Thundering Waters Transportation Master Plan

Paradigm Transportation Solutions Limited

July 2016

Project Summary

Project Number
151385

July 2016

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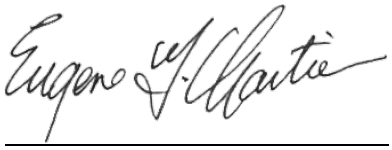
Thundering Waters Transportation Master Plan

List of Revisions

Version	Date	Author	Description
1	November 2015	MB/AE/GC	Existing Conditions Submitted for Steering Committee Review
2	May 2016	MB/AE/GC	Partial Draft for Client Review
3	July 25, 2016	GC/AE/AS	Draft Submitted for Client Review
4	July 28, 2016	GC/AE/AS	Submitted for Agency Review

Signatures



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Disclaimer

Executive Summary

Introduction

The Thundering Waters Secondary Plan area (the Thundering Waters lands) is located in the City of Niagara Falls generally south of Oldfield Road, west of the Thundering Waters Golf Course and Stanley Avenue Industrial Business Park, north of the Welland River, and east of the Ontario Power Generation (OPG) Canal. As part of the preparation of the Secondary Plan for development of the Thundering Waters lands, this Transportation Master Plan (TMP) has been prepared to guide the provision of fully integrated transportation infrastructure and services.

The primary focus of the Thundering Waters TMP is the identification of road network improvements required to serve the proposed development within the broader Study Area shown in **Figure E.1**, in particular the required intersection improvements at the 24 locations noted in the figure. The plan also provides the conceptual internal road network and related policies, and direction regarding transit, walking, cycling and Transportation Demand Management.

Preparation of the Thundering Waters TMP followed the Master Planning provisions of the Municipal Class Environmental Assessment (EA), addressing Phases 1 and 2 of the Class EA planning and design process. Future infrastructure projects needed to support development of the Thundering Waters lands are identified in the plan, with a description of the anticipated EA scope, timing and proponent.

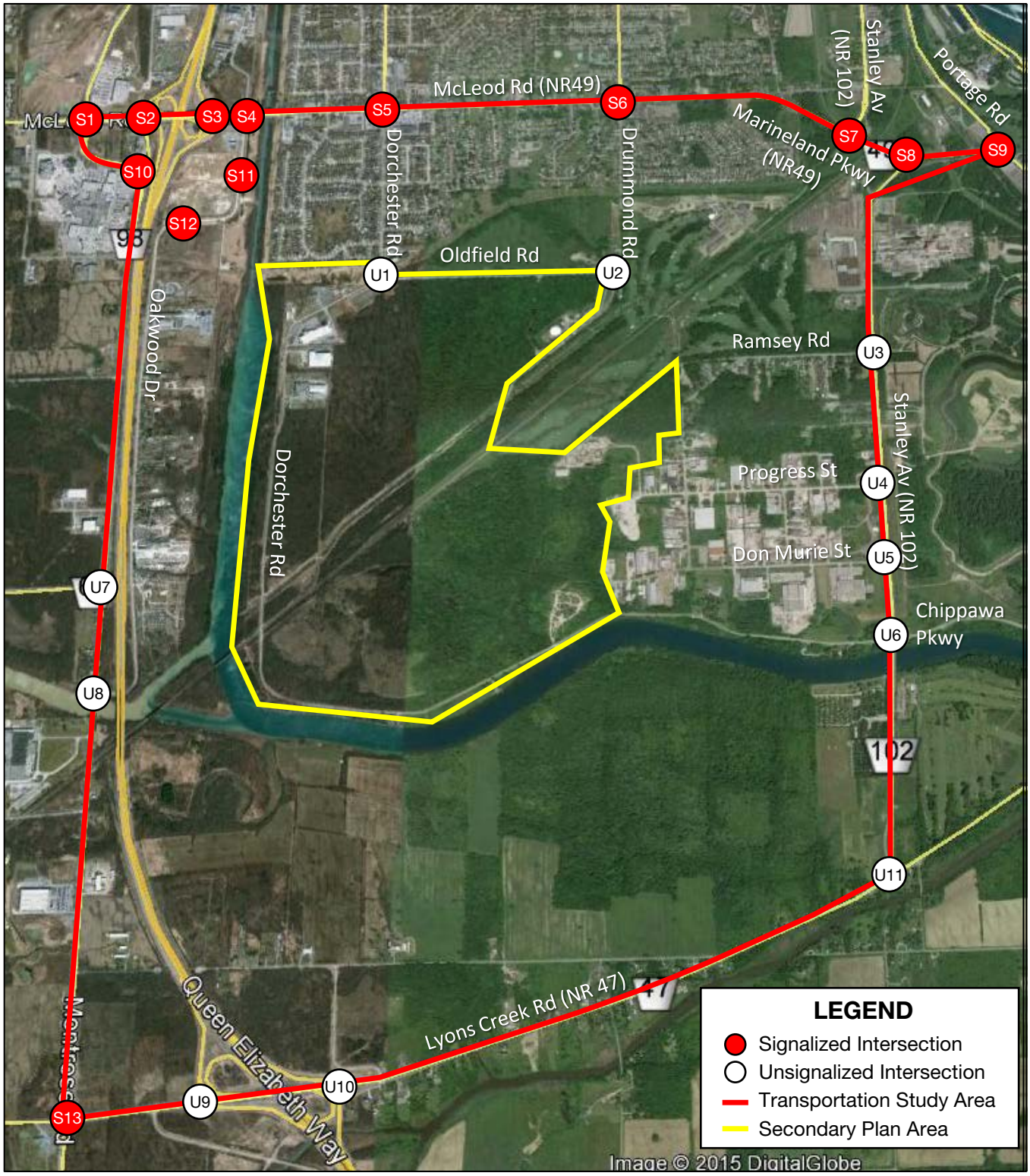
The findings and directions set out in the City of Niagara Falls Sustainable TMP and McLeod Road and Montrose Road Class EA Study were assumed in preparing the plan.

Public and Stakeholder Involvement

The public and stakeholder engagement program for the Study involved key agencies, stakeholders and local residents throughout the process. The program included the following activities:

- Ongoing Steering Committee meetings with staff from the City of Niagara Falls, Niagara Region and the Niagara Peninsula Conversation Authority (NPCA);
- Meetings with City and Region transportation staff regarding specific issues; and
- Public Meetings and Open Houses, held at critical points in the Study process, to engage interested residents and businesses.

The Ministry of Transportation declined to participate in the Study, citing that the Thundering Waters lands are beyond the Ministry's permit control area.



Source: Google Maps

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Study Area

Thundering Waters Transportation Master Plan
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Figure E.1

Existing Transportation Conditions

The existing transportation network serving the Study Area consists of roads, transit routes, and active transportation (walking and cycling) infrastructure. Major roads in the Study Area include: McLeod Road (Niagara Region Road 49), Stanley Avenue (Niagara Region Road 102), Montrose Road (Niagara Region Road 98), Lyons Creek Road (Niagara Region Road 47), Oakwood Drive and Dorchester Road.

Intersection capacity analyses undertaken to assess existing summer weekday morning (AM), weekday afternoon (PM) and Saturday midday peak hour traffic conditions for the Study Area intersections with existing lane configurations illustrated that:

- All intersections operate with satisfactory levels of service and no critical turning movements in the AM peak hour;
- With the exception of Montrose Road and Lyons Creek Road/Biggar Road, all intersections operate with satisfactory levels of service in the PM peak hour. Critical turning movements were noted at the intersections of McLeod Road and Oakwood Drive, McLeod Road and Dorchester Road and Montrose Road and Lyons Creek Road/Biggar Road; and
- With the exception of McLeod Road and Dorchester Road, all intersections operate with satisfactory levels of service in the Saturday peak hour. Critical turning movements were noted at the intersections McLeod Road and Oakwood Drive, and McLeod Road and Dorchester Road.

The City of Niagara Falls and Niagara Region could address these concerns by optimizing signal timings and adding:

- A second northbound left-turn lane at McLeod Road and Oakwood Drive;
- An exclusive southbound right-turn lane at McLeod Road and Dorchester Road; and
- Exclusive westbound and southbound left turn lanes Montrose Road and Lyons Creek Road/Biggar Road.

Identification of Problems and Opportunities

The Thundering Waters lands are being planned to accommodate approximately 8,250 people, 3,300 dwelling units and 2,000 jobs. The lands will be developed with a mix of housing, employment, commercial services and community facilities, as well as an integrated open space system that meets the needs of its residents. The development area is also intended to provide services that attract people from outside of the community and tourists.

Development of the Thundering Waters lands will require a robust, multi-modal transportation system to serve proposed development and provide efficient access and mobility for residents, businesses and visitors. Some of the current challenges to implementing this system include:

- The Thundering Waters lands are not well serviced from a transportation perspective.
- Water courses to the west and south complicate connections to the broader transportation network, in particular the QEW.
- The existing transportation network has constraints that impact its ability to serve future development.
- Transit and active transportation use is not common in Niagara Falls.

On this basis, the following problem statement has been developed to guide the Thundering Waters TMP:

"The Thundering Waters Secondary Plan area does not currently have a comprehensive, multi-modal transportation system capable of accommodating anticipated future travel needs generated by the planned new community in an efficient, effective and sustainable manner."

Assessment of Alternative Strategies

Three (3) alternative transportation strategies were considered to serve the Thundering Waters lands:

- Auto-Oriented Strategy, with the development area served primarily through the widening and construction of more roads;
- Transit-Oriented Strategy, with the development area served mostly through high levels of bus transit service; and
- Balanced Transportation Strategy, with the development area served by a range of travel modes, with supporting policy to discourage use of the private automobile.

Based on the evaluation completed, the Balanced Transportation Strategy was identified as the preferred alternative transportations service solution. This strategy formed the basis for the development of the road, transit, walking and cycling components of the TMP.

Future Travel Demand and Impact Assessment

Year 2031 travel demand forecasts were prepared to assess the adequacy of existing and planned infrastructure within the Study Area to support development of the Thundering Waters lands. In total, the development will encompass approximately 107.2 ha (265 ac.) of land, comprising about 151,350 m^2 (1.629 million sq ft) of non-residential (retail, commercial, office) floor space, nearly 3,500 residential units, hotel rooms and assisted living residences, a 500 seat live theatre, and a 2.0 ha (5 ac.) park.

Forecasting Process

The forecasting process involved:

- Determining horizon year background traffic volumes by applying a compound growth rate of 1.0 per cent per annum to existing traffic counts;
- Estimating vehicle trips generated based on data provided in the Institute of Transportation Engineers Trip Generation Manual[1]. The conservative ITE Manual trip generation rates were reduced by 5% to reflect non-auto travel and a further 7-10% to account for internal capture;
- Distributing trips generated by the Thundering Waters lands to the Study Area road network based on:
  - Data from the 2011 Transportation Tomorrow Survey (TTS); and
  - Output from the Niagara Region Travel Demand Forecasting Model used for the Niagara Falls Sustainable Transportation Master (the TransCAD Model).

  About 10% of the trips assigned to the QEW North were diverted to arterial roads north of the Study Area (i.e. Dorchester Road, Drummond Road, Stanley Avenue and Portage Road) to account for changing travel patterns over time; and
- Assigning trips to the Study Area road network based on year 2026 travel forecasts from the TransCAD Model, as this was the only source of information available for this purpose.

Traffic Impact Assessment

Using the future background and total traffic volumes derived through this process, intersection capacity analyses were completed to identify the infrastructure improvements required to serve the Thundering Waters development. The analyses assumed the planned road improvements identified in the Niagara Falls Sustainable TMP and the McLeod Road and Montrose Road Class EA would be constructed by the year 2031.

The analysis of 2031 background traffic volumes illustrated that:

- All intersections are forecast to operate with satisfactory levels of service and no critical turning movements in the AM peak hour;
- All intersections are forecast to operate with satisfactory levels of service in the PM peak hour. Critical turning movements were noted at the intersections McLeod Road and Oakwood Drive, McLeod Road and Dorchester Drive, and Marineland Parkway and Portage Road; and

[1] Institute of Transportation Engineers, Trip Generation Manual, 9th Edition, 2012, Washington, D.C.

- All intersections are forecast to operate with satisfactory levels of service in the Saturday peak hour. Critical turning movements were noted at the intersection of Marineland Parkway and Portage Road.

Assuming the same road network assumptions, the analysis of 2031 total traffic volumes illustrated that:

- All intersections are forecast to operate with satisfactory levels of service in the AM peak hour. Critical turning movements were noted at the intersections of McLeod Road and Dorchester Road, Stanley Avenue and Dorchester Road/Chippawa Parkway, and Lyons Creek Road and Stanley Avenue;
- With the exception of McLeod Road and Oakwood Drive, McLeod Road and Dorchester Road, and McLeod Road and Drummond Road, the remaining intersections are forecast to operate with satisfactory levels of service in the PM peak hour. Critical turning movements were noted at several intersections within the Study Area; and
- With the exception of McLeod Road/Oakwood Drive and McLeod Road/Dorchester Road, the remaining intersections are forecast to operate with satisfactory levels of service in the Saturday peak hour. Critical turning movements were noted at several intersections within the Study Area.

Further changes to roadway geometry and traffic control beyond the improvements identified in the Niagara Falls Sustainable TMP and McLeod Road and Montrose Road Class EA would be required to accommodate forecasted traffic volumes. The analysis of 2031 total traffic volumes with these additional improvements illustrated that:

- All intersections are forecast to operate with satisfactory levels of service in the AM peak hour. Critical turning movements would remain at the intersection of McLeod Road and Dorchester Road.
- With the exception of McLeod Road and Oakwood Drive, all intersections are forecast to operate with satisfactory levels of service in the PM peak hour. Critical movements would remain at the intersections of McLeod Road and Montrose Road, McLeod Road and Oakwood Drive, McLeod Road and Dorchester Road, and McLeod Road and Drummond Road.
- All intersections operate with satisfactory levels of service in the Saturday peak hour. Critical movements would remain at the intersections of McLeod Road and Oakwood Drive and McLeod Road and Dorchester Road.

Several key intersections, in particular McLeod Road and Oakwood Drive and McLeod Road and Dorchester Road, are still forecast to operate with less than satisfactory levels of service in the year 2031 with all identified road improvements. Further road capacity would likely be required to support the build out of the Thundering Waters lands.

Potential Watercourse Crossing

The Hydro (OPG) Canal crossing recommended by the Niagara Falls Sustainable TMP is one potential solution to identified capacity constraints. Two (2) potential watercourse crossing options were considered through the planning process, being across the: (1) OPG Canal to the west; or (2) Welland River to the south.

One of the many factors to be considered in determining the need and preferred location for a potential crossing would be its impact on external traffic generated by the Thundering Waters lands. Intersection capacity analyses undertaken using future total traffic volumes showed that:

- A watercourse crossing would not alleviate the need to implement planned and additional road network improvements.
- The provision of a crossing with all identified road improvements would help to alleviate projected capacity concerns at the critical McLeod Road and Oakwood Drive and McLeod Road and Dorchester Road intersections. By contrast, the scenario without the watercourse crossing would still exhibit capacity deficiencies with the base and additional infrastructure improvements identified.
- Both potential watercourse crossing concepts would provide additional capacity and help to redirect site generated traffic towards Lyons Creek Road and its QEW interchange, but to differing degrees and with varying impacts.
- Neither crossing option completely addresses all requirements or resolves every road network capacity concern.

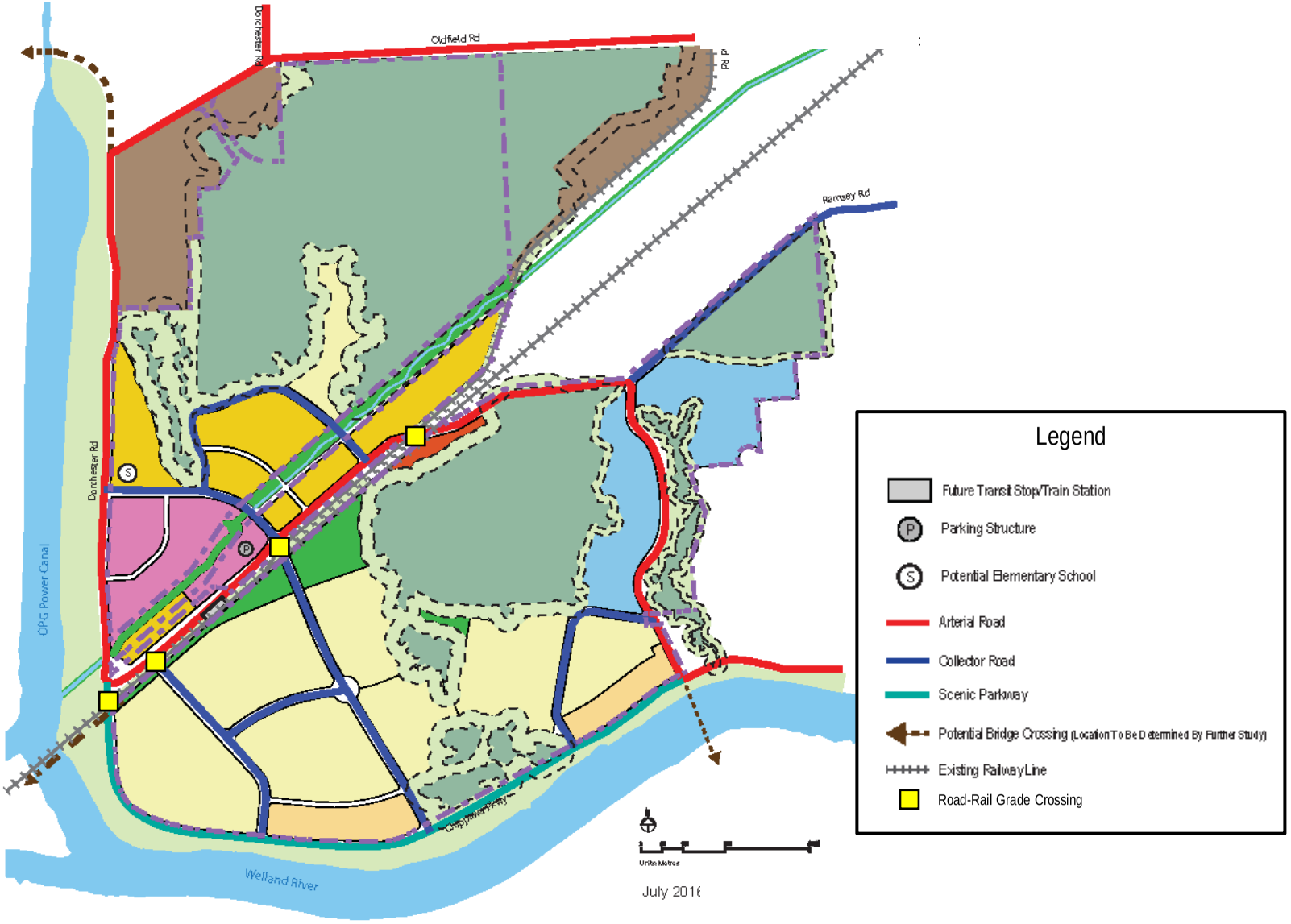
The preliminary assessment suggests that the OPG Canal crossing is preferred to the Welland River crossing, but more detailed technical investigations would be required to confirm a preferred location and alignment. This assessment would typically be carried out through a Municipal Class EA study.

Road Network Plans and Policies

Conceptual Network

Figure E.2 illustrates the conceptual road network plan. The key road segments of the plan consist of:

- Upgraded Dorchester Road north of the proposed Town Centre and Chippawa Parkway from the east-west arterial to Stanley Avenue as arterial roads;
- An “east-west” arterial roadway extending from Dorchester Road to Chippawa Parkway in a northwest to southeast orientation;
- Improved Chippawa Parkway from Dorchester Road to the east as a scenic parkway;



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Conceptual Road Network Plan

- Extension and upgrading of Ramsey Road to the east-west arterial as a collector road; and
- A modified grid network of collector roads.

As noted above, a crossing of the OPG Canal or Welland River may also be needed in the future to relieve capacity constraints on McLeod Road and serve anticipated traffic demands for the Thundering Waters lands.

Intersection Improvements

The intersections listed in **Table E.1** should be expanded and/or are expected to require traffic control signals to serve the proposed development. The actual need for signals and the approximate timing of installation at each location will be subject to future warrant assessment.

Roundabouts were found to offer operational advantages and should be considered at the intersections of:

- Stanley Avenue and Chippawa Parkway;
- Lyons Creek Road and Chippawa Parkway;
- Montrose Road and Oakwood Road, if the OPG Canal crossing is pursued; and
- Lyons Creek Road and the new access road to Thundering Waters, if the Welland River crossing is pursued.

Railway Crossings

The Thundering Waters lands are bisected by the CP Rail Montrose Subdivision, a lightly used industrial spur. There are four (4) planned crossings of the spur line by collector (3) and arterial (1) roads within the development area, given its prominent location and the roadway circulation and capacity needs of the Secondary Plan land uses. It is unlikely that any of the crossings will require grade separation given the low volume of rail traffic on the spur line, although gates may be required. A warning system with gates should also be considered for the grade crossings of the pedestrian, cyclist and electric cart networks, given the railway design speed and the number of tracks.

Neighbourhood Traffic Management and Trucking

A Neighbourhood Traffic Management plan should be prepared to assess the need for traffic calming measures on roads within and adjacent to the Thundering Waters lands, and identify potential measures and preferred placement if implementation is justified. The plan should be sufficiently flexible to permit refinements of the strategy as development progresses.

TABLE E.1: PROPOSED INTERSECTION IMPROVEMENTS

Intersection	Base (2015) Year	Horizon (2031) Year			
	Existing Conditions	Future Background	Future Total	Future Total with OPG Canal Crossing	Future Total with Welland River Crossing
McLeod Road and Montrose Road		EB TL WB TL			
McLeod Road and QEW EB Off-Ramp/Niagara Square Drive		EB TL WB TL			
McLeod Road and QEW WB Off-Ramp		EB TL WB TL			
McLeod Road and Oakwood Drive	2nd NB LTL	EB TL WB TL 2nd WB LTL	Congested		
McLeod Road and Dorchester Road	SB RTL	2nd EB LTL	2nd NB LTL EB RTL WB RTL	2nd NB LTL	2nd NB LTL EB RTL
McLeod Road and Drummond Road		EB LTL WB LTL	Dual NB LTLs		NB LTL
Marineland Parkway and Stanley Avenue		Jog Elimination			
Montrose Road and Niagara Square Drive					
Montrose Road and Lyons Creek Road/ Biggar Road	WB LTL SB LTL			WB RTL	
Oakwood Drive and Walmart North Driveway					
Oakwood Drive and Walmart South Driveway					
Marineland Parkway and Portage Road		EB LTL	Traffic Signals[1]	Traffic Signals[1]	Traffic Signals[1]
Stanley Avenue and Ramsey Road					
Stanley Avenue and Progress Street					
Stanley Avenue and Don Murie Street					
Stanley Avenue and Chippawa Parkway			Traffic Signals Dual NB LTLs EB LTL Channelized EB RTL SB RTL or Roundabout	Traffic Signals NB LTL EB LTL or Roundabout	Traffic Signals or Roundabout

TABLE E.1: PROPOSED INTERSECTION IMPROVEMENTS

Intersection	Base (2015) Year	Horizon (2031) Year			
	Existing Conditions	Future Background	Future Total	Future Total with OPG Canal Crossing	Future Total with Welland River Crossing
Lyons Creek Road and Stanley Avenue			Traffic Signals/ Roundabout	Traffic Signals/ Roundabout	Traffic Signals/ Roundabout
Lyons Creek Road and QEW WB Off-Ramp			Traffic Signals	Traffic Signals	Traffic Signals
Lyons Creek Road and QEW EB Off-Ramp			Traffic Signals	Traffic Signals	Traffic Signals
Montrose Road and Oakwood Drive				Traffic Signals NB RTL SB LTL or Roundabout	
Montrose Road and Chippawa Creek Road					
Lyons Creek Road and Thundering Waters Access Road				N/A	Traffic Signals EB LTL WB RTL or Roundabout
Oakwood Drive and Thundering Waters Access Road				Unsignalized EB LTL	N/A

The arterial and major collector roads within the Thundering Waters lands should be designed to accommodate heavy vehicle traffic and should not have restrictions or impediments to truck use. These roads should incorporate features to better facilitate truck use in their design and operation, such as larger corner radii. To discourage truck traffic in residential neighbourhoods, potential locations where trucks may cut through should be identified and signed to prohibit through truck traffic.

Phasing of Development and Road Improvements

Development of the Thundering Waters lands is planned to be phased given the scale of the plan. Required road improvements should be phased to coincide with the development build-out generally as follows:

- Upgrade existing rural arterial roads (Dorchester Road and Chippawa Parkway) to appropriate standards (likely urban cross-section) as development occurs on adjacent lands;
- Expand intersections on the Study Area road network incrementally to accommodate the additional demand generated by the development. Improvements may be triggered when their performance falls below the critical thresholds set out in the Niagara Region and City of Niagara Falls Transportation Impact Study guidelines;
- Implement the modified grid network of collector roads that are required to service the lands within the development area; and
- Provide a watercourse crossing if insufficient residual capacity remains in the road network and future demand warrants.

Roadway Capacity Available to Serve Development

From a road capacity perspective, there are no immediate impediments to initiating the first phase of development, other than upgrades to the existing roads within the Thundering Waters lands (Dorchester Road and Chippawa Parkway) and the intersection improvements to address existing capacity concerns.

Assuming traffic volumes grow at a constant rate, the McLeod Road and Dorchester Road intersection, which is projected to offer the least satisfactory level of service within the Study Area in the future, is expected to exceed capacity in the year 2021 during the critical PM peak hour. This infers that approximately 38% of the Thundering Waters development could proceed before the road capacity threshold is reached, assuming the necessary road infrastructure improvements are provided.

Monitoring Program

It is difficult to identify specific transportation phasing plans at this time given the myriad uncertainties pertaining to the Thundering Waters development. For this reason, a transportation monitoring program should

be initiated to track development levels and trends, and associated travel characteristics over time. The findings of the transportation monitoring program will be used primarily to gauge the need for and timing of major infrastructure improvements, in particular the potential watercourse crossing. This approach would allow development to proceed in the near term based on available capacity, while ensuring development does not outpace available roadway capacity.

The preparation of Transportation Impact Studies in support of future planning applications is another component of the monitoring program.

Other Plan Elements

Transit

Figure E.3 illustrates the conceptual transit plan. The proposed plan utilizes the proposed modified grid pattern of arterial and collector roadways to support the extension of existing and future transit service to the development area, with buses operating in mixed traffic. Development of the Future Transit Stop/Train Station would better facilitate possible future connections with local, regional and inter-regional bus services. The route coverage density places most properties within 300 metres of a bus stop.

Walking and Cycling

Figures E.4 and **E.5** illustrate the conceptual pedestrian circulation and cycling plans, respectively. Both plans rely on the proposed modified grid pattern of arterial and collector roadways to provide the framework for their networks of routes. Collector roadways are the preferred location for bike lanes as these roads generally carry lower traffic volumes at slower speeds than arterials and provide direct property access to residential land uses. The active transportation strategy will evolve as development occurs, given that the Thundering Waters lands are predominately vacant currently with no existing walking or cycling infrastructure.

Electric Carts (Neighbourhood Electric Vehicles)

Figure E.6 illustrates the conceptual electric cart circulation plan. The proposed network parallels the proposed modified grid pattern of arterial and collector roads, similar to the active transportation network. The carts will operate in a separate corridor given Provincial legislation and City regulations pertaining to their use. The electric cart network will evolve as development occurs and be coordinated with other infrastructure provision. Design guidelines specific to this mode will be developed to guide implementation. The guidelines will address facility design, parking requirements and operating provisions.

Transportation Demand Management (TDM)

The TMP recommends a broad range of TDM measures to influence whether, why, when, where and how people will travel. These TDM actions are intended to encourage the use of sustainable modes of transportation and minimize single-occupant vehicle trips as part of an overall community transportation management strategy. The measures should be considered for all future development within the Thundering Waters lands.

Conclusions and Recommendations

From the analyses completed for the Thundering Waters TMP, the fundamental conclusions are as follows:

1. There are no immediate impediments to initiating the first phase of development from a traffic perspective, assuming the existing roads within the Thundering Waters lands (Dorchester Road and Chippawa Parkway) are improved and existing intersection capacity issues are addressed through currently programmed improvements.

2. Approximately 38% of the Thundering Waters development could proceed before the road capacity threshold is reached, assuming the programmed and identified road infrastructure improvements are implemented.

3. A watercourse crossing of the Hydro (OPG) Canal (or the Welland River), as recommended by the Niagara Falls Sustainable TMP, is a potential (and likely) solution to identified road capacity constraints. Need and timing will depend on development of the Thundering Waters lands.

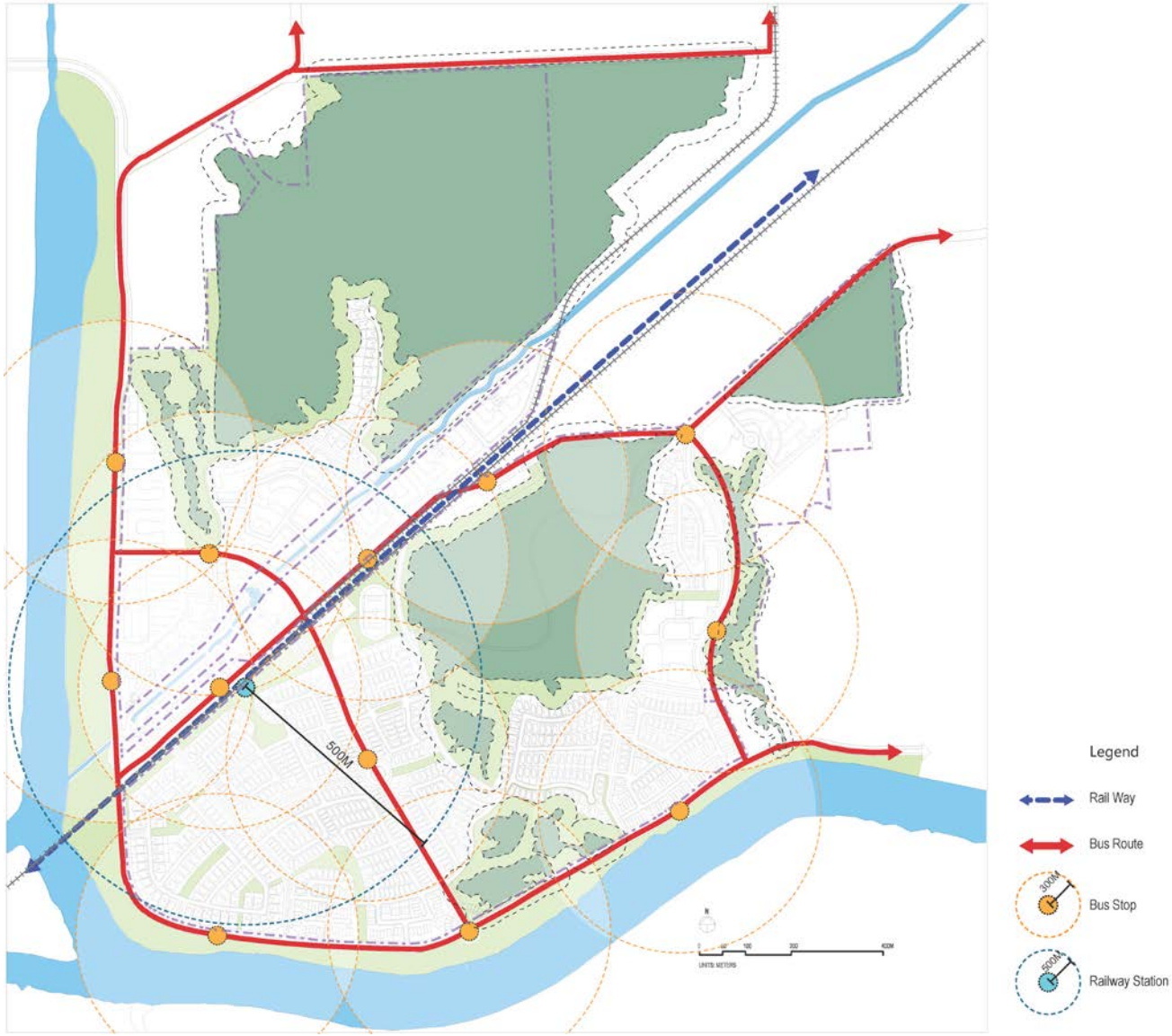
On the basis of the foregoing, it is recommended that:

1. The Thundering Waters development proceed in phases, subject to the provision of required infrastructure improvements to support the planned phase of development, as identified in the Thundering Waters TMP.

2. A more detailed implementation plan be prepared once the development phasing strategy is better defined to articulate the timing of required infrastructure improvements.

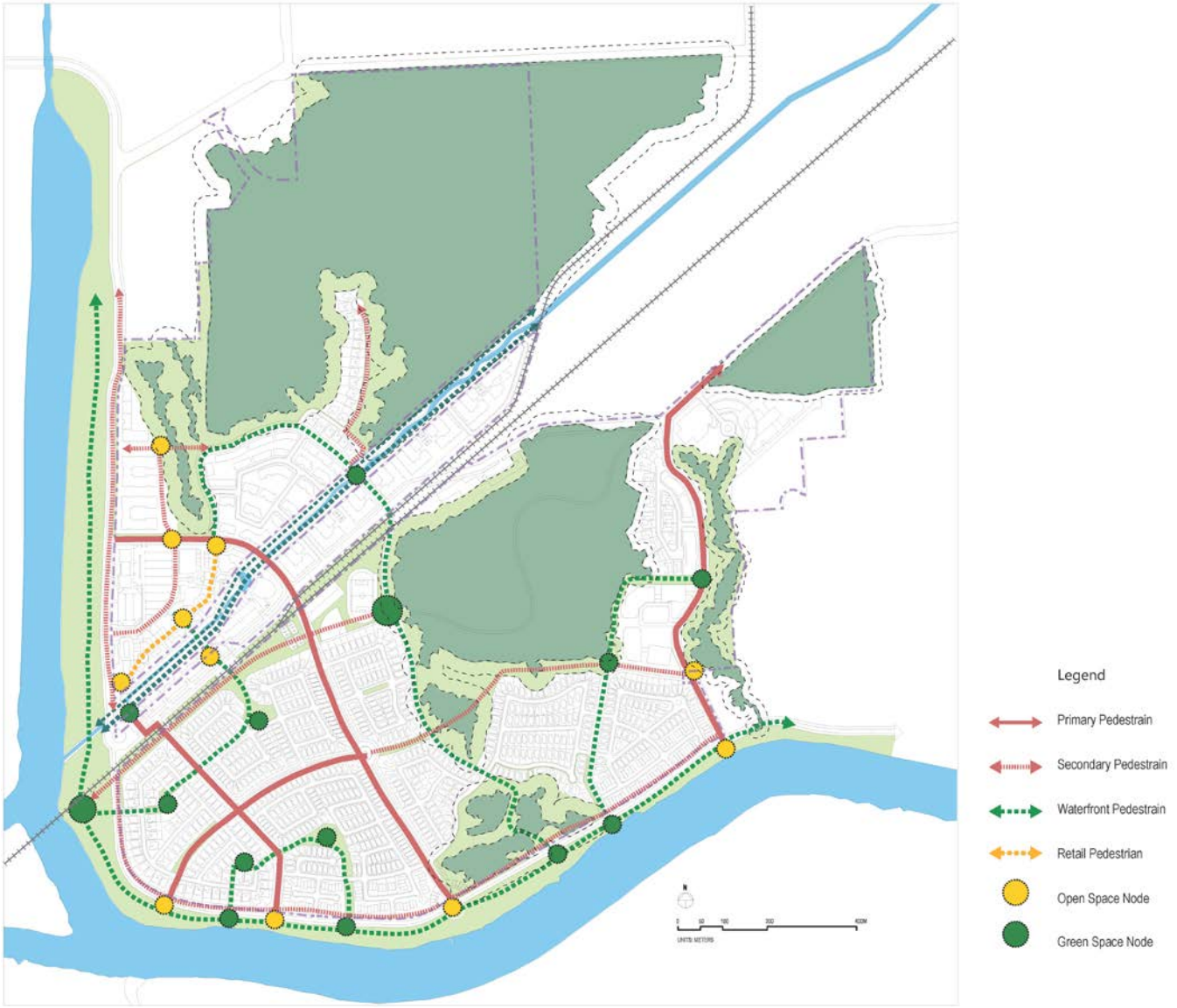
3. A TDM program be implemented for the Thundering Waters lands to minimize vehicular traffic generation.

4. A transportation monitoring program be implemented to track development levels and trends, and associated travel characteristics over time, with the findings being used to gauge the need for and timing of major infrastructure improvements, in particular the potential watercourse crossing.



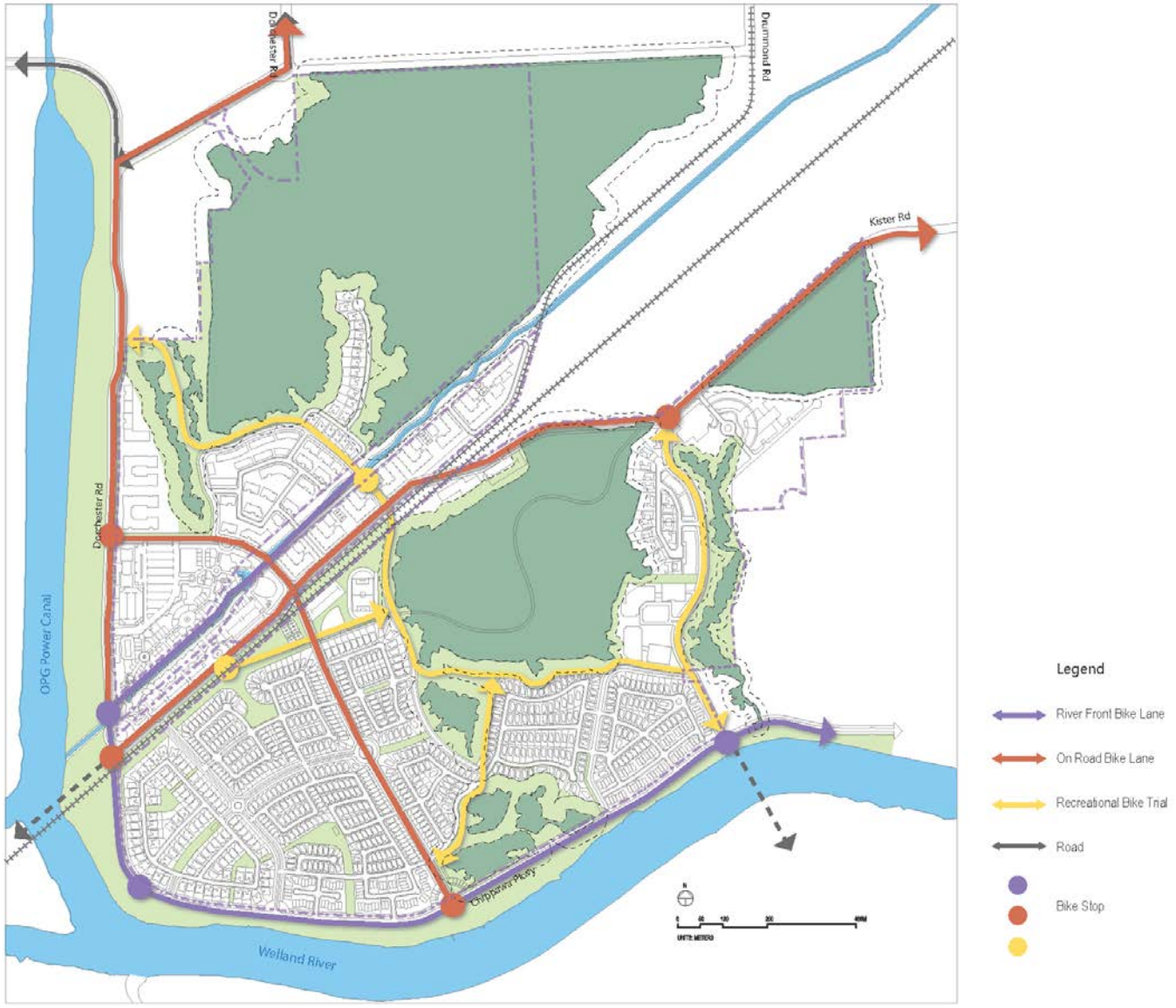
Source: City of Niagara Falls Riverfront Community Master Plan, RTKL

Conceptual Transit Plan



Source: City of Niagara Falls Riverfront Community Master Plan, RTKL

Conceptual Pedestrian Circulation Plan



Source: City of Niagara Falls Riverfront Community Master Plan, RTKL

Conceptual Cycling Plan

Source: City of Niagara Falls Riverfront Community Master Plan, RTKL

Conceptual Electric Cart Circulation Plan

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Appendices (under separate cover)

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Tables

1 Introduction

1.1 Study Purpose

GR (CAN) Investment Co. Ltd. has acquired approximately 479 acres [193.8 ha (+/-)] of land adjacent to the Thundering Waters Golf Course in the City of Niagara Falls, Ontario. The property owner intends to develop the lands with a mix of commercial (retail shops, nursing homes, sports complexes and fields, a school and hotels), residential (single family homes, townhouses, and apartment building/condo minimum units both low and high rise), park lands (green space) and office business park.

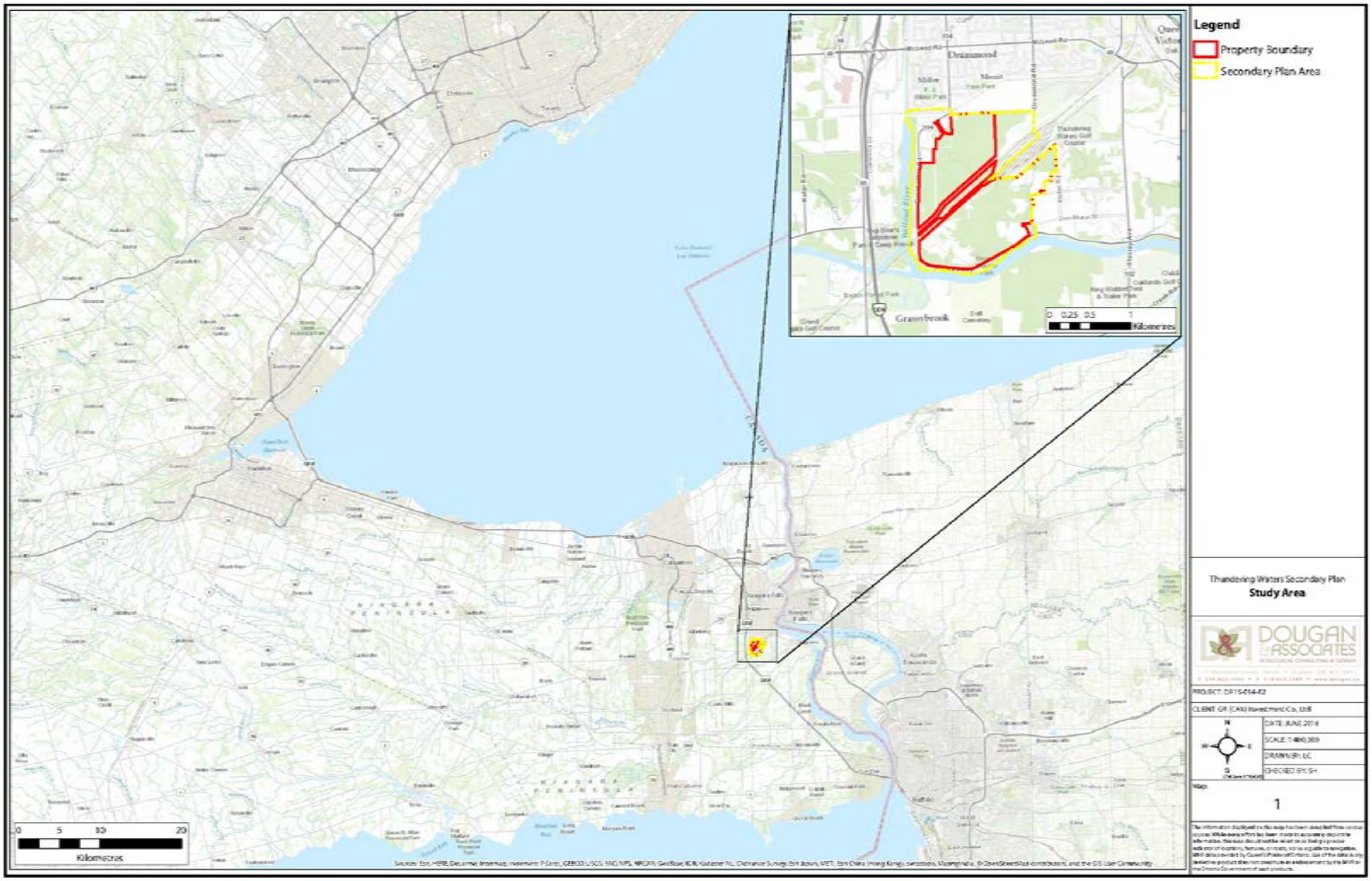
The subject lands are identified as Special Policy Area 56 (SPA 56) in the City of Niagara Falls Official Plan. SPA 56 states that development of this area will occur in accordance with a Secondary Plan to be adopted as an amendment to the Official Plan. As a result, a Secondary Plan study is being undertaken to provide a detailed set of policies and schedules to guide the future development of the lands and protect the natural heritage features.

Paradigm Transportation Solutions Limited (Paradigm) was retained by GR (CAN) Investment Co. Ltd. to undertake the **Thundering Waters Transportation Master Plan Study** (herein referred to as the Study) as part of the Secondary Plan study. The Thundering Waters Secondary Plan area (herein referred to as the Thundering Waters lands) is located in the southern part of the City, as shown in **Figure 1.1**. The area is generally bounded by Oldfield Road to the north, Thundering Waters Golf Course and Stanley Avenue Industrial Business Park to the east, the Welland River to the south, and the Ontario Power Generation (OPG) Canal to the west. The subject lands are predominantly vacant at this time, and bisected by the Con Rail Drainage Ditch and the infrequently used CP Rail Montrose spur line that serves a few industrial sites at the periphery of the Thundering Waters lands.

The primary focus of this Transportation Master Plan is the identification of external road network improvements required to serve the proposed Thundering Waters development. The plan also outlines the internal road network plan and provides direction for transit, walking and cycling use.

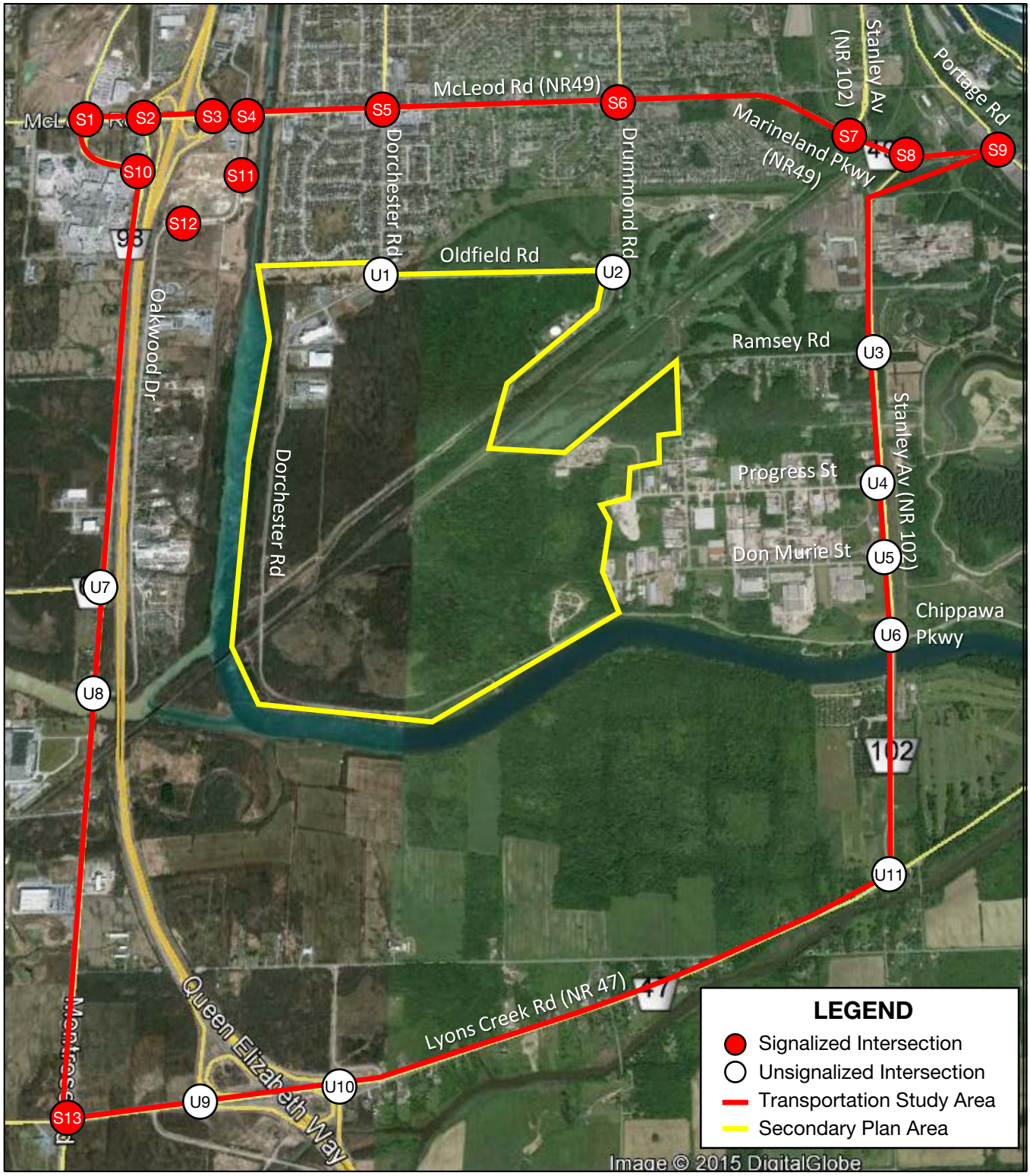
1.2 Study Area

The study area for the Transportation Master Plan, as shown in **Figure 1.2** (and herein referred to as the Study Area), encompasses transportation facilities likely to be impacted by the proposed development of the Thundering Waters lands. The Study Area is bounded by McLeod Road/ Marineland Parkway (Niagara Road 43) to the north, Stanley Avenue (Niagara Road 102) to the east, Lyons Creek Road/Biggar Road (Niagara Road 47) to the south, and Montrose Road (Regional Road 98) to the west. The Queen Elizabeth Way (QEW) travels through the Study Area. The immediately adjacent signalized intersection of Marineland Parkway and Portage Road has also been included for the traffic operational analysis.



Source: Dougan and Associates

Context Plan – Thundering Waters Secondary Plan Area



Source: Google Maps

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Study Area

Thundering Waters Transportation Master Plan
151385

Figure 1.2

1.3 Goals and Objectives of the Transportation Master Plan

The intent of the Thundering Waters Transportation Master Plan is to:

1. Articulate a comprehensive transportation strategy that serves the recommended land use plan, while achieving accessibility and mobility in a manner consistent with the guiding principles stated in the Secondary Plan;

2. Satisfy Phases 1 and 2 of the Municipal Class Environmental Assessment process and integrate the assessment of infrastructure requirements for existing and future land use with environmental assessment planning principles. A key goal of the plan is to identify the needs of future development, examine alternative transportation strategies to meet those needs, and determine the most appropriate solution;

3. Identify and address the opportunities and constraints associated with the current transportation network, including but not limited to existing and proposed land uses, street network capacity, transit availability, and active transportation; and

4. Identify and address transportation network needs to the 2031 horizon including:

   - Any roadway infrastructure improvements required to support the preferred land use concept, as well as opportunities for integration between existing and new infrastructure; and
   - Transit and active transportation (pedestrian and cycling) networks to serve planned uses and provide linkages to and between commercial areas, community facilities, parks and trails, in particular the nearby Millennium Trail (shown as Route No. 1 on **Figure 1.4**).

1.4 Environmental Assessment Process

1.4.1 Municipal Class Environmental Assessment

The Municipal Class Environmental Assessment (EA)[2] provides the approved process that a proponent must follow to meet the requirements of the provincial *Environmental Assessment Act* (*EA Act*) for municipal infrastructure projects. A Class EA is a method of obtaining approval under the *EA Act* and provides an alternative to carrying out an individual EA for each potential undertaking. These undertakings generally do not require project-specific approval under the *EA Act*, provided the approved Class EA planning process is followed.

[2] Municipal Engineers' Association (MEA), Municipal Class Environmental Assessment, October 2000 (as amended in 2007 and 2011)

As **Figure 1.3** illustrates, the Municipal Class EA planning and design process comprises five (5) basic phases, depending on the scope of the project:

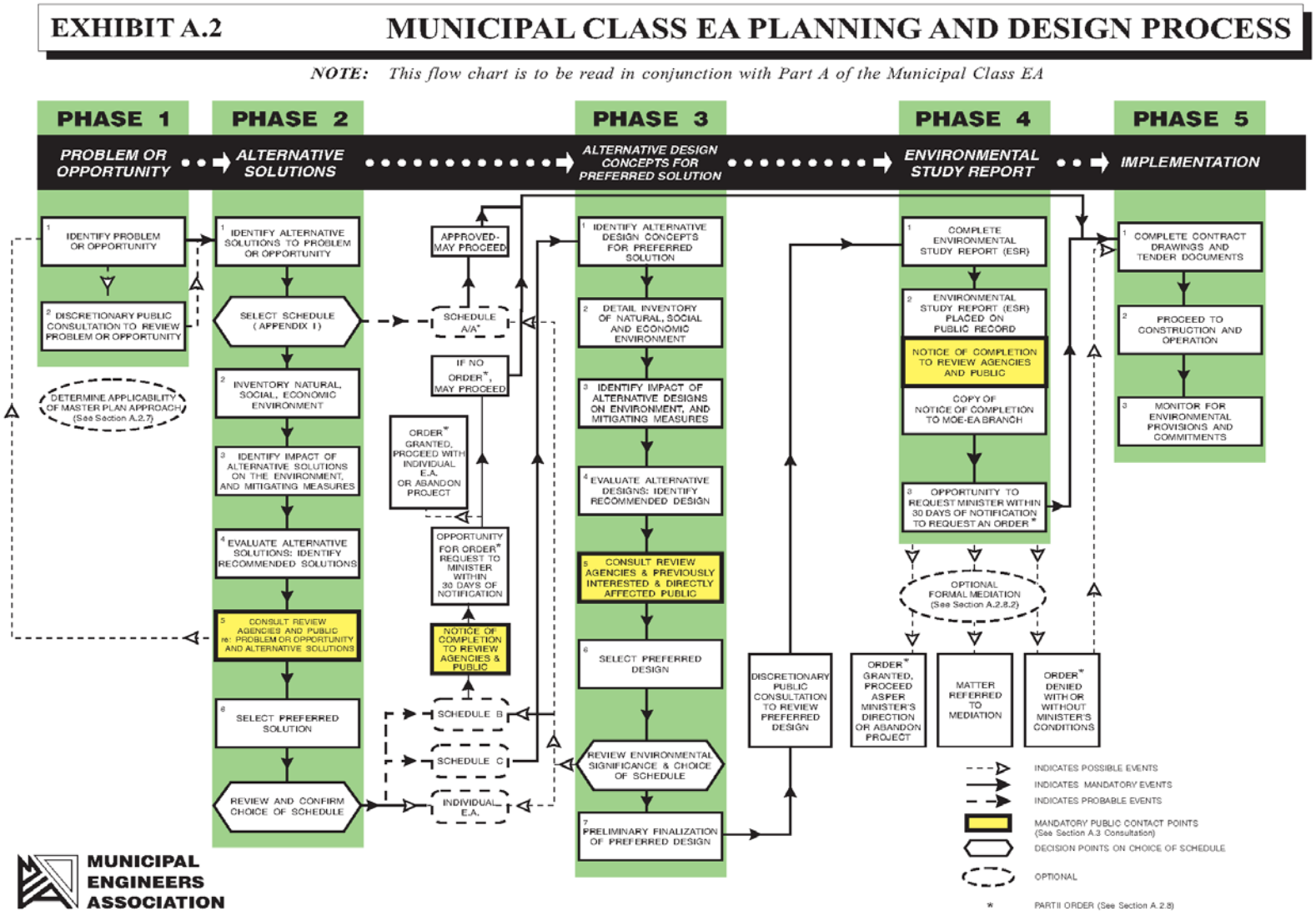
- Phase 1 – Identify the problem or opportunity;
- Phase 2 – Identify alternative solutions to address the problem or opportunity through consideration of the existing environment, and then establishing a preferred solution;
- Phase 3 – Examine alternative methods of implementing the preferred solution;
- Phase 4 – Complete an Environmental Study Report (ESR) that documents the study rationale, planning, design and consultation process of the project; and
- Phase 5 – Complete contract drawings and documents, then proceed to construction and operation.

Master Plans

Master Plans are long range plans that integrate infrastructure requirements for existing and future land use with EA planning principles. These plans examine infrastructure systems or groups of related projects to define an implementation framework for subsequent projects and/or developments with environmental protection and mitigation measures integrated into the project.

The work undertaken in preparing a Master Plan will usually follow the planning and design process of the Municipal Class EA and incorporate key principles of successful environmental assessment planning. At a minimum, Master Plans will typically address Phases 1 and 2 of the process. As a result, the plan can provide the basis for carrying out follow-on EA studies for project-specific improvements. Public and stakeholder consultation must take place during each phase of the process, specifically at the initiation of the Master Plan study and at the selection of the preferred alternative.

Municipal Class EA Master Plans typically differ from project-specific studies in several key respects. The long range master planning process enables the proponent to comprehensively identify needs and establish broader infrastructure options to satisfy those objectives. The opportunity to integrate infrastructure and land use planning also enables the municipality to consider different perspectives when examining the full impact of the proposed development in the decision-making process.



paradigm TRANSPORTATION SOLUTIONS LIMITED

Municipal Class EA Planning and Design Process

Preparation of the Thundering Waters Transportation Master Plan has followed the Master Planning process (Approach #1) outlined in Section A.2.7 and Appendix 4 of the Municipal Class EA, incorporating the key principles of effective environmental planning set out by the *EA Act*. Once complete, the plan will be filed and made available for review by the public and/or any agency that expresses interest in the study. Requests to the Minister of the Environment and Climate Change for a Part II Order (to require an Individual EA) are possible only for specific projects identified in the Master Plan, not the plan itself.

Integration with the *Planning Act*

Many communities will prepare a Master Plan to comprehensively assess and define infrastructure requirements for Secondary Plans adopted as Official Plan amendments. Although the amendment is enacted pursuant to the *Planning Act*, the opportunity exists to coordinate the planning processes and approvals required under the *EA Act* (for infrastructure) and *Planning Act* (for land use planning policy), provided the intent and obligations of both acts are met.

The integrated approach provides the opportunity to simultaneously satisfy the *Planning Act* and Municipal Class EA processes, including public/ stakeholder notification and consultation requirements, technical reports and analyses, and land use planning and environmental protection decisions. Undertaking the processes together in an integrated approach streamlines efforts, helps to avoid duplication, and ensures improved environmental protection. Completion of the procedural requirements of the Municipal Class EA based on whether the undertaking is classified as a Schedule B or C project is still required, though.

Development of the Transportation Master Plan has replied upon the *Planning Act* integration provisions cited in Section A.2.9 of the Municipal Class EA, with the plan being prepared simultaneously with the overarching Secondary Plan. In particular, this study is dependent on the environmental inventories and consultation process being conducted for the Secondary Plan study to satisfy the Municipal Class EA requirements.

1.4.2 Requirement for Subsequent Studies

The Municipal Class EA classifies projects into different “Schedules” (A, A+, B or C) according to their level of complexity and potential environmental implications. A detailed description of each Schedule and the types of projects that typically fall into each category can be found in the Municipal Class EA document.

Section 7.1 specifies the appropriate Schedule for each identified improvement project. Since the process of preparing this plan has addressed Phases 1 and 2 of the Municipal Class EA process, Schedule B projects will only need to fulfill consultation and documentation requirements prior to implementation. For Schedule C projects, it will be necessary to complete Phases 3 and 4 of the Municipal Class EA process to consider

more detailed, site-specific issues that are beyond the scope of the Master Planning process.

In completing Phases 3 and 4, the proponent of a Schedule C project will be required to prepare a detailed inventory of the natural, social and economic environment. This assessment will identify the potential implications of alternatives alignments for new or expanded infrastructure, while attempting to mitigate any impacts that cannot be avoided through design. Depending on the complexity or magnitude of the project, the analysis may involve detailed environmental studies to ensure that sufficient and appropriate information is available to base ensuing decisions, and allow the public to fully understand the environmental implications of the project.

In addition to describing the potential impacts of a project, appropriate mitigating measures should be identified and evaluated. For example, if a new bridge is being considered to extend an existing road, all measures necessary to minimize the negative impacts to residents and the surrounding environment as a result of the undertaking must be identified.

1.5 Planning Context

1.5.1 City of Niagara Falls Sustainable Transportation Master Plan

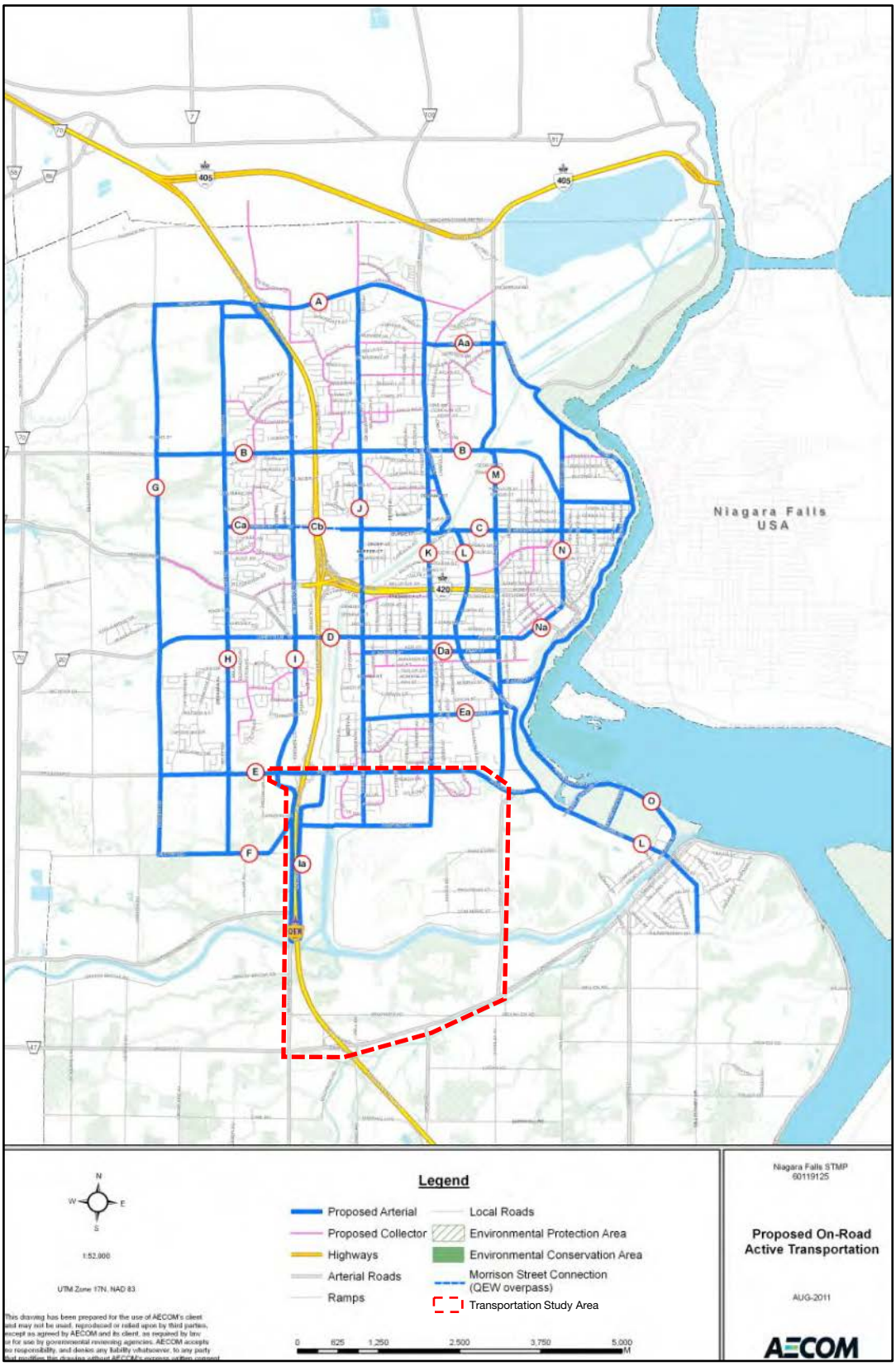
The Study relied on the City's Sustainable Transportation Master Plan (STMP) [3] to provide the future transportation system context. The Sustainable Transportation Master Plan details a comprehensive and forward-looking multi-modal transportation strategy to the year 2031 of priority improvements and programs required for the City to meet its transportation challenges. Development of the plan followed the Municipal Class EA planning process, meeting the requirements of Phases 1 and 2.

The Sustainable Transportation Master Plan addresses operational, planning and policy issues for all modes in the context of tourism, economics, environment and the community, and provides a vision for future transportation that is consistent with community values and can be achieved in a sustainable manner. The multi-modal transportation plan and comprehensive policy and decision-making framework set out in this long range policy document comprises the following key elements of interest for the Thundering Waters lands:

- **Active Transportation** – The Sustainable Transportation Master Plan recommends a comprehensive network of active transportation routes for the City. **Figures 1.4** and **1.5** show the proposed off-road and on-road projects, respectively. The figures identify the Study Area with a red outline to assist in identifying the projects of significance to this plan. The projects have been organized into groups based upon ease and timetable of implementation.

[3] AECOM, City of Niagara Falls Sustainable Transportation Master Plan, October 2011

STMP Proposed Off-Road Active Transportation Routes



STMP Proposed On-Road Active Transportation Routes

- **Transit** – The Sustainable Transportation Master Plan assumes a transit mode share target of 3.2% by 2018, as identified in the City of Niagara Falls Transit Strategic Business Plan and Ridership Growth Strategy[4] and Official Plan. **Figure 1.6** illustrates the planned future transit system.
- **Transportation Demand Management (TDM)** – The Sustainable Transportation Master Plan proposes a broad range of TDM measures to encourage change in personal travel behaviour, with the goal of reducing vehicular traffic demands.
- **Roads** – The Sustainable Transportation Master Plan recommends a comprehensive road improvement program, along with a general timescale for implementation and estimated costs. **Figure 1.7** displays the planned 2031 road network.

1.5.2 Niagara Region Transportation Master Plan Study

At the time of conducting this Study, Niagara Region was in the process of preparing a Transportation Master Plan. This comprehensive strategic planning document will define policies, programs, and infrastructure improvements required to satisfy transportation and growth needs to the year 2041 in the Region. The plan will address needs for all travel modes, including walking, cycling, transit, automobiles, and goods movement.

This Study was not able to rely on material produced by the Region's study, (including an updated travel demand forecasting model constructed on the emme platform), as their work will not be completed until 2017.

1.5.3 McLeod Road and Montrose Road Class EA Study

In 2011, Niagara Region, together with the City of Niagara Falls, completed a Class EA Study for McLeod Road (Regional Road 49)/Marineland Parkway from Pin Oak Drive to Portage Road, and Montrose Road (Regional Road 98) from McLeod Road to approximately 1 km north[5]. The purpose of the study was to address various issues including, but not limited to:

- Existing and future travel demand;
- Operational and infrastructure deficiencies;
- Land servicing needs;
- Approved and proposed changes in land use; and
- Inadequate pedestrian, cycling and transit facilities.

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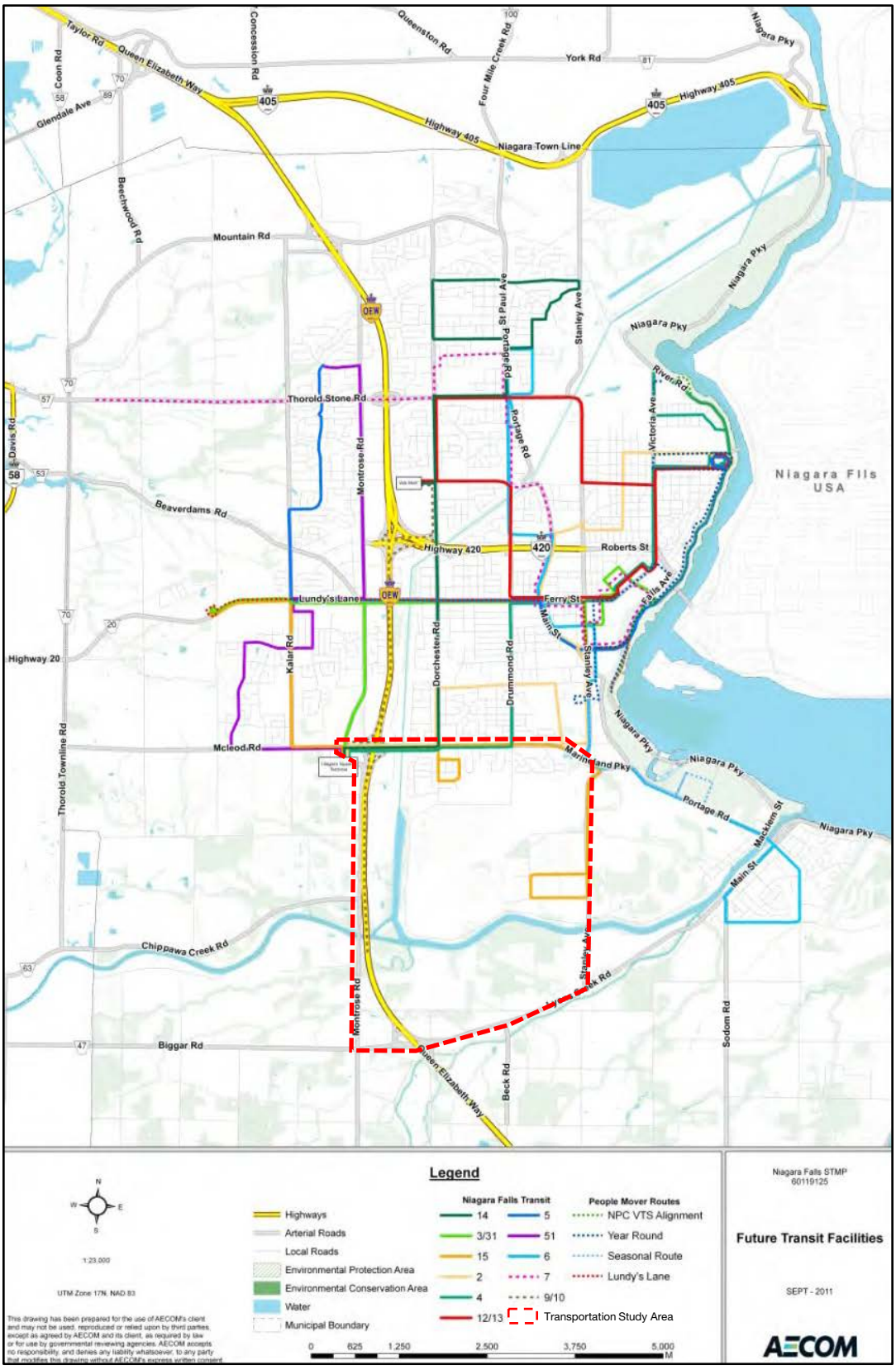
4 IBI Group, Transit Strategic Business Plan and Ridership Growth Strategy, March 2009

5 Delcan, Environmental Study Report for Regional Road 49 (McLeod Road)/Marineland Parkway from Pin Oak Drive to Portage Road and Regional Road 98 (Montrose Road) from McLeod Road to Approximately 1 km North, City of Niagara Falls, November 2011



STMP Planned Future Transit System

STMP 2031 Horizon Road Network Improvements

The study recommended widening McLeod Road/Marineland Parkway, with auxiliary turn lanes at major intersections (as required) and dedicated bike lanes, boulevards and sidewalk along both sides of the corridor. Widening and intersection improvements were also recommended for Montrose Road. A staged implementation strategy was proposed, recognizing the potential challenges and impacts of acquiring the ultimate road allowance in the short term.

1.6 Technical Analysis Approach

The technical analyses for the Study Area road network were conducted in accordance with the Transportation Impact Study guidelines for both the City of Niagara Falls and Niagara Region. The general approach to completing the analyses, developed in consultation with City and Region staff and articulated in the Terms of Reference contained in **Appendix A**, is summarized as follows:

1. Establish base year traffic volumes for the Study Area intersections shown in **Figure 1.2** for the summer weekday morning and afternoon and Saturday midday peak hours based on observed count information (herein referred to as Existing Conditions). The City and Region requested an analysis of summer conditions as they tend to represent the worst-case scenario for Niagara Falls with its high volume of tourist travel.

2. Factor base year traffic volumes to a 2031 horizon year using an average annual growth rate and account for traffic generated by planned development in the vicinity (herein referred to as Future Background Conditions).

3. Estimate traffic generated by the proposed Secondary Plan uses based on the Institute of Transportation Engineers (ITE) Trip Generation Manual (9th Edition)[6], with appropriate modifications, assign the trips to the Study Area network, and add the Future Background Conditions to determine total future traffic volumes for the 2031 horizon year (herein referred to as Future Total Conditions).

4. Analyze Existing, Future Background and Future Total Conditions for the intersections within the Study Area to identify road network improvements required to serve the proposed development.

[6] Institute of Transportation Engineers, Trip Generation Manual, 9th Edition, 2012, Washington, D.C.

