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REPORT

City of Welland

Northwest Welland Secondary Plan Transportation Assessment Preferred Plan



MAY 2020

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1 INTRODUCTION

The intended function of this report is to document the assessment of the transportation facilities within the proposed development area referred to as the Northwest Welland Secondary Plan situated within the City of Welland’s rural boundary. Because of the development of the area, it is understood that the City’s urban boundary will be expanded to include these development lands.

1.1 Development Context

The Northwest Welland Secondary Plan is a proposed mixed-use residential development that will provide housing for full-time residents within the City of Welland. The development area will be a community marked by sustainable transportation infrastructure through the implementation of sidewalks, cycling facilities, and/or multi-use pathways creating a unified and integrated network for all modes of transportation. The development area is comprised of approximately 190 hectares of primarily rural/agricultural designated lands. Within the project limits, there are approximately 55 hectares (or 29% of the area) of land presently developed and municipally serviced.

Situated within the northwest quadrant of the City of Welland in a currently zoned rural area, **Figure 1-1** illustrates the location plan of the Northwest Welland Secondary Plan. Situated to the east of the development lands, Highway 406 is accessed via Regional Road 37 (Merritt Road), Regional Road 50 (Niagara Street/Merrittville Highway), and Quaker Road. Traversing east-west to the south of the development lands is Regional Road 51 (Woodlawn Road) while Regional Road 36 (Pelham Road) traverses north-south and is located to the west of the development lands.

While single-detached residential is the predominant existing populated land use within the development lands, there are other land uses including, but not necessarily limited to: agricultural and fallow land, institutional land (Niagara Catholic District School Board, École Élémentaire Nouvel Horizon, etc.), open space and recreational land (former Welland Soccer Club), wetlands, and wooded areas. Of these non-residential land uses, agricultural lands and wooded areas are the most dominant.

Adjacent to the Northwest Welland Secondary Plan development lands, the surrounding area is comprised of single-detached residential, agricultural and fallow lands, institutional (Niagara College), open space and recreational land, and commercial. Lands to the immediate north are located within the urban boundary of the Town of Pelham (including the recent East Fonthill Secondary Plan) and City of Thorold (including the proposed Port Robinson West Secondary Plan). The East Fonthill Secondary Plan and Port Robinson West Secondary Plan are discussed further in the following section of this report.

1.2 Development Lands and Study Area

The proposed development lands are in the northwest quadrant of the City of Welland, bounded to the north by the City of Welland’s municipal limits, to the west by Line Avenue/Clare Avenue, and to the east by the rear property line of those properties fronting onto Regional Road 50 (Niagara Street). The boundary of the development lands to the south is more complex which is bounded immediately north of Briarsdale Crescent, Northwood Drive, Ash Court, and the Seneca Trail before jogging to the north avoiding Rollins Drive up to Quaker Road where it continues east. **Figure 1-2** illustrates the approximate location of the boundary of the development lands alongside the arterial and collector roadways within the limits.

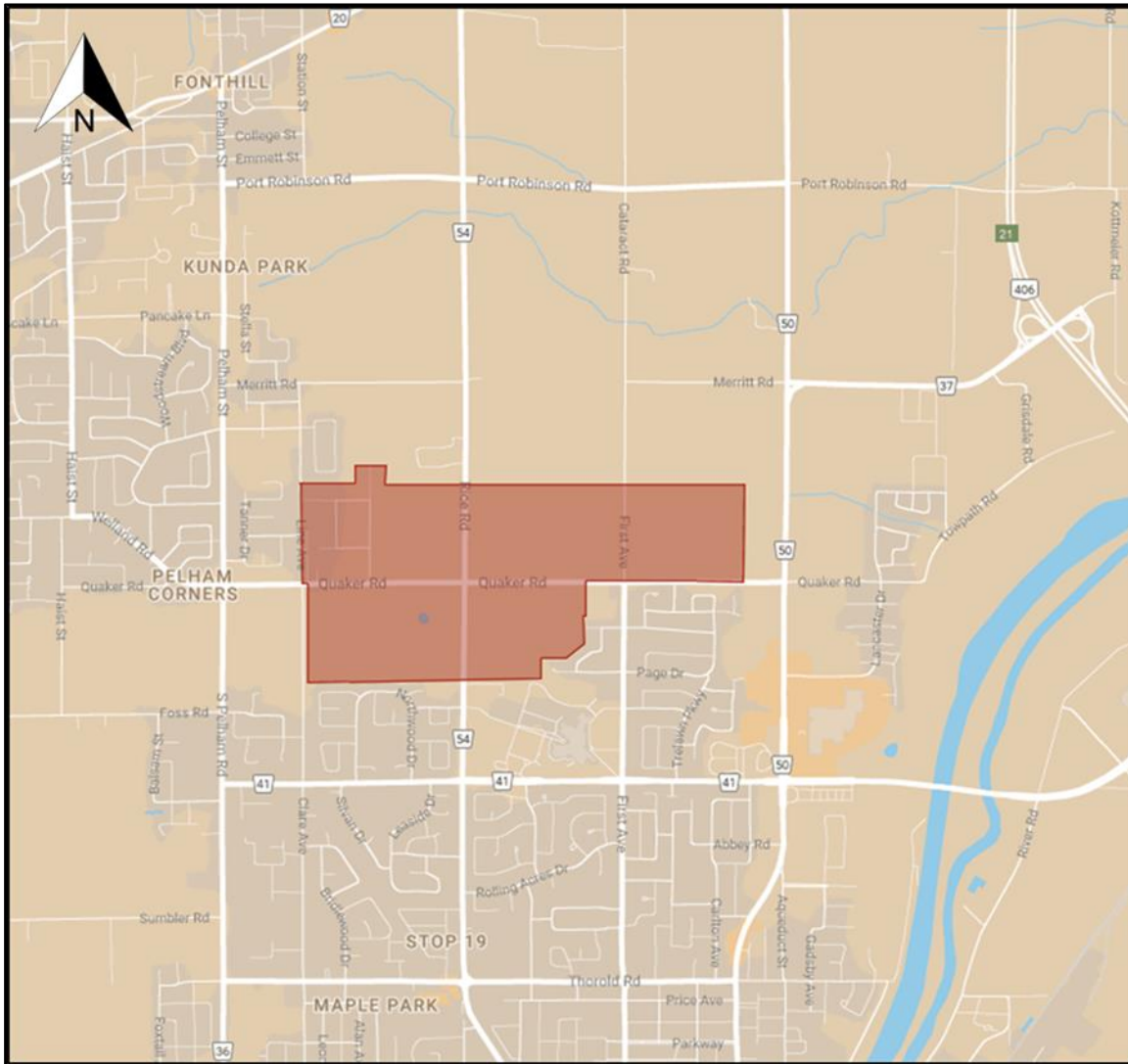


Figure 1-1: Northwest Welland Secondary Plan Location Plan

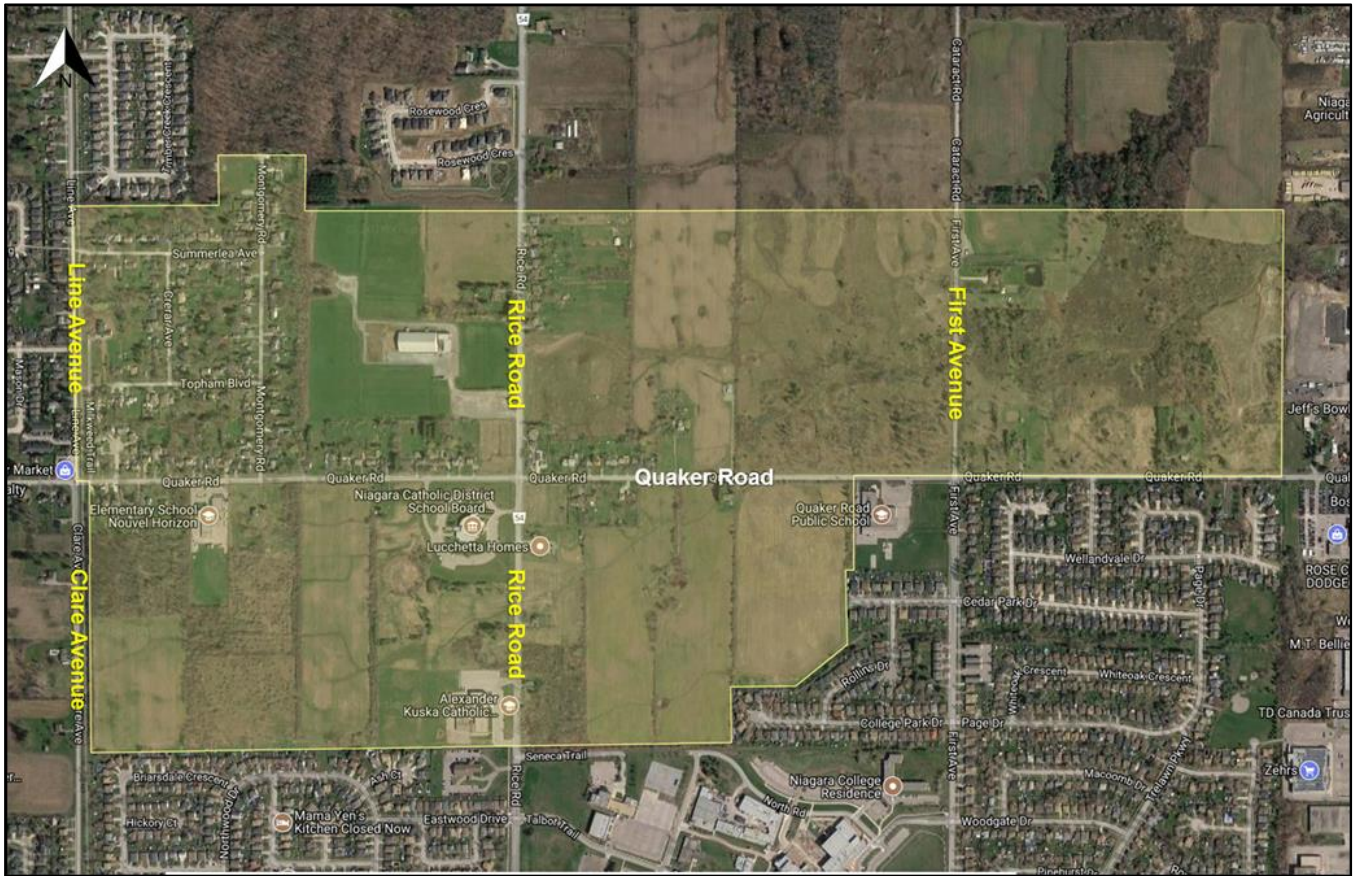


Figure 1-2: Northwest Welland Secondary Plan Development Limits

1.3 Objectives and Transportation Assessment

To effectively understand the existing and proposed state of the transportation infrastructure within the Northwest Welland Secondary Plan development lands, the following objectives are set forth for the transportation assessment documented within this report:

Base Year (2018), Background Traffic Conditions

- Collect and analyze eight (8) hour turning movement counts (TMCs) and twenty-four (24) hour automated traffic recorder (ATR) data including traffic volume, vehicle classification, and observed speed for the intersections and midblock roadway sections within the study area during the weekday morning (AM) and afternoon (PM) peak hours;
- Assess traffic operations during the base year (2018) for background traffic volumes to set a benchmark for comparison to the anticipated level of service for future years before and after the full-build out of the development lands; and

- Undertake a detailed field investigation to document and review existing conditions in terms of roadway geometry, roadway cross-section, intersection control, and presence of active transportation facilities, and transit service.

Horizon Year (2031), Background Traffic Conditions

- Project base year (2018) background traffic volumes to horizon year (2031) background traffic volumes based on projected traffic conditions on key roads within the study area

Horizon Year (2031), Development Traffic Conditions

- Determine the trip generation and trip attraction with regards to the proposed land use(s) using the Institute of Transportation Engineers Trip General Manual; and
- Determine the trip distribution of the development traffic volumes based on directional splits in the 2031 background traffic data and existing travel patterns derived from the eight (8) hour TMCs for the study area intersections.

Horizon Year (2031), Total Traffic Conditions

- Assess traffic operations during the horizon year (2031) for total traffic volumes (background plus development) and compare to the horizon year (2031) background traffic conditions to identify changes to the level of service experienced because of development-related growth within the area; and
- Assess the capabilities of the existing transportation infrastructure to accommodate all types of road users ranging from the increased vehicular volume at intersections as well as how the traffic accesses the existing road network to the presence of pedestrians and cyclists because of the sustainability-focused design of the development lands.

2 EXISTING TRANSPORTATION INFRASTRUCTURE

The following section documents the state of the existing multi-modal transportation infrastructure within the study area and assesses the performance of the subject intersections through the utilization of the existing traffic data and traffic modelling software. Furthermore, the following subsections describe and discuss the existing transportation network.

2.1 Roadway Classification

Within the development lands, the major existing roadways are Quaker Road, Regional Road 54 (Rice Road), and First Avenue. Immediately outside of the western boundary of the study area is Line Avenue/Clare Avenue. Each of the three north-south roadways (Rice Road, First Avenue, Clare Avenue) intersects Quaker Road at a four-legged intersection. It is noted that Line Avenue/Clare Avenue is marginally offset between the north and south approaches.

The twenty-four (24) hour ATR data provided by the Regional Municipality of Niagara and the City of Welland was used to determine the roadway classifications per the Transportation Association of Canada's Geometric Design Guide for Canadian Roadways, 2017. **Table 2-1** summarizes the traffic volume and resulting roadway classification based on the average annual daily traffic (AADT) volumes.

Table 2-1: Existing Roadway Classification

Roadway	From/To Roadways	Year	AADT	Classification
Quaker Road	Line Avenue/Clare Avenue to Regional Road 54 (Rice Road)	2017	6,000	Rural Arterial
Quaker Road	First Avenue to Regional Road 50 (Niagara Street)	2017	9,100	Rural Arterial
Regional Road 54 (Rice Road)	Port Robinson Road to Quaker Road	2016	7,500	Rural Arterial
Regional Road 54 (Rice Road)	Quaker Road to Regional Road 41 (Woodlawn Road)	2016	7,700	Rural Arterial
First Avenue	Regional Road 37 (Merritt Road) to Quaker Road	2017	3,400	Rural Collector
First Avenue	Quaker Road to Regional Road 41 (Woodlawn Road)	2017	6,000	Urban Collector

Two (2) major regional roadways are located to the west and east of the study area: Regional Road 36 (Pelham Street) and Regional Road 50 (Niagara Street). Regional Road 36 (Pelham Street) is an arterial roadway that has an approximate AADT volume of 12,000 to 13,000 vehicles per day, while Regional Road 50 (Niagara Street) is an arterial roadway that has an approximate AADT volume of 15,000 to 18,000 vehicles per day. Line Avenue/Clare Avenue carries approximately 2,400 vehicles per day and would be considered a rural collector. Given their proximity to the development lands, traffic data was assessed since they are roadways likely to be impacted by the development traffic.

2.2 Roadway Cross-Section and Intersection Control

Within the study development lands, there are three (3) primary roadways that will be impacted because of the additional traffic generated by the Northwest Welland Secondary Plan: Quaker Road, Regional Road 54 (Rice Road), and First Avenue.

Quaker Road is currently a two-lane roadway comprised of a rural cross-section bisecting east-west through the middle of the study area. **Figure 2-1** illustrates the typical roadway cross-section throughout the corridor. As per the traffic data, Quaker Road operates as a rural arterial roadway with traffic volumes in the range of 6,000 to 9,000 vehicles per day. From west to east, Quaker Road intersects with Regional Road 36 (Pelham Street) under traffic signal control, Line Avenue/Clare Avenue under all-way stop control, Regional Road 54 (Rice Road) under all-way stop control, First Avenue under all-way stop control, and Regional Road 50 (Niagara Street) under traffic signal control. All minor intersections along this corridor operate under stop control for the minor roadway approaches only. Under existing conditions, Quaker Road operates with a posted regulatory speed limit of 50 kilometres per hour except for the school zones where School Zone Maximum Speed When Flashing signs are present, reducing the speed to 40 kilometres per hour. In general, Quaker Road has a relatively straight and flat alignment within the study area.



Figure 2-1: Quaker Road Cross-Section (View to West at Montgomery Avenue)

Regional Road 54 (Rice Road) is currently a two-lane roadway comprised of a rural cross-section traversing north-south through the study area. **Figure 2-2** illustrates the typical roadway cross-section throughout the corridor. As per the traffic data, Regional Road 54 (Rice Road) operates as a rural arterial roadway with traffic volumes in the range of 7,500 to 7,700 vehicles per day. Under existing conditions, Regional Road 54 (Rice Road) operates with a posted regulatory speed limit of 50 kilometres per hour and 40 kilometres per hour to the north and south of Quaker Road, respectively. In general, Regional Road 54 (Rice Road) has a relatively straight and flat alignment within the study area.



Figure 2-2: Regional Road 54 (Rice Road) Cross-Section (View to South at Quaker Road)

First Avenue is currently a two-lane roadway comprised of a rural cross-section (north of Quaker Road) and an urban cross-section (south of Quaker Road) traversing north-south through the study area. It is noted that only the section of First Avenue north of Quaker Road is situated within the study area. **Figure 2-3** illustrates the typical roadway cross-section throughout the corridor. As per the traffic data, First Avenue (north of Quaker Road) operates as a rural collector roadway with traffic volumes of approximately 3,400 vehicles per day. First Avenue (south of Quaker Road) operates as an urban collector roadway with traffic volumes of approximately 6,000 vehicles per day. Under existing conditions, First Avenue operates with a posted regulatory speed limit of 50 kilometres per hour. In general, First Avenue has a relatively straight and flat alignment within the study area.



Figure 2-3: First Avenue Cross-Section (View to North Near Quaker Road)

As previously indicated, the intersections of Quaker Road with Regional Road 54 (Rice Road) and First Avenue currently operate under all-way stop control. All other minor roadways within the development lands operate under stop control along the minor roadway. The signalized intersections of Quaker Road with Regional Road 36 (Pelham Street) and Regional Road 50 (Niagara Street) were included in the scope of this assessment due to their proximity to the development lands and likelihood that they will provide a link to the arterial road network. The intersection of Regional Road 50 (Niagara Street/Merrittville Highway) and Regional Road 37 (Merritt Road) is also signalized and included because of its strategic importance as a gateway intersection from Highway 406 into the northwest quadrant of Welland. **Figure 2-4** illustrates the intersection control at the subject intersections within and around the development lands. Eight (8) hour TMCs and traffic signal phasing and timing plans (as applicable) were requested for each of these intersections.

Refer to **Appendix A** for the traffic data collected as part of this study.

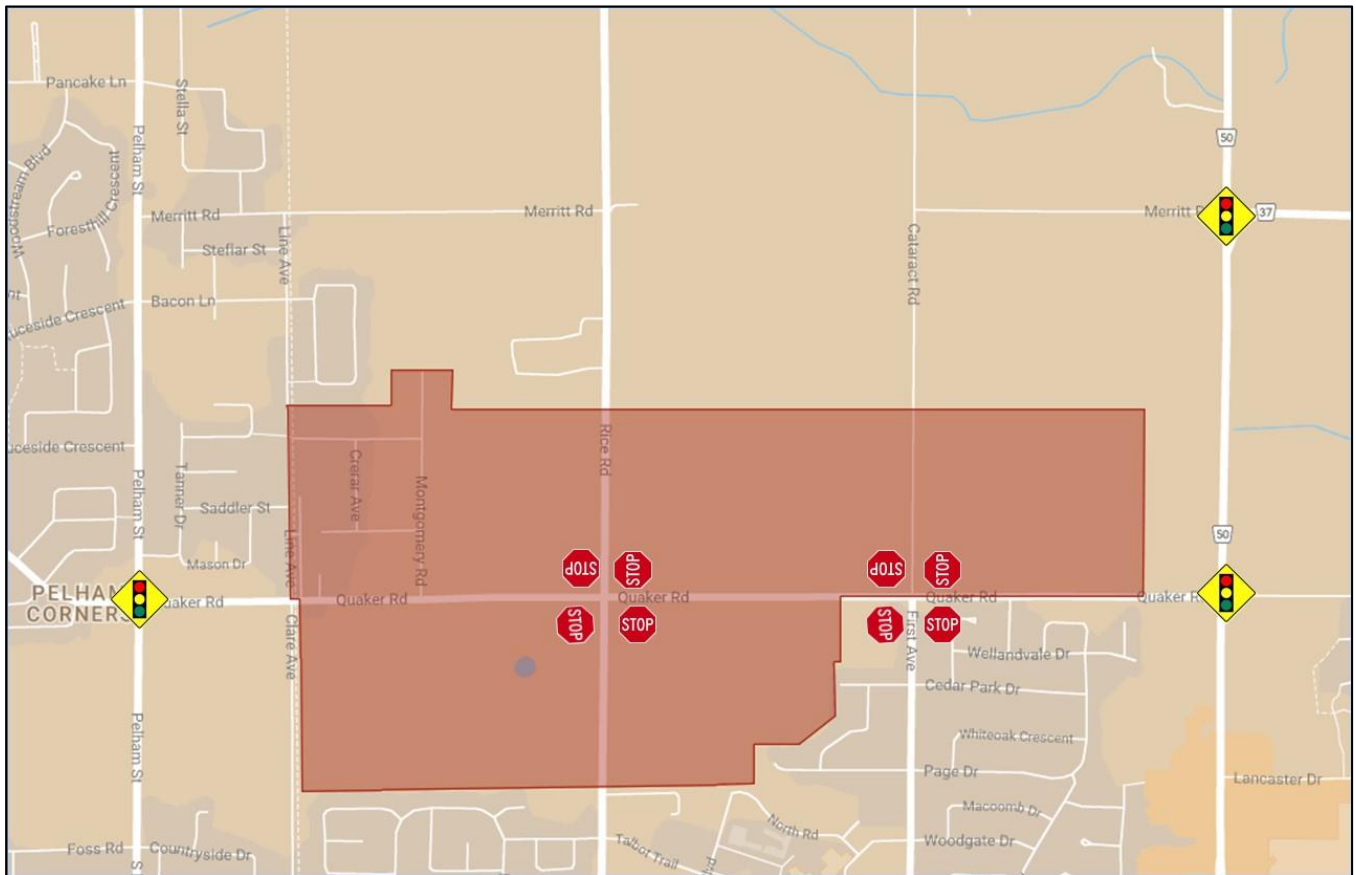


Figure 2-4: Existing Intersection Control

2.3 Active Transportation Facilities

Alongside Quaker Road, limited active transportation facilities are present. There is a separated segment of granular pathway on the north side of Quaker Road between Regional Road 54 (Rice Road) and 622 Quaker Road with a ladder cross-walk providing access to École Élémentaire Nouvel Horizon. No dedicated cyclist facilities have been provided along Quaker Road.

With regards to the north-south roadways within or adjacent to the development lands:

- Regional Road 54 (Rice Road) has no active transportation facilities present;
- First Avenue (north of Quaker Road) has no active transportation facilities present;
- First Avenue (south of Quaker Road) has semi-mountable curbs, concrete sidewalks, and bicycle lanes on both sides of the roadway; and
- Claire Road/Line Avenue has semi-mountable curbs with a concrete sidewalk on the west side of the roadway while the Steve Bauer Trail (a multi-use trail maintained by the Town of Pelham) is situated alongside the east side of the roadway.

None of the remaining minor roadways within the development lands have sidewalks or cyclist facilities. According to the Regional Municipality of Niagara's *Strategic Cycling Network Development Technical Paper (2017)*, First Avenue/Cataract Road was confirmed as a candidate for enhanced cyclist facilities.

Opportunities exist to provide or improve active transportation facilities within the development lands to accommodate pedestrians and cyclists more effectively.

2.4 Transit Routes and Facilities

The existing transit service within and around the development lands is depicted in **Figure 2-5**. Within the Northwest Welland Secondary Plan, the only sections of roadway serviced via Welland Transit (Route 8 and Route 10) is along Quaker Road between First Avenue and Regional Road 50 (Niagara Street). Route 8 offers regular service with buses arriving every 30 to 60 minutes between Monday and Sunday. Route 10 offers regular service with buses arriving every 30 to 60 minutes between Monday and Saturday with an extended bus service during off-peak periods. Immediately to the south, Route 2 provides service. Welland Transit operates under stop-request service allowing for riders to alight the bus at a location specified other than standard transit stops.

Opportunities exist to provide or improve transit routes and facilities within the development lands to accommodate transit users more effectively.



Figure 2-5: Existing Transit Routes and Facilities

2.5 Turning Movement Counts and Traffic Signal Phasing and Timing Plans

The Regional Municipality of Niagara and the City of Welland provided eight (8) hour turning movement counts for each of the five (5) intersections identified within or adjacent to the development lands which may be impacted because of the Northwest Welland Secondary Plan development. **Table 2-2** highlights the weekday one-hour morning (AM) and afternoon (PM) peak traffic periods.

Additionally, the Regional Municipality of Niagara provided traffic signal phasing and timing plans for the signalized intersections previously noted.

Table 2-2: Existing Weekday (AM) and Afternoon (PM) Peak Traffic Periods

Intersection	Weekday Morning (AM) Peak	Weekday Afternoon (PM) Peak
Quaker Road and Regional Road 50 (Rice Road)	7:45 a.m. – 8:45 a.m.	3:45 p.m. – 4:45 p.m.
Quaker Road and First Avenue	8:00 a.m. – 9:00 a.m.	4:15 p.m. – 5:15 p.m.
Regional Road 36 (Pelham Street) and Quaker Road	8:00 a.m. – 9:00 a.m.	5:00 p.m. – 6:00 p.m.
Regional Road 50 (Niagara Street) and Quaker Road	8:00 a.m. – 9:00 a.m.	4:15 p.m. – 5:15 p.m.
Regional Road 37 (Merritt Road) and Regional Road 50 (Niagara Street/Merrittville Highway)	7:45 a.m. – 8:45 a.m.	4:30 p.m. – 5:30 p.m.

2.6 Traffic Analysis Methodology

Within the roadway network, intersections are typically the critical capacity control points. The five (5) intersections previously discussed have been analyzed to determine the existing level of service, average vehicular delay, and any capacity constraints as measured by volume-to-capacity ratios using Synchro 9 and SimTraffic 9. All the traffic operations modelling is per the Regional Municipality of Niagara’s *Guidelines for Traffic Impact Studies (2012)*.

2.7 Base Year (2018) Background Traffic Conditions

Figure 2-6 illustrates the turning movement counts during the weekday morning (AM) and afternoon (PM) peak hours used within the traffic operations assessment. From **Figure 2-6**, it is apparent that the heaviest traffic flows are along Regional Road 37 (Merritt Road) and Regional Road 50 (Niagara Street) stressing the importance of these corridors as connectors to the Provincial Highway Network and as a gateway into the northwest quadrant of Welland. Traffic flows are approximately balanced between the north-south and east-west movements at the subject intersections.

Level of Service (a performance measure based on delay) was calculated for each approach and movement. Level of Service is a qualitative measure of traffic flow at an intersection and is dependent upon vehicular delay and vehicle queue lengths on the various intersection approaches. The values range from a Level of Service of A (little or no delay) to Level of Service of F (congested conditions with significant delay). **Appendix B** provides further information on the Level of Service definitions (A through F). The Level of Service for each intersection is presented by approach and movement in **Figure 2-7**

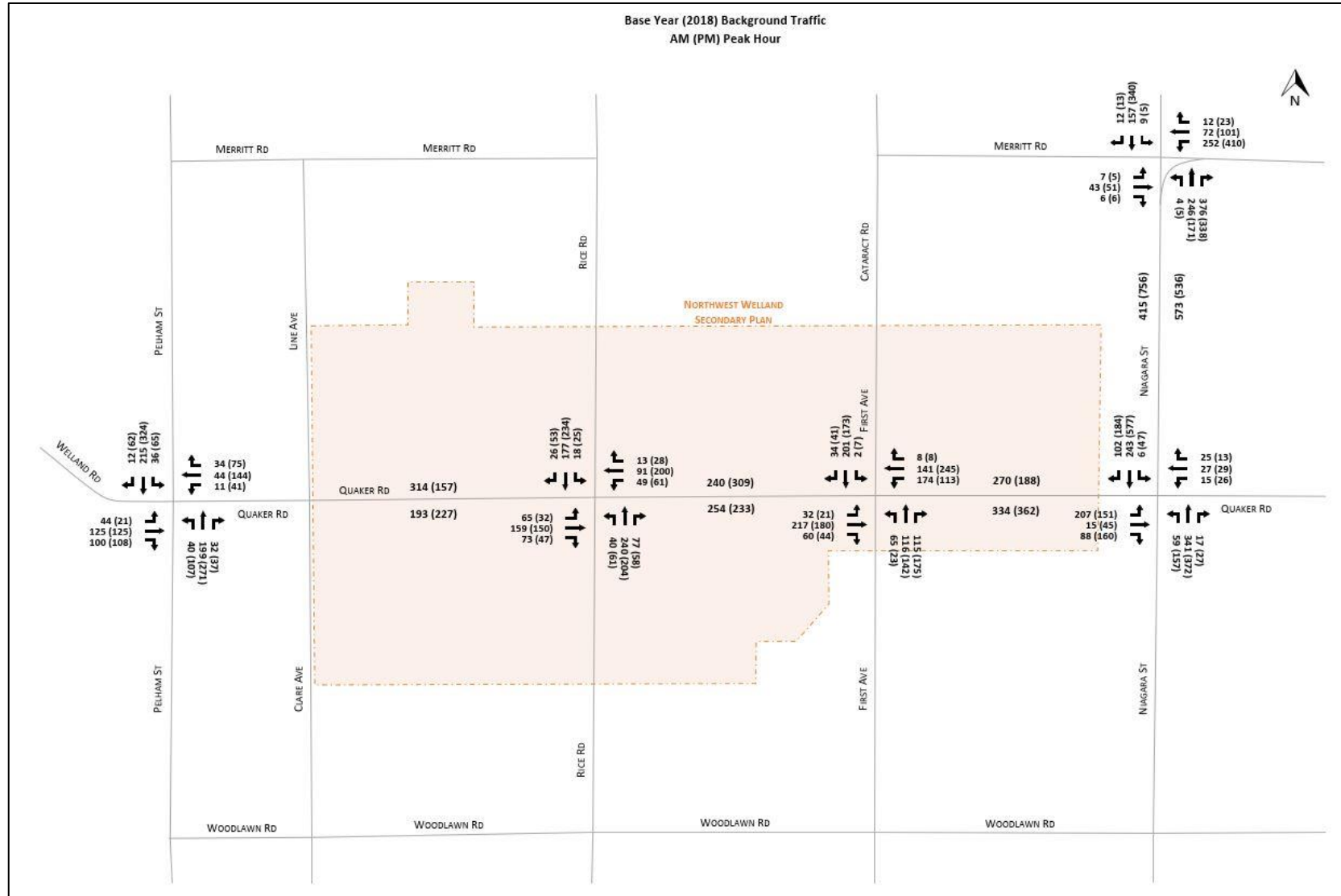


Figure 2-6: Base Year (2018) Background Traffic Peak Hour Turning Movement Volumes

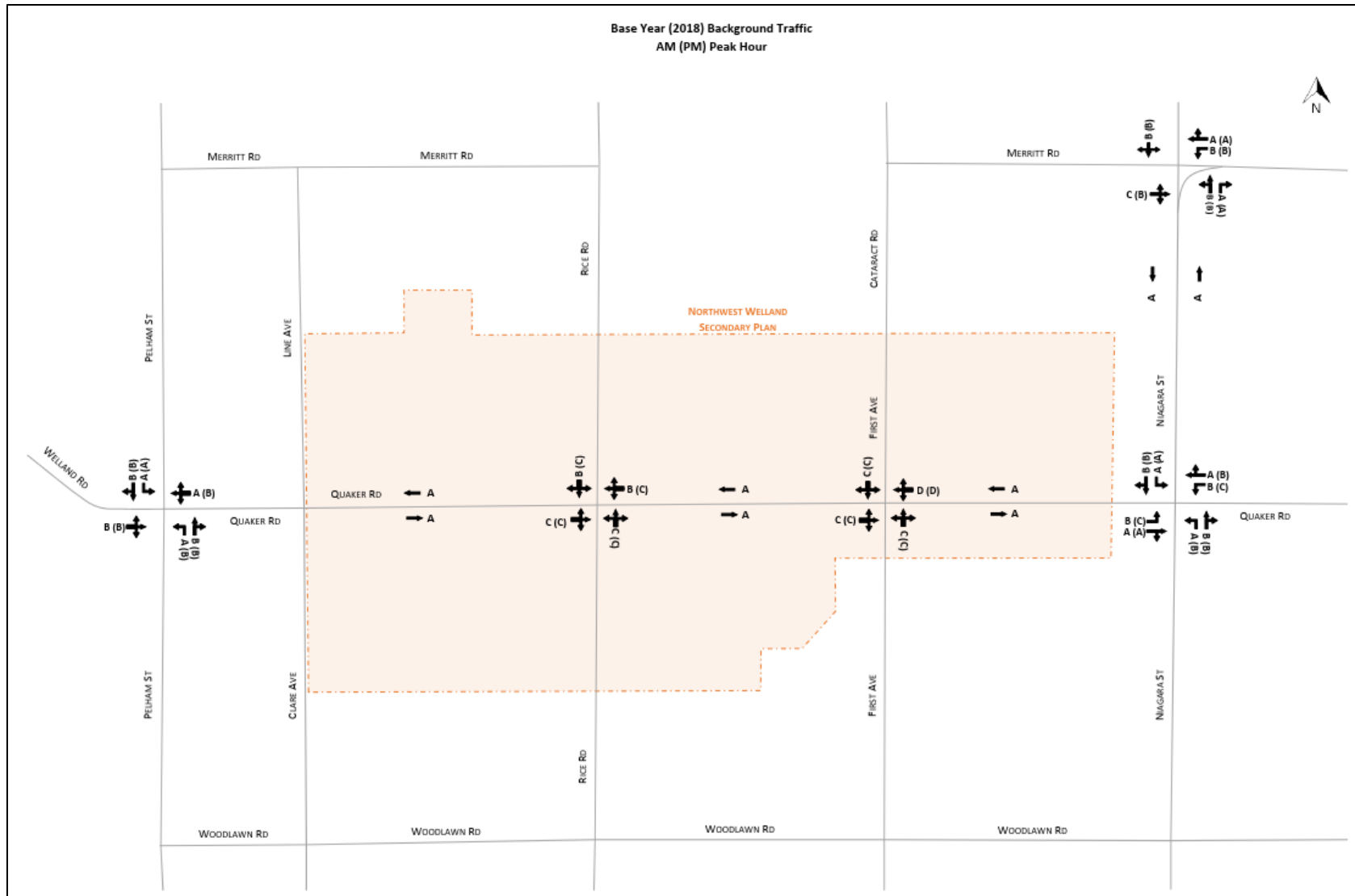


Figure 2-7: Base Year (2018) Background Traffic Peak Hour Levels of Service

The analysis indicates that, overall, the intersections are all operating below capacity with an adequate Level of Service; all movements noted as being a Level of Service of C or better. The one exception is the intersection of First Avenue and Quaker Road, which is experiencing a Level of Service of D on the east approach (all movements); indicating that long delays may be occurring during peak hour conditions in both the AM and PM peak hours. During the AM peak hour, the control delay on the eastbound approach is 25.3 seconds (per vehicle on average). During the PM peak hour, the control delay on the eastbound approach is 29.5 seconds (per vehicle on average). **Appendix B** provides the traffic operations assessment reports for the base year (2018) background traffic.

2.8 Traffic Control Signal Justifications

The intersections of Quaker Road with Regional Road 54 (Rice Road) and First Avenue are currently operating under all-way stop control. The justification for installing traffic signals was evaluated per the Ontario Ministry of Transportation's *Ontario Traffic Manual, Book 12: Traffic Signals (2012)*. The results, provided in Appendix C, indicate that, in the base year (2018), background traffic conditions, traffic control signals are not justified for either of the two (2) intersections.

2.9 Surrounding Development and Anticipated Impacts to Traffic

As part of the transportation assessment, the surrounding area was reviewed in terms of proposed developments and the impact of the associated traffic would have on the Northwest Welland Secondary Plan.

2.9.1 East Fonthill Secondary Plan

The East Fonthill Secondary Plan was included in the Town of Pelham Official Plan and adopted in 2012.

Existing lands within the East Fonthill Secondary Plan are categorized as either "greenfield" or "intensification" zones. The Land Use Plan describes scheduled land uses within the secondary plan area, and includes a mix of low, medium, and high-density residential areas, environmental protection zones, mixed-use commercial centres, and public parkland. The most dominant of these are low-density residential areas and environmental protection zones. With the implementation of the Secondary Plan, the entire area within the Secondary Plan is expected to achieve a minimum gross density of 50 persons and jobs combined per hectare.

