Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

REPORT

City of Welland

Northwest Welland Secondary Plan Traffic Impact Assessment

DECEMBER 2024

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1 INTRODUCTION

Associated Engineering (Associated) was previously retained by SGL Planning and Design (SGL) to conduct a transportation assessment for the Northwest Welland Secondary Plan (NWWSP). The intended function of this report is to document the assessment of the transportation facilities within the proposed development area situated within the City of Welland's (the City) 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.

This study was updated from the 2023 report to reflect current transportation conditions, including recent traffic data on Quaker Road at Rice Road and at First Avenue, and the revised population densities for the NWWSP, to address the City of Welland's comments, and update the analysis based on an updated development plan.

1.1 Development Context

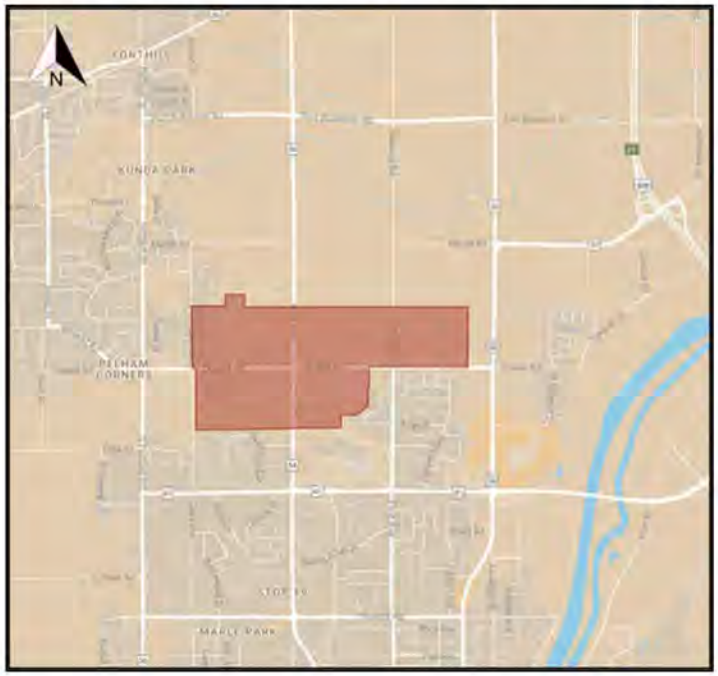
The NWWSP is an area with proposed residential developments that will provide housing for full-time residents within the City of Welland (the City). The development area will be a community marked by sustainable transportation infrastructure through the implementation of sidewalks, cycling facilities, 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 in a currently zoned rural area, Figure 1-1 illustrates the location plan of the NWWSP. 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 NWWSP 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.

Figure 1-1 Northwest Welland Secondary Plan Location Plan



1.2 Development Lands and Study Area

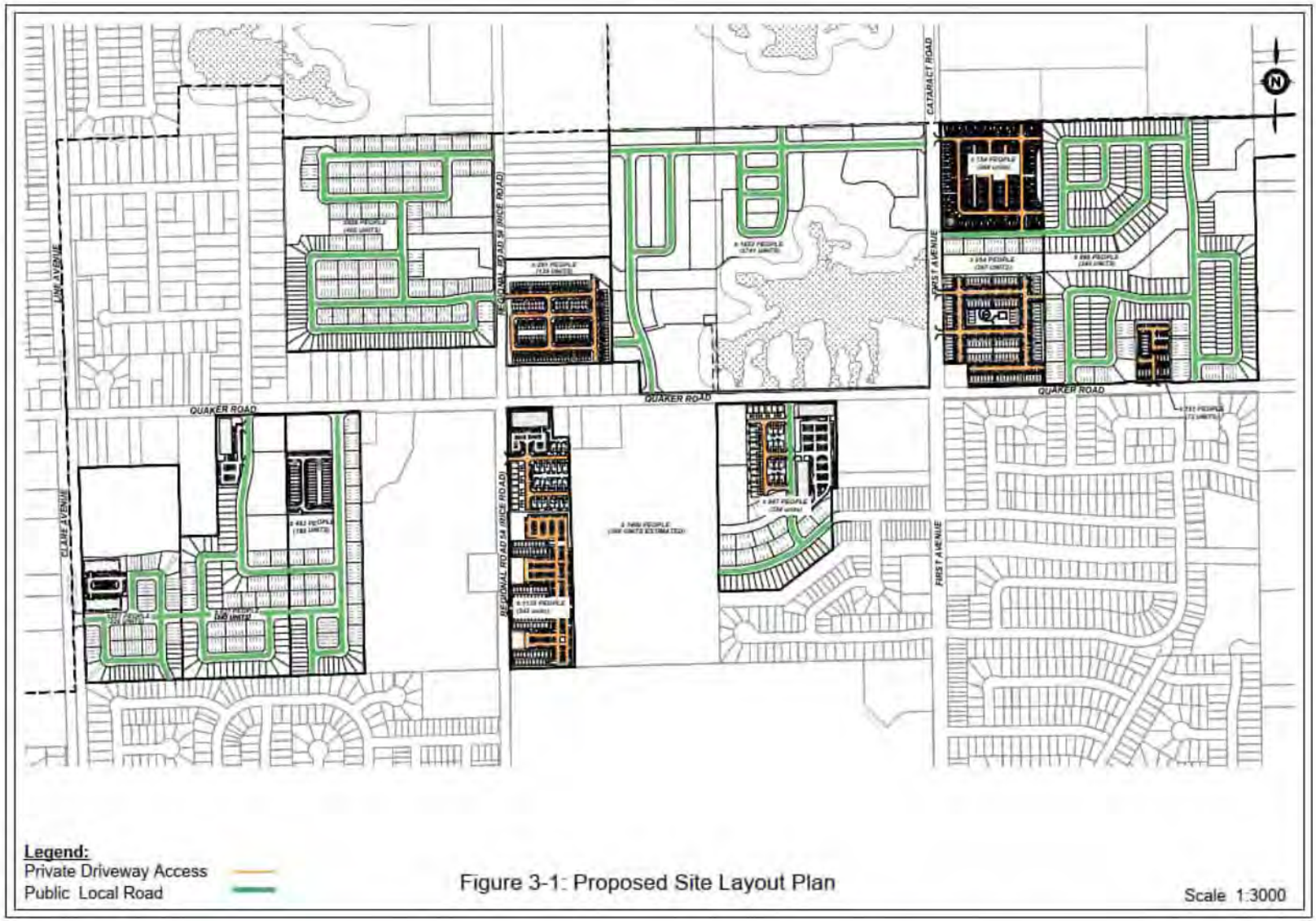
The proposed development lands are in the northwest quadrant of the City, bounded to the north by the City of Welland's municipal limits, to the west by Line Avenue/Clare Avenue, and to the east by the rear property line of those properties fronting onto Regional Road 50 (Niagara Street). The boundary 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 1-2 NNWSP Development Limits

1.3 Proposed Development Plans

Figure 1-3 shows the proposed site layout plan representing the full build-out of the NWWSP. The site has a mix of medium density development (townhouse and condominium complexes) and low density development (single family dwellings) requiring new accesses and intersections along Quaker Road, Clare Avenue, Rice Road, and First Avenue/Cataract Road. New local roads that will be in the jurisdiction of the City and new private access roads that will be maintained by the property owners are also shown on the figure. The two local roads that are shown as extending to the north are expected to provide connectivity to smaller residential areas and are not anticipated to generate a large enough amount of traffic that they would need to be collector streets.

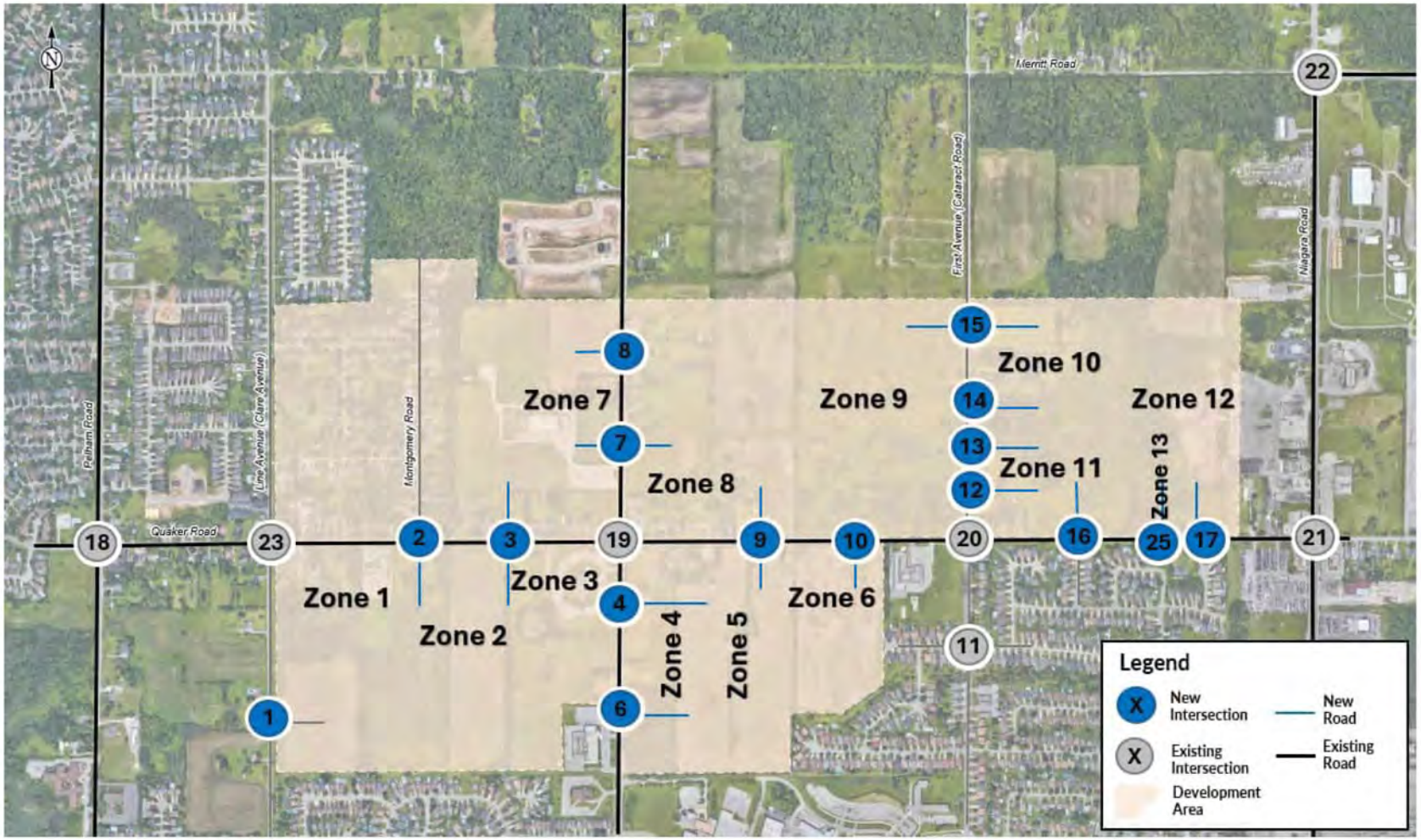
Figure 1-3 Proposed Site Layout Plan



1.4 Study Intersections

A total of seventeen (17) intersections are proposed to be added to the road network. The City of Welland has requested analysis at existing major intersections and all new intersections in the development area. The locations of the study intersections and an arbitrarily assigned identification number for use in this report are illustrated in Figure 1-4.

Figure 1-4 Study Intersections



1.5 Objectives and Transportation Assessment

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

Base Year, 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 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 (2034), Background Traffic Conditions

- Project base year (2023) background traffic volumes to horizon year (2034) background traffic volumes based on projected traffic conditions on key roads within the study area.

Horizon Year (2034), 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, 11th Edition (ITE TGM); and
- Determine the trip distribution of the development traffic volumes based on directional splits in the 2034 background traffic data and existing travel patterns derived from the eight (8) hour TMCs for the study area intersections.

Horizon Year (2034), Total Traffic Conditions

- Assess full build-out traffic operations (background plus development) and compare to the horizon year (2034) background traffic conditions to identify changes to the level of service experienced because of development-related growth within the area;
- Assess traffic operations during the horizon year (2034) for total traffic volumes on three intersections (Merrit Road @ Regional Road 50, Regional Road 50 @ Quaker, and First Avenue @ Quaker) under an upgraded Merritt Road between Regional Road 50 and Cataract Road (First Avenue) scenario;
- Determine infrastructure upgrades needed to accommodate development generated traffic and assess their impact on intersection performance; and
- Assess the capabilities of the existing transportation infrastructure to accommodate all types of road users including the increased vehicular volume at intersections, how the traffic accesses the existing road network, and 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 major existing 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 and Traffic Volume

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.

According to Schedule E of the City's Official Plan, 2019 the classification of Rice Road, Quaker Road and First Avenue is Arterial and on Clare Avenue it is Collector.

The twenty-four (24) hour ATR data was provided by the Regional Municipality of Niagara and the City of Welland Table 2-1 summarizes the annual daily traffic (AADT) volumes provided by the Regional Municipality of Niagara and the City of Welland for previous years and for 2023. The majority of the road segments have the same or less traffic in 2023 likely due to the change in the number of people working from home that started during the Covid-19 pandemic and continues to be a pattern.

Table 2-1 Daily Traffic Volume

Roadway	From/To Roadways	Previous Year	Previous Year AADT	2023 AADT
Quaker Road	Clare Avenue to Regional Road 54 (Rice Road)	2017	6000	5,500
Quaker Road	Regional Road 54 (Rice Road) to First Avenue	n/a	n/a	5,500
Quaker Road	First Avenue to Regional Road 50 (Niagara Street)	2017	9,100	8,500
Regional Road 54 (Rice Road)	Port Robinson Road to Quaker Road	2016	7,500	7,500
Regional Road 54 (Rice Road)	Quaker Road to Regional Road 41 (Woodlawn Road)	2016	7,700	7,500
First Avenue	Regional Road 37 (Merritt Road) to Quaker Road	2017	3,400	3,600
First Avenue	Quaker Road to Regional Road 41 (Woodlawn Road)	2017	6,000	6,000

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), respectively. 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 2,900 vehicles per day.

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 NWWSP: 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 5,500 to 8,500 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 7,700 to 8,000 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 3,600 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 north of Quaker Road and 40 kilometres per hour south of Quaker Road. 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.

Figure 2-4 Existing Intersection Control

2.3 Active Transportation Facilities

Along 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 crosswalk 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.
- Clare Avenue/Line Avenue has semi-mountable curbs with a concrete sidewalk on the west side of the roadway north of Quaker Road, while the Steve Bauer Trail (a multi-use trail maintained by the Town of Pelham) is situated alongside the east side of the roadway.
- Niagara Street, south of Quaker Road, has concrete sidewalks on both sides of the roadway. Niagara Street, north of Merritt Road, has paved shoulders on both sides of the roadway. Pedestrian phases are present on all approaches at the Niagara Street and Quaker Road intersection.
- Pelham Street, south of Quaker Road, has a concentre sidewalk on the west side of the roadway.
- Merritt Road has no active transportation facilities present.

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

On January 1st, 2023, the new Niagara Region Transit (NRT) consolidated all previous transit systems in the Region including Niagara Region Transit, St. Catharines Transit, Welland Transit and Fort Erie Transit into one transit operator. The existing transit service within and around the development lands is depicted in **Figure 2-5.**

Within the NWWSP, the only sections of roadway serviced by NRT are along Quaker Road between First Avenue and Regional Road 50 (Niagara Street). NRT Route 509 Niagara St. travels between Quaker Road and the Welland Downtown Bus Terminal with important stops at Niagara College Welland Campus and Seeway Mall. The closest bus stop is located on the north side of Quaker Road, approximately 50 metres west of Niagara Street. The route offers regular service with buses arriving every 30 minutes during the daytime from Monday to Saturday, and every 60 minutes in the evenings from Monday to Saturday and all day Sunday.

There are also regional NRT bus routes that travel through the study area but no stops within the NWWSP area. Route 70/75 travels between the City of St. Catharines and the City of Welland with bus stops just outside the NWWSP area. Route 60A/65A is an express bus that travels between Niagara College Welland Campus and the Morrison-Dorchester Hub in the City of Niagara Falls.

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 Timing Plans

The Regional Municipality of Niagara and the City of Welland provided eight (8) hour turning movement counts for five (5) existing intersections identified within or adjacent to the development lands which may be impacted because of the NWWSP development. Table 2-2 highlights the weekday one-hour morning (AM) and afternoon (PM) peak traffic periods. Refer to Appendix A for the traffic data used as part of this study.

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

[1] Existing refers to traffic volumes provided for the 2020 traffic study. Since the traffic volumes were mainly unchanged from 2016 to 2023, no adjustments to the turning movement counts were made.

Table 2-2 Existing[1] Weekday (AM) and Afternoon (PM) Peak Traffic Periods

Intersection	AM Peak Hour	PM Peak Hour
Regional Road 50 (Rice Road) and Quaker Road	8:00 a.m. – 9:00 a.m.	4:00 p.m. – 5:00 p.m.
First Avenue and Quaker Road	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 50 (Niagara Street/Merrittville Highway) and Regional Road 37 (Merritt Road)	7:45 a.m. – 8:45 a.m.	4:30 p.m. – 5:30 p.m.

