Traffic conflicts points for each option is rated as high/medium/low, where:*
>
> - *High (0 points): the option has more than 50 conflict points.*
> - *Medium (5 points): the option has between 25 and 50 conflict points.*
> - *Low (10 points): the option has less than 25 conflict points.*

This metric, considers only the number of conflict points, not the type/severity of collision, nor a prediction of collision frequency. Modern roundabouts are generally regarded as one of the safest types of intersection control in the world. The US Federal Highway Administration recognizes modern roundabouts as a “proven safety countermeasure” because they can substantially reduce collisions that result in serious injury or death. Compared to other at-grade intersections such as traffic signals, there are fewer conflict points at roundabouts. Figure 14 compares a single lane roundabout (i.e. one lane per approach/exit) to a typical 4-way intersection (also with one lane per approach/exit).

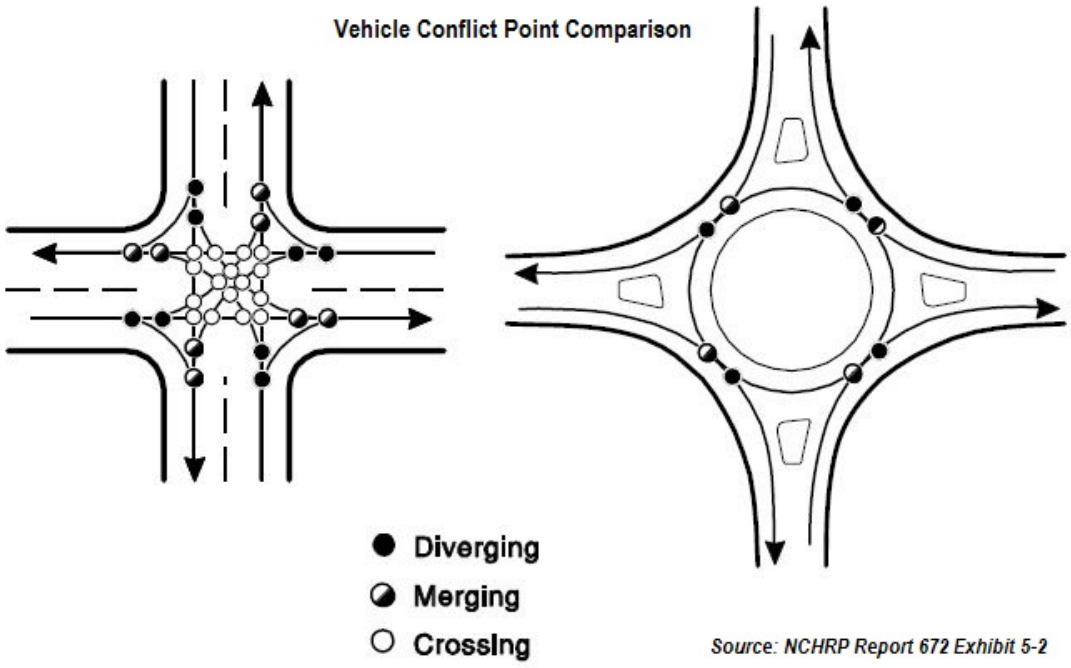

Figure 14: Comparison of Conflict Points at At-Grade Intersections

When compared to primarily grade separated options like the cloverleaf and flyover, as is the case in the comprehensive options evaluation, the roundabout corridor option has more conflict points. However, the cloverleaf and flyover options have a greater number of high-speed highway conflict points which are more conducive to serious injury and/or fatal collisions, and the cloverleaf interchange has stop-controlled intersection conflict points which while at lower speed are more conducive to serious injury and/or fatal collision types than roundabouts. A breakdown of conflict points by highway and intersection type for each option is shown in Table 39.

Table 39: Highway and Intersection Conflict Points

Conflict Points	Option 2 Roundabout Corridor	Option 3 Cloverleaf Interchange	Option 5 Route 2/3 Interchange Flyover
Highway *Higher speeds, higher severity*	4	16	11
Roundabout *Lower speeds, lower severity*	60	18	36
Stop Controlled Intersection *Lower speeds, higher severity*	-	13	-
Total Conflict Points	**64**	**47**	**47**

Unfortunately, collisions are a reality, and a critical component of transportation engineering involves mitigating not only the frequency, but the severity of these collisions. People using the road (drivers, pedestrians and cyclists alike) make mistakes, they always have and likely always will. A mistake made at a traditional intersection, like running a stop sign or a red light, can have serious and sometimes fatal consequences. Modern roundabouts however, can reduce the number of conflict points (in some cases) and the severity of collisions by incorporate geometric design features that require a reduction of speed.

Another point of note is that a 2019 IIHS study also showed that the safety of multi-lane roundabouts improves over time, as drivers become more familiar with them (Hu & Cicchino, 2019). The researchers looked at roundabouts built in Washington State between 2009 and 2015. They found that collisions at two-lane roundabouts decreased at an average of 9 percent a year.

10 Microsimulation

PTV Vissim 2021 is a microscopic multi-modal traffic flow simulation software package. PTV Vissim was used to develop microsimulation models for the preferred option, to simulate vehicular traffic flow and confirm the results of the traffic analysis.

In the traffic analysis, Arcady was used to model the intersections individually and while the queue length results from the various analyses are a good indicator of interactions between adjacent intersections, microscopic simulation models of the entire corridor were used to confirm the results of the intersection performance analysis. Microsimulation models were developed for the following road network configurations:

- 2025 (AM/PM) Interim Configuration:
- 2035 (AM/PM) Ultimate Configuration: 3-lane entries NB

10.1 2025

The 2025 morning peak hour model confirms that the roundabouts at the Route 2 interchange will operate at acceptable levels of service with average queue lengths of less than 25 metres. No interactions were identified between the two closely spaced roundabouts the Route 2 interchange.

