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

APPENDIX

A Transportation Assessment Report

If technical reports are required in an alternative format for accessibility needs, please contact:

Maged Elmadhoon, M.Eng., P.Eng.
Manager, Transportation Planning - Public Works, Niagara Region
Phone: 905-980-6000 ext. 3583
Email: Maged.Elmadhoon@niagararegion.ca

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

Transportation Assessment Report

WSP Canada Inc.
3450 Harvester Road, Suite 100
Burlington, ON L7N 3W5

T +1 905-335-2353
wsp.com

2024-02-15

Project # IM10103036| 2024-02-15

Table of Contents

1.0 Introduction 1
2.0 Background Studies 3
2.1 Niagara Region Transportation Master Plan (2017) 3
2.2 City of Thorold Transportation Master Plan (2020) 3
2.3 City of Welland's Northwest Welland Secondary Plan (2020) 3
2.4 Town of Pelham's East Fonthill Secondary Plan (2014) 4
2.5 City of Thorold's Port Robinson Secondary Plan (2010) 4
2.6 Niagara Region Complete Streets Design Guidelines (2017) 5
2.7 Niagara Region Complete Streets Design Manual (Ongoing) 5
3.0 Study Area 8
4.0 Methodology 11
4.1 Data Collection 11
4.1.1 Signal Timing Plans 11
4.1.2 Turning Movement Counts 11
4.1.3 Collision Data 12
4.2 Travel Demand Forecasting 12
4.3 Link Capacity Analysis 13
4.4 Intersection Capacity Analysis 13
4.5 Multimodal Level of Service 14
4.6 Signal Warrant 17
5.0 Existing Conditions (2020) Assessment 18
5.1 Existing Travel Demand 18
5.2 Existing (2020) Conditions Link Capacity Analysis 21
5.3 Existing (2020) Conditions Intersection Capacity Analysis 24
6.0 Safety Analysis 30
6.1 Methodology 30
6.2 Collision Analysis 30
6.2.1 Merritt Road at Cataract Road 30
6.2.2 Merritt Road at Niagara Street/Merrittville Highway 31
6.2.3 Merritt Road between Niagara Street/Merrittville Highway and Highway 406 32
6.2.4 Rice Road at Merritt Road 34
6.3 Field Investigation 34
6.3.1 Segment 1 - Merritt Road between Rice Road and Cataract Road 34
6.3.2 Segment 2 - Merritt Road between Cataract Road and Merrittville Highway/Niagara Street 35
6.3.3 Segment 3 - Merritt Road between Merrittville Highway/Niagara Street and Highway 406 interchange 36
6.3.4 Segment 4 – Rice Road between Merritt Road and Quaker Road 39
7.0 Future (2031) Assessment 40
7.1 2031 Future Traffic Demand – Scenario 1 40
7.1.1 2031 Conditions Link Capacity Analysis – Scenario 1 43
7.1.2 2031 Conditions Intersection Analysis – Scenario 1 46
7.2 2031 Future Traffic Demand – Scenario 2 52
7.2.1 2031 Conditions Link Capacity Analysis – Scenario 2 54
7.2.2 2031 Conditions Intersection Analysis – Scenario 2 57

8.0 Future (2041) Assessment 68
8.1 2041 Future Traffic Demand – Scenario 1 68
8.1.1 2041 Conditions Link Capacity Analysis – Scenario 1 70
8.1.2 2041 Intersection Analysis – Scenario 1 73
8.2 2041 Future Traffic Demand – Scenario 2 80
8.2.1 2041 Conditions Link Capacity Analysis – Scenario 2 82
8.2.2 2041 Intersection Capacity Analysis – Scenario 2 85
8.3 Turn Lane Storage – Scenario 2 97
9.0 Comparison of Performance Measures 98
9.1.1 Link Capacity Analysis 98
9.1.2 Intersection Capacity Analysis 98
9.2.1 Link Capacity Analysis 101
9.2.2 Intersection Capacity Analysis 102
10.0 Modifications to Highway 406 Interchange 104
10.1 Recommended Option for Highway 406 Interchange 105
11.0 Active Transportation Assessment 110
11.1 Existing Sustainable Transportation Modes 110
11.2 Active Transportation Plans 111
11.2.1 Niagara Region 111
11.2.2 City of Thorold 112
11.2.3 Town of Pelham 113
11.2.4 City of Welland 114
11.3 Multi-Modal Level of Service Assessment 114
11.4 Active Transportation Under Scenario 2 Conditions 116
12.0 Summary of Key Findings and Recommendations 117
12.1 Findings 117
12.2 Recommendations 121

List of Figures

Figure 1: Subject Segments of Merritt Road and Rice Road 1
Figure 2: Northwest Welland Secondary Plan Study Area 3
Figure 3: East Fonthill Secondary Plan Study Area 4
Figure 4: Port Robinson West Secondary Plan Land Use Area 5
Figure 5: Rural Scenic Cross Section - Complete Streets Design Manual 6
Figure 6: Urban General Cross Section - Complete Streets Design Manual 7
Figure 7: Study Area 8
Figure 8: Pedestrian Level of Service Criteria and Definitions from "Transportation Mobility Plan Guidelines for Development Applications" (York Region, 2016) 15
Figure 9: Bicycle Level of Service Criteria and Definitions from "Transportation Mobility Plan Guidelines for Development Applications" (York Region, 2016) 16
Figure 10: Directions of Segments for MMLOS Assessment from "Transportation Mobility Plan Guidelines for Development Applications" (York Region, 2016) 17
Figure 11: Existing (2020) Lane Configurations 19
Figure 12: Existing (2020) Traffic Volumes 20
Figure 13: Existing 2020 Intersection Operation Conditions 29
Figure 14: Location of Collisions on Rice Road and Merritt Road Based on Reported Collision Data 30
Figure 15: Unopened Road Allowance Looking East from Rice Road 35

Figure 16: Merritt Road east of Cataract Road 36
Figure 17: Merritt Road east of Merrittville Highway/Niagara Street 37
Figure 18: Rice Road between Merritt Road and Quaker Road 39
Figure 19: Future (2031) Traffic Volumes (Scenario 1) 42
Figure 20: 2031 Intersection Operation Conditions – Scenario 1 51
Figure 21: Future (2031) Traffic Volumes (Scenario 2) 53
Figure 22: Future (2031) Intersection Operation Conditions (Scenario 2) 60
Figure 23: Future (2031) Intersection Operation Conditions (Scenario 2) 67
Figure 24: Future (2041) Traffic Volumes (Scenario 1) 69
Figure 25: Future (2041) Intersection Operation Conditions (Scenario 1) 79
Figure 26: Future (2041) Traffic Volumes (Scenario 2) 81
Figure 27: Future (2041) Lane Configurations and Intersection Controls (Scenario 2) 86
Figure 28: Future (2041) Intersection Operation Conditions (Scenario 2) 96
Figure 29: Proposed Cross-Section for Merritt Road at Highway 406 Overpass 107
Figure 30: Proposed Design for Merritt Road at Highway 406 Overpass 109
Figure 31: Sustainable Transportation Modes 110
Figure 32: Planned Strategic Cycling Network Map Close-Up 112
Figure 33: City of Welland Conceptual Trail Network (City of Welland Parks, Recreation, and Culture Master Plan) 114

List of Tables

Table 1: Characteristics of Road Segments Subject to this Assessment 9
Table 2: Characteristics of Other Roads within the Study Area 10
Table 3: Turning Movement Counts 11
Table 4: Level of Service Criteria for Signalized and Unsignalized Intersections 13
Table 5: Link Capacity Analysis – Existing (2020) AM Peak Hour 22
Table 6: Link Capacity Analysis – Existing (2020) PM Peak Hour 23
Table 7: Existing 2020 Signalized Intersection Operations (Niagara Street/Merrittville Hwy and Merritt Road) 25
Table 8: Existing 2020 Signalized Intersection Operations (Niagara Street and Quaker Road) 25
Table 9: Existing 2020 Unsignalized Intersection Operations (Merritt Rd and Hwy 406 SB Ramp) 26
Table 10: Existing 2020 Unsignalized Intersection Operations (Merrittville Hwy and Port Robinson Rd) 26
Table 11: Existing 2020 Unsignalized Intersection Operations (Cataract Rd and Port Robinson Rd) 26
Table 12: Existing 2020 Unsignalized Intersection Operations (Cataract Rd and Merritt Rd) 27
Table 13: Existing 2020 Unsignalized Intersection Operations (First Ave/Cataract Rd and Quaker Rd) 27
Table 14: Existing 2020 Unsignalized Intersection Operations (Rice Rd and Port Robinson Rd) 27
Table 15: Existing 2020 Unsignalized Intersection Operations (Rice Rd and Merritt Rd) 28
Table 16: Existing 2020 Unsignalized Intersection Operations (Rice Rd and Quaker Rd) 28
Table 17: Existing 2020 Unsignalized Intersection Operations (Hwy 406 NB Ramp and Merritt Rd) 28
Table 18: Summary of Collision Records at Merritt Road at Cataract Road 31
Table 19: Summary of Collision Records at Merritt Road at Niagara Street/Merrittville Highway 32
Table 20: Summary of Collisions at Merritt Road between Niagara Street and Highway 406 33
Table 21: Summary of Collisions at Rice Road at Merritt Road 34
Table 22: Segment 3 Site Visit Observations at Various Intersections 37
Table 23: Annual Growth Rates (Existing to 2031) – Scenario 1 40
Table 24: 2031 Link Capacity Analysis – Scenario 1 – AM Peak Hour 44
Table 25: 2031 Link Capacity Analysis – Scenario 1 – PM Peak Hour 45

Table 26: 2031 Signalized Intersection Operations – Scenario 1 – Niagara Street/Merrittville Hwy and Merritt Road 47
Table 27: 2031 Signalized Intersection Operations – Scenario 1 – Niagara Street and Quaker Road 47
Table 28: 2031 Unsignalized Intersection Operations – Scenario 1 – Merritt Rd and Hwy 406 SB Ramp 48
Table 29: 2031 Unsignalized Intersection Operations – Scenario 1 – Merrittville Hwy and Port Robinson Rd 48
Table 30: 2031 Unsignalized Intersection Operations – Scenario 1 – Cataract Rd and Port Robinson Rd 48
Table 31: 2031 Unsignalized Intersection Operations – Scenario 1 – Cataract Rd and Merritt Rd 49
Table 32: 2031 Unsignalized Intersection Operations – Scenario 1 – First Ave/Cataract Rd and Quaker Rd 49
Table 33: 2031 Unsignalized Intersection Operations – Scenario 1 – Rice Rd and Port Robinson Rd 49
Table 34: 2031 Unsignalized Intersection Operations – Scenario 1 – Rice Rd and Merritt Rd 50
Table 35: 2031 Unsignalized Intersection Operations – Scenario 1 – Rice Rd and Quaker Rd 50
Table 36: 2031 Unsignalized Intersection Operations – Scenario 1 – Hwy 406 NB Ramp and Merritt Rd 50
Table 37: 2031 Link Capacity Analysis – Scenario 2 – AM Peak Hour 55
Table 38: 2031 Link Capacity Analysis – Scenario 2 – PM Peak Hour 56
Table 39: 2031 Signalized Intersection Operations – Scenario 2 – Niagara Street/Merrittville Hwy and Merritt Road 62
Table 40: 2031 Signalized Intersection Operations – Scenario 2 – Niagara Street and Quaker Road 62
Table 41: 2031 Signalized Intersection Operations – Scenario 2 – Rice Rd and Port Robinson Rd 63
Table 42: 2031 Signalized Intersection Operations – Scenario 2 – Rice Rd and Merritt Rd 63
Table 43: 2031 Signalized Intersection Operations – Scenario 2 – Rice Rd and Quaker Rd 64
Table 44: 2031 Unsignalized Intersection Operations – Scenario 2 – Merritt Rd and Hwy 406 SB Ramp 64
Table 45: 2031 Unsignalized Intersection Operations – Scenario 2 – Merrittville Hwy and Port Robinson Rd 65
Table 46: 2031 Unsignalized Intersection Operations – Scenario 2 – Cataract Rd and Port Robinson Rd 65
Table 47: 2031 Unsignalized Intersection Operations – Scenario 2 – Cataract Rd and Merritt Rd 65
Table 48: 2031 Unsignalized Intersection Operations – Scenario 2 – First Ave/Cataract Rd and Quaker Rd 66
Table 49: 2031 Unsignalized Intersection Operations – Scenario 2 – Hwy 406 NB Ramp and Merritt Rd 66
Table 50: Annual Growth Rates (2031 to 2041) – Scenario 1 68
Table 51: 2041 Link Capacity Analysis – Scenario 1 – AM Peak Hour 71
Table 52: 2041 Link Capacity Analysis – Scenario 1 – PM Peak Hour 72
Table 53: 2041 Signalized Intersection Operations – Scenario 1 – Niagara Street/Merrittville Hwy and Merritt Road 75
Table 54: 2041 Signalized Intersection Operations – Scenario 1 – Niagara Street and Quaker Road 75
Table 55: 2041 Unsignalized Intersection Operations – Scenario 1 - Merritt Rd and Hwy 406 SB Ramp 76
Table 56: 2041 Unsignalized Intersection Operations – Scenario 1 - Merrittville Hwy and Port Robinson Rd 76
Table 57: 2041 Unsignalized Intersection Operations – Scenario 1 - Cataract Rd and Port Robinson Rd 76
Table 58: 2041 Unsignalized Intersection Operations – Scenario 1 - Cataract Rd and Merritt Rd 77
Table 59: 2041 Unsignalized Intersection Operations – Scenario 1 - First Ave/Cataract Rd and Quaker Rd 77
Table 60: 2041 Unsignalized Intersection Operations – Scenario 1 - Rice Rd and Port Robinson Rd 77
Table 61: 2041 Unsignalized Intersection Operations – Scenario 1 - Rice Rd and Merritt Rd 78
Table 62: 2041 Unsignalized Intersection Operations – Scenario 1 - Rice Rd and Quaker Rd 78
Table 63: 2041 Unsignalized Intersection Operations – Scenario 1 - Hwy 406 NB Ramp and Merritt Rd 78
Table 64: 2041 Link Capacity Analysis – Scenario 2 – AM Peak Hour 83
Table 65: 2041 Link Capacity Analysis – Scenario 2 – PM Peak Hour 84
Table 66: 2041 Signalized Intersection Operations – Scenario 2 – Niagara Street/Merrittville Hwy and Merritt Road 88

Table 67: 2041 Signalized Intersection Operations – Scenario 2 – Niagara Street and Quaker Road 89
Table 68: 2041 Signalized Intersection Operations – Scenario 2 – Cataract Rd and Merritt Rd 90
Table 69: 2041 Signalized Intersection Operations – Scenario 2 – First Ave/Cataract Rd and Quaker Rd 91
Table 70: 2041 Signalized Intersection Operations – Scenario 2 – Rice Rd and Port Robinson Rd 92
Table 71: 2041 Signalized Intersection Operations – Scenario 2 – Rice Rd and Merritt Rd 92
Table 72: 2041 Signalized Intersection Operations – Scenario 2 – Rice Rd and Quaker Rd 93
Table 73: 2041 Unsignalized Intersection Operations – Scenario 2 – Merrittville Hwy and Port Robinson Rd 93
Table 74: 2041 Unsignalized Intersection Operations – Scenario 2 – Cataract Rd and Port Robinson Rd 94
Table 75: 2041 Unsignalized Intersection Operations – Scenario 2 – Hwy 406 NB Ramp and Merritt Rd 94
Table 76: Left and Right Turn Lane Storage Requirements 97
Table 77: Comparison of the 2031 Link Capacity Analysis Results Under Scenario 1 and 2 98
Table 78: Comparison of 2031 Intersection Capacity Analysis Results Under Scenario 1 and 2 100
Table 79: Comparison of the 2041 Link Capacity Analysis Results Under Scenario 1 and 2 101
Table 80: Comparison of 2041 Intersection Capacity Analysis Results Under Scenario 1 and 2 103
Table 81: Existing Transit Information 111
Table 82: Planned Sidewalk Network Project Details 113
Table 83: Planned Cycling Network Project Details 113
Table 84: Existing Conditions (2020) Pedestrian Level of Service Summary 115
Table 85: Existing Conditions (2020) Bicycle Level of Service Summary 115
Table 86: Recommended Road Improvements 123
Table 87: Recommended Intersection Improvements 124

List of Appendices

Appendix A – Signal Timing Plan
Appendix B – Turning Movement Count
Appendix C – Growth Rate and Diversion Analysis
Appendix D – Synchro Output (Existing Condition)
Appendix E – Signal Warrant Calculation (Scenario 1) 2031
Appendix F – Synchro Output – Future (Scenario 1) 2031
Appendix G – Signal Warrant Calculation (Scenario 2) 2031
Appendix H - Synchro Output – Future (Scenario 2) 2031
Appendix I – Signal Warrant Calculation (Scenario 1) 2041
Appendix J – Synchro Output – Future (Scenario 1) 2041
Appendix K - Signal Warrant Calculation (Scenario 2) 2041
Appendix L – Synchro Output – Future (Scenario 2) 2041
Appendix M – Highway 406 Interchange Redesign Memorandum

1.0 Introduction

Niagara Region retained WSP E&I Canada Limited (Formerly Wood Environment & Infrastructure Solutions) to complete a Municipal Class Environmental Assessment (EA) for improvements to Merritt Road and Rice Road to accommodate future traffic growth in the area as a result of future developments in the Town of Pelham, the City of Thorold and the City of Welland. For the purpose of thi Study, the subject roadways were divided into the following road segments:

- Segment 1: Merritt Road Allowance between Regional Road 54 (Rice Road) and Cataract Road;
- Segment 2: Merritt Road between Cataract Road and Regional Road 50 (Merrittville Highway) / Niagara Street;
- Segment 3: Regional Road 37 (Merritt Road) between Regional Road 50 (Merrittville Highway) / Niagara Street and Highway 406; and
- Segment 4: Regional Road 54 (Rice Road) between 200 meters north of Merritt Road and Quaker Road.