2.6 Traffic Analysis Methodology

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).

Within the roadway network, intersections are typically the critical capacity control points. The study intersections previously presented 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 12. The capacity analysis results are based on the Highway Capacity Manual (HCM) 7th Edition methodology. Critical movements identified are the following:

- At signalized intersections, movements with v/c ratio greater than 0.85 and/or LOS "E" or worse are deemed to be "critical" in terms of operations. Movements that exceed those thresholds shall be evaluated for possible operational improvements.
- At unsignalized intersections, movements expected to operate at LOS "D" or worse and/or where the estimated 95th percentile queue length for an individual movement exceeds the available queuing space.
- Any site accesses where entrances or egress is anticipated to be blocked by traffic queues from an upstream/downstream intersection.
- An exclusive turning movement in which the 95th percentile queue will exceed the available storage space.
- Exclusive left- and right turn lanes that are inaccessible due to the length of queues in the adjacent through lanes.

The queue length was evaluated using Synchro's 95th percentile function. Synchro reports 95th percentile queues after two cycles. It should be noted that # symbol means the 95th percentile queue exceeds the capacity of the cycle length resulting in queues spilling from one cycle to another. In practice, 95th percentile queue shown will rarely be exceeded and the queues shown with the # symbol are acceptable for the design of storage bays if the reported v/c < 1. The report identifies cases where the v/c >1 and # is reported in the 95th percentile queue.

For all scenarios except the Merrit Road extension sensitivity analysis, the results of the AM and PM peak hour analysis are provided in the body of the report to make comparison between the two peak hours easier. Detailed results are found in the appendices.

2.7 Base Year Background Traffic Conditions

Turning movement counts during the weekday morning (AM) and afternoon (PM) peak hours used within the traffic operations assessment are shown in Figure 2-6. The counts show that the heaviest traffic flows are along Regional Road 37 (Merritt Road) east of Niagara Street 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 the City. Traffic flows are approximately even between the north-south and east-west movements at the subject intersections.

The Level of Service for the existing study intersections is presented by movement in Figure 2-7. Table 2-3 and Table 2-4 provides the traffic operations assessment reports for the base year background traffic for the AM and PM peak hour. Detailed results of both peak hour analysis are found in Appendix C.

The analysis indicates that, overall, the three intersections outside of the NWWSP are all operating below capacity with an adequate Level of Service (Level of Service of C or better).

Within the NWWSP area, the intersection of Rice Road and Quaker Road is experiencing a Level of Service of F on all approaches during the PM peak. This indicates a congested state (all approaches v/c >= 1) and that long delays are occurring during the PM peak hour. The delays are between 69 to 113 seconds (per vehicle on average). At the First Avenue and Quaker Road intersection, the Level of Service is E for the westbound approach in the PM peak, where the delay is 41.9 seconds (per vehicle on average).

Figure 2-6 Base Year Background Traffic Turning Movement Volumes

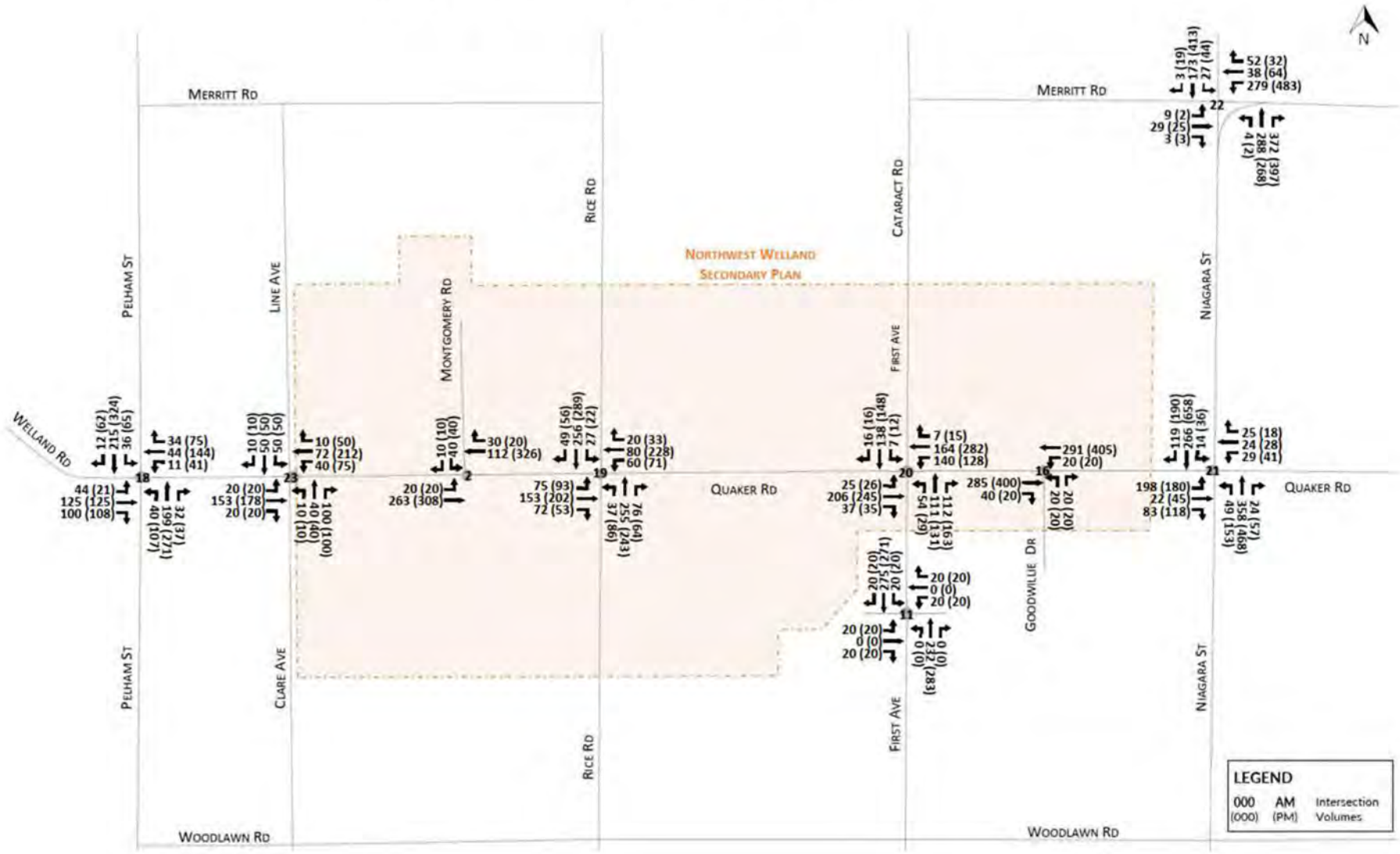


Figure 2-7 Base Year Background Level of Service

Table 2-3 Base Year Intersection Performance – AM Peak

AM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
19 - Regional Road 54 (Rice Road) @ Quaker	LOS	C	C	C	C	C	C	C	C	C	B	B	B
	v/c	0.719	0.719	0.719	0.658	0.658	0.658	0.617	0.617	0.617	0.359	0.359	0.359
	95th% Queue (veh/ln)	5.9	5.9	5.9	4.8	4.8	4.8	4.1	4.1	4.1	1.6	1.6	1.6
20 - First Ave @ Quaker Road	LOS	C	C	C	B	B	B	B	B	B	C	C	C
	v/c	0.503	0.503	0.503	0.315	0.315	0.315	0.49	0.49	0.49	0.571	0.571	0.571
	95th% Queue veh/ln	2.8	2.8	2.8	1.3	1.3	1.3	2.7	2.7	2.7	3.6	3.6	3.6
18 - Pelham St @ Quaker Road	LOS	A	B	B	A	B	B	B	B	B	A	A	A
	v/c	0.10	0.37	0.37	0.09	0.36	0.36	0.48	0.48	0.48	0.16	0.16	0.16
	95th% Queue (m / ln)	8.1	32.3	32.3	7.4	32.6	32.6	34.9	34.9	34.9	11.3	11.3	11.3
21 - Regional Road 50 @ Quaker	LOS	B	B	B	B	B	B	A	A	A	B	B	B
	v/c	0.21	0.35	0.35	0.06	0.30	0.30	0.34	0.18	0.18	0.10	0.12	0.12
	95th% Queue (m / ln)	14.9	37.0	37.0	6.1	31.1	31.1	24.6	7.9	7.9	7.8	8.3	8.3
22 - Regional Road 50 @ Merritt Road	LOS	B	A	A	B	B	B	C	C	C	B	A	A
	v/c	0.43	0.43	0.47	0.22	0.22	0.22	0.16	0.16	0.16	0.61	0.16	0.16
	95th% Queue (m/ln)	48.0	48.0	15.1	15.7	15.7	15.7	11.4	11.4	11.4	38.5	8.6	8.6
23 - Quaker Road @ Clare Avenue	LOS	A	A	A	A	A	A	A	A	A	A	A	A
	v/c	0.205	0.205	0.205	0.167	0.167	0.167	0.277	0.277	0.277	0.182	0.182	0.182
	95th% Queue (veh / ln)	6	6	6	5	5	5	8	8	8	5	5	5
2 - Quaker Road @ Montgomery	LOS				B	B	B	A	A	A	A	A	A
	v/c				0.097	0.097	0.097	0.016	0.016	0.016	0.00	0.00	0.00
	95th% Queue (veh/ln)				2	2	2	0	0	0	0	0	0
16 - Quaker Road @ Goodwill	LOS	B	B	B				A	A	A	A	A	A
	v/c	0.085	0.085	0.085				0.00	0.00	0.00	0.018	0.018	0.018
	95th% Queue (veh/ln)	2	0	0				0	0	0	0.1	0.1	0.1
11 - Quaker Road @ Cedar Park Dr	LOS	A	A	A	A	A	A	B	B	B	B	B	B
	v/c	0.00	0.00	0.00	0.016	0.016	0.016	0.085	0.085	0.085	0.082	0.082	0.082
	95th% Queue (veh/ln)	0	0	0	1	1	1	2	2	2	2	2	2

Table 2-4 Base Year Intersection Performance – PM Peak

PM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
19 - Regional Road 54 (Rice Road) @ Quaker	LOS	F	F	F	F	F	F	F	F	F	F	F	F
	v/c	1.12	1.12	1.12	1.08	1.08	1.08	1.04	1.04	1.04	1.00	1.00	1.00
	95th% Q (veh/ln)	15	15	15	13	13	13	11	11	11	10	10	10
20 - First Ave @ Quaker Road	LOS	C	C	C	C	C	C	C	C	C	E	E	E
	v/c	0.68	0.68	0.68	0.42	0.42	0.42	0.66	0.66	0.66	0.88	0.88	0.88
	95th% Q (veh/ln)	5	5	5	2	2	2	5	5	5	10	10	10
18 - Pelham St @ Quaker Road	LOS	B	B	B	B	B	B	B	B	B	B	B	B
	v/c	0.38	0.47	0.47	0.19	0.59	0.59	0.44	0.44	0.44	0.49	0.49	0.49
	95th% Q (m/ln)	21	45	45	12	59	59	31	31	31	36	36	36
21 - Regional Road 50 (Niagara Street) @ Quaker	LOS	C	B	B	C	C	C	C	A	A	C	B	B
	v/c	0.58	0.30	0.30	0.15	0.76	0.76	0.50	0.32	0.32	0.25	0.18	0.18
	95th% Queue (m/ln)	#40.8	46	46	14	#120.7	#120.7	38	17	17	13	10	10
22 - Regional Road 50 (Niagara Street) @ Merritt Road	LOS	B	A	A	B	B	B	C	C	C	C	A	A
	v/c	0.46	0.46	0.53	0.50	0.50	0.50	0.13	0.13	0.13	0.85	0.14	0.14
	95th% Queue (m/ln)	53	53	18	43	43	43	9	9	9	#73.8	10	10
23 - Quaker Road @ Clare Avenue	LOS	A	A	A	B	B	B	B	B	B	B	B	B
	v/c	0.24	0.24	0.24	0.19	0.19	0.19	0.35	0.35	0.35	0.51	0.51	0.51
	95th% Queue (m ln)	7	7	7	5	5	5	11	12	11	23	23	23
2 - Quaker Road @ Montgomery	LOS				C	C	C	A	A	A	A	A	A
	v/c				0.14	0.14	0.14	0.02	0.02	0.02	0.00	0.00	0.00
	95th% Queue (m ln)				4	4	4	1	1	1	0	0	0
16 - Quaker Road @ Goodwill	LOS	C	C	C				A	A	A	A	A	A
	v/c	0.11	0.11	0.11				0.00	0.00	0.00	0.02	0.02	0.02
	95th% Queue (m ln)	3	0	0				0	0	0	0	0	0
11 - Quaker Road @ Cedar Park Dr	LOS	A	A	A	A	A	A	B	B	B	B	B	B
	v/c	0.00	0.00	0.00	0.02	0.02	0.02	0.09	0.09	0.09	0.09	0.09	0.09
	95th% Queue (m ln)	0	0	0	1	1	1	2	2	2	2	2	2

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)*. Based on the turning movement counts provided by the city, both intersections satisfy the minimum 8-hour vehicular volumes warrant. The results, provided in **Appendix D**, indicate that in the base year background traffic conditions, traffic control signals are justified for both 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 the associated traffic would have on the NWWSP.

2.9.1 East Fonthill Secondary Plan

The East Fonthill Secondary Plan was included in the Town of Pelham Official Plan and adopted in 2014.

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 limited increase in traffic flow along Regional Road 54 (Rice Road) through the study area.

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.

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 *TMP, 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 TMP indicated that design and construction of this extension is planned within the 2017-2021 phase (to be updated as part of the MCEA, Spring 2024). As of today, the design of the Merritt Road extension is currently being assessed as part of the Environmental Assessment study for Merritt Road between Rice Road and Highway 406 as discussed in the next section. 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. Because of this, a sensitivity analysis with the Regional Road 37 (Merritt Road) extension has been completed and is discussed in Section 5.4.

2.9.5 Merritt Road (Regional Road 37) and Rice Road (Regional Road 54) Widening

As of March 2024, Niagara Region has completed a Schedule C Municipal Class Environmental Assessment (MCEA), including a detailed transportation assessment for Merritt Road (Regional Road 37) and Rice Road (Regional Road 54) in Pelham, Thorold, and Welland. The study was initiated in December 2020 and three Public Information Centre sessions were conducted in 2021. The objectives of the study are to identify intersection improvements, provide a direct connection between Rice Road and Highway 406 via Merritt Road, and provide dedicated active transportation facilities.

The preliminary indication (to be confirmed through the MCEA) for preferred design for Rice Road between Quaker Road and Merritt Road is a four-lane cross-section with a two-way cycle track on the west side and sidewalks on both sides of the roadway with an anticipated completion date of 2041. At the Rice Road and Quaker Road intersection, left-turn lanes are recommended on all approaches with the south leg widened to four lanes to transition to the four-lane cross-section north of Quaker Road.

The preliminary indication (to be confirmed through the MCEA) for preferred design for Merritt Road between Rice Road and Merrittville Highway/Niagara Street is a two-lane cross-section with a two-way cycle track and sidewalk on the north side of the roadway. Between Merrittville Highway/Niagara Street and Grisdale Road, the preliminary preferred design is a four-lane cross-section with a two-way cycle track and sidewalk on the south side of the roadway. At the Merrittville Highway/Niagara Street and Merritt Road intersection, the potential design includes adding separate left-turn lanes at the northbound, southbound, and eastbound approaches. The west leg is widened to four lanes to transition to the four-lane cross-section east of Merrittville Highway/Niagara Street. Pedestrian and cyclist crossings will be provided on all approaches at the intersection.

3 TRAFFIC FORECAST

The site generated traffic was estimated using the institute of Transportation Engineers Trip Generation Manual, 11th Edition. The traffic forecast is used to determine site-generated traffic and add it to existing background traffic. The combined traffic volumes are then distributed to the broader region and assigned routes to access the broader region. The traffic forecast was developed by using the established three step method using ITE trip generation rates with trip generation, distribution, and assignment.

3.1 Trip Generation and Distribution

Each of the development areas was assigned a zone identification number as shown in Figure 3-1. A summary of the number of units and expected population for each zone is provided in Table 3-1. The majority of development will be single-family housing and low-rise multifamily housing, while one development zone will be student housing meant for the college campus to the south of the development area. The 13 development areas are expected to house approximately 11,000 population.

