North Perth Traffic Study
Final Report

Paradigm Transportation Solutions Limited

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Project Summary

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North Perth (Listowel) Transportation Study

List of Revisions

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Signatures and Seals

Signature

Engineer's Seal

Disclaimer

Executive Summary

Content

Paradigm Transportation Solutions Limited (Paradigm) was retained to conduct a traffic study for the Municipality of North Perth. This study includes guidelines for adoption of the All-Way Stop Policy, an assessment of stop sign compliance, a roadway classification review, analyses of NuMetric traffic data, proposed Downtown Listowel by-pass routing, assessment of the impacts of closing Inkerman Street, an assessment of the existing (2015) traffic operations, recommendations regarding converting Inkerman Street to one-way operation, an assessment of provision of one-way street pairs, and recommendations regarding left turn lanes on Main Street.

Stop Sign Policies and Procedures

Adoption of the All-Way Stop Policy will provide the Municipality with clear and consistent guiding principles regarding the need for and installation of all-way stop control at intersections.

Stop Sign Compliance

Stop sign compliance ranged from 63% to 76% at intersections where all-way stop control was not warranted. Stop sign compliance was found to be 98% at intersections where all-way stop control was warranted.

Changes in approach and departure speeds were found to be minor at the intersections where spot speed surveys were conducted. there was a correlation between a greater variance in approach / departure speeds at the unwarranted all-way stop locations compared to the single warranted all-way stop location.

Roadway Classification Review

The roadway classification review confirmed that the majority of roadways examined as part of this study are appropriately designated. A total of six roadway segments require reclassification as per the threshold values stated in Ontario Regulation 239/02.

NuMetric Analyses

The 85th percentile operating speeds on the three roadway segments where NuMetric ATR data was collected are between 13 and 16 kilometres per hour higher than the posted speed limit. The section of Wallace Avenue South from Armstrong Street to Line 84 and the section of Tremaind Road

from Clayton Street East to Perth Line 86 should be considered for remediation.

Downtown By-Pass

Provision of a properly planned and staged by-pass that is both safe and efficient will help to alleviate congestion on Main Street within Downtown Listowel. The proposed by-pass routing contained herein should provide a route that is comparable to the existing route through Downtown Listowel.

Potential Impacts of Closing Inkerman Street (2012)

If the closure of the west leg of Inkerman Street was to occur, eastbound volumes may shift northerly to Elizabeth Street. No capacity issues are likely to arise at any of the side street intersections as a result of closing the west leg of Inkerman Street. However, there is currently no capacity justification to support a closure.

2015 Traffic Operations

The intersections in the study area are operating with acceptable levels of service during the Friday afternoon and Saturday peak hours.

The northbound through movement at the intersection of Main Street West and Barber Avenue is operating at LOS E during the Friday peak hour. Delay on this movement is due to the volume of traffic on Main Street West since less than 10 vehicles were recorded on the movement itself during the higher Friday peak hour.

The southbound through/right-turn 95th percentile queue at the intersection of Main Street and Wallace Avenue is estimated to spill back and potentially interfere with operations at the intersection of Wallace Avenue and Inkerman Street during the Friday afternoon and Saturday peak hours.

2015 Traffic Operations with Main Street and Wallace Avenue Lane Reconfiguration

The intersection of Main Street and Wallace Avenue will improve to overall level of service B (from level of service C) during the Friday and Saturday peak hours with reconfiguration of the lanes to provide:

- Separate eastbound and westbound left turn lanes;
- One eastbound shared through/right-turn lane; and
- One through lane and one shared through/right-turn lane in the westbound direction

Five on-street parking spaces on the south side of Main Street East between Wallace Avenue and Wellington Avenue South will have to be removed in order to facilitate the lane reconfiguration.

Inkerman Street Conversion to One-Way Operation

The 2015 analyses estimated the 95th percentile southbound queue lengths at the intersection of Main Street and Wallace Avenue will exceed the available distance between this intersection and the Wallace Avenue and Inkerman Street intersection. Therefore, the Municipality should explore the option of converting Inkerman Street between Wallace Avenue and Argyle Avenue North to one-way operations.

If the lanes are reconfigured at the intersection of Main Street and Wallace Avenue, the southbound queues should not interfere with operations at Wallace Avenue and Inkerman Street, negating the need to convert Inkerman Street to one-way operation.

Alternative Congestion Alleviation Measure – One-Way Pairs

Traffic volumes will increase on Inkerman Street and decrease on Elma Street during the Friday peak hour if Inkerman Street is converted to one-way westbound and Alma Street is converted to one-way eastbound operations between Victoria Avenue and Nichol Avenue. However, traffic volumes will not increase to the degree that mitigation will be required.

Provision of a one-way pair via Inkerman Street and Elma Street should remove the need to reconfigure the lanes at the intersection Main Street and Wallace Avenue since any traffic not origined or destined to/from Downtown should reassign to these roadways.

Left Turn Lanes

Based on the 2015 traffic volumes, left turn lanes are warranted on Main Street as follows:

- A left turn lane with 15 metres storage is warranted in both the eastbound and westbound directions on Main Street at Victoria Avenue;
- An eastbound left turn lane with 25 metres storage and a westbound left turn lane with 15 metres storage is warranted on Main Street at Barber Avenue;
- An eastbound left turn lane with 25 metres storage and a westbound left turn lane with 15 metres storage is warranted on Main Street at Livingstone Avenue;

- A westbound left turn lane with 15 metres storage is warranted on Main Street at Wellington Avenue. Although this lane is warranted, the offset configuration of Wellington Avenue with Main Street, will not permit provision of this lane; and
- A westbound left turn lane with 15 metres storage is warranted on Main Street at Davidson Avenue

In order to provide the warranted stand alone left turn lanes, 26 to 31 parking spaces will require removal on Main Street between Victoria Avenue and Livingstone Avenue. The total number of stalls that will require removal is dependent upon the side of the street from which parking is removed.

Provision of a central two-way left turn lane on Main Street between Victoria Street and Wallace Avenue will ensure that adequate left turn storage is provided at all intersections in the area and will also provide a safe refuge for vehicles making mid-block turns into driveways. This will require removal of an additional 16 to 17 marked on-street spaces over and above the 26 to 31 spaces required for provision of stand alone left turn lanes where warranted.

Provision of a central TWLTL between Victoria Avenue and Wallace Avenue can be achieved through pavement markings to provide one travel lane in each direction, the central TWLTL and parking on one side of the roadway.

Recommendations

Based on the findings of this study, it is recommended that:

- The Municipality of North Perth should adopt and implement the All-Way Stop warrant;
- In situations where alternatives to all-way stop control are not feasible, the Municipality should consider speed reduction techniques and the installation of warning signage and/or flashing lights when all-way stop control is not recommended;
- The Municipality update the North Perth Road Condition Assessment in order to reflect the updated roadway classifications contained herein;
- Detailed traffic calming studies be undertaken to address the speeding issues identified within the Wallace Street and Tremaine Avenue corridors;
- The Municipality undertake a Class Environmental Assessment Study to justify the need for a by-pass of the Downtown and to provide an opportunity for public and stakeholder input;
- A staged approach is utilized when implementing the by-pass;
- The by-pass should be implemented on a trial basis with pre- and post-by-pass monitoring to gauge its effectiveness;

- All roadways under jurisdiction of the Municipality that are recognized as forming part of the by-pass are updated to arterial classification within the Official Plan;
- Alignment of the intersection of Main Street and Wallace Avenue should be identified in the Municipality's Official Plan with the actual alignment determined through a future Class Environmental Assessment Study;
- The intersection of Main Street and Wallace Avenue should continue to operate with split signal phasing as this provides the best levels of service for the intersection;
- If the Municipality pursues conversion of Inkerman Street to one-way between Wallace Avenue and Argyle Avenue North, it should operate in the westbound direction.
- The Municipality install signage at the intersections of Wallace Avenue and Inkerman Street and Inkerman Street and Argyle Street North as per the recommended plan to ensure motorists adhere to the one-way limitation on Inkerman Street;
- Any existing all-way stop control between Victoria Avenue and Nichol Avenue should be changed to two-way stop control, with right-of-way given to the eastbound/westbound traffic if Inkerman Street and Elma Street are converted to one-way operations;
- Ample clear informational and directional signage guiding drivers to the alternate routes (Inkerman Street and Elma Street) will be required on Main Street to ensure these roadways function as intended if converted to a one-way pair;
- The Municipality consider the installation of a central two-way left-turn lane on Main Street from Victoria Street to Wallace Avenue. Provision of this lane will ensure that adequate left turn storage is provided at all intersections in the area and will also provide a safe refuge for vehicles making mid-block turns into driveways;
- A westbound left turn lane with 15 metres storage should be provided on Main Street at Davidson Avenue; and
- The Municipality proceed with the development and implementation of an on-going traffic counting program which should be undertaken annually, until traffic data has been collected for all Municipal roads. Once data has been collected for all roads and a baseline has been established, it is recommended that a three to five-year collection cycle be implemented.

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1 Phase 1 – Stop Sign Policies and Procedures

The purpose of this policy is to define the prerequisites and develop warranting criteria necessary to justify the need for all-way stop control at an intersection within the municipality.

1.1 Background

- The purpose of a stop sign is to clearly assign right-of-way between vehicles approaching an intersection. The stop sign requires the driver to stop the vehicle before entering the intersection, yield to any traffic in or approaching the intersection, and then proceed when safe to do so. All-way stop control should only be considered at the intersection of two roadways having relatively equal volumes of opposing traffic and similar operating characteristics. All-way stop control is appropriately installed in response to concerns regarding collisions or excessive motorist delay.
- The improper use of all-way stop control unnecessarily restricts traffic flow and results in driver frustration, non-compliance, and general disregard for stop signs and other traffic control devices. Furthermore, the improper use of all-way stop signs has been associated with providing a false sense of security to pedestrians. The installation of an unwarranted all-way stop also negatively affects the environment in terms of increased air and noise pollution, negative impact on emergency services, as well as increased fuel consumption.
- Many citizens, elected officials and community groups believe that the installation of stop signs will serve the purpose of calming traffic, thereby improving the liveability of a neighbourhood. Indeed, the installation of a stop sign will stop or slow down a driver at an intersection, but numerous studies have proven that vehicle speeds are only affected within approximately 30 metres of the stop location. Often, drivers accelerate to an ever greater speed in order to make up for the perceived “lost time”, thereby negating any speed reduction achieved at the stop location. Therefore, the use of all-way stop control for the purpose of reducing vehicle speeds on a roadway is not considered appropriate. Alternatively, solutions such as modifications to parking restrictions, speed reductions or the implementation of traffic calming measures would be better suited to address speed and cut-through traffic concerns. For an example of such measures, please refer to **Section 4.2.4**.

1.2 Policy

When a request is made for all-way stop control, the intersection location is evaluated under the Municipality of North Perth All-Way Stop Policy which is comprised of two parts. The first section defines the prerequisite roadway

characteristics required in order for all-way stop control to be considered. This serves as a high-level screening tool which enables the technician to determine if the candidate location is suitable for an all-way stop installation based on roadway characteristics, posted maximum speed limit, intersection geometrics and proximity to adjacent traffic control devices. If the prerequisite requirements are met, the subsequent volume and collision warrants must be satisfied in order to recommend all-way stop control at an intersection. It is noted that all-way stop control may be used as an interim measure where traffic control signals are warranted but cannot be implemented immediately.

1.2.1 Prerequisite Roadway Conditions

Table 1.1 outlines the prerequisites that must be met in order to consider the intersection feasible for the installation of all-way stop control.

TABLE 1.1: ALL-WAY STOP CONTROL PREREQUISITES

Criteria	Prerequisite	Rationale
Classification	The roadway must be classified local, collector or arterial	All-way stop control is not applicable on freeway-type facilities
Speed	The roadway must operate with a speed limit of at least 40 km/h and no more than 80 km/h	All-way stop control is considered unnecessary on road with speed limits less than 40 km/h and non-applicable on highway facilities (posted maximum speed limits in excess of 80 km/h).
Intersection Geometrics	The intersection must have three or four legs with no more than two lanes on each approach. Each leg of the intersection must be a minimum of 150 metres in length	Multi-lane approaches may crate driver confusion or result in pedestrian safety issues associated with reduced visibility. All-way stop control should not be placed on accesses or short cul-de-sacs.
Proximity to other TCDs	Must not be located within close proximity to other traffic control devices: - 700 metres for arterial roadways - 250 metres for collector roadways; - 150 metres for local roadways.	On arterial roadways, drivers generally do not expect to stop. Placing traffic control devices in close proximity to one another may create drive confusion and increase collision risk.

1.2.2 Warrant Criteria

Once the roadway characteristic prerequisites are met, one of the following warrants must be satisfied in order to recommend the installation of all-way stop control:

1 – Traffic Volume Warrant

- For an arterial intersection, the total vehicle volume of all intersection approaches must exceed 500 vehicles per hour with a combined minimum vehicle and pedestrian volume of 200 entering from the minor street for each of any eight hours of the day. The volume split is not to exceed 70/30. At locations where traffic volumes are lower than these minimum volume thresholds, the resulting vehicle delay and environmental impacts are increased greatly by stopping major street traffic flows. Conversely, intersections with traffic volumes significantly higher than these thresholds may be considered for traffic signal installation.
- For a minor intersection, the total vehicle volume of all intersection approaches must exceed 200 vehicles per hour with a combined vehicle and pedestrian volume of 50 entering from the minor street for each of any eight hours of the day. The volume split is not to exceed 65/35 for a four-leg intersection or 75/25 for a T-intersection. The minimum volume thresholds are lower for minor intersections due to the lower traffic volume expected and the need to maintain balance of delay between the major and minor streets.

2 – Collision Experience Warrant

- For the purpose of this warrant, a high collision experience is considered when an intersection experiences an average of three collisions per year over 36 consecutive months. Only collisions considered correctable through the implementation of all-way stop control are to be included (i.e. right-angle or turning movement type collisions).

3 – Combination Warrant

- All-way stop control may occasionally be justified where no one particular warrant is satisfied completely, but a combination of factors is present. In particular, if the collision experience warrant is satisfied to 100%, the installation of all-way stop control is recommended.
- If the intersection satisfies a combination of the traffic volume and collision warrants to 80% of the stated values and the volume splits do not exceed the stated thresholds, installation of all-way stop control should be considered.

The resulting All-Way Stop Traffic Control Warrant is contained in **Appendix A**.

Staff shall **not** support the installation of an **unwarranted** all-way stop for the following reasons:

1) Adverse Environmental Impacts – i.e. increased vehicle emissions, increased fuel consumption, noise generated by breaking and acceleration, etc.

2) False Sense of Security – unwarranted all-way stops provide a false sense of security to pedestrians who assume that the driver will obey the stop sign and come to a complete stop when in actuality, drivers tend to roll through the intersection or fail to stop altogether if it is perceived to be unnecessary (i.e. infrequent side-street traffic encountered).

3) Non Compliance – installation of unwarranted all-way stop control creates disrespect for stop signs and other traffic control devices in general.

4) Inconvenience – installation of unwarranted all-way stop control results in an inconvenience to local residents who legitimately use the roadway.

5) Impact to Transit and Trucks – installation of all-way stop control on transit and truck routes results in increased noise and significant increases in fuel consumption due to the breaking / accelerating of heavy vehicles. Unnecessary stops also result in increased travel times and/or longer delays.

A sample All-Way Stop denial letter is contained in **Appendix B** for future use.