The Team Gushue Highway and Commonwealth Avenue/Brookfield Road roundabout will operate at acceptable levels of service with average queue lengths of less than 75 metres. The model indicates the potential for longer delays on the Route 3 northbound approach and the lower volume Brookfield Road approach due to volume imbalances on the roundabout approaches. These approaches are affected by high volumes on the Commonwealth Avenue eastbound approach which experience almost free flow conditions entering the roundabout due to low volumes on the Route 3 southbound approach. Should significant or delays or queues materialize on the northbound approach, the third entry lane could be implemented prior to 2035.

The 2025 afternoon peak hour model confirms that the roundabout corridor will operate at acceptable levels of service with average queue lengths of less than 20 metres on all roundabout approaches.

Figure 15: Microsimulation AM Peak Hour (2025)

10.2 2035

The 2035 morning peak hour model confirms that the roundabouts at the Route 2 interchange will operate at acceptable levels of service with average queue lengths of less than 15 metres with the exception of the northbound approach at the Route 3 and Route 2 Eastbound Ramps roundabout. The model indicates the potential for longer delays and significant queues on the Route 3 northbound approach due to volume imbalances on the roundabout approaches. The Route 3 NB approach is affected by high volumes on the Route 2 eastbound off-ramp approach which experiences almost free flow conditions entering the

roundabout due to low volumes on the Route 3 southbound approach. No interactions were identified between the two closely spaced roundabouts the Route 2 interchange.

The Team Gushue Highway and Commonwealth Avenue/Brookfield Road roundabout will operate at acceptable levels of service with average queue lengths of less than 30 metres. The model indicates the potential for longer delays on the lower volume Brookfield Road approach due to volume imbalances on the roundabout approaches.

The 2035 afternoon peak hour model confirms that the roundabouts at the Route 2 interchange will operate at acceptable levels of service with average queue lengths of less than 40 metres with the exception of the eastbound approach at the Route 3 and Route 2 Eastbound Ramps roundabout. The model indicates the potential for longer delays and queues on the Route 2 eastbound off ramp approach due to volume imbalances on the roundabout approaches. This approach is affected by high volumes on the southbound approach which experiences almost free flow conditions entering the roundabout due to low volumes of conflicting traffic circulating in the roundabout. No interactions were identified between the two closely spaced roundabouts the Route 2 interchange.

The Team Gushue Highway and Commonwealth Avenue/Brookfield Road roundabout will operate at acceptable levels of service with average queue lengths of less than 55 metres. The model indicates the potential for longer delays on the lower volume Brookfield Road approach due to volume imbalances on the roundabout approaches.

Should the 2035 traffic volumes materialize as projected in this study ramp metering may be required at the Route 3 and Route 2 Eastbound Ramps roundabout.

Essentially, the micro simulation shows that the roundabout corridor will function effectively for the present day and projected 2025 volumes. The model is based on the average of several ‘runs’ which account for different scenarios with respect to the time intervals at which vehicles arrive at the intersection. While the average queue lengths are acceptable, some of the runs did indicate that long queue lengths could materialize in certain situations. This can be resolved for the 2025 volumes by introducing the third lanes that are required for the 2035 volumes. For the 2035 scenario, the overall capacity and average queue lengths are acceptable. As noted however, imbalanced volumes can result in long queue lengths on some approaches in some scenarios. Should the 2035 volumes materialize, signalized ramp metering could resolve the imbalance issue.

10.3 Modelling of Circulatory Lanes

Third entry lanes are required to accommodate 2035 volumes on the northbound approach of the Team Gushue Highway and Commonwealth Avenue/Brookfield Road roundabout and the northbound approach of the Route 3 and Route 2 Westbound Ramps roundabout. The third entry lanes are shown in Figure 5 and Figure 11 and are referenced in Section 10.1 and 10.2. However, the concept drawings do not show the detailed circulatory lane configurations throughout the roundabouts.

No third entry is required at the Route 3 and Route 2 Eastbound Ramps roundabout; however, a third circulatory lane is depicted in the microsimulation model between the Route 2 Eastbound Off-Ramp and the Route 3 south approach as shown in Figure 16.

The roundabout was modelled with a third circulatory lane to allow dual lane entries to complete a left turn maneuver from the Route 2 Eastbound Off-Ramp to the Route 3 north approach while also maintaining dual lane entries for the southbound through on Route 3. While this may not be an accurate representation of the final circulatory configuration which will be established in the detailed design phase, it does simulate the correct operation of the roundabout.