Figure 3-1 Development Zone Identification Numbers

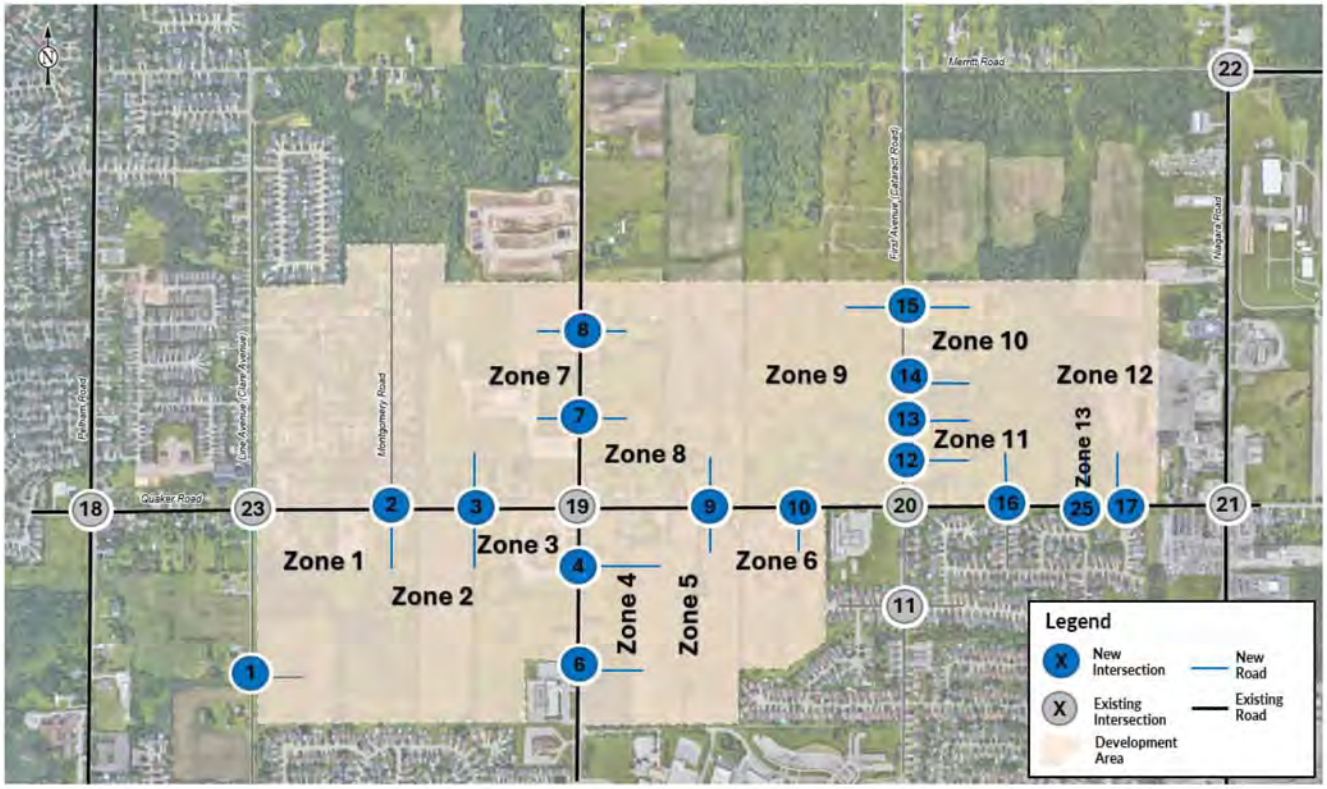


Table 3-1 Estimated Land Development by Zone

Zone	Land Use Type	Number of Units	Estimated Population
Zone 1	Single-Family Housing	226	557
Zone 2	Single-Family Housing	245	627
Zone 3	Single-Family Housing	180	493
Zone 4	Off-Campus Student Apartment (Low-Rise)	542	1,135
Zone 5	Single-Family Housing	500	1,400
Zone 6	Multifamily Housing (Low-Rise)	334	847
Zone 7	Single-Family Housing	405	929
Zone 8	Multifamily Housing (Low-Rise)	139	291
Zone 9	Single-Family Housing	741	1,853
Zone 10	Multifamily Housing (Low-Rise)	360	754
Zone 11	Multifamily Housing (Low-Rise)	397	854
Zone 12	Single-Family Housing	340	996
Zone 13	Multifamily Housing (Low-Rise)	72	151
	TOTAL	4,481	10,887

New site trips were estimated using the following codes from the Institute of Transportation Engineers Trip General Manual, 11th Edition:

- Single Family Attached Housing (Land Use Code 215),
- Multifamily Housing - Low-Rise (Land Use Code 220), and
- Off-Campus Student Apartment – Low Rise (Land Use Code 225).

The independent variable for single-family housing and multifamily housing is number of units. This independent variable was not available for student housing in the ITE TGM. Therefore, "people" was selected as the independent variable for student housing. The trip generation rates for the AM and PM peak hours are summarized in Table 3-2 and Table 3-3.

Trip distribution through the study network was based on over 50 years of direct knowledge of traffic movement patterns around the study area including the greater Welland, Fonthill and Thorold municipalities, and were confirmed with City of Welland staff prior to proceeding with analysis. The assumptions for distributing traffic account for current data availability and condition of the road network (cross section, road condition, etc.), and were compared to available AADT. A small percentage of trips (14%) were assigned to the local community to/from the elementary schools and Niagara College Canada (Welland Campus).

Table 3-4 summarizes the trip distribution assumptions for the AM and PM peak hours. Trips destined to/ or from the East include trips to Highway 406 as well as trips to the Seaway Mall. For the analysis, a larger number of vehicles were assigned to The Regional Road 50 (Niagara Street)/Quaker Road route than the Regional Road 50 (Niagara Street)/Merrit Road route. The current road condition of Merrit Road was seen as a factor limiting the number of vehicles from reaching Highway 406 via the Merrit Road at First Avenue intersection instead. These assumptions means that if anything, the number of turns at intersections may be higher than what will actually occur.

Table 3-2 Development Trip Generation, AM Peak

Zone	ITE Code	Independent Variable	Trip Rate	% In	Trips In	% Out	Trips Out	Total Trips
1	215	226 units	T = 0.52X - 5.70	25%	28	75%	84	**112**
2	215	245 units	T = 0.52X - 5.70	25%	30	75%	91	**121**
3	215	180 units	T = 0.52X - 5.70	25%	22	75%	66	**88**
4	225	1135 people	Ln(T) = 0.62Ln(X) + 0.34	38%	42	62%	68	**110**
5	215	500 units	T = 0.52X - 5.70	25%	64	75%	190	**254**
6	220	334 units	T = 0.31X + 22.85	24%	30	76%	96	**126**
7	215	405 units	T = 0.52X - 5.70	25%	51	75%	154	**205**
8	220	139 units	T = 0.31X + 22.85	24%	16	76%	50	**66**
9	215	741 units	T = 0.52X - 5.70	25%	95	75%	285	**380**
10	220	360 units	T = 0.31X + 22.85	24%	32	76%	102	**134**
11	220	397 units	T = 0.31X + 22.85	24%	35	76%	111	**146**
12	215	340 units	T = 0.52X - 5.70	25%	43	75%	128	**171**
13	220	72 units	T = 0.31X + 22.85	24%	11	76%	34	**45**
TOTAL					**499**		**1459**	**1958**

ITE Codes:
215 - Single-Family Attached Housing
225 - Off-Campus Student Apartment (Low-Rise)
220 - Multifamily Housing (Low-Rise)

Table 3-3 Development Trip Generation, PM Peak

Zone	ITE Code	Independent Variable	Trip Rate	% In	Trips In	% Out	Trips Out	Total Trips
1	215	226 units	T = 0.60X - 3.93	59%	78	41%	54	**132**
2	215	245 units	T = 0.60X - 3.93	59%	84	41%	59	**143**
3	215	180 units	T = 0.60X - 3.93	59%	61	41%	43	**104**
4	225	1135	Ln(T) = 0.76Ln(X) + 0.13	50%	120	50%	120	**240**
5	215	500 units	T = 0.60X - 3.93	59%	175	41%	121	**296**
6	220	334 units	T = 0.43X + 20.55	63%	103	37%	61	**164**
7	215	405 units	T = 0.60X - 3.93	59%	141	41%	98	**239**
8	220	139 units	T = 0.43X + 20.55	63%	50	37%	30	**80**
9	215	741 units	T = 0.60X - 3.93	59%	260	41%	180	**440**
10	220	360 units	T = 0.43X + 20.55	63%	110	37%	65	**175**
11	220	397 units	T = 0.43X + 20.55	63%	120	37%	71	**191**
12	215	340 units	T = 0.60X - 3.93	59%	118	41%	82	**200**
13	220	72 units	T = 0.43X + 20.55	63%	32	37%	19	**51**
TOTAL					1452		**1003**	**2455**

ITE Codes:
215 - Single-Family Attached Housing
225 - Off-Campus Student Apartment (Low-Rise)
220 - Multifamily Housing (Low-Rise)

Table 3-4 Trip Distribution

Destination	AM Peak		PM Peak	
	% In	% Out	% In	% Out
North	17%	13%	17%	13%
South	30%	26%	30%	34%
East	34%	43%	34%	34%
West	5%	4%	5%	5%
Local Community	14%	14%	14%	14%
TOTAL	**100%**	**100%**	**100%**	**100%**

3.2 Turning Movement Traffic Forecasts

Based on historic daily traffic volumes and in consultation with the City, a growth rate of 1% per year has been applied to background traffic volumes. This growth factor was not applied to 2024 volumes but starting from 2025. This was converted to a growth factor of 1.09 and applied to the AM and PM peak hour turning movements to calculate the 2034 background traffic volumes. Given the relatively low expected background growth adjacent to the study area, the background traffic growth is not expected to impact traffic operations in the study area and development traffic is more critical in this analysis. Figure 3-2 and Figure 3-3 show the future background traffic volumes at the 2034 horizon year for the existing and new intersections respectively.

Figure 3-4 and Figure 3-5 shows the traffic volumes for development traffic based on the trip generation and distribution described in Section 3.1 for the existing and new intersections respectively. Figure 3-5 and Figure 3-6 show the total traffic volumes which are the sum of the background traffic for the 2034 horizon year and the full build-out development traffic for the existing and new intersections respectively.

Figure 3-2 2034 Horizon Year Background Traffic Turning Movement Volumes – Major Intersections

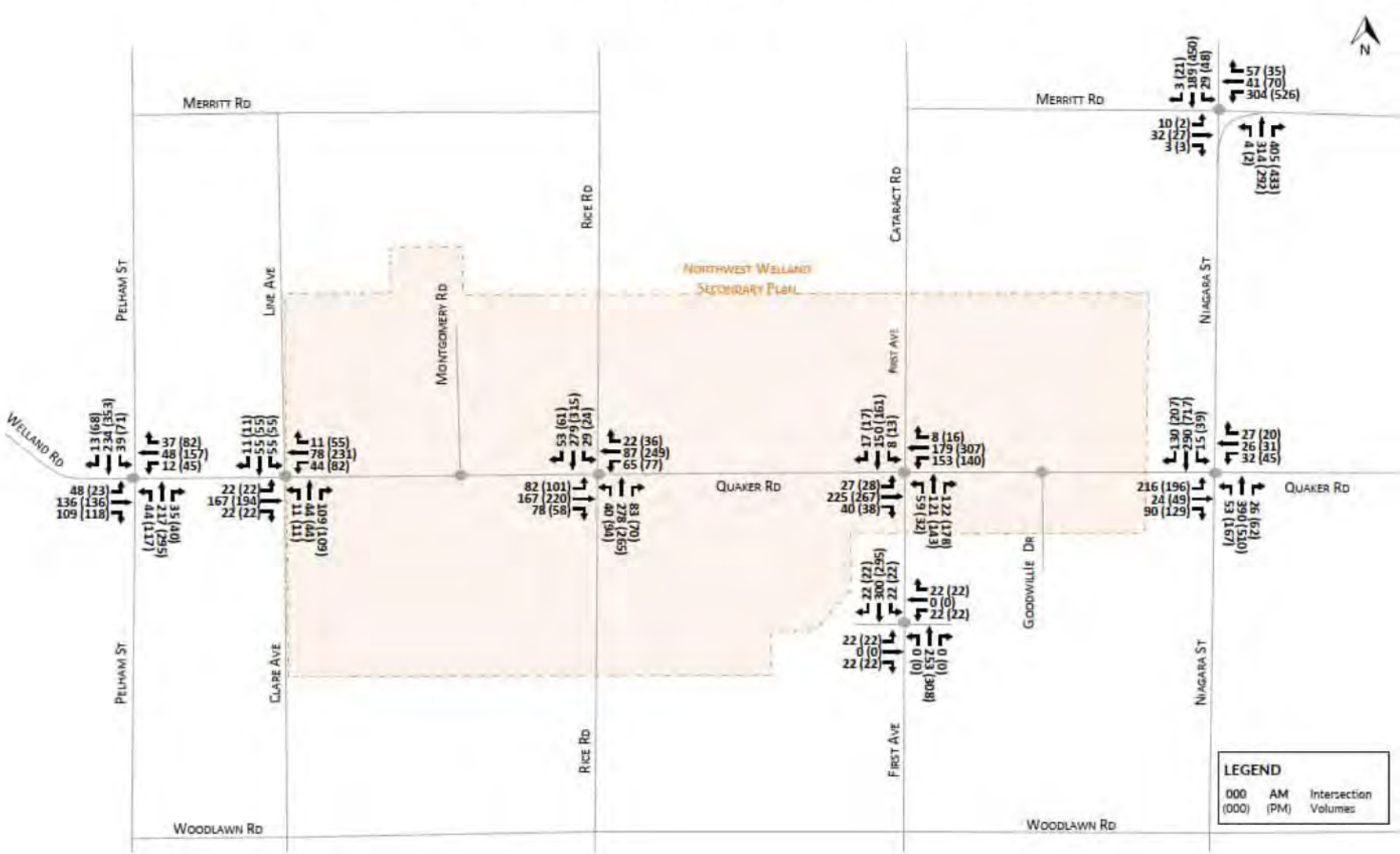


Figure 3-3 2034 Horizon Year Background Traffic Turning Movement Volumes – Minor Intersections