1.3 Guidelines for Use

Installation of all-way stop control should **not** be considered under the following circumstances:

- Solely for the purpose of providing pedestrian protection as long as that protection can be satisfactorily addressed by other means (i.e. school crossing guard);
- As a speed control device;
- On roadways where progressive signal timing exists;
- On roads within urban areas having a posted speed limit in excess of 60 km/h;
- At intersections that have less than three or more than four approaches;
- At intersections that are offset, poorly defined or geometrically substandard;
- On truck or bus routes except in industrial areas or where two such routes intersect;

- On multi-lane approaches where a parked or stopped vehicle on the right will obscure the stop sign;
- Where traffic would be required to stop on grades;
- Solely for the purpose of deterring the movement of through traffic within a residential area;
- Where visibility of the sign is hampered by curves or grades and insufficient safe stopping sight distance exists; and
- Where any other traffic device controlling right-of-way is permanently in place within the allowable proximity with the exception of a Yield sign.

1.4 Procedure

Upon receipt of a request from the public for consideration of an all-way stop, staff shall direct the individual(s) or group requesting same to forward, in writing, the request to Council.

1) In the event that Council wishes to conduct a review of the intersection, they shall pass a resolution requesting an engineering study of the intersection.

2) The engineering study shall be based on the Municipality of North Perth All-Way Stop Policy as well as any other factors that are considered relevant such as adjacent land uses, collision history, intersection geometrics and/or emergency response routes.

3) The findings of the engineering study shall be documented in a report which contains recommendations on the installation of the all-way stop. Where applicable, the report shall also include any recommendations related to traffic calming where speed was identified as a concern.

4) Upon receiving the engineering report, Council shall review the recommendations and make a decision to either approve or deny the all-way stop request.

When the engineering report recommendations do not support the petitioner's request:

- The report will be forwarded to the Manager of Operations who will contact the representative of the petitioning group to determine if a meeting is required;
- If the petitioners are satisfied with the recommendations of the engineering report, or after a meeting with the staff, the petitioners accept the recommendations of the report, the engineering report and petitioner's comments (if applicable) will be forwarded to Council as an information item only;

- Should the petitioners still request all-way stop control after the meeting, the engineering report recommendations and petitioner's comments will be presented to Council for review and recommendation.

1.5 Alternatives to All-Way Stop Control

Although provincial regulations state that all-way stop control should not be used as a device to control traffic speeds, it is widely recognized that many citizens perceive stop signs as the panacea or "cure-all" to community traffic problems, assuming that the installation of an all-way stop is a valid tool for speed reduction. Although the implementation of an all-way stop is considered relatively low-cost, it often results in expensive and labour intensive enforcement efforts to effectively lower travel speeds and increase compliance with the stop sign, thereby negating the perceived cost-effectiveness of the unwarranted all-way stop.

When vehicle speeds are identified as a neighbourhood traffic issue, a technical assessment should be undertaken in order to confirm the problem and identify contributing factors. Specifically, vehicle speed data should be collected for a minimum of 3 days with summaries of average and 85th percentile operating speeds. Where vehicle speeds are confirmed to be an issue, a number of low-cost, easily implemented front-line mitigating measures can be considered:

- Implementation of community based initiatives such as traffic safety awareness campaigns, speed display board programs or promotion of a Road Watch program;
- Implementation of regulatory measures such as turning restrictions or speed limit review. However, in order to be effective, increased enforcement is required and should be coordinated with local police services in order to conduct targeted enforcement efforts within the subject neighbourhood.

Where the implementation of the above noted "front-line" measures is found to be ineffective, the Municipality, in consultation with the community, may wish to consider the implementation of traffic calming measures.

Traffic calming is defined as the implementation of physical or physiological changes to the roadway in order to reduce traffic speeds or volumes and improve safety and overall "quality of life" within a neighbourhood. Traffic calming installations are generally appropriate for local residential and minor collector roadways but elements can be applied to major collector or arterial roadways which do not affect the function or capacity of the roadway, instead change the driver's perception of the local environment (i.e. landscaped boulevards, streetscaping, rural-to-urban gateway treatments, etc.).

The following traffic calming measures have proven successful in reducing vehicle speeds and can be considered as an alternative to installing unwarranted all-way stops:

- Pavement Markings / Lane Narrowing – use of pavement markings (i.e. delineated bike lanes) to visually narrow the travelled portion of the roadway, thereby encouraging lower travel speeds;
- Curb Extensions – horizontal intrusion of the curb into the roadway resulting in a narrower section of roadway. Effective at locations with high pedestrian volumes as it achieves speed reduction, reduces crossing distance for pedestrians and increases pedestrian visibility;
- Raised Crosswalk – marked pedestrian crosswalk at either an intersection or mid-block location which is constructed at a higher elevation than the adjacent roadway. This measure is effective at reducing vehicle speeds, improving pedestrian visibility and reducing pedestrian-vehicle conflicts;
- Raised Median Island – elevated median islands constructed on the centreline of the roadway in order to reduce the overall road width. Effective at reducing vehicle speeds and can function as a pedestrian refuge area, thereby reducing vehicle-pedestrian conflicts;
- Speed Hump / Speed Cushions – raised area of roadway that results in a vertical deflection of the vehicle wheels which produces an uncomfortable sensation when travelling at speeds higher than the design speed (i.e. 40 km/h or greater), results in effectively reducing vehicle speeds. The speed cushions are designed to allow the passage of buses, trucks, and emergency services vehicles while still requiring a change in the vertical change in the path of travel for typical passenger vehicles; and
- Chicane – series of curb extensions on alternating sides of the roadway which are used to narrow the travelled portion of the road, requiring drivers to steer from one side to the other in order to travel through the chicane. Chicanes are used to discourage through traffic and are effective at reducing vehicle speeds.

It is recognized that in certain situations, an alternative solution may not exist or be considered feasible. Under such circumstances, staff shall consider potential speed reduction techniques and the installation of warning signage and/or flashing lights when recommending against the installation of all-way stop control at an intersection.

2 Phase 2 – Stop Sign Compliance

Further to the development of an All-Way Stop warrant for the Municipality of North Perth, PTSL has selected five existing all-way stop locations to be analyzed for stop sign compliance. The selection of the five locations was based on those intersections that least satisfied the all-way stop warranted contained as part of the overall traffic study.

The purpose of the stop sign compliance review is to determine if the selected all-way stop locations are functioning based on their intended use, and to determine the occurrence of driver violation of the stop condition.

2.1 Background

The stop sign is one of the most valuable and effective traffic control devices when used at the right location, under appropriate conditions. The intended use is to help motorists and pedestrians decide who has the right-of-way when approaching an intersection.

Appropriate application of all-way stop control is at an intersection of two roadways which have relatively equal volumes of opposing traffic and similar operating characteristics (posted speeds, cross-section elements, etc.). All-way stop control may be appropriately installed in response to collision experience, or complaints of excessive motorist delay at two-way stop controlled intersections.

A common misapplication of all-way stop control is in attempts to reduce speeds by interrupting through traffic, either by causing mainline traffic to stop or by creating an inconvenience which forces traffic to use alternate routes. When all-way stop control is installed as a means to calm traffic speeds, there is a high incidence of intentional violation. In those locations where motorists **do** comply with traffic control (i.e. come to a complete stop), speed reduction is typically only effective in the immediate vicinity of the stop sign (150 metres either side of the intersection) and speeds are actually found to be higher between intersections. In most cases, the motorist accelerates when leaving the intersection in order to make up for the perceived “lost time”.

In terms of compliance, motorists tend to ignore unwarranted stop signs when deemed unnecessary. When a motorist is frequently required to stop at an intersection, yet rarely observes any traffic on the opposing street, they tend to become impatient and disregard the stop sign, assuming that there is no obvious need to bring their vehicle to a complete stop. In turn, this can result in a false sense of security and decreased safety for pedestrians, especially small children, as pedestrians generally expect vehicles to stop at stop signs. Motorists may be in the habit of “running” or “rolling through” the unwarranted stop, disregarding the stop sign that has no “obvious” need, thereby increasing collision risk and resulting in potentially tragic

results. Disadvantages of installing unwarranted all-way stop control are summarized as follows:

- Reduces effectiveness of warranted stop signs
- Largely disregarded by motorists and contributes to frustration and contempt
- Results in a false sense of security for pedestrians
- May result in an increased risk for collisions
- Unnecessarily increases fuel consumption, air pollution and noise

Installation of an all-way stop should not be viewed as a "cure all" for solving traffic safety problems as a number of other measures are more effective than the installation of an unwarranted all-way stop.

2.2 Compliance Review

Based on a review of the recently developed all-way stop control warrants for the Municipality of North Perth which are contained in this report, the following all-way stop locations have been selected for review as they have been identified as being unwarranted based on a review of existing traffic conditions:

- McKenzie Street and Richmond Avenue – unwarranted;
- Winston Street and Richmond Avenue – unwarranted;
- York Avenue and Blake Street – unwarranted; and
- York Avenue and Campbell Street – unwarranted

In addition, the following intersection was selected for comparative analysis as the warrant has confirmed that all-way stop control is appropriate given existing traffic conditions:

- Elizabeth Street and Argyle Avenue – warranted

Stop sign compliance studies were undertaken at the above-noted intersection locations on Wednesday June 12, 2013. Weather conditions were clear and dry and traffic conditions were considered "normal".

In order to determine stop sign compliance at each of the selected intersections, 1-hour field observations were undertaken in which a trained surveyor observed vehicles as they arrived at the stop sign then recorded driver behaviour and adherence to the stop condition. For the purposes of this study, driver action at the stop sign has been classified as follows:

- ***Voluntary Stop*** – the motorist brings the vehicle to a complete stop irrespective of the presence of opposing traffic, complete compliance with the stop condition;

- ***Stopped by Traffic*** – the motorist brings the vehicle to a complete stop as a result of conflicting side street traffic, compliance with the stop condition;

- ***Rolling Stop (0-10 km/h)*** – the motorist rolls through the intersection slowly and cautiously without bringing the vehicle to a complete stop. Indicative of non-compliance with the stop condition;

- ***Slowed to Enter (10 – 20 km/h)*** – the motorists travels through the intersection at a slow – moderate rate of speed, disregarding the stop condition;

- ***Ignored Stop*** – the motorist disregards the stop condition and does not attempt to slow or stop the vehicle when approaching the intersection.

In addition to recording driver behaviour, spot speed studies were conducted along the major approach, approximately 150 metres either side of the intersection, in order to confirm approach and departure speeds.

2.3 Analysis of Results

The results of the stop sign compliance study are summarized in **Table 2.1** and the results of the spot speed survey are summarized in **Table 2.2**.

TABLE 2.1: STOP SIGN COMPLIANCE

Existing All-Way Stop	8-hr TMC Data			Observed Driver Behaviour					
	Major Approach Volume (8-hr)	Minor Approach Volume (8-hr)	% Split	Voluntary Stop	Stopped by Traffic	Rolling Stop	Slowed to Enter	Ignored Stop	% Compliance
McKenzie Street at Richmond Avenue	118	64	65 / 35	18	0	9	0	0	66.7%
Winston Street at Richmond Avenue	103	69	60 / 40	17	0	9	1	0	63.0%
York Avenue at Blake Street	102	92	53 / 47	21	1	8	1	0	71.0%
York Avenue at Campbell Street	99	89	53 / 47	34	0	8	3	0	75.6%
Elizabeth Street at Argyle Street	1,048	671	61 / 39	232	34	4	1	0	98.2%

Note: "Voluntary Stop" and "Stopped by Traffic" driver actions are considered in compliance with stop condition. The combined values were used in calculation of percent compliance.

As illustrated in **Table 2.1**, the percent compliance varied considerably between the four unwarranted all-way stop locations and the single warranted location. Compliance at the unwarranted locations ranged from 63% to 76%, and it was noted that a higher proportion of vehicles either rolled through the intersection or slowed upon entry. In contrast, compliance at the warranted all-way stop location was found to be 98% with only a limited number of vehicles disregarding the stop condition.

TABLE 2.2: SPOT SPEED REVIEW

Existing All-Way Stop	Speed Review		
	Average Approach Speed	Average Departure Speed	Net Change
McKenzie Street at Richmond Avenue	25 km/h	28 km/h	(+/- 3 km/h)
Winston Street at Richmond Avenue	28 km/h	30 km/h	(+/- 2 km/h)
York Avenue at Blake Street	27 km/h	29 km/h	(+/- 2 km/h)
York Avenue at Campbell Street	25 km/h	29 km/h	(+/- 4 km/h)
Elizabeth Street at Argyle Street	31 km/h	32 km/h	(+/- 1 km/h)

In terms of speed reduction, spot speed surveys were conducted at each study intersection in order to determine the approach and departure speeds along the major roadway. Although the net change in speed was found to be relatively minor, the results in **Table 2.2** illustrate that there was a correlation between a greater variance in approach / departure speeds at the unwarranted all-way stop locations compared to the single warranted all-way stop location.

2.4 Recommended Action

The results of the stop sign compliance review confirm that the arbitrary installation of unwarranted all-way stop control results in lowered compliance which may negatively affect intersection operations and safety due to the perceived false sense of security for motorists and pedestrians alike.

Although the removal of unwarranted all-way stop control is not recommended at this time (due to the lack of a formal AWS removal policy), it is recommended that the municipality adopt and implement the AWS warrant developed for North Perth; and furthermore, that the municipality examine the feasibility of implementing traffic calming measures and/or modifications to parking restrictions should speed or traffic volume be identified as a contributing concern in the request for an all-way stop. Further detail pertaining to alternatives to all-way stop control can be found in the **Chapter 1**.

3 Phase 3 – Traffic Count Program

3.1 Background

The Municipality of North Perth is located in the northern reaches of Perth County, in the heart of Southwestern Ontario, covering an area of approximately 717 square kilometres. North Perth is comprised of the Town of Listowel as well as a number of smaller communities including Atwood, Monkton, Elma and Wallace Township.

The Municipality of North Perth is responsible for the operation and maintenance of approximately 470 kilometres of both rural and urban roadway network and as such, has identified the need to develop and implement a traffic counting program which will be used in conjunction with the Asset Management Program in the maintenance and determination of future road needs for the Municipality.

Paradigm Transportation Solutions Limited (PTSL), in association with Pyramid Traffic Incorporated (Pyramid), were retained by the Municipality to design and conduct the 2012 Annual Average Daily Traffic (AADT) Count Program for Municipal roads, as well as undertake a comprehensive review of the existing classification of highways based on the Minimum Maintenance Standards of for Municipal Highways. The information acquired through the 2012 Traffic Count Program will be utilized by the Municipality of North Perth for the purpose of roadway maintenance and the planning and implementation of future roadway improvements.

Contained within this report are actual AADT volumes (based on the 2012 counts) and estimated AADT forecast volumes for all Municipal roads. The extents of the Municipality are illustrated in **Figure 3.1** for further reference.

3.2 Methodology

The following describes the various methodologies used in order to derive AADT estimates for a given roadway segment within the Municipality of North Perth.

A number of data collection approaches have been utilized in estimating the AADT volumes on the Municipal roadways including:

- 24-hour automatic traffic recorder (ATR) tube counts;
- 7-day NuMetric Traffic Analyzer counts (volume, speed and classification); and
- 8-hour Turning Movement Counts (TMC).

Given that many roadway segments have low traffic volumes, use of short duration sample counts may result in some locations having little to no data collected during the count period and as such, it would therefore not be

possible to develop an accurate AADT estimate. Furthermore, the relationship between daily and short duration sample counts would not be conducive to accurate traffic volumes on low volume roads.

Given the inconsistent traffic patterns on low volume roads (i.e. variations in day-to-day traffic or in some cases, variations from hour-to-hour), a short duration sample count would have to be sufficiently long (i.e. 8 to 12 hours) in order to provide a functional baseline in which an AADT could be developed. Although a 12-hour count would cost marginally less than a 24-hour count, the additional time required to manipulate the short duration data in order to develop an accurate AADT estimate would more than exceed the cost of collecting a full 24-hour count.

