

Township of South Frontenac

Perth Road Corridor Study

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Project Number:

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Date:

April, 2016

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April 15, 2016

Mark Segsworth, P. Eng.
Public Works Manager
Township of South Frontenac
Box 100, 2490 Keeley Road
Sydenham, ON K0H 2T0

Dear Mr. Segsworth:

Project No: 60436840
Regarding: **Perth Road Corridor Study**

We are pleased to submit this Corridor Study for the 10 kilometres of Perth Road (also known as Township Road 10) between Rutledge Road and Spooner Road. Our corridor study includes an assessment of the existing corridor conditions and an analysis of future impacts to the transportation network associated with background growth and planned development growth.

Please don't hesitate to contact me if you have any questions.

Sincerely,
AECOM Canada Ltd.



Vanessa Skelton, P. Eng.
Senior Engineer, Transportation
Vanessa.Skelton@aecom.com

Distribution List

# of Hard Copies	PDF Required	Association / Company Name
0	1	Township of South Frontenac

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
DRAFT	S. McDonald	December 16, 2015	Draft Release
1	V. Skelton	February 18, 2016	Revisions based on comments from Township
2	V. Skelton	April 14, 2016	New information concerning development

AECOM Signatures

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Appendix A. Site Visit Photos (July 4, 2015)

1. Introduction

1.1 Purpose

The objective of this corridor study is to provide the Township of South Frontenac with a corridor improvement plan for Perth Road (also known as Township Road 10) between Rutledge Road and Spooner Road. The corridor study includes an assessment of the existing corridor conditions and an analysis of future impacts to the transportation network associated with background growth and planned development growth.

1.2 Study Area

The Perth Road corridor study area is the ten kilometres between Rutledge Road and Spooner Road and includes the Hamlet of Inverary. External influences that are outside the corridor, such as planned developments, are considered for the intersection capacity analysis. The study area is shown in **Figure 1**.

1.3 Time Horizons

For our corridor study we considered the traffic conditions and operations along the study corridor for the following three time horizons:

- Existing traffic volumes (2015)
- Estimated future traffic volumes (2025)
- Estimated future traffic volumes (2035)

2. Existing Transportation Conditions

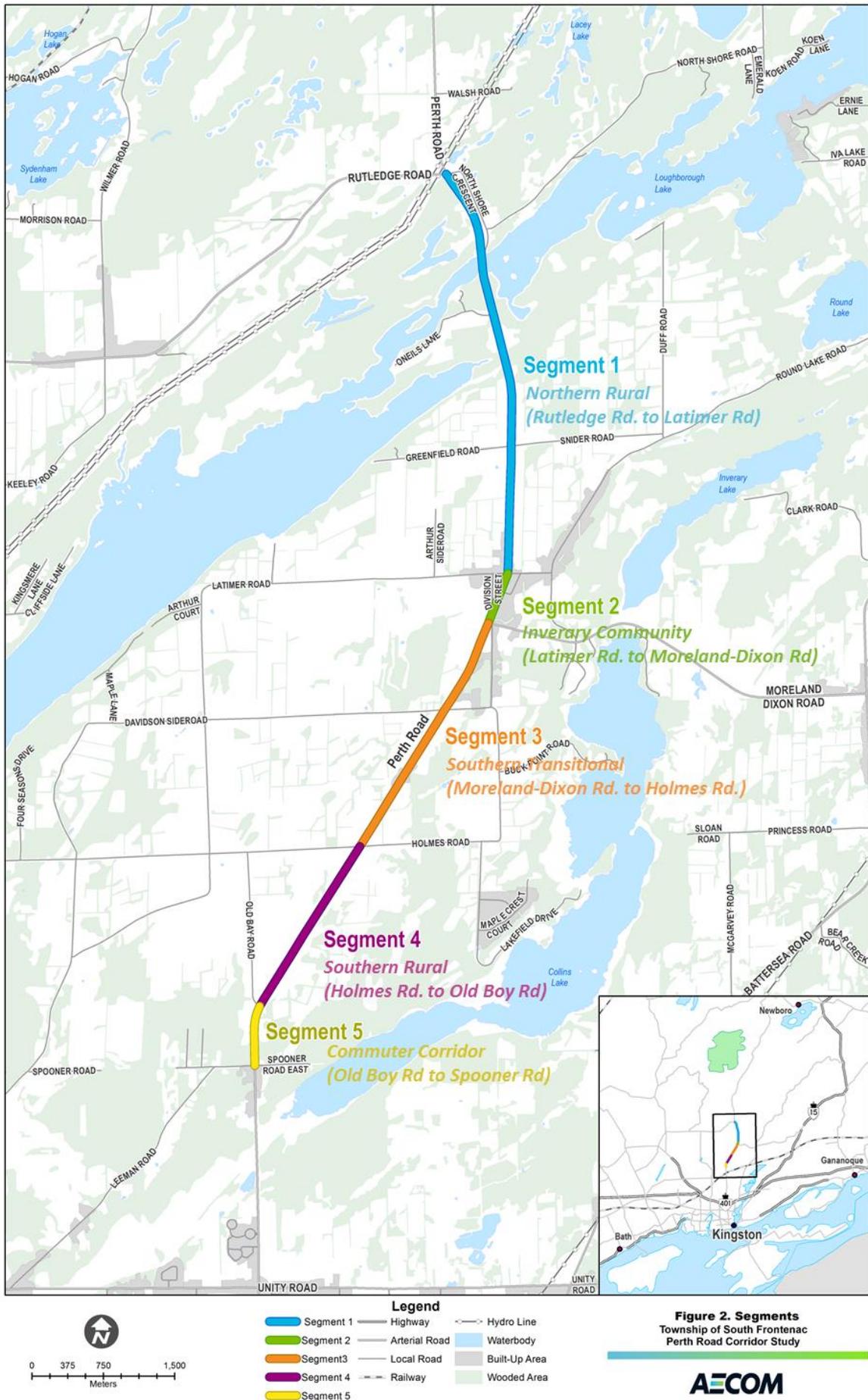
2.1 Transportation Network

2.1.1 Vehicle Facilities

Perth Road is a connecting link between the Town of Perth and the City of Kingston. Throughout the study area, it is a two lane undivided roadway with one lane in each direction and acts as a commuter corridor between the Township of South Frontenac and the City of Kingston. The lane width is consistent at approximately 3.5 metres.

The study corridor can be divided into five segments selected for their similar traffic volumes, roadway characteristics, and speed zones. They are described below and shown in **Figure 2**:

- Northern Rural (Rutledge Road to Latimer Road)
- Inverary Community (Latimer Greenfield Road to Moreland-Dixon Road)
- Southern Transitional (Moreland-Dixon Road to Holmes Road)
- Southern Rural (Holmes Road to Old Boy Road)
- Commuter Corridor (Old Boy Road to Spooner Road)



The intersections reviewed as part of our corridor analysis are summarized in **Table 1**. All intersections currently give priority to vehicles traveling north and south along Perth Road.

Table 1. Intersections

Intersection with Perth Road	Control Type	Illumination	Additional Lanes
Rutledge Road	2-way stop with an overhead intersection control beacon	NE corner	-
Greenfield Road	2-way stop	SE corner	-
Latimer Road	Signalized	All four corners	-
Moreland-Dixon Road	1-way stop with an overhead intersection control beacon	SE corner	Southbound bypass lane Northbound right lane
Davidson Road	2-way stop	-	-
Holmes Road	2-way stop	NW corner	-
Old Boy Road	2-way stop	SW corner	Northbound bypass lane
Spooner Road	2-way stop	NW corner	-

2.1.2 Parking Facilities

There are two areas within the corridor that have accommodations for on-street vehicle parking: the Hamlet of Inverary and the Loughborough Boat Ramp. The urban area of Inverary, between Latimer Road and Division Street, has a paved boulevard behind a mountable curb on both sides of the road that can be used for parking. The Loughborough Boat Ramp has a widened gravel shoulder for approximately 100 metres on west side of Perth Road that is used as overflow parking.

2.1.3 Active Transportation (Pedestrian and Cycling Facilities)

There are limited pedestrian facilities (sidewalks or paved trails) throughout the Perth Road corridor. While gravel shoulders provide space for able bodied pedestrians when they are dry and maintained, they are not maintained or intended for pedestrian usage and should not be considered pedestrian facilities.

The roadway segment between Latimer Road and Division Street in the Hamlet of Inverary has a paved boulevard behind a mountable curb on both sides of the road. This boulevard is used for both vehicle parking and pedestrian movement.

The Perth Road corridor has no designated cycling facilities. When the shoulder isn't paved, cyclists share the travelled lane with vehicles.

2.1.4 Field Observations

We undertook a corridor visit on Saturday July 4, 2015. Our visual observations are documented in the following table and the site photos are included as **Appendix A**.

Table 2. Field Observations

Intersection with Perth Road	Field Observations
Rutledge Road	Poor sightlines for WB vehicles turning south onto Perth Road.
Greenfield Road	Good sightlines. Turning vehicles overtrack into shoulder area.
Latimer Road	Good sightlines.
Moreland-Dixon Road	Good sightlines.
Davidson Road	Poor sightlines for EB vehicles turning north onto Perth Road.
Holmes Road	Poor sightlines for WB vehicles with stop sign placed too far from stop bar.
Old Boy Road	Good sightlines.
Spooner Road	NW corner in poor condition. Grade difference between Spooner and Perth.

2.2 Policy

2.2.1 Speed Zones

The speed limit along the rural sections of Perth Road is 80km/h in accordance with the Highway Traffic Act (R.S.O. 1990, c. H.8). Township Bylaw 2000-01 further defines three speed zones which are described in **Table 3** and shown in **Figure 3**. All northbound and southbound speed zones within our study area are aligned. A formal speed study was not completed as part of this study.