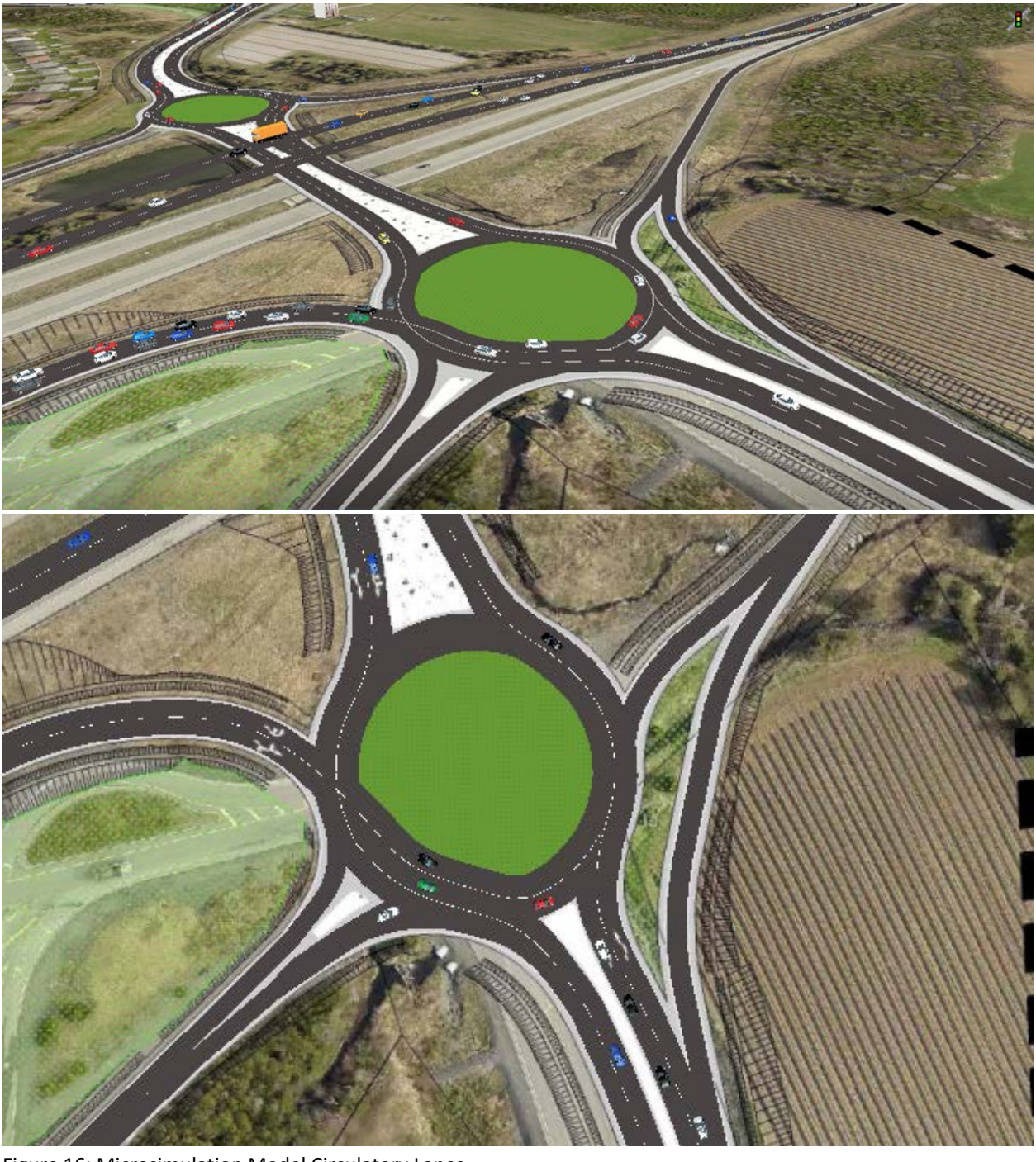

Figure 16: Microsimulation Model Circulatory Lanes

11 Part C: Team Gushue Highway Interchange with Topsail Road

11.1 Existing Operations (2020)

The existing traffic operations at the Topsail Road Interchange were evaluated. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 40. The detailed Synchro and SimTraffic reports can be found in Appendix K.

The signalized intersection operates at an overall acceptable level of service during the morning peak hour. While all movements operate at acceptable levels of service in Synchro, SimTraffic shows the northbound through movement (Dunn's Road) operating at LOS E. The 95th% queue lengths for the northbound left and right movements indicate that queues exceed the storage capacity of the left turn and right turn lanes during the morning peak hour.

The signalized intersection also operates at an overall acceptable level of service during the afternoon peak hour. Synchro shows the southbound through and right movements (Team Gushue Highway Ramps) operating at LOS E, while SimTraffic shows the southbound through movement operating at LOS F and the southbound right movement operating at LOS E. The 95th% queue lengths for the northbound right (Dunn's Road) and southbound left (Team Gushue Highway Ramps) movements indicate that queues exceed the storage capacity of the right turn and left turn lanes during the afternoon peak hour.

Table 40: Topsail Road Interchange Intersection Operations - Existing (2020)

Topsail Road Interchange		Weekday AM Peak Hour							
Intersection		2020							
		Volume (veh/hr)	Synchro				SimTraffic		
			Delay (s/veh)	LOS	v/c	95th%ile Queue (m)	Delay (s/veh)	LOS	95th%ile Queue (m)
Topsail Road & Dunns Road/TGH Ramps		**2532**	**26.1**	**C**			**29.1**	**C**	
Topsail Road	EB-L	102	19.0	B	0.28	22.6	22.8	C	27.8
	EB-T	456	28.5	C	0.43	54.0	26.3	C	57.6
	EB-R	49	0.3	A	0.09	0.0	3.0	A	1.7
	WB-L	151	22.4	C	0.45	32.2	23.4	C	36.4
	WB-T	439	27.0	C	0.38	52.1	24.3	C	53.3
	WB-R	214	5.1	A	0.33	16.1	4.5	A	12.7
Dunns Road	NB-L	76	17.6	B	0.19	17.2	40.5	D	82.0
	NB-T	435	48.8	D	0.86	125.0	57.4	E	140.6
	NB-R	242	12.5	B	0.45	32.8	30.7	C	53.2
Team Gushue Highway Ramps	SB-L	144	29.8	C	0.62	29.9	33.2	C	41.1
	SB-T	110	22.1	C	0.39	47.0	28.9	C	39.1
	SB-R	114					3.9	A	