The residential growth within the East Fonthill Secondary Plan is limited to a maximum of 3,000 residents and jobs combined by 2021, 4,500 residents and jobs combined by 2026, and 5,350 residents and jobs combined by 2031. The growth within the Commercial/Employment Centre is limited to a maximum of 785 residents and jobs combined by 2021, and a maximum of 1,190 residents and jobs combined by 2031.

It is anticipated that traffic generated by the East Fonthill Secondary Plan will result in a future increase in traffic flow along Regional Road 54 (Rice Road) through the study area. Further information on the impacts of the East Fonthill Secondary Plan will be requested from the Regional Municipality of Niagara.

2.9.2 West Port Robinson Secondary Plan

The West Port Robinson Secondary Plan was included in the City of Thorold Official Plan and adopted in 2016.

Existing lands within the Port Robinson West Secondary Plan are considered "greenfield". The lands generally include a mix of low, medium, and high-density residential properties, institutional, mixed-use commercial, industrial, and environmental protection zones. The most dominant of these are low-density residential and environmental

protection zones. With the implementation of the Secondary Plan, the residential areas are expected to achieve a gross density of 50 persons and jobs combined per hectare.

The Secondary Plan area is expected to generate approximately 12,500 people and jobs, divided into 8,500 people for residential areas, 2,400 jobs for employment areas, and 1,850 jobs for commercial areas. The employment area is expected to develop as a Business Park and include both light industrial uses and office uses.

It is anticipated that traffic generated by the West Port Robinson Secondary Plan will result in a future increase in traffic flow along Regional Road 50 (Niagara Street) through the study area. Further information on the impacts of the West Port Robinson Secondary Plan will be requested from the Regional Municipality of Niagara.

2.9.3 Niagara College, Welland Campus

The Niagara College, Welland Campus is located between Regional Road 54 (Rice Road) and First Avenue on Regional Road 41 (Woodlawn Road). According to the City of Welland, they have not been made aware of any significant expansion plans at Niagara College, Welland Campus that would result in significant impacts on traffic operations within the study area.

2.9.4 Regional Road 37 (Merritt Road) Extension

In the Regional Municipality of Niagara's *Transportation Master Plan, Subarea Analysis Summary (2017)*, it was recommended that the Capital Budget 2017 include a project to construct a new connector roadway, extending Regional Road 37 (Merritt Road) between Regional Road 54 (Rice Road) and Cataract Road. The Region indicated that within the next five (5) years, this extension will be designed and constructed. This is expected to significantly impact traffic operations in the surrounding area, as the section would be a candidate to become a Regional Roadway and act to relieve Regional Road 20 of additional capacity heading towards Highway 406. Further information on the impacts of the Regional Road 37 (Merritt Road) extension will be requested from the Regional Municipality of Niagara.

3 PREFERRED PLAN

Figure 3-1 shows the preferred plan representing the full build-out of the North West Welland Secondary Plan. A collector road has been proposed that will service low density residential development within the development. The collector road will provide new points of access on Clare Avenue and Regional Road 54 (Rice Road) south of Quaker Road, on Quaker Road between Regional Road 54 (Rice Road) and First Avenue and First Avenue north of Quaker Road, creating new intersections.

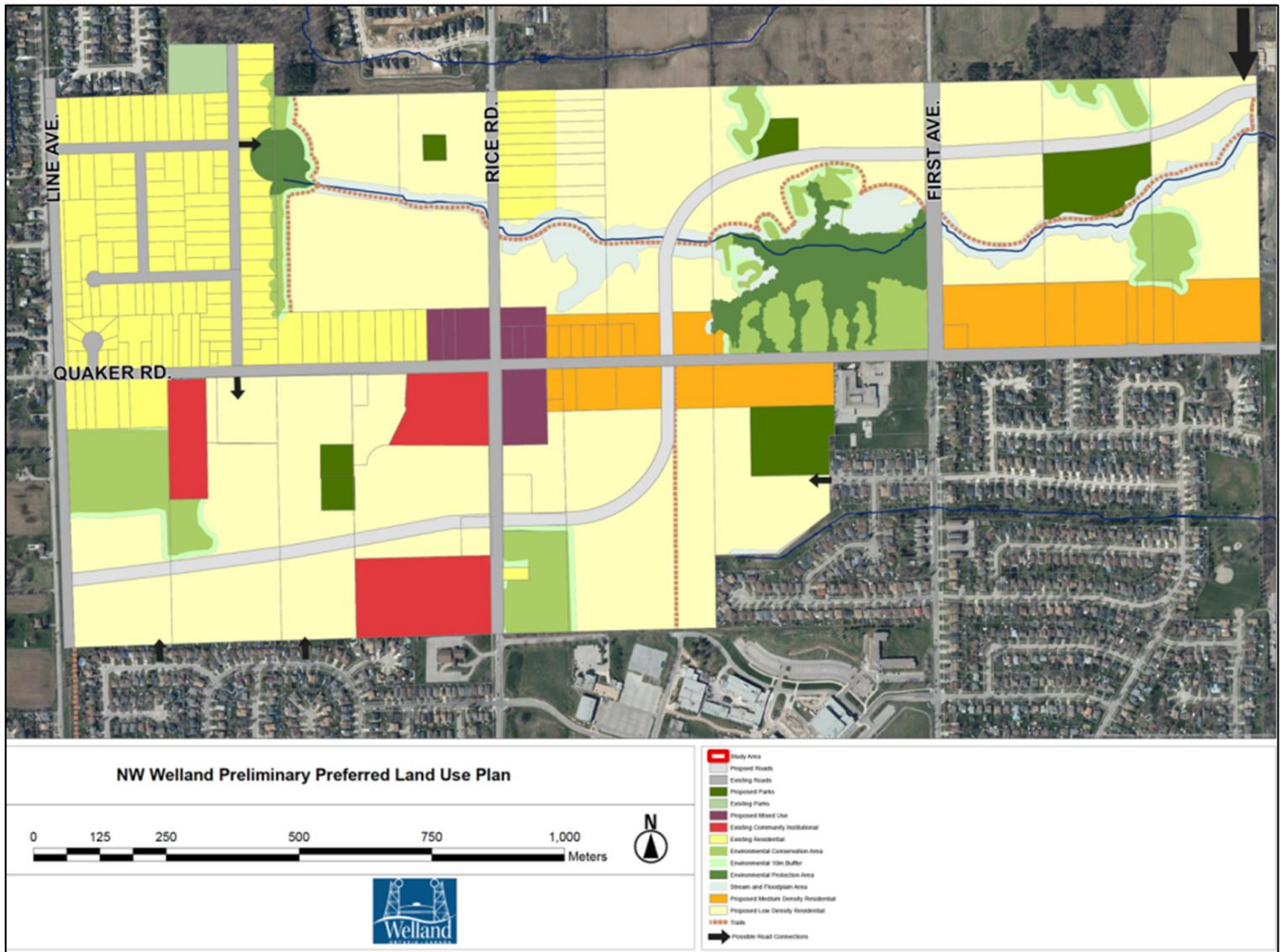


Figure 3-1: Preferred Land Use Plan

Medium density development (townhouse and condominium complexes) will be located along Quaker Road, with direct access to Quaker Road. Low density development (single family dwellings) will be located along the collector road or local roads (not shown in the preferred land use plan). Mixed use development will be located on the northwest, northeast and southeast quadrants of the intersection of Quaker Road and Regional Road 54 (Rice Road).

Given the above, for the traffic analysis relating to the collector roads, these roads were given a name Street 'A', Street 'B', Street 'C' and Street 'D' as shown in **Figure 3-2**, corresponding to Blocks A through D. It has also been assumed that all medium density development will have direct access onto the existing road network (Regional Road 54 (Rice Road), Quaker Road or First Avenue). The collector roads will provide access to the low-density development (single family dwellings) except for single-family development located on the west side of Rice Road. SGL Planning indicated the total number of single-family dwelling units located within the North West Welland Secondary Plan.

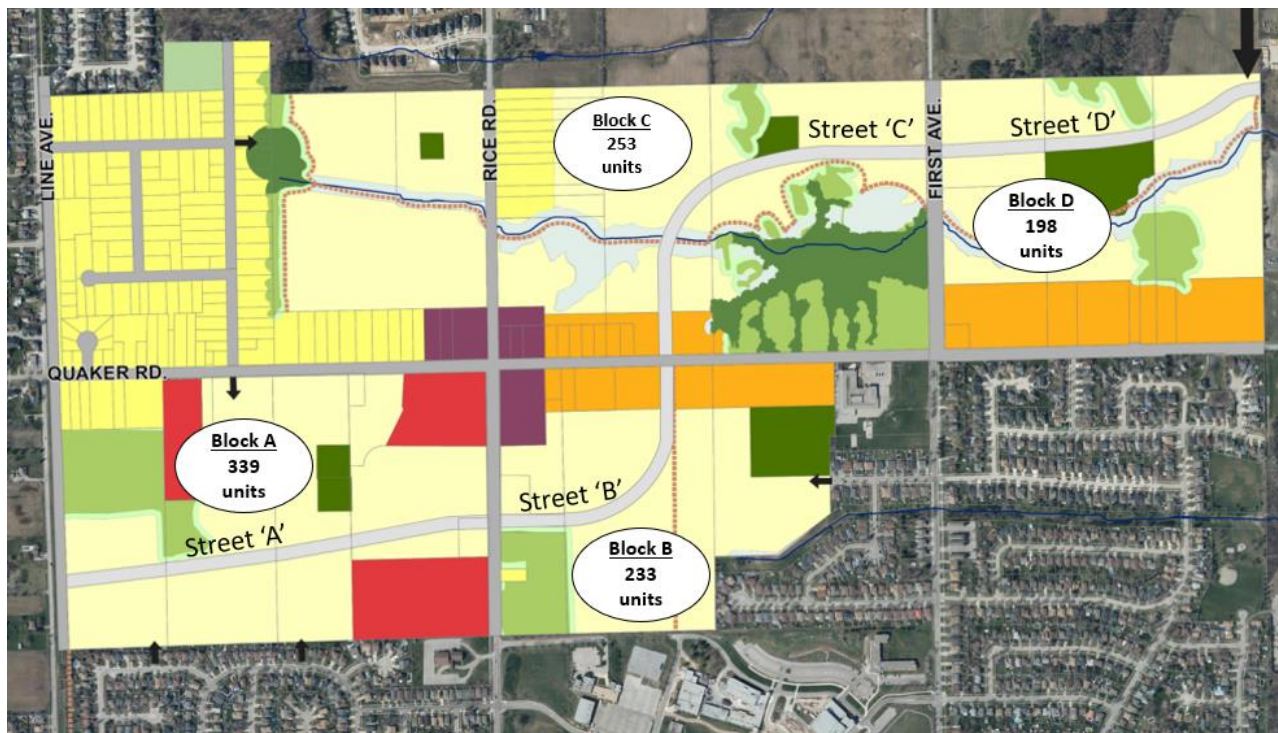


Figure 3-2: Street Names and Single Residential Units

4 FUTURE TRAFFIC CONDITIONS

To assess future traffic conditions in 2031, the Region of Niagara retained IBI Group to use the Niagara Region Travel Forecasting Model to forecast traffic flow along key roads in the study area. A copy of the memorandum containing the results of their analysis is provided in **Appendix D**. In the study area, it was presumed that there would be no changes to the cross-section of Regional Road 36 (Pelham Street), First Avenue, Regional Road 50 (Niagara Street) or Quaker Road because of area development (including the North West Welland Secondary Plan). However, the Region is forecasting that Regional Road 54 (Rice Road) will need to be widened to a 4-lane cross-section. Also, Merritt Road

would need to be widened to a 4-lane cross-section and an extension would be built between Regional Road 54 (Rice Road) and Cataract Road. The extension would also have a 4-lane cross-section.

SGL Planning and Design provided the Region of Niagara and their modelling consultant IBI Group with population and employment figures for the growth zones within the study area for the preferred option as previously shown in Figure 3-1. A copy of the growth zones and the corresponding population and employment growth is shown in **Figure 4-1** and **Table 4-1**. A population increase of 6,279 is anticipated to occur by 2031 as a direct result of the new development in the North West Welland Secondary Plan. A modest increase in employment is anticipated to occur, 84 jobs in total.

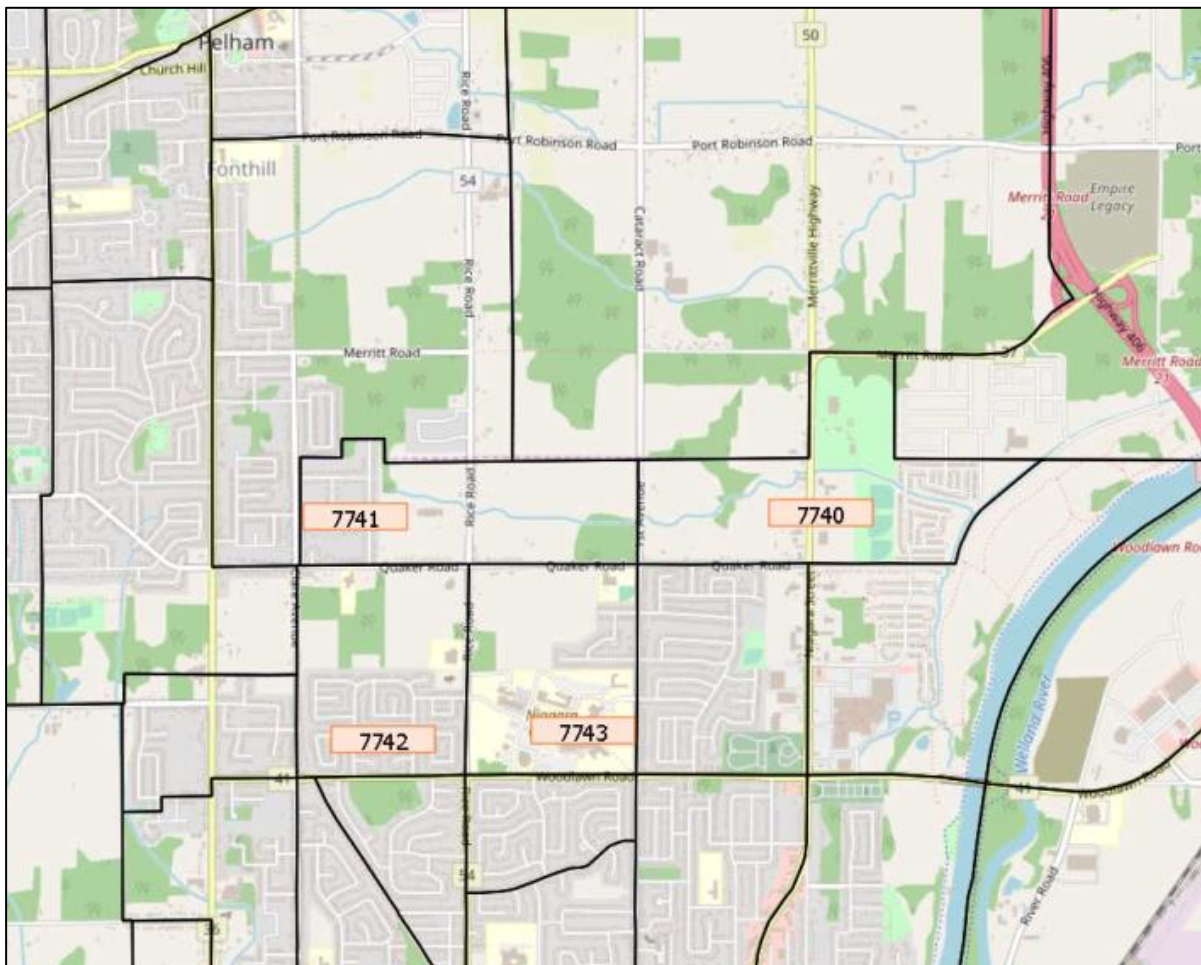


Figure 4-1: North West Welland Secondary Plan Growth Zones

Table 4-1: Population and Employment Growth

Zone	2011		2031 Base		Increase from Secondary Plan		2031 NWWSP		2011 2031 Growth	
	Total Pop.	Total Jobs	Total Pop.	Total Jobs	Pop.	Jobs	Total Pop.	Total Jobs	Total Pop.	Total Jobs
7740	1,100	379	1,151	635	1,414	0	2,564	635	133%	68%
7741	522	242	447	288	2,237	84	2,684	372	414%	54%
7742	1,148	403	982	491	1,335	0	2,317	491	102%	22%
7743	418	942	357	1,185	1,293	0	1,650	1,185	295%	26%
Total	3,187	1,966	2,937	2,598	6,279	84	9,216	2,682	189%	36%

Table 4-2 shows the change in traffic flow between 2011 and 2031 during the AM peak, as a result of the increase in population and employment within the North West Welland Secondary Plan area, in addition to the forecasted increase in population and employment in the surrounding area, along with changes to the surrounding road network (i.e. the widening of Rice Road and Merritt Road and the extension of Merritt Road between Cataract Road and Rice Road). The following is noted in the AM peak:

- Regional Road 54 (Rice Road) between Port Robinson Road and Regional Road 41 (Woodlawn Road) will experience a significant increase in traffic flow (188% northbound; 17% southbound);
- Niagara Street between Port Robinson Road and Regional Road 41 (Woodlawn Road) will experience a significant increase in traffic (55% northbound; 34% southbound)
- Merritt Road between Pelham Street and Rice Road will experience a significant increase in traffic flow (151% eastbound; 487% westbound)
- Regional Road 37 (Merritt Road) between Cataract Road and Highway 406 will experience a significant increase in traffic flow (452% eastbound, 147% westbound);
- Quaker Road will experience a significant increase in traffic flow (101% eastbound, 47% westbound)

Sections of Regional Road 36 (Pelham Street) and First Avenue will not experience a significant change in traffic because of the changes to the surrounding road network.

IBI Group did not provide results for the PM peak, indicating that they had less confidence in the model outputs.

Table 4-2: Population and Employment Growth

Street	Corridor	2011 AM Peak Hour Volume		2031 AM Peak Hour Volume NWWSP		2011 2031 NWWSP Growth	
		NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
Pelham Street	Port Robinson Road to Woodlawn Road	221	256	257	283	16%	11%
Rice Road	Port Robinson Road to Woodlawn Road	212	189	611	221	188%	17%
Cataract Road/ First Avenue	Port Robinson Road to Woodlawn Road	291	432	278	448	-4%	4%
Niagara Street	Port Robinson Road to Woodlawn Road	286	237	443	317	55%	34%
Merritt Road	Pelham Street and Rice Road	146	31	367	182	151%	487%
Merritt Road	Rice Road and Cataract Road (Extension)	-	-	867	310	-	-
Merritt Road	Cataract Road and Highway 406	214	330	1181	815	452%	147%
Quaker Road	Pelham Street and Niagara Street	253	78	509	115	101%	47%

**Note Auto volumes have not been calibrated to local level*

5 ANALYSIS OF FUTURE TOTAL TRAFFIC CONDITIONS

Based on the above, Associated Engineering developed an estimate of future traffic conditions at the five study intersections during the AM and PM peak, in addition to anticipated traffic conditions at the four new collector road intersections (AM only) because of development within the North West Welland Secondary Plan. The following section presents the findings under horizon year conditions (with no changes to traffic control) and with any identified improvements (because of the additional traffic).

5.1 Horizon Year Conditions (2031)

Using the growth factors provided in **Table 4-1**, an estimate of future turning movement counts was developed for the five study intersections. For the AM peak, the 2011-2031 growth factor was applied to the 2018 turning movement counts (specific to each approach), prorated to reflect an exponential growth and the year of the count (2018). For the PM peak, as directed by the Region, the same 2011-2031 growth factor (in the AM) was applied to the 2018 turning movement counts (specific to each approach) and prorated to reflect an exponential growth and the year of the count (2018). As such, the results presented in this report for the PM peak are only meant to highlight potential future issues with capacity (by inference) and should be treated with caution.

Figure 5-1 shows the turning movement counts (AM and PM) for the five study intersections in addition to link volumes. Of note, is a heavy northbound right/westbound left traffic flow at the intersection of Regional Road 50 (Niagara Street) and Regional Road 37 (Merritt Road), and a significant increase in through traffic along Regional Road 54 (Rice Road) and Quaker Road.

5.2 Trip Generation and Distribution on Collector Roads

It was assumed that the collector roads (Street ‘A’, Street ‘B’, Street ‘C’ and Street ‘D’) would only service low density residential development. Traffic generated by medium density and mixed-use development indicated in the preferred plan would have direct access to Quaker Road, Regional Road 54 (Rice Road) or First Avenue and would, therefore, have already been accounted for in the analysis prepared by IBI Group (Table 4-2). Trip generation on the collector roads in Block A, B, C and D was estimated using the ITE Trip Generation Manual, 10th Edition for Single Family Detached Housing (Land Use Code 210) and is shown in **Table 5-2**. Trips generated by low density residential development on the west side of Regional Road 54 (Rice Road) north of Quaker Road would directly access Regional Road 54 (Rice Road) via a local road and is presumed to have been accounted for in the analysis prepared by IBI Group.

Table 5-1: Trip Generation - Single Family Detached Housing

Location	# Units	AM Peak		AM Peak	
		In	Out	In %	Out %
Block A	339	61	184	25	75
Block B	233	42	128	25	75
Block C	253	46	138	25	75
Block D	198	36	109	25	75

Inbound and outbound trips at the intersection of Regional Road 54 (Rice Road) and Street ‘A’/Street ‘B’, Quaker Road and Street ‘B’/Street ‘C’ and First Street and Street ‘D’ were distributed per the traffic flow on the major road (Regional Road 54 (Rice Road), Quaker Road and First Street) as noted in Table 4-2, with an equal amount of traffic entering and exiting Blocks A, B, C by the two proposed collector road accesses provided. At the intersection of Claire Road and Street ‘A’, a 50/50 split was presumed in the distribution of northbound/southbound traffic, reflecting AM peak hour traffic conditions based on a recent ATR count provided by the City of Welland. Traffic generation was not calculated for the PM peak hour, given the lack of information regarding directional flow.

Figure 5-2 shows the distribution of traffic at the four collector road intersections during the AM peak hour. Major road through movements (Quaker Road, Regional Road 54 (Rice Road) and First Avenue) were estimated at the four collector road intersections based on the traffic volumes on the downstream intersection. A growth factor was applied to northbound/southbound through movements on Claire Avenue based on AM peak hour data collected from a recent Automated Traffic Recorder count¹. Finally, it was assumed that there would be no eastbound-westbound through traffic across Regional Road 54 (Rice Road) or First Avenue or northbound-southbound through traffic across Quaker Road.

¹ The growth factor was 22% for northbound traffic and 16% for southbound traffic, based on the average growth for other north-south roadways in the study area as presented in the IBI Group report.

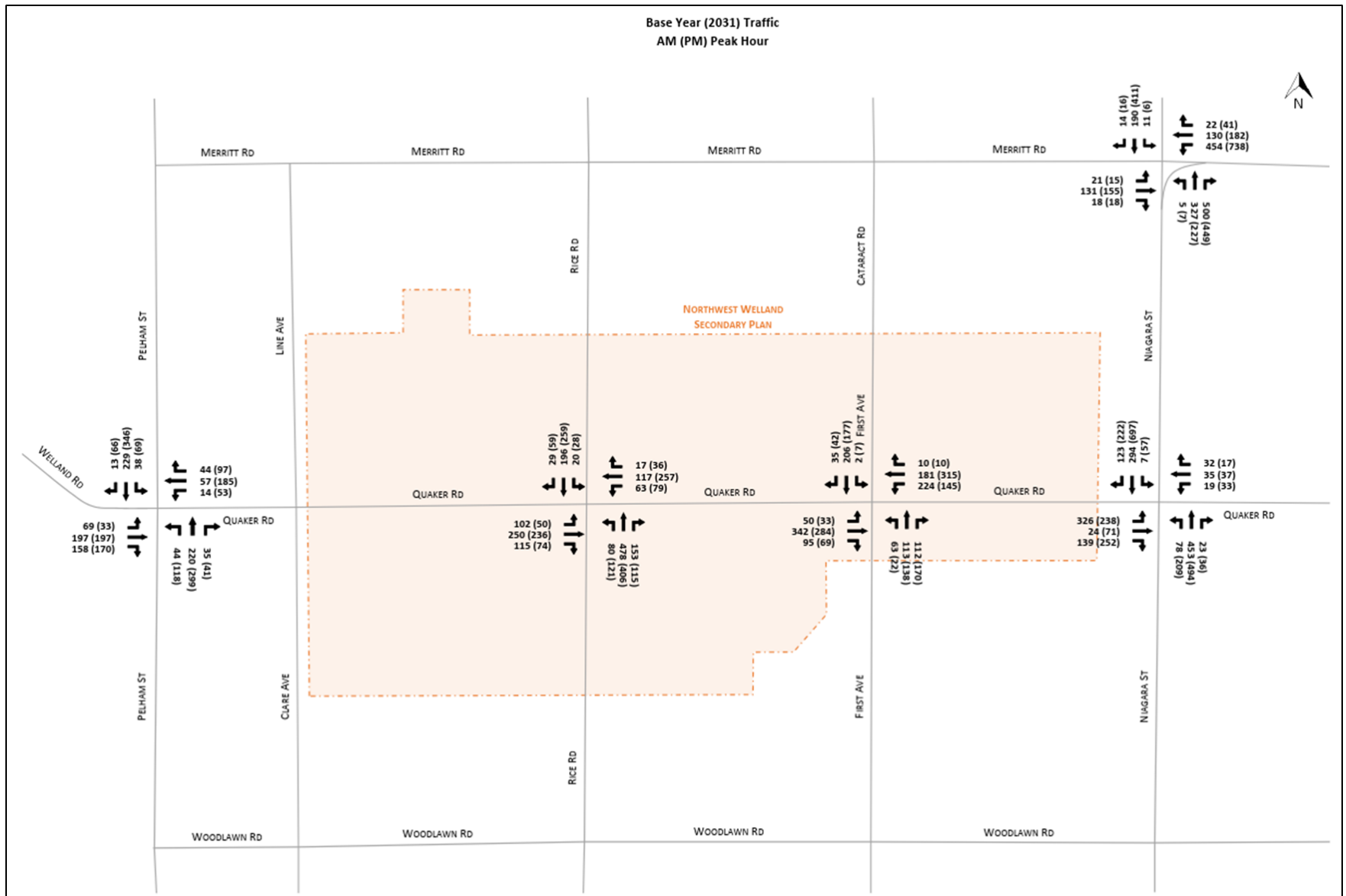


Figure 5-1: Future (2031) Peak Hour Turning Movement Volumes – Major Roads

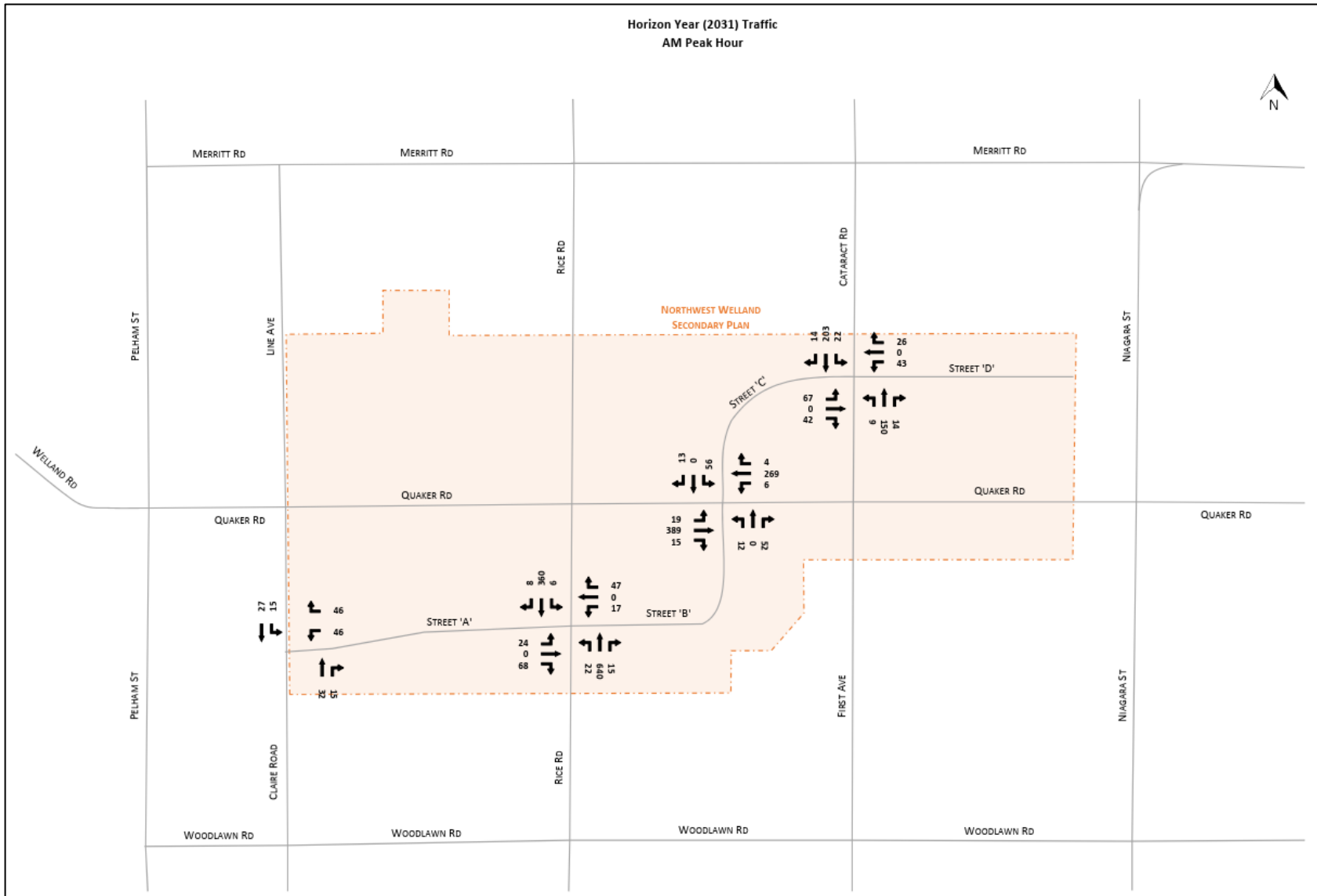


Figure 5-2: Future (2031) Peak Hour Turning Movement Volumes – Collector Roads

5.3 Horizon Year Traffic Conditions (No Improvements)

Figure 5-3 shows the anticipated Level of Service at the study intersections for the 2031 horizon year with no improvements (i.e. additional auxiliary lanes or changes to traffic control), aside from the widening anticipated to occur on Regional Road 54 (Rice Road) to 4-lanes, Merritt Road (to 4-lanes) and the Merritt Road extension (between Regional Road 54 (Rice Road) and Cataract Road (4-lanes)). **Appendix E** shows the Synchro outputs for the horizon year (2031) with no improvements.

Regional Road 36 (Pelham Street) and Quaker Road

The intersection of Regional Road 36 (Pelham Street) and Quaker Road, currently signalized, is anticipated to continue to operate well below capacity, with a Level of Service of B or better, largely due to the modest growth anticipated along this roadway. No changes to the lane configuration or traffic control are recommended.

Regional Road 54 (Rice Road) and Quaker Road

While Regional Road 54 (Rice Road) will be widened to a four-lane cross-section, the intersection of Regional Road 54 (Rice Road) and Quaker Road, currently under all-way Stop control, will experience significant congestion because of the noted increase in traffic in the AM and PM peak hour. In the AM peak hour, significant delay (Level of Service of F) was noted on the eastbound approach (96.1 seconds/vehicle) and the northbound approach (317.8 seconds/vehicle). In the PM peak hour, significant delay was noted on all four approaches (ranging from 90 seconds/vehicle to 417 seconds/vehicle), all are at a Level of Service of F. Based on anticipated traffic conditions, this intersection meets the warranting requirements for a traffic signal when applying the same growth rates to the base year 8-hour turning movement count. The signal warrants for the 2031 horizon year are provided in **Appendix F**.

First Avenue/Cataract Road and Quaker Road

The intersection of First Avenue and Quaker Road, also currently under all-way Stop control, will experience significant congestion because of the noted increase in traffic in the AM and PM peak hour on Quaker Road. In the AM peak hour, significant delay (Level of Service of F) was noted on the eastbound approach (125.3 seconds/vehicle) and the westbound approach (83.8 seconds/vehicle). In the PM peak hour, significant delay (Level of Service of F) was also noted on the eastbound approach (55.5 seconds/vehicle) and the westbound approach (121 seconds/vehicle), with the northbound approach at a Level of Service of E (38.1 seconds/vehicle). Based on anticipated traffic conditions, this intersection meets the warranting requirements for a traffic signal when applying the same growth rates to the base year 8-hour turning movement count. The signal warrants for the 2031 horizon year are provided in **Appendix F**.

Regional Road 50 (Niagara Street) and Quaker Road

The intersection of Regional Road 50 (Niagara Street) and Quaker Road, currently signalized, will continue to operate well below capacity in the AM and PM peak hour, with all movements at a Level of Service of C or better, except for the eastbound left turn movement, which will be operating at a Level of Service of D during the PM peak. This movement will still be well below capacity with a v/c ratio of 0.72. It appears that there will continue to be sufficient storage in the eastbound left turn lane to accommodate left turn movements.

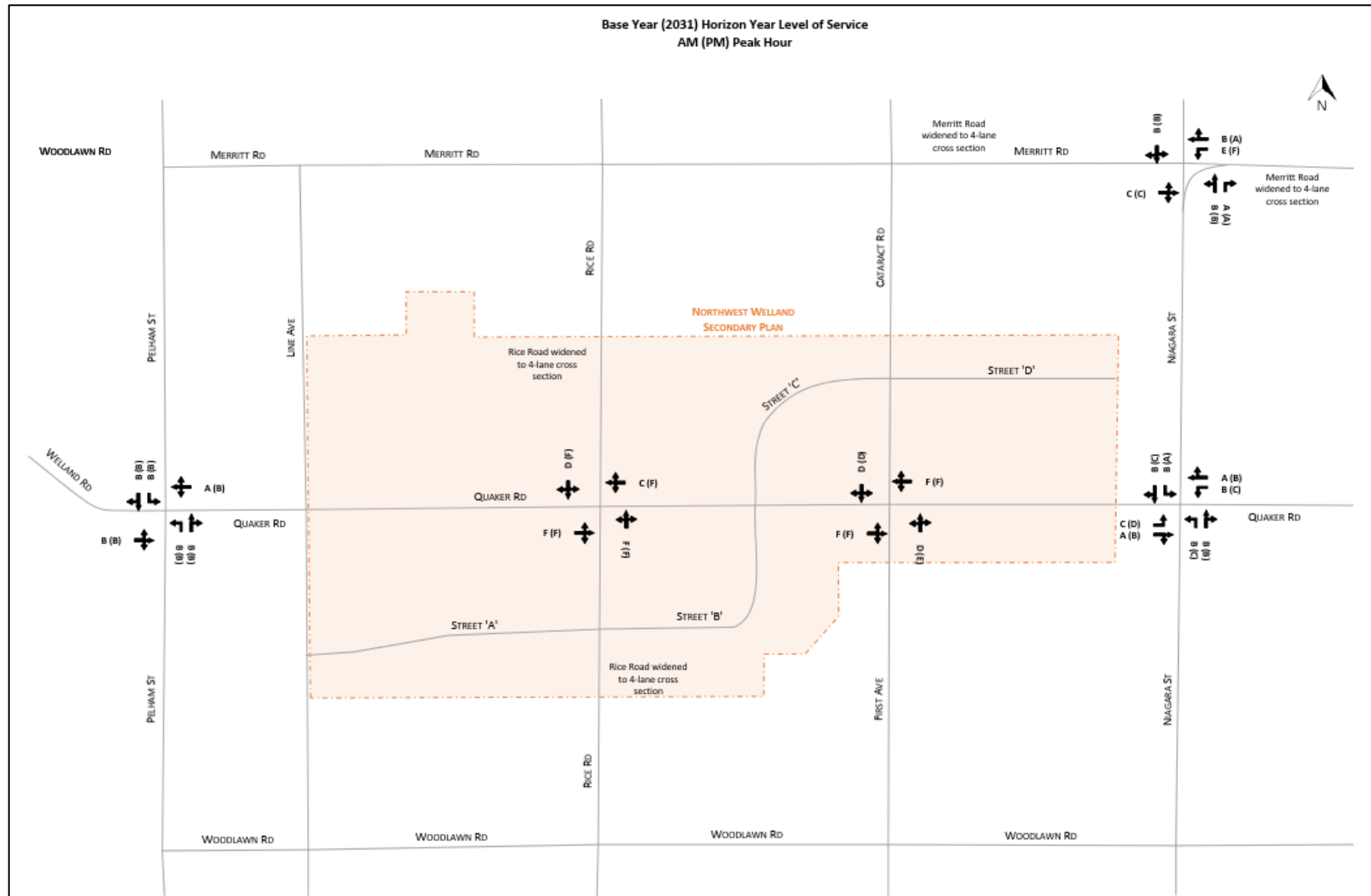


Figure 5-3: Level of Service Study Intersections (2031 Horizon Year)

Regional Road 50 (Niagara Street) and Regional Road 37 (Merritt Road)

While Merritt Road will be widened to a four-lane cross section, the intersection of Regional Road 50 (Niagara Street) and Merritt Road, currently signalized, will experience considerable delay for the westbound left-turn during the AM peak hour (Level of Service of E) and will experience excessive delay and will be operating beyond capacity for the westbound left-turn during the PM peak hour (Level of Service of F and a volume-to-capacity ratio of 1.45). Storage for the westbound left turn will not be able to accommodate the anticipated traffic volume.