1.7 Report Organization

This report documents the development of the Thundering Waters Transportation Master Plan. The plan is organized as follows:

- Chapter 2 summarizes the **public consultation** program for the Study;
- Chapter 3 reviews **existing transportation conditions** within the Study Area;
- Chapter 4 outlines the **identification of problems and opportunities** for the Thundering Waters lands, required pursuant to the Municipal Class EA;
- Chapter 5 provides an **assessment of the alternative strategies** for serving the Thundering Waters lands from a transportation perspective;
- Chapter 6 estimates and analyzes **future travel demand** for the area based on the proposed land use concept;
- Chapter 7 details the **road network plan and policies** for serving the Thundering Waters lands; and
- Chapter 8 summarizes the **other plan elements**, including the transit, active transportation and Transportation Demand Management components.

Appendices containing more detailed information are provided under separate cover.

2 Public and Stakeholder Involvement

2.1 Program Importance and Outline

Meaningful and effective consultation with agencies, stakeholders and the public is a critical component of the environmental assessment planning process and to the development of an effective Transportation Master Plan.

The consultation strategy for the Study involved key agencies, stakeholders and local residents throughout the process. The program included the following activities:

- Ongoing Steering Committee meetings with staff from the City of Niagara Falls, Niagara Region and the Niagara Peninsula Conversation Authority (NPCA);
- Meetings with City and Region transportation staff to discuss matters specific to the Transportation Master Plan Study. The Ministry of Transportation declined an invitation to participate in the Study, citing that the Thundering Waters lands are beyond the Ministry's permit control area; and
- Public Meetings and Open Houses, held at critical points in the Study process, to provide interested residents and businesses an opportunity to engage in the planning process and provide valuable input to the Project Team.

The following provides a summary of public and agency involvement for the Study. **Appendix B** provides the details of the involvement process leading to the completion of the Transportation Master Plan report.

2.2 Program Elements

2.2.1 Notice of Study Commencement

The City of Niagara Falls issued a combined Notice of Public Open House and Study Commencement for the Thundering Waters Secondary Plan Study. The notice was placed on the City's website and in the Niagara Falls Review, the local newspaper. The advertisement noted that a Transportation Master Plan satisfying the requirements of Phases 1 and 2 of the Municipal Class EA was being carried out as part of the Secondary Plan study. The public notice also indicated that the planning process would identify the problem/opportunity to be addressed, develop and evaluate a reasonable range of alternative solutions, recommend a preferred alternative, and provide opportunities for public input.

2.2.2 Steering Committee Meetings

A Steering Committee of staff from various departments within the City, Region and NPCA met with the Project Team on a regular basis over the

course of the Secondary Plan study to provide input and advice to in their respective areas of expertise and/or interest. Committee members were responsible for consulting with other members of their organizations to obtain consolidated comments and input, and for keeping landowners, Council and other staff informed of Study progress as requested.

The meetings provided an opportunity for the Project Team to update the Steering Committee on progress and seek clarification on matters related to the Study.

2.2.3 Meetings with Municipal Transportation Staff

Five meetings were held with City and Regional transportation staff over the course of the Study to review progress and address specific issues as they arose. **Table 2.1** provides a summary of the meetings.

TABLE 2.1: MUNICIPAL TRANSPORTATION STAFF MEETINGS

Meeting #	Date	Purpose
1	27 July 2015	Introduce project, present and receive feedback on draft Study Terms of Reference
2	18 November 2015	Discuss comments on Existing Conditions report, review travel demand forecasting process
3	8 January 2016	Provide progress update, discuss forecasting approach (future background conditions, trip generation and trip distribution assumptions), review bridge crossing options
4	10 June 2016	Review and confirm forecasting approach and key assumptions
5	27 July 2016	Review draft Transportation Master Plan

Appendix B provides agendas, notes and presentations from the meetings.

2.2.4 Public Open Houses

Three (3) Public Open Houses were held over the course of the Study. **Appendix B** provides agendas, notes and presentations from the sessions.

Public Open House #1 – 22 September 2015

The first Public Open House was held on Tuesday 22 September 2015 from 6:00 to 8:00 PM at the Thundering Waters Golf Course. Notice of the Public Open House and Study Commencement was published on the City's website and in the Niagara Falls Review.

The purpose of the first Public Open House was to introduce the Thundering Waters Secondary Plan Study, including the study area, vision and objectives, component technical studies and their scope (e.g.

transportation), and related timelines. Attendees were also informed of the remaining steps to be undertaken as part of the planning process and requested to offer input. For the transportation component, information about the Study process and data collection program was provided.

The meeting was structured as a drop-in session with a series of display boards. Project Team staff responded to questions and queries raised by attendees, who were also encouraged to complete and return comment sheets.

Public Meeting and Public Open House #2 – 26 and 27 April 2016

The second Public Open House was held on Wednesday 27 April 2016 from 4:00 to 6:00 PM at the Gale Centre. In addition, the City convened a Public Meeting on Tuesday 26 April 2016 at 7:00 PM, immediately prior to the regularly scheduled City Council, for Council to receive stakeholder feedback on the project. Notice of the Public Meeting and Public Open House was published on the City's website and in the Niagara Falls Review.

The purpose of the Public Meeting and the second Public Open House was to update stakeholders on Secondary Plan study, present the preliminary Secondary Plan concept and related plans, provide further information on the component studies, in particular the environmental impact assessment, and receive comments from the public on the information. For the transportation component, existing and future background traffic conditions were summarized, along with next steps in the Study.

The Public Open House was structured as a drop-in session with a series of display boards from 4:00 to 5:00 PM, and a presentation and questions and answer period between 5:00 and 6:00 PM. Project Team staff responded to questions and queries raised by attendees, who were also encouraged to complete and return comment sheets. Much of the discussion focused on the natural environmental implications of the proposed development. No questions were raised about transportation.

Public Open House #3 – 11 July 2016

The third Public Open House was held on Monday 11 July 2016 from 4:00 to 7:00 PM at the Gale Centre. Notice of the Public Meeting and Public Open House was published on the City's website and in the Niagara Falls Review.

The purpose of the third Public Open House was to update stakeholders on Secondary Plan study progress, present the proposed Secondary Plan concept and related plans, explain the component studies, and receive comments from the public on the information. For the transportation component, the Study process and findings were presened.

The Public Open House was structured as a drop-in session with a series of display boards from 4:00 to 5:00 PM, and a presentation and questions and answer period between 5:00 and 7:00 PM. Project Team staff responded to questions and queries raised by attendees, who were also encouraged to

complete and return comment sheets. Two questions were raised about transportation regarding future background traffic assumptions.

2.2.5 Follow-up Consultation of Transportation Master Plan

The Transportation Master Plan report was completed in July 2016 and circulated to interested parties for review and comment. Following the consultation period, the input received from the various stakeholders will be assessed and the plan refined to reflect the feedback received.

3 Existing Transportation Conditions

3.1 Existing System

3.1.1 Roads

The main roadways in the Study Area include:

- **McLeod Road (Niagara Region Road 49**), which is an east-west arterial road under Niagara Region jurisdiction with a four-lane cross-section throughout most of the Study Area. At the east end, McLeod Road continues as Marineland Parkway through its intersections with Stanley Avenue and Portage Road. McLeod Road provides access to the QEW from the southern built-up area of the City of Niagara Falls. It has a posted speed limit of 50 to 60 kilometres per hour within the Study Area. Key intersections along McLeod Road in the Study Area include Montrose Road, QEW, Oakwood Drive, Dorchester Road, Drummond Road, Stanley Avenue, and Portage Road.
- **Stanley Avenue (Niagara Region Road 102)** is a north-south arterial road under Niagara Region jurisdiction with a four-lane cross-section north of Marineland Parkway and a two-lane section to the south. Stanley Avenue provides direct access to Downtown Niagara Falls and the Falls Tourist district from the Study Area. North of Marineland Parkway, Stanley Avenue has a posted speed limit of 50 kilometres per hour, while south of Marineland Parkway, the road has a posted speed limit of 60 kilometres per hour. South of Marineland Parkway, there are four (4) unsignalized intersections with Ramsey Road, Progress Street, Don Murie Street, and Dorchester Road/ Chippawa Parkway within the Study Area.
- **Montrose Road (Niagara Region Road 98)** is a north-south road under Niagara Region jurisdiction with a two-lane cross-section. It widens to a four-lane cross-section at the Niagara Square Commercial Centre to McLeod Road. The road runs parallel with and provides an alternate route to the QEW during emergency closures or delays on the highway. South of McLeod Road to the south limit of the Niagara Square Shopping Centre, Montrose Road has a posted speed limit of 50 kilometres per hour. South of the Niagara Square Shopping Centre, Montrose Road has a posted speed limit of 60 kilometres per hour. Key intersections along Montrose Road in the Study Area include McLeod Road, Niagara Square Drive, Chippawa Creek Road, Oakwood Drive, and Lyons Creek Road/ Biggar Road.
- **Lyons Creek Road (Niagara Region Road 47)** is an east-west arterial road under Niagara Region jurisdiction with a two-lane cross-section that connects Montrose Road to Stanley Avenue in the Study Area. West of its intersection with Montrose Road, the road continues as Biggar Road. Lyons Creek Road widens to a four-lane

cross-section at its grade separated interchange with the QEW. The road provides a direct connection to the QEW from rural Niagara Falls and the community of Chippawa. Lyons Creek Road has a posted speed limit of 60 to 80 kilometres per hour in the Study Area. Within the Study Area, key intersections include Montrose Road, QEW, and Stanley Avenue.

- **Oakwood Drive** is a north-south collector road under the jurisdiction of the City of Niagara Falls. The road connects McLeod Road to the SmartCentres commercial plaza on the east side of QEW, as well as the residential and commercial land uses situated between the QEW and the Welland River. At its southern limit, Oakwood Drive curves under the QEW and connects to Montrose Road. There are two (2) signalized intersections with the SmartCentres commercial plaza on Oakwood Drive. The posted speed limit for Oakwood Drive ranges from 50 to 60 kilometres per hour.
- **Dorchester Road** is a north-south road under the jurisdiction of the City of Niagara Falls. The road is designated as an arterial in the City's Official Plan, except for the short segment between McLeod Road and Oldfield Road within the Study Area that is classified as a collector. Dorchester Road extends from the north limit of Niagara Falls into the Study Area, where it curves and connects to Chippawa Parkway. The speed limit on Dorchester Road is 50 kilometres per hour (unposted).

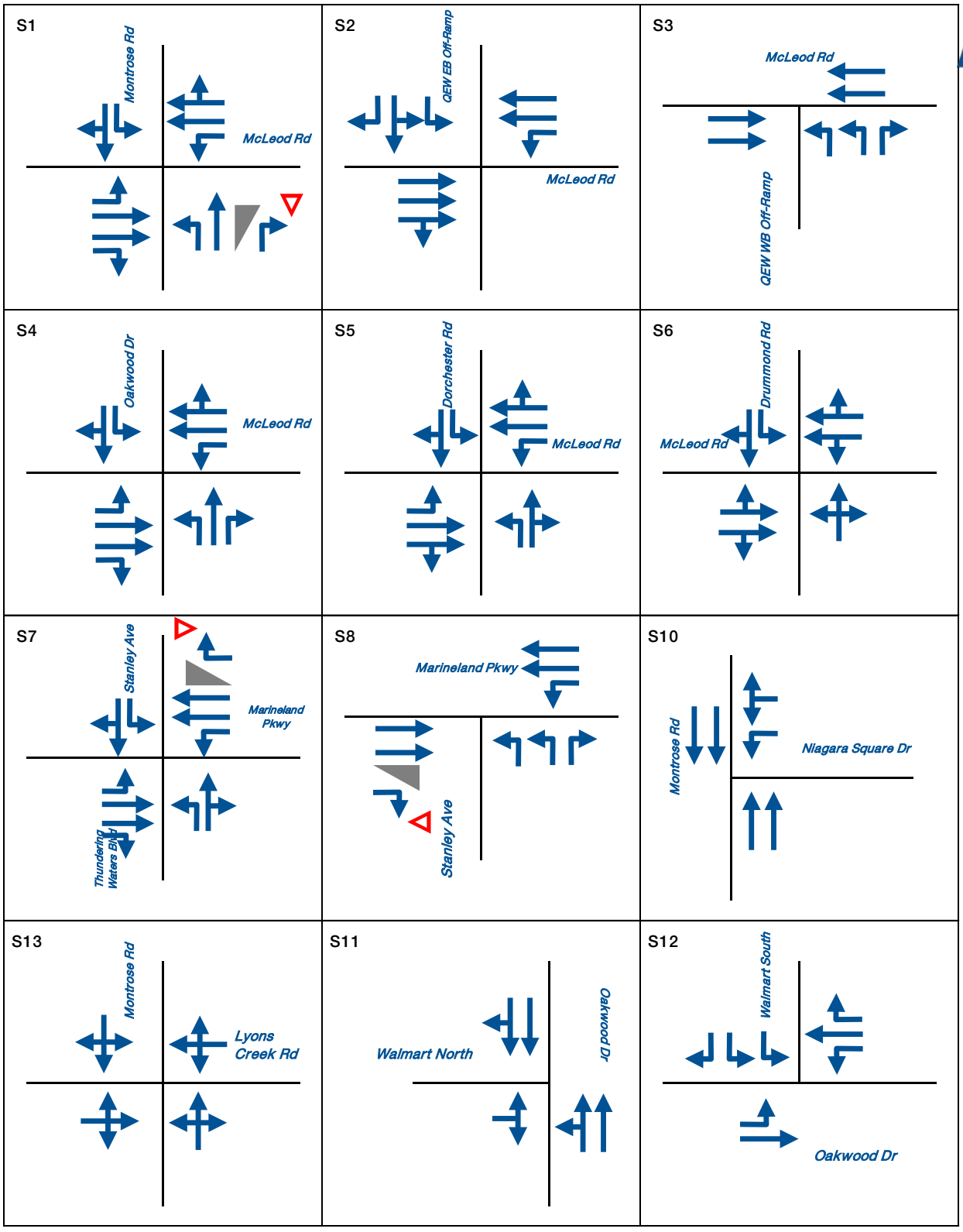
Figure 3.1 shows the lane configurations and traffic control provisions for the signalized and unsignalized intersections within the Study Area.

3.1.2 Transit

Niagara Falls Transit currently operates six (6) routes in the Study Area, specifically on McLeod Road between Montrose Road and Dorchester Road, with the Niagara Square Shopping Centre serving as a primary hub.

Route 101 provides hourly service between 6:30 AM to 6:30 PM from the Main/Ferry transit stop and the Niagara Square transit stop via McLeod Road and Dorchester Road from Monday to Saturday.

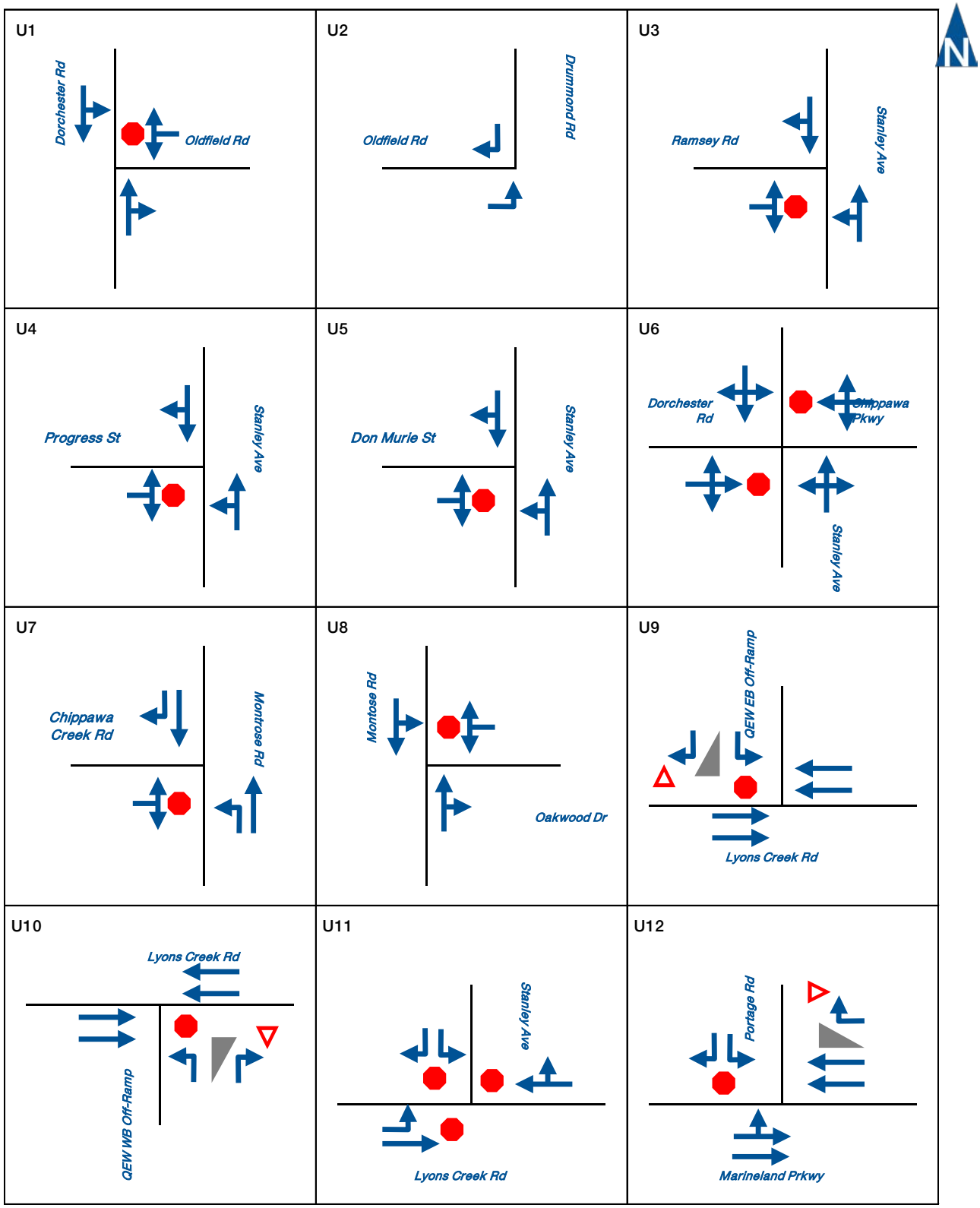
Route 103 provides hourly transit service between 6:30 AM to 6:30 PM from Main / Ferry transit stop and the Niagara Square transit stop via McLeod Road and Drummond Road from Monday to Saturday. Route 103 operates as Route 203 during the evenings on Monday to Saturday as well as on Sundays and holidays.



Traffic Lane
Channelized Right Turn

Existing Lane Configuration (Signalized Intersections)

Figure 3.1A



Existing Lane Configuration (Unsignalized Intersections)

Route 105 provides hourly transit service between 6:15 AM to 6:15 PM from Mt. Carmel Plaza transit stop and the Niagara Square transit stop via McLeod Road and Kerr Road from Monday to Saturday. Route 105 operates as Route 205 during the evenings on Monday to Saturday as well as on Sundays and holidays.

Route 111 provides hourly transit service between 6:00 AM to 6:30 PM from Morrison/Dorchester transit stop and the Niagara Square transit stop via McLeod Road and Drummond Road from Monday to Saturday.

Route 112 provides hourly transit service between 7:15 AM to 5:15 PM from Chippawa transit stop and the Niagara Square transit stop via McLeod Road, Stanley Avenue, and Marineland Parkway from Monday to Saturday.

Route 113 provides hourly transit service between 6:15 AM to 6:15 PM from Mt. Carmel Plaza transit stop and the Niagara Square transit stop via McLeod Road and Montrose Road from Monday to Saturday. Route 113 operates as Route 213 during the evenings on Monday to Saturday as well as on Sundays and holidays.

In addition to Niagara Falls Transit, two (2) other public transit systems serve the general Study Area:

- WEGO, operated jointly by the City and the Niagara Falls Parks Commission, primarily serves the Falls Tourist area. The WEGO Blue route provides service along Stanley Avenue to just north of Marineland Parkway. During the summer months, the route is extended to the Study Area with service along Marineland Parkway.
- Niagara Region Transit Routes 60 (to Welland) and 65 (from Welland) operate along Montrose Road within the Study Area. The routes provide hourly transit service between 7:00 AM and 8:45 PM.

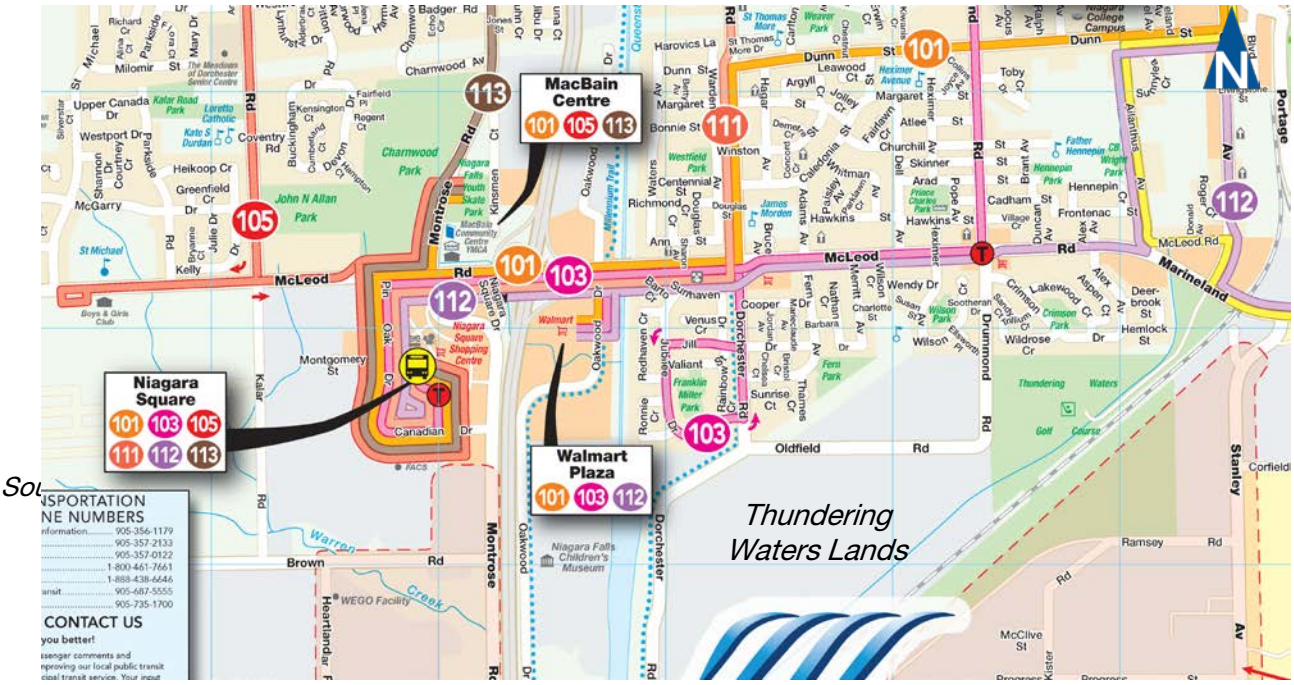
Figure 3.2 illustrates the transit route maps.

3.1.3 Cycling

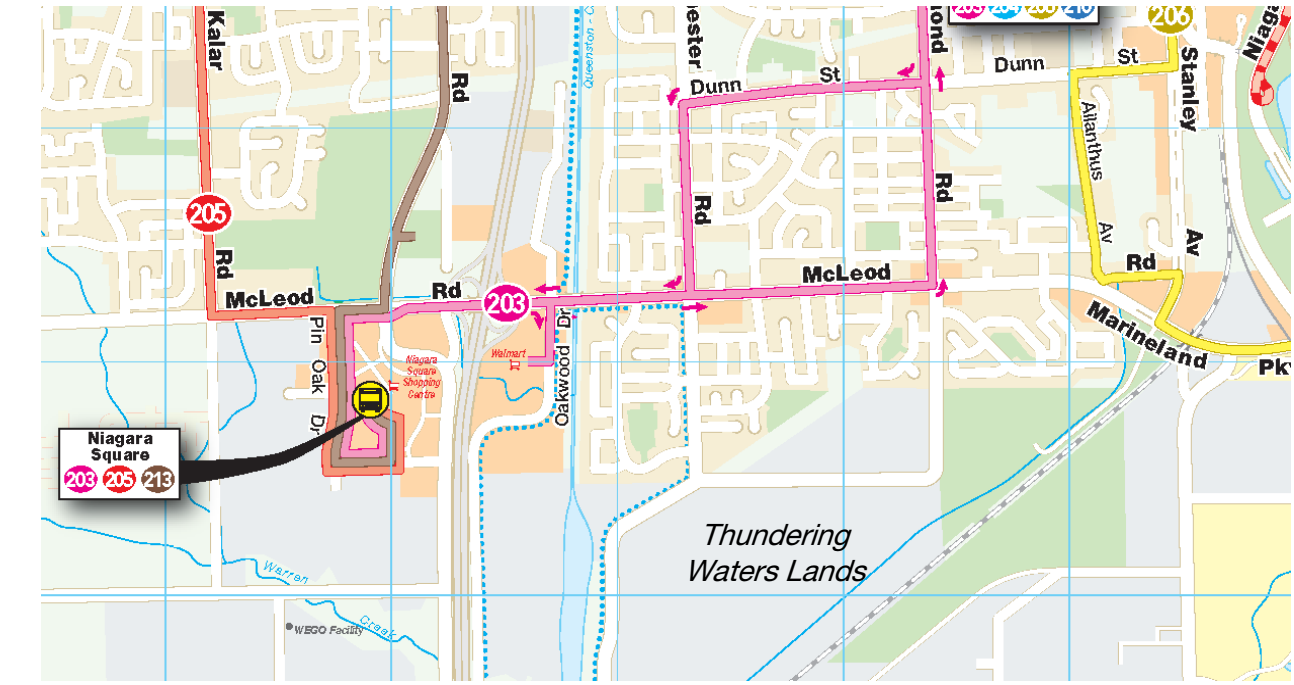
Cycling infrastructure in the Study Area includes bicycle lanes, paved-shoulders, and multi-use trails. Roads with on-street cycle lanes include:

- McLeod Road west from the QEW EB Off-ramp;
- Oakwood Drive between McLeod Road and commercial driveway;
- Drummond Road north of McLeod Road; and
- Stanley Avenue north of McLeod Road.

Monday to Saturday Daytime Service

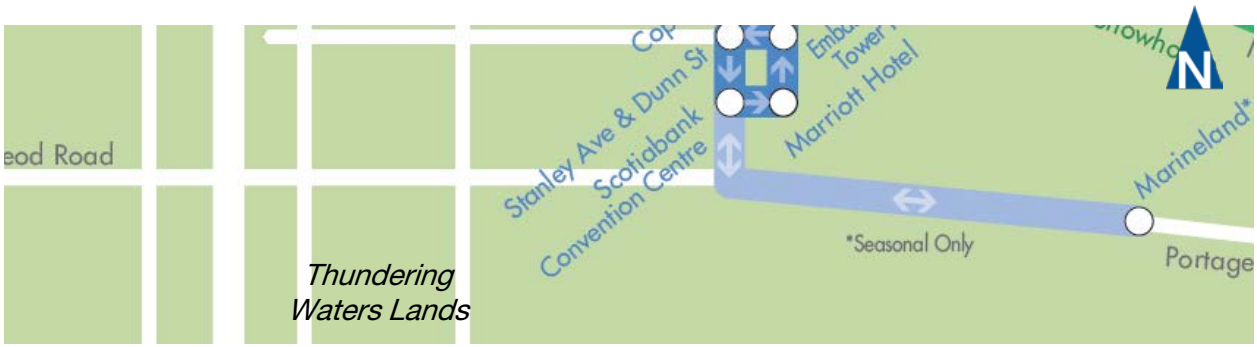


Monday to Saturday Evening, Sunday, and Holiday Service



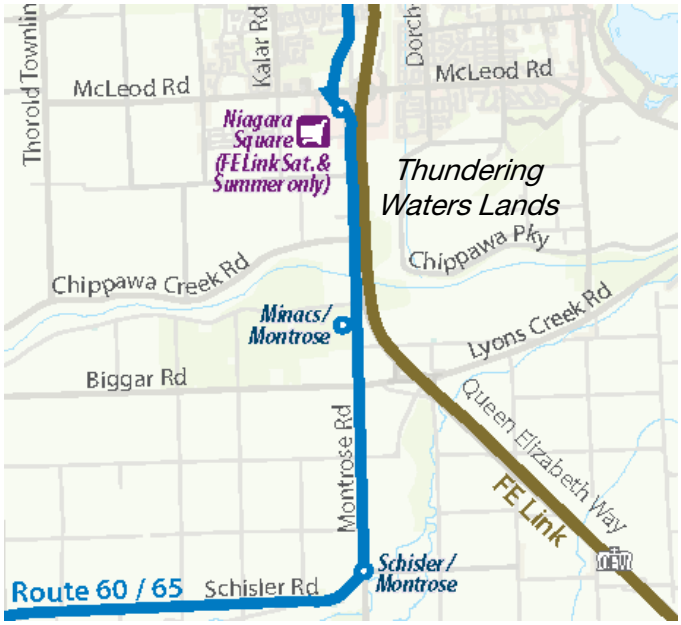
Source: City of Niagara Falls

Existing Transit Service – Niagara Falls Transit



Source: WEGO

Niagara Region Transit Regular Weekday Service



Source: Niagara Region

Roads in the Study Area with paved shoulders include:

- East side of Stanley Avenue between Marineland Parkway and Lyons Creek Road;
- Lyons Creek Road from Montrose Road and Stanley Avenue; and
- Chippawa Creek Road west from Montrose Road.

A paved multi-use path runs from McLeod Road at Oakwood Drive, north to Lundy's Lane.

Figure 3.3 illustrates the existing cycling infrastructure within the Study Area.

3.1.4 Pedestrian

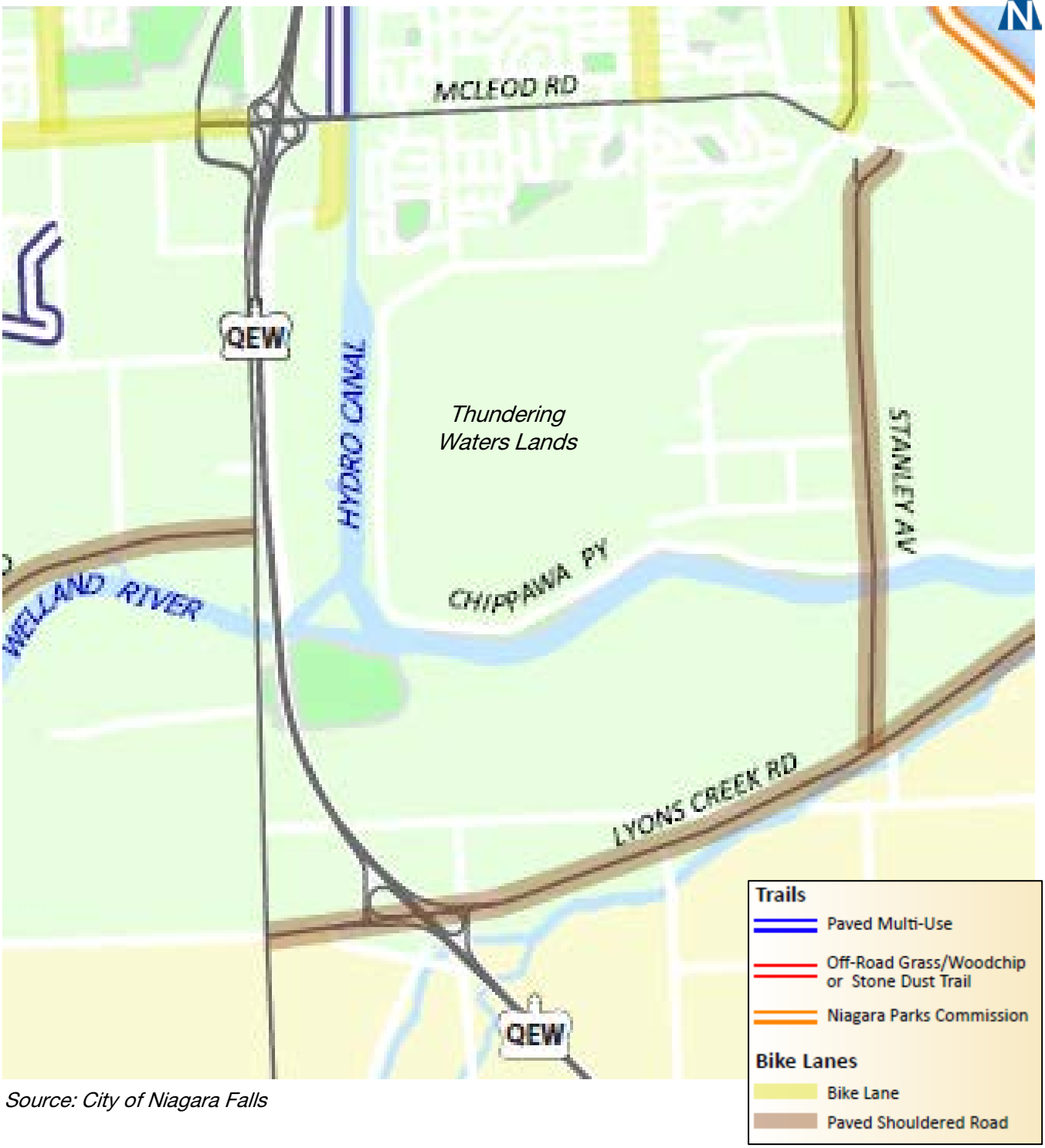
Pedestrian infrastructure consists of sidewalks along roadways as well as the trail system (including the Millennium Trail, which runs along the Hydro Canal between McLeod Road and Lundy's Lane). Within the Study Area, sidewalks can be found on the following roads:

- McLeod Road, on both sides of the road, from Montrose Road to east of Drummond Road, where the sidewalk then continues on the north side of the road to Stanley Avenue;
- Marineland Parkway, on the north side of the road, between the two (2) legs of Stanley Avenue. It continues on the south side of the road east of the Stanley Road intersection;
- Montrose Road, on the west side of the road, between McLeod Road and Niagara Square Drive;
- Oakwood Drive, on the west side of the road, from McLeod Road to the south driveway;
- Dorchester Road, on both sides of the road, south of McLeod Road; and
- Drummond Road, on both sides of the road, south of McLeod Road to just north of Lionshead Avenue.

Sidewalks are generally provided on one (1) side or both side of roads in the built-up urban area of the City of Niagara Falls. There are typically no sidewalks on rural roads in the City.

3.2 Existing Traffic Volumes

Turning movement volumes for the Study Area intersections for the summer weekday morning (AM) and afternoon (PM) peak hours and Saturday (weekend) midday peak hour were either provided by Niagara Region or City of Niagara Falls, or collected by Paradigm during the summer of 2015. **Table 3.1** shows the count date of each intersection.



Source: City of Niagara Falls

Existing Cycle Infrastructure

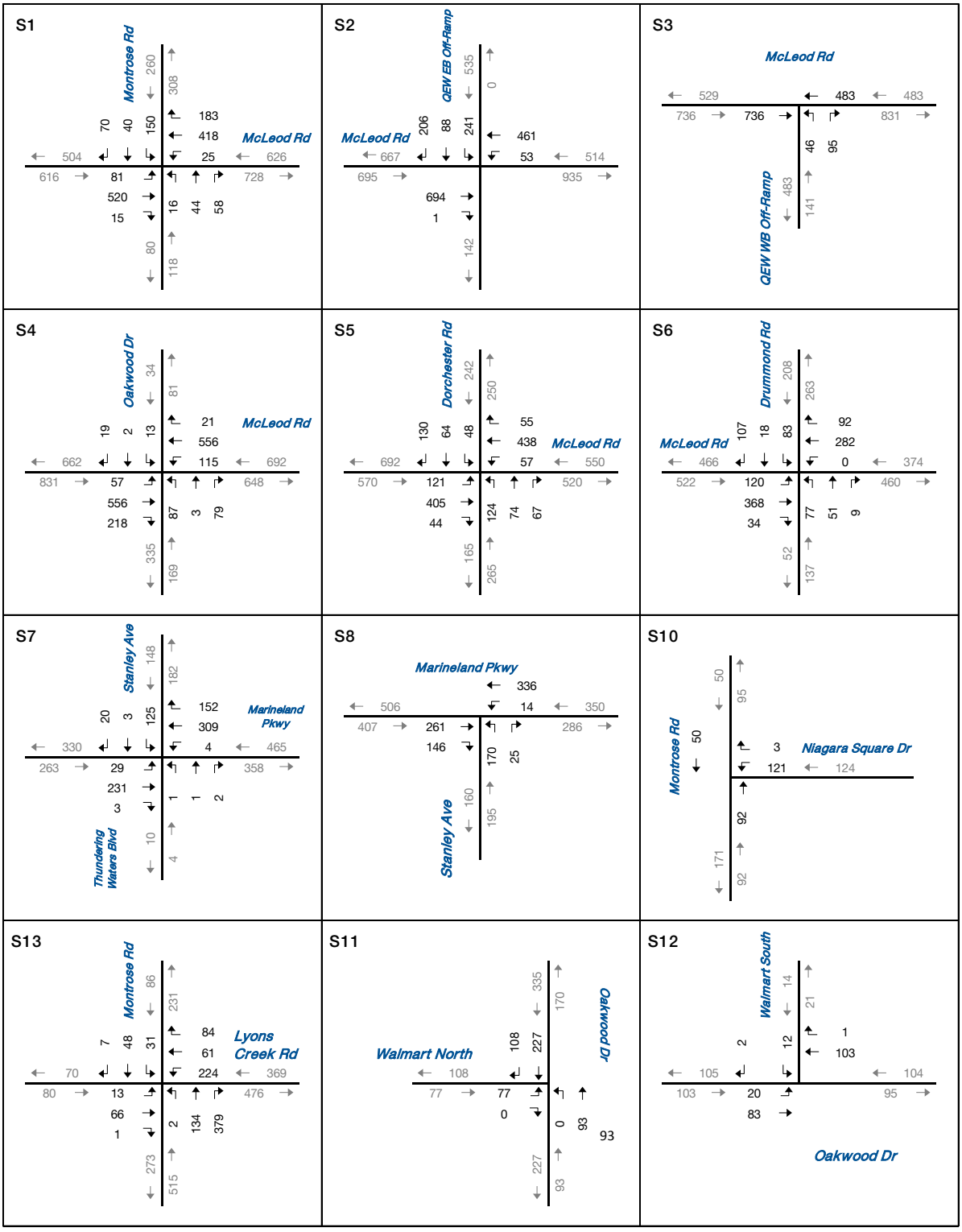
As noted in the table, traffic counts were not available for four (4) intersections within the Study Area. Counts were not collected during the weekday morning peak hour at the intersection of McLeod Road and Oakwood Drive due to a camera malfunction. To address this gap in data, morning volumes were estimated based on the upstream and downstream volumes and the turning percentages from the weekday afternoon and Saturday midday peak hour counts. The same procedure was used to estimate volumes for the Saturday midday peak hour at the intersection of Montrose Road and Niagara Square Drive.

TABLE 3.1: TRAFFIC COUNT DATES

Intersection	Summer Weekday		Summer Weekend
	AM	PM	
McLeod Road & Montrose Road	02-Sep-15	02-Sep-15	05-Sep-15
McLeod Road & QEW Off-Ramp / Niagara Square Drive	02-Sep-15	02-Sep-15	29-Aug-15
McLeod Road & QEW Off-Ramp	02-Sep-15	02-Sep-15	29-Aug-15
McLeod Road & Oakwood Drive	Camera Malfunction	02-Sep-15	05-Sep-15
McLeod Road & Dorchester Road	27-Jul-15	27-Jul-15	05-Sep-15
McLeod Road & Drummond Road	29-Jul-15	29-Jul-15	05-Sep-15
Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	02-Sep-15	02-Sep-15	05-Sep-15
Marineland Parkway & Stanley Avenue	09-Sep-15	09-Sep-15	05-Sep-15
Marineland Parkway & Portage Road	02-Sep-15	02-Sep-15	05-Sep-15
Montrose Road & Niagara Square Drive	03-Sep-15	03-Sep-15	Not Counted
Montrose Road & Chippawa Creek Road	03-Sep-15	03-Sep-15	05-Sep-15
Montrose Road & Oakwood Drive	03-Sep-15	03-Sep-15	05-Sep-15
Montrose Road & Lyons Creek Road / Biggar Road	26-Aug-15	26-Aug-15	05-Sep-15
Lyons Creek Road & QEW Off-Ramp	02-Sep-15	02-Sep-15	29-Aug-15
Lyons Creek Road & QEW Off-Ramp	02-Sep-15	02-Sep-15	29-Aug-15
Lyons Creek Road & Stanley Avenue (North Leg)	03-Sep-15	03-Sep-15	05-Sep-15
Stanley Avenue & Ramsey Road	02-Sep-15	02-Sep-15	05-Sep-15
Stanley Avenue & Progress Street	02-Sep-15	02-Sep-15	05-Sep-15
Stanley Avenue & Don Murie Street	02-Sep-15	02-Sep-15	05-Sep-15
Stanley Avenue & Dorchester Road / Chippawa Parkway	03-Sep-15	03-Sep-15	05-Sep-15
Oakwood Drive & Walmart North Driveway	02-Sep-15	02-Sep-15	05-Sep-15
Oakwood Drive & Walmart South Driveway	02-Sep-15	02-Sep-15	05-Sep-15
Dorchester Road & Oldfield Road			
Drummond Road & Oldfield Road			

The intersections of Dorchester Road at Oldfield Road and Drummond Road at Oldfield Road were not counted because of ongoing construction in the vicinity. Given the nature of the intersections, it was assumed that traffic volumes would be relatively low and that the intersections operate with satisfactory levels of service under existing conditions. These two (2) intersections are expected to experience an increase in traffic with development of the Thundering Waters lands.

Figures 3.4, 3.5 and **3.6** summarize the existing traffic volumes for the summer weekday morning, weekday afternoon, and Saturday midday peak hours, respectively.



Existing Traffic Volumes Weekday AM Peak Hour (Signalized Intersections)

Thundering Waters Transportation Master Plan
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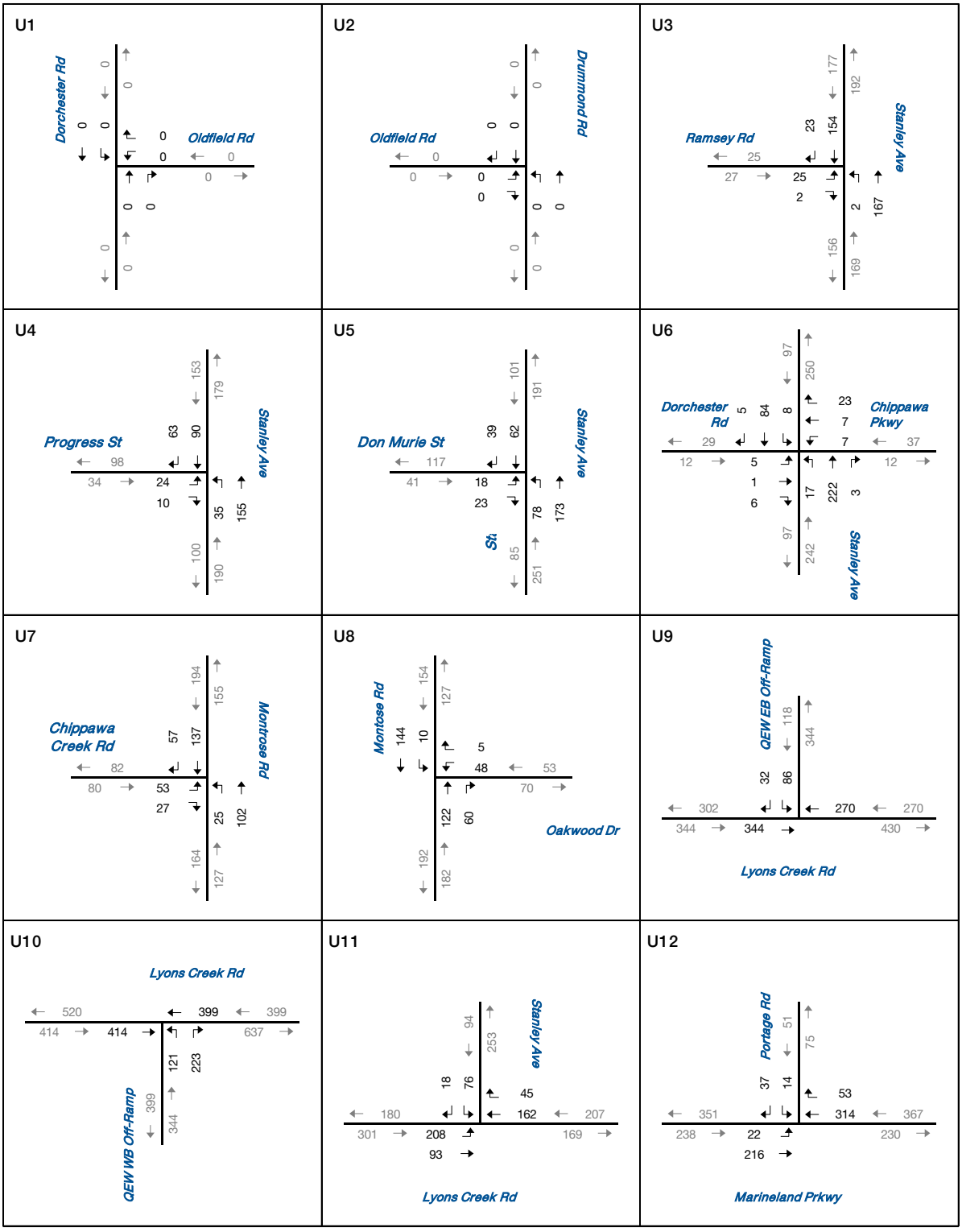
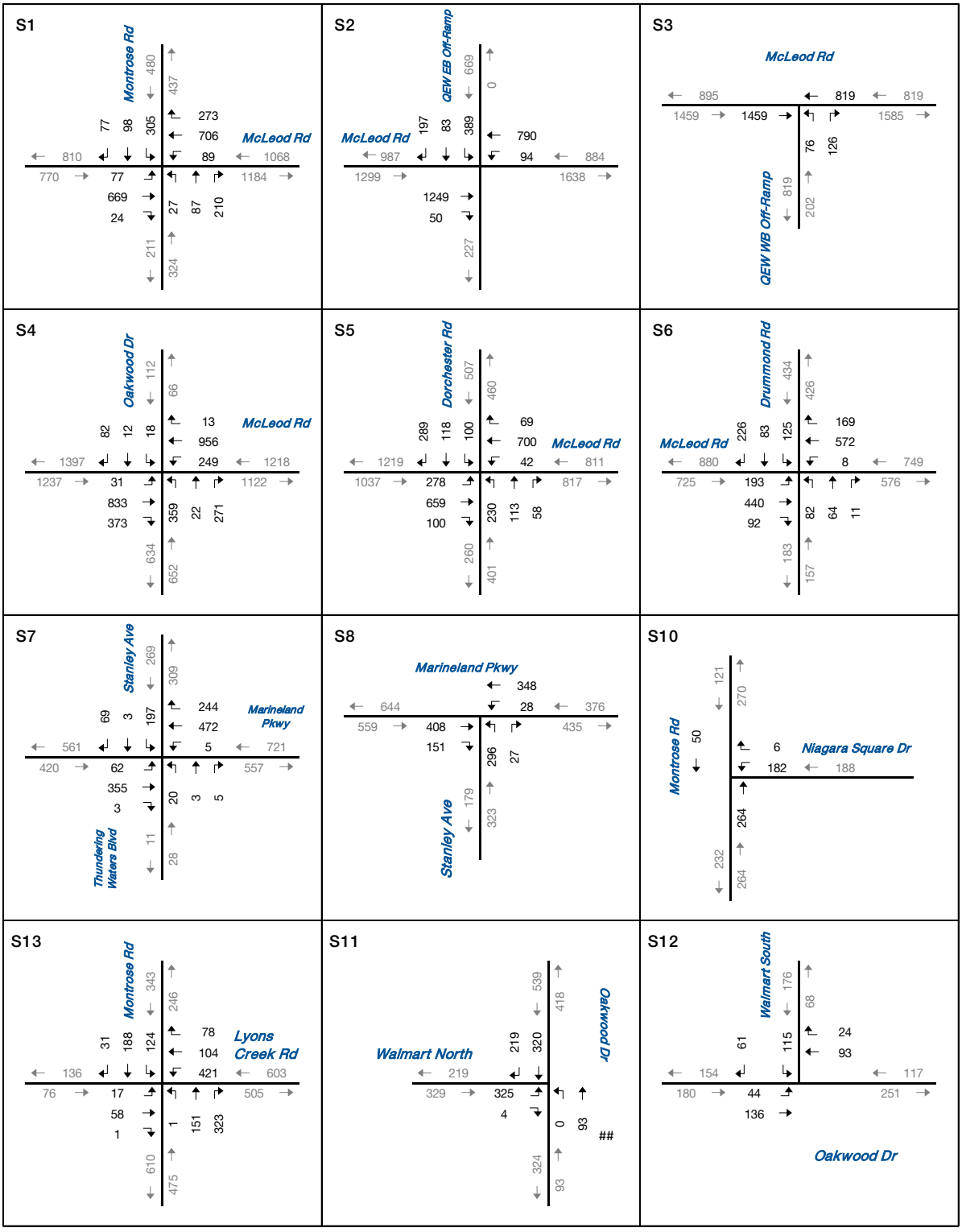
Figure 3.4A



Existing Traffic Volumes Weekday AM Peak Hour (Unsignalized Intersections)

Thundering Waters Transportation Master Plan
151385

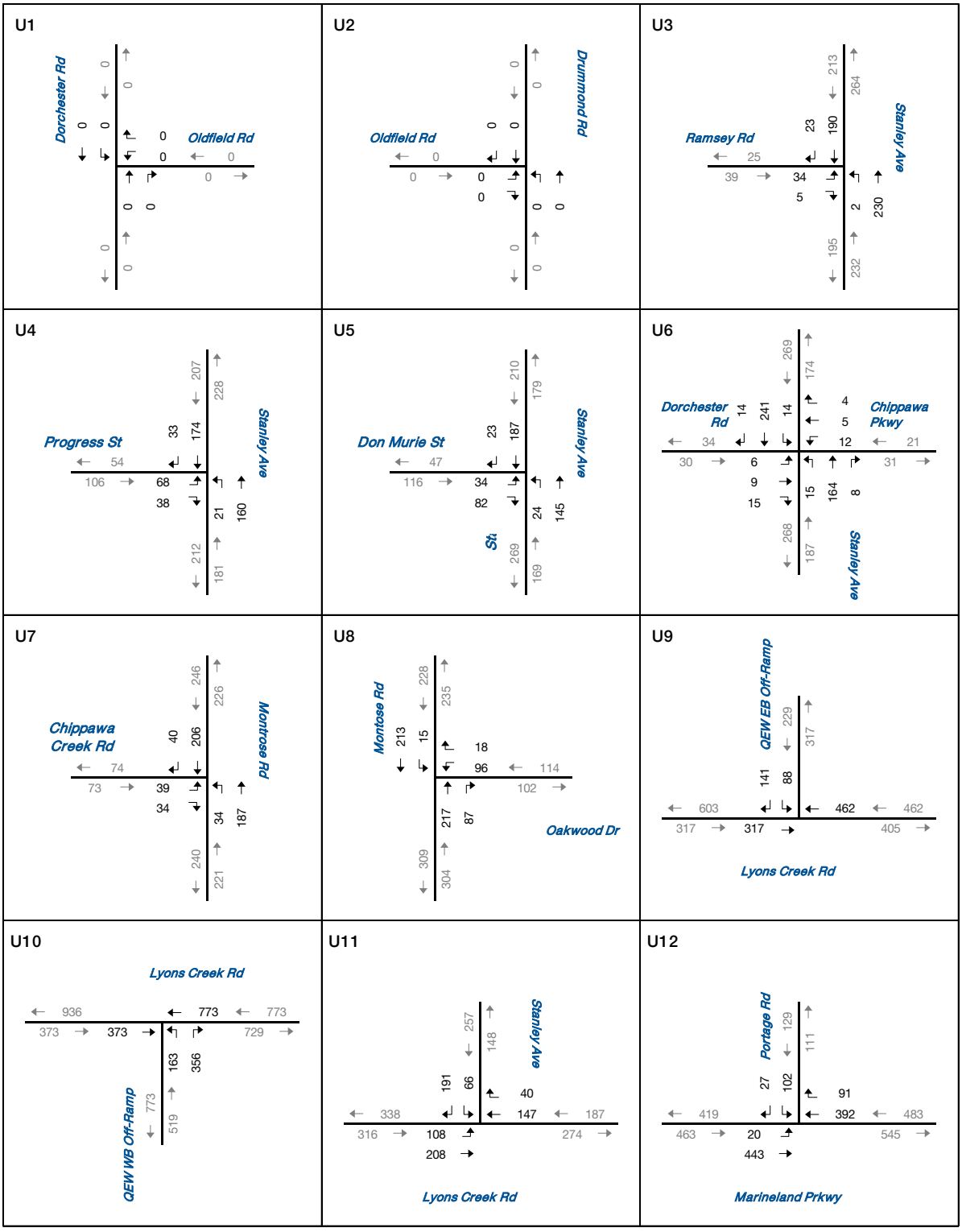
Figure 3.4B



Existing Traffic Volumes Weekday PM Peak Hour (Signalized Intersections)

Thundering Waters Transportation Master Plan
151385

Figure 3.5A



Existing Traffic Volumes Weekday PM Peak Hour (Unsignalized Intersections)

Thundering Waters Transportation Master Plan
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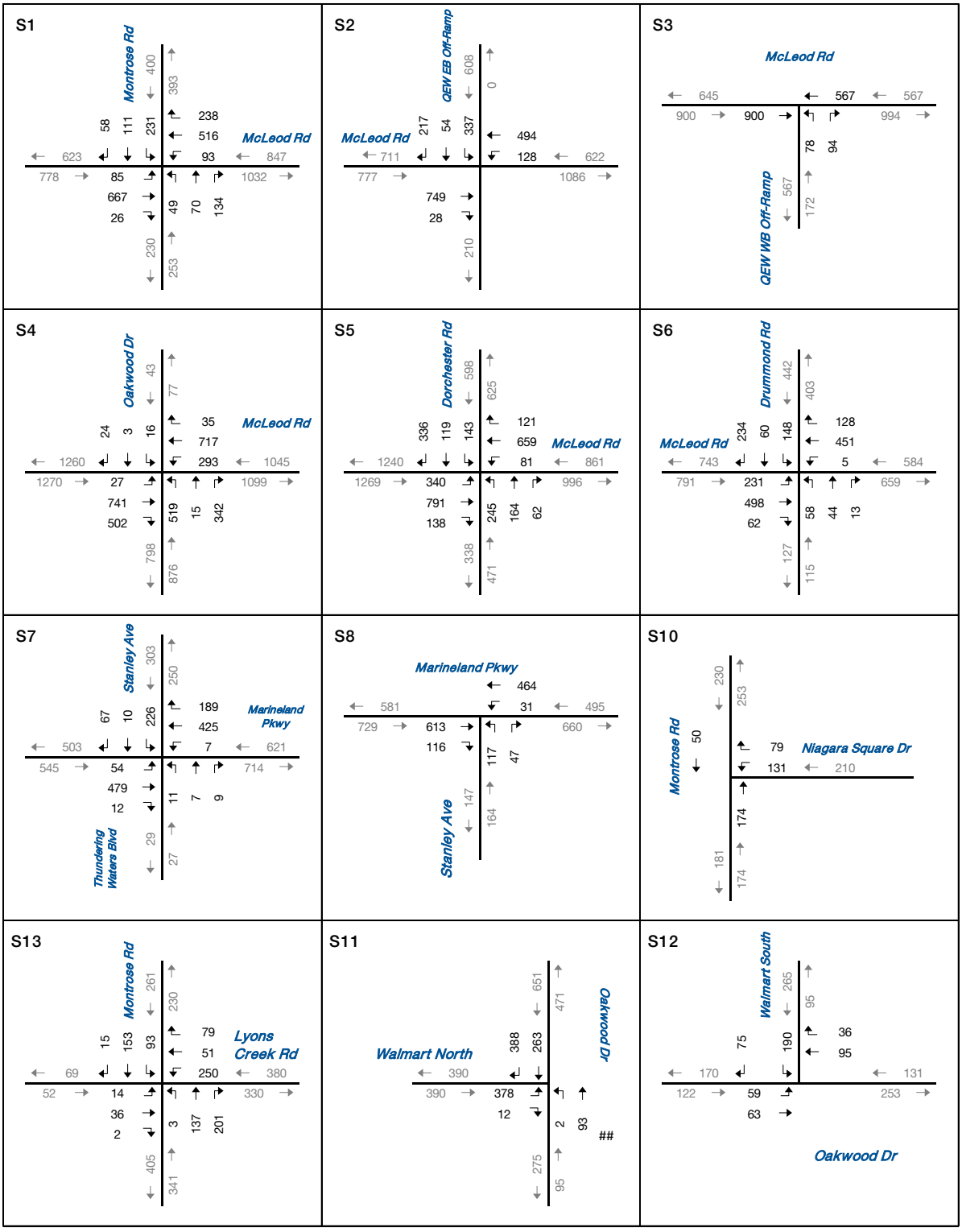
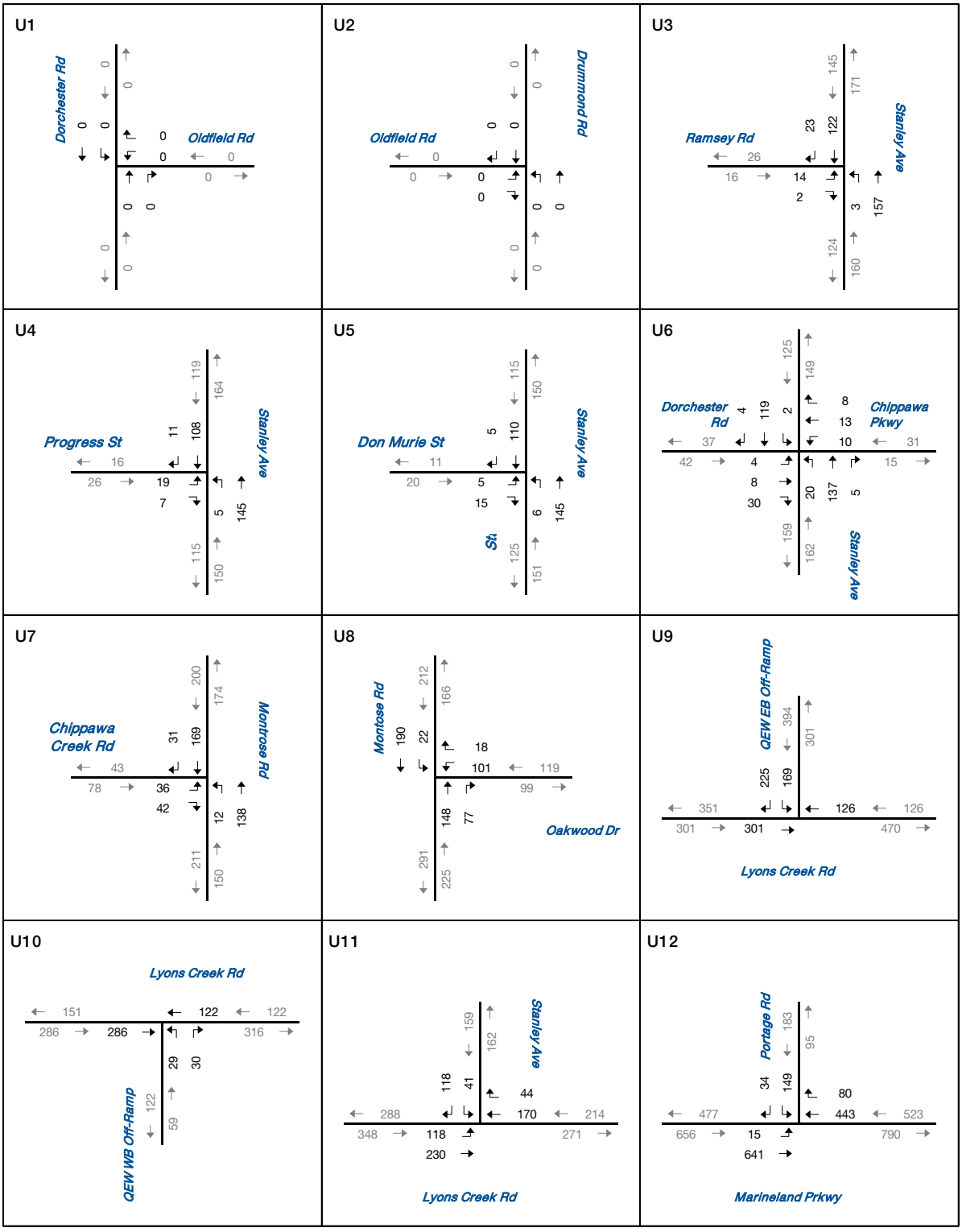
Figure 3.5B



Existing Traffic Volumes Saturday Midday Peak Hour (Signalized Intersections)

Thundering Waters Transportation Master Plan
151385

Figure 3.6A



Existing Traffic Volumes Saturday Midday Peak Hour (Unsignalized Intersections)

Thundering Waters Transportation Master Plan
151385

Figure 3.6B

3.3 Existing Traffic Operations

3.3.1 Methodology

Intersection capacity analyses were completed for key intersections within the Study Area to assess future operating conditions, identify potential traffic impacts to the adjacent transportation system, and confirm future infrastructure required to accommodate planned development. The analyses were undertaken based on Highway Capacity Manual (HCM) methodologies and Synchro 9.0 software.

Signalized Intersections

Capacity analysis for signalized intersections is based on the procedures described in the Highway Capacity Manual (HCM). For signalized intersections, the analysis focuses on performance measures such as intersection level of service (LOS), volume-to-capacity ratios (v/c) and control delay (measured in seconds).

LOS is a qualitative measure of operational performance based on control delay. LOS A is represented by a control delay of less than 10 seconds per vehicles (referred to as free-flow operating conditions), while LOS F is represented by a control delay greater than 80 seconds per vehicles (referred to as restricted flow operating conditions).

In determining the LOS performance for signalized intersections, the average control delay per vehicle is estimated for each lane group and aggregated for each approach, and for the intersection as a whole. **Table 3.2** provides the criteria specified in the City of Niagara Falls and Niagara Region Transportation Impact Study Guidelines for determining acceptable signalized intersection operations. Individual movements experiencing a v/c ratio greater than the values specified in the table are deemed to be "critical" in terms of operation, indicating that the movement may be considered for geometric or other improvement, such as signal optimization.

TABLE 3.2: CRITICAL MOVEMENT CRITERIA

Jurisdiction	Critical Movement Criteria	
	Signalized	Unsignalized
Niagara Region	Through > 0.85 Shared Through / Turning > 0.85 Exclusive Turn > 0.90	LOS on Individual Movements > D 95th Percentile Queue Exceed Storage
City of Niagara Falls	Overall Intersection > 0.85 Through > 0.85 Shared Through / Turning > 0.85 Exclusive Turn > 0.95 95th Percentile Queue Exceed Storage	LOS on Individual Movements > E 95th Percentile Queue Exceed Storage

With the majority of roads and intersections within the Study Area under Regional jurisdiction, the Region's criteria served as the primary basis for

determining criticality. It is noted that both sets of criteria are similar, with the Regional thresholds slightly more stringent than the City values.

Unsignalized Intersections

When analyzing unsignalized intersections, LOS is determined by the computed or measured control delay and is defined for each minor ("critical") movement. In determining the performance of unsignalized intersections, the average control delay per vehicle is estimated for each lane group and aggregated for each approach. Control delay includes the initial deceleration delay, queue move-up time, stopped delay and the final acceleration delay. The LOS criteria for unsignalized intersections are somewhat different from the criteria used for signalized intersections, primarily because different transportation facilities create different driver perceptions. The expectation is that a signalized intersection is designed to carry higher volumes of traffic and experience greater delay than that of an unsignalized intersection.

Table 3.2 also provides the criteria specified in the City and Region guidelines for determining acceptable unsignalized intersection operations. LOS F occurs where there are not enough gaps of suitable size to allow the minor street demand to safely cross, turn into, or through, traffic on the major street. This is evident from long control delays experienced by minor street traffic and by queuing on the minor street approaches. LOS E represents effective capacity of a movement.

It is important to use caution when using the HCM methodology to assess unsignalized intersections. Even under low-volume traffic conditions, the HCM delay equation will often predict greater than 50 seconds of delay (LOS F) for many unsignalized intersections that permit minor street left-turn movements. LOS F is commonly predicted regardless of the volume of minor street left-turning traffic. HCM notes that "even with a LOS F estimate, most low volume minor-street approaches would not meet any of the Manual on Uniform Traffic Control Devices (MUTCD) volume or delay warrants for signalization. As a result, analysts that use the HCM level of service thresholds to determine the design adequacy of two-way stop controlled intersections should do so with caution."

3.3.2 Analysis with Existing Lane Configurations

Intersection capacity analyses were undertaken to assess existing peak hour traffic conditions for the Study Area intersections with existing lane configurations. The parameters used in the analyses include:

- Heavy vehicle percentages as derived from existing traffic counts;
- Existing peak hour factors as derived from existing traffic counts;
- Current signal timings for the signalized intersections, as provided by Niagara Region. Signal timings for the McLeod Road and QEW Off-Ramp intersections were not available, but were assumed based on the surrounding signal timings; and

- Synchro default values for all other inputs.

Tables 3.3, 3.4 and **3.5** summarize the analysis results for the summer weekday morning, weekday afternoon and Saturday midday existing traffic forecasts, respectively (**Figures 3.4, 3.5** and **3.6**). The tables provide LOS, delay, volume to capacity (v/c) ratios and 95% queue length for the Study Area intersections. **Appendix C** provides the Synchro analysis output. The following is noted from the analyses:

- **Weekday Morning Peak Hour** – All intersections operate with satisfactory levels of service and no critical turning movements.
- **Weekday Afternoon Peak Hour** – With the exception of Montrose Road and Lyons Creek Road/Biggar Road (LOS E), all intersections operate with satisfactory levels of service. Critical turning movements were noted at the following intersections:
  - McLeod Road and Oakwood Drive (westbound left and northbound left);
  - McLeod Road and Dorchester Road (westbound through-right and northbound left); and
  - Montrose Road and Lyons Creek Road/Biggar Road (shared westbound left-through-right and shared southbound left-through-right).
- **Saturday Midday Peak Hour** – With the exception of McLeod Road and Dorchester Road (LOS E), all intersections operate with satisfactory levels of service. Critical turning movements were noted at the following intersections:
  - McLeod Road and Oakwood Drive (westbound left and northbound left); and
  - McLeod Road and Dorchester Road (eastbound left, westbound through-right, northbound left and southbound through-right).