As such, it was determined that in order to maximize effort and obtain accurate data, 24-hour ATR counts would be undertaken at key locations in order to assist in the interpolation/estimation of adjacent roadway segments and provide a cost-effective approach to the development of the 2012 AADT program. Maps illustrating the count locations are contained in **Appendix C**.

3.3 Data Collection

3.3.1 24-Hour Traffic Counts

Typical 24-hour ATR counts were undertaken by Pyramid Traffic Inc. at 34 locations within the Municipality of North Perth. In accordance with accepted traffic engineering protocol, traffic counts were only conducted on Tuesdays, Wednesdays or Thursdays. Traffic recorders were set for a 24-hour period commencing at 12:00 a.m. on Tuesday November 6, 2012 and summarized data in one-hour time intervals. After the 24-hour period was complete, data was retrieved from the ATR and processed to arrive at the resulting 24-hour traffic volume. The detailed list of 24-hour ATR locations is summarized in **Table 3.1**. Three of the count locations included in this table are from 7 day counts which are discussed below.

3.3.2 7-Day Traffic Counts

The methodology and procedures utilized for the 24-hour ATR studies was used to undertake the 7-day traffic counts. The 7-day ATR counts were undertaken at three locations in order to generate a sample of rural road segments within the Municipality of North Perth. The locations selected for the 7-day ATR studies are summarized in **Table 3.2**.

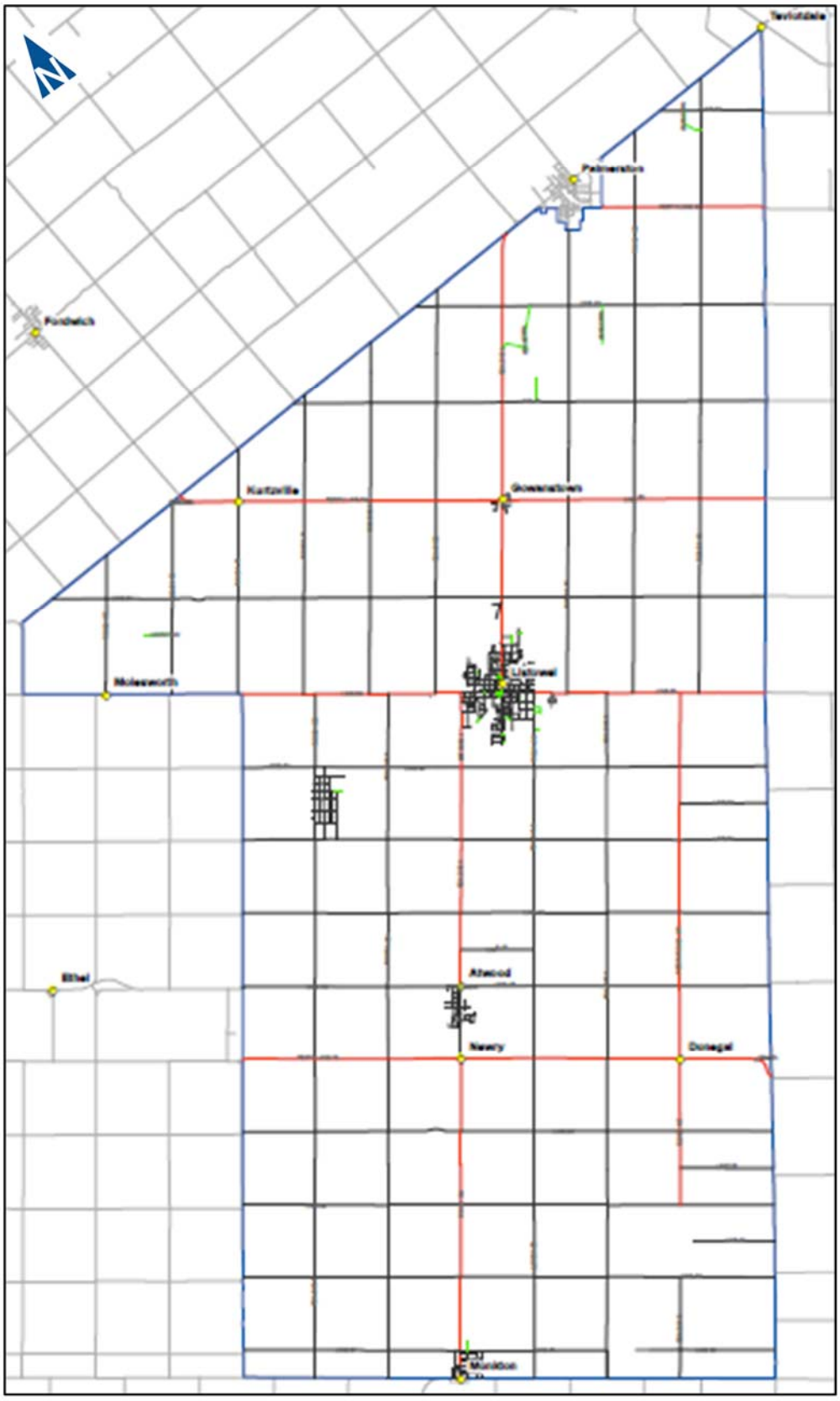

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Figure 3.1

TABLE 3.1: 24-HOUR TRAFFIC COUNT LOCATIONS

Count Number	Road Segment					Travel Direction
1	Line 60	btwn	Road 148	&	Road 154	E/W
2	Line 60	btwn	Road 159	&	Road 164	E/W
3	Line 60	btwn	Road 164	&	Road 166	E/W
4	Line 60	btwn	Road 169	&	Road 173	E/W
5	Line 75	btwn	Road 166	&	Road 164	E/W
6	Line 81	btwn	Road 140	&	Road 147	E/W
7	Line 84	btwn	Road 147	&	Road 140	E/W
8	Line 84	btwn	Road 147	&	Road 153	E/W
9	Line 84	btwn	Road 169	&	Road 172	E/W
10	Line 87	btwn	Road 176	&	Road 177	E/W
11	Line 87	btwn	Road 157	&	Road 152	E/W
13	Line 87	btwn	Road 164	&	Road 165	E/W
14	Line 88	btwn	Road 140	&	Road 146	E/W
15	Line 88	btwn	Road 164	&	Road 157	E/W
16	Line 89	btwn	Road 167	&	Road 171	E/W
17	Line 89	btwn	Road 164	&	Road 157	E/W
18	Line 89	btwn	Road 140	&	Road 146	E/W
19	Line 90	btwn	Road 165	&	Perth Road 178	E/W
20	Line 90	btwn	Road 157	&	Road 164	E/W
21	Line 90	btwn	Road 140	&	Road 146	E/W
22	Road 140	btwn	Line 84	&	Line 86	N/S
23	Road 140	btwn	Line 68	&	Line 71	N/S
25	Road 157	btwn	Line 89	&	Line 90	N/S
26	Road 157	btwn	Line 87	&	Line 88	N/S
27	Road 157	btwn	Line 86	&	Line 87	N/S
28	Road 158	btwn	Line 81	&	Line 84	N/S
30	Road 158	btwn	Line 75	&	Line 77	N/S
31	Road 165	btwn	Line 86	&	Line 87	N/S
32	Road 165	btwn	Line 87	&	Line 88	N/S
33	Road 166	btwn	Line 72	&	South of Landfill	N/S
34	Road 166	btwn	Line 75	&	North of Landfill	N/S
35	Road 166	btwn	Line 78	&	Line 81	N/S
36	Road 166	btwn	Line 84	&	Line 86	N/S
37	Road 176	btwn	Line 86	&	Line 87	N/S

TABLE 3.2: 7-DAY TRAFFIC COUNT LOCATIONS

Count Number	Road Segment					Travel Direction
12	Line 87	btwn	Road 157	&	Road 164	E/W
24	Road 157	btwn	Line 90	&	Palmerston Limits	N/S
29	Road 158	btwn	Line 84	&	Line 86	N/S

3.3.3 NuMetric Traffic Counts

At the request of the Municipality, seven-day NuMetric studies were undertaken at three key locations as a result of on-going resident concern with respect to traffic volumes and vehicle speeds. Data collected as part of the NuMetric traffic analysis included:

- Traffic Volume
- Vehicle Speed
- Weather
- Vehicle Classification
- Headway

The locations selected for NuMetric traffic analysis are summarized in **Table 3.3**.

TABLE 3.3: NUMETRIC TRAFFIC COUNT LOCATIONS

Count Number	Road Segment					Travel Direction
N1	Wallace Avenue South	btwn	Armstrong Street	&	Lin 84	E/W
N2	Line 84	btwn	Bassett Avenue South	&	Wallace Avenue South	E/W
N3	Road 158	btwn	Clayton Street East	&	Perth Line 86	E/W

3.3.4 8-Hour Intersection Turning Movement Counts

Eight-hour turning movement counts (TMC's) were conducted at 30 urban locations within the Town of Listowel in attempts to obtain a relative sample of urban traffic volumes. Seven additional TMC's were obtained from the Ministry of Transportation of Ontario (MTO). These counts were undertaken in order to assist in the estimation of AADT volumes within the urban area, and to assess and quantify various traffic concerns identified within the Town of Listowel. **Table 3.4** summarizes the TMC locations.

All traffic data collected has been summarized and is provided in **Appendix D** for future reference.

TABLE 3.4: 8-HOUR TURNING MOVEMENT COUNT LOCATIONS

Count Number	Road A		Road B
TMC 1	Edgar Street West	&	Albert Avenue North
TMC 2	Binning Street West	&	Albert Avenue North
TMC 3	Elizabeth Street West	&	Albert Avenue North
TMC 4	Elizabeth Street West	&	Victoria Avene North
TMC 5	Elizabeth Street West	&	Barber Avenue North
TMC 6	Elizabeth Street West	&	Livingstone Avenue North
TMC 7	Elizabeth Street West	&	Argyle Avenue North
TMC 8	Inkerman Street West	&	Wallace Avenue North
TMC 9	Inkerman Street West	&	Barber Avenue North
TMC 10	Elizabeth Street East	&	Davidson Avenue North
TMC 12	Campbell Street	&	York Avenue North
TMC 13	Winston Street East	&	Richmond Avenue North
TMC 14	Winston Street East	&	Davidson Avenue North
TMC 15	Blake Street East	&	Davidson Avenue North
TMC 16	Blake Street East	&	York Avenue North
TMC 17	McKenzie Street East	&	Richmond Avenue North
TMC 18	Main Street West	&	Road 164 (Highway 23)
TMC 19	Main Street	&	Wallace Avenue
TMC 20	Elma Street West	&	Nelson Avenue South
TMC 21	Elma Street West	&	Hay Avenue South
TMC 22	Elma Street	&	Wallace Avenue South
TMC 23	Elma Street East	&	Davidson Avenue South
TMC 24	Kincaid Street West	&	Nelson Avenue South
TMC 25	Clayton Street East	&	Reserve Avenue South
TMC 26	Clayton Street East	&	Maitland Avenue South
TMC 27	Bright Street East	&	Reserve Avenue South
TMC 28	Bright Street East	&	Tremaine Avenue South
TMC 29	Anger Street West	&	Wallace Avenue South
TMC 30	Hutton Street West	&	Wallace Avenue South
MTO 1	Highway 23	&	Perth Line 84
MTO 2	Highway 23	&	Perth Line 87
MTO 3	Highway 23	&	Perth Line 55 (E)
MTO 4	Highway 23	&	Perth Line 72
MTO 5	Highway 23	&	Perth Line 86 (W)
MTO 6	Highway 23	&	Perth Line 88
MTO 7	Highway 23	&	Wellington 123 / Perth 93

3.3.5 AADT Adjustment Factors

The development and calibration of adjustment factors such as day of week, time of year, and 24-hour period are often necessary in order to estimate an AADT volume. The resulting 24-hour and daily adjustment factors have been based upon a review of both the 7-day and NuMetric traffic count data which was collected at six locations. The data has been reduced and then used to identify daily fluctuations in traffic during a "typical" week.

The resulting day of week adjustment factors are summarized in **Table 3.5**. Using the same methodology and data set, a 24-hour adjustment factor has been calculated in order to adjust the 8-hour turning movement count data collected at the intersections summarized in **Table 3.4** to result in an estimated 24-hour volume. The resulting 24-hour factor applied to the 8-hour TMC data was calculated to be 1.76.

TABLE 3.5: DAILY TRAFFIC ADJUSTMENT FACTORS

Day of Week	Two-Way Volume	Factor
Sunday	4,906	0.71
Monday	7,037	1.01
Tuesday	7,901	1.14
Wednesday	8,044	1.16
Thursday	7,732	1.11
Friday	7,609	1.09
Saturday	5,411	0.78
Average	6,949	1.00

Seasonal fluctuations in traffic demand reflect the social and economic activity of the area being served by the highway. Data suggests that monthly variations are more pronounced on rural routes compared to urban routes, and are more pronounced on rural routes serving primarily recreational traffic than on rural routes that service primarily business traffic. Commuter and business-oriented travel tends to occur in a more uniform pattern, while recreational traffic is subject to the greatest variation. Use of seasonal adjustment factors takes into consideration variables such as recreational or tourism traffic, which may occasionally affect traffic demands during certain periods of the year.

Historical seasonal adjustment factors have been calculated based on a review of the available seasonal data for two Linear Highway Referencing System (LHRS) segments under the jurisdiction of the Ministry of Transportation Ontario. Data was reviewed for LHRS 24570 – Highway 23, located 7.6 kilometres north of Perth Line 72; and LHRS 24590 – Highway 23, located 7.8 kilometres north of the East Junction Perth Road 86.

The seasonal variation in traffic observed along Highway 23 was adopted for the calculation of AADT volumes within the Municipality of North Perth. **Table 3.6** summarizes the seasonal adjustment factors used in the calculation of AADT volumes.

TABLE 3.6: SEASONAL ADJUSTMENT FACTORS

Month	Factor
March	0.78
July	1.08
November	1.14
Year	1.00

3.4 AADT Estimations

Given the quantity of roadways within the Municipality, installing 24-hour automatic traffic counters at every road segment would be cost-prohibitive and impractical. Alternatively, a well-developed, active count program can systematically collect actual count volumes across the majority of the Municipality over a period of time. Accordingly, traffic estimates for the Municipality were prepared for both urban and rural roadway segments based on actual count data collected during the month of November 2012.

3.4.1 Rural Segment Estimates

AADT estimates for rural roadway segments which were not counted using automatic traffic recorders were extrapolated, where possible, by extending or projecting known AADT volumes from adjacent count locations. An example of an extrapolated AADT value can be seen on Line 60 between Road 166 and Road 169. At this location, a 24-hour count was conducted on Line 60, east of Road 166 and west of Road 169.

3.4.2 Urban Segment Estimates

The AADT volumes for urban roadway segments were estimated using the 8-hour turning movement count data collected at the previously noted 30 intersection locations (as summarized in **Table 3.4**). Given the urban nature of the smaller communities located within the Municipality of North Perth (i.e.

Listowel, Atwood and Monkton), it is difficult to estimate accurate AADT volumes on urban roadway segments where count data is unavailable.

Plots of the 2012 Annual Average Daily Traffic (AADT) Count Program for the Municipality of North Perth are provided in **Appendix E** for further reference.

4 Phase 4 – Transportation Initiatives

4.1 Roadway Classification Review

The resulting 2012 AADT volume data has been used in order to undertake a comprehensive review of the existing Minimum Maintenance Standards (MMS)[1] Classification of Highways, as contained in the North Perth Road Condition Assessment (2007). This review examined both the posted speed limit and existing traffic volumes (based on the AADT data presented in this report) in order to determine the appropriate class of highway and identify, when appropriate, where a roadway segment requires reclassification.