Collector Road Intersections

Figure 5-4 shows the anticipated Level of Service at the collector road intersections for the 2031 horizon for the AM peak hour only. Based on the analysis, it was noted that all intersections would be operating well below capacity with minimal to modest delay (Level of Service of C or better), likely due to the relatively low amount of traffic generated by Blocks A through D. A review of the anticipated minor road traffic volumes indicates that there is no evidence that a traffic signal would be warranted at any of the study intersections and as such they would be able to operate with a Stop control on the minor road.

In the AM peak, there is no evidence to suggest that a left turn lane would be warranted on the major roads to facilitate left turn movements into any of the developments at the collector road intersections, given the anticipated left turn volumes. However, in the PM peak, a review of the ITE Trip Generation Manual, 10th Edition, left turn volumes (into the residential developments) will be higher on the major roads (Regional Road 54 (Rice Road), Quaker Road and First Avenue), reflecting the higher potential of inbound trips (63% compared to 25%) according to the ITE Trip Generation Manual, 10th Edition. Furthermore, the review indicates that there is a higher amount of traffic generated during the PM peak hour for single family detached housing (Land Use Code 210). Given this, there may be a possibility for left turn lanes to be required in the future on the major approaches.

5.4 Horizon Year Traffic Conditions (with Improvements)

Based on the results of the previous assessment of traffic operations at the study intersections, the following improvements were considered.

- Quaker Road and Regional Road 54 (Rice Road) – signalization and addition of left turn lanes on all four approaches;
- Quaker Road and First Avenue -signalization and addition of left turn lane on all four approaches; and
- Regional Road 50 (Niagara Street) and Regional Road 37 (Merritt Road) - Increase time for exclusive westbound left turn phase and increase storage for westbound left turn lane (90 metres).

No improvements were considered for the intersections of Quaker Road and Regional Road 36 (Pelham Street) and Quaker Road and Regional Road 50 (Niagara Street).

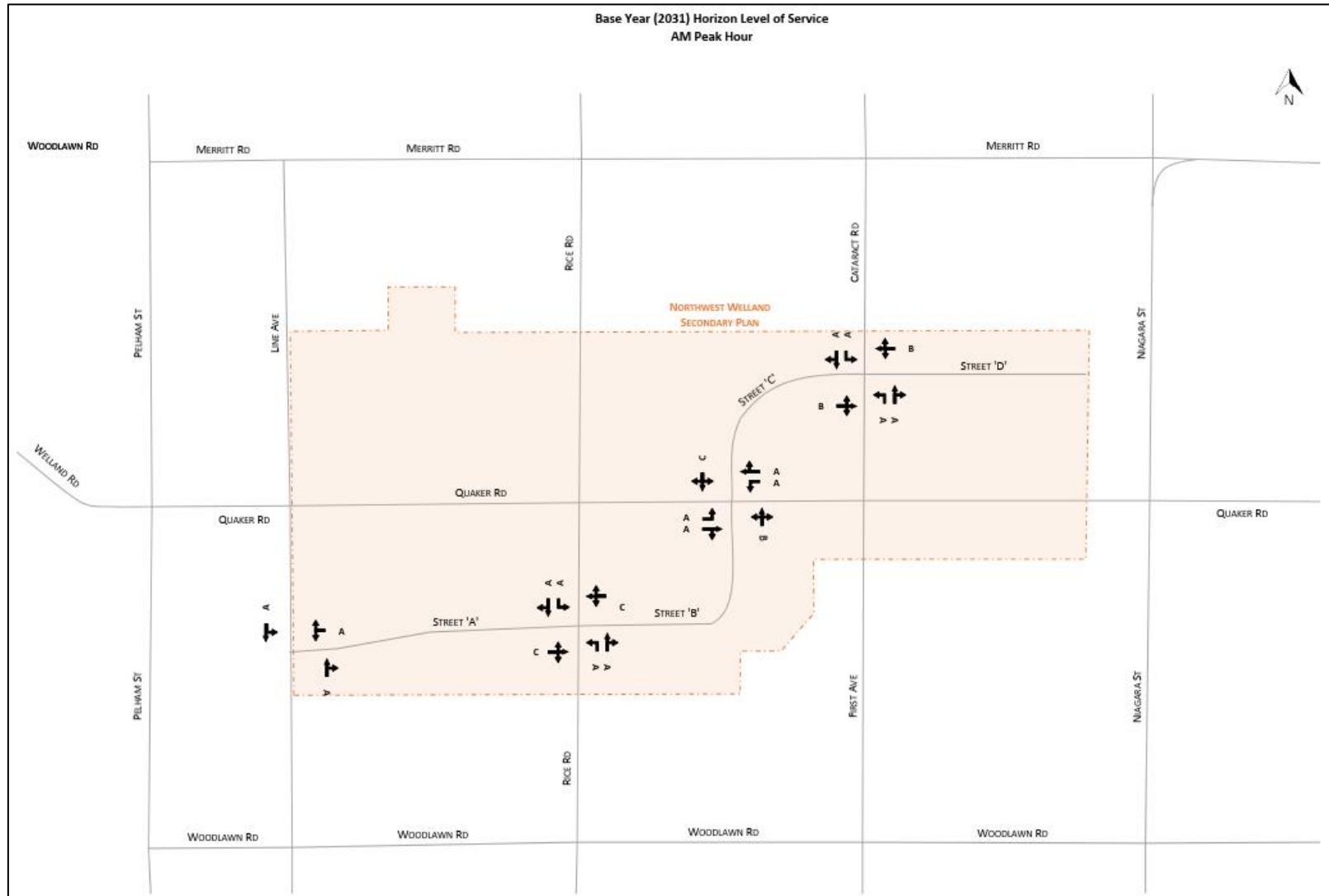


Figure 5-4: Level of Service for Collector Road Intersections (2031 Horizon Year)

Figure 5-5 shows the anticipated Level of Service at the study intersections for the 2031 horizon year with the indicated improvements in the AM and PM peak hours. The following was noted:

- Under signal control, the intersection of Quaker Road and Regional Road 54 (Rice Road) will operate at a Level of Service of B or better during both the AM and PM peak hour;
- Under signal control, the intersection of Quaker Road and First Avenue will operate at a Level of Service of C or better during both the AM and PM peak hour;
- With the increase in time for the exclusive westbound left turn phase, the Level of Service for the AM peak/PM peak will improve to B and C respectively. A Level of Service of D is noted for the eastbound left/through movements in the PM peak hour.

While not formally assessed, the intersection of Quaker Road and Regional Road 54 (Rice Road) and the intersection of Quaker Road and First Avenue are anticipated to operate adequately as a roundabout. Given that Regional Road 54 (Rice Road) has a four-lane cross section, a multi-lane roundabout is recommended for the intersection of Quaker Road and Regional Road 54 (Rice Road). A single-lane roundabout should be adequate for the intersection of Quaker Road and First Avenue.

Table 5-2 shows the recommended storage for the left turn lanes based on the above analysis.

Table 5-2: Recommended Storage

Intersection	EB	WB	NB	SB
Quaker Road and Regional Road 50 (Rice Road)	30	30	30	30
Quaker Road and First Avenue	30	30	30	30
Regional Road 37 (Merritt Road) and Regional Road 50 (Niagara Street/Merrittville Highway)	30	90	N/A	N/A

Appendix G shows the Synchro outputs for the horizon year (2031) with the improvements described in this section.

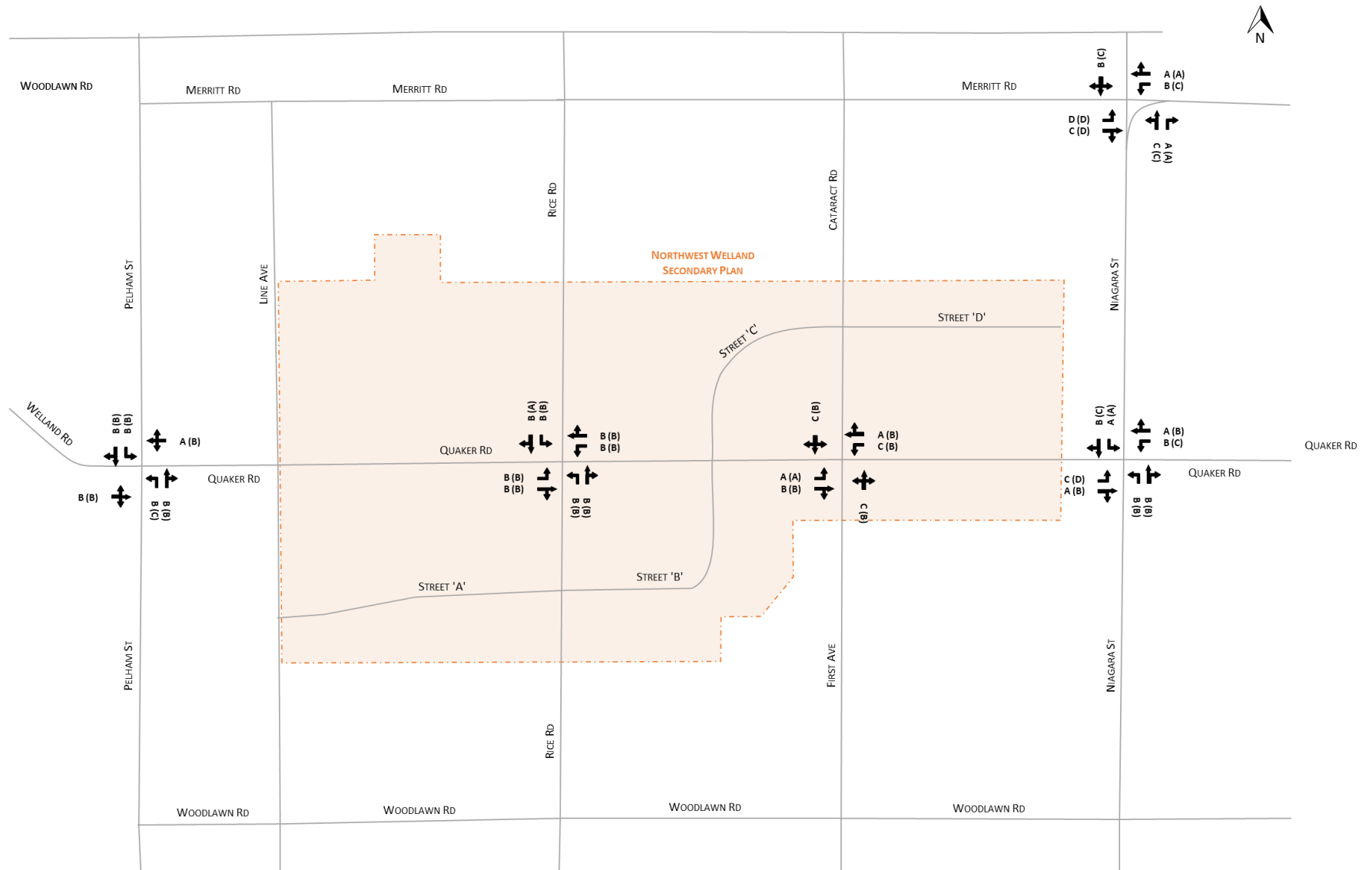


Figure 5-5: Level of Service for Study Intersections (2031 Horizon Year) with Improvements

6 CONCLUSIONS AND RECOMMENDATIONS

The previous sections within this report document the review of existing and future horizon year conditions from a transportation engineering perspective. The following is noted.

6.1 Existing Conditions

A review of existing conditions indicates that both Quaker Road and Regional Road 54 (Rice Road) through the study area are characterized as rural arterial roadways. First Avenue acts as a collector roadway, having an urban cross-section south of Quaker Road and a rural-cross section north of Quaker Road. Immediately west and east of the study area, Regional Road 36 (Pelham Street) and Regional Road 50 (Niagara Street) function as arterial roadways.

The two (2) major intersections within the study area are Quaker Road and Regional Road 54 (Rice Road) and Quaker Road and First Street; both of which operate under all-way stop control. Regional Road 36 (Pelham Street) and Quaker Road, Regional Road 50 (Niagara Street) and Quaker Road, and Regional Road 37 (Merritt) and Regional Road 50 (Niagara Street/Merrittville Highway) all operate under traffic signal control. These intersections were chosen due to the proximity to the study area and the potential for traffic generated by the development to impact traffic at these intersections.

The roadways within the study area have very limited active transportation facilities. There is a separated segment of granular pathway on the north side of Quaker Road between Regional Road 54 (Rice Road) and 622 Quaker Road with a ladder cross-walk providing access to École Élémentaire Nouvel Horizon. No dedicated cyclist facilities have been provided along Quaker Road.

With the development of the Northwest Welland Secondary Plan, there is an opportunity to provide dedicated active transportation facilities for pedestrians and cyclists. According to the Regional Municipality of Niagara's *Strategic Cycling Network Development Technical Paper (2017)*, First Avenue/Cataract Road was confirmed as a candidate for enhanced cyclist facilities. Limited transit service is provided within the study area with only a short segment of Quaker Road between First Street and Regional Road 50 (Niagara Street) being serviced by Welland Transit. Expanded transit service should be considered in conjunction with the development of the subject lands.

Under existing conditions, the traffic operations analysis indicates that overall, the study intersections are all operating below capacity with an adequate Level of Service; all movements noted as being a Level of Service of C or better.

6.2 Future Conditions (2031 Horizon Year)

The preferred plan representing the full build-out of the North West Welland Secondary Plan will result in a population increase of 6,279 and an increase in employment of 84 jobs. A collector road has been proposed that will service residential development within the development. The collector road will provide new points of access on Claire Road and Rice Road south of Quaker Road, on Quaker Road between Rice Road and First Avenue and First Avenue north of Quaker Road, creating new intersections and is assumed to service low density residential development within different portions of the development.

Traffic conditions were assessed for the horizon year (2031), in consideration of the anticipated development of the North West Welland Secondary Plan, in addition to surrounding development. The Region has indicated that Regional Road 54 (Rice Road) and Merritt Road will be widened to a four-lane cross-section, and Merritt Road will be extended west to connect Regional Road 54 (Rice Road) to Cataract Road.

Associated Engineering applied growth factors to the study intersections based on a memo provided by IBI Group. The memo presents growth factors between 2011-2031 indicating changes in traffic patterns during the AM peak hour because of the anticipated growth both within the North West Secondary Plan, in the surrounding area, and because of the road improvements within the study area. Several roads within the study area will see a marked increase in traffic, particularly Regional Road 54 (Rice Road) and Regional Road 37 (Merritt Road) and to a lesser degree, Quaker Road. IBI Group did not provide results for the PM peak, indicating that they had less confidence in the model outputs.

Based on the above, Associated Engineering developed an estimate of future traffic conditions at the five study intersections during the AM and PM peak. The PM peak results should only be used to make general inferences about future traffic conditions. Additionally, Associated Engineering developed an estimate of anticipated traffic conditions at the four new collector road intersections (AM only) because of development within the North West Welland Secondary Plan.

Under the horizon year (2031), the intersection of Regional Road 54 (Rice Road) and Quaker Road and the intersection of First Avenue and Quaker Road will experience congestion and a Level of Service of F on some or all approaches to the intersection. Traffic signals are warranted at both intersections.

The eastbound left turn movement at the intersection of Regional Road 50 (Niagara Street) and Regional Road 37 (Merritt Road) will operate beyond capacity. No capacity issues were identified at the intersection of Pelham Street and Quaker Road or the intersection of Regional Road 50 (Niagara Street) and Quaker Road.

Under the horizon year (2031), the collector road intersections are anticipated to operate well below capacity in the AM peak. All the intersections should be able to operate with a Stop control on the minor road. There may be a need for left turn lanes (on the arterial road) in the future.

Based on the results of the previous assessment of traffic operations at the study intersections, the following improvements were considered.

- Quaker Road and Regional Road 54 (Rice Road) – signalization and addition of left turn lanes on all four approaches;
- Quaker Road and First Avenue – signalization and addition of left turn lanes on all four approaches; and
- Regional Road 50 (Niagara Street) and Regional Road 37 (Merritt Street) - Increase time for exclusive westbound left turn phase and increase storage for westbound left turn lane.

Based on the review of the anticipated Level of Service, the three intersections are anticipated to operate adequately under signal control. While not formally assessed, the intersection of Quaker Road and Regional Road 54 (Rice Road) and the intersection of Quaker Road and First Avenue are anticipated to operate adequately as a roundabout.

6.3 Anticipated Improvements

Based on the above, the following improvements are anticipated to be required to accommodate the level of traffic and for meeting future active transportation and transit needs because of the North West Welland Secondary Plan. Further traffic analysis should be undertaken closer to full build-out to further evaluate the timing and extent of the improvements.

Capacity Improvements

- Signalization of the intersection of Regional Road 54 (Rice Road) and Quaker Road with separate left turn lanes (30 metres on each approach) or a multi-lane roundabout (subject to a review of adjacent utilities and property requirements);
- Signalization of the intersection of First Avenue and Quaker Road with separate left turn lanes (30 metres on each approach) or a single-lane roundabout (subject to a review of adjacent utilities and property requirements)²;
- Increase westbound left turn lane storage (90 metres) and make phasing adjustments to the intersection of Regional Road 50 (Niagara Street) and Regional Road 37 (Merritt Road) by increasing the length of westbound left turn phase;
- Provide 30 metre left turn lanes for the collector road intersections on the major approaches:
- Northbound/southbound Rice Road at Street 'A'/Street 'B';
- Eastbound/westbound Quaker Road at Street 'B'/Street 'C'; and
- Northbound/southbound First Avenue at Street 'C'/Street 'D'.

Active Transportation

- Consider the provision of either dedicated bicycle lanes (both sides) or a multi-use pathway (on one side) of Quaker Road, Regional Road 54 (Rice Road) and First Avenue
- If bicycle lanes are being considered, provide 1.8 metre sidewalks along both sides of Quaker Road, Regional Road 54 (Rice Road) and First Avenue within the North West Welland Secondary Plan area
- Provide a 1.8 metre sidewalk on one side of the collector roads (Street 'A', Street 'B', Street 'C' and Street 'D')

Transit

- A dedicated transit line along the entire length of Quaker Road within the North West Welland Secondary Plan area
- Consider a transit line that services the low-density residential areas on the north and south side of Quaker Road

² This intersection did not meet the warranting requirements for a traffic signal.

6.4 Order of Magnitude Costs

The estimated order-of-magnitude cost for all the road works associated with the North West Welland Secondary Plan, including all the required improvements, is approximately **\$20.1 Million**. The order-of-magnitude cost assumes the following:

- Full reconstruction of City roads within the study limits (Quaker Road and First Avenue);
- 2800 metres of new collector road (Street 'A', Street 'B', Street 'C', and Street 'D'), built to City of Welland standards for a collector road;
- 7300 metres of new local road (not shown on preferred plan), built to City of Welland standards for a local road;
- Signalization of two intersections (Regional Road 54 (Rice Road) and Quaker Road and First Avenue and Quaker Road with left turn lanes (all approaches)
- 30 metre left turn lanes on
 - Northbound/southbound Rice Road at Street 'A'/Street 'B';
 - Eastbound/westbound Quaker Road at Street 'B'/Street 'C'; and
 - Northbound/southbound First Avenue at Street 'C'/Street 'D'.

APPENDIX A - TRAFFIC DATA

Signal Code: PLHQK						
Intersection: PELHAM ST.& QUAKER RD.						
Municipality: pelham						
Owner: city						
Last Modified: 5/14/2015 1:23:40 PM						
Timing Parameters	NBD & SBD THRU PELHAM RD.	EBD & WBD THRU QUAKER RD.	n/a	n/a	n/a	n/a
Min Green	10	8	0	0	0	0
Walk	10	10	0	0	0	0
Ped Clearance	17	16	0	0	0	0
Vehicle Ext.	2.5	2.5	0	0	0	0
Max Green	30	24	0	0	0	0
Yellow	4.1	4.1	0	0	0	0
All Red	2.2	2.4	0	0	0	0

		Offset
Minimum Cycle	30.8	0
Pedestrian Cycle	65.8	
Maximum Cycle	66.8	0
Operation	FA	

Installed On:

3/21/2005

Count Date:

7/23/2012

FA = Fully Actuated

SA = Semi Actuated

FT = Fixed Time

Close Window

Print Entry*

Refresh Entry

***Note: you need to change the paper orientation from Portrait to Landscape**

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Signal Code: 050QUK						
Intersection: RR50 (NIAGARA ST.) & QUAKER RD.						
Municipality: welland						
Owner: Region						
Last Modified: 1/24/2018 8:52:53 AM						
Timing Parameters	NBD & SBD ADVANCE NIAGARA ST.	NBD & SBD THRU NIAGARA ST.	EBD & WBD THRU QUAKER RD.	n/a	n/a	n/a
Min Green	6	10	8	0	0	0
Walk	0	9	11	0	0	0
Ped Clearance	0	14	18	0	0	0
Vehicle Ext.	2.5	2.5	2.5	0	0	0
Max Green	15	35	25	0	0	0
Yellow	3	4.1	4.1	0	0	0
All Red	0	2.5	2.8	0	0	0

		Offset
Minimum Cycle	31.5	0
Pedestrian Cycle	65.5	
Maximum Cycle	91.5	0
Operation	FA	

Installed On:

9/11/1995

Count Date:

7/14/2017

FA = Fully Actuated

SA = Semi Actuated

FT = Fixed Time

Close Window

Print Entry*

Refresh Entry

***Note: you need to change the paper orientation from Portrait to Landscape**

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Signal Code: 037050						
Intersection: RR37 (MERRITT RD.) & RR50 (NIAGARA ST.)						
Municipality: welland						
Owner: Region						
Last Modified: 4/9/2018 9:38:41 AM						
Timing Parameters	NBD & SBD NIAGARA ST.	WBD ADV. MERRITT RD.	EBD & WBD MERRITT RD.	n/a	n/a	n/a
Min Green	10	10	8	0	0	0
Walk	0	0	0	0	0	0
Ped Clearance	0	0	0	0	0	0
Vehicle Ext.	5	3	3	0	0	0
Max Green	40	15	20	0	0	0
Yellow	4.1	3	4.1	0	0	0
All Red	2.3	0	2	0	0	0

		Offset
Minimum Cycle	30.5	0
Pedestrian Cycle	0	
Maximum Cycle	90.5	0
Operation	FA	

Installed On:

1/29/2002

Count Date:

6/21/2016

FA = Fully Actuated

SA = Semi Actuated

FT = Fixed Time

Close Window

Print Entry*

Refresh Entry

***Note: you need to change the paper orientation from Portrait to Landscape**

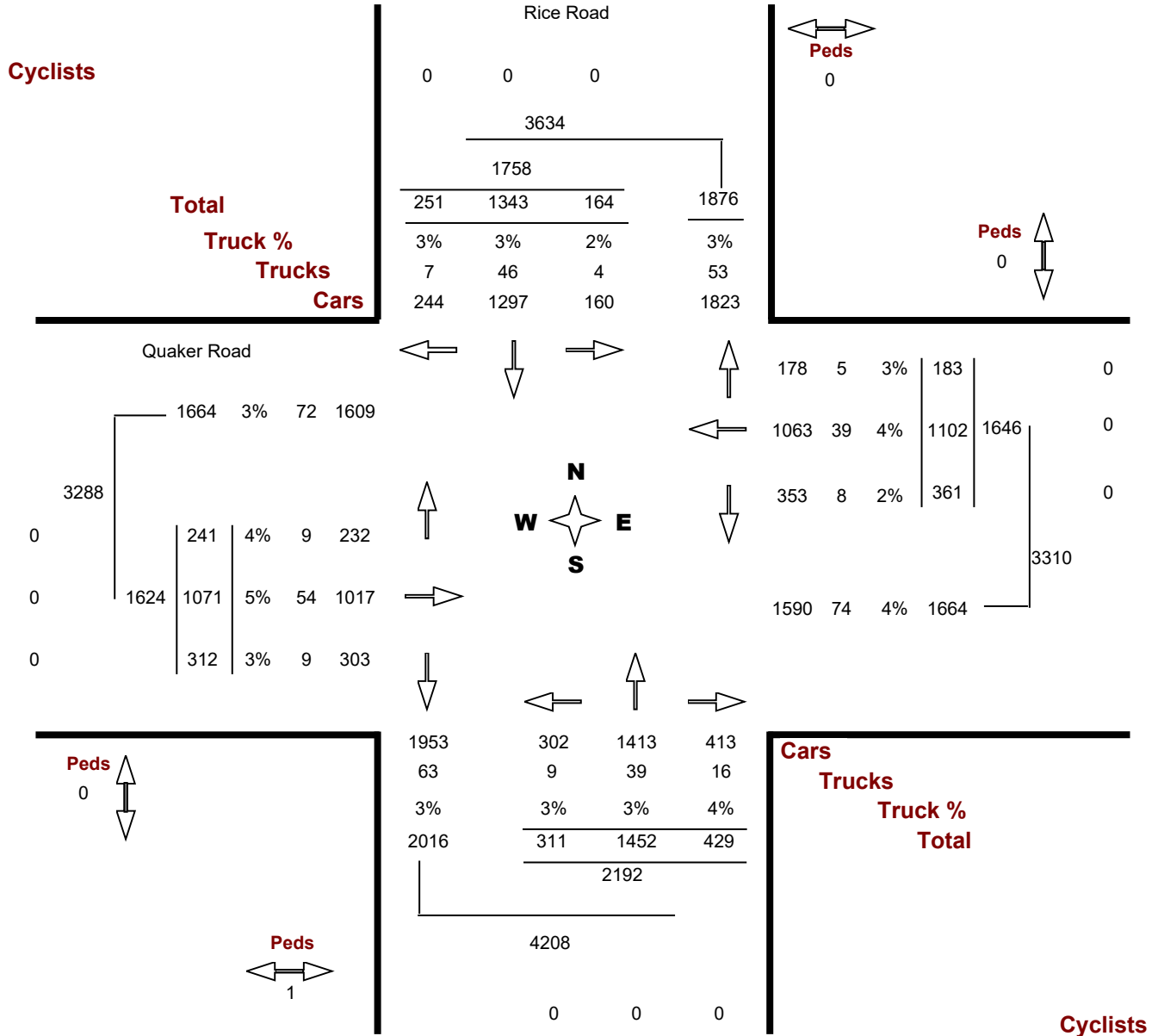
Copyright 2001 © Regional Niagara

Location..... Quaker Road @ Rice Road

Municipality..... WELLAND

GeoID..... 07178

Count Date..... Monday, 13 June, 2016



Location..... Quaker Road @ Rice Road

GeoID..... 07178

Municipality. WELLAND

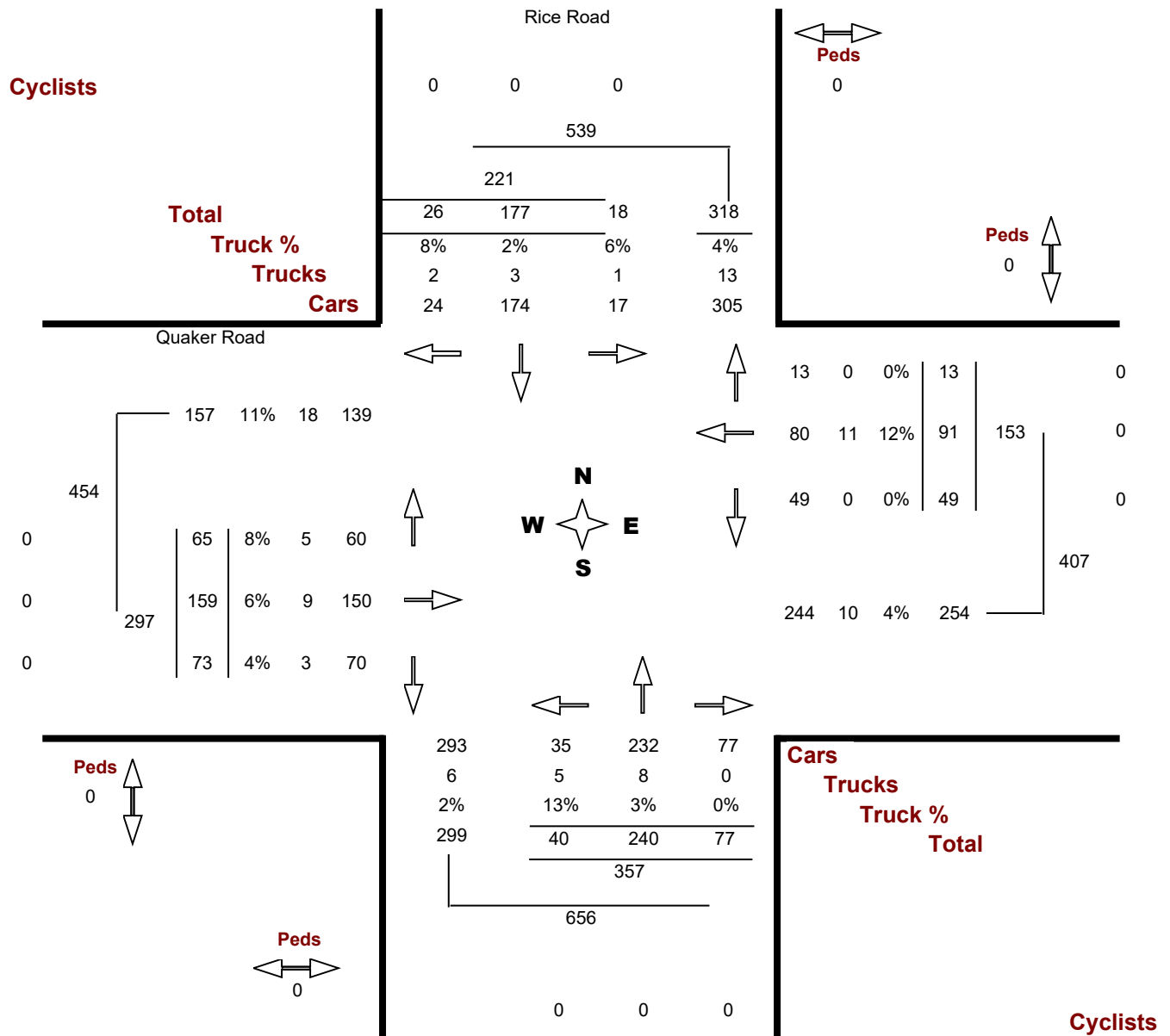
Count Date. Monday, 13 June, 2016

Traffic Cont. Stop sign

Count Time. 07:00 AM — 09:00 AM

Major Dir..... None

Peak Hour.. 07:45 AM — 08:45 AM



Location..... Quaker Road @ Rice Road

GeoID..... 07178

Municipality. WELLAND

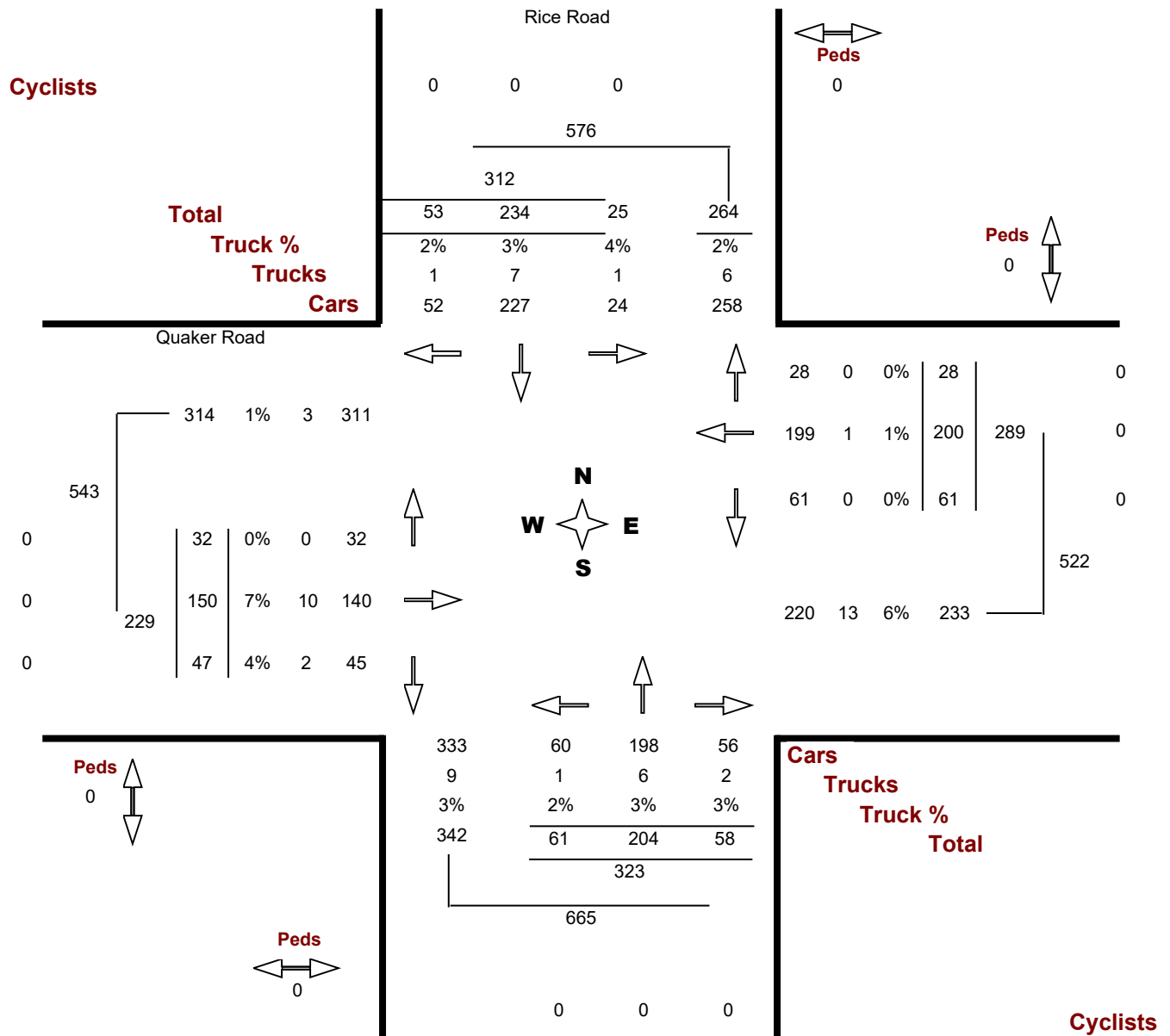
Count Date. Monday, 13 June, 2016

Traffic Cont. Stop sign

Count Time. 03:00 PM — 06:00 PM

Major Dir..... None

Peak Hour.. 03:45 PM — 04:45 PM



First Ave @ Quaker Rd

Total Count Diagram

Municipality: Welland
Site #: 000000002
Intersection: Quaker Rd & First Ave
TFR File #: 2
Count date: 22-Mar-2016

Weather conditions:
 Clear/Dry
Person(s) who counted:
 Diane

**** Non-Signalized Intersection ****

Major Road: Quaker Rd runs W/E

North Leg Total: 2421
 North Entering: 1327
 North Peds: 0
 Peds Cross: ∇

Heavys	1	0	0	1
Trucks	3	14	0	17
Cars	216	1038	55	1309
Totals	220	1052	55	

Heavys	1
Trucks	13
Cars	1080
Totals	1094

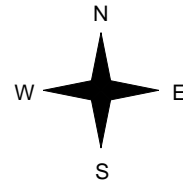
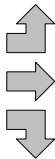
East Leg Total: 4434
 East Entering: 2157
 East Peds: 1
 Peds Cross: ∇