Table 3. Speed Zones (Bylaw 2000-01)

Schedule	Speed Limit	From	To
A-10	60 km/h	200 metres north of Latimer Road	Northerly 300 metres
A-11	50 km/h	100 metres north of Moreland-Dixon Road	200 metres north of Latimer Road
A-12	60 km/h	100 metres south of Moreland-Dixon Road	100 metres north of Davidson Side Road

2.2.2 Parking Zones

During the winter months (December through March) there is a daily parking prohibition in effect from 12:00am to 7:00am along Perth Road between Moreland-Dixon Road and Latimer Road (Bylaw 2000-01, Schedule B-1).

2.2.3 Passing Zones

The existing passing zones within the Perth Road corridor are shown in **Figure 4**. The passing zones were not evaluated to determine the validity of existing passing sight distances. In general, the restrictions on passing are appropriate for the area type, terrain and intensity of development.

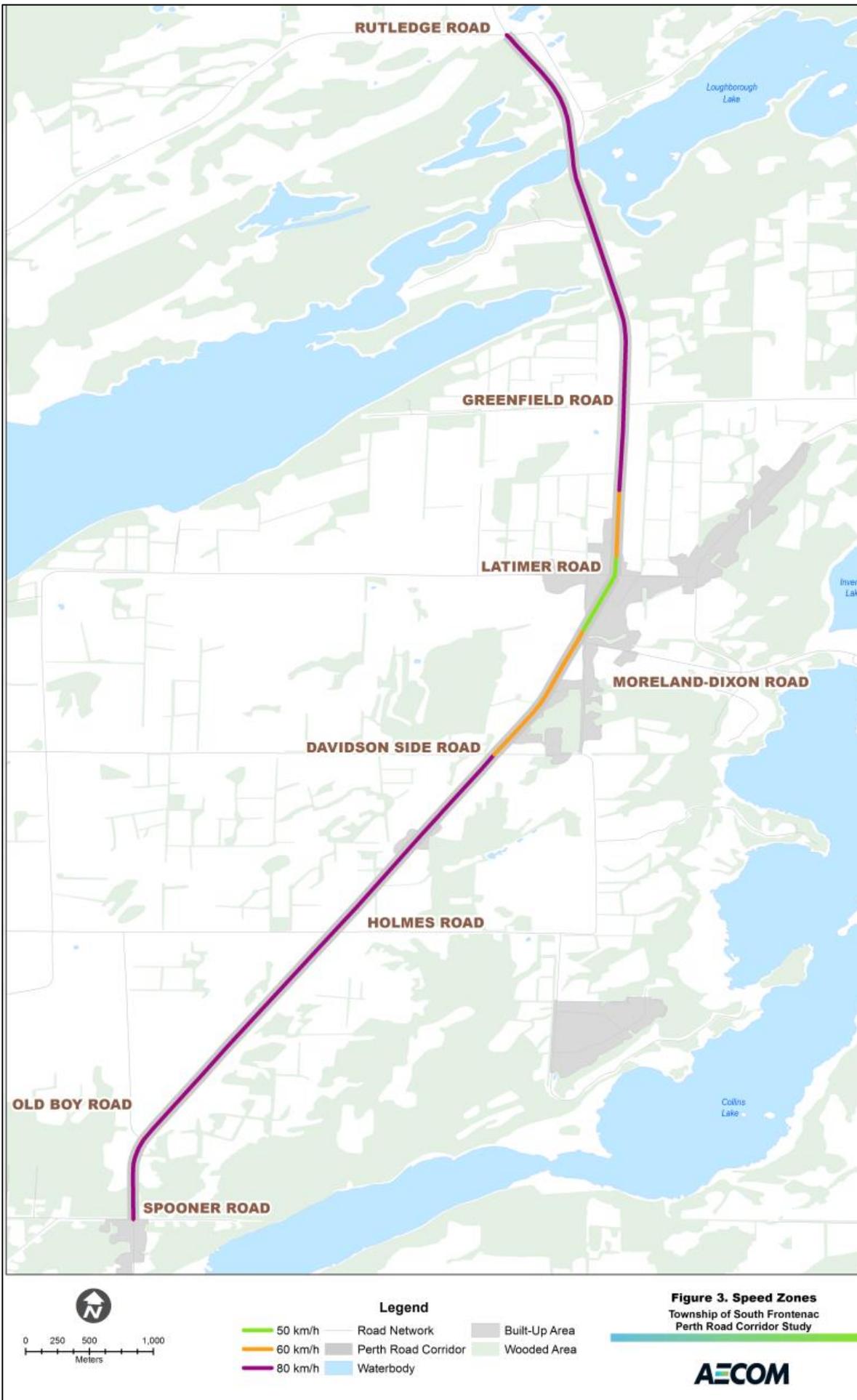
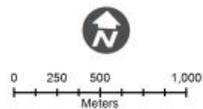


Figure 3. Speed Zones



Legend

- Road Network
- ▭ Perth Road Corridor
- ▭ Waterbody
- ▭ Built-Up Area
- ▭ Wooded Area
- - - NB and SB Passing
- NB Only Passing
- No Passing
- ← SB Only Passing

Figure 4. Passing Zones
Township of South Frontenac
Perth Road Corridor Study



Figure 4. Passing Zones

2.3 Traffic Volumes

There were four locations with recent Average Annual Daily Traffic (AADT) counts available and relevant to our study. For the purpose of assessing traffic growth, the count locations within our study area had insufficient data for the past four years (2012-2015). We used the data the City of Kingston boundary count station, which had four years of data available, to determine the general traffic growth trend.

Table 4. Average Annual Daily Traffic (AADT) from 2012-2015

Location on Perth Road	Average	2015	2014	2013	2012
South of Rutledge Road	5862	4424	-	-	7300
North of Moreland-Dixon	6792	-	6792	-	-
South of Moreland-Dixon	6888	6566	7210	-	-
City of Kingston boundary	8078	7454	7921	8604	8331

Intersection traffic count data was collected by the Township of South Frontenac in August 2015 at eight intersections with Perth Road: Rutledge Road, Greenfield Road, Latimer Road, Moreland-Dixon Road, Davidson Road, Holmes Road, Old Boy Road, and Spooner Road. Turning movement data was separated into 15 minute intervals between 7:00am and 10:00am and 3:00pm and 5:45pm. From the 15 minute counts, we were able to determine the peak hours and heavy vehicle percentages along the corridor:

- AM Peak Hour from 7:15am to 8:15am with an average of 4% heavy vehicles
- PM Peak Hour from 4:15pm to 5:15pm with an average of 2% heavy vehicles

The existing traffic volumes are provided in **Figure 5**.

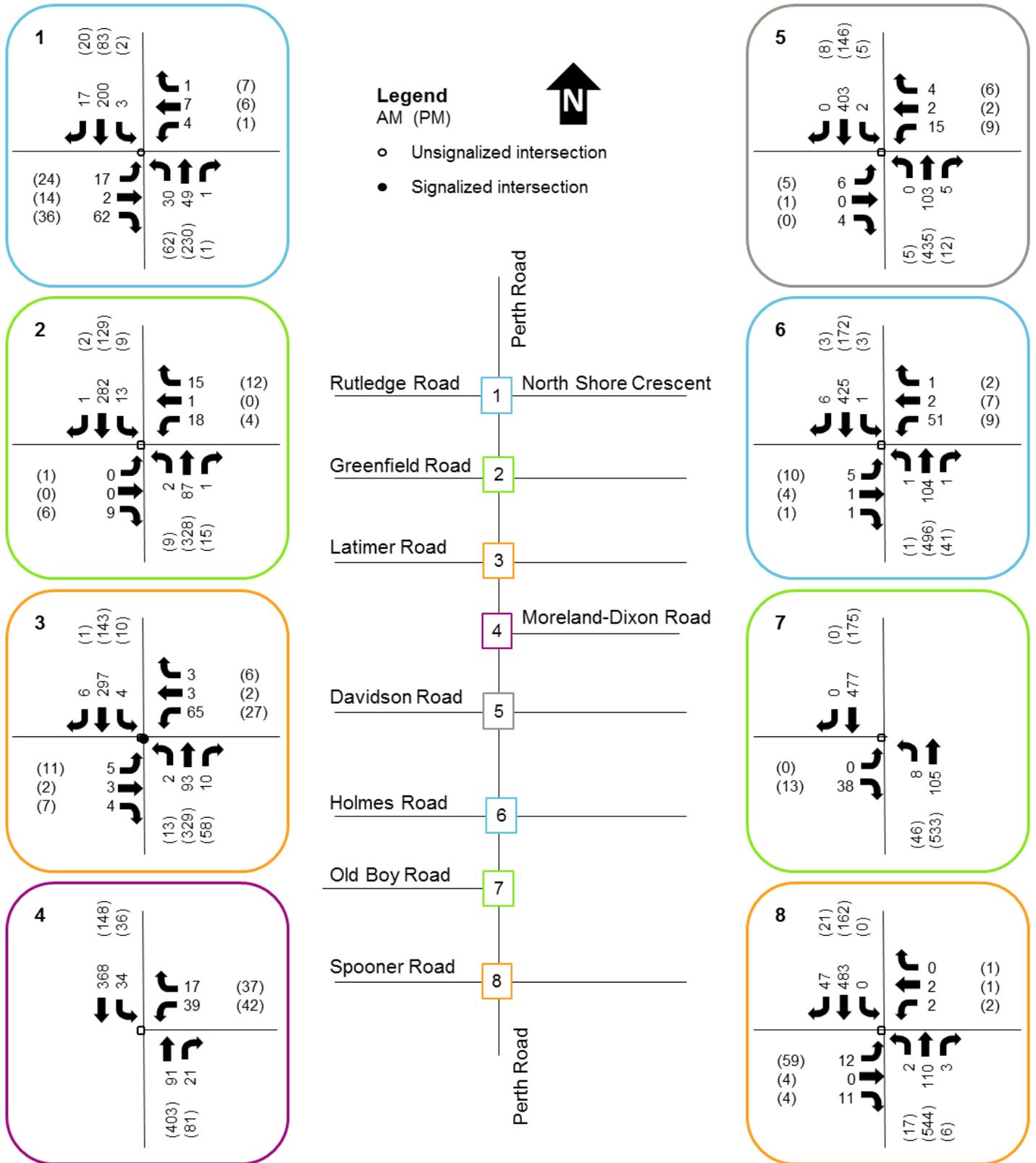


Figure 5. Existing Traffic Volumes (2015)

2.4 Additional Concerns

The Township expressed concern over the existing and future operations at the Moreland-Dixon Road intersection.