Topsail Road Interchange		Weekday PM Peak Hour							
Intersection		2020							
		Volume (veh/hr)	Synchro				SimTraffic		
			Delay (s/veh)	LOS	v/c	95th%ile Queue (m)	Delay (s/veh)	LOS	95th%ile Queue (m)
Topsail Road & Dunns Road/TGH Ramps		**3121**	**34.7**	**C**			**37.9**	**D**	
Topsail Road	EB-L	140	25.7	C	0.45	33.3	25.7	C	35.4
	EB-T	485	41.1	D	0.55	74.5	38.0	D	66.6
	EB-R	150	4.1	A	0.29	10.4	6.5	A	31.7
	WB-L	364	43.7	D	0.87	106.9	37.2	D	98.8
	WB-T	570	31.6	C	0.49	76.8	25.7	C	64.4
	WB-R	168	5.1	A	0.26	14.9	3.9	A	0.0
Dunns Road	NB-L	49	24.8	C	0.32	14.4	31.5	C	32.3
	NB-T	226	34.2	C	0.43	65.7	34.7	C	90.8
	NB-R	299	5.4	A	0.46	19.1	7.0	A	51.7
Team Gushue Highway Ramps	SB-L	104	22.3	C	0.27	26.5	36.7	D	199.3
	SB-T	490	64.6	E	0.95	207.1	92.5	F	188.7
	SB-R	76					68.8	E	

11.2 TGH Connection (2020)

Operations at the signalized intersection were evaluated under the projected 2020 traffic volumes. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 41. The detailed Synchro and SimTraffic reports can be found in Appendix K.

The changes in travel patterns caused by the full opening of the Team Gushue Highway will improve operations at the intersection. All movements at the signalized intersection will operate at acceptable levels of service during both the morning and afternoon peak hours. The 95th% queue lengths for the northbound right movement (Dunn's Road) indicate that queues may exceed the storage capacity of the right turn lane during the morning peak hour.

Table 41: Topsail Road Interchange Intersection Operations - TGH Connection (2020)

Topsail Road Interchange		Weekday AM Peak Hour							
Intersection		2020							
		Volume (veh/hr)	Synchro				SimTraffic		
			Delay (s/veh)	LOS	v/c	95th%ile Queue (m)	Delay (s/veh)	LOS	95th%ile Queue (m)
Topsail Road & Dunns Road/TGH Ramps		**2464**	**22.5**	**C**			**21.6**	**C**	
Topsail Road	EB-L	41	15.7	B	0.10	11.1	18.8	B	15.2
	EB-T	456	25.8	C	0.41	54.0	24.6	C	58.3
	EB-R	49	0.3	A	0.09	0.0	3.1	A	0.0
	WB-L	151	19.6	B	0.41	32.2	21.4	C	34.2
	WB-T	417	22.7	C	0.32	49.4	19.5	B	49.3
	WB-R	276	4.7	A	0.37	17.9	4.8	A	12.9
Dunns Road	NB-L	76	18.6	B	0.22	17.2	23.6	C	53.9
	NB-T	322	41.8	D	0.75	82.5	36.4	D	113.2
	NB-R	242	8.3	A	0.46	21.9	10.8	B	53.7
Team Gushue Highway Ramps	SB-L	203	36.7	D	0.73	42.9	42.5	D	64.7
	SB-T	95	21.6	C	0.45	45.1	28.7	C	39.1
	SB-R	136					4.0	A	
Topsail Road Interchange		**Weekday PM Peak Hour**							
Intersection		2020							
		Volume (veh/hr)	Synchro				SimTraffic		
			Delay (s/veh)	LOS	v/c	95th%ile Queue (m)	Delay (s/veh)	LOS	95th%ile Queue (m)
Topsail Road & Dunns Road/TGH Ramps		**2967**	**22.9**	**C**			**20.4**	**C**	
Topsail Road	EB-L	140	18.4	B	0.38	29.4	18.3	B	30.2
	EB-T	485	32.8	C	0.48	68.3	29.4	C	62.6
	EB-R	150	3.8	A	0.26	10.0	3.7	A	19.0
	WB-L	364	25.9	C	0.75	82.3	24.4	C	74.8
	WB-T	513	23.7	C	0.39	61.8	19.2	B	52.7
	WB-R	390	4.3	A	0.47	19.5	4.9	A	0.0
Dunns Road	NB-L	49	24.3	C	0.22	14.7	30.0	C	22.9
	NB-T	111	34.8	C	0.30	34.5	36.5	D	46.0
	NB-R	299	7.4	A	0.55	20.0	4.3	A	30.9
Team Gushue Highway Ramps	SB-L	148	27.3	C	0.39	36.8	27.8	C	40.7
	SB-T	289	45.5	D	0.73	93.1	36.7	D	82.0
	SB-R	29					11.8	B	

11.3 TGH Connection (2025)

Operations at the signalized intersection were evaluated under the projected 2025 traffic volumes. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 42. The detailed Synchro and SimTraffic reports can be found in Appendix K.

With new signal timings in place, all movements at the signalized intersection will continue to operate at acceptable levels of service during both the morning and afternoon peak hours. The 95th% queue lengths for the northbound right movement (Dunn's Road) indicate that queues may exceed the storage capacity of the right turn lane during both peak hours.