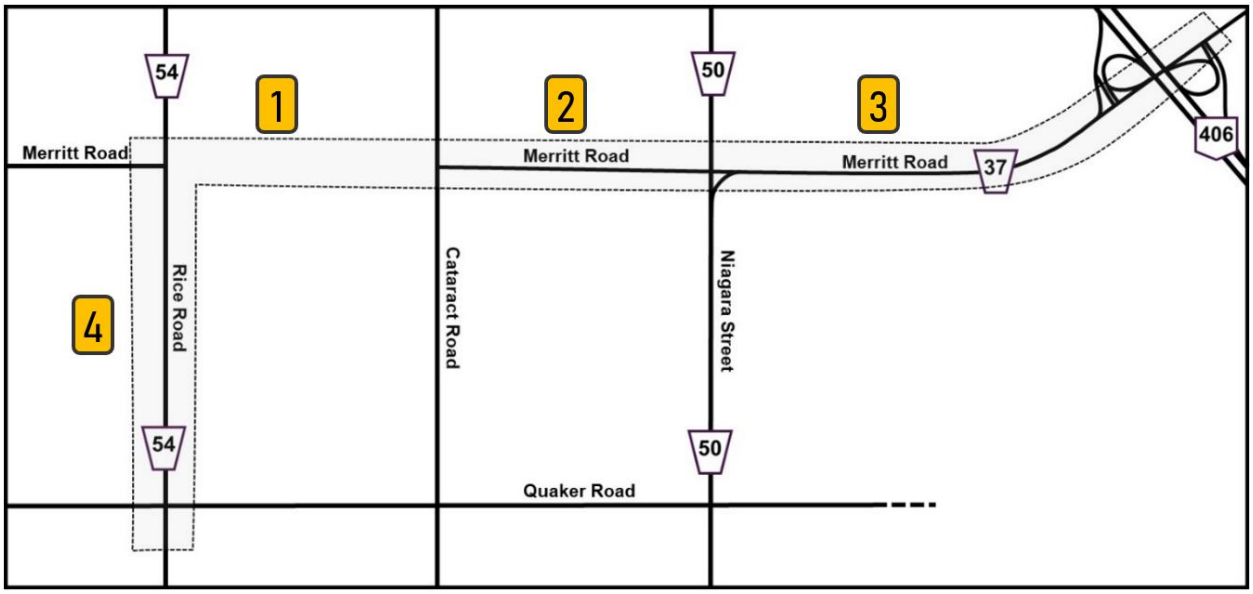


Figure 1: Subject Segments of Merritt Road and Rice Road

The Class EA Study was built on the recommendations of the Niagara Region's approved Transportation Master Plan (TMP) and it was aimed at identifying improvements to the two roadways to meet the future needs of the surrounding community for all road users. The study also aimed at addressing active transportation needs by providing dedicated pedestrian and cyclist infrastructure that is safe, attractive, conforms to a complete streets approach, and is compatible with the changing land use in the three local municipalities.

This detailed transportation assessment was completed as part of the Class EA Study to assess existing and future traffic conditions to determine the transportation needs along Merrit Road and Rice Road within the study area, and assess traffic demand and operations. This report documents the analysis, methodology, and results of the transportation assessment and proposed road network improvements to accommodate future demand within the study area.

The assessment included determining the existing traffic conditions for the 2020 base year as well as for the horizon years 2031 and 2041. Two scenarios were discussed for each of the future (2031 and 2041) horizon years. Descriptions of both scenarios are provided below.

Scenario 1 – Do Nothing

In Scenario 1, the traffic assessments were undertaken based on 2031 and 2041 traffic forecasts on the existing road network. The assessments were completed assuming that no improvements were implemented for either future horizon year (i.e., no capacity improvements were undertaken, and Merritt Road was not extended to provide a connection between Cataract Road and Rice Road).

Scenario 2 – With Improvements

In Scenario 2, the traffic assessments for 2031 and 2041 horizon years were undertaken on the modified road network assuming the implementation of proposed improvements for each horizon year. The proposed improvements included the Merritt Road extension between Rice Road and Cataract Road, intersection control modifications, and geometric improvements along the corridor.

The proposed improvements for each future horizon year (2031 and 2041) were determined based on the recommendations of the Niagara Region TMP (2017), the City of Thorold TMP (2020) and the results of the link capacity and intersection capacity analyses for Scenario 1 – Do Nothing, and consultation with the Niagara Region and the Ministry of Transportation (MTO).

2.0 Background Studies

The following section outlines background studies that provide the planning context for this study.

2.1 Niagara Region Transportation Master Plan (2017)

The Niagara Region TMP, 2017 presents a long-term strategy to guide the planning, development, and renewal of a multi-modal transportation system that is consistent with projected needs, aligned with the region's growth, and the overall vision for a sustainable Niagara Region. The TMP outlines that the Niagara Region's 10-year Capital Program includes the following improvements as related to this study:

- Capacity Improvements on Merritt Road, from Niagara Street to Highway 406;
- An extension of Merritt Road from Rice Road to Cataract Road; and
- Capacity Improvements on Rice Road between Merritt Road and Quaker Road

2.2 City of Thorold Transportation Master Plan (2020)

The City of Thorold Transportation Master Plan was developed in 2020. The TMP sets out a long-term strategic planning framework to guide the City's transportation priorities and policy directions through the next 20 years. The TMP recommends capacity improvements along Merritt Road between Cataract Road and Highway 406 and Merritt Road be extended to connect between Rice Road to Cataract Road.

2.3 City of Welland's Northwest Welland Secondary Plan (2020)

The Northwest Welland Secondary Plan is a proposed mixed-use residential development that will provide housing for full-time residents within the City of Welland (**Figure 2)**. This Secondary Plan adds population and employment over the original land use 2031 forecasts that were used in the Region's transportation demand forecast model. The Region's model was updated to reflect the addition of 6,280 people and 84 jobs to the study area by 2031 based on the Secondary Plan. This transportation assessment uses the latest update to the Region's model, incorporating the land use data.

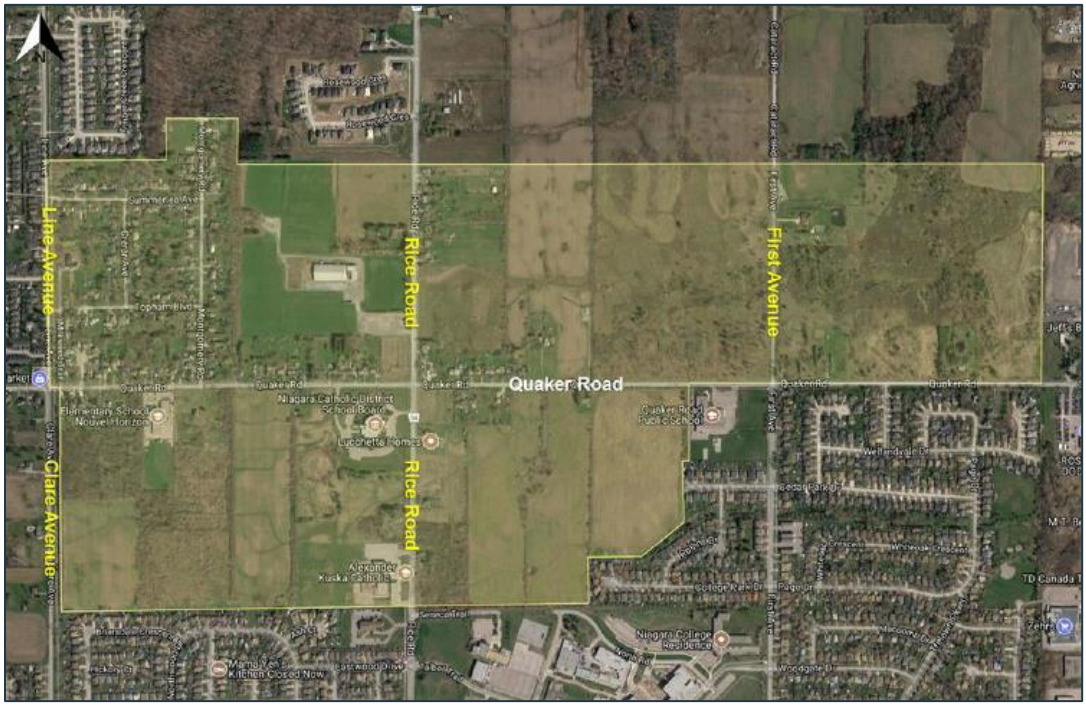


Figure 2: Northwest Welland Secondary Plan Study Area

2.4 Town of Pelham's East Fonthill Secondary Plan (2014)

The Town of Pelham's East Fonthill Secondary Plan was approved concurrently with the Official Plan in 2014. The study area for this Secondary Plan is shown in **Figure 3**. The Secondary Plan provides policies for a comprehensively planned community structure that will accommodate between 6,500 and 7,500 new residents and jobs combined. This planned land use is incorporated in the transportation assessment of this study and has been accounted for in the Region's forecast model.

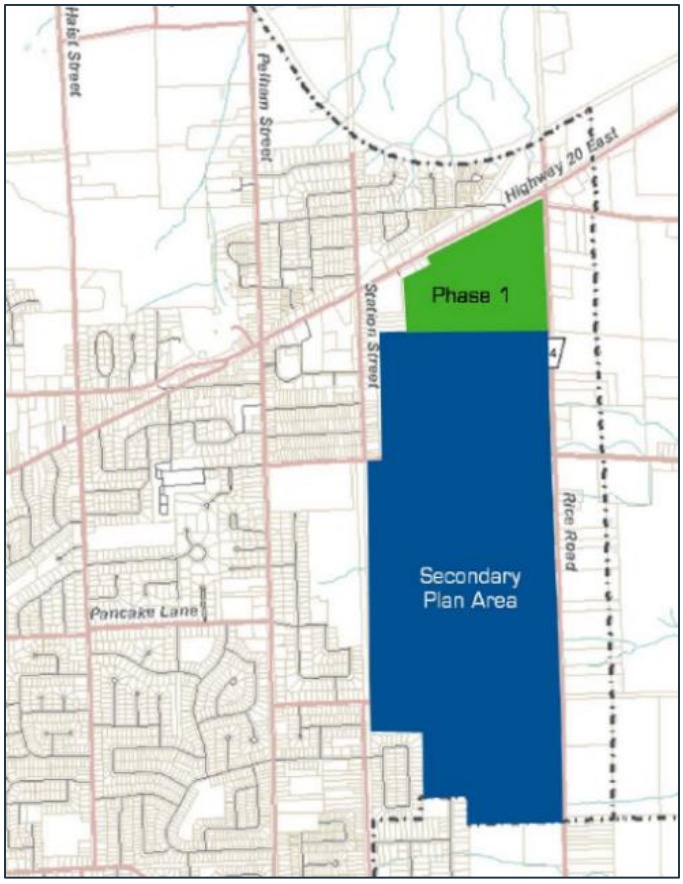


Figure 3: East Fonthill Secondary Plan Study Area

2.5 City of Thorold's Port Robinson Secondary Plan (2010)

The Port Robinson Secondary Plan study area is located at the city's southern limit and is generally bounded by the Welland Canal to the east, Port Robinson Road to the north, and the Thorold-Pelham border, as shown in **Figure 4**. The southern boundary is the Thorold-Welland border. Within the Secondary Plan study area is the proposed Port Robinson Road Residential Development which was considered in the transportation analysis in this study.

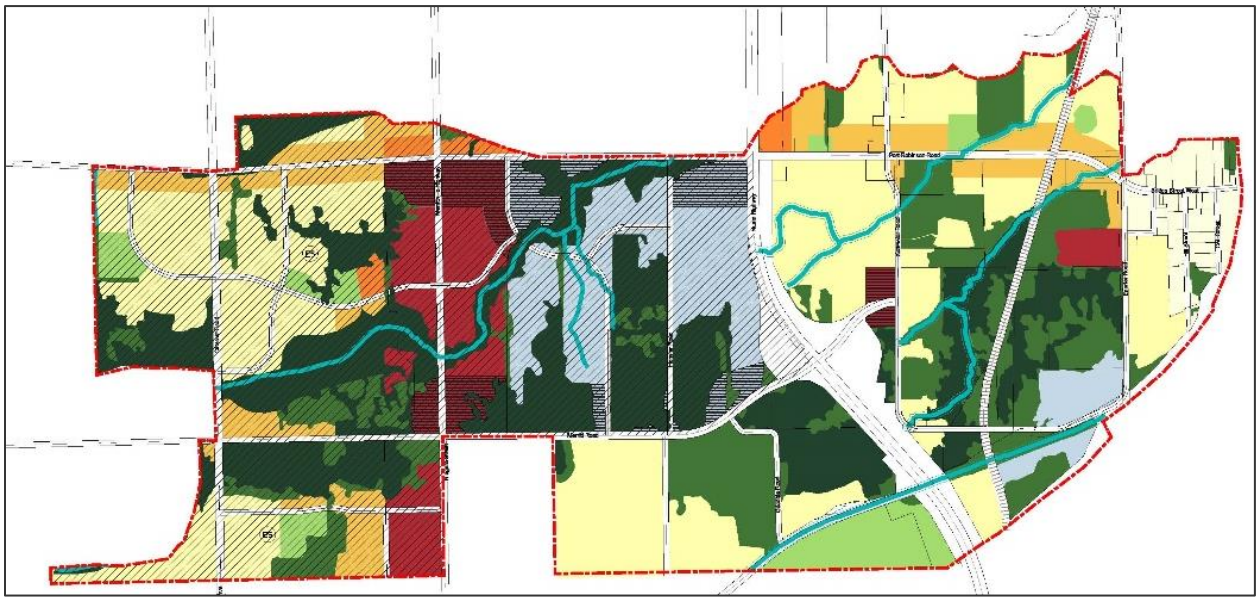


Figure 4: Port Robinson West Secondary Plan Land Use Area

2.6 Niagara Region Complete Streets Design Guidelines (2017)

Niagara Region's Transportation Master Plan lays the foundation for the Region to develop Complete Corridors. Complete Corridors uses the public right-of-way and adjacent land uses to support all mobility modes based on context and assist people of all ages and abilities to travel throughout the Region.

A Complete Streets approach considers various mobility needs, land use contexts, and natural heritage and built form conditions. Niagara Region is currently developing a Complete Streets Design Manual.

2.7 Niagara Region Complete Streets Design Manual (Ongoing)

The ongoing Complete Streets Design Manual (CSDM) is a design directive for complete streets on the Regional roadway network. It provides Regional staff and practitioners guidance on how to design, implement, and maintain complete streets. Design practice included in the CSDM is based off best practices and updated standards included in the Transportation Association of Canada Geometric Design Guidelines for Canadian Roads and Ontario Traffic Manual.

Regional Road Typologies provide a Complete Streets classification system for roads in the Region with context sensitive planning and design direction. Typologies act as an additional layer to the functional roadway classification system. The typologies reflect aspirational visions for Regional roads and planned rights-of-way. Each typology reflects common operational characteristics, land use, built form and urban design attributes. The typologies included in the CSDM build off the foundational typologies included in the Niagara TMP – Complete Streets Guidelines.

The six original road typologies developed as part of the 2017 TMP were reviewed and refined. Typologies were refined based on principles and values of complete streets, vision zero and other emerging planning and design principles. Regional roads are classified into Main Street, Urban General, Urban Thoroughfare, Rural Thoroughfare, Rural Scenic and Hamlet typologies. The text below provides descriptions of typologies that are relevant to this project.

Rural Scenic Cross Section

Rural Scenic roadways serve a mobility and tourism function with an emphasis on cycling. Many Rural Scenic streets are in agricultural or natural areas throughout the Region, such as adjacent to wineries or along the escarpment. These streets provide an opportunity to enhance cycle tourism throughout the Region. These streets have moderate target speeds and low vehicle volumes. Rural Scenic characteristics include 26.2 meters ROW, 50 – 60 km/h target speed (50km/h typical), maximum 2 travel lanes (median not required), and on-street parking is restricted. A cross-section of this typology is provided in **Figure 5**.

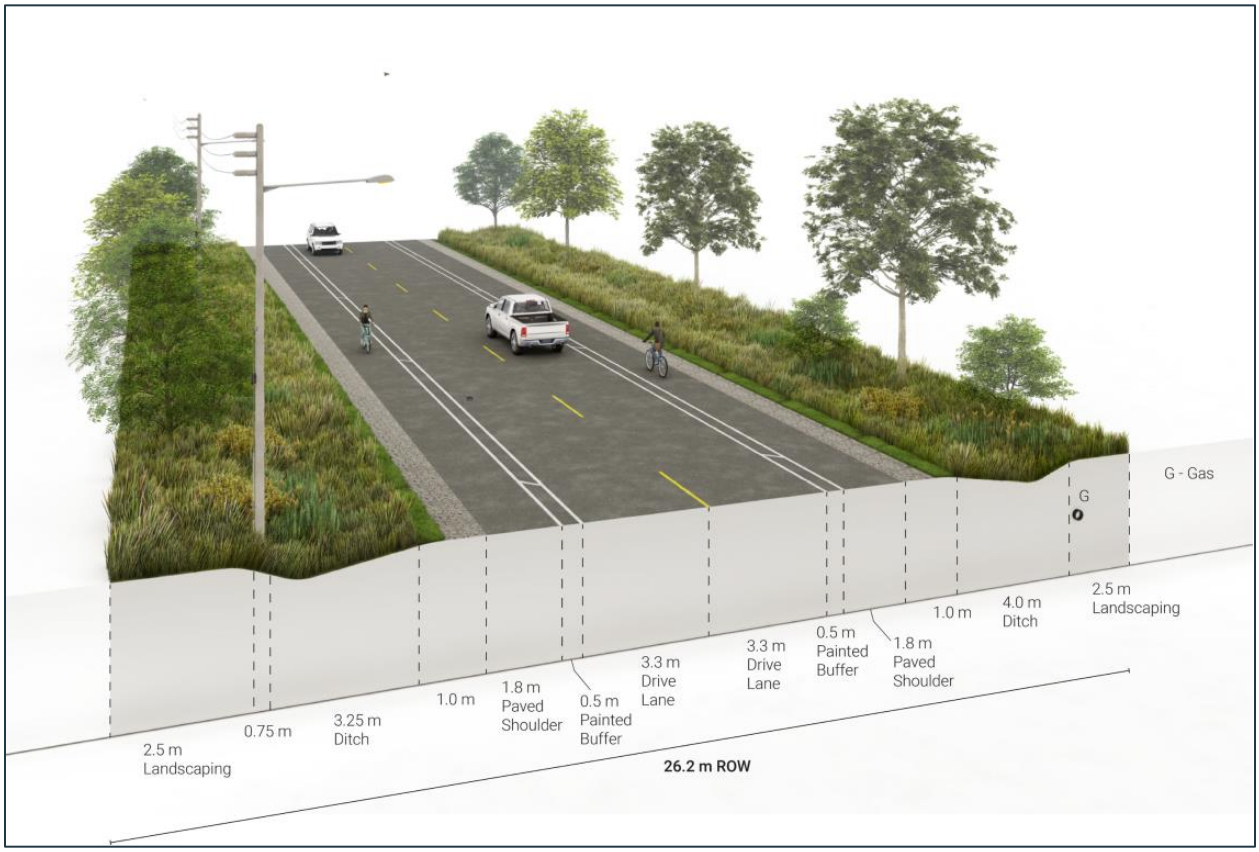


Figure 5: Rural Scenic Cross Section - Complete Streets Design Manual

Urban General Cross Section

Urban General streets are traditionally found within the Region's largest, mixed-use urban centres. These streets may be within existing and future built-up areas that reflect balanced mobility and place-making priorities. These streets often serve commercial retail and service businesses, connect through residential neighbourhoods within communities and carry medium to large volumes of all modes. Urban General characteristics include 26.2 – 30.5 meters ROW, 40 – 50 km/h target speed, and typical three-lane configuration, with two-way left turn lane. (Alternative configurations ranging from two to five lanes may be considered.) A cross-section of this typology is provided in **Figure 6**.