3. Future Conditions

3.1 Background Growth

The Township suggested using a linear background growth rate of 1% throughout the Township to account for unknown future local growth and external growth. A growth rate of 1% is a reasonable rate for the Township based on the type of community and its location. This growth rate does not include new, planned developments that will impact the volume of traffic along the Perth Road corridor.

3.2 Development Growth

There are eight known residential and commercial developments planned for the study area that will impact traffic operations along the Perth Road corridor. They are shown in **Figure 6**.

For the purposes of this study, the timeline for the planned developments have been separated into two phases with time horizons of 10 years (2025) and 20 years (2035). The general information for each development is provided in **Table 5**. We have assumed that all residential lots are single family dwellings. As part of the Collins Lake Estates, there are 6.9 hectares that are designated for commercial development. Based on lot usage in neighbouring communities, it was estimated that 15% of the area is available as leasable space.

Table 5. Planned Developments (2025 and 2035)

Development	Total	Complete in 10 Years (2025)	Complete in 20 years (2035)
North Shore Road	14 residential lots	50% 7 residential lots	100% 14 residential lots
Keir Road	22 residential lots	50% 11 residential lots	100% 22 residential lots
Inverary East	50 residential lots	50% 25 residential lots	100% 50 residential lots
Willowbrook Estates	16 residential lots 5,950 sq.m commercial	50% 8 residential lots 2,975 sq.m commercial	100% 16 residential lots 5,950 sq.m commercial
Collins Lake Estates	600 residential lots 10,320 sq.m commercial	50%300 residential lots 5,160 sq.m commercial	100% 600 residential lots 10,320 sq.m commercial
Marshall Estate	5 residential lots	50% 2 residential lots	100% 5 residential lots
Brett Campbell Estate	24 residential lots	50% 12 residential lots	100% 24 residential lots
Sandstone Estate	11 residential lots	50% 5 residential lots	100% 11 residential lots

Development Potential on Perth Road (South Frontenac)

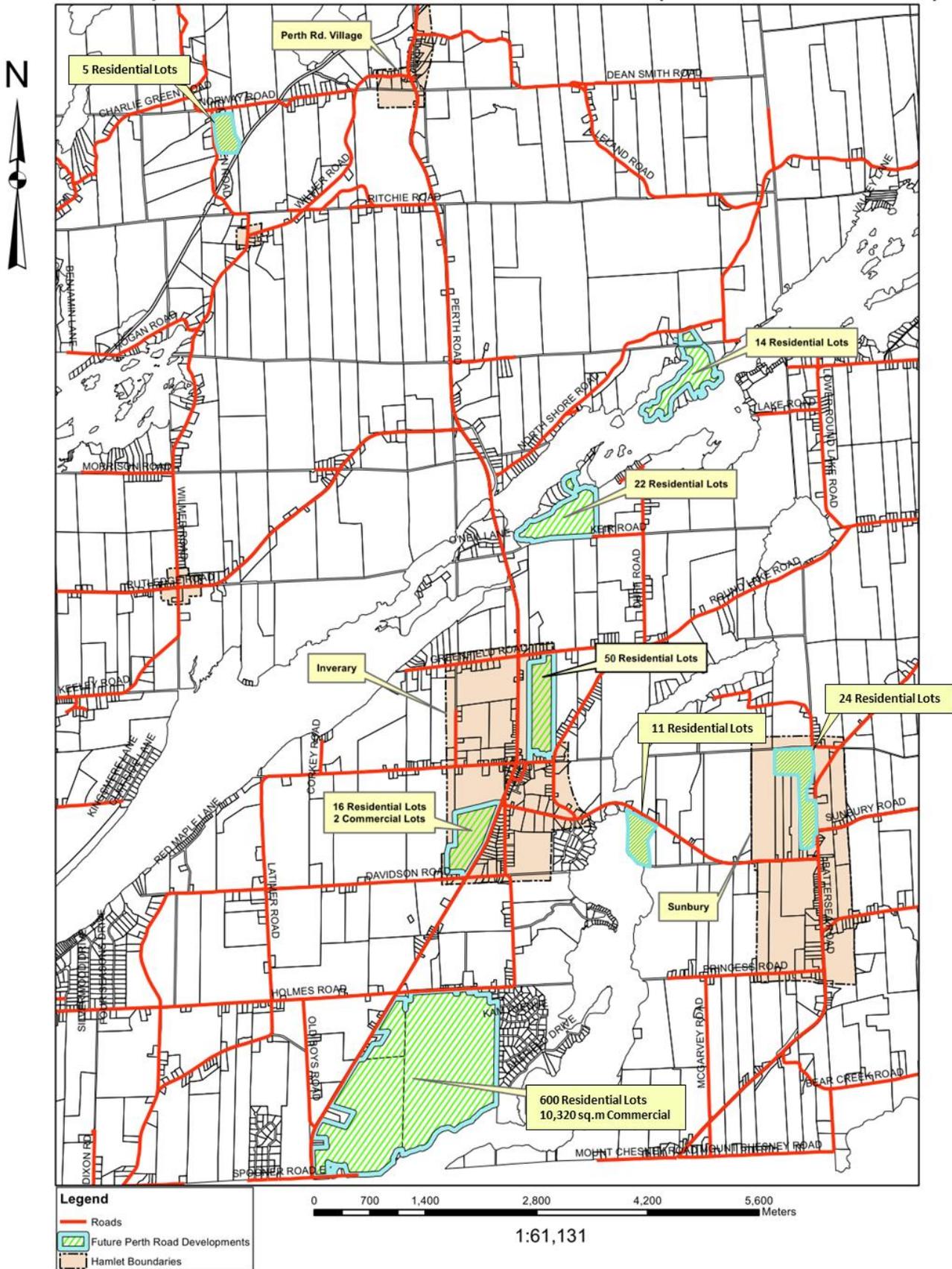


Figure 6. Development Potential on Perth Road

Trip generation rates from the Institute for Traffic Engineers (ITE) *Trip Generation Manual* (9th Edition) were used to estimate the number of trips generated by each development for each time horizon. The rates used were for Single-Family Detached Housing (land use code 210) and Shopping Centre (land use code 820). We used the fitted curve equations to calculate trips generated by both development types. This method was selected following the guidelines of the ITE *Trip Generation Handbook* (2nd Edition). The total number of trips generated by the development is based on the number of residential units and commercial leasable square feet.

The total number of trips includes primary trips and pass-by trips. Primary trips are made for the specific purpose of visiting the planned development, while pass-by trips are intermediate stops on an existing trip that are made without a route diversion.

We estimated the pass-by trips for the commercial development using data in the ITE Trip Generation Handbook and assumed that there are no AM pass-by trips and that PM pass-by trips are generated using the fitted curve equation: $\text{Ln}(T) = -0.29\text{Ln}(X) + 5.00$. We then estimated the number of primary trips (total trips minus pass-by trips) generated by each development. These are the new trips added to the existing road network by the development. They are summarized in **Table 6**.

Table 6. Trip Generation for Planned Development

ITE Land Use	AM Peak Hour		PM Peak Hour		
	2025	2035	2025	2035	
Single-Family Detached Housing (210)					
Equation	$T = 0.70(X) + 9.74$		$\text{Ln}(T) = 0.90\text{Ln}(X) + 0.51$		
Entering / Exiting (%)	25% / 75%		63% / 37%		
North Shore Road	4 / 11	5 / 15	6 / 4	11 / 7	
Keir Road	4 / 13	6 / 19	9 / 5	17 / 10	
Inverary East	7 / 20	11 / 33	19 / 11	35 / 21	
Willowbrook Estates	4 / 12	5 / 16	7 / 4	13 / 7	
Collins Lake Estates	55 / 165	107 / 322	178 / 104	332 / 195	
Shopping Centre (820)					
Equation	$\text{Ln}(T) = 0.61\text{Ln}(X) + 2.24$		$\text{Ln}(T) = 0.67\text{Ln}(X) + 3.31$		
Entering / Exiting (%)	62% / 38%		48% / 52%		
Willowbrook Estates	Total Trips	48 / 30	74 / 45	134 / 145	213 / 231
	Pass-by	0 / 0	0 / 0	76 / 76	99 / 99
	Primary	48 / 30	74 / 45	58 / 69	115 / 132
Collins Lake Estates	Total Trips	68 / 41	103 / 63	194 / 210	308 / 334
	Pass-by	0 / 0	0 / 0	94 / 94	122 / 122
	Primary	68 / 41	103 / 63	100 / 117	187 / 212

3.3 Trip Distribution and Assignment

Trips generated by the planned residential developments were distributed based on existing traffic patterns with external origin/destinations locations as follows:

- Perth to the north via Perth Road
- Sydenham to the north via Rutledge Road
- Sunbury to the east via Moreland-Dixon Road
- Kingston to the south via Perth Road and west via Holmes Road and Spooner Road

When distributing the trips, we assumed that most of the new traffic used Perth Road. Our assumptions for the residential trip distribution and assignment are listed in the following table.

Table 7. Residential Trip Distribution and Assignment Assumptions

Residential Development	Distribution (origin / destination)	Assignment (Access to Perth Road)
North Shore Road	All trips travel to/from Perth Road. Distributed on Perth Road using existing traffic patterns.	Rutledge Road / North Shore Crescent
Keir Road	All trips travel to/from Perth Road. Distributed at intersection using existing traffic patterns.	Latimer Road
Inverary East	All trips travel to/from Perth Road. Distributed at intersection using existing traffic patterns.	Latimer Road
Willowbrook Estates	All trips travel to/from Perth Road. Distributed at intersection using existing traffic patterns.	New direct access between Moreland-Dixon Road and Davidson Road
Collins Lake Estates	All northbound vehicles exit onto Perth Road. 50% of southbound vehicles entering access via Perth Road, the other 50% access via Holmes Road.	33% at Holmes Road 33% at a new direct access opposite Old Boy Road 33% at Spooner Road

Trips generated by the commercial development were distributed to Perth Road based on existing traffic patterns and were assumed to have direct access to Perth Road between Moreland-Dixon Road and Davidson Road opposite the existing Home Hardware. The trip distribution is consistent with the Traffic Impact Study's prepared for the Matias Business Park (May 2015) and Willowbrook Subdivision (March 2015).