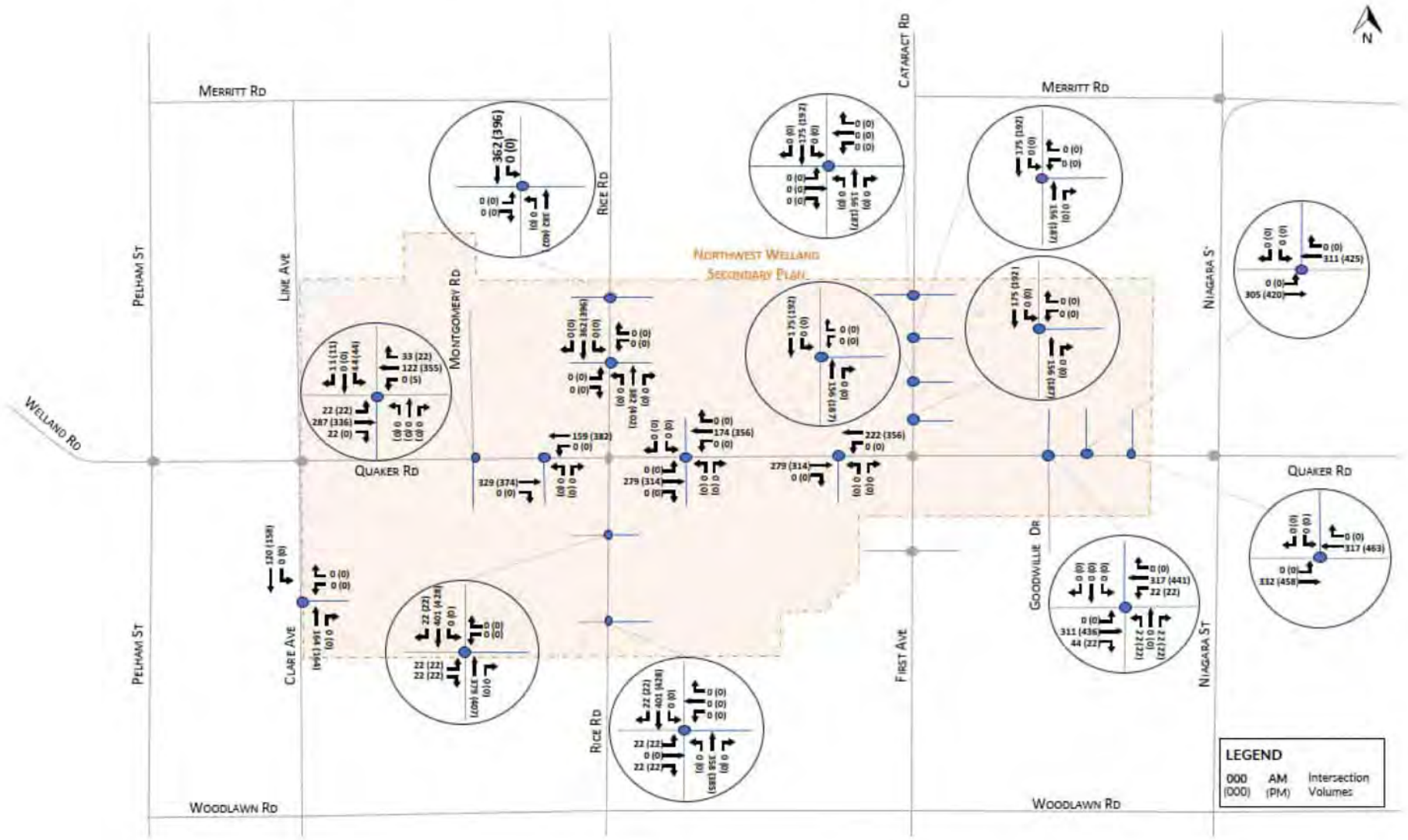


Figure 3-4 Development Traffic Turning Movement Volumes – Existing Intersections

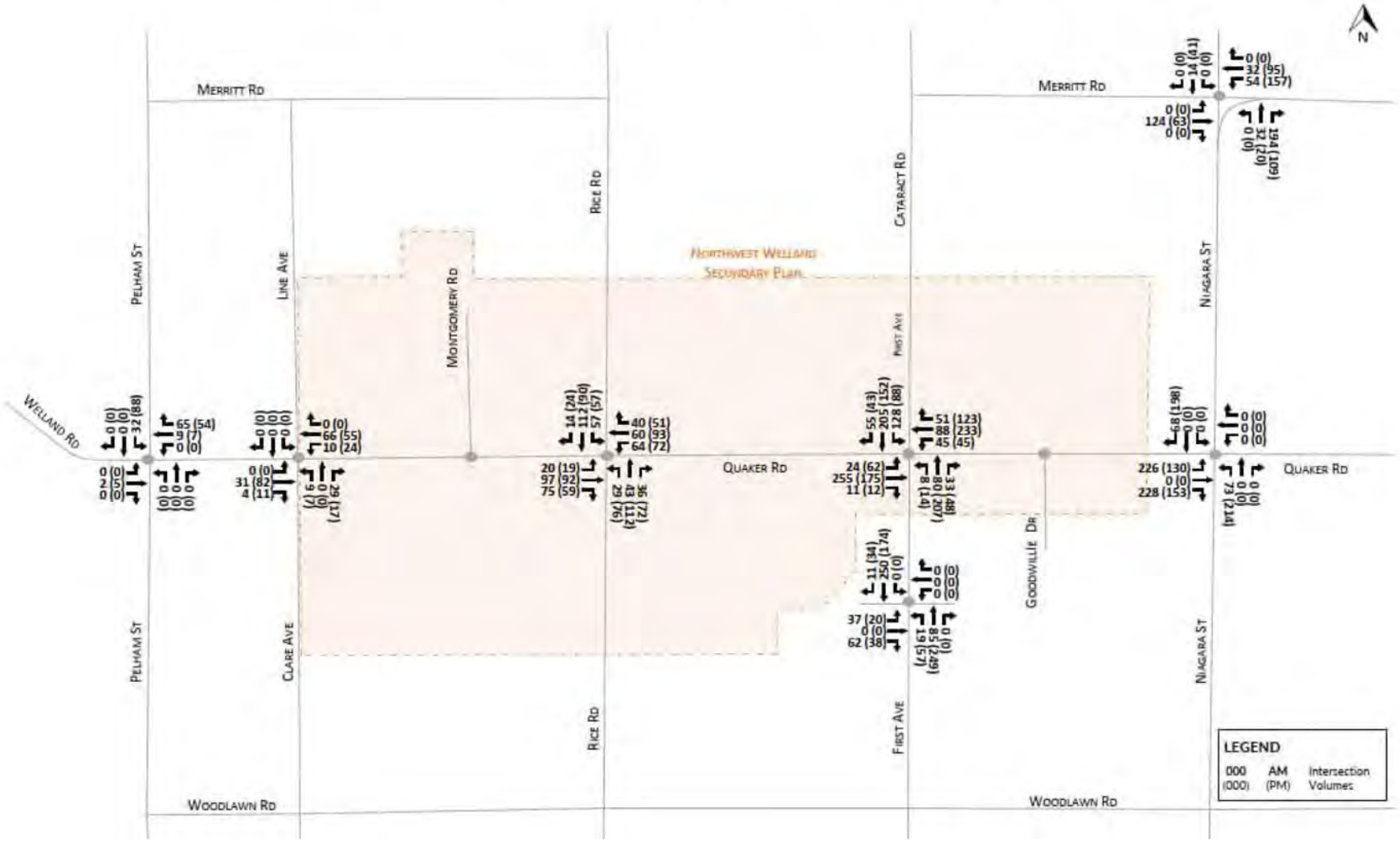


Figure 3-5 Development Traffic Turning Movement Volumes – Minor Intersections

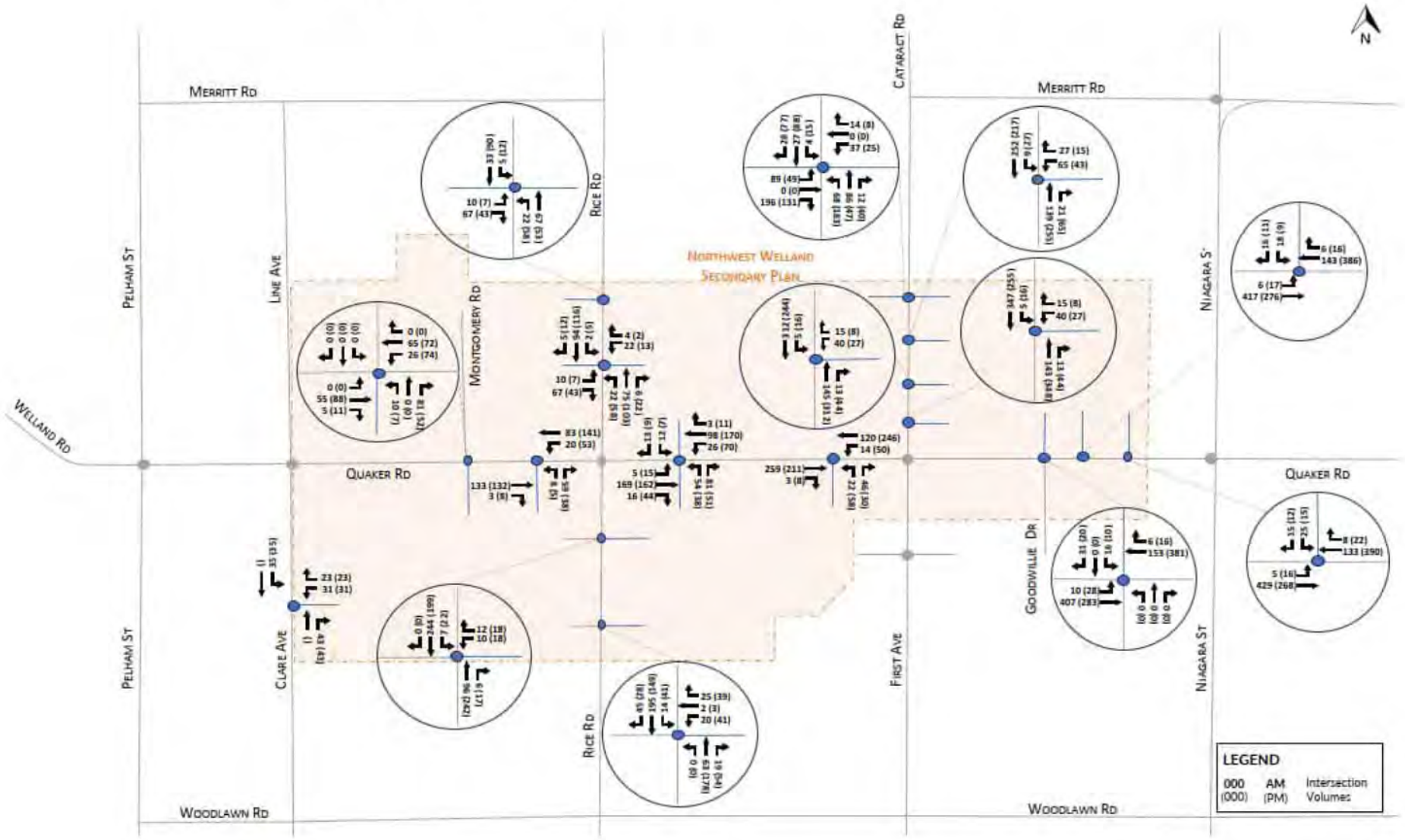


Figure 3-6 Horizon Year Total Traffic Turning Movement Volumes – Major Intersections

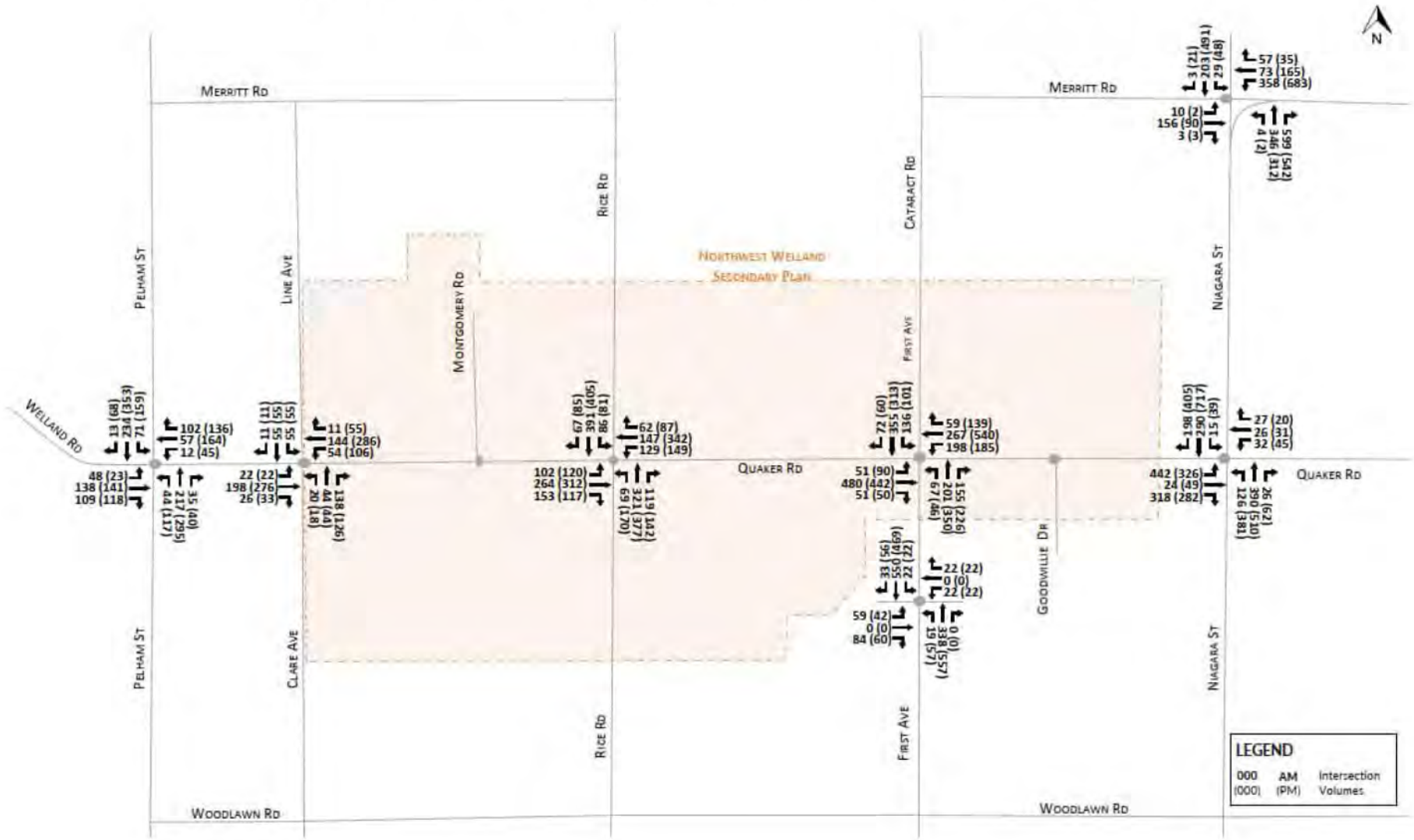
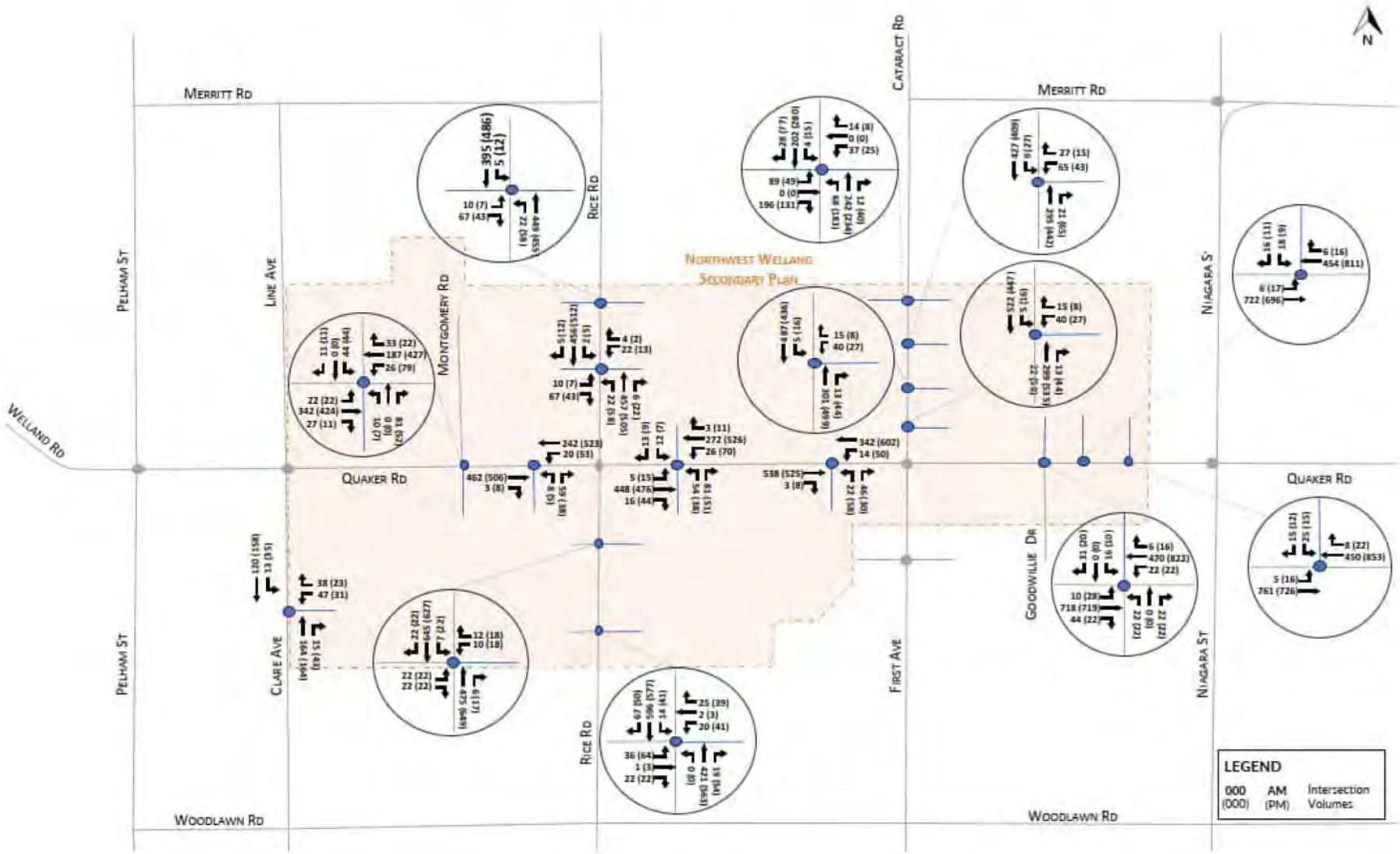


Figure 3-7 Horizon Year Total Traffic Turning Movement Volumes – Minor Intersections



4 ROAD NETWORK PLANS

This section discusses the base assumptions for the road network plan.

4.1 Number of Traffic Lanes Along Each Corridor

The City is in the process of establishing a standard cross section for arterials. Cross section elements include active transportation facilities , landscaping a 14.0 m traffic width which is sufficient for four lanes that could either have one parking lane and one driving lane in each direction or two driving lanes in each direction.

Quaker Road – The development group has questioned whether it is excessive to provide a 14.0 m traffic width on Quaker Road because of the economic, social, and traffic safety impacts of a larger road, and relatively low forecast traffic volumes for an arterial. This is a valid concern in the sense that roads with more travel lanes result in longer crossing distances for pedestrians and roads with excess traffic capacity can result in speeding. The expected daily volumes max out at 12,000 vehicles per day between First Avenue and Regional Road 50 (Niagara Street) which is commonly below the threshold for four laning in an urban environment.

A two way left turn lane (TWLTL) with one driving lane on Quaker Road from Clare Avenue to Niagara Street is proposed. This will provide additional storage for vehicles turning left along Quaker Road at the major intersections and to new accesses/and local streets as a result of the development.

The majority of the corridor is unlikely to have any on-street parking demand because there is no frontage along the corridor, except a small amount of on-street parking demand may occur near the multi-family sites. The corridor will have some low volume tee-intersections and/or private driveways with a small number of left turn movements.

Rice Road – The Schedule 'C' Municipal Class Environmental Assessment for Merritt Road (Regional Road 37) and Rice Road (Regional Road 54) in the Town of Pelham, the City of Thorold and the City of Welland Environmental Study Report recommends that Rice Road north of Quaker become a five lane roadway with two driving lanes and one TWLTL. Since the forecast volume is only 9,200 vehicles per day on Rice Road, a base scenario with one lane in each direction plus a TWLTL for a total of three lanes was used for this corridor.