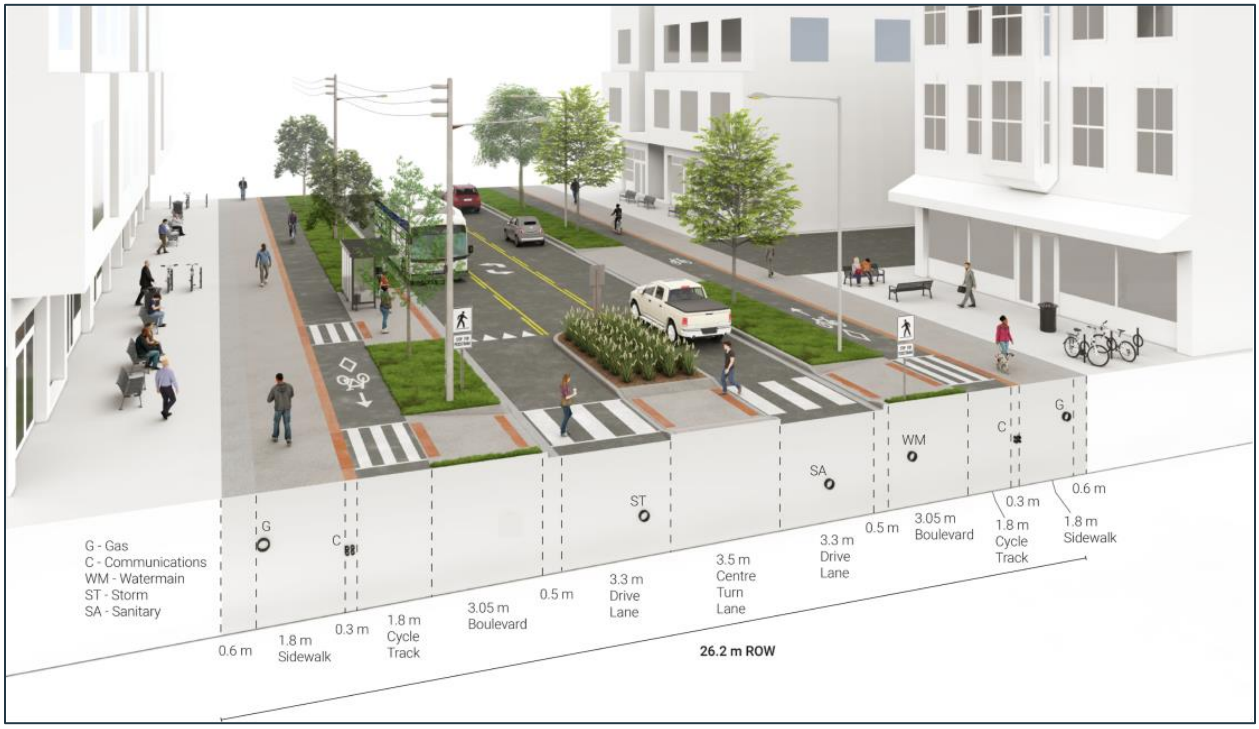


Figure 6: Urban General Cross Section - Complete Streets Design Manual

3.0 Study Area

The study area is located within the City of Thorold, the Town of Pelham, and the City of Welland. The study area for the transportation study is bounded by Port Robinson Road to the north, Highway 406 to the east, Quaker Road to the south, and Rice Road to the west, as shown in **Figure 7**. The following four segments identify the study corridors which were the focus of the study:

- Segment 1: Merritt Road between Regional Road 54 (Rice Road) and Cataract Road;
- Segment 2: Merritt Road between Cataract Road and Regional Road 50 (Merrittville Highway)/Niagara Street;
- Segment 3: Regional Road 37 (Merritt Road) between Regional Road 50 (Merrittville Highway)/Niagara Street and Highway 406; and
- Segment 4: Regional Road 54 (Rice Road) between 200 meters North of Merritt Road and Quaker Road.

Figure 7: Study Area

The study area characteristics for the four Regional roadway segments are included in **Table 1**. Characteristics for the other roads within the study area are presented in **Table 2**.

Table 1: Characteristics of Road Segments Subject to this Assessment

Road Segments	Road Authority	Road Characterization	Current Right-of-Way	Ultimate Right-of-Way	Speed Limit
Segment 1 - Future Merritt Road between Rice Road and Cataract Road	Niagara Region	Unopened road allowance	20 m	26 m[1]	N/A
Segment 2 – Merritt Road between Cataract Road and Merrittville Highway/Niagara Street	Niagara Region	Two lanes, rural, local, undivided roadway	20 m	N/A	50 km/h
Segment 3 – Merritt Road between Merrittville Highway/Niagara Street and Highway 406 interchange	Niagara Region	Two lanes, rural, arterial, undivided roadway	30 m	35 m[2]	60 km/h
Segment 4 – Rice Road between Merritt Road and Quaker Road	Niagara Region	Two lanes, rural, collector, undivided roadway	20 m (between Quaker Road and Rosewood Crescent) 23 m between Rosewood Crescent and Merritt Road	26.2 m[2]	60 km/h (Town of Pelham portion) 50 km/h (City of Welland portion

1 City of Thorold Official Plan (2016)
2 Niagara Region Official Plan (2014)

Table 2: Characteristics of Other Roads within the Study Area

Road Segments	Road Authority	Road Characterization	Current Right-of-Way	Speed Limit
Rice Road between Merritt Road and Port Robinson Road	Niagara Region	Two lanes, rural, arterial, undivided roadway	23.3 m (typical)	60 km/h
Port Robinson Road between Rice Road and Kottmeier Road	Town of Pelham/City of Thorold	Two lanes, rural, local, undivided roadway	20.0 m (typical)	50 km/h
Merrittville Highway between Port Robinson Road and Merritt Road	Niagara Region	Two lanes, rural, arterial, undivided roadway	26.0 m (typical)	60 km/h
Niagara Street between Merritt Road and Quaker Road	Niagara Region	Four lanes, rural, arterial, undivided roadway	28.0 m (typical)	60 km/h
Quaker Road between Rice Road and Niagara Street	City of Welland	Two lanes, rural, local, undivided roadway	20.7 m - 23.4 m (varies)	50 km/h
Cataract Road/First Avenue between Port Robinson Road and Quaker Road	City of Thorold/City of Welland	Two lanes, rural, local, undivided roadway	21.0 (typical in City of Thorold); 29.1 m (typical in City of Welland)	50 km/h

4.0 Methodology

The transportation assessment consisted of a capacity analysis for existing (2020) and future (2031 and 2041) conditions and a multi-modal assessment. An intersection capacity analysis was conducted using Synchro 11 to assess existing and future conditions for the weekday morning and afternoon peak hours. The link capacity performance metric was the volume-to-capacity (v/c) ratio, and the intersection operations performance metrics were reported in terms of Level of Service (LOS), delays, 95th percentile queue length and v/c ratios.

4.1 Data Collection

4.1.1 Signal Timing Plans

Currently there are three signalized intersections within the study area; Rice Road at Port Robinson Road, Merritt Road at Merrittville Highway/Niagara Street and Niagara Street at Quaker Road. The intersection of Rice Road and Port Robinson Road was signalized after the traffic data collection for the base conditions, therefore it was assumed that there were two signalized intersections within the study area for the base conditions analysis.

The existing signal timing plans (STP) for the intersection at Rice Road and Port Robinson Road were received from the Region in May 2021 while STPs for the other two signalized intersections were received from the Region in January 2021.

The signal timing plans are attached in **Appendix A**.

4.1.2 Turning Movement Counts

The existing/historical turning movement counts (TMCs) for intersections in the study area were provided by the Region in January/May 2021. When available, the 15-minute volumes were used to compute peak hour factors (PHFs) per intersection. The list of intersections and count dates are summarized in **Table 3.**

Table 3: Turning Movement Counts

Intersection	Count Date	15-Min Volume
Merritt Rd at Hwy 406 NB Ramp	2017-03-29, 2016-06-21, 2017-03-29, 2015-01-14	Available, Available, Available, Available
Merritt Rd at Hwy 406 SB Ramp	2017-03-29, 2015-01-14	Available, Available
Merrittville Hwy at Port Robinson Rd	2020-11-17, 2007-11-16, 2016-06-21	Available, Available, Available
Niagara St - Merrittville Hwy at Merritt Rd	2019-05-02, 2016-06-21, 2011-07-28	Available, Available, Available

Intersection	Count Date	15-Min Volume
Niagara St at Quaker Rd	2020-10-27, 2017-07-14, 2014-11-24, 2011-08-03, 2007-03-19, 2004-11-25	Available, Available, Available, Available, Available, Available
Port Robinson Rd at Cataract Rd	2016-08-25, 2006-06-20	Unavailable, Unavailable
Merritt Rd at Cataract Rd	-	-
Quaker Rd at First Ave - Cataract Rd	2016-06-21	Available
Port Robinson Rd at Rice Rd	2016-04-27	Available
Rice Rd at Merritt Rd	2016-06-13	Available
Quaker Rd at Rice Rd	2016-06-13	Available

For intersections with TMCs available from multiple dates, the latest counts were used, except for the 2020 counts, which were noted to be lower than earlier counts, given the COVID-19 pandemic. In addition, earlier counts were used at the intersection of Merritt Road and Merrittville Highway/Niagara Street.

TMCs for Merritt Road at Cataract Road were not available. Therefore, the TMCs at the upstream and downstream intersections were used to estimate the intersection volumes via balancing.

Existing conditions (2020) balanced counts were derived by growing historical turning movement counts at an annual rate of 1.5%.

The turning movement counts are included in **Appendix B**.

4.1.3 Collision Data

Niagara Region provided historical collision data between 2015 and 2020 (partial year) based on police MVA reports for Rice Road and Merritt Road. Based on this data, there were 41 collisions during this period along Merritt Road and two collisions during this period along Rice Road. This data was used for the safety analysis.

4.2 Travel Demand Forecasting

Travel demand forecasting considered model output from the Niagara Region EMME model for 2031 and 2041 plus Niagara Region land use forecasts to guide the development of traffic volume growth rates. The process of developing the growth rates used in this project is described in detail in **Appendix C**.

Travel demand forecasting for Scenario 2 considered select link analysis from the Niagara Region EMME model, to inform adjustments to demand with the proposed Merritt Road extension. A detailed description of these calculations is also provided in **Appendix C**.

4.3 Link Capacity Analysis

The volume-to-capacity (v/c) ratios for the Merritt Road and Rice Road corridors were calculated for the weekday AM and PM peak hours using the existing and forecasted traffic volumes. The assumed lane capacity was based on capacities used in the Region's EMME Transportation Demand Model. Link volume to capacity ratios greater than 0.85 have been identified as "critical" since the demand is approaching the capacity for the link.

4.4 Intersection Capacity Analysis

The intersection capacity analysis was conducted using Synchro 11 and the Highway Capacity Manual (HCM), published by the Transportation Research Board (TRB). The methodology of traffic operations assessment was based on a review of "Niagara Region Guidelines for Transportation Impact Studies" (Niagara Region, 2012). The performance metrics included v/c ratios, delays, 95th percentile queue length and level of service (LOS). The LOS criteria for signalized and unsignalized intersections are summarized in **Table 4**.

Table 4: Level of Service Criteria for Signalized and Unsignalized Intersections

Level of Service	Average Control Delay per Vehicle (seconds / vehicle)	
	Signalized Intersection[1]	Unsignalized Intersection[1]
A	≤ 10	≤ 10
B	>10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 15 and ≤ 25
D	> 35 and ≤ 55	> 25 and ≤ 35
E	> 55 and ≤ 80	> 35 and ≤ 50
F	> 80	> 50

Note(s)

1. Highway Capacity Manual (HCM) 2000

Peak hour factors determiend based on the traffic counts were used, except for intersections which did not have 15-minute volumes for the calculations of peak hour factors (PHFs). In this case, a PHF of 0.92 was used per "Niagara Region Guidelines for Transportation Impact Studies" (Niagara Region, 2012). In the AM, the PHF at the Merrittville Highway at Port Robinson Road intersection was 0.77, which seemed unreasonably low. It was suspected that this was because the data collection period did not capture the entirety of the actual peak hour – it seemed that the data collection period ended earlier than the end of the actual peak hour. However, the PHF of 0.77 instead of 0.92 was used to provide conservative results.

To determine bus blockages applicable for the intersection capacity analysis, maps and schedules published by relevant transit agencies were reviewed.

According to the "Niagara Region Guidelines for Transportation Impact Studies" (dated May 2012) by the Niagara Region, critical movements for signalized and unsignalized intersections are defined as follows:

- "At signalized intersections, through and/or through-right and/or right-turn movements with a v/c ratio greater than 0.85 are deemed to be "critical" in terms of operations. Dedicated left-turn movements with a v/c ratio greater than 0.90 are deemed to be "critical" in terms of operations." and

- "At unsignalized intersections, the analysis must highlight where movements are 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."

For intersecitons under MTO jurisdiction, MTO's "General Guidelines for the Preparation of Traffic Impact Studies" indicates the following critical performance measures:

- at signalized intersections, movements with a v/c ratio of greater than 0.85 are deemed to be critical in terms of operations
- for ramps, a v/c ratio for terminal ramp approaches with a value greater than 0.75 would be deemed critical and requires evaluation for possible operational improvements

These critical movements were identified and discussed as part of the intersection capacity analyses.

4.5 Multimodal Level of Service

As part of the active transportation assessment, the multimodal level of service (LOS) assessment was conducted based on a review of "Transportation Mobility Plan Guidelines for Development Applications" (York Region, 2016). Pedestrian and Bicycle LOS were determined at segment levels based on infrastructure provision criteria. The assessment was carried out for the four study segments indicated in "Project Management Plan Merritt Road/Rice Road Municipal Class Environmental Assessment and Detailed Transportation Study" (Wood, 2020). Google Maps, Google Earth, and Google Street View were used for most segments. See **Figure 8** and **Figure 9** for pedestrian and bicycle LOS criteria, respectively.

Level of Service	Segment	Intersection
A	≥2.0 m sidewalk with minimum 3.5 m buffer including planting and edge zone; or ≥3.0 m multi-use path	▪ ≥2.0 m sidewalk with minimum 3.5 m buffer including planting and edge zone; or ≥3.0 m multi-use path ▪ Pedestrian signal head with sufficient pedestrian clearance time ▪ Clearly delineated cross-walk
B	≥1.5 m sidewalk with minimum 1.0 m buffer including edge zone; or <3.0 m multi-use path	▪ ≥1.5 m sidewalk with minimum 1.0 m buffer including edge zone; or <3.0 m multi-use path ▪ Pedestrian signal head with sufficient pedestrian clearance time ▪ Clearly delineated cross-walk
C	≥1.5 m curb-faced sidewalk (no buffer)	▪ ≥1.5 m curb-faced sidewalk (no buffer) ▪ Pedestrian signal head with sufficient pedestrian clearance time ▪ Clearly delineated cross-walk
D	<1.5 m sidewalk	▪ <1.5 m sidewalk ▪ Pedestrian signal head sufficient pedestrian clearance time ▪ No clearly delineated cross-walk
E	Paved shoulder or no sidewalk provision	▪ Paved shoulder or no sidewalk provision ▪ No pedestrian signal head ▪ No clearly delineated cross-walk
F	No sidewalk provision	▪ No sidewalk provision ▪ No pedestrian signal head ▪ Not clearly delineated cross-walk

Definitions

Buffer: green or landscaped space separating the sidewalk and pavement street curb.

Curb-faced: the sidewalk is located adjacent to the pavement and street curb.

Delineated cross-walk: painted or special pavement to facilitate pedestrians.

Figure 8: Pedestrian Level of Service Criteria and Definitions from "Transportation Mobility Plan Guidelines for Development Applications" (York Region, 2016)

Level of Service	Segment	Intersection
A	Separated cycling facilities (e.g. cycle tracks, multi-use path)	Separated cycling facilities Bicycle box or clearly delineated bicycle treatment or bicycle signal head
B	≥1.8 m dedicated cycling facilities (e.g. bicycle lanes with and without buffer)	>1.8 m dedicated cycling facilities (e.g. bicycle lanes with and without buffer), Bicycle box, clearly delineated bicycle treatment or bicycle signal head
C	<1.8 m dedicated cycling facilities with no buffer	<1.8 m dedicated cycling facilities with no buffer, Bicycle box, clearly delineated bicycle treatment or bicycle signal head
D	≤1.5 m bicycle lane with no buffer	≤1.5 m bicycle lane and no buffer Bicycle treatment
E	Shared facilities (e.g. signed routes, sharrows or paved shoulder with minimum 1.2 m in constrained area)	Shared facilities (e.g. signed routes, sharrows or paved shoulder with minimum 1.2 m in constrained area) No clearly delineated bicycle treatment
F	No bicycle provision	No bicycle provision

Definitions

Shared: Shared facilities include roadways or streets where cyclists and motorists use the same road space. Types of shared facilities include signed routes, bicycle boulevards or shared lanes ("sharrows"). Since cyclists and motorists share the same space, these facilities are appropriate on streets with low traffic volumes and/or low speeds.

Dedicated: Designated or dedicated facilities are those that provide space on the road intended for use by cyclists only. They are generally adjacent to motor vehicle lanes and defined by pavement markings. In urban areas, dedicated facilities typically include bike lanes and buffered bike lanes while paved shoulders provide dedicated space on rural roads.

Separated: Separated bikeways are separated from traffic by more than just a painted line. Separation may consist of bollards or delineators, mountable or barrier curbs, planters, concrete medians, etc. Types of separated facilities can include cycle tracks, raised bike lanes, or multi-use trails. These facilities improve safety and comfort for cyclists along higher-speed, busy roadways.

Buffer: a painted area or physical barrier that separates the bicycle lane from the adjacent traffic lane.

Bicycle box: A bike box is used at intersections with dedicated bike lanes or a cycle track to designate a space for cyclists to wait at a red light or to assist cyclists in making left turns. Cyclists stop in front of motorists and can proceed through the intersection first when the light turns green.