An internal capture rate is the percentage reduction that can be applied to trip generation estimates for individual land uses to account for trips internal to a site. Typically internal capture rates are used for multi-use developments within a defined, congruous area. The Perth Road corridor is not a multi-use development; however we recognized that some trips generated by the Matias Business Park commercial development would have an origin/destination of one of the new residential developments. To account for these trips we applied daily internal capture rates from the ITE *Trip Generation Handbook* (2nd Edition) to the PM peak period and assumed these vehicles did not travel further north than Latimer Road or further south than Spooner Road. The rates applied are 38% from Residential to Retail and 11% from Retail to Residential. The same internal capture rates were used for Collins Lake Estates to account for the trips between the residential development and the commercial development.

3.4 Estimated Future Traffic Volumes

The estimated future traffic volumes for both time horizons include the 1% linear background growth (**Section 3.1**) and development growth (**Section 3.2**). Volume figures are provided in **Figure 7** (2025) and **Figure 8** (2035).

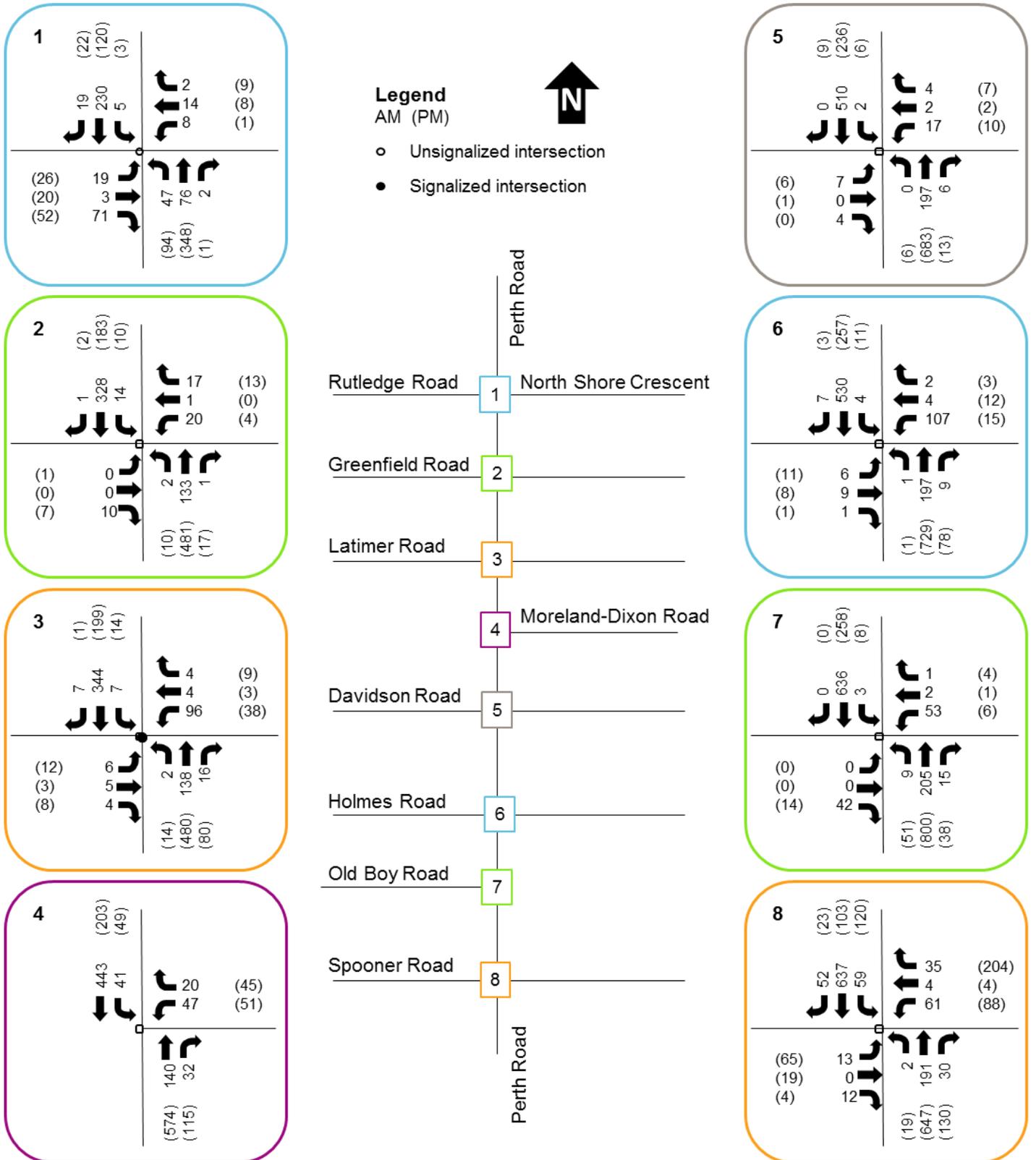


Figure 7. Future Traffic Volumes (2025)

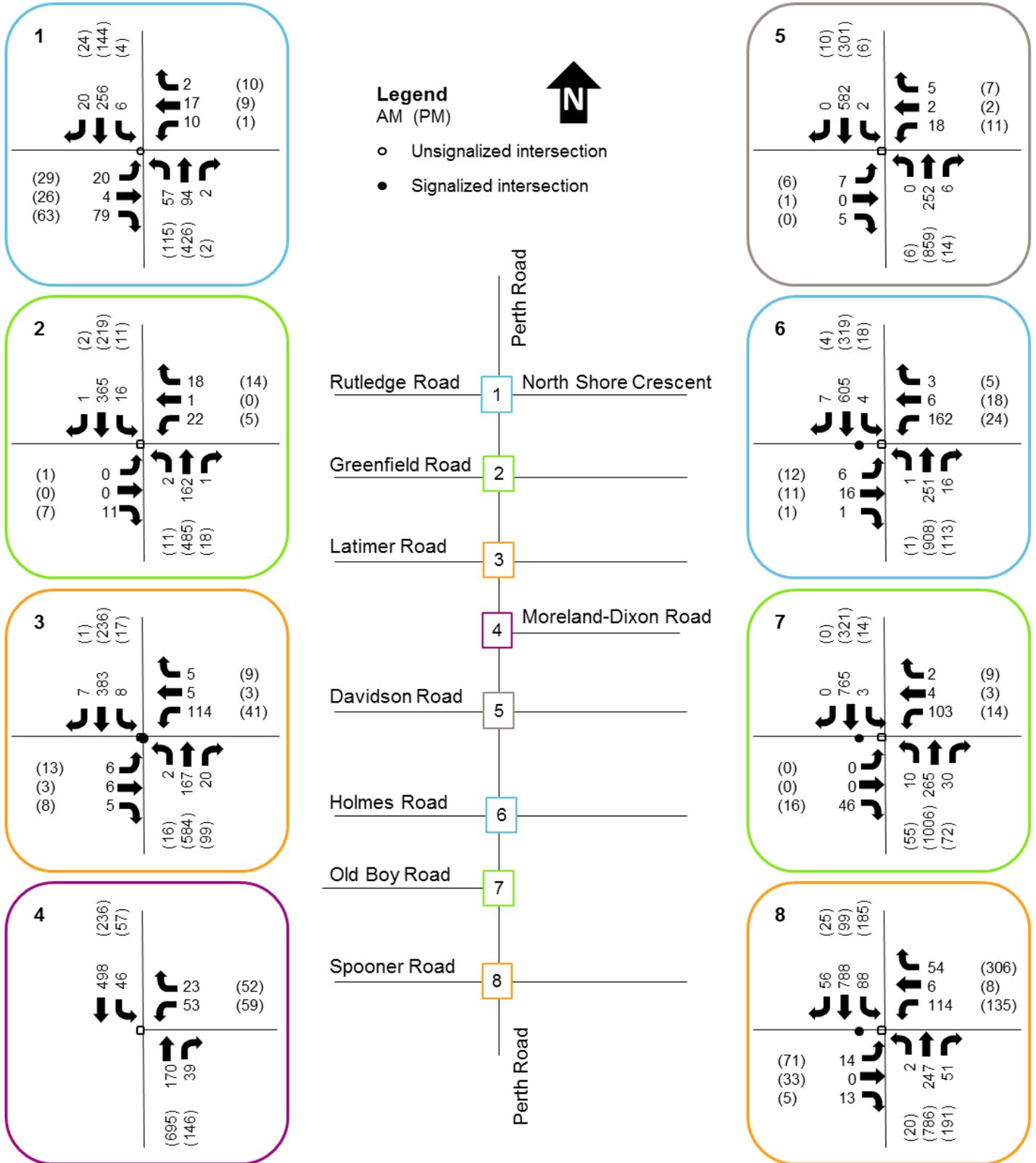


Figure 8. Future Traffic Volumes (2035)

4. Capacity Analysis

4.1 Methodology

Level of Service (LOS) is used by the Highway Capacity Manual 2010 (HCM 2010) to describe the quality of service of a transportation facility. There are six levels defined, which range from A to F. LOS 'A' represents the best operating conditions from the traveller's perspective and LOS 'F' represents the worst. The metric for defining LOS varies between transportation facilities.

On two-lane highways, the LOS is based on the class of highway defined by the Highway Capacity Manual. This classification has no relation to the Classification of Highways defined in the Minimum Maintenance Standards for Municipal Highways (Ontario Regulation 239/02).