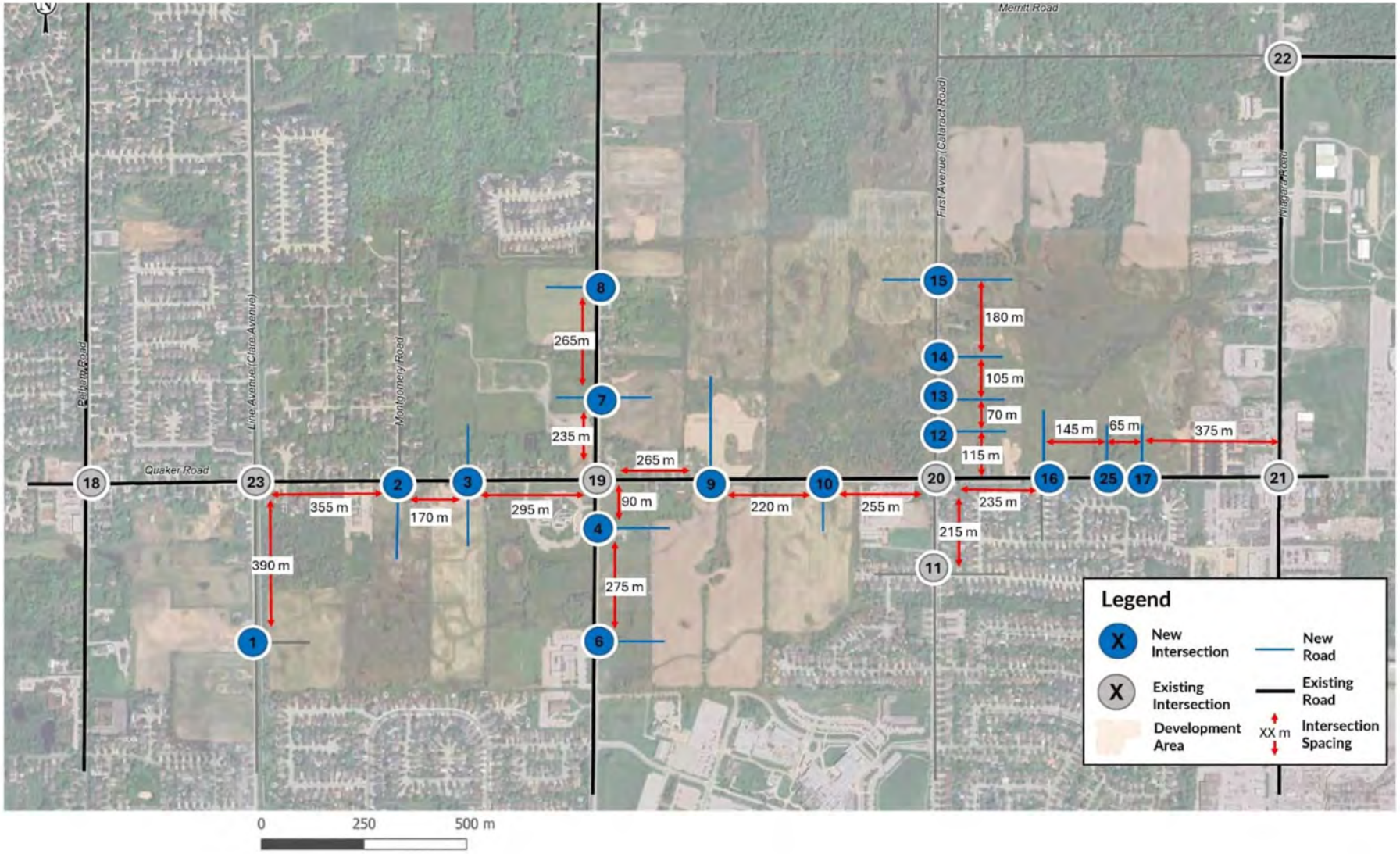
First Avenue/Cataract Road – First Avenue south of Quaker Road is a two-lane rural road with single detached housing with individual driveways along the corridor. This segment is functioning like a collector street and likely not to change. Cataract Road north of Quaker Road is forecast to have 8,400 vehicles per day which is bordering on the collector or minor arterial classification. For this roadway, the base scenario was assumed to be one lane in each direction.

Merritt Road is assumed to not have been constructed between Rice Road and Cataract Road in the base scenario. A sensitivity analysis was done to test the impact of building this road on Quaker Road.

4.2 Intersection Spacing

The intersection spacing between existing and proposed driveways and intersections is shown in Figure 4-1. For each of the new intersections, the spacing between intersections was considered during the future conditions analysis to determine whether any traffic queues would affect the operations of adjacent intersections. For any intersections where this is a concern, a mitigation was included in the improvement scenario. Refer to Section 5 for more information.

Figure 4-1 Intersection Spacing



4.3 Local Road Connections to the City of Thorold Road Network

Two new public local roads proposed in the NNWSP will continue through to the City of Thorold, the first road is between Regional Road 54 (Rice Road) and First Avenue (Cataract Road). The second road is between First Avenue (Cataract Road) and Regional Road 50 (Niagara Street). Figure 4-2 shows the growth plan for the City of Thorold immediately north of Welland. The growth from Thorold is not expected to bring significant traffic to the study area via the first road as it connects to residential roads and does not provide direct or through connection to higher classified roads. The second proposed road runs from Quaker Road to the City limit in the north. This road is expected to "T" intersect with a new east-west road in the City of Thorold as part of the West Port Robinson Secondary Plan. Therefore expected traffic from growth in Thorold will be spread out and not have a significant impact on the operation of the study intersections, and if anything may result in a decrease in traffic using Quaker Road to travel in and out of the area. Re-classification of this street to a collector classification is not needed.

Figure 4-2 Road Connections to City of Thorold

5 FUTURE TRAFFIC ANALYSIS

The future traffic analysis considers the following three scenarios: Background Future Traffic, Total Future Traffic (No Improvements), and Total Future Traffic (with Improvements). A sensitivity analysis for a Merritt Road upgrade provides analysis at key intersections that would be affected by this upgrade.

5.1 Background Future Traffic

This scenario analyzes existing intersection performance with the Horizon Year (2034) background traffic volume. This scenario includes the necessary signalization of the First Avenue and Rice Road intersections with Quaker Road, with LT storage lanes sized for future background traffic volumes which are necessary infrastructure upgrades based on base year peak hour traffic volumes independent of the proposed developments.

Figure 5-1 shows the anticipated Level of Service at the study intersections for the horizon year with background volumes only. Table 5-1 and Table 5-2 show the LOS, v/c, and anticipated 95th Percentile Queue lengths at the existing intersections for the AM and PM peak hour. Appendix E shows the detailed Synchro outputs for the Background Future Traffic analysis.

The analysis shows that all of the lane groups at the signalized intersections perform with LOS D or greater and v/c less than 0.85 and all lane groups at unsignalized intersections perform with LOS C or better for both peak hours.

The 95th percentile queue lengths for EB and WB thru traffic at the First Avenue at Quaker Road intersection are 41 m and 45 m, respectively. These will be the required length of the left turn lanes so that the through traffic queue does not block access to the left turn storage lanes. At Rice Road, the planned TWLTL provides significant storage for left-turn movements, mitigating access issues to the left turn bay. At Regional Road 50 (Niagara Street), the SB thru queue may hinder access to the southbound left turn storage lane if the queue continues to grow after two cycles.

5.2 Total Future Traffic (No Improvements)

This scenario analyzes the total (background and development) traffic at the 2034 horizon year with the same infrastructure as the Background Future Traffic scenario. The potential need for infrastructure upgrades related to development are identified in this scenario and potential mitigation is tested in the Total Future Traffic (with Improvements). A slight change is that the major intersections that are existing with either traffic signals or a four way stop are on one figure and the minor intersections that are new or have a new leg added are on the second figure in the series. This places all of the intersections with two way stops on the same figure and in the same analysis tables.

Figure 5-2 and Figure 5-3 show the LOS of the major and minor intersections. Table 5-3 to Table 5-10 show the LOS, v/c, and anticipated 95th Percentile Queue lengths for the AM and PM peak hour. Appendix F shows@ the detailed Synchro outputs for the horizon year (2034) with no improvements for both peak hours. Analysis results are discussed after each section of the study area.

Roundabouts at the Regional Road 54 at Quaker and First Avenue at Quaker Road intersections were also analyzed under this scenario. The details of the analysis are shown in Appendix G. The analysis showed the following:

- Regional Road 50 at Quaker Road: One approach lane and one lane in the roundabout will result in LOS B or better at all of the approaches for both peak hours.
- Quaker Road at First Avenue: One major lane and one short lane at each approach with a two lane round about will result in LOS B or better for all approaches during both peak hours.

Figure 5-1 Horizon Year Background Traffic Level of Service

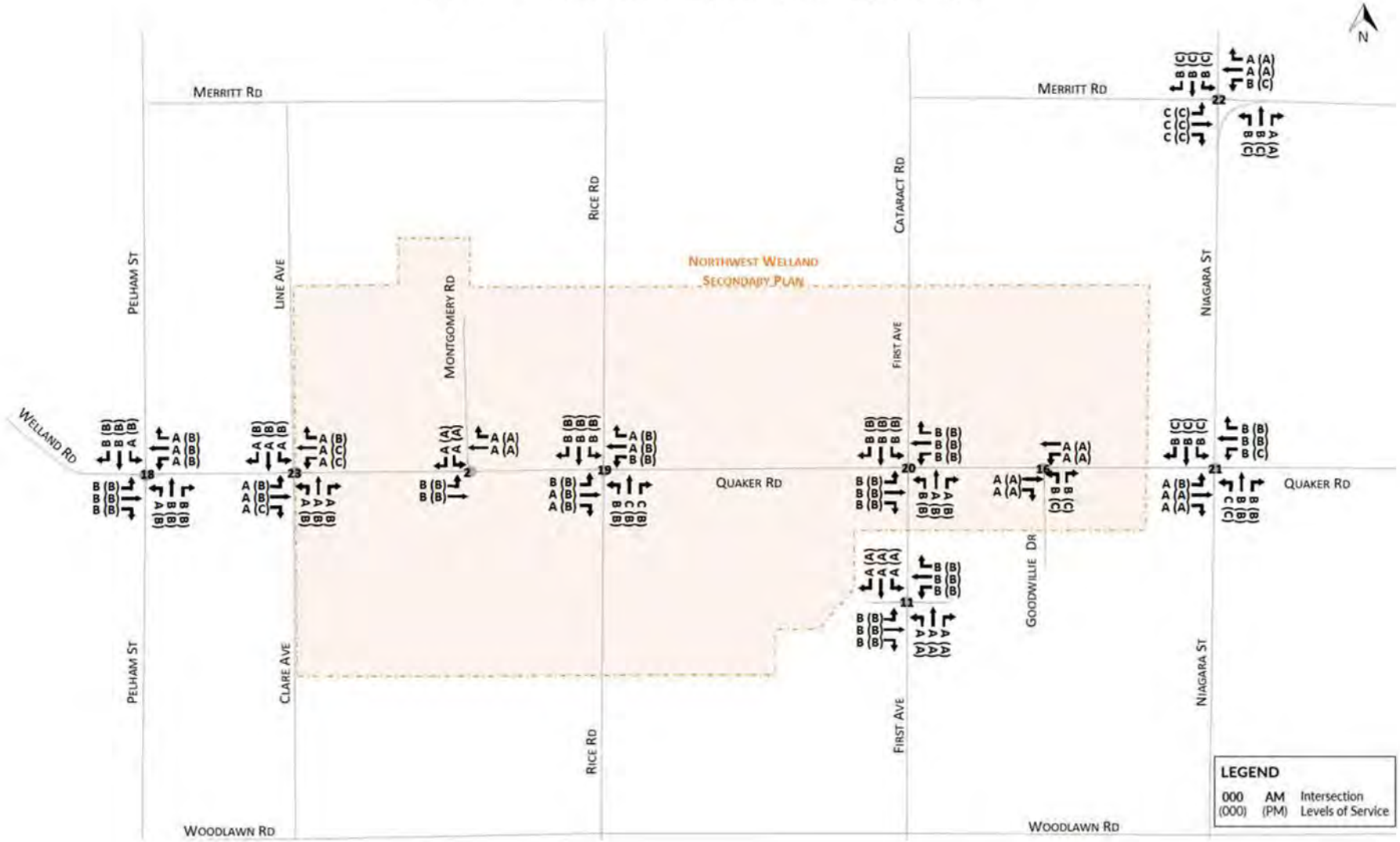


Table 5-1 Horizon Year Background Traffic Intersection Performance (Existing) – AM Peak

AM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
19 - Regional Road 54 (Rice Road) @ Quaker	LOS	B	C	C	B	B	B	B	A	A	B	A	A
	v/c	0.16	0.71	0.71	0.13	0.66	0.66	0.18	0.38	0.38	0.17	0.17	0.17
	95th% Queue (m/ln)	8.1	#52.4	#52.4	6.5	45.8	45.8	12.1	26.2	26.2	10.3	12.8	12.8
20 - First Ave @ Quaker Road	LOS	B	A	A	B	B	B	B	B	B	B	B	B
	v/c	0.16	0.41	0.41	0.02	0.29	0.29	0.07	0.43	0.43	0.42	0.30	0.30
	95th% Queue (m/ln)	10.3	23.8	23.8	2.7	22.1	22.1	5.4	32.3	32.3	23.4	23.6	23.6
18 - Pelham St @ Quaker Road	LOS	A	B	B	A	B	B	B	B	B	A	A	A
	v/c	0.12	0.41	0.41	0.11	0.40	0.40	0.51	0.51	0.51	0.17	0.17	0.17
	95th% Queue (m / ln)	8.7	35.4	35.4	7.9	35.6	35.6	38.7	38.7	38.7	12.1	12.1	12.1
21 - Regional Road 50 (Niagara Street) @ Quaker	LOS	C	B	B	B	B	B	A	A	A	B	B	B
	v/c	0.25	0.40	0.40	0.07	0.34	0.34	0.36	0.18	0.18	0.12	0.14	0.14
	95th% Queue (m / ln)	16.2	40.3	40.3	6.4	34.6	34.6	26.9	8.3	8.3	8.6	8.8	8.8
22 - Regional Road 50 (Niagara Street) @ Merritt Road	LOS	B	B	A	B	B	B	C	C	C	B	A	A
	v/c	0.46	0.46	0.50	0.24	0.24	0.24	0.18	0.18	0.18	0.66	0.18	0.18
	95th% Queue (m/ln)	55.4	55.4	15.9	18.0	18.0	18.0	13.4	13.4	13.4	45.7	9.6	9.6
23 - Quaker Road @ Clare Avenue	LOS	A	A	A	A	A	A	A	A	A	A	A	A
	v/c	0.23	0.23	0.23	0.19	0.19	0.19	0.31	0.31	0.31	0.20	0.20	0.20
	95th% Queue (m/ ln)	7	7	7	5	5	5	10	10	10	5	5	5
2 - Quaker Road @ Montgomery	LOS				B	B	B	A	A	A	A	A	A
	v/c				0.12	0.12	0.12	0.02	0.02	0.02	0.00	0.00	0.00
	95th% Queue (m/ln)				3	3	3	1	1	1	0	0	0
16 - Quaker Road @ Goodwill	LOS	B	B	B				A	A	A	A	A	A
	v/c	0.16	0.16	0.16				0.00	0.00	0.00	0.02	0.02	0.02
	95th% Queue (m/ln)	4	4	4				0	0	0	0	0	0
11 - Quaker Road @ Cedar Park Dr	LOS	A	A	A	A	A	A	B	B	B	B	B	B
	v/c	0.00	0.00	0.00	0.02	0.02	0.02	0.11	0.11	0.11	0.11	0.11	0.11
	95th% Queue (m/ln)	0	0	0	1	1	1	3	3	3	2	2	2

Table 5-2 Horizon Year Background Traffic Intersection Performance (Existing) – PM Peak

PM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
19 - Regional Road 54 (Rice Road) @ Quaker	LOS	B	B	B	B	B	B	B	B	B	B	B	B
	v/c	0.33	0.53	0.53	0.08	0.60	0.60	0.32	0.49	0.49	0.24	0.50	0.50
	95th% Q (m/ln)	17	45	45	5	52	52	18	39	39	14	41	41
20 - First Ave @ Quaker Road	LOS	B	B	B	B	B	B	B	B	B	B	B	B
	v/c	0.09	0.53	0.53	0.04	0.31	0.31	0.09	0.50	0.50	0.41	0.53	0.53
	95th% Q (m/ln)	7	33	33	4	24	24	6	41	41	23	45	45
18 - Pelham St @ Quaker Road	LOS	B	B	B	B	B	B	B	B	B	B	B	B
	v/c	0.45	0.50	0.50	0.22	0.63	0.63	0.48	0.48	0.48	0.53	0.53	0.53
	95th% Q (m/ln)	24	49	49	13	66	66	35	35	35	40	40	40
21 - Regional Road 50 (Niagara Street) @ Quaker	LOS	C	B	B	C	C	C	B	A	A	C	B	B
	v/c	0.66	0.33	0.33	0.17	0.81	0.81	0.46	0.34	0.34	0.27	0.20	0.20
	95th% Q (m/ln)	#51.7	51	51	15	#139.7	#139.7	36	16	16	13	10	10
22 - Regional Road 50 (Niagara Street) @ Merritt Road	LOS	C	C	A	C	C	C	C	C	C	C	A	A
	v/c	0.54	0.54	0.59	0.60	0.60	0.60	0.15	0.15	0.15	0.84	0.14	0.14
	95th% Q (m/ln)	60	60	19	49	49	49	10	10	10	#93.5	11	11
23 - Quaker Road @ Clare Avenue	LOS	B	B	B	B	B	B	B	B	C	C	C	B
	v/c	0.27	0.27	0.27	0.22	0.22	0.22	0.39	0.39	0.39	0.58	0.58	0.58
	95th% Q (m/ln)	8	8	8	6	6	6	14	14	14	28	29	28
2 - Quaker Road @ Montgomery	LOS				C	C	C	B	B	B	A	A	A
	v/c				0.20	0.20	0.20	0.02	0.02	0.02	0.01	0.01	0.01
	95th% Q (m/ln)				5	5	5	1	1	1	0	0	0
16 - Quaker Road @ Goodwill	LOS	B	B	B				A	A	A	A	A	A
	v/c	0.16	0.16	0.16				0.00	0.00	0.00	0.02	0.02	0.02
	95th% Q (m/ln)	4	4	4				0	0	0	0	0	0
11 - Quaker Road @ Cedar Park Dr	LOS	A	A	A	A	A	A	B	B	B	B	B	B
	v/c	0.00	0.00	0.00	0.02	0.02	0.02	0.11	0.11	0.11	0.11	0.11	0.11
	95th% Q (m/ln)	0	0	0	1	1	1	3	3	3	2	2	2