Paved shoulder: Paved shoulders are located next to the travelled portion of the roadway and used to accommodate cyclists on rural roads.

Figure 9: Bicycle Level of Service Criteria and Definitions from "Transportation Mobility Plan Guidelines for Development Applications" (York Region, 2016)

Note that for a north-south segment, northbound refers to the east side of the segment, and southbound refers to the west side of the segment. Similarly, for an east-west segment, eastbound refers to the south side of the segment, and westbound refers to the north side of the segment, illustrated in **Figure 10**.

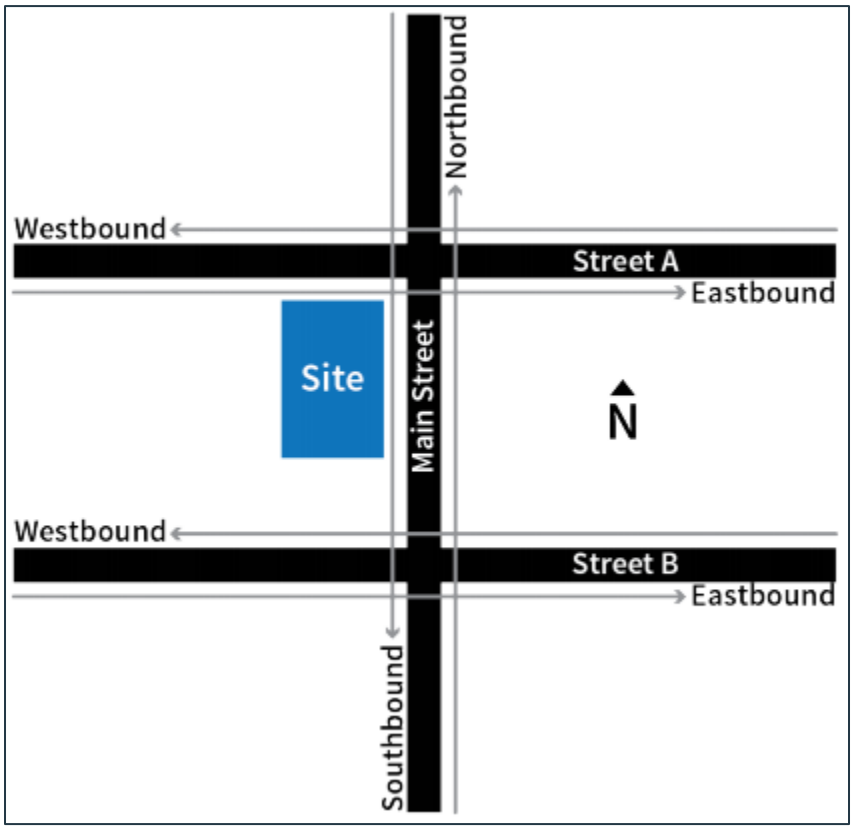


Figure 10: Directions of Segments for MMLOS Assessment from "Transportation Mobility Plan Guidelines for Development Applications" (York Region, 2016)

4.6 Signal Warrant

For unsginalized intersections operating at critical conditions in the future horizon years (2031 and 2041), a signal warrant analysis was conducted per Ontario Traffic Manual (OTM) Book 12 - Traffic Signals.

Since only the weekday morning (AM) and afternoon peak (PM) hours were forecasted, the future 8-hour intersection volumes were estimated using the existing 8-hour intersection volumes and the forecasted AM and PM peak hours. First, ratios of hourly volumes to the total 8-hour volumes were calculated using the existing 8-hour intersection volumes. Then, using the ratios, the forecasted AM and PM peak hour volumes were applied separately to estimate the 8-hour intersections volumes. Then, for each turning movement per hour, the higher of the two (AM or PM) were selected to produce conservative estimates.

For the intersections for which there were no available existing 8-hour volumes, namely Merritt Road at Rice Road and Cataract Road; ratios of hourly volumes to total 8-hour volumes are adopted from adjacent upstream/downstream intersections as appropriate and applied to previously forecasted AM and PM Peak Hour volumes to estimate horizon year 8-hour intersection volumes.

5.0 Existing Conditions (2020) Assessment

5.1 Existing Travel Demand

The baseline volumes were established based on turning movements counts and signal timing plans described in **Section 4.1**.

The existing (2020) lane configurations and intersection controls were reviewed using Google Maps, Google Earth, Bing Maps, and Google Street View, as illustrated in **Figure 11**. The existing (2020) balanced traffic volumes are presented in **Figure 12.** Note that since the count data preceded signalization of Rice Road and Port Robinson Road, the existing conditions analysis considered this intersection as all-way stop controlled.

A review of the turning movement counts shows a heavy traffic flow between the Highway 406 ramps (to and from the north), along Merritt Road between the ramps and Merritville Highway/Niagara Street, along Niagara Street south to Quaker Road and to a lesser degree along Quaker Road. This highlights the importance of this corridor in carrying traffic between Highway 406 (and points north) and the City of Welland.

Rice Road is another key gateway into the study area, carrying a sizable amount of traffic between Highway 20 and the City of Welland.

In contrast, Port Robinson Road, which does not have a direct connection to Highway 406, does not carry significant traffic. Merritt Road west of Merrittville Highway/Niagara Street also does not carry significant traffic.

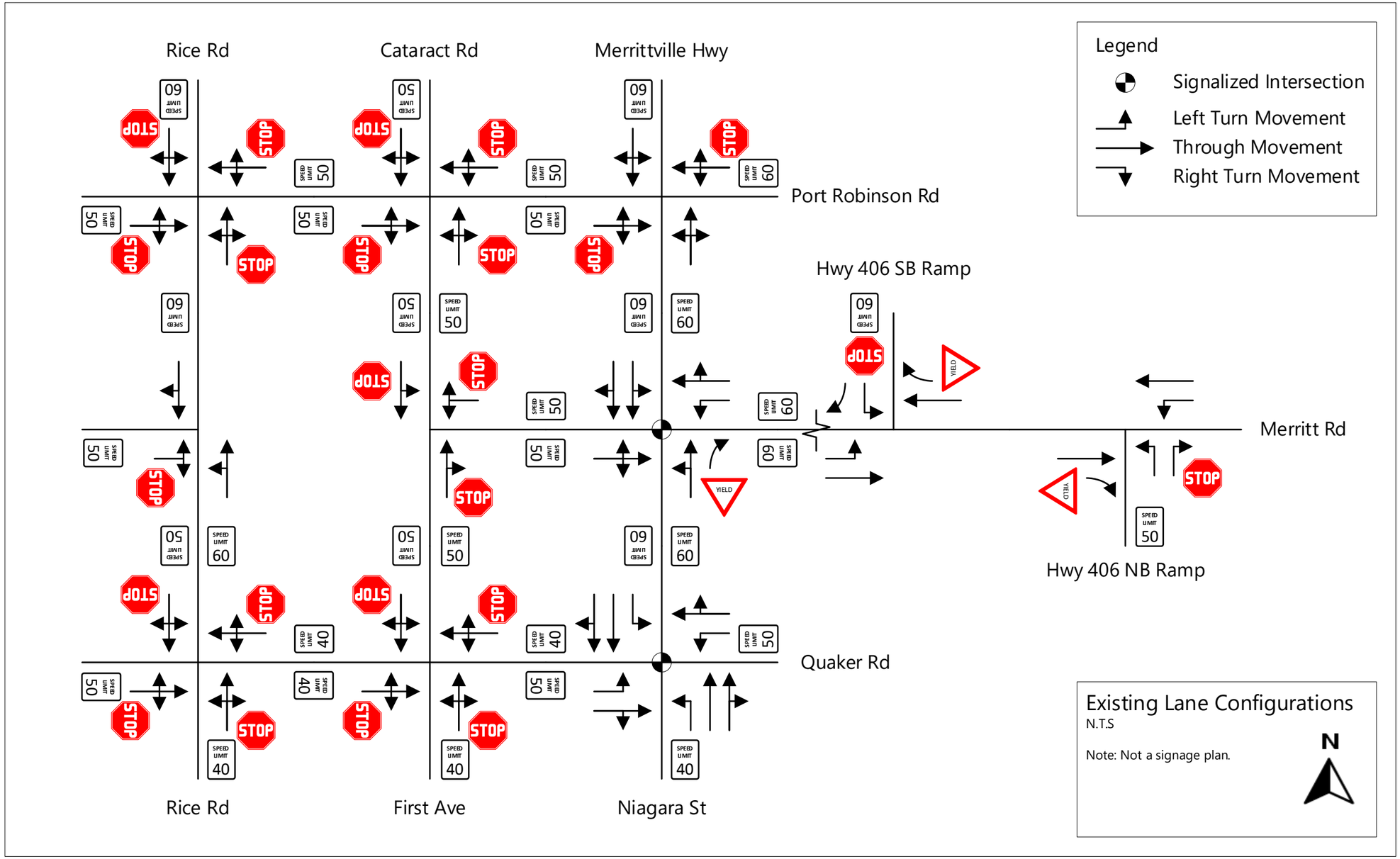


Figure 11: Existing (2020) Lane Configurations

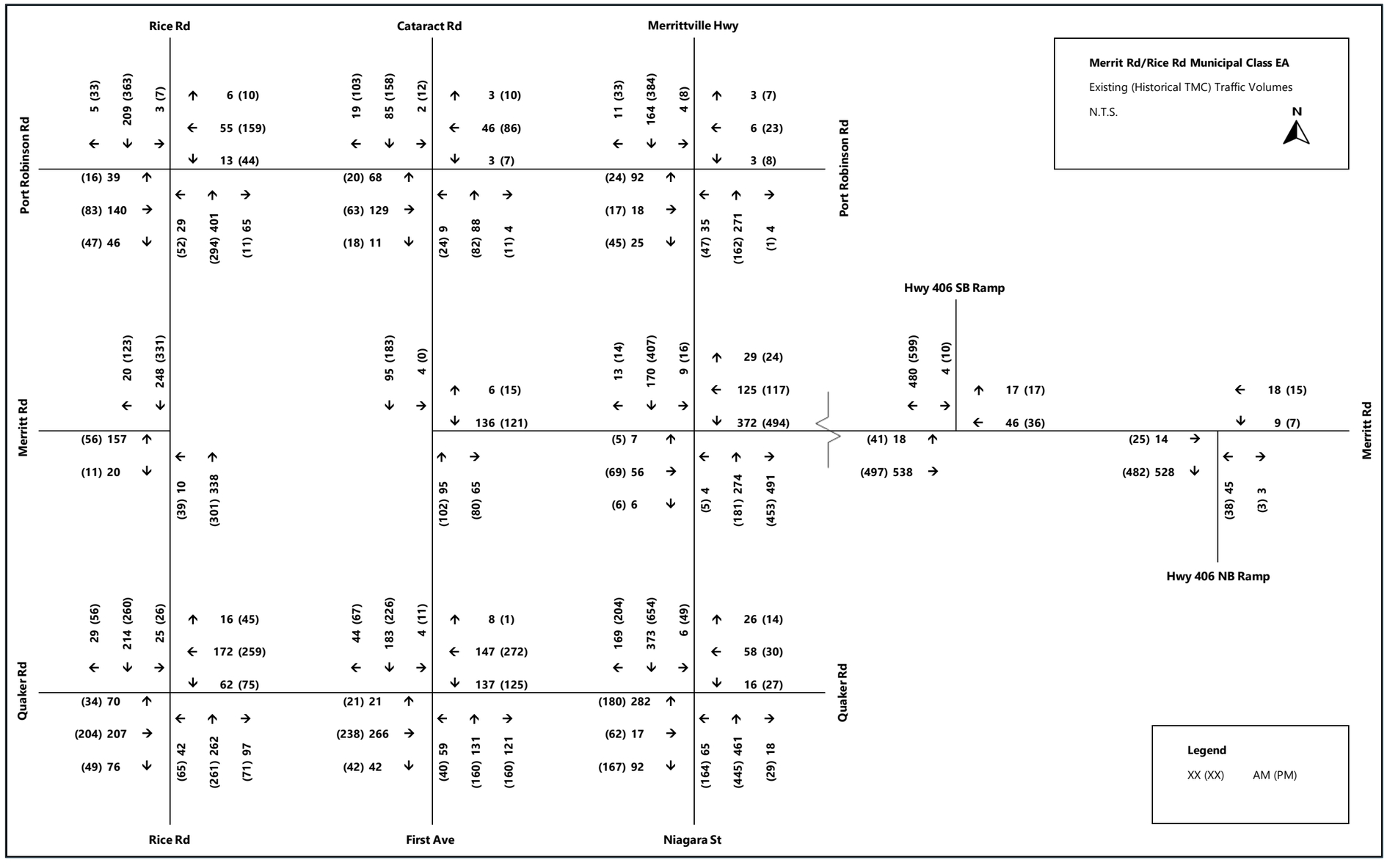


Figure 12: Existing (2020) Traffic Volumes

5.2 Existing (2020) Conditions Link Capacity Analysis

The link capacity analysis was undertaken with a methodology described in **Section 4.3**. The results summarized in **Table 5** and **Table 6** indicate that all the links operate well below capacity under existing conditions. The lane capacity for rural roads within the study area is assumed to be 850 vehicles per hour per lane, with the exception of the Merritt Road from Cataract Road to Merrittville Highway (i.e., Segment 2) due to its cross-section. This segement is a narrow road with speed humps and a lane capacity of 500 Vehicles per hour per lane.

The findings of the assessment indicated that under existing conditions, all links are operating well below capacity, with no volume to capacity ratios above the critical threshold of 0.85.

Table 5: Link Capacity Analysis – Existing (2020) AM Peak Hour

Segment	Direction	# Of Lanes	Total Capacity (Vehicle/Hour/lane)	Volume (Vehicle/Hour)	Volume to Capacity Ratio (V/C)
Merritt Road (East of Niagara Street/Merrittville Highway	EB	1	850	556	0.65
Merritt Road (East of Niagara Street/Merrittville Highway	WB	1	850	526	0.62
Merritt Road (East of Cataract Road)	EB	1	500	69	0.14
Merritt Road (East of Cataract Road)	WB	1	500	142	0.28
Rice Road (North of Quaker Road)	NB	1	850	348	0.41
Rice Road (North of Quaker Road)	SB	1	850	268	0.32
Rice Road (North of Merritt Road)	NB	1	850	495	0.58
Rice Road (North of Merritt Road)	SB	1	850	268	0.32

Table 6: Link Capacity Analysis – Existing (2020) PM Peak Hour

Segment	Direction	# Of Lanes	Total Capacity (Vehicle/Hour/lane)	Volume (Vehicle/Hour)	Volume to Capacity Ratio (V/C)
Merritt Road (East of Niagara Street/Merrittville Highway)	EB	1	850	538	0.63
Merritt Road (East of Niagara Street/Merrittville Highway)	WB	1	850	635	0.75
Merritt Road (East of Cataract Road)	EB	1	500	80	0.16
Merritt Road (East of Cataract Road)	WB	1	500	136	0.27
Rice Road (North of Quaker Road)	NB	1	850	340	0.40
Rice Road (North of Quaker Road)	SB	1	850	342	0.40
Rice Road (North of Merritt Road)	NB	1	850	357	0.42
Rice Road (North of Merritt Road)	SB	1	850	454	0.53

5.3 Existing (2020) Conditions Intersection Capacity Analysis

As summarized in **Table 7** and **Table 8**, the signalized intersections operate at an acceptable level of operations.

In addition, the ramp terminals of Highway 406 with Merritt Road operate acceptably with no volume to capacity ratios above MTO thresholds for critical movements.

For the unsignalized intersections shown in **Table 9** through **Table 17**, the northbound movements at Rice Road at Port Robinson Road, all movements at Rice Road at Quaker Road, and at Quaker Road at Cataract Road – First Avenue operate at LOS D or worse in the weekday morning and/or afternoon peak hours. The aforementioned critical movements are illustrated in **Figure 13.**

As noted in **Section 4.4**, the intersection at Merritville Highway at Port Robinson Road is modelled with a highly conservative PHF; the results should be interpreted as such.

Synchro reports are compiled in **Appendix D**.