Heavys	Trucks	Cars	Totals
3	56	1724	1783



Quaker Rd

Heavys	Trucks	Cars	Totals
1	1	150	152
4	38	1304	1346
1	15	267	283
6	54	1721	



First Ave

Cars	Trucks	Heavys	Totals
58	0	0	58
1259	44	2	1305
733	60	1	794
2050	104	3	

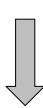


Quaker Rd

Cars	Trucks	Heavys	Totals
2189	83	5	2277

Peds Cross: ∇
 West Peds: 0
 West Entering: 1781
 West Leg Total: 3564

Cars	2038
Trucks	89
Heavys	2
Totals	2129



Cars	249	872	830	1951
Trucks	9	12	45	66
Heavys	0	0	1	1
Totals	258	884	876	

Peds Cross: ∇
 South Peds: 1
 South Entering: 2018
 South Leg Total: 4147

Comments

First Ave @ Quaker Rd

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 8:00:00

To: 9:00:00

Municipality: Welland
Site #: 000000002
Intersection: Quaker Rd & First Ave
TFR File #: 2
Count date: 22-Mar-2016

Weather conditions:
 Clear/Dry
Person(s) who counted:
 Diane

**** Non-Signalized Intersection ****

Major Road: Quaker Rd runs W/E

North Leg Total: 393
 North Entering: 237
 North Peds: 0
 Peds Cross: \times

Heavys	0	0	0	0
Trucks	1	4	0	5
Cars	33	197	2	232
Totals	34	201	2	



Heavys	0
Trucks	1
Cars	155
Totals	156

East Leg Total: 657
 East Entering: 323
 East Peds: 0
 Peds Cross: \times

Heavys	0
Trucks	8
Cars	232
Totals	240

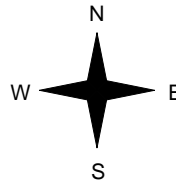


First Ave

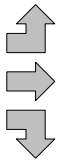
Cars	8	0	0	8
Trucks	137	4	0	141
Heavys	159	15	0	174
Totals	304	19	0	



Quaker Rd



Heavys	0
Trucks	0
Cars	32
Totals	32
Heavys	0
Trucks	13
Cars	204
Totals	217
Heavys	0
Trucks	4
Cars	56
Totals	60
Heavys	0
Trucks	17
Cars	292
Totals	292



First Ave

Quaker Rd



Cars	308	26	0	334
Trucks				
Heavys				
Totals	308	26	0	334

Peds Cross: \times
 West Peds: 0
 West Entering: 309
 West Leg Total: 549

Cars	412	62	115	102	279
Trucks	23	3	1	13	17
Heavys	0	0	0	0	0
Totals	435	65	116	115	



Peds Cross: \times
 South Peds: 0
 South Entering: 296
 South Leg Total: 731

Comments

First Ave @ Quaker Rd

Afternoon Peak Diagram

Specified Period

From: 15:00:00
To: 18:00:00

One Hour Peak

From: 16:15:00
To: 17:15:00

Municipality: Welland
Site #: 000000002
Intersection: Quaker Rd & First Ave
TFR File #: 2
Count date: 22-Mar-2016

Weather conditions:
Clear/Dry
Person(s) who counted:
Diane

**** Non-Signalized Intersection ****

Major Road: Quaker Rd runs W/E

North Leg Total: 392
North Entering: 221
North Peds: 0
Peds Cross: \times

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	41	173	7	221
Totals	41	173	7	



Heavys	0
Trucks	2
Cars	169
Totals	171

East Leg Total: 728
East Entering: 366
East Peds: 0
Peds Cross: \times

Heavys	0
Trucks	4
Cars	305
Totals	309

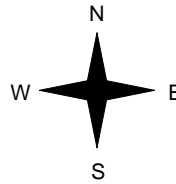


First Ave

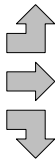
Cars	8	0	0	8
Trucks	241	4	0	245
Heavys	104	9	0	113
Totals	353	13	0	



Quaker Rd



Heavys	0
Trucks	0
Cars	21
Totals	21
Heavys	0
Trucks	7
Cars	173
Totals	180
Heavys	0
Trucks	0
Cars	44
Totals	44
Heavys	0
Trucks	7
Cars	238
Totals	245



Quaker Rd



First Ave



Cars	349	13	0	362
Trucks				
Heavys				
Totals				

Peds Cross: \times
West Peds: 0
West Entering: 245
West Leg Total: 554

Cars	321	23	140	169	332
Trucks	9	0	2	6	8
Heavys	0	0	0	0	0
Totals	330	23	142	175	



Peds Cross: \times
South Peds: 0
South Entering: 340
South Leg Total: 670

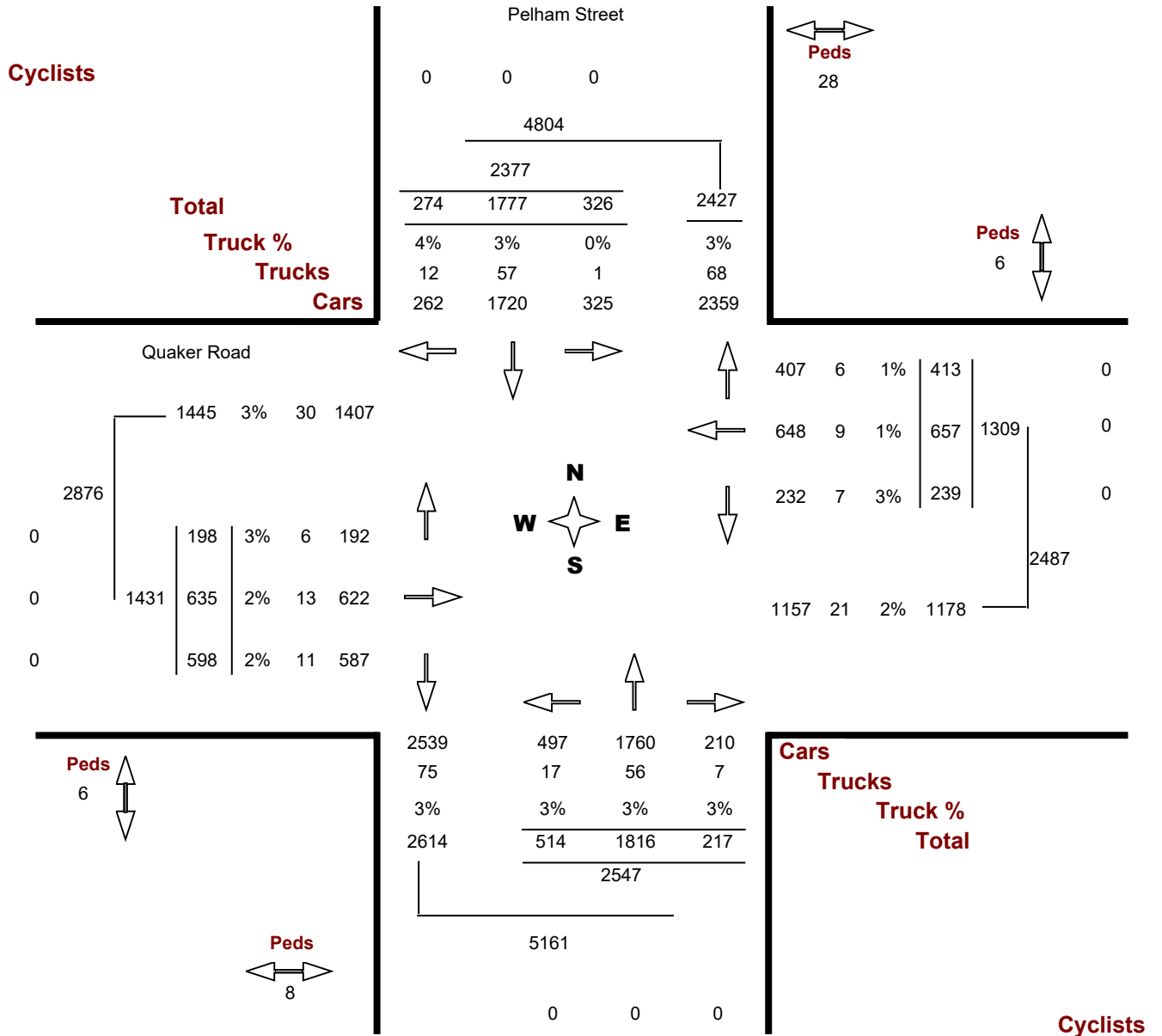
Comments

Location..... Pelham Street @ Quaker Road

Municipality..... PELHAM

GeoID..... 00488

Count Date..... Monday, 23 July, 2012



Location..... Pelham Street @ Quaker Road

GeoID..... 00488

Municipality. PELHAM

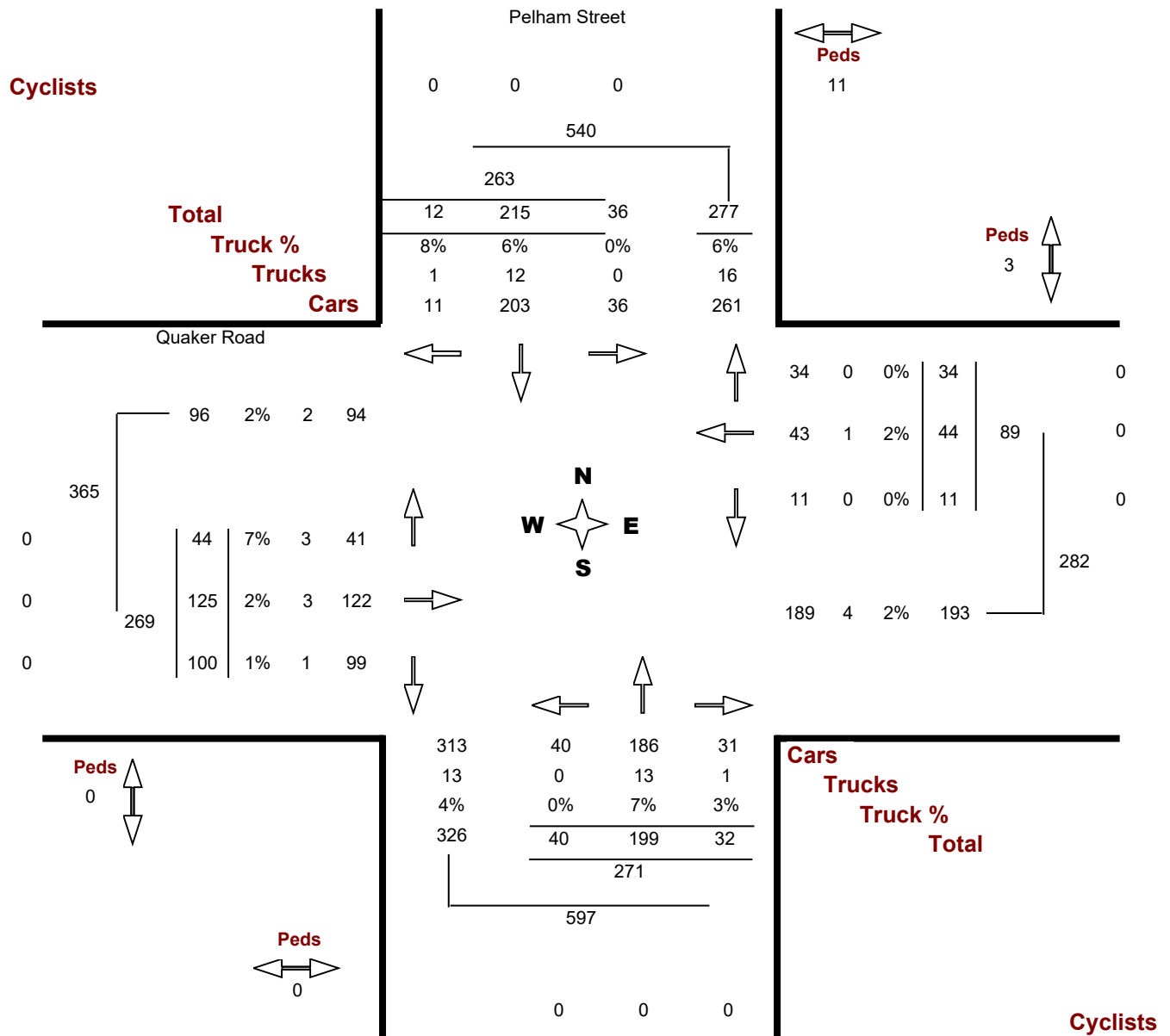
Count Date. Monday, 23 July, 2012

Traffic Cont. Traffic signal

Count Time. 07:00 AM — 09:00 AM

Major Dir..... None

Peak Hour.. 08:00 AM — 09:00 AM



Location..... Pelham Street @ Quaker Road

GeoID..... 00488

Municipality. PELHAM

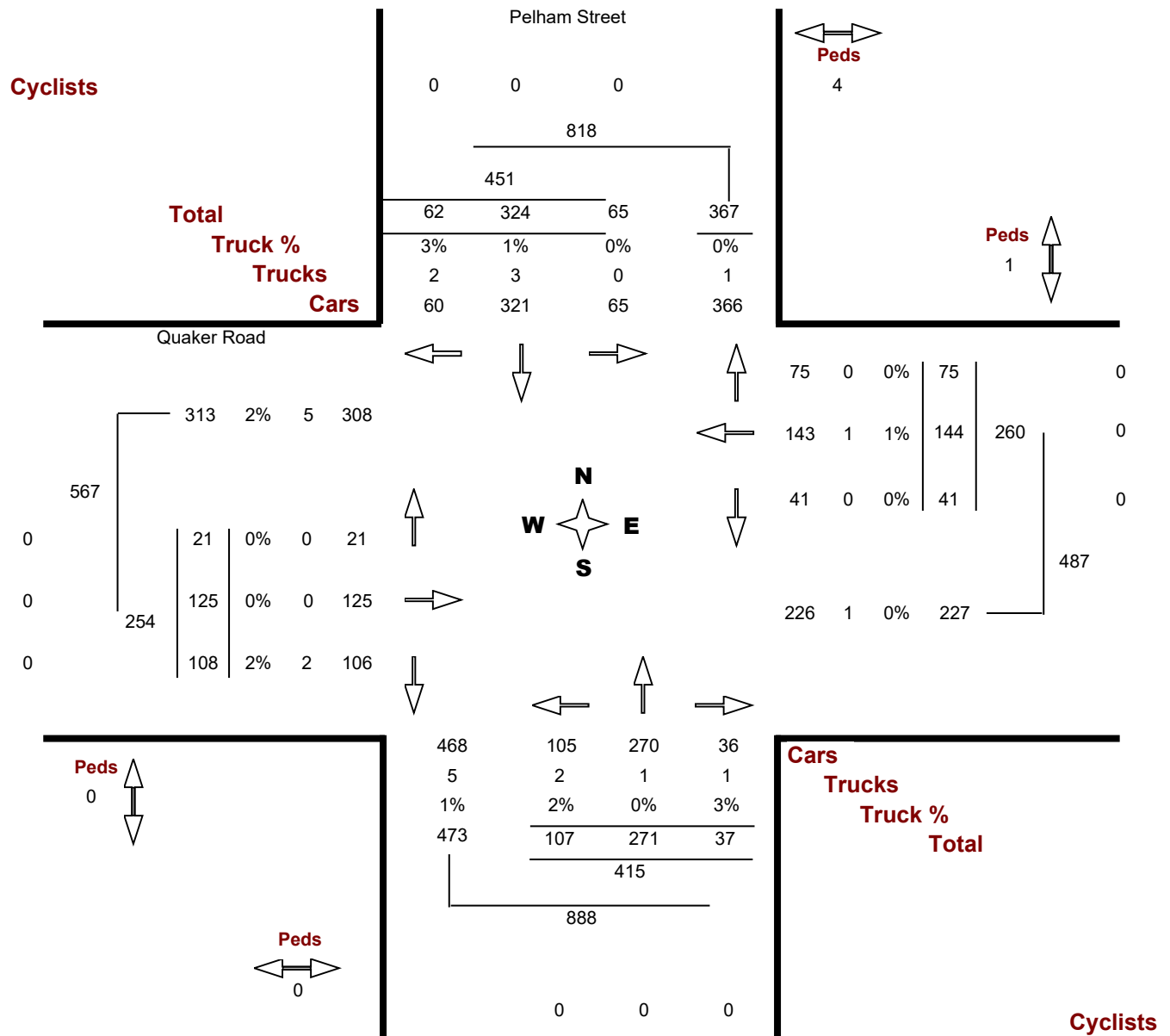
Count Date. Monday, 23 July, 2012

Traffic Cont. Traffic signal

Count Time. 03:00 PM — 06:00 PM

Major Dir..... None

Peak Hour.. 05:00 PM — 06:00 PM

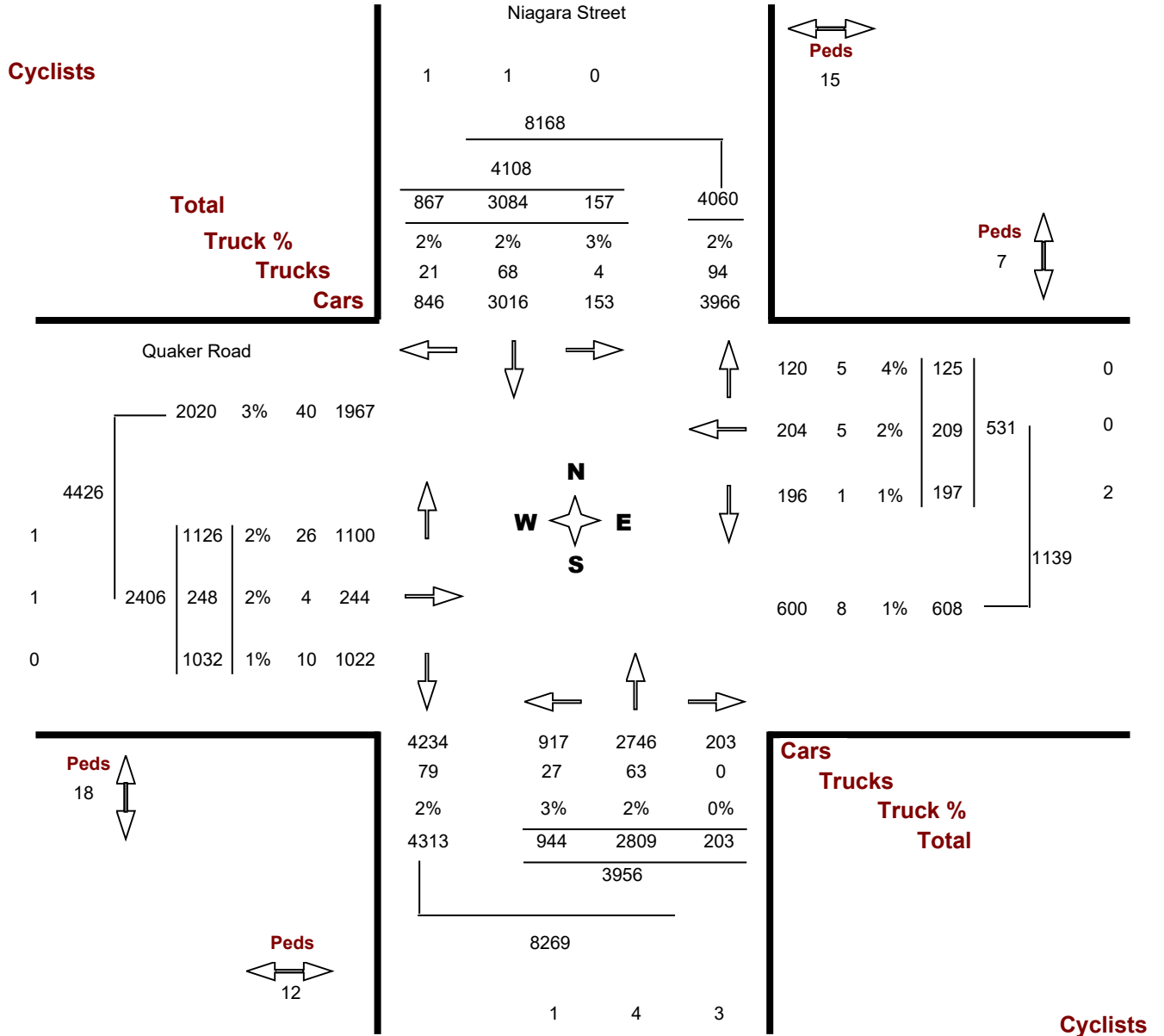


Location..... Niagara Street @ Quaker Road

Municipality..... WELLAND

GeoID..... 00838

Count Date..... Friday, 14 July, 2017



Location..... Niagara Street @ Quaker Road

GeoID..... 00838

Municipality. WELLAND

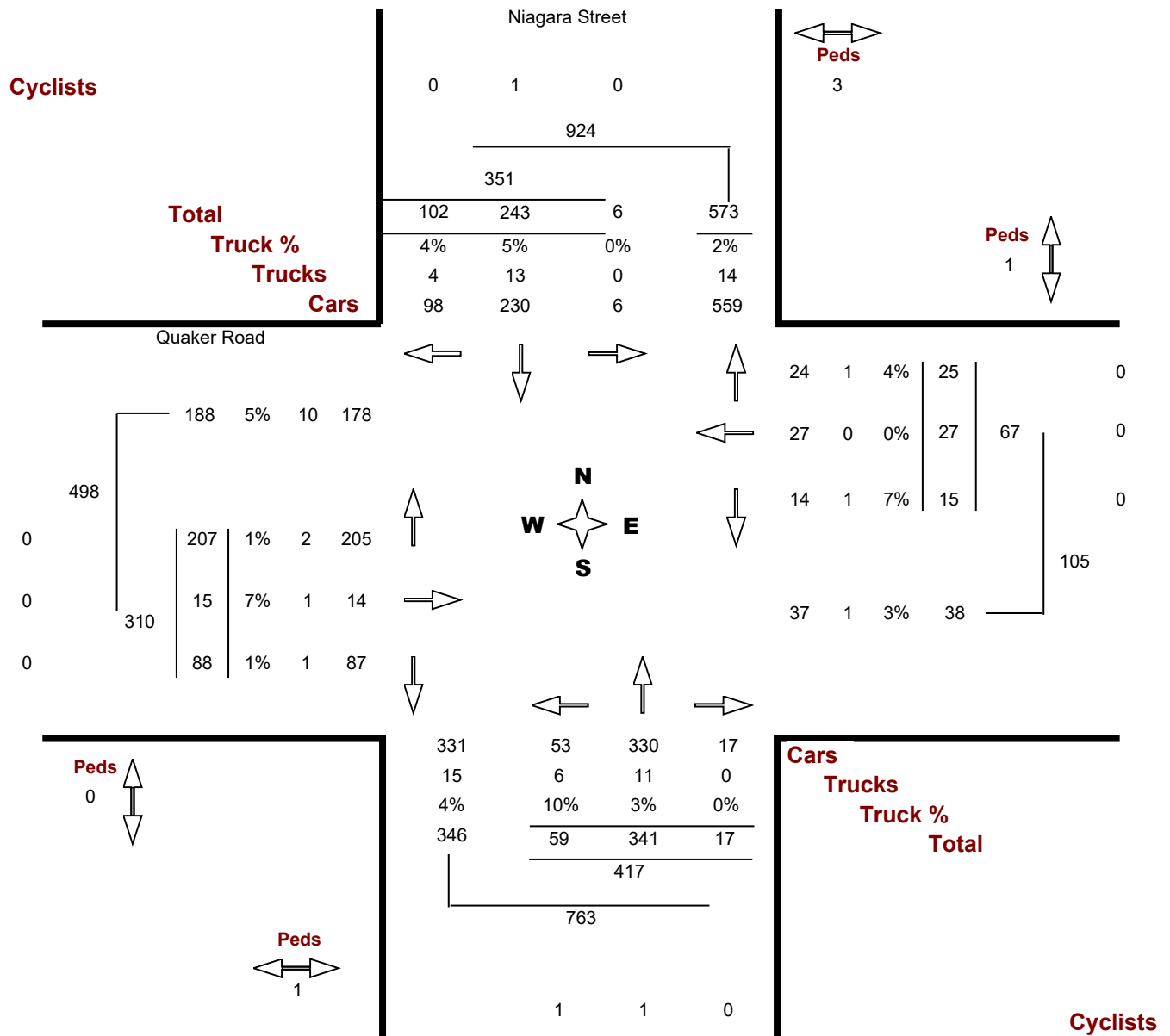
Count Date. Friday, 14 July, 2017

Traffic Cont. Traffic signal

Count Time. 07:00 AM — 09:00 AM

Major Dir..... None

Peak Hour.. 08:00 AM — 09:00 AM



Location..... Niagara Street @ Quaker Road

GeoID..... 00838

Municipality. WELLAND

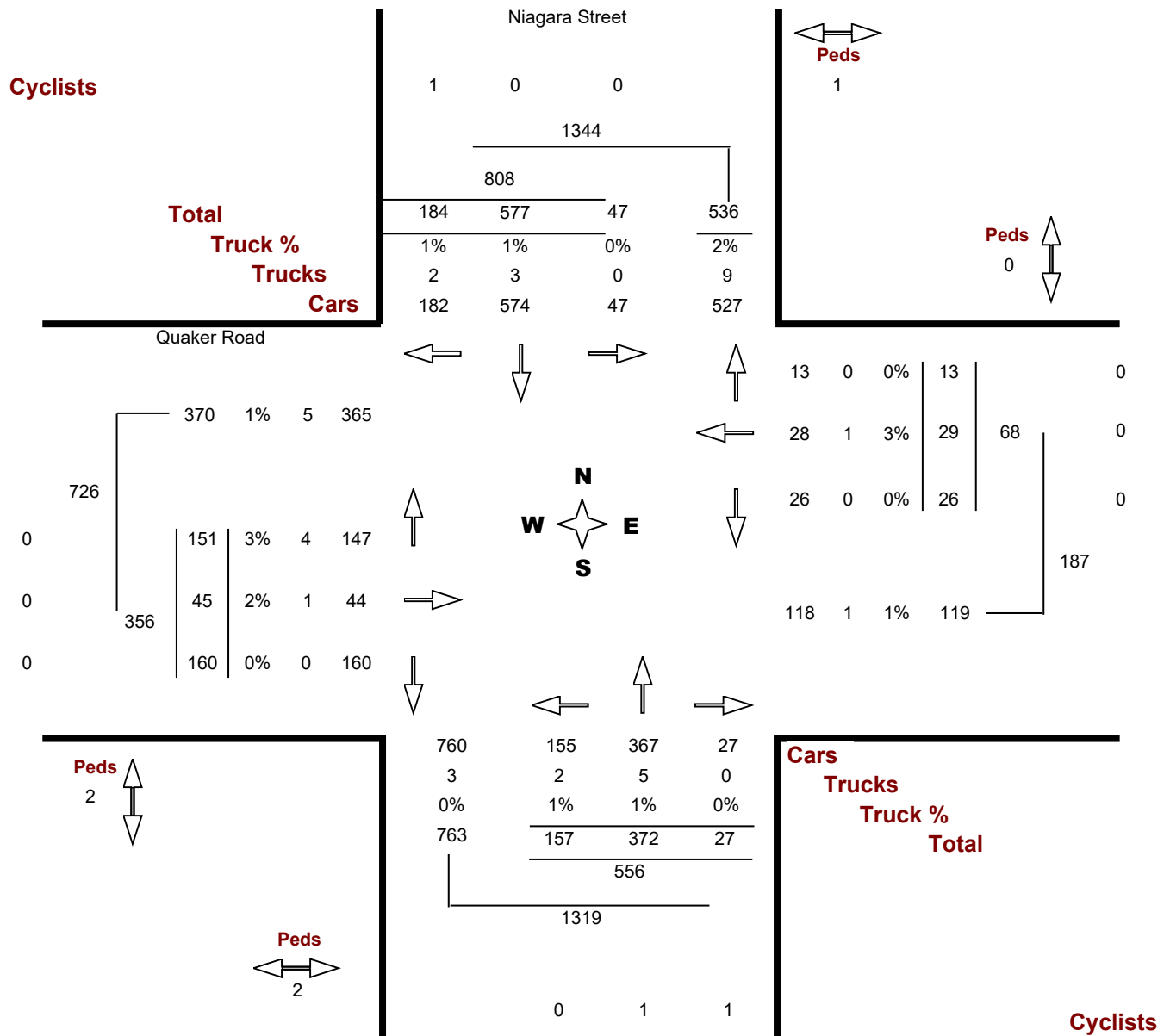
Count Date. Friday, 14 July, 2017

Traffic Cont. Traffic signal

Count Time. 03:00 PM — 06:00 PM

Major Dir..... None

Peak Hour.. 04:15 PM — 05:15 PM

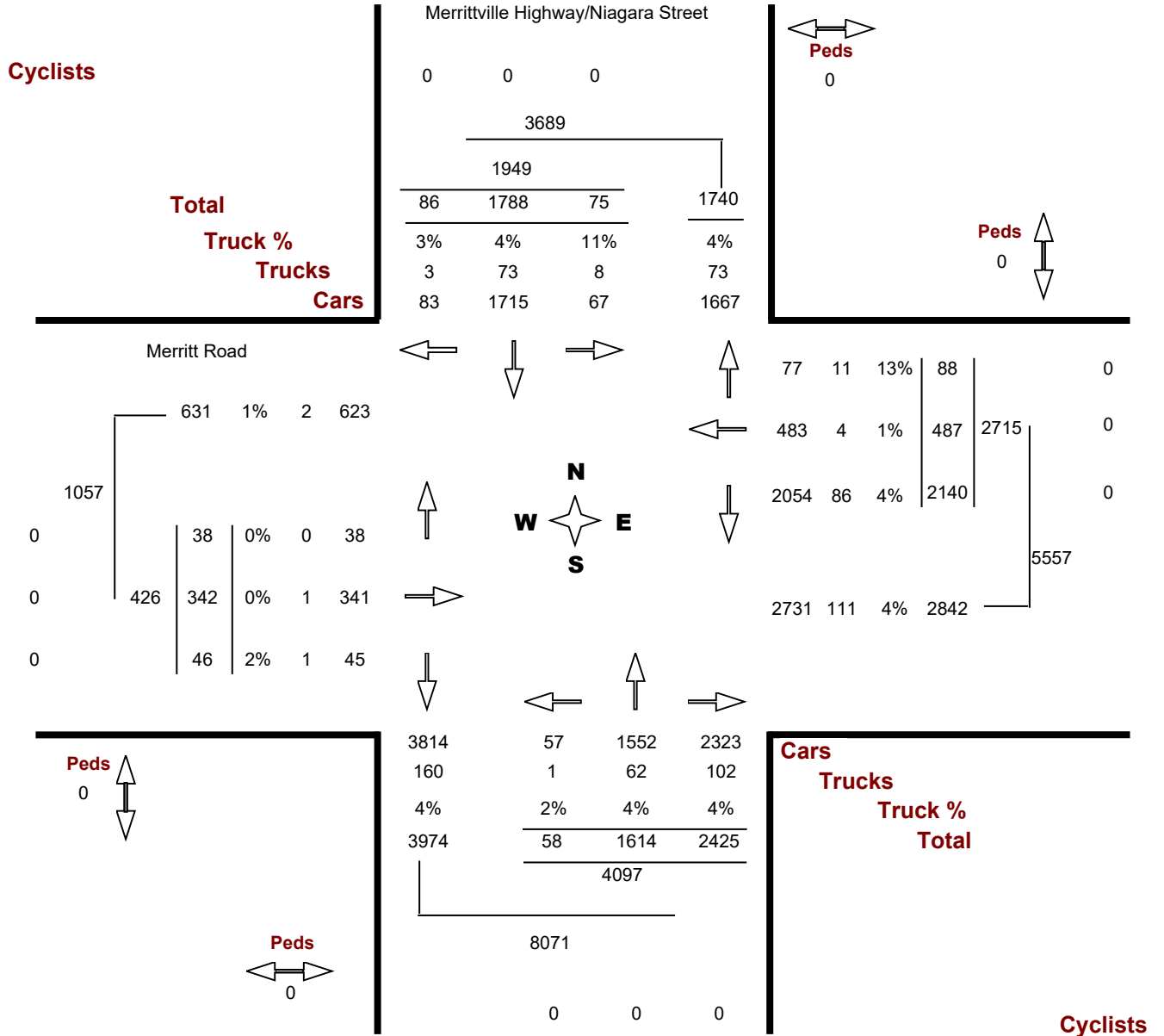


Location..... Merritt Road @ Merrittville Highway/Niagara Street

Municipality..... WELLAND

GeoID..... 00424

Count Date..... Tuesday, 21 June, 2016



Location..... Merritt Road @ Merrittville Highway/Niagara Street

GeoID..... 00424

Municipality. WELLAND

Count Date. Tuesday, 21 June, 2016

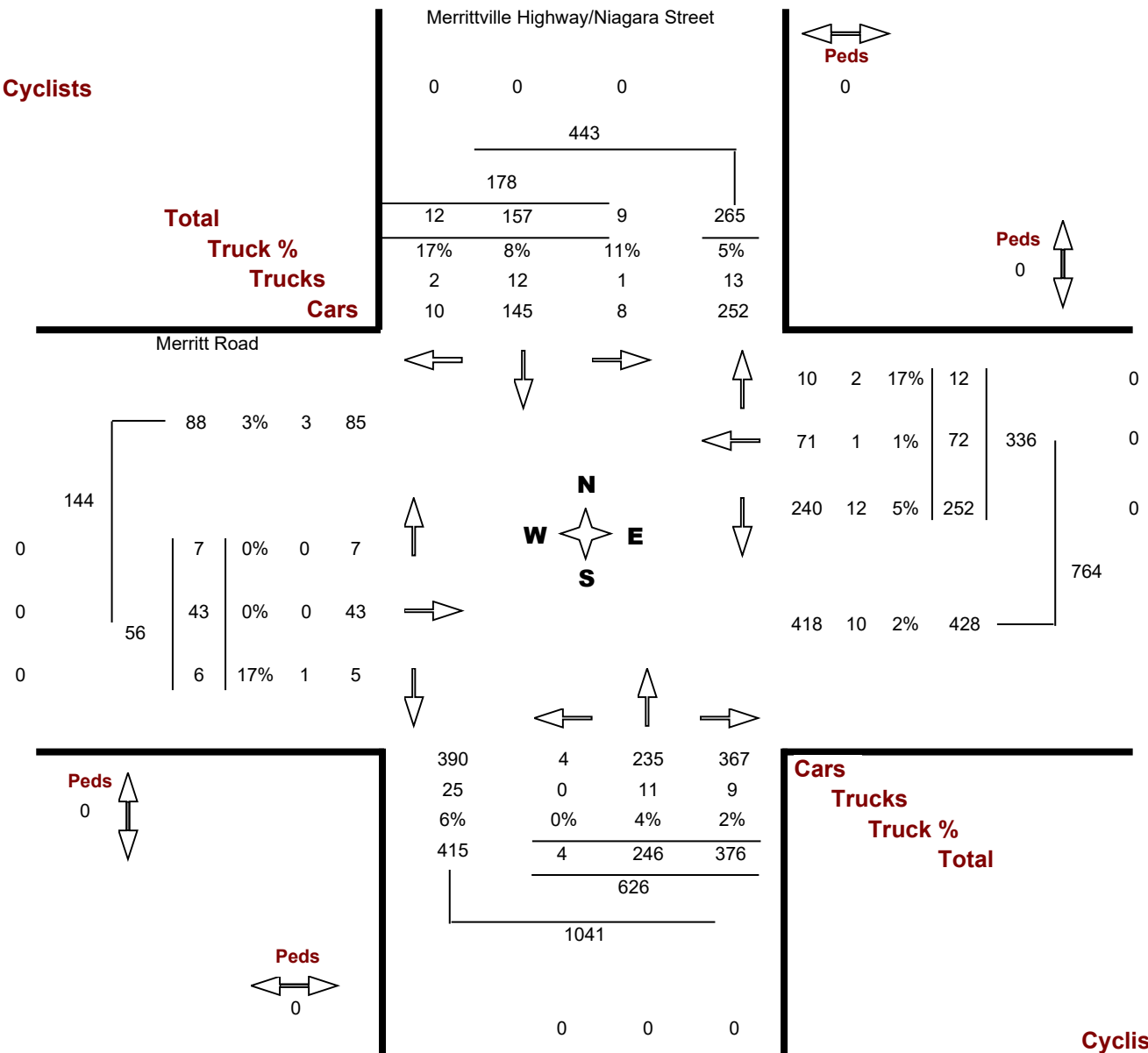
Traffic Cont. Traffic signal

Count Time. 07:00 AM — 09:00 AM

Major Dir..... None

Peak Hour.. 07:45 AM — 08:45 AM

Cyclists



Location..... Merritt Road @ Merrittville Highway/Niagara Street

GeoID..... 00424

Municipality. WELLAND

Count Date. Tuesday, 21 June, 2016

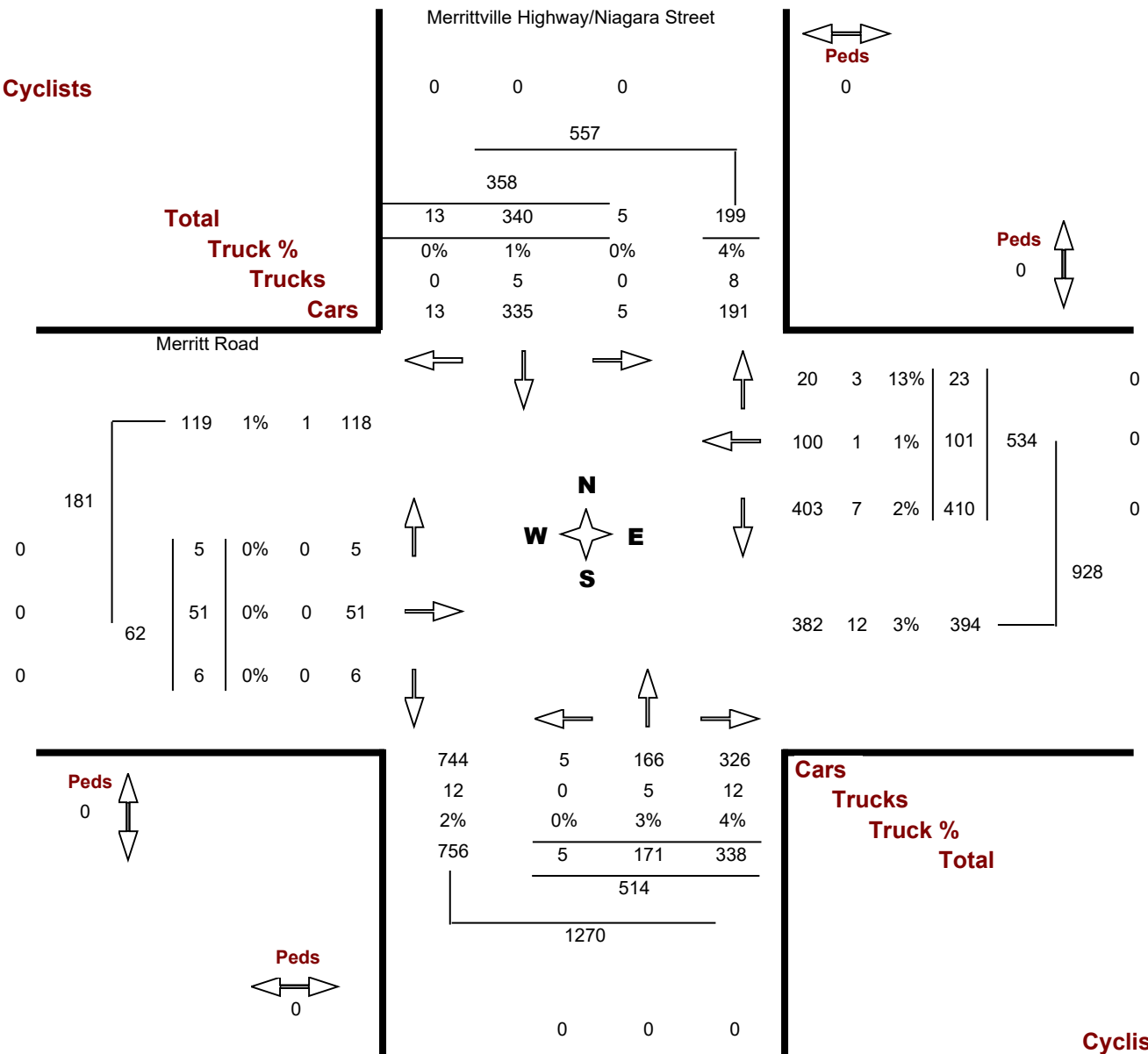
Traffic Cont. Traffic signal

Count Time. 03:00 PM — 06:00 PM

Major Dir..... None

Peak Hour.. 04:30 PM — 05:30 PM

Cyclists



APPENDIX B - TRAFFIC OPERATIONS ASSESSMENT REPORTS (BASE YEAR, BACKGROUND TRAFFIC)