TABLE 3.3A: EXISTING TRAFFIC OPERATIONS SUMMARY, WEEKDAY AM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Overall
AM Peak Hour	McLeod Road & Montrose Road	TCS	LOS	B	B	B	**B**	A	A		**A**	B	B	B	**B**	B	B		**B**	**B**
			Delay	13	13	11	**13**	8	7		**7**	12	12	12	**12**	14	12		**13**	**11**
			V/C	0.40	0.52	0.01		0.09	0.37			0.05	0.10	0.05		0.43	0.15			
			Q	19	39	0		5	28			5	10	6		30	14			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		B		**B**	A	A		**A**					B	B	B	**B**	**B**
			Delay		14		**14**	8	6		**7**					15	15	13	**14**	**12**
			V/C		0.50			0.16	0.29							0.39	0.40	0.16		
			Q		35			8	25							32	33	13		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		**A**		A		**A**	A		A	**A**					**A**
			Delay		8		**8**		7		**7**	9		9	**9**					**8**
			V/C		0.54				0.37			0.50		0.07						
			Q		28				17			4		8						
	McLeod Road & Oakwood Drive	TCS	LOS	B	B	B	**B**	A	A		**A**	B	B	B	**B**	B	B		**B**	**A**
			Delay	11	12	10	**12**	7	5		**6**	14	13	13	**14**	13	13		**13**	**9**
			V/C	0.25	0.52	0.18		0.33	0.34			0.29	0.01	0.06		0.04	0.02			
			Q	12	38	12		11	24			19	2	9		5	5			
	McLeod Road & Dorchester Road	TCS	LOS	B	B		**B**	B	C		**B**	B	B		**B**	B	C		**C**	**B**
			Delay	13	17		**16**	14	20		**20**	18	20		**19**	19	22		**21**	**19**
			V/C	0.42	0.48			0.17	0.61			0.44	0.32			0.16	0.41			
			Q	20	43			11	53			27	31			12	35			
	McLeod Road & Drummond Road	TCS	LOS		A		**A**		A		**A**		A		**A**	A	A		**A**	**A**
			Delay		8		**8**		7		**7**		10		**10**	9	9		**9**	**8**
			V/C		0.52				0.28				0.33			0.21	0.12			
			Q		28				16				21			14	10			
	Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	TCS	LOS	B	B	B	**B**	B	C	B	**B**	A	C		**A**	C	B		**B**	**B**
			Delay	14	12	11	**12**	18	20	18	**20**	2	21		**2**	20	18		**20**	**20**
			V/C	0.11	0.20	0.00		0.02	0.47	0.12		0.00	0.00			0.38	0.03			
			Q	7	18	0		3	32	13		1	2			29	6			
	Marineland Parkway & Stanley Avenue	TCS	LOS		A	A	**A**	A	A		**A**	A		A	**A**					**A**
			Delay		6	6	**6**	6	6		**6**	7		7	**7**					**6**
			V/C		0.23	0.12		0.04	0.29			0.20		0.02						
			Q		9	5		2	11			7		2						
	Montrose Road & Niagara Square Drive	TCS	LOS					A			**A**		A		**A**		A		**A**	**A**
			Delay					6			**6**		6		**6**		6		**6**	**6**
			V/C					0.12					0.09				0.05			
			Q					4					3				2			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**		B		**B**		C		**C**		B		**B**	**B**
			Delay		9		**9**		18		**18**		22		**22**		13		**13**	**19**
			V/C		0.12				0.68				0.73				0.20			
			Q		13				65				113				21			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	A			**A**						A		**A**		A		**A**	**A**
			Delay	8			**8**						6		**6**		6		**6**	**6**
			V/C	0.16									0.08				0.24			
			Q	8									4				8			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	B	B		**B**		C	B	**C**					B		B	**B**	**B**
			Delay	14	12		**12**		20	19	**20**					19		19	**19**	**16**
			V/C	0.06	0.13				0.29	0.00						0.03		0.00		
			Q	5	15				24	0						3		0		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 3.3B: EXISTING TRAFFIC OPERATIONS SUMMARY, WEEKDAY AM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q		A 2 0.09 1		**A** **1**		A 0 0.10 0	A 0 0.03 0	**A** **0**					B 13 0.03 1		A 10 0.05 1	**B** **11**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	B 11 0.05 1			**B** **11**						A 0 0.00 0		**A** **0**		A 0 0.11 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 11 0.06 2			**B** **12**						A 2 0.03 1		**A** **2**		A 0 0.10 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 11 0.07 2			**B** **11**						A 3 0.06 2		**A** **3**		A 0 0.06 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		B 11 0.02 1		**B** **11**		B 11 0.06 2		**B** **11**		A 1 0.01 0		**A** **1**		A 1 0.01 0		**A** **1**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	B 11 0.65	A 8 0.08		**A** **10**		B 10 0.31		**B** **10**					A 10 0.15		A 8 0.03	**A** **9**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.08 0		**A** **0**		A 0 0.13 0		**A** **0**	B 13 0.28 9		A 0 0.00 0	**B** **13**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.05 0		**A**		A 0 0.09 0		**A**					B 11 0.16 4		A 0 0.00 0	**B** **11**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					B 11 0.09 2			**B** **11**		A 0 0.12 0		**A** **0**		A 1 0.01 0		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 11 0.13 3			**B** **11**					A 8 0.02 1	A 0 0.07 0		**A** **2**		A 0 0.09 0	A 0 0.04 0	**A** **0**	

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 3.4A: EXISTING TRAFFIC OPERATIONS SUMMARY, WEEKDAY PM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Overall
PM Peak Hour	McLeod Road & Montrose Road	TCS	LOS	C	B	B	**B**	B	B		**B**	B	B	B	**B**	C	B		**C**	**B**
			Delay	21	19	14	**19**	12	13		**13**	14	15	15	**15**	25	15		**22**	**17**
			V/C	0.55	0.63	0.02		0.36	0.64			0.07	0.16	0.16		0.74	0.27			
			Q	28	71	0		16	81			9	22	14		93	34			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		B		**B**	B	A		**A**					C	C	B	**C**	**B**
			Delay		18		**18**	11	8		**8**					22	23	19	**21**	**16**
			V/C		0.72			0.37	0.45							0.57	0.59	0.29		
			Q		92			16	59							56	58	26		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		B		**B**		A		**A**	B		B	**B**					**B**
			Delay		12		**12**		6		**6**	15		16	**16**					**10**
			V/C		0.83				0.46			0.10		0.35						
			Q		122				39			7		22						
	McLeod Road & Oakwood Drive	TCS	LOS	B	C	B	**C**	F	B		**C**	D	B	B	**D**	B	B		**B**	**C**
			Delay	17	23	19	**22**	80	13		**27**	50	16	18	**36**	16	17		**17**	**26**
			V/C	0.20	0.74	0.45		1.03	0.61			0.93	0.04	0.21		0.04	0.09			
			Q	10	85	42		73	73			116	8	16		7	12			
	McLeod Road & Dorchester Road	TCS	LOS	D	C		**C**	C	D		**D**	F	C		**F**	C	D		**D**	**D**
			Delay	38	24		**27**	24	46		**45**	162	26		**104**	24	41		**38**	**46**
			V/C	0.83	0.64			0.21	0.92			1.22	0.35			0.30	0.81			
			Q	83	98			11	142			97	45			25	103			
	McLeod Road & Drummond Road	TCS	LOS		A		**A**		B		**B**		C		**C**	B	B		**B**	**B**
			Delay		9		**9**		15		**15**		33		**33**	19	19		**19**	**15**
			V/C		0.64				0.63				0.75			0.43	0.46			
			Q		45				66				47			30	39			
	Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	TCS	LOS	B	B	B	**B**	B	C	C	**C**	C	C		**C**	C	B		**C**	**C**
			Delay	15	14	12	**14**	19	24	20	**22**	27	26		**26**	24	20		**23**	**20**
			V/C	0.25	0.29	0.00		0.02	0.58	0.19		0.09	0.02			0.52	0.06			
			Q	15	33	0		3	58	18		11	5			55	11			
	Marineland Parkway & Stanley Avenue	TCS	LOS		A	A	**A**	A	A		**A**	A		A	**A**					**A**
			Delay		7	6	**7**	6	7		**7**	8		7	**8**					**7**
			V/C		0.34	0.13		0.10	0.29			0.31		0.02						
			Q		16	7		4	14			14		3						
	Montrose Road & Niagara Square Drive	TCS	LOS					A			**A**		A		**A**		A		**A**	**A**
			Delay					6			**6**		6		**6**		6		**6**	**6**
			V/C					0.19					0.25				0.11			
			Q					6					8				4			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		B		**B**		E		**E**		C		**C**		F		**F**	**E**
			Delay		11		**11**		69		**69**		28		**28**		101		**101**	**60**
			V/C		0.11				1.05				0.73				1.09			
			Q		14				185				99				124			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	A			**A**						A		**A**		A		**A**	**A**
			Delay	9			**9**						8		**8**		8		**8**	**8**
			V/C	0.54									0.20				0.38			
			Q	39									14				21			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**A**
			Delay	8	6		**6**		12	12	**12**					12		12	**12**	**10**
			V/C	0.10	0.16				0.21	0.02						0.14		0.05		
			Q	5	12				15	0						9		0		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control
RBT - Roundabout

TABLE 3.4B: EXISTING TRAFFIC OPERATIONS SUMMARY, WEEKDAY PM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q		A 1 0.19 1		**A** **0**		A 0 0.13 0	A 0 0.06 0	**A** **0**					C 20 0.31 10		A 10 0.04 1	**C** **18**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	B 12 0.07 2			**B** **12**						A 0 0.00 0		**A** **0**		A 0 0.13 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 11 0.18 5			**B** **11**						A 1 0.02 1		**A** **1**		A 0 0.13 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 11 0.16 5			**B** **11**						A 1 0.02 1		**A** **1**		A 0 0.13 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		B 11 0.06 2		**B** **12**		B 13 0.05 1		**B** **13**		A 1 0.01 0		**A** **1**		A 1 0.01 0		**A** **1**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	A 9 0.20	B 11 0.36		**B** **10**		B 11 0.31		**B** **11**					A 9 0.13		A 10 0.31	**A** **9**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.12 0		**A** **0**		A 0 0.25 0		**A** **0**	C 19 0.58 31		A 0 0.00 0	**C** **19**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.10 0		**A**		A 0 0.15 0		**A**					B 15 0.20 6		A 0 0.00 0	**B** **15**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					B 14 0.24 7			**B** **14**		A 0 0.19 0		**A** **0**		A 1 0.01 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 12 0.13 4			**B** **12**					A 8 0.03 1	A 0 0.12 0		**A** **1**		A 0 0.13 0	A 0 0.03 0	**A** **0**	

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TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 3.5A: EXISTING TRAFFIC OPERATIONS SUMMARY, SATURDAY MIDDAY PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Overall
Saturday Peak Hour	McLeod Road & Montrose Road	TCS	LOS	B	B	B	**B**	B	A		**A**	B	B	B	**B**	B	B		**B**	**B**
			Delay	16	17	13	**17**	10	9		**9**	14	14	14	**14**	19	15		**18**	**14**
			V/C	0.46	0.61	0.02		0.33	0.47			0.15	0.13	0.11		0.61	0.31			
			Q	27	70	0		16	523			14	18	12		59	34			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		B		**B**	A	A		**A**					B	B	B	**B**	**B**
			Delay		15		**15**	9	7		**7**					16	16	14	**15**	**13**
			V/C		0.53			0.38	0.30							0.45	0.46	0.16		
			Q		43			17	29							41	41	14		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		**A**		A		**A**	B		B	**B**					**A**
			Delay		8		**8**		7		**7**	10		10	**10**					**8**
			V/C		0.60				0.38			0.09		0.09						
			Q		35				20			7		10						
	McLeod Road & Oakwood Drive	TCS	LOS	B	C	C	**C**	F	B		**D**	F	B	B	**F**	B	B		**B**	**D**
			Delay	16	22	20	**21**	121	12		**42**	142	15	18	**91**	16	16		**16**	**47**
			V/C	0.13	0.67	0.56		1.16	0.47			1.12	0.02	0.31		0.04	0.02			
			Q	9	72	52		88	52			178	6	25		6	6			
	McLeod Road & Dorchester Road	TCS	LOS	E	C		**D**	C	E		**E**	F	C		**F**	C	D		**D**	**E**
			Delay	61	30		**38**	28	67		**63**	217	29		**127**	26	51		**45**	**59**
			V/C	0.95	0.79			0.48	1.00			1.35	0.47			0.48	0.88			
			Q	121	143			19	143			107	62			35	133			
	McLeod Road & Drummond Road	TCS	LOS		B		**B**		B		**B**		C		**C**	C	C		**C**	**B**
			Delay		11		**11**		11		**11**		26		**26**	24	21		**22**	**14**
			V/C		0.73				0.42				0.58			0.55	0.35			
			Q		85				45				29			35	26			
	Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	TCS	LOS	B	B	B	**B**	B	C	C	**C**	C	C		**C**	C	B		**C**	**B**
			Delay	16	15	13	**15**	20	24	21	**23**	26	26		**26**	24	19		**22**	**20**
			V/C	0.22	0.39	0.01		0.04	0.55	0.15		0.05	0.04			0.56	0.08			
			Q	14	46	0		5	52	16		7	8			58	11			
	Marineland Parkway & Stanley Avenue	TCS	LOS		A	A	**A**	A	A		**A**	A		A	**A**					**A**
			Delay		7	5	**6**	5	6		**6**	8		8	**8**					**6**
			V/C		0.46	0.09		0.11	0.35			0.13		0.03						
			Q		20	5		4	15			7		5						
	Montrose Road & Niagara Square Drive	TCS	LOS					A			**A**		A		**A**		A		**A**	**A**
			Delay					6			**6**		6		**6**		6		**6**	**6**
			V/C					0.16					0.16				0.21			
			Q					5					6				7			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**		B		**B**		A		**A**		A		**A**	**A**
			Delay		10		**10**		10		**10**		8		**8**		9		**9**	**9**
			V/C		0.10				0.21				0.42				0.44			
			Q		10				18				29				30			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	A			**A**						A		**A**		A		**A**	**A**
			Delay	10			**10**						9		**9**		9		**9**	**9**
			V/C	0.60									0.25				0.40			
			Q	48									17				21			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**B**
			Delay	8	5		**7**		12	12	**12**					12		12	**12**	**11**
			V/C	0.13	0.07				0.21	0.03						0.23		0.06		
			Q	6	7				16	0						13		0		

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AWSC - All-Way Stop Control
RBT - Roundabout

TABLE 3.5B: EXISTING TRAFFIC OPERATIONS SUMMARY, SATURDAY MIDDAY PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
Saturday Peak Hour	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q		A 1 0.27 0		**A** **0**		A 0 0.14 0	A 0 0.05 0	**A** **0**					D 32 0.56 25		A 10 0.05 1	**D** **28**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	B 11 0.03 1			**B** **11**						A 0 0.10 0		**A** **0**		A 0 0.09 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	A 10 0.04 1			**A** **10**						A 0 0.00 0		**A** **0**		A 0 0.08 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	A 9 0.02 1			**A** **9**						A 0 0.01 0		**A** **0**		A 0 0.07 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		A 10 0.06 2		**A** **10**		B 11 0.05 1		**B** **11**		A 1 0.02 0		**A** **1**		A 0 0.00 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	A 9 0.21	B 10 0.37		**A** **10**		B 11 0.33		**B** **11**					A 9 0.08		A 8 0.19	**A** **9**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.09 0		**A** **0**		A 0 0.04 0		**A** **0**	B 10 0.05 1		A 0 0.00 0	**B** **10**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.10 0		**A**		A 0 0.04 0		**A**					B 11 0.31 11		A 0 0.00 0	**B** **11**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					B 13 0.22 7			**B** **13**		A 0 0.14 0		**A** **0**		A 1 0.02 0		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 11 0.12 3			**B** **11**					A 8 0.01 0	A 0 0.09 0		**A** **1**		A 0 0.12 0	A 0 0.02 0	**A** **0**	

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3.3.3 Analysis with Modified Lane Configurations

As noted above, the operational analyses of existing traffic conditions identified critical turning movements at three (3) intersections within the Study Area currently. The City of Niagara Falls and Niagara Region could consider the following improvements to address these concerns:

- McLeod Road and Oakwood Drive – A second northbound left turn movement with optimized signal cycle and phase timings would improve operations during the weekday afternoon and Saturday midday peak hours.
- McLeod Road and Dorchester Road – An exclusive southbound right turn lane with optimized signal phase timings would improve the operations during the weekday afternoon and Saturday midday peak hours.
- Montrose Road and Lyons Creek Road/Biggar Road – Exclusive westbound and southbound left turn lanes would improve the operations during the weekday afternoon peak hour.

Table 3.6 summarizes the capacity analyses completed for the intersections with the improvements, based on the summer weekday morning, weekday afternoon and Saturday midday existing traffic forecasts, respectively (**Figures 3.4, 3.5** and **3.6**). **Appendix D** provides the Synchro analysis output. The table illustrates that the intersections would operate with satisfactory levels of service if these road improvements were implemented.

TABLE 3.6: EXISTING TRAFFIC OPERATIONS SUMMARY WITH IMPROVEMENTS, ALL PEAK HOURS (SIGNALIZED INTERSECTIONS ONLY)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	McLeod Road & Oakwood Drive	TCS	LOS	B	B	B	**B**	B	A		**A**	C	B	B	**B**	B	B		**B**	**B**
			Delay	15	17	14	**16**	11	9		**9**	22	12	12	**17**	19	19		**19**	**13**
			V/C	0.27	0.58	0.22		0.40	0.39			0.23	0.00	0.06		0.06	0.02			
			Q	13	42	16		14	29			12	2	8		6	6			
	McLeod Road & Dorchester Road	TCS	LOS	B	B		**B**	B	B		**B**	B	B		**B**	B	C	C	**C**	**B**
			Delay	13	16		**16**	14	20		**19**	18	20		**19**	19	21	22	**21**	**18**
			V/C	0.41	0.47			0.17	0.61			0.37	0.34			0.17	0.21	0.10		
			Q	19	41			10	50			27	31			12	20	15		
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**	B	A		**B**		B	B	**B**	B	A		**A**	**B**
			Delay		8		**8**	14	8		**11**		10	12	**12**	11	9		**10**	**11**
			V/C		0.12			0.55	0.16				0.23	0.29		0.10	0.10			
			Q		13			40	13				24	17		8	11			
PM Peak Hour	McLeod Road & Oakwood Drive	TCS	LOS	C	C	C	**C**	D	B		**B**	D	B	C	**C**	C	D		**C**	**C**
			Delay	21	31	26	**29**	37	14		**19**	41	19	20	**32**	34	35		**35**	**26**
			V/C	0.22	0.80	0.60		0.83	0.59			0.73	0.04	0.21		0.10	0.29			
			Q	13	114	78		77	94			56	8	16		10	25			
	McLeod Road & Dorchester Road	TCS	LOS	C	B		**B**	B	C		**C**	D	C		**D**	C	C	C	**C**	**C**
			Delay	27	17		**19**	18	28		**28**	46	30		**39**	27	30	29	**29**	**26**
			V/C	0.78	0.56			0.17	0.78			0.84	0.51			0.41	0.39	0.21		
			Q	71	79			9	111			61	47			26	36	22		
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**	B	A		**B**		B	B	**B**	B	B		**B**	**B**
			Delay		7		**7**	16	8		**14**		16	17	**17**	18	17		**18**	**15**
			V/C		0.10			0.72	0.20				0.30	0.25		0.41	0.42			
			Q		13			91	20				33	18		31	45			
Saturday Peak Hour	McLeod Road & Oakwood Drive	TCS	LOS	C	C	D	**D**	D	B		**C**	D	B	C	**C**	D	D		**D**	**C**
			Delay	24	33	44	**37**	49	14		**24**	44	19	21	**35**	39	38		**38**	**32**
			V/C	0.15	0.76	0.84		0.89	0.47			0.82	0.02	0.26		0.11	0.04			
			Q	12	100	131		94	67			82	6	18		10	9			
	McLeod Road & Dorchester Road	TCS	LOS	C	B		**C**	C	D		**C**	D	D		**D**	D	C	C	**D**	**C**
			Delay	26	19		**24**	22	36		**34**	54	36		**45**	46	34	33	**36**	**32**
			V/C	0.84	0.65			0.38	0.84			0.88	0.64			0.75	0.40	0.25		
			Q	12	112			16	124			69	65			38	39	24		
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**	A	A		**A**		A	A	**A**	A	A		**A**	**A**
			Delay		8		**8**	9	8		**8**		7	8	**8**	9	7		**8**	**8**
			V/C		0.09			0.07	0.15				0.22	0.15		0.26	0.25			
			Q		8			5	11				14	9		12	16			

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4 Identification of Problems and Opportunities

4.1 Problem Identification

The Thundering Waters Secondary Plan area is an unique parcel of land strategically located in the City of Niagara Falls. It represents an opportunity to create a dynamic new community that supports densities that meet the Growth Plan for the Greater Golden Horseshoe requirements and takes advantage of its setting to provide an array of housing forms that will meet the needs of a variety of ages and households.

At build-out the Thundering Waters lands are designed to accommodate approximately 8,250 people, 3,300 dwelling units and 2,000 jobs. The lands will be developed as a complete community with a mix of housing, employment, commercial services and community facilities, as well as an integrated open space system that meets the needs of the residents. The area is also intended to provide services that attract people from outside of the community and tourists. This multi-cultural community will be connected with the rest of the City and help to sustain a fiscally vibrant economy for the City and the Region.

Development of the Thundering Waters lands will require a robust, multi-modal transportation system to serve proposed development and provide efficient access and mobility for residents, businesses and visitors. Some of the current challenges to implementing this type of system include:

- The Thundering Waters lands are not well served from a transportation perspective. Roadway access consists principally of unimproved, two-lane Dorchester Road/Chippawa Parkway located along the west and south boundary of the area. In its current configuration, this roadway provides limited capacity to accommodate future traffic volumes and the existing rural cross-section is not considered appropriate for an urbanized environment. Drummond Road/Oldfield Road and Ramsey Road also provide access to the Secondary Plan area, but design and abutting land uses limit their capacity to service the Thundering Waters lands. Transit and active transportation infrastructure and service to the area are also limited (non-existent).
- Water courses to the west and south of the Thundering Waters lands complicate connections to the broader transportation network, in particular the QEW. The number, location and utility of crossings are limited by cost, feasibility and potential environmental impact. Similarly, the existing residential and industrial development to the north and east of the Thundering Waters lands, respectively, also limit potential connections.

- The existing transportation network has constraints that impact its ability to serve the proposed development area. McLeod Road, the most prominent east-west arterial in proximity to the Thundering Waters lands, is already heavily travelled due to its strategic location within the City and because the road crosses and connects with the QEW. Expansion opportunities are restricted because of its relatively narrow road allowance. Stanley Avenue, a significant north-south arterial, is also discontinuous at McLeod Road/Marineland Parkway.
- The use of transit, active transportation and other non-auto modes is not common in Niagara Falls, with only about 5-6% of all trips made by modes of travel other than the automobile.

The guiding principles and objectives for the future development of the Thundering Waters lands articulate a clear desire to support a more sustainable form of development, as evidenced by the following statements related to transportation captured in the proposed Secondary Plan:

- *Principle 1 – Create a Healthy, Complete Community*
  - *To create an interconnected street system that is transit-supportive, comfortable and engaging for pedestrians and efficiently transports people and goods;*
  - *To create an interwoven system of parks, greenways, trails and open space linkages throughout the community that encourages active transportation and a healthy lifestyle and facilitates connections to nearby recreational opportunities;*
- *Principle 2 – Create a Sustainable, Resilient, Green Community*
  - *To promote travel by more sustainable and less environmentally harmful modes of transportation, such as walking and cycling and to facilitate the use of electric vehicles where feasible;*
- *Principle 3 – Create a Dynamic Residential Community*
  - *To develop a dynamic residential community with its own special character that integrates with the established character of the Niagara Falls urban area and ensures land use compatibility with surrounding areas, while providing for a diverse range of housing types and densities that caters to people in all stages of their lifecycle and allows for a range of affordability levels.*
  - *To meet the needs of residents of all ages including children, students, adults, and seniors, and ensure that development is accessible to all abilities;*
- *Principle 4 – Development of a Linked Open Space System and Natural Heritage System*
  - *To provide connected public open spaces throughout the community to enhance connectivity as well as provide view corridors;*

- *Principle 5 – Create Employment Opportunities and support a Vibrant Local Economy*
  - *To provide an efficient, integrated transportation network that enables connectivity between employment and residential areas, maintains linkages to the greater community, accommodates the long term travel needs of the area and supports the use of all modes of transportation (including walking, cycling and public transit).*

As noted above, the proposed Secondary Plan envisions an increased reliance on transit, walking, cycling and other modes to meet the mobility needs of future residents.

4.2 Problem Statement

The following problem statement has been developed to guide the Thundering Waters Transportation Master Plan:

"The Thundering Waters Secondary Plan area does not currently have a comprehensive, multi-modal transportation system capable of accommodating anticipated future travel needs generated by the planned new community in an efficient, effective and sustainable manner."

4.3 Opportunities

Notwithstanding the challenges noted above, the following opportunities have been identified that will help support the development of the Thundering Waters lands with a sustainable transportation system:

- Lyons Creek Road and its interchange with the QEW have available capacity to support development of the Thundering Waters lands.
- Niagara Region has plans to upgrade McLeod Road, which will provide some additional capacity to accommodate travel demand resulting from development of the Thundering Waters lands.
- The Niagara Falls Sustainable Transportation Master Plan has identified the need for a new OPG Hydro Canal crossing between Dorchester Road and Oakwood Drive for implementation prior to 2031. The specific location of the crossing will need to be determined through a Municipal Class EA Study, and could be oriented across the Welland River if more appropriate. The new crossing will provide additional capacity to accommodate travel demand resulting from development of the Thundering Waters lands.
- The City's transportation plan has also identified the future widening of Dorchester Road and Drummond Road and elimination of the jog at the Stanley Avenue and Marineland Parkway intersection, which will provide additional capacity to serve the development area.
- Niagara Falls Transit currently provides local bus services on six (6) routes in the vicinity of the Thundering Waters lands. Niagara Region

Transit and WEGO also offer transit service nearby. The existing transit routes could potentially be extended/rerouted into the Thundering Waters lands or connected by transfer, providing the new development area with direct access to public transit from its inception. This service expansion would also connect the Thundering Waters lands to the rest of the City and beyond, helping to reduce dependence on the automobile for travel.

- There are existing off-road trails, including the Millennium Trail, and on-road cycling routes located in proximity to the Thundering Waters lands. The Niagara Falls Sustainable Transportation Master Plan has also proposed several new trails and routes in the vicinity of the development area. This creates the opportunity to provide a network of cycling facilities that will accommodate both commuter and casual cyclists travelling to a broader range of destinations within the City, thereby reducing dependency on the private automobile for travel. The Region has also adopted the Regional Niagara Bikeways Master Plan and encourages cycling as a part of active living and for tourism (Niagara Regional Official Plan Objective 9.F.1). Dorchester Road and Chippawa Parkway in the Study Area are both part of the Niagara Region Bicycling Network.
- The proposed land use plan envisions a compact, mixed used and well-balanced development with both residential and employment opportunities located within the Thundering Waters lands. This will enable some residents to both work and live within the community, rather than commuting longer distances to employment outside the development area. The potential to accommodate both residential and employment activity, along with shopping, dining and recreation, within relatively short distances also provides increased opportunity for local residents to travel by non-auto modes, thereby reducing dependency on the private automobile.

5 Assessment of Alternative Strategies

5.1 Alternative Transportation Strategies

The following three (3) alternative transportation strategies were considered to meet the accessibility and mobility needs arising from the development of the Thundering Waters lands:

5.1.1 Auto-Oriented Strategy

Under this strategy, the Thundering Waters lands would be served primarily through the widening and construction of more roads, reflective of a community that is a highly automobile-oriented and heavily dependent on a high level of service on the roadway system. A full network of arterial, collector and local roadways designed to operate with high levels of service and minimal congestion during peak periods would be provided. Significant improvements to existing boundary arterial roads and new arterial road connections would be required to serve the development area. Provision of a new watercourse crossing would be necessary.

As described, this alternative would place little emphasis on diverting travel needs from use of the private automobile to public transit and other modes. Transit service extension into the Thundering Waters lands would be negligible, if at all. Provision for pedestrians and cyclists would be limited to sidewalks on new roads.

5.1.2 Transit-Oriented Strategy

Under this strategy, the Thundering Waters lands would be served by high-levels of bus transit service, with an emphasis on accommodating a substantial share of future travel demand by public transit. The transit hub currently contemplated in the Town Centre Commercial area would serve as the focal point of the system. There would also be extensive local transit service in the development area, with most buildings located within a 400 metre walking distance of a bus stop. Expansion of GO Rail service to Niagara Falls would also be an important requirement.

With a greater emphasis on public transit, the network of arterial and collector roadways within the development area could be downsized considerably from the system envisaged under the Auto-Oriented Strategy. There would also need to be greater provision for pedestrians and cyclists to facilitate access to the transit system and for travel within the Thundering Waters lands.

5.1.3 Balanced Transportation Strategy

The emphasis of a balanced transportation strategy is to provide a reasonable range of travel modes to offer users choice, with supporting policy to encourage reduced usage of the private automobile. This strategy

is achieved through investment in pedestrian and cycling infrastructure and a reasonable level of public transit service.

A balanced transportation strategy would include a complete network of bicycle lanes for both commuter and recreational cyclists and a continuous, integrated multi-use trail system, both with connections to the on and off-road routes outside the Thundering Waters lands. Public transit service would consist of select service extensions to the development area from outside and local bus routes connecting to key destinations within the community. The proposed transit hub near the Town Centre Commercial area would serve as a key element of the system.

5.2 Evaluation of Alternative Transportation Strategies

5.2.1 Overview of the Evaluation Process and Criteria

The three (3) alternative transportation strategies developed for the Thundering Waters lands were assessed in accordance with the requirements of the Municipal Class EA process. The assessment was also guided by the overarching goals and objectives of the Transportation Master Plan Study as discussed in Section 1.3.

The alternative strategies were evaluated against each other using a series of indicators from four (4) different criteria groups, resulting in the recommendation of a preferred alternative. **Table 5.1** summarizes the screening criteria used.

5.2.2 Evaluation of Alternatives

The alternative strategies were assessed based on the criteria summarized in **Table 5.1**. Using these qualitative measures, the relative advantages and disadvantages of each alternative were examined and compared to the other strategies using a reasoned argument approach. The recommended alternative for each criteria grouping is highlighted in the concluding summary section for the grouping. **Table 5.2** summarizes the results.

TABLE 5.1: SCREENING CRITERIA

Criteria Group	Objective	Indicators
Transportation	To provide a transportation system where residents, employees and visitors can travel within and to/from the community safely, with ease and efficiency by a range of travel modes, but specifically encouraging active modes of transportation.	▶ Mobility ▶ Access ▶ Support for Non-Auto Modes ▶ Compatibility with Existing and Planned Infrastructure
Natural Environment	To minimize impact to the natural and man-made environment. This includes curtailing the carbon footprint as well as mitigating impact to vegetation and wildlife habitat.	▶ Air Quality ▶ Noise Impacts
Social Environment	To ensure that the preferred alternative has a positive impact, supports the development of a vibrant and sustainable Town Centre, provides connectivity between the uses and activities within the community, and emphasizes a healthy lifestyle.	▶ Support for Vibrant Town Centre ▶ Connectivity ▶ Support for Active Living
Economic Environment	To ensure that the preferred alternative results in affordable transportation infrastructure while avoiding the need for extensive rights-of-way. Aims to provide a comprehensive transportation system that supports vibrant, sustainable and economically healthy businesses within the community.	▶ Support for Planned Development ▶ Capital Cost ▶ Operating / Maintenance Cost

TABLE 5.2: EVALUATION SUMMARY

Evaluation Criteria	Alternative 1 Auto-Oriented Strategy	Alternative 2 Transit-Oriented Strategy	Alternative 3 Balanced Transportation Strategy
Transportation			
Mobility	Offers a high level of mobility for auto users, but limited for users of other modes	Reduces level of mobility for users by placing high dependency on transit to serve demands	Achieves a high level of mobility for all users
Access	Offers high degree of access for auto users, but limited for users of other modes	Reduces degree of access for users by placing high dependency on transit to serve demands	Achieves a high degree of access for all users
Support for Non-Auto Modes	Gives little consideration to non-auto modes of travel	Supports transit but gives little consideration to other modes of non-auto travel, specifically cycling	Strongly supports all modes of travel including transit, cycling and walking
Compatibility with Existing and Planned Infrastructure	Is consistent with planned road infrastructure works, but likely requires crossing of OPG Canal (or Welland River) sooner to serve demands. Inconsistent with planned improvements for other modes.	Reduces road infrastructure requirements, but transit unlikely to have sufficient impact to diminish road needs. Inconsistent with planned improvements for other modes except transit.	Reduces road infrastructure requirements, although transit, cycling and walking unlikely to have sufficient impact to significantly diminish road needs. Consistent with planned improvements for other modes.
Summary	*The Balanced Transportation Strategy is preferred as it achieves higher levels of mobility and access for all users, supports the use of non-auto modes and results in more moderate infrastructure requirements.*		
Natural Environment			
Air Quality	Generates highest level of emissions with most reliance on private vehicles for travel, resulting in more adverse impact to the natural environment	Results in lower levels of emissions and less adverse impact to the natural environment with reduced reliance on the private vehicles for travel, although transit vehicles still cause emissions	Results in lower levels of emissions and less adverse impact to the natural environment with reduced reliance on the private vehicles for travel and greater use of walking and cycling, although transit vehicles still cause emissions
Noise Impacts	Highest level of noise impact	Moderate level of noise impact	Moderate level of noise impact
Summary	*The Transit-Oriented and Balanced Transportation Strategies are both anticipated to result in less impact on the natural environment given their lower reliance on automobiles for travel. However, the Balanced Transportation Strategy has the potential to reduce the carbon footprint more than the Transit-Oriented Strategy, so is preferred.*		

TABLE 5.2: EVALUATION SUMMARY

Evaluation Criteria	Alternative 1 Auto-Oriented Strategy	Alternative 2 Transit-Oriented Strategy	Alternative 3 Balanced Transportation Strategy
Social Environment			
Support for Vibrant Town Centre	Conflicts with desired vision of a sustainable, pedestrian-oriented area	Supports desired vision to be more sustainable, but not as pedestrian-oriented	Supports desired vision to be more sustainable and pedestrian-oriented
Connectivity	Provides good internal connectivity for auto users, but offers poor connectivity for other users, particularly children and other vulnerable road users	Offers moderate level of connectivity assuming that all residents will be located within a 400 metre walking distance of a transit stop, but may not provide adequate connectivity for other users such as children	Meets the connectivity needs of all users including vulnerable road users through a broader range of options
Support for Active Living	Places little to no emphasis on maintaining a healthy lifestyle as walking and cycling are not promoted or accommodated	Contributes to a healthier lifestyle as transit users required to walk to nearby bus stops, but walking and cycling are not strongly promoted	Places considerable emphasis on maintaining a healthier lifestyle with the emphasis on walking and cycling
Summary	*With an emphasis on non-auto travel modes, particularly walking and cycling, the Balanced Transportation Strategy is preferred as it best supports the development of a vibrant and sustainable Town Centre, provides for the highest level of connectivity, and results in a strategy that not only encourages, but stresses the importance of a healthy lifestyle.*		
Economic Environment			
Support for Planned Development	Supports planned residential and employment growth	Supports planned residential and employment growth	Supports planned residential and employment growth
Capital Cost	Imposes highest capital costs attributed to widening and new road construction and right-of-way requirements	Offers lower capital costs for widening and new road construction, but expenditures for transit fleet and infrastructure requirements	Offers lower capital costs for widening and new road construction, but expenditures for pedestrian, cycling and transit infrastructure
Operating/ Maintenance Cost	Moderate operating/ maintenance costs	Higher ongoing operating/ maintenance costs to the municipality due to transit service	Moderate operating / maintenance costs
Summary	*The Balanced Transportation Strategy is preferred as it best balances capital and long-term operating and maintenance costs.*		

5.3 Selection of Preferred Transportation Strategy

From the assessment above, the Transit-Oriented and Balanced Transportation Strategies are most compatible with the guiding principles for the Thundering Waters Secondary Plan and Transportation Master Plan. However, the Transit-Oriented Strategy has certain limitations:

- It is unlikely that a Transit-Oriented Strategy can effectively and efficiently serve the broad range of travel patterns for the Thundering Waters lands, especially trips to other municipalities;
- It is also unlikely that transit can achieve the market penetration required to significantly reduce automobile demands given service levels, relative attractiveness and current behaviour; and
- The Transit-Oriented Strategy will require significant capital investment to provide the necessary fleet and infrastructure, as well as higher ongoing maintenance and operating costs. The magnitude of these capital and operating costs is unknown, but experience in other communities demonstrates that it may be substantial and/or cost prohibitive.

Based on the evaluation summarized in **Table 5.2** and considering the limitations noted above, the Balanced Transportation Strategy is the preliminary preferred alternative transportations service solution for the Thundering Waters lands. This strategy has been developed to support the planned development and has kept with the broad principles set out in the City and Regional Official Plans, the City's Sustainable Transportation Master Plan and the proposed Secondary Plan to develop a multi-modal transportation system that:

- Offers safe, convenient and efficient movement of goods, services and people, including persons with disabilities;
- Provides an adequate network of transportation linkages within the City and between the City and adjacent municipalities;
- Is efficient, cost-effective and well-integrated with the City's land use planning goals, objectives and policies; and
- Supports the sustainability objectives and policies of the Official Plan.

This strategy has formed the basis for the development of the road, transit, walking and cycling components of the Transportation Master Plan.

6 Future Travel Demand

6.1 Overview

Forecasts of future travel demand assuming full build-out of the Thundering Waters lands have been prepared to assess the adequacy of existing and planned infrastructure within the Study Area to serve the proposed development. The year 2031 has been selected as the build-out horizon as the lands are anticipated to be largely developed by this date. A 2031 horizon year is also consistent with approved transportation planning activities undertaken for the City of Niagara Falls and the only available travel demand forecasting model for the area.

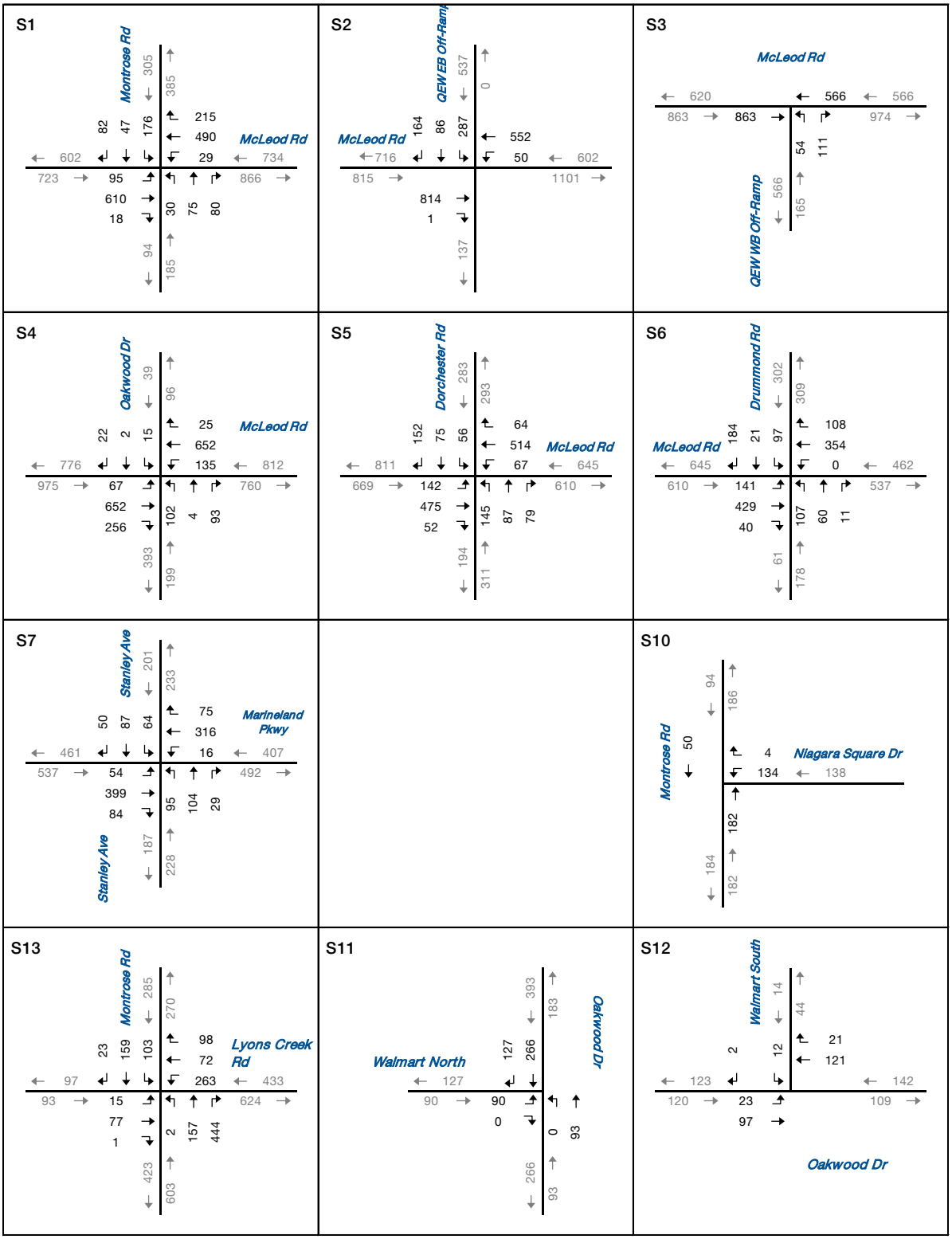
6.2 Future Background Traffic

Horizon year (2031) background traffic volumes were estimated by applying a compound growth rate of 1.0 per cent per annum to existing traffic volumes. This rate (provided by the Region and City) reflects typical annual increases in traffic in growing, but stable communities, and in this context, accounts for the general population and employment growth expected to occur in the vicinity of the Study Area over time.

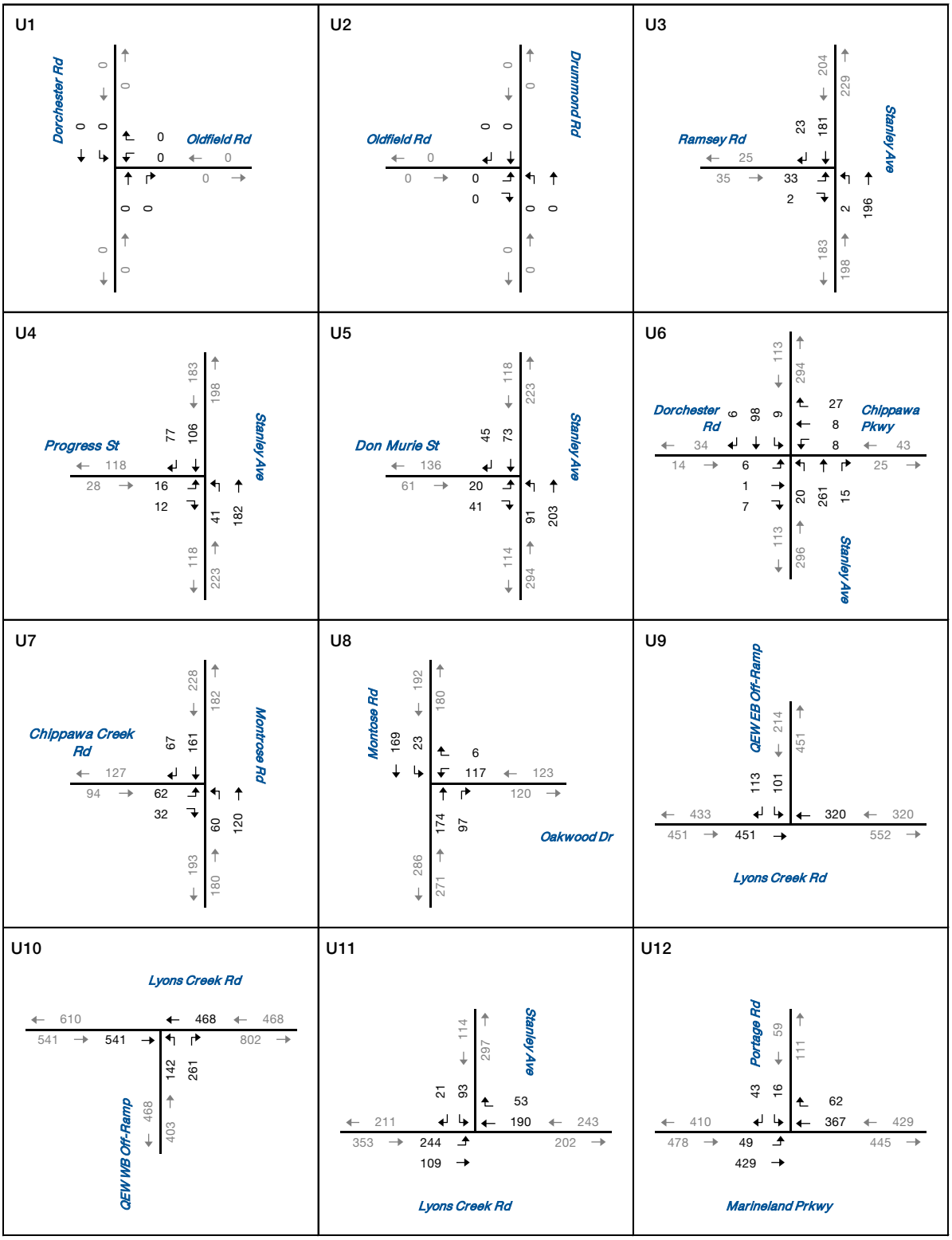
Figures 6.1, 6.2 and **6.3** summarize the future background traffic volumes for the summer weekday morning, weekday afternoon and Saturday midday peak hours, respectively.

At the time of preparing the Study Terms of Reference in August 2015, the Region and City requested traffic generated by the residential development currently under construction on the north side of Oldfield Road between Dorchester Road and Drummond Road, and two (2) significant plans in the preliminary stages – the Grand Niagara Secondary Plan area and a new regional hospital – be included in the background forecasts. The Oldfield Road residential subdivision traffic forecasts have been included in the future background volumes.

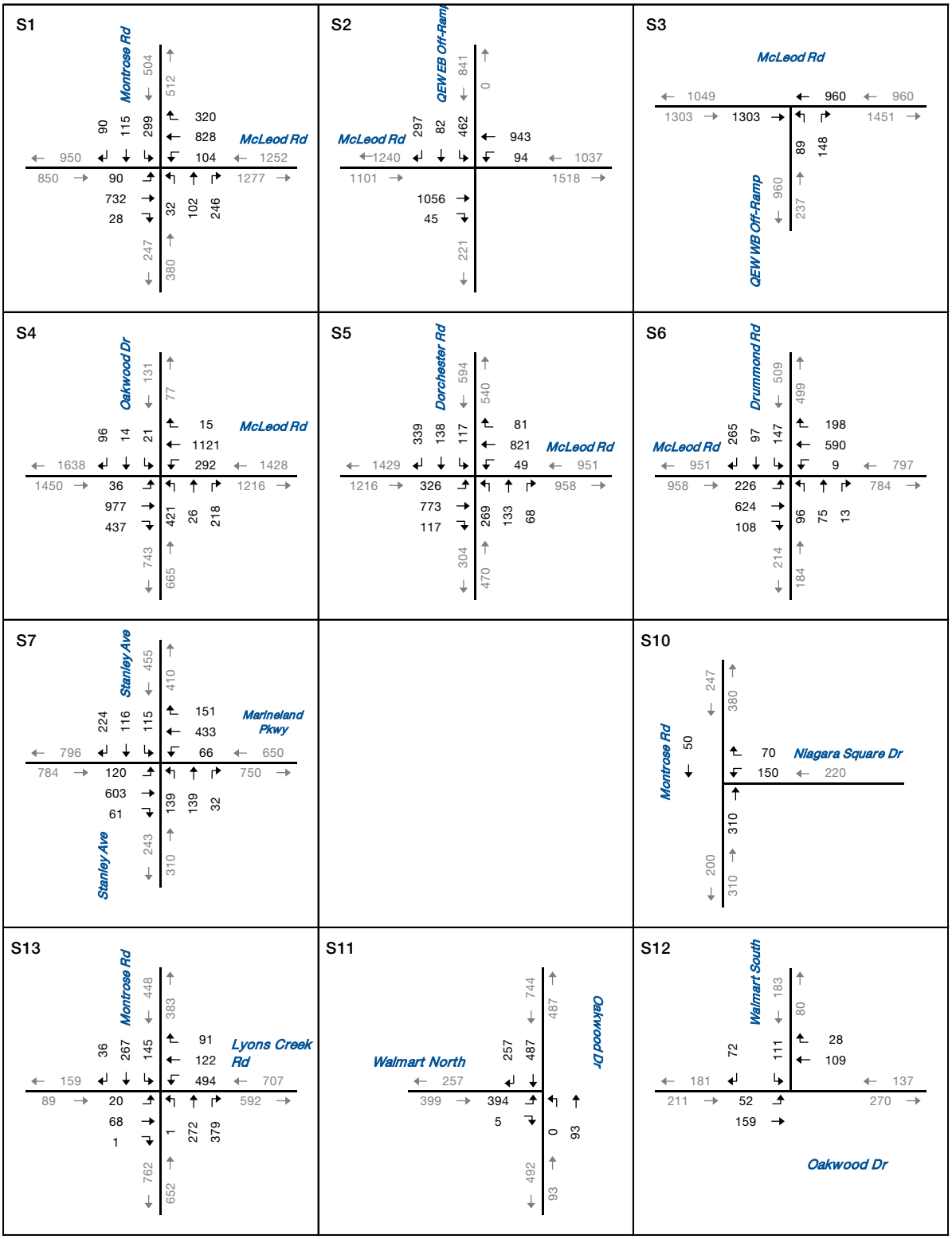
Through the process of preparing this Transportation Master Plan, Paradigm contacted MMM Group, the transportation consultant for the Grand Niagara development, to coordinate data collection and analysis approach. At the time of preparing this report, Grand Niagara had not confirmed its land use plan and could not offer site-generated traffic volumes or distributions, nor an indication of development potential. Information about the potential hospital was also not available. For these reasons, it was not possible to include trips to be generated by these developments in the background traffic forecasts. It is acknowledged that these uses will add further traffic to the network and could detrimentally impact the available capacity and operation of certain intersections in the vicinity, in particular Lyons Creek Road/Biggar Road in the vicinity of the QEW interchange.



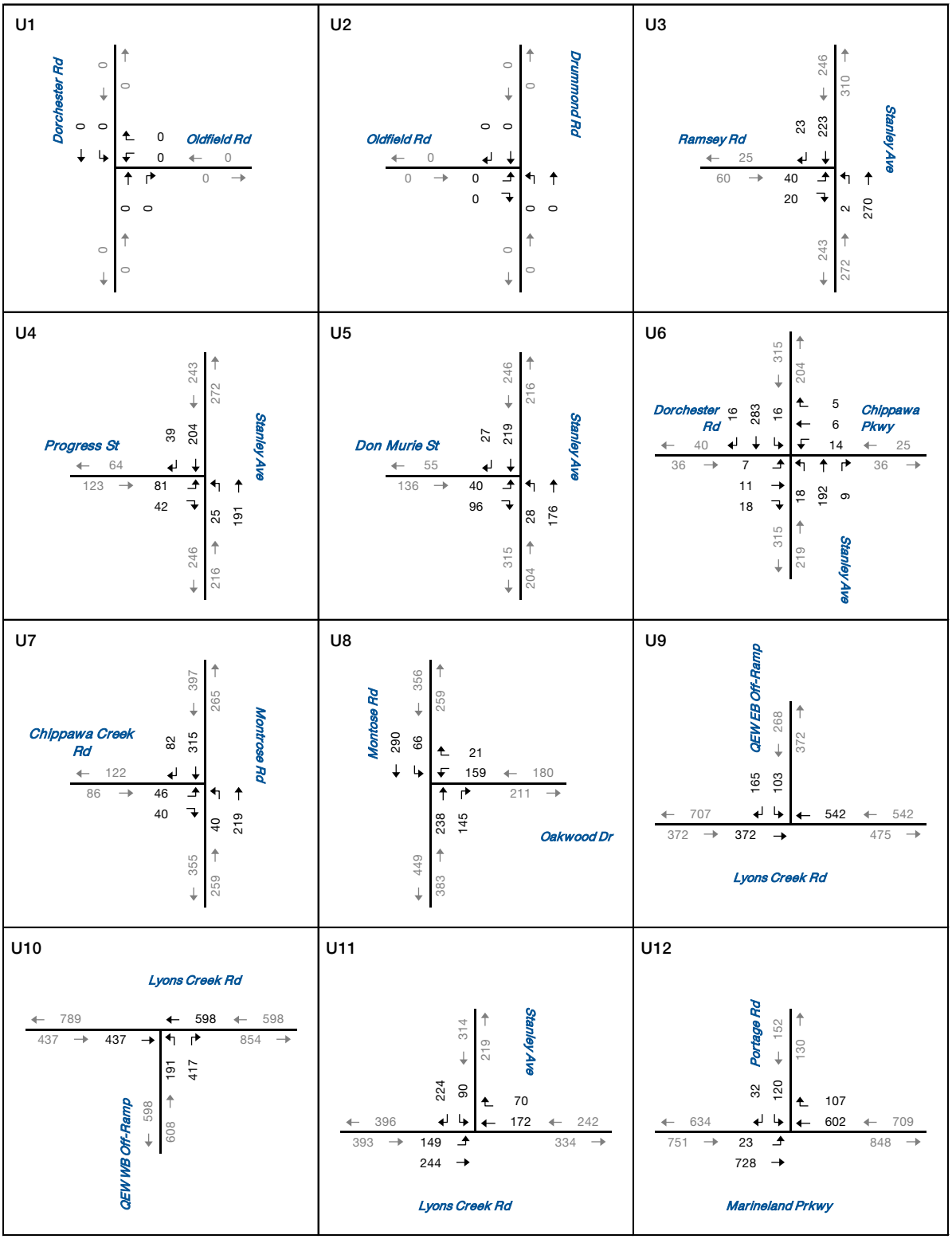
2031 Background Traffic Volumes Weekday AM Peak Hour (Signalized Intersections)



2031 Background Traffic Volumes Weekday AM Peak Hour (Unsignalized Intersections)



2031 Background Traffic Volumes Weekday PM Peak Hour (Signalized Intersections)



2031 Background Traffic Volumes Weekday PM Peak Hour (Unsignalized Intersections)

Thundering Waters Transportation Master Plan
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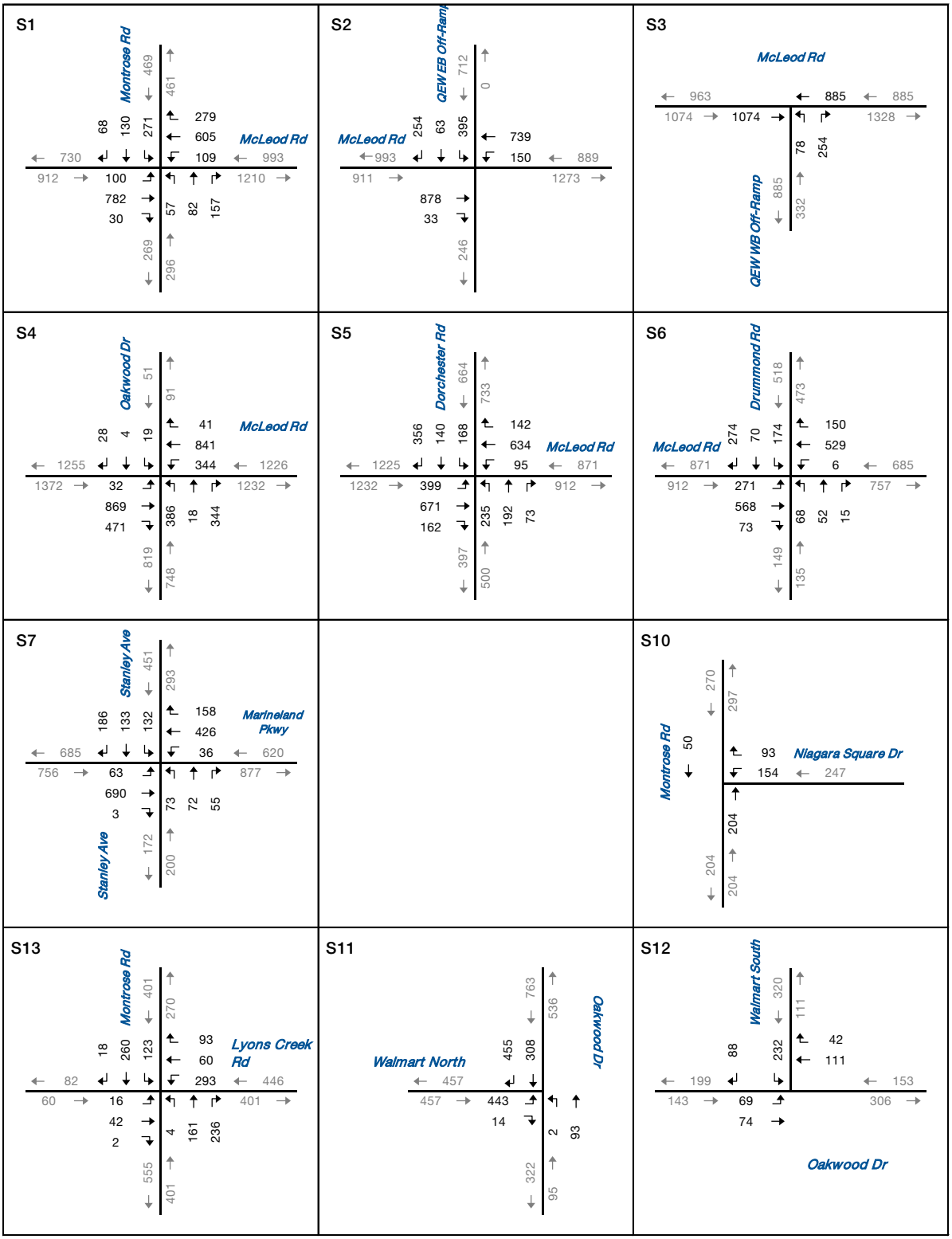
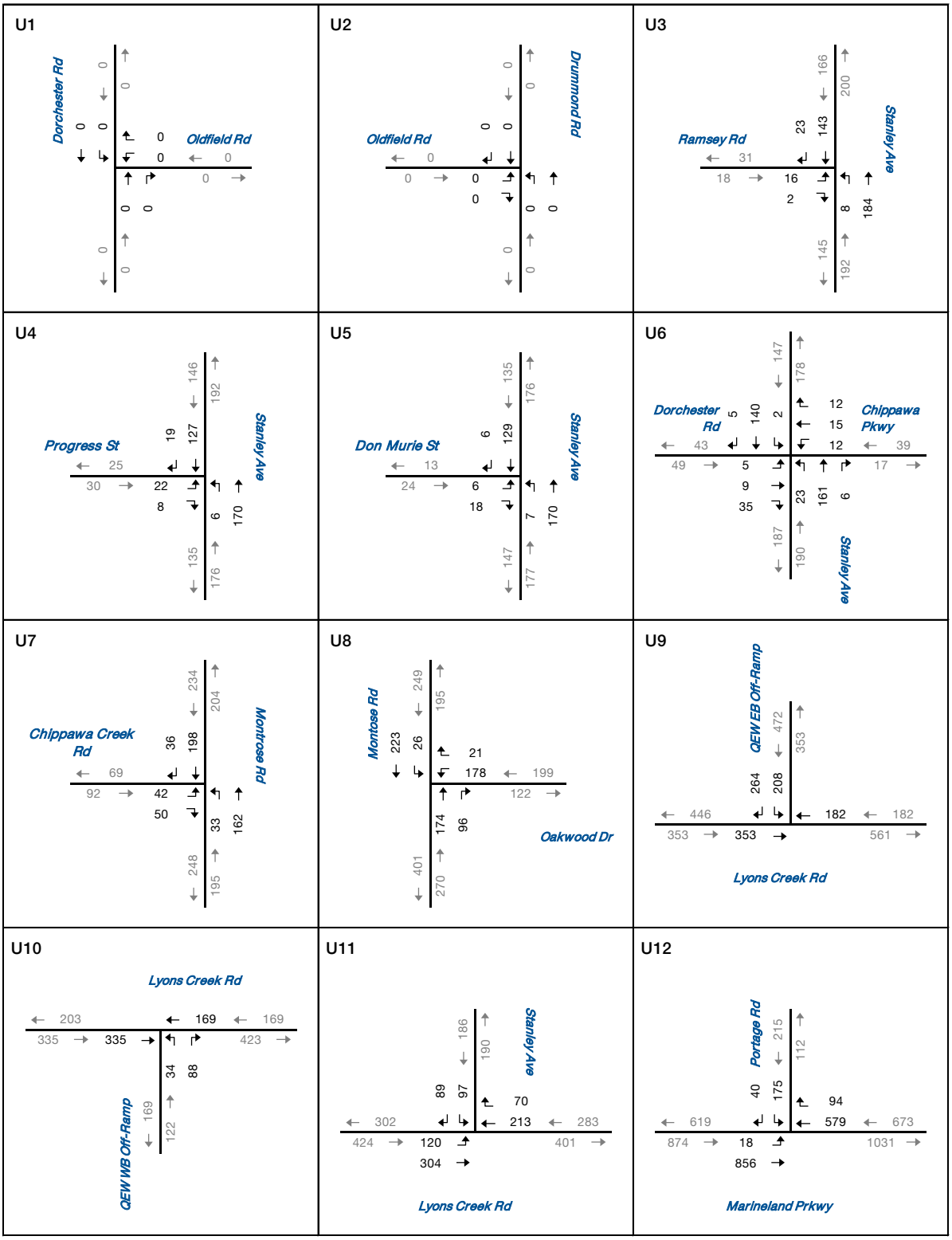
Figure 6.2B



2031 Background Traffic Volumes Saturday Midday Peak Hour (Signalized Intersections)



2031 Background Traffic Volumes Saturday Midday Peak Hour (Unsignalized Intersections)

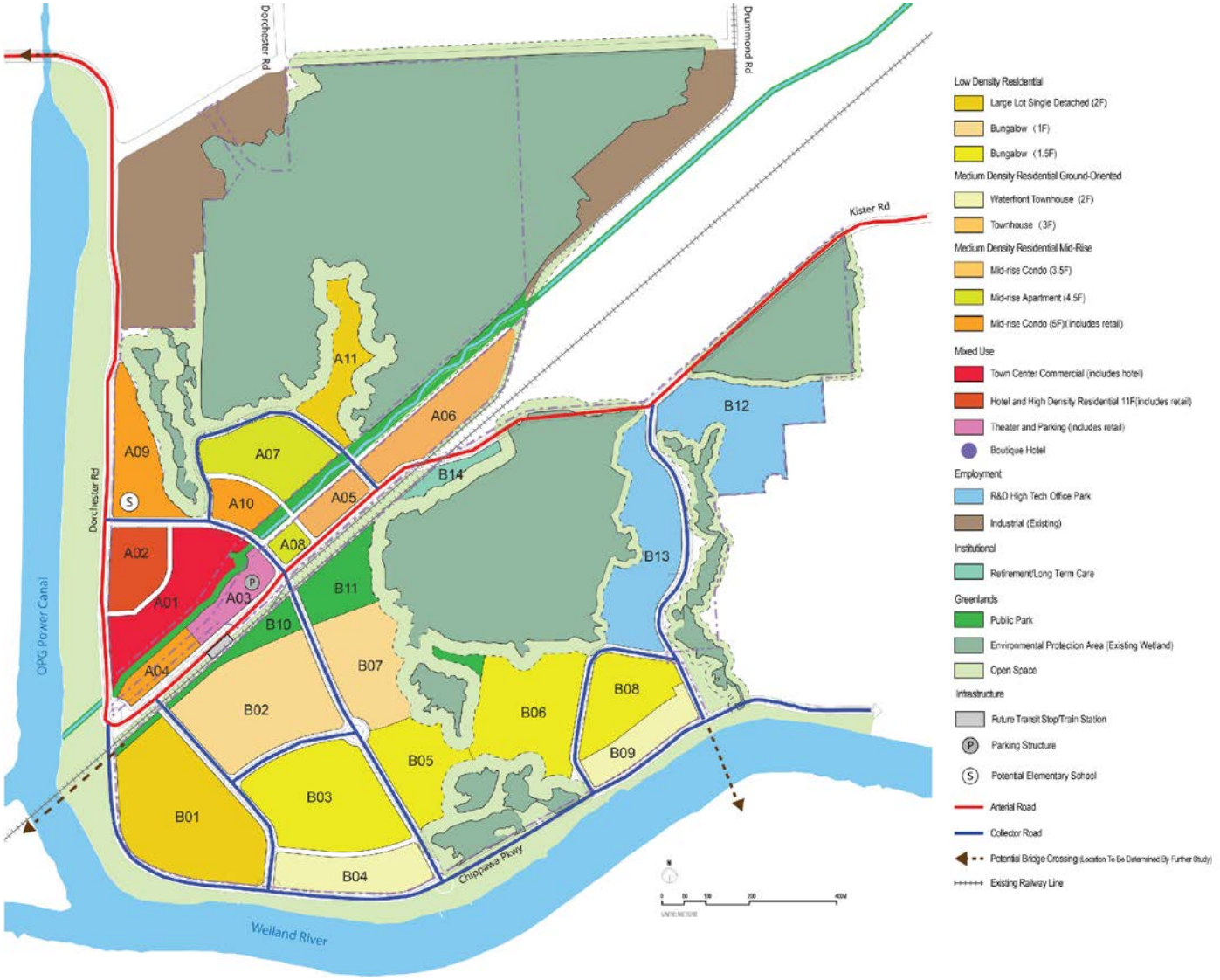
6.3 Land Use Assumptions

The proposed Thundering Waters Secondary Plan comprises a mix of commercial, residential, community, park and employment uses, some of which are not common to Canada. **Table 6.1** lists the proposed land uses, gross floor areas (GFA) and/or units, rooms or seats for each use by area based on the latest master plan land use concept. **Figure 6.4** depicts the spatial distribution of the land uses corresponding to the table.

In total, the proposed development will encompass approximately 107.2 ha (265 ac.) of land, comprising about 151,350 m^2 (1.629 million sq. ft.) of non-residential (retail, commercial, office) floor space, nearly 3,500 residential units, hotel rooms and assisted living residences, a 500 seat live theatre, and a 2.0 ha (5 ac.) park.

TABLE 6.1: PROPOSED LAND USES AND DEVELOPMENT YIELDS

Area	Description	Non-Residential GFA (sq.m)	Units/ Rooms/ Seats
A01	Town Center Commercial with hotel	28,000	50
A02	Time Share Hotel and Apartment (11F) with ground level (GL) retail	200	400
A03	Live Theater with retail	300	500
A04	Mid-rise Condo (4F) with GL retail	100	106
A05	Mid-rise Condo (3F) with GL retail	100	195
A06	Mid-rise Condo (3F) with GL retail	100	497
A07	Townhouse (3F) and Mid-rise Apartment		361
A08	Mid-rise Apartment (4.5F) with GL retail	100	106
A09	Mid-rise Condo (5F) with GL retail	100	636
A10	Mid-rise Condo (3F) with GL retail	100	222
A11	Luxury Single Family House (2F)		20
B01	Luxury Single Family House (2F)		92
B02	Bungalow (1F)		127
B03	Bungalow (1.5F)		140
B04	Waterfront Townhouse (2F)		63
B05	Bungalow (1.5F)		55
B06	Bungalow (1.5F)		97
B07	Bungalow (1F)		65
B08	Bungalow (1.5F)		61
B09	Waterfront Townhouse (2F)		56
B10	Station and Green Belt	n/a	
B11	Centre Sports Park	*2.0 ha*	
B12	R&D High Tech Office Park	60,592	
B13	R&D High Tech Office Park with Office HQ	61,658	
B14	Nursing Home		140



Proposed Land Uses for Thundering Waters Secondary Plan Area

6.4 Trip Generation

6.4.1 Approach and Rationale

The ITE Trip Generation Manual[7] (the ITE Manual) is a common source of data used to forecast the number of vehicle trips generated by a proposed development. The trip generation rates presented in the ITE Manual are based primarily on traffic surveys conducted at suburban locations with limited to no access to transit or active transportation services. In most cases, the vehicle trip estimates prepared using these rates can be considered conservative (high).

Given the mixed use, compact form of the proposed development and planned initiatives to foster the use of non-auto transportation modes, it is reasonable to assume that the ITE Manual rates will overestimate the number of new external vehicle trips generated by the Thundering Waters lands. For this reason, the trip generation rates used for the Study were adjusted to account for non-auto travel, internalization of trip making, and interaction between land uses.

6.4.2 Base Trip Generation Rates

Trip generation rates for the following land use codes (LUC) were selected from the ITE Manual:

- **LUC 210 (Single Family Detached)** was used to estimate the trips generated by the Luxury Single Family House (A11 and B01) and Bungalow (B02, B03, B05, B06, B07 and B08) land uses. The ITE Manual defines LUC 210 as inclusive of all single-family detached homes on individual lots. Semi-detached lots are usually included in this land use code as well.
- **LUC 230 (Residential Townhouse/Condominium)** was used to estimate the trips generated by the Mid-rise Condo (A04, A05, A06, A08, A09 and A10), Townhouse (A07), and Waterfront Townhouse (B04 and B09) land uses. The ITE Manual defines LUC 230 as ownership units that have at least one (1) other owned unit within the same building structure.
- **LUC 255 (Continuing Care Retirement Community)** was used to estimate the trips generated by the proposed Nursing Home (B14). The ITE Manual defines LUC 255 as a land use that provides multiple elements of senior adult living, which combine aspects of independent living with increased care.
- **LUC 310 (Hotel)** was used to estimate the trips generated by the proposed hotel (part of A01 and A02) land uses. The ITE Manual defines LUC 310 as a place of lodging that provides sleeping accommodation and support facilities such as restaurants, cocktail

[7] Institute of Transportation Engineers, Trip Generation Manual, 9th Edition, 2012, Washington, D.C.

lounges, meeting and banquet rooms, limited recreational facilities, and/or other retail and service shops.

- **LUC 411 (City Park)** was used to estimate the trips generated by the Center Sports Park (B11). The ITE Manual defines LUC 411 as a park that can contain a number of facilities such as boating or swimming facilities, ball fields, soccer fields, camp sites, picnic facilities, and general open spaces.
- **LUC 760 (Research and Development Center)** was used to estimate the trips generated by the R&D High Tech Office Park and Office HQ (B12 and B13). The ITE Manual defines LUC 760 as facilities or groups of facilities devoted almost exclusively to research and development activities, and may contain offices and light fabrication areas.
- **LUC 820 (Shopping Centre)** was used to estimate the trips generated by all retail land uses, including the Town Centre Commercial (most of A01). The ITE Manual defines LUC 820 as an integrated group of commercial establishments that is planned, developed, owned or managed as a unit. Although not entirely representative of the specialty retail services being proposed, it is the only LUC that covered the range of uses contemplated and that offered trip generation rates for all three (3) time periods being analyzed.

Although similar in description to the proposed theatre for the Town Centre area, ITE Manual data for LUC 441 (Live Theatre) is limited and does not include rates for all three (3) time periods being analyzed. In lieu, trip generation data from a study completed for the proposed Durham Live development in Pickering[8] were used. The trip rates applied in the Durham Live study were based on a survey of the 631 seat Richmond Hill Centre for the Performing Arts, which is similar in size and nature to the proposed theater.

If provided, data for the peak hour of adjacent street traffic were used to estimate trip generation. Fitted curve equations with satisfactory R^2 values were applied if available. If no equation was provided, the average rate was used.

6.4.3 Non-Auto Mode Use

The ITE Manual trip generation rates were reduced by 5% to account for transit and active transportation usage and other TDM strategies expected for the development, as directed by City and Region staff on 10 June 2016. This non-auto mode share is generally consistent with current trends observed in the City of Niagara Falls, and the City's Official Plan transit use

[8] BA Group, Durham Live Tourist Destination Phase 1 Approval Area Urban Transportation Study, June 2014

target of 3.2%, which is based on the Transit Strategic Business Plan and Ridership Growth Strategy.

It is noted that the Niagara Falls Sustainable Transportation Master Plan targets 18% total non-auto use by the year 2031, based on the recommendations of the Niagara Falls Transit Business Plan and Ridership Growth Strategy[9] and implementation of the TDM policies contained in the plan. City and Region staff were of the opinion this mode share target was overly ambitious for the Thundering Waters lands given current and expected local travel behaviour, anticipated transit and active transportation service levels and market penetration, and the relative location of the development.

6.4.4 Internalization and Interaction

Given the size and land use mix of the proposed Thundering Waters development, a significant opportunity exists for internalization of generated trips through interaction or synergy between uses. This internalization will serve to reduce the overall number of "external" trips on the surrounding road network. Interaction between complementary land uses will also help to reduce peak inbound and/or outbound movements for uses that exhibit sharp peaking of travel demand, such as the theatre. The presence of nearby restaurants and shops will lessen the peak arrival rate as audience members may arrive in advance of the event to partake in those services.

Table 6.2 lists the land use combinations that tend to exhibit the most synergy from a transportation perspective and the degree of interaction between the uses[10].

TABLE 6.2: SYNERGY IN MIXED-USE DEVELOPMENTS

Land Use	Degree of Support/Synergy			
	Residential	Hotel	Retail	Cultural/Civic
Office	Weak	Very Strong	Strong	Moderate
Residential	Moderate	Moderate	Strong	Very Strong
Hotel	Very Strong	Moderate	Strong	Strong
Retail	Very Strong	Very Strong	Very Strong	Strong
Cultural/Civic	Strong	Very Strong	Very Strong	Moderate

The internal trip capture due to internalization and interaction between land uses was calculated based on the methodologies outlined in the ITE Trip Generation Handbook[11]. **Table 6.3** summarizes the capture rates applied in

9 IBI Group, Niagara Falls Transit Business Plan and Ridership Growth Strategy, March 2009

10 Transportation Research Board, NCHRP Report 684 – Enhancing Internal Trip Capture Estimation for Mixed-Use Developments, 2011, Washington, D.C.

11 Institute of Transportation Engineers, Trip Generation Handbook, 2nd Edition, June 2004, Washington, D.C.

the analyses. The Daily and Midday Peak Hour rates cited in the guidebook were used for the weekday morning and Saturday midday, respectively, in the absence of data specific to those time periods.

TABLE 6.3: INTERNAL CAPTURE RATES

			Weekday Morning[1]	Weekday Afternoon	Saturday Midday[2]
Origin	From Office	to Retail	22%	23%	20%
		to Residential	2%	2%	0%
	From Retail	to Office	3%	3%	3%
		to Residential	11%	12%	7%
	From Residential	to Office	0%	0%	0%
		to Retail	38%	53%	34%
Destination	To Office	from Retail	15%	31%	38%
		from Residential	0%	0%	0%
	To Retail	from Office	4%	2%	4%
		from Residential	28%	9%	5%
	To Residential	from Office	3%	2%	0%
		from Retail	33%	31%	37%

Source: Tables 7.1 and 7.2, ITE Trip Generation Handbook, 2th Edition

Notes: 1. "Daily" rates
2. "p.m. Peak Hour Midday Peak Hour of Adjacent Daily Street Traffic" rates
3. "Midday Peak Hour" rates

Using this approach, the average internal capture rates for the Thundering Waters lands were estimated to be:

- 7% for the weekday morning peak hour;
- 10% for the weekday afternoon peak hour; and
- 8% for the Saturday midday peak hour.

Appendix E provides the detailed calculations.

It is noted that the ITE Trip Generation Handbook procedure for determining internal trip capture does not account for a number of key variables likely to affect the internal capture rate, such as proximity of on-site land uses (and pedestrian connections between them) and location of the multi-use site within the urban/suburban area (and the proximity of competing or complementary land uses). These factors could contribute to further reductions in external vehicle trip generation.

6.4.5 Net External Vehicle Trip Generation

Table 6.4 summarizes the resulting net external vehicle trip generation for the Thundering Waters lands taking into account non-auto mode share and internal trip capture. The table suggests an approximate overall reduction in external trips ranging from 12% to 15% could be realized at build-out due to non-auto mode use and synergy between land uses. As noted above, the potential exists for further reductions if higher non-auto mode splits are achieved and greater internal trip capture occurs than expected by the municipalities.

As noted in the table, the Thundering Waters lands are forecast to generate the following net external vehicle trips (approximately):

- 2,590 trips (1,420 inbound and 1,170 outbound) during the weekday morning peak hour;
- 3,540 trips (1,610 inbound and 1,930 outbound) during the weekday afternoon peak hour; and
- 3,340 trips (1,810 inbound and 1,530 outbound) during the Saturday midday peak hour.

6.5 Trip Distribution and Assignment

6.5.1 Approach

Trips generated by the Thundering Waters lands were distributed to the Study Area road network based on:

- Data from the 2011 Transportation Tomorrow Survey (TTS). The Thundering Waters lands are located in TTS traffic zone 6240. Since there is limited residential development in the area currently, neighbouring zone 6235 was also referenced; and
- Output from the Niagara Region Travel Demand Forecasting Model used for the Niagara Falls Sustainable Transportation Master (the TransCAD Model). The Thundering Waters lands are located in Model traffic zones 885, 886 and 887.

6.5.2 Super Zone Trip Distribution

The 2011 TTS data served as the primary source of information for the trip distribution estimates. Trips originating from or destined to zones 6235 and 6240 in the TTS trip database were aggregated into four (4) groups, or “super zones”:

- QEW North for longer distance trips to and from TTS zones north of the Study Area;
- QEW South for longer distance trips to and from TTS zones south of the Study Area;

TABLE 6.4: NET EXTERNAL VEHICLE TRIP GENERATION

ITE Land Use Code	Variable	Units	AM Peak Hour				PM Peak Hour				SAT Peak Hour			
			Rate	In	Out	Total	Rate	In	Out	Total	Rate	In	Out	Total
210 - Single Family Detached Housing	units	657	eq.	117	353	**470**	eq.	360	212	**572**	eq.	321	273	**594**
230 - Residential Condominium / Townhouse	units	2243	eq.	106	516	**622**	eq.	516	254	**770**	eq.	374	319	**693**
255 - Continuing Care Retirement Community	rooms	140	eq.	19	10	**29**	eq.	12	18	**30**	eq.	23	19	**42**
310 - Hotel	rooms	450	0.53	141	98	**239**	0.60	138	132	**270**	eq.	176	139	**315**
441 - Live Theatre[1]	seats	500		15	15	**30**	6.00	60	10	**70**	3.50	105	30	**135**
411 - City Park	acres	5.00	4.50	13	10	**23**	3.50	10	8	**18**	4.50	11	12	**23**
760 - Research and Development Center	GFA 1000ft^2	1315.89	eq.	1014	208	**1222**	eq.	168	952	**1120**	eq.	120	90	**210**
820 - Shopping Centre	GFA 1000ft^2	313.23	eq.	194	119	**313**	eq.	618	669	**1287**	eq.	955	881	**1836**
Total Trip Generation				**1619**	**1329**	**2948**		**1882**	**2255**	**4137**		**2085**	**1763**	**3848**
Reductions:														
Non-Auto Share			5%	81	66	147	5%	94	113	207	5%	104	88	192
Internal Capture														
AM Peak Hour			7%	117	96	213								
PM Peak Hour							10%	180	215	395				
SAT Peak Hour											8%	170	144	314
Net Generation				**1421**	**1167**	**2588**		**1608**	**1927**	**3535**		**1811**	**1531**	**3342**
% Overall Trip Reduction						**12%**				**15%**				**13%**

Notes: 1. Theatre rates from Durham Live Tourist Destination Phase 1 Approval Area Urban Transportation Study completed by BA Group in 2014
2. eq – ITE Manual equation used

- Non QEW/Non Internal for trips to and from TTS zones in closer proximity to, but not within, the Study Area; and
- Internal for trips to and from the Study Area TTS zones.

Although the TTS data provide a reliable basis for distributing existing trips, travel patterns can change over time. In particular, the share of trips to/from the north via the QEW is likely to diminish over time as the Thundering Waters development becomes more integrated with the remainder of the City. It is also reasonable to assume that local employment, shopping and social opportunities will increase over time as the City and Region continue to grow and mature, lessening the need to travel to larger centres (e.g. Hamilton, Toronto) for these purposes.