As stated in the Municipal Act, all minimum maintenance standards are based on the specification classification of the highway. Higher tier highways carry higher volumes of traffic and often operate at higher rates of speed, and therefore require more frequent patrolling and are held to a higher maintenance standard. The resulting highway classification is determined by a combination of factors; the posted or assumed maximum speed limit of the roadway, and average daily traffic volume (AADT or estimated AADT according to accepted traffic engineering standards).

The roadway classification review confirmed that the majority of roadways examined as part of this study are appropriately designated. However, upon review of current AADT volumes, a number of roadway segments were identified as falling within a higher tier highway classification, thereby requiring increased patrolling frequency. **Table 4.1** identifies the specific roadway segments which require reclassification as per the threshold values stated in Ontario Regulation 239/02.

TABLE 4.1: ROADWAYS REQUIRING RECLASSIFICATION

Roadway	Section Limits	Current Class	Posted Speed	AADT	Recommended Class
Road 158	Line 81 to Line 84	4	80 km/h	1,880	3
Road 158	Line 84 to Line 86	4	80 km/h	2,255	3
Road 158	Line 75 to Line 77	4	80 km/h	1,330	3
Line 84	Bassett Avenue South to Wallace Avenue South	4	80 km/h	1,385	3
Davidson Ave S	Elma Street East to Main Street East	5	50 km/h	700	4
Reserve Ave S	Hutton Street East to Bright Street East	5	50 km/h	505	4

It is recommended that the Municipality update the North Perth Road Condition Assessment in order to reflect the updated roadway classification

[1] Minimum Maintenance Standards for Municipal Highways, Ontario Regulation 239/02.

as per this review. Detailed roadway classification and traffic volume data is summarized in **Appendix F** for further reference.

4.2 NuMetric Analyses

Three key roadway segments were selected for detailed review based on complaints received by the Municipality pertaining to perceived high volumes of traffic and excessive vehicle speeds. NuMetric automated traffic recorders were used in order to confirm traffic volumes, operating speeds and percentage of heavy vehicles. The three segments targeted for analyses include:

- Wallace Avenue South between Armstrong Street and Line 84;
- Line 84 between Bassett Avenue South and Wallace Avenue South; and
- Road 158 (Tremaine Avenue South) between Clayton Street East and Line 86 (Main Street East).

The findings of the NuMetric traffic analyzer surveys are summarized in **Table 4.2**. Detailed summary reports are contained in **Appendix G** for further reference.

TABLE 4.2: NUMETRIC ATR DATA

Station	1		2		3	
Location	Wallace Avenue South		Line 84		Road 158	
Limits	Armstrong St to Line 84		Bassett Ave S to Wallace Ave S		Clayton St E to Perth Line 86	
	NB	SB	EB	WB	NB	SB
AADT	490 vpd		1,385 vpd		2,500 vpd	
Posted Speed	50 km/h	50 km/h	80 km/h	80 km/h	50 km/h	50 km/h
85th %ile Speed	64 km/h	66 km/h	93 km/h	92 km/h	64 km/h	66 km/h
% Trucks	2.50%	2.50%	10.00%	11.50%	2.50%	2.50%

4.2.1 Wallace Avenue South between Armstrong Street and Line 84

The findings of the NuMetric analysis confirm that although the section of Wallace Avenue South, between Armstrong Street and Line 84, is experiencing relatively low traffic volumes, the observed travel speeds were found to be significantly higher than the posted maximum speed limit of 50 kilometres per hour. The NuMetric studies indicate that the 85th percentile speed (which is defined as the "operating" speed of the roadway) ranged between 64 kilometres per hour and 66 kilometres per hour, approximately 15 kilometres per hour higher than the posted speed limit. Approximately 2.5% of traffic along this section of Wallace Avenue South consists of trucks. This percentage is considered acceptable for urban collector roadways.

4.2.2 Line 84 between Bassett Avenue South and Wallace Avenue South

The findings of the analysis confirm that the section of Line 84, between Bassett Avenue South and Wallace Avenue South, is experiencing acceptable levels of traffic for the rural arterial function of the roadway. The 85th percentile speed ranged between 92 kilometres per hour and kilometres per hour, approximately kilometres per hour higher than the posted speed limit. Given the rural nature of the roadway, these speeds are considered acceptable as they are less than kilometres per hour higher than the posted maximum speed limit of 80 kilometres per hour. Approximately 10% of traffic along this section of roadway consists of trucks and heavy vehicles which is typical of this classification of rural road. No further action is required in order to mitigate the perceived speeding concerns.

4.2.3 Road 158 between Clayton Street East and Line 86

The findings of the analysis confirm that the section of Road 158 (Tremaine Avenue), between Clayton Street East and Line 86 (Main Street East), is experiencing acceptable levels of traffic for the urban arterial function of the roadway. However, the observed travel speeds were found to be significantly higher than the posted maximum speed limit of 50 kilometres per hour. The 85th percentile speed ranged between 64 kilometres per hour and kilometres per hour, approximately kilometres per hour higher than the posted speed limit. Approximately 2.5% of traffic along this section of Wallace Avenue South consists of trucks. This percentage is considered acceptable for urban arterial roadways.

4.2.4 Speed Management Measures

Despite the posted maximum speed, observed operating speeds on Wallace Avenue South and Tremaine Avenue were found to be in excess of the 50 kilometres per hour speed limit, indicating that the prevailing speed of traffic is inappropriate for the character and use of the roadway. In order for a roadway to be considered for remediation, the 85th percentile speed should be a minimum of 10 kilometres per hour to kilometres per hour over the posted maximum speed limit in combination with traffic volumes in the range of 1,500 and 8,000 vehicles per day. However, if the 85th percentile speed is in excess of kilometres per hour over the posted maximum speed limit, no minimum volume is required due to the potential safety risks associated with the high rate of speed.

As urban collector and arterial streets mainly service residential areas, excessive vehicle speeds tend to interfere with the livability of a neighbourhood and often result in a perceived risk of conflict which discourages pedestrian and cyclist activities within the corridor. In order to reinstate the function of the roadway, traffic speeds need to be reduced, or reasonably close to, the posted maximum speed limit (±5 kilometres per hour). To the motorist, the roadway must convey the message that this is an urban area where speeds in excess of the posted speed limit are unacceptable.

In order to mitigate the excessive vehicle speeds experienced along Wallace Avenue and Tremaine Avenue, a number of traffic calming measures could be considered in order to restore the identified streets to their intended function. Traffic calming is generally intended to achieve one or more of the following objectives:

- Reduced vehicular speeds;
- Discourage through traffic;
- Minimize conflict; and
- Improve the neighbourhood environment.

The following provides a brief description of potential measures that would be considered effective in mitigating the speed related concerns of local residents. It is noted that the applicability and feasibility of the implementation of these measures would require additional studies and public consultation:

- **Urban Cross Section** – Provision of a consistent, urbanized cross-section conveys the message to the motorist that they've entered an urban area and that lower travel speeds are expected.
- **Roadway Narrowing** – Narrowing of the roadway platform width by use of edge treatments or on-road bike lanes. The use of edge treatments results in the delineation of two narrowed travel lanes (3.25 metres) and has been shown to reduce travel speeds. Provision of bike lanes as part of the narrowing treatment achieves additional benefits by way of providing separation between automobile and bicycle traffic. Alternatively, the roadway could be narrowed to a width between 6 metres and 8.5 metres to provide two travel lanes of 3 to 4.25 metres in width. Parking or bike lanes would not be provided in either direction.
- **Gateway or Streetscaping Features** – Use of gateway or streetscaping features on key roadways within the periphery of the urban area are used to influence driver behavior by providing visual cues to remind drivers that they have entered an urban / residential environment. Gateway features can also be used to highlight special areas of interest. Used alone they have little to no measurable impact on speeds but are commonly used in conjunction with other traffic calming measures (i.e. roadway narrowing and urbanized cross section).
- **Speed Humps** – Speed humps consist of a raised area of roadway which achieves a vertical defection of the vehicle wheels, thereby producing an uncomfortable sensation for vehicle occupants when traveling at speeds higher than the design speed (typically designed for 40 km/h), resulting in an effective speed reduction. The ultimate impact is dependent upon the number and placement of speed humps. It is important to note that speed humps have an adverse

effect on emergency service response times, noise, and maintenance efforts.

- **Raised Crosswalks** – Similar to a speed hump, a raised crosswalk is a marked pedestrian crosswalk at an intersection (or midblock location) which is constructed at a higher elevation than the adjacent roadway which achieves a vertical deflection of vehicle wheels, thereby reducing vehicle speeds. Construction of raised crosswalks at select locations (generally located adjacent to pedestrian generators or intersections with high pedestrian volumes) are use to highlight the likely presence of pedestrians crossing the roadway as well as to slow traffic through the intersection and reduce pedestrian-vehicle conflicts.
- **Curb Extensions** – Curb extensions are commonly used in conjunction with raised crosswalks and are effective at reducing the speed of turning vehicles at an intersection. The vertical deflection into the roadway creates a sense of road narrowing and results in reduced vehicle speeds when traveling through the intersection. Curb extensions are primarily used to enhance pedestrian safety and visibility, and are often used in conjunction with gateway or streetscaping features.
- **Mini Island** – Mini islands consist of a raised, treated centre and are effective at reducing the speed of vehicles since it is constructed at a higher elevation than the adjacent roadway which achieves a vertical deflection of vehicle wheels, thereby reducing vehicle speeds. Mini islands should be installed in 125 to 175 metre increments with multiple islands installed in succession on straight segments of roadway. Mini splitters that assist in directing and slowing traffic would be installed on each approach leg.

Given that a wide range of traffic calming measures exist, and that the combination of measures and resulting effectiveness of reducing vehicle speeds is dependent upon the characteristics of the subject roadway, and furthermore that the successful implementation of a traffic calming program requires community input and public support, it is recommended that the Municipality proceed with undertaking a detailed traffic calming review for both the Wallace Street and Tremaine Avenue corridors in order to develop a preferred traffic calming plan.

Although the Environmental Assessment Act now excludes traffic calming measures for the purposes of the Act, impacted stakeholders should be notified. As such, the traffic calming review should include a public consultation component which includes surveying affected residents, business owners and agencies in order to achieve community support. In the interim, increased enforcement and community based initiatives such as use of speed display boards and traffic safety awareness campaigns should be considered.

4.3 Downtown By-Pass

The Municipality of North Perth has been considering the idea of potentially implementing a formal by-pass of Downtown Listowel due to the congestion that is experienced along Main Street. The congestion is more acute during the summer period.

In order for the by-pass to be effective it will need to be both safe and efficient and provide those utilizing the route with the same level of service experienced now when using Main Street or even the potential for reduced travel times and the perception of less congestion.

Given the design characteristics of trucks combined with their different braking and acceleration characteristics the by-pass needs to be designed to help truck traffic maintain travel speeds while minimizing stopping and starting in an effort to minimize travel times and make the by-pass a more attractive route than continuing to use Main Street through the Downtown area.

There also needs to be consideration provided to the existing and future land uses along the proposed by-pass routes around the Downtown. For example, residential and institutional land uses are sensitive to truck traffic from a noise and vibration perspective. The same approach needs to be applied when assessing the existing impacts from truck traffic through the Downtown where there is a significant amount of pedestrian traffic.

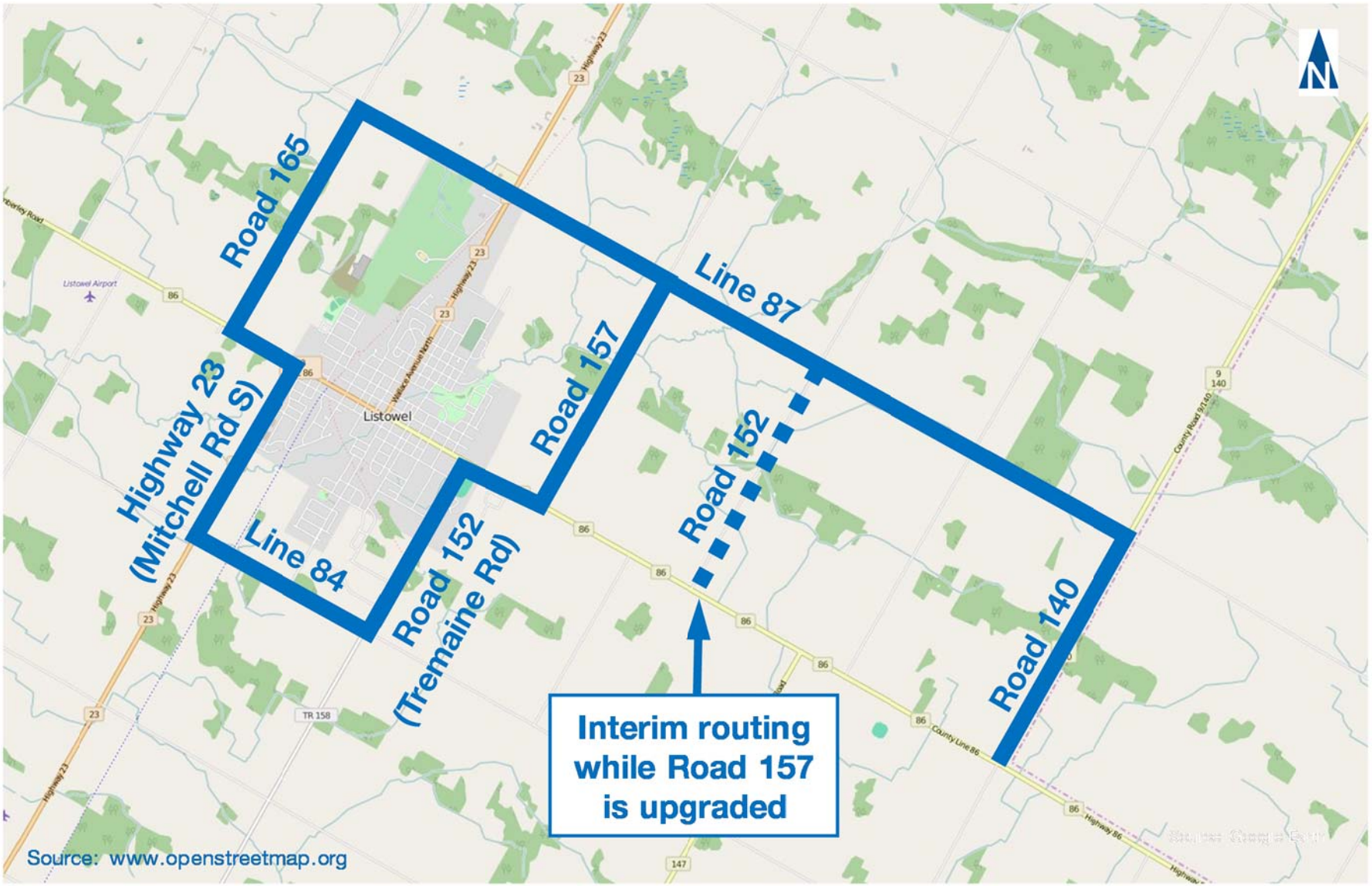
4.3.1 Route Selection

The intent of a by-pass would be to provide through traffic (both trucks and cars) with an alternative route around the Downtown as well as to Perth Line 86, Highway 23 and Road 164. The by-pass would not be intended to restrict traffic from accessing the Downtown. Any vehicles, regardless of their size would still be able to travel along Main Street assuming they have a legitimate origin or destination within the area.