The LOS is further based on either the time a vehicle is spent following a vehicle preceding them or free flow speed. Class I highways are primary connectors and daily commuter routes whose LOS is based on the Percent Time Spent Following (PTSF). Class II highways are accesses to Class I facilities and are often the beginning or end of longer trips. Their LOS is also based on PTSF. Class III highways are portions of Class I or II facilities that pass through small towns. Their LOS is based on the Percent Free Flow Speed (PFFS). Perth Road has sections that are Class I, Class II, and Class III.

At intersections, LOS is related to the average delay experienced by each vehicle at the intersection. The v/c ratio represents the capability of a transportation facility to accommodate the traffic demand. As the v/c ratio approaches 1.00 there is an increased possibility of delays and queuing. Once the v/c ratio exceeds 1.00 excessive delays and queues are expected. We've provided the calculated v/c ratio as an evaluation of the overall capacity of a road segment.

4.1.1 Corridor Capacity Analysis

The corridor capacity analysis was completed using Highway Capacity Software 2010 (HCS) for the five corridor segments described in **Section 2.1.1** and for a sixth segment south of our study area. The sixth segment (Commuter Corridor Extension) is included to show the impact of future development in the Inverary area on the Kingston commuter corridor.

When examining the analysis results, we considered the LOS which is related to the percentage of vehicles travelling at the free flow speed on a two-lane highway. The free flow speed of a road is the speed at which a vehicle travels when there are no other vehicles on the roadway. The LOS thresholds for a two-lane highway are shown in the following table. For our v/c ratio calculations, we have assumed that the capacity along the corridor is 800 vehicles per hour per lane.

Table 8. Two-Lane Highway Level of Service (Source: Highway Capacity Manual, 2010)

Level of Service	HCM Class I Highway % Time Spent Following	HCM Class II Highway % Time Spent Following	HCM Class III Highway % of Free Flow Speed
A	<=35	<=40	> 91.7%
B	>35-50	>40-55	83.3% - 91.7%
C	>50-65	>55-70	75.0% - 83.3%
D	>65-80	>70-85	66.7% - 75.0%
E	>80	>85	<= 66.7%
F	demand exceeds capacity	demand exceeds capacity	demand exceeds capacity

4.1.2 Intersection Capacity Analysis

The intersection capacity analysis was completed with Synchro software version 9 using the HCM 2010 methodology. For our approach-based assessments, LOS is defined by intersection delay as shown in the following table.

Table 9. Intersection Level of Service (Source: Highway Capacity Manual, 2010)

Level of Service	Unsignalized Delay (s/veh)	Signalized Delay (s/veh)
A	0 – 10	<= 10
B	>10 – 15	>10 – 20
C	>15 – 25	>20 – 35
D	>25 – 35	>35 – 55
E	>35 – 50	>55 – 80
F	>50	>80

We assessed each approach of each intersection using LOS and delay. Additionally, we identified any movement with a v/c ratio greater than 0.90 at a signalized intersection or a LOS 'F' at an unsignalized intersection. These critical movements could result in unstable traffic conditions should the traffic volumes increase without any corresponding adjustments to the signal timing, road geometry, or traffic distribution.

4.2 Existing Conditions (2015)

4.2.1 Corridor Analysis

The existing corridor operations were analysed to determine the existing LOS during weekday AM and PM peak hours for five segments along the Perth Road corridor and an additional segment to the south. The results of the existing corridor capacity analysis for the peak direction are summarized in the following table.

Table 10. Summary of Existing Conditions (2015) Corridor Capacity Analysis

Perth Road Corridor Segment	Segment	AM Peak Hour & Direction				PM Peak Hour & Direction			
		Volume-to-Capacity	PTSF	PFFS	LOS	Volume-to-Capacity	PTSF	PFFS	LOS
Northern Rural	1	0.22	61.0%	-	C	0.26	61.6%	-	C
Inverary Community	2	0.29	-	81.3%	C	0.36	-	75.7%	C
Southern Transitional	3	0.32	67.2%	-	C	0.42	69.2%	-	C
Southern Rural	4	0.36	65.0%	-	C	0.45	37.0%	-	D
Commuter Corridor	5	0.39	75.8%	-	D	0.48	75.3%	-	D
Commuter Corridor Extension	6	0.38	71.2%	-	D	0.46	71.9%	-	D

The corridor capacity analysis indicates that the six segments currently have residual capacity for additional vehicles and operate at an acceptable LOS during the AM and PM peak hours.

4.2.2 Intersection Analysis

The intersection operations were analysed to determine the existing LOS during weekday AM and PM peak hours at eight intersections within the Perth Road corridor. The results of the existing intersection capacity analysis are summarized in the following table.

Table 11. Summary of Existing Conditions (2015) Intersection Capacity Analysis

Intersection at Perth Road	Control Type	AM Peak Hour		PM Peak Hour	
		LOS (Delay in seconds) ⁽¹⁾	Critical Movements ⁽²⁾	LOS (Delay in seconds) ⁽¹⁾	Critical Movements ⁽²⁾
Rutledge Road / North Shore Road	2-Way Stop	A (7.7)	-	A (7.5)	-
Greenfield Road	2-Way Stop	B (10.8)	-	B (11.2)	-
Latimer Road	Signalized	A (5.7)	-	A (4.0)	-
Moreland-Dixon Road	2-Way Stop	A (7.6)	-	B (14.3)	-
Davidson Side Road	2-Way Stop	B (12.8)	-	C (15.4)	-
Holmes Road	2-Way Stop	B (14.8)	-	C (17.0)	-
Old Boy Road	2-Way Stop	B (12.0)	-	A (9.3)	-
Spoooner Road	2-Way Stop	C (15.2)	-	C (20.8)	-

1. LOS at an unsignalized intersection is defined by the movement with the highest delay
2. Critical movements are those with a volume-to-capacity ratio exceeded 0.90 for a signalized intersection or with a LOS 'F' for an unsignalized intersection.

The capacity analysis indicates that the eight intersections operate at an acceptable LOS during the AM and PM peak hours. The longest delay experienced by a driver is 20.8 seconds at the eastbound approach to the Perth Road and Spoooner Road intersection.

4.2.3 Summary of the 2015 Capacity Analysis

The roadway segments and intersections along the Perth Road corridor currently operate acceptably from a traveller's perspective.

4.3 Interim Development (2025)

4.3.1 Corridor Analysis

We evaluated the Perth Road corridor segments using the forecasted traffic volumes for 2025 (Figure 7). The 2025 traffic volumes include a 1% background growth and the development growth. The development growth assumes that 30% to 50% of all planned developments in the surrounding area have been completed.

The results of the corridor capacity analysis for the peak direction are summarized in the following table.

Table 12. Summary of 2025 Corridor Capacity Analysis

Perth Road Corridor Segment	Segment	AM Peak Hour & Direction				PM Peak Hour & Direction			
		Volume-to-Capacity	PTSF	PFFS	LOS	Volume-to-Capacity	PTSF	PFFS	LOS
Northern Rural	1	0.19	62.8%	-	C	0.26	70.4%	-	D
Inverary Community	2	0.27	-	77.7%	C	0.34	-	70.1%	D
Southern Transitional	3	0.29	70.0%	-	C	0.41	76.5%	-	D
Southern Rural	4	0.38	69.4%	-	D	0.48	77.9%	-	D
Commuter Corridor	5	0.43	81.7%	-	E	0.52	89.3%	-	E
Commuter Corridor Extension	6	0.42	76.7%	-	D	0.47	78.2%	-	D

The corridor capacity analysis indicates that the six segments have residual capacity for additional vehicles in 2025. The corridor operates at an acceptable LOS during the AM and PM peak hours from Rutledge Road to Old Boy Road but there is a LOS 'E' from Old Boy Road south to the City of Kingston boundary, which indicates that a vehicle has a high percentage of traveling in a slow platoon. This limits the driver's freedom to maneuver and reduces the comfort and convenience of commuting. This LOS is due to the additional traffic generated by the "Collins Lake Estates" development. Mitigation measures such as turn lanes or localised widening should be considered.

4.3.2 Intersection Analysis

We evaluated the key intersections along the Perth Road corridor using the forecasted traffic volumes for 2025 (Figure 7). Traffic from the "Collins Lake Estates" development was assigned evenly between the Holmes Road, Old Boy Road, and Spooner Road intersections. As part of our analysis, we used modified lane configurations at Old Boy Road and Spooner Road, which were selected as two new access points to the new "Collins Lake Estates" development. These intersections were modified to limit the number of potential new conflict points on Perth Road. The two modified intersections were analyzed as a 2-way stop with priority to Perth Road.

We have assumed that an entrance opposite the existing Perth Road / Old Boy Road intersection was constructed as part of the new residential development "Collins Lake Estates". This access converts the existing 3-leg

intersection to a 4-leg intersection. The suggested lane configuration for the new approach includes a westbound left turn lane and a westbound through-right lane and a northbound right turn lane was added at the intersection.

We have also assumed that the new residential development “Collins Lake Estates” and the commercial development at “Collins Lake Estates” have a connection to Spooner Road. The suggested modified lane configuration at Spooner Road and Perth Road includes a northbound right turn lane, a westbound left turn lane, and a westbound through-right lane.

The results of the intersection capacity analysis are summarized in the following table.

Table 13. Summary of 2025 Intersection Capacity Analysis

Intersection at Perth Road	Control Type	AM Peak Hour		PM Peak Hour	
		LOS (Delay in seconds) ⁽¹⁾	Critical Movements ⁽²⁾	LOS (Delay in seconds) ⁽¹⁾	Critical Movements ⁽²⁾
Rutledge Road / North Shore Road	2-Way Stop	A (7.9)	-	A (7.6)	-
Greenfield Road	2-Way Stop	B (11.8)	-	B (13.1)	-
Latimer Road	Signalized	A (6.7)	-	A (4.7)	-
Moreland-Dixon Road	2-Way Stop	B (14.4)	-	C (20.5)	-
Davidson Side Road	2-Way Stop	C (16.1)	-	C (23.4)	-
Holmes Road	2-Way Stop	D (26.5)	-	D (29.3)	-
Old Boy Road	2-Way Stop	D (28.8)	-	D (34.6)	-
Spooner Road	2-Way Stop	E (36.6)	WB L	F (276.9)	EB LTR WB L

1. LOS at an unsignalized intersection is defined by the movement with the highest delay
2. Critical movements are those with a volume-to-capacity ratio exceeded 0.90 for a signalized intersection or with a LOS 'E' for an unsignalized intersection.