Figure 5-2 Horizon Year Total Traffic Level of Service – Major Intersections

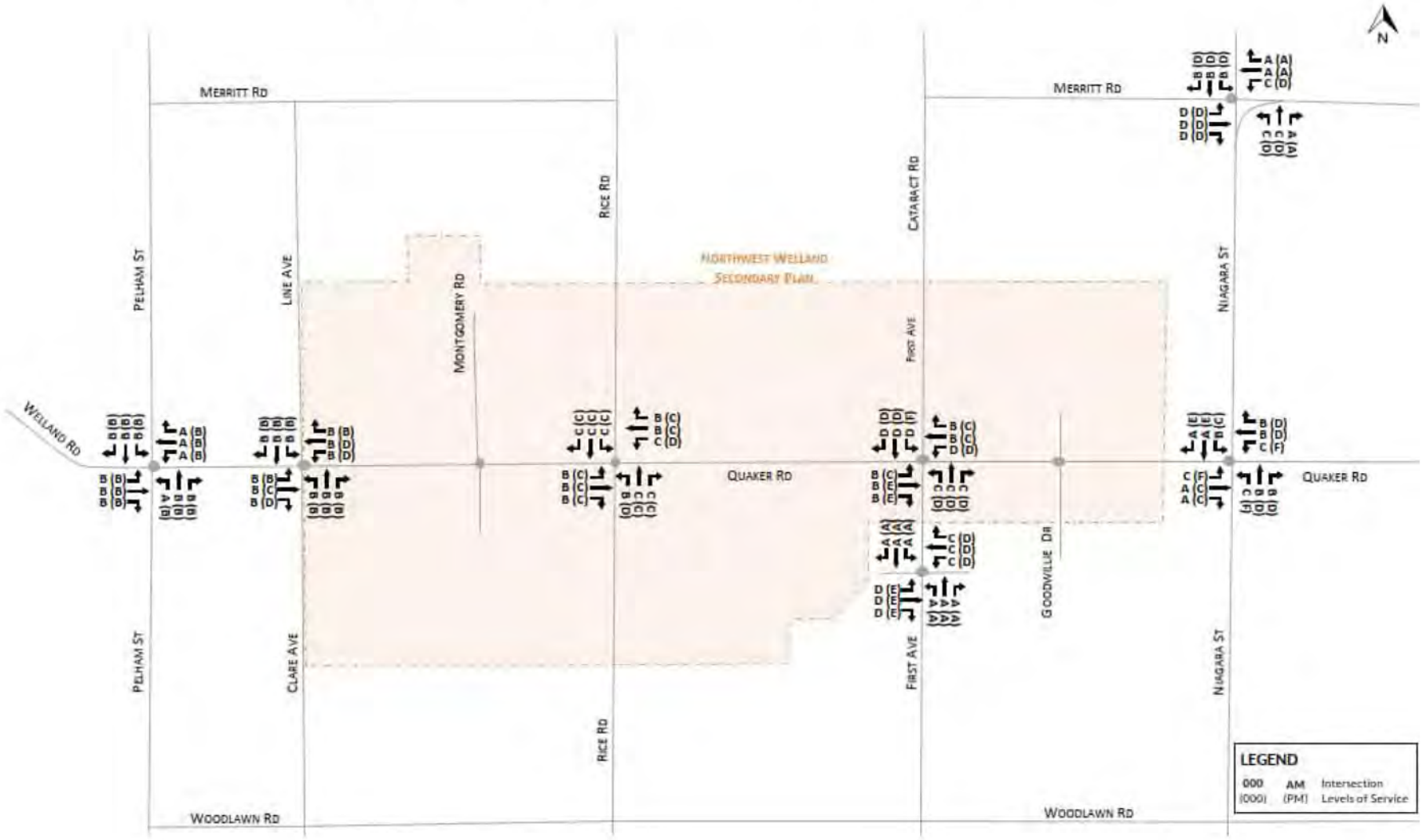


Figure 5-3 Horizon Year Total Traffic Level of Service – Minor Intersections

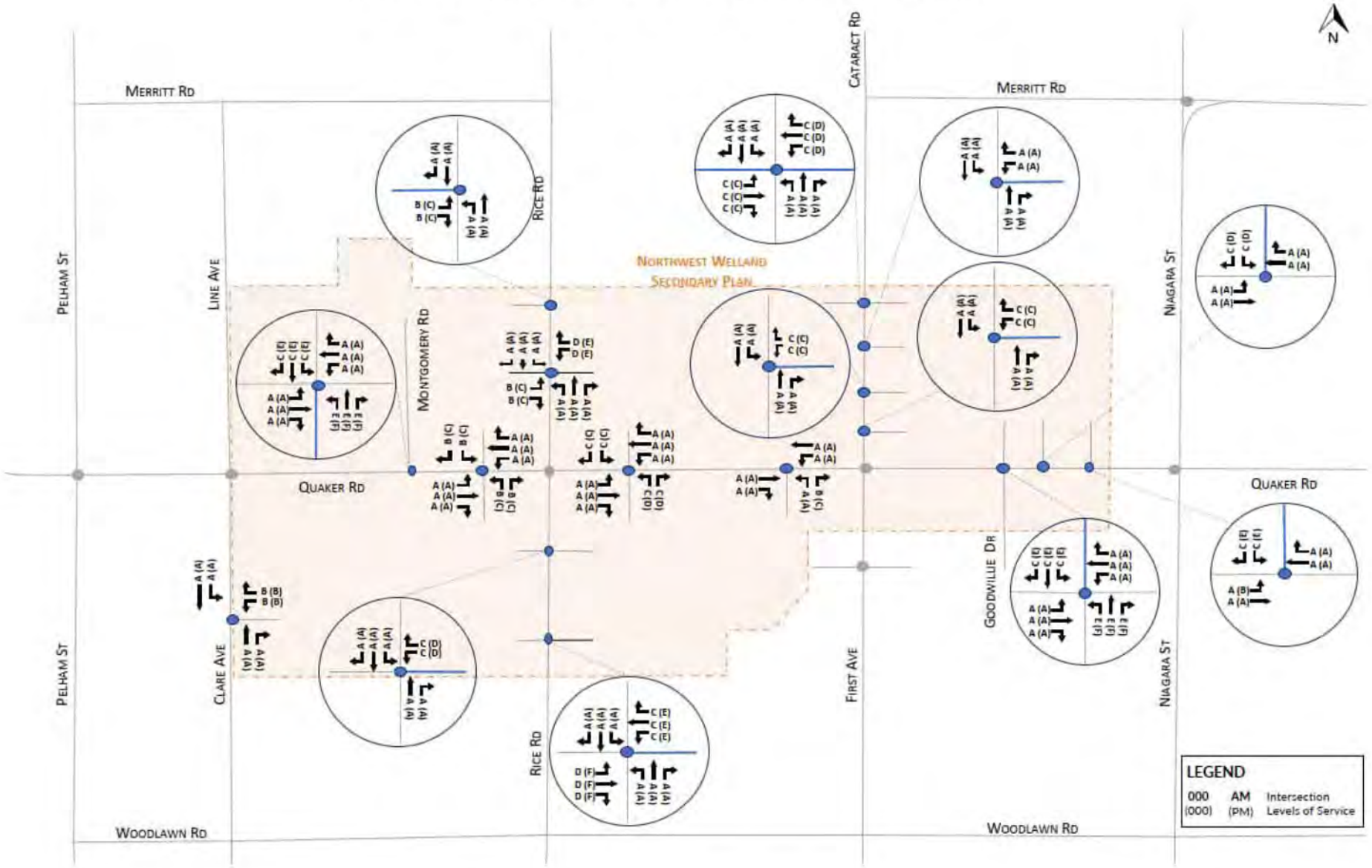


Table 5-3 Future Total AM Peak Operations – Major Intersections on Quaker Road

AM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
18 - Pelham St @ Quaker Road	LOS	A	B	B	B	B	B	B	B	B	A	A	A
	v/c	0.12	0.41	0.41	0.20	0.40	0.40	0.52	0.52	0.52	0.29	0.29	0.29
	95th% Q (m/ln)	9	35	35	13	36	36	39	39	39	15	15	15
23 - Quaker Road @ Clare Avenue	LOS	B	B	B	B	B	B	B	B	B	B	B	B
	v/c	0.31	0.31	0.31	0.21	0.21	0.21	0.39	0.39	0.39	0.34	0.34	0.34
	95th% Q (m/ln)	10	10	10	6	6	6	14	0	0	12	12	12
19 - Regional Road 54 (Rice Road) @ Quaker	LOS	C	C	C	C	C	C	B	B	B	C	B	B
	v/c	0.39	0.78	0.78	0.45	0.81	0.81	0.26	0.66	0.66	0.51	0.33	0.33
	95th% Q (m/ln)	17	#77.6	#77.6	20	#92.3	#92.3	19	66	66	28	29	29
20 - First Ave @ Quaker Road	LOS	C	C	A	C	D	D	B	C	C	D	B	B
	v/c	0.43	0.54	0.54	0.43	0.83	0.83	0.13	0.70	0.70	0.82	0.43	0.43
	95th% Q (m/ln)	21	48	48	27	92	92	11	105	105	#68.8	53	53
21 - Regional Road 50 (Niagara Street) @ Quaker	LOS	B	B	B	B	C	A	C	A	A	B	B	B
	v/c	0.28	0.27	0.27	0.07	0.29	0.29	0.86	0.55	0.55	0.13	0.20	0.20
	95th% Q (m/ln)	28	39	39	8	41	41	#108.1	21	21	8	11	11

Table 5-4 Future Total PM Peak Operations – Major Intersections on Quaker Road

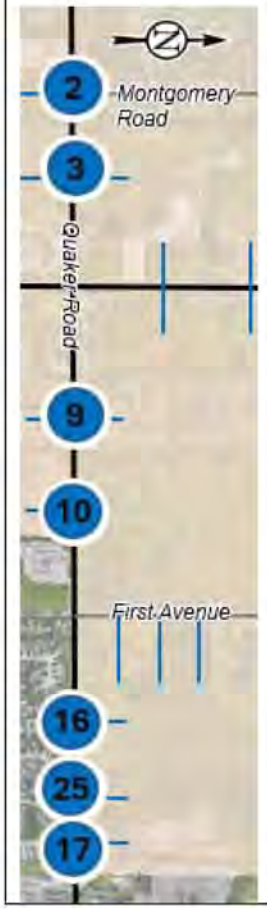
PM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
18 - Pelham St @ Quaker Road	LOS	B	B	B	B	B	B	B	B	B	B	B	B
	v/c	0.47	0.51	0.51	0.50	0.64	0.64	0.48	0.48	0.48	0.61	0.61	0.61
	95th% Q (m/ln)	25	49	49	31	66	66	36	36	36	49	49	49
23 - Quaker Road @ Clare Avenue	LOS	B	B	B	B	B	B	C	C	C	D	D	D
	v/c	0.36	0.36	0.36	0.25	0.25	0.25	0.59	0.59	0.59	0.76	0.76	0.76
	95th% Q (m/ln)	12	12	12	8	8	8	29	0	0	56	56	56
19 - Regional Road 54 (Rice Road) @ Quaker	LOS	D	C	C	C	C	C	C	C	C	D	C	C
	v/c	0.85	0.81	0.81	0.45	0.77	0.77	0.59	0.75	0.75	0.74	0.75	0.75
	95th% Q (m/ln)	#50	82	82	18	76	76	#37	#95	#95	#48	#96	#96
20 - First Ave @ Quaker Road	LOS	B	D	D	F	C	C	F	E	E	D	D	D
	v/c	0.45	0.92	0.92	1.00	0.92	0.92	0.39	0.97	0.97	0.83	0.68	0.68
	95th% Q (m/ln)	19	#163	#163	#52	#161	#161	27	#154	#154	#53	100	100
21 - Regional Road 50 (Niagara Street) @ Quaker	LOS	F	D	D	C	E	E	F	C	C	F	D	D
	v/c	1.02	0.69	0.69	0.07	1.00	1.00	1.04	0.71	0.71	0.78	0.29	0.29
	95th% Q (m/ln)	#199	107	107	18	#246	#246	#139	71	71	24	19	19

The First Avenue at Quaker Road intersection is nearing capacity for all movements during the PM peak hour making it difficult to improve LOS with just increased signal cycle length and adjusted split times. Additional turning lanes would improve operation of the intersection. Consideration is needed to determine any property impacts on the SE corner of the intersection with the addition of turning lanes. The land adjacent to the NE corner of the intersection is wetland that may require more expensive infrastructure if any pavement is extended in that direction. Long queues at this intersection will make it difficult to access left-turn storage lanes in all directions. The SBT queue is expected to extend past the newly proposed intersection #12 which is 115 m north of the intersection. The expected EBT queue of 155 m will back up past the school access. There are no critical movements in the AM peak hour for this intersection.

The EBL, SBT, SBR, and NBL movements at the Regional Road 50 (Niagara Street) at Quaker Road intersection are above capacity with the current lane configuration during the PM Peak hour. The WBL performs with LOS F. There are no critical movements in the AM peak hour.

The 4 way stop control at Clare Avenue at Quaker Road causes the WB movements to operate with LOS D. The existing two lane roadway configuration without left turn lanes on Quaker Road does not exceed capacity thresholds. No significant intersection upgrades are recommended at this time. The intersection will also operate acceptably without turn lanes if traffic signals are installed with these total traffic volumes in place

Table 5-5 Future Total AM Peak Operations – Minor Intersections on Quaker Road



	AM	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	LOS	B	B	B	C	C	C	A	A	A	A	A	A
	v/c	0.17	0.17	0.17	0.19	0.19	0.19	0.02	0.02	0.02	0.03	0.03	0.03
	95th% Q (m/ln)	5	5	5	5	5	5	1	1	1	1	1	1
3	LOS	B	B	B					A	A	A	A	
	v/c	0.14	0.14	0.14					0.00	0.00	0.02	0.02	
	95th% Q (m/ln)	4	0	0					0	0	0	0	
9	LOS	C	C	C	C	C	C	A	A	A	A	A	A
	v/c	0.38	0.38	0.38	0.08	0.08	0.08	0.00	0.00	0.00	0.03	0.00	0.00
	95th% Queue (veh/ln)	13	13	13	2	2	2	0	0	0	1	0	0
10	LOS	B	B	B					A	A	A	A	
	v/c	0.13	0.13	0.13					0.00	0.00	0.02	0.00	
	95th% Q (m/ln)	3	3	3					0	0	0	8	
16	LOS	D	D	D	C	C	C	A	A	A	A	A	A
	v/c	0.28	0.28	0.28	0.21	0.21	0.21	0.01	0.01	0.01	0.03	0.03	0.03
	95th% Q (m/ln)	8	8	8	6	6	6	0	0	0	1	1	1
25	LOS				B	B	B	A	A	A	A	A	A
	v/c				0.09	0.09	0.09	0.01	0.01	0.01	0.00	0.00	0.00
	95th% Q (m/ln)				2	2	2	0	0	0	0	0	0
17	LOS				C	C	C	A	A	A	A	A	A
	v/c				0.12	0.12	0.12	0.01	0.01	0.01	0.00	0.00	0.00
	95th% Q (m/ln)				3	3	3	0	0	0	0	0	0

Table 5-6 Future Total PM Peak Operations – Minor Intersections on Quaker Road

	PM	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	LOS	C	C	C	E	E	E	A	A	A	A	A	A
	v/c	0.15	0.15	0.15	0.39	0.39	0.39	0.02	0.02	0.02	0.08	0.08	0.08
	95th% Q (m/ln)	4	4	4	13	13	13	1	1	1	2	2	2
3	LOS	C	C	C					A	A	A	A	
	v/c	0.12	0.12	0.12					0.01	0.01	0.06	0.06	
	95th% Q (m/ln)	3	0	0					0	0	0	0	
9	LOS	D	D	D	C	C	C	A	A	A	A	A	A
	v/c	0.45	0.45	0.45	0.09	0.09	0.09	0.02	0.00	0.00	0.08	0.00	0.00
	95th% Queue (m/ln)	16	16	16	2	2	2	0	0	0	2	0	0
10	LOS	C	C	C					A	A	A	A	
	v/c	0.10	0.10	0.10					0.00	0.00	0.06	0.00	
	95th% Q (m/ln)	2	2	2					0	0	2	8	
16	LOS	F	F	F	E	E	E	A	A	A	A	A	A
	v/c	0.53	0.53	0.53	0.27	0.27	0.27	0.04	0.04	0.04	0.03	0.03	0.03
	95th% Q (m/ln)	18	18	18	8	8	8	1	1	1	1	1	1
25	LOS				D	D	D	A	A	A	A	A	A
	v/c				0.13	0.13	0.13	0.02	0.02	0.02	0.00	0.00	0.00
	95th% Q (m/ln)				3	3	3	1	1	1	0	0	0
17	LOS				E	E	E	B	A	A	A	A	A
	v/c				0.22	0.22	0.22	0.02	0.02	0.02	0.00	0.00	0.00
	95th% Q (m/ln)				6	6	6	1	1	1	0	0	0

All of the minor intersections listed in Table 5-5 and 5-6 are modelled with two-way stop control on the side street, and one lane in each direction with no auxiliary left turn or right turn lanes for all four legs of the intersection. The common theme is that Quaker Road has a LOS A and the minor road has a poor level of service. The v/c ratios are low, indicating the capacity of the road is not the issue, but rather availability of a gap.