The proposed by-pass would be made up of the following road linkages which would create a ring road route around Listowel as illustrated in **Figure 4.1**:

- Road 157 from Perth Line 86 (Main Street) to Line 87;
- Line 87 from Road 140 to Road 165;
- Road 165 from Line 87 to Perth Line 86 (Main Street);
- Perth Line 86 (Main Street) from Road 165 to Mitchell Road South (Hwy 23);
- Mitchell Road South (Hwy 23) from Perth Line 86 (Main Street) to Line 84;
- Line 84 from Mitchell Road South (Hwy 23) to Perth Road 158 (Tremaine Road);

- Perth Road 158 (Tremaine Road) from Line 84 to Perth Line 86 (Main Street); and
- Perth Line 86 (Main Street) from Perth Road 158 (Tremaine Road) to Road 157.



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Proposed By-Pass Routing of Downtown Listowel

North Perth Traffic Study
121380

Figure 4.1

4.3.2 Route Details

The following provides a high level review of the proposed by-pass route and provides preliminary recommendations for improvements required to bring the by-pass route up to a standard that could be compared to as equal as the route through Downtown Listowel.

- **Line 87 from Road 140 to Road 165** – Traffic control and/or warning signs at the intersection of Road 140 and Line 87 would need to be analyzed due to the possible sight line concern for northbound traffic on Road 140. Increasing the corner radii would be needed to accommodate the turning radius of articulated trucks. The installation of an exclusive eastbound right turn lane could also be required due to the delay to through traffic caused by right turning vehicles. Line 87 is currently a paved rural road with narrow shoulders and no pavement markings between Road 140 and Road 165. A centre line would be required to separate the eastbound and westbound lanes. At the intersection of Road 164 and Line 87, northbound and southbound left turn lanes would need to be installed to accommodate by-pass turning traffic. Northbound and southbound right turn tapers currently exist at the intersection and these should be adequate for the short term. Traffic should be monitored at the intersection of Road 164 and Line 87 to monitor capacity and delay. If traffic volumes increase at this intersection, traffic control such as traffic signals or a roundabout could be required. At the intersection of Line 87 and Road 165 the corner radii should be increased to accommodate the turning radii of articulated trucks. A westbound left turn lane could be also be installed to reduce delay to westbound through traffic.
- **Road 165 from Line 87 to Perth Line 86 (Main Street)** – Between Line 87 and Perth Line 86, Road 165 is currently paved with a rural cross-section, narrow shoulders and no pavement markings. A centre line should be painted on Road 165 to separate the northbound and southbound traffic lanes. At the intersection of Perth Line 86 and Road 165, an eastbound left turn lane and a westbound right turn lane would be required to separate the turning traffic from the through traffic. Future traffic volumes at the intersection of Perth Line 86 and Road 165 should be monitored to assess the capacity and delay and if required, traffic control such as traffic signals or roundabout be considered.
- **Perth Line 86 (Main Street) from Road 165 to Mitchell Road South (Hwy 23)** – As this is the main east-west route through Listowel, Perth Line 86 would not require any physical improvements other than an exclusive eastbound left turn lane and westbound right turn lane at the intersection of Perth Line 86 and Road 165. Future traffic volumes at the intersection of Perth Line 86 and Mitchell Road South (Highway 23) should be monitored for capacity and delay constraints and if required, traffic control such as a traffic signal or roundabout be considered.

- **Mitchell Road South (Hwy 23) from Perth Line 86 (Main Street) to Line 84** –A southbound left turn lane at the intersection of Line 84 currently exists. A northbound right turn lane could be installed to reduce delay to northbound through traffic due to right turning vehicles. A westbound left turn lane on Line 84 at Highway 23 should also be considered to separate the left turning traffic from the through and right turn traffic. Future traffic volumes at the intersection of Mitchell Road South and Line 84 should be monitored to determine if any changes to traffic control are required.
- **Line 84 from Mitchell Road South (Hwy 23) to Perth Road 158 (Tremaine Road)** – Between Mitchell Road South and Road 158, Line 84 is a paved road with a rural cross-section, narrow shoulders, and no pavement markings. A centre line should be painted on Line 84 to separate the eastbound and westbound traffic lanes. At the intersection of Line 84 and Road 158 (Tremaine Road), the corner radii should to be increased to accommodate the turning radius of articulated trucks.
- **Perth Road 158 (Tremaine Road) from Line 84 to Perth Line 86 (Main Street)** – Tremaine Road between Line 84 and Perth Line 86 is a paved route with narrow shoulders and no pavement markings. A centre line should be painted to separate the northbound and southbound traffic lanes. There are a significant number of intersections and accesses on this section of Tremaine Road when compared to the other sections of the potential by-pass. Consideration of widening Tremaine Road to include exclusive turning lanes at the intersections and/or a two-way left turn lane for the driveways and intersections should be considered to maintain an attractive travel time and minimal delay on this section. At the intersection of Perth Line 86 and Tremaine Road, corner radii should be increased to accommodate the turning radius of large trucks. A westbound left turn lane at the intersection of Perth Line 86 and Tremaine Road should be considered to separate the turning traffic from the through traffic. The future traffic volumes at the intersection of Perth Line 86 and Tremaine Road should be monitored for capacity and delay constraints and if required, traffic control such as traffic signals or a roundabout should be considered.

  Consideration should be given to a future extension of Tremaine Avenue that would connect Main Street to Line 87 north of Listowel. Extended Tremaine Avenue northward would provide additional by-pass options that may potentially further alleviate congestion within the Downtown area. A suggested alignment of this extension is provided in **Figure 4.2**.

- **Perth Road 140 (Wellington Road 9) from Perth Line 86 to Line 87 -** is a paved road with a rural cross-section and narrow shoulders near the intersection of Line 87. A northbound left turn lane on Perth Road 140 at Line 87 should also be considered to separate the left turning traffic from the through and right turn traffic. At the intersection of Road 140 and Line 87, the corner radii should to be

increased to accommodate the turning radius of articulated trucks. Future traffic volumes at the intersection of Perth Line 86 and Perth Road 140 should be monitored to determine if any changes to traffic control are required.

- **Perth Line 86 (Main Street) from Perth Road 158 (Tremaine Road) to Road 157** – An eastbound acceleration lane on Perth Line 86 east of the intersection of Tremaine Road should be considered to allow for heavy vehicles turning from Tremaine Road to accelerate up to speed without causing delay to eastbound traffic on Perth Line 86. An eastbound left turn lane and westbound right turn lane at the intersection of Road 157 should also be installed to minimize delay to the through traffic on Perth Line 86.

4.3.3 Next Steps

Implementing a by-pass of the Downtown will be a concern for many stakeholders. Before implementation it is recommended that a specific by-pass study be carried out using the Class Environmental Assessment Process to ensure that the need and justification for the by-pass is clearly defined, a number of alternatives are assessed and a public consultation process be provided to allow the public and stakeholders to provide input throughout the duration of the study.

It is recommended that a staged approach be utilized when implementing the by-pass. It would be most cost effective if the Municipality first installed signage along the entire length of the by-pass routes and they also made minor road improvements (increasing corner radii, provision of auxiliary turn lanes) were required to facilitate the truck turning movements. Inclusive in the signing plan would be a review of the existing stop control, assignment of right-of-way and very clear directional signage (positive guidance).

A by-pass should be implemented on a trial basis where monitoring of pre-by-pass and post by-pass traffic conditions be monitored to gauge the effectiveness of the by-pass through volume, speed and vehicle classification counts, origin and destination studies to confirm the number of vehicles using the by-pass, and an operational assessment of the key intersection(s) along Main Street.

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Suggested Routing of Tremaine Road Extension

North Perth Traffic Study
121380

Figure 4.2

4.4 Official Plan Amendments

4.4.1 Roadway Classification

At present, only two roadways that form part of the proposed by-pass are classified on Schedule B - Roads Plan for Listowel Ward in the Official Plan[2]. These roadways are:

- Line 84 from Mitchell Road South (Hwy 23) to Perth Road 158 (Tremaine Road) – arterial classification; and
- Perth Road 158 (Tremaine Road) from Line 84 to Perth Line 86 (Main Street) – arterial classification.

It is recommended that all roadways under the jurisdiction of the Municipality that are recognized as forming part of the by-pass (**Figure 4.1**) are updated within the Official Plan to arterial classification and included on Schedule B – Roads Plan for Listowel Ward. Those roadways are:

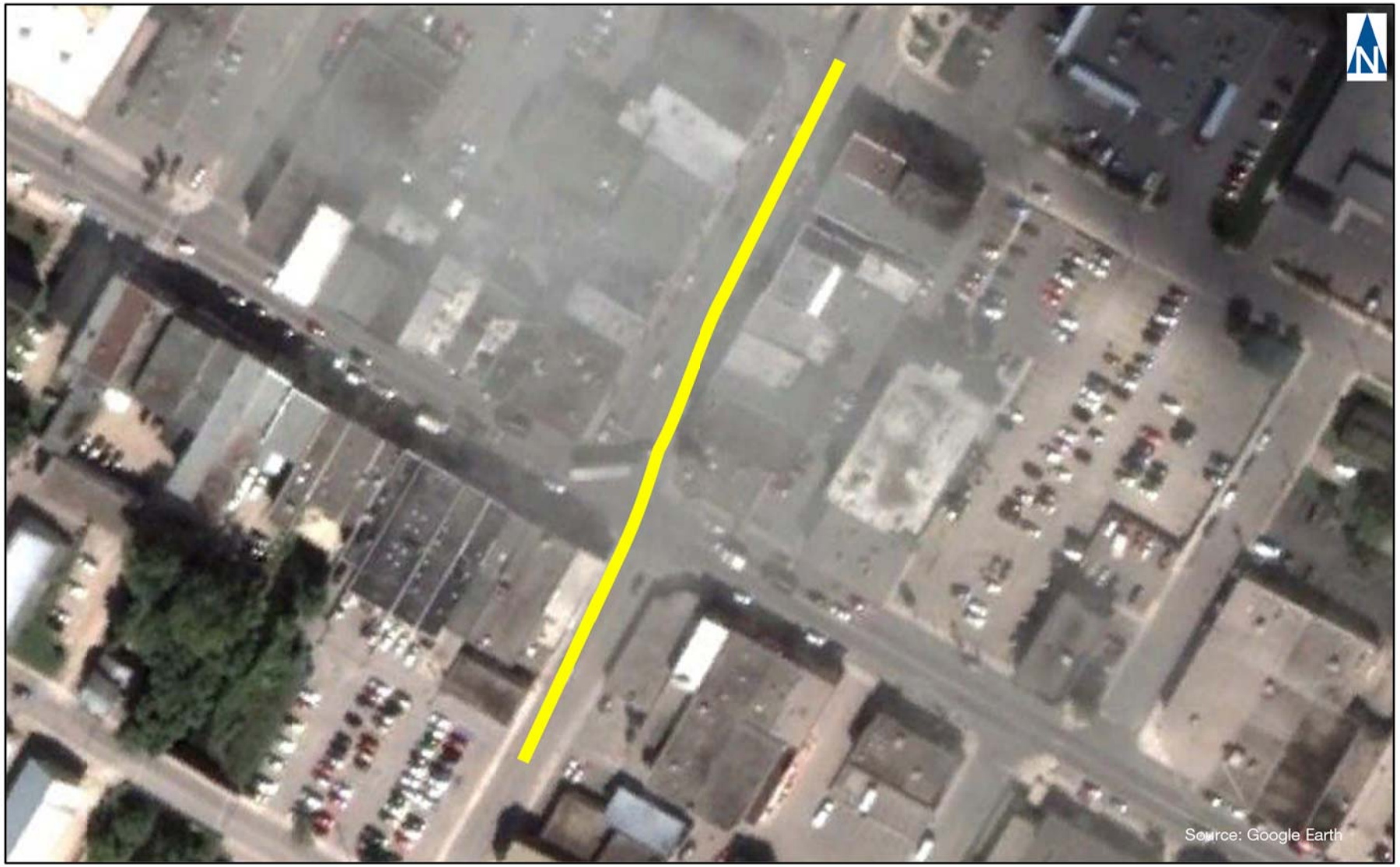
- Line 87 from Road 140 to Road 165;
- Road 165 from Line 87 to Perth Line 86 (Main Street);
- Perth Line 86 (Main Street) from Road 165 to Mitchell Road South (Hwy 23);
- Mitchell Road South (Hwy 23) from Perth Line 86 (Main Street) to Line 84;
- Perth Line 86 (Main Street) from Perth Road 158 (Tremaine Road) to Road 157; and
- Road 140 from Perth Line 86 to Line 87.

In addition, the Tremaine Avenue corridor identified in **Section 4.3.2** should be identified on Schedule B as part of the on-going Official Plan update to preserve the option for a possible future extension of the Downtown by-pass.

4.4.2 Intersection Alignment

At present, Wallace Avenue north of Main Street is offset from Wallace Avenue south of Main Street by approximately 20 metres. This offset is creating operational issues that the Town recognizes. The Town would prefer to eliminate this offset in the future. In order to do so, it is recommended that removal the offset should be identified in Schedule B - Roads Plan for Listowel Ward in the Official Plan update. A proposed alignment of this intersection is provided in **Figure 4.3**. The actual alignment should be determined through a future Class Environmental Assessment Study.

[2] Official Plan for the Listowel Ward, Municipality of North Perth, North Perth Planning and Development Department, March 2010.



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Potential Re-alignment of Main Street and Wallace Avenue

North Perth Traffic Study
121380

Figure 4.3

4.5 Potential Impacts of Closing Inkerman Street west of Wallace Avenue

The existing conditions analyses identified queuing issues at the intersection of Main Street and Wallace Avenue whereby the southbound queue extends northward and blocks Inkerman Street. The Municipality was considering a possible closure of Inkerman Street west of Wallace Avenue in order to address the queue conflicts.

Synchro level of service analyses were undertaken for the existing conditions at the intersections of Main Street and Wallace Avenue and Wallace Avenue and Inkerman Street to assess the need for the closure. The results for the Fall 2012 and Summer 2013 analyses are outlined in this section.

4.5.1 Fall 2012 – Existing Signal Timing

The results of the Synchro analyses for the Fall 2012 conditions using the existing split phase timing plan are summarized in **Table 4.3**. The following observations were made:

- The existing timing favours east/west movements;
- Southbound 95th percentile queues on Wallace Avenue range from 128 metres (AM) to 115 metres (PM), confirming that queues reach back beyond the Inkerman Street and Wallace Avenue intersection; and
- The unsignalized intersection of Inkerman Street and Wallace Avenue operates satisfactorily with acceptable levels of delay on both the eastbound and westbound stopped approaches. Significant queuing was noted on the southbound approach which results from the downstream operation of the Main Street traffic signal.