Under the forecasted traffic conditions for 2025, the intersections along Perth Road between Rutledge Road and Holmes Road are expected to operate with low to moderate delay and a good level of service. The operations at these intersections have not changed significantly from the existing conditions.

The additional traffic from the “Collins Lake Estates” development at the intersections at Holmes Road, Old Boy Road and Spooner Road cause an increase in delay for eastbound and westbound traffic. The eastbound lane at Spooner Road in particular, experiences a delay of 276.9 seconds in the PM peak. The queue lengths are longer than the existing conditions and the LOS is deteriorating. These conditions are expected to occur when 50% of the planned “Collins Lake Estates” development has been built (300 residential lots and 5160 sq. metres of commercial development, **Section 3.2**).

4.3.3 Summary of the 2025 Capacity Analysis

The roadway segments and intersections between Rutledge Road and Holmes Road continue to operate acceptably from a traveller’s perspective in 2025. However, with the additional traffic generated by the planned residential and commercial developments, and specifically the “Collins Lake Estates” development, the roadway and intersection operations from Holmes Road to Spooner Road begin to experience slower free flow speeds, moderate delay, and queueing. Roadway and intersection improvements should be considered to address growth. Traffic signals and left turn lanes at Spooner Road could improve intersection and corridor operations.

4.4 Development Completion (2035)

4.4.1 Corridor Analysis

We evaluated the Perth Road corridor segments using the forecasted traffic volumes for 2035 (Figure 8). The 2035 traffic volumes include a 1% background growth and development growth. The development growth assumes that 100% of all planned developments in the surrounding area have been completed. The results of the corridor capacity analysis for the peak direction are summarized in the following table.

Table 14. Summary of 2035 Corridor Capacity Analysis

Perth Road Corridor Segment	Segment	AM Peak Hour & Direction				PM Peak Hour & Direction			
		Volume- to- Capacity	PTSF	PFFS	LOS	Volume- to- Capacity	PTSF	PFFS	LOS
Northern Rural	1	0.21	65.0%	-	C	0.32	71.4%	-	D
Inverary Community	2	0.30	-	71.9%	D	0.41	-	67.1%	D
Southern Transitional	3	0.32	70.1%	-	D	0.50	82.4%	-	D
Southern Rural	4	0.45	77.2%	-	D	0.60	84.2%	-	E
Commuter Corridor	5	0.54	89.9%	-	E	0.67	96.3%	-	E
Commuter Corridor Extension	6	0.54	83.5%	-	E	0.59	84.9%	-	E

The Perth Road corridor operates with residual capacity between Rutledge Road and Old Boy Road. However, with the addition of the traffic generated by a completed “Collins Lake Estates” development, the corridor segments from Holmes Road to Unity Road in Kingston operate with a LOS ‘E’, which indicates that a vehicle has a high percentage of traveling in a slow platoon. In the PM peak period, between Old Boy Road and Spooner, the northbound traffic spends 96.3% of the time following another vehicle. This limits the driver’s freedom to maneuver and reduces the comfort and convenience of commuting.

4.4.2 Intersection Analysis

We evaluated the key intersections along the Perth Road corridor using the forecasted traffic volumes for 2035 (Figure 8) with the suggested intersection configuration changes used for the 2025 analysis.

The results of the intersection capacity analysis are summarized in the following table.

Table 15. Summary of 2035 Intersection Capacity Analysis

Intersection at Perth Road	Control Type	AM Peak Hour		PM Peak Hour	
		LOS (Delay in seconds) ⁽¹⁾	Critical Movements ⁽²⁾	LOS (Delay in seconds) ⁽¹⁾	Critical Movements ⁽²⁾
Rutledge Road / North Shore Road	2-Way Stop	A (8.0)	-	A (7.8)	-
Greenfield Road	2-Way Stop	B (12.6)	-	C (15.1)	-
Latimer Road	Signalized	A (7.3)	-	A (5.2)	-
Moreland-Dixon Road	2-Way Stop	C (16.3)	-	D (29.8)	-
Davidson Side Road	2-Way Stop	C (18.6)	-	D (33.7)	-
Holmes Road	2-Way Stop	F (68.4)	WB	F (58.5)	WB, EB
Old Boy Road	2-Way Stop	F (86)	WB	F (67.9)	WBL
Spooner Road	2-Way Stop	F (216)	WBL, EB	F (>300s)	WB, EB

1. LOS at an unsignalized intersection is defined by the movement with the highest delay
2. Critical movements are those with a volume-to-capacity ratio exceeded 0.90 for a signalized intersection or with a LOS 'F' for an unsignalized intersection.

The three intersections used by the traffic from the “Collins Lake Estates” development will have excessive westbound delays with LOS F, particularly Spooner Road with delays of over 200 seconds with a 2-way stop when the development is completed (600 residential lots and 10,320 m² of commercial space). Improvements to the corridor and intersections are required between Holmes Road and Spooner Road prior to the completion of the ‘Collins Lake Estates’ development to mitigate the impacts of the additional traffic generated by this development.

4.4.3 Summary of the 2035 Capacity Analysis

The roadway segments and intersections between Rutledge Road and Holmes Road continue to operate acceptably from a traveller’s perspective in 2035. However, with the additional traffic generated by the planned residential and commercial developments, specifically the “Collins Lake Estates” development, the roadway and intersection operations from Holmes Road to Spooner Road will experience slow free flow speeds, excessive delay, and queuing. Roadway and intersection improvements should be considered to accommodate this planned growth.

Improvements to the corridor and intersections are required between Holmes Road and Spooner Road prior to the completion of the ‘Collins Lake Estates’ development to mitigate the impacts of the additional traffic generated by this development. The mitigation measures to be considered are:

- Widening Perth Road from 2 lanes to 4 lanes south of Holmes Road
- Installing traffic signals at the Holmes Road, Old Boy Road, and Spooner Road intersections
- Providing dedicated turn lanes into and out of the “Collins Lake Estates” development

Widening Perth Road from 2 lanes to 4 lanes south of Holmes Road will cause a problem at the boundary between the Township of South Frontenac and the City of Kingston. Based on the current direction in the City of Kingston's Transportation Master Plan, upgrading any road from the municipal boundary southward would not be a favourable alternative. Without a roadway upgrade from the municipal boundary southward, the benefits of widening Perth Road between Holmes Road to the municipal boundary are negatively offset. It may be possible to add lanes or drop lanes at the Spooner Road intersection if the traffic destined for the commercial development is sufficient to warrant a separate lane between Old Boy Road and Spooner Road.

The number of residences and the impact to the road capacity should be confirmed by a detailed traffic impact study completed for the "Collins Lake Estates" development that considers the impact to the Perth Road corridor between Holmes Road and the municipal boundary.

It is possible that traffic will redistribute to other roads if Perth Road is operating at capacity. Some drivers may choose to travel north on Holmes Road to connect to Moreland-Dixon Road and travel east through Sunbury before going south toward Kingston. Another possible route is on Spooner Road across Perth Road to Leeman Road to connect to Sydenham Road.

5. Corridor Assessment

5.1 Parking

5.1.1 Commercial

There are four existing and operational commercial developments along the Perth Road corridor that have private parking lots for their customers. They include Northway Country Supply, North Country Marine, Custom Auto Repair, and Home Hardware.

At the south-west corner of Perth Road and Latimer Road is a building with a Canada Post outlet, a general store (currently closed), and a residential rental unit. There is currently parking available adjacent to the building on Latimer Road and Perth Road for these land uses. The parking area provides unmarked space where the driver drives up to the building to park and backs out directly onto the roadway to exit. Both parking areas are within 20 metres of the signalized Latimer Road intersection. The provision for parking should be re-examined if the building is renovated or the land use is changed. The parking should move to an area outside of the operational influence of the intersection to minimize conflicts.

The building where the Village Market was located in Inverary has been demolished and the land is currently available for commercial lease as a “will build to suit”. When the land is being developed, the owner should include appropriate on-site parking.

5.1.2 Public

There is a boat ramp with a small paved parking lot where Perth Road crosses Loughborough Lake. The Loughborough Boat Ramp is located on the west side of Perth Road and the boats launch on south side of the lake. The parking area is approximately 20 meters wide with a 40m frontage on Perth Road. During boating season, this parking lot cannot accommodate the volume of vehicles and boat trailers are using the boat ramp. The overflow of vehicles primarily park on the west side of Perth Road on the widened gravel shoulder. However, some vehicles/trailers park on the east side of Perth Road, which causes pedestrians to cross Perth Road in an 80 km/h speed zone.

To mitigate conflicts between pedestrians and vehicles, the Township should consider:

- Expanding the existing parking lot if land is available and suitable for construction of a parking area
- Restricting parking along the east side of Perth Road in this area
- Lengthening the widened shoulder to the south of the boat ramp on the west side of Perth Road to accommodate potential overflow parking

5.2 Access Management

5.2.1 Willowbrook Estates

Land preparation for Willowbrook Estates (**Section 3.2**) has begun and there have been two Traffic Impact Reports submitted; one for the residential subdivision (July 29, 2013) and one for the commercial business park (May 6, 2015).

The proposed residential site plan indicates that there will be 16 new residential lots with a single access point opposite the Northway Home Hardware store entrance. The traffic impact report confirms that sight distances for the proposed access meets the sight distance requirements in the Ministry’s Geometric Design Standards for Ontario Highways.

The proposed commercial site plan indicates that there will be two buildings with a single direct access entrance to Perth Road. The traffic impact report confirms that sight distances for the proposed access meets the sight distance requirements in the Ministry’s Geometric Design Standards for Ontario Highways.

Based on this corridor study and our previous review of both the residential and commercial traffic impact study reports, the proposed access points will limit the number of potential new conflict points on Perth Road by utilizing and upgrading existing accesses where available. The existing access to Northway Home Hardware should be reviewed to identify opportunities to redesign the access to limit conflicts between vehicles entering/exiting the residential subdivision and the commercial parking lot.