Intersection

Intersection Delay, s/veh	17.1
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	65	159	73	49	91	13	40	240	77	18	177	26
Future Vol, veh/h	65	159	73	49	91	13	40	240	77	18	177	26
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	8	6	4	0	12	0	13	3	0	6	2	8
Mvmt Flow	71	173	79	53	99	14	43	261	84	20	192	28
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	17.3	12.7	20.6	14.2
HCM LOS	C	B	C	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	11%	22%	32%	8%
Vol Thru, %	67%	54%	59%	80%
Vol Right, %	22%	25%	8%	12%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	357	297	153	221
LT Vol	40	65	49	18
Through Vol	240	159	91	177
RT Vol	77	73	13	26
Lane Flow Rate	388	323	166	240
Geometry Grp	1	1	1	1
Degree of Util (X)	0.663	0.566	0.309	0.427
Departure Headway (Hd)	6.152	6.31	6.684	6.402
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	586	571	536	562
Service Time	4.201	4.362	4.748	4.459
HCM Lane V/C Ratio	0.662	0.566	0.31	0.427
HCM Control Delay	20.6	17.3	12.7	14.2
HCM Lane LOS	C	C	B	B
HCM 95th-tile Q	4.9	3.5	1.3	2.1

Intersection	
Intersection Delay, s/veh	21.8
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	32	217	60	174	141	8	65	116	115	2	201	34
Future Vol, veh/h	32	217	60	174	141	8	65	116	115	2	201	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	6	7	9	3	0	5	1	11	0	2	3
Mvmt Flow	35	236	65	189	153	9	71	126	125	2	218	37
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	21.7	25.3	21.2	17.8
HCM LOS	C	D	C	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	22%	10%	54%	1%
Vol Thru, %	39%	70%	44%	85%
Vol Right, %	39%	19%	2%	14%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	296	309	323	237
LT Vol	65	32	174	2
Through Vol	116	217	141	201
RT Vol	115	60	8	34
Lane Flow Rate	322	336	351	258
Geometry Grp	1	1	1	1
Degree of Util (X)	0.626	0.643	0.698	0.516
Departure Headway (Hd)	7.001	6.895	7.159	7.216
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	515	521	502	497
Service Time	5.065	4.962	5.223	5.288
HCM Lane V/C Ratio	0.625	0.645	0.699	0.519
HCM Control Delay	21.2	21.7	25.3	17.8
HCM Lane LOS	C	C	D	C
HCM 95th-tile Q	4.3	4.5	5.4	2.9

Lanes, Volumes, Timings
 100: Rice Road & Quaker Rd

04/19/2018



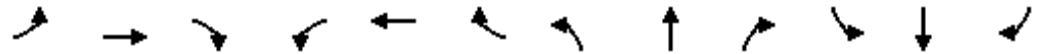
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	65	159	73	49	91	13	40	240	77	18	177	26
Future Volume (vph)	65	159	73	49	91	13	40	240	77	18	177	26
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.967			0.989			0.971			0.984	
Flt Protected		0.989			0.984			0.994			0.996	
Satd. Flow (prot)	0	1562	0	0	1572	0	0	1614	0	0	1646	0
Flt Permitted		0.989			0.984			0.994			0.996	
Satd. Flow (perm)	0	1562	0	0	1572	0	0	1614	0	0	1646	0
Link Speed (k/h)		50			50			40			50	
Link Distance (m)		836.8			819.8			627.0			519.3	
Travel Time (s)		60.2			59.0			56.4			37.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	8%	6%	4%	0%	12%	0%	13%	3%	0%	6%	2%	8%
Adj. Flow (vph)	71	173	79	53	99	14	43	261	84	20	192	28
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	323	0	0	166	0	0	388	0	0	240	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		2.5			2.5			2.5			2.5	
Two way Left Turn Lane												
Headway Factor	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	58.3%
ICU Level of Service	B
Analysis Period (min)	15

Lanes, Volumes, Timings
200: First Ave & Quaker Rd

04/19/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	32	217	60	174	141	8	65	116	115	2	201	34
Future Volume (vph)	32	217	60	174	141	8	65	116	115	2	201	34
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.974			0.997			0.948			0.981	
Flt Protected		0.995			0.974			0.989				
Satd. Flow (prot)	0	1589	0	0	1583	0	0	1534	0	0	1662	0
Flt Permitted		0.995			0.974			0.989				
Satd. Flow (perm)	0	1589	0	0	1583	0	0	1534	0	0	1662	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		819.8			825.5			222.1			515.9	
Travel Time (s)		59.0			59.4			16.0			37.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	6%	7%	9%	3%	0%	5%	1%	11%	0%	2%	3%
Adj. Flow (vph)	35	236	65	189	153	9	71	126	125	2	218	37
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	336	0	0	351	0	0	322	0	0	257	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		2.5			2.5			2.5			2.5	
Two way Left Turn Lane												
Headway Factor	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	82.7%
ICU Level of Service	E
Analysis Period (min)	15

Lanes, Volumes, Timings
300: Pelham St & Welland Rd/Quaker Rd

04/19/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘		↗	↘	
Traffic Volume (vph)	44	125	100	11	44	34	40	199	32	36	215	12
Future Volume (vph)	44	125	100	11	44	34	40	199	32	36	215	12
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	0.0		0.0	55.0		0.0	55.0		0.0
Storage Lanes	0		0	0		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00			0.99			1.00		1.00		
Frt		0.950			0.949			0.979			0.992	
Flt Protected		0.992			0.994		0.950			0.950		
Satd. Flow (prot)	0	1592	0	0	1596	0	1644	1586	0	1644	1618	0
Flt Permitted		0.935			0.938		0.606			0.603		
Satd. Flow (perm)	0	1497	0	0	1506	0	1049	1586	0	1041	1618	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		53			37			17			6	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		251.9			404.7			1006.2			780.9	
Travel Time (s)		18.1			29.1			60.4			46.9	
Confl. Peds. (#/hr)	11						11		3	3		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	7%	2%	1%	0%	2%	0%	0%	7%	3%	0%	6%	8%
Adj. Flow (vph)	48	136	109	12	48	37	43	216	35	39	234	13
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	293	0	0	97	0	43	251	0	39	247	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		2.5			2.5			2.5			2.5	
Two way Left Turn Lane												
Headway Factor	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lanes, Volumes, Timings
300: Pelham St & Welland Rd/Quaker Rd

04/19/2018

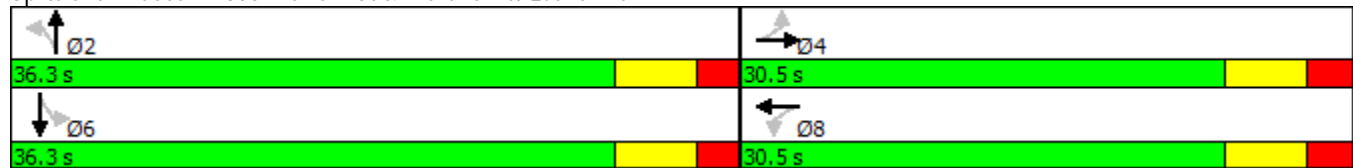


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	14.5	14.5		14.5	14.5		16.3	16.3		16.3	16.3	
Total Split (s)	30.5	30.5		30.5	30.5		36.3	36.3		36.3	36.3	
Total Split (%)	45.7%	45.7%		45.7%	45.7%		54.3%	54.3%		54.3%	54.3%	
Maximum Green (s)	24.0	24.0		24.0	24.0		30.0	30.0		30.0	30.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.4	2.4		2.4	2.4		2.2	2.2		2.2	2.2	
Lost Time Adjust (s)		-2.5			-2.5		-2.3	-2.3		-2.3	-2.3	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Walk Time (s)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10.0	
Flash Dont Walk (s)	16.0	16.0		16.0	16.0		17.0	17.0		17.0	17.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		13.7			13.7		14.2	14.2		14.2	14.2	
Actuated g/C Ratio		0.38			0.38		0.39	0.39		0.39	0.39	
v/c Ratio		0.49			0.16		0.10	0.40		0.10	0.39	
Control Delay		10.3			6.2		8.7	10.3		8.6	10.5	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		10.3			6.2		8.7	10.3		8.6	10.5	
LOS		B			A		A	B		A	B	
Approach Delay		10.3			6.2			10.0			10.2	
Approach LOS		B			A			B			B	
90th %ile Green (s)	17.5	17.5		17.5	17.5		17.1	17.1		17.1	17.1	
90th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Gap		Hold	Hold	
70th %ile Green (s)	12.8	12.8		12.8	12.8		12.4	12.4		12.4	12.4	
70th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Gap		Gap	Gap	
50th %ile Green (s)	10.3	10.3		10.3	10.3		10.1	10.1		10.1	10.1	
50th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Gap		Gap	Gap	
30th %ile Green (s)	8.4	8.4		8.4	8.4		10.0	10.0		10.0	10.0	
30th %ile Term Code	Gap	Gap		Hold	Hold		Min	Min		Min	Min	
10th %ile Green (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
10th %ile Term Code	Min	Min		Hold	Hold		Min	Min		Min	Min	
Queue Length 50th (m)		8.7			1.9		1.4	8.6		1.3	8.9	
Queue Length 95th (m)		27.9			9.1		6.5	26.1		6.1	26.3	
Internal Link Dist (m)		227.9			380.7			982.2			756.9	
Turn Bay Length (m)							55.0			55.0		
Base Capacity (vph)		1140			1142		945	1430		937	1458	
Starvation Cap Reductn		0			0		0	0		0	0	
Spillback Cap Reductn		0			0		0	0		0	0	
Storage Cap Reductn		0			0		0	0		0	0	
Reduced v/c Ratio		0.26			0.08		0.05	0.18		0.04	0.17	

Intersection Summary

Area Type:	Other
Cycle Length:	66.8
Actuated Cycle Length:	36.1
Natural Cycle:	40
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.49
Intersection Signal Delay:	9.8
Intersection LOS:	A
Intersection Capacity Utilization	55.8%
ICU Level of Service	B
Analysis Period (min)	15
90th %ile Actuated Cycle:	47.4
70th %ile Actuated Cycle:	38
50th %ile Actuated Cycle:	33.2
30th %ile Actuated Cycle:	31.2
10th %ile Actuated Cycle:	30.8

Splits and Phases: 300: Pelham St & Welland Rd/Quaker Rd



Lanes, Volumes, Timings
400: Niagara St & Quaker Rd

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Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	207	15	88	15	27	25	59	341	17	6	243	102
Future Volume (vph)	207	15	88	15	27	25	59	341	17	6	243	102
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	65.0		0.0	20.0		0.0	75.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			55.0			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor	1.00	0.99		1.00	0.99			1.00		1.00		
Frt		0.871			0.928			0.993				0.956
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1628	1463	0	1536	1564	0	1495	3171	0	1644	3002	0
Flt Permitted	0.720			0.685			0.421			0.522		
Satd. Flow (perm)	1230	1463	0	1107	1564	0	662	3171	0	902	3002	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		96			27			6				80
Link Speed (k/h)		50			50			50				60
Link Distance (m)		825.5			214.4			467.2				1021.4
Travel Time (s)		59.4			15.4			33.6				61.3
Confl. Peds. (#/hr)	3		1	1		3			1	1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	7%	1%	7%	0%	4%	10%	3%	0%	0%	5%	4%
Adj. Flow (vph)	225	16	96	16	29	27	64	371	18	7	264	111
Shared Lane Traffic (%)												
Lane Group Flow (vph)	225	112	0	16	56	0	64	389	0	7	375	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5				3.5
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		2.5			2.5			2.5				2.5
Two way Left Turn Lane								Yes				
Headway Factor	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lanes, Volumes, Timings
400: Niagara St & Quaker Rd

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Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	14.9	14.9		14.9	14.9		11.1	16.6		11.1	16.6	
Total Split (s)	35.9	35.9		35.9	35.9		18.0	41.6		18.0	41.6	
Total Split (%)	37.6%	37.6%		37.6%	37.6%		18.8%	43.6%		18.8%	43.6%	
Maximum Green (s)	29.0	29.0		29.0	29.0		15.0	35.0		15.0	35.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		3.0	4.1		3.0	4.1	
All-Red Time (s)	2.8	2.8		2.8	2.8		0.0	2.5		0.0	2.5	
Lost Time Adjust (s)	-2.9	-2.9		-2.9	-2.9		1.0	-2.6		1.0	-2.6	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		None	Min		None	Min	
Walk Time (s)	11.0	11.0		11.0	11.0			9.0			9.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			14.0			14.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	17.1	17.1		17.1	17.1		20.1	19.0		17.3	14.8	
Actuated g/C Ratio	0.37	0.37		0.37	0.37		0.44	0.41		0.38	0.32	
v/c Ratio	0.49	0.19		0.04	0.09		0.16	0.30		0.02	0.37	
Control Delay	16.8	4.9		11.4	7.8		9.2	11.0		8.7	12.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	16.8	4.9		11.4	7.8		9.2	11.0		8.7	12.8	
LOS	B	A		B	A		A	B		A	B	
Approach Delay		12.8			8.6			10.8			12.8	
Approach LOS		B			A			B			B	
90th %ile Green (s)	23.0	23.0		23.0	23.0		8.8	18.0		6.0	15.2	
90th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Hold		Min	Gap	
70th %ile Green (s)	16.4	16.4		16.4	16.4		8.0	23.1		0.0	12.1	
70th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Hold		Skip	Gap	
50th %ile Green (s)	13.4	13.4		13.4	13.4		6.9	20.0		0.0	10.1	
50th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Hold		Skip	Gap	
30th %ile Green (s)	10.9	10.9		10.9	10.9		0.0	10.0		0.0	10.0	
30th %ile Term Code	Gap	Gap		Hold	Hold		Skip	Min		Skip	Min	
10th %ile Green (s)	8.0	8.0		8.0	8.0		0.0	10.5		0.0	10.5	
10th %ile Term Code	Min	Min		Hold	Hold		Skip	Dwell		Skip	Dwell	
Queue Length 50th (m)	14.3	0.8		0.9	1.6		2.6	8.8		0.3	10.2	
Queue Length 95th (m)	35.3	9.0		4.2	7.7		9.6	28.2		2.2	25.0	
Internal Link Dist (m)		801.5			190.4			443.2			997.4	
Turn Bay Length (m)	65.0			20.0			75.0			30.0		
Base Capacity (vph)	912	1109		821	1167		572	2603		652	2478	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.25	0.10		0.02	0.05		0.11	0.15		0.01	0.15	

Intersection Summary

Area Type:	Other
Cycle Length:	95.5
Actuated Cycle Length:	46
Natural Cycle:	45
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.49
Intersection Signal Delay:	11.8
Intersection LOS:	B
Intersection Capacity Utilization:	45.4%
ICU Level of Service:	A
Analysis Period (min):	15
90th %ile Actuated Cycle:	63.5
70th %ile Actuated Cycle:	53
50th %ile Actuated Cycle:	46.9
30th %ile Actuated Cycle:	34.4
10th %ile Actuated Cycle:	32

Splits and Phases: 400: Niagara St & Quaker Rd

18 s	41.6 s	35.9 s
18 s	41.6 s	35.9 s

Lanes, Volumes, Timings
500: Niagara St/Merrittville Hwy & Merritt Rd

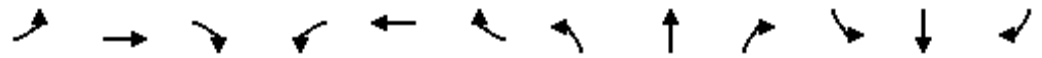
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Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↖	↗			↖	↗		↕	
Traffic Volume (vph)	7	43	6	252	72	12	4	246	376	9	157	12
Future Volume (vph)	7	43	6	252	72	12	4	246	376	9	157	12
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	55.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	1		0	0		1	0		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95
Frt		0.985			0.979				0.850		0.990	
Flt Protected		0.994		0.950				0.999			0.997	
Satd. Flow (prot)	0	1662	0	1566	1640	0	0	1663	1442	0	2984	0
Flt Permitted		0.938		0.619				0.996			0.936	
Satd. Flow (perm)	0	1569	0	1020	1640	0	0	1658	1442	0	2801	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7			12				409			11
Link Speed (k/h)		50			80			60				60
Link Distance (m)		831.3			202.8			1021.4				164.8
Travel Time (s)		59.9			9.1			61.3				9.9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	17%	5%	1%	17%	0%	4%	2%	11%	8%	17%
Adj. Flow (vph)	8	47	7	274	78	13	4	267	409	10	171	13
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	62	0	274	91	0	0	271	409	0	194	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5				3.5
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		2.5			2.5			2.5				2.5
Two way Left Turn Lane												
Headway Factor	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2	1	1		2
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left		Thru
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1		30.5
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1		1.8
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0
Detector 2 Position(m)		28.7			28.7			28.7				28.7
Detector 2 Size(m)		1.8			1.8			1.8				1.8
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm		NA
Protected Phases		4		3	8			2				6

Lanes, Volumes, Timings
 500: Niagara St/Merrittville Hwy & Merritt Rd

04/19/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2		2	6		
Detector Phase	4	4		3	8		2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		10.0	8.0		10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	14.1	14.1		13.0	14.1		16.4	16.4	16.4	16.4	16.4	
Total Split (s)	26.1	26.1		18.0	26.1		46.4	46.4	46.4	46.4	46.4	
Total Split (%)	28.8%	28.8%		19.9%	28.8%		51.3%	51.3%	51.3%	51.3%	51.3%	
Maximum Green (s)	20.0	20.0		15.0	20.0		40.0	40.0	40.0	40.0	40.0	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1	4.1	4.1	4.1	
All-Red Time (s)	2.0	2.0		0.0	2.0		2.3	2.3	2.3	2.3	2.3	
Lost Time Adjust (s)		-2.1		1.0	-2.1			-2.4	-2.4		-2.4	
Total Lost Time (s)		4.0		4.0	4.0			4.0	4.0		4.0	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?	Yes	Yes		Yes								
Vehicle Extension (s)	3.0	3.0		3.0	3.0		5.0	5.0	5.0	5.0	5.0	
Recall Mode	None	None		None	None		Min	Min	Min	Min	Min	
Act Effct Green (s)		11.5		19.7	19.7			22.2	22.2			22.2
Actuated g/C Ratio		0.23		0.39	0.39			0.44	0.44			0.44
v/c Ratio		0.17		0.52	0.14			0.37	0.47			0.16
Control Delay		21.3		15.6	9.8			13.1	3.6			10.1
Queue Delay		0.0		0.0	0.0			0.0	0.0			0.0
Total Delay		21.3		15.6	9.8			13.1	3.6			10.1
LOS		C		B	A			B	A			B
Approach Delay		21.3			14.2			7.4				10.1
Approach LOS		C			B			A				B
90th %ile Green (s)	10.7	10.7		15.0	28.7		29.7	29.7	29.7	29.7	29.7	29.7
90th %ile Term Code	Gap	Gap		Max	Hold		Gap	Gap	Gap	Hold	Hold	Hold
70th %ile Green (s)	8.5	8.5		14.3	25.8		22.8	22.8	22.8	22.8	22.8	22.8
70th %ile Term Code	Gap	Gap		Gap	Hold		Gap	Gap	Gap	Hold	Hold	Hold
50th %ile Green (s)	8.0	8.0		11.5	22.5		17.9	17.9	17.9	17.9	17.9	17.9
50th %ile Term Code	Min	Min		Gap	Hold		Gap	Gap	Gap	Hold	Hold	Hold
30th %ile Green (s)	0.0	0.0		11.1	8.0		14.8	14.8	14.8	14.8	14.8	14.8
30th %ile Term Code	Skip	Skip		Hold	Hold		Gap	Gap	Gap	Hold	Hold	Hold
10th %ile Green (s)	0.0	0.0		11.1	8.0		12.9	12.9	12.9	12.9	12.9	12.9
10th %ile Term Code	Skip	Skip		Hold	Hold		Dwell	Dwell	Dwell	Dwell	Dwell	Dwell
Queue Length 50th (m)		4.4		15.7	3.9			18.2	0.0			5.7
Queue Length 95th (m)		15.8		41.6	13.8			38.7	13.5			12.7
Internal Link Dist (m)		807.3			178.8			997.4				140.8
Turn Bay Length (m)				55.0								
Base Capacity (vph)		749		607	1308			1357	1254			2295
Starvation Cap Reductn		0		0	0			0	0			0
Spillback Cap Reductn		0		0	0			0	0			0
Storage Cap Reductn		0		0	0			0	0			0
Reduced v/c Ratio		0.08		0.45	0.07			0.20	0.33			0.08

Intersection Summary

Area Type: Other

Cycle Length: 90.5






Actuated Cycle Length: 50.7

Lanes, Volumes, Timings
 500: Niagara St/Merrittville Hwy & Merritt Rd

04/19/2018

Natural Cycle: 45	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.52	
Intersection Signal Delay: 10.4	Intersection LOS: B
Intersection Capacity Utilization 50.3%	ICU Level of Service A
Analysis Period (min) 15	
90th %ile Actuated Cycle: 70.9	
70th %ile Actuated Cycle: 61.1	
50th %ile Actuated Cycle: 52.9	
30th %ile Actuated Cycle: 35.3	
10th %ile Actuated Cycle: 33.4	

Splits and Phases: 500: Niagara St/Merrittville Hwy & Merritt Rd

 Ø2	 Ø3	 Ø4
46.4 s	18 s	26.1 s
 Ø6	 Ø8	
46.4 s	26.1 s	

Intersection

Intersection Delay, s/veh	20.5
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	32	150	47	61	200	28	61	204	58	25	234	53
Future Vol, veh/h	32	150	47	61	200	28	61	204	58	25	234	53
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	7	4	0	1	0	2	3	3	4	3	2
Mvmt Flow	35	163	51	66	217	30	66	222	63	27	254	58
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	16.9	20.4	22.2	21.5
HCM LOS	C	C	C	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	19%	14%	21%	8%
Vol Thru, %	63%	66%	69%	75%
Vol Right, %	18%	21%	10%	17%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	323	229	289	312
LT Vol	61	32	61	25
Through Vol	204	150	200	234
RT Vol	58	47	28	53
Lane Flow Rate	351	249	314	339
Geometry Grp	1	1	1	1
Degree of Util (X)	0.662	0.491	0.609	0.644
Departure Headway (Hd)	6.785	7.105	6.979	6.832
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	530	505	515	529
Service Time	4.842	5.17	5.038	4.89
HCM Lane V/C Ratio	0.662	0.493	0.61	0.641
HCM Control Delay	22.2	16.9	20.4	21.5
HCM Lane LOS	C	C	C	C
HCM 95th-tile Q	4.8	2.7	4	4.5

Intersection

Intersection Delay, s/veh	22.7
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	21	180	44	113	245	8	23	142	175	7	173	41
Future Vol, veh/h	21	180	44	113	245	8	23	142	175	7	173	41
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	4	0	8	2	0	0	1	3	0	0	0
Mvmt Flow	23	196	48	123	266	9	25	154	190	8	188	45
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	17.6	29.5	22.9	16.8
HCM LOS	C	D	C	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	7%	9%	31%	3%
Vol Thru, %	42%	73%	67%	78%
Vol Right, %	51%	18%	2%	19%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	340	245	366	221
LT Vol	23	21	113	7
Through Vol	142	180	245	173
RT Vol	175	44	8	41
Lane Flow Rate	370	266	398	240
Geometry Grp	1	1	1	1
Degree of Util (X)	0.682	0.522	0.768	0.48
Departure Headway (Hd)	6.642	7.058	6.946	7.187
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	543	509	521	500
Service Time	4.702	5.128	5.004	5.257
HCM Lane V/C Ratio	0.681	0.523	0.764	0.48
HCM Control Delay	22.9	17.6	29.5	16.8
HCM Lane LOS	C	C	D	C
HCM 95th-tile Q	5.2	3	6.8	2.6

Lanes, Volumes, Timings
 100: Rice Road & Quaker Rd

04/19/2018



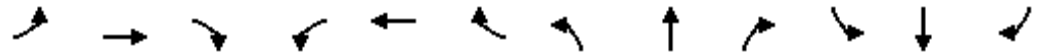
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	32	150	47	61	200	28	61	204	58	25	234	53
Future Volume (vph)	32	150	47	61	200	28	61	204	58	25	234	53
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.972			0.987			0.976			0.977	
Flt Protected		0.993			0.990			0.991			0.996	
Satd. Flow (prot)	0	1585	0	0	1679	0	0	1628	0	0	1636	0
Flt Permitted		0.993			0.990			0.991			0.996	
Satd. Flow (perm)	0	1585	0	0	1679	0	0	1628	0	0	1636	0
Link Speed (k/h)		50			50			40			50	
Link Distance (m)		836.8			819.8			627.0			519.3	
Travel Time (s)		60.2			59.0			56.4			37.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	7%	4%	0%	1%	0%	2%	3%	3%	4%	3%	2%
Adj. Flow (vph)	35	163	51	66	217	30	66	222	63	27	254	58
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	249	0	0	313	0	0	351	0	0	339	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		2.5			2.5			2.5			2.5	
Two way Left Turn Lane												
Headway Factor	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	67.9%
ICU Level of Service	C
Analysis Period (min)	15

Lanes, Volumes, Timings
200: First Ave & Quaker Rd

04/19/2018



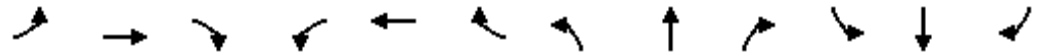
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	21	180	44	113	245	8	23	142	175	7	173	41
Future Volume (vph)	21	180	44	113	245	8	23	142	175	7	173	41
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.976			0.997			0.930			0.975	
Flt Protected		0.996			0.985			0.997			0.998	
Satd. Flow (prot)	0	1634	0	0	1637	0	0	1574	0	0	1684	0
Flt Permitted		0.996			0.985			0.997			0.998	
Satd. Flow (perm)	0	1634	0	0	1637	0	0	1574	0	0	1684	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		819.8			825.5			222.1			515.9	
Travel Time (s)		59.0			59.4			16.0			37.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	4%	0%	8%	2%	0%	0%	1%	3%	0%	0%	0%
Adj. Flow (vph)	23	196	48	123	266	9	25	154	190	8	188	45
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	267	0	0	398	0	0	369	0	0	241	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		2.5			2.5			2.5			2.5	
Two way Left Turn Lane												
Headway Factor	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	77.2%
Analysis Period (min)	15
	ICU Level of Service D

Lanes, Volumes, Timings
 300: Pelham St & Welland Rd/Quaker Rd

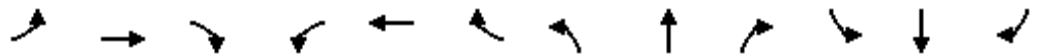
04/19/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘		↗	↘	
Traffic Volume (vph)	21	125	108	41	144	75	107	271	37	65	324	62
Future Volume (vph)	21	125	108	41	144	75	107	271	37	65	324	62
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	0.0		0.0	55.0		0.0	55.0		0.0
Storage Lanes	0		0	0		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00			0.99			1.00		1.00		
Frt		0.943			0.961			0.982			0.976	
Flt Protected		0.996			0.992		0.950			0.950		
Satd. Flow (prot)	0	1612	0	0	1629	0	1612	1689	0	1644	1667	0
Flt Permitted		0.954			0.911		0.431			0.519		
Satd. Flow (perm)	0	1543	0	0	1496	0	731	1689	0	898	1667	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		66			36			14			20	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		251.9			404.7			1006.2			780.9	
Travel Time (s)		18.1			29.1			60.4			46.9	
Confl. Peds. (#/hr)	4					4			1	1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	2%	0%	1%	0%	2%	0%	3%	0%	1%	3%
Adj. Flow (vph)	23	136	117	45	157	82	116	295	40	71	352	67
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	276	0	0	284	0	116	335	0	71	419	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		2.5			2.5			2.5			2.5	
Two way Left Turn Lane												
Headway Factor	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lanes, Volumes, Timings
 300: Pelham St & Welland Rd/Quaker Rd

04/19/2018

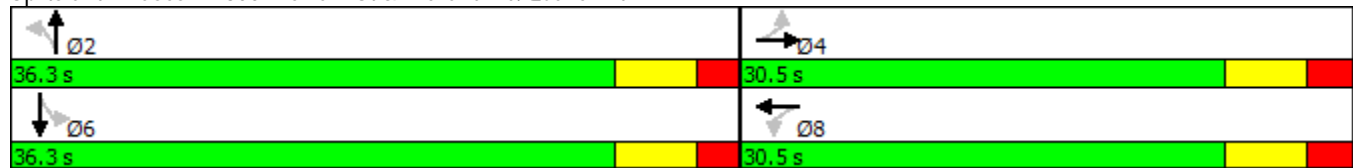


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	14.5	14.5		14.5	14.5		16.3	16.3		16.3	16.3	
Total Split (s)	30.5	30.5		30.5	30.5		36.3	36.3		36.3	36.3	
Total Split (%)	45.7%	45.7%		45.7%	45.7%		54.3%	54.3%		54.3%	54.3%	
Maximum Green (s)	24.0	24.0		24.0	24.0		30.0	30.0		30.0	30.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.4	2.4		2.4	2.4		2.2	2.2		2.2	2.2	
Lost Time Adjust (s)		-2.5			-2.5		-2.3	-2.3		-2.3	-2.3	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Walk Time (s)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10.0	
Flash Dont Walk (s)	16.0	16.0		16.0	16.0		17.0	17.0		17.0	17.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		15.4			15.4		18.4	18.4		18.4	18.4	
Actuated g/C Ratio		0.36			0.36		0.43	0.43		0.43	0.43	
v/c Ratio		0.46			0.50		0.37	0.45		0.18	0.57	
Control Delay		11.4			13.6		12.8	10.8		9.5	12.6	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		11.4			13.6		12.8	10.8		9.5	12.6	
LOS		B			B		B	B		A	B	
Approach Delay		11.4			13.6			11.3			12.1	
Approach LOS		B			B			B			B	
90th %ile Green (s)	21.6	21.6		21.6	21.6		27.1	27.1		27.1	27.1	
90th %ile Term Code	Hold	Hold		Gap	Gap		Hold	Hold		Gap	Gap	
70th %ile Green (s)	15.1	15.1		15.1	15.1		19.2	19.2		19.2	19.2	
70th %ile Term Code	Hold	Hold		Gap	Gap		Hold	Hold		Gap	Gap	
50th %ile Green (s)	11.6	11.6		11.6	11.6		14.4	14.4		14.4	14.4	
50th %ile Term Code	Hold	Hold		Gap	Gap		Hold	Hold		Gap	Gap	
30th %ile Green (s)	9.2	9.2		9.2	9.2		11.4	11.4		11.4	11.4	
30th %ile Term Code	Hold	Hold		Gap	Gap		Hold	Hold		Gap	Gap	
10th %ile Green (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
10th %ile Term Code	Min	Min		Min	Min		Min	Min		Min	Min	
Queue Length 50th (m)		9.6			11.8		4.7	13.5		2.6	17.8	
Queue Length 95th (m)		33.2			38.2		18.1	38.8		10.7	50.8	
Internal Link Dist (m)		227.9			380.7			982.2			756.9	
Turn Bay Length (m)							55.0			55.0		
Base Capacity (vph)		1049			1008		586	1357		720	1341	
Starvation Cap Reductn		0			0		0	0		0	0	
Spillback Cap Reductn		0			0		0	0		0	0	
Storage Cap Reductn		0			0		0	0		0	0	
Reduced v/c Ratio		0.26			0.28		0.20	0.25		0.10	0.31	

Intersection Summary

Area Type:	Other
Cycle Length:	66.8
Actuated Cycle Length:	42.3
Natural Cycle:	40
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.57
Intersection Signal Delay:	12.0
Intersection LOS:	B
Intersection Capacity Utilization:	66.8%
ICU Level of Service:	C
Analysis Period (min):	15
90th %ile Actuated Cycle:	61.5
70th %ile Actuated Cycle:	47.1
50th %ile Actuated Cycle:	38.8
30th %ile Actuated Cycle:	33.4
10th %ile Actuated Cycle:	30.8