Table 42: Topsail Road Interchange Intersection Operations - TGH Connection (2025)

Topsail Road Interchange		Weekday AM Peak Hour							
Intersection		2025							
		Volume (veh/hr)	Synchro				SimTraffic		
			Delay (s/veh)	LOS	v/c	95th%ile Queue (m)	Delay (s/veh)	LOS	95th%ile Queue (m)
Topsail Road & Dunns Road/TGH Ramps		**2626**	**24.3**	**C**			**23.0**	**C**	
Topsail Road	EB-L	42	17.1	B	0.11	11.2	20.5	C	15.4
	EB-T	525	30.4	C	0.52	64.6	27.8	C	65.4
	EB-R	49	0.3	A	0.09	0.0	3.2	A	8.0
	WB-L	151	21.5	C	0.46	32.2	22.4	C	37.7
	WB-T	488	25.6	C	0.39	59.7	21.2	C	54.2
	WB-R	288	5.0	A	0.39	18.8	4.8	A	0.0
Dunns Road	NB-L	76	18.0	B	0.20	17.2	26.9	C	62.7
	NB-T	322	46.2	D	0.78	87.9	43.5	D	124.0
	NB-R	242	10.0	B	0.48	25.9	15.1	B	53.9
Team Gushue Highway Ramps	SB-L	211	28.4	C	0.65	42.0	30.8	C	59.6
	SB-T	95	22.5	C	0.43	48.8	28.1	C	38.3
	SB-R	137					4.1	A	

Topsail Road Interchange		Weekday PM Peak Hour							
Intersection		2025							
		Volume (veh/hr)	Synchro				SimTraffic		
			Delay (s/veh)	LOS	v/c	95th%ile Queue (m)	Delay (s/veh)	LOS	95th%ile Queue (m)
Topsail Road & Dunns Road/TGH Ramps		**3225**	**25.2**	**C**			**21.8**	**C**	
Topsail Road	EB-L	140	18.8	B	0.39	28.2	19.7	B	31.2
	EB-T	569	35.9	D	0.51	89.4	30.6	C	71.8
	EB-R	150	3.8	A	0.24	10.5	4.0	A	24.4
	WB-L	364	26.1	C	0.76	78.3	23.7	C	72.1
	WB-T	620	24.4	C	0.43	75.1	19.2	B	61.0
	WB-R	429	4.0	A	0.48	19.0	5.3	A	8.7
Dunns Road	NB-L	49	28.4	C	0.24	16.5	34.6	C	25.2
	NB-T	111	40.9	D	0.33	38.9	41.4	D	53.9
	NB-R	299	8.3	A	0.57	22.5	4.9	A	37.7
Team Gushue Highway Ramps	SB-L	174	33.0	C	0.47	48.2	31.4	C	48.9
	SB-T	289	54.0	D	0.77	106.3	44.2	D	95.3
	SB-R	31					15.1	B	

11.4 TGH Connection 2035

Operations at the signalized intersection were evaluated under the projected 2035 traffic volumes. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths are summarized in Table 43. The detailed Synchro and SimTraffic reports can be found in Appendix K.

With new signal timings in place, all movements at the signalized intersection will continue to operate at acceptable levels of service during both the morning and afternoon peak hours. The 95th% queue lengths for the northbound right movement (Dunn's Road) indicate that queues may exceed the storage capacity of the right turn lane during both peak hours.

Table 43: Topsail Road Interchange Intersection Operations - TGH Connection (2035)

Topsail Road Interchange		Weekday AM Peak Hour							
Intersection		2035							
		Volume (veh/hr)	Synchro				SimTraffic		
			Delay (s/veh)	LOS	v/c	95th%ile Queue (m)	Delay (s/veh)	LOS	95th%ile Queue (m)
Topsail Road & Dunns Road/TGH Ramps		**2844**	**24.6**	**C**			**23.8**	**C**	
Topsail Road	EB-L	42	17.1	B	0.12	11.2	22.3	C	15.6
	EB-T	601	30.8	C	0.58	73.7	28.2	C	73.1
	EB-R	49	0.3	A	0.09	0.0	3.4	A	6.4
	WB-L	151	23.6	C	0.51	32.2	24.6	C	37.6
	WB-T	546	26.1	C	0.44	66.6	21.7	C	56.1
	WB-R	352	5.0	A	0.45	20.2	5.1	A	9.8
Dunns Road	NB-L	76	18.0	B	0.20	17.2	28.7	C	67.3
	NB-T	322	46.4	D	0.78	87.9	45.9	D	128.7
	NB-R	242	10.0	B	0.48	25.9	16.1	B	53.6
Team Gushue Highway Ramps	SB-L	228	31.6	C	0.71	48.9	34.0	C	64.6
	SB-T	95	22.4	C	0.44	49.2	28.6	C	37.6
	SB-R	140					4.1	A	

Topsail Road Interchange		Weekday PM Peak Hour							
Intersection		2035							
		Volume (veh/hr)	Synchro				SimTraffic		
			Delay (s/veh)	LOS	v/c	95th%ile Queue (m)	Delay (s/veh)	LOS	95th%ile Queue (m)
Topsail Road & Dunns Road/TGH Ramps		**3549**	**26.7**	**C**			**23.3**	**C**	
Topsail Road	EB-L	143	19.6	B	0.41	29.4	20.2	C	39.2
	EB-T	646	39.0	D	0.62	101.6	33.0	C	80.2
	EB-R	150	3.8	A	0.25	10.4	5.0	A	39.1
	WB-L	364	32.9	C	0.81	91.7	25.3	C	75.4
	WB-T	668	26.1	C	0.48	84.5	21.5	C	83.9
	WB-R	560	4.6	A	0.59	22.4	6.9	A	36.6
Dunns Road	NB-L	49	27.7	C	0.24	16.3	34.4	C	22.7
	NB-T	111	40.0	D	0.32	38.5	44.2	D	54.3
	NB-R	299	8.1	A	0.56	22.2	5.2	A	38.5
Team Gushue Highway Ramps	SB-L	233	37.6	D	0.62	63.3	36.1	D	71.3
	SB-T	289	52.7	D	0.77	107.4	44.0	D	101.0
	SB-R	37					14.6	B	