5.2.2 “Collins Lake Estates” Development

A traffic impact report for the proposed “Collins Lake Estates” development (**Section 3.2**) has not been prepared. In the absence of a report that would provide information about access points to the development, we have developed preliminary suggestions regarding access locations. Given the proposed size and location of the development along Perth Road, we suggest limiting the number of new direct accesses. Based on our review of the corridor, we suggest connecting the development to Perth Road via Holmes Road and Spooner Road and providing one new direct access opposite the existing Old Boy Road.

5.3 Speed Control

The speed zones within the study area are appropriate for the surrounding land uses and frequency of direct access. Furthermore, the location for the beginning of a northbound speed zone matches the end of a southbound speed zone, which provides consistency to drivers.

The Township has expressed concern about traffic operations and safety at the Moreland-Dixon Road intersection. Based on our capacity analysis for the existing and future traffic conditions (**Section 4**), a change in traffic control is not necessary from an operational perspective. However, when considering speed management and the location of this intersection within a transitional area speed area, the installation of a roundabout rather than stop control or traffic signal control could be beneficial. From the *Roundabout in Canada: A Primer for Decision Makers* (November 2013) the key advantages and disadvantages of roundabouts compared to stop control or traffic signal control are:

Table 16. Advantages and Disadvantages of Roundabouts

Advantages of Roundabouts	Disadvantages of Roundabouts
<ul style="list-style-type: none"> • Improved safety • Lower vehicle delays and queues • Lower life cycle costs • Lower fuel consumption and emissions • Opportunities for gateway features 	<ul style="list-style-type: none"> • Higher construction costs • More space/property required • Difficult to upgrade from a stop control with live traffic • Requires public education

Additionally, roundabouts are a recommended treatment for speed management between high-speed and low-speed transition zones on rural highways approaching a small town. According to the National Cooperative Highway

Research Program (NCHRP) Report 737, *Design Guidance for High-Speed to Low-Speed Transition Zones for Rural Highways* (2012), the use of roundabouts in these zones increases the rate of compliance of vehicles traveling at or below the speed limit by 15 to 20 percent. The suggested location for roundabouts in these transition zones is at the downstream end of the deceleration area. The Moreland-Dixon Road intersection is an ideal location for a roundabout. A schematic plan of the area following the NCHRP Report's transition zone study is shown in **Figure 9** and described below.

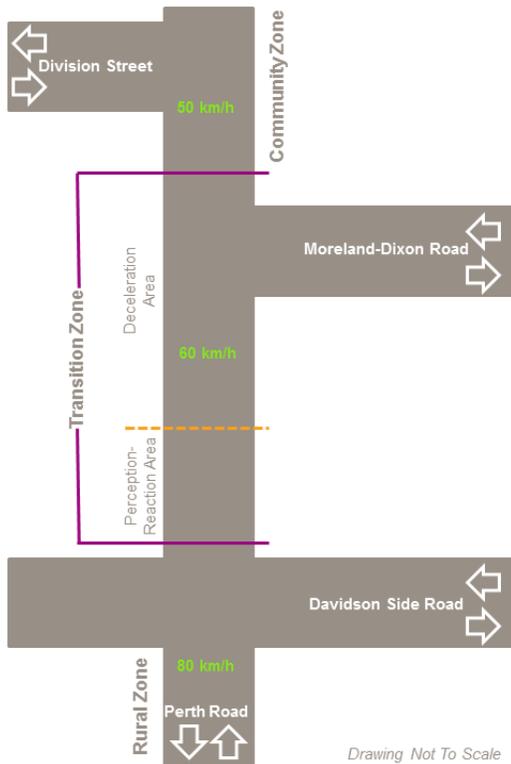


Figure 9. High-Speed to Low-Speed Transition Zone

The **rural zone** is the high-speed, rural roadway outside of a developed community. For the Perth Road corridor, this is the road segment between Spooner Road and Davidson Side Road.

The **transition zone** is located between the rural and community zones and is the area where drivers are expected to reduce their speed. For the Perth Road corridor, this is the road segment between Davidson Side Road and Division Street.

The perception-reaction area is the portion of the transition zone where drivers are made aware of the impending speed change. For the Perth Road corridor, this is the roadway segment between Davidson Side Road and the beginning of the 60 km/h speed zone defined by Schedule A-12 of Bylaw 2000-01 (**Section 2.2.1**).

The deceleration area is the portion of the transition zone where the driver is expected to decelerate to a safe operating speed prior to entering the developed area. For the Perth Road corridor, this is the 60 km/h speed zone defined by Schedule A-12 of Bylaw 2000-01 (**Section 2.2.1**).

The **community zone** is the portion of roadway serving the more developed community area. For the Perth Road corridor, this is the 50 km/h speed zone defined by Schedule A-11 of Bylaw 2000-01 (**Section 2.2.1**) and roughly located between Division Street and a point north of Latimer Road.

In addition to a roundabout at the Moreland-Dixon Road intersection, the Township should consider the following treatments as part of the transition zone study area in an effort to manage speeds as traffic volumes continue to grow with commuter traffic: transverse pavement markings within the perception-reaction area and an improved gateway to the Hamlet of Inverary to the north of Moreland-Dixon Road. Typically, a gateway includes a distinct change in the roadway environment and includes a combination of the following transitional zone treatments:

- Central island / raised median
- Roadway narrowing
- Coloured pavement
- Welcome signs
- Landscaping that promotes the character of the area

For a community the size of Inverary, an appropriate gateway could include coloured pavement and welcome signs with enhanced landscaping.

5.4 Roadway Alignment and Cross Section

There is a difference in grade between Perth Road and the minor road at the Holmes Road intersection and the Spooner Road intersection. The minor roads are lower than Perth Road and this grade difference is problematic because it can reduce the visibility of the stop control to the vehicles on the minor streets and impact sight distances for vehicles turning from the minor street onto Perth Road. These intersections also have corner radii that are in poor condition. The grade differential could be improved by raising the approach grade of the east and west approach at both intersections.

At the Holmes Road intersection, the southeast corner radius is in poor condition, which could provide reduced traction compared to the roadway and is a potential hazard for northbound vehicles turning east onto Holmes Road. Paving a larger section of the southeast corner could improve safety by providing increased traction.

At the Spooner Road intersection, the northwest corner radius is in poor condition, which could provide reduced traction compared to the roadway is a potential hazard for southbound vehicles turning west onto Spooner Road. Paving a larger section in the northwest corner could improve safety by providing increased traction.

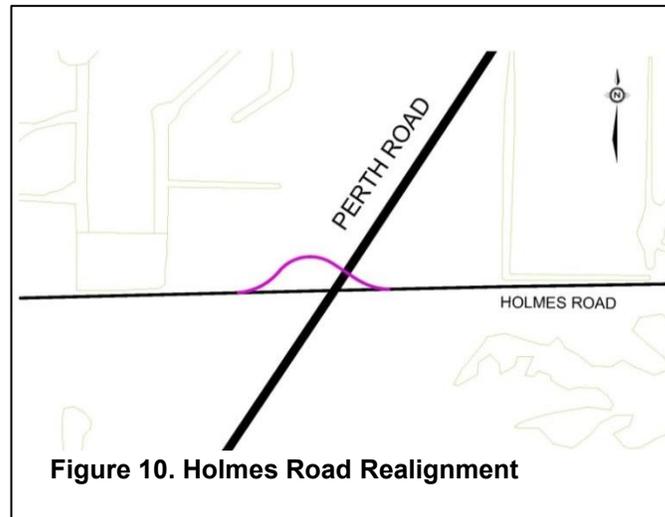
Based on our capacity analysis, the existing cross section of Perth Road will not have sufficient capacity for the expected traffic generated by planned developments in 2035. Widening Perth Road from 2 lanes to 4 lanes from Holmes Road southward would provide sufficient roadway capacity for future conditions.

5.5 Intersection Sightlines

The **Rutledge Road intersection** has poor sightlines for westbound vehicles turning south onto Perth Road. Sightlines are impeded by the existing rock outcrop to the south. A remedial action at this intersection is not recommended since the forecasted westbound traffic volumes are low. However, the intersection should be monitored in the future as traffic volumes increase for increased collisions between westbound left turning traffic and oncoming vehicles.

The **Holmes Road intersection** has poor sightlines for westbound vehicles turning south onto Perth Road. The sightlines are impeded by the existing residences, the skewed intersection configuration, and the grade difference between Holmes Road and Perth Road. Intersection control upgrades and improvements to the roadway alignment and cross section should improve sightlines at this intersection.

A possible pathway for roadway realignment at this intersection is shown in **Figure 10**.



Other potential alternatives that could lessen the impact of the skew include:

- Painting skip lines through the intersection
- Adding protected left turn phases with future traffic signal control timing
- Converting the intersection to a roundabout

The **Davidson Side Road intersection** has poor sightlines for eastbound vehicles turning north onto Perth Road. Sightlines could be improved by removing the existing trees on private property in the north-west corner of the intersection. Furthermore, the Davidson Side Road intersection is skewed which contributes to the poor sightlines. A realignment of Davidson Side Road to permit a 90 degree angle at the intersection will improve the sightlines.

6. Corridor Improvement Plan

The recommendations of this study are presented as a corridor improvement plan for the following timeframes:

- Near future, 0-5 years, based on existing conditions and needs
- Short Term, 5-15 years, based on interim development conditions and needs
- Long Term, 15+ years, based on full development conditions and needs

Additionally, we have provided some recommendations for ongoing programs to support future traffic operations and decision making along the Perth Road corridor.

6.1 Near Future Improvements

1. Include transverse pavement markings at beginning of the northbound 60km/h speed zone defined by Schedule A-12 in Bylaw 2000-01
2. Construct a gateway feature at the Moreland-Dixon Road intersection to transition between 80 km/h to 50 km/h in the village area. This gateway feature could be a roundabout with enhanced landscaping or other traffic calming measures.