Splits and Phases: 300: Pelham St & Welland Rd/Quaker Rd



Lanes, Volumes, Timings
400: Niagara St & Quaker Rd

04/19/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	151	45	160	26	29	13	157	372	27	47	577	184
Future Volume (vph)	151	45	160	26	29	13	157	372	27	47	577	184
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	65.0		0.0	20.0		0.0	75.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			55.0			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor	1.00	0.99		1.00	1.00		1.00				0.99	
Frt		0.883			0.954			0.990			0.964	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1596	1505	0	1644	1611	0	1628	3225	0	1644	3120	0
Flt Permitted	0.727			0.517			0.183			0.500		
Satd. Flow (perm)	1220	1505	0	894	1611	0	313	3225	0	865	3120	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		174			14			9			53	
Link Speed (k/h)		50			50			50			60	
Link Distance (m)		825.5			214.4			467.2			1021.4	
Travel Time (s)		59.4			15.4			33.6			61.3	
Confl. Peds. (#/hr)	1		2	2		1	2					2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	2%	0%	0%	3%	0%	1%	1%	0%	0%	1%	1%
Adj. Flow (vph)	164	49	174	28	32	14	171	404	29	51	627	200
Shared Lane Traffic (%)												
Lane Group Flow (vph)	164	223	0	28	46	0	171	433	0	51	827	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		2.5			2.5			2.5			2.5	
Two way Left Turn Lane								Yes				
Headway Factor	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lanes, Volumes, Timings
400: Niagara St & Quaker Rd

04/19/2018









Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	14.9	14.9		14.9	14.9		11.1	16.6		11.1	16.6	
Total Split (s)	35.9	35.9		35.9	35.9		18.0	41.6		18.0	41.6	
Total Split (%)	37.6%	37.6%		37.6%	37.6%		18.8%	43.6%		18.8%	43.6%	
Maximum Green (s)	29.0	29.0		29.0	29.0		15.0	35.0		15.0	35.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		3.0	4.1		3.0	4.1	
All-Red Time (s)	2.8	2.8		2.8	2.8		0.0	2.5		0.0	2.5	
Lost Time Adjust (s)	-2.9	-2.9		-2.9	-2.9		1.0	-2.6		1.0	-2.6	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		None	Min		None	Min	
Walk Time (s)	11.0	11.0		11.0	11.0			9.0			9.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			14.0			14.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	17.5	17.5		17.5	17.5		39.1	34.0		30.7	25.1	
Actuated g/C Ratio	0.27	0.27		0.27	0.27		0.60	0.52		0.47	0.39	
v/c Ratio	0.50	0.42		0.12	0.10		0.44	0.26		0.11	0.67	
Control Delay	28.4	9.4		22.3	16.5		10.2	10.4		7.4	19.2	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	28.4	9.4		22.3	16.5		10.2	10.4		7.4	19.2	
LOS	C	A		C	B		B	B		A	B	
Approach Delay		17.4			18.7			10.4			18.5	
Approach LOS		B			B			B			B	
90th %ile Green (s)	24.5	24.5		24.5	24.5		15.0	42.5		7.5	35.0	
90th %ile Term Code	Gap	Gap		Hold	Hold		Max	Hold		Gap	Max	
70th %ile Green (s)	17.4	17.4		17.4	17.4		13.0	32.8		6.4	26.2	
70th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Hold		Gap	Gap	
50th %ile Green (s)	13.8	13.8		13.8	13.8		10.5	26.4		6.0	21.9	
50th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Hold		Min	Gap	
30th %ile Green (s)	10.7	10.7		10.7	10.7		9.2	29.6		0.0	17.4	
30th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Hold		Skip	Gap	
10th %ile Green (s)	8.0	8.0		8.0	8.0		6.7	23.1		0.0	13.4	
10th %ile Term Code	Min	Min		Hold	Hold		Gap	Hold		Skip	Gap	
Queue Length 50th (m)	16.0	4.3		2.4	2.8		7.5	15.0		2.1	37.2	
Queue Length 95th (m)	41.6	23.3		10.0	11.6		20.5	31.0		7.6	74.3	
Internal Link Dist (m)		801.5			190.4			443.2			997.4	
Turn Bay Length (m)	65.0			20.0			75.0			30.0		
Base Capacity (vph)	635	867		465	845		488	2036		685	1935	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.26	0.26		0.06	0.05		0.35	0.21		0.07	0.43	

Intersection Summary

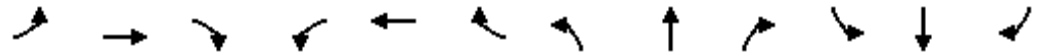
Area Type:	Other
Cycle Length:	95.5
Actuated Cycle Length:	65
Natural Cycle:	50
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.67
Intersection Signal Delay:	15.8
Intersection LOS:	B
Intersection Capacity Utilization:	66.7%
ICU Level of Service:	C
Analysis Period (min):	15
90th %ile Actuated Cycle:	91
70th %ile Actuated Cycle:	73.1
50th %ile Actuated Cycle:	62.7
30th %ile Actuated Cycle:	53.8
10th %ile Actuated Cycle:	44.6

Splits and Phases: 400: Niagara St & Quaker Rd

 Ø1	 Ø2	 Ø4
18 s	41.6 s	35.9 s
 Ø5	 Ø6	 Ø8
18 s	41.6 s	35.9 s

Lanes, Volumes, Timings
500: Niagara St/Merrittville Hwy & Merritt Rd

04/19/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↖	↗			↖	↗		↕	
Traffic Volume (vph)	5	51	6	410	101	23	5	171	338	5	340	13
Future Volume (vph)	5	51	6	410	101	23	5	171	338	5	340	13
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	55.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	1		0	0		1	0		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95
Frt		0.986			0.972				0.850		0.995	
Flt Protected		0.996		0.950				0.999			0.999	
Satd. Flow (prot)	0	1700	0	1612	1630	0	0	1680	1414	0	3238	0
Flt Permitted		0.958		0.606				0.986			0.951	
Satd. Flow (perm)	0	1635	0	1028	1630	0	0	1658	1414	0	3082	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6			16				367			5
Link Speed (k/h)		50			80			60			60	
Link Distance (m)		831.3			202.8			1021.4			164.8	
Travel Time (s)		59.9			9.1			61.3			9.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	2%	1%	13%	0%	3%	4%	0%	1%	0%
Adj. Flow (vph)	5	55	7	446	110	25	5	186	367	5	370	14
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	67	0	446	135	0	0	191	367	0	389	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		2.5			2.5			2.5			2.5	
Two way Left Turn Lane												
Headway Factor	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2	1	1		2
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left		Thru
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1		30.5
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1		1.8
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0
Detector 2 Position(m)		28.7			28.7			28.7				28.7
Detector 2 Size(m)		1.8			1.8			1.8				1.8
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm		NA
Protected Phases		4		3	8			2				6

Lanes, Volumes, Timings
 500: Niagara St/Merrittville Hwy & Merritt Rd

04/19/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2		2	6		
Detector Phase	4	4		3	8		2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		10.0	8.0		10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	14.1	14.1		13.0	14.1		16.4	16.4	16.4	16.4	16.4	
Total Split (s)	26.1	26.1		18.0	26.1		46.4	46.4	46.4	46.4	46.4	
Total Split (%)	28.8%	28.8%		19.9%	28.8%		51.3%	51.3%	51.3%	51.3%	51.3%	
Maximum Green (s)	20.0	20.0		15.0	20.0		40.0	40.0	40.0	40.0	40.0	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1	4.1	4.1	4.1	
All-Red Time (s)	2.0	2.0		0.0	2.0		2.3	2.3	2.3	2.3	2.3	
Lost Time Adjust (s)		-2.1		1.0	-2.1			-2.4	-2.4			-2.4
Total Lost Time (s)		4.0		4.0	4.0			4.0	4.0			4.0
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?	Yes	Yes		Yes								
Vehicle Extension (s)	3.0	3.0		3.0	3.0		5.0	5.0	5.0	5.0	5.0	
Recall Mode	None	None		None	None		Min	Min	Min	Min	Min	
Act Effct Green (s)		11.3		20.9	20.9			18.0	18.0			18.0
Actuated g/C Ratio		0.24		0.44	0.44			0.38	0.38			0.38
v/c Ratio		0.17		0.72	0.19			0.30	0.48			0.33
Control Delay		19.4		18.5	8.0			14.1	4.2			12.9
Queue Delay		0.0		0.0	0.0			0.0	0.0			0.0
Total Delay		19.4		18.5	8.0			14.1	4.2			12.9
LOS		B		B	A			B	A			B
Approach Delay		19.4			16.1			7.6				12.9
Approach LOS		B			B			A				B
90th %ile Green (s)	10.2	10.2		15.0	28.2		22.3	22.3	22.3	22.3	22.3	22.3
90th %ile Term Code	Gap	Gap		Max	Hold		Gap	Gap	Gap	Hold	Hold	Hold
70th %ile Green (s)	8.4	8.4		15.0	26.4		17.5	17.5	17.5	17.5	17.5	17.5
70th %ile Term Code	Gap	Gap		Max	Hold		Gap	Gap	Gap	Hold	Hold	Hold
50th %ile Green (s)	8.0	8.0		15.0	26.0		14.8	14.8	14.8	14.8	14.8	14.8
50th %ile Term Code	Min	Min		Max	Hold		Gap	Gap	Gap	Hold	Hold	Hold
30th %ile Green (s)	0.0	0.0		13.4	10.3		12.2	12.2	12.2	12.2	12.2	12.2
30th %ile Term Code	Skip	Skip		Gap	Hold		Gap	Gap	Gap	Hold	Hold	Hold
10th %ile Green (s)	0.0	0.0		11.1	8.0		10.0	10.0	10.0	10.0	10.0	10.0
10th %ile Term Code	Skip	Skip		Hold	Hold		Min	Min	Min	Min	Min	Min
Queue Length 50th (m)		5.0		25.0	5.2			13.7	0.0			14.6
Queue Length 95th (m)		15.1		#62.0	15.5			27.8	13.9			24.9
Internal Link Dist (m)		807.3			178.8			997.4				140.8
Turn Bay Length (m)				55.0								
Base Capacity (vph)		824		673	1339			1399	1250			2602
Starvation Cap Reductn		0		0	0			0	0			0
Spillback Cap Reductn		0		0	0			0	0			0
Storage Cap Reductn		0		0	0			0	0			0
Reduced v/c Ratio		0.08		0.66	0.10			0.14	0.29			0.15

Intersection Summary

Area Type: Other

Cycle Length: 90.5

Actuated Cycle Length: 47.6

Lanes, Volumes, Timings

500: Niagara St/Merrittville Hwy & Merritt Rd

04/19/2018

Natural Cycle: 45

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.72

Intersection Signal Delay: 12.5

Intersection LOS: B

Intersection Capacity Utilization 52.5%

ICU Level of Service A

Analysis Period (min) 15

90th %ile Actuated Cycle: 63

70th %ile Actuated Cycle: 56.4

50th %ile Actuated Cycle: 53.3

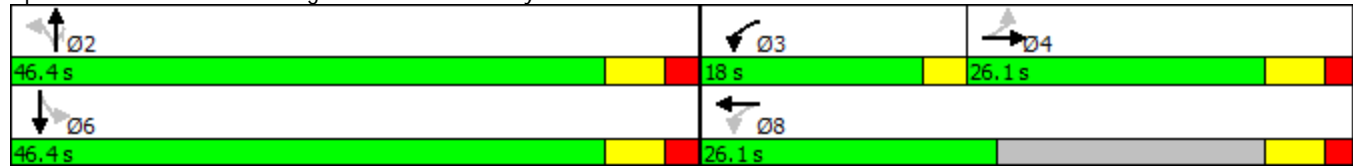
30th %ile Actuated Cycle: 35

10th %ile Actuated Cycle: 30.5

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 500: Niagara St/Merrittville Hwy & Merritt Rd



APPENDIX C - TRAFFIC CONTROL SIGNAL JUSTIFICATION (BASE YEAR, BACKGROUND TRAFFIC)

First Ave @ Quaker Rd

Count Date: 22-Mar-2016

Intersection: Quaker Rd & First Ave

Municipality: Welland

Major Road: Quaker Rd

Major Road Runs: E/W one lane each way

Operating Speed of Major Road: 50 km/hr

Operating under restricted flow conditions

Warrant #1: Minimum Vehicular Volumes.

A. All Approaches.

80% Satisfied

No. of Lanes	Minimum Requirements					Hours Ending								Percentage
	1 Lane Each Way	2 Lanes Each Way	3 Lanes	8:00	9:00	12:00	13:00	14:00	16:00	17:00	18:00			
Flow Condition	1 Lane F. Flow (Code 1)	1 Lane R. Flow (Code 2)	2 Lane F. Flow (Code 3)	2 Lane R. Flow (Code 4)	or More R. Flow (Code 5)									
100%	480	720	600	900	1125									100%
80%	385	575	480	720	900	608	1165	783	769	752	996	1130	1080	Yes: No: X
All Approaches	100% Fulfilled						100	100	100	100	100	100	100	700
	80% Fulfilled					80								80
	Actual % if Below 80%													0

Total:	780
Actual Average (Total/8):	98%

B. Minor Street Both Approaches.

100%	120	170	120	170	170									100%
80%	95	135	95	135	135	295	533	336	364	358	437	569	453	Yes: No: X
Minor Street Both Approaches	100% Fulfilled					100	100	100	100	100	100	100	100	800
	80% Fulfilled													0
	Actual % if Below 80%													0

Total:	800
Actual Average (Total/8):	100%

First Ave @ Quaker Rd

Count Date: 22-Mar-2016

Intersection: Quaker Rd & First Ave

Municipality: Welland

Major Road: Quaker Rd

Major Road Runs: E/W one lane each way

Operating Speed of Major Road: 50 km/hr

Operating under restricted flow conditions

Warrant #2: Delay to Cross Traffic.

A. Major Street Both Approaches.

Not Satisfied

No. of Lanes	Minimum Requirements					Hours Ending								Percentage
	1 Lane Each Way	2 Lanes Each Way	3 Lanes	8:00	9:00	12:00	13:00	14:00	16:00	17:00	18:00			
Flow Condition	1 Lane F. Flow (Code 1)	1 Lane R. Flow (Code 2)	2 Lane F. Flow (Code 3)	2 Lane R. Flow (Code 4)	or More R. Flow (Code 5)									
100%	480	720	600	900	1125									100%
80%	385	575	480	720	900	313	632	447	405	394	559	561	627	Yes: No: X
All Approaches	100% Fulfilled													0
	80% Fulfilled						80						80	160
	Actual % if Below 80%					43		62	56	55	78	78		372

Total:	532
Actual Average (Total/8):	67%

B. Traffic Crossing Major Street.

100%	50	75	50	75	75									100%
80%	40	60	40	60	60	126	268	154	142	131	196	208	199	Yes: No: X
All Approaches	100% Fulfilled					100	100	100	100	100	100	100	100	800
	80% Fulfilled													0
	Actual % if Below 80%													0

Total:	800
Actual Average (Total/8):	100%

First Ave @ Quaker Rd

Count Date: 22-Mar-2016

Intersection: Quaker Rd & First Ave

Municipality: Welland

Major Road: Quaker Rd

Major Road Runs: E/W one lane each way

Operating Speed of Major Road: 50 km/hr

Operating under restricted flow conditions

Warrant #3: Accident Experience.

Not Satisfied

A. Reportable accidents within a twelve month period averaged over 36 consecutive months susceptible to correction by a traffic signal.

Minimum Requirements	Actual Number of Accidents	Average Number of Accidents	Fulfilled
5	0 in 0 years	Invalid	0%
B. Adequate trial of less restrictive remedies has failed to reduce accident frequency.			No
C. Either Warrant 1 (Minimum Vehicular Volume) or Warrant 2 (Delay to Cross Traffic) satisfied 80% or more.			Yes

**Warrant #4: Combination Warrant.
(Used if no warrant satisfied 100%)**

Not Satisfied

Minimum Requirements	Warrant Satisfied 80% or More	Fulfilled
Two Warrants Satisfied 80%	Warrant 1 (Minimum Vehicular Volume) Warrant 2 (Delay to Cross Traffic) Warrant 3 (Accident Experience)	Yes No No

Conclusion: Traffic signal not warranted.

Intersection: Quaker Road / Rice Road

Count Date: 2016-06-13

Summary Results

	Justification	Compliance	Signal Justified?	
			YES	NO
1. Minimum Vehicular Volume	A Total Volume	100 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	B Crossing Volume	100 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2. Delay to Cross Traffic	A Main Road	57 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	B Crossing Road	100 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3. Combination	A Justificaton 1	100 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	B Justification 2	57 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4. 4-Hr Volume		100 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>

5. Collision Experience		0 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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6. Pedestrians	A Volume	Justification not met	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	B Delay	Justification not met	<input type="checkbox"/>	<input checked="" type="checkbox"/>

LEVEL OF SERVICE ANALYSIS AT SIGNALIZED INTERSECTIONS

To assist in clarifying the arithmetic analysis associated with traffic engineering, it is often useful to refer to “Level of Service”. The term Level of Service implies a qualitative measure of traffic flow at an intersection. It is dependent upon vehicle delay and vehicle queue lengths at the approaches. Specifically, Level of Service criteria are stated in terms of the average stopped delay per vehicle for a 15-minute analysis period. The following table describes the characteristics of each level:

<u>Level of Service</u>	<u>Features</u>	<u>Stopped Delay per Vehicle (sec)</u>
A	At this level of service, almost no signal phase is fully utilized by traffic. Very seldom does a vehicle wait longer than one red indication. The approach appears open, turning movements are easily made and drivers have freedom of operation.	≤ 5.0
B	At this level, an occasional signal phase is fully utilized and many phases approach full use. Many drivers begin to feel somewhat restricted within platoons of vehicles approaching the intersection.	> 5.0 and ≤ 15.0
C	At this level, the operation is stable though with more frequent fully utilized signal phases. Drivers feel more restricted and occasionally may have to wait more than one red signal indication, and queues may develop behind turning vehicles. This level is normally employed in urban intersection design.	> 15.0 and ≤ 25.0
D	At this level, the motorist experiences increasing restriction and instability of flow. There are substantial delays to approaching vehicles during short peaks within the peak period, but there are enough cycles with lower demand to permit occasional clearance of developing queues and prevent excessive backups.	> 25.0 and ≤ 40.0
E	At this level, capacity is reached. There are long queues of vehicles waiting upstream of the intersection and delays to vehicles may extend to several signal cycles.	> 40.0 and ≤ 60.0
F	At this level, saturation occurs, with vehicle demand exceeding the available capacity.	> 60.0

LEVEL OF SERVICE ANALYSIS AT UNSIGNALIZED INTERSECTIONS⁽¹⁾

The term "level of service" implies a qualitative measure of traffic flow at an intersection. It is dependent upon the vehicle delay and vehicle queue lengths at approaches. The level of service at unsignalized intersections is often related to the delay accumulated by flows on the minor streets, caused by all other conflicting movements. The following table describes the characteristics of each level.

Level of Service	Features
A	Little or no traffic delay occurs. Approaches appear open, turning movements are easily made, and drivers have freedom of operation.
B	Short traffic delays occur. Many drivers begin to feel somewhat restricted in terms of freedom of operation.
C	Average traffic delays occur. Operations are generally stable, but drivers emerging from the minor street may experience difficulty in completing their movement. This may occasionally impact on the stability of flow on the major street.
D	Long traffic delays occur. Motorists emerging from the minor street experience significant restriction and frustration. Drivers on the major street will experience congestion and delay as drivers emerging from the minor street interfere with the major through movements.
E	Very long traffic delays occur. Operations approach the capacity of the intersection.
F	Saturation occurs, with vehicle demand exceeding the available capacity. Very long traffic delays occur.

⁽¹⁾ Highway Capacity Manual - Special Report No. 209, Transportation Research Board, 1985.

APPENDIX D - IBI MEMO

Region of Niagara
Jordan Frost – December 17, 2019

Memorandum

To/Attention	Region of Niagara Jordan Frost	Date	December 17, 2019
From	IBI Group	Project No	118569
cc	David Forsey Greg Lue		
Subject	DRAFT North West Welland Secondary Plan Model Run		

Purpose

The City of Welland retained SGL Planning & Design Inc. to develop the North West Welland Secondary Plan (NWWSP). To inform the design of local transportation infrastructure in the community, the City has requested a summary of future transportation demand from the Niagara Region Transportation Model. To this end, this memorandum describes the technical work undertaken by IBI Group to modify and re-run the model with new information provided by SGL.

Scope

IBI Group was tasked with adding 2031 land use development for the North West Welland Secondary Plan into the Niagara Region Model and forecasting the vehicle growth on corridors of interest within the study area. For this study, IBI Group used the model to estimate the growth between 2011 and 2031 within the North West Welland Secondary Plan Development.

The corridors of interest are:

- Pelham Street between Port Robinson Road and Woodlawn Road;
- Rice Road between Port Robinson Road and Woodlawn Road;
- Cataract Road/First Avenue between Port Robinson Road and Woodlawn Road;
- Niagara Street between Port Robinson Road and Woodlawn Road;
- Merritt Road between Pelham Street and Rice Road;
- Merritt Road between Rice Road and Cataract Road (Extension);
- Merritt Road between Cataract Road and Highway 406; and
- Quaker Road between Pelham Street and Niagara Street.

Niagara Region Travel Forecasting Model

The Niagara Region Travel Forecasting Model is a tool used to predict and analyze travel behaviour in the Regional Municipality of Niagara and in the western municipalities of the

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Greater Toronto and Hamilton Area (GTHA). The purpose of the model is to quantify changes in travel behaviour, congestion, transit ridership, and many other metrics in response to changing demographic and transportation conditions.

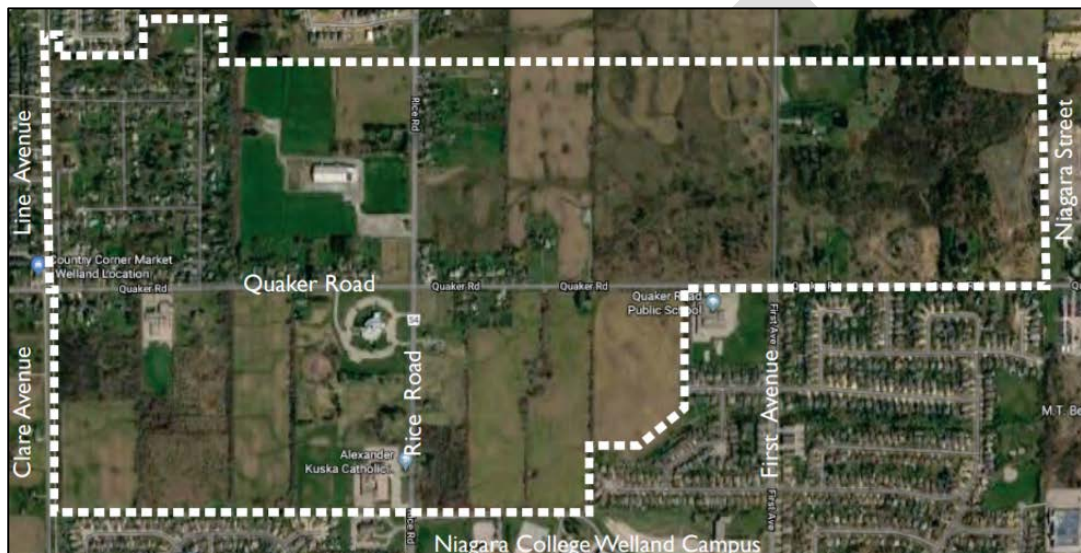
The Model was developed in 2016 for the Niagara Region Transportation Master Plan and calibrated to a 2011 base year using Transportation Tomorrow Survey (TTS) data and observed counts. Population and employment is used as input to forecast a.m. and p.m. peak hour travel patterns for 2021, 2031, and 2041 horizon years

Niagara Region Model Network version 1.2 was used for this assignment.

Population and Employment Growth

The North West Welland Secondary Plan study area covers Quaker Road between Line Avenue/Clare Avenue and Niagara Street, shown in Exhibit 1.

Exhibit 1: North West Welland Study Area



Source: North West Welland Secondary Plan Study – Public Information Session 1

The North West Welland Secondary Plan adds population and employment to the model over and above the base case development assumptions for 2031. This growth is concentrated in four traffic zones within the City of Welland, as illustrated in Exhibit 2. The growth in total population and employment place of work (POW) for each zone is summarized in Exhibit 3. Between 2011 and 2031, the model's base case population and employment forecasts show a decrease of approximately 250 people and an increase of 630 jobs. However, the North West Welland Development adds approximately 6,280 people and 84 jobs to the study area by 2031. For this assignment it was assumed that the 2031 base growth occurs within the existing developed area while the Secondary Plan growth occurs in the undeveloped areas. This results in 2011-2031 net absolute growth of 6,030 people (189%) and 714 jobs (36%).

The Model uses detailed population and employment breakdowns (age groups, employment type, etc) as input to forecast traffic patterns. For the purpose of this analysis, no changes to the age distribution or employment job sector distribution were applied.

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Exhibit 2: North West Welland Secondary Plan Growth Zones

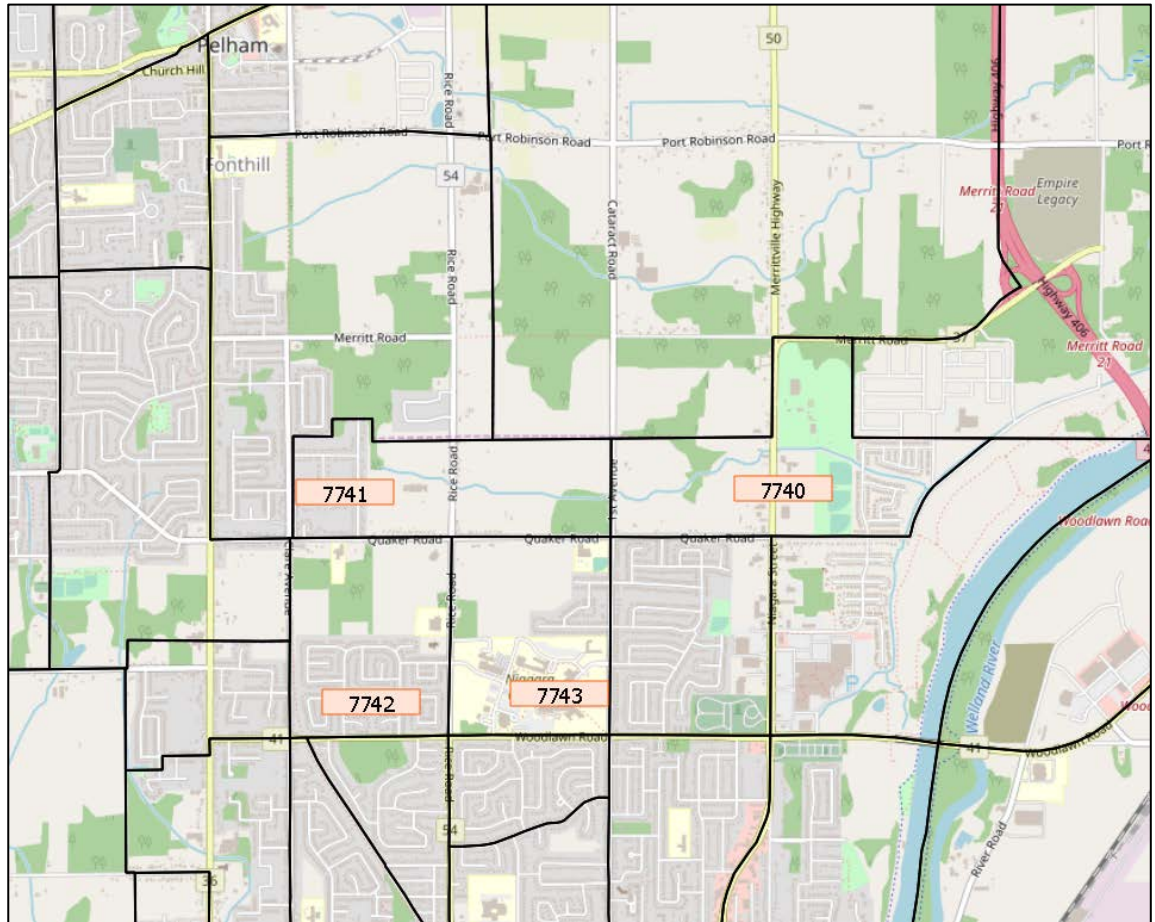


Exhibit 3: Population and Employment Growth

Zone	2011		2031 Base		Increase from Secondary Plan		2031 NWWSP		2011 2031 Growth	
	Total Pop.	Total Jobs	Total Pop.	Total Jobs	Pop.	Jobs	Total Pop.	Total Jobs	Total Pop.	Total Jobs
7740	1,100	379	1,151	635	1,414	0	2,564	635	133%	68%
7741	522	242	447	288	2,237	84	2,684	372	414%	54%
7742	1,148	403	982	491	1,335	0	2,317	491	102%	22%
7743	418	942	357	1,185	1,293	0	1,650	1,185	295%	26%
Total	3,187	1,966	2,937	2,598	6,279	84	9,216	2,682	189%	36%

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Network Assumptions

Version 1.2 of the Niagara Region Travel Forecasting Model was used for this exercise, which incorporates updates to the road network in the City of Thorold and minor land use modifications and corrections within Thorold. In addition, transit itineraries were modified for Niagara Region Transit to better match existing service.

In the study area, there are no significant changes to Pelham Street, Cataract Road, Niagara Street or Quaker Road assumed in the model between 2011 and 2031. By 2031, Rice Road is assumed to be widened to 2 lanes in each direction between Port Robinson Road and Woodlawn Road. Merritt Road is assumed to be extended from Cataract Road to Rice Road and widened to 2 lanes in each direction by 2031. Exhibit 4 summarizes the number of lanes and capacity assumptions for the study area.

Exhibit 4: North West Welland Network Assumptions

Street	Corridor	2011		2031	
		Lanes per direction	Capacity per lane	Lanes per direction	Capacity per lane
Pelham Street	Port Robinson Road to Woodlawn Road	1	800	1	800
Rice Road	Port Robinson Road to Woodlawn Road	1	1000	2	1000
Cataract Road/First Avenue	Port Robinson Road to Woodlawn Road	1	1000	1	1000
Niagara Street	Port Robinson Road to Woodlawn Road	2	1100	2	1100
Merritt Road	Pelham Street and Rice Road	1	500	1	500
Merritt Road	Rice Road and Cataract Road (Extension)	--	--	2	500
Merritt Road	Cataract Road and Highway 406	1	1000	2	1000
Quaker Road	Pelham Street and Niagara Street	1	700	1	700

Results

Absolute growth in auto vehicle traffic was calculated for the corridors of interest. Exhibit 5 summarizes the auto volume growth along the corridors of interest. Note that the model has not been calibrated to local auto volumes for this assignment; therefore only the growth rates should be relied upon. Exhibit 6 and Exhibit 7 show modelled auto volumes for 2011 and 2031 NWWSP scenarios, respectively.

Population in the study area doubles while employment is increased marginally from the North West Welland Secondary Plan development. The 2031 results with the development show a significant increase in auto traffic in the a.m. peak hour. The majority of the traffic growth will be carried by Rice Road and Merritt Road, which will be used to access Highway 406.

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Exhibit 5: North West Welland 2011-2031 A.M. Peak Hour Auto Volume Growth by Corridor

Street	Corridor	2011 AM Peak Hour Volume		2031 AM Peak Hour Volume NWWSP		2011 2031 NWWSP Growth	
		NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
Pelham Street	Port Robinson Road to Woodlawn Road	221	256	257	283	16%	11%
Rice Road	Port Robinson Road to Woodlawn Road	212	189	611	221	188%	17%
Cataract Road/First Avenue	Port Robinson Road to Woodlawn Road	291	432	278	448	-4%	4%
Niagara Street	Port Robinson Road to Woodlawn Road	286	237	443	317	55%	34%
Merritt Road	Pelham Street and Rice Road	146	31	367	182	151%	487%
Merritt Road	Rice Road and Cataract Road (Extension)	--	--	867	310	--	--
Merritt Road	Cataract Road and Highway 406	214	330	1181	815	452%	147%
Quaker Road	Pelham Street and Niagara Street	253	78	509	115	101%	47%

**Note: Auto volumes have not been calibrated to local level*

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Exhibit 6: 2011 AM Peak Hour Auto Volume

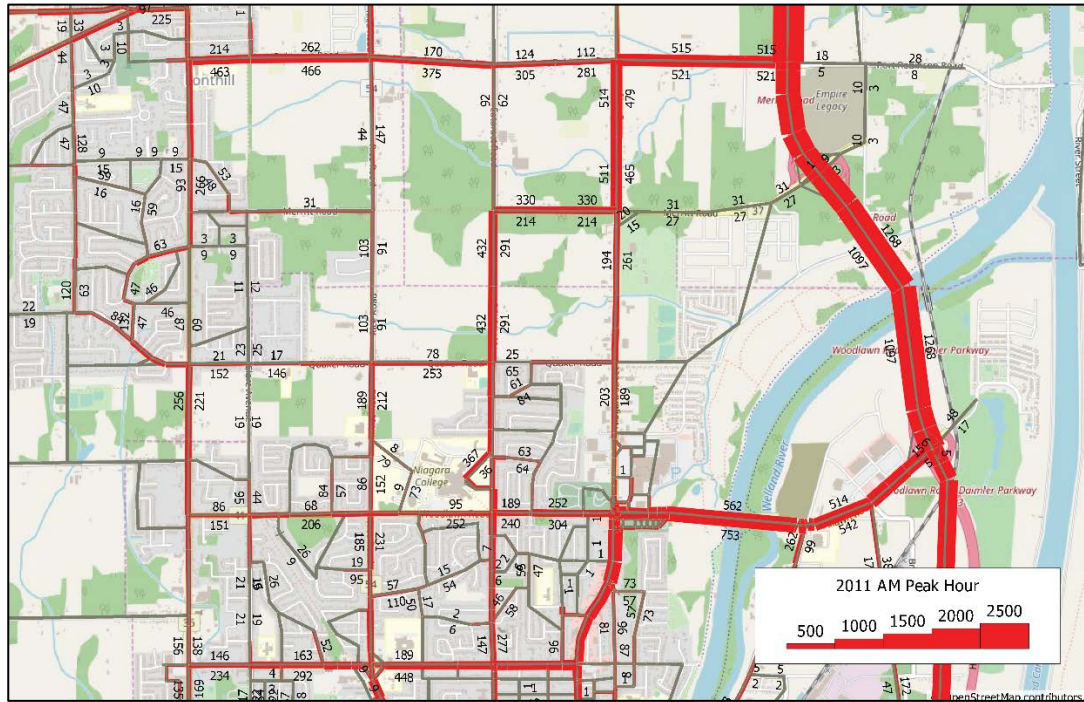
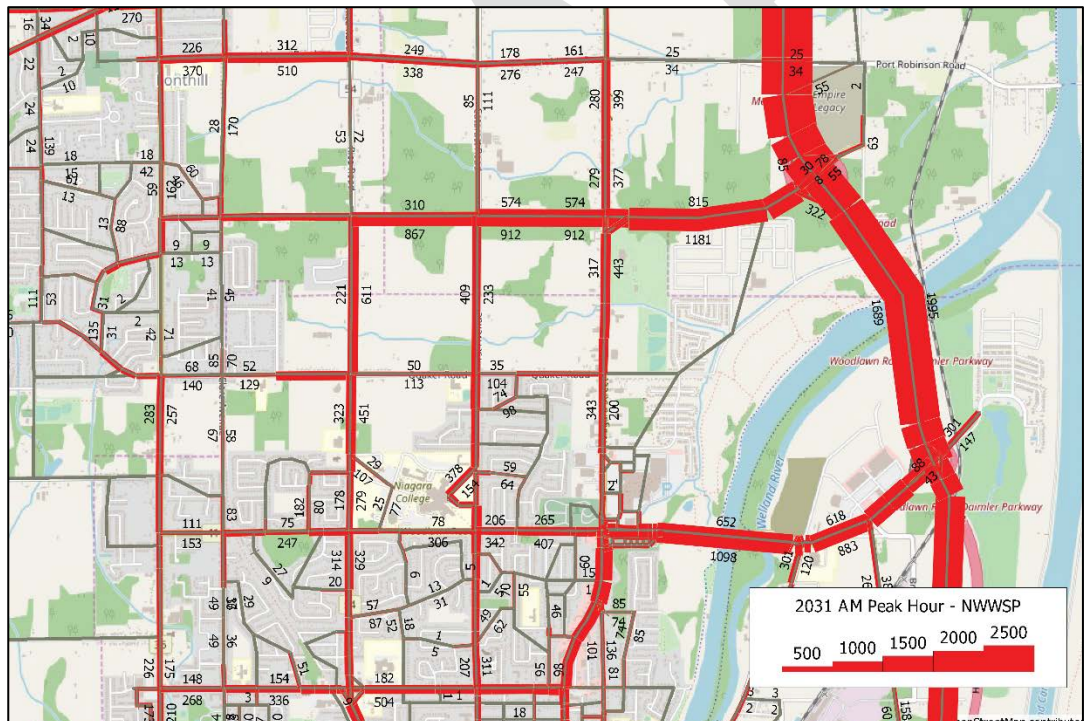