Table 6.5 summarizes the proportion of daily trips entering and exiting the Study Area (i.e. zones 6335 and 6340) that originate from or are destined to the four (4) "super zones" denoted above based on the 2011 TTS data. The table also provides a revised distribution that assumes 10% of the trips assigned to the QEW North are diverted to arterial roads north of the Study Area (i.e. Dorchester Road, Drummond Road, Stanley Avenue and Portage Road). This assumes that the proportion of travel between the Thundering Waters lands and the remainder of the City (which is mostly to the north) grows over time, as suggested above.

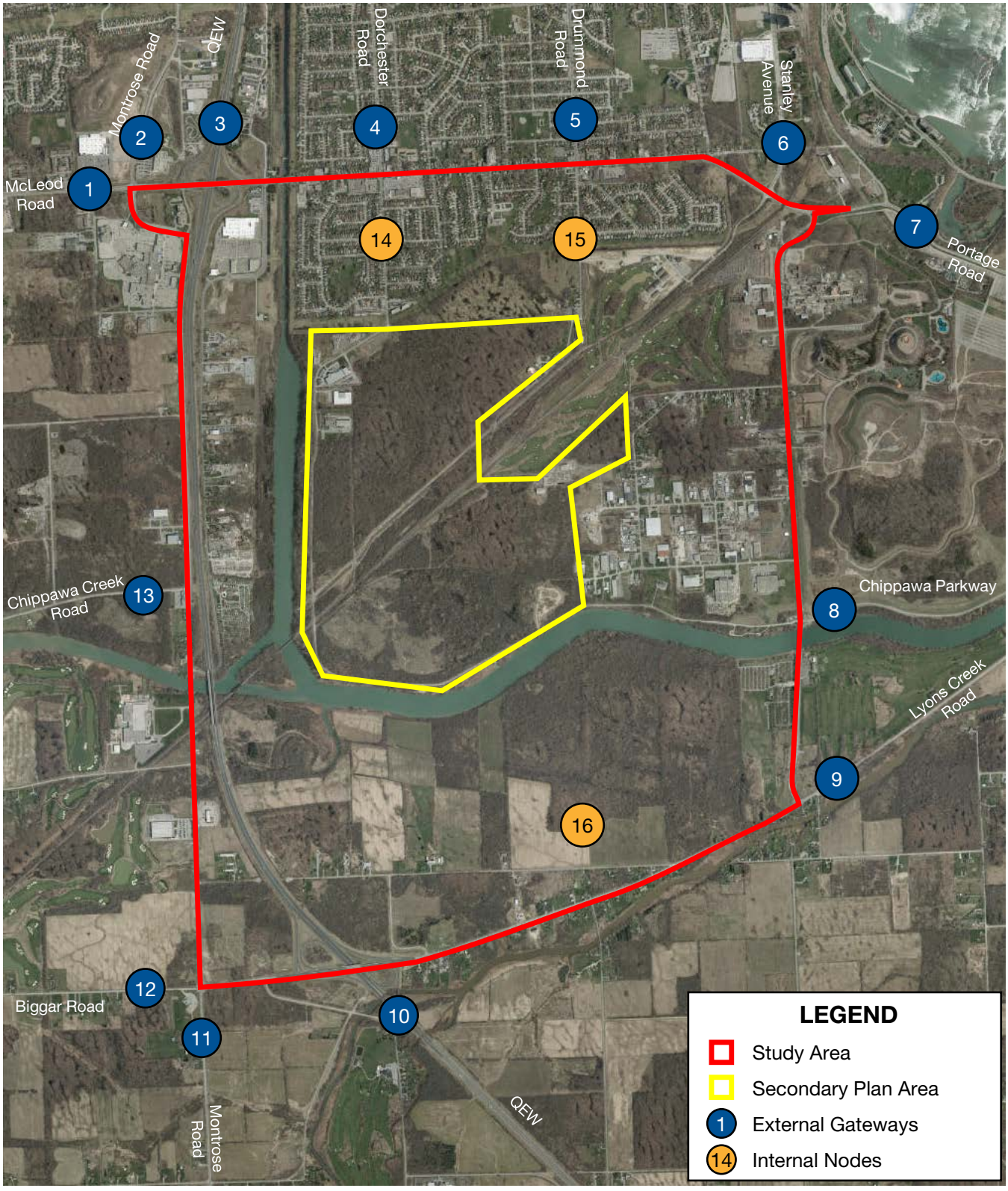
TABLE 6.5: "SUPER ZONE" TRIP DISTRIBUTION

Origin/Destination "Super Zone"	2011 TTS Distribution	Revised Distribution
QEW North	39.0%	29.0%
QEW South	2.6%	2.6%
Non QEW/Non Internal	43.4%	53.4%
Internal	15.0%	15.0%
Total	**100.0%**	**100.0%**

6.5.3 Disaggregated Trip Distribution

The revised trip distribution summarized in **Table 6.5** was further disaggregated to facilitate trip assignment to the Study Area road network using year 2026 travel forecasts from the TransCAD Model. The zone system for the TransCAD Model is more refined than the TTS system, thereby providing more detailed trip interchange forecasts between zones. Although based on data from the 2006 TTS, the TransCAD Model is the primary (only) source of information available for this purpose, at least until Niagara Region releases its new emme travel demand forecasting model.

Vehicle trips from the year 2026 TransCAD Model afternoon peak hour assignment entering and exiting the Study Area were aggregated at 13 external "gateways". Trips assigned within the Study Area were summarized at three (3) internal "nodes". **Figure 6.5** illustrates this zone system.



Source: Google Maps

Trip Distribution Zones

Table 6.6 provides the proportion of afternoon peak hour vehicle trips entering and exiting the Study Area (i.e. TransCAD Model zones 885, 886 and 887) that originate from or are destined to the 13 gateways and three (3) nodes (see Column A). Relative percentages were used rather than absolute numbers since trip generation for the Thundering Waters lands is being forecast separately. It is interesting to note that the TransCAD Model assigned 29% of trips entering or exiting the Study Area to the North (QEW) zone, similar to the assumption postulated above regarding travel behaviour change over time.

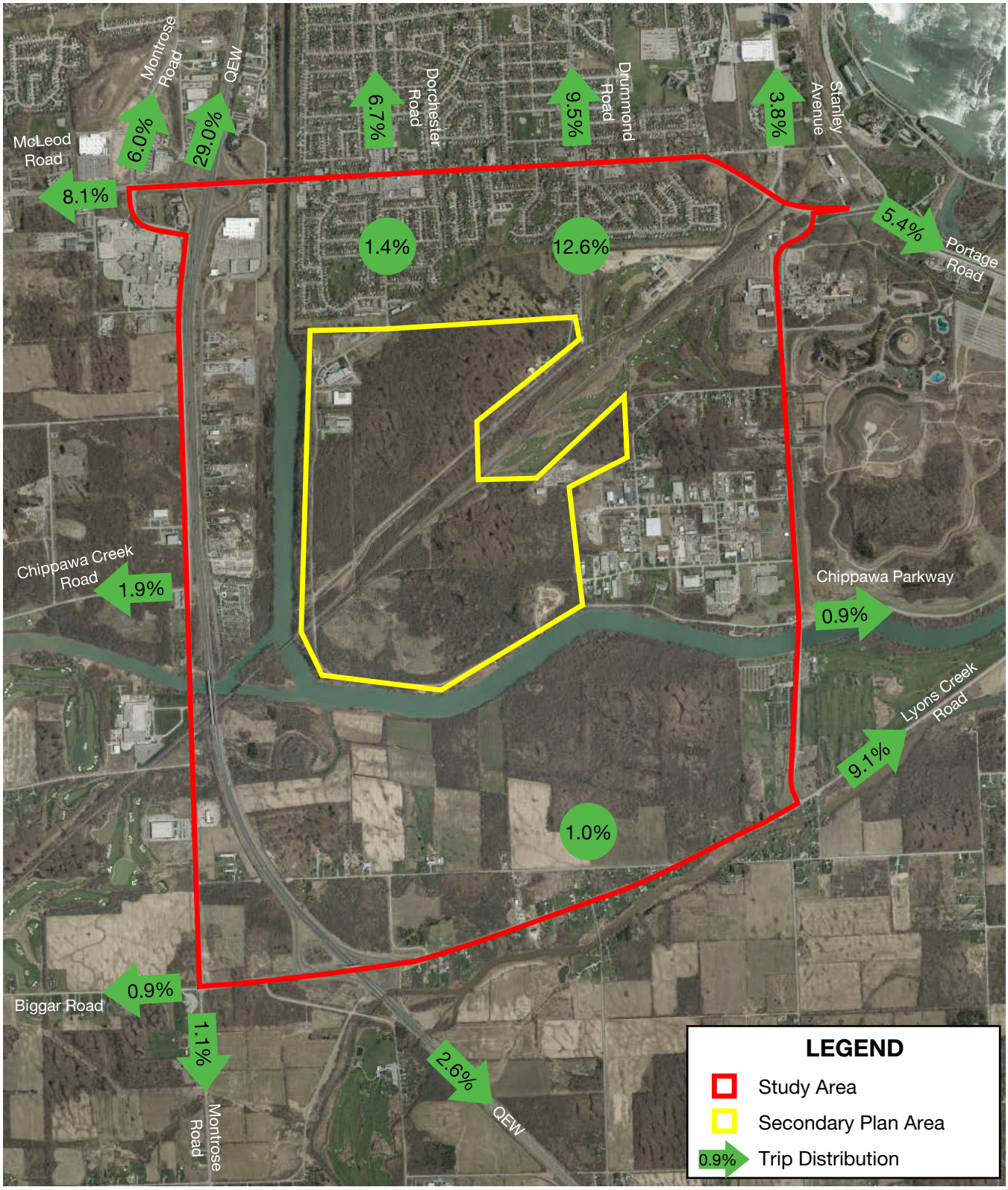
TABLE 6.6: MODEL AND REVISED TRIP DISTRIBUTION

			A	B	C	D	E
Zone		Origin/Destination	Model Distribution	Internal	Non QEW/ Non Internal	Additional 10% from QEW North	Revised Distribution
				15.0%	43.4%	10.0%	
External Gateways	1	West (McLeod)	11.3%		18.6%		8.1%
	2	North (Montrose)	8.4%		13.9%		6.0%
	3	North (QEW)	29.0%				29.0%
	4	North (Dorchester)	5.7%		9.4%	26.5%	6.7%
	5	North (Drummond)	8.0%		13.2%	37.2%	9.5%
	6	North (Stanley)	3.2%		5.3%	14.9%	3.8%
	7	East (Portage)	4.6%		7.6%	21.4%	5.4%
	8	East (Chippawa Parkway)	1.3%		2.1%		0.9%
	9	East (Lyons Creek)	12.7%		21.0%		9.1%
	10	South (QEW)	6.1%				2.6%
	11	South (Montrose)	1.5%		2.5%		1.1%
	12	West (Biggar)	1.2%		2.0%		0.9%
	13	West (Chippawa Creek)	2.7%		4.5%		1.9%
Internal Nodes	14	Internal (North Dorchester)	0.4%	9.3%			1.4%
	15	Internal (North Drummond)	3.6%	83.7%			12.6%
	16	Internal (South)	0.3%	7.0%			1.0%
		Total	100.0%	100.0%	100.0%	100.0%	100.0%

The table also summarizes the revised trip distribution used to complete the Study analyses (see Column E). This distribution, which is based on the values cited in **Table 6.5**, was calculated by:

- Applying the trip distribution values for the QEW North and QEW South zones (29.0% and 2.6% of total, respectively) to the North (QEW) and South (QEW) external gateways, respectively;
- Allocating the Internal zone trips (15.0% of total) to the three (3) internal nodes (see Column B);
- Allocating the Non QEW/Non Internal zone trips before 10% reallocation from the QEW North zone (43.4% of total) to the 11 remaining external gateways (see Column C); and
- Assigning the 10% reallocation from the QEW North zone to the following four (4) external gateways: North (Dorchester Road), North (Drummond Road), North (Stanley Avenue) and East (Portage Road) (see Column D).

Figure 6.6 illustrates the revised trip distribution estimates.



Trip Distribution

Thundering Waters Transportation Master Plan
151385

Figure 6.6

6.6 Trip Assignment

Forecast traffic volumes for the Thundering Waters lands shown in **Table 6.4** were manually assigned to the Study Area road network based on the traffic distribution pattern in **Table 6.6** and the area road network characteristics. **Figures 6.7, 6.8** and **6.9** illustrate the development-related traffic volumes based on this assignment.

At the outset of the Study, a VISSIM micro-simulation model of the Study Area road network was created to assist with the trip assignment and traffic impact analysis. Three VISSIM models calibrated to existing summer weekday morning, weekday afternoon and Saturday midday peak hour traffic conditions were developed and initially used to complete the analysis. Unfortunately, the models became unstable when applied with future traffic conditions and their application proved impractical for the Study.

6.7 Future Total Traffic

The future background traffic forecasts (**Figures 6.1, 6.2** and **6.3**) were combined with the Thundering Waters lands traffic assignments (**Figures 6.7, 6.8** and **6.9**) to estimate the future total traffic volumes for the 2031 horizon year. **Figures 6.10, 6.11** and **6.12** summarize the volumes for the summer weekday morning, weekday afternoon, and Saturday midday peak hours, respectively.

6.8 Traffic Impact Assessment

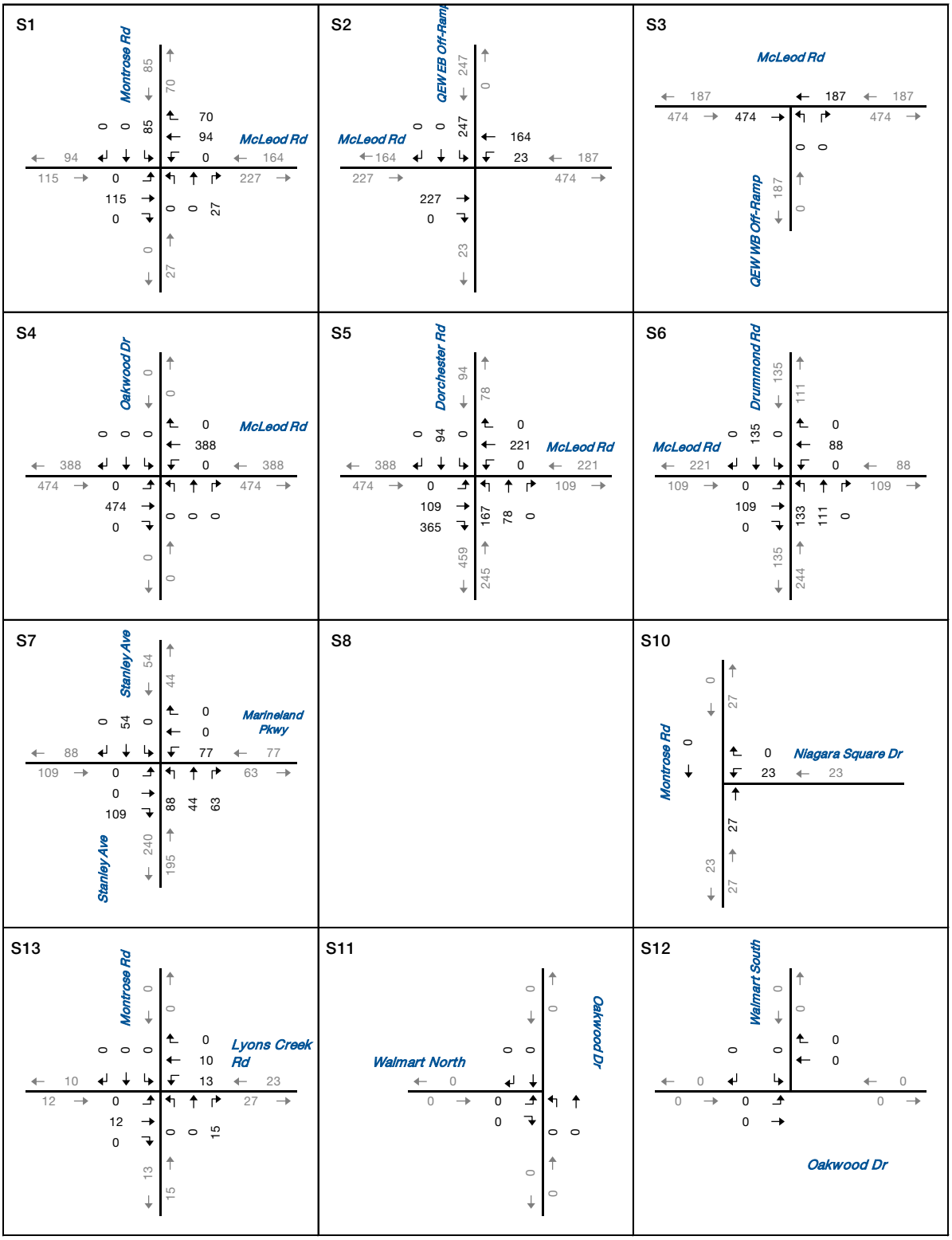
The assessment of future traffic impact was based on an iterative approach that examined the forecasted peak hour traffic volumes and various modes of intersection traffic control to develop recommended lane requirements. This process balances the need for high levels of service and safe operation, with the desire to design a transportation network that encourages all modes of travel.

6.8.1 Planned and Programmed Road Network Improvements

The following summarizes the planned road network improvements in the vicinity of the Thundering Waters lands by the year 2031. The list of improvements was obtained from two (2) sources:

Niagara Falls Sustainable Transportation Master Plan

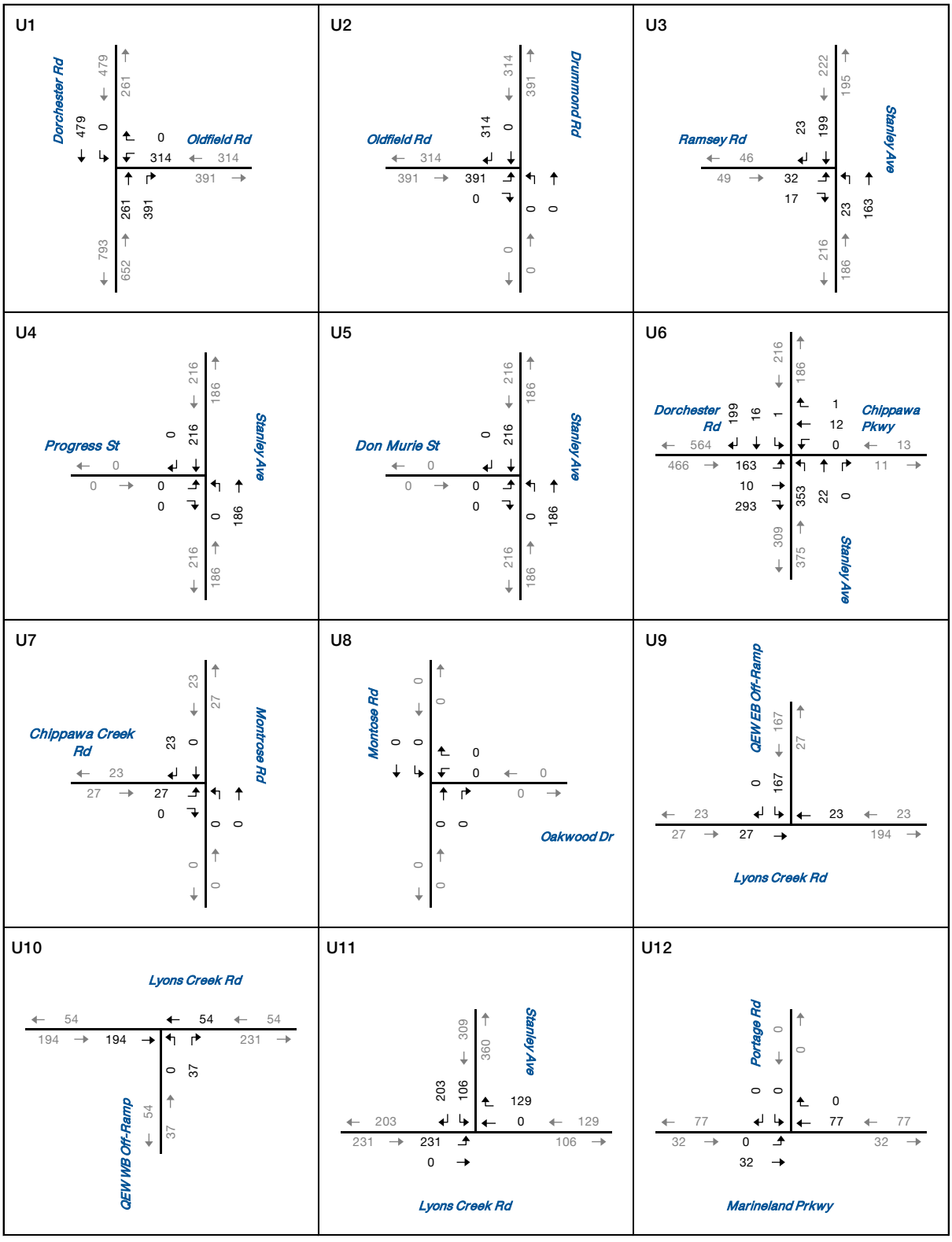
- Widening of Dorchester Road and Drummond Road north from McLeod Road from two (2) to four (4) lanes. (It is noted that these road expansion projects are not required to support development of the Thundering Waters lands).
- Jog elimination or improvement at Stanley Avenue and Marineland Parkway intersection



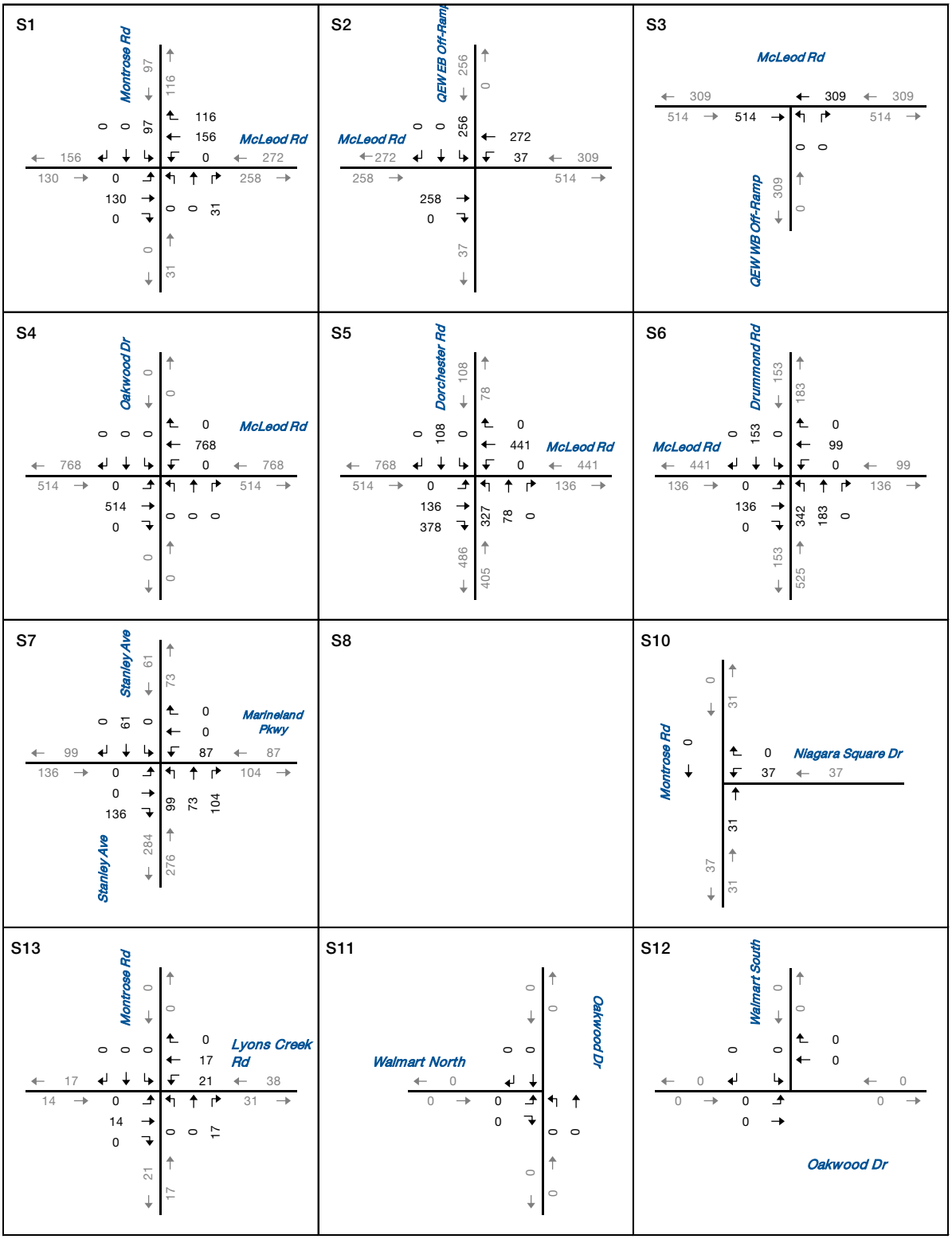
Site Generated Traffic Volumes Weekday AM Peak Hour (Signalized Intersections)

Thundering Waters Transportation Master Plan
151385

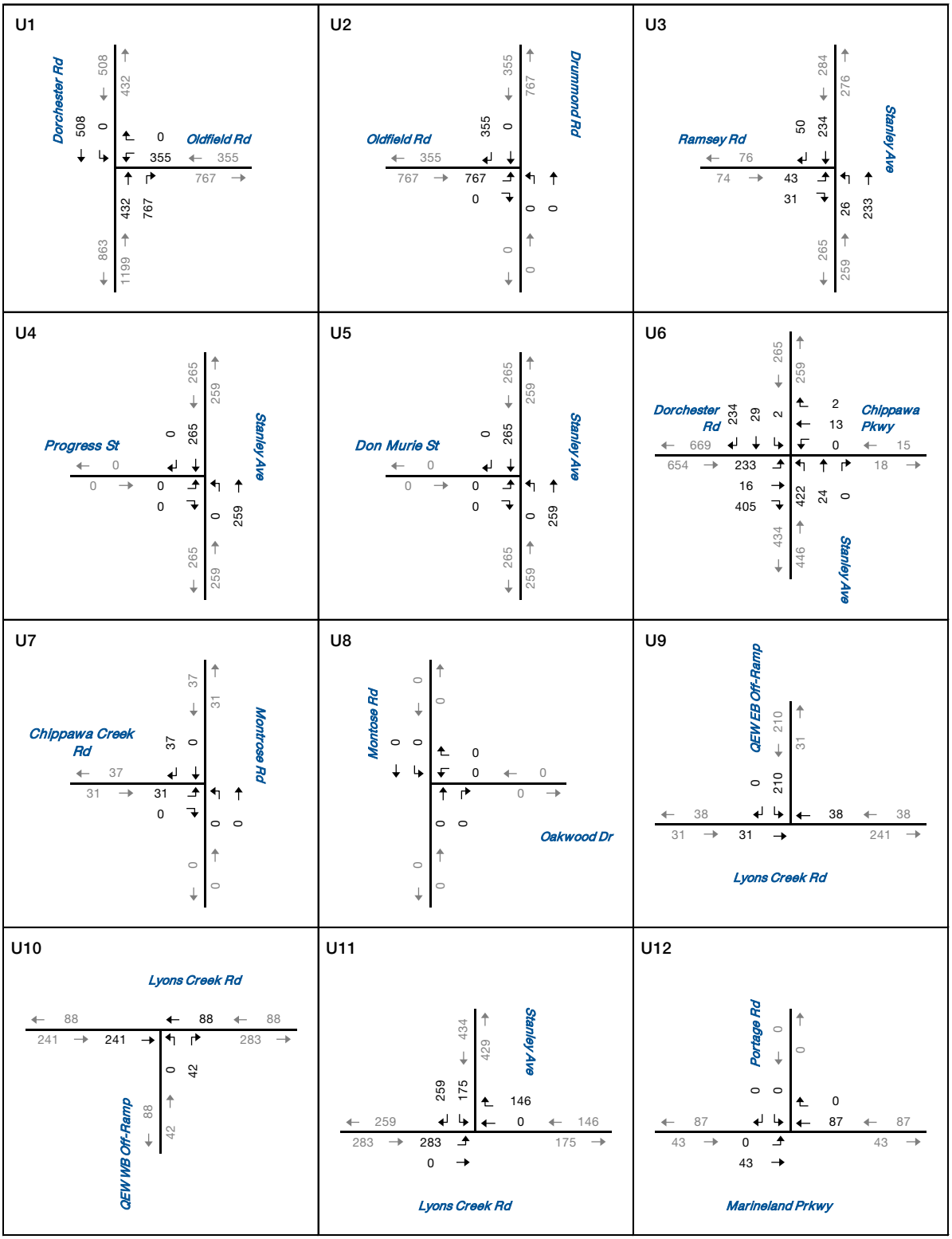
Figure 6.7A



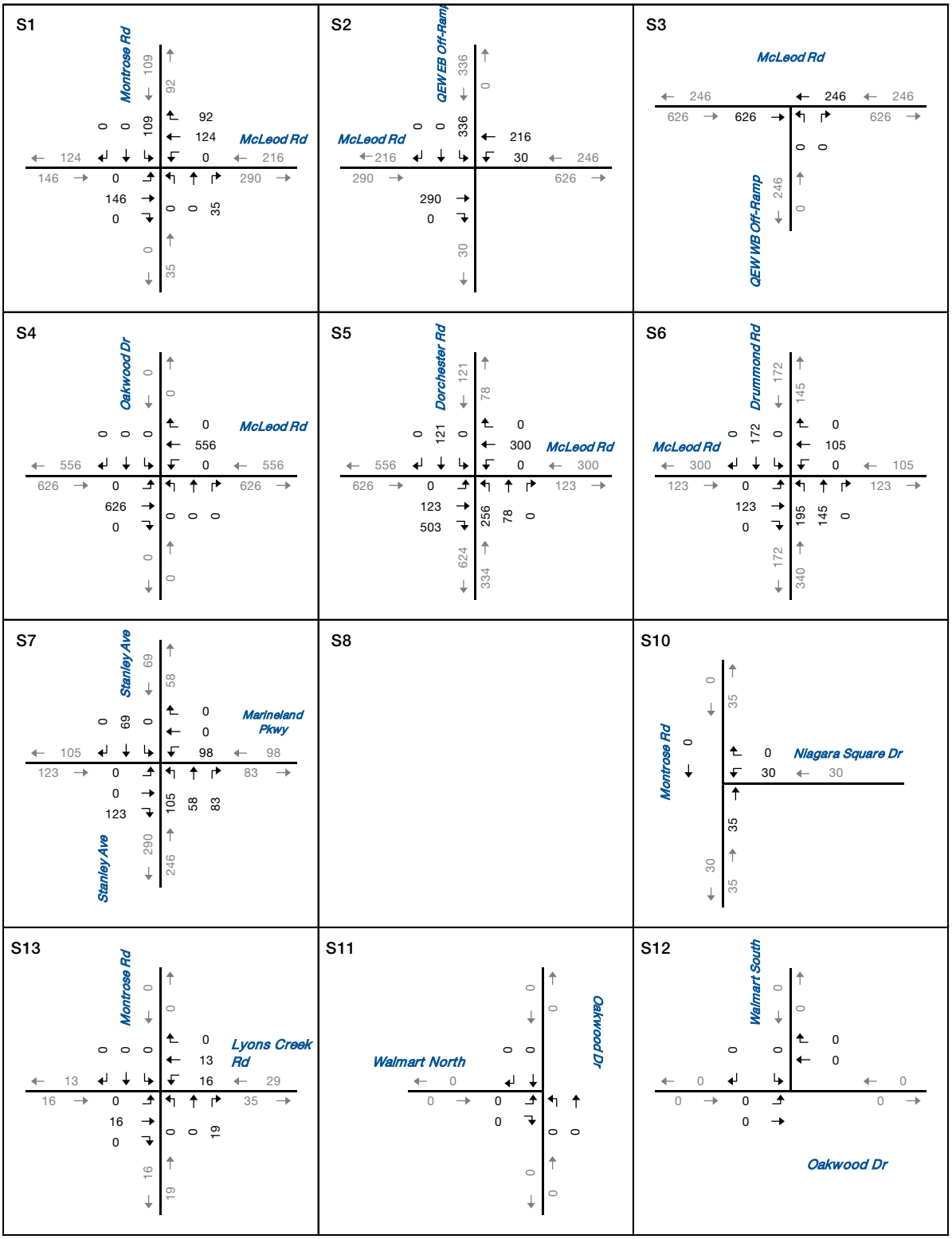
Site Generated Traffic Volumes Weekday AM Peak Hour (Unsignalized Intersections)



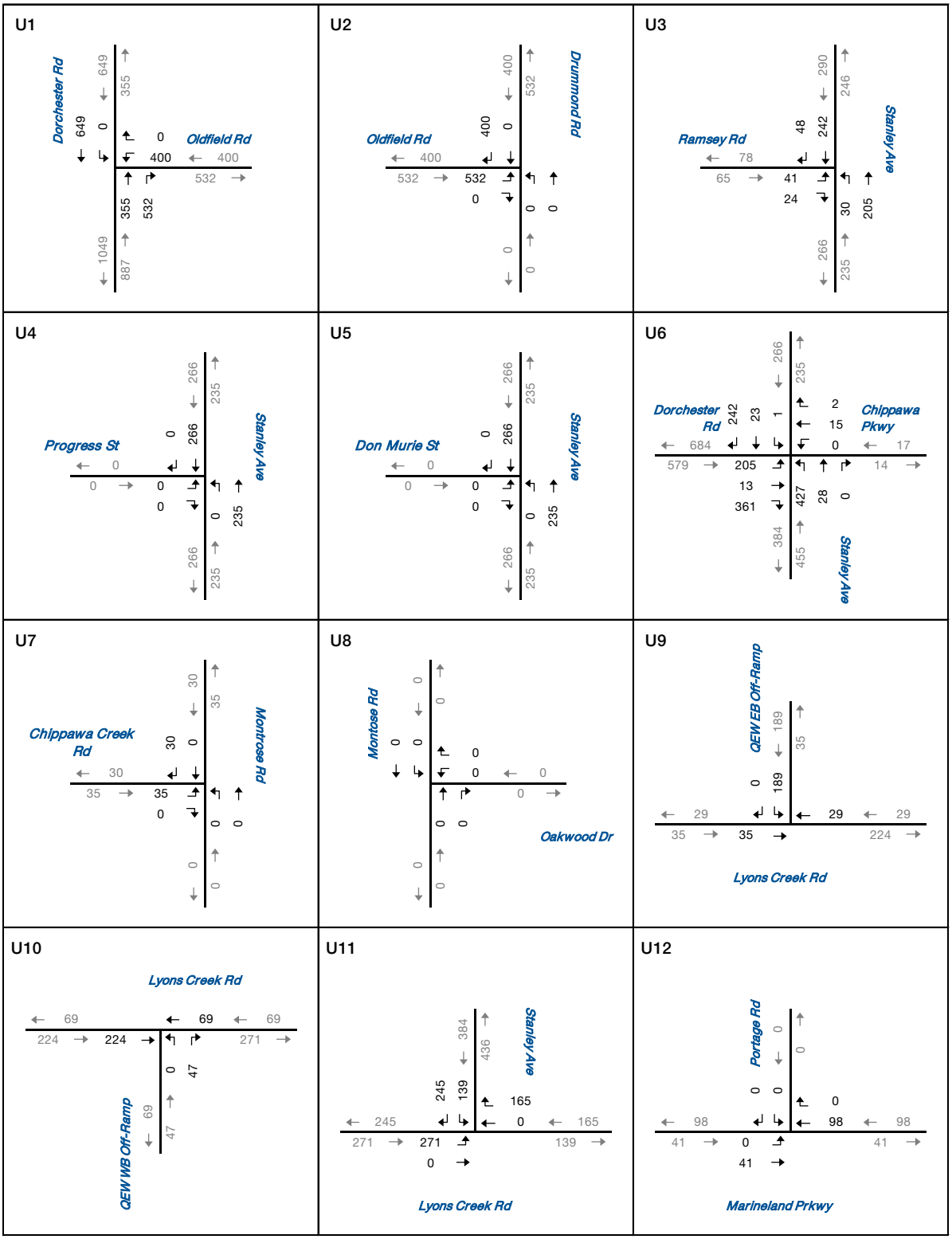
Site Generated Traffic Volumes Weekday PM Peak Hour (Signalized Intersections)



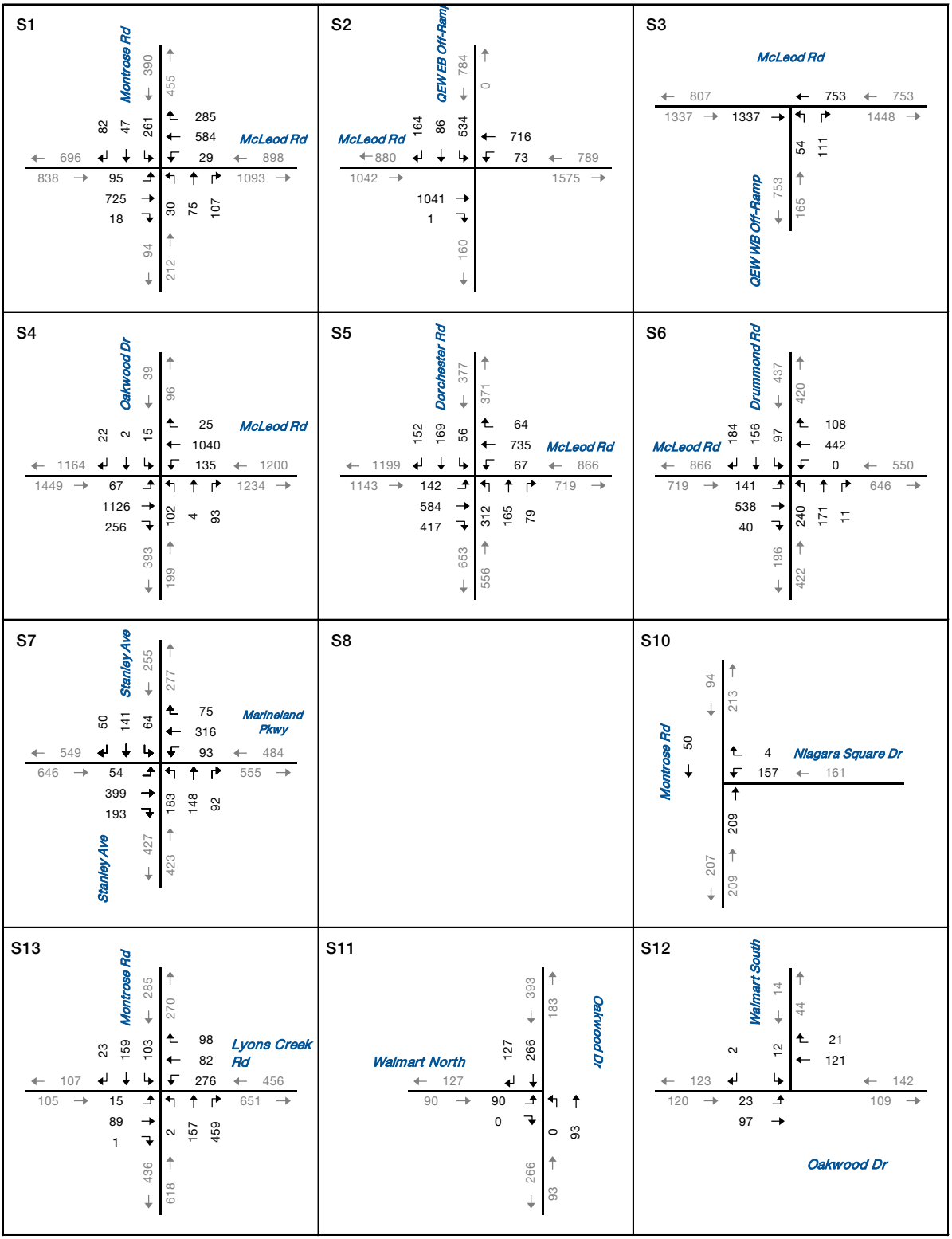
Site Generated Traffic Volumes Weekday PM Peak Hour (Unsignalized Intersections)



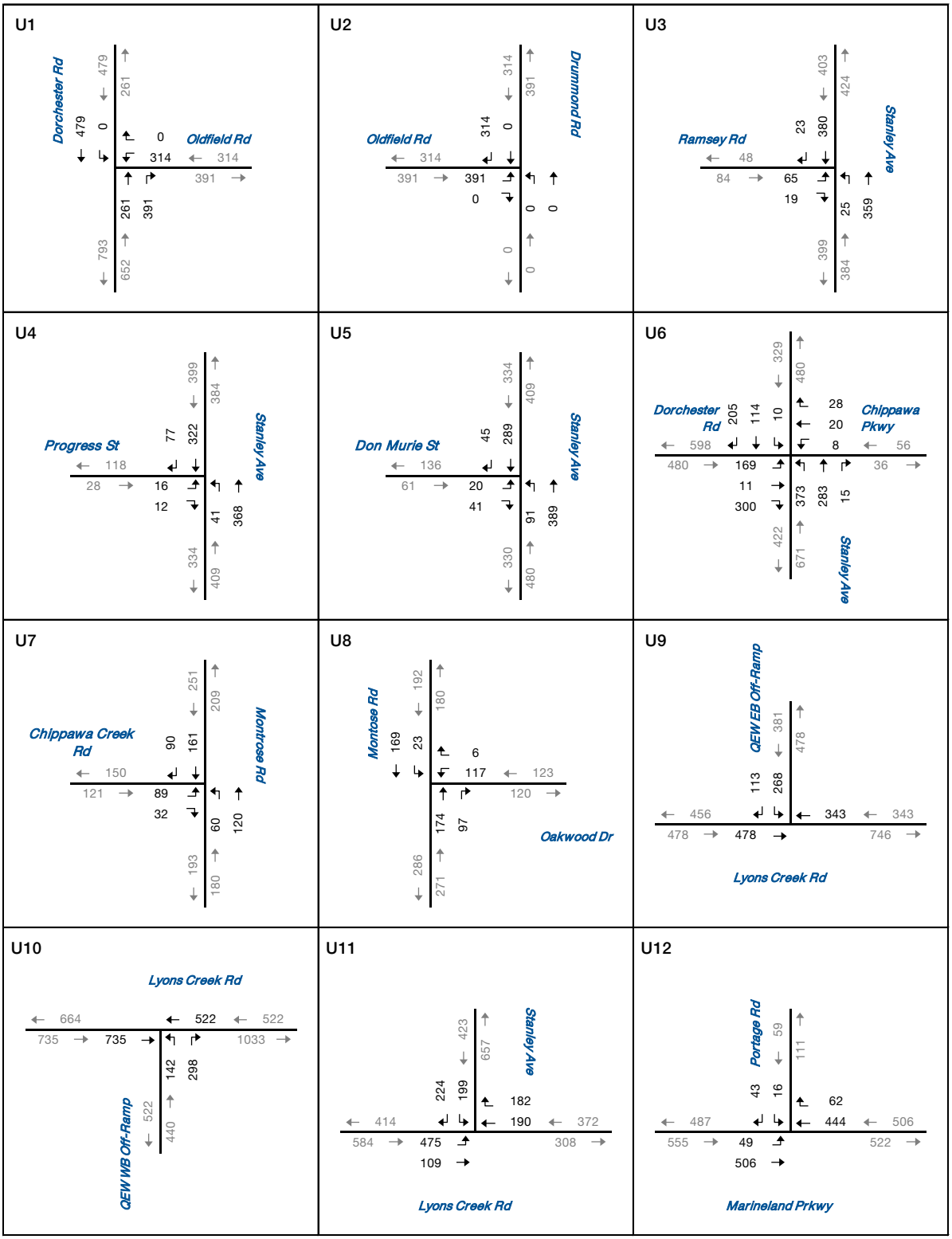
Site Generated Traffic Volumes Saturday Midday Peak Hour (Signalized Intersections)



Site Generated Traffic Volumes Saturday Midday Peak Hour (Unsignalized Intersections)



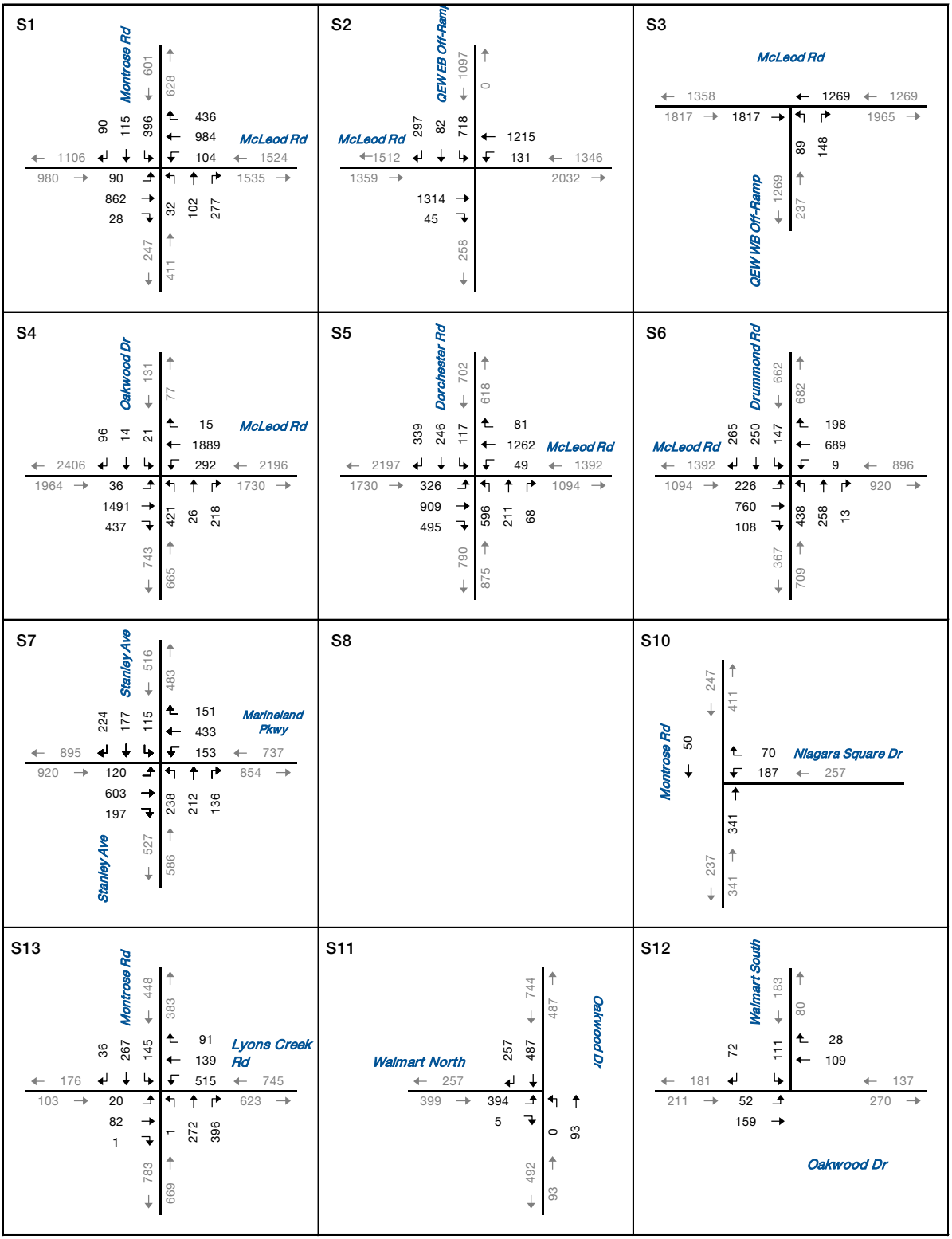
2031 Future Total Traffic Volumes Weekday AM Peak Hour (Signalized Intersections)



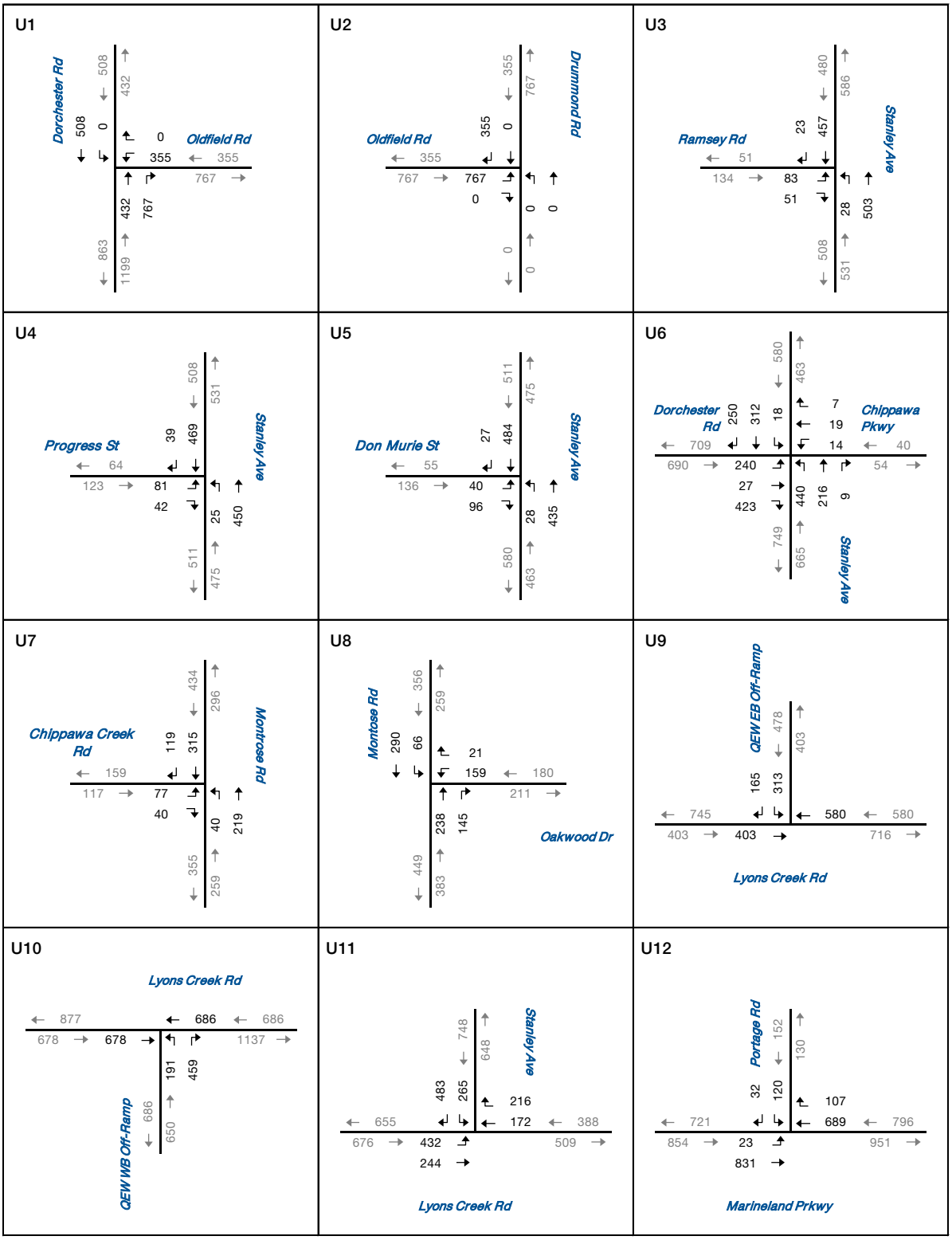
2031 Future Total Traffic Volumes Weekday AM Peak Hour (Unsignalized Intersections)

Thundering Waters Transportation Master Plan
151385

Figure 6.10B



2031 Future Total Traffic Volumes Weekday PM Peak Hour (Signalized Intersections)



2031 Future Total Traffic Volumes Weekday PM Peak Hour (Unsignalized Intersections)

Thundering Waters Transportation Master Plan
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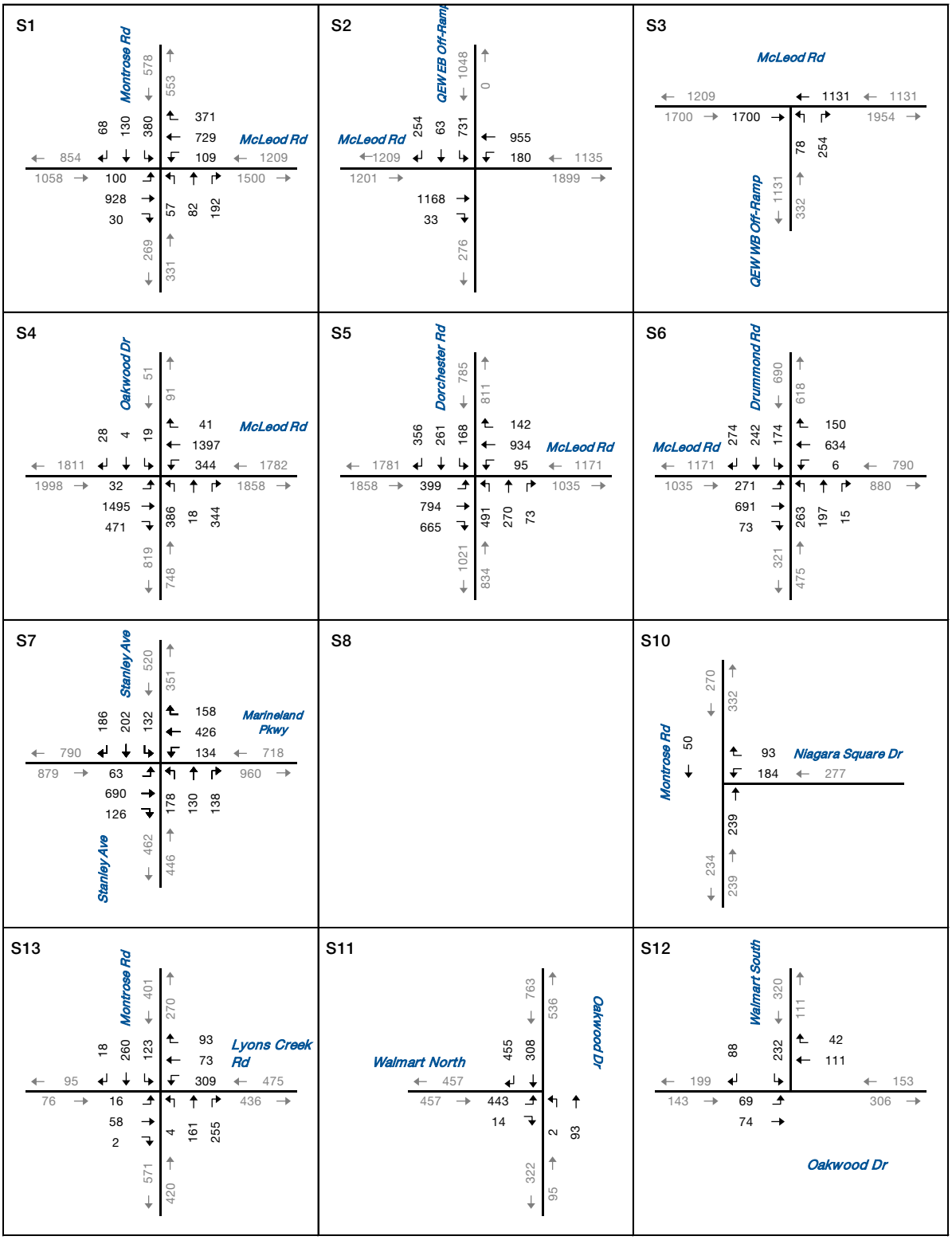
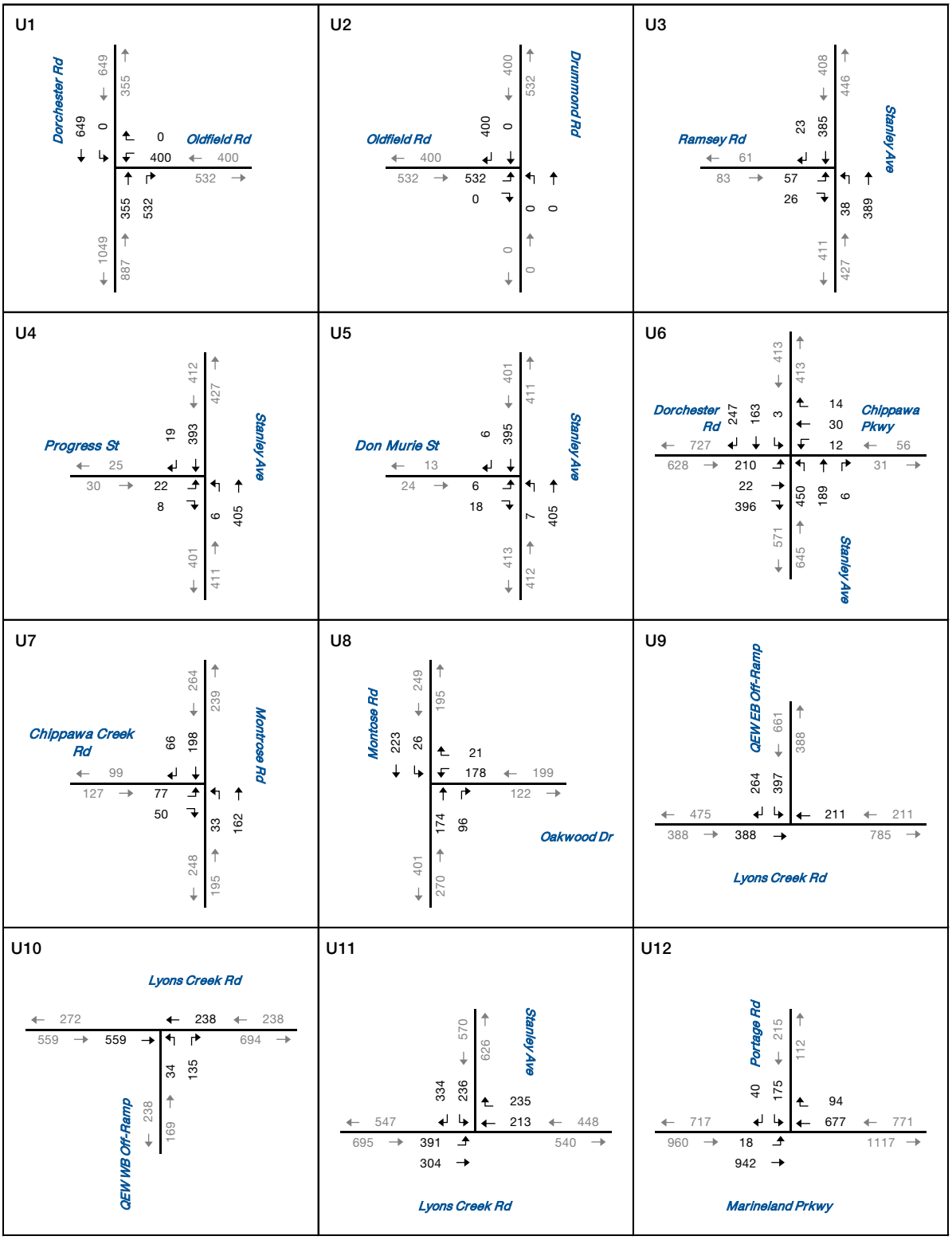
Figure 6.11B



2031 Future Total Traffic Volumes Saturday Midday Peak Hour (Signalized Intersections)

Thundering Waters Transportation Master Plan
151385

Figure 6.12A



2031 Future Total Traffic Volumes Saturday Midday Peak Hour (Unsignalized Intersections)

These road improvements are not currently identified in the City of Niagara Falls (Dorchester Road or Drummond Road) or Niagara Region (Stanley Avenue and Marineland Parkway) long-term capital programs.

The Sustainable Transportation Master Plan also identifies a new OPG Canal Crossing from Dorchester Road to Oakwood Drive (or Welland River Crossing). This crossing is not assumed as part of the base network improvements for the analyses in the remainder of Section 6.8. The implications of this crossing are assessed in further detail in Section 6.9

McLeod Road and Montrose Road EA

- Widening of McLeod Road from Montrose Road to Oakwood Drive from four (4) to six (6) lanes with auxiliary turn lanes at intersections, including dual westbound left turn lanes at Oakwood Drive.
- Intersection improvements at McLeod Road/Marineland Parkway and:
  - Sharon Avenue/Jubilee Drive, Drummond Road and Alex Avenue to provide eastbound and westbound left turn lanes;
  - Dorchester Road to provide dual eastbound left turn lanes; and
  - Portage Road and Old McLeod Road to provide eastbound left turn lane.
- Provision of a centre two-way left turn lane on McLeod Road from Oakwood Drive to west of Stanley Avenue where auxiliary left turn lanes are not provided (longer term).
- Widening of Montrose Road from 2 to 4 lanes from McLeod Road to north entrance of MacBain Community Centre and from two (2) to three (3) lanes (two (2) southbound and one (1) northbound) north of the community centre, with auxiliary turn lanes at intersections.

The McLeod Road improvements are currently identified in the 2016 Niagara Region ten-year capital forecast for implementation as follows:

- Phase 1 (Montrose Road to Hydro Electric Power Canal) – 2018/2019, subject to further discussion with the Ministry of Transportation (MTO) regarding the structure over the QEW
- Phase 2 (Hydro Electric Power Canal to Wilson Crescent) – 2019/2020
- Phase 3 (Wilson Crescent to Stanley Avenue) – six (6) to ten (10) year forecast

6.8.2 Road Network Improvements to Address Existing Conditions

The operational analyses of existing traffic conditions in Section 3.3 identified critical turning movements at three (3) intersections within the Study Area currently, and noted that the following improvements could address these concerns:

- McLeod Road and Oakwood Drive – A second northbound left turn movement with optimized signal cycle and phase timings.
- McLeod Road and Dorchester Road – An exclusive southbound right turn lane with optimized signal phase timings.
- Montrose Road and Lyons Creek Road/Biggar Road – Exclusive westbound and southbound left turn lanes.

These road improvements are not currently identified in either the City of Niagara Falls or Niagara Region long-term capital programs.

6.8.3 Future Background Traffic Operations with Base Network Improvements

Intersection capacity analyses were undertaken to assess future background peak hour traffic conditions for the Study Area intersections. The analyses followed the same methodology and parameters as used for the existing conditions analysis, but assumed the base road network improvements identified in Sections 6.8.1 and 6.8.2 above would be implemented by 2031. Signal timings were also optimized using Synchro.

Tables 6.7, 6.8 and **6.9** summarize the analysis results for the summer weekday morning, weekday afternoon and Saturday midday future background traffic forecasts, respectively (**Figures 6.1, 6.2** and **6.3**). **Appendix F** provides the Synchro analysis output. The following is noted from the analyses:

- **Weekday Morning Peak Hour** – All intersections are forecast to operate with satisfactory levels of service and no critical turning movements.
- **Weekday PM Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements were noted at the following intersections:
  - McLeod Road and Oakwood Drive (eastbound through);
  - McLeod Road and Dorchester Drive (northbound left); and
  - Marineland Parkway and Portage Road (southbound left).
- **Saturday Midday Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements were noted at the following intersection:
  - Marineland Parkway and Portage Road (southbound left).

With the exception of a few turning movements that are approaching, but not, exceeding capacity, overall traffic conditions are expected to be within acceptable levels of service for the 2031 horizon year without the Thundering Waters development. Since the intersections are expected to operate with satisfactory levels of service for the 2031 horizon year, no further improvements would be required. Traffic control signals at Marineland Parkway and Portage Road may be warranted to address the critical southbound left turn movement.

TABLE 6.7A: FUTURE BACKGROUND TRAFFIC OPERATIONS SUMMARY, WEEKDAY AM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Overall
AM Peak Hour	McLeod Road & Montrose Road	TCS	LOS	B	B	B	**B**	A	A	A	**A**	B	B	B	**B**	B	B		**B**	**B**
			Delay	13	14	11	**14**	8	7	8	**7**	13	13	13	**13**	16	13		**15**	**12**
			V/C	0.39	0.58	0.01		0.11	0.31	0.17		0.10	0.16	0.07		0.51	0.09			
			Q	23	52	0		6	30	10		9	17	9		39	8			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		B	B	**B**	A	A		**A**					B	B	B	**B**	**B**
			Delay		14	13	**15**	8	6		**6**					16	16	14	**16**	**12**
			V/C		0.55	0.00		0.16	0.24							0.44	0.45	0.13		
			Q		44	0		8	21							39	40	12		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		**A**		A		**A**	A		A	**A**					**A**
			Delay		7		**7**		7		**7**	8		8	**8**					**7**
			V/C		0.46				0.31			0.05		0.12						
			Q		20				13			4		9						
	McLeod Road & Oakwood Drive	TCS	LOS	B	B	B	**B**	C	A		**B**	C	B	B	**C**	C	C		**C**	**B**
			Delay	15	17	14	**16**	25	8		**11**	27	14	14	**21**	21	21		**21**	**15**
			V/C	0.33	0.63	0.19		0.37	0.42			0.39	0.01	0.07		0.07	0.02			
			Q	16	51	13		18	34			15	2	10		7	6			
	McLeod Road & Dorchester Road	TCS	LOS	C	B		**B**	B	C		**C**	B	C		**C**	C	C	C	**C**	**C**
			Delay	23	17		**18**	14	21		**20**	19	22		**21**	21	23	24	**23**	**20**
			V/C	0.27	0.52			0.21	0.66			0.44	0.41			0.20	0.24	0.12		
			Q	20	53			12	64			31	38			14	22	16		
	McLeod Road & Drummond Road	TCS	LOS	A	A		**A**	A	A		**A**		A		**A**	A	A	A	**A**	**A**
			Delay	9	8		**8**	0	8		**8**		10		**10**	9	8	10	**10**	**8**
			V/C	0.46	0.37			0.00	0.36				0.39			0.25	0.04	0.14		
			Q	23	25			0	23				31			18	6	12		
	Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	TCS	LOS	B	B	B	**B**	B	C	B	**C**	C	C		**C**	C	B		**C**	**B**
			Delay	14	13	11	**13**	18	22	19	**21**	23	23		**23**	22	19		**21**	**18**
			V/C	0.21	0.38	0.01		0.02	0.55	0.14		0.00	0.01			0.44	0.05			
			Q	12	39	0		3	45	15		2	3			38	9			
	Marineland Parkway & Stanley Avenue	TCS	LOS		A	A	**A**	A	A		**A**	A		A	**A**					**A**
			Delay		6	6	**6**	6	7		**6**	8		7	**8**					**7**
			V/C		0.38	0.14		0.06	0.33			0.23		0.02						
			Q		17	6		3	15			10		3						
	Montrose Road & Niagara Square Drive	TCS	LOS					A			**A**		A		**A**		A		**A**	**A**
			Delay					6			**6**		6		**6**		6		**6**	**6**
			V/C					0.14					0.17				0.09			
			Q					4					6				3			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**		A		**B**		B		**B**		B		**B**	**B**
			Delay		8		**8**	13	9		**11**		11	14	**13**	12	12		**12**	**12**
			V/C		0.14			0.56	0.19				0.27	0.34		0.30	0.35			
			Q		16			50	16				30	18		23	34			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	A			**A**						A		**A**		A		**A**	**A**
			Delay	8			**8**						6		**6**		6		**6**	**6**
			V/C	0.18									0.10				0.28			
			Q	9									4				10			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**A**
			Delay	8	5		**6**		13	12	**12**					12		12	**12**	**10**
			V/C	0.05	0.12				0.26	0.02						0.02		0.00		
			Q	3	9				19	0						2		0		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.7B: FUTURE BACKGROUND TRAFFIC OPERATIONS SUMMARY, WEEKDAY AM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.05 1	A 0 0.14 0		**A** **1**		A 0 0.12 0	A 0 0.04 0	**A** **0**					C 17 0.05 1		A 10 0.06 2	**B** **12**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	B 12 0.07 2			**B** **12**						A 0 0.00 0		**A** **0**		A 0 0.12 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 11 0.05 1			**B** **11**						A 2 0.03 1		**A** **2**		A 0 0.12 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 11 0.10 3			**B** **11**						A 3 0.07 2		**A** **3**		A 0 0.08 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		B 12 0.03 1		**B** **12**		B 11 0.08 2		**B** **11**		A 1 0.01 0		**A** **1**		A 1 0.01 0		**A** **1**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	B 12 0.43	A 8 0.17		**B** **11**		B 11 0.38		**B** **11**					B 10 0.19		A 8 0.04	**A** **10**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.17 0		**A** **0**		A 0 0.15 0		**A** **0**	C 20 0.55 27		A 0 0.00 0	**C** **20**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.14 0		**A**		A 0 0.10 0		**A**					B 13 0.25 8		A 0 0.00 0	**B** **11**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					B 14 0.24 8			**B** **14**		A 0 0.17 0		**A** **0**		A 1 0.02 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 12 0.17 5			**B** **12**					A 8 0.06 1	A 0 0.08 0		**A** **3**		A 0 0.10 0	A 0 0.04 0	**A** **0**	

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Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.8A: FUTURE BACKGROUND TRAFFIC OPERATIONS SUMMARY, WEEKDAY PM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Overall
PM Peak Hour	McLeod Road & Montrose Road	TCS	LOS	B	C	B	C	B	B	B	B	B	B	B	B	C	B		C	B
			Delay	20	20	14	20	13	12	11	12	15	15	15	15	26	15		22	16
			V/C	0.53	0.68	0.02		0.44	0.54	0.24		0.09	0.18	0.19		0.75	0.15			
			Q	30	80	0		19	70	13		11	25	15		91	15			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		B		B	B	A		A					C	C	C	C	B
			Delay		19		19	12	9		9					24	24	23	23	17
			V/C		0.72			0.38	0.38							0.61	0.63	0.58		
			Q		97			17	48							69	72	60		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		A		A		A	B		B	B					A
			Delay		8		8		7		7	11		13	12					8
			V/C		0.59				0.43			0.10		0.33						
			Q		44				30			8		24						
	McLeod Road & Oakwood Drive	TCS	LOS	C	D	C	D	D	B		C	D	B	B	D	C	C		C	C
			Delay	24	47	23	39	44	18		24	47	18	19	37	33	35		35	32
			V/C	0.35	0.96	0.36		0.73	0.73			0.83	0.05	0.16		0.11	0.41			
			Q	17	159	28		51	129			74	9	14		11	32			
	McLeod Road & Dorchester Road	TCS	LOS	D	B		C	B	C		C	E	C		D	C	C	D	D	C
			Delay	42	19		26	19	32		31	61	31		48	32	34	38	36	33
			V/C	0.73	0.65			0.24	0.84			0.92	0.52			0.48	0.46	0.62		
			Q	62	114			12	146			79	54			30	44	56		
	McLeod Road & Drummond Road	TCS	LOS	B	A		A	B	B		B		B		B	C	B	B	B	B
			Delay	13	7		8	13	20		20		20		20	20	17	19	19	15
			V/C	0.64	0.42			0.05	0.74				0.53			0.53	0.22	0.20		
			Q	48	45			4	77				37			32	20	15		
	Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	TCS	LOS	B	B	B	B	C	C	C	C	C	C		C	C	C		C	C
			Delay	17	16	12	16	21	27	23	25	31	31		31	28	23		25	22
			V/C	0.47	0.50	0.00		0.04	0.64	0.27		0.11	0.02			0.59	0.18			
			Q	28	71	0		5	75	26		13	6			69	18			
	Marineland Parkway & Stanley Avenue	TCS	LOS		A	A	A	A	A		A	B		A	B					A
			Delay		7	6	7	7	7		7	10		9	10					7
			V/C		0.52	0.15		0.32	0.41			0.32		0.02						
			Q		33	7		11	25			19		5						
	Montrose Road & Niagara Square Drive	TCS	LOS					A			A		A		A		A		A	A
			Delay					6			6		7		7		6		6	6
			V/C					0.18					0.29				0.22			
			Q					6					10				8			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		A	C	A		C		B	B	B	C	C		C	B
			Delay		8		8	26	9		21		20	17	18	28	21		23	20
			V/C		0.12			0.86	0.24				0.52	0.30		0.64	0.55			
			Q		14			132	24				55	17		41	60			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			B						A		A		B		B	B
			Delay	13			13						9		9		10		10	11
			V/C	0.64									0.22				0.55			
			Q	64									18				43			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		A		B	B	B					B		B	B	A
			Delay	8	6		6		13	12	12					12		12	12	10
			V/C	0.12	0.19				0.24	0.02						0.14		0.05		
			Q	6	14				17	0						8		0		

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LOS - Level of Service
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Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control
RBT - Roundabout

TABLE 6.8B: FUTURE BACKGROUND TRAFFIC OPERATIONS SUMMARY, WEEKDAY PM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.03 1	A 0 0.23 0		**A** **0**		A 0 0.19 0	A 0 0.07 0	**A** **0**					F 52 0.65 31		B 11 0.05 1	**E** **43**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	B 12 0.12 3			**B** **12**						A 0 0.00 0		**A** **0**		A 0 0.16 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 13 0.23 7			**B** **13**						A 1 0.06 1		**A** **1**		A 0 0.16 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 12 0.22 7			**B** **12**						A 1 0.03 1		**A** **1**		A 0 0.16 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		B 13 0.08 2		**B** **13**		B 14 0.06 2		**B** **14**		A 1 0.02 0		**A** **1**		A 1 0.01 0		**A** **1**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	B 11 0.29	B 13 0.46		**B** **12**		B 13 0.43		**B** **13**					B 15 0.47		A 9 0.16	**B** **13**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.14 0		**A** **0**		A 0 0.29 0		**A** **0**	D 33 0.85 81		A 0 0.00 0	**D** **33**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.12 0		**A**		A 0 0.17 0		**A**					C 16 0.35 13		A 0 0.00 0	**C** **16**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					D 27 0.55 25			**D** **27**		A 0 0.25 0		**A** **0**		A 2 0.06 2		**A** **2**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 14 0.19 6			**B** **14**					A 8 0.04 1	A 0 0.14 0		**A** **1**		A 0 0.20 0	A 0 0.05 0	**A** **0**	

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LOS - Level of Service
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Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.9A: FUTURE BACKGROUND TRAFFIC OPERATIONS SUMMARY, SATURDAY MIDDAY PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Overall
Saturday Peak Hour	McLeod Road & Montrose Road	TCS	LOS	B	B	B	**B**	B	A	A	**A**	B	B	B	**B**	C	B		**C**	**B**
			Delay	17	19	13	**19**	12	9	10	**10**	16	16	15	**16**	25	16		**21**	**15**
			V/C	0.44	0.69	0.02		0.44	0.38	0.21		0.17	0.15	0.12		0.71	0.16			
			Q	30	85	1		19	46	12		16	21	13		73	16			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		B		**B**	B	A		**A**					C	C	B	**C**	**B**
			Delay		17		**17**	12	7		**8**					21	21	20	**21**	**15**
			V/C		0.68			0.54	0.30							0.54	0.54	0.41		
			Q		81			25	32							55	55	36		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		**A**		A		**A**	A		B	**B**					**A**
			Delay		9		**9**		8		**8**	10		12	**11**					**9**
			V/C		0.53				0.44			0.08		0.47						
			Q		39				31			7		37						
	McLeod Road & Oakwood Drive	TCS	LOS	B	C	C	**C**	D	B		**C**	D	B	C	**C**	C	C		**C**	**C**
			Delay	20	29	21	**26**	44	13		**21**	42	19	21	**32**	34	33		**33**	**26**
			V/C	0.19	0.80	0.35		0.78	0.53			0.78	0.03	0.28		0.12	0.04			
			Q	12	104	22		55	70			59	7	22		10	9			
	McLeod Road & Dorchester Road	TCS	LOS	D	C		**C**	C	C		**C**	D	C		**D**	D	C	C	**C**	**C**
			Delay	42	22		**28**	22	34		**33**	38	35		**36**	44	30	29	**33**	**32**
			V/C	0.77	0.66			0.42	0.81			0.76	0.67			0.79	0.37	0.27		
			Q	70	109			21	122			60	77			46	43	23		
	McLeod Road & Drummond Road	TCS	LOS	B	A		**A**	B	C		**C**		B		**B**	C	B	B	**B**	**B**
			Delay	12	7		**9**	16	21		**21**		18		**18**	21	17	19	**19**	**15**
			V/C	0.64	0.37			0.04	0.70				0.35			0.56	0.15	0.21		
			Q	55	42			4	69				29			40	17	16		
	Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	TCS	LOS	B	B	B	**B**	C	C	C	**C**	C	C		**C**	C	C		**C**	**C**
			Delay	17	18	14	**18**	21	26	22	**24**	29	29		**29**	26	20		**24**	**22**
			V/C	0.28	0.56	0.01		0.05	0.61	0.17		0.06	0.05			0.61	0.16			
			Q	16	72	0		5	65	18		9	9			72	17			
	Marineland Parkway & Stanley Avenue	TCS	LOS		A	A	**A**	A	A		**A**	B		A	**B**					**A**
			Delay		7	5	**7**	5	6		**6**	10		10	**10**					**7**
			V/C		0.55	0.11		0.16	0.39			0.18		0.04						
			Q		31	5		5	21			11		6						
	Montrose Road & Niagara Square Drive	TCS	LOS					A			**A**		A		**A**		A		**A**	**A**
			Delay					6			**6**		6		**6**		6		**6**	**6**
			V/C					0.19					0.19				0.25			
			Q					6					7				8			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**	B	A		**B**		B	B	**B**	B	B		**B**	**B**
			Delay		8		**8**	16	9		**13**		12	13	**13**	15	14		**14**	**13**
			V/C		0.08			0.61	0.15				0.27	0.17		0.35	0.45			
			Q		11			60	15				35	15		31	58			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			**B**						B		**B**		B		**B**	**B**
			Delay	11			**11**						10		**10**		11		**11**	**11**
			V/C	0.65									0.31				0.48			
			Q	65									21				27			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**B**
			Delay	8	5		**7**		13	12	**12**					13		12	**13**	**11**
			V/C	0.15	0.09				0.25	0.03						0.28		0.06		
			Q	7	8				19	0						16		0		

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Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.9B: FUTURE BACKGROUND TRAFFIC OPERATIONS SUMMARY, SATURDAY MIDDAY PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
Saturday Peak Hour	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.02 1	A 0 0.27 0		**A** **0**		A 0 0.18 0	A 0 0.06 0	**A** **0**					F 110 0.98 66		B 11 0.06 2	**F** **92**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	B 11 0.03 1			**B** **11**						A 0 0.01 0		**A** **0**		A 0 0.11 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 10 0.05 1			**B** **10**						A 0 0.00 0		**A** **0**		A 0 0.09 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	A 10 0.03 1			**A** **10**						A 0 0.01 0		**A** **0**		A 0 0.09 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		B 10 0.07 2		**B** **10**		B 12 0.07 2		**B** **12**		A 1 0.02 0		**A** **1**		A 0 0.00 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	A 10 0.22	B 13 0.51		**B** **12**		B 13 0.46		**B** **13**					B 11 0.20		A 9 0.15	**A** **10**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.11 0		**A** **0**		A 0 0.05 0		**A** **0**	B 11 0.12 3		A 0 0.00 0	**B** **11**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.11 0		**A**		A 0 0.06 0		**A**					B 13 0.39 15		A 0 0.00 0	**B** **13**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					C 17 0.42 17			**C** **17**		A 0 0.17 0		**A** **0**		A 1 0.02 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 12 0.15 4			**B** **12**					A 8 0.03 1	A 0 0.10 0		**A** **1**		A 0 0.13 0	A 0 0.02 0	**A** **0**	

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RBT - Roundabout

6.8.4 Future Total Traffic Operations with Base Network Improvements

Intersection capacity analyses were undertaken to assess future total peak hour traffic conditions for the Study Area intersections. The analyses followed the same methodology and parameters used for the future background conditions analysis, and assumed the same base road network improvements. Signal timings were also optimized using Synchro.