3. Consider including coloured pavement and improved signage north of the Moreland-Dixon Road intersection to further emphasize the transition from a rural speed zone to a community speed zone
4. Investigate possibility of expanding the Loughborough Boat Ramp parking lot
5. Restrict summer parking along the east side of Perth Road opposite the Loughborough Boat Ramp
6. Lengthen and widen the paved shoulder south of the Loughborough Boat Ramp on the west side of Perth Road to safely accommodate potential parking overflow

6.2 Short Term Improvements

7. Realign Davidson Road at Perth Road to remove or lessen the existing intersection skew
8. Improve the eastbound and westbound approach grades at the Holmes Road and Spooner Road intersections to match the existing Perth Road grade
9. Convert the Old Boy Road intersection from a 3-leg stop control to a 4-leg stop control to accommodate direct access to the planned “Collins Lake Estates” development (in accordance with their site plan and traffic impact report)
10. Construct additional northbound right and westbound turning lanes at the Old Boy Road and Spooner Road intersections to meet needs of development growth

6.3 Long Term Improvements

11. Add traffic signals at Holmes Road, Old Boy Road, and Spooner Road intersections to meet the needs of development growth
12. Realign Holmes Road at Perth Road to remove or lessen the existing intersection skew

6.4 Ongoing Programs

13. Investigate the merits of limiting residential and commercial development along the Perth Road corridor to meet the current roadway capacity to eliminate the need for future widening near the City of Kingston boundary on a shared commuter corridor
14. Continue to obtain annual traffic counts along the study corridor. It will become increasingly important to have accurate traffic data to determine the impact of the planned developments.
15. Implement a collision monitoring program to determine if intersection improvements are required at skewed intersections (Davidson Side Road and Holmes Road) and at intersections with impeded sightlines (Rutledge Road, Latimer Road, Davidson Side Road, and Holmes Road)

16. Require any large development along the corridor to complete an in-depth traffic impact study that will consider the traffic impact on Perth Road from Moreland-Dixon Road southwards. A traffic impact study is required for the planned developments discussed in this corridor study to monitor the threshold for widening Perth Road from two-lanes to four-lanes south of Holmes Road.

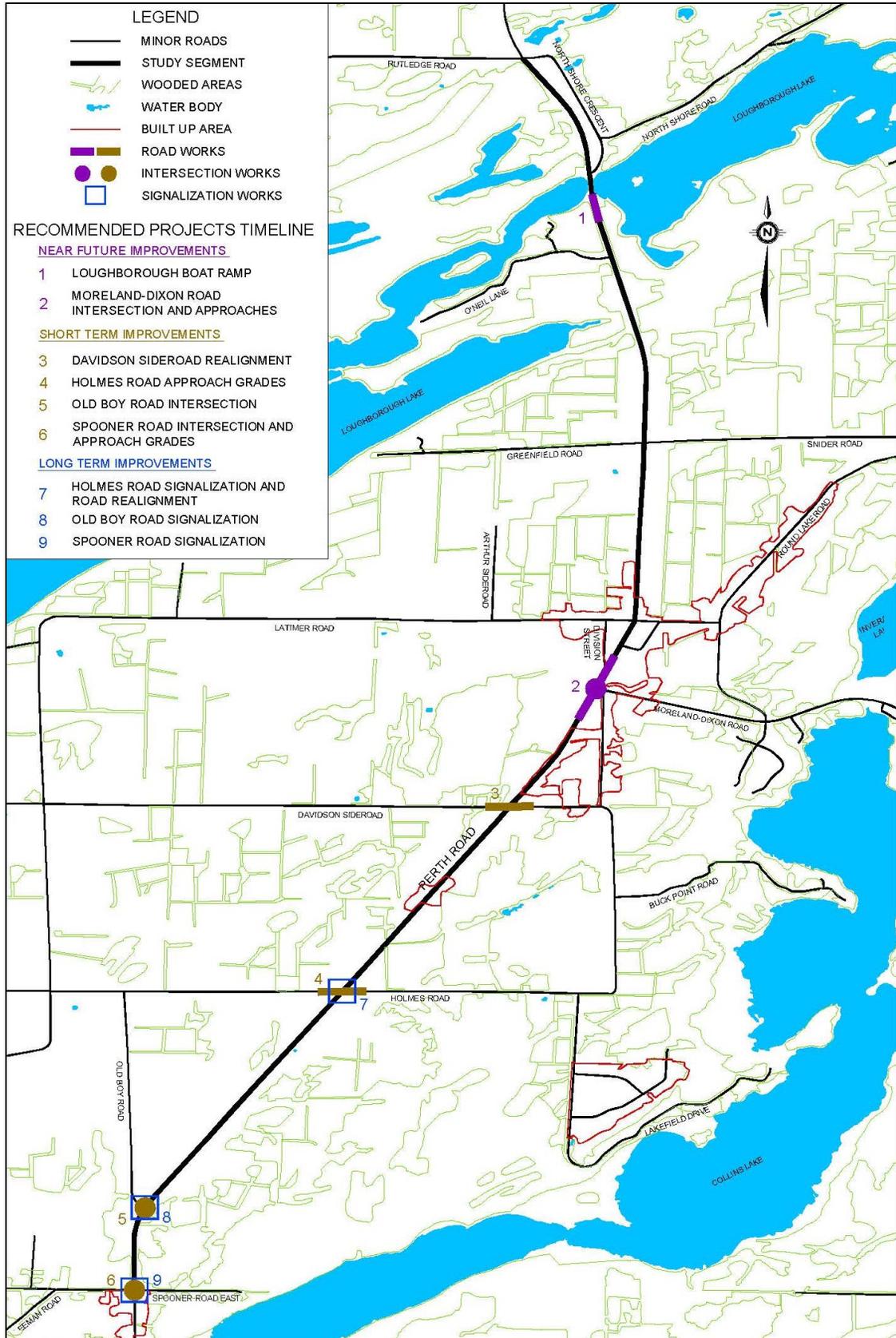


Figure 11. Recommended Projects Timeline

6.5 Effects of Development

Under current conditions, traffic control upgrades or additional turn lanes are unnecessary to address capacity or operational issues. Certain short term and long term recommendations are required due to development. Based on the capacity analysis for the future traffic conditions, there will be a need for intersection control upgrades. The table below indicates whether the recommendations are related to the development.

Table 17. Summary of the effect of Development for the Road Recommendations

Intersection with Perth Road	Near Future		Short Term		Long Term	
	Improvement	% Development	Improvement	% Development	Improvement	% Development
Moreland-Dixon Road	Gateway/speed control features Loughborough boat ramp	0%	-	-	-	-
Davidson Road			Realign Davidson Road	0%	-	-
Holmes Road				-	Realign Holmes Road Traffic signals Dedicated turning lanes ⁽¹⁾	80% Collins Lake Estates
Old Boy Road			New access to “Collins Lake Estates” development Dedicated turning lanes ⁽¹⁾	100% Collins Lake Estates	Traffic signals Dedicated turning lanes ⁽¹⁾	100% Collins Lake Estates
Spooner Road			Dedicated turning lanes ⁽¹⁾	100% Collins Lake Estates	Traffic signals Dedicated turning lanes ⁽¹⁾	100% Collins Lake Estates

1. Lanes as identified by an in-depth Traffic Impact Study for the “Collins Lake Estates” residential development

Site Visit Photos

July 4, 2015

Rutledge Road Intersection



Photograph 1. ↑
Westbound approach looking west



Photograph 2. ↑
Westbound approach looking north



Photograph 3. ↑
Westbound approach looking south



Photograph 4. ↑
Traffic control

Loughborough Boat Ramp



Photograph 5. ↑
Southbound Approach
Parking lot is full with overflow on the east and west sides of Perth Road

Greenfield Road Intersection



Photograph 6. ↑
Westbound approach looking west



Photograph 7. ↑
Westbound approach looking west



Photograph 8. ↑
Westbound approach looking north



Photograph 9. ↑
Westbound approach looking south

Latimer Road Intersection



Photograph 10. ↑
Westbound approach



Photograph 11. ↑
Westbound approach looking south



Photograph 12. ↑
Westbound approach looking south

Moreland Dixon Road Intersection



Photograph 13. ↑
Westbound approach looking west



Photograph 14. ↑
Westbound approach looking west



Photograph 15. ↑
Westbound approach looking north



Photograph 16. ↑
Westbound approach looking west



Photograph 17. ↑
Westbound approach looking west



Photograph 18. ↑
Westbound approach looking south

Davidson Road Intersection



Photograph 19. ↑
Westbound approach looking west



Photograph 20. ↑
Westbound approach looking south



Photograph 21. ↑
Westbound approach looking north



Photograph 22. ↑
Transition to from 80km/h 60 km/h north of intersection



Photograph 23. ↑
Westbound approach looking south



Photograph 24. ↑
Eastbound approach looking north



Photograph 25. ↑
Eastbound approach looking east

Holmes Road Intersection



Photograph 26. ↑
Westbound approach



Photograph 27. ↑
Farm access immediately east of the intersection



Photograph 28. ↑
Farm access between south and east leg of intersection



Photograph 29. ↑
Westbound approach looking south



Photograph 30. ↑
Westbound approach looking north



Photograph 31. ↑
Westbound approach looking west



Photograph 32. ↑
Northbound approach looking north



Photograph 33. ↑
Eastbound approach looking north



Photograph 34. ↑
Eastbound approach looking east

Old Boy Road Intersection



Photograph 35. ↑
Intersection looking west



Photograph 36. ↑
Eastbound approach looking south



Photograph 37. ↑
Eastbound approach looking south



Photograph 38. ↑
SB#37C - Interior

Spoooner Road Intersection



Photograph 39. ↑
Eastbound approach looking east



Photograph 40. ↑
Curb in north-west corner of intersection



Photograph 41. ↑
Eastbound approach looking north



Photograph 42. ↑
Eastbound approach looking south



Photograph 43. ↑
Eastbound approach looking east



Photograph 44. ↑
Westbound approach looking south



Photograph 45. ↑
Westbound approach looking west