Table 7: Existing 2020 Signalized Intersection Operations (Niagara Street/Merrittville Hwy and Merritt Road)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.22	22.7	C	18	0.26	21.9	C	18	832
WBL	0.63	15.8	B	55	0.70	15.2	B	#66	65
WBTR	0.27	11.0	B	22	0.20	8.2	A	17	1297
NBLT	0.54	19.7	B	49	0.44	20.7	C	34	1026
NBR	0.37	0.7	A	0	0.35	0.7	A	0	1026
SBLTR	0.21	13.6	B	15	0.57	20.3	C	35	1027
Overall	-	-	**B**	-	-	-	**B**	-	-

Notes

#: 95th percentile volume exceeds capacity, queue may be longer

Table 8: Existing 2020 Signalized Intersection Operations (Niagara Street and Quaker Road)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	0.61	25.0	C	#74	0.75	46.3	D	53	80
EBTR	0.17	6.0	A	12	0.58	18.2	B	36	825
WBL	0.04	15.4	B	6	0.16	27.3	C	11	30
WBTR	0.13	12.3	B	16	0.13	19.5	B	13	481
NBL	0.23	12.7	B	11	0.51	13.1	B	25	75
NBTR	0.48	18.9	B	44	0.35	13.6	B	42	404
SBL	0.02	10.3	B	2	0.12	7.6	A	9	65
SBTR	0.74	26.9	C	48	0.85	29.3	C	97	1026
Overall	-	-	**C**	-	-	-	**C**	-	-

Notes

#: 95th percentile volume exceeds capacity, queue may be longer

Table 9: Existing 2020 Unsignalized Intersection Operations (Merritt Rd and Hwy 406 SB Ramp)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	0.01	7.4	A	0	0.03	7.3	A	1	100
EBT	0.39	0	-	0	0.30	0	-	0	1297
WBT	0.03	0	-	0	0.02	0	-	0	340
WBR	0.01	0	-	0	0.01	0	-	0	210
SBL	0.58	13.4	B	29	0.60	13.6	B	14	574
SBR	-	-	-	-	-	-	-	-	150

Table 10: Existing 2020 Unsignalized Intersection Operations (Merrittville Hwy and Port Robinson Rd)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.46	22.4	C	18	0.23	16.7	C	7	834
WBLTR	0.04	15.0	B	1	0.13	17.9	C	3	681
NBLTR	0.04	1.2	A	1	0.05	2.2	A	1	1027
SBLTR	0	0.2	A	0	0.01	0.2	A	0	497

Table 11: Existing 2020 Unsignalized Intersection Operations (Cataract Rd and Port Robinson Rd)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.30	9.7	A	-	0.15	9.0	A	-	839
WBLTR	0.08	8.4	A	-	0.16	9.2	A	-	838
NBLTR	0.15	8.6	A	-	0.17	8.8	A	-	991
SBLTR	0.15	8.6	A	-	0.37	10.1	B	-	524

Table 12: Existing 2020 Unsignalized Intersection Operations (Cataract Rd and Merritt Rd)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
WBLR	0.20	8.9	A	-	0.20	9.2	A	-	832
NBTR	0.20	8.3	A	-	0.23	8.6	A	-	1030
SBLT	0.14	8.3	A	-	0.25	9.0	A	-	991

Table 13: Existing 2020 Unsignalized Intersection Operations (First Ave/Cataract Rd and Quaker Rd)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.77	31	D	-	0.88	51.0	F	-	822
WBLTR	0.71	27.2	D	-	1.15	123.4	F	-	825
NBLTR	0.73	27.7	D	-	0.99	71.0	F	-	402
SBLTR	0.57	20.5	C	-	0.87	49.5	E	-	1030

Table 14: Existing 2020 Unsignalized Intersection Operations (Rice Rd and Port Robinson Rd)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.42	13.6	B	-	0.28	12.4	B	-	431
WBLTR	0.15	11.0	B	-	0.41	14.3	B	-	839
NBLTR	0.79	25.8	D	-	0.63	18.7	C	-	1037
SBLTR	0.38	12.5	B	-	0.69	21.1	C	-	467

Table 15: Existing 2020 Unsignalized Intersection Operations (Rice Rd and Merritt Rd)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLR	0.49	21.8	C	20	0.25	20.0	C	7	435
NBLT	0.01	0.3	A	0	0.04	1.4	A	1	1037
SBTR	0.18	0	-	0	0.31	0.0	-	0	1037

Table 16: Existing 2020 Unsignalized Intersection Operations (Rice Rd and Quaker Rd)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.90	50.5	F	-	0.80	41.3	E	-	441
WBLTR	0.68	28.5	D	-	1.00	75.7	F	-	822
NBLTR	0.99	67.6	F	-	1.07	96.9	F	-	400
SBLTR	0.71	30.3	D	-	0.92	58.8	F	-	1037

Table 17: Existing 2020 Unsignalized Intersection Operations (Hwy 406 NB Ramp and Merritt Rd)

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBT	0.01	0	-	-	0.02	0.0	-	-	340
EBR	0.35	0	-	-	0.34	0.0	-	-	200
WBL	0.01	7.2	A	-	0.01	7.3	A	-	65
WBT	0.01	0	-	-	0.01	0.0	-	-	198
NBL	0.05	9	A	-	0.05	9.1	A	-	501
NBR	-	-	-	-	-	-	-	-	180

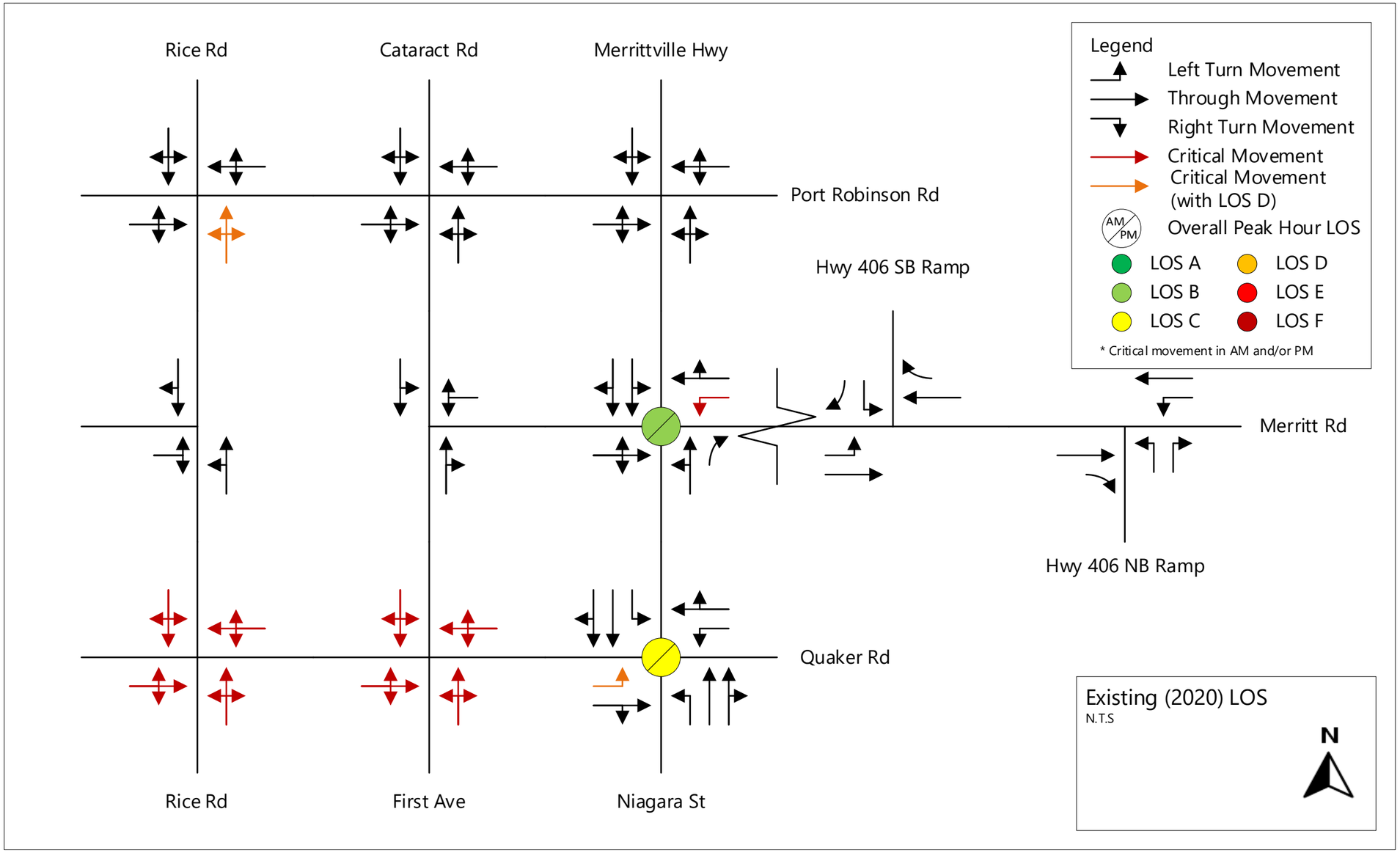


Figure 13: Existing 2020 Intersection Operation Conditions

6.0 Safety Analysis

This section documents a safety assessment completed to identify and mitigate potential safety-related concerns.

6.1 Methodology

The safety assessment consisted of an in-office review of historical collision data followed by a field investigation. The in-office review helped identify any patterns with respect to collision type, direction, severity, and other contributing factors. These collision analysis findings provide an understanding of the overall safety performance of the study corridor for intersections and midblock segments. A site visit was conducted to confirm road geometry (vertical and horizontal alignments), signage, delineation, pavement conditions, lighting and pedestrian/cycling facilities.

6.2 Collision Analysis

Based on the collision reporting data, there were 41 collisions between 2015 and late 2020 along Merritt Road and two collisions along Rice Road. Wood received the collision data set in December 2020, so the data set is not representative of the entire year. There were no fatal injuries during this time in this data set. The collision analysis was undertaken at the following four geographic locations:

- Merritt Road at Cataract Road,
- Merritt Road at Niagara Street,
- Merritt Road between Niagara Street/Merrittville Highway and Highway 406, and
- Rice Road at Merritt Road.

In **Section 6.3**, the findings of the collision analysis were compared to the field observations to identify potential mitigating measures. The location of the collisions is shown in in **Figure 14**.

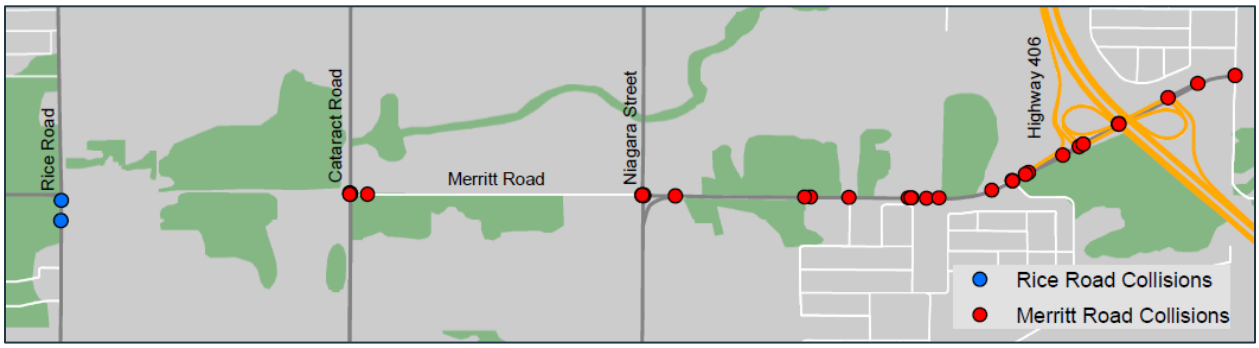


Figure 14: Location of Collisions on Rice Road and Merritt Road Based on Reported Collision Data

6.2.1 Merritt Road at Cataract Road

Seven (7) collisions were identified at the intersection of Merritt Road and Cataract Road. A summary of these collisions can be found in **Table 18**. No clear pattern of occurrence was noted in the collisions, with most of the collisions being only property damage.

Table 18: Summary of Collision Records at Merritt Road at Cataract Road

Year	Frequency
2017	2
2018	3
2019	1
2020 (partial)	1

Environment & Light	Frequency
Clear, Daylight	3
Clear, Dark	1
Snow, Daylight	1
Snow, Dusk	1
Snow, Dark	1

Classification	Frequency
P.D Only	6
Non-Fatal	1

Initial Impact	Frequency
Angle	3
Rear End	1
SMV Other	2
Other	1

Apparent Driver Action	Frequency
Driving Properly	3
Lost Control	1
Failing to Yield	1
Speed too fast	1
No Information	1

6.2.2 Merritt Road at Niagara Street/Merrittville Highway

There were ten (10) collisions identified at the Merritt Road at Niagara Street/Merrittville Highway intersection. A summary of these collisions can be found in **Table 19**.

No clear pattern of occurrence was noted with the collisions.

Table 19: Summary of Collision Records at Merritt Road at Niagara Street/Merrittville Highway

Year	Frequency
2015	2
2016	4
2018	1
2019	2
2020 (partial)	1

Environment & Light	Frequency
Clear, Daylight	5
Clear, Dark	2
Snow, Daylight	1
Strong wind, Daylight	1
Rain, Daylight	1

Classification	Frequency
P.D Only	2
Non-reportable	4
Non-Fatal	4

Initial Impact	Frequency
Angle	1
Turning movement	3
Rear End	1
SMV Other	4
Other	1

Apparent Driver Action	Frequency
Driving Properly	2
Lost Control	1
Failing to Yield	2
Improper Turn	1
Following Too Close	1
No Information	3

6.2.3 Merritt Road between Niagara Street/Merrittville Highway and Highway 406

There were 21 collisions identified along Merritt Road between Niagara Street and Highway 406. A summary of these collisions can be found in **Table 20**.

Table 20: Summary of Collisions at Merritt Road between Niagara Street and Highway 406

Year	Frequency
2015	5
2016	4
2017	4
2018	5
2019	1
2020 (partial)	2

Environment & Light	Frequency
Clear, Daylight	10
Clear, Dark	3
Clear, Dusk, Artificial	1
Clear, Dusk	1
Rain, Daylight	2
Rain, Dark, Artificial	2
Snow, Daylight	2

Classifi-cation	Frequency
P.D Only	12
Non-reportable	3
Non-Fatal	1
No Information	5

Initial Impact	Frequency
SMV Other/Unattended vehicle	12
Rear End	6
Angle	2
Sideswipe	1

Apparent Driver Action	Frequency
Driving Properly	8
Exceeding Speed limit/speed too fast	3
Lost Control	1
Failed to Yield	1
Other	1
No Information	7

The collisions were noted as primarily single-motor vehicle collisions, with low severity and primarily occurring during daylight hours. Six rear-end collisions were noted. Two of these rear-end collisions occurred before the installation of the median separating southbound traffic exiting Highway 406 onto westbound Merritt Road and westbound traffic on Merritt Road and may be attributable to conflicts between these vehicles.

No information was available about the cause of the single motor vehicle collisions. Given the forested areas on both sides of the roadway, it is likely that some of them involved animals. It is also possible that some collisions involved excessive speed, although this cannot be verified due to the lack of information on the driver's action leading up to the collision event.

6.2.4 Rice Road at Merritt Road

There were two collisions identified along Rice Road, both of which were close to Merritt Road. A summary of these collisions can be found below in **Table 21**. No discernable pattern of occurrence was noted.

Table 21: Summary of Collisions at Rice Road at Merritt Road

Year	Frequency
2015	1
2018	1

Environment & Light	Frequency
Clear, Dark	1
Clear, Dawn	1

Classification	Frequency
P.D Only	2

Initial Impact	Frequency
SMV Other	2

6.3 Field Investigation

A site visit was undertaken on February 21st, 2021, to evaluate existing conditions and future needs within the study area concerning road safety and active transportation. Conditions at the time of the site visit were dry and sunny. The following sections outline the findings.

6.3.1 Segment 1 - Merritt Road between Rice Road and Cataract Road

The first segment of Merritt Road is currently an unopened road allowance with a 20 .0 m right-of-way that passes through a forested area with wetlands, as shown in **Figure 15**. At either end of the unopened road allowance, there are currently two tee intersections at Merritt Road and Rice Road and Merritt Road and Cataract Road. Merritt Road and Rice Road is stop-controlled on the west approach (Merritt Road). Merritt Road and Cataract Road are stop-controlled on all approaches. When Merritt Road is opened to the travelling public, there will be a need for clearing and grubbing to provide adequate sight distance. With increased traffic on Merritt Road, the need for a change in traffic control at both intersections should be explored.

A set of utility poles is located along the north side of the road allowance. To maintain an adequate clear zone to these utility poles, the roadway alignment will need to be shifted to the south, or the set of utility poles will need to be relocated or removed altogether (i.e., replaced with underground utilities).

Dedicated active transportation facilities are recommended along this segment of Merritt Road. Active transportation between the utility poles and the travel lanes is a feasible way to address the clear zone issue.

Figure 15: Unopened Road Allowance Looking East from Rice Road

The preliminary recommendations based on the field investigations for this segment include the following:

- Investigate the need for change in traffic control at either end of Merritt Road (at intersections with Rice Road and Cataract Road),
- Clearing and grubbing of vegetation to improve intersection sight distance at east and west outlets,
- Review clear zone needs with respect to utility poles, and
- Consider a multi-use pathway on the north side of the roadway between the utility poles and the travel lanes.

6.3.2 Segment 2 - Merritt Road between Cataract Road and Merrittville Highway/Niagara Street

The second segment of Merritt Road is a two-lane road segment with a 20.0 m right of way, as shown in **Figure 16**. This section of Merritt Road has a dozen residential homes on the north side of the roadway near the west end, while the south side of the roadway is primarily vacant land that is forested. The cross-section is rural with narrow gravel shoulders and ditches. A set of utility poles is provided on the north side of the roadway (on the far side of the ditch) with an offset of approximately 4.0 meters from the edge of the westbound travel lane. The travel lane widths are roughly 2.7 meters, narrower than desirable for a Regional road. Localized clearing and grubbing should be done on the southeast corner of the intersection of Merritt Road and Cataract Road to improve sightlines.

The roadway is posted at 50 km/h. However, the Town of Thorold has installed speed humps at two locations (bracketing the residential development on the north) and posted an advisory speed of 40 km/h in the vicinity of the speed humps. Given this road's function as a Regional road, which provides a direct connection between Highway 406 and the Town of Pelham, it is recommended that the traffic calming be removed (in conjunction with the provision of active transportation facilities as discussed below). Trees growing on the south side of Merritt Road are located within the clear zone and represent a fixed object hazard.

No active transportation facilities are located along this segment of Merritt Road. Different active transportation options (sidewalk, bicycle lanes and/or a multi-use pathway) should be explored.

Figure 16: Merritt Road east of Cataract Road

As noted earlier, the intersection of Merritt Road and Cataract Road had seven collisions. No clear pattern was noted with the collisions. The preliminary recommendations based on the field investigations for this segment include the following:

- Widen travel lanes to meet Regional standards,
- Provide dedicated active transportation facilities,
- Remove speed humps,
- Clearing and grubbing of vegetation to improve intersection sight distance on the southeast corner of Merritt Road and Cataract Road, and
- Clearing and grubbing of vegetation on the south side of Merritt Road to meet clear zone standards.

6.3.3 Segment 3 - Merritt Road between Merrittville Highway/Niagara Street and Highway 406 interchange

The third segment of Merritt Road is a two-lane road segment with a 30.0 m right of way, as shown in **Figure 17**. This segment of Merritt Road begins at the signalized intersection of Merritt Road and Merrittville Highway/Niagara Street and continues east to the Highway 406 interchange. Land on the north side of the roadway is vacant with forested areas. Land on the south side of the roadway is a mixture of vacant lands with forested areas and a residential subdivision (Merritt Meadows).

Figure 17: Merritt Road east of Merrittville Highway/Niagara Street

The roadway has a rural cross-section with partially paved shoulders and ditches on both sides. The travel lanes are 3.5 meters in width with a 1.5-meter paved shoulder for cyclists. As traffic volumes increase in the future, there will be a need to investigate providing a buffer between cyclists and the adjacent travel lanes or a separate multi-use pathway that is entirely off the roadway. The roadway is posted at 60 km/h. Close to the Highway 406 interchange, a 1.0 m center raised median is provided to prevent left-turn movements from the N-W off-ramp from Highway 406. Southbound motorists wishing to turn left into Grisdale Road must use the N-E/W off-ramp, turn right and then turn left to access Grisdale Road. The paved shoulders continue across the Highway 406 overpass.

No facilities are provided for pedestrians. Further discussion is needed relating to the need to provide dedicated pedestrian facilities along this segment of Merritt Road in the context of future land-use changes.

Several intersections are noted along this segment of Merritt Road. Observations along these intersections were made along this segment of Merritt Road, as shown in **Table 22.**

Table 22: Segment 3 Site Visit Observations at Various Intersections

Roadway Intersection	Observations
Merritt Road and Merrittville Highway/Niagara Street	This intersection is signalized. To facilitate heavy south to east/east to south traffic flow (between Highway 406 and points south in the City of Welland), a westbound left-turn lane and a northbound channelized right-turn lane are provided. Sightlines are adequate on all approaches for all movements. No active transportation facilities are provided at this intersection. No pedestrian countdown timers, push buttons or crosswalks are provided.