Tables 6.10, 6.11 and **6.12** summarize the analysis results for the summer weekday morning, weekday afternoon and Saturday midday future total traffic forecasts, respectively (**Figures 6.10, 6.11** and **6.12**). **Appendix G** provides the Synchro analysis output. The following is noted from the analyses:

- **Weekday Morning Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements were noted at the following intersections:
  - McLeod Road and Dorchester Road (northbound left);
  - Stanley Avenue and Dorchester Road/Chippawa Parkway (eastbound left-through-right, westbound left-through-right); and
  - Lyons Creek Road and Stanley Avenue (eastbound left).
- **Weekday Afternoon Peak Hour** – With the exception of McLeod Road and Oakwood Drive (LOS F), McLeod Road and Dorchester Road (LOS F), and McLeod Road and Drummond Road (LOS F), the remaining intersections are forecast to operate with satisfactory levels of service. Critical turning movements were noted at the following intersections:
  - McLeod Road and Montrose Road (southbound left);
  - McLeod Road and Oakwood Drive (eastbound through and westbound through-right);
  - McLeod Road and Dorchester Road (eastbound through, westbound through-right and northbound left);
  - McLeod Road and Drummond Road (westbound through-right and northbound left-through-right);
  - Marineland Parkway and Stanley Avenue (northbound left);
  - Montrose Road and Lyons Creek Road/Biggar Road (westbound left);
  - Stanley Avenue and Dorchester Road/Chippawa Parkway (eastbound left-through-right and westbound left-through-right);
  - Lyons Creek and Stanley Avenue (eastbound left and southbound right);
  - Lyons Creek Road and QEW WB Off-Ramp (northbound left);
  - Lyons Creek Road and QEW EB Off-Ramp (southbound left);

- **Saturday Midday Peak Hour** – With the exception of McLeod Road and Oakwood Drive (LOS F), and McLeod Road and Dorchester Road (LOS F), the remaining intersections are forecast to operate with satisfactory levels of service. Critical turning movements were noted at the following intersections:
  - McLeod Road and Oakwood Drive (eastbound through and westbound through-right);
  - McLeod Road and Dorchester Road (eastbound through-right, northbound left and southbound left);
  - McLeod Road and Drummond Road (eastbound left, westbound through-right and northbound left-through-right);
  - Marineland Parkway and Portage Road (southbound left);
  - Stanley Avenue and Dorchester Road/Chippawa Parkway (eastbound left-through-right and westbound left-through-right); and
  - Lyons Creek Road and Stanley Avenue (eastbound left and westbound through-right)

The analyses illustrate that several intersections and turning movements are forecast to operate with less than satisfactory levels of service with the additional traffic generated by the Thundering Waters lands, even if the road improvements identified in Section 6.8.1 are implemented.

TABLE 6.10A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY, WEEKDAY AM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	McLeod Road & Montrose Road	TCS	LOS	B	B	B	**B**	B	A	A	**A**	B	B	B	**B**	C	B		**B**	**B**
			Delay	16	18	13	**17**	10	9	10	**9**	14	14	14	**14**	22	14		**19**	**14**
			V/C	0.42	0.65	0.01		0.13	0.38	0.22		0.09	0.15	0.09		0.68	0.09			
			Q	27	75	0		7	45	13		10	19	10		68	9			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		B	B	**B**	B	A		**A**					C	C	B	**C**	**B**
			Delay		19	15	**19**	11	9		**9**					22	22	16	**21**	**16**
			V/C		0.65	0.00		0.28	0.31							0.65	0.65	0.16		
			Q		72	0		13	34							77	77	15		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		**A**		A		**A**	B		B	**B**					**A**
			Delay		8		**8**		6		**6**	11		12	**12**					**8**
			V/C		0.59				0.34			0.06		0.25						
			Q		40				20			6		19						
	McLeod Road & Oakwood Drive	TCS	LOS	B	C	B	**B**	C	A		**B**	C	B	B	**C**	C	C		**C**	**B**
			Delay	14	22	12	**20**	31	9		**11**	33	19	19	**26**	27	26		**27**	**17**
			V/C	0.39	0.84	0.19		0.43	0.58			0.46	0.01	0.07		0.09	0.03			
			Q	19	108	12		19	62			16	3	10		7	7			
	McLeod Road & Dorchester Road	TCS	LOS	C	C		**C**	B	C		**C**	F	C		**E**	C	C	C	**C**	**C**
			Delay	29	21		**29**	14	22		**21**	112	26		**74**	21	24	24	**23**	**35**
			V/C	0.31	0.91			0.32	0.82			1.04	0.61			0.24	0.48	0.12		
			Q	22	145			15	126			93	61			14	45	15		
	McLeod Road & Drummond Road	TCS	LOS	C	B		**B**		B		**B**		B		**B**	A	A	B	**A**	**B**
			Delay	25	16		**18**		16		**16**		18		**18**	10	10	10	**10**	**16**
			V/C	0.69	0.52				0.49				0.75			0.24	0.21	0.14		
			Q	39	48				43				133			25	33	13		
	Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	TCS	LOS		A		**A**		A		**A**				**A**					**A**
			Delay																	
			V/C																	
			Q																	
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	B		**B**	B	B		**B**	C	B		**C**	B	B		**B**	**B**
			Delay	13	17		**17**	13	15		**15**	22	19		**20**	17	18		**18**	**17**
			V/C	0.17	0.59			0.35	0.40			0.64	0.29			0.24	0.27			
			Q	9	41			13	29			30	17			12	16			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**	B	A		**B**		B	B	**B**	B	B		**B**	**B**
			Delay		8		**8**	13	9		**12**		12	14	**14**	13	13		**13**	**13**
			V/C		0.15			0.58	0.21				0.27	0.35		0.30	0.35			
			Q		18			56	19				30	18		23	34			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	A			**A**						A		**A**		A		**A**	**A**
			Delay	8			**8**						6		**6**		6		**6**	**6**
			V/C	0.18									0.10				0.28			
			Q	9									4				10			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**A**
			Delay	8	5		**6**		13	12	**12**					12		12	**12**	**10**
			V/C	0.05	0.12				0.26	0.02						0.02		0.00		
			Q	3	9				19	0						2		0		

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TCS - Traffic Control Signal
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AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.10B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY, WEEKDAY AM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.05 1	A 0 0.16 0		**A** **1**		A 0 0.14 0	A 0 0.04 0	**A** **0**					C 19 0.06 2		B 10 0.06 2	**B** **13**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	C 20 0.28 9			**C** **20**						A 1 0.02 1		**A** **1**		A 0 0.27 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	C 16 0.08 2			**C** **16**						A 1 0.04 1		**A** **1**		A 0 0.26 0		**A** **0**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	C 16 0.17 5			**C** **16**						A 2 0.08 2		**A** **2**		A 0 0.21 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		F Err 3.72 Err		**F** **Err**		F 99 0.66 26		**F** **99**		A 7 0.33 12		**A** **7**		A 0 0.01 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	F 87 1.07	B 11 0.23		**F** **73**		D 25 0.73		**D** **25**					C 17 0.48		C 15 0.48	**C** **16**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.23 0		**A** **0**		A 0 0.17 0		**A** **0**	E 35 0.79 61		A 0 0.00 0	**E** **35**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.15 0		**A** **0**		A 0 0.11 0		**A** **0**					D 25 0.70 45		A 0 0.00 0	**D** **25**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					B 14 0.24 8			**B** **14**		A 0 0.17 0		**A** **0**		A 1 0.02 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 13 0.23 7			**B** **13**					A 8 0.06 1	A 0 0.08 0		**A** **3**		A 0 0.10 0	A 0 0.06 0	**A** **0**	

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RBT - Roundabout

TABLE 6.11A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY, WEEKDAY PM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	McLeod Road & Montrose Road	TCS	LOS	D	C	B	**C**	B	B	B	**B**	B	B	B	**B**	D	B		**C**	**C**
			Delay	37	27	17	**28**	18	16	14	**16**	15	16	17	**16**	43	16		**34**	**22**
			V/C	0.71	0.79	0.02		0.53	0.66	0.33		0.08	0.17	0.24		0.90	0.15			
			Q	41	99	0		19	88	15		11	25	20		136	17			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	**C**	B	B		**B**					C	C	C	**C**	**C**
			Delay		24	17	**24**	18	12		**13**					31	33	22	**29**	**22**
			V/C		0.78	0.03		0.58	0.52							0.79	0.81	0.52		
			Q		101	4		25	65							121	126	62		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		B		**B**		A		**A**	B		B	**B**					**A**
			Delay		11		**11**		7		**7**	15		17	**16**					**10**
			V/C		0.82				0.51			0.12		0.42						
			Q		100				44			8		27						
	McLeod Road & Oakwood Drive	TCS	LOS	C	F	C	**F**	D	F		**F**	D	B	B	**D**	C	D		**C**	**F**
			Delay	32	243	26	**191**	46	129		**118**	49	18	19	**38**	33	36		**35**	**134**
			V/C	0.56	1.46	0.57		0.75	1.22			0.85	0.04	0.16		0.10	0.45			
			Q	25	291	71		52	332			76	9	14		11	36			
	McLeod Road & Dorchester Road	TCS	LOS	D	F		**E**	C	F		**F**	F	C		**F**	C	D	D	**D**	**F**
			Delay	50	82		**76**	25	166		**161**	667	34		**465**	31	38	38	**37**	**168**
			V/C	0.78	1.09			0.35	1.28			2.39	0.64			0.53	0.67	0.65		
			Q	67	261			13	282			306	79			29	75	67		
	McLeod Road & Drummond Road	TCS	LOS	C	B		**B**	B	D		**D**		F		**F**	B	B	B	**B**	**F**
			Delay	31	14		**18**	19	48		**48**		458		**458**	17	17	16	**17**	**118**
			V/C	0.81	0.59			0.06	0.97				1.95			0.43	0.39	0.20		
			Q	57	67			5	113				251			34	47	15		
	Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	TCS	LOS		A		**A**		A		**A**				**A**					**A**
			Delay																	
			V/C																	
			Q																	
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	C		**C**	B	B		**B**	E	C		**D**	B	C		**C**	**C**
			Delay	14	21		**20**	18	17		**17**	67	21		**39**	20	21		**21**	**24**
			V/C	0.45	0.78			0.62	0.55			0.97	0.41			0.47	0.40			
			Q	18	79			23	46			51	23			20	21			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**	C	A		**C**		B	B	**B**	C	C		**C**	**C**
			Delay		8		**8**	33	9		**25**		20	18	**19**	28	21		**23**	**22**
			V/C		0.14			0.91	0.27				0.52	0.31		0.64	0.55			
			Q		16			141	28				55	18		41	60			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			**B**						A		**A**		B		**B**	**B**
			Delay	13			**13**						9		**9**		10		**10**	**11**
			V/C	0.64									0.22				0.55			
			Q	64									18				43			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**A**
			Delay	8	6		**6**		13	12	**12**					12		12	**12**	**10**
			V/C	0.12	0.19				0.24	0.02						0.14		0.05		
			Q	6	14				17	0						8		0		

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AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.11B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY, WEEKDAY PM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.03 1	A 0 0.27 0		**A** **0**		A 0 0.22 0	A 0 0.07 0	**A** **0**					F 87 0.82 43		B 11 0.06 1	**F** **71**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	D 33 0.54 24			**D** **33**						A 1 0.04 1		**A** **1**		A 0 0.34 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	D 28 0.46 19			**D** **28**						A 1 0.03 1		**A** **1**		A 0 0.32 0		**A** **0**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	C 20 0.39 14			**C** **20**						A 1 0.04 1		**A** **2**		A 0 0.33 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		F Err 12.40 Err		**F** **Err**		F Err 8.46 Err		**F** **Err**		B 11 0.51 23		**B** **11**		A 0 0.02 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	F 85 1.06	C 20 0.57		**F** **61**		D 35 0.82		**D** **35**					C 24 0.65		F 68 1.01	**F** **52**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.22 0		**A** **0**		A 0 0.32 0		**A** **0**	F 378 1.77 354		A 0 0.00 0	**F** **378**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.13 0		**A** **0**		A 0 0.19 0		**A** **0**					F 184 1.31 188		A 0 0.00 0	**F** **184**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					D 27 0.55 27			**D** **27**		A 0 0.25 0		**A** **0**		A 2 0.06 1		**A** **2**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	C 16 0.27 9			**C** **16**					A 9 0.04 1	A 0 0.14 0		**A** **1**		A 0 0.20 0	A 0 0.08 0	**A** **0**	

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RBT - Roundabout

TABLE 6.12A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY, SATURDAY MIDDAY PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
Saturday Peak Hour	McLeod Road & Montrose Road	TCS	LOS	C	C	B	**C**	B	B	B	**B**	B	B	B	**B**	D	B		**C**	**C**
			Delay	21	27	16	**26**	17	13	13	**13**	17	16	17	**17**	41	16		**32**	**21**
			V/C	0.50	0.81	0.02		0.53	0.48	0.28		0.15	0.13	0.15		0.88	0.15			
			Q	32	109	1		19	59	14		17	21	14		128	16			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	**C**	C	B		**B**					C	C	B	**C**	**B**
			Delay		22	17	**22**	24	11		**13**					28	28	19	**26**	**20**
			V/C		0.71	0.02		0.73	0.42							0.76	0.77	0.42		
			Q		83	1		46	48							102	104	46		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		B		**B**		A		**A**	B		B	**B**					**B**
			Delay		11		**11**		8		**8**	13		17	**16**					**10**
			V/C		0.74				0.49			0.09		0.59						
			Q		75				42			7		45						
	McLeod Road & Oakwood Drive	TCS	LOS	C	F	C	**F**	D	C		**C**	D	B	C	**C**	C	C		**C**	**F**
			Delay	24	199	24	**155**	44	21		**26**	43	19	21	**32**	34	34		**34**	**83**
			V/C	0.44	1.37	0.58		0.78	0.86			0.79	0.03	0.30		0.12	0.11			
			Q	18	249	66		55	155			60	7	24		10	12			
	McLeod Road & Dorchester Road	TCS	LOS	D	F		**F**	C	D		**D**	F	D		**F**	E	C	C	**D**	**F**
			Delay	50	110		**98**	29	36		**35**	496	41		**309**	68	34	30	**39**	**115**
			V/C	0.83	1.16			0.57	0.81			2.00	0.78			0.90	0.61	0.34		
			Q	74	265			23	129			247	104			57	79	32		
	McLeod Road & Drummond Road	TCS	LOS	D	B		**C**	C	E		**E**		E		**E**	B	B	B	**B**	**D**
			Delay	47	19		**26**	27	73		**72**		79		**79**	17	15	16	**16**	**44**
			V/C	0.90	0.58			0.05	1.03				1.05			0.47	0.32	0.21		
			Q	82	75			5	124				166			43	47	14		
	Marineland Parkway & Stanley Avenue / Thundering Waters Boulevard	TCS	LOS		A		**A**		A		**A**				**A**					**A**
			Delay																	
			V/C																	
			Q																	
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	C		**C**	B	B		**B**	C	C		**C**	B	C		**C**	**C**
			Delay	13	22		**22**	16	16		**16**	29	20		**24**	20	21		**21**	**20**
			V/C	0.24	0.80			0.55	0.54			0.73	0.28			0.49	0.42			
			Q	11	85			20	46			29	16			22	23			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**	B	A		**B**		B	B	**B**	B	B		**B**	**B**
			Delay		8		**8**	17	9		**14**		13	14	**13**	16	14		**15**	**14**
			V/C		0.10			0.64	0.17				0.27	0.19		0.35	0.45			
			Q		14			65	17				33	15		29	55			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			**B**						B		**B**		B		**B**	**B**
			Delay	11			**11**						10		**10**		11		**11**	**11**
			V/C	0.65									0.31				0.48			
			Q	65									21				27			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**B**
			Delay	8	5		**7**		13	12	**12**					13		12	**13**	**11**
			V/C	0.15	0.09				0.25	0.03						0.28		0.06		
			Q	7	8				19	0						16		0		

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RBT - Roundabout

TABLE 6.12B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY, SATURDAY MIDDAY PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
Saturday Peak Hour	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.02 1	A 0 0.30 0		**A** **0**		A 0 0.22 0	A 0 0.06 0	**A** **0**					F 209 1.24 88		B 11 0.07 2	**F** **172**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	C 22 0.30 10			**C** **22**						A 1 0.04 1		**A** **1**		A 0 0.30 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	C 16 0.09 2			**C** **16**						A 0 0.01 0		**A** **0**		A 0 0.26 0		**A** **0**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 13 0.05 1			**B** **13**						A 0 0.01 0		**A** **0**		A 0 0.26 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		F Err 7.79 Err		**F** **Err**		F 754 2.02 57		**F** **754**		A 10 0.46 19		**A** **10**		A 0 0.00 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	F 56 0.94	C 24 0.68		**E** **42**		F 51 0.93		**F** **51**					C 21 0.59		C 24 0.71	**C** **23**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.18 0		**A** **0**		A 0 0.08 0		**A** **0**	B 13 0.21 6		A 0 0.00 0	**B** **13**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.12 0		**A** **0**		A 0 0.07 0		**A** **0**					C 24 0.80 68		A 0 0.00 0	**C** **24**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					C 17 0.42 17			**C** **17**		A 0 0.17 0		**A** **0**		A 1 0.02 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 13 0.22 7			**B** **13**					A 8 0.03 1	A 0 0.10 0		**A** **8**		A 0 0.13 0	A 0 0.04 0	**A** **0**	

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6.8.5 Future Total Traffic Operations with Base and Additional Network Improvements

Further changes to roadway geometry and traffic control beyond the base road network improvements identified in Sections 6.8.1 and 6.8.2 would be required to accommodate forecasted traffic volumes, including:

Signalized Intersections

- Optimization of traffic signal timings at all intersections
- McLeod Road and Dorchester Road
  - Exclusive eastbound and westbound right turn lanes
  - Dual northbound left turn lane under fully protected phasing
- McLeod Road and Drummond Road
  - Dual northbound left turn lane under fully protected phasing

Unsignalized Intersections

- Marineland Parkway and Portage Road
  - Traffic control signals with actuated uncoordinated control
- Stanley Avenue and Chippawa Parkway
  - Traffic control signals with actuated uncoordinated control
  - Dual northbound left turn lanes operating under fully protected phasing
  - Eastbound left turn lane
  - Channelized eastbound right turn
  - Southbound right turn lane
- Lyons Creek Road and Stanley Avenue
  - Traffic control signals with actuated uncoordinated control and protected permissive eastbound left turn movement
- Lyons Creek Road and QEW Westbound Off Ramp
  - Traffic control signals with actuated uncoordinated control
- Lyons Creek Road and QEW Eastbound Off Ramp
  - Traffic control signals with actuated uncoordinated control

Tables 6.13, 6.14 and **6.15** summarize the results of the intersection capacity analyses completed to assess operating conditions for the summer weekday morning, weekday afternoon and Saturday midday future total traffic forecasts (**Figures 6.10, 6.11** and **6.12**) with these additional improvements. **Appendix H** provides the Synchro analysis output. The following is noted from the analyses:

- **Weekday Morning Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements remain at the following intersection:
  - McLeod Road and Dorchester Road (northbound left).
- **Weekday Afternoon Peak Hour** – With the exception of McLeod Road and Oakwood Drive (LOS E), all intersections are forecast to operate with satisfactory levels of service. Critical movements remain at the following intersections:
  - McLeod Road and Montrose Road (southbound left)
  - McLeod Road and Oakwood Drive (eastbound through, westbound left and westbound through-right, and northbound left)
  - McLeod Road and Dorchester Road (eastbound left, westbound through-right and northbound left)
  - McLeod Road and Drummond Road (westbound through-right)
- **Saturday Midday Peak Hour** – All intersections operate with satisfactory levels of service. Critical movements were noted at the following intersections:
  - McLeod Road and Oakwood Drive (eastbound through, westbound left and northbound left)
  - McLeod Road and Dorchester Road (northbound left)

The analyses illustrate that certain intersections, in particular McLeod Road at Oakwood Drive and Dorchester Road, are forecast to operate with less than satisfactory levels of service in the year 2031, even with all the road improvements identified in this section. Although it is conceivable that traffic growth will not occur to the extent forecast, the analyses herein suggest that further roadway capacity will be required to support the build out of the Thundering Waters lands.

TABLE 6.13A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH ADDITIONAL IMPROVEMENTS, WEEKDAY AM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	McLeod Road & Montrose Road	TCS	LOS Delay V/C Q	B 16 0.42 27	B 18 0.66 76	B 13 0.01 0	**B** **18**	B 11 0.13 7	A 9 0.38 46	A 10 0.22 13	**A** **9**	B 14 0.09 10	B 14 0.15 19	B 14 0.09 10	**B** **14**	C 22 0.68 68	B 14 0.09 9		**B** **19**	**B** **14**
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS Delay V/C Q		B 19 0.65 76	B 15 0.00 0	**B** **19**	B 11 0.28 14	A 9 0.31 37		**A** **9**					C 22 0.64 79	C 22 0.64 79	B 16 0.16 16	**C** **21**	**B** **17**
	McLeod Road & WB QEW Off-Ramp	TCS	LOS Delay V/C Q		A 8 0.59 40		**A** **8**		A 6 0.34 20		**A** **6**	B 11 0.06 6		B 12 0.25 19	**B** **12**					**A** **8**
	McLeod Road & Oakwood Drive	TCS	LOS Delay V/C Q	B 13 0.37 18	B 19 0.80 101	B 11 0.19 12	**B** **18**	C 33 0.52 19	A 9 0.58 62		**B** **11**	C 33 0.46 16	B 19 0.01 3	B 20 0.07 11	**C** **27**	C 27 0.09 7	C 27 0.03 7		**C** **27**	**B** **16**
	McLeod Road & Dorchester Road	TCS	LOS Delay V/C Q	C 29 0.39 21	B 18 0.55 61	B 18 0.36 24	**B** **19**	B 13 0.24 13	C 23 0.78 99		**C** **23**	E 68 0.96 57	C 24 0.58 52		**D** **49**	C 22 0.24 12	C 25 0.49 41	C 24 0.12 14	**C** **24**	**C** **27**
	McLeod Road & Drummond Road	TCS	LOS Delay V/C Q	C 27 0.51 20	B 11 0.45 43		**B** **14**		B 19 0.62 50		**B** **19**	C 27 0.62 36	B 12 0.28 31		**C** **21**	B 20 0.40 25	B 20 0.42 35	B 19 0.14 15	**B** **20**	**B** **18**
	Marineland Parkway & Stanley Avenue	TCS	LOS Delay V/C Q	B 13 0.17 9	B 17 0.59 41		**B** **17**	B 13 0.35 13	B 15 0.40 29		**B** **15**	C 22 0.64 30	B 19 0.29 17		**C** **20**	B 17 0.24 12	B 19 0.27 16		**B** **18**	**B** **17**
	Marineland Parkway & Portage Road	TCS	LOS Delay V/C Q	A 5 0.17 5	A 6 0.39 15		**A** **6**		A 5 0.34 13	A 5 0.05 3	**A** **5**					A 7 0.04 3		A 7 0.04 4	**A** **7**	**A** **6**
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TCS	LOS Delay V/C Q	C 16 0.56 33	B 13 0.36 19		**B** **14**		B 11 0.08 9		**B** **11**	C 19 0.61 41	A 7 0.38 35		**B** **13**		C 15 0.39 24	B 14 0.15 13	**B** **14**	**B** **14**
	Lyons Creek & Stanley Avenue	TCS	LOS Delay V/C Q	D 26 0.85 122	A 5 0.11 13		**C** **22**		E 42 0.86 107		**E** **42**					D 29 0.62 51		C 24 0.21 18	**D** **26**	**C** **29**
	Lyons Creek & QEW WB Off-Ramp	TCS	LOS Delay V/C Q		A 10 0.61 45		**A** **10**		A 8 0.40 29		**A** **8**	A 9 0.29 19		B 11 0.55 34	**B** **11**					**A** **9**
	Lyons Creek & QEW EB Off-Ramp	TCS	LOS Delay V/C Q		A 8 0.44 27		**A** **8**		A 8 0.32 19		**A** **8**					A 9 0.45 33		A 7 0.08 7	**A** **8**	**A** **8**
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS Delay V/C Q		A 8 0.17 18		**A** **8**	B 15 0.63 62	A 9 0.21 18		**B** **12**		B 10 0.26 22	B 13 0.35 15	**B** **12**	B 11 0.29 17	B 11 0.33 24		**B** **11**	**B** **12**
	Montrose Road & Niagara Square Drive	TCS	LOS Delay V/C Q					A 6 0.16 5			**A** **6**		A 6 0.20 6		**A** **6**		A 6 0.09 3		**A** **6**	**A** **6**
	Oakwood Drive & Walmart North Driveway	TCS	LOS Delay V/C Q	A 8 0.18 9			**A** **8**						A 6 0.10 4		**A** **6**		A 6 0.28 10		**A** **6**	**A** **6**
	Oakwood Drive & Walmart South Driveway	TCS	LOS Delay V/C Q	A 8 0.05 3	A 5 0.12 9		**A** **6**		B 13 0.26 19	B 12 0.02 0	**B** **12**					B 12 0.02 2		B 12 0.00 0	**B** **12**	**A** **10**

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.13B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH ADDITIONAL IMPROVEMENTS, WEEKDAY AM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	C 20 0.28 9			**C** **20**						A 1 0.02 1		**A** **1**		A 0 0.27 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	C 16 0.08 2			**C** **16**						A 1 0.04 1		**A** **1**		A 0 0.26 0		**A** **0**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	C 16 0.17 5			**C** **16**						A 2 0.08 2		**A** **2**		A 0 0.21 0		**A** **0**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					B 14 0.24 8			**B** **14**		A 0 0.17 0		**A** **0**		A 1 0.02 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 13 0.23 7			**B** **13**					A 8 0.06 1	A 0 0.08 0		**A** **3**		A 0 0.10 0	A 0 0.06 0	**A** **0**	

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Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

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TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.14A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH ADDITIONAL IMPROVEMENTS, WEEKDAY PM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	McLeod Road & Montrose Road	TCS	LOS	C	C	B	C	C	B	B	B	B	B	B	B	D	B		D	C
			Delay	33	28	17	28	23	16	13	16	16	17	18	17	47	16		36	23
			V/C	0.67	0.79	0.02		0.63	0.64	0.33		0.08	0.17	0.31		0.92	0.15			
			Q	39	99	0		25	88	15		11	25	31		136	17			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	C	C	B		B					C	C	C	C	C
			Delay		28	19	27	21	12		13					31	33	21	29	23
			V/C		0.83	0.03		0.62	0.52							0.78	0.80	0.48		
			Q		105	0		33	67							109	117	53		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		B		B		A		A	B		B	B					A
			Delay		10		10		7		7	15		17	16					9
			V/C		0.81				0.50			0.12		0.42						
			Q		92				43			8		27						
	McLeod Road & Oakwood Drive	TCS	LOS	C	D	C	D	F	E		E	F	D	D	F	D	D		D	E
			Delay	29	49	21	42	96	78		80	134	40	42	100	45	53		52	67
			V/C	0.27	0.98	0.47		0.95	1.09			1.11	0.07	0.30		0.09	0.31			
			Q	8	296	67		77	401			111	15	40		11	32			
	McLeod Road & Dorchester Road	TCS	LOS	F	C	C	D	C	F		F	F	D		F	D	E	E	E	E
			Delay	108	33	34	47	29	103		100	156	40		119	44	60	65	60	78
			V/C	1.06	0.69	0.64		0.37	1.11			1.18	0.55			0.45	0.75	0.79		
			Q	83	162	120		18	326			165	99			37	104	102		
	McLeod Road & Drummond Road	TCS	LOS	E	B		C	C	C		D	E	C		D	C	D	C	C	D
			Delay	61	20		28	23	32		47	56	30		46	25	39	33	33	38
			V/C	0.83	0.62			0.06	0.94			0.89	0.56			0.43	0.68	0.35		
			Q	51	105			6	155			86	74			32	76	34		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	C		C	C	C		C	D	C		C	C	C		C	C
			Delay	19	30		29	25	23		23	41	28		33	27	30		30	28
			V/C	0.47	0.83			0.67	0.58			0.84	0.42			0.48	0.47			
			Q	24	105			41	63			62	30			26	29			
	Marineland Parkway & Portage Road	TCS	LOS	A	A		A		A	A	A					A		A	A	A
			Delay	5	7		7		7	5	6					10		9	10	7
			V/C	0.09	0.57				0.48	0.08						0.27		0.02		
			Q	4	36				29	5						17		4		
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TCS	LOS	C	C		C		C		C	D	A		C		C	C	C	C
			Delay	25	18		20		16		16	30	7		22		24	17	21	21
			V/C	0.70	0.42				0.13			0.79	0.28				0.72	0.20		
			Q	59	27				10			55	26				69	16		
	Lyons Creek & Stanley Avenue	TCS	LOS	C	A		C		E		E					D		C	C	C
			Delay	24	6		17		37		37					27		21	23	24
			V/C	0.82	0.28				0.83							0.66		0.37		
			Q	103	31				100							61		24		
	Lyons Creek & QEW WB Off-Ramp	TCS	LOS		B		B		C		C	B		C	C					B
			Delay		12		12		18		18	11		19	17					16
			V/C		0.56				0.82			0.34		0.76						
			Q		44				85			27		81						
	Lyons Creek & QEW EB Off-Ramp	TCS	LOS		B		B		B		B					A		A	A	B
			Delay		12		12		13		13					10		7	9	11
			V/C		0.38				0.56							0.45		0.16		
			Q		23				34							40		11		
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		A	C	A		B		B	B	B	C	B		C	B
			Delay		8		8	25	9		20		19	17	18	27	20		22	19
			V/C		0.14			0.85	0.27				0.51	0.31		0.63	0.54			
			Q		17			137	28				54	17		39	58			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			A		A		A		A		A	A
			Delay					7			7		7		7		6		6	7
			V/C					0.22					0.32				0.22			
			Q					8					11				8			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			B						A		A		A		A	A
			Delay	11			11						8		8		9		9	10
			V/C	0.63									0.22				0.53			
			Q	58									15				33			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		A		B	B	B					B		B	B	A
			Delay	7	4		5		13	12	13					12		12	12	9
			V/C	0.12	0.17				0.25	0.02						0.14		0.05		
			Q	6	12				18	0						9		0		

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AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.14B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH ADDITIONAL IMPROVEMENTS, WEEKDAY PM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	D 33 0.54 24			**D** **33**						A 1 0.04 1		**A** **1**		A 0 0.34 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	D 28 0.46 19			**D** **28**						A 1 0.03 1		**A** **1**		A 0 0.32 0		**A** **0**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	C 21 0.39 14			**C** **21**						A 1 0.04 1		**A** **2**		A 0 0.33 0		**A** **0**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					D 27 0.55 25			**D** **27**		A 0 0.25 0		**A** **0**		A 2 0.06 1		**A** **2**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	C 16 0.27 9			**C** **16**					A 9 0.04 1	A 0 0.14 0		**A** **1**		A 0 0.20 0	A 0 0.08 0	**A** **0**	

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control
RBT - Roundabout

TABLE 6.15A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH ADDITIONAL IMPROVEMENTS, SATURDAY MIDDAY PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	
SAT Peak Hour	McLeod Road & Montrose Road	TCS	LOS	C	C	B	C	B	B	B	B	B	B	B	B	D	B		C	C
			Delay	21	27	16	26	17	13	13	13	17	16	17	17	41	16		32	21
			V/C	0.50	0.81	0.02		0.53	0.48	0.28		0.15	0.13	0.15		0.88	0.15			
			Q	32	109	1		19	59	14		17	21	14		128	16			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	C	C	B		B					C	C	B	C	C
			Delay		24	18	23	22	11		13					28	28	20	26	21
			V/C		0.73	0.02		0.69	0.42							0.75	0.76	0.42		
			Q		90	2		44	51							105	107	47		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		B		B		A		A	B		B	B					B
			Delay		11		11		8		8	13		18	17					10
			V/C		0.73				0.49			0.09		0.59						
			Q		73				41			7		46						
	McLeod Road & Oakwood Drive	TCS	LOS	B	D	C	D	F	B		C	F	D	D	E	E	E		E	D
			Delay	19	44	21	38	86	15		29	84	36	43	64	56	55		56	39
			V/C	0.29	0.96	0.50		0.93	0.71			0.94	0.04	0.54		0.17	0.05			
			Q	16	290	76		87	170			95	11	74		14	12			
	McLeod Road & Dorchester Road	TCS	LOS	D	C	C	C	C	D		D	D	D		D	D	C	C	C	D
			Delay	49	24	33	32	26	41		39	55	39		48	46	33	29	34	37
			V/C	0.82	0.64	0.78		0.48	0.86			0.95	0.77			0.81	0.60	0.36		
			Q	76	106	146		23	134			61	104			49	79	35		
	McLeod Road & Drummond Road	TCS	LOS	A	A		A	B	C		C	B	B		B	C	B	B	B	B
			Delay	10	9		9	15	21		21	19	18		19	23	18	18	19	16
			V/C	0.42	0.46			0.04	0.75			0.55	0.42			0.64	0.48	0.21		
			Q	18	56			4	94			28	43			44	49	16		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	C		C	B	B		B	C	C		C	C	C		C	C
			Delay	13	22		21	16	16		16	29	20		24	20	21		21	20
			V/C	0.23	0.80			0.55	0.54			0.73	0.28			0.49	0.42			
			Q	11	84			20	46			30	16			23	23			
	Marineland Parkway & Portage Road	TCS	LOS	A	A		A		A	A	A					B		A	B	A
			Delay	5	8		8		7	5	7					11		9	11	8
			V/C	0.07	0.65				0.47	0.07						0.37		0.03		
			Q	4	49				32	6						23		4		
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TCS	LOS	B	B		B		B		B	E	A		D		B	B	B	B
			Delay	15	13		14		11		11	37	7		28		15	14	14	19
			V/C	0.56	0.37				0.11			0.90	0.25				0.40	0.18		
			Q	39	20				10			59	22				29	14		
	Lyons Creek & Stanley Avenue	TCS	LOS	C	A		B		D		D					D		C	C	C
			Delay	20	6		14		35		35					25		21	22	22
			V/C	0.78	0.31				0.85							0.61		0.25		
			Q	89	37				117							54		18		
	Lyons Creek & QEW WB Off-Ramp	TCS	LOS		A		A		A		A	A		A	A					A
			Delay		6		6		5		5	8		8	8					6
			V/C		0.43				0.18			0.08		0.10						
			Q		19				8			6		8						
	Lyons Creek & QEW EB Off-Ramp	TCS	LOS		B		B		A		A					A		A	A	A
			Delay		10		10		9		9					9		6	8	9
			V/C		0.40				0.22							0.58		0.20		
			Q		27				15							46		9		
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		A	B	A		B		B	B	B	B	B		B	B
			Delay		8		8	19	9		16		11	12	11	13	12		13	13
			V/C		0.11			0.70	0.18				0.26	0.19		0.34	0.44			
			Q		13			73	17				22	11		21	37			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			A		A		A		A		A	A
			Delay					6			6		6		6		6		6	6
			V/C					0.22					0.22				0.25			
			Q					7					8				9			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			B						A		A		B		B	B
			Delay	11			11						10		10		10		10	10
			V/C	0.67									0.30				0.48			
			Q	64									18				22			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		A		B	B	B					B		B	B	B
			Delay	8	5		7		13	12	12					13		12	13	11
			V/C	0.15	0.09				0.25	0.03						0.28		0.06		
			Q	7	8				19	0						16		0		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.15B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH ADDITIONAL IMPROVEMENTS, SATURDAY MIDDAY PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
SAT Peak Hour	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	C 22 0.30 10			**C** **22**						A 1 0.04 1		**A** **1**		A 0 0.30 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	C 16 0.09 2			**C** **16**						A 0 0.01 0		**A** **0**		A 0 0.26 0		**A** **0**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 13 0.05 1			**B** **13**						A 0 0.01 0		**A** **0**		A 0 0.26 0		**A** **0**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					C 17 0.42 17			**C** **17**		A 0 0.17 0		**A** **0**		A 1 0.02 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 13 0.22 7			**B** **13**					A 8 0.03 1	A 0 0.10 0		**A** **1**		A 0 0.13 0	A 0 0.04 0	**A** **0**	

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

6.9 Assessment of Potential Watercourse Crossings

6.9.1 Overview

The Hydro (OPG) Canal crossing recommended by the Niagara Falls Sustainable Transportation Master Plan is one potential solution to the future roadway capacity challenges. This crossing could provide capacity to serve full build-out of the Thundering Waters lands by creating a more direct connection to Lyons Creek Road and its interchange with the QEW. The bridge would improve connectivity of the development area to the City and Regional Road networks, and provide an alternative to the congested McLeod Road corridor to access the QEW and locations to the west.

During the planning process for the Thundering Waters lands, City and Region staff identified another possible orientation of the crossing towards the south over the Welland River. It was agreed that this study would provide an initial assessment of the need and preferred location for the crossing.

Figure 6.13 illustrates three (3) potential watercourse crossing locations initially contemplated, which can be described as:

- The Oldfield Road extension from Dorchester Road to Oakwood Drive (Location 1) across the OPG Canal to the west;
- Along the alignment/parallel to the existing CP Rail bridge across the OPG Canal to the southwest (Location 2); and
- Across the Welland River to the south (Location 3).

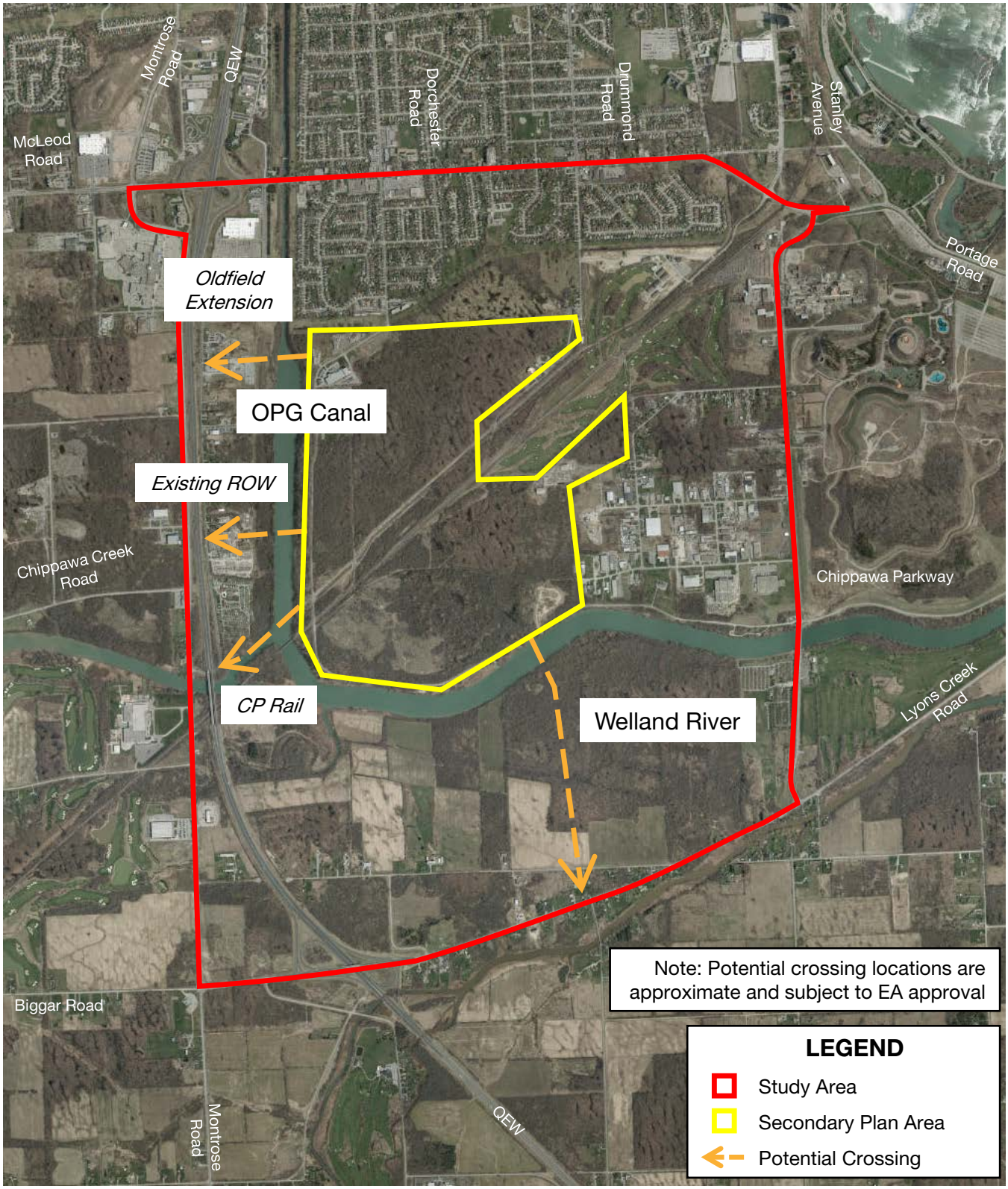
For analysis purposes, Locations 1 and 2 were consolidated into one alternative because the traffic analysis process is insufficiently precise to differentiate between the two crossing locations. Thus, two options – OPG Canal and Welland River – were carried forward for preliminary assessment.

6.9.2 Preliminary Overview and Assessment

The following provides a preliminary overview and assessment of the relative advantages and disadvantages of the two (2) potential watercourse crossing locations from a transportation planning perspective. It is noted that the ultimate location and alignment of the crossing would be determined through a future Municipal Class EA Study.

OPG Canal Crossing

This crossing would traverse the OPG Canal to the west of Thundering Waters lands, connecting Dorchester Road to Oakwood Drive. Vehicles attempting to access or cross the QEW could travel north to McLeod Road on Oakwood Drive, or south to Biggar Road/ Lyons Creek Road via Montrose Road after reaching Oakwood Drive. The Niagara Falls Sustainable Transportation Master Plan identifies a further extension of this crossing over the QEW, which is not being considered for this study.



Potential Water Crossing Locations

Three (3) potential locations for the crossing have been suggested through the Thundering Waters planning process, as follows:

- Oldfield Road Extension – This crossing would extend Oldfield Road westerly to traverse the OPG Canal near the north end of the Thundering Waters lands. The shortest crossing distance over the canal, this bridge would connect to Oakwood Drive closest to McLeod Road, which diminishes its effectiveness in redirecting trips to Biggar Road/Lyons Creek Road;
- CP Rail – This crossing would follow the alignment of the CP Rail Montrose Spur that crosses the OPG Canal and Welland River in the southwest corner of the Thundering Waters lands. A crossing in this location would likely connect to the south end of Oakwood Drive near its intersection with Montrose Road, under the QEW bridge over the Welland River.
- Existing City Right-of-Way – This crossing would use the right-of-way designated/protected by the City for the connection. Initially, these lands were assumed to extend westerly from Oldfield Road, but after further discussion with City staff, the reserve is understood to be located about midpoint between the Oldfield Road Extension and CP Rail alignments.

Property will be required from private land owners to implement this option regardless of the alignment selected. Existing residential and/or commercial uses would be disturbed, unlike the Welland River option. There are also certain technical challenges with implementing the CP Rail and Existing City Right-of-Way concepts, given the narrow width of the road connection under the QEW. The intersection of Oakwood Drive and Montrose Road also presents road safety challenges with its less than desirable alignment.

The OPG Canal option provides the most direct routing to the west, in particular for access to the QEW. This location also has the advantage of providing another crossing of the QEW via Oakwood Drive and Montrose Road. The connection should be designed to promote vehicle travel to the south along Montrose Road to Biggar Road/Lyons Creek Road instead of to the north on Oakwood Drive given projected capacity constraints on McLeod Road.

Welland River Crossing

This crossing traverses the Welland River to the south of the Thundering Waters lands, connecting Chippawa Parkway to Lyons Creek Road east of the QEW. The intent is to direct traffic towards the less used Lyons Creek Road interchange, and away from McLeod Road.

Although a general location for the potential crossing has not been determined, different concepts were discussed through the Thundering Waters planning process. More westerly alignments would place the connection closer to the QEW interchange, but would be longer (and costlier) and intersect the Thundering Waters road network in a location

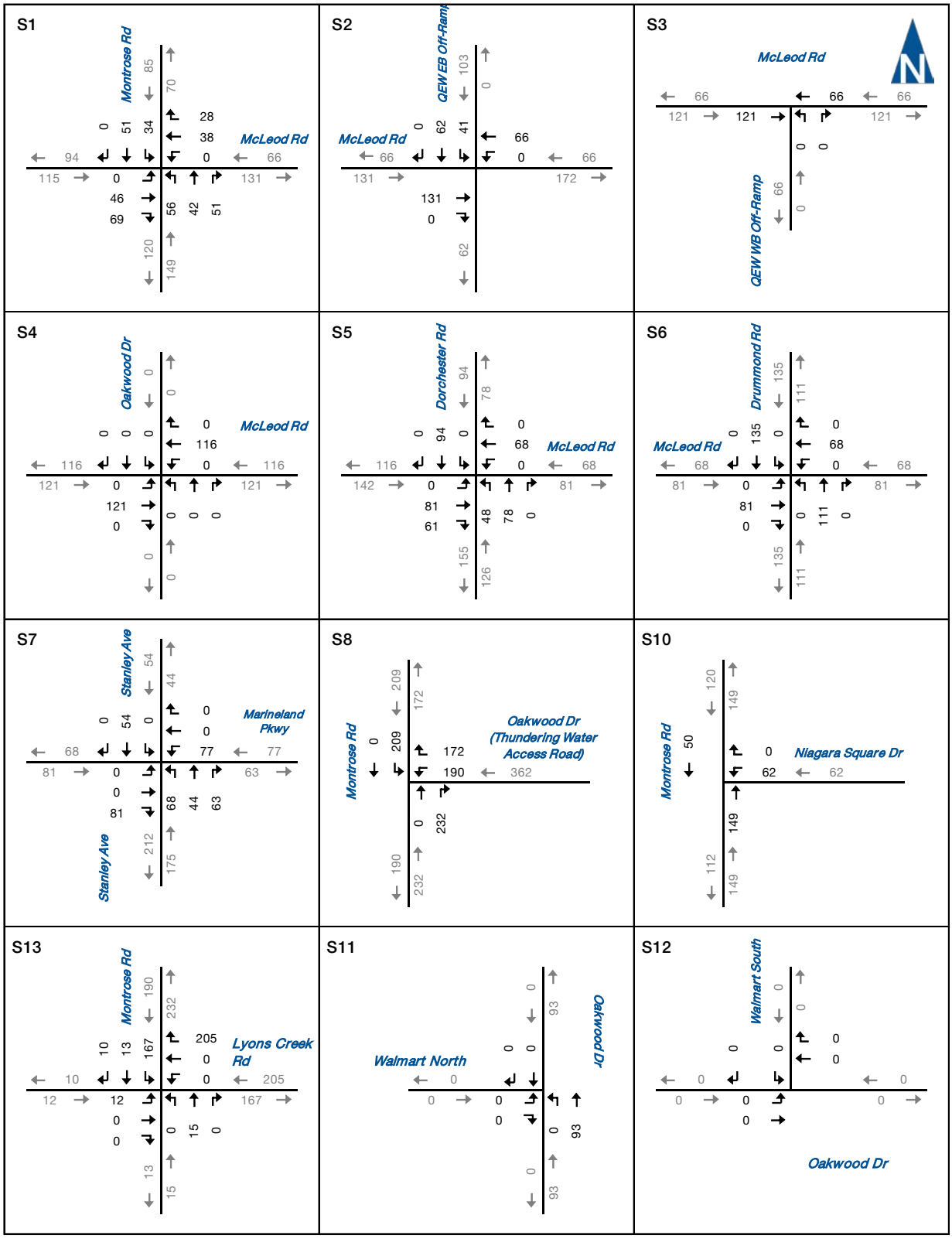
inconsistent with the land use and urban form objectives of the Secondary Plan. An easterly alignment would locate the crossing closer to the existing Stanley Avenue structure over the Welland River, raising questions about the need for a second crossing in such close proximity to an existing bridge (which already appears to have sufficient deck width to accommodate two additional lanes). There may also be natural environmental considerations given the woodlot south of the river in this vicinity. Property will be required from private land owners to implement this option regardless of the alignment selected.

The Welland River option would be most attractive to trips destined to the south (on the QEW and Lyons Creek Road) and west (on Biggar Road). Traffic oriented to the north (on the QEW) and west (on McLeod Road) may find this option more circuitous, but less congested given expected conditions for McLeod Road in the future. It would also be more effective in directing vehicles to the QEW interchange at Lyons Creek Road than the OPG Canal crossing location, depending on design.

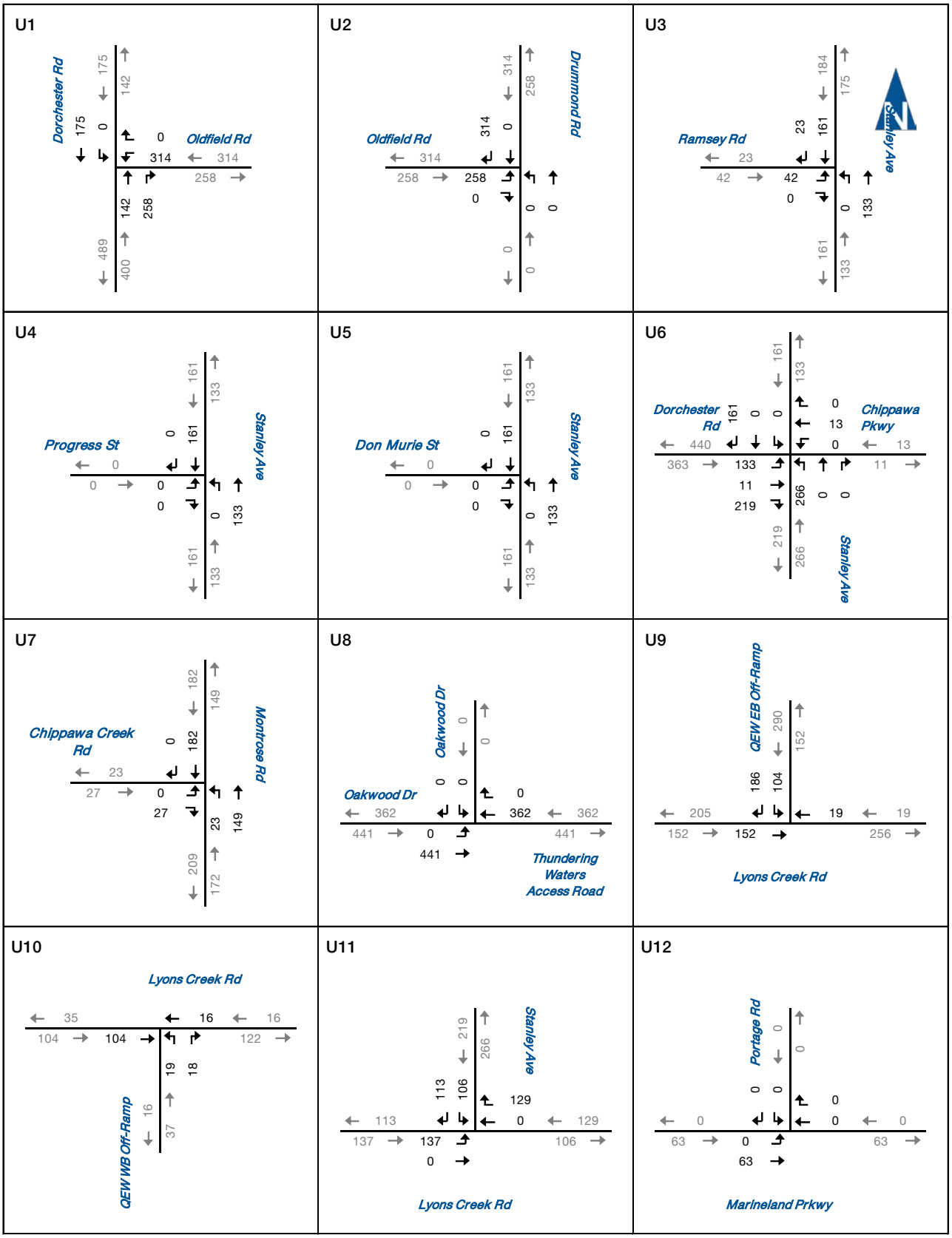
6.9.3 Future Traffic Volumes with Watercourse Crossings

The development-related traffic assignments were manually redistributed to account for the influence of the OPG Canal and Welland River crossings, respectively, on traffic patterns. **Figures 6.14, 6.15** and **6.16** provide the revised traffic volumes with the OPG Canal crossing, while **Figures 6.17, 6.18** and **6.19** show the volumes with the Welland River crossing.

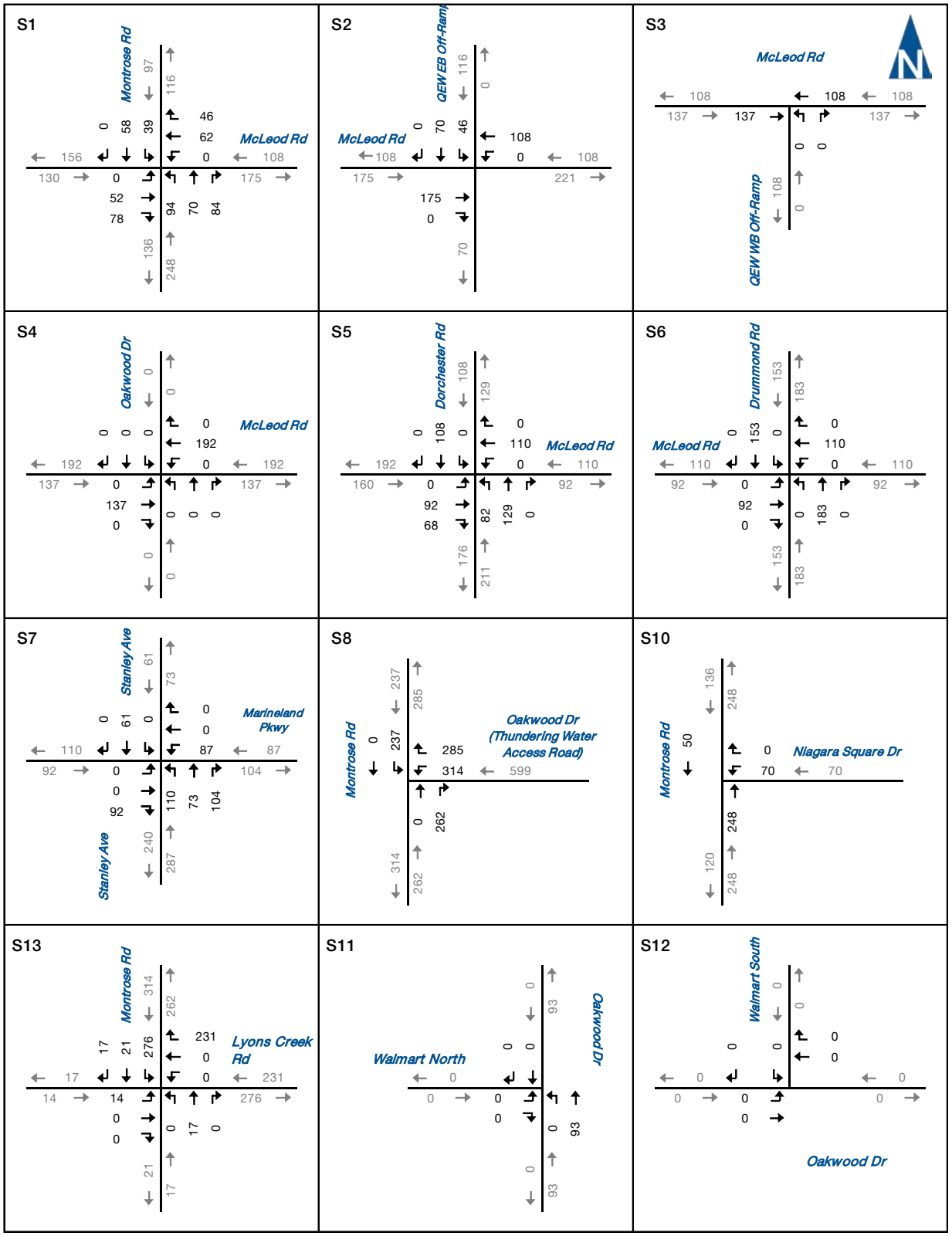
The future background traffic forecasts (**Figures 6.1, 6.2** and **6.3**) were then combined with the revised Thundering Waters lands traffic assignments for the OPG Canal (**Figures 6.14, 6.15** and **6.16**) and Welland River (**Figures 6.17, 6.18** and **6.19**) crossing scenarios to estimate the future total traffic volumes for the 2031 horizon year. **Figures 6.20, 6.21** and **6.22** summarize the volumes for the summer weekday morning, weekday afternoon, and Saturday midday peak hours, respectively, with the OPG Canal crossing. **Figures 6.23, 6.24** and **6.25** provide the volumes for the Welland River crossing scenario.