This applies to the AM and PM peak hours at Montgomery Road and intersections 9, 16, 25 and 17. Potential mitigations that could be considered are:

- Traffic signals which would be a last resort as the minor street volumes are so low.
- Left turn lanes on Quaker Road are a possibility and has the same capacity as a TWLTL.

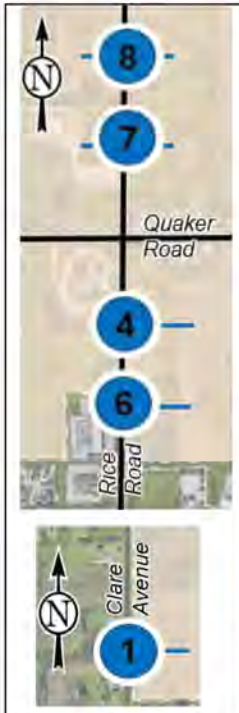
- Turn restrictions to prohibit left turns from the minor road to Quaker Road could be implemented at a later date as needed, or
- Two lanes on the minor road so that right turn traffic is not delayed by left turn traffic could be implemented on local roads but not the private access roads.

For purpose of this traffic impact study, the main objective is to make decisions about the number of lanes on Quaker Road. To achieve this objective, the effectiveness of adding left turn lanes on Quaker Road is analysed in Section 5.3

Table 5-7 Future Total AM Peak Operations – Minor Intersections on Rice Road and on Clare Avenue

	AM	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
8	LOS	A	A	A	A	A	A	C	C	C			
	v/c	0.021	0.00	0.00	0.00	0.00	0.00	0.165	0.165	0.165			
	95th% Q (m/ln)	1	0	0	0	0	0	5	5	5			
7	LOS	A	A	A	A	A	A	C	C	C	E	E	E
	v/c	0.022	0	0	0.002	0	0	0.182	0.182	0.182	0.145	0.145	0.145
	95th% Q (m/ln)	1	0	0	0	0	0	5	5	5	4	4	4
4	LOS	A	A	A	A	A	A	E	E	E	D	D	D
	v/c	0.00	0.00	0.00	0.007	0.00	0.00	0.22	0.22	0.22	0.099	0.099	0.099
	95th% Q (m/ln)	0	0	0	0	0	0	6	6	6	2	2	2
6	LOS	A	A	A	A	A	A				E	E	E
	v/c	0.00	0	0	0.014	0.014	0.014				0.191	0.191	0.191
	95th% Q (m/ln)	0	0	0	0	0	0				5	5	5
1	LOS	A	A	A	A	A	A				B	B	B
	v/c	0.00	0.00	0.00	0.01	0.01	0.01				0.127	0.127	0.127
	95th% Q (m/ln)	0	0	0	0	0	0				3	3	3

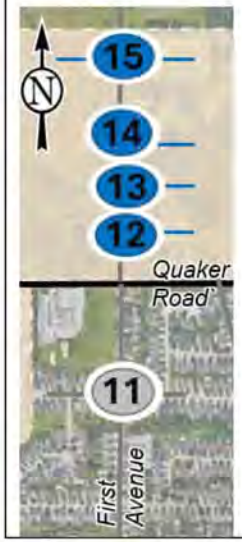
Table 5-8 Future Total PM Peak Operations – Intersections on Rice Road and on Clare Avenue



	PM	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
8	LOS	A	A	A	A	A	A	C	C	C			
	v/c	0.06	0.00	0.00	0.00	0.00	0.00	0.13	0.13	0.13			
	95th% Q (m/ln)	2	0	0	0	0	0	4	4	4			
7	LOS	A	A	A	A	A	A	C	C	C	E	E	E
	v/c	0.06	0	0	0	0	0	0	0	0	0	0	0
	95th% Q (m/ln)	2	0	0	0	0	0	4	4	4	3	3	3
4	LOS	A	A	A	A	A	A	E	E	E	D	D	D
	v/c	0.00	0.00	0.00	0.03	0.00	0.00	0.29	0.29	0.29	0.24	0.24	0.24
	95th% Q (m/ln)	0	0	0	1	0	0	9	9	9	7	7	7
6	LOS	A	A	A	A	A	A				E	E	E
	v/c	0.00	0	0	0	0	0				1	1	1
	95th% Q (m/ln)	0	0	0	2	2	2				20	20	20
1	LOS	A	A	A	A	A	A				B	B	B
	v/c	0.00	0.00	0.00	0.03	0.03	0.03				0.09	0.09	0.09
	95th% Q (m/ln)	0	0	0	1	1	1				2	2	2

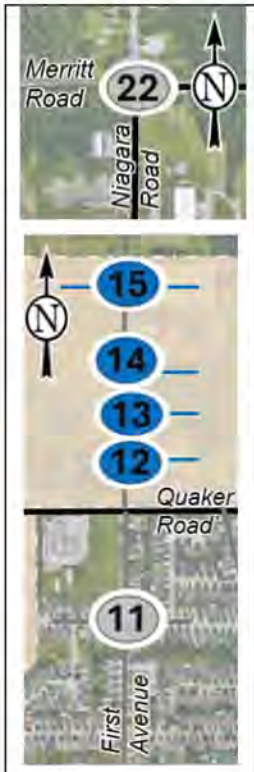
The intersections along Rice Road (intersections 6, 4, 7, and 8) were modelled with left turn lanes to emulate the TWLTL being planned by the region. Clare Road (Intersection 1) was modelled as single lane with no turn lanes. The minor lanes at intersections 6, 7, and 8 perform with LOS D or worse during both peak hours. These intersections are expected to have two-way stop-control on the minor leg. Similar to the minor roads intersecting Quaker Road, the most likely option is to tolerate the poor level of service or restrict left turns given the relatively low volumes to/from the minor roads, low v/c, and low queue lengths.

Table 5-9 Future Total AM Peak Operations – Intersections on First Avenue & Regional Road 50



AM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
22 - Niagara @ Merritt	LOS	C	C	A	B	B	B	D	D	D	C	A	A
	v/c	0.61	0.61	0.70	0.25	0.25	0.25	0.00	0.72	0.72	0.81	0.17	0.17
	95th% Q (m/ln)	80	80	24	24	24	24	47	47	47	#77.7	16	16
15	LOS	A	A	A	A	A	A	C	C	C	C	C	C
	v/c	0.06	0.06	0.06	0.00	0.00	0.00	0.54	0.54	0.54	0.17	0.17	0.17
	95th% Q (m/ln)	2	2	2	0	0	0	24	24	24	5	5	5
14	LOS		A	A	A	A					C	C	C
	v/c		0	0	0	0					0	0	0
	95th% Q (m/ln)		0	0	0	0					8	8	8
13	LOS		A	A	A	A					C	C	C
	v/c		0.00	0.00	0.00	0.00					0.29	0.29	0.29
	95th% Q (m/ln)		0	0	0	0					9	9	9
12	LOS		A	A	A	A					C	C	C
	v/c		0.00	0.00	0.00	0.00					0.17	0.17	0.17
	95th% Q (m/ln)		0	8	0	0					5	5	5
11 - Quaker @ Cedar	LOS	A	A	A	A	A	A	D	D	D	C	C	C
	v/c	0.02	0.02	0.02	0.02	0.02	0.02	0.54	0.54	0.54	0.19	0.19	0.19
	95th% Q (m/ln)	0	0	0	0	0	0	23	23	23	5	5	5

Table 5-10 Future Total PM Peak Operations – Intersections on First Avenue & Regional Road 50



PM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
22 - Niagara @ Merritt	LOS	D	D	A	D	D	D	D	D	D	D	A	A
	v/c	0.69	0.69	0.71	0.87	0.87	0.87	0.62	0.62	0.62	0.99	0.22	0.22
	95th% Q (m/ln)	89	89	29	#86.6	#86.6	#86.6	32	32	32	#196.4	27	27
15	LOS	A	A	A	A	A	A	C	C	C	D	D	D
	v/c	0.17	0.17	0.17	0.01	0.01	0.01	0.53	0.53	0.53	0.21	0.21	0.21
	95th% Q (m/ln)	5	5	5	0	0	0	22	22	22	6	6	6
14	LOS		A	A	A	A					A	A	A
	v/c		0	0	0	0					0	0	0
	95th% Q (m/ln)		0	0	1	1					6	6	6
13	LOS		A	A	A	A					C	C	C
	v/c		0	0	0	0					0	0	0
	95th% Q (m/ln)		0	0	1	1					4	4	4
12	LOS		A	A	A	A					C	C	C
	v/c		0.00	0.00	0.02	0.02					0.15	0.15	0.15
	95th% Q (m/ln)		0	8	1	1					4	4	4
11 - Quaker @ Cedar	LOS	A	A	A	A	A	A	E	E	E	D	D	D
	v/c	0.06	0.06	0.06	0.02	0.02	0.02	0.52	0.52	0.52	0.27	0.27	0.27
	95th% Q (m/ln)	0	0	0	0	0	0	21	21	21	8	8	8

Two of the minor intersections are forecast to perform with LOS D or worse. Given the relatively low volumes to/from the minor roads, low v/c, and low queue lengths no infrastructure upgrades are recommended. Some mitigation measures to improve mobility on the minor street would come at the impact of movements along the major road, eg. Signalization.

5.3 Total Future Traffic (with Improvements)

This scenario analyzes the intersection performance with potential mitigation measures that aim to improve mobility as a result of the Total Future Traffic scenario in Section 5.2. This is a planning level analysis with forecasted volumes. A more detailed signal timing plan may be developed at the time of implementing a signal. The LOS of the intersection and movements may be further improved. The improvements tested for intersections in the study area are as follows:

Quaker Road at Clare Avenue (Rice Road):

- Signalize the intersection assuming that this will be warranted in the horizon year. This will accommodate a WBL turn lane resulting from the proposed TWLTL from Clare Avenue to Regional Road 50 (Niagara Street). Additional EB storage lanes

can be included if needed to transition the cross section west of Clare Avenue.

Quaker Road at Regional Road 54 (Rice Road):

- Extend EBL storage lanes to approx. 100 m to allow access due to EBT queues.

Quaker Road at First Avenue:

- New NBR storage lane to approximately 30 m long. New NBL storage lane to approximately 30 m long. This will increase the width of the cross section at the south approach. More detailed design is needed at a later stage to determine any property and access constraints to the adjacent lots. A mitigation option at this intersection without a NBR lane was evaluated and there are capacity issues causing the intersection to fail.
- New SBL storage lane to approximately 40 m long and SBT/SBR lane.
- As part of these mitigation measures, intersection 12 will need to be a right in right out to prevent queue spillback from affecting the operation and safety of this intersection.

Quaker Road at Regional Road 50 (Niagara Street):

- SBR new storage lane approx. 150 m
- Protected EBL phase and overlap with SBR phase

Regional Road 50 (Niagara Street) at Merritt Road:

- WBL extend storage lane to approx. 180 m

Quaker Road from Clare Avenue to Regional Road 50 (Niagara Street):

- TWLTL to improve mobility to/from the minor approaches at intersections

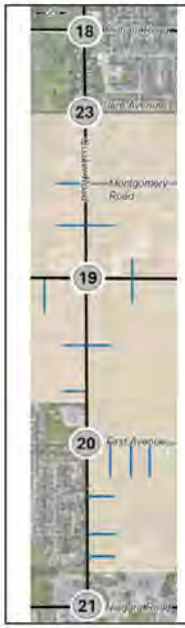
As previously mentioned, despite that many of the movements from the minor roads to the major roads and the existing and new intersections operate with LOS D or worse, no recommendations are made due to their relatively low volumes, low 95th percentile queue lengths and low v/c ratios. The TWLTL between Clare Avenue and Regional Road 50 (Niagara Street) will provide additional left turn storage at Clare Avenue, First Avenue and Regional Road 50 intersections as well as make it easier for vehicles to turn onto the major road from accesses 2,3,9,10, 16, 17, and 25, and reduce congestion caused by left turning vehicles off of Quaker Road.

Table 5-11 and Table 5-12 show the performance of only the intersections with the implemented recommendations for the AM and PM peak hours. Details of the AM and PM peak analysis are found in Appendix H.

Table 5-11 Future Total AM Peak Operations – Major Intersections on Quaker Road w/ Improvements

AM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
18 - Pelham St @ Quaker Road	LOS	A	B	B	B	B	B	B	B	B	A	A	A
	v/c	0.12	0.41	0.41	0.20	0.40	0.40	0.52	0.52	0.52	0.29	0.29	0.29
	95th% Q (m/ln)	9	35	35	13	36	36	39	39	39	15	15	15
23 - Quaker Road @ Clare Avenue	LOS	A	A	A	A	A	A	B	B	B	B	B	B
	v/c	0.24	0.24	0.24	0.16	0.16	0.16	0.55	0.55	0.55	0.19	0.38	0.38
	95th% Q (m/ln)	12	12	12	12	12	12	24	24	24	7	17	17
19 - Regional Road 54 (Rice Road) @ Quaker	LOS	C	C	C	C	C	C	B	B	B	C	B	B
	v/c	0.39	0.78	0.78	0.45	0.81	0.81	0.26	0.66	0.66	0.51	0.33	0.33
	95th% Q (m/ln)	17	#77.6	#77.6	20	#92.3	#92.3	19	66	66	28	29	29
20 - First Ave @ Quaker Road	LOS	C	C	A	C	D	D	B	C	C	D	B	B
	v/c	0.43	0.54	0.54	0.43	0.83	0.83	0.13	0.70	0.70	0.82	0.43	0.43
	95th% Q (m/ln)	21	48	48	27	92	92	11	105	105	#68.8	53	53
21 - Regional Road 50 (Niagara Road) @ Quaker	LOS	B	B	B	B	C	A	C	A	A	B	B	B
	v/c	0.28	0.27	0.27	0.07	0.29	0.29	0.86	0.55	0.55	0.13	0.20	0.20
	95th% Q (m/ln)	28	39	39	8	41	41	#108.1	21	21	8	11	11

Table 5-12 Future Total PM Peak Operations – Major Intersections on Quaker Road w/ Improvements



PM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
18 - Pelham St @ Quaker Road	LOS	B	B	B	B	B	B	B	B	B	B	B	B
	v/c	0.47	0.51	0.51	0.50	0.64	0.64	0.48	0.48	0.48	0.61	0.61	0.61
	95th% Q (m/ln)	25	49	49	31	66	66	36	36	36	49	49	49
23 - Quaker Road @ Clare Avenue	LOS	A	A	A	A	A	A	B	B	B	B	B	B
	v/c	0.27	0.27	0.27	0.21	0.21	0.21	0.65	0.65	0.65	0.39	0.64	0.64
	95th% Q (m/ln)	11	11	11	13	13	13	34	34	34	14	34	34
19 - Regional Road 54 (Rice Road) @ Quaker	LOS	D	C	C	B	C	C	D	C	C	D	C	C
	v/c	0.83	0.80	0.80	0.44	0.76	0.76	0.61	0.76	0.76	0.76	0.77	0.77
	95th% Q (m/ln)	#48.0	79	79	17	73	73	#38.5	#97.7	#97.7	#49.6	#99.3	#99.3
20 - First Ave @ Quaker Road	LOS	C	D	A	D	D	D	C	D	D	B	C	C
	v/c	0.33	0.75	0.75	0.64	0.81	0.81	0.48	0.84	0.84	0.56	0.82	0.82
	95th% Q (m/ln)	17	87	87	#37.1	93	93	28	#134.8	#134.8	27	#169.4	#169.4
21 - Regional Road 50 (Niagara Road) @ Quaker	LOS	C	B	B	B	D	A	D	C	C	C	C	C
	v/c	0.78	0.31	0.31	0.23	0.83	0.83	0.82	0.71	0.71	0.30	0.24	0.24
	95th% Q (m/ln)	#120.6	53	53	20	#151.3	#151.3	94	53	53	14	15	15

Table 5-13 Future Total AM Peak Operations – Minor Intersections on Quaker Road w/ Improvements