TABLE 4.3: 2012 FALL ANALYSES – EXISTING SPLIT PHASING

Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Main Street West & Wallace Avenue North / South	Signal	LOS	B	B	>	**B**	<	D	C	**C**	<	E	>	**E**	<	F	>	**F**	**F**
			Delay	19	17	>	**18**	<	35	29	**32**	<	73	>	**73**	<	220	>	**220**	**87**
			V/C	0.44	0.34	>		<	0.46	0.14		<	0.81	>		<	1.35	>		
			Q	46	45	>		<	39	6		<	39	>		<	128	>		
	Inkerman Street & Wallace Avenue	TWSC	LOS		B	>		<	B				A	>		A	A			**B**
			Delay		13	>		<	12				5	>		8	0			
			V/C		0.07	>		<	0.09				0.02	>		0.08	0.22			
			Q		37	>		<	16				11	>		36	308			
PM Peak Hour	Main Street West & Wallace Avenue North / South	Signal	LOS	B	B	>	**B**	<	D	C	**D**	<	F	>	**E**	<	F	>	**F**	**F**
			Delay	19	17	>	**18**	<	40	30	**35**	<	145	>	**73**	<	278	>	**278**	**116**
			V/C	0.48	0.36	>		<	0.62	0.17		<	1.11	>		<	1.50	>		
			Q	43	45	>		<	55	16		<	55	>		<	115	>		
	Inkerman Street & Wallace Avenue	TWSC	LOS		B	>		<	B				A	>		A	A			**B**
			Delay		12	>		<	12				1	>		8	0			
			V/C		0.07	>		<	0.08				0.02	>		0.08	0.21			
			Q		28	>		<	14				14	>		36	126			

Signal - Traffic Control Signals *LOS - Level of Service* *< - Shared Left-Turn Lane*
TWSC - Two-Way Stop Control *V/C - Volume to Capacity Ratio* *> - Shared Right-Turn Lane*
MOE - Measure of Effectiveness *Q - 95th Percentile Queue Length (m)*

4.5.2 Fall 2012 – Optimized Signal Phasing

Synchro analyses was undertaken for the Fall 2012 volumes using optimized signal timing splits. Note that split phasing was maintained due to intersection geometry. Analyses of the optimized signal timing are summarized in **Table 4.4**. The following observations were made:

- Field observations confirmed that the existing split phasing has to remain in place due to the intersection geometry and as a result, a "traditional" signal timing is not considered feasible at this location. As such, opportunity is limited for improvement to be gained through the optimization of the signal timing;
- Optimized splits allocate additional time to the northbound and southbound approaches;
- Southbound 95th %ile queues on Wallace Avenue range from 78 metres (AM) to 112 metres (PM), confirming that queues reach back beyond the Inkerman Street and Wallace Avenue intersection; and
- Optimization of the intersection splits results in improvements to queuing experienced during the AM peak hour and reduces interference with Inkerman Street. However, only marginal improvement is gained during the PM peak hour as the southbound approach experiences queues in excess of 112 metres, which continues to interfere with the operation of Inkerman Street.

TABLE 4.4: 2012 FALL ANALYSES – OPTIMIZED SIGNAL PHASING

Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Main Street West & Wallace Avenue North / South	Signal	LOS	D	C	>	**C**	<	D	C	**D**	<	E	>	**E**	<	D	>	**D**	**D**
			Delay	40	28	>	**34**	<	41	32	**36**	<	63	>	**63**	<	42	>	**42**	**40**
			V/C	0.71	0.49	>		<	0.54	0.14		<	0.75	>		<	0.79	>		
			Q	74	57	>		<	40	6		<	42	>		<	78	>		
	Inkerman Street & Wallace Avenue	TWSC	LOS		B	>		<	B				A	>		A	A			**B**
			Delay		13	>		<	12				5	>		8	0			
			V/C		0.07	>		<	0.09				0.02	>		0.08	0.22			
			Q		16	>		<	16				7	>		17	2			
PM Peak Hour	Main Street West & Wallace Avenue North / South	Signal	LOS	D	C	>	**D**	<	D	C	**D**	<	E	>	**E**	<	E	>	**E**	**D**
			Delay	46	28	>	**36**	<	43	31	**37**	<	80	>	**80**	<	70	>	**70**	**52**
			V/C	0.78	0.51	>		<	0.65	0.17		<	0.89	>		<	0.98	>		
			Q	63	55	>		<	59	12		<	55	>		<	112	>		
	Inkerman Street & Wallace Avenue	TWSC	LOS		B	>		<	B				A	>		A	A			**B**
			Delay		12	>		<	12				1	>		8	0			
			V/C		0.07	>		<	0.08				0.02	>		0.08	0.21			
			Q		11	>		<	16				13	>		25	45			

Signal - Traffic Control Signals *LOS - Level of Service* *< - Shared Left-Turn Lane*
TWSC - Two-Way Stop Control *V/C - Volume to Capacity Ratio* *> - Shared Right-Turn Lane*
MOE - Measure of Effectiveness *Q - 95th Percentile Queue Length (m)*

4.5.3 Summer 2013 – Existing Signal Timing

Synchro analyses were undertaken for "peak" summer conditions based on intersection turning movement data obtained from July 2013 counts and the split phase timing plan. Analyses of peak summer conditions are summarized in **Table 4.5**. The following was noted:

- The intersection was re-counted in July, 2013 to represent "peak" summer traffic conditions;
- The existing signal timing favours eastbound / westbound movements;
- Southbound 95th %ile queues on Wallace Avenue range from 129 metres (AM) to 113 metres (PM), confirming that queues reach back beyond the Inkerman Street and Wallace Avenue intersection; and
- The unsignalized intersection of Inkerman Street at Wallace Avenue operates satisfactorily with acceptable levels of delay on the minor-street stopped approaches. Significant queuing is experienced on the southbound approach (>250 metres) which is directly attributable to the operations of the downstream signal at Main Street.

TABLE 4.5: 2013 SUMMER ANALYSES – EXISTING SIGNAL PHASING

Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Main Street West & Wallace Avenue North / South	Signal	LOS	C	B	>	**B**	<	D	C	**C**	<	F	>	**F**	<	F	>	**F**	**F**
			Delay	20	18	>	**19**	<	40	30	**34**	<	316	>	**316**	<	195	>	**195**	**114**
			V/C	0.50	0.43	>		<	0.60	0.19		<	1.55	>		<	1.29	>		
			Q	52	55	>		<	52	20		<	142	>		<	129	>		
	Inkerman Street & Wallace Avenue	TWSC	LOS		B	>		<	B				A	>		A	A			**B**
			Delay		13	>		<	12				5	>		8	0			
			V/C		0.07	>		<	0.09				0.02	>		0.08	0.22			
			Q		29	>		<	15				13	>		40	274			
PM Peak Hour	Main Street West & Wallace Avenue North / South	Signal	LOS	C	B	>	**B**	<	E	C	**D**	<	F	>	**F**	<	F	>	**F**	**F**
			Delay	23	18	>	**20**	<	70	31	**53**	<	288	>	**288**	<	394	>	**394**	**167**
			V/C	0.57	0.43	>		<	0.93	0.21		<	1.47	>		<	1.76	>		
			Q	40	47	>		<	93	52		<	56	>		<	113	>		
	Inkerman Street & Wallace Avenue	TWSC	LOS		B	>		<	B				A	>		A	A			**B**
			Delay		12	>		<	12				1	>		8	0			
			V/C		0.07	>		<	0.08				0.02	>		0.08	0.21			
			Q		57	>		<	45				13	>		44	281			

Signal - Traffic Control Signals *LOS - Level of Service* *< - Shared Left-Turn Lane*
TWSC - Two-Way Stop Control *V/C - Volume to Capacity Ratio* *> - Shared Right-Turn Lane*
MOE - Measure of Effectiveness *Q - 95th Percentile Queue Length (m)*

4.5.4 Summer 2012 – Optimized Signal Phasing

Final Synchro analyses were undertaken using the "peak" summer traffic volumes using optimized signal phasing. It is noted that split phasing was maintained due to intersection geometry. Analyses of the optimized signal timing are summarized in **Table 4.6**. The following was noted:

- Optimized splits allocate additional time to the northbound and southbound approaches while forcing the eastbound left-turn lane to capacity. No significant improvement is gained under this scenario as the northbound and southbound approaches continue to operate at capacity and experience excessive levels of delay;
- The southbound 95th%tile queues on Wallace Avenue range from 50 metres (AM) to 116 metres (PM);
- Optimizing the splits helps to improve queuing during the AM peak hour and reduces queuing interference with the operation of Inkerman Street. However, marginal improvement is achieved during the PM peak hour. Optimization of splits reduces overall intersection delay and marginally improves northbound and southbound operation, but results in degraded operation of the mainline eastbound and westbound approaches;
- If the closure of the west leg of Inkerman Street was to occur, eastbound volumes may shift northerly to Elizabeth Street. The "grid" layout of the Downtown area is convenient in accommodating alternate routes. No capacity issues are likely to arise at any of the

side street intersections as a result of closing the west leg of Inkerman Street. However, more count data is required in order to accurately assess any impacts associated with the potential road closure. We suspect that a diversion to the north is already occurring should southbound queues at the intersection of Wallace Avenue and Main Street reach back to block movements at Inkerman Street; and

- It is noted that there is currently no capacity justification to support a closure. Level-of-Service on the east and west legs of the Main Street / Wallace Avenue intersection operate at satisfactory levels of service with acceptable delays and v/c ratios given that this is the central business district and the "worst case" peak tourism scenario has been modeled.

TABLE 4.6: 2013 SUMMER ANALYSES – OPTIMIZED SIGNAL PHASING

Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Main Street West & Wallace Avenue North / South	Signal	LOS	F	D	>	**E**	<	D	C	**D**	<	E	>	**E**	<	E	>	**E**	**E**
			Delay	86	39	>	**59**	<	54	34	**43**	<	70	>	**70**	<	62	>	**62**	**57**
			V/C	0.97	0.70	>		<	0.75	0.19		<	0.91	>		<	0.92	>		
			Q	90	47	>		<	31	5		<	31	>		<	50	>		
	Inkerman Street & Wallace Avenue	TWSC	LOS		B	>		<	B				A	>		A	A			**B**
			Delay		13	>		<	12				5	>		8	0			
			V/C		0.07	>		<	0.09				0.02	>		0.08	0.22			
			Q		12	>		<	15				11	>		14	3			
PM Peak Hour	Main Street West & Wallace Avenue North / South	Signal	LOS	F	C	>	**F**	<	F	C	**E**	<	F	>	**F**	<	F	>	**F**	**F**
			Delay	160	34	>	**84**	<	83	31	**61**	<	142	>	**142**	<	106	>	**106**	**90**
			V/C	1.19	0.65	>		<	0.98	0.21		<	1.12	>		<	1.10	>		
			Q	197	71	>		<	107	50		<	60	>		<	116	>		
	Inkerman Street & Wallace Avenue	TWSC	LOS		B	>		<	B				A	>		A	A			**B**
			Delay		12	>		<	12				1	>		8	0			
			V/C		0.07	>		<	0.08				0.02	>		0.08	0.21			
			Q		12	>		<	15				19	>		15	32			

Signal - Traffic Control Signals *LOS - Level of Service* *< - Shared Left-Turn Lane*
TWSC - Two-Way Stop Control *V/C - Volume to Capacity Ratio* *> - Shared Right-Turn Lane*
MOE - Measure of Effectiveness *Q - 95th Percentile Queue Length (m)*

5 2015 Transportation Assessment

In order to address existing congestion issues on Main Street between Reserve Avenue and Victoria Avenue, additional traffic counts and analyses were conducted in September 2015. This section will outline the count methodology and resulting analyses, provide information regarding a partial closure of Inkerman Street and provide alternative Main Street congestion mitigation measures.

5.1 2015 Listowel Downtown Traffic Counts – Data Collection

Traffic counts were conducted at 11 locations by Paradigm using Miovision camera equipment on Friday, September 18 between the hours of noon and 6:00 PM and Saturday, September 19 between the hours of 10:00 AM and 6:00 PM. Municipal staff requested counts during these hours since they represent the times of highest traffic activity on Main Street within Downtown Listowel. The count locations are outlined in **Table 5.1**.

TABLE 5.1: 2015 TURNING MOVEMENT COUNT LOCATIONS

Count Number	Road A		Road B
1	Main Street West	&	Victoria Avenue
2	Main Street West	&	Barber Avenue
3	Main Street West	&	Livingstone Avenue
4	Main Street West	&	Argyle Avenue North
5	Main Street West	&	Wallace Avenue
6	Main Street East	&	Wellington Avenue
7	Main Street East	&	Davidson Avenue
8	Main Street East	&	Reserve Avenue
9	Wallace Avenue	&	Elizabeth Street
10	Wallace Avenue	&	Inkerman Street
11	Wallace Avenue	&	Elma Street

5.2 2015 Traffic Operations

Synchro 9 level of service analyses were conducted for the 2015 volumes using the following peak hours:

- Friday: 4:45 PM to 5:45 PM; and
- Saturday: 11:00 AM to 12:00 PM

The results of the analyses are provided in **Table 5.2A** and **Table 5.2B** and indicate the following:

- The intersections in the study area are operating with acceptable levels of service during the Friday and Saturday peak hours;
- The northbound through movement at the intersection of Main Street West and Barber Avenue is operating at LOS E during the Friday peak hour. Delay on this movement is due to the volume of traffic on Main Street West since less than 10 vehicles were recorded on the movement itself during the higher Friday peak hour;
- The Synchro estimated 95th percentile queue lengths on Main Street at the study area intersections are typically less than 40 metres (five vehicles) during the Friday and Saturday peak hours; and
- The signalized intersection of Main Street and Wallace Avenue experiences the longest queues during the peak hours:
  - Eastbound through/right-turn lane = 71 metres (10 vehicles) during the Friday peak hour and 79 metres (11 vehicles) during the Saturday peak hour;
  - Westbound through/right-turn lane = 61 metres (8 vehicles) during the Friday peak hour and 74 meters (10 vehicles) during the Saturday peak hour;
  - Northbound through/right-turn lane = 59 metres (8 vehicles) during the Friday peak hour and 53 metres (7 vehicles) during the Saturday peak hour; and
  - Southbound through/right-turn lane = 124 metres (17 vehicles) during the Friday peak hour and 118 meters (16 vehicles) during the Saturday peak hour.

    There is approximately 120 metres (centreline to centreline) between the intersections of Main Street and Wallace Avenue and Wallace Avenue and Inkerman Street. The Friday peak hour 95th percentile southbound queue at the intersection of Main Street and Wallace Avenue is estimated to be 124 metres, with Saturday estimated to be marginally shorter. The analyses indicate that the southbound queue at Main Street and Wallace Avenue will spill back through the intersection of Wallace Street and Inkerman Street during peak periods and potentially interfere with intersection operations.