12 Conclusions and Recommendations

The Team Gushue Highway is a major component of the regional road network. The arterial highway currently extends from the Outer Ring Road (Route 1) to Topsail Road, linking the cities of St. John's and Mount Pearl. The final phase of the Team Gushue Highway will extend the highway from Topsail Road to the Commonwealth Avenue, Brookfield Road, Heavy Tree Road area and provide a connection to the Pitts Memorial Drive (Route 2) and Robert E. Howlett Memorial Drive (Route 3) interchange. The alignment of the Team Gushue Highway and the connection to Pitts Memorial Drive and Robert E. Howlett Memorial Drive was developed approximately 30 years ago. In that time, there have been significant changes to the surrounding environment that will impact the Team Gushue Highway connection to Pitts Memorial Drive and Robert E. Howlett Memorial Drive.

The Newfoundland and Labrador Department of Transportation and Infrastructure has undertaken a detailed study to review the impact of recent and future development on the Team Gushue Highway and the existing Pitts Memorial Drive and Robert E. Howlett Memorial Drive interchange. The study includes three components:

- **Part A:** Evaluate traffic operations for the 2020, 2025 and 2035 timeframes at the Pitts Memorial Drive and Robert E. Howlett Memorial Drive interchange and Team Gushue Highway infrastructure. The Team Gushue Highway infrastructure will include the evaluation of multiple at-grade and grade separated options for the connection to Commonwealth Avenue, Brookfield Road, Heavy Tree Road area and the Pitts Memorial Drive and Robert E. Howlett Memorial Drive interchange.
- **Part B:** Develop preliminary concepts for the at-grade and grade separated options to connect the Team Gushue Highway to Pitts Memorial Drive and Robert E. Howlett Memorial Drive. Select the top three preliminary options to complete a detailed evaluation from an operational, capacity, safety and geometric perspective.
- **Part C:** Review the existing Team Gushue Highway connection to Topsail Road and evaluate traffic operations under the fully operational configuration for the 2020, 2025 and 2035 timeframes. Identify if future improvements will be required at the connection from an operational, capacity, and safety perspective.

The City of St. John's PTV Visum 2025 Travel Demand Forecasting Model was used to establish travel demand forecasts. The regional model includes the City of St. John's, the City of Mount Pearl, the Town of Paradise, the Town of Conception Bay South and nine other communities: Portugal Cove- St. Philip's, Torbay, Logy Bay-Middle Cove-Outer Cove, Pouch Cove, Flatrock, Bay Bulls, Witless Bay, Petty Harbour-Maddox Cove and Bauline. The model was updated to reflect the current and future regional road network and future development projections.

The Team Gushue Highway connection will have a significant impact on regional travel patterns, the regional model was used to estimate the redistribution of traffic in 2020. Traffic volumes before and after the Team Gushue Highway connection were obtained from the model and used to establish changes in travel patterns throughout the study area. The changes in travel patterns observed in the before/after comparison of model volumes were applied to existing traffic count data to obtain redistributed traffic volumes for the analysis.

Residential, commercial, and industrial development projections for the municipalities of St. John's, Mount Pearl, Paradise and Conception Bay South were established based on stakeholder consultations with the City of St. John's, City of Mount Pearl, Dewcor (Galway Development) and Fairview Investments (Southlands Development) and background documents.

The trip estimates associated with the development projections were assigned and distributed to the regional road network using the regional model. The "select zone analysis" feature of the software was used to distribute the trips associated with the development projections to the road network and obtain traffic volumes throughout the study area. The traffic volumes for each timeframe were superimposed onto the 2020 base traffic volumes to produce the projected 2025 and 2035 traffic volumes.

Part A: Team Gushue Highway Connection to Commonwealth Avenue/Brookfield Road

Part A included a review of current traffic operations at the Pitts Memorial Drive (Route 2) and Robert E. Howlett Memorial Drive (Route 3) interchange.

The analysis of the current traffic operations at the interchange identified operational deficiencies at both unsignalized intersections. The left turn and through movements on both the eastbound and westbound off-ramps experience poor levels of service during the morning peak hour. During the afternoon peak hour, the left turn and through movements on the westbound off-ramp experience poor levels of service and exceed capacity.

The Transportation Association of Canada's (TAC) Traffic Signal Warrant Matrix was used to evaluate if traffic signals should be considered at the unsignalized intersections. The Route 3 and Route 2 Westbound Ramps intersection scored 99 out of 100 points, traffic signals may be warranted at the intersection since the intersection score is only one point short of the threshold for traffic signals.

Part A also included a review of traffic operations for proposed at-grade and grade separated options for the connection of the Team Gushue Highway to Commonwealth Avenue and Brookfield for the 2020,2025 and 2035 timeframes. The connection options identified by NLDTI include:

- At-Grade Signalized Intersection
- At-Grade Roundabout
- Grade-Separated Interchange

At-Grade Signals: Operations for a signalized intersection with a dual left turn on the eastbound approach (Commonwealth Avenue) and a free flow right turn on the southbound approach (Team Gushue Highway) were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The analysis identified operational deficiencies on the Commonwealth Avenue and Brookfield Road approaches in 2020; additional operational deficiencies on the Team Gushue Highway approaches in 2025 and 2035.