Exhibit 7: 2031 AM Peak Hour Auto Volumes - NWWSP



**Note: Auto volumes have not been calibrated to local level*

APPENDIX E - HORIZON YEAR (2031) - NO IMPROVEMENTS

Northwest Welland Secondary Plan
100: Rice Road & Quaker Road

Horizon Year (2031) Total Traffic
Time Period: AM Weekday Peak

Intersection	
Intersection Delay, s/veh	174.4
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	102	250	115	63	117	17	80	478	153	20	196	29
Future Vol, veh/h	102	250	115	63	117	17	80	478	153	20	196	29
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	8	6	4	0	12	0	13	3	0	6	2	8
Mvmt Flow	111	272	125	68	127	18	87	520	166	22	213	32
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	96.1	24.2	317.8	28
HCM LOS	F	C	F	D

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	11%	22%	32%	8%
Vol Thru, %	67%	54%	59%	80%
Vol Right, %	22%	25%	9%	12%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	711	467	197	245
LT Vol	80	102	63	20
Through Vol	478	250	117	196
RT Vol	153	115	17	29
Lane Flow Rate	773	508	214	266
Geometry Grp	1	1	1	1
Degree of Util (X)	1.639	1.071	0.511	0.618
Departure Headway (Hd)	8.006	9.082	10.622	10.027
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	464	406	343	362
Service Time	6.006	7.082	8.622	8.027
HCM Lane V/C Ratio	1.666	1.251	0.624	0.735
HCM Control Delay	317.8	96.1	24.2	28
HCM Lane LOS	F	F	C	D
HCM 95th-tile Q	42.4	14.5	2.8	3.9

Northwest Welland Secondary Plan
 200: First Avenue/Cataract Road & Quaker Road

Horizon Year (2031) Total Traffic
 Time Period: AM Weekday Peak

Intersection	
Intersection Delay, s/veh	78.6
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	50	342	95	224	181	10	63	113	112	2	206	35
Future Vol, veh/h	50	342	95	224	181	10	63	113	112	2	206	35
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	6	7	9	3	0	5	1	11	0	2	3
Mvmt Flow	54	372	103	243	197	11	68	123	122	2	224	38
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	125.3	83.8	34.5	28.3
HCM LOS	F	F	D	D

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	22%	10%	54%	1%
Vol Thru, %	39%	70%	44%	85%
Vol Right, %	39%	20%	2%	14%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	288	487	415	243
LT Vol	63	50	224	2
Through Vol	113	342	181	206
RT Vol	112	95	10	35
Lane Flow Rate	313	529	451	264
Geometry Grp	1	1	1	1
Degree of Util (X)	0.744	1.17	1.034	0.647
Departure Headway (Hd)	9.185	8.159	8.774	9.492
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	398	450	415	383
Service Time	7.185	6.159	6.774	7.492
HCM Lane V/C Ratio	0.786	1.176	1.087	0.689
HCM Control Delay	34.5	125.3	83.8	28.3
HCM Lane LOS	D	F	F	D
HCM 95th-tile Q	5.9	19.4	13.5	4.4

Northwest Welland Secondary Plan
300: Pelham St & Quaker Road

Horizon Year (2031) Total Traffic
Time Period: AM Weekday Peak

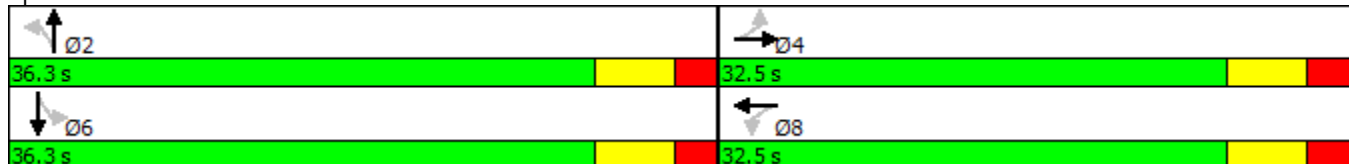


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕		↗↖	↗↖		↗↖	↗↖	
Traffic Volume (vph)	69	197	158	14	57	44	44	220	35	38	229	13
Future Volume (vph)	69	197	158	14	57	44	44	220	35	38	229	13
Satd. Flow (prot)	0	1574	0	0	1576	0	1626	1569	0	1626	1600	0
Flt Permitted		0.930			0.929		0.571			0.554		
Satd. Flow (perm)	0	1473	0	0	1473	0	977	1569	0	946	1600	0
Satd. Flow (RTOR)		53			48			16			6	
Lane Group Flow (vph)	0	461	0	0	125	0	48	277	0	41	263	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	32.5	32.5		32.5	32.5		36.3	36.3		36.3	36.3	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)		19.8			19.8		17.1	17.1		17.1	17.1	
Actuated g/C Ratio		0.44			0.44		0.38	0.38		0.38	0.38	
v/c Ratio		0.69			0.19		0.13	0.46		0.12	0.43	
Control Delay		16.1			6.9		11.5	13.7		11.4	13.7	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		16.1			6.9		11.5	13.7		11.4	13.7	
LOS		B			A		B	B		B	B	
Approach Delay		16.1			6.9			13.4			13.4	
Approach LOS		B			A			B			B	
Queue Length 50th (m)		20.5			2.9		2.3	14.1		1.9	13.8	
Queue Length 95th (m)		69.5			14.2		8.7	36.7		7.8	35.3	
Internal Link Dist (m)		228.0			380.5			982.2			756.9	
Turn Bay Length (m)							60.0			60.0		
Base Capacity (vph)		1003			1001		740	1193		717	1214	
Starvation Cap Reductn		0			0		0	0		0	0	
Spillback Cap Reductn		0			0		0	0		0	0	
Storage Cap Reductn		0			0		0	0		0	0	
Reduced v/c Ratio		0.46			0.12		0.06	0.23		0.06	0.22	

Intersection Summary

Cycle Length: 68.8
 Actuated Cycle Length: 45.4
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.69
 Intersection Signal Delay: 13.8
 Intersection Capacity Utilization 66.5%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 300: Pelham St & Quaker Road



Northwest Welland Secondary Plan
 400: Niagara St/Niagara Street & Quaker Road

Horizon Year (2031) Total Traffic
 Time Period: AM Weekday Peak

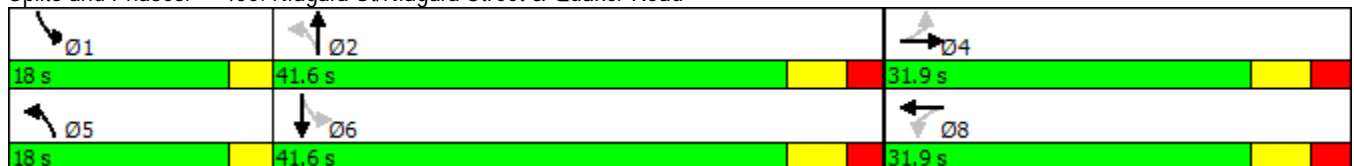


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↕		↖	↗	
Traffic Volume (vph)	326	24	139	19	35	32	78	453	23	7	294	123
Future Volume (vph)	326	24	139	19	35	32	78	453	23	7	294	123
Satd. Flow (prot)	1609	1448	0	1519	1547	0	1478	3135	0	1626	2968	0
Flt Permitted	0.709			0.646			0.302			0.461		
Satd. Flow (perm)	1198	1448	0	1032	1547	0	470	3135	0	788	2968	0
Satd. Flow (RTOR)		151			35			7			85	
Lane Group Flow (vph)	354	177	0	21	73	0	85	517	0	8	454	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Total Split (s)	31.9	31.9		31.9	31.9		18.0	41.6		18.0	41.6	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)	28.1	28.1		28.1	28.1		24.4	22.9		19.7	15.9	
Actuated g/C Ratio	0.46	0.46		0.46	0.46		0.40	0.38		0.32	0.26	
v/c Ratio	0.64	0.24		0.04	0.10		0.28	0.44		0.02	0.54	
Control Delay	21.2	4.4		11.8	7.6		13.7	15.8		11.1	19.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	21.2	4.4		11.8	7.6		13.7	15.8		11.1	19.1	
LOS	C	A		B	A		B	B		B	B	
Approach Delay		15.6			8.5			15.5			19.0	
Approach LOS		B			A			B			B	
Queue Length 50th (m)	29.6	1.6		1.3	2.3		5.7	20.2		0.5	19.0	
Queue Length 95th (m)	69.1	12.4		5.5	10.0		13.9	42.3		2.7	35.0	
Internal Link Dist (m)		801.7			190.3			443.2			85.3	
Turn Bay Length (m)							75.0			22.5		
Base Capacity (vph)	578	778		498	765		430	1999		520	1921	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.61	0.23		0.04	0.10		0.20	0.26		0.02	0.24	

Intersection Summary

Cycle Length: 91.5
 Actuated Cycle Length: 60.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.64
 Intersection Signal Delay: 16.1
 Intersection LOS: B
 Intersection Capacity Utilization 55.8%
 ICU Level of Service B
 Analysis Period (min) 15

Splits and Phases: 400: Niagara St/Niagara Street & Quaker Road



Northwest Welland Secondary Plan
 500: Niagara Street/Niagara St & Merritt Rd

Horizon Year (2031) Total Traffic
 Time Period: AM Weekday Peak

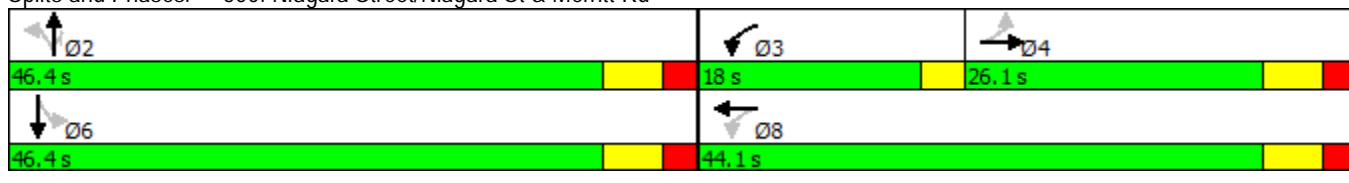


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↖	↗			↖	↗		↕	
Traffic Volume (vph)	21	131	18	454	130	22	5	327	500	11	190	14
Future Volume (vph)	21	131	18	454	130	22	5	327	500	11	190	14
Satd. Flow (prot)	0	1645	0	1548	1620	0	0	1645	1426	0	2951	0
Flt Permitted		0.945		0.406				0.996			0.932	
Satd. Flow (perm)	0	1564	0	662	1620	0	0	1640	1426	0	2759	0
Satd. Flow (RTOR)		6			12				543		10	
Lane Group Flow (vph)	0	185	0	493	165	0	0	360	543	0	234	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		
Total Split (s)	26.1	26.1		18.0	44.1		46.4	46.4	46.4	46.4	46.4	
Total Lost Time (s)		4.0		4.0	4.0			4.0	4.0		4.0	
Act Effct Green (s)		15.5		34.1	34.1			27.9	27.9		27.9	
Actuated g/C Ratio		0.22		0.49	0.49			0.40	0.40		0.40	
v/c Ratio		0.53		0.98	0.21			0.55	0.61		0.21	
Control Delay		31.3		56.5	12.4			19.9	4.7		13.7	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		31.3		56.5	12.4			19.9	4.7		13.7	
LOS		C		E	B			B	A		B	
Approach Delay		31.3			45.4			10.8			13.7	
Approach LOS		C			D			B			B	
Queue Length 50th (m)		20.2		44.8	10.5			34.2	0.0		9.5	
Queue Length 95th (m)		46.4		#159.3	28.6			64.2	16.5		18.3	
Internal Link Dist (m)		807.1			178.8			887.9			140.9	
Turn Bay Length (m)												
Base Capacity (vph)		512		503	961			1023	1094		1725	
Starvation Cap Reductn		0		0	0			0	0		0	
Spillback Cap Reductn		0		0	0			0	0		0	
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.36		0.98	0.17			0.35	0.50		0.14	

Intersection Summary

Cycle Length: 90.5
 Actuated Cycle Length: 70.3
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.98
 Intersection Signal Delay: 24.5
 Intersection LOS: C
 Intersection Capacity Utilization 70.3%
 ICU Level of Service C
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 500: Niagara Street/Niagara St & Merritt Rd



Northwest Welland Secondary Plan
600: Clair Avenue & Street 'A'

Horizon Year (2031) Total Traffic
Time Period: AM Weekday Peak

Intersection						
Int Delay, s/veh	5.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	46	46	32	15	15	27
Future Vol, veh/h	46	46	32	15	15	27
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	2	0	0	2
Mvmt Flow	50	50	35	16	16	29

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	104	43	0	0	51	0
Stage 1	43	-	-	-	-	-
Stage 2	61	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	899	1033	-	-	1568	-
Stage 1	985	-	-	-	-	-
Stage 2	967	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	890	1033	-	-	1568	-
Mov Cap-2 Maneuver	890	-	-	-	-	-
Stage 1	985	-	-	-	-	-
Stage 2	957	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.2	0	2.6
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	956	1568
HCM Lane V/C Ratio	-	-	0.105	0.01
HCM Control Delay (s)	-	-	9.2	7.3
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0.3	0

Northwest Welland Secondary Plan
700: Rice Road & Street 'A'/Street 'B'

Horizon Year (2031) Total Traffic
Time Period: AM Weekday Peak

Intersection												
Int Delay, s/veh	2.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	24	0	68	17	0	47	22	640	15	6	360	8
Future Vol, veh/h	24	0	68	17	0	47	22	640	15	6	360	8
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0	0	3	0	0	2	0
Mvmt Flow	26	0	74	18	0	51	24	696	16	7	391	9

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1188	1170	396	1199	1166	704	400	0	0	712	0	0
Stage 1	410	410	-	752	752	-	-	-	-	-	-	-
Stage 2	778	760	-	447	414	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	167	195	658	164	196	440	1170	-	-	897	-	-
Stage 1	623	599	-	405	421	-	-	-	-	-	-	-
Stage 2	392	417	-	595	597	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	143	186	658	141	187	440	1170	-	-	897	-	-
Mov Cap-2 Maneuver	143	186	-	141	187	-	-	-	-	-	-	-
Stage 1	602	593	-	391	407	-	-	-	-	-	-	-
Stage 2	335	403	-	523	591	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB			
HCM Control Delay, s	20		22		0.3		0.1			
HCM LOS	C		C							

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1170	-	-	339	281	897	-	-
HCM Lane V/C Ratio	0.02	-	-	0.295	0.248	0.007	-	-
HCM Control Delay (s)	8.1	0	-	20	22	9	0	-
HCM Lane LOS	A	A	-	C	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	1.2	1	0	-	-

Northwest Welland Secondary Plan
 800: Street 'B'/Street 'C' & Quaker Road

Horizon Year (2031) Total Traffic
 Time Period: AM Weekday Peak

Intersection												
Int Delay, s/veh	3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	19	389	15	6	269	4	12	0	52	56	0	13
Future Vol, veh/h	19	389	15	6	269	4	12	0	52	56	0	13
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	6	0	0	3	0	0	0	0	0	0	0
Mvmt Flow	21	423	16	7	292	4	13	0	57	61	0	14

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	296	0	0	439	0	0	788	783	431	810	789	294
Stage 1	-	-	-	-	-	-	473	473	-	308	308	-
Stage 2	-	-	-	-	-	-	315	310	-	502	481	-
Critical Hdwy	4.1	-	-	4.1	-	-	7.1	6.5	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1277	-	-	1132	-	-	311	328	629	301	325	750
Stage 1	-	-	-	-	-	-	576	562	-	706	664	-
Stage 2	-	-	-	-	-	-	700	663	-	555	557	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1277	-	-	1132	-	-	299	318	629	268	316	750
Mov Cap-2 Maneuver	-	-	-	-	-	-	299	318	-	268	316	-
Stage 1	-	-	-	-	-	-	563	550	-	690	659	-
Stage 2	-	-	-	-	-	-	682	658	-	494	545	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.4	0.2	13	20.6
HCM LOS			B	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	521	1277	-	-	1132	-	-	305
HCM Lane V/C Ratio	0.134	0.016	-	-	0.006	-	-	0.246
HCM Control Delay (s)	13	7.9	0	-	8.2	0	-	20.6
HCM Lane LOS	B	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	0.5	0	-	-	0	-	-	0.9

Northwest Welland Secondary Plan
 900: Cataract Road & Street 'C'/Street 'D'

Horizon Year (2031) Total Traffic
 Time Period: AM Weekday Peak

Intersection												
Int Delay, s/veh	4.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	67	0	42	43	0	26	9	150	14	22	202	14
Future Vol, veh/h	67	0	42	43	0	26	9	150	14	22	202	14
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0	0	1	0	0	2	0
Mvmt Flow	73	0	46	47	0	28	10	163	15	24	220	15

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	481	474	228	490	474	171	235	0	0	178	0	0
Stage 1	276	276	-	191	191	-	-	-	-	-	-	-
Stage 2	205	198	-	299	283	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	499	492	816	492	492	878	1344	-	-	1410	-	-
Stage 1	735	685	-	815	746	-	-	-	-	-	-	-
Stage 2	802	741	-	714	681	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	473	478	816	455	478	878	1344	-	-	1410	-	-
Mov Cap-2 Maneuver	473	478	-	455	478	-	-	-	-	-	-	-
Stage 1	729	671	-	808	740	-	-	-	-	-	-	-
Stage 2	770	735	-	661	667	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	13.1		12.5		0.4		0.7	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1344	-	-	564	556	1410	-
HCM Lane V/C Ratio	0.007	-	-	0.21	0.135	0.017	-
HCM Control Delay (s)	7.7	0	-	13.1	12.5	7.6	0
HCM Lane LOS	A	A	-	B	B	A	A
HCM 95th %tile Q(veh)	0	-	-	0.8	0.5	0.1	-

Northwest Welland Secondary Plan
100: Rice Road & Quaker Road

Horizon Year (2031) Total Traffic
Time Period: PM Weekday Peak

Intersection	
Intersection Delay, s/veh	218.2
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	50	236	74	79	257	36	121	406	115	28	259	59
Future Vol, veh/h	50	236	74	79	257	36	121	406	115	28	259	59
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	7	4	0	1	0	2	3	3	4	3	2
Mvmt Flow	54	257	80	86	279	39	132	441	125	30	282	64
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	97.3	109.9	417.6	90.5
HCM LOS	F	F	F	F

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	19%	14%	21%	8%
Vol Thru, %	63%	66%	69%	75%
Vol Right, %	18%	21%	10%	17%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	642	360	372	346
LT Vol	121	50	79	28
Through Vol	406	236	257	259
RT Vol	115	74	36	59
Lane Flow Rate	698	391	404	376
Geometry Grp	1	1	1	1
Degree of Util (X)	1.853	1.029	1.073	1.001
Departure Headway (Hd)	10.029	12.244	12.159	12.437
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	370	301	303	293
Service Time	8.029	10.244	10.159	10.437
HCM Lane V/C Ratio	1.886	1.299	1.333	1.283
HCM Control Delay	417.6	97.3	109.9	90.5
HCM Lane LOS	F	F	F	F
HCM 95th-tile Q	43.9	11.2	12.3	10.4

Northwest Welland Secondary Plan
 200: First Avenue/Cataract Road & Quaker Road

Horizon Year (2031) Total Traffic
 Time Period: PM Weekday Peak

Intersection	
Intersection Delay, s/veh	68.4
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	33	284	69	145	315	10	22	138	170	7	177	42
Future Vol, veh/h	33	284	69	145	315	10	22	138	170	7	177	42
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	4	0	8	2	0	0	1	3	0	0	0
Mvmt Flow	36	309	75	158	342	11	24	150	185	8	192	46
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	55.5	121	38.1	25.2
HCM LOS	F	F	E	D

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	7%	9%	31%	3%
Vol Thru, %	42%	74%	67%	78%
Vol Right, %	52%	18%	2%	19%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	330	386	470	226
LT Vol	22	33	145	7
Through Vol	138	284	315	177
RT Vol	170	69	10	42
Lane Flow Rate	359	420	511	246
Geometry Grp	1	1	1	1
Degree of Util (X)	0.8	0.922	1.157	0.595
Departure Headway (Hd)	8.572	8.407	8.152	9.336
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	427	436	444	388
Service Time	6.572	6.407	6.246	7.336
HCM Lane V/C Ratio	0.841	0.963	1.151	0.634
HCM Control Delay	38.1	55.5	121	25.2
HCM Lane LOS	E	F	F	D
HCM 95th-tile Q	7.1	10.3	18.7	3.7

Northwest Welland Secondary Plan
300: Pelham St & Quaker Road

Horizon Year (2031) Total Traffic
Time Period: PM Weekday Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘		↗	↘	
Traffic Volume (vph)	33	197	170	53	185	97	118	299	41	69	346	66
Future Volume (vph)	33	197	170	53	185	97	118	299	41	69	346	66
Satd. Flow (prot)	0	1594	0	0	1606	0	1594	1669	0	1626	1648	0
Flt Permitted		0.946			0.892		0.380			0.460		
Satd. Flow (perm)	0	1513	0	0	1444	0	637	1669	0	785	1648	0
Satd. Flow (RTOR)		66			36			14			19	
Lane Group Flow (vph)	0	435	0	0	364	0	128	370	0	75	448	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2				6
Permitted Phases	4			8			2			6		
Total Split (s)	32.5	32.5		32.5	32.5		36.3	36.3		36.3	36.3	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)		19.6			19.6		20.9	20.9		20.9	20.9	
Actuated g/C Ratio		0.40			0.40		0.43	0.43		0.43	0.43	
v/c Ratio		0.68			0.61		0.47	0.52		0.23	0.63	
Control Delay		17.3			16.6		18.3	13.7		12.1	15.9	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		17.3			16.6		18.3	13.7		12.1	15.9	
LOS		B			B		B	B		B	B	
Approach Delay		17.3			16.6			14.9			15.4	
Approach LOS		B			B			B			B	
Queue Length 50th (m)		22.9			19.8		7.2	20.5		3.7	26.3	
Queue Length 95th (m)		65.6			56.2		24.4	49.7		13.0	63.4	
Internal Link Dist (m)		228.0			380.5			982.2			756.9	
Turn Bay Length (m)							60.0			60.0		
Base Capacity (vph)		973			918		449	1181		553	1167	
Starvation Cap Reductn		0			0		0	0		0	0	
Spillback Cap Reductn		0			0		0	0		0	0	
Storage Cap Reductn		0			0		0	0		0	0	
Reduced v/c Ratio		0.45			0.40		0.29	0.31		0.14	0.38	

Intersection Summary

Cycle Length: 68.8

Actuated Cycle Length: 49.1

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.68

Intersection Signal Delay: 16.0

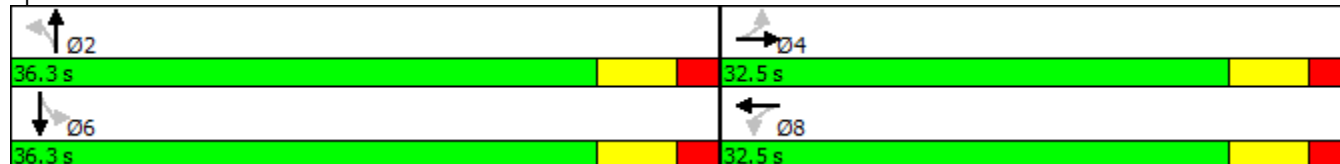
Intersection LOS: B

Intersection Capacity Utilization 76.1%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 300: Pelham St & Quaker Road



Northwest Welland Secondary Plan
 400: Niagara St/Niagara Street & Quaker Road

Horizon Year (2031) Total Traffic
 Time Period: PM Weekday Peak

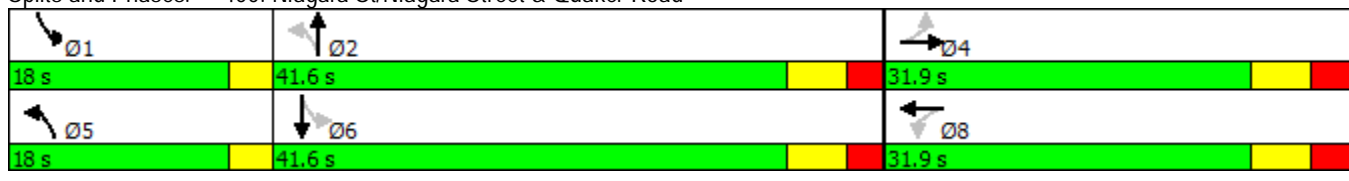


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↕		↖	↗	
Traffic Volume (vph)	238	71	252	33	37	17	209	494	36	57	697	222
Future Volume (vph)	238	71	252	33	37	17	209	494	36	57	697	222
Satd. Flow (prot)	1578	1489	0	1626	1590	0	1609	3184	0	1626	3103	0
Flt Permitted	0.719			0.332			0.125			0.435		
Satd. Flow (perm)	1191	1489	0	568	1590	0	212	3184	0	744	3103	0
Satd. Flow (RTOR)		201			18			10			56	
Lane Group Flow (vph)	259	351	0	36	58	0	227	576	0	62	999	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Total Split (s)	31.9	31.9		31.9	31.9		18.0	41.6		18.0	41.6	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)	23.8	23.8		23.8	23.8		46.8	39.4		36.7	30.8	
Actuated g/C Ratio	0.30	0.30		0.30	0.30		0.59	0.50		0.46	0.39	
v/c Ratio	0.72	0.60		0.21	0.12		0.68	0.36		0.15	0.80	
Control Delay	39.0	15.4		26.5	17.1		25.4	14.1		9.4	26.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	39.0	15.4		26.5	17.1		25.4	14.1		9.4	26.8	
LOS	D	B		C	B		C	B		A	C	
Approach Delay		25.5			20.7			17.3			25.8	
Approach LOS		C			C			B			C	
Queue Length 50th (m)	37.2	18.7		4.3	4.6		17.1	28.7		3.8	70.1	
Queue Length 95th (m)	67.9	47.7		12.5	13.5		#49.9	47.3		10.0	104.9	
Internal Link Dist (m)		801.7			190.3			443.2			85.3	
Turn Bay Length (m)							75.0			22.5		
Base Capacity (vph)	450	688		214	612		384	1722		584	1574	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.58	0.51		0.17	0.09		0.59	0.33		0.11	0.63	

Intersection Summary

Cycle Length: 91.5
 Actuated Cycle Length: 79
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.80
 Intersection Signal Delay: 22.9
 Intersection LOS: C
 Intersection Capacity Utilization 81.0%
 ICU Level of Service D
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 400: Niagara St/Niagara Street & Quaker Road



Northwest Welland Secondary Plan
500: Niagara Street/Niagara St & Merritt Rd

Horizon Year (2031) Total Traffic
Time Period: PM Weekday Peak

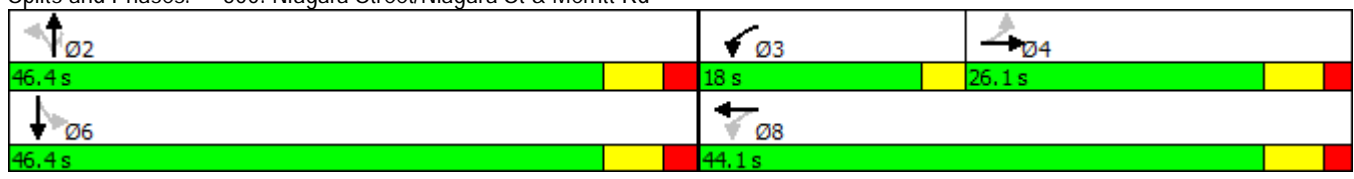


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↖	↗			↖	↗		↕	
Traffic Volume (vph)	15	155	18	738	182	41	7	227	449	6	411	16
Future Volume (vph)	15	155	18	738	182	41	7	227	449	6	411	16
Satd. Flow (prot)	0	1682	0	1594	1611	0	0	1659	1399	0	3201	0
Flt Permitted		0.961		0.390				0.981			0.950	
Satd. Flow (perm)	0	1623	0	654	1611	0	0	1631	1399	0	3044	0
Satd. Flow (RTOR)		6			16				488		6	
Lane Group Flow (vph)	0	204	0	802	243	0	0	255	488	0	471	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		
Total Split (s)	26.1	26.1		18.0	44.1		46.4	46.4	46.4	46.4	46.4	
Total Lost Time (s)		4.0		4.0	4.0			4.0	4.0		4.0	
Act Effct Green (s)		15.2		33.7	33.7			22.0	22.0		22.0	
Actuated g/C Ratio		0.24		0.53	0.53			0.34	0.34		0.34	
v/c Ratio		0.52		1.45	0.28			0.45	0.61		0.45	
Control Delay		26.9		228.7	10.0			19.4	5.4		17.6	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		26.9		228.7	10.0			19.4	5.4		17.6	
LOS		C		F	B			B	A		B	
Approach Delay		26.9			177.9			10.2			17.6	
Approach LOS		C			F			B			B	
Queue Length 50th (m)		19.9		~106.3	13.3			22.3	0.0		21.2	
Queue Length 95th (m)		43.8		#243.9	33.4			45.4	17.2		37.4	
Internal Link Dist (m)		807.1			178.8			887.9			140.9	
Turn Bay Length (m)												
Base Capacity (vph)		579		555	1042			1109	1107		2072	
Starvation Cap Reductn		0		0	0			0	0		0	
Spillback Cap Reductn		0		0	0			0	0		0	
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.35		1.45	0.23			0.23	0.44		0.23	

Intersection Summary

Cycle Length: 90.5
 Actuated Cycle Length: 63.9
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.45
 Intersection Signal Delay: 84.1
 Intersection LOS: F
 Intersection Capacity Utilization 84.4%
 ICU Level of Service E
 Analysis Period (min) 15
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 500: Niagara Street/Niagara St & Merritt Rd



Northwest Welland Secondary Plan
600: Clair Avenue & Street 'A'

Horizon Year (2031) Total Traffic
Time Period: PM Weekday Peak

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	0	0	0	0
Future Vol, veh/h	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	2	0	0	2
Mvmt Flow	0	0	0	0	0	0

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	1	0	0	0	0	0
Stage 1	0	-	-	-	-	-
Stage 2	1	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	1027	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	1028	-	-	-	-	-
Platoon blocked, %						
Mov Cap-1 Maneuver	1027	-	-	-	-	-
Mov Cap-2 Maneuver	1027	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	1028	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	-	-

Northwest Welland Secondary Plan
700: Rice Road & Street 'A'/Street 'B'

Horizon Year (2031) Total Traffic
Time Period: PM Weekday Peak

Intersection												
Int Delay, s/veh	0											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Future Vol, veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0	0	3	0	0	2	0
Mvmt Flow	0	0	0	0	0	0	0	0	0	0	0	0

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	1	1	1	1	1	0	1	0	0	0	0	0
Stage 1	1	1	-	0	0	-	-	-	-	-	-	-
Stage 2	0	0	-	1	1	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	1027	899	1090	1027	899	-	1635	-	-	-	-	-
Stage 1	1027	899	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	1027	899	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	899	1090	1027	899	-	1635	-	-	-	-	-
Mov Cap-2 Maneuver	-	899	-	1027	899	-	-	-	-	-	-	-
Stage 1	1027	899	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	1027	899	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	0		0		0		0	
HCM LOS	A		A					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1635	-	-	-	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-	-	-	-
HCM Control Delay (s)	0	-	-	0	0	0	-	-
HCM Lane LOS	A	-	-	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-	-	-	-

Northwest Welland Secondary Plan
 800: Street 'B'/Street 'C' & Quaker Road

Horizon Year (2031) Total Traffic
 Time Period: PM Weekday Peak

Intersection												
Int Delay, s/veh	0											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Future Vol, veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	6	0	0	3	0	0	0	0	0	0	0
Mvmt Flow	0	0	0	0	0	0	0	0	0	0	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1	0	0	1	0	0	2	2	1	2	2	1
Stage 1	-	-	-	-	-	-	1	1	-	1	1	-
Stage 2	-	-	-	-	-	-	1	1	-	1	1	-
Critical Hdwy	4.1	-	-	4.1	-	-	7.1	6.5	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1635	-	-	1635	-	-	1026	898	1090	1026	898	1090
Stage 1	-	-	-	-	-	-	1027	899	-	1027	899	-
Stage 2	-	-	-	-	-	-	1027	899	-	1027	899	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1635	-	-	1635	-	-	1026	898	1090	1026	898	1090
Mov Cap-2 Maneuver	-	-	-	-	-	-	1026	898	-	1026	898	-
Stage 1	-	-	-	-	-	-	1027	899	-	1027	899	-
Stage 2	-	-	-	-	-	-	1027	899	-	1027	899	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	0			0			0			0		
HCM LOS							A			A		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	-	1635	-	-	1635	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-	-	-	-
HCM Control Delay (s)	0	0	-	-	0	-	-	0
HCM Lane LOS	A	A	-	-	A	-	-	A
HCM 95th %tile Q(veh)	-	0	-	-	0	-	-	-

Northwest Welland Secondary Plan
 900: Cataract Road & Street 'C'/Street 'D'

Horizon Year (2031) Total Traffic
 Time Period: PM Weekday Peak

Intersection												
Int Delay, s/veh	0											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Future Vol, veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0	0	1	0	0	2	0
Mvmt Flow	0	0	0	0	0	0	0	0	0	0	0	0

Major/Minor	Minor2		Minor1		Major1			Major2			
Conflicting Flow All	1	1	1	1	1	0	1	0	0	0	0
Stage 1	1	1	-	0	0	-	-	-	-	-	-
Stage 2	0	0	-	1	1	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-
Pot Cap-1 Maneuver	1027	899	1090	1027	899	-	1635	-	-	-	-
Stage 1	1027	899	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	1027	899	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	899	1090	1027	899	-	1635	-	-	-	-
Mov Cap-2 Maneuver	-	899	-	1027	899	-	-	-	-	-	-
Stage 1	1027	899	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	1027	899	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0	0	0
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1635	-	-	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-	-	-
HCM Control Delay (s)	0	-	-	0	0	0	-
HCM Lane LOS	A	-	-	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	-	-	-	-

APPENDIX F - TRAFFIC SIGNAL/LEFT TURN LANE WARRANTS

Quaker Road and Rice Road

Justification 1: Minimum Vehicle Volumes

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	13:00	14:00	16:00	17:00	18:00		
1A	480	720	600	900	1056	1521	1186	1169	1101	1567	1642	1514		
	COMPLIANCE %				100%	100%	100%	100%	100%	100%	100%	100%	800%	100%
1B	120	170	120	170	619	881	652	633	612	920	938	861		
	COMPLIANCE %				100%	100%	100%	100%	100%	100%	100%	100%	800%	100%

Justification 2: Delay to Cross Traffic

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	13:00	14:00	16:00	17:00	18:00		
2A	480	720	600	900	442	647	537	538	492	655	710	658		
	COMPLIANCE %				61%	80%	75%	75%	68%	80%	80%	80%	599%	75%
2B	50	75	50	75	347	444	310	347	293	440	475	424		
	COMPLIANCE %				100%	100%	100%	100%	100%	100%	100%	100%	800%	100%

Warrant Summary

Justification		Compliance		Signal Justified?	
				YES	NO
1. Minimum Vehicular Volume	A Total Volume	1	%	✓	
	B Crossing Volume	1	%		
2. Delay to Cross Traffic	A Main Road	75%	%		✓
	B Crossing Road	1	%		
3. Combination	Either Justification 1 or 2 equals 100% or both greater than 80%?			✓	

Quaker Road and First Avenue

Justification 1: Minimum Vehicle Volumes

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	13:00	14:00	16:00	17:00	18:00		
1A	480	720	600	900	738	1415	951	934	913	1209	1372	1311		
	COMPLIANCE %				100%	100%	100%	100%	100%	100%	100%	100%	800%	100%
1B	120	170	120	170	294	532	335	363	357	436	567	452		
	COMPLIANCE %				100%	100%	100%	100%	100%	100%	100%	100%	800%	100%

Justification 2: Delay to Cross Traffic

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	13:00	14:00	16:00	17:00	18:00		
2A	480	720	600	900	448	904	640	580	564	800	803	897		
	COMPLIANCE %				62%	100%	80%	80%	78%	100%	100%	100%	701%	88%
2B	50	75	50	75	126	267	154	142	131	195	207	198		
	COMPLIANCE %				100%	100%	100%	100%	100%	100%	100%	100%	800%	100%

Warrant Summary

Justification		Compliance		Signal Justified?	
				YES	NO
1. Minimum Vehicular Volume	A Total Volume	100%	%	✓	
	B Crossing Volume	100%	%		
2. Delay to Cross Traffic	A Main Road	88%	%		✓
	B Crossing Road	100%	%		
3. Combination	Either Justification 1 or 2 equals 100% or both greater than 80%?			✓	