Roadway Intersection	Observations
Merritt Road and Eastman Gateway	This is a stop-controlled intersection. Eastman Gateway leads into the Merritt Meadows subdivision. A westbound left-turn lane is provided. A flush median is provided on the eastbound approach, presumably for future access on the north side of Merritt Road.
Merritt Road and Grisdale Road	This is a stop-controlled intersection. The existing N-W Highway 406 off-ramp merges with Merritt Road west of the intersection of Merritt Road and Grisdale Road, therefore drivers currently exiting Highway 406 via this ramp are already past Grisdale Road when they merge and cannot turn left onto Grisdale Road.
Merritt Road west of Highway 406 west ramp terminal	Southbound traffic exiting Highway 406 via the direct merge onto westbound Merritt Road is likely travelling at higher than desirable speeds. Measures to reinforce a lower and more appropriate speed should be investigated.
Merritt Road and Highway 406 west ramp terminal	This is a stop-controlled intersection with a free-flow ramp for north-to-west movements (off-ramp) and a second free-flow ramp for east-to-south movements (on-ramp), both on the north side of Merritt Road. It would be more desirable to provide active transportation facilities on the south side of Merritt Road, crossing Highway 406.
Horizontal curve located just west of Grisdale Road	This is a stop-controlled intersection with a free-flow W-N on-ramp for Highway 406. While there is a requirement to cross a free-flow ramp, given the issues at the west ramp terminal, it is still considered desirable to provide active transportation facilities on the south side of Merritt Road only.

The preliminary recommendations based on the field investigations for this segment include the following:

- Install pedestrian countdown timers, push buttons or crosswalks at the signalized intersection (Merritt Road and Merrittville Highway/Niagara Street);
- Review the need to provide a dedicated cycling facility (with a buffer between the bicycle lane and the adjacent travel lanes) or a multi-use pathway (the south side is preferred given the two free-flow ramps on the north side of Merritt Road at Highway 406 interchange);
- Review possible enhancements to active transportation facilities across Highway 406 overpass on the south side only;
- Prohibit access on the north side of Merritt Road in the vicinity of the horizontal curve; and
- Investigate measures to reinforce a lower and more appropriate speed limit.

6.3.4 Segment 4 – Rice Road between Merritt Road and Quaker Road

The last segment is Rice Road between Merritt Road and Quaker Road, as shown in **Figure 18**. This is a two-lane road segment with a 20.0 m right of way between Quaker Road and Rosewood Crescent and a 23.0 m right of way between Rosewood Crescent and Merritt Road. Lands on the east and west side of the roadway are a mixture of residential development (Rosewood Crescent subdivision), some residential homes directly fronting Rice Road and some vacant lands.

Figure 18: Rice Road between Merritt Road and Quaker Road

The roadway has a rural cross-section with partially paved shoulders and ditches on both sides. The travel lanes are 3.5 meters in width with a 0.5-meter gravel shoulder for cyclists. Utility poles are provided on both the east and west sides of the roadway, beyond the ditch, at a distance of approximately 5.0 – 6.0 meters from the edge of the travel lane (outside the current clear zone). The roadway is posted at 50 km/h. No facilities are provided for pedestrians or cyclists, with the exception of a short section of sidewalk provided on the west side of Rice Road in conjunction with the Rosewood Crescent subdivision.

The preliminary recommendations based on the field investigations for this segment include the following:

- Explore different active transportation options (sidewalk, bicycle lanes and/or a multi-use pathway) to be implemented within this segment.

7.0 Future (2031) Assessment

To evaluate the impacts of constructing Merritt Road between Rice Road and Cataract Road, future conditions with no road network improvements and with the road construction and other road network improvements were analyzed. The analysis included separate traffic forecasts for the two network options, road link capacity analysis, traffic signal warrant analysis and intersection capacity analysis. The scenario with no improvements is referred to as Scenario 1 and the scenario with improvements is referred to as Scenario 2.

Under Scenario 1, the assessment for the 2031 horizon year was undertaken on the existing (2020 base year) road network, assuming that no improvements were implemented (i.e., no capacity improvements were undertaken, and Merritt Road was not extended to provide a connection between Cataract Road and Rice Road. This scenario was evaluated to determine how well the existing road network could accommodate the forecasted traffic volumes for 2031 horizon year and identify any deficiencies in the existing road network. Therefore, the road network and lane configurations are consistent with the existing conditions, as illustrated previously in **Figure 11**.

Under scenario 2, the assessment for the 2031 horizon year was undertaken on the modified road network, assuming the inclusion of the Merritt Road extension along Segment 1 and the implementation of signalized and unsignalized intersection control modifications, geometric improvements, and signalization where other network improvements would not suffice. To prioritize pedestrian and cyclist safety, it was agreed that the channelized right turns would be removed (at the intersection of Merritt Road / Merrittville Highway – Niagara Street) and replaced with a right turn lane at the stop bar. For the same reason, channelized right turn lanes were not considered for other intersections. For the unsignalized intersections with critical movements, geometric improvements such as adding left turn lanes were tested to address critical movements.

7.1 2031 Future Traffic Demand – Scenario 1

Traffic demand for this combination of horizon year and road network was calculated based on the method outlined in **Section 4.2** and described in detail in **Appendix C**. **Table 23** shows the specific annual growth rates applied for each road segment by direction of travel and time of day. The forecasted traffic volumes are illustrated in **Figure 19.**

Table 23: Annual Growth Rates (Existing to 2031) – Scenario 1

Segment	AM	PM
Eastbound		
Port Robinson Road	1.7%	2.1%
Merritt Road	1.5%	3.0%
Quaker Road	3.0%	3.0%
Westbound		
Port Robinson Road	3.0%	1.5%
Merritt Road	2.2%	3.0%
Quaker Road	1.9%	1.5%
Northbound		

Segment	AM	PM
Rice Road	3.2%	3.0%
Cataract Road	3.0%	1.5%
Niagara Street	2.2%	2.2%
Southbound		
Rice Road	1.5%	1.5%
Cataract Road	1.5%	1.9%
Niagara Street	1.5%	2.0%

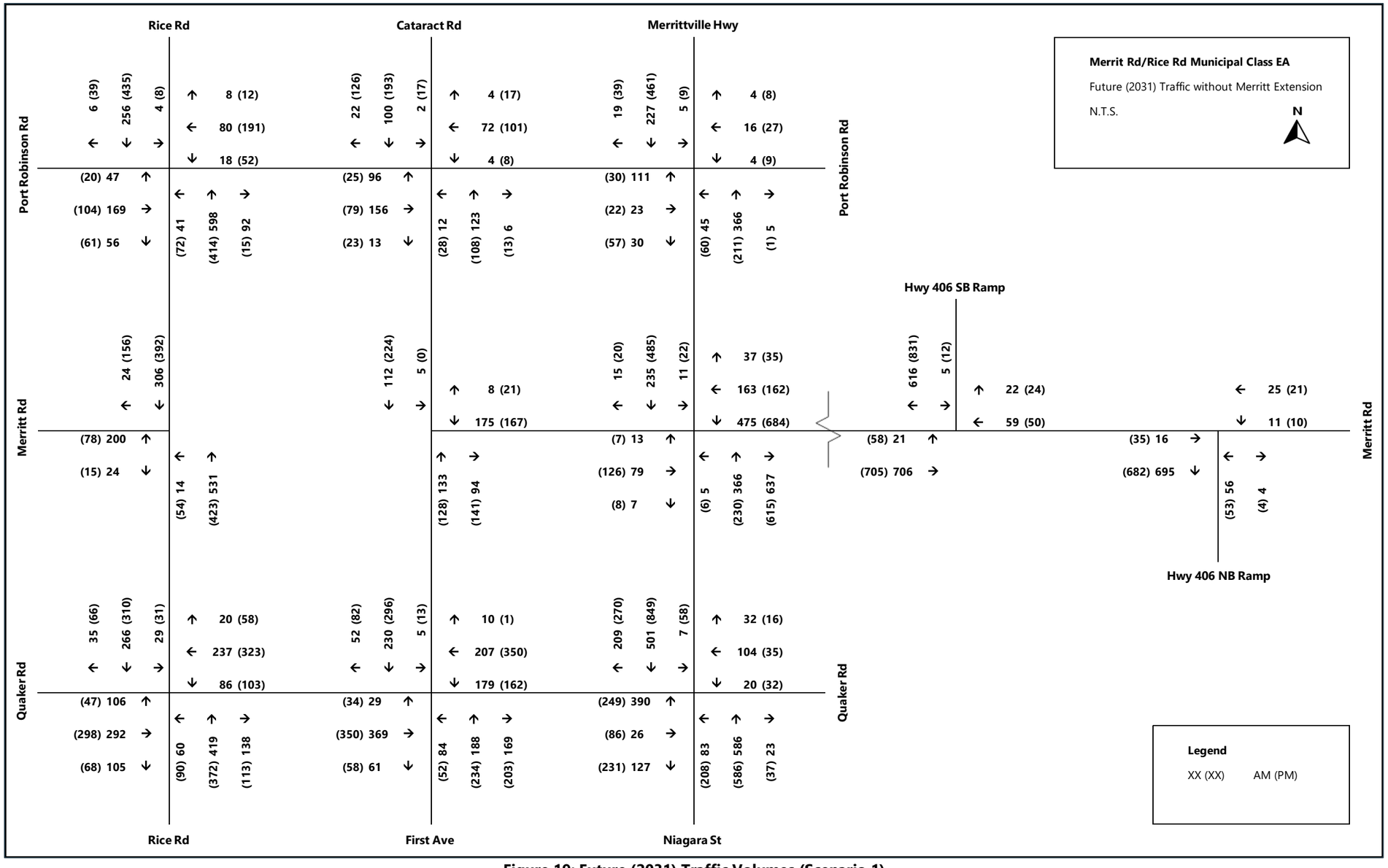


Figure 19: Future (2031) Traffic Volumes (Scenario 1)

7.1.1 2031 Conditions Link Capacity Analysis – Scenario 1

The future (2031) traffic volumes were forecasted, as discussed in **Section 7.1**.

The link capacity analysis was undertaken with the methodology described in **Section 4.3** for Scenario 1. The results summarized in **Table 24** and **Table 25** demonstrate that the following are expected to approach or exceed capacity by 2031.

- Merritt Road east of Niagara Street/Merrittville Highway in the eastbound direction during the weekday morning peak hour
- Rice Road north of Merritt Road in the northbound direction during the weekday morning peak hour
- Merritt Road east of Niagara Street/Merrittville Highway in the eastbound direction during the weekday afternoon peak hour
- Merritt Road east of Niagara Street/Merrittville Highway in the westbound direction during the weekday afternoon peak hour

Table 24: 2031 Link Capacity Analysis – Scenario 1 – AM Peak Hour

Segment	Direction	# Of Lanes	Total Capacity (Vehicle/Hour/lane)	Volume (Vehicle/Hour)	Volume to Capacity Ratio (V/C)
Merritt Road (East of Niagara Street/Merrittville Highway	EB	1	850	727	0.86
Merritt Road (East of Niagara Street/Merrittville Highway	WB	1	850	675	0.79
Merritt Road (East of Cataract Road)	EB	1	500	99	0.20
Merritt Road (East of Cataract Road)	WB	1	500	183	0.37
Rice Road (North of Quaker Road)	NB	1	850	545	0.64
Rice Road (North of Quaker Road)	SB	1	850	330	0.39
Rice Road (North of Merritt Road)	NB	1	850	731	0.86
Rice Road (North of Merritt Road)	SB	1	850	330	0.39

Table 25: 2031 Link Capacity Analysis – Scenario 1 – PM Peak Hour

Segment	Direction	# Of Lanes	Total Capacity (Vehicle/Hour/lane)	Volume (Vehicle/Hour)	Volume to Capacity Ratio (V/C)
Merritt Road (East of Niagara Street/Merrittville Highway	EB	1	850	763	0.90
Merritt Road (East of Niagara Street/Merrittville Highway	WB	1	850	881	1.04
Merritt Road (East of Cataract Road)	EB	1	500	141	0.28
Merritt Road (East of Cataract Road)	WB	1	500	188	0.38
Rice Road (North of Quaker Road)	NB	1	850	477	0.56
Rice Road (North of Quaker Road)	SB	1	850	407	0.48
Rice Road (North of Merritt Road)	NB	1	850	501	0.59
Rice Road (North of Merritt Road)	SB	1	850	548	0.64

7.1.2 2031 Conditions Intersection Analysis – Scenario 1

Signal Warrant Analysis:

For information purposes, a signal warrant analysis was conducted for the following four intersections as described in **Section 4.6**.

- Rice Road / Quaker Road,
- Rice Road / Port Robinsons Road,
- Merrittville Highway / Port Robinson Road, and
- Quaker Road / First Avenue – Cataract Road.

A signal was justified for all four intersections – the detailed calculation sheets are provided in **Appendix E**. This analysis is provided for information only, to identify intersections where traffic volumes meet traffic signal warrant conditions. Capacity analysis for those intersections was based on the existing (2020) traffic control.

Intersection Capacity Analysis:

The results of the traffic operations assessment in Synchro for signalized and unsignalized intersections are summarized in **Table 26** through **Table 36**.

For the signalized intersections,

- the westbound left movement on Niagara Street – Merrittville Highway at Merritt Road is a critical movement in the afternoon peak hour.
- At Niagara Street at Quaker Road, the eastbound left (in the AM) and southbound through-right movement (in the PM) are identified as critical movements.

For the unsignalized intersections,

- the eastbound movement at Merrittville Highway at Port Robinson Road is a critical movement in the AM. As noted in **Section 4.4**, this intersection is modelled with a highly conservative PHF; the results should be interpreted as such.
- All movements at First Avenue/Cataract Road at Quaker Road have volume to capacity ratios greatater than 1.00 during one or both peak hours, and LOS E or F during both peak hours
- The northbound approach to Rice Road at Port Robinson Road has a volume to capacity ratio greater than 1 during both peak hours and the southbound approach has a volume to capacity ratio of 1.00 during the PM peak hour; these are all incombination with LOS F
- All approaches to the intersection of Rice Road and Quaker Road have volume to capacity ratios grater than 1.00 during at least one peak hour and all are LOS F during both peak hours
- The eastbound approach at Rice Road at Merritt Road is critical with LOS F during the AM peak hour and LOS E during the PM peak hour.

For the MTO Highway 406 ramps,

- The southbound left turn movement from the Highway 406 Southbound Ramp to Merritt Road exceeds the MTO thresholds for ramp volume to capacity ratios, with a v/c of 0.76 in the AM peak hour and 0.85 in the PM peak hour.

Figure 20 illustratres the critical movements. Synchro reports are compiled in **Appendix F**.

Table 26: 2031 Signalized Intersection Operations – Scenario 1 – Niagara Street/Merrittville Hwy and Merritt Road

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.36	29.3	C	28	0.41	25.8	C	33	832
WBL	0.80	27.1	C	#128	1.08	77.3	E	#183	65
WBTR	0.32	14.0	B	36	0.28	10.2	B	28	1297
NBLT	0.68	24.6	C	72	0.51	22.4	C	46	1026
NBR	0.48	1.2	A	0	0.47	1.1	A	0	1026
SBLTR	0.27	15.0	B	21	0.63	21.9	C	47	1027
Overall	-	-	**B**	-	-	-	**C**	-	-

Notes

#: 95th percentile volume exceeds capacity, a queue may be longer

Table 27: 2031 Signalized Intersection Operations – Scenario 1 – Niagara Street and Quaker Road

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	1.05	87.9	F	#138	0.93	69.5	E	#89	80
EBTR	0.27	7.4	A	17	0.74	27.7	C	62	825
WBL	0.06	20.1	C	8	0.27	32.1	C	13	30
WBTR	0.24	18.9	B	30	0.14	19.6	B	14	481
NBL	0.29	11.0	B	12	0.74	32.2	C	49	75
NBTR	0.50	16.1	B	52	0.48	17.2	B	58	404
SBL	0.02	8.1	A	2	0.17	8.6	A	9	65
SBTR	0.79	26.7	C	65	1.05	68.0	E	161	1026
Overall	-		**C**	-	-	-	**D**	-	-

Notes

#: 95th percentile volume exceeds capacity, a queue may be longer

Table 28: 2031 Unsignalized Intersection Operations – Scenario 1 – Merritt Rd and Hwy 406 SB Ramp

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	0.02	7.4	A	0	0.04	7.4	A	1	100
EBT	0.51	0.0	-	0	0.43	0.0	-	0	1297
WBT	0.04	0.0	-	0	0.03	0.0	-	0	340
WBR	0.02	0.0	-	0	0.01	0.0	-	0	210
SBL	0.76	19.2	C	58	0.85	24.7	C	83	574
SBR	-	-	-	-	-	-	-	-	150

Table 29: 2031 Unsignalized Intersection Operations – Scenario 1 – Merrittville Hwy and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.85	66.0	F	52	0.38	23.3	C	13	834
WBLTR	0.12	20.7	C	3	0.20	23.5	C	6	681
NBLTR	0.05	1.4	A	1	0.06	2.4	A	2	1027
SBLTR	0.01	0.2	A	0	0.01	0.2	A	0	497

Table 30: 2031 Unsignalized Intersection Operations – Scenario 1 – Cataract Rd and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.4	11.2	B	-	0.21	9.9	A	-	839
WBLTR	0.13	9.0	A	-	0.21	10.1	B	-	838
NBLTR	0.22	9.6	A	-	0.23	9.7	A	-	991
SBLTR	0.19	9.3	A	-	0.49	12.2	B	-	524

Table 31: 2031 Unsignalized Intersection Operations – Scenario 1 – Cataract Rd and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	
WBLR	0.27	9.8	A	-	0.30	10.5	B	-	832
NBTR	0.30	9.3	A	-	0.36	10.0	A	-	1030
SBLT	0.17	8.8	A	-	0.33	10.2	B	-	991

Table 32: 2031 Unsignalized Intersection Operations – Scenario 1 – First Ave/Cataract Rd and Quaker Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	1.33	193.5	F	-	1.34	196.6	F	-	822
WBLTR	1.17	130.6	F	-	1.56	290.6	F	-	825
NBLTR	1.27	165.2	F	-	1.44	238.6	F	-	402
SBLTR	0.86	49.6	E	-	1.17	129.6	F	-	1030

Table 33: 2031 Unsignalized Intersection Operations – Scenario 1 – Rice Rd and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.56	18.2	C	-	0.45	18.0	C	-	431
WBLTR	0.24	13.0	B	-	0.60	22.8	C	-	839
NBLTR	1.31	172.5	F	-	1.05	81.8	F	-	1037
SBLTR	0.52	16.6	C	-	1.00	67.5	F	-	467