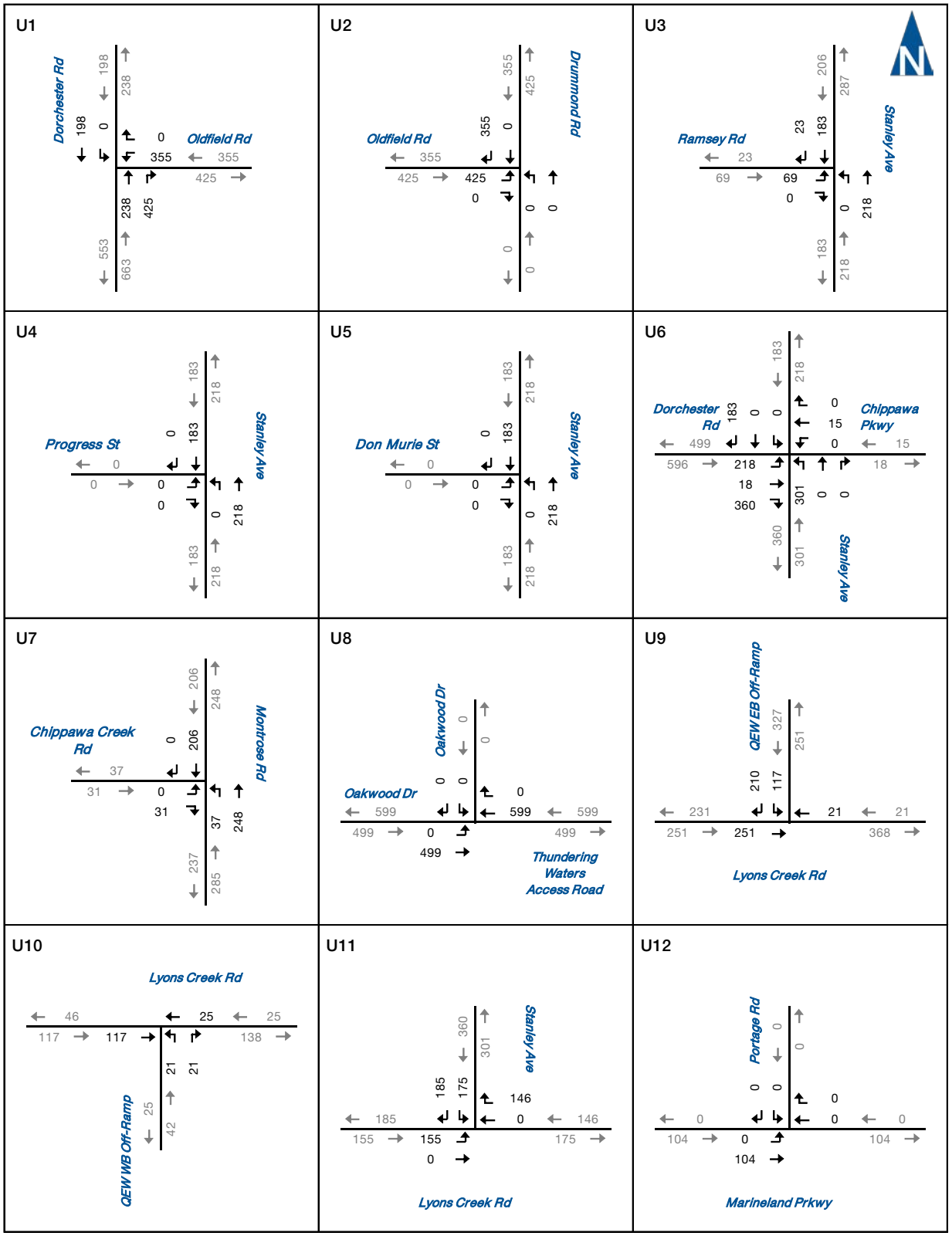
Site Generated Traffic Volumes OPG Canal Crossing - AM Peak Hour (Signalized Intersections)



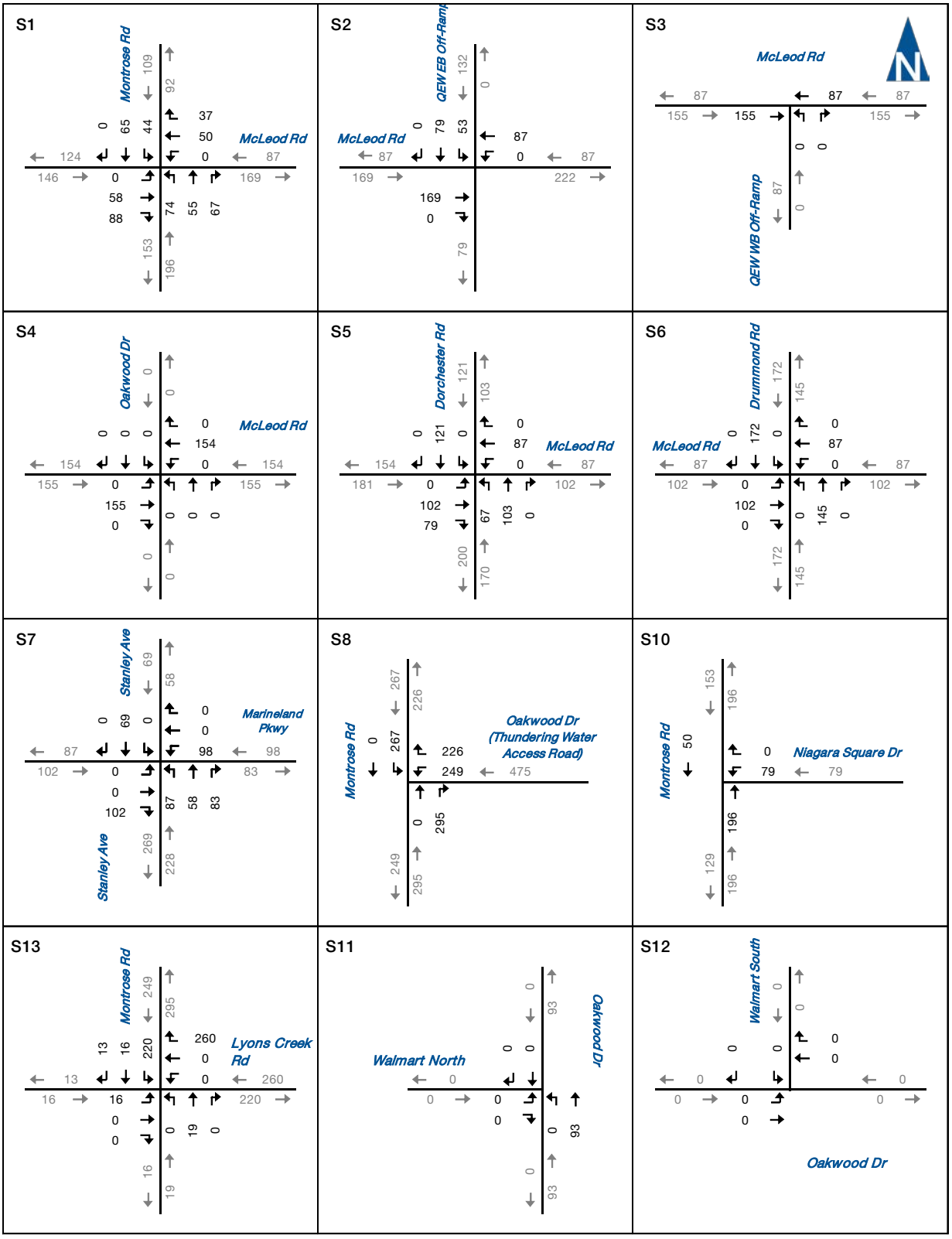
Site Generated Traffic Volumes OPG Canal Crossing - AM Peak Hour (Unsignalized Intersections)



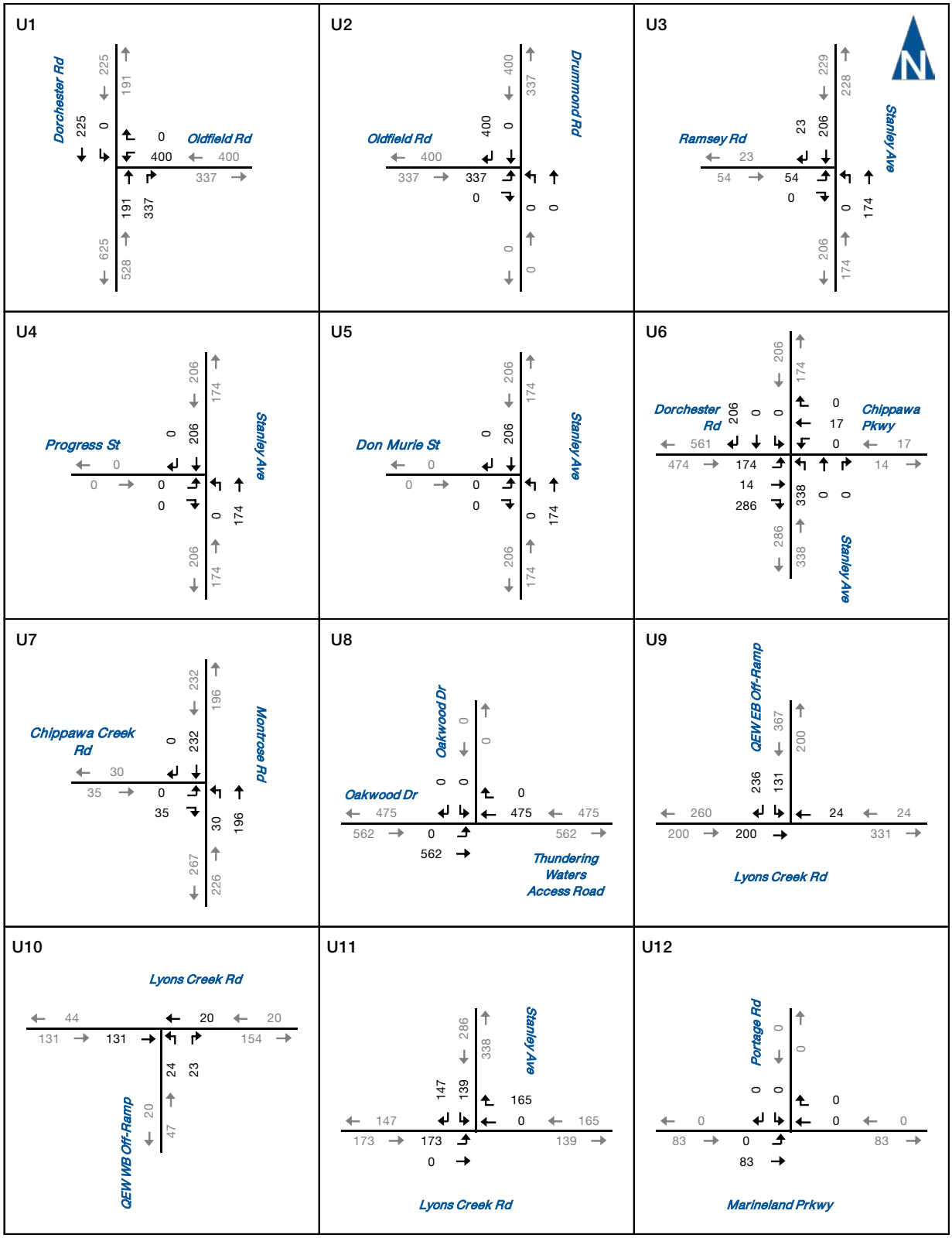
Site Generated Traffic Volumes OPG Canal Crossing - PM Peak Hour (Signalized Intersections)



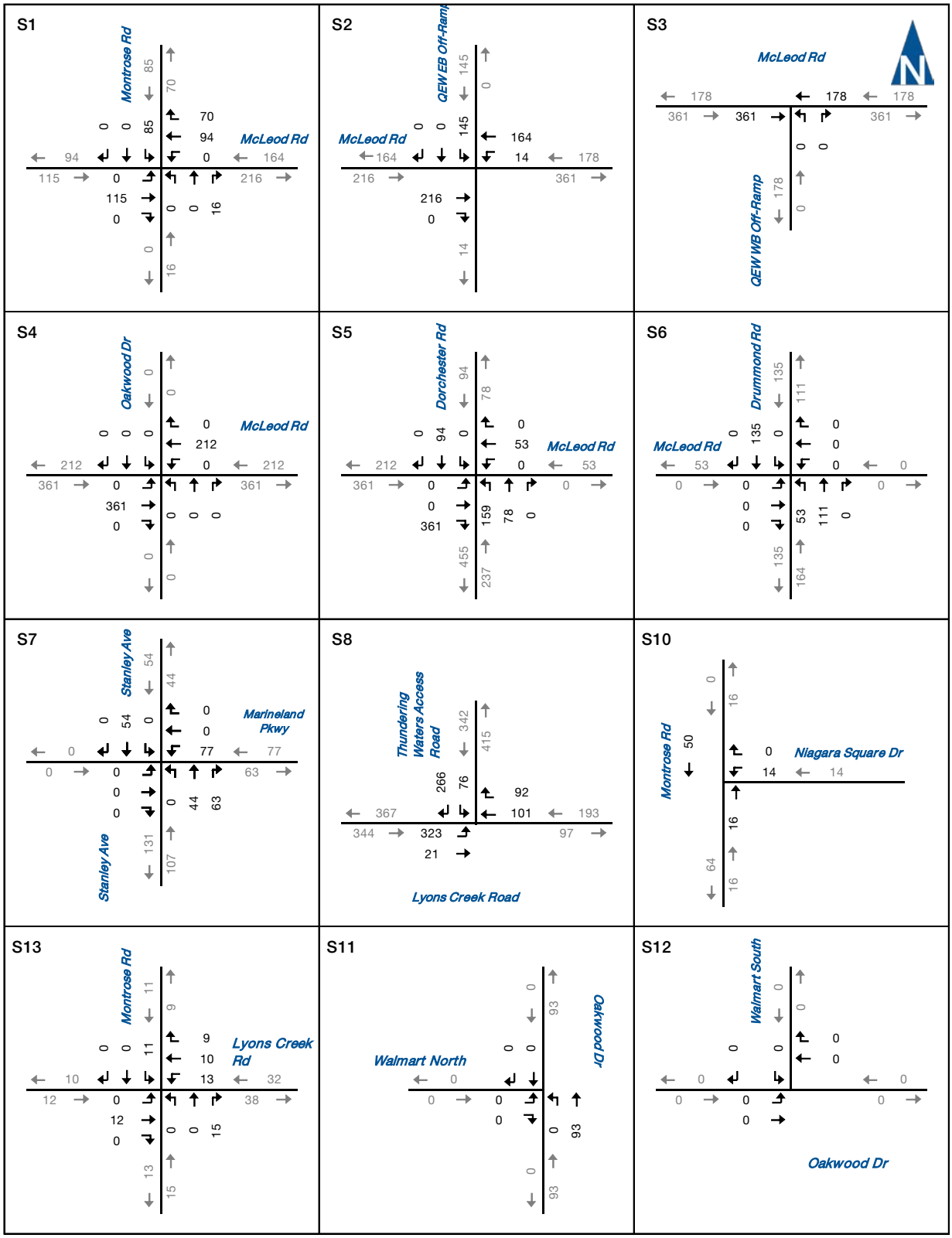
Site Generated Traffic Volumes
OPG Canal Crossing - PM Peak Hour
(Unsignalized Intersections)



Site Generated Traffic Volumes
OPG Canal Crossing - Saturday Peak Hour
(Signalized Intersections)



Site Generated Traffic Volumes
OPG Canal Crossing - Saturday Peak Hour
(Unsignalized Intersections)



Site Generated Traffic Volumes
Welland River Crossing - AM Peak Hour
(Signalized Intersections)

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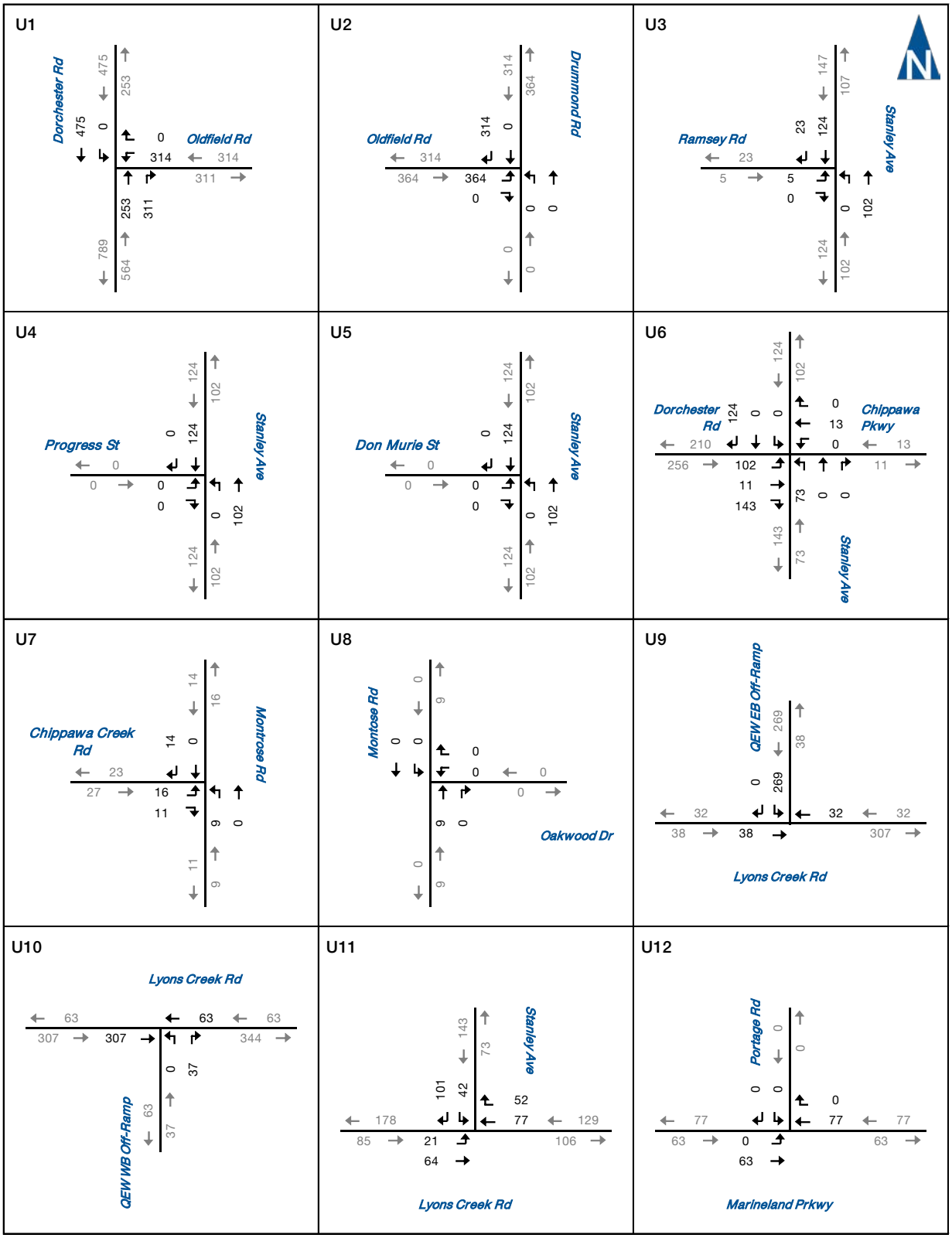
Figure 6.17A



Site Generated Traffic Volumes
Welland River Crossing - AM Peak Hour
(Unsignalized Intersections)

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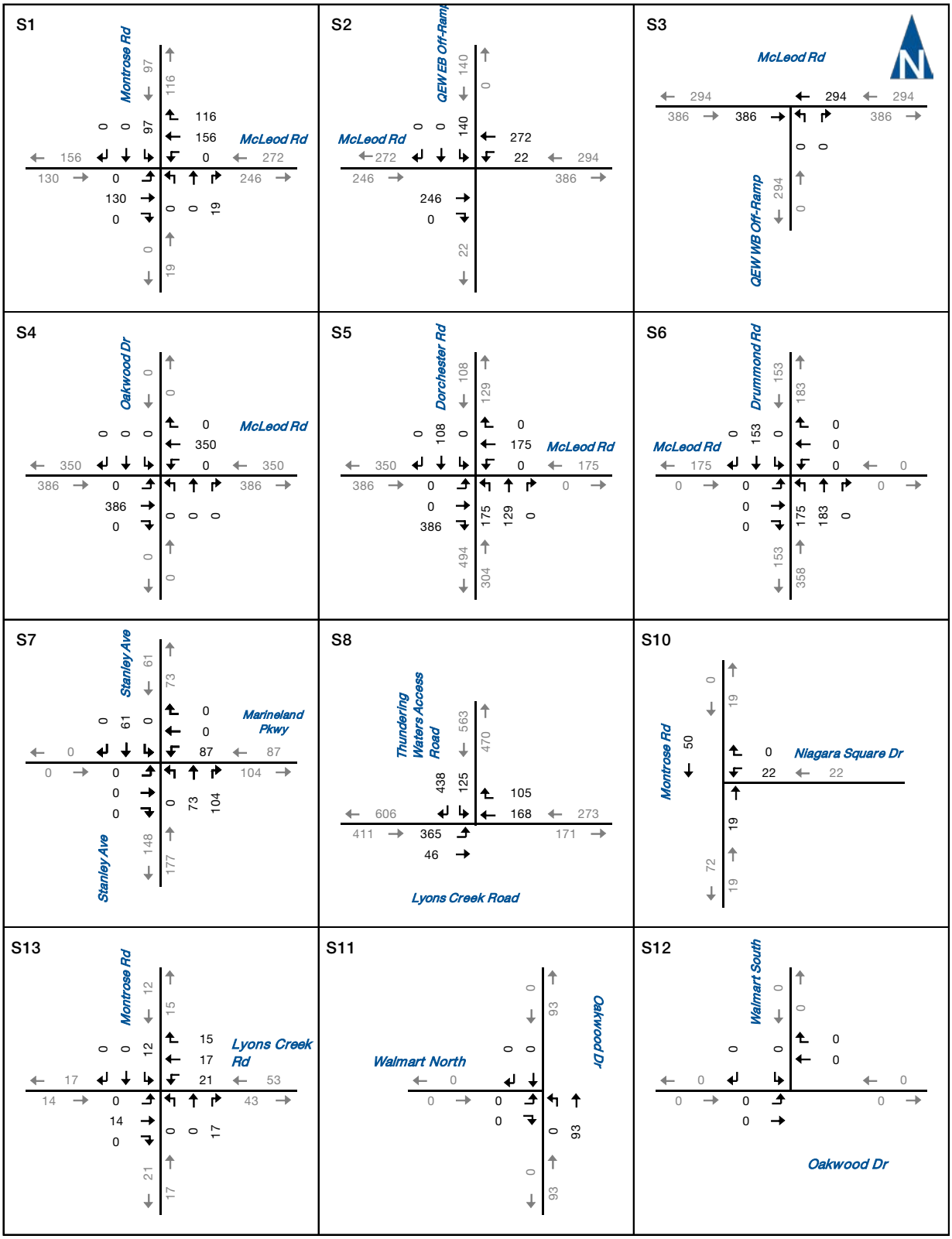
Figure 6.17B



Site Generated Traffic Volumes
Welland River Crossing - PM Peak Hour
(Signalized Intersections)

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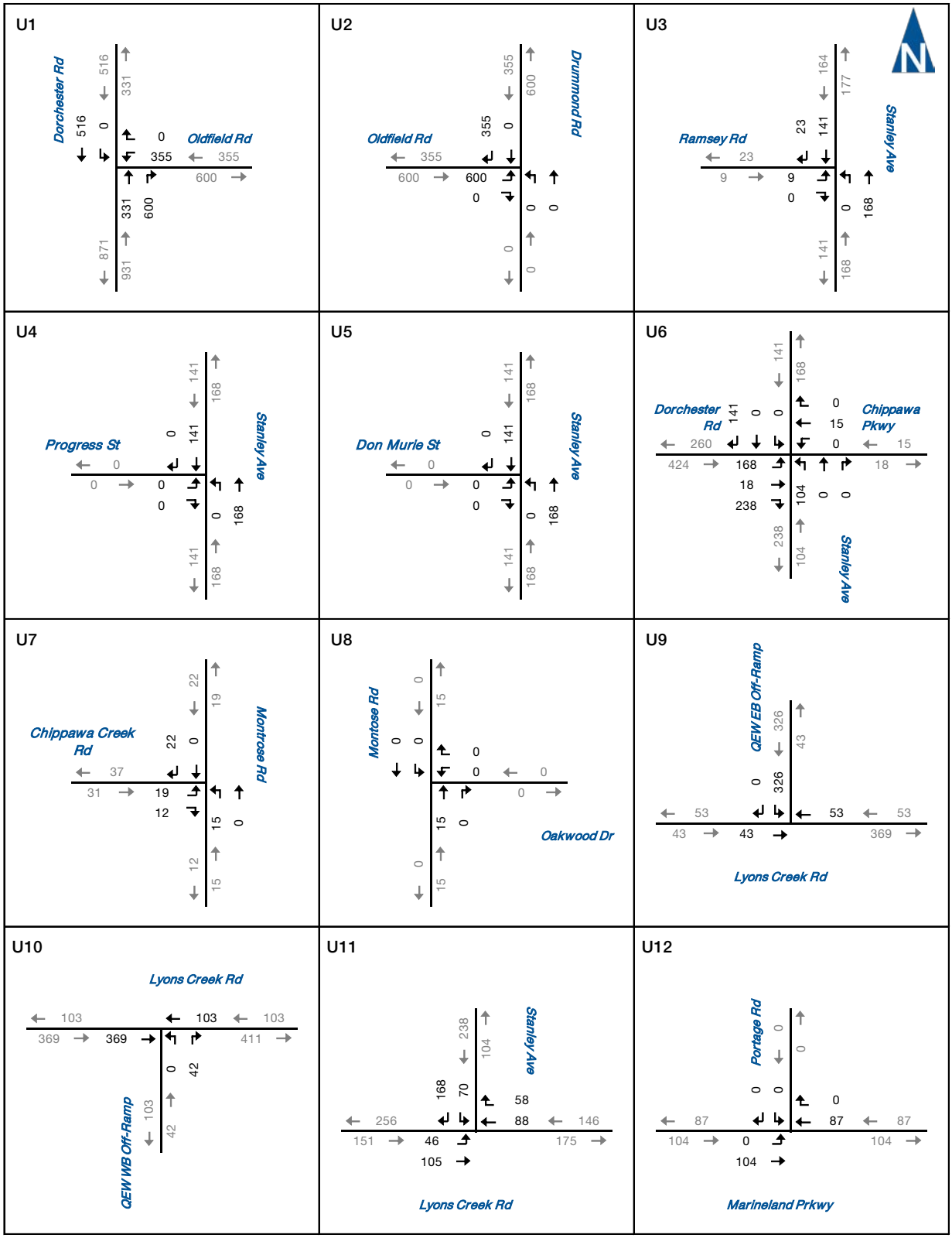
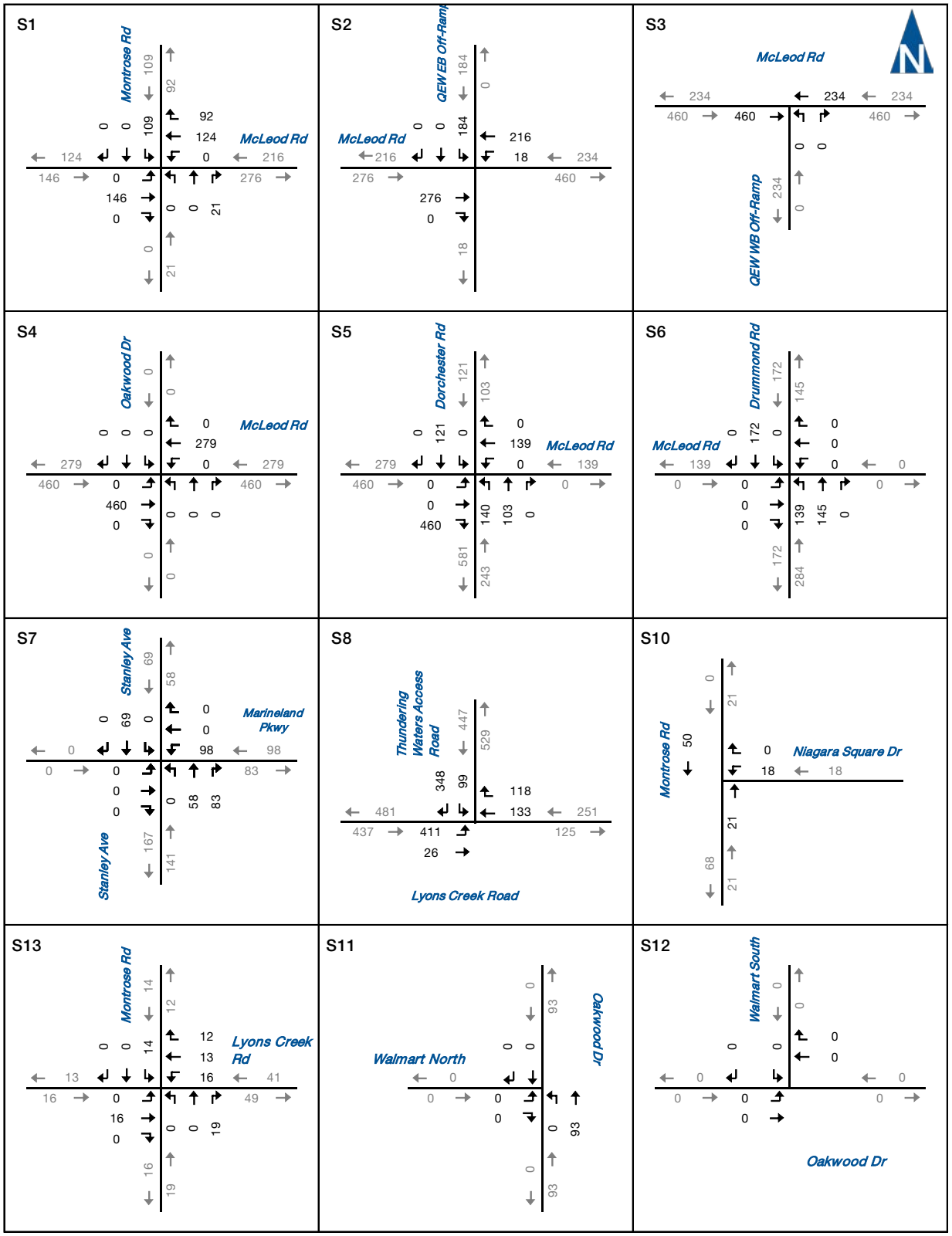
Figure 6.18A



Site Generated Traffic Volumes
Welland River Crossing - PM Peak Hour
(Unsignalized Intersections)



Site Generated Traffic Volumes
Welland River Crossing - Saturday Peak Hour (Signalized Intersections)

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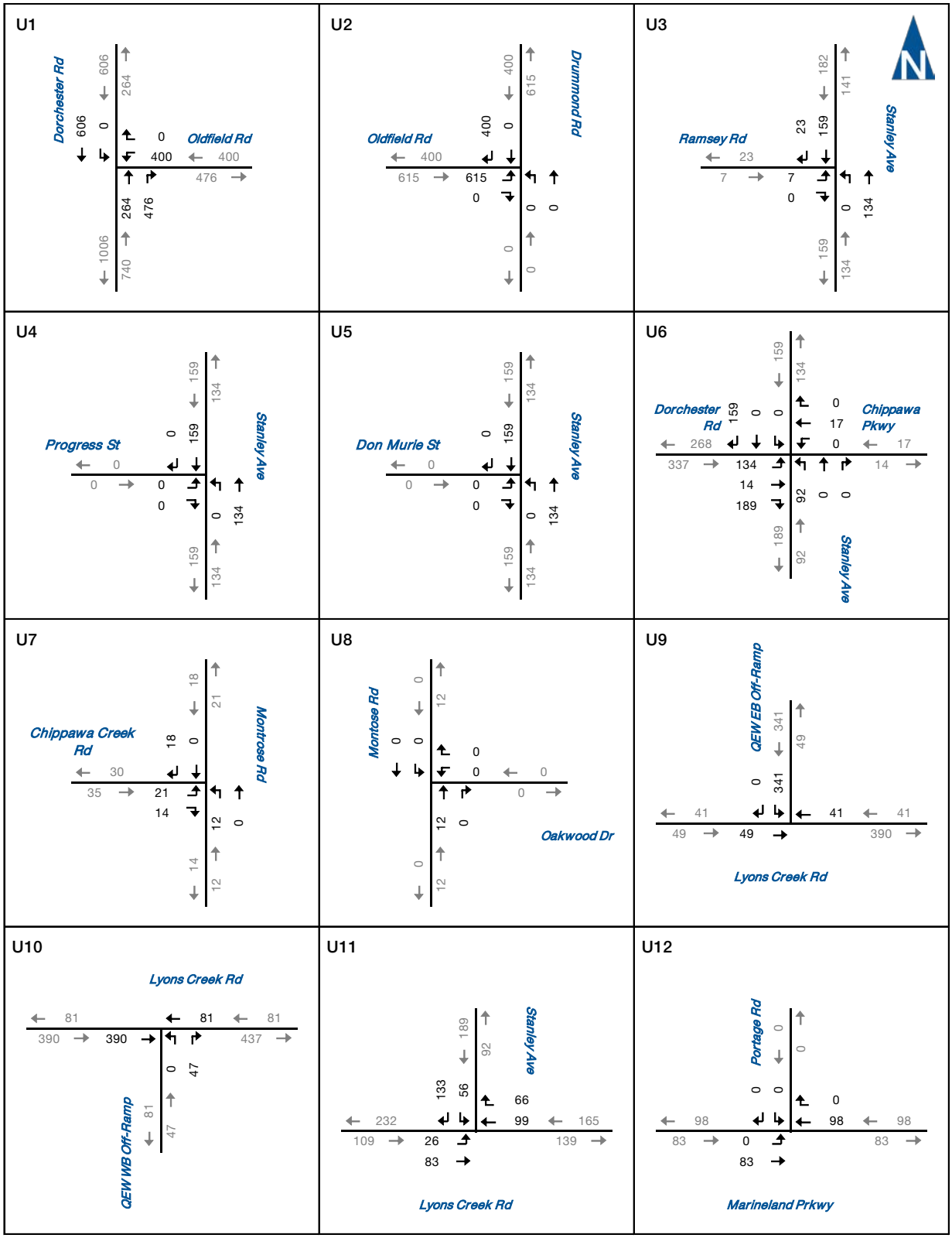
Figure 6.19A


U1
Dorchester Rd
Oldfield Rd
606
0
400
400
476
264
476
606
264
0
1006
740
U2
Oldfield Rd
Drummond Rd
400
615
615
400
0
400
0
0
0
0
U3
Ramsey Rd
Stanley Ave
23
7
7
0
23
159
182
141
0
134
134
159
U4
Progress St
Stanley Ave
0
0
0
0
159
159
134
0
134
159
134
U5
Don Murie St
Stanley Ave
0
0
0
0
159
159
134
0
134
159
134
U6
Dorchester Rd
Chippawa Pkwy
Stanley Ave
268
337
159
0
134
14
189
0
17
0
17
14
0
92
0
159
134
0
0
189
92
U7
Chippawa Creek Rd
Montrose Rd
30
35
21
14
18
0
18
21
12
0
14
12
U8
Montose Rd
Oakwood Dr
0
0
0
0
0
0
0
0
12
12
12
0
U9
QEW EB Off-Ramp
Lyons Creek Rd
41
49
49
41
41
390
0
341
341
49
U10
Lyons Creek Rd
QEW WB Off-Ramp
81
390
390
81
81
437
0
47
81
47
U11
Stanley Ave
Lyons Creek Rd
232
109
26
83
133
56
66
99
165
139
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Portage Rd
Marineland Prkwy
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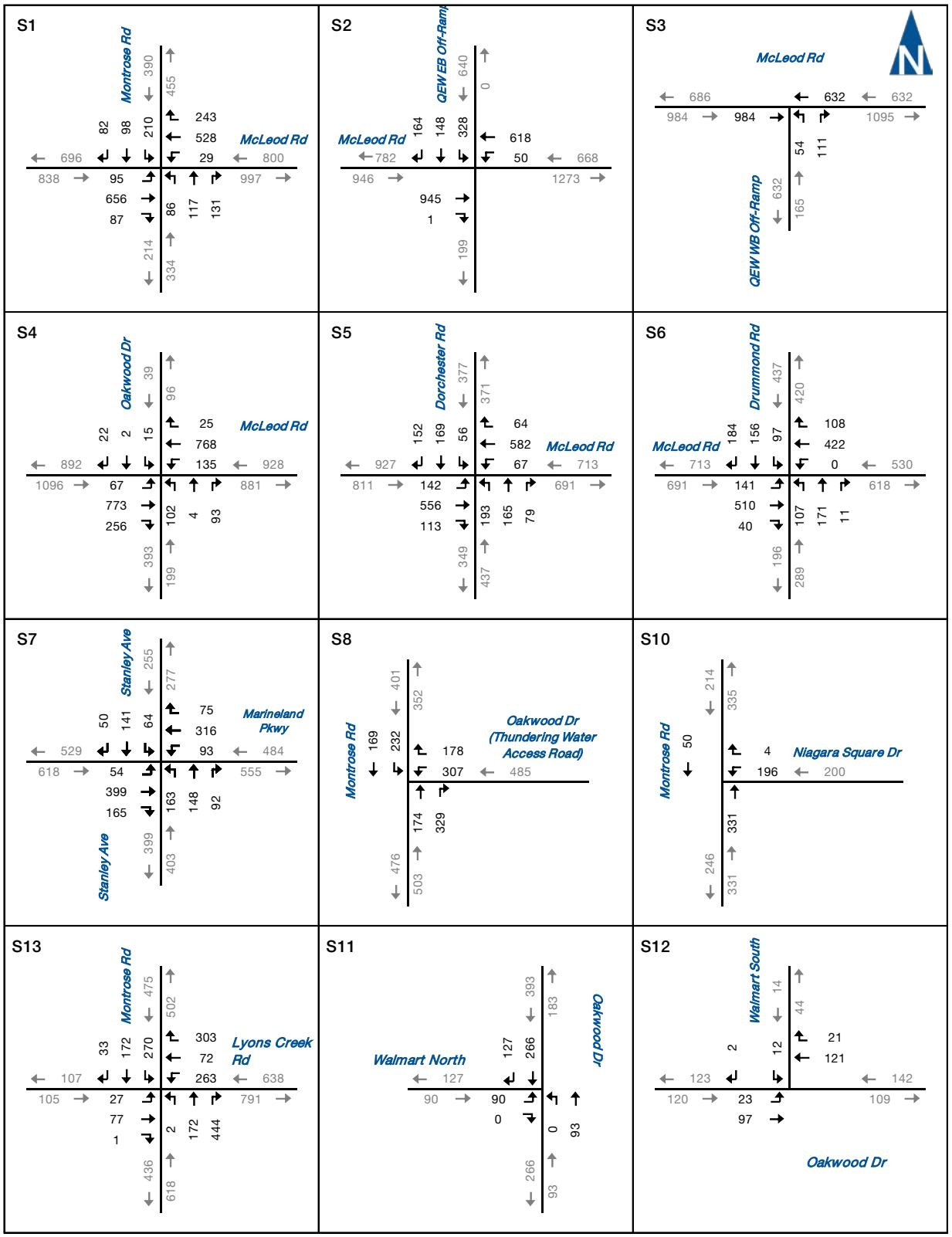
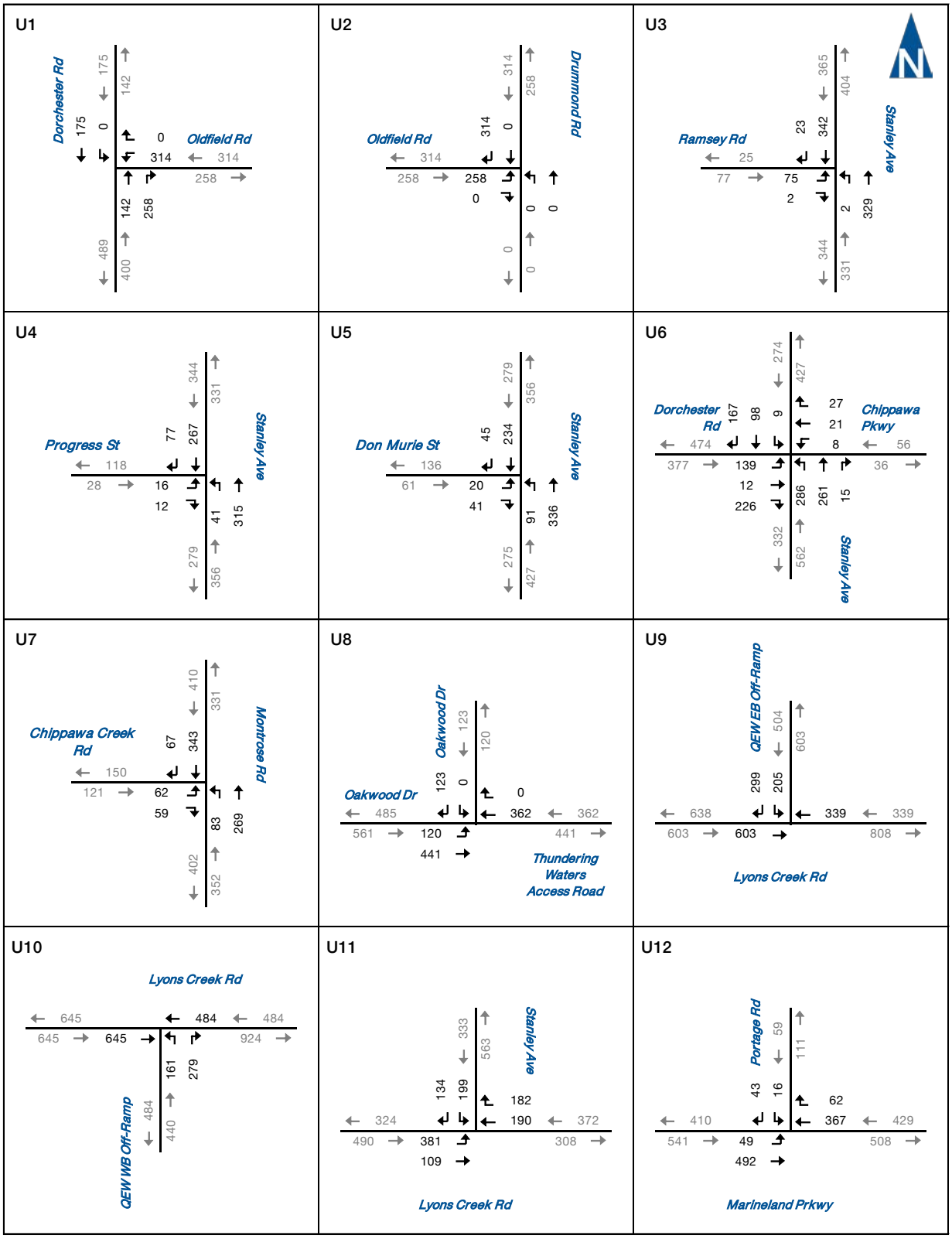


2031 Future Total Traffic Volumes OPG Canal Crossing - AM Peak Hour (Signalized Intersections)



2031 Future Total Traffic Volumes OPG Canal Crossing - AM Peak Hour (Unsignalized Intersections)

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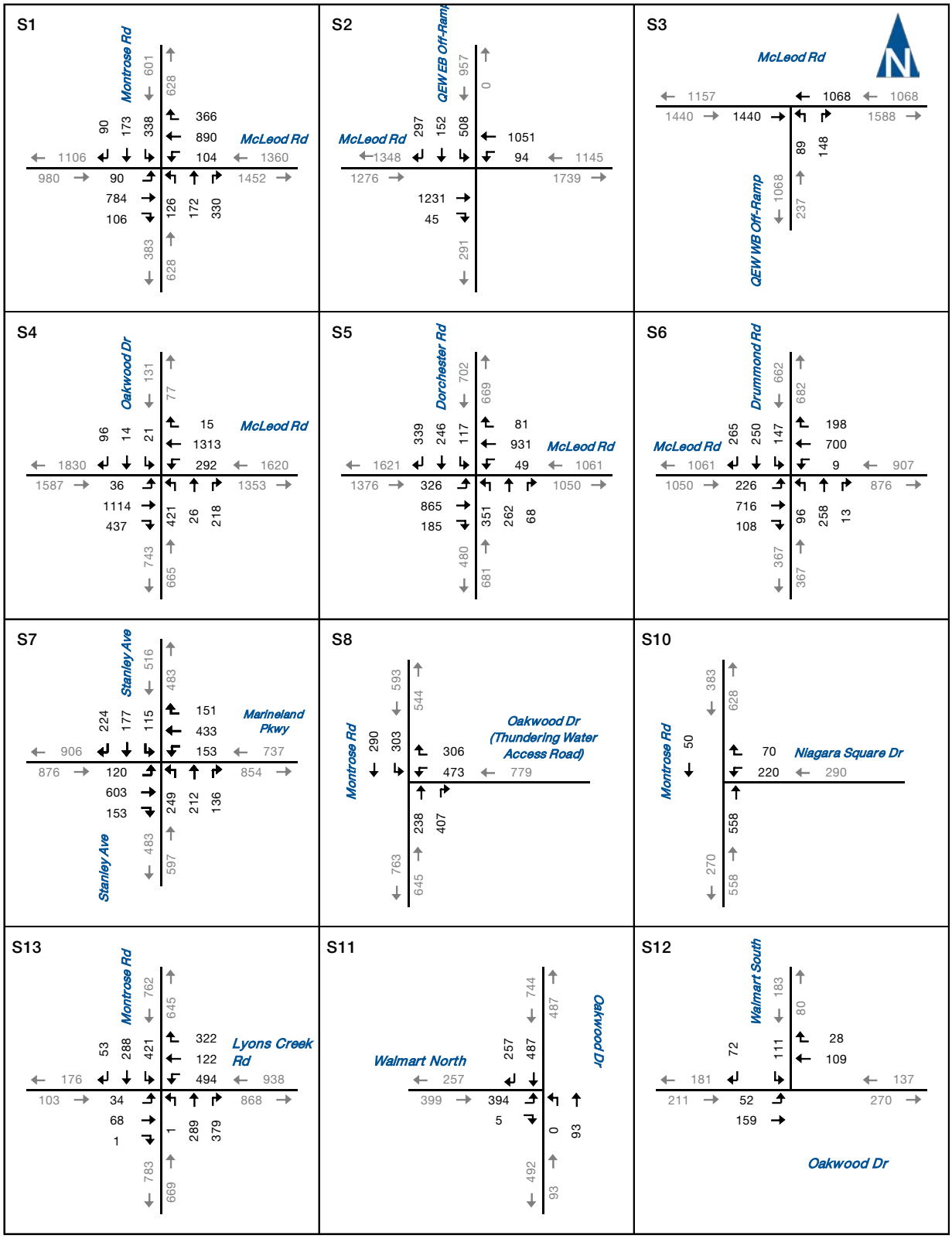
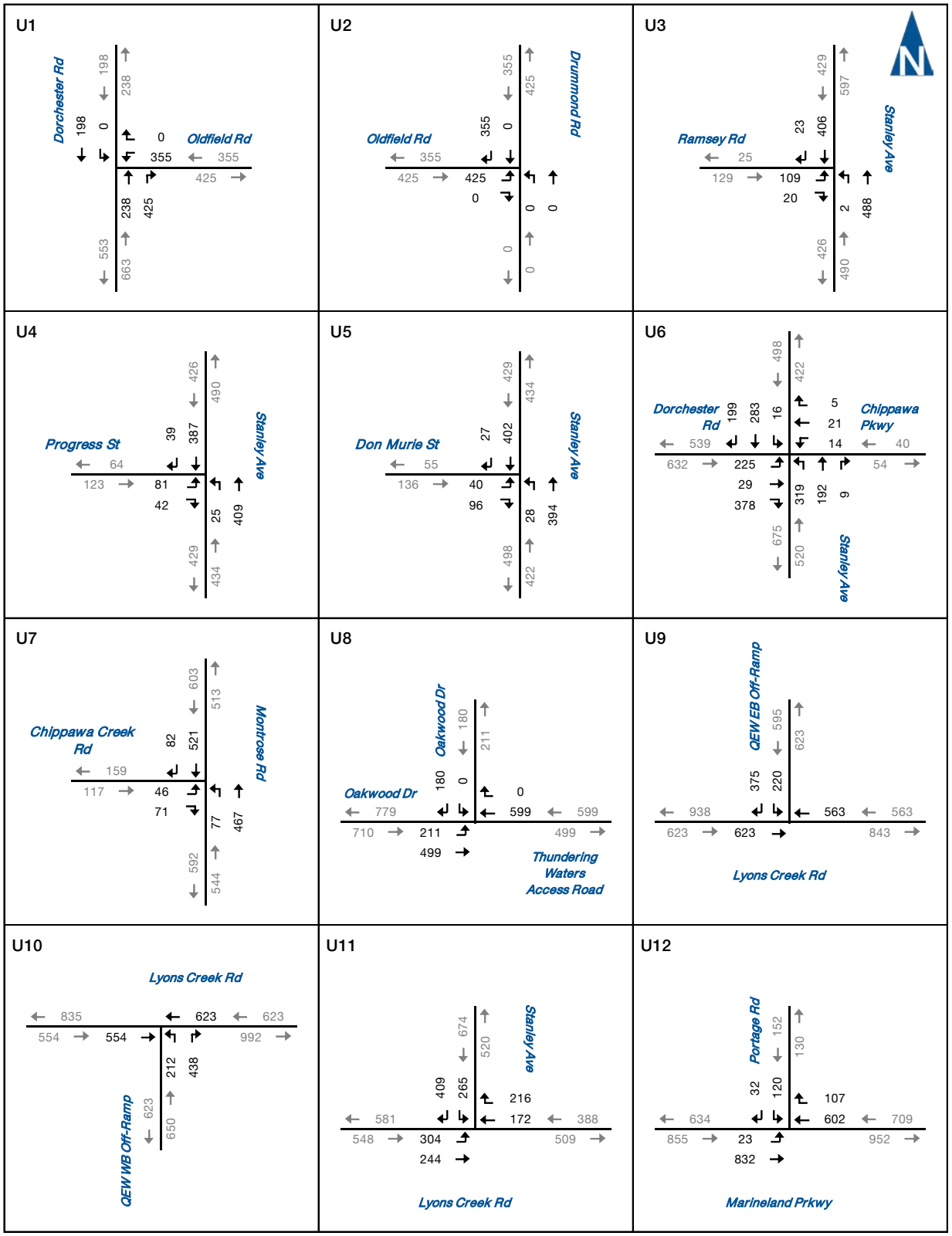
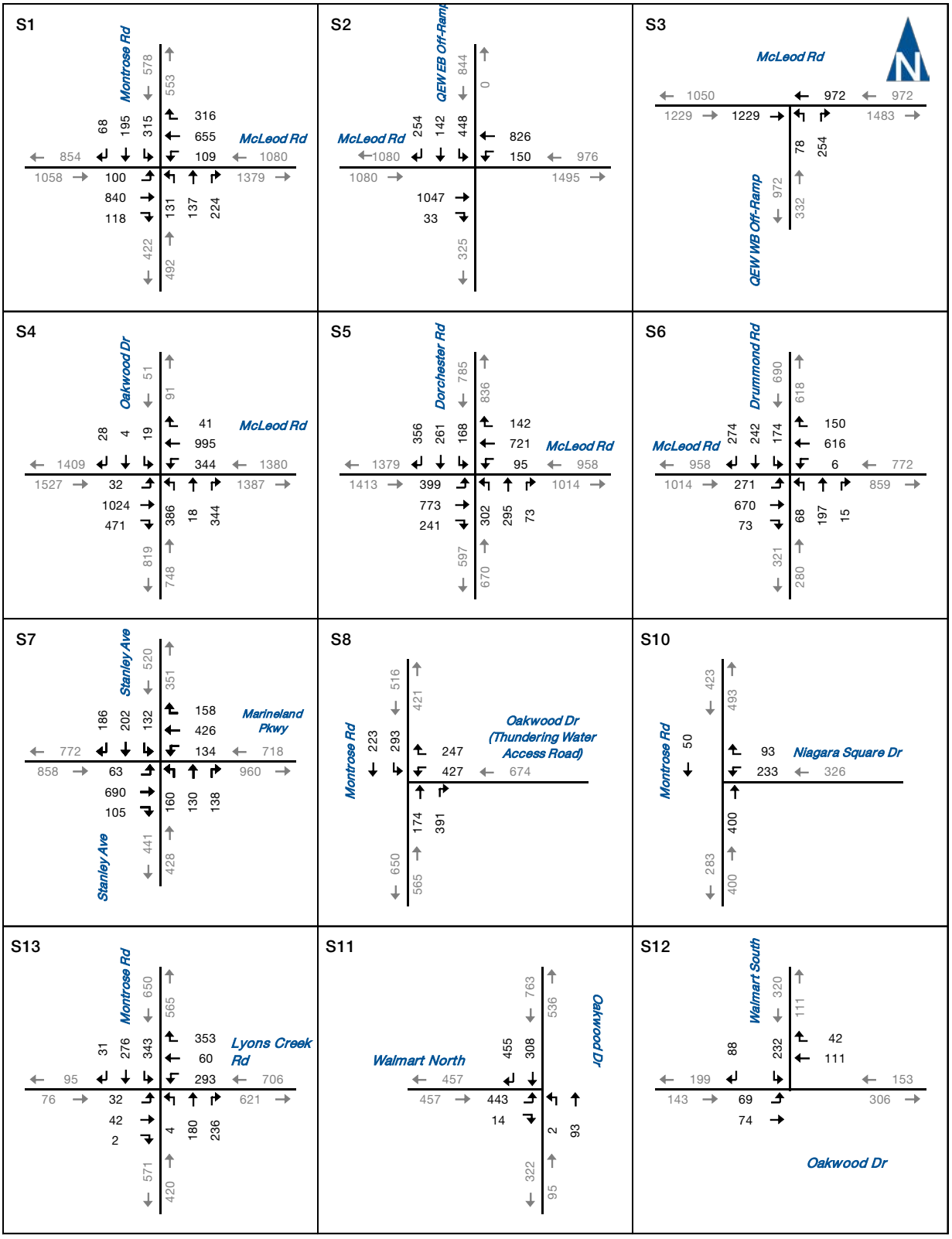
Figure 6.20B



2031 Future Total Traffic Volumes OPG Canal Crossing - PM Peak Hour (Signalized Intersections)



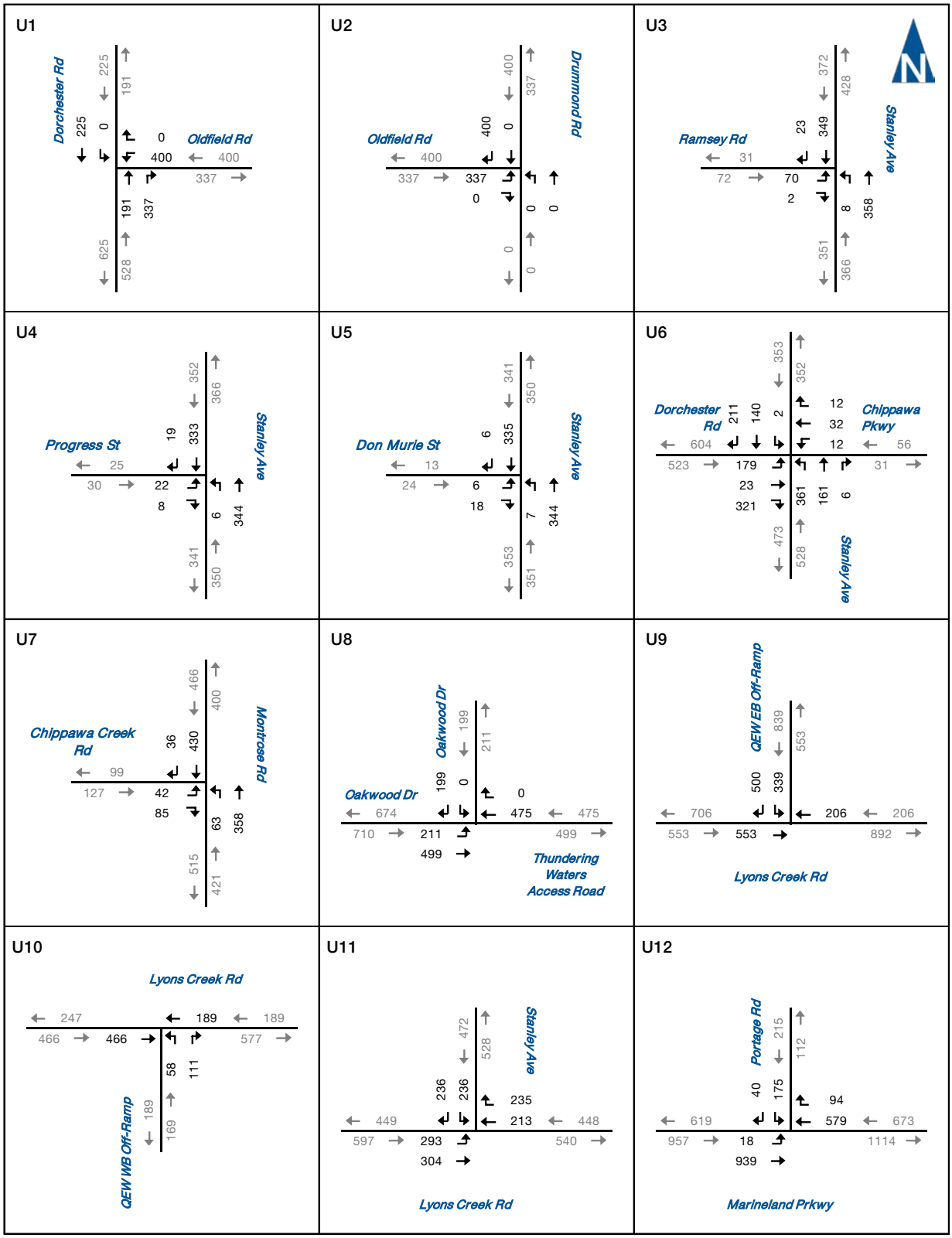
2031 Future Total Traffic Volumes OPG Canal Crossing - PM Peak Hour (Unsignalized Intersections)



2031 Future Total Traffic Volumes
OPG Canal Crossing - Saturday Peak Hour
(Signalized Intersections)

Thundering Waters Transportation Master Plan
151385

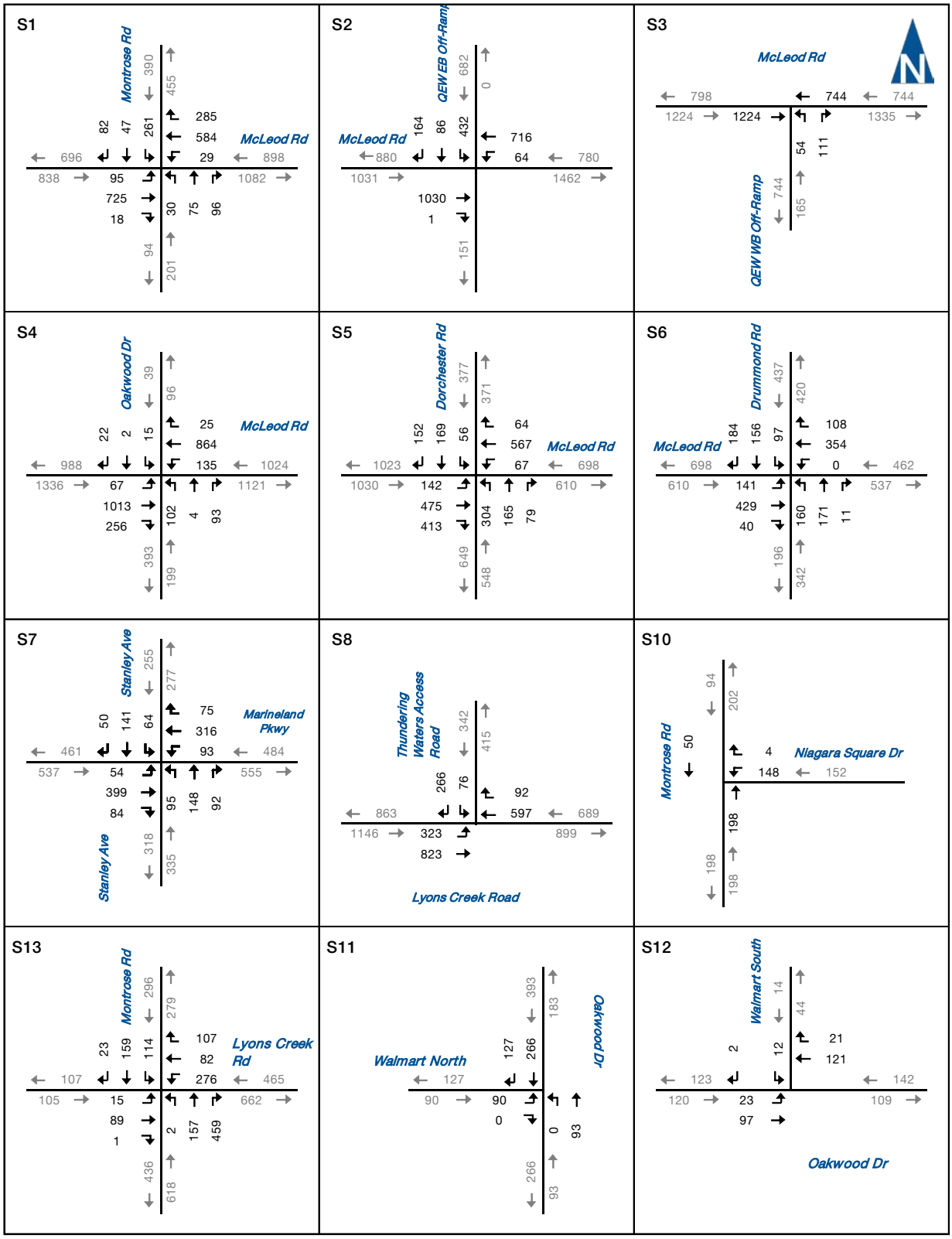
Figure 6.22A



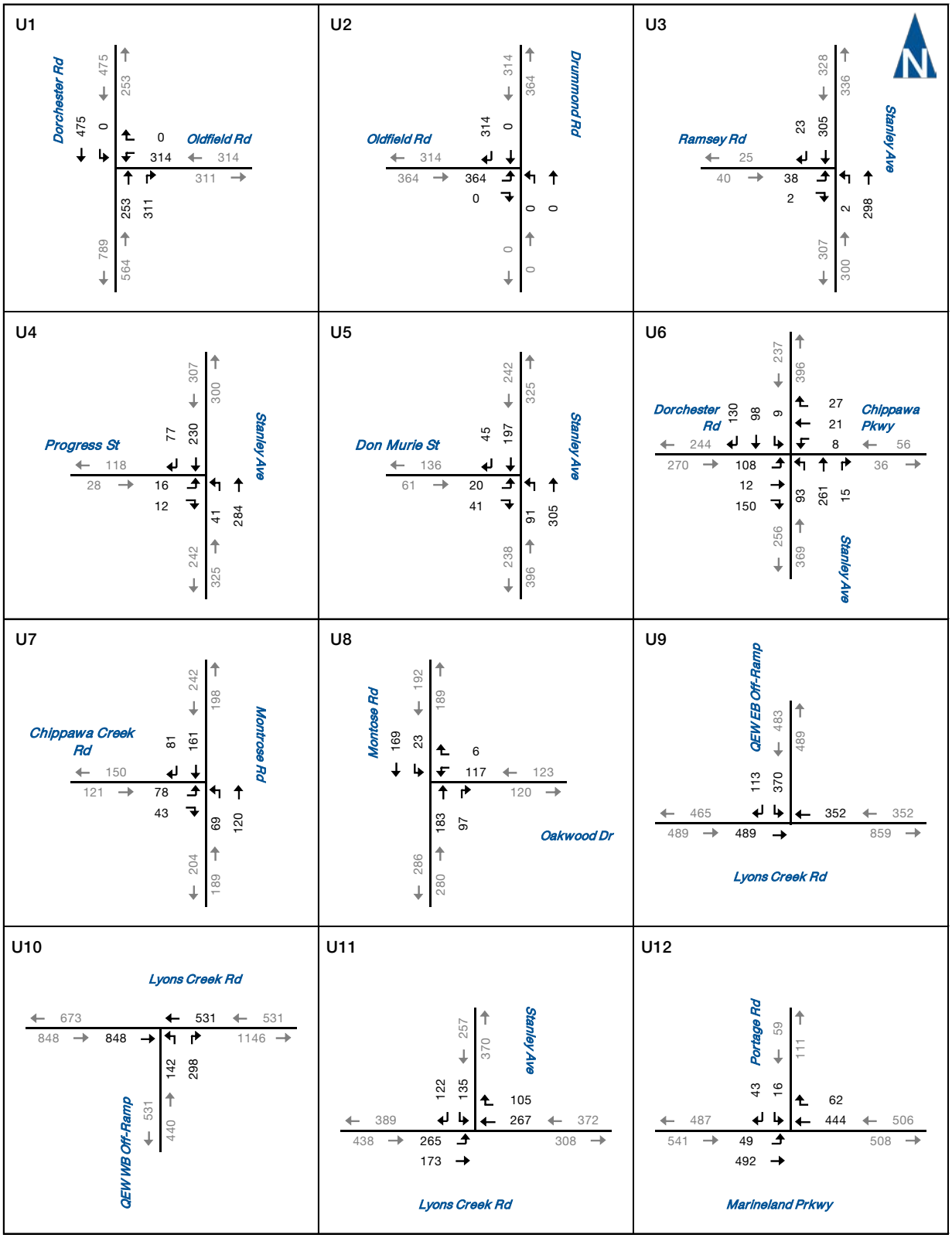
2031 Future Total Traffic Volumes
OPG Canal Crossing - Saturday Peak Hour
(Unsignalized Intersections)

Thundering Waters Transportation Master Plan
151385

Figure 6.22B



2031 Future Total Traffic Volumes
Welland River Crossing - AM Peak Hour
(Signalized Intersections)



2031 Future Total Traffic Volumes Welland River Crossing - AM Peak Hour (Unsignalized Intersections)

Thundering Waters Transportation Master Plan
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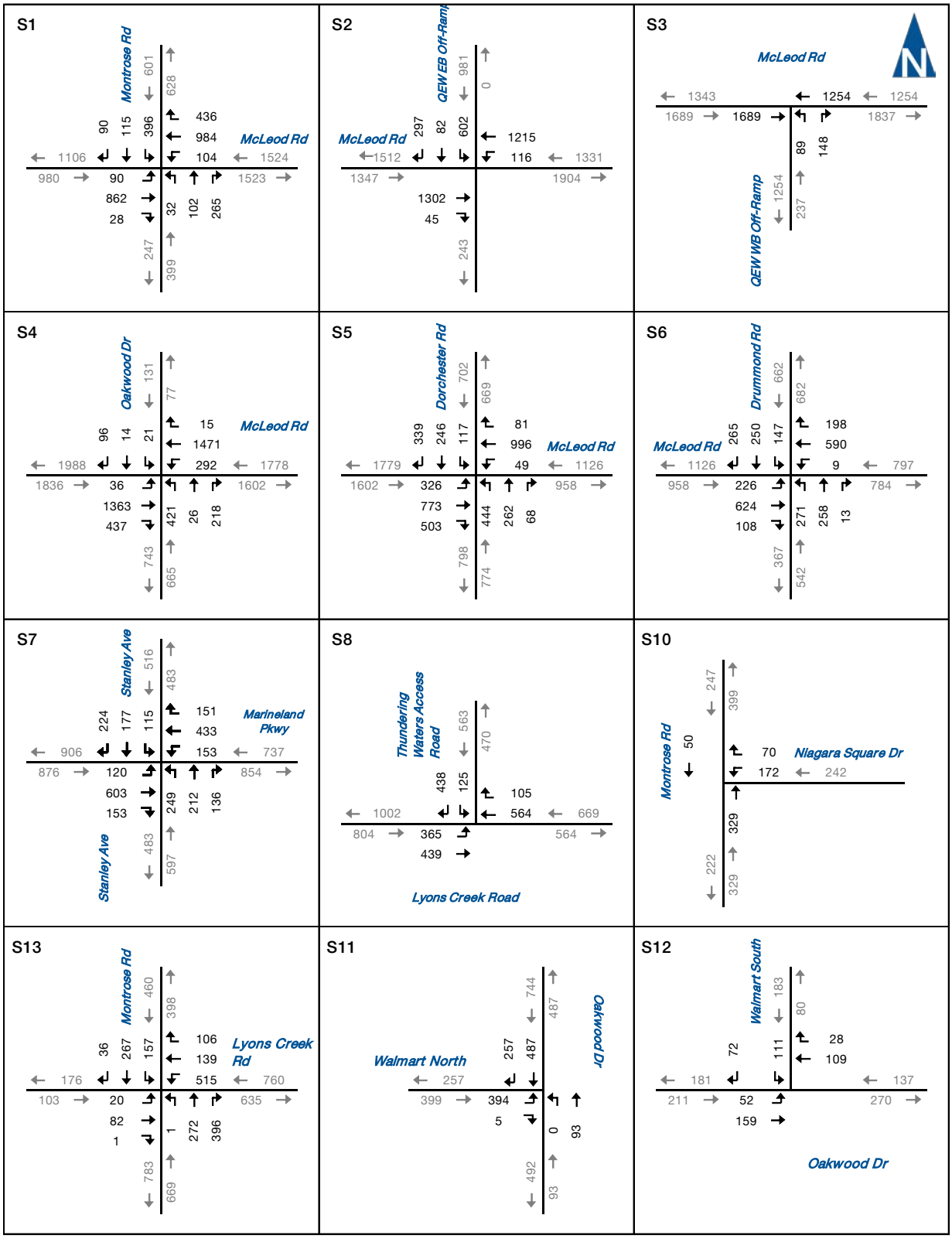
Figure 6.23B



2031 Future Total Traffic Volumes Welland River Crossing - PM Peak Hour (Signalized Intersections)

Thundering Waters Transportation Master Plan
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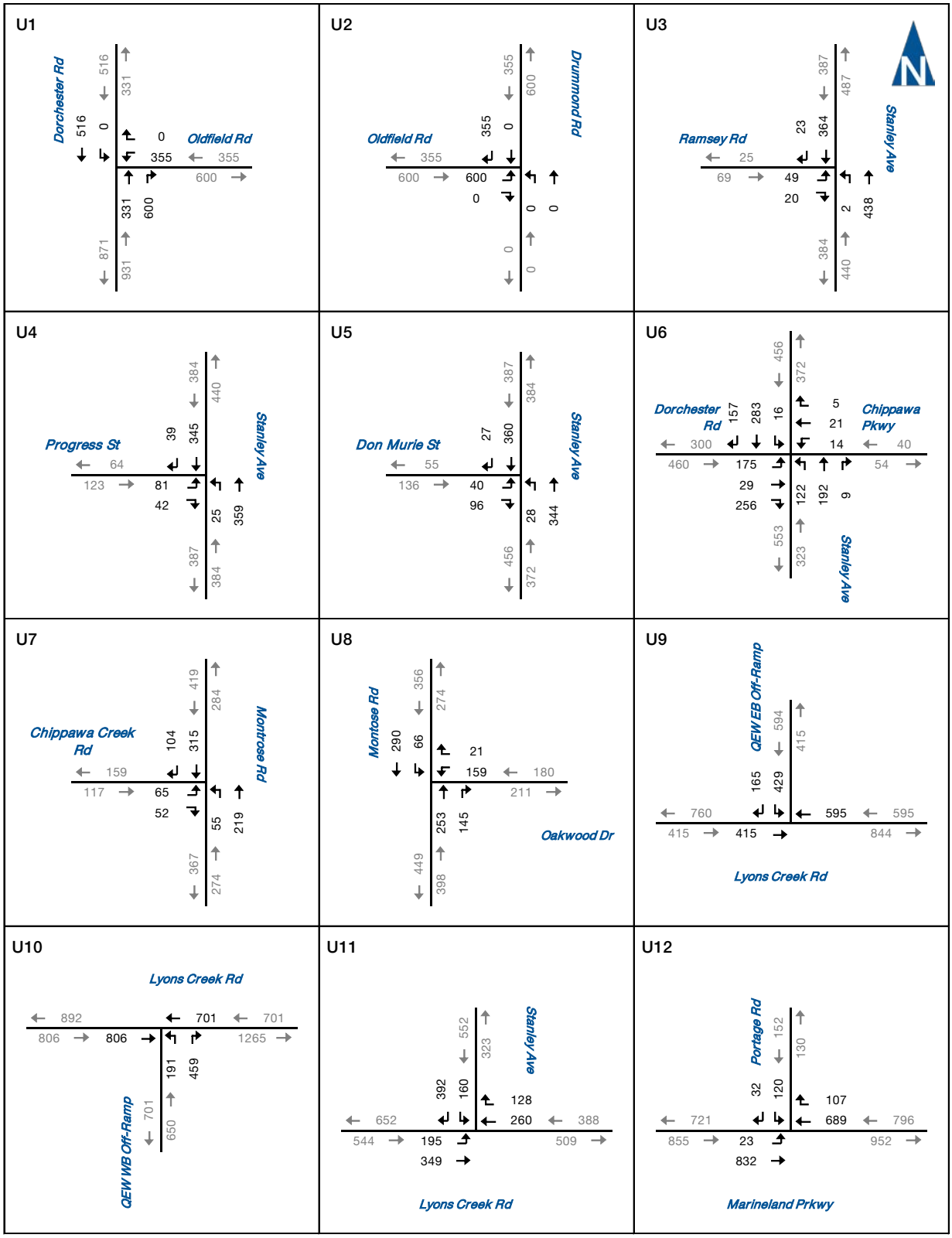
Figure 6.24A



2031 Future Total Traffic Volumes Welland River Crossing - PM Peak Hour (Unsignalized Intersections)

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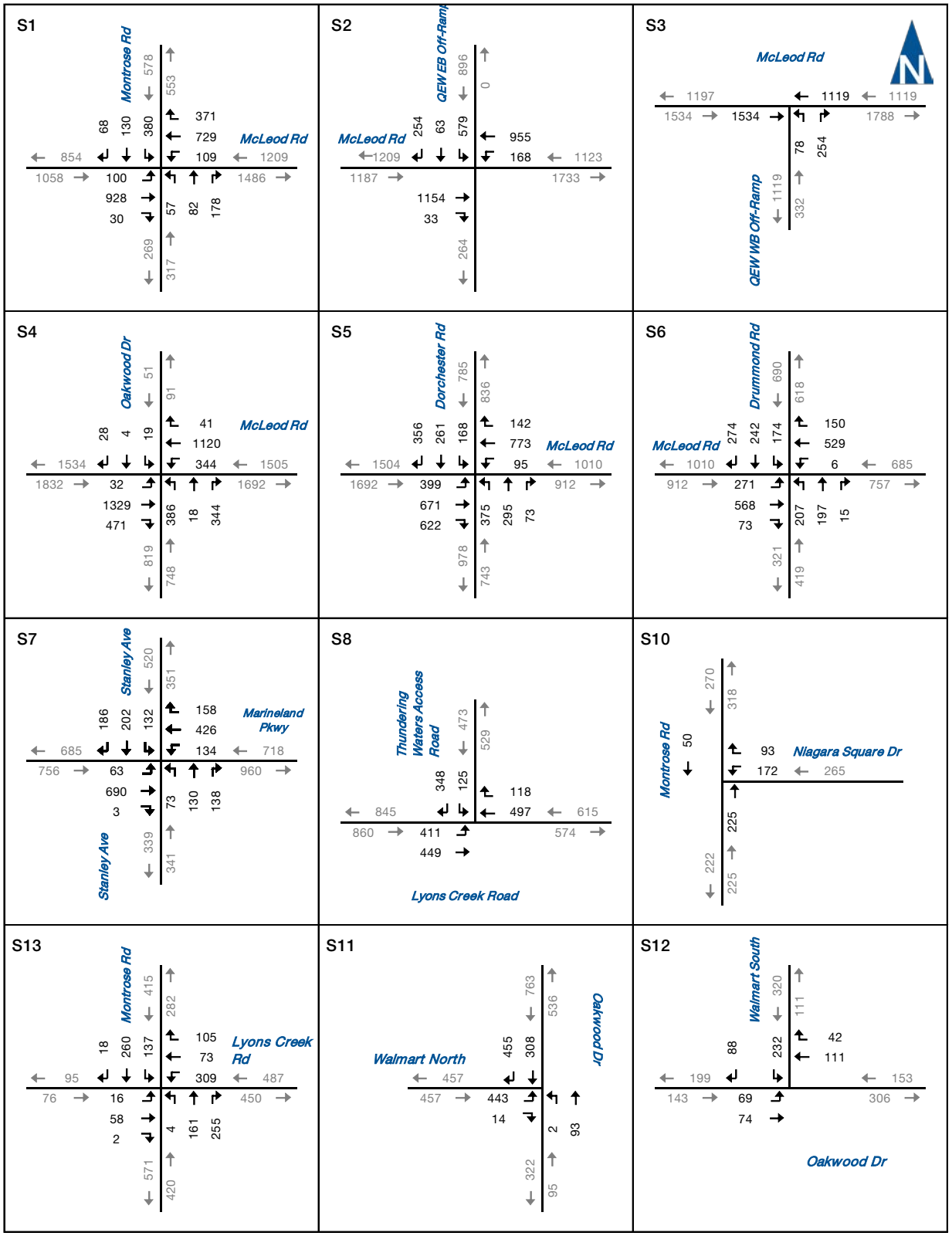
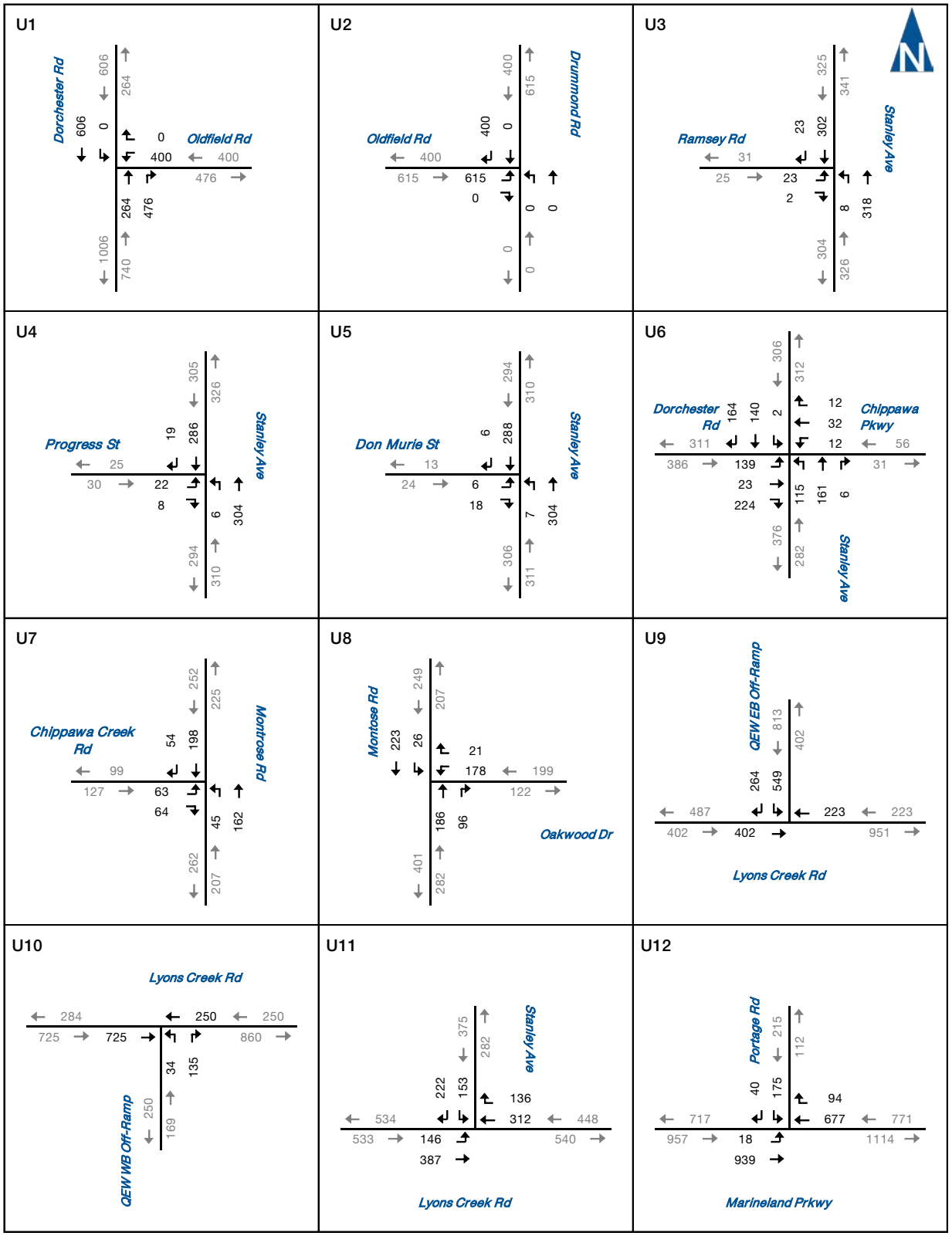
Figure 6.24B



2031 Future Total Traffic Volumes
Welland River Crossing - Saturday Peak Hour
(Signalized Intersections)

Thundering Waters Transportation Master Plan
151385

Figure 6.25A



2031 Future Total Traffic Volumes
Welland River Crossing - Saturday Peak Hour
(Unsignalized Intersections)

Thundering Waters Transportation Master Plan
151385

Figure 6.25B

6.9.4 Future Total Traffic Operations with Watercourse Crossings

One of the many factors to be considered in determining the preferred location for a potential crossing would be its impact on external traffic generated by the Thundering Waters lands. Intersection capacity analyses were undertaken to assess the future total peak hour traffic conditions for the Study Area intersections with the crossings, which were compared to the existing (without crossing) results. The analyses followed the same methodology and parameters as used for the future total traffic operations analysis with the base road network improvements identified in Sections 6.8.1 and 6.8.2 above. Signal timings were also optimized using Synchro.

OPG Canal Crossing

Tables 6.16, 6.17 and **6.18** summarize the results of the intersection capacity analyses completed to assess operating conditions for the summer weekday morning, weekday afternoon and Saturday midday future total traffic forecasts with the OPG Canal crossing (**Figures 6.20, 6.21** and **6.22**). **Appendix I** provides the Synchro analysis output. The following is noted from the analyses:

- **Weekday Morning Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements remain at the following intersection:
  - Stanley Avenue and Dorchester Road/Chippawa Parkway (eastbound left-through-right and westbound left-through-right).
- **Weekday Afternoon Peak Hour** – With the exception of McLeod Road and Dorchester Road (LOS E), all intersections are forecast to operate with satisfactory levels of service. Critical movements remain at the following intersections:
  - McLeod Road and Oakwood Drive (eastbound through, westbound left and northbound left);
  - McLeod Road and Dorchester Road (westbound through-right and northbound left);
  - Montrose Road and Lyons Creek Road/Biggar Road (westbound left and southbound left);
  - Marineland Parkway and Portage Road (southbound left);
  - Stanley Avenue and Dorchester Road/Chippawa Parkway (eastbound left-through-right and westbound left-through-right);
  - Lyons Creek Road and QEW WB Off-Ramp (northbound left); and
  - Lyons Creek Road and QEW EB Off-Ramp (southbound left).
- **Saturday Midday Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements remain at the following intersections:

- McLeod Road and Oakwood Drive (eastbound through);
- McLeod Road and Dorchester Road (westbound through-right, northbound left and southbound left); and
- McLeod Road and Drummond Road (eastbound left, westbound through-right and northbound left-through-right).
- Marineland Parkway and Portage Road (southbound left);
- Stanley Avenue and Dorchester Road/Chippawa Parkway (eastbound left-through-right and westbound left-through-right);
- Lyons Creek Road and Stanley Avenue (westbound through-right).