APPENDIX G - HORIZON YEAR (2031) - WITH IMPROVEMENTS

Northwest Welland Secondary Plan
100: Rice Road & Quaker Road

Horizon Year (2031) Total Traffic - With Improvements

Time Period: AM Weekday Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↕		↖	↗	
Traffic Volume (vph)	102	250	115	63	117	17	80	478	153	20	196	29
Future Volume (vph)	102	250	115	63	117	17	80	478	153	20	196	29
Satd. Flow (prot)	1505	1548	0	1626	1519	0	1439	3064	0	1534	3100	0
Flt Permitted	0.665			0.455			0.600			0.327		
Satd. Flow (perm)	1054	1548	0	779	1519	0	909	3064	0	528	3100	0
Satd. Flow (RTOR)		36			11			57			22	
Lane Group Flow (vph)	111	397	0	68	145	0	87	686	0	22	245	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	49.0	49.0		49.0	49.0		41.0	41.0		41.0	41.0	
Total Lost Time (s)	5.3	5.3		5.3	5.3		4.3	4.3		4.3	4.3	
Act Effect Green (s)	20.0	20.0		20.0	20.0		19.0	19.0		19.0	19.0	
Actuated g/C Ratio	0.41	0.41		0.41	0.41		0.39	0.39		0.39	0.39	
v/c Ratio	0.26	0.61		0.22	0.23		0.25	0.56		0.11	0.20	
Control Delay	12.3	15.5		12.4	10.7		14.1	13.6		13.3	10.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	12.3	15.5		12.4	10.7		14.1	13.6		13.3	10.6	
LOS	B	B		B	B		B	B		B	B	
Approach Delay		14.8			11.2			13.7			10.8	
Approach LOS		B			B			B			B	
Queue Length 50th (m)	5.7	21.6		3.4	6.7		4.6	19.8		1.1	6.0	
Queue Length 95th (m)	17.9	55.9		12.4	19.9		16.7	46.8		6.0	16.5	
Internal Link Dist (m)		813.0			302.4			271.6			495.4	
Turn Bay Length (m)	22.5			22.5			22.5			22.5		
Base Capacity (vph)	917	1352		678	1324		704	2386		409	2406	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.12	0.29		0.10	0.11		0.12	0.29		0.05	0.10	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 49.2

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.61

Intersection Signal Delay: 13.3

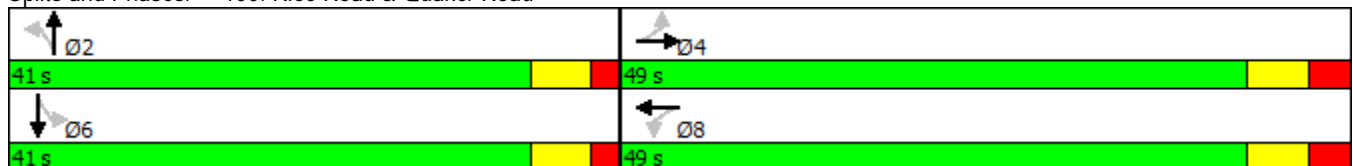
Intersection LOS: B

Intersection Capacity Utilization 72.5%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 100: Rice Road & Quaker Road



Northwest Welland Secondary Plan Horizon Year (2031) Total Traffic - With Improvements
 200: First Avenue/Cataract Road & Quaker Road Time Period: AM Weekday Peak

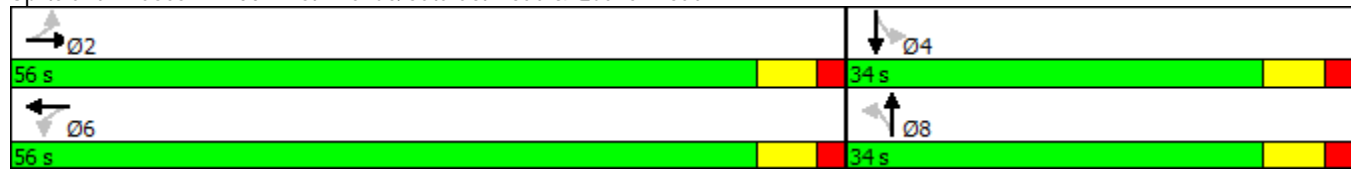


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗			↕			↕	
Traffic Volume (vph)	50	342	95	224	181	10	63	113	112	2	206	35
Future Volume (vph)	50	342	95	224	181	10	63	113	112	2	206	35
Satd. Flow (prot)	1626	1558	0	1491	1651	0	0	1515	0	0	1644	0
Flt Permitted	0.628			0.397				0.883			0.997	
Satd. Flow (perm)	1075	1558	0	623	1651	0	0	1353	0	0	1639	0
Satd. Flow (RTOR)		26			5			38			10	
Lane Group Flow (vph)	54	475	0	243	208	0	0	313	0	0	264	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Total Split (s)	56.0	56.0		56.0	56.0		34.0	34.0		34.0	34.0	
Total Lost Time (s)	4.3	4.3		4.3	4.3			4.3			4.3	
Act Effect Green (s)	31.1	31.1		31.1	31.1			20.2			20.2	
Actuated g/C Ratio	0.51	0.51		0.51	0.51			0.33			0.33	
v/c Ratio	0.10	0.59		0.77	0.25			0.66			0.48	
Control Delay	8.7	13.4		31.0	9.3			25.9			21.9	
Queue Delay	0.0	0.0		0.0	0.0			0.0			0.0	
Total Delay	8.7	13.4		31.0	9.3			25.9			21.9	
LOS	A	B		C	A			C			C	
Approach Delay		13.0			21.0			25.9			21.9	
Approach LOS		B			C			C			C	
Queue Length 50th (m)	2.7	30.0		18.8	10.9			24.5			21.2	
Queue Length 95th (m)	9.0	69.1		#63.1	26.8			69.3			57.0	
Internal Link Dist (m)		469.2			801.7			197.9			345.7	
Turn Bay Length (m)	22.5			75.0								
Base Capacity (vph)	880	1280		510	1352			772			920	
Starvation Cap Reductn	0	0		0	0			0			0	
Spillback Cap Reductn	0	0		0	0			0			0	
Storage Cap Reductn	0	0		0	0			0			0	
Reduced v/c Ratio	0.06	0.37		0.48	0.15			0.41			0.29	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 61.2
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.77
 Intersection Signal Delay: 19.4 Intersection LOS: B
 Intersection Capacity Utilization 85.5% ICU Level of Service E
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 200: First Avenue/Cataract Road & Quaker Road



Northwest Welland Secondary Plan
300: Pelham St & Quaker Road

Horizon Year (2031) Total Traffic - With Improvements

Time Period: AM Weekday Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘		↗	↘	
Traffic Volume (vph)	69	197	158	14	57	44	44	220	35	38	229	13
Future Volume (vph)	69	197	158	14	57	44	44	220	35	38	229	13
Satd. Flow (prot)	0	1574	0	0	1573	0	1626	1568	0	1626	1600	0
Flt Permitted		0.929			0.930		0.571			0.553		
Satd. Flow (perm)	0	1470	0	0	1472	0	977	1568	0	943	1600	0
Satd. Flow (RTOR)		51			48			10			4	
Lane Group Flow (vph)	0	461	0	0	125	0	48	277	0	41	263	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2				6
Permitted Phases	4			8			2			6		
Total Split (s)	53.0	53.0		53.0	53.0		37.0	37.0		37.0	37.0	
Total Lost Time (s)		4.7			4.7		4.5	4.5		4.5	4.5	
Act Effct Green (s)		21.4			21.4		16.9	16.9		16.9	16.9	
Actuated g/C Ratio		0.44			0.44		0.35	0.35		0.35	0.35	
v/c Ratio		0.68			0.18		0.14	0.50		0.12	0.47	
Control Delay		15.7			6.7		14.1	16.9		13.9	16.6	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		15.7			6.7		14.1	16.9		13.9	16.6	
LOS		B			A		B	B		B	B	
Approach Delay		15.7			6.7			16.5			16.3	
Approach LOS		B			A			B			B	
Queue Length 50th (m)		21.8			3.1		2.5	15.9		2.1	15.2	
Queue Length 95th (m)		68.6			13.9		10.8	46.7		9.7	44.6	
Internal Link Dist (m)		228.0			380.5			982.2			756.9	
Turn Bay Length (m)							60.0			60.0		
Base Capacity (vph)		1346			1348		712	1145		687	1167	
Starvation Cap Reductn		0			0		0	0		0	0	
Spillback Cap Reductn		0			0		0	0		0	0	
Storage Cap Reductn		0			0		0	0		0	0	
Reduced v/c Ratio		0.34			0.09		0.07	0.24		0.06	0.23	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 48.3

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.68

Intersection Signal Delay: 15.1

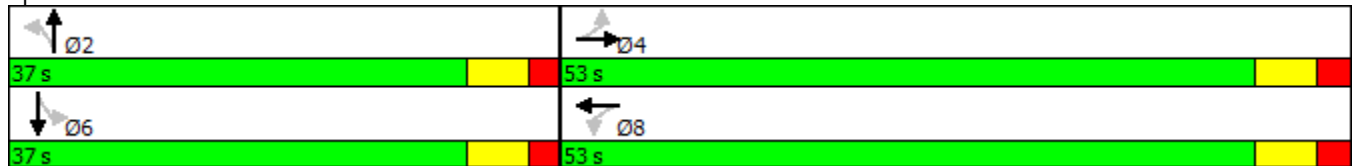
Intersection LOS: B

Intersection Capacity Utilization 67.9%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 300: Pelham St & Quaker Road



Northwest Welland Secondary Plan Horizon Year (2031) Total Traffic - With Improvements

400: Niagara St/Niagara Street & Quaker Road

Time Period: AM Weekday Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	326	24	139	19	35	32	78	453	23	7	294	123
Future Volume (vph)	326	24	139	19	35	32	78	453	23	7	294	123
Satd. Flow (prot)	1609	1448	0	1519	1547	0	1478	3135	0	1626	2968	0
Flt Permitted	0.709			0.646			0.411			0.461		
Satd. Flow (perm)	1198	1448	0	1032	1547	0	639	3135	0	788	2968	0
Satd. Flow (RTOR)		151			35			6			70	
Lane Group Flow (vph)	354	177	0	21	73	0	85	517	0	8	454	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Total Split (s)	50.0	50.0		50.0	50.0		11.0	31.0		9.0	29.0	
Total Lost Time (s)	5.1	5.1		5.1	5.1		1.2	4.8		1.2	4.8	
Act Effct Green (s)	25.4	25.4		25.4	25.4		28.3	23.1		26.3	16.5	
Actuated g/C Ratio	0.42	0.42		0.42	0.42		0.47	0.38		0.43	0.27	
v/c Ratio	0.71	0.26		0.05	0.11		0.20	0.43		0.02	0.53	
Control Delay	24.0	4.3		11.6	7.4		12.9	17.5		12.3	20.9	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	24.0	4.3		11.6	7.4		12.9	17.5		12.3	20.9	
LOS	C	A		B	A		B	B		B	C	
Approach Delay		17.4			8.3			16.9			20.8	
Approach LOS		B			A			B			C	
Queue Length 50th (m)	31.3	1.7		1.3	2.4		4.8	19.3		0.4	19.3	
Queue Length 95th (m)	69.4	12.0		5.4	9.8		17.3	54.3		3.3	43.8	
Internal Link Dist (m)		801.7			190.3			443.2			85.3	
Turn Bay Length (m)							22.5			22.5		
Base Capacity (vph)	905	1130		779	1177		447	1520		460	1346	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.39	0.16		0.03	0.06		0.19	0.34		0.02	0.34	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 60.7

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.71

Intersection Signal Delay: 17.6

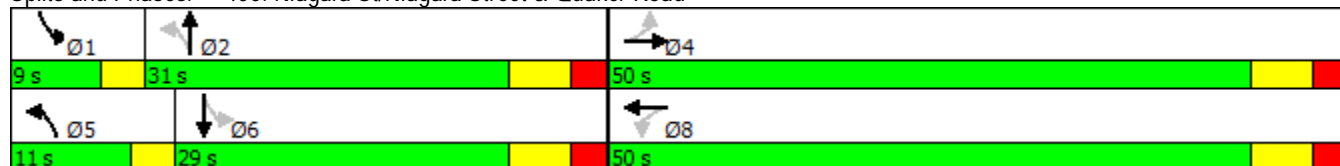
Intersection LOS: B

Intersection Capacity Utilization 57.4%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 400: Niagara St/Niagara Street & Quaker Road



Northwest Welland Secondary Plan Horizon Year (2031) Total Traffic - With Improvements
 500: Niagara Street/Niagara St & Merritt Rd Time Period: AM Weekday Peak

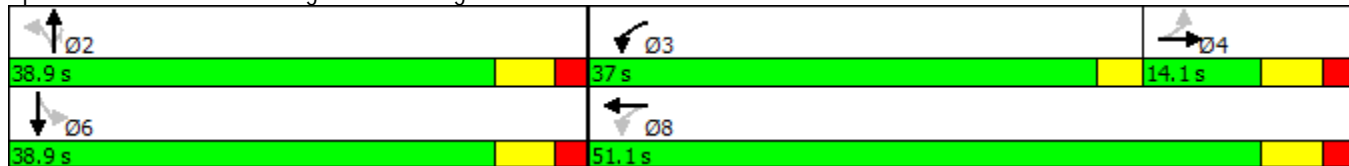


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗			↖	↗		↗	↖
Traffic Volume (vph)	21	131	18	454	130	22	5	327	500	11	190	14
Future Volume (vph)	21	131	18	454	130	22	5	327	500	11	190	14
Satd. Flow (prot)	1626	3124	0	1548	3077	0	0	1645	1426	0	2951	0
Flt Permitted	0.648			0.582				0.996			0.931	
Satd. Flow (perm)	1109	3124	0	948	3077	0	0	1640	1426	0	2756	0
Satd. Flow (RTOR)		14			24				543		9	
Lane Group Flow (vph)	23	162	0	493	165	0	0	360	543	0	234	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4		3	8			2				6
Permitted Phases	4			8			2		2	6		
Total Split (s)	14.1	14.1		37.0	51.1		38.9	38.9	38.9	38.9		38.9
Total Lost Time (s)	4.3	4.3		1.2	4.3			4.6	4.6			4.6
Act Effect Green (s)	10.3	10.3		37.9	34.6			26.2	26.2			26.2
Actuated g/C Ratio	0.15	0.15		0.54	0.49			0.37	0.37			0.37
v/c Ratio	0.14	0.34		0.70	0.11			0.59	0.62			0.23
Control Delay	36.0	31.6		18.0	9.1			23.3	5.4			16.1
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0			0.0
Total Delay	36.0	31.6		18.0	9.1			23.3	5.4			16.1
LOS	D	C		B	A			C	A			B
Approach Delay		32.1			15.8			12.6				16.1
Approach LOS		C			B			B				B
Queue Length 50th (m)	2.7	9.2		40.6	4.8			35.5	0.0			9.8
Queue Length 95th (m)	11.0	22.5		81.1	11.0			75.7	20.6			21.7
Internal Link Dist (m)		807.1			178.8			887.9				140.9
Turn Bay Length (m)	22.5			90.0								
Base Capacity (vph)	163	471		882	2166			843	997			1422
Starvation Cap Reductn	0	0		0	0			0	0			0
Spillback Cap Reductn	0	0		0	0			0	0			0
Storage Cap Reductn	0	0		0	0			0	0			0
Reduced v/c Ratio	0.14	0.34		0.56	0.08			0.43	0.54			0.16

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 70.2
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.70
 Intersection Signal Delay: 15.9 Intersection LOS: B
 Intersection Capacity Utilization 67.8% ICU Level of Service C
 Analysis Period (min) 15

Splits and Phases: 500: Niagara Street/Niagara St & Merritt Rd



Intersection						
Int Delay, s/veh	5.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	46	46	32	15	15	27
Future Vol, veh/h	46	46	32	15	15	27
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	2	0	0	2
Mvmt Flow	50	50	35	16	16	29

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	104	43	0	0	51	0
Stage 1	43	-	-	-	-	-
Stage 2	61	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	899	1033	-	-	1568	-
Stage 1	985	-	-	-	-	-
Stage 2	967	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	890	1033	-	-	1568	-
Mov Cap-2 Maneuver	890	-	-	-	-	-
Stage 1	985	-	-	-	-	-
Stage 2	957	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.2	0	2.6
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	956	1568
HCM Lane V/C Ratio	-	-	0.105	0.01
HCM Control Delay (s)	-	-	9.2	7.3
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0.3	0

Northwest Welland Secondary Plan
700: Rice Road & Street 'A'

Horizon Year (2031) Total Traffic - With Improvements

Time Period: AM Weekday Peak

Intersection												
Int Delay, s/veh	2.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	24	0	68	17	0	47	22	640	15	6	360	8
Future Vol, veh/h	24	0	68	17	0	47	22	640	15	6	360	8
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0	0	3	0	0	2	0
Mvmt Flow	26	0	74	18	0	51	24	696	16	7	391	9

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	806	1170	200	962	1166	356	400	0	0	712	0	0
Stage 1	410	410	-	752	752	-	-	-	-	-	-	-
Stage 2	396	760	-	210	414	-	-	-	-	-	-	-
Critical Hdwy	7.5	6.5	6.9	7.5	6.5	6.9	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.5	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.5	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	277	195	814	213	196	646	1170	-	-	897	-	-
Stage 1	595	599	-	373	421	-	-	-	-	-	-	-
Stage 2	606	417	-	778	597	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	247	186	814	187	187	646	1170	-	-	897	-	-
Mov Cap-2 Maneuver	247	186	-	187	187	-	-	-	-	-	-	-
Stage 1	575	593	-	360	407	-	-	-	-	-	-	-
Stage 2	539	403	-	700	591	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	13.8		16.2		0.4		0.1	
HCM LOS	B		C					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1170	-	-	509	391	897	-	-
HCM Lane V/C Ratio	0.02	-	-	0.196	0.178	0.007	-	-
HCM Control Delay (s)	8.1	0.1	-	13.8	16.2	9	0	-
HCM Lane LOS	A	A	-	B	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.7	0.6	0	-	-

Northwest Welland Secondary Plan
800: Street 'A' & Quaker Road

Horizon Year (2031) Total Traffic - With Improvements

Time Period: AM Weekday Peak

Intersection												
Int Delay, s/veh	3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	19	389	15	6	269	4	12	0	52	56	0	13
Future Vol, veh/h	19	389	15	6	269	4	12	0	52	56	0	13
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	6	0	0	3	0	0	0	0	0	0	0
Mvmt Flow	21	423	16	7	292	4	13	0	57	61	0	14

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	296	0	0	439	0	0	788	783	431	810	789	294
Stage 1	-	-	-	-	-	-	473	473	-	308	308	-
Stage 2	-	-	-	-	-	-	315	310	-	502	481	-
Critical Hdwy	4.1	-	-	4.1	-	-	7.1	6.5	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1277	-	-	1132	-	-	311	328	629	301	325	750
Stage 1	-	-	-	-	-	-	576	562	-	706	664	-
Stage 2	-	-	-	-	-	-	700	663	-	555	557	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1277	-	-	1132	-	-	299	318	629	268	316	750
Mov Cap-2 Maneuver	-	-	-	-	-	-	299	318	-	268	316	-
Stage 1	-	-	-	-	-	-	563	550	-	690	659	-
Stage 2	-	-	-	-	-	-	682	658	-	494	545	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.4			0.2			13			20.6		
HCM LOS							B			C		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	521	1277	-	-	1132	-	-	305
HCM Lane V/C Ratio	0.134	0.016	-	-	0.006	-	-	0.246
HCM Control Delay (s)	13	7.9	0	-	8.2	0	-	20.6
HCM Lane LOS	B	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	0.5	0	-	-	0	-	-	0.9

Northwest Welland Secondary Plan
 900: Cataract Road & Street 'A'

Horizon Year (2031) Total Traffic - With Improvements

Time Period: AM Weekday Peak

Intersection												
Int Delay, s/veh	4.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	67	0	42	43	0	26	9	150	14	22	202	14
Future Vol, veh/h	67	0	42	43	0	26	9	150	14	22	202	14
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0	0	1	0	0	2	0
Mvmt Flow	73	0	46	47	0	28	10	163	15	24	220	15

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	481	474	228	490	474	171	235	0	0	178	0	0
Stage 1	276	276	-	191	191	-	-	-	-	-	-	-
Stage 2	205	198	-	299	283	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	499	492	816	492	492	878	1344	-	-	1410	-	-
Stage 1	735	685	-	815	746	-	-	-	-	-	-	-
Stage 2	802	741	-	714	681	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	473	478	816	455	478	878	1344	-	-	1410	-	-
Mov Cap-2 Maneuver	473	478	-	455	478	-	-	-	-	-	-	-
Stage 1	729	671	-	808	740	-	-	-	-	-	-	-
Stage 2	770	735	-	661	667	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	13.1		12.5		0.4		0.7	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1344	-	-	564	556	1410	-
HCM Lane V/C Ratio	0.007	-	-	0.21	0.135	0.017	-
HCM Control Delay (s)	7.7	0	-	13.1	12.5	7.6	0
HCM Lane LOS	A	A	-	B	B	A	A
HCM 95th %tile Q(veh)	0	-	-	0.8	0.5	0.1	-

Northwest Welland Secondary Plan
100: Rice Road & Quaker Road

Horizon Year (2031) Total Traffic - With Improvements

Time Period: PM Weekday Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↕		↖	↗	
Traffic Volume (vph)	50	236	74	79	257	36	121	406	115	28	259	59
Future Volume (vph)	50	236	74	79	257	36	121	406	115	28	259	59
Satd. Flow (prot)	1626	1552	0	1626	1666	0	1594	3052	0	1563	3074	0
Flt Permitted	0.560			0.537			0.544			0.416		
Satd. Flow (perm)	958	1552	0	919	1666	0	913	3052	0	684	3074	0
Satd. Flow (RTOR)		23			10			51			38	
Lane Group Flow (vph)	54	337	0	86	318	0	132	566	0	30	346	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2				6
Permitted Phases	4			8			2			6		
Total Split (s)	47.0	47.0		47.0	47.0		43.0	43.0		43.0	43.0	
Total Lost Time (s)	5.3	5.3		5.3	5.3		4.3	4.3		4.3	4.3	
Act Effct Green (s)	16.6	16.6		16.6	16.6		16.2	16.2		16.2	16.2	
Actuated g/C Ratio	0.39	0.39		0.39	0.39		0.38	0.38		0.38	0.38	
v/c Ratio	0.15	0.55		0.24	0.49		0.38	0.48		0.12	0.29	
Control Delay	10.4	13.9		11.7	13.0		14.7	11.2		11.3	9.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	10.4	13.9		11.7	13.0		14.7	11.2		11.3	9.6	
LOS	B	B		B	B		B	B		B	A	
Approach Delay		13.4			12.8			11.9			9.7	
Approach LOS		B			B			B			A	
Queue Length 50th (m)	2.3	15.8		3.8	15.2		6.4	13.5		1.3	7.4	
Queue Length 95th (m)	9.1	43.1		13.7	40.2		21.4	31.5		6.4	18.8	
Internal Link Dist (m)		813.0			302.4			271.6			495.4	
Turn Bay Length (m)	22.5			22.5			22.5			22.5		
Base Capacity (vph)	882	1430		846	1534		809	2710		606	2728	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.06	0.24		0.10	0.21		0.16	0.21		0.05	0.13	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 42.9

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.55

Intersection Signal Delay: 11.9

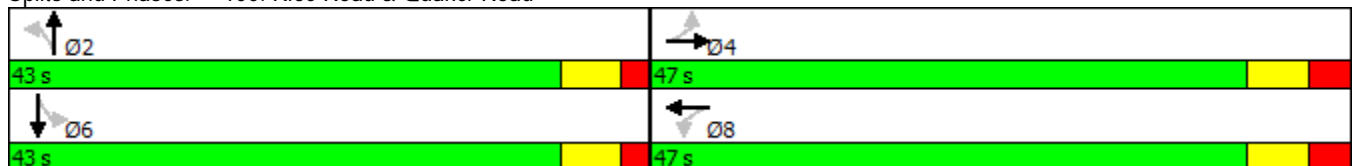
Intersection LOS: B

Intersection Capacity Utilization 65.5%

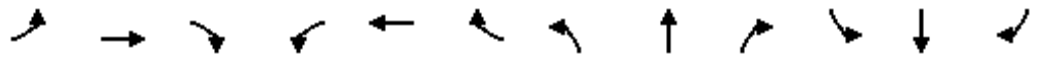
ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 100: Rice Road & Quaker Road



Northwest Welland Secondary Plan Horizon Year (2031) Total Traffic - With Improvements
 200: First Avenue/Cataract Road & Quaker Road Time Period: PM Weekday Peak

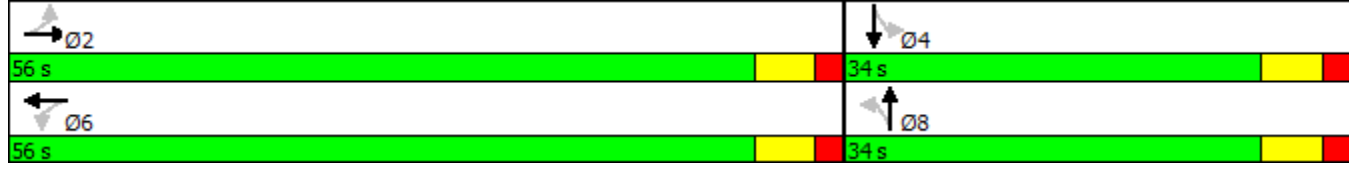


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖ ↗			↖ ↗				↕			↕	
Traffic Volume (vph)	33	284	69	145	315	10	22	138	170	7	177	42
Future Volume (vph)	33	284	69	145	315	10	22	138	170	7	177	42
Satd. Flow (prot)	1626	1610	0	1505	1670	0	0	1556	0	0	1665	0
Flt Permitted	0.500			0.467				0.967			0.983	
Satd. Flow (perm)	856	1610	0	740	1670	0	0	1509	0	0	1640	0
Satd. Flow (RTOR)	23			3				63			14	
Lane Group Flow (vph)	36	384	0	158	353	0	0	359	0	0	246	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	2			6				8			4	
Permitted Phases	2			6				8			4	
Total Split (s)	56.0	56.0		56.0	56.0		34.0	34.0		34.0	34.0	
Total Lost Time (s)	4.3	4.3		4.3	4.3			4.3			4.3	
Act Effect Green (s)	18.8	18.8		18.8	18.8			16.1			16.1	
Actuated g/C Ratio	0.43	0.43		0.43	0.43			0.37			0.37	
v/c Ratio	0.10	0.55		0.50	0.50			0.61			0.41	
Control Delay	9.5	13.0		16.9	12.6			15.2			13.1	
Queue Delay	0.0	0.0		0.0	0.0			0.0			0.0	
Total Delay	9.5	13.0		16.9	12.6			15.2			13.1	
LOS	A	B		B	B			B			B	
Approach Delay	12.7			13.9				15.2			13.1	
Approach LOS	B			B				B			B	
Queue Length 50th (m)	1.4	17.3		7.5	16.4			15.5			11.4	
Queue Length 95th (m)	6.8	49.9		27.5	46.3			49.4			34.7	
Internal Link Dist (m)	469.2			801.7				197.9			345.7	
Turn Bay Length (m)	22.5			75.0								
Base Capacity (vph)	820	1543		709	1600			1109			1190	
Starvation Cap Reductn	0	0		0	0			0			0	
Spillback Cap Reductn	0	0		0	0			0			0	
Storage Cap Reductn	0	0		0	0			0			0	
Reduced v/c Ratio	0.04	0.25		0.22	0.22			0.32			0.21	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 44.1
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.61
 Intersection Signal Delay: 13.7 Intersection LOS: B
 Intersection Capacity Utilization 70.7% ICU Level of Service C
 Analysis Period (min) 15

Splits and Phases: 200: First Avenue/Cataract Road & Quaker Road



Northwest Welland Secondary Plan
300: Pelham St & Quaker Road

Horizon Year (2031) Total Traffic - With Improvements

Time Period: PM Weekday Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘		↗	↘	
Traffic Volume (vph)	33	197	170	53	185	97	118	299	41	69	346	66
Future Volume (vph)	33	197	170	53	185	97	118	299	41	69	346	66
Satd. Flow (prot)	0	1594	0	0	1604	0	1594	1669	0	1626	1648	0
Flt Permitted		0.946			0.887		0.380			0.460		
Satd. Flow (perm)	0	1512	0	0	1434	0	637	1669	0	785	1648	0
Satd. Flow (RTOR)		64			35			9			12	
Lane Group Flow (vph)	0	435	0	0	364	0	128	370	0	75	448	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2				6
Permitted Phases	4			8			2			6		
Total Split (s)	53.0	53.0		53.0	53.0		37.0	37.0		37.0	37.0	
Total Lost Time (s)		4.7			4.7		4.5	4.5		4.5	4.5	
Act Effct Green (s)		22.0			22.0		23.8	23.8		23.8	23.8	
Actuated g/C Ratio		0.39			0.39		0.43	0.43		0.43	0.43	
v/c Ratio		0.69			0.62		0.47	0.52		0.22	0.63	
Control Delay		19.1			18.5		20.2	15.5		13.8	17.9	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		19.1			18.5		20.2	15.5		13.8	17.9	
LOS		B			B		C	B		B	B	
Approach Delay		19.1			18.5			16.7			17.3	
Approach LOS		B			B			B			B	
Queue Length 50th (m)		29.7			25.5		8.7	25.1		4.5	32.3	
Queue Length 95th (m)		66.6			57.0		28.3	59.7		15.3	76.2	
Internal Link Dist (m)		228.0			380.5			982.2			756.9	
Turn Bay Length (m)							60.0			60.0		
Base Capacity (vph)		1280			1209		403	1060		497	1048	
Starvation Cap Reductn		0			0		0	0		0	0	
Spillback Cap Reductn		0			0		0	0		0	0	
Storage Cap Reductn		0			0		0	0		0	0	
Reduced v/c Ratio		0.34			0.30		0.32	0.35		0.15	0.43	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 55.8

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.69

Intersection Signal Delay: 17.8

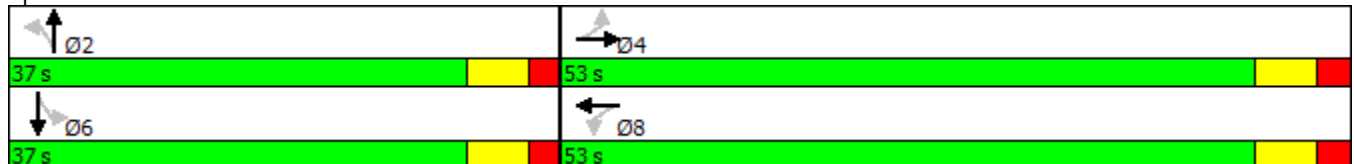
Intersection LOS: B

Intersection Capacity Utilization 77.5%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 300: Pelham St & Quaker Road



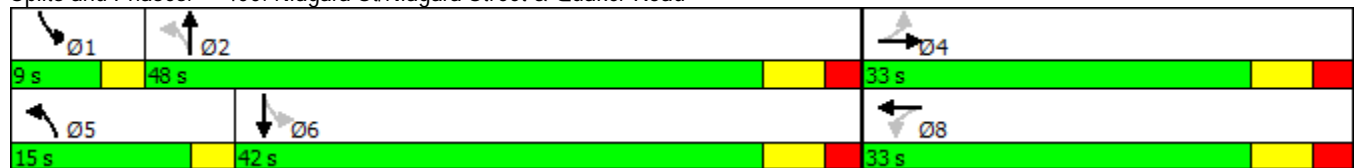
Northwest Welland Secondary Plan Horizon Year (2031) Total Traffic - With Improvements
 400: Niagara St/Niagara Street & Quaker Road Time Period: PM Weekday Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	238	71	252	33	37	17	209	494	36	57	697	222
Future Volume (vph)	238	71	252	33	37	17	209	494	36	57	697	222
Satd. Flow (prot)	1578	1489	0	1626	1590	0	1609	3184	0	1626	3103	0
Flt Permitted	0.719			0.347			0.148			0.435		
Satd. Flow (perm)	1191	1489	0	593	1590	0	251	3184	0	744	3103	0
Satd. Flow (RTOR)		206			18			11			58	
Lane Group Flow (vph)	259	351	0	36	58	0	227	576	0	62	999	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Total Split (s)	33.0	33.0		33.0	33.0		15.0	48.0		9.0	42.0	
Total Lost Time (s)	5.1	5.1		5.1	5.1		1.2	4.8		1.2	4.8	
Act Effect Green (s)	22.5	22.5		22.5	22.5		47.9	39.4		41.6	29.7	
Actuated g/C Ratio	0.29	0.29		0.29	0.29		0.62	0.51		0.54	0.39	
v/c Ratio	0.74	0.60		0.21	0.12		0.59	0.35		0.13	0.81	
Control Delay	40.2	15.2		25.8	16.8		17.2	13.4		7.8	26.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	40.2	15.2		25.8	16.8		17.2	13.4		7.8	26.6	
LOS	D	B		C	B		B	B		A	C	
Approach Delay		25.8			20.2			14.5			25.5	
Approach LOS		C			C			B			C	
Queue Length 50th (m)	35.4	17.2		4.1	4.4		13.7	28.3		3.3	65.9	
Queue Length 95th (m)	66.7	46.0		12.1	13.2		39.1	46.0		9.2	101.0	
Internal Link Dist (m)		801.7			190.3			443.2			85.3	
Turn Bay Length (m)							22.5			22.5		
Base Capacity (vph)	458	699		228	623		410	1871		495	1595	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.57	0.50		0.16	0.09		0.55	0.31		0.13	0.63	

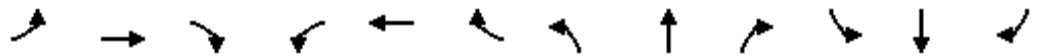
Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 77
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.81
 Intersection Signal Delay: 21.9 Intersection LOS: C
 Intersection Capacity Utilization 82.5% ICU Level of Service E
 Analysis Period (min) 15

Splits and Phases: 400: Niagara St/Niagara Street & Quaker Road



Northwest Welland Secondary Plan Horizon Year (2031) Total Traffic - With Improvements
 500: Niagara Street/Niagara St & Merritt Rd Time Period: PM Weekday Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗			↖	↗		↗	↖
Traffic Volume (vph)	15	155	18	738	182	41	7	227	449	6	411	16
Future Volume (vph)	15	155	18	738	182	41	7	227	449	6	411	16
Satd. Flow (prot)	1626	3199	0	1594	3061	0	0	1659	1399	0	3201	0
Flt Permitted	0.601			0.567				0.980			0.949	
Satd. Flow (perm)	1028	3199	0	951	3061	0	0	1630	1399	0	3041	0
Satd. Flow (RTOR)		11			45				488		4	
Lane Group Flow (vph)	16	188	0	802	243	0	0	255	488	0	471	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4		3	8			2				6
Permitted Phases	4			8			2		2	6		
Total Split (s)	14.1	14.1		45.0	59.1		30.9	30.9	30.9	30.9		30.9
Total Lost Time (s)	4.3	4.3		1.2	4.3			4.6	4.6			4.6
Act Effect Green (s)	10.2	10.2		50.4	47.2			22.0	22.0			22.0
Actuated g/C Ratio	0.13	0.13		0.64	0.60			0.28	0.28			0.28
v/c Ratio	0.12	0.44		0.89	0.13			0.56	0.66			0.55
Control Delay	38.5	36.9		24.6	5.9			30.9	7.4			27.6
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0			0.0
Total Delay	38.5	36.9		24.6	5.9			30.9	7.4			27.6
LOS	D	D		C	A			C	A			C
Approach Delay		37.0			20.3			15.5				27.6
Approach LOS		D			C			B				C
Queue Length 50th (m)	2.5	14.8		83.6	6.5			36.1	0.0			34.6
Queue Length 95th (m)	8.6	26.0		#162.8	11.6			60.1	24.3			50.3
Internal Link Dist (m)		807.1			178.8			887.9				140.9
Turn Bay Length (m)	22.5			90.0								
Base Capacity (vph)	133	424		1013	2233			567	805			1061
Starvation Cap Reductn	0	0		0	0			0	0			0
Spillback Cap Reductn	0	0		0	0			0	0			0
Storage Cap Reductn	0	0		0	0			0	0			0
Reduced v/c Ratio	0.12	0.44		0.79	0.11			0.45	0.61			0.44

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 78.4
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.89
 Intersection Signal Delay: 21.6 Intersection LOS: C
 Intersection Capacity Utilization 80.9% ICU Level of Service D
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 500: Niagara Street/Niagara St & Merritt Rd