	AM	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	LOS	B	B	B	C	C	C	A	A	A	A	A	A
	v/c	0.17	0.17	0.17	0.19	0.19	0.19	0.02	0.02	0.02	0.03	0.03	0.03
	95th% Q (m/ln)	5	5	5	5	5	5	1	1	1	1	1	1
3	LOS	B	B	B					A	A	A	A	A
	v/c	0.14	0.14	0.14					0.00	0.00	0.02	0.02	0.02
	95th% Q (m/ln)	4	0	0					0	0	0	0	0
9	LOS	C	C	C	C	C	C	A	A	A	A	A	A
	v/c	0.38	0.38	0.38	0.08	0.08	0.08	0.00	0.00	0.00	0.03	0.00	0.00
	95th% Queue (veh/ln)	13	13	13	2	2	2	0	0	0	1	0	0
10	LOS	B	B	B					A	A	A	A	
	v/c	0.13	0.13	0.13					0.00	0.00	0.02	0.00	
	95th% Q (m/ln)	3	3	3					0	0	0	8	
16	LOS	D	D	D	C	C	C	A	A	A	A	A	A
	v/c	0.28	0.28	0.28	0.21	0.21	0.21	0.01	0.01	0.01	0.03	0.03	0.03
	95th% Q (m/ln)	8	8	8	6	6	6	0	0	0	1	1	1
25	LOS				B	B	B	A	A	A	A	A	A
	v/c				0.09	0.09	0.09	0.01	0.01	0.01	0.00	0.00	0.00
	95th% Q (m/ln)				2	2	2	0	0	0	0	0	0
17	LOS				C	C	C	A	A	A	A	A	A
	v/c				0.12	0.12	0.12	0.01	0.01	0.01	0.00	0.00	0.00
	95th% Q (m/ln)				3	3	3	0	0	0	0	0	0

Table 5-14 Future Total PM Peak Operations – Minor Intersections on Quaker Road w/ Improvements

	PM	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	LOS	C	C	C	E	E	E	A	A	A	A	A	A
	v/c	0.15	0.15	0.15	0.39	0.39	0.39	0.02	0.02	0.02	0.08	0.08	0.08
	95th% Q (m/ln)	4	4	4	13	13	13	1	1	1	2	2	2
3	LOS	C	C	C					A	A	A	A	A
	v/c	0.12	0.12	0.12					0.01	0.01	0.06	0.06	0.06
	95th% Q (m/ln)	3	0	0					0	0	0	0	0
9	LOS	D	D	D	C	C	C	A	A	A	A	A	A
	v/c	0.45	0.45	0.45	0.09	0.09	0.09	0.02	0.00	0.00	0.08	0.00	0.00
	95th% Queue (veh/ln)	16	16	16	2	2	2	0	0	0	2	0	0
10	LOS	C	C	C					A	A	A	A	
	v/c	0.10	0.10	0.10					0.00	0.00	0.06	0.00	
	95th% Q (m/ln)	2	2	2					0	0	2	8	
16	LOS	F	F	F	E	E	E	A	A	A	A	A	A
	v/c	0.50	0.50	0.50	0.26	0.26	0.26	0.04	0.04	0.04	0.03	0.03	0.03
	95th% Q (m/ln)	17	17	17	8	8	8	1	1	1	1	1	1
25	LOS				C	C	C	A	A	A	A	A	A
	v/c				0.08	0.08	0.08	0.02	0.02	0.02	0.00	0.00	0.00
	95th% Q (m/ln)				2	2	2	1	1	1	0	0	0
17	LOS				C	C	C	B	B	B	A	A	A
	v/c				0.11	0.11	0.11	0.02	0.02	0.02	0.00	0.00	0.00
	95th% Q (m/ln)				3	3	3	1	1	1	0	0	0

Table 5-15 Future Total Operations – Merrit Road at Regional Road 50 (Niagara Street) w/ Improvements

AM	LOS	B	B	B	B	C	A	C	A	A	B	B	B
	v/c	0.28	0.27	0.27	0.07	0.29	0.29	0.86	0.55	0.55	0.13	0.20	0.20
	95th% Q (m/ln)	28	39	39	8	41	41	#108.1	21	21	8	11	11
PM	LOS	C	B	B	B	D	A	D	C	C	C	C	C
	v/c	0.78	0.31	0.31	0.23	0.83	0.83	0.82	0.71	0.71	0.30	0.24	0.24
	95th% Q (m/ln)	#120.6	53	53	20	#151.3	#151.3	94	53	53	14	15	15

The following is noted upon analyzing the potential mitigation measures:

Quaker Road at Clare Avenue: The signalization of the intersection and the addition of a WB left turn lane for the WB vehicles improved the LOS from D to A compared to the 4 way stop control. The additional WB LT storage capacity is needed at this intersection however this integrates with the TWLTL that continues east.

Quaker Road at Rice Road: The performance of the Quaker Road at Regional Road 54 intersection improved with all movements meeting the minimum LOS and v/c thresholds. The improvements mentioned earlier in this section for this intersection are recommended.

Quaker Road at First Avenue: The performance of the First Avenue at Quaker Road intersection improved with all movements meeting the minimum LOS and v/c thresholds with the addition of the NBR, NBL, SBL, and EBL/WBL lanes. The EBT queue is expected to reach over 100 m, past the west access to the adjacent school. The SBT queue will not impact the adjacent access to intersection 12 due to the right-in right out configuration. The improvements mentioned earlier in this section for this intersection are recommended.

Merritt Road at Niagara Street: The WBL and SBT at the Merritt Road and Regional Road 50 intersection will operate above the 0.85 v/c threshold but below 1.0. This indicates that the intersection will operate efficiently with no wasted green time. The improvements mentioned earlier in this section for this intersection are recommended.

Quaker Road from Clare Avenue to Niagara Street – TWLTL: The performance of the minor intersections are close to unchanged. The lack of gaps in traffic is what is causing the poor performance of the minor legs for intersections 2 ,9,10,16,25, and 17, adding additional turning lanes on Quaker will not change that.

The reason for considering a TWLTL is that roadways with a TWLTL are generally safer than undivided roadways under certain circumstances.[2] Roadways in urban and suburban areas with projected average daily volumes of less than 24,000 vpd are appropriate for TWLTLs. [3]A TWLTL will minimize delays caused by stopped vehicles waiting to turn left off the major roadway and act as an area where those turning from minor roads can complete a staged left-turn maneuver. Safety issues may arise due to left turn movements caused by access locations on both sides of the road that are not planned with this issue in mind. The west portion of the segment between Clare Avenue and Regional Road 54 (Rice Road) has several staggered accesses to single family lots on both sides of the roadway that may cause overlapping left turn movements. The is the lowest volume section which is forecast to have 7,200 vehicles per day. Several of these homes will be adjacent to a left turn lane and their access will be limited to right turns only. During the design process, the access restriction requirements for the remaining single family driveways will be examined.

Between Regional Road 54 (Rice Road) and Regional Road 50 (Niagara Street), there are less properties directly fronting the roadway on both sides of the road minimizing the risk for overlapping left turn movements. Accesses in this section are consolidated and will make ingress and egress to access 9,10,16,25,17 easier.

[2] Kristine M. Williams et al., Access Management Manual, 2nd ed. (Washington, D.C.: Transportation Research Board, 2014), 408, citing W. M. Bretherton, J. E. Womble, P. S. Parsonson, and G. W. Black Jr., "One Suburban County's Policy for Selecting Median Treatments for Arterials," Proceedings of the ITE 60th Annual Meeting, Orlando, Fla., 1990.

[3] Williams et al., Access Management Manual, 410

5.4 Sensitivity Analysis – Merritt Upgrade

This scenario is a sensitivity analysis to evaluate the impact of a potential Merrit Road upgrade from First Avenue to Regional Range Road 50 (Niagara Street). The sensitivity analysis focuses on the following intersections and uses the intersection upgrades as described in Section 5.3:

- Regional Road 50 (Niagara Street) at Quaker Road
- Regional Road 50 (Niagara Street) at Merritt Road
- First Avenue at Quaker Road

This scenario reassigns 200 vehicles from the Niagara Street / Quaker Road route to a Merritt Road / First Avenue Road route. This is to assess the impact of upgrading Merritt Road, making it a more attractive route for residents and visitors. Traffic currently making a westbound left at the Regional Road 50 (Niagara Street) at Merritt Road intersection then SBR at the Regional Road 50 (Niagara Street) at Quaker Road are re routed. The new route is WBT the Merritt Road at Regional Road 50 (Niagara Street) then SBR at First Avenue at Quaker Road intersection. This sensitivity analysis was only completed for the PM peak hour as this is the critical peak hour. This is a more conservative sensitivity analysis. If Merritt Road is upgraded, vehicles leaving the study area that are currently assigned making a NBR and SBL at the Quaker Road at Merrit Intersection and EBL at the Quaker Road at Regional Road 50 intersection would now travel north along First Avenue then take Merritt Road to access Highway 406. This would decrease traffic along Quaker Road improving traffic operations. This analysis only focuses on vehicles entering the development area. Table 5-13 shows the results of the analysis.

The analysis shows improved operation at the Regional Road 50 at Quaker Road intersection. The NBL and SBT/SBR are above the 0.85 v/c threshold but operate below 1.0. This may be tolerated for the worst 15 minutes during the PM peak hour because this intersection is already as large as desirable. All movements at that intersection operate with LOS D or better. The re-distribution of traffic improves the LOS for the minor movements at intersections 16, 17, and 25. All the movements meet the minimum LOS except for the NB movement at intersection 16 (LOS D). The intersection of First Avenue at Quaker Road will continue to operate with acceptable levels of service. Some movements are nearing v/c > 0.9 however with signal timing adjustment as development progresses, performance of this intersection can be improved.

Table 5-16 Horizon Year Total Traffic Intersection Performance Merrit Upgrade – PM Peak

PM		NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
20 - First Ave @ Quaker Road	LOS	C	C	C	C	C	C	C	D	D	C	B	B
	v/c	0.70	0.70	0.70	0.88	0.88	0.88	0.34	0.90	0.90	0.72	0.64	0.64
	95th% Queue (m/ln)	58	58	58	#79.1	#79.1	#79.1	26	#145.0	#145.0	#42.1	96	96
21 - Regional Road 50 (Niagara Street) @ Quaker	LOS	D	B	B	C	D	D	D	A	A	D	C	C
	v/c	0.89	0.31	0.31	0.09	0.98	0.98	0.81	0.56	0.56	0.39	0.23	0.23
	95th% Queue (m / ln)	#136.7	52	52	17	#184.0	#184.0	83	26	26	17	13	13
22 - Regional Road 50 (Niagara Street) @ Merritt Road	LOS	C	C	A	C	C	C	D	D	D	C	B	B
	v/c	0.59	0.59	0.68	0.69	0.69	0.69	0.51	0.51	0.51	0.84	0.49	0.49
	95th% Queue (m/ln)	89	89	29	77	77	77	32	32	32	86	60	60

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. This section provides a summary of conclusions and recommendations made throughout the report.

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 development area are Quaker Road at Regional Road 54 (Rice Road) and Quaker Road at First Street; both of which currently operate under all-way stop control. Also within the study area, 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 included in the analysis 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 crosswalk providing access to École Élémentaire Nouvel Horizon. No dedicated cyclist facilities have been provided along Quaker Road.
With the development of the NWWSP, 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 Niagara Region 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, most of the study intersections are operating below capacity with an adequate Level of Service. However, the intersection of Rice Road and Quaker Road is operating with LOS F during the PM peak. The westbound approach at the First Avenue and Quaker Road intersection is operating with LOS E during the PM peak. The traffic signal warrants indicate that traffic signals are justified at both intersections under existing conditions.

6.2 Future Conditions (2034 Horizon Year)

The proposed development plan representing the full build-out of the NWWSP will result in a population increase of 11,000. Connections between the developments to the major roads in the study area have been proposed. The new points of access are on Clare Avenue south of Quaker Road, on Rice Road both north and south of Quaker Road, on Quaker Road between Montgomery Road and Niagara Street, and on First Avenue north of Quaker Road.

Traffic conditions were assessed for the Horizon Year (2034), in consideration of the anticipated development of the NWWSP, in addition to surrounding development. The Background Future Traffic

analysis accounts for anticipated future infrastructure upgrades independent of proposed developments. These changes include the signalization of the First Avenue at Quaker Road intersection, and the Quaker Road at Rice Road intersection, with left turn storage lanes at all approaches. Additionally, Rice Road is analyzed with one travel lane in each direction with the addition of a two-way left turn lane to access adjacent developments along Regional Road 54 (Rice Road).

Associated applied a 1% per year growth factor to background traffic from Base Year to Horizon Year. The development will generate 1,958 trips in the AM and 2,455 trips in the PM peak hours. If Merritt Road is upgraded more development and background vehicles will take that road then First Avenue to access the development area. This will decrease traffic volumes along Quaker and improve intersection performance.

The analysis of the Total Future Traffic Scenario without improvement showed the following:

- The PM peak hour is the more critical peak hour due to higher traffic volumes in the study area.
- One travel lane in each direction along First Avenue and Merrit Road is sufficient to handle the forecasted traffic.
- The EB and WB thru queues at the Regional Road 54 (Rice Road) at Quaker intersection may make it difficult to access the EB and WB left storage lanes.
- The First Avenue at Quaker Road intersection is nearing capacity for all movements during the PM. Long queues may make it difficult to access left storage lanes in all directions without improvement.
- The EBL, SBT, SBR, and NBL movements at the Regional Road 50 (Niagara Street) at Quaker Road intersection are above capacity during the PM Peak hour.
- The WBL at Regional Road 50 at Merritt Road is nearing capacity. The SB movements are slightly above the 0.85 v/c threshold.
- The minor movements onto the major road at the Quaker Road at Goodwillie intersection and Quaker Road at Cedar Park Road experience LOS D or worse
- Some minor movements onto the major roads at the following intersections do not meet LOS C or greater. These intersections are #2, #4, #6, #7, #9, #11, #15, #16, #17, #25.

The following recommendations are made based on the Total Future Traffic scenario with improvements:

Travel Lanes along Quaker Road:

- TWLTL from Clare Avenue to Regional Road 50 (Niagara Street) to facilitate access to/from the adjacent school and to new accesses along Quaker Road. The left turn lanes will increase storage capacity for EB and WB movements at First Avenue, the WBL movement at Regional Road 54 (Rice Road), the EBL movement at Regional Road 50 (Niagara Street), and the WBL movement at Clare Avenue.

Quaker Road at Clare Avenue:

- The WB movement fails as a 4 way stop controlled intersection in the PM peak hour. When the TWLTL is implemented between Clare Avenue and Regional Road 54 (Rice Road), a left turn lane would be added at Clare Avenue. Signalizing this intersection at that time is recommended.

Quaker Road at Regional Road 54 (Rice Road):

With Traffic Signalization:

- EBL storage will need to be 100m to allow vehicles wishing to use the storage lane to be unobstructed by the queue in the thru lane.

With Roundabout:

- Single lane roundabout with one lane at each approach

Quaker Road at First Avenue:

Potential Signalization:

- NBL, NBR, and SBL at 30 m, 30 m, and 40 m respectively. Adding the NBR storage lane will improve intersection performance by adding capacity. Just adding left turn storage lanes at this intersection will not provide sufficient capacity.

With Roundabout:

- 2 lane roundabout
- 1 major lane (thru, left) and one minor lane (thru, right) at each approach
- 2 receiving lanes at each approach which merge back to one lane

Quaker Road at Regional Road 50 (Niagara Street):

- In the scenario that Merritt Road is not upgraded, a SBR new storage lane approx. 150 m is needed. The construction of this additional lane will require relocation of the existing power poles and relocation or closing of the 947 Niagara St access onto Niagara Street. A preliminary design is needed prior to detailed design of this option to confirm conflicts and ROW acquisition requirements (if needed). A protected EBL phase will overlap with SBR phase during the PM peak hour.
- In the scenario that Merritt is upgraded, no new SBR turn lane is needed. However the improvements at First Avenue at Quaker Road will still be needed. The SB thru movement will be operating close to capacity and the SBL storage lane will need to be extended to approximately 185m to allow access of left turning vehicles to the storage lane. The NBL and SBT/SBR are above the 0.85 v/c threshold but operate below 1.0.

Regional Road 50 (Niagara Street) at Merritt Road:

- WBL extend storage lane to approx. 180 m. The WBL and SBT at the Merritt Road and Regional Road 50 intersection will operate above the 0.85 v/c threshold but below 1.0.

Other Minor Roads intersecting with Major Roads (Quaker, Regional Road 54, and First Avenue:

- Intersections where movements from minor roads onto the major roads perform with LOS D or worse are not recommended for any infrastructure changes (stop controlled on minor legs only). These include intersections 2, 4, 6, 7, 9, 11, 15. Given the relatively low volumes to/from the minor roads, low v/c, and low queue lengths no changes are recommended.

In addition to the recommendations dependent upon Merrit Road upgrade, the following are to be considered:

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 NWWSP area.
- Provide sidewalks per City of Welland guidelines.
- Install pedestrian signals at Regional Road 54 (Rice Road) and Quaker Road, and First Avenue and Quaker Road.

Transit

- A dedicated transit line along the entire length of Quaker Road within the NWWSP area
- Consider a transit line that services the low-density residential areas on the north and south side of Quaker Road.

CERTIFICATION PAGE

This report presents our findings regarding the City of Welland Northwest Welland Secondary Plan Traffic Impact Assessment .

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