Welland River Crossing

Tables 6.19, 6.20 and **6.21** summarize the results of the intersection capacity analyses completed to assess operating conditions for the summer weekday morning, weekday afternoon and Saturday midday future total traffic forecasts (**Figures 6.23, 6.24** and **6.25**) with the Welland River crossing. **Appendix J** provides the Synchro analysis output. The following is noted from the analyses:

- **Weekday Morning Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements remain at the following intersection:
  - Lyons Creek Road and QEW WB Off Ramp (northbound left).
- **Weekday Afternoon Peak Hour** – With the exception of McLeod Road and Oakwood Drive (LOS F), McLeod Road and Dorchester Road (LOS E) and McLeod Road and Drummond Road (LOS E) all intersections are forecast to operate with satisfactory levels of service. Critical turning movements remain at the following intersections:
  - McLeod Road and Oakwood Drive (eastbound through and westbound through-right);
  - McLeod Road and Dorchester Road (eastbound through, westbound through-right and northbound left);
  - McLeod Road and Drummond Road (northbound left-through-right);
  - Montrose Road and Lyons Creek Road/Biggar Road (westbound left-through);
  - Marineland Parkway and Portage Road (southbound left);
  - Stanley Avenue and Dorchester Road/Chippawa Parkway (eastbound left-through-right, westbound left-through-right);
  - Lyons Creek Road and QEW WB Off-Ramp (northbound left);
  - Lyons Creek Road and OEW EB Off-Ramp (southbound left).

- **Saturday Midday Peak Hour** – With the exception of McLeod Road and Oakwood Drive (LOS E) and McLeod Road and Dorchester Road (LOS E) all intersections are forecast to operate with satisfactory levels of service. Critical turning movements remain at the following intersections:
  - McLeod Road and Oakwood Drive (northbound through);
  - McLeod Road and Dorchester Road (eastbound through-right, westbound through-right, northbound left and southbound left);
  - McLeod Road and Drummond Road (northbound left-through-right);
  - Marineland Parkway and Portage Road (southbound left);
  - Stanley Avenue and Dorchester Road/Chippawa Parkway (eastbound left-through-right);
  - Lyons Creek Road and Stanley Avenue (westbound through-right); and
  - Lyons Creek Road and QEW EB Off-Ramp (southbound left).

TABLE 6.16A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING, WEEKDAY AM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	McLeod Road & Montrose Road	TCS	LOS	B	B	B	**B**	A	A	A	**A**	B	B	B	**B**	B	B		**B**	**B**
			Delay	15	16	12	**16**	9	8	9	**8**	15	14	14	**14**	18	14		**16**	**13**
			V/C	0.41	0.61	0.09		0.12	0.34	0.19		0.28	0.23	0.11		0.59	0.14			
			Q	26	65	11		7	40	12		22	26	11		6	13			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		B	B	**B**	A	A		**A**					B	B	B	**B**	**B**
			Delay		16	14	**16**	9	7		**7**					19	19	16	**18**	**14**
			V/C		0.61	0.00		0.18	0.26							0.53	0.56	0.13		
			Q		63	0		9	27							55	58	13		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		**A**		A		**A**	A		A	**A**					**A**
			Delay		7		**7**		7		**7**	9		9	**9**					**7**
			V/C		0.49				0.33			0.06		0.16						
			Q		25				15			5		12						
	McLeod Road & Oakwood Drive	TCS	LOS	B	B	B	**B**	C	A		**B**	C	B	B	**C**	C	C		**C**	**B**
			Delay	15	18	13	**17**	27	8		**11**	29	15	16	**22**	23	23		**23**	**15**
			V/C	0.34	0.67	0.19		0.39	0.47			0.41	0.01	0.07		0.08	0.02			
			Q	16	62	12		19	41			16	3	10		7	7			
	McLeod Road & Dorchester Road	TCS	LOS	C	C		**C**	B	C		**C**	C	C		**C**	C	C	C	**C**	**C**
			Delay	27	21		**22**	15	24		**22**	23	26		**24**	22	25	25	**24**	**23**
			V/C	0.30	0.65			0.26	0.71			0.62	0.60			0.23	0.46	0.12		
			Q	22	81			15	84			41	61			14	45	15		
	McLeod Road & Drummond Road	TCS	LOS	B	A		**B**	A	A		**A**		B		**B**	B	B	B	**B**	**B**
			Delay	12	10		**10**	0	10		**10**		13		**13**	11	10	11	**11**	**11**
			V/C	0.53	0.44			0.00	0.42				0.56			0.27	0.26	0.14		
			Q	34	43			0	40				65			24	33	13		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	B		**B**	B	B		**B**	B	B		**B**	B	B		**B**	**B**
			Delay	13	17		**17**	13	15		**15**	19	19		**19**	18	19		**19**	**17**
			V/C	0.17	0.58			0.34	0.40			0.56	0.29			0.24	0.27			
			Q	9	41			13	29			28	17			13	16			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			**A**		A		**A**		A		**A**	**A**
			Delay					6			**6**		6		**6**		6		**6**	**6**
			V/C					0.20					0.30				0.20			
			Q					7					9				6			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		B		**B**	B	B		**B**		B	B	**B**	C	B		**B**	**B**
			Delay		12		**12**	17	14		**15**		12	14	**13**	21	13		**17**	**15**
			V/C		0.19			0.57	0.37				0.25	0.34		0.68	0.33			
			Q		21			57	27				32	17		68	37			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	A			**A**						A		**A**		A		**A**	**A**
			Delay	8			**8**						6		**6**		6		**6**	**6**
			V/C	0.18									0.10				0.28			
			Q	9									4				10			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**A**
			Delay	8	5		**6**		13	12	**12**					12		12	**12**	**10**
			V/C	0.05	0.12				0.26	0.02						0.02		0.00		
			Q	3	9				19	0						2		0		
	Montrose Road & Oakwood Drive (Thundering Water Access Road)	TCS	LOS					B		B	**B**		B	B	**B**	A	A		**A**	**B**
			Delay					18		14	**17**		18	17	**17**	8	7		**8**	**14**
			V/C					0.62		0.13			0.45	0.24		0.45	0.20			
			Q					62		12			37	18		31	22			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.16B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING, WEEKDAY AM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.05 1	A 0 0.16 0		**A** **1**		A 0 0.12 0	A 0 0.04 0	**A** **0**					C 17 0.05 1		A 10 0.06 2	**B** **12**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	C 18 0.24 7			**C** **18**						A 0 0.00 0		**A** **0**		A 0 0.26 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 14 0.07 2			**B** **14**						A 1 0.04 1		**A** **1**		A 0 0.22 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 14 0.15 4			**B** **14**						A 2 0.08 2		**A** **2**		A 0 0.18 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		F 434 1.84 231		**F** **434**		E 37 0.35 12		**E** **37**		A 6 0.24 8		**A** **6**		A 0 0.01 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	D 33 0.82	B 10 0.21		**D** **28**		C 22 0.70		**C** **22**					C 16 0.47		B 11 0.28	**B** **14**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.21 0		**A** **0**		A 0 0.15 0		**A** **0**	D 30 0.75 53		A 0 0.00 0	**D** **30**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.19 0		**A**		A 0 0.11 0		**A**					C 18 0.59 32		A 0 0.00 0	**C** **18**	
	Oakwood Drive & Thundering Waters Access Road	TWSC	LOS Delay V/C Q	A 9 0.11 3	A 0 0.14		**A** **2**		A 0 0.15 0		**A** **0**					A 0 0.00 0		B 10 0.17 5	**B** **10**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	C 19 0.34 12			**C** **19**					A 9 0.09 2	A 0 0.17 0		**A** **2**		A 0 0.22 0	A 0 0.04 0	**A** **0**	

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LOS - Level of Service
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Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.17A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING, WEEKDAY PM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	McLeod Road & Montrose Road	TCS	LOS	C	C	B	C	B	B	B	B	B	B	B	B	D	B		C	B
			Delay	26	25	18	25	17	15	13	15	17	16	17	16	36	15		27	20
			V/C	0.60	0.74	0.13		0.52	0.61	0.28		0.37	0.28	0.33		0.85	0.18			
			Q	32	87	15		19	77	14		34	40	31		118	21			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	C	B	B		B					C	C	C	C	B
			Delay		23	15	22	14	10		11					27	28	23	26	20
			V/C		0.79	0.03		0.41	0.43							0.70	0.73	0.56		
			Q		111	4		17	54							87	91	62		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		A		A		A	B		B	B					A
			Delay		8		8		7		7	12		14	13					8
			V/C		0.63				0.48			0.11		0.36						
			Q		52				34			8		25						
	McLeod Road & Oakwood Drive	TCS	LOS	C	D	B	C	F	B		C	F	B	B	E	C	C		C	D
			Delay	24	40	19	34	92	20		33	82	19	19	59	31	34		33	38
			V/C	0.50	0.94	0.39		1.00	0.82			1.00	0.05	0.17		0.10	0.43			
			Q	22	172	32		62	158			82	9	15		10	34			
	McLeod Road & Dorchester Road	TCS	LOS	D	C		C	C	D		D	F	D		F	C	D	C	C	E
			Delay	52	28		34	23	51		50	217	38		130	34	37	34	35	56
			V/C	0.81	0.82			0.35	0.97			1.37	0.74			0.61	0.65	0.51		
			Q	67	168			13	189			159	96			29	75	52		
	McLeod Road & Drummond Road	TCS	LOS	C	B		B	B	D		D		C		C	C	B	B	B	C
			Delay	23	11		14	16	35		35		33		33	22	18	17	18	24
			V/C	0.53	0.44			0.00	0.42				0.56			0.27	0.26	0.14		
			Q	57	62			5	115				94			37	47	15		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	C		C	B	B		B	C	C		C	C	C		C	C
			Delay	16	25		24	19	20		20	28	22		24	24	26		25	23
			V/C	0.45	0.78			0.61	0.56			0.76	0.36			0.46	0.44			
			Q	21	85			27	56			50	25			22	26			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			A		A		A		A		A	A
			Delay					8			8		7		7		6		6	7
			V/C					0.26					0.47				0.31			
			Q					12					20				13			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		D		D	E	C		D		D	C	D	E	B		D	D
			Delay		45		45	65	29		48		45	33	38	65	17		44	44
			V/C		0.52			0.99	0.65				0.74	0.30		1.00	0.43			
			Q		41			187	100				100	27		143	75			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			B						A		A		B		B	B
			Delay	13			13						9		9		10		10	11
			V/C	0.64									0.22				0.55			
			Q	64									18				43			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		A		B	B	B					B		B	B	A
			Delay	8	6		6		13	12	12					12		12	12	10
			V/C	0.12	0.19				0.24	0.02						0.14		0.05		
			Q	6	14				17	0						8		0		
	Montrose Road & Oakwood Drive (Thundering Water Access Road)	TCS	LOS					C		B	C		B	B	B	C	A		B	B
			Delay					25		13	20		19	17	18	24	10		17	18
			V/C					0.82		0.22			0.54	0.32		0.81	0.38			
			Q					134		15			44	18		47	37			

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Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.17B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING, WEEKDAY PM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.03 1	A 0 0.27 0		**A** **1**		A 0 0.19 0	A 0 0.07 0	**A** **0**					F 62 0.71 35		B 11 0.05 1	**F** **51**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	D 30 0.50 21			**D** **30**						A 0 0.00 0		**A** **0**		A 0 0.31 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	C 22 0.39 14			**C** **22**						A 1 0.03 1		**A** **1**		A 0 0.27 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	C 17 0.33 12			**C** **17**						A 1 0.03 1		**A** **1**		A 0 0.27 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		F Err 4.41 Err		**F** **Err**		F 590 1.56 41		**F** **590**		A 8 0.34 12		**A** **8**		A 0 0.01 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	D 29 0.73	C 19 0.57		**C** **25**		D 33 0.81		**D** **33**					C 23 0.64		D 35 0.84	**D** **30**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.18 0		**A** **0**		A 0 0.20 0		**A** **0**	E 39 0.90 98		A 0 0.00 0	**E** **39**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.20 0		**A**		A 0 0.18 0		**A**					F 78 1.06 143		A 0 0.00 0	**F** **78**	
	Oakwood Drive & Thundering Waters Access Road	TWSC	LOS Delay V/C Q	B 10 0.25 8	A 0 0.16		**A** **2**		A 0 0.26 0		**A** **0**					A 0 0.00 0		B 13 0.29 10	**B** **13**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	D 27 0.44 17			**D** **27**					A 9 0.09 2	A 0 0.30 0		**A** **1**		A 0 0.33 0	A 0 0.05 0	**A** **0**	

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Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.18A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING, SATURDAY MIDDAY PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
Saturday Peak Hour	McLeod Road & Montrose Road	TCS	LOS	B	C	B	**C**	B	B	B	**B**	B	B	B	**B**	C	B		**C**	**B**
			Delay	19	23	16	**22**	15	12	12	**12**	18	17	16	**17**	32	16		**25**	**18**
			V/C	0.47	0.74	0.15		0.50	0.42	0.24		0.39	0.23	0.18		0.80	0.22			
			Q	31	95	17		19	52	13		35	32	15		102	23			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	**C**	B	A		**A**					C	C	C	**C**	**B**
			Delay		20	14	**20**	16	8		**10**					24	25	20	**23**	**18**
			V/C		0.76	0.02		0.59	0.34							0.64	0.65	0.42		
			Q		100	1		30	40							704	72	41		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		**A**		A		**A**	B		B	**B**					**A**
			Delay		9		**9**		8		**8**	11		14	**13**					**9**
			V/C		0.63				0.48			0.11		0.36						
			Q		46				35			7		42						
	McLeod Road & Oakwood Drive	TCS	LOS	C	D	C	**C**	D	B		**C**	D	B	C	**C**	C	C		**C**	**C**
			Delay	20	41	21	**34**	44	14		**21**	43	19	21	**32**	34	33		**33**	**29**
			V/C	0.22	0.94	0.40		0.78	0.62			0.79	0.03	0.29		0.12	0.04			
			Q	12	144	31		55	88			59	7	23		10	9			
	McLeod Road & Dorchester Road	TCS	LOS	D	C		**D**	C	D		**D**	F	D		**F**	E	C	C	**D**	**D**
			Delay	52	32		**38**	28	46		**45**	147	43		**90**	78	33	29	**41**	**49**
			V/C	0.84	0.83			0.57	0.92			1.18	0.81			0.94	0.58	0.33		
			Q	74	163			23	155			120	114			61	79	31		
	McLeod Road & Drummond Road	TCS	LOS	B	A		**B**	B	C		**C**		C		**C**	C	B	B	**C**	**B**
			Delay	17	9		**11**	17	25		**25**		25		**25**	29	19	19	**21**	**19**
			V/C	0.71	0.45			0.04	0.79				0.68			0.71	0.47	0.21		
			Q	64	56			4	96				62			46	49	16		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	C		**C**	B	B		**B**	C	C		**C**	C	C		**C**	**B**
			Delay	13	22		**21**	15	16		**16**	25	20		**22**	20	21		**21**	**20**
			V/C	0.23	0.78			0.54	0.54			0.65	0.28			0.49	0.42			
			Q	11	82			20	47			27	17			23	23			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			**A**		A		**A**		A		**A**	**A**
			Delay					7			**7**		7		**7**		7		**7**	**7**
			V/C					0.27					0.35				0.37			
			Q					10					14				15			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		B		**B**	C	B		**B**		B	B	**B**	C	B		**C**	**B**
			Delay		13		**13**	23	15		**18**		12	13	**13**	31	14		**23**	**18**
			V/C		0.14			0.67	0.35				0.25	0.17		0.82	0.42			
			Q		14			61	21				37	15		111	61			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			**B**						B		**B**		B		**B**	**B**
			Delay	11			**11**						10		**10**		11		**11**	**11**
			V/C	0.65									0.31				0.48			
			Q	65									21				27			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**B**
			Delay	8	5		**7**		13	12	**12**					13		12	**13**	**11**
			V/C	0.15	0.09				0.25	0.03						0.28		0.06		
			Q	7	8				19	0						16		0		
	Montrose Road & Oakwood Drive (Thundering Water Access Road)	TCS	LOS					B		B	**B**		B	B	**B**	C	A		**B**	**B**
			Delay					19		11	**16**		16	15	**16**	24	9		**17**	**16**
			V/C					0.75		0.18			0.41	0.29		0.80	0.30			
			Q					93		13			29	16		39	26			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.18B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING, SATURDAY MIDDAY PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
Saturday Peak Hour	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.02 1	A 0 0.30 0		**A** **0**		A 0 0.18 0	A 0 0.06 0	**A** **0**					F 134 1.05 72		B 11 0.06 2	**F** **111**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	C 20 0.24 7			**C** **20**						A 0 0.01 0		**A** **0**		A 0 0.28 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 14 0.08 2			**B** **14**						A 0 0.01 0		**A** **0**		A 0 0.23 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 12 0.05 1			**B** **12**						A 0 0.01 0		**A** **0**		A 0 0.22 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		F Err 3.15 Err		**F** **Err**		F 151 0.82 32		**F** **151**		A 8 0.35 13		**A** **8**		A 0 0.00 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	C 24 0.67	C 21 0.65		**C** **22**		E 41 0.89		**E** **41**					A 2 0.57		B 15 0.49	**C** **18**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.15 0		**A** **0**		A 0 0.06 0		**A** **0**	B 12 0.16 5		A 0 0.00 0	**B** **12**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.18 0		**A**		A 0 0.07 0		**A**					C 22 0.77 64		A 0 0.00 0	**C** **22**	
	Oakwood Drive & Thundering Waters Access Road	TWSC	LOS Delay V/C Q	A 9 0.22 7	A 0 0.16		**A** **3**		A 0 0.20 0		**A** **0**					A 0 0.00 0		B 12 0.29 10	**B** **12**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	C 18 0.34 12			**C** **18**					A 9 0.06 2	A 0 0.23 0		**A** **1**		A 0 0.27 0	A 0 0.02 0	**A** **0**	

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.19A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING, WEEKDAY AM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	McLeod Road & Montrose Road	TCS	LOS	B	B	B	**B**	B	A	A	**A**	B	B	B	**B**	C	B		**B**	**B**
			Delay	16	18	13	**17**	10	9	10	**9**	14	14	14	**14**	22	14		**19**	**14**
			V/C	0.42	0.65	0.01		0.13	0.38	0.22		0.09	0.15	0.08		0.68	0.09			
			Q	27	75	0		7	45	13		10	19	10		68	9			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		B	B	**B**	B	A		**A**					C	C	B	**B**	**B**
			Delay		18	14	**18**	10	8		**8**					20	21	16	**20**	**15**
			V/C		0.66	0.00		0.24	0.30							0.57	0.59	0.16		
			Q		75	0		12	34							61	63	15		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		**A**		A		**A**	B		B	**B**					**A**
			Delay		7		**7**		6		**6**	11		12	**11**					**7**
			V/C		0.56				0.35			0.06		0.23						
			Q		35				20			6		17						
	McLeod Road & Oakwood Drive	TCS	LOS	B	B	B	**B**	C	A		**B**	C	B	B	**C**	C	C		**C**	**B**
			Delay	14	19	12	**18**	30	8		**11**	32	18	19	**26**	26	26		**26**	**16**
			V/C	0.33	0.77	0.19		0.43	0.49			0.45	0.01	0.07		0.09	0.03			
			Q	17	90	12		19	48			16	3	10		7	7			
	McLeod Road & Dorchester Road	TCS	LOS	C	C		**C**	B	C		**C**	D	C		**C**	C	C	C	**C**	**C**
			Delay	33	27		**28**	17	23		**22**	36	24		**31**	26	30	29	**29**	**27**
			V/C	0.40	0.80			0.36	0.63			0.84	0.52			0.23	0.54	0.12		
			Q	24	95			15	73			77	58			14	50	16		
	McLeod Road & Drummond Road	TCS	LOS	B	B		**B**	A	B		**B**		B		**B**	A	A	B	**A**	**B**
			Delay	13	11		**12**	0	11		**11**		14		**14**	10	9	10	**10**	**11**
			V/C	0.52	0.40			0.00	0.38				0.64			0.26	0.23	0.14		
			Q	25	38			0	34				76			22	30	12		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	B		**B**	B	B		**B**	B	B		**B**	B	B		**B**	**B**
			Delay	13	17		**17**	13	15		**15**	17	19		**18**	17	19		**18**	**17**
			V/C	0.17	0.54			0.32	0.41			0.32	0.29			0.23	0.26			
			Q	9	38			13	29			17	18			13	16			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			**A**		A		**A**		A		**A**	**A**
			Delay					6			**6**		6		**6**		6		**6**	**6**
			V/C					0.15					0.19				0.09			
			Q					5					6				3			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**	B	A		**B**		B	B	**B**	B	B		**B**	**B**
			Delay		8		**8**	13	9		**12**		12	14	**14**	13	13		**13**	**13**
			V/C		0.15			0.58	0.22				0.27	0.35		0.34	0.35			
			Q		18			56	20				30	18		25	34			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	A			**A**						A		**A**		A		**A**	**A**
			Delay	8			**8**						6		**6**		6		**6**	**6**
			V/C	0.18									0.10				0.28			
			Q	9									4				10			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**A**
			Delay	8	5		**6**		13	12	**12**					12		12	**12**	**10**
			V/C	0.05	0.12				0.26	0.02						0.02		0.00		
			Q	3	9				19	0						2		0		
	Lyons Creek Road & Thundering Water Access Road	TCS	LOS	C	A		**B**		C	B	**C**					C		C	**C**	**B**
			Delay	21	8		**11**		25	11	**23**					28		27	**27**	**18**
			V/C	0.75	0.71				0.83	0.09						0.32		0.20		
			Q	75	131				159	10						25		21		

MOE - Measure of Effectiveness
LOS - Level of Service
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Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.19B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING, WEEKDAY AM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.05 1	A 0 0.16 0		**A** **1**		A 0 0.14 0	A 0 0.04 0	**A** **0**					B 13 0.06 2		B 10 0.06 2	**B** **13**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	B 15 0.10 3			**B** **15**						A 0 0.00 0		**A** **0**		A 0 0.20 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 13 0.07 2			**B** **13**						A 1 0.04 1		**A** **1**		A 0 0.20 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 14 0.14 4			**B** **14**						A 2 0.08 2		**A** **2**		A 0 0.15 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		D 31 0.69 41		**D** **31**		C 16 0.16 5		**C** **16**		A 3 0.08 2		**A** **3**		A 0 0.01 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	C 16 0.53	B 11 0.32		**B** **14**		C 19 0.65		**C** **19**					B 13 0.31		B 11 0.24	**B** **12**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.27 0		**A** **0**		A 0 0.17 0		**A** **0**	F 53 0.96 98		A 0 0.00 0	**F** **53**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.16 0		**A**		A 0 0.11 0		**A**					F 84 1.05 127		A 0 0.00 0	**F** **84**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					B 14 0.25 8			**B** **14**		A 0 0.18 0		**A** **0**		A 1 0.02 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 13 0.23 7			**B** **13**					A 8 0.06 2	A 0 0.08 0		**A** **3**		A 0 0.10 0	A 0 0.05 0	**A** **0**	

MOE - Measure of Effectiveness
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Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.20A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING, WEEKDAY PM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	McLeod Road & Montrose Road	TCS	LOS	D	C	B	**C**	B	B	B	**B**	B	B	B	**B**	D	B		**C**	**C**
			Delay	37	27	17	**28**	18	16	14	**16**	15	16	16	**16**	43	16		**34**	**22**
			V/C	0.71	0.79	0.02		0.53	0.66	0.33		0.08	0.17	0.22		0.90	0.15			
			Q	41	99	0		19	88	15		11	25	18		136	17			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	**C**	B	B		**B**					C	C	C	**C**	**C**
			Delay		24	16	**24**	16	11		**11**					29	30	23	**28**	**21**
			V/C		0.83	0.03		0.51	0.50							0.72	0.75	0.56		
			Q		121	4		22	65							91	95	62		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		**A**		A		**A**	B		B	**B**					**A**
			Delay		9		**9**		7		**7**	14		16	**15**					**9**
			V/C		0.70				0.52			0.11		0.40						
			Q		67				43			8		26						
	McLeod Road & Oakwood Drive	TCS	LOS	C	F	C	**F**	D	C		**D**	D	B	B	**D**	C	D		**C**	**F**
			Delay	32	186	25	**145**	45	34		**35**	49	18	19	**38**	33	35		**35**	**81**
			V/C	0.56	1.33	0.53		0.74	0.95			0.85	0.04	0.16		0.10	0.44			
			Q	25	258	63		52	226			76	9	14		11	35			
	McLeod Road & Dorchester Road	TCS	LOS	D	D		**D**	C	E		**E**	F	D		**F**	C	D	D	**D**	**F**
			Delay	50	49		**49**	25	71		**69**	376	38		**232**	34	38	37	**37**	**86**
			V/C	0.79	0.99			0.35	1.04			1.74	0.74			0.61	0.65	0.62		
			Q	67	219			13	208			220	96			29	75	65		
	McLeod Road & Drummond Road	TCS	LOS	C	B		**B**	B	C		**C**		F		**F**	B	B	B	**B**	**E**
			Delay	30	13		**17**	19	33		**33**		207		**207**	18	16	16	**16**	**56**
			V/C	0.81	0.50			0.05	0.87				1.38			0.48	0.39	0.20		
			Q	57	53			5	92				182			36	47	15		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	C		**C**	B	B		**B**	C	C		**C**	C	C		**C**	**C**
			Delay	16	25		**24**	19	20		**20**	28	22		**24**	24	26		**25**	**23**
			V/C	0.45	0.78			0.61	0.56			0.76	0.36			0.46	0.44			
			Q	21	85			29	56			50	25			22	26			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			**A**		A		**A**		A		**A**	**A**
			Delay					7			**7**		7		**7**		6		**6**	**7**
			V/C					0.20					0.31				0.22			
			Q					7					11				8			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**	D	A		**C**		B	B	**B**	C	B		**C**	**C**
			Delay		9		**9**	36	10		**28**		19	17	**18**	28	20		**23**	**22**
			V/C		0.14			0.92	0.29				0.50	0.31		0.66	0.54			
			Q		17			144	30				54	17		47	59			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			**B**						A		**A**		B		**B**	**B**
			Delay	13			**13**						9		**9**		10		**10**	**11**
			V/C	0.64									0.22				0.55			
			Q	64									18				43			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**A**
			Delay	8	6		**6**		13	12	**12**					12		12	**12**	**10**
			V/C	0.12	0.19				0.24	0.02						0.14		0.05		
			Q	6	14				17	0						8		0		
	Lyons Creek Road & Thundering Water Access Road	TCS	LOS	C	A		**B**		C	B	**C**					C		C	**C**	**B**
			Delay	21	8		**11**		25	11	**23**					28		27	**27**	**18**
			V/C	0.75	0.71				0.83	0.09						0.32		0.20		
			Q	75	131				159	10						25		21		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control
RBT - Roundabout

TABLE 6.20B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING, WEEKDAY PM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.03 1	A 0 0.27 0		**A** **0**		A 0 0.22 0	A 0 0.07 0	**A** **0**					F 87 0.82 43		B 11 0.06 1	**F** **71**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	C 18 0.21 6			**C** **18**						A 0 0.00 0		**A** **0**		A 0 0.25 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	C 19 0.34 12			**C** **19**						A 1 0.03 1		**A** **1**		A 0 0.25 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	C 16 0.30 10			**C** **16**						A 1 0.03 1		**A** **1**		A 0 0.25 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		F 268 1.50 220		**F** **268**		E 44 0.32 10		**E** **44**		A 4 0.13 3		**A** **4**		A 0 0.01 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	C 16 0.46	D 32 0.79		**D** **26**		D 33 0.81		**D** **33**					B 15 0.39		D 31 0.80	**D** **26**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.26 0		**A** **0**		A 0 0.26 0		**A** **0**	F 364 1.73 348		A 0 0.00 0	**F** **364**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.13 0		**A**		A 0 0.19 0		**A**					F 427 1.87 344		A 0 0.00 0	**F** **427**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					D 28 0.56 26			**D** **28**		A 0 0.25 0		**A** **0**		A 2 0.06 2		**A** **2**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	C 16 0.27 9			**C** **16**					A 9 0.05 1	A 0 0.14 0		**A** **2**		A 0 0.20 0	A 0 0.07 0	**A** **0**	

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.21A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING, SATURDAY MIDDAY PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Overall
Saturday Peak Hour	McLeod Road & Montrose Road	TCS	LOS	C	C	B	**C**	B	B	B	**B**	B	B	B	**B**	D	B		**C**	**C**
			Delay	21	27	16	**26**	17	13	13	**13**	17	16	16	**16**	41	16		**32**	**21**
			V/C	0.50	0.81	0.02		0.53	0.48	0.28		0.15	0.13	0.14		0.88	0.15			
			Q	32	109	1		19	59	14		17	21	13		128	16			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	**C**	C	A		**B**					C	C	C	**C**	**B**
			Delay		23	15	**23**	21	9		**11**					26	26	21	**24**	**19**
			V/C		0.82	0.02		0.69	0.39							0.67	0.68	0.45		
			Q		113	1		43	48							78	80	46		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		**A**		A		**A**	B		B	**B**					**A**
			Delay		10		**10**		8		**8**	12		16	**15**					**10**
			V/C		0.68				0.50			0.08		0.57						
			Q		64				41			7		45						
	McLeod Road & Oakwood Drive	TCS	LOS	C	F	C	**F**	D	B		**C**	D	B	C	**C**	C	C		**C**	**E**
			Delay	21	133	23	**103**	44	15		**22**	43	19	21	**32**	34	33		**33**	**60**
			V/C	0.26	1.21	0.53		0.78	0.70			0.79	0.03	0.30		0.12	0.04			
			Q	13	212	57		55	105			59	7	24		10	9			
	McLeod Road & Dorchester Road	TCS	LOS	D	E		**E**	C	E		**D**	F	D		**F**	E	C	C	**D**	**E**
			Delay	52	62		**59**	30	56		**54**	265	43		**155**	80	33	30	**42**	**71**
			V/C	0.84	1.02			0.57	0.97			1.47	0.81			0.94	0.58	0.35		
			Q	74	216			23	170			180	114			61	79	35		
	McLeod Road & Drummond Road	TCS	LOS	C	B		**B**	C	C		**C**		F		**F**	B	B	B	**B**	**C**
			Delay	27	13		**17**	22	30		**30**		88		**88**	20	17	17	**18**	**31**
			V/C	0.80	0.43			0.04	0.79				1.07			0.55	0.38	0.21		
			Q	64	46			4	73				142			46	49	16		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	B		**B**	B	B		**B**	B	B		**B**	B	C		**C**	**B**
			Delay	13	20		**19**	15	17		**16**	18	20		**20**	19	21		**20**	**19**
			V/C	0.24	0.71			0.52	0.56			0.30	0.28			0.48	0.41			
			Q	11	63			20	46			14	16			23	23			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			**A**		A		**A**		A		**A**	**A**
			Delay					6			**6**		6		**6**		6		**6**	**6**
			V/C					0.21					0.21				0.25			
			Q					7					7				9			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		**A**	B	A		**B**		B	B	**B**	B	B		**B**	**B**
			Delay		8		**8**	17	9		**14**		13	14	**13**	16	14		**15**	**14**
			V/C		0.10			0.64	0.18				0.27	0.19		0.39	0.45			
			Q		14			65	17				33	15		33	55			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			**B**						B		**B**		B		**B**	**B**
			Delay	11			**11**						10		**10**		11		**11**	**11**
			V/C	0.65									0.31				0.48			
			Q	65									21				27			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		**A**		B	B	**B**					B		B	**B**	**B**
			Delay	8	5		**7**		13	12	**12**					13		12	**13**	**11**
			V/C	0.15	0.09				0.25	0.03						0.28		0.06		
			Q	7	8				19	0						16		0		
	Lyons Creek Road & Thundering Water Access Road	TCS	LOS	C	A		**B**		C	B	**C**					C		C	**C**	**C**
			Delay	23	4		**13**		30	15	**27**					29		28	**28**	**21**
			V/C	0.79	0.39				0.83	0.11						0.38		0.26		
			Q	106	52				144	13						31		24		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.21B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING, SATURDAY MIDDAY PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
Saturday Peak Hour	Marineland Parkway & Portage Road	TWSC	LOS Delay V/C Q	A 9 0.02 1	A 0 0.30 0		**A** **0**		A 0 0.22 0	A 0 0.06 0	**A** **0**					F 207 1.24 88		B 11 0.07 2	**F** **171**	
	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	B 15 0.07 2			**B** **15**						A 0 0.01 0		**A** **0**		A 0 0.22 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 13 0.07 2			**B** **13**						A 0 0.01 0		**A** **0**		A 0 0.20 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 11 0.04 1			**B** **11**						A 0 0.01 0		**A** **0**		A 0 0.19 0		**A** **0**	
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		F 51 0.90 80		**F** **51**		C 22 0.22 7		**C** **22**		A 4 0.11 3		**A** **4**		A 0 0.01 0		**A** **0**	
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	B 12 0.32	D 29 0.78		**C** **24**		E 36 0.86		**E** **36**					B 14 0.36		B 14 0.45	**B** **14**	
	Lyons Creek & QEW WB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.23 0		**A** **0**		A 0 0.08 0		**A** **0**	B 15 0.24 8		A 0 0.00 0	**B** **15**					
	Lyons Creek & QEW EB Off-Ramp	TWSC	LOS Delay V/C Q		A 0 0.13 0		**A**		A 0 0.07 0		**A**					F 187 1.35 300		A 0 0.00 0	**F** **187**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					C 17 0.43 17			**C** **17**		A 0 0.18 0		**A** **0**		A 1 0.02 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 12 0.21 6			**B** **12**					A 8 0.03 1	A 0 0.10 0		**A** **1**		A 0 0.13 0	A 0 0.03 0	**A** **0**	

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

6.9.5 Future Total Traffic Operations with Crossings and Additional Network Improvements

Further changes to roadway geometry and traffic control beyond the base road network improvements identified in Sections 6.8.1 and 6.8.2 would be required to accommodate forecasted traffic volumes, even with the crossings. **Table 6.22** summarizes and compares the additional road network improvement needed to provide more satisfactory levels of service, by crossing scenario (OPG Canal crossing, Welland River crossing and no crossing for comparison). The improvements have been incorporated into the analyses below.

OPG Canal Crossing

Tables 6.23, 6.24 and **6.25** summarize the results of the intersection capacity analyses completed to assess operating conditions for the summer weekday morning, weekday afternoon and Saturday midday future total traffic forecasts (**Figures 6.20, 6.21** and **6.22**) with the OPG Canal crossing and the additional improvements. **Appendix K** provides the Synchro analysis output. The following is noted from the analyses:

- **Weekday Morning Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. No critical turning movements were noted.
- **Weekday Afternoon Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements remain at the following intersections:
  - McLeod Road and Oakwood Drive (eastbound through, westbound left and northbound left);
  - McLeod Road and Dorchester Road (eastbound left, westbound through-right and northbound left); and
  - Montrose Road and Lyons Creek Road/Biggar Road (westbound left and southbound left).
- **Saturday Midday Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements remain at the following intersections:
  - McLeod Road and Oakwood Drive (eastbound through); and
  - McLeod Road and Dorchester Road (eastbound left and northbound left).

Welland River Crossing

Tables 6.26, 6.27 and **6.28** summarize the results of the Intersection capacity analyses completed to assess operating conditions for the summer weekday morning, weekday afternoon and Saturday midday future total traffic forecasts (**Figures 6.23, 6.24** and **6.25**) with the Welland River

crossing and the additional improvements. **Appendix L** provides the Synchro analysis output. The following is noted from the analyses:

- **Weekday Morning Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. No critical turning movements were noted.
- **Weekday Afternoon Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements remain at the following intersections:
  - McLeod Road and Oakwood Drive (eastbound through, westbound left and northbound left);
  - McLeod Road and Dorchester Road (westbound through-right and northbound left); and
  - McLeod Road and Drummond Road (westbound through-right).
- **Saturday Midday Peak Hour** – All intersections are forecast to operate with satisfactory levels of service. Critical turning movements remain at the following intersections:
  - McLeod Road and Oakwood Drive (eastbound through); and
  - McLeod Road and Dorchester Road (northbound through-right).

TABLE 6.22: COMPARISON OF ADDITIONAL ROAD NETWORK IMPROVEMENTS BY CROSSING SCENARIO

Intersection	STMP and McLeod EA Improvements	No Crossing Scenario	OPG Canal Crossing Scenario	Welland River Crossing Scenario
McLeod Road & Montrose Road	- EB TL - WB TL			
McLeod Road & QEW EB Off-Ramp/Niagara Square Drive	- EB TL - WB TL			
McLeod Road & QEW WB Off-Ramp	- EB TL - WB TL			
McLeod Road & Oakwood Drive	- EB TL - WB TL - 2nd WB LTL	Congested	Congested	Congested
McLeod Road & Dorchester Road	- 2nd EB LTL	- 2nd NB LTL - EB RTL - WB RTL	- 2nd NB LTL	- 2nd NB LTL - EB RTL
McLeod Road & Drummond Road	- EB LTL - WB LTL	- Dual NB LTLs		- NB LTL
Marineland Parkway & Stanley Avenue	- Jog Elimination			
Montrose Road & Niagara Square Drive				
Montrose Road & Lyons Creek Road/Biggar Road			- WB RTL	
Oakwood Drive & Walmart North Driveway				
Oakwood Drive & Walmart South Driveway				
Marineland Parkway & Portage Road	- EB LTL	- Traffic Signals[1]	- Traffic Signals[1]	- Traffic Signals[1]
Stanley Avenue & Ramsey Road				
Stanley Avenue & Progress Street				
Stanley Avenue & Don Murie Street				
Stanley Avenue & Dorchester Road/Chippawa Parkway		- Traffic Signals or Roundabout - Dual NB LTLs - EB LTL - Chan'd EB RTL - SB RTL	- Traffic Signals or Roundabout - NB LTL - EB LTL	- Traffic Signals or Roundabout
Lyons Creek Road & Stanley Avenue		- Traffic Signals or Roundabout	- Traffic Signals or Roundabout	- Traffic Signals or Roundabout
Lyons Creek Road & QEW WB Off-Ramp		- Traffic Signals	- Traffic Signals	- Traffic Signals
Lyons Creek Road & QEW EB Off-Ramp		- Traffic Signals	- Traffic Signals	- Traffic Signals
Montrose Road & Oakwood Drive			- Traffic Signals - NB RTL - SB LTL	
Montrose Road & Chippawa Creek Road				
Lyons Creek Road & Thundering Waters Access Road			N/A	- Traffic Signals or Roundabout - EB LTL - WB RTL
Oakwood Drive & Thundering Waters Access Road			- Unsignalized - EB LTL	N/A

[1] Improvement required based on future background traffic operations

All signalized intersections operate with optimized signal timings

TABLE 6.23A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING AND ADDITIONAL IMPROVEMENTS, WEEKDAY AM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	McLeod Road & Montrose Road	TCS	LOS Delay V/C Q	B 15 0.41 26	B 16 0.61 65	B 12 0.09 11	**B 16**	A 9 0.12 7	A 8 0.34 40	A 9 0.19 12	**A 8**	B 15 0.28 22	B 14 0.23 26	B 14 0.11 11	**B 14**	B 18 0.59 6	B 14 0.14 13		**B 16**	**B 13**
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS Delay V/C Q		B 16 0.61 63	B 14 0.00 0	**B 16**	A 9 0.18 9	A 7 0.26 27		**A 7**					B 19 0.53 55	B 19 0.56 58	B 16 0.13 13	**B 18**	**B 14**
	McLeod Road & WB QEW Off-Ramp	TCS	LOS Delay V/C Q		A 7 0.49 25		**A 7**		A 7 0.33 15		**A 7**	A 9 0.06 5		A 9 0.16 12	**A 9**					**A 7**
	McLeod Road & Oakwood Drive	TCS	LOS Delay V/C Q	B 15 0.34 16	B 18 0.67 62	B 13 0.19 12	**B 17**	C 27 0.39 19	A 8 0.47 41		**B 11**	C 29 0.41 16	B 15 0.01 3	B 16 0.07 10	**C 22**	C 23 0.08 7	C 23 0.02 7		**C 23**	**B 15**
	McLeod Road & Dorchester Road	TCS	LOS Delay V/C Q	C 31 0.47 23	C 21 0.67 71		**C 23**	B 16 0.27 14	C 24 0.72 73		**C 24**	C 30 0.49 29	C 23 0.55 56		**C 26**	C 22 0.22 14	C 26 0.50 45	C 25 0.12 15	**C 25**	**C 24**
	McLeod Road & Drummond Road	TCS	LOS Delay V/C Q	B 12 0.53 34	A 10 0.44 43		**B 10**	A 0 0.00 0	A 10 0.42 40		**A 10**		B 13 0.56 65		**B 13**	B 11 0.27 24	B 10 0.26 33	B 11 0.14 13	**B 11**	**B 11**
	Marineland Parkway & Stanley Avenue	TCS	LOS Delay V/C Q	B 13 0.17 9	B 17 0.58 41		**B 17**	B 13 0.34 13	B 15 0.40 29		**B 15**	B 19 0.56 28	B 19 0.29 17		**B 19**	B 18 0.24 13	B 19 0.27 16		**B 19**	**B 17**
	Montrose Road & Niagara Square Drive	TCS	LOS Delay V/C Q					A 6 0.20 7			**A 6**		A 6 0.30 9		**A 6**		A 6 0.20 6		**A 6**	**A 6**
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS Delay V/C Q		B 11 0.19 18		**B 12**	B 17 0.60 49	B 11 0.12 13	B 13 0.25 15	**B 14**		A 9 0.24 23	B 11 0.34 15	**B 11**	B 17 0.66 49	A 10 0.32 26		**B 14**	**B 13**
	Oakwood Drive & Walmart North Driveway	TCS	LOS Delay V/C Q	A 8 0.18 9			**A 8**						A 6 0.10 4		**A 6**		A 6 0.28 10		**A 6**	**A 6**
	Oakwood Drive & Walmart South Driveway	TCS	LOS Delay V/C Q	A 8 0.05 3	A 5 0.12 9		**A 6**		B 13 0.26 19	B 12 0.02 0	**B 12**					B 12 0.02 2		B 12 0.00 0	**B 12**	**A 10**
	Montrose Road & Oakwood Drive (Thundering Water Access Road)	TCS	LOS Delay V/C Q					B 18 0.62 62		B 14 0.13 12	**B 17**		B 18 0.45 37	B 17 0.24 18	**B 17**	A 8 0.45 31	A 7 0.20 22		**A 8**	**B 14**
	Marineland Parkway & Portage Road	TCS	LOS Delay V/C Q	A 5 0.16 5	A 6 0.39 15		**A 6**		A 5 0.29 11	A 5 0.05 3	**A 5**					A 7 0.04 3		A 7 0.04 4	**A 7**	**A 6**
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TCS	LOS Delay V/C Q	B 12 0.44 28	B 11 0.28 16		**B 11**		A 10 0.08 9		**A 10**	B 10 0.61 44	A 7 0.38 33		**A 9**		A 7 0.29 18		**A 7**	**A 9**
	Lyons Creek & Stanley Avenue	TCS	LOS Delay V/C Q	C 23 0.85 113	A 5 0.11 13		**B 19**		A 6 0.37 35		**A 6**					C 24 0.57 51		B 20 0.13 13	**C 22**	**B 16**
	Lyons Creek & QEW WB Off-Ramp	TCS	LOS Delay V/C Q		A 9 0.54 39		**A 9**		A 8 0.38 28		**A 8**	A 9 0.33 21		B 10 0.47 27	**A 10**					**A 9**
	Lyons Creek & QEW EB Off-Ramp	TCS	LOS Delay V/C Q		A 8 0.50 32		**A 8**		A 7 0.28 18		**A 7**					A 9 0.38 27		A 8 0.22 12	**A 9**	**A 8**

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.23B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING AND ADDITIONAL IMPROVEMENTS, WEEKDAY AM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	C 18 0.24 7			**C** **18**						A 0 0.00 0		**A** **0**		A 0 0.26 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 14 0.07 2			**B** **14**						A 1 0.04 1		**A** **1**		A 0 0.22 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 14 0.15 4			**B** **14**						A 2 0.08 2		**A** **2**		A 0 0.18 0		**A** **0**	
	Oakwood Drive & Thundering Waters Access Road	TWSC	LOS Delay V/C Q	A 9 0.11 3	A 0 0.14		**A** **2**		A 0 0.15 0		**A** **0**					A 0 0.00 0		B 10 0.17 5	**B** **10**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	C 19 0.34 12			**C** **19**					A 9 0.09 2	A 0 0.17 0		**A** **2**		A 0 0.22 0	A 0 0.04 0	**A** **0**	

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.24A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING AND ADDITIONAL IMPROVEMENTS, WEEKDAY PM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	McLeod Road & Montrose Road	TCS	LOS	C	C	B	C	B	B	B	B	B	B	B	B	D	B		C	B
			Delay	26	25	18	25	17	15	13	15	17	16	17	16	36	15		27	20
			V/C	0.60	0.74	0.13		0.52	0.61	0.28		0.37	0.28	0.33		0.85	0.18			
			Q	32	87	15		19	77	14		34	40	31		118	21			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	C	B	B		B					C	C	C	C	B
			Delay		23	15	22	14	10		11					27	28	23	26	20
			V/C		0.79	0.03		0.41	0.43							0.70	0.73	0.56		
			Q		111	4		17	54							87	91	62		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		A		A		A	B		B	B					A
			Delay		8		8		7		7	12		14	13					8
			V/C		0.63				0.48			0.11		0.36						
			Q		52				34			8		25						
	McLeod Road & Oakwood Drive	TCS	LOS	C	D	C	C	E	C		C	D	C	C	D	D	D		D	C
			Delay	26	41	23	34	64	21		29	55	22	24	45	39	42		42	35
			V/C	0.45	0.92	0.43		0.86	0.79			0.87	0.05	0.16		0.12	0.46			
			Q	23	195	46		65	178			85	10	16		12	38			
	McLeod Road & Dorchester Road	TCS	LOS	E	C		D	C	D		D	E	D		E	D	D	D	D	D
			Delay	64	29		38	24	47		46	71	40		56	36	44	43	42	44
			V/C	0.87	0.80			0.35	0.94			0.92	0.72			0.57	0.70	0.66		
			Q	76	118			14	197			83	104			31	84	72		
	McLeod Road & Drummond Road	TCS	LOS	C	B		B	B	D		D		C		C	C	B	B	B	C
			Delay	23	11		14	16	35		35		33		33	22	18	17	18	24
			V/C	0.53	0.44			0.00	0.42				0.56			0.27	0.26	0.14		
			Q	57	62			5	115				94			37	47	15		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	C		C	B	B		B	C	C		C	C	C		C	C
			Delay	16	25		24	19	20		20	28	22		24	24	26		25	23
			V/C	0.45	0.78			0.61	0.56			0.76	0.36			0.46	0.44			
			Q	21	85			27	56			50	25			22	26			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			A		A		A		A		A	A
			Delay					8			8		7		7		6		6	7
			V/C					0.26					0.47				0.31			
			Q					12					20				13			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		D		D	E	C	C	D		D	D	D	E	B		D	D
			Delay		49		49	59	21	24	42		52	37	43	66	19		45	44
			V/C		0.49			0.96	0.19	0.25			0.78	0.30		0.99	0.43			
			Q		44			197	34	18			116	29		157	82			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			B						A		A		B		B	B
			Delay	13			13						9		9		10		10	11
			V/C	0.64									0.22				0.55			
			Q	64									18				43			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		A		B	B	B					B		B	B	A
			Delay	8	6		6		13	12	12					12		12	12	10
			V/C	0.12	0.19				0.24	0.02						0.14		0.05		
			Q	6	14				17	0						8		0		
	Montrose Road & Oakwood Drive (Thundering Water Access Road)	TCS	LOS					B		B	B		B	B	B	A	A		A	B
			Delay					18		14	17		18	17	17	8	7		8	14
			V/C					0.62		0.13			0.45	0.24		0.45	0.20			
			Q					62		12			37	18		31	22			
	Marineland Parkway & Portage Road	TCS	LOS	A	A		A		A	A	A					B		A	A	A
			Delay	5	7		7		6	5	6					10		9	10	7
			V/C	0.08	0.57				0.42	0.08						0.27		0.02		
			Q	4	37				25	5						17		4		
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TCS	LOS	C	B		B		B		B	C	A		B		A		A	B
			Delay	24	18		20		16		16	25	6		18		9		9	16
			V/C	0.67	0.39				0.12			0.84	0.25				0.56			
			Q	59	28				11			88	23				60			
	Lyons Creek & Stanley Avenue	TCS	LOS	B	A		B		A		A					B		B	B	B
			Delay	20	7		14		8		8					16		14	15	13
			V/C	0.79	0.32				0.41							0.56		0.32		
			Q	77	31				37							45		16		
	Lyons Creek & QEW WB Off-Ramp	TCS	LOS		A		A		A		A	A		B	B					B
			Delay		9		9		10		10	9		12	11					10
			V/C		0.46				0.52			0.36		0.65						
			Q		32				36			27		48						
	Lyons Creek & QEW EB Off-Ramp	TCS	LOS		A		A		A		A					A		B	B	A
			Delay		9		9		9		9					9		11	10	9
			V/C		0.51				0.47							0.38		0.58		
			Q		36				32							28		39		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.24B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING AND ADDITIONAL IMPROVEMENTS, WEEKDAY PM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	D 30 0.50 21			**D** **30**						A 0 0.00 0		**A** **0**		A 0 0.31 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	C 22 0.39 14			**C** **22**						A 1 0.03 1		**A** **1**		A 0 0.27 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	C 17 0.33 12			**C** **17**						A 1 0.03 1		**A** **1**		A 0 0.27 0		**A** **0**	
	Oakwood Drive & Thundering Waters Access Road	TWSC	LOS Delay V/C Q	B 10 0.25 8	A 0 0.16		**A** **2**		A 0 0.26 0		**A** **0**					A 0 0.00 0		B 13 0.29 10	**B** **13**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	D 27 0.44 17			**D** **27**					A 9 0.09 2	A 0 0.30 0		**A** **1**		A 0 0.33 0	A 0 0.05 0	**A** **0**	

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.25A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING AND ADDITIONAL IMPROVEMENTS, SATURDAY MIDDAY PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
Saturday Peak Hour	McLeod Road & Montrose Road	TCS	LOS	B	C	B	C	B	B	B	B	B	B	B	B	C	B		C	B
			Delay	19	23	16	22	15	12	12	12	18	17	16	17	32	16		25	18
			V/C	0.47	0.74	0.15		0.50	0.42	0.24		0.39	0.23	0.18		0.80	0.22			
			Q	31	95	17		19	52	13		35	32	15		102	23			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	C	B	A		A					C	C	C	C	B
			Delay		20	14	20	16	8		10					24	25	20	23	18
			V/C		0.76	0.02		0.59	0.34							0.64	0.65	0.42		
			Q		100	1		30	40							704	72	41		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		A		A		A	B		B	B					A
			Delay		9		9		8		8	11		14	13					9
			V/C		0.63				0.48			0.11		0.36						
			Q		46				35			7		42						
	McLeod Road & Oakwood Drive	TCS	LOS	B	C	C	C	D	B		C	D	C	C	C	D	D		D	C
			Delay	19	33	21	29	49	13		22	48	21	23	32	36	35		35	28
			V/C	0.20	0.87	0.40		0.82	0.60			0.82	0.03	0.33		0.12	0.04			
			Q	12	141	31		59	88			64	8	31		11	10			
	McLeod Road & Dorchester Road	TCS	LOS	E	C		D	C	D		D	E	D		E	D	D	D	D	D
			Delay	60	33		41	34	50		48	70	47		57	49	39	36	40	45
			V/C	0.86	0.83			0.64	0.92			0.89	0.82			0.81	0.63	0.51		
			Q	87	165			29	164			72	124			48	87	59		
	McLeod Road & Drummond Road	TCS	LOS	B	A		B	B	C		C		C		C	C	B	B	C	B
			Delay	17	9		11	17	25		25		25		25	29	19	19	21	19
			V/C	0.71	0.45			0.04	0.79				0.68			0.71	0.47	0.21		
			Q	64	56			4	96				62			46	49	16		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	C		C	B	B		B	C	C		C	C	C		C	B
			Delay	13	22		21	15	16		16	25	20		22	20	21		21	20
			V/C	0.23	0.78			0.54	0.54			0.65	0.28			0.49	0.42			
			Q	11	82			20	47			27	17			23	23			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			A		A		A		A		A	A
			Delay					7			7		7		7		7		7	7
			V/C					0.27					0.35				0.37			
			Q					10					14				15			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		B		B	C	B	B	B		B	B	B	C	B		B	B
			Delay		14		13	25	13	16	20		10	11	11	23	12		18	17
			V/C		0.14			0.69	0.10	0.26			0.24	0.17		0.75	0.39			
			Q		18			76	15	18			28	11		78	46			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			B						B		B		B		B	B
			Delay	11			11						10		10		11		11	11
			V/C	0.65									0.31				0.48			
			Q	65									21				27			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		A		B	B	B					B		B	B	B
			Delay	8	5		7		13	12	12					13		12	13	11
			V/C	0.15	0.09				0.25	0.03						0.28		0.06		
			Q	7	8				19	0						16		0		
	Montrose Road & Oakwood Drive (Thundering Water Access Road)	TCS	LOS					B		B	B		B	B	B	C	A		B	B
			Delay					19		11	16		16	15	16	24	9		17	16
			V/C					0.75		0.18			0.41	0.29		0.80	0.30			
			Q					93		13			29	16		39	26			
	Marineland Parkway & Portage Road	TCS	LOS	A	A		A		A	A	A					B		A	B	A
			Delay	5	9		8		7	5	6					11		9	11	8
			V/C	0.06	0.65				0.40	0.07						0.37		0.03		
			Q	4	49				27	6						23		4		
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TCS	LOS	C	B		C		B		B	B	A		B		C		C	B
			Delay	29	19		22		18		18	19	5		15		24		24	20
			V/C	0.69	0.32				0.15			0.79	0.18				0.69			
			Q	45	23				13			74	18				66			
	Lyons Creek & Stanley Avenue	TCS	LOS	B	A		B		C		C					C		B	B	B
			Delay	17	6		12		27		27					22		18	20	19
			V/C	0.73	0.32				0.80							0.58		0.18		
			Q	59	37				104							50		15		
	Lyons Creek & QEW WB Off-Ramp	TCS	LOS		A		A		A		A	A		A	A					A
			Delay		6		6		5		5	7		7	7					6
			V/C		0.38				0.15			0.13		0.08						
			Q		16				7			8		6						
	Lyons Creek & QEW EB Off-Ramp	TCS	LOS		A		A		A		A					A		A	A	A
			Delay		10		10		8		8					10		9	9	9
			V/C		0.49				0.18							0.55		0.38		
			Q		32				12							44		15		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.25B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH OPG CANAL CROSSING AND ADDITIONAL IMPROVEMENTS, SATURDAY MIDDAY PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
Saturday Peak Hour	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	C 20 0.24 7			**C** **20**						A 0 0.01 0		**A** **0**		A 0 0.28 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 14 0.08 2			**B** **14**						A 0 0.01 0		**A** **0**		A 0 0.23 0		**A**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 12 0.05 1			**B** **12**						A 0 0.01 0		**A** **0**		A 0 0.22 0		**A** **0**	
	Oakwood Drive & Thundering Waters Access Road	TWSC	LOS Delay V/C Q	A 9 0.22 7	A 0 0.16		**A** **3**		A 0 0.20 0		**A** **0**					A 0 0.00 0		B 12 0.29 10	**B** **12**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	C 18 0.34 12			**C** **18**					A 9 0.06 2	A 0 0.23 0		**A** **1**		A 0 0.27 0	A 0 0.02 0	**A** **0**	

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.26A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING AND ADDITIONAL IMPROVEMENTS, WEEKDAY AM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	McLeod Road & Montrose Road	TCS	LOS Delay V/C Q	B 16 0.42 27	B 18 0.65 75	B 13 0.01 0	**B** **17**	B 10 0.13 7	A 9 0.38 45	A 10 0.22 13	**A** **9**	B 14 0.09 10	B 14 0.15 19	B 14 0.08 10	**B** **14**	C 22 0.68 68	B 14 0.09 9		**B** **19**	**B** **14**
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS Delay V/C Q		B 18 0.66 75	B 14 0.00 0	**B** **18**	B 10 0.24 12	A 8 0.30 34		**A** **8**					C 20 0.57 61	C 21 0.59 63	B 16 0.16 15	**B** **20**	**B** **15**
	McLeod Road & WB QEW Off-Ramp	TCS	LOS Delay V/C Q		A 7 0.56 35		**A** **7**		A 6 0.35 20		**A** **6**	B 11 0.06 6		B 12 0.23 17	**B** **11**					**A** **7**
	McLeod Road & Oakwood Drive	TCS	LOS Delay V/C Q	B 13 0.32 16	B 18 0.76 86	B 12 0.19 12	**B** **17**	C 31 0.49 19	A 8 0.50 48		**B** **11**	C 32 0.44 16	B 18 0.01 3	B 18 0.07 10	**C** **25**	C 26 0.08 7	C 25 0.03 7		**C** **25**	**B** **15**
	McLeod Road & Dorchester Road	TCS	LOS Delay V/C Q	C 29 0.39 22	C 20 0.52 51	C 21 0.35 25	**C** **22**	B 16 0.24 14	C 24 0.72 70		**C** **24**	C 29 0.60 40	C 20 0.48 51		**C** **25**	C 22 0.22 12	C 26 0.51 44	C 25 0.12 12	**C** **25**	**C** **23**
	McLeod Road & Drummond Road	TCS	LOS Delay V/C Q	A 9 0.46 26	A 8 0.38 28		**A** **8**		A 8 0.36 26		**A** **8**	B 10 0.42 31	A 9 0.31 31		**A** **10**	A 9 0.26 20	A 9 0.27 28	B 10 0.14 12	**A** **10**	**A** **9**
	Marineland Parkway & Stanley Avenue	TCS	LOS Delay V/C Q	B 13 0.17 9	B 17 0.54 38		**B** **17**	B 13 0.32 13	B 15 0.41 29		**B** **15**	B 17 0.32 17	B 19 0.29 18		**B** **18**	B 17 0.23 13	B 19 0.26 16		**B** **18**	**B** **17**
	Montrose Road & Niagara Square Drive	TCS	LOS Delay V/C Q					A 6 0.15 5			**A** **6**		A 6 0.19 6		**A** **6**		A 6 0.09 3		**A** **6**	**A** **6**
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS Delay V/C Q		A 8 0.15 18		**A** **8**	B 13 0.58 56	A 9 0.22 20		**B** **12**		B 12 0.27 30	B 14 0.35 18	**B** **14**	B 13 0.34 25	B 13 0.35 34		**B** **13**	**B** **13**
	Oakwood Drive & Walmart North Driveway	TCS	LOS Delay V/C Q	A 8 0.18 9			**A** **8**						A 6 0.10 4		**A** **6**		A 6 0.28 10		**A** **6**	**A** **6**
	Oakwood Drive & Walmart South Driveway	TCS	LOS Delay V/C Q	A 8 0.05 3	A 5 0.12 9		**A** **6**		B 13 0.26 19	B 12 0.02 0	**B** **12**					B 12 0.02 2		B 12 0.00 0	**B** **12**	**A** **10**
	Lyons Creek Road & Thundering Water Access Road	TCS	LOS Delay V/C Q	C 21 0.75 75	A 8 0.71 131		**B** **11**		C 25 0.83 159	B 11 0.09 10	**C** **23**					C 28 0.32 25		C 27 0.20 21	**C** **27**	**B** **18**
	Marineland Parkway & Portage Road	TCS	LOS Delay V/C Q	A 5 0.17 5	A 6 0.38 15		**A** **6**		A 6 0.35 13	A 5 0.05 3	**A** **6**					A 7 0.04 3		A 7 0.04 4	**A** **7**	**A** **6**
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TCS	LOS Delay V/C Q		B 13 0.57 36		**B** **13**		A 9 0.08 8		**A** **9**		B 11 0.63 22		**B** **11**		A 8 0.29 6		**A** **8**	**B** **11**
	Lyons Creek & Stanley Avenue	TCS	LOS Delay V/C Q	B 12 0.68 58	A 5 0.21 18		**A** **9**		A 6 0.43 37		**A** **6**					B 13 0.35 25		B 12 0.11 10	**B** **13**	**A** **9**
	Lyons Creek & QEW WB Off-Ramp	TCS	LOS Delay V/C Q		B 11 0.66 61		**B** **11**		A 8 0.39 33		**A** **8**	B 11 0.29 22		B 11 0.57 42	**B** **13**					**B** **10**
	Lyons Creek & QEW EB Off-Ramp	TCS	LOS Delay V/C Q		B 10 0.47 36		**B** **10**		A 10 0.34 25		**A** **10**					A 10 0.56 51		A 7 0.08 7	**A** **9**	**A** **10**

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.26B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING AND ADDITIONAL IMPROVEMENTS, WEEKDAY AM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	B 15 0.10 3			**B** **15**						A 0 0.00 0		**A** **0**		A 0 0.20 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 13 0.07 2			**B** **13**						A 1 0.04 1		**A** **1**		A 0 0.20 0		**A** **0**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 14 0.14 4			**B** **14**						A 2 0.08 2		**A** **2**		A 0 0.15 0		**A** **0**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					B 14 0.25 8			**B** **14**		A 0 0.18 0		**A** **0**		A 1 0.02 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 13 0.23 7			**B** **13**					A 8 0.06 2	A 0 0.08 0		**A** **3**		A 0 0.10 0	A 0 0.05 0	**A** **0**	

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.27A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING AND ADDITIONAL IMPROVEMENTS, WEEKDAY PM PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	McLeod Road & Montrose Road	TCS	LOS Delay V/C Q	D 37 0.71 14	C 27 0.79 73	B 17 0.02 0	**C** **28**	B 18 0.53 10	B 16 0.66 68	B 14 0.33 0	**B** **16**	B 15 0.08 11	B 16 0.17 25	B 16 0.22 18	**B** **16**	D 43 0.90 136	B 16 0.15 17		**C** **34**	**C** **22**
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS Delay V/C Q		C 24 0.83 121	B 16 0.03 4	**C** **24**	B 16 0.51 22	B 11 0.50 65		**B** **11**					C 29 0.72 91	C 30 0.75 95	C 23 0.56 62	**C** **28**	**C** **21**
	McLeod Road & WB QEW Off-Ramp	TCS	LOS Delay V/C Q		A 9 0.70 67		**A** **9**		A 7 0.52 43		**A** **7**	B 14 0.11 8		B 16 0.40 26	**B** **15**					**A** **9**
	McLeod Road & Oakwood Drive	TCS	LOS Delay V/C Q	C 25 0.49 24	D 48 0.98 244	C 21 0.42 43	**D** **41**	E 79 0.91 69	B 20 0.81 191		**C** **30**	E 74 0.93 91	C 28 0.06 12	C 31 0.26 33	**E** **58**	D 46 0.14 13	D 51 0.54 42		**D** **50**	**D** **39**
	McLeod Road & Dorchester Road	TCS	LOS Delay V/C Q	E 78 0.90 84	C 26 0.57 118	C 27 0.55 79	**D** **37**	C 25 0.23 15	E 62 0.99 233		**E** **60**	F 82 0.96 110	C 28 0.51 96		**E** **59**	D 51 0.63 53	D 53 0.72 96	E 57 0.77 94	**D** **54**	**D** **50**
	McLeod Road & Drummond Road	TCS	LOS Delay V/C Q	C 35 0.75 80	B 17 0.48 83		**C** **21**	C 26 0.05 6	D 44 0.87 139		**D** **43**	D 45 0.86 87	D 36 0.60 90		**D** **40**	C 33 0.53 40	D 45 0.72 90	D 36 0.20 23	**D** **39**	**C** **35**
	Marineland Parkway & Stanley Avenue	TCS	LOS Delay V/C Q	B 16 0.45 21	C 25 0.78 85		**C** **24**	B 19 0.61 27	B 20 0.56 56		**B** **20**	C 28 0.76 50	C 22 0.36 25		**C** **24**	C 24 0.46 22	C 26 0.44 26		**C** **25**	**C** **23**
	Montrose Road & Niagara Square Drive	TCS	LOS Delay V/C Q					A 7 0.20 7			**A** **7**		A 7 0.31 11		**A** **7**		A 6 0.22 8		**A** **6**	**A** **7**
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS Delay V/C Q		A 9 0.14 17		**A** **9**	C 25 0.83 148	A 10 0.28 32		**A** **10**		C 23 0.52 67	C 20 0.31 20	**C** **21**	D 37 0.72 59	C 24 0.56 73		**C** **28**	**C** **22**
	Oakwood Drive & Walmart North Driveway	TCS	LOS Delay V/C Q	B 13 0.64 64			**B** **13**						A 9 0.22 18		**A** **9**		B 10 0.55 43		**B** **10**	**B** **11**
	Oakwood Drive & Walmart South Driveway	TCS	LOS Delay V/C Q	A 8 0.12 6	A 6 0.19 14		**A** **6**		B 13 0.24 17	B 12 0.02 0	**B** **12**					B 12 0.14 8		B 12 0.05 0	**B** **12**	**A** **10**
	Lyons Creek Road & Thundering Water Access Road	TCS	LOS Delay V/C Q	C 29 0.82 105	A 5 0.39 56		**B** **16**		C 31 0.85 169	B 14 0.10 13	**C** **28**					C 29 0.45 37		C 28 0.33 26	**C** **29**	**C** **23**
	Marineland Parkway & Portage Road	TCS	LOS Delay V/C Q	A 5 0.10 4	A 7 0.55 38		**A** **7**		A 5 0.41 25	A 5 0.08 5	**A** **5**					B 11 0.28 20		A 10 0.02 4	**B** **10**	**A** **6**
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TCS	LOS Delay V/C Q		C 22 0.80 90		**C** **22**		A 10 0.07 8		**A** **10**		C 21 0.78 75		**C** **21**		B 15 0.68 70		**B** **15**	**B** **19**
	Lyons Creek & Stanley Avenue	TCS	LOS Delay V/C Q	A 7 0.49 28	A 8 0.52 44		**A** **7**		A 8 0.51 43		**A** **8**					B 10 0.33 26		B 10 0.30 16	**B** **10**	**A** **9**
	Lyons Creek & QEW WB Off-Ramp	TCS	LOS Delay V/C Q		B 15 0.69 65		**B** **15**		B 13 0.61 54		**B** **13**	A 9 0.29 24		B 15 0.71 67	**B** **13**					**B** **14**
	Lyons Creek & QEW EB Off-Ramp	TCS	LOS Delay V/C Q		B 11 0.38 31		**B** **10**		B 12 0.55 46		**B** **12**					B 11 0.63 59		A 7 0.20 13	**B** **10**	**B** **11**

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Avail. - Available Storage (m)

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TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 6.27B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING AND ADDITIONAL IMPROVEMENTS, WEEKDAY PM PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
PM Peak Hour	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	C 18 0.21 6			**C** **18**						A 0 0.00 0		**A** **0**		A 0 0.25 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	C 19 0.34 12			**C** **19**						A 1 0.03 1		**A** **1**		A 0 0.25 0		**A** **0**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	C 16 0.30 10			**C** **16**						A 1 0.03 1		**A** **1**		A 0 0.25 0		**A** **0**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					D 28 0.56 26			**D** **28**		A 0 0.25 0		**A** **0**		A 2 0.06 2		**A** **2**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	C 16 0.27 9			**C** **16**					A 9 0.05 1	A 0 0.14 0		**A** **2**		A 0 0.20 0	A 0 0.07 0	**A** **0**	

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RBT - Roundabout

TABLE 6.28A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING AND ADDITIONAL IMPROVEMENTS, SATURDAY MIDDAY PEAK HOUR (SIGNALIZED INTERSECTIONS)

Analysis 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	
Saturday Peak Hour	McLeod Road & Montrose Road	TCS	LOS	C	C	B	C	B	B	B	B	B	B	B	B	D	B		C	C
			Delay	21	27	16	26	17	13	13	13	17	16	16	16	41	16		32	21
			V/C	0.50	0.81	0.02		0.53	0.48	0.28		0.15	0.13	0.14		0.88	0.15			
			Q	32	109	1		19	59	14		17	21	13		128	16			
	McLeod Road & EB QEW Off-Ramp / Niagara Square Drive	TCS	LOS		C	B	C	C	A		B					C	C	C	C	B
			Delay		23	15	23	21	9		11					26	26	21	24	19
			V/C		0.82	0.02		0.69	0.39							0.67	0.68	0.45		
			Q		113	1		43	48							78	80	46		
	McLeod Road & WB QEW Off-Ramp	TCS	LOS		A		A		A		A	B		B	B					A
			Delay		10		10		8		8	12		16	15					10
			V/C		0.68				0.50			0.08		0.57						
			Q		64				41			7		45						
	McLeod Road & Oakwood Drive	TCS	LOS	B	D	B	C	E	B		C	E	C	C	D	D	D		D	C
			Delay	17	36	20	32	70	12		25	65	30	35	50	48	47		47	33
			V/C	0.19	0.92	0.43		0.90	0.60			0.89	0.04	0.51		0.17	0.05			
			Q	13	222	43		76	110			82	10	63		13	11			
	McLeod Road & Dorchester Road	TCS	LOS	E	C	C	C	C	D		D	E	D		E	E	D	D	D	D
			Delay	64	24	29	35	27	50		48	72	45		59	63	49	41	48	45
			V/C	0.87	0.50	0.65		0.38	0.92			0.90	0.78			0.86	0.73	0.51		
			Q	91	95	102		25	185			92	130			62	98	58		
	McLeod Road & Drummond Road	TCS	LOS	C	B		B	C	C		C	D	C		D	C	C	C	C	C
			Delay	23	12		15	21	29		29	45	26		35	28	28	25	26	25
			V/C	0.76	0.42			0.04	0.78			0.85	0.52			0.65	0.60	0.21		
			Q	72	54			4	89			48	50			35	59	18		
	Marineland Parkway & Stanley Avenue	TCS	LOS	B	B		B	B	B		B	B	B		B	B	C		C	B
			Delay	13	20		19	15	17		16	18	20		20	19	21		20	19
			V/C	0.24	0.71			0.52	0.56			0.30	0.28			0.48	0.41			
			Q	11	63			20	46			14	16			23	23			
	Montrose Road & Niagara Square Drive	TCS	LOS					A			A		A		A		A		A	A
			Delay					6			6		6		6		6		6	6
			V/C					0.21					0.21				0.25			
			Q					7					7				9			
	Montrose Road & Lyons Creek Road / Biggar Road	TCS	LOS		A		A	B	A		B		B	B	B	B	B		B	B
			Delay		8		8	17	9		14		13	14	13	16	14		15	14
			V/C		0.10			0.64	0.18				0.27	0.19		0.39	0.45			
			Q		14			65	17				33	15		33	55			
	Oakwood Drive & Walmart North Driveway	TCS	LOS	B			B						B		B		B		B	B
			Delay	11			11						10		10		11		11	11
			V/C	0.65									0.31				0.35			
			Q	65									21				27			
	Oakwood Drive & Walmart South Driveway	TCS	LOS	A	A		A		B	B	B					B		B	B	B
			Delay	8	5		7		13	12	12					13		12	13	11
			V/C	0.15	0.09				0.25	0.03						0.28		0.06		
			Q	7	8				19	0						16		0		
	Lyons Creek Road & Thundering Water Access Road	TCS	LOS	C	A		B		C	B	C					C		C	C	C
			Delay	23	4		13		30	15	27					29		28	28	21
			V/C	0.79	0.39				0.83	0.11						0.38		0.26		
			Q	106	52				144	13						31		24		
	Marineland Parkway & Portage Road	TCS	LOS	A	A		A		A	A	A					B		B	B	A
			Delay	5	8		8		7	5	6					12		11	12	8
			V/C	0.07	0.62				0.44	0.07						0.38		0.03		
			Q	4	52				34	5						30		6		
	Stanley Avenue & Dorchester Road / Chippawa Parkway	TCS	LOS		B		B		A		A		B		B		A		A	B
			Delay		13		13		8		8		12		12		9		9	11
			V/C		0.63				0.09				0.58				0.39			
			Q		51				9				48				33			
	Lyons Creek & Stanley Avenue	TCS	LOS	A	A		A		A		A					B		A	A	A
			Delay	8	7		8		8		8					11		10	10	9
			V/C	0.49	0.51				0.58							0.33		0.17		
			Q	22	42				47							27		13		
	Lyons Creek & QEW WB Off-Ramp	TCS	LOS		B		B		A		A	A		A	A					B
			Delay		13		13		10		10	8		8	8					11
			V/C		0.63				0.22			0.05		0.15						
			Q		42				14			6		11						
	Lyons Creek & QEW EB Off-Ramp	TCS	LOS		B		B		B		B					B		A	A	B
			Delay		13		13		12		12					11		6	10	11
			V/C		0.44				0.25							0.71		0.20		
			Q		31				18							78		9		

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TABLE 6.28B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY WITH WELLAND RIVER CROSSING AND ADDITIONAL IMPROVEMENTS, SATURDAY MIDDAY PEAK HOUR (UNSIGNALIZED INTERSECTIONS)

Analysis 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	
SAT Peak Hour	Stanley Avenue & Ramsey Road	TWSC	LOS Delay V/C Q	B 15 0.07 2			**B** **15**						A 0 0.01 0		**A** **0**		A 0 0.22 0		**A** **0**	
	Stanley Avenue & Progress Street	TWSC	LOS Delay V/C Q	B 13 0.07 2			**B** **13**						A 0 0.01 0		**A** **0**		A 0 0.20 0		**A** **0**	
	Stanley Avenue & Don Murie Street	TWSC	LOS Delay V/C Q	B 11 0.04 1			**B** **11**						A 0 0.01 0		**A** **0**		A 0 0.19 0		**A** **0**	
	Montrose Road & Oakwood Drive	TWSC	LOS Delay V/C Q					C 17 0.43 17			**C** **17**		A 0 0.18 0		**A** **0**		A 1 0.02 1		**A** **1**	
	Montrose Road & Chippawa Creek Road	TWSC	LOS Delay V/C Q	B 12 0.21 6			**B** **12**					A 8 0.03 1	A 0 0.10 0		**A** **1**		A 0 0.13 0	A 0 0.03 0	**A** **0**	

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6.9.6 Findings and Comparison

The primary reasons for implementing a watercourse crossing would be to provide additional road network capacity and offer an alternative means of access to the Thundering Waters lands that does not rely on McLeod Road. Other potential benefits include greater network flexibility/redundancy, improved access for emergency services, and opportunities for further transit, cycling and pedestrian linkages.