TABLE 5.2A: 2015 FRIDAY PEAK HOUR LEVEL OF SERVICE CONDITIONS

Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
Friday Peak Hour	Main Street West & Victoria Avenue	TWSC	LOS	<	A	>		<	A	>		<	D	>		<	C	>		A
			Delay	<	1	>		<	0	>		<	29	>		<	19	>		3
			V/C	<	0.03	>		<	0.02	>		<	0.20	>		<	0.28	>		
			Q	<	24	>		<	27	>		<	16	>		<	16	>		
	Main Street West & Barber Avenue	TWSC	LOS	<	A	>		<	A	>		<	E	>		<	C	>		A
			Delay	<	2	>		<	1	>		<	40	>		<	16	>		3
			V/C	<	0.09	>		<	0.02	>		<	0.16	>		<	0.22	>		
			Q	<	54	>		<	28	>		<	15	>		<	26	>		
	Main Street West & Livingstone Avenue	TWSC	LOS	<	A	>		<	A	>		<	C	>		<	D	>		A
			Delay	<	2	>		<	1	>		<	24	>		<	27	>		4
			V/C	<	0.06	>		<	0.03	>		<	0.12	>		<	0.37	>		
			Q	<	43	>		<	27	>		<	13	>		<	25	>		
	Main Street West & Argyle Avenue North	TWSC	LOS	<	A				A	>							B	>		A
			Delay	<	2				0	>							14	>		2
			V/C	<	0.07				0.30	>							0.14	>		
			Q	<	67				24	>							25	>		
	Main Street West & Wallace Avenue North / South	Signal	LOS	A	B	>	B	<	D	A	C	<	C	>	C	<	D	B	C	C
			Delay	9	12	>	11	<	36	7	26	<	30	>	30	<	48	11	28	23
			V/C	0.32	0.31	>		<	0.62	0.31		<	0.54	>		<	0.74	0.51		
			Q	20	71	>		<	61	37		<	59	>		<	124	20		
	Main Street West & Wellington Avenue South	TWSC	LOS		A	>		<	A				C	>						A
			Delay		0	>		<	1				17	>						2
			V/C		0.27	>		<	0.05				0.17	>						
			Q		21	>		<	18				18	>						
	Main Street West & Wellington Avenue North	TWSC	LOS	<	A				A	>							B	>		A
			Delay	<	2				0	>							14	>		3
			V/C	<	0.07				0.24	>							0.22	>		
			Q	<	22				9	>							21	>		
	Main Street West & Davidson Avenue	TWSC	LOS	<	A	>		<	A	>		<	C	>		<	C	>		A
			Delay	<	1	>		<	1	>		<	20	>		<	21	>		4
			V/C	<	0.03	>		<	0.02	>		<	0.24	>		<	0.31	>		
			Q	<	18	>		<	18	>		<	15	>		<	22	>		
	Main Street West & Reserve Avenue	TWSC	LOS		A	>		<	A				C	>						A
			Delay		0	>		<	0				18	>						1
			V/C		0.27	>		<	0.01				0.18	>						
			Q		0	>		<	14				14	>						
	Wallace Avenue North & Elizabeth Street	Signal	LOS	<	B	>	B	<	B	>	B	A	B	>	B	A	B	>	B	B
			Delay	<	19	>	19	<	10	>	10	9	11	>	11	9	15	>	15	14
			V/C	<	0.52	>		<	0.21	>		0.12	0.49	>		0.19	0.69	>		
			Q	<	39	>		<	21	>		21	52	>		353	110	>		
	Wallace Avenue North & Inkerman Street	TWSC	LOS	<	D	>		<	E	>		<	A	>		A	A	>		A
			Delay	<	28	>		<	38	>		<	1	>		9	0	>		8
			V/C	<	0.39	>		<	0.62	>		<	0.03	>		0.10	0.29	>		
			Q	<	29	>		<	55	>		<	22	>		22	54	>		
	Wallace Avenue South & Elma Street	TWSC	LOS	<	C	>		<	C	>		<	A	>		<	A	>		B
			Delay	<	17	>		<	22	>		<	3	>		<	2	>		13
			V/C	<	0.44	>		<	0.57	>		<	0.04	>		<	0.02	>		
			Q	<	26	>		<	24	>		<	5	>		<	6	>		

Signal - Traffic Control Signals
TWSC - Two-Way Stop Control
MOE - Measure of Effectiveness
LOS - Level of Service
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

TABLE 5.2B: 2015 SATURDAY PEAK HOUR LEVEL OF SERVICE CONDITIONS

Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
Friday Peak Hour	Main Street West & Victoria Avenue	TWSC	LOS	<	A	>		<	A	>		<	D	>		<	C	>		A
			Delay	<	1	>		<	1	>		<	25	>		<	21	>		3
			V/C	<	0.04	>		<	0.02	>		<	0.20	>		<	0.30	>		
			Q	<	26	>		<	33	>		<	14	>		<	33	>		
	Main Street West & Barber Avenue	TWSC	LOS	<	A	>		<	A	>		<	B	>		<	C	>		A
			Delay	<	1	>		<	0	>		<	14	>		<	19	>		2
			V/C	<	0.05	>		<	0.01	>		<	0.03	>		<	0.22	>		
			Q	<	39	>		<	14	>		<	12	>		<	19	>		
	Main Street West & Livingstone Avenue	TWSC	LOS	<	A	>		<	A	>		<	C	>		<	C	>		A
			Delay	<	1	>		<	1	>		<	19	>		<	23	>		3
			V/C	<	0.05	>		<	0.03	>		<	0.13	>		<	0.28	>		
			Q	<	52	>		<	30	>		<	13	>		<	27	>		
	Main Street West & Argyle Avenue North	TWSC	LOS	<	A				A	>							B	>		A
			Delay	<	2				0	>							14	>		2
			V/C	<	0.07				0.31	>							0.15	>		
			Q	<	38				24	>							17	>		
	Main Street West & Wallace Avenue North / South	Signal	LOS	B	B	>	B	<	D	A	C	<	C	>	C	<	D	B	C	C
			Delay	10	13	>	12	<	37	7	26	<	24	>	24	<	52	12	34	23
			V/C	0.39	0.38	>		<	0.64	0.33		<	0.38	>		<	0.79	0.46		
			Q	22	79	>		<	74	48		<	53	>		<	118	19		
	Main Street West & Wellington Avenue South	TWSC	LOS		A	>		<	A				C	>						A
			Delay		0	>		<	2				16	>						2
			V/C		0.23	>		<	0.06				0.14	>						
			Q		24	>		<	22				17	>						
	Main Street West & Wellington Avenue North	TWSC	LOS	<	A				A	>							B	>		A
			Delay	<	2				0	>							13	>		2
			V/C	<	0.06				0.22	>							0.15	>		
			Q	<	23				17	>							17	>		
	Main Street West & Davidson Avenue	TWSC	LOS	<	A	>		<	A	>		<	C	>		<	B	>		A
			Delay	<	1	>		<	1	>		<	17	>		<	13	>		3
			V/C	<	0.03	>		<	0.02	>		<	0.17	>		<	0.10	>		
			Q	<	17	>		<	16	>		<	15	>		<	14	>		
	Main Street West & Reserve Avenue	TWSC	LOS		A	>		<	A				B	>						A
			Delay		0	>		<	0				15	>						1
			V/C		0.26	>		<	0.01				0.13	>						
			Q		0	>		<	7				15	>						
	Wallace Avenue North & Elizabeth Street	Signal	LOS	<	D	>	D	<	B	>	B	A	B	>	B	A	B	>	B	B
			Delay	<	38	>	38	<	13	>	13	6	17	>	17	6	18	>	17	16
			V/C	<	0.72	>		<	0.23	>		0.07	0.56	>		0.12	0.62	>		
			Q	<	42	>		<	22	>		18	66	>		14	68	>		
	Wallace Avenue North & Inkerman Street	TWSC	LOS	<	D	>		<	D	>		<	A	>		A	A	>		A
			Delay	<	26	>		<	30	>		<	1	>		9	0	>		6
			V/C	<	0.29	>		<	0.53	>		<	0.03	>		0.10	0.26	>		
			Q	<	21	>		<	25	>		<	17	>		18	13	>		
	Wallace Avenue South & Elma Street	TWSC	LOS	<	B	>		<	B	>		<	A	>		<	A	>		A
			Delay	<	14	>		<	13	>		<	2	>		<	1	>		9
			V/C	<	0.36	>		<	0.24	>		<	0.03	>		<	0.01	>		
			Q	<	26	>		<	20	>		<	11	>		<	5	>		

Signal - Traffic Control Signals
TWSC - Two-Way Stop Control
MOE - Measure of Effectiveness
LOS - Level of Service
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
< - Shared Left-Turn Lane
> - Shared Right-Turn Lane

5.3 2015 Traffic Operations with Main Street and Wallace Avenue Lane Reconfiguration

In order to try to improve the operations of the intersection of Main Street and Wallace Avenue, the intersection was analyzed with the lanes reconfigured as follows:

- Separate eastbound and westbound left turn lanes;
- One eastbound shared through/right-turn lane; and
- One through lane and one shared through/right-turn lane in the westbound direction.

Synchro 9 level of service analyses were conducted for the peak hours for the intersection of Main Street and Wallace Avenue with the reconfigured lanes and optimized signal timings. The results are shown in **Table 5.3** and indicate:

- The intersection operations will improve from LOS C (with the existing configuration) to LOS B (with the new configuration);
- Synchro 95th percentile queues are estimated to reduce to 47 metres (6 vehicles) or less on all movements; and
- The southbound 95th percentile queue is estimated to be no longer than 41 metres. A queue of this length will not interfere with the operations of the intersection of Wallace Avenue and Inkerman Street.

TABLE 5.3: 2015 PEAK HOUR LEVEL OF SERVICE CONDITIONS WITH RECONFIGURATION

Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
Friday Peak Hour	Main Street West & Wallace Avenue North / South	Signal	LOS	B	B	>	**B**	<	B	B	**B**	<	B	>	**B**	<	C	A	**B**	**B**
			Delay	14	16	>	**15**	<	20	17	**17**	<	18	>	**18**	<	25	5	**15**	**16**
			V/C	0.45	0.39	>		<	0.02	0.47		<	0.42	>		<	0.54	0.42		
			Q	27	7	>		<	1	27		<	31	>		<	35	11		
Saturday Peak Hour	Main Street West & Wallace Avenue North / South	Signal	LOS	B	B	>	**B**	<	C	B	**B**	<	B	>	**B**	<	C	A	**B**	**B**
			Delay	16	17	>	**17**	<	21	15	**15**	<	14	>	**14**	<	26	5	**17**	**16**
			V/C	0.54	0.48	>		<	0.06	0.46		<	0.30	>		<	0.58	0.37		
			Q	30	47	>		<	4	24		<	23	>		<	41	12		

Signal - Traffic Control Signals *LOS - Level of Service* *< - Shared Left-Turn Lane*
TWSC - Two-Way Stop Control *V/C - Volume to Capacity Ratio* *> - Shared Right-Turn Lane*
MOE - Measure of Effectiveness *Q - 95th Percentile Queue Length (m)*

Note that in order to permit the intersection lane reconfiguration, five on-street parking spaces on the south side of Main Street East between Wallace Avenue and Wellington Avenue South will have to be removed.

5.4 Inkerman Street Conversion to One-Way Operation

The 2015 analyses estimated the 95th percentile southbound queue lengths at the intersection of Main Street and Wallace Avenue will exceed the available distance between this intersection and the Wallace Avenue and Inkerman Street intersection. When this occurs, vehicles turning to/from the west on Inkerman Street will have to wait until the queue clears or will rely on "driver courtesy" in order to make the desired turning movement.

The Municipality has identified the need to explore options that will alleviate this issue, including converting Inkerman Street from two-way to one-way operation between Argyle Avenue North and Wallace Avenue. Upon review of the traffic patterns in the area, it was found that about twice as much traffic is traveling in the westbound direction on Inkerman Street west of Wallace Avenue then in the eastbound direction. Additionally, vehicles currently turning from eastbound on Inkerman Street to Wallace Avenue may not be able to do so if the intersection is blocked by the southbound queue at Main Street.

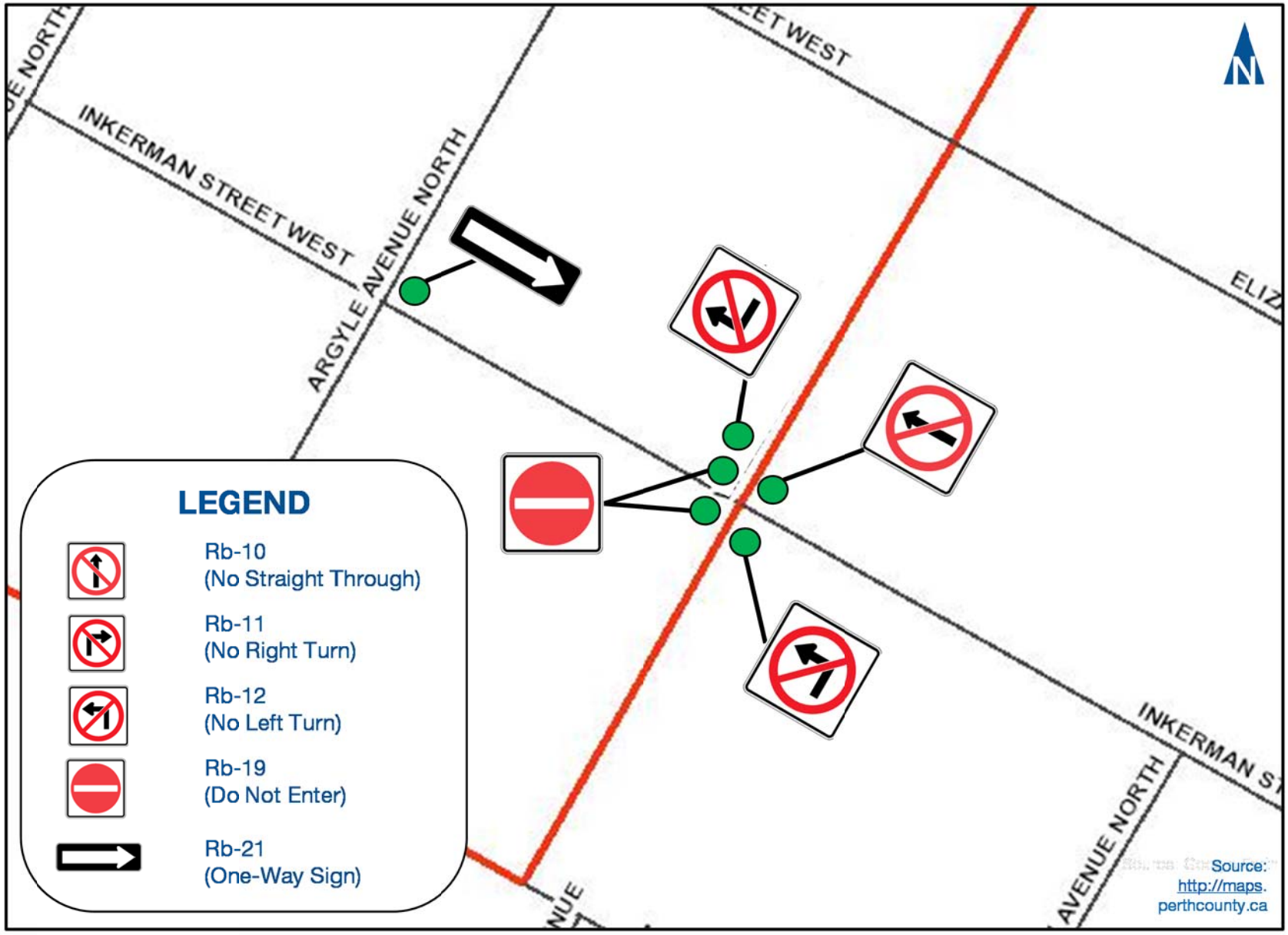
Based on the above, it is recommended that if the Municipality pursues conversion of Inkerman Street to one-way between Wallace Avenue and Argyle Avenue North, it should operate in the westbound direction. There are several other benefits to maintaining westerly traffic flow in this section or Inkerman Street. They are:

- Access will be retained to all parking areas on Inkerman Street;
- Removal of the northbound left-turn movement from Wallace Avenue to Inkerman Street will create a safer environment for pedestrians. At present, if a pedestrian is crossing the west side of Inkerman Street in the northbound direction, they may not be able to see vehicles turning left onto Inkerman Street due to queue blockage; and
- The conversion from two-way to one-way operation is cost-effective in that changes are limited to signage and pavement markings.

As identified above, effective signage will be required at several locations to ensure motorists adhere to the one-way limitation. Signage will be required at the intersection of Wallace Avenue and Inkerman Street and Inkerman Street and Argyle Street North. A recommended signage plan[3] is provided in **Figure 5.1**.

It should be noted that the reconfiguration of the intersection of Main Street and Wallace Avenue as discussed in **Section 5.3**, should reduce the southbound queues on Wallace Street at Main Street to lengths that will not interfere with intersection operations at Wallace Avenue and Inkerman Street. Therefore, this will negate the need to convert Inkerman Street to one-way operation.