At-Grade Roundabout: Operations for a multi-lane roundabout with two-lane entries on all approaches and a right turn by-pass on the southbound approach (Team Gushue Highway) were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The roundabout will operate at acceptable levels of service during the peak hours in 2020, 2025 with two lane entries on the Team Gushue Highway. In 2035, a third northbound entry lane will be required to maintain acceptable levels of service during the peak hours.

Grade Separated Interchange: Operations for a grade separated interchange with unsignalized intersections were evaluated under the projected 2020, 2025 and 2035 traffic volumes. The southbound ramp intersection will operate at acceptable levels of service during the peak hours in 2020, 2025 and 2035. The analysis identified operational deficiencies for the left turn movement on the northbound off-ramp in 2020, 2025 and 2035.

The at-grade roundabout and grade separated options could work as an interim connection. However, these options were analyzed in isolation of the upstream and downstream intersections. The Route 2 interchange will experience operational issues in 2020 with the connection of the Team Gushue Highway in its present configuration and with existing traffic controls. Therefore, in order to evaluate any of the three options, they must be evaluated as a component of the overall corridor; corridor options are considered in Part B.

Part B: Team Gushue Highway, Pitts Memorial Drive (Route 2) and Robert E. Howlett Memorial Drive (Route 3) Reconfiguration

Part B included the development of preliminary concepts for reconfiguration options to connect the Team Gushue Highway to Pitts Memorial Drive and Robert E. Howlett Memorial Drive and the evaluation of the preliminary options to select the top three preliminary options to complete a detailed evaluation from an operational, capacity, safety and geometric perspective.

Seven (7) preliminary options were developed for the reconfiguration of the Team Gushue Highway connection area including Pitts Memorial Drive (Route 2), Robert E. Howlett Memorial Drive (Route 3). The options include:

- **Option 1 Signalized Corridor:** a signalized corridor with traffic signal control at the following intersections: Team Gushue Highway & Commonwealth Avenue/Brookfield Road, Route 3/Commonwealth Avenue & Route 2 Westbound Ramps and Route 3/Commonwealth Avenue & Route 2 Eastbound Ramps.
- **Option 2 Roundabout Corridor:** a multi-lane roundabout corridor with roundabout control at the following intersections: Team Gushue Highway & Commonwealth Avenue/Brookfield Road, Route 3/Commonwealth Avenue & Route 2 Westbound Ramps and Route 3/Commonwealth Avenue & Route 2 Eastbound Ramps.
- **Option 3 Cloverleaf Interchange:** a cloverleaf interchange between Route 2 and Route 3 with a roundabout on Route 3 to maintain access to Commonwealth Avenue and Heavy Tree Road.
- **Option 4 Diverging Diamond Interchange:** a diverging diamond interchange between Route 2 and Route 3 with a roundabout on Route 3 to maintain access to Commonwealth Avenue and Heavy Tree Road.
- **Option 5 Route 2/Route 3 Interchange Flyover:** a new interchange between Route 2 and Route 3 with roundabout control at the ramps and a flyover from Route 2 eastbound to the Team Gushue Highway.
- **Option 6 Route 2 Flyover:** a new interchange between Route 2 the Team Gushue Highway with a flyover from Route 2 eastbound to the Team Gushue Highway.
- **Option 7 Route 2 Underpass:** a new interchange between Route 2 the Team Gushue Highway with roundabout control at the Route 2 eastbound ramp terminal.

Conceptual drawings were developed for each option and used to prepare Class 'D' opinions of probable construction cost and estimate land acquisition required to construct each option. Traffic operations on Route 2, Route 3 and intersections were evaluated for each option under the projected 2020, 2025, 2035 traffic volumes.

The preliminary options were evaluated and ranked based on evaluation criteria developed for the context of this study and outlined in the RFP. An evaluation matrix was developed to assess and compare the preliminary options, the matrix assigns a weighing factor to each criterion for a total of 100 points. Each criterion is rated using a poor/fair/good or high/medium/low scale, the rating translates to a specific number of points. The preliminary options were evaluated based on the following criteria:

- **Driver Comfort (maximum 5 points):** considers the familiarity of the type of control and expected comfort for the average driver. Driver comfort is rated as poor/fair/good.
- **Land Impact (maximum 5 points):** considers disturbances to existing developed areas and environmental aspects associated with disturbance of wetlands and/or water bodies. The land impact of each option is rated as high/medium/low.
- **Utility Impact (maximum 5 points):** considers the impact to utilities including water supply, sanitary sewer, high voltage transmission lines, and electrical/communications lines. The utility impact for each option is rated as high/medium/low.
- **Land acquisition (maximum 10 points):** considers the area of land acquisition required to construct each option. The land acquisition for each option is rated as high/medium/low.
- **Construction Cost (maximum 15 points):** considers cost to construction each option. The construction cost of each option is rated as high/medium/low.
- **Traffic Operations (maximum 60 points):** considers future traffic operations with the completion of the Team Gushue Highway for the 2020, 2025 and 2035 timeframes. A maximum of 10 points is allotted for the 2020 timeframe, a maximum of 20 points is allotted for the 2025 timeframe and a maximum of 30 points is allotted for the 2035 timeframe, for a total maximum of 60 points. Traffic operations are rated as poor/fair/good for each timeframe.