As illustrated in Section 6.8.5, several movements at the Study Area intersections are forecast to operate with less than satisfactory levels of service during the critical weekday afternoon peak hour in the year 2031 with the proposed development, even with planned and other possible road improvements. In particular, the McLeod Road/Oakwood Drive and McLeod Road/Dorchester Road intersections are expected to experience over capacity conditions, as summarized in **Table 6.29**. The yellow highlighted cells are movements, approaches or overall conditions exceeding the critical thresholds set out in the Niagara Region Transportation Impact Study Guidelines, as outlined in Section 3.3.1. This situation can be largely attributed to the proportion of future travel demand oriented to the north and west, primarily via the QEW.

Table 6.29 also provides a comparison of the forecasted operating conditions at McLeod Road/Oakwood Drive and McLeod Road/Dorchester Road intersections for the different potential watercourse crossing scenarios. The table illustrates that the provision of a crossing, with other road improvements, would help to alleviate projected capacity concerns at the two (2) intersections. By contrast, the scenario without the watercourse crossing would still exhibit capacity deficiencies with the base and additional infrastructure improvements identified in **Table 6.22** implemented.

Both potential watercourse crossing concepts would provide additional capacity and help to redirect site generated traffic towards Lyons Creek Road and its QEW interchange, but to differing degrees and with varying impacts. Neither option completely addresses all requirements or resolves every road network capacity concern, as **Table 6.29** illustrates.

Table 6.30 provides a simplified comparison of the two (2) crossing options based on several different considerations (or criteria) and the preliminary overview and assessment presented in Section 6.9.2. Although this cursory assessment would suggest the OPG Canal crossing may be preferred to the Welland River crossing, more detailed technical investigations (traffic and engineering) would be required to fully assess the viability of the options and confirm a preferred location and configuration. This assessment would typically be carried out through a follow-on Municipal Class EA study focussed on identifying the technically preferred watercourse crossing.

TABLE 6.29: COMPARISON OF FUTURE TOTAL TRAFFIC OPERATIONS SUMMARIES FOR MCLEOD ROAD/OAKWOOD DRIVE AND MCLEOD ROAD/DORCHESTER ROAD INTERSECTIONS FOR DIFFERENT HORIZON YEAR SCENARIOS, WEEKDAY PM PEAK HOUR

Analysis Period	Horizon Year (2031) Forecast Scenario	MOE	Direction / Movement / Approach																	
			Eastbound				Westbound				Northbound				Southbound				Overall
			Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
Oakwood Drive - PM Peak Hour	Background with Base Improvements	LOS	C	D	C	D	D	B		C	D	B	B	D	C	C		C	C
		Delay	24	47	23	39	44	18		24	47	18	19	37	33	35		35	32
		V/C	0.35	0.96	0.36		0.73	0.73			0.83	0.05	0.16		0.11	0.41			
		Q	17	159	28		51	129			74	9	14		11	32			
	Total with Base Improvements	LOS	C	F	C	F	D	F		F	D	B	B	D	C	D		C	F
		Delay	32	243	26	191	46	129		118	49	18	19	38	33	36		35	134
		V/C	0.56	1.46	0.57		0.75	1.22			0.85	0.04	0.16		0.10	0.45			
		Q	25	291	71		52	332			76	9	14		11	36			
	Total with Base and Additional Improvements	LOS	C	D	C	D	F	E		E	F	D	D	F	D	D		D	E
		Delay	29	49	21	42	96	78		80	134	40	42	100	45	53		52	67
		V/C	0.27	0.98	0.47		0.95	1.09			1.11	0.07	0.30		0.09	0.31			
		Q	8	296	67		77	401			111	15	40		11	32			
	Total with Base Improvements and OPG Canal Crossing	LOS	C	D	B	C	F	B		C	F	B	B	E	C	C		C	D
		Delay	24	40	19	34	92	20		33	82	19	19	59	31	34		33	38
		V/C	0.50	0.94	0.39		1.00	0.82			1.00	0.05	0.17		0.10	0.43			
		Q	22	172	32		62	158			82	9	15		10	34			
	Total with Base and Additional Improvements and OPG Canal Crossing	LOS	C	D	C	C	E	C		C	D	C	C	D	D	D		D	C
		Delay	26	41	23	34	64	21		29	55	22	24	45	39	42		42	35
		V/C	0.45	0.92	0.43		0.86	0.79			0.87	0.05	0.16		0.12	0.46			
		Q	23	195	46		65	178			85	10	16		12	38			
	Total with Base Improvements and Welland River Crossing	LOS	C	F	C	F	D	C		D	D	B	B	D	C	D		C	F
		Delay	32	186	25	145	45	34		35	49	18	19	38	33	35		35	81
		V/C	0.56	1.33	0.53		0.74	0.95			0.85	0.04	0.16		0.10	0.44			
		Q	25	258	63		52	226			76	9	14		11	35			
	Total with Base and Additional Improvements and Welland River Crossing	LOS	C	D	C	D	E	B		C	E	C	C	E	D	D		D	D
		Delay	25	48	21	41	79	20		30	74	28	31	58	46	51		50	39
		V/C	0.49	0.98	0.42		0.91	0.81			0.93	0.06	0.26		0.14	0.54			
		Q	24	244	43		69	191			91	12	33		13	42			
Dorchester Road - PM Peak Hour	Background with Base Improvements	LOS	D	B		C	B	C		C	E	C		D	C	C	D	D	C
		Delay	42	19		26	19	32		31	61	31		48	32	34	38	36	33
		V/C	0.73	0.65			0.24	0.84			0.92	0.52			0.48	0.46	0.62		
		Q	62	114			12	146			79	54			30	44	56		
	Total with Base Improvements	LOS	D	F		E	C	F		F	F	C		F	C	D	D	D	F
		Delay	50	82		76	25	166		161	667	34		465	31	38	38	37	168
		V/C	0.78	1.09			0.35	1.28			2.39	0.64			0.53	0.67	0.65		
		Q	67	261			13	282			306	79			29	75	67		
	Total with Base and Additional Improvements	LOS	F	C	C	D	C	F		F	F	D		F	D	E	E	E	E
		Delay	108	33	34	47	29	103		100	156	40		119	44	60	65	60	78
		V/C	1.06	0.69	0.64		0.37	1.11			1.18	0.55			0.45	0.75	0.79		
		Q	83	162	120		18	326			165	99			37	104	102		
	Total with Base Improvements and OPG Canal Crossing	LOS	D	C		C	C	D		D	F	D		F	C	D	C	C	E
		Delay	52	28		34	23	51		50	217	38		130	34	37	34	35	56
		V/C	0.81	0.82			0.35	0.97			1.37	0.74			0.61	0.65	0.51		
		Q	67	168			13	189			159	96			29	75	52		
	Total with Base and Additional Improvements and OPG Canal Crossing	LOS	E	C		D	C	D		D	E	D		E	D	D	D	D	D
		Delay	64	29		38	24	47		46	71	40		56	36	44	43	42	44
		V/C	0.87	0.80			0.35	0.94			0.92	0.72			0.57	0.70	0.66		
		Q	76	118			14	197			83	104			31	84	72		
	Total with Base Improvements and Welland River Crossing	LOS	D	D		D	C	E		E	F	D		F	C	D	D	D	F
		Delay	50	49		49	25	71		69	376	38		232	34	38	37	37	86
		V/C	0.79	0.99			0.35	1.04			1.74	0.74			0.61	0.65	0.62		
		Q	67	219			13	208			220	96			29	75	65		
	Total with Base and Additional Improvements and Welland River Crossing	LOS	E	C	C	D	C	E		E	F	C		E	D	D	E	D	D
		Delay	78	26	27	37	25	62		60	82	28		59	51	53	57	54	50
		V/C	0.90	0.57	0.55		0.23	0.99			0.96	0.51			0.63	0.72	0.77		
		Q	84	118	79		15	233			110	96			53	96	94		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control
RBT - Roundabout

TABLE 6.30: COMPARISON OF POTENTIAL WATERCOURSE CROSSING OPTIONS

Consideration	OPG Canal Crossing	Welland River Crossing
Connects more directly to Lyons Creek Road and QEW interchange		✓
Less circuitousness to access from within the Thundering Waters lands	✓	
Better addresses road network capacity constraints (based on operational analyses)	✓1	✓1
Less challenging to implement from a technical perspective		✓
Less impact on existing land uses		✓
Less impact on natural environmental features	✓	
Shorter connection	✓	
More compatible with the Thundering Waters Secondary Plan	✓	
Identified in Niagara Falls Sustainable Transportation Master Plan	✓	

Note: 1. OPG Canal Crossing better addresses critical movements, whereas Welland River Crossing provides better overall intersection improvement. Section 7.2.3 explains this finding further.

7 Road Network Plans and Policies

7.1 Network Description

Figure 7.1 depicts the conceptual road network to serve the Thundering Waters lands. The network has been based upon the residential unit and non-residential floor space targets set out in Section 6.3 of this plan. The network has been designed to support the proposed levels of development, incorporate the results of previous technical work undertaken, consider comments received from the public and review agencies, and has kept with the broad transportation system principles set out in the City of Niagara Falls Official Plan.

The conceptual road network achieves the principles for the Thundering Waters Secondary Plan, which promote a multi-modal transportation system with an emphasis on non-auto modes of travel, including transit, cycling and walking. The resulting network allows for the use of all modes of transportation and strives to achieve a balance between the need to:

- Provide acceptable levels of mobility and land access;
- Support the development of a vibrant and sustainable Town Centre that places a strong emphasis on active transportation; and
- Develop an integrated road network that supports transit and links the Secondary Plan area to the adjacent road structure.

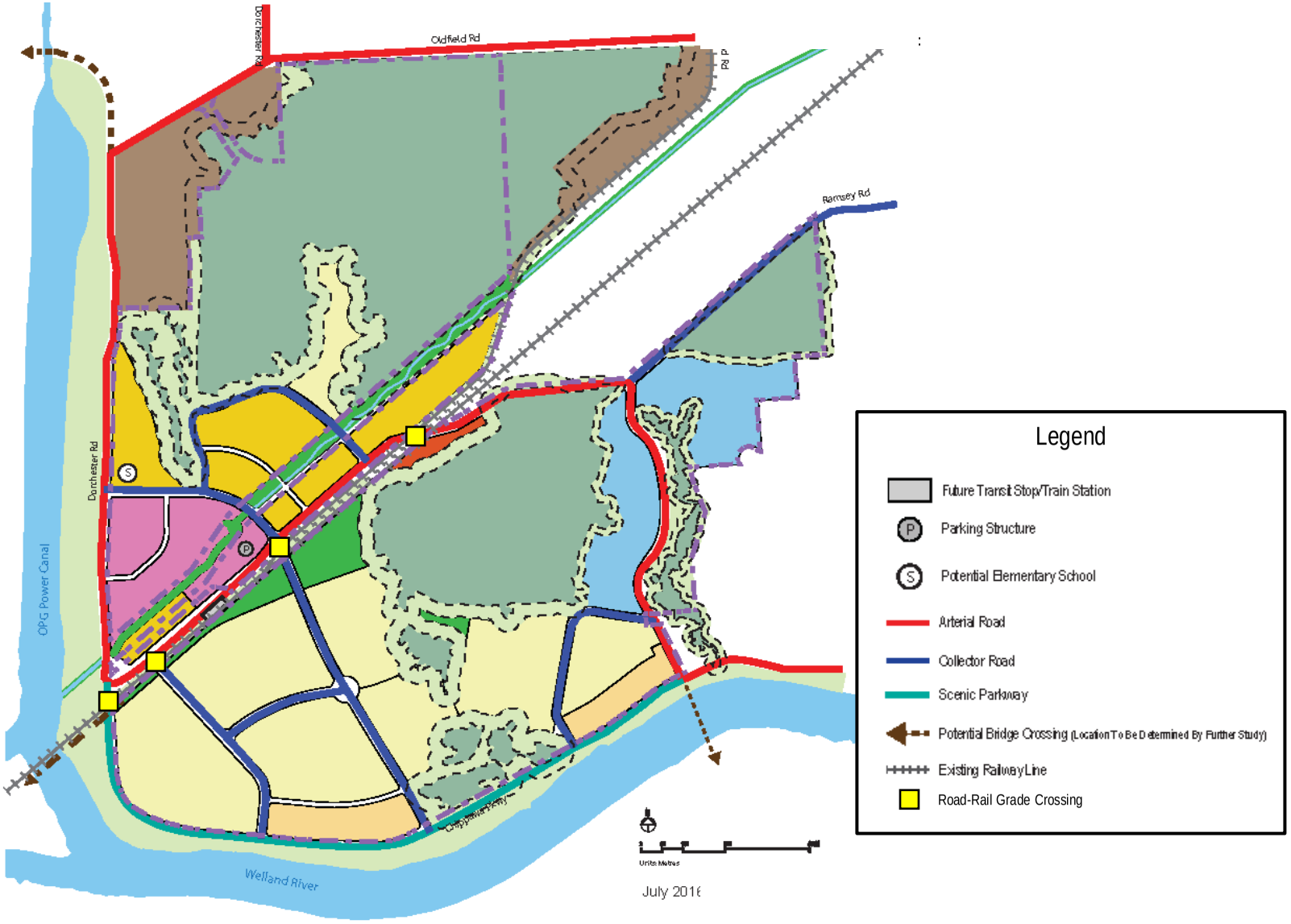
The conceptual road network forms the basis upon which the transit, cycling and pedestrian plans have been developed. In combination, these networks form the recommended transportation strategy, which supports the proposed levels of development set out in the Secondary Plan.

7.2 Key Elements

7.2.1 Road Segments

The key road segments of the conceptual road network plan consist of:

- Upgraded Dorchester Road north of the proposed Town Centre as an arterial road. This road will become the primary gateway to the Thundering Waters lands from the north and provide access to the high density residential lands and the Town Centre in the northerly portion of the development area. The roadway will also serve as a key transit route, and an important pedestrian and cycling corridor.



paradigm TRANSPORTATION SOLUTIONS LIMITED

Conceptual Road Network Plan

- An “east-west” arterial roadway extending from Dorchester Road to Chippawa Parkway in a northwest to southeast orientation. This road will serve as the primary internal “spine” road, providing direct access to the various development lands within the Secondary Plan area. The east-west road will provide needed traffic capacity to serve the development area, while accommodating transit service and connecting the community with the Future Transit Stop/Train Station. It also serves as a key cycling corridor, linking the Town Centre, public facilities and recreational destinations by way of an interconnected system of on and off-street cycling facilities. Design of this roadway will be critical to serving its intended functions, given the curvilinear configuration. The road will need to be designed to emphasize through movement of vehicular traffic, while still accommodating other modes of travel and intersecting streets. Effective horizontal alignment (i.e. curve) design will be key.
- Upgraded Chippawa Parkway from the east-west arterial to Stanley Avenue as an arterial road. This road will become the primary gateway to the Thundering Waters lands from the east and south and provide access to the office and low and medium density residential lands in the northerly portion of the development area. The roadway will also serve as a key transit route, and an important pedestrian and cycling corridor.
- Improved Chippawa Parkway from Dorchester Road to the east as a scenic parkway. Similar in function to a collector road, this route will meander along the OPG Canal and Welland River waterfront and provide access to the low and medium density residential lands as well as the Town Centre. The road will also serve important transit, pedestrian and cycling functions, placing less emphasis on vehicle movement and capacity.
- Extension and upgrading of Ramsey Road to the east-west arterial as a collector road. The road will serve as a secondary access to the Thundering Waters lands, with less emphasis placed on vehicle service and movement and greater priority given to serving transit, pedestrian and cycling functions.
- A modified grid network of collector roads. This network provides access and connectivity between the residential, recreational, mixed-use, institutional, office and commercial land uses, while serving transit, accommodating pedestrian and cycling activity and providing key linkages with off-road trail system.

Table 7.1 summarizes the key road segments, their existing and proposed City of Niagara Falls Official Plan designations and road allowance requirements, expected future lanes, and other comments pertaining to the roadways. This fine grain network allows for an internal road network strategy that requires at most four (4) lanes on the arterials within the development area. Section 7.4 provides further information about phasing and timing for implementation.

TABLE 7.1: KEY ROAD SEGMENTS

Key Road Section	Designation	Road Allowance	Expected Future Lanes	Comments
Dorchester Road (McLeod Road to Town Centre)	Arterial (as per Official Plan)	26 metres	Up to four (4) plus turning lanes and cycling facilities	Additional road allowance width may be required at intersections to facilitate auxiliary turn lanes or roundabouts.
Chippawa Parkway (East-West Arterial to Stanley Avenue)	Arterial (as per Official Plan)	26 metres	Up to four (4) plus turning lanes and cycling facilities	Additional road allowance width may be required at intersections to facilitate auxiliary turn lanes or roundabouts.
East-West Arterial (Dorchester Road to Chippawa Parkway)	Arterial (new, replaces Dorchester Road/ Chippawa Parkway connection)	26 metres	Up to four (4) plus turning lanes and cycling facilities	Additional road allowance width may be required at intersections to facilitate auxiliary turn lanes or roundabouts.
Chippawa Parkway (Dorchester Road to East-West Arterial)	Scenic Parkway (currently arterial in Official Plan)	26 metres	Two (2) plus turning lanes and cycling facilities	Additional road allowance width may be required at intersections to facilitate auxiliary turn lanes or roundabouts. Intersections with East-West Arterial and Dorchester Road to be designed to discourage use of Chippawa Parkway for through traffic.
Ramsey Road (East-West Arterial to Stanley Avenue)	Collector (as per Official Plan)	26 metres	Two (2) plus turning lanes and cycling facilities	Additional road allowance width may be required at intersections to facilitate auxiliary turn lanes or roundabouts. Intersection with East-West Arterial to be designed to discourage use of Ramsey Road.
All other roads	Collector and Local (new)	As specified in Official Plan	Two (2) plus turning lanes and cycling facilities	Additional road allowance width may be required at intersections to facilitate auxiliary turn lanes or roundabouts.

7.2.2 Intersections

Several intersections within the Study Area will need to be expanded and/or require traffic control signals to serve the proposed development. **Table 7.2**, which is based on the information provided in **Table 6.22**, summarizes the list of improvements for the different potential watercourse crossing scenarios, which can be divided into four (4) categories:

- Category 1 – Improvements to Address Existing Deficiencies (see Sections 3.3.3 and 6.8.2) (blue text in table)
- Category 2 – Programmed Improvements (see Section 6.8.1) (black text in table)
- Category 3 – Other Improvements Identified in the Niagara Falls Sustainable Transportation Master Plan (see Section 6.8.1) (green text in table)
- Category 4 – Additional Improvements to Serve Proposed Development (see Section 6.8.5) (red text in table)

The property owner would not be responsible for implementing the intersection improvements in Categories 1, 2 and 3, as these needs are caused by background traffic growth not attributable to the Thundering Waters lands. The improvements in Category 4 may fall to the property owner, as these items arise due to the proposed development. The timing of these development-related intersection works will depend on the phasing of development, discussed further in Section 7.4.

In considering traffic patterns and roadway geometry, roundabouts may offer advantages to Stop controlled or signalized intersections at the following locations:

- Stanley Avenue and Chippawa Parkway, due to the orientation of primary traffic flows, the extent of the required turn lane improvements, and the close proximity of the Stanley Avenue bridge over the Welland River.
- Lyons Creek Road and Chippawa Parkway, due to the orientation of primary traffic flows.
- Montrose Road and Oakwood Road *if the OPG Canal crossing is pursued*, due to the orientation of traffic flows, the objective to direct traffic away from the McLeod Road and Oakwood Drive intersection, and safety concerns with the existing intersection configuration and sight lines.
- Lyons Creek Road and the new access road to Thundering Waters *if the Welland River crossing is pursued*, due to the orientation of primary traffic flows and the potential presence of another roundabout at the Stanley Avenue intersection.

TABLE 7.2: INTERSECTION IMPROVEMENTS

Intersection	Base (2015) Year	Horizon (2031) Year			
	Existing Conditions	Future Background	Future Total	Future Total with OPG Canal Crossing	Future Total with Welland River Crossing
McLeod Road and Montrose Road		EB TL WB TL			
McLeod Road and QEW EB Off-Ramp/Niagara Square Drive		EB TL WB TL			
McLeod Road and QEW WB Off-Ramp		EB TL WB TL			
McLeod Road and Oakwood Drive	2nd NB LTL	EB TL WB TL 2nd WB LTL	Congested		
McLeod Road and Dorchester Road	SB RTL	2nd EB LTL	2nd NB LTL EB RTL WB RTL	2nd NB LTL	2nd NB LTL EB RTL
McLeod Road and Drummond Road		EB LTL WB LTL	Dual NB LTLs		NB LTL
Marineland Parkway and Stanley Avenue		Jog Elimination			
Montrose Road and Niagara Square Drive					
Montrose Road and Lyons Creek Road/ Biggar Road	WB LTL SB LTL			WB RTL	
Oakwood Drive and Walmart North Driveway					
Oakwood Drive and Walmart South Driveway					
Marineland Parkway and Portage Road		EB LTL	Traffic Signals[1]	Traffic Signals[1]	Traffic Signals[1]
Stanley Avenue and Ramsey Road					
Stanley Avenue and Progress Street					
Stanley Avenue and Don Murie Street					
Stanley Avenue and Chippawa Parkway			Traffic Signals Dual NB LTLs EB LTL Channelized EB RTL SB RTL or Roundabout	Traffic Signals NB LTL EB LTL or Roundabout	Traffic Signals or Roundabout

TABLE 7.2: INTERSECTION IMPROVEMENTS

Intersection	Base (2015) Year	Horizon (2031) Year			
	Existing Conditions	Future Background	Future Total	Future Total with OPG Canal Crossing	Future Total with Welland River Crossing
Lyons Creek Road and Stanley Avenue			Traffic Signals/ Roundabout	Traffic Signals/ Roundabout	Traffic Signals/ Roundabout
Lyons Creek Road and QEW WB Off-Ramp			Traffic Signals	Traffic Signals	Traffic Signals
Lyons Creek Road and QEW EB Off-Ramp			Traffic Signals	Traffic Signals	Traffic Signals
Montrose Road and Oakwood Drive				Traffic Signals NB RTL SB LTL or Roundabout	
Montrose Road and Chippawa Creek Road					
Lyons Creek Road and Thundering Waters Access Road				N/A	Traffic Signals EB LTL WB RTL or Roundabout
Oakwood Drive and Thundering Waters Access Road				Unsignalized EB LTL	N/A

Legend:

EB – Eastbound, WB – Westbound, NB – Northbound, SB – Southbound
TL – Through Lane, LTL – Left-Turn Lane, RTL – Right-Turn Lane

Category 1 – Improvements to Address Existing Deficiencies
Category 2 – Programmed Improvements
Category 3 – Other Improvements Identified in the Niagara Falls Sustainable Transportation Master Plan
Category 4 – Additional Improvements to Serve Proposed Development

Notes:

1. Improvement required based on future background traffic operations

Capacity analyses were completed at the intersections of Stanley Avenue/ Chippawa Parkway and Stanley Avenue/Lyons Creek Road to assess the operation of roundabouts at these locations compared to other forms of intersection control. The analyses were carried out with the future total traffic forecasts for the critical summer weekday afternoon peak hour using ARCADY.

Table 7.3 summarizes the analysis results for the no crossing (**Figure 6.11** volumes), OPG Canal crossing (**Figure 6.21** volumes) and Welland River crossing (**Figure 6.24** volumes) options. **Appendix M** provides the ARCADY analysis output. The analyses illustrate that the intersections would operate at better levels of service and with less delay with roundabouts installed than with all-way Stop control or traffic control signals.

Further detailed investigation would be required to assess the feasibility and suitability of providing roundabouts at these intersections, and to confirm the preferred configurations. This assessment can be provided with the planning application for the appropriate phase of development or completed as a separate investigation.

7.2.3 Potential Watercourse Crossing

The analyses provided in Section 6.9 illustrate that a crossing of the OPG Canal or Welland River may be needed in the future to address capacity constraints on McLeod Road and serve anticipated traffic demands for the development area. The preferred location and configuration of the crossing would need to be established through a Municipal Class EA study in the future. Timing for the provision of a watercourse crossing, if required, is discussed further in Section 7.4.

7.2.4 Rail Crossings

The Thundering Waters lands are bisected by the CP Rail Montrose Subdivision. Classified as an industrial spur, this lightly used rail line connects to the CP Rail Hamilton Subdivision west of the development area and terminates just east of the lands near Fallsview Boulevard and Livingston Street. The rail line serves local industrial businesses on an on-demand basis.

Rail traffic along the spur line is currently low and consists of two (2) to three (3) freight trains per week to meet specific customer needs, as well as infrequently scheduled maintenance. There has been discussion of excursion and tourist train service along the line, but nothing definitive existed at the time of preparing this report.

Recent discussions with CP Rail representatives indicate that the railway is not expecting any significant growth in traffic on the spur line for the foreseeable future (longer-term traffic estimates are difficult to forecast). It was noted that the current designation of the rail line permits speeds of up to approximately 40 kilometres per hour.

TABLE 7.3A: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY AND COMPARISON WITH ROUNDABOUTS AT STANLEY AVENUE INTERSECTIONS, WEEKDAY PM PEAK HOUR WITHOUT WATERCOURSE CROSSING

Analysis 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	
PM Peak Hour	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS		F		**F**		F		**F**		B		**B**		A		**A**	
			Delay		Err		**Err**		Err		**Err**		11		**11**		0		**0**	
			V/C		12.40				8.46				0.51				0.02			
			Q		Err				Err				23				0			
		TCS	LOS	C	C		**C**		C		**C**	D	A		**C**		C	C	**C**	**C**
			Delay	25	18		**20**		16		**16**	30	7		**22**		24	17	**21**	**21**
			V/C	0.70	0.42				0.13			0.79	0.28				0.72	0.20		
			Q	59	27				10			55	26				69	16		
		RBT	LOS		C		**C**		A		**A**		B		**B**		B		**B**	**B**
			Delay		15		**15**		6		**6**		12		**12**		13		**13**	**13**
			V/C		0.77				0.07				0.71				0.70			
			Q		22				0				17				16			
	Lyons Creek & Stanley Avenue	AWSC	LOS	F	C		**F**		D		**D**					C		F	**F**	
			Delay	85	20		**61**		35		**35**					24		68	**52**	
			V/C	1.06	0.57				0.82							0.65		1.01		
			Q																	
		TCS	LOS	C	A		**C**		E		**E**					D		C	**C**	**C**
			Delay	24	6		**17**		37		**37**					27		21	**23**	**24**
			V/C	0.82	0.28				0.83							0.66		0.37		
			Q	103	31				100							61		24		
		RBT	LOS		B		**B**		A		**A**						B		**B**	**B**
			Delay		12		**12**		7		**7**						13		**13**	**11**
			V/C		0.72				0.46								0.75			
			Q		17				6								21			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 7.3B: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY AND COMPARISON WITH ROUNDABOUTS AT STANLEY AVENUE INTERSECTIONS, WEEKDAY PM PEAK HOUR WITH OPG CANAL CROSSING

Analysis 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	
PM Peak Hour	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS		F		**F**		F		**F**		A		**A**		A		**A**	
			Delay		Err		**Err**		590		**590**		8		**8**		0		**0**	
			V/C		4.41				1.56				0.34				0.01			
			Q		Err				41				12				0			
		TCS	LOS	C	B		**B**		B		**B**	C	A		**B**		A		**A**	**B**
			Delay	24	18		**20**		16		**16**	25	6		**18**		9		**9**	**16**
			V/C	0.67	0.39				0.12			0.84	0.25				0.56			
			Q	59	28				11			88	23				60			
		RBT	LOS		B		**B**		A		**A**		A		**A**		A		**A**	**A**
			Delay		11		**11**		5		**5**		8		**8**		8			**9**
			V/C		0.69				0.06				0.55				0.56			
			Q		15				0				9				9			
	Lyons Creek & Stanley Avenue	AWSC	LOS	D	C		**C**		D		**D**					C		D	**D**	
			Delay	29	19		**25**		33		**33**					23		35	**30**	
			V/C	0.73	0.57				0.81							0.64		0.84		
			Q																	
		TCS	LOS	B	A		**B**		A		**A**					B		B	**B**	**B**
			Delay	20	7		**14**		8		**8**					16		14	**15**	**13**
			V/C	0.79	0.32				0.41							0.56		0.32		
			Q	77	31				37							45		16		
		RBT	LOS		A		**A**		A		**A**						B		**B**	**A**
			Delay		8		**8**		6		**6**						10		**10**	**9**
			V/C		0.58				0.42								0.68			
			Q		10				5								14			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

TABLE 7.3C: FUTURE TOTAL TRAFFIC OPERATIONS SUMMARY AND COMPARISON WITH ROUNDABOUTS AT STANLEY AVENUE INTERSECTIONS, WEEKDAY PM PEAK HOUR WITH WELLAND RIVER CROSSING

Analysis 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	
PM Peak Hour	Stanley Avenue & Dorchester Road / Chippawa Parkway	TWSC	LOS Delay V/C Q		F 268 1.50 220		**F** **268**		E 44 0.32 10		**E** **44**		A 4 0.13 3		**A** **4**		A 0 0.01 0		**A** **0**	
		TCS	LOS Delay V/C Q		C 22 0.80 90		**C** **22**		A 10 0.07 8		**A** **10**		C 21 0.78 75		**C** **21**		B 15 0.68 70		**B** **15**	**B** **19**
		RBT	LOS Delay V/C Q		A 7 0.50 7		**A** **7**		A 4 0.05 0		**A** **4**		A 5 0.33 4		**A** **5**		A 6 0.45 6		**A** **6**	**A** **6**
	Lyons Creek & Stanley Avenue	AWSC	LOS Delay V/C Q	C 16 0.46	D 32 0.79		**D** **26**		D 33 0.81		**D** **33**					B 15 0.39		D 31 0.80	**D** **26**	
		TCS	LOS Delay V/C Q	A 7 0.49 28	A 8 0.52 44		**A** **7**		A 8 0.51 43		**A** **8**					B 10 0.33 26		B 10 0.30 16	**B** **10**	**A** **9**
		RBT	LOS Delay V/C Q		A 7 0.54 8		**A** **7**		A 5 0.39 5		**A** **5**						A 8 0.58 10		**A** **8**	**A** **7**

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)

TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control

RBT - Roundabout

As **Figure 7.1** illustrates, there are four (4) planned crossings of the railway by collector (3) and arterial (1) roads within the Thundering Waters lands. It is not possible to avoid crossing the spur line given its prominent location within the development area and the roadway circulation and capacity needs of the Secondary Plan land uses. The crossings are also needed to:

- Accommodate future local bus service;
- Provide a reasonable level of connectivity within the development area for pedestrians, cyclists, and service vehicles; and
- Ensure flexibility for emergency vehicles in the event of road closures.

The Grade Crossing Standards[12] published by Transport Canada define the requirements for warning systems for public road-railway grade crossings. The standards specify that:

- A warning system without gates is required where:
  - The forecast cross-product (number of daily trains multiplied by the average annual daily traffic (AADT)) is 2,000 or more;
  - There is no sidewalk, path or trail and the railway design speed is more than 129 kilometres per hour;
  - There is a sidewalk, path or trail and the railway design speed is more than 81 kilometres per hour; or
  - The railway design speed is more than 25 kilometres per hour but less than the railway design speeds referred to above and
    - There are two or more lines of railway where railway equipment may pass each other; or
    - The distance between a Stop sign at an intersection and the nearest rail in the crossing surface is less than 30 metres; or
    - In the case of an intersection with a traffic signal, the distance between the stop line of the intersection and the nearest rail in the crossing surface is less than 60 metres, or where there is no stop line, the distance between the travelled way and the nearest rail in the crossing surface is less than 60 metres.
- A warning system with gates is required where:
  - The forecast cross-product is 50,000 or more;
  - There are two (2) or more lines (tracks) of railway where railway equipment may pass each other;
  - The railway design speed is more than 81 kilometres per hour;

[12] Transport Canada, Grade Crossing Standards, July 2014

- The distance between a Stop sign at an intersection and the nearest rail in the crossing surface is less than 30 metres; or
- In the case of an intersection with a traffic signal, the distance between the stop line of the intersection and the nearest rail in the crossing surface is less than 60 metres, or where there is no stop line, the distance between the travelled way and the nearest rail in the crossing surface is less than 60 metres.

While there are currently no specified thresholds in Canada to assess the need for a grade-separated crossing, many municipalities and road authorities consider a cross-product of 200,000 as an indicator that a grade separation may be warranted, subject to more detailed review.

On the basis of these criteria, it is unlikely that any of the road-rail crossings within the Thundering Waters lands will require grade separation given the low volume of rail traffic on the CP Rail Montrose Subdivision. The provision for gates should be maintained for all crossings, especially given the uncertainty in estimating traffic demands, the sensitive characteristics of adjacent land uses, the potential for pedestrian and cyclist traffic, and the alignment of the roadways. Detailed engineering studies should be undertaken to review the need for protected crossings with future planning applications, especially if traffic volumes and/or rail operations increase. Particular attention should be given to the crossing of the proposed east-west arterial with the rail line, given anticipated traffic volumes on the roadway, the angle of intersection, and the number of tracks.

The Grade Crossing Standards also define the warning system requirements for railway crossings of a sidewalk, path or trail. The document specifies that:

- A warning system is required where:
  - The sidewalk, path or trail is outside the island circuit of an adjacent warning system; and
  - The railway design speed is more than 81 kilometres per hour;
- A warning system with gates is required where:
  - The sidewalk, path or trail is outside the island circuit of an adjacent warning system;
  - The railway design speed is more than 25 kilometres per hour; and
  - There are two (2) or more lines (tracks) of railway.

These criteria suggest a warning system with gates will likely be required for the grade crossings of the pedestrian, cyclist and electric cart networks with the rail line, given the railway design speed and the number of tracks. Again, detailed engineering studies should be undertaken with future planning applications to confirm need and requirements.

7.2.5 Provincial Highways

The QEW is the only provincial highway facility (albeit major) within the Study Area. Ramp terminal volumes for the QEW interchanges at McLeod Road and Lyons Creek Road were developed with the traffic forecasts prepared in Section 6. Capacity analyses were completed at the intersections using Synchro 9 to assess operating conditions under all future total traffic scenarios (without and with the different potential watercourse crossings). The analyses, summarized in Section 6, illustrate that the intersections are forecast to operate at satisfactory levels of service under future traffic conditions with the proposed development.

The operation of the interchange ramps and the QEW mainline were not formally analyzed as the Ministry of Transportation declined to participate in the study. A cursory capacity review for the critical E to N ramp at McLeod Road was performed to assess potential implications with the development, specifically if the ramp could queue back and interfere with the operation of this well-travelled arterial road. The analyses suggest that the ramp would operate at a satisfactory level of service based on the design service flow rates set out in the Ministry of Transportation Geometric Design Standards for Ontario Highways[13] (Chapter B – Traffic and Capacity).

7.3 Guidelines and Policies

7.3.1 Road Design

The design of all new and expanded roads serving the Thundering Waters lands should conform to current practices and standards as per the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads[14], Ministry of Transportation Geometric Design Standards for Ontario Highways, and applicable City of Niagara Falls and Niagara Region engineering standards, policies and guidelines.

7.3.2 Traffic Control

The future need for traffic control signals was determined based on the results of the traffic operations analysis and reflects the long-term traffic demands anticipated as a result of full build-out of the Thundering Waters lands. It is estimated that up to seven (7) intersections within the Study Area will require traffic signal control by the year 2031, in conjunction with other geometric requirements including auxiliary turn lanes. Future intersections within the development area may also require signalization.

The actual need for traffic control signals and the approximate timing of installation at each location will be subject to future signal warrant

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[13] Ministry of Transportation, Ontario, Geometric Design Standards for Ontario Highways, Queen's Printer for Ontario, 1985

[14] Transportation Association of Canada, Geometric Design Guide for Canadian Roads, 1999

assessment in accordance with City of Niagara Falls and Niagara Region policies. The design details and timing for implementation of intersection traffic control and geometric improvements should be established as part of site-specific traffic assessment studies to be submitted in support of individual development applications.

7.3.3 Neighbourhood Traffic Management

Neighbourhood Traffic Management, of traffic calming, is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behaviour and improve conditions for non-motorized street users. Potential physical traffic calming measures include vertical (e.g. speed humps) and horizontal (e.g. curb extensions) deflections in the roadway, as well as obstructions (e.g. diverters) and traffic regulations (e.g. reduced speed limit).

Traffic calming is primarily used on residential local and collector streets within urban areas to restore the street to its intended function, which depends on its classification and the context of adjacent land uses. The use of traffic calming is generally oriented to: roadways that are identified as having a high potential for cut-through traffic; in areas adjacent to schools, parks and recreational facilities; and in areas where vulnerable roadway users could be negatively impacted by vehicular movements. The installation of traffic calming measures may be deemed necessary when street users and/or area residents consider traffic volumes, speeds or operational characteristics to be inappropriate for the type of adjacent land use and corresponding pedestrian, cyclist and other activities that occur along the street.

The City of Niagara Falls Speed Control Policy sets out guidelines for the application and selection of traffic calming measures on City streets. Consistent with this policy, traffic calming should be considered for use on roads within the Thundering Waters lands and the broader Study Area where suitable. Streets within the abutting residential communities to the north of the Thundering Waters lands may be future candidates for traffic calming measures and should be monitored through build-out of the Secondary Plan.

A Neighbourhood Traffic Management plan should be prepared to examine the need for traffic calming on roads within the subdivision, and identify potential measures and preferred placement if implementation is justified. The plan should ensure that the recommended measures are compatible with the community's needs and that any potential negative impacts are minimized.

Selection, design and implementation of site-specific traffic calming measures are context-sensitive and have to be carefully integrated into the transportation system. Inappropriate use could result in undermining the continuity and connectivity principles that have formed the basis of the roadway network for the Thundering Waters lands. It is important to note that the implementation of traffic calming measures along arterial or higher

volume collector roadways may impair its function as a carrier of moderate traffic volumes and interfere with the delivery of future transit service. Some traffic calming measures, such as speed humps, can also adversely impact cycling and other active transportation use.

The design and implementation of traffic calming measures should be based upon the guidelines contained in the TAC Canadian Guide to Neighbourhood Traffic Calming[15] and the City of Niagara Falls Speed Control Policy. Specific implementation requirements should be addressed as part of future detail design activities for the roads within the Thundering Waters lands.

7.3.4 Heavy Vehicle Traffic

Arterial and most collector roads within the Thundering Waters lands should be designed to accommodate heavy vehicle traffic and should not have restrictions or impediments to truck use. These roads should incorporate features to better facilitate truck use in their design and operation, such as larger corner radii.

The design of individual development sites must also accommodate safe and efficient access by heavy vehicles, while also ensuring such provisions do not adversely impact the opportunity to promote the use of more sustainable transportation modes. Proper driveway design and location, site circulation, placement of loading facilities and on-site operating procedures are key to achieving this objective.

Efficient truck access is important to the City's economy, but needs to be balanced with community livability objectives, especially in established and developing neighbourhoods. To provide for the safe and efficient movement of trucks through and within the Thundering Waters lands, and minimize the impact of heavy vehicles on residential areas, especially in the low and medium density residential neighbourhoods:

- Through truck traffic should be encouraged to use the arterial roadways;
- Collector roadways should only serve as connectors to arterial roadways, where facilities permit; and
- Truck traffic should be prohibited on local roadways, with the exception of deliveries and in the absence of alternative routes.

In some instances, the City may wish to restrict heavy truck usage on part or all of a municipal road through passage of a "No Heavy Truck" by-law, if warranted due to structural condition or community impact.

To discourage truck traffic in residential neighbourhoods, potential locations where trucks may cut through should be identified and possibly signed (and by-lawed) to prohibit through truck traffic and actively enforced by police.

[15] Transportation Association of Canada, Canadian Guide to Neighbourhood Traffic Calming, December 1998

Commercial developments should also be designed to place delivery and loading areas in locations accessible by arterial roadways, where possible. Additionally, developers/tenants should be encouraged to receive deliveries during off peak times (but not late at night) to limit impact to the road network during peak periods.

7.4 Implementation

7.4.1 Class EA Requirements

The process followed to develop the Thundering Waters Transportation Master Plan has intended to address the requirements of Phases 1 and 2 of the Municipal Class EA planning process by providing an assessment of existing problems and opportunities as well as presenting and evaluating a range of alternative transportation strategies. As a result of this study and the Secondary Plan process, a number of future infrastructure projects have been identified to accommodate the development of the Thundering Waters lands. **Table 7.4** summarizes the anticipated road works with a description of the anticipated scope, timing and proponent.

Recommended infrastructure projects categorized as Schedule C undertakings have greater potential for environmental impacts. These works require further project-specific studies to complete Phases 3 through 5 of the Municipal Class EA process, including additional points of public contact and submission of an Environmental Study Report.

7.4.2 Phasing of Development and Timing for Road Improvements

Development of the Thundering Waters lands is planned to be phased given the scale of the plan. Phasing will be dependent upon the coordinated implementation of the various municipal services (including transportation) and environmental initiatives planned to support the development.

From a transportation perspective, there are no immediate impediments to initiating the first phase of development, as illustrated in Section 7.4.3, other than upgrades to the existing roads servicing the Thundering Waters lands to provide safe and efficient access, as noted below. The road improvements identified in Section 3.3.3 should also be implemented to address existing capacity concerns.

Road improvements to support growth of the Thundering Waters lands should be implemented to coincide with the development build-out. In general, phasing of the transportation improvements should proceed as follows:

TABLE 7.4: ROADWAY IMPROVEMENT ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Project	Description	Schedule	Proponent and Timing
Dorchester Road (McLeod Road to Town Centre)	Study to determine ultimate roadway alignment, cross-section requirements and detailed intersection design.	Schedule C	To be completed by property owner prior to development.
Chippawa Parkway (East-West Arterial to Stanley Avenue)	Study to determine cross-section requirements and detailed intersection design, including consideration of roundabout at Stanley Avenue.	Schedule C	To be completed by property owner prior to development.
East-West Arterial (Dorchester Road to Chippawa Parkway)	Study to determine ultimate roadway alignment, cross-section requirements and detailed intersection design.	Schedule C	To be completed by property owner prior to development.
Chippawa Parkway (Dorchester Road to East-West Arterial)	Study to determine cross-section requirements and detailed intersection design, including consideration of roundabouts.	Schedule B	To be completed by property owner prior to development.
Ramsey Road (East-West Arterial to Stanley Avenue)	Study to determine cross-section requirements and detailed intersection design, including consideration of roundabouts.	Schedule B	To be completed by property owner prior to development.
Potential Watercourse Crossing (over OPG Canal or Welland River)	Study to determine ultimate roadway alignment, cross-section requirements and detailed intersection design.	Schedule C	To be completed by City or Region following initial phases of development, with timing dependent on monitoring.
Study Area Intersection Improvements	Study to determine cross-section requirements and detailed intersection design, including consideration of roundabouts where appropriate.	Schedule A+, B and C (depending on value)	To be completed by City or Region as required.
Collector and Local Roads	Planning and design of all other collector and local roadways is to be undertaken as part of the planning process through development agreements.	Schedule A+	Satisfied through future subdivision applications.

- Upgrade existing rural arterial roads (Dorchester Road and Chippawa Parkway) to appropriate standards (likely urban cross-section) as development occurs on adjacent lands;
- Expand intersections on the Study Area road network incrementally to accommodate the additional demand generated by the development;
- Implement the modified grid network of collector roads that are required to service the lands within the development area. These collector roads will be implemented with development in each phase; and
- Provide a watercourse crossing if insufficient residual capacity remains in the road network and future demand warrants.

Upgrades to the key intersections along McLeod Road are programmed by Niagara Region for construction within the next ten (10) years. It would be prudent to incorporate the additional turn lane requirements identified for these intersections into the Region's planned works to avoid additional disruption and throw-away costs in the future. The remaining intersection improvements identified in **Table 7.2** may be triggered when their v/c ratios and/or levels of service begin to exceed the critical thresholds set out in the Niagara Region and City of Niagara Falls Transportation Impact Study guidelines discussed in Section 3.3.1.

Other major network improvements, including the Marineland Parkway and Stanley Avenue jog elimination and the potential watercourse crossing, are not currently identified in the capital programs for the City or Region. Their implementation will occur as demand warrants and funding becomes available.

It is difficult to identify specific transportation phasing plans at this time given the myriad uncertainties pertaining to the development. For this reason, the need and implementation timing for the infrastructure improvements identified in this Transportation Master Plan should be phased and monitored as development progresses. This approach would allow development to proceed in the near term based on available capacity, while ensuring development does not outpace available roadway capacity. Section 7.4.4 outlines the proposed monitoring strategy.

7.4.3 Roadway Capacity Available to Serve Development

The roadway intersection capacity available to serve development of the Thundering Waters lands now and at the 2031 horizon year under different potential watercourse crossing scenarios was determined through an analysis of Intersection Capacity Utilization (ICU). The ICU explains how much reserve capacity is available or how much the intersection is overcapacity. The ICU performance measures are designed to be used in conjunction with delay-based methods, such as LOS, to illustrate overall intersection performance. Unlike those methods, the ICU does not predict

delay, but can be used to forecast how often an intersection will experience congestion.[16]

Table 7.5 provides the ICU rates for intersections located along the Study Area boundary roads, as calculated by Synchro. All scenarios assume that the intersection improvements noted in **Table 7.2** for that scenario are in place by the year 2031.

Intersections with an ICU greater than 90% (the value at which an intersection is considered to be approaching capacity based on this methodology) are highlighted in yellow. The table indicates that the McLeod Road and Drummond Road intersection is the only location currently exceeding/ approaching capacity. The table also shows that the intersections of McLeod Road with Oakwood Drive, Dorchester Road and Drummond Road are forecast to experience near to over capacity conditions in the future for some or all of the scenarios.

As similarly illustrated through previous analyses in this report, the weekday afternoon peak hour is the critical (worst case) time period for assessing intersection operations within the Study Area. The ICU values shown in the table imply that for the critical peak hour:

- Network capacity is available at this time, subject to improvements at the intersection of McLeod Road and Drummond Road, suggesting the development could proceed.
- The intersections of McLeod Road with Oakwood Drive, Dorchester Road and Drummond Road are forecast to exceed capacity by the year 2031 without a watercourse crossing, with Dorchester Road experiencing the highest ICU at 115%.
- Assuming traffic volumes grow at a constant rate, **Table 7.6** illustrates that the McLeod Road and Dorchester Road intersection would exceed capacity in the year 2021. This infers that approximately 38% of the Thundering Waters development could proceed before the capacity threshold is reached, assuming the necessary road infrastructure improvements are provided.

[16] Husch, D. and Albeck, J., Intersection Capacity Utilization Evaluation Procedures for Intersections and Interchanges, 2003 Edition, Trafficware, Albany, CA, August 2003

FIGURE 7.5: INTERSECTION CAPACITY UTILIZATION (ICU) BY ROAD CORRIDOR

Intersection		Weekday AM Peak Hour					Weekday PM Peak Hour					Saturday Midday Peak Hour				
		Existing	Future Backg'd	Future Total	Future Total with OPG Canal Crossing	Future Total with Welland River Crossing	Existing	Future Backg'd	Future Total	Future Total with OPG Canal Crossing	Future Total with Welland River Crossing	Existing	Future Backg'd	Future Total	Future Total with OPG Canal Crossing	Future Total with Welland River Crossing
McLeod	Montrose	54%	57%	64%	60%	64%	74%	73%	79%	80%	79%	71%	71%	82%	75%	82%
	QEW EB Off-Ramp	42%	46%	57%	52%	55%	65%	67%	79%	73%	75%	47%	58%	69%	65%	70%
	QEW WB Off-Ramp	36%	34%	44%	36%	38%	47%	44%	60%	47%	50%	39%	46%	59%	50%	54%
	Oakwood	49%	52%	64%	55%	59%	68%	72%	95%	78%	83%	73%	66%	85%	71%	80%
	Dorchester	53%	53%	78%	60%	74%	74%	77%	115%	90%	99%	87%	81%	114%	88%	102%
	Drummond	59%	51%	73%	65%	66%	95%	71%	112%	91%	98%	86%	66%	98%	86%	91%
	Stanley	32%	46%	55%	52%	46%	44%	57%	78%	74%	74%	46%	60%	70%	68%	59%
Montrose	Niagara Square	20%	20%	20%	23%	20%	21%	23%	25%	33%	24%	20%	23%	24%	30%	23%
	Chippawa Creek	26%	29%	30%	42%	31%	30%	37%	39%	52%	39%	23%	31%	33%	47%	33%
	Oakwood	27%	45%	45%	52%	45%	39%	65%	65%	70%	66%	43%	53%	53%	63%	53%
	Lyons Creek	54%	61%	62%	66%	62%	64%	80%	81%	89%	81%	44%	60%	61%	75%	61%
Lyons Creek	QEW EB Off-Ramp	20%	26%	37%	37%	44%	25%	34%	43%	49%	50%	27%	30%	42%	47%	52%
	QEW WB Off-Ramp	30%	40%	49%	45%	52%	43%	48%	58%	53%	62%	19%	23%	33%	32%	38%
	Stanley	39%	45%	74%	68%	56%	32%	47%	76%	68%	56%	33%	40%	76%	70%	55%
Stanley	Ramsay	21%	23%	55%	35%	29%	25%	28%	69%	44%	38%	22%	28%	67%	38%	35%
	Progress	34%	37%	60%	54%	50%	40%	44%	62%	60%	57%	23%	25%	38%	35%	33%
	Don Murie	31%	34%	61%	55%	51%	39%	45%	65%	63%	60%	24%	26%	39%	36%	34%
	Chippawa	28%	32%	108%	91%	70%	29%	32%	136%	118%	92%	31%	35%	121%	104%	77%

FIGURE 7.6: INTERSECTION CAPACITY UTILIZATION (ICU) FOR MCLEOD ROAD AND DORCHESTER ROAD OVER TIME

Year	Cumulative Growth	ICU
2015		74.2%
2016	6.3%	76.7%
2017	12.5%	79.3%
2018	18.8%	81.8%
2019	25.0%	84.4%
2020	31.3%	86.9%
2021	37.5%	89.5%
2022	43.8%	92.0%
2023	50.0%	94.6%
2024	56.3%	97.1%
2025	62.5%	99.6%
2026	68.8%	102.2%
2027	75.0%	104.7%
2028	81.3%	107.3%
2029	87.5%	109.8%
2030	93.8%	112.4%
2031	100.0%	114.9%

7.4.4 Monitoring Program

The analyses presented in this report indicate that the traffic demands generated by the proposed development may not be fully mitigatable through expansion of existing roads and intersections. The provision of a crossing over the OPG Canal or Welland River is an option being considered to address this concern. The need and timing of this potential improvement is difficult to predict given the uncertainty around: development phasing; travel behaviour assumptions (i.e. mode choice, internal capture, trip distribution); timing of identified, planned infrastructure improvements; and other development activity in the area.

Given this uncertainty, a transportation monitoring program should be initiated to track development levels and trends, and associated travel characteristics over time. Establishing a plan monitoring framework recognizes that a Transportation Master Plan is a “living” document and must be adaptable to changes in land use development patterns, travel behaviour, policy direction and other conditions in the City.

The monitoring program would examine:

- Traffic volumes on major streets and at key intersections, based on periodic traffic counts in the area;
- Travel characteristics of employees, residents and visitors, including vehicle occupancy, modal split, trip distribution and peak hours of travel;
- Traffic volumes and transit ridership in the context of available capacity;
- Existing, planned and proposed development;
- Traffic infiltration in adjacent residential areas; and
- The results of Transportation Demand Management measures and the extent to which the objectives of the Thundering Waters Transportation Master Plan are being achieved.

The findings of the transportation monitoring program will be used primarily to gauge the need for and timing of major infrastructure improvements, in particular the potential watercourse crossing. The program may also identify future development constraints that must be addressed. In addition, the information from the program would:

- Form the basis of transportation studies submitted in support of future development applications; and;
- Be referenced in the development of local neighbourhood traffic management plans, if required.

The preparation of Transportation Impact Studies in support of future planning applications is another component of the monitoring program. These studies should:

- Identify pedestrian and cycling opportunities with regard to policy, guidelines and other requirements;
- Assess the impact of the development on the transportation system and demonstrate that site-related traffic will not contribute to significantly reducing the level of service of the road network;
- Identify, consider and evaluate transportation improvements or mitigating measures to address transportation impacts; and
- Identify, consider and evaluate measures to assist in reducing vehicular trips.

8 Other Plan Elements

8.1 Transit Plan

The implementation of an efficient and accessible bus transit system is critical to the success of the Thundering Waters development. Achieving higher transit mode shares diminishes road construction needs, encourages greater use of active transportation modes (to access bus service) and reduces reliance on the automobile for personal travel.

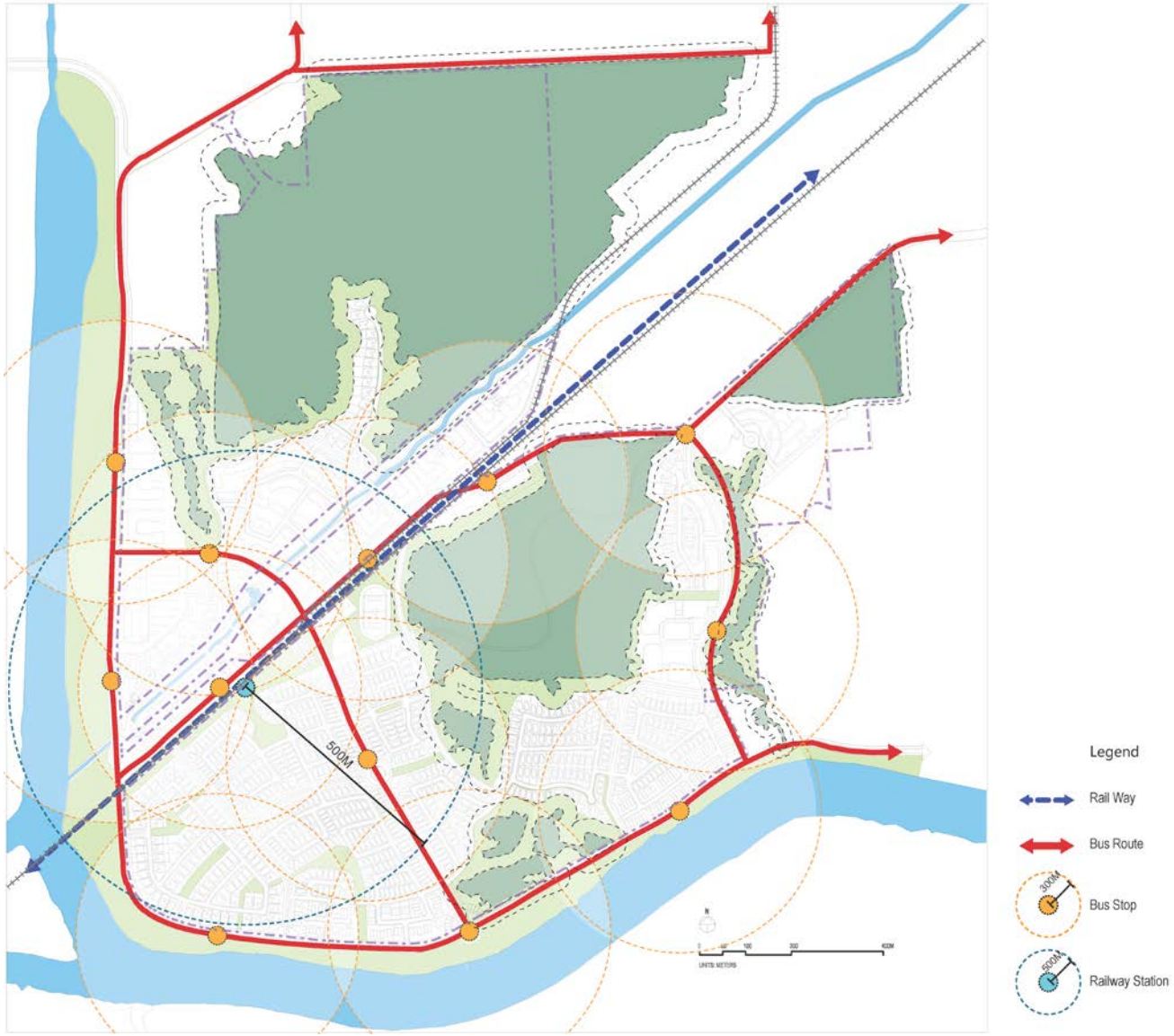
Figure 8.1 illustrates the conceptual transit plan for the Thundering Waters lands. The proposed plan provides the basis for an efficient internal transit network that utilizes the proposed modified grid pattern of arterial and collector roadways to support the extension of existing and future transit service to the development area. The plan contemplates buses operating in mixed traffic, with no dedicated transit or high-occupancy vehicle lanes proposed. Service would likely begin through the extension of Niagara Falls Transit Route 103 initially, then by rerouting Routes 101, 111 and 112 into the Thundering Waters lands. Regional and inter-regional (GO Transit) bus service to the development area could follow, depending on demand and travel patterns.

The plan has been designed based on the goal of providing sustainable and efficient transit access to key nodes within the Thundering Waters lands, particularly the Town Centre and the Future Transit Stop/Train Station. Development of the transit hub would better facilitate possible future connections with local, regional and inter-regional bus services, thereby providing efficient and direct service to the Thundering Waters lands from a broad range of locations. The plan also provides a density of route coverage that places most properties within 300 metres of a bus stop.

While most transit service within the area is likely to be provided through extensions of existing and future bus routes, a separate local/community service may also be a viable option, subject to potential ridership.

8.2 Walking and Cycling Networks

Thundering Waters presents an opportunity to design and implement a walking and cycling-friendly community through the careful planning and integration of existing external facilities, similar to the proposed approach for the roadway network and transit services. Walking and cycling are key indicators of a community's liveability. A community that promotes and encourages waking and cycling through relevant and progressive land use and application of supportive transportation and environmental policies can expect an enhanced quality of life for residents. A community's liveability also has a profound impact on attracting business and tourism.



Source: City of Niagara Falls Riverfront Community Master Plan, RTKL

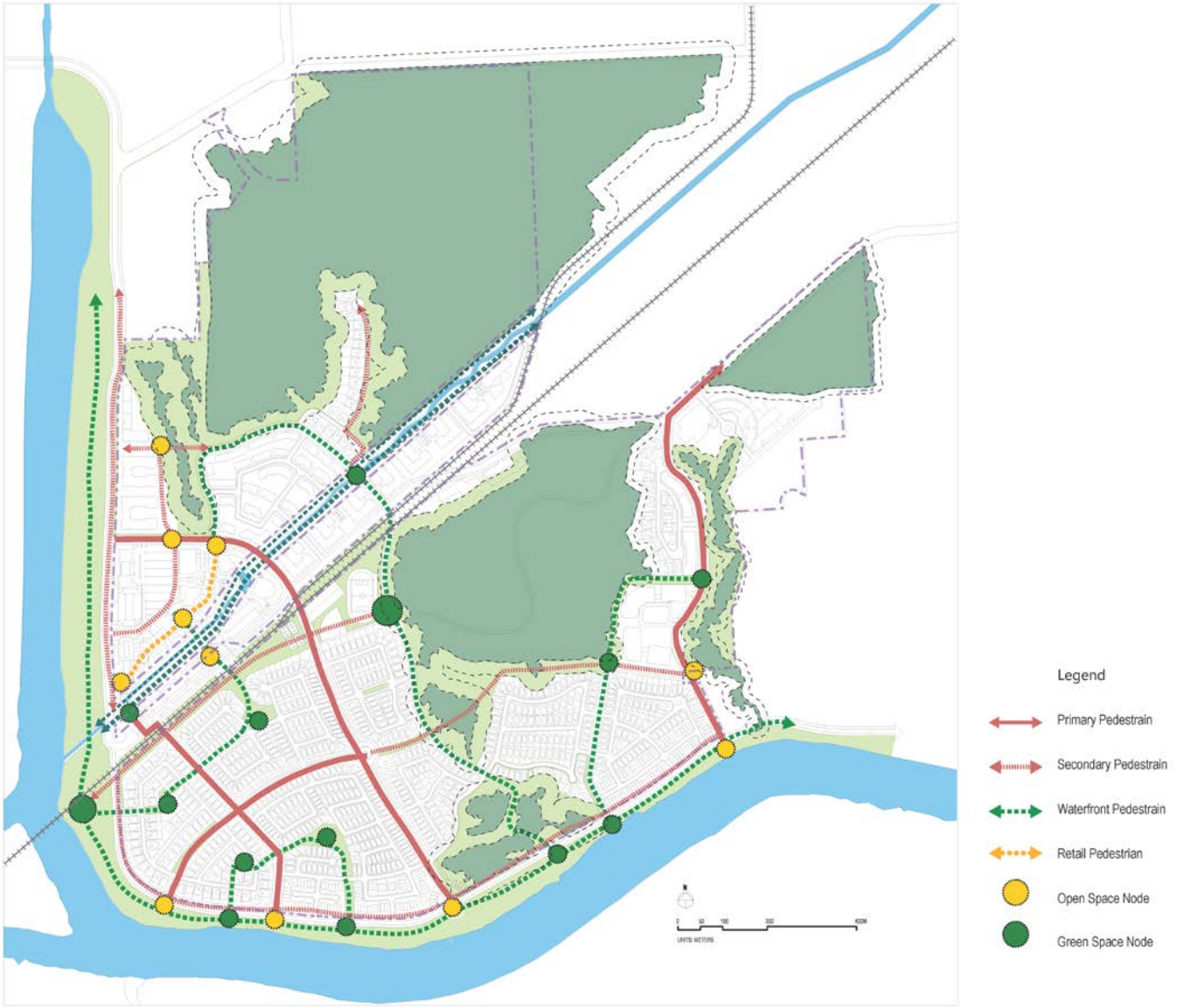
Conceptual Transit Plan

The key objectives of the pedestrian and cycling strategy for the Thundering Waters lands are to:

- Promote integrated pedestrian and cycling facilities as a sustainable alternative to vehicular transportation;
- Accommodate cyclists with differing cycling skills and attitudes towards motorized traffic and different trip purposes;
- Establish a seamless, interconnected active transportation network that extends and links to existing and planned municipal pedestrian and cycling facilities, in particular the Millennium Trail, helping to serve destinations both within the Thundering Waters lands and other areas of the City;
- Facilitate the formation of an Active and Safe Routes to School program through the provision of direct and connected active transportation routes;
- Provide safe crossings of major roads and the rail line within the development area;
- Enable safe, efficient and comfortable connections to transit;
- Promote safe walking and cycling by providing well-designed facilities and adhering to applicable legislation.

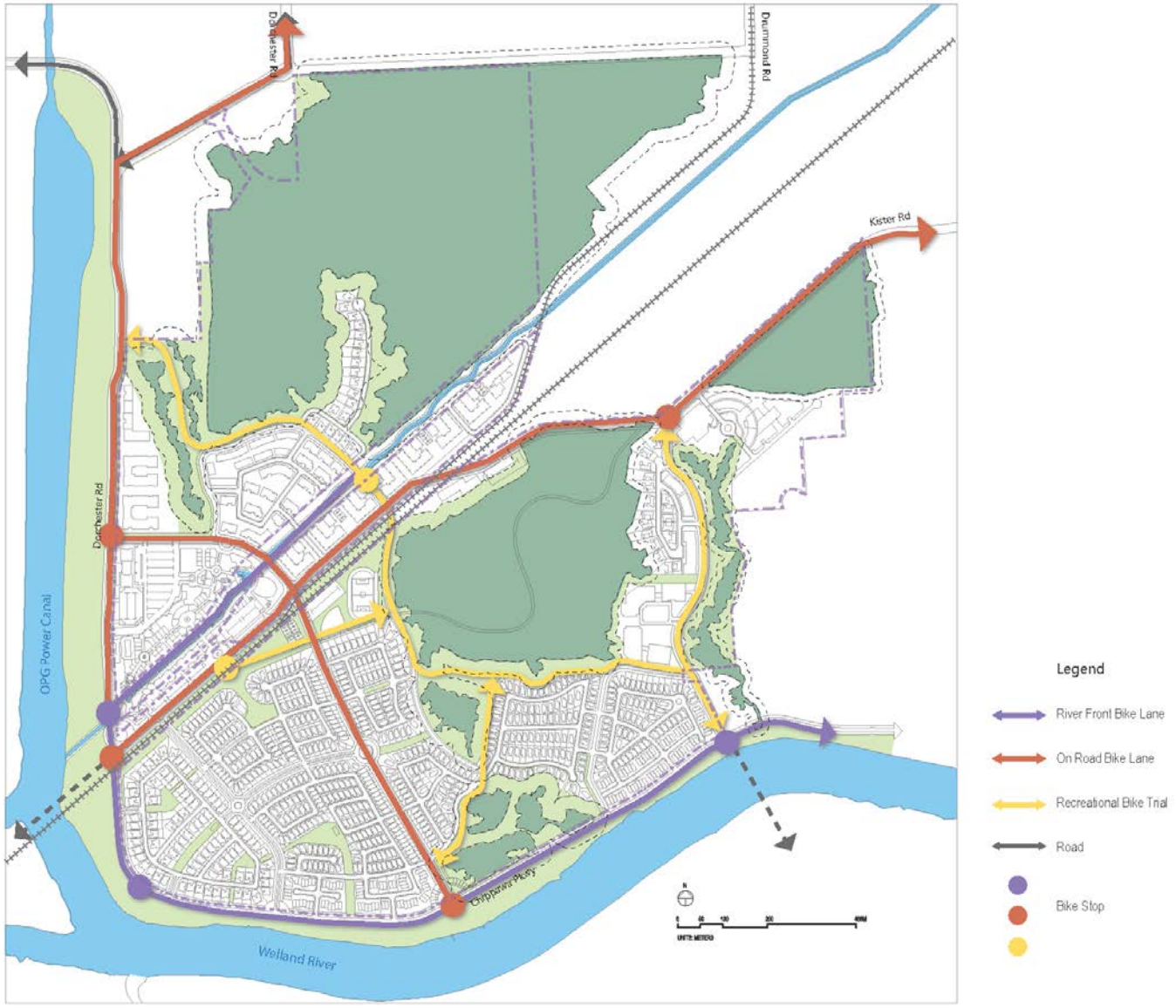
Building on these objectives, **Figures 8.2** and **8.3** illustrate the conceptual pedestrian circulation and cycling plans, respectively, for the Thundering Waters lands. The proposed plans provide the basis for a comprehensive active transportation network for the development area. Both plans rely on the proposed modified grid pattern of arterial and collector roadways to provide the framework for their networks of routes. Collector roadways are the preferred location for bike lanes as these roads generally carry lower traffic volumes at slower speeds than arterials and provide direct property access to residential land uses.

The active transportation strategy will evolve as development occurs, given that the Thundering Waters lands are predominately vacant currently with no existing walking or cycling infrastructure. The nearest signed cycling routes are located on Drummond Road, north of Hawkins Street/Village Crescent (just north of McLeod Road), and Oakwood Drive south of McLeod Road. The Millennium Trail starts north of McLeod Road at Oakwood Drive. The Niagara Falls Sustainable Transportation Master Plan outlines future extensions of both the on- and off-road active transportation networks in the vicinity, which will be implemented over time.



Source: City of Niagara Falls Riverfront Community Master Plan, RTKL

Conceptual Pedestrian Circulation Plan



Source: City of Niagara Falls Riverfront Community Master Plan, RTKL

Conceptual Cycling Plan

8.3 Electric Cart Circulation Plan

The Thundering Waters development is taking a somewhat unique approach in Canada to encouraging sustainable travel behaviour for individuals who choose to live, work, recreate and shop within their community. A separate network for electric carts, also known as Low-Speed Vehicles (LSVs) or Neighbourhood Electric Vehicles (NEVs), is being proposed for the development area. Electric carts have proven to be a clean, non-polluting and efficient form of transportation in many active communities across North America, and effective in serving shorter distance trips not conducive to walking for individuals not wishing to cycle.

Figure 8.4 illustrates the conceptual electric cart circulation plan recommended for the development area. The proposed network parallels the proposed modified grid pattern of arterial and collector roads, similar to the active transportation network shown in **Figures 8.2** and **8.3**. The carts will operate in a separate corridor in light of Provincial legislation and City regulations pertaining to their use. LSVs are not permitted to operate on public roads in Ontario, but can be used on private property/roads and on sidewalks/trails where permitted by municipal by-law. The City of Niagara Falls Parks By-law prohibits motor vehicles on lands owned by the City for park purposes, which includes trails. An electric cart would be considered a motor vehicle based on the definition in this by-law.

The electric cart network will evolve as development occurs and be coordinated with other infrastructure provision. Design guidelines specific to this mode will be developed to guide implementation. The guidelines will address facility design, parking requirements and operating provisions.

8.4 Transportation Demand Management Strategy

Transportation Demand Management (TDM) uses policies, programs, services and products to influence whether, why, when, where and how people travel. TDM measures help shape the economic and social factors behind personal travel decisions. Many TDM actions are intended to encourage the use of sustainable modes of transportation and minimize single-occupant vehicle trips as part of an overall community transportation management strategy.

The following TDM policies and guidelines should be considered as part of all future development projects within the Thundering Waters lands and are considered appropriate for residential (in particular multiple residential uses), commercial (retail and service commercial uses) and employment (employment and institutional uses) developments. Applicable TDM measures can be categorized by four (4) types of strategies that can be used to promote walking, cycling, transit and car sharing/carpooling:

Source: City of Niagara Falls Riverfront Community Master Plan, RTKL

Conceptual Electric Cart Circulation Plan

- Site Organization involves designing the site in a way that gives higher priority to sustainable modes of transportation over single-occupant vehicles. Design opportunities include building placement, building entrance locations, location of parking facilities and parking supply. These strategies are typically decided at the beginning of the site design process.
- Site Layout includes the internal transportation network of the site, parking facility layout for vehicles and bicycles, location of transit facilities and location of pick-up/drop-off areas. All efforts should be made to minimize conflict potential in attempts to ensure safe operations for all modes of transportation. Factors to consider include size, type, capacity and orientation of parking facilities.
- Site Infrastructure should be designed in a manner that places higher priority on sustainable modes of transportation versus the single-occupant vehicle. These aspects may be altered after the site is constructed, although emphasis should be placed on site infrastructure during the design phase.
- Site Amenities can impact a user's decision regarding sustainable transportation. Provision of end-of-trip facilities such as bicycle racks, showers, change rooms, transit shelters and street furniture can contribute to the traveller feeling safe and comfortable in their mode choice and may have a significant impact on their future transportation choices. The majority of amenities can be added after site completion but should be considered as part of the design phase.

Table 8.1 outlines a range of TDM strategies and identifies the applicability of each potential measure.

TABLE 8.1: POTENTIAL TRANSPORTATION DEMAND MANAGEMENT STRATEGIES

TDM Strategy		Land Use		
		Residential	Commercial	Employment
Exterior Design	Provide a clearly visible "way-finding system" which provides direction to everyone including persons with impairment of one or more senses. Features may include textured surfaces, coloured lines and patters, lights, raised letters, large lettering and other clearly understandable directional cues.	✓	✓	✓
	Locate signs indicating entrances, amenities such as showers, lockers, transit stations/stops and transportation information kiosk strategically throughout the site.		✓	✓
	Provide signs indicating clear direction from transit to public facilities and service centres.	✓	✓	✓
	Unbundle parking costs from multifamily residential units at the time of purchase or rental.	✓		
Interior Design	Provide adequate signage and wayfinding at main entrances to all facilities or amenities such as showers, lockers, information/transit ticket purchase service.			✓
	Provide a permanent TDM booth at main entrances of all buildings and facilities to display transportation information including a monitor with transit schedules for the nearest transit station/ stop.	✓		✓
	Provide for direct access to transit facilities from the lobby of major buildings located along a transit route.	✓	✓	✓
Carpool	Promote carpooling initiatives and investigate partnerships with private ride-matching services.			✓
	Locate carpool parking stalls near the main entrance of the building.			✓
	Provide ample carpool stalls to meet or exceed requirements.			✓
	Clearly mark carpool parking stalls as reserved for carpool vehicles.			✓
	Direct carpoolers to reserved areas through the use of clear and intuitive signage.			✓
Walking	Provide the most direct, convenient and shortest connections from buildings to public sidewalks, to off-site pedestrian paths, and to transit stops as well as direct connections between buildings on-site. Ensure sidewalks are paved and maintained in winter.	✓	✓	✓
	Ensure main entrances of new buildings front directly onto, and are clearly visible from, the public street.	✓	✓	✓

TABLE 8.1: POTENTIAL TRANSPORTATION DEMAND MANAGEMENT STRATEGIES

TDM Strategy		Land Use		
		Residential	Commercial	Employment
	Ensure pedestrian circulation is well-defined with safe and convenient connections to parking areas (both auto and bike parking) and off-site pedestrian facilities, and that pedestrian specific lighting is provided onto sidewalks and pathways.	✓	✓	✓
	Ensure sidewalks are continuous and barrier-free with at least 2.0 metres wide to accommodate simultaneous passage of a pedestrian and a wheelchair.	✓	✓	✓
	Construct multi-use pathways 3.0 to 4.5 metres in width with 1.0 metre "clear zones" on either side.	✓	✓	✓
	Design sidewalks and pathways to ensure personal security and safety through adequate lighting, unobstructed sign lines and provision of at-grade facilities.	✓	✓	✓
Transit	Ensure that transit services are provided to new development at an early stage, with support from developer funding.	✓	✓	✓
	Promote awareness of available transit services.	✓	✓	✓
	Develop and encourage the use of employer transit pass programs.			✓
	Develop and encourage the use of a flexible transit pass program for students.	✓	✓	
	Provide covered shelters at transit stations and key bus stop locations which include adequate seating and lighting.		✓	✓