[3] Ontario Traffic Manual Book 5 Regulatory Signs, Government of Ontario, March 2000



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Recommended Signage Plan for Inkerman Street Conversion

5.5 Alternative Congestion Alleviation Measure – One-Way Pairs

In addition to the measures outlined in **Section 5.3** and **Section 5.4**, the Municipality could consider the possibility of providing one-way pairs in the downtown area of Listowel in order to alleviate congestion. One-way pairs are two streets in relatively close proximity to each other that have opposite directions of one-way traffic flow. Provision of one-way pairs in the downtown area will provide the opportunity to relocate traffic to the one-way street instead of Main Street, alleviating some of the congestion through the area.

The most likely streets for conversion to one-way are Inkerman Street and Elma Street between Victoria Avenue and Nichol Avenue due to the following:

- Located within 120 metres of Main Street;
- Ample connections to Main Street within Downtown via north-south streets;
- Can connect to Main Street at the outer limits of the study area via north-south streets (Victoria Avenue and Nichol Avenue); and
- Two-way traffic volumes during peak hours are less than 400 vehicles per hour.

Inkerman Street is recommended to run westbound and Elma Street is recommended to run eastbound. In doing so, this will tie into the recommendation in **Section 5.5** regarding the one-way westbound conversion of Inkerman Street west of Wallace Avenue.

If Inkerman Street and Elma Street are converted to one-way operations, any existing all-way stop control between Victoria Avenue and Nichol Avenue should be changed to two-way stop control, with right-of-way given to the eastbound/westbound through traffic. The existing all-way stop controlled intersections are:

- Inkerman Street and Argyle Avenue North;
- Elma Street West and Victoria Avenue South; and
- Elma Street East and Davidson Avenue South

5.5.1 Impacts of One-Way Pair

If Inkerman Street and Elma Street are converted to one-way operation, traffic reassignment will occur since vehicles will no longer be able to travel in both directions on these roadways. A conservative estimate has been developed that outlines the impact that the reassignment of traffic will have on both roadways. This estimate assumes that all eastbound traffic on Inkerman Street is reassigned to eastbound on Elma Street and all westbound traffic on Elma Street is reassigned to westbound on Inkerman

Street. The estimates were prepared based on the Friday peak hour volumes since they are slightly higher than the Saturday volumes. The estimates are provided in **Table 5.4**. These estimates indicate that traffic volumes will increase on Inkerman Street and decrease on Elma Street during the Friday peak hour. However, traffic volumes will not increase to the degree that mitigation will be required.

TABLE 5.4: ONE-WAY PAIR REASSIGNED TRAFFIC ESTIMATES

Street	Existing Friday Peak Hour Volumes						Future Friday Peak Hour Volumes					
	West of Wallace Ave			East of Wallace Ave			West of Wallace Ave			East of Wallace Ave		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
Inkerman Street	48	95	143	118	125	243	-	273	273	-	324	324
Elma Street	187	178	365	176	199	375	235	-	235	294	-	294

Provision of a one-way pair via Inkerman Street and Elma Street should remove the need to reconfigure the lanes at the intersection Main Street and Wallace Avenue since any traffic not origined or destined to/from Downtown should reassign to these roadways. In order to ensure these roadways function as intended, ample clear informational and directional signage guiding drivers to the alternate routes will be required on Main Street in advance of the “link” streets (Victoria Avenue and Nichol Avenue).

5.6 Main Street Left Turn Lanes

The need for eastbound and westbound left turn lanes on Main Street at the study area intersections was assessed based on the Friday peak hour traffic volumes based on the Ministry of Transportation (MTO) left turn lane warrant for an unsignalized intersection with a two-lane cross section for a 60 kilometre per hour design speed (10 kilometres per hour over the posted speed limit).

The warrants can be found in **Appendix H** and indicate:

- A left turn lane with 15 metres storage is warranted in both the eastbound and westbound directions on Main Street at Victoria Avenue;
- An eastbound left turn lane with 25 metres storage and a westbound left turn lane with 15 metres storage is warranted on Main Street at Barber Avenue;
- An eastbound left turn lane with 25 metres storage and a westbound left turn lane with 15 metres storage is warranted on Main Street at Livingstone Avenue;
- A westbound left turn lane with 15 metres storage is warranted on Main Street at Wellington Avenue. Although this lane is warranted, the offset configuration of Wellington Avenue with Main Street, will not permit provision of this lane; and

- A westbound left turn lane with 15 metres storage is warranted on Main Street at Davidson Avenue.

5.6.2 Left Turn Lane Impacts on Parking

Provision of the warranted left-turn lanes in both directions at the Main Street study area intersections west of Wallace Avenue will require removal of parking on one side of the street. This will result in a net loss of on-street parking of seven to nine marked spaces and approximately 19 to 22 unmarked spaces between Victoria Avenue and Livingston Avenue.

Provision of the warranted westbound left turn lanes at the intersection of Main Street and Davidson Avenue will not result in a loss of parking since parking is not permitted on either side of Main Street between Davidson Avenue and Reserve Avenue.

Overall, in order to provide the warranted left turn lanes, 26 to 31 parking spaces will require removal on Main Street between Victoria Avenue and Livingstone Avenue. The total number of stalls that will require removal is dependent upon the side of the street from which parking is removed.

5.6.2 Left Turn Lane Recommendations

As identified in **Section 5.6**, left-turn lanes are warranted in both the eastbound and westbound directions on Main Street between Victoria Avenue and Livingstone Avenue. If the left-turn lanes are provided in the form of two stand-alone lanes between the intersections of Victoria Avenue and Barber Avenue and Barber Avenue and Livingstone Avenue, it will essentially create back-to-back left turn lanes with minimal distance between. Provision of left turn lanes in this manner can become confusing to drivers as they may not be aware of where one lane ends and the next one begins.

Given the close proximity of the Main Street intersections of Victoria Avenue, Barber Avenue and Livingstone Avenue and the need for left-turn lanes in both directions, it is recommended that a central two-way left-turn lane (TWLTL) is installed in this area. Provision of this lane will ensure that adequate left turn storage is provided at all intersections in the area and will also provide a safe refuge for vehicles making mid-block turns into driveways. In order to provide a consistent cross-section and lane configuration on Main Street west of Wallace Avenue, it is recommended that the Municipality consider extending the TWLTL eastward to the intersection of Main Street and Wallace Avenue. This will require removal of an additional 16 to 17 marked on-street parking spaces over and above the 26 to 31 spaces identified in **Section 5.6.1**.

At present, Main Street has a four-lane cross section from Victoria Avenue to Davidson Avenue. Predominantly there is one travel lane and one parking lane in each direction. Provision of a central TWLTL between Victoria Avenue and Wallace Avenue can be achieved through pavement markings to provide

one travel lane in each direction, the central TWLTL and parking on one side of the roadway.

A westbound left turn lane with 15 metres storage should be provided on Main Street at Davidson Avenue as warranted.

5.7 Traffic Count Recommendations

It is recommended that the Municipality proceed with the development and implementation of an on-going traffic counting program which should be undertaken annually, until traffic data has been collected for all Municipal roads. Once data has been collected for all roads and a baseline has been established, it is recommended that a three to five-year collection cycle be implemented in which each location would be counted once every thirty-six to sixty months. Routine data collection will provide the Municipality with information that can be used for analytical purposes such as adjustments to roadway classification and assessment of roadway needs or modifications based on current data.

6 Conclusions and Recommendations

6.1 Conclusions

Stop Sign Policies and Procedures

Adoption of the All-Way Stop Policy will provide the Municipality with clear and consistent guiding principles regarding the need for and installation of all-way stop control at intersections.

Stop Sign Compliance

Stop sign compliance ranged from 63% to 76% at intersections where all-way stop control was not warranted. Stop sign compliance was found to be 98% at intersections where all-way stop control was warranted.

Changes in approach and departure speeds were found to be minor at the intersections where spot speed surveys were conducted. there was a correlation between a greater variance in approach / departure speeds at the unwarranted all-way stop locations compared to the single warranted all-way stop location.

Roadway Classification Review

The roadway classification review confirmed that the majority of roadways examined as part of this study are appropriately designated. A total of six roadway segments require reclassification as per the threshold values stated in Ontario Regulation 239/02.

NuMetric Analyses

The 85th percentile operating speeds on the three roadway segments where NuMetric ATR data was collected are between 13 and 16 kilometres per hour higher than the posted speed limit. The section of Wallace Avenue South from Armstrong Street to Line 84 and the section of Tremaind Road from Clayton Street East to Perth Line 86 should be considered for remediation.

Downtown By-Pass

Provision of a properly planned and staged by-pass that is both safe and efficient will help to alleviate congestion on Main Street within Downtown Listowel. The proposed by-pass routing contained herein should provide a route that is comparable to the existing route through Downtown Listowel.

Potential Impacts of Closing Inkerman Street (2012)

If the closure of the west leg of Inkerman Street was to occur, eastbound volumes may shift northerly to Elizabeth Street. No capacity issues are likely to arise at any of the side street intersections as a result of closing the west leg of Inkerman Street. However, there is currently no capacity justification to support a closure.

2015 Traffic Operations

The intersections in the study area are operating with acceptable levels of service during the Friday afternoon and Saturday peak hours.

The northbound through movement at the intersection of Main Street West and Barber Avenue is operating at LOS E during the Friday peak hour. Delay on this movement is due to the volume of traffic on Main Street West since less than 10 vehicles were recorded on the movement itself during the higher Friday peak hour.

The southbound through/right-turn 95th percentile queue at the intersection of Main Street and Wallace Avenue is estimated to spill back and potentially interfere with operations at the intersection of Wallace Avenue and Inkerman Street during the Friday afternoon and Saturday peak hours.

2015 Traffic Operations with Main Street and Wallace Avenue Lane Reconfiguration

The intersection of Main Street and Wallace Avenue will improve to overall level of service B (from level of service C) during the Friday and Saturday peak hours with reconfiguration of the lanes to provide:

- Separate eastbound and westbound left turn lanes;
- One eastbound shared through/right-turn lane; and
- One through lane and one shared through/right-turn lane in the westbound direction

Five on-street parking spaces on the south side of Main Street East between Wallace Avenue and Wellington Avenue South will have to be removed in order to facilitate the lane reconfiguration.

Inkerman Street Conversion to One-Way Operation

The 2015 analyses estimated the 95th percentile southbound queue lengths at the intersection of Main Street and Wallace Avenue will exceed the available distance between this intersection and the Wallace Avenue and Inkerman Street intersection. Therefore, the Municipality should explore the option of converting Inkerman Street between Wallace Avenue and Argyle Avenue North to one-way operations.

If the lanes are reconfigured at the intersection of Main Street and Wallace Avenue, the southbound queues should not interfere with operations at Wallace Avenue and Inkerman Street, negating the need to convert Inkerman Street to one-way operation.

Alternative Congestion Alleviation Measure – One-Way Pairs

Traffic volumes will increase on Inkerman Street and decrease on Elma Street during the Friday peak hour if Inkerman Street is converted to one-way westbound and Alma Street is converted to one-way eastbound operations between Victoria Avenue and Nichol Avenue. However, traffic volumes will not increase to the degree that mitigation will be required.

Provision of a one-way pair via Inkerman Street and Elma Street should remove the need to reconfigure the lanes at the intersection Main Street and Wallace Avenue since any traffic not origined or destined to/from Downtown should reassign to these roadways.

Left Turn Lanes

Based on the 2015 traffic volumes, left turn lanes are warranted on Main Street as follows:

- A left turn lane with 15 metres storage is warranted in both the eastbound and westbound directions on Main Street at Victoria Avenue;
- An eastbound left turn lane with 25 metres storage and a westbound left turn lane with 15 metres storage is warranted on Main Street at Barber Avenue;
- An eastbound left turn lane with 25 metres storage and a westbound left turn lane with 15 metres storage is warranted on Main Street at Livingstone Avenue;
- A westbound left turn lane with 15 metres storage is warranted on Main Street at Wellington Avenue. Although this lane is warranted, the offset configuration of Wellington Avenue with Main Street, will not permit provision of this lane; and
- A westbound left turn lane with 15 metres storage is warranted on Main Street at Davidson Avenue

In order to provide the warranted stand alone left turn lanes, 26 to 31 parking spaces will require removal on Main Street between Victoria Avenue and Livingstone Avenue. The total number of stalls that will require removal is dependent upon the side of the street from which parking is removed.

Provision of a central two-way left turn lane on Main Street between Victoria Street and Wallace Avenue will ensure that adequate left turn storage is provided at all intersections in the area and will also provide a safe refuge for

vehicles making mid-block turns into driveways. This will require removal of an additional 16 to 17 marked on-street spaces over and above the 26 to 31 spaces required for provision of stand alone left turn lanes where warranted.

Provision of a central TWLTL between Victoria Avenue and Wallace Avenue can be achieved through pavement markings to provide one travel lane in each direction, the central TWLTL and parking on one side of the roadway.

6.2 Recommendations

Based on the findings of this study, it is recommended that:

- The Municipality of North Perth should adopt and implement the All-Way Stop warrant;
- In situations where alternatives to all-way stop control are not feasible, the Municipality should consider speed reduction techniques and the installation of warning signage and/or flashing lights when all-way stop control is not recommended;
- The Municipality update the North Perth Road Condition Assessment in order to reflect the updated roadway classifications contained herein;
- Detailed traffic calming studies be undertaken to address the speeding issues identified within the Wallace Street and Tremaine Avenue corridors;
- The Municipality undertake a Class Environmental Assessment Study to justify the need for a by-pass of the Downtown and to provide an opportunity for public and stakeholder input;
- A staged approach is utilized when implementing the by-pass;
- The by-pass should be implemented on a trial basis with pre- and post-by-pass monitoring to gauge its effectiveness;
- All roadways under jurisdiction of the Municipality that are recognized as forming part of the by-pass are updated to arterial classification within the Official Plan;
- Alignment of the intersection of Main Street and Wallace Avenue should be identified in the Municipality's long-term plan with the actual alignment determined through a future Class Environmental Assessment Study;
- The intersection of Main Street and Wallace Avenue should continue to operate with split signal phasing as this provides the best levels of service for the intersection;
- If the Municipality pursues conversion of Inkerman Street to one-way between Wallace Avenue and Argyle Avenue North, it should operate in the westbound direction.
- The Municipality install signage at the intersections of Wallace Avenue and Inkerman Street and Inkerman Street and Argyle Street

as per the recommended plan to ensure motorists adhere to the one-way limitation on Inkerman Street;

- Any existing all-way stop control between Victoria Avenue and Nichol Avenue should be changed to two-way stop control, with right-of-way given to the eastbound/westbound traffic if Inkerman Street and Elma Street are converted to one-way operations;
- Ample clear informational and directional signage guiding drivers to the alternate routes (Inkerman Street and Elma Street) will be required on Main Street to ensure these roadways function as intended if converted to a one-way pair;
- The Municipality consider the installation of a central two-way left-turn lane on Main Street from Victoria Street to Wallace Avenue. Provision of this lane will ensure that adequate left turn storage is provided at all intersections in the area and will also provide a safe refuge for vehicles making mid-block turns into driveways;
- A westbound left turn lane with 15 metres storage should be provided on Main Street at Davidson Avenue; and
- The Municipality proceed with the development and implementation of an on-going traffic counting program which should be undertaken annually, until traffic data has been collected for all Municipal roads. Once data has been collected for all roads and a baseline has been established, it is recommended that a three to five-year collection cycle be implemented.

Appendix A

All-Way Stop Traffic Control Warrant

Appendix B

All-Way Stop Denial Letter (Sample)

Appendix C

Traffic Count Location Mapping

Appendix D

Summarized Traffic Count Data

Appendix E

2012 AADT Plots

Appendix F

Roadway Classification & Traffic Volume Summary

Appendix G

NuMetric Summary Reports

Appendix H

Main Street Left Turn Lane Warrants