Each option was rated and given a total score out of 100 points. The total score was used to rank the preliminary options and identify the top three options. The three options which should proceed to detailed concept layouts, opinions of probable cost and comprehensive analysis are:

1. Option 2 Roundabout Corridor
2. Option 3 Cloverleaf Interchange
3. Option 5 Route 2/2 Interchange Flyover

The conceptual drawings for the top three options were refined, the detailed concept drawings reflect a level of design completion of approximately 33 percent required to develop Class 'C' opinions of probable construction cost as defined "*Guide to Cost Predictability in Construction: An Analysis of Issues Affecting the Accuracy of Construction Cost Estimates"* prepared by the Joint Federal Government/Industry Cost predictability taskforce.

A comprehensive analysis of the significant design and decision parameters was completed to inform the selection of the appropriate design connection for the Team Gushue Highway. The following factors were considered in the evaluation:

- Level of service and capacity
- Traffic conflict points
- Construction staging sequence, duration and traffic impacts
- Land/property requirements
- Interface/access points with private property owners
- Ability to accommodate farming operations

- Environmental considerations
- Drainage and storm water detention requirements
- Structures, overpass and bridge requirements
- Unique operational considerations
- Project development costs

Each option was rated and given a total score out of 100 points. The total score was used to rank the preliminary options and identify the preferred option for the reconfiguration of the Team Gushue Highway connection to Route 2. **Option 2 Roundabout Corridor was identified as the preferred option.** The roundabout corridor option is, by a significant margin, the lowest cost alternative. Based on the traffic analysis, this option will provide adequate levels of service through to 2035 given some fairly significant regional development. If this regional development does not take place at the pace assumed on the study horizons, it could service traffic in this area for an even longer period of time. As previously noted, the alignment of the Team Gushue Highway and the connection to Pitts Memorial Drive and Robert E. Howlett Memorial Drive was developed approximately 30 years ago. It is our understanding that the original intent was to provide two free flowing, high-speed routes (Route 2 and Route 3), with a connection between the two in the vicinity of the Commonwealth Avenue interchange. Over the past 30 years however, there have been significant changes to the surrounding areas that have impacted the Team Gushue Highway connection to Pitts Memorial Drive and Robert E. Howlett Memorial Drive, not the least of which has been a fairly significant increase in the traffic volumes on Commonwealth Avenue. Maintaining a connection between Route 2, Route 3 and Commonwealth Avenue necessarily requires an intersection that will impede the free flow of traffic along Route 3. While the roundabout corridor does not provide a high-speed route along Route 3, it does provide a form of free flow in that vehicles are not impeded by traffic signals or stop signs. The roundabout corridor will allow the completion of this connection at the lowest cost without precluding the future development of higher levels of interchange control, like the cloverleaf of flyover, should it be required at some point in the future.

Part C: Topsail Road Interchange

Part C included a review of the existing Team Gushue Highway connection to Topsail Road. Traffic operations were evaluated for the current partial opening configuration and for the fully operational configuration for the 2020, 2025 and 2035 timeframes to identify if future improvements will be required at the connection from an operational, capacity, and safety perspective.

Under the current partial Team Gushue Highway opening configuration at the Topsail Road interchange, the signalized intersection of Topsail Road and Dunn's Road/Team Gushue Highway Ramps experience some operational deficiencies on Dunn's Road during the morning peak hour and on the Team Gushue Highway Ramps during the afternoon peak hour.

With the full opening of the Team Gushue Highway, the development projections and modelling exercises indicate that there will initially be an overall reduction in total traffic volume at this intersection. With projected development growth considered, the overall intersection volume on the 2035 horizon is approximately 12% higher than the present-day intersection volume in the morning peak hour and approximately 14% higher in the afternoon peak hour. With progressive changes to the signal timing

plans, however, the signalized intersection will continue to operate at acceptable levels of service on the 2025 and 2035 horizons and, with the projected changes in traffic patterns, the level of service on most individual approaches improves when compared to the present-day signal operation. This indicates that no significant improvements will be required at this intersection up to the 2035 horizon. The analysis does indicate that the queue length for northbound right turning traffic on Dunn's Road exceeds the available pocket lane storage length for that movement. Again, however, that is also the case for the present-day conditions and extension of the Team Gushue Highway does not worsen this existing condition. This is something the City may wish to consider if/when intersection and/or road upgrades are considered at this location.

Finally, it is worthy of note that estimating future traffic volumes involves making informed decisions based on the data and statistics available to planners and designers at present. Most of the operational issues realized in the various scenarios explored in this report occur on the 2035 horizon. This scenario assumes the full build out of the Southlands and Galway developments and assumes that traffic growth and travel patterns will continue as "normal" over this 15-year period. However, a conversation about how travel, traffic and transportation may evolve after this present COVID-19 pandemic has passed is gaining momentum within the traffic and transportation industry. In the CITE community particularly, there are many interesting conversations around changes in the industry, covering everything from whether or not to put pedestrian traffic signals on recall, to the pros and cons of reallocating traditional vehicular spaces to pedestrians and cyclists, to how to effectively work from home, to the short- and long-term effects on modes of public transit. Many in the industry believe transportation planning and operations may change once things return to a "new normal". The COVID-19 pandemic will likely be a pivotal point in societal progression and significant change is highly probable. One such change, for instance, is the very real possibility of widespread adoption and societal acceptance of remote work and communication practices as well as online shopping that could have a significant impact on traffic volumes and travel patterns as well as traditional "bricks and mortar" development. As a result of all this, there is a high likelihood that the 2035 volumes identified in this report may not be realized until much further into the future, if at all. This is an important factor to be considered in the current decision-making process for the Team Gushue Highway extension.