Table 34: 2031 Unsignalized Intersection Operations – Scenario 1 – Rice Rd and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLR	0.93	78.3	F	67	0.50	37.1	E	19	435
NBLT	0.01	0.4	A	0	0.07	1.8	A	2	1037
SBTR	0.23	0.0	-	0	0.38	0.0	-	0	1037

Table 35: 2031 Unsignalized Intersection Operations – Scenario 1 – Rice Rd and Quaker Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	1.48	254.5	F	-	1.18	135.1	F	-	441
WBLTR	1.01	82.1	F	-	1.38	213.4	F	-	822
NBLTR	1.80	393.0	F	-	1.64	323.1	F	-	400
SBLTR	0.98	72.3	F	-	1.16	126.7	F	-	1037

Table 36: 2031 Unsignalized Intersection Operations – Scenario 1 – Hwy 406 NB Ramp and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBT	0.01	0.0	-	0	0.02	0.0	-	0	340
EBR	0.46	0.0	-	0	0.48	0.0	-	0	200
WBL	0.01	7.3	A	0	0.01	7.3	A	0	65
WBT	0.02	0.0	-	0	0.01	0.0	-	0	198
NBL	0.07	9.1	A	2	0.07	9.4	A	2	501
NBR	-	-	-	-	-	-	-	-	180

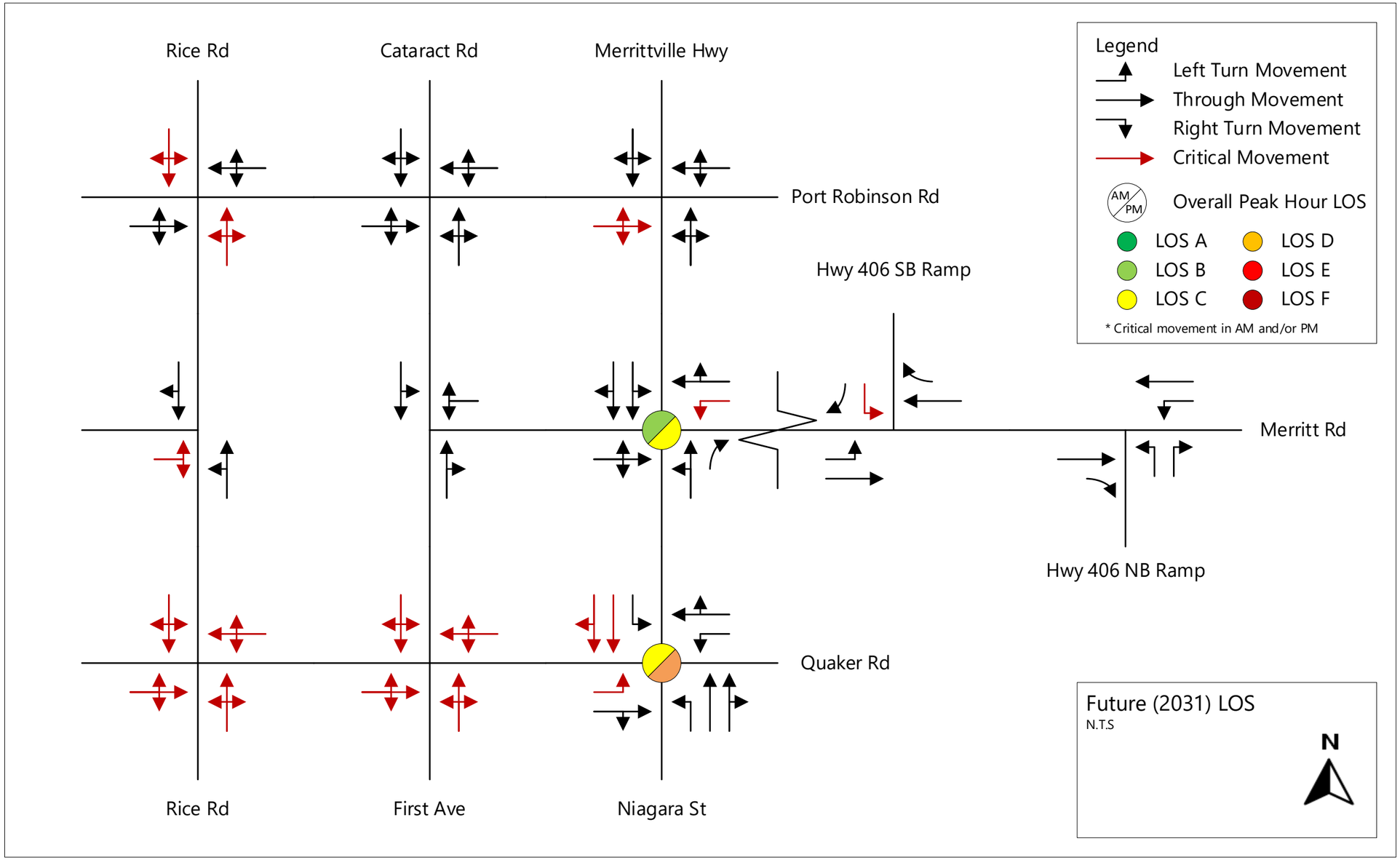


Figure 20: 2031 Intersection Operation Conditions – Scenario 1

7.2 2031 Future Traffic Demand – Scenario 2

With the inclusion of the Merritt Road extension between Rice Road and Cataract Road, there will be a noticable increase in traffic along Merritt Road from Cataract Road to Merrittville Highway/Niagara Street. There will be a corresponding decrease in traffic along Quaker Road and Niagara Street (compared to Scenario 1).

Travel patterns indicate that most eastbound and westbound traffic along Merritt Road is associated with trips to and from Highway 406. Without the proposed Merritt Road extension, eastbound traffic accessing Highway 406 originating from areas west in the Town of Pelham must travel on Rice Road north to Highway 20 or south via Quaker Road and Niagara Street. Similarly, traffic moving westbound from Highway 406 would use either Highway 20/Rice Road or Niagara Street/Quaker Road to access areas west in the Town of Pelham. The Merritt Road extension offers more direct access, alleviating congestion associated with the above longer routes.

As described in detail in **Appendix C**, diversion analysis was conducted whereby link traffic volumes from the Scenario 1 2031 year assignment were compared with the traffic assignments from the Region's model and adjustments made to reflect forecast traffic demand for the Scenario 2 road network.

The forecasted traffic volumes are illustrated in **Figure 21.**

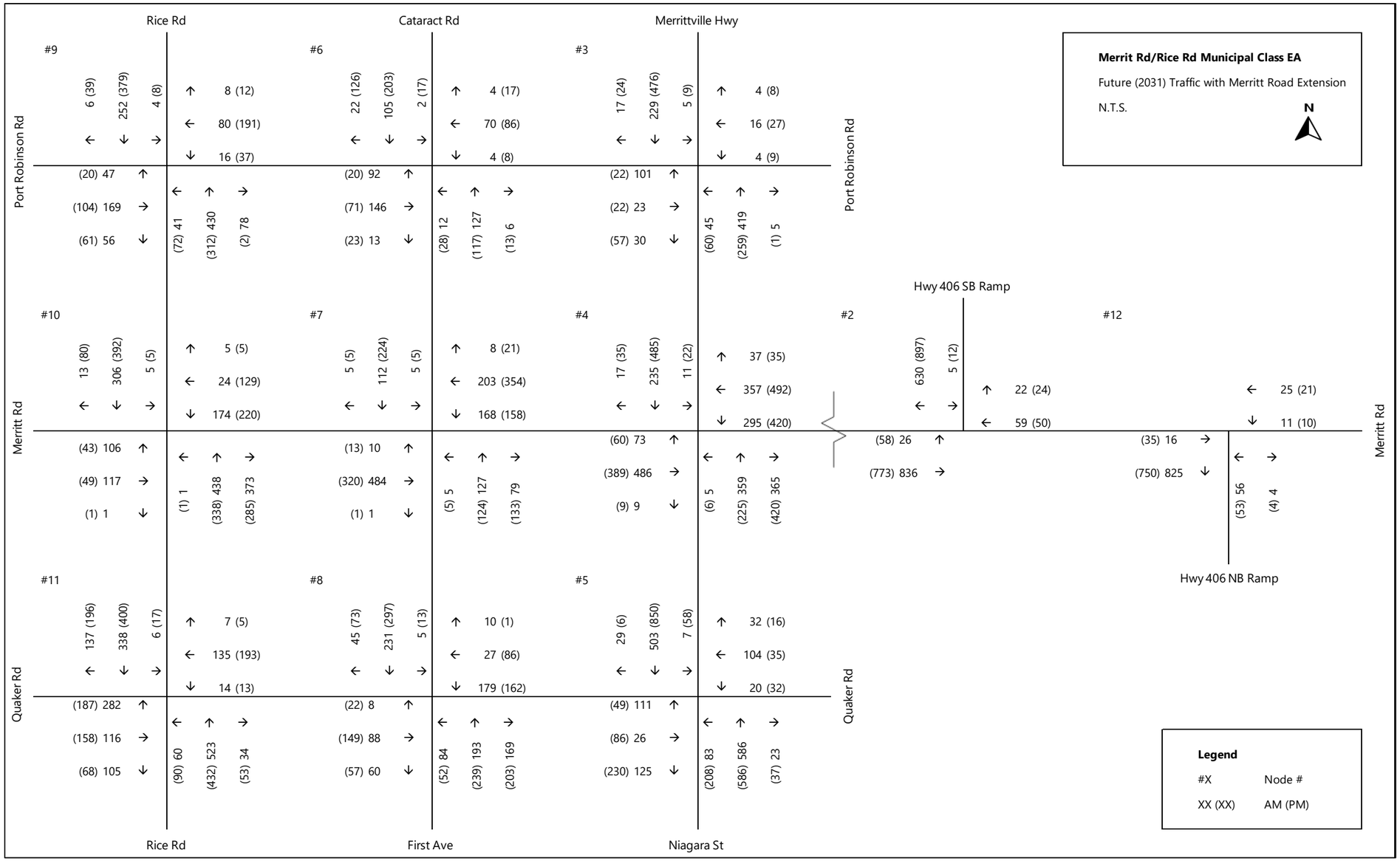


Figure 21: Future (2031) Traffic Volumes (Scenario 2)

7.2.1 2031 Conditions Link Capacity Analysis – Scenario 2

The future (2031) traffic volumes were forecasted as discussed in **Section 4.2** and **Section 8.1**.

The link capacity analysis was undertaken with the methodology described in **Section 4.3**. The results summarized in **Table 37** and **Table 38** demonstrate that with the proposed right of way and geometric improvements, with the widening of Merritt Road to a four-lane cross-section between Merrittville Highway/Niagara Street and the Highway 406 interchange, none of the study area segments will have traffic exceeding capacity by 2031. However, Rice Road between Quaker Road and Merritt Road will approach capacityfor northbound movements in the AM peak hour and PM peak hour.

Table 37: 2031 Link Capacity Analysis – Scenario 2 – AM Peak Hour

Segment	Direction	Lane Capacity	# Of Lanes	Total Capacity (Vehicle/Hour/lane)	Volume (Vehicle/Hour)	Volume to Capacity Ratio (V/C)
Merritt Road (East of Niagara Street/Merrittville Highway)	EB	850	2	1700	862	0.51
Merritt Road (East of Niagara Street/Merrittville Highway)	WB	850	2	1700	689	0.41
Merritt Road (East of Cataract Road)	EB	850	1	850	568	0.67
Merritt Road (East of Cataract Road)	WB	850	1	850	379	0.45
Rice Road (North of Quaker Road)	NB	850	1	850	812	0.96
Rice Road (North of Quaker Road)	SB	850	1	850	481	0.57
Rice Road (North of Merritt Road)	NB	850	1	850	549	0.65
Rice Road (North of Merritt Road)	SB	850	1	850	324	0.38

Table 38: 2031 Link Capacity Analysis – Scenario 2 – PM Peak Hour

Segment	Direction	Lane Capacity	# Of Lanes	Total Capacity (Vehicle/Hour/lane)	Volume (Vehicle/Hour)	Volume to Capacity Ratio (V/C)
Merritt Road (East of Niagara Street/Merrittville Highway	EB	850	2	1700	1097	0.65
Merritt Road (East of Niagara Street/Merrittville Highway	WB	850	2	1700	1188	0.70
Merritt Road (East of Cataract Road)	EB	850	1	850	549	0.65
Merritt Road (East of Cataract Road)	WB	850	1	850	641	0.75
Rice Road (North of Quaker Road)	NB	850	1	850	722	0.85
Rice Road (North of Quaker Road)	SB	850	1	850	707	0.83
Rice Road (North of Merritt Road)	NB	850	1	850	469	0.55
Rice Road (North of Merritt Road)	SB	850	1	850	566	0.67

7.2.2 2031 Conditions Intersection Analysis – Scenario 2

Signal Warrant Analysis:

Signal warrant analysis was conducted for the following five unsignalized intersections as described in **Section 4.6**:

- Rice Road and Quaker Road,
- Rice Road and Merritt Road,
- Merritt Road and Cataract Road,
- Merrittville Highway and Port Robinson Road, and
- Quaker Road and First Avenue/Cataract Road

A signal was justified for all the five intersections – the detailed calculation sheets are provided in **Appendix G**.

As an alternative to installing signals at each of these intersections, lane configuration changes were tested in conjunction with the existing all-way or two-way stop control to determine whether acceptable or tolerable peak hour operation could be achieved without traffic signals. Operation was considered tolerable if only a single movement was critical and/or the volume to capacity ratio remained at or below 1.00.

Roundabout operation (as an alternative to traffic signals) was considered at the intersection of Rice Road and Quaker Road, Rice Road and Merritt Road, Cataract Road and Merritt Road, and Merritt Road and Merrittville Highway / Niagara Street in a separate report (*Evaluation of Alternative Designs: Schedule 'C' Municipal Class Environmental Assessment for Regional Road 37 (Merritt Road) and Regional Road 54 (Rice Road) in the Town of Pelham, City of Thorold and City of Welland, Ontario*).

Based on the evaluation in that report, roundabouts were not considered to be suitable for these intersections given the following:

- Significant property impacts as a result of the need to accommodate active transportation around the circulatory roadway;
- Proximity to nearby driveways;
- Inconsistency with adjacent intersections (which are signalized); and
- Higher construction costs.

Based on the analysis, only the following intersections were assumed to be signalized in 2031:

- Rice Road / Quaker Road;
- Rice Road / Merritt Road; and
- Rice Road / Port Robinson Road.

Lane Configurations:

Future (2031) lane configurations and right-of-way for midblock locations were decided based not only on the results of the 2031 intersection and link capacity analyses but also on the 2041 analyses to accommodate staging.

Following are the notes on the modifications to the future (2031) study area road network, made based on the results of link capacity analyses, intersection capacity analyses, and consultation with the Region/MTO:

Highway 406 SB off-ramp at Merritt Road

- For 2031 conditions, the existing lane configuration and traffic control were retained for the 2031 analysis under Scenario 2. Note that implementation of geometric changes and signalization of this ramp terminal intersection in 2031 would facilitate the transition of Merritt Road improvements east of Niagara Street and Merrittville Highway and the construction of the multi-use path east of Grisdale Road, therefore it may be desirable to consider those improvements in 2031.

Merritt Road between Merrittville Highway/Niagara Street and the Highway 406 interchange

- Merritt Road was widened between Merrittville Highway/Niagara Street and the Highway 406 interchange to four travel lanes (two in each direction) to meet future demand (**Section 7.1**)

Merrittville Hwy/Niagara Street at Merritt Road

- Currently signalized;
- The second westbound through lane will carry through the intersection and terminate on the departing leg;
- The second eastbound through lane was introduced on the west approach;
- A dedicated eastbound left-turn lane was added to relieve noted congestion;
- For this horizon, the southbound approach retained a shared right-turn and through lane and a shared left-turn and through lane; and
- The northbound right channelized lane was converted to a regular right turn lane.

Merritt Road at Cataract Road

- Currently under all-way Stop control; and
- Add westbound left turn lane to reduce delay for this high-volume movement and an eastbound left turn lane for good geometric design with aligned left turn lanes.

Merritt Road between Rice Road and Merrittville Hwy/Niagara Street

- Two travel lanes on the newly opened segment of Merritt Road between Rice Road and Cataract Road (**Section 7.1**).

Rice Road between Quaker Road and Merritt Road

- Rice Road between Quaker Road and Merritt Road remains at two travel lanes (**Section 7.1**). However, consideration will be given to implementing active transportation more immediately.

Rice Road at Merritt Road

- Currently, stop-controlled on Merritt Road;
- Rice Road widened to two lanes in each direction through the intersection. Note that sensitivity testing of only adding left turn lanes northbound and southbound, and not also widening with the second through lane in each direction, was done for this future horizon. It was found that operation without the widening would be very similar to operation with the widening, indicating that deferral of this improvement beyond 2031 would not negatively affect operation.
- Rice Road and Merritt Road meet the warranting conditions for a traffic signal in 2031;
- No geometric improvements could be identified that would continue to accommodate unsignalized operation without critical movements; and

- Signalize intersection and add dedicated left-turn lanes on all approaches per the Niagara Region's policy for signalized intersections.

Rice Road at Quaker Road

- Currently, all-way Stop controlled;
- Rice Road and Quaker Road meet the warranting conditions for a traffic signal in 2031;
- Rice Road widened to two lanes in each direction through the intersection. Note that sensitivity testing of only adding left turn lanes northbound and southbound, and not also widening with the second through lane in each direction, was done for this future horizon. It was found that operation without the widening would be very similar to operation with the widening, indicating that deferral of this improvement beyond 2031 would not negatively affect operation.;
- No geometric improvements could be identified that would continue to permit unsignalized operation; and
- Signalize intersection and add dedicated left-turn lanes on all approaches.

First Avenue/Cataract Road and Quaker Road

- Currently all-way stop controlled
- Signal warrant met for 2031
- Northbound right turn lane improves operation and only minor problems remain.

No changes are recommended at any of the remaining intersections. The road network, lane configurations, and intersection controls are illustrated in **Figure 22.**

Intersection Capacity Analysis:

The results of the traffic operations assessment in Synchro for signalized and unsignalized intersections are summarized in **Table 39** through **Table 49.**

Figure 23 illustrates the critical movements.

Synchro reports are compiled in **Appendix H**.

For the signalized intersections;

- At Niagara Street/Merrittville Highway and Merritt Road, with the widening of Merritt Road and conversion of the northbound channelized right turn lane to a right turn lane at the stop bar, the westbound left movement is expected to have minor queueing problems during the PM peak hour, with 64 meters of available storage and an 81 meter long 95th percentile queue. A minor intersection improvement to increase the available storage length could mitigate this issue;
- At Niagara Street and Quaker Road, the westbound left turn is expected to have a minor delay problem in the PM peak hour, with LOS D;
- At the intersection of Rice Road and Port Robinson Road, the eastbound approach is expected to have LOS D during the AM peak hour and the westbound approach is expected to have LOS D during the PM peak hour;
- At the intersection of Merritt Road and Rice Road, the westbound left turn is expected to have minor delays with a LOS D during the AM peak hour and during the PM peak hour;
- At Rice Road and Quaker Road, the westbound left turn is expected to have minor delays during the AM peak hour, with LOS D.

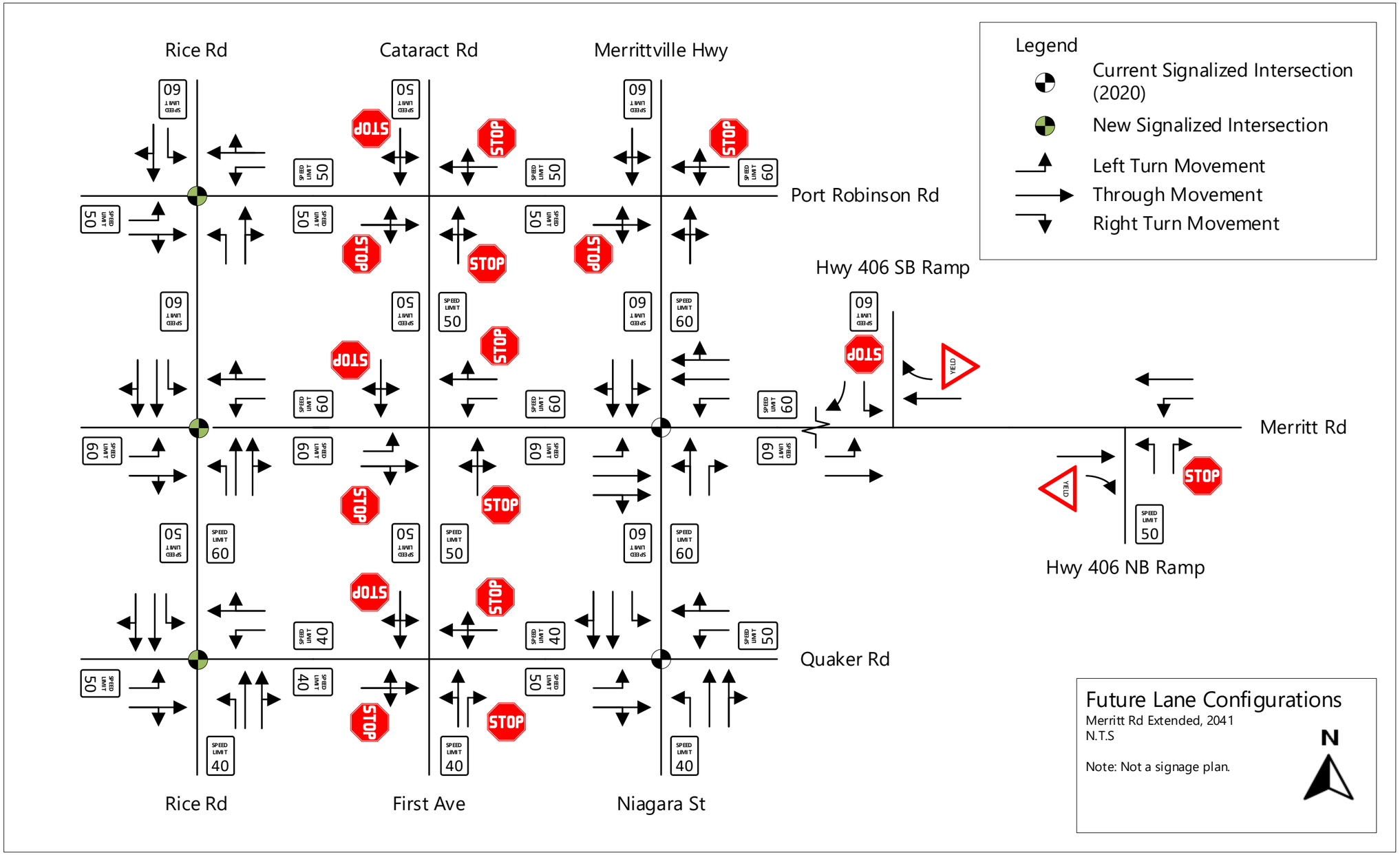


Figure 22: Future (2031) Intersection Operation Conditions (Scenario 2)

For the unsignalized intersections;

- At Merrittville Highway and Port Robinson Road, the eastbound left-through-right movement is critical in the AM peak hour with a volume to capacity ratio of 0.87 (LOS F). As noted in **Section 4.4**, this intersection is modelled with a highly conservative PHF; in future, the PHF may be higher, resulting in a better volume to capacity ratio and LOS. The westbound approach is expected to experience minor delays during the PM peak hour with LOS D;
- No issues were identified at the intersection of Cataract Road and Port Robinson Road;
- Cataract Road and Merritt Road satisfies the warrant for a signal in 2031, however the addition of a westbound left turn lane and retention of the all-way stop control was tested to determine whether deferral of traffic signal control would result in tolerable operation. With this improvement, minor problems are expected with a volume to capacity ratio of 0.96 and LOS F during the AM peak hour and a volume to capacity ratio of 0.86 and average delay of 40.2 seconds per vehicle for the westbound left turn in the PM peak hour. In addition, the eastbound through and right and westbound left are expected to have LOS D in the PM peak hour. These are relatively minor operating problems that could be accepted as an interim operation.
- First Avenue and Quaker Road is also expected to satisfy a traffic signal warrant in 2031. With the existing all-way stop control and addition of a northbound right turn lane, minor operating problems including LOS D for the westbound approach during the PM peak hour and a volume to capacity ratio of 0.92 and LOS F for the southbound approach, also in the PM peak hour, are expected. These are relatively minor problems that could be tolerated for an interim period.

For the MTO Highway 406 ramps,

- At Merritt Road and Highway 406 southbound ramp, the southbound left-right movement is critical based on MTO criteria in the AM peak hour with the volume to capacity ration of 0.78 and in the PM peak hour with a v/c ratio of 0.92 and LOS D;
- No issues were identified at the Merritt Road and Highway 406 Northbound Ramp.

Table 39: 2031 Signalized Intersection Operations – Scenario 2 – Niagara Street/Merrittville Hwy and Merritt Road

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	0.37	33.5	C	25	0.36	32.1	C	21	90
EBTR	0.67	32.8	C	61	0.56	28.3	C	47	150
WBL	0.70	24.4	C	#61	0.74	20.7	C	#81	65
WBTR	0.29	14.2	B	34	0.34	11.2	B	40	1297
NBLT	0.67	26.4	C	74	0.52	25.3	C	49	1026
NBR	0.50	4.4	A	15	0.62	6.2	A	18	1026
SBLTR	0.27	16.7	B	23	0.67	26.0	C	53	1027
Overall	-	-	**C**	-	-	-	**B**	-	-

Notes

#: 95th percentile volume exceeds capacity, a queue may be longer

Table 40: 2031 Signalized Intersection Operations – Scenario 2 – Niagara Street and Quaker Road

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	0.45	24.6	C	26	0.22	27.6	C	17	80
EBTR	0.35	8.6	A	15	0.82	33.5	C	62	825
WBL	0.08	18.7	B	7	0.35	36.2	D	13	30
WBTR	0.35	18.9	B	26	0.16	19.8	B	14	481
NBL	0.20	6.6	A	9	0.62	18.4	B	38	75
NBTR	0.50	11.9	B	45	0.48	15.8	B	58	404
SBL	0.02	5.7	A	2	0.16	7.8	A	9	65
SBT-TR	0.58	17.6	B	43	0.84	29.8	C	99	1026
Overall	-	-	**B**	-	-	-	**C**	-	-

Table 41: 2031 Signalized Intersection Operations – Scenario 2 – Rice Rd and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	0.22	29.7	C	15	0.14	30.4	C	9	30
EBTR	0.75	44.6	D	55	0.55	31.5	C	37	431
WBL	0.13	28.8	C	7	0.21	32.0	C	13	30
WBTR	0.30	29.1	C	24	0.70	45.5	D	52	839
NBL	0.08	8.2	A	8	0.14	7.6	A	12	30
NBTR	0.52	11.8	B	88	0.30	8.1	A	42	887
SBL	0.01	8.0	A	2	0.01	6.9	A	2	30
SBTR	0.26	8.6	A	38	0.40	8.9	A	59	467
Overall	-	-	**B**	-	-	-	**B**	-	-

Table 42: 2031 Signalized Intersection Operations – Scenario 2 – Rice Rd and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	0.44	31.2	C	27	0.18	23.2	C	12	41
EBTR	0.34	27.6	C	28	0.13	21.6	C	13	435
WBL	0.74	46.5	D	44	0.77	44.7	D	53	80
WBTR	0.08	20.1	C	9	0.34	25.5	C	29	824
NBL	0.00	9.0	A	1	0.00	11.0	B	1	80
NBTR	0.48	7.1	A	41	0.38	6.5	A	29	1037
SBL	0.02	10.0	A	m2	0.01	10.6	B	m1	50.5
SBTR	0.20	10.1	B	31	0.31	11.8	B	44	1037
Overall	-	-	**B**	-	-	-	**B**	-	-

Notes

m: Volume for the 95th percentile queue is metered by an upstream signal

Table 43: 2031 Signalized Intersection Operations – Scenario 2 – Rice Rd and Quaker Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	0.64	22.3	C	48	0.86	60.7	E	50	90
EBTR	0.34	10.4	B	27	0.55	27.7	C	44	441
WBL	0.10	31.6	C	8	0.07	20.6	C	5	40
WBTR	0.63	45.7	D	42	0.48	29.1	C	42	822
NBL	0.25	21.9	C	19	0.24	11.9	B	20	90
NBTR	0.45	19.9	B	60	0.27	9.0	A	37	400
SBL	0.03	18.2	B	4	0.04	9.8	A	5	70
SBTR	0.40	16.7	B	46	0.34	8.0	A	40	1037
Overall	-	-	**C**	-	-	-	**B**	-	-

Table 44: 2031 Unsignalized Intersection Operations – Scenario 2 – Merritt Rd and Hwy 406 SB Ramp

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	0.02	7.4	A	1	0.04	7.4	A	1	1297
EBT	0.60	0.0	-	0	0.47	0.0	-	0	1297
WBT	0.04	0.0	-	0	0.03	0.0	-	0	340
WBR	0.02	0.0	-	0	0.01	0.0	-	0	210
SBL	0.78	20.1	C	62	0.92	32.2	D	108	574/150
SBR	-	-	-	-	-	-	-	-	150

Table 45: 2031 Unsignalized Intersection Operations – Scenario 2 – Merrittville Hwy and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.87	76.0	F	54	0.36	23.3	C	12	838
WBLTR	0.13	22.6	C	3	0.22	25.5	D	6	681
NBLTR	0.05	1.4	A	1	0.06	2.2	A	2	1027
SBLTR	0.01	0.2	A	0	0.01	0.2	A	0	497

Table 46: 2031 Unsignalized Intersection Operations – Scenario 2 – Cataract Rd and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.38	10.9	B	-	0.19	9.7	A	-	839
WBLTR	0.12	9.0	A	-	0.19	9.9	A	-	838
NBLTR	0.22	9.5	A	-	0.24	9.7	A	-	991
SBLTR	0.20	9.3	A	-	0.49	12.2	B	-	524

Table 47: 2031 Unsignalized Intersection Operations – Scenario 2 – Cataract Rd and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBL	0.02	9.1	F	-	0.03	10.5	D	-	30
EBTR	0.96	54.2	F	-	0.77	31.6	D	-	824
WBL	0.37	13.5	B	-	0.39	15.1	D	-	30
WBTR	0.44	13.8	B	-	0.86	40.7	D	-	681
NBLTR	0.44	15.0	C	-	0.59	20.8	C	-	1030
SBLTR	0.27	13.2	B	-	0.55	20.2	C	-	991

Table 48: 2031 Unsignalized Intersection Operations – Scenario 2 – First Ave/Cataract Rd and Quaker Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBLTR	0.34	13.2	B	-	0.60	23.2	C	-	822
WBLTR	0.47	16.1	C	-	0.66	26.4	D	-	825
NBLT	0.60	18.3	C	-	0.75	31.0	C	-	402
NBR	0.32	10.5	-	-	0.47	15.7	-	-	20
SBLTR	0.57	17.4	C	-	0.92	52.2	F	-	1030

Table 49: 2031 Unsignalized Intersection Operations – Scenario 2 – Hwy 406 NB Ramp and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meters)	
EBT	0.01	0.0	-	0	0.02	0.0	-	0	340
EBR	0.55	0.0	-	0	0.53	0.0	-	0	200
WBL	0.01	7.3	A	0	0.01	7.3	A	0	65
WBT	0.02	0.0	-	0	0.01	0.0	-	0	198
NBLR	0.07	9.1	A	2	0.07	9.4	A	2	501/180

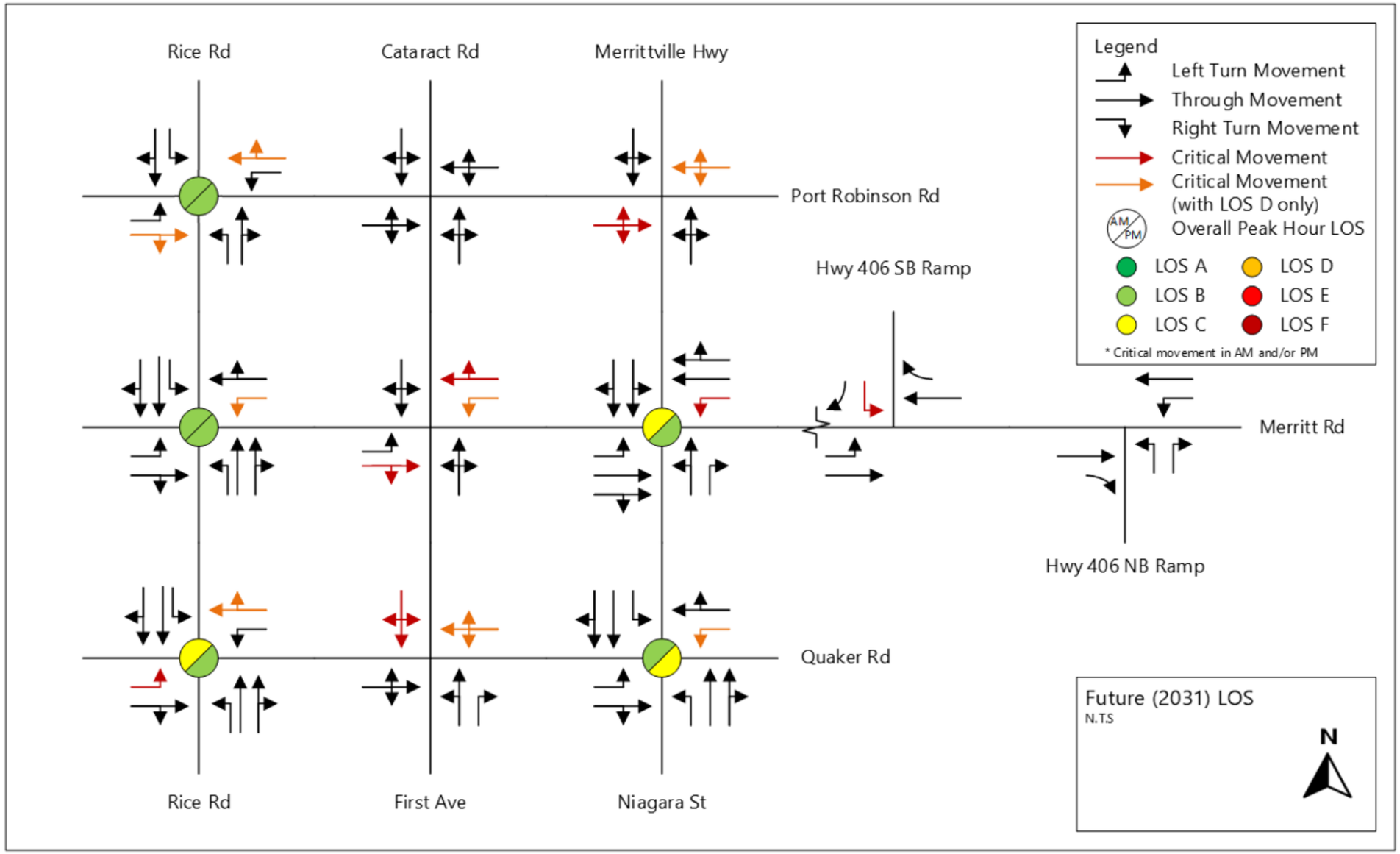


Figure 23: Future (2031) Intersection Operation Conditions (Scenario 2)

8.0 Future (2041) Assessment

Under Scenario 1, the assessment for the future 2041 horizon year was undertaken on the existing (2020 base year) road network, assuming that no improvements were implemented (i.e., no capacity improvements were undertaken, and Merritt Road was not extended to provide a connection between Cataract Road and Rice Road. This scenario was evaluated to determine how well the existing road network could accommodate the forecasted traffic volumes for 2041 horizon year as well as to determine deficiencies in the road network. Therefore, the road network and lane configurations are consistent with the existing conditions, as illustrated previously in **Figure 11**.

Under scenario 2, the assessment for the 2041 horizon year built on the 2031 Scenario 2 road network. The implementation of additional traffic signal phases, geometric improvements, and signalization was considered, as was discussion with the Region and MTO.

8.1 2041 Future Traffic Demand – Scenario 1

Traffic demand for this combination of horizon year and road network was calculated based on the method outlined in **Section 4.2** and described in detail in **Appendix C.**

Table 50 shows the annual growth rates applied for each road segment by direction of travel and time of day. The future (2041) traffic volumes are illustrated in **Figure 24**.

Table 50: Annual Growth Rates (2031 to 2041) – Scenario 1

Segment	AM	PM
Eastbound		
Port Robinson Road	1.5%	1.5%
Merritt Road	2.7%	2.8%
Quaker Road	1.5%	1.5%
Westbound		
Port Robinson Road	2.7%	2.7%
Merritt Road	2.0%	1.5%
Quaker Road	1.5%	1.6%
Northbound		
Rice Road	1.5%	1.5%
Cataract Road	1.7%	1.5%
Niagara Street	1.7%	2.4%
Southbound		
Rice Road	1.7%	1.5%
Cataract Road	1.5%	3.0%
Niagara Street	3.0%	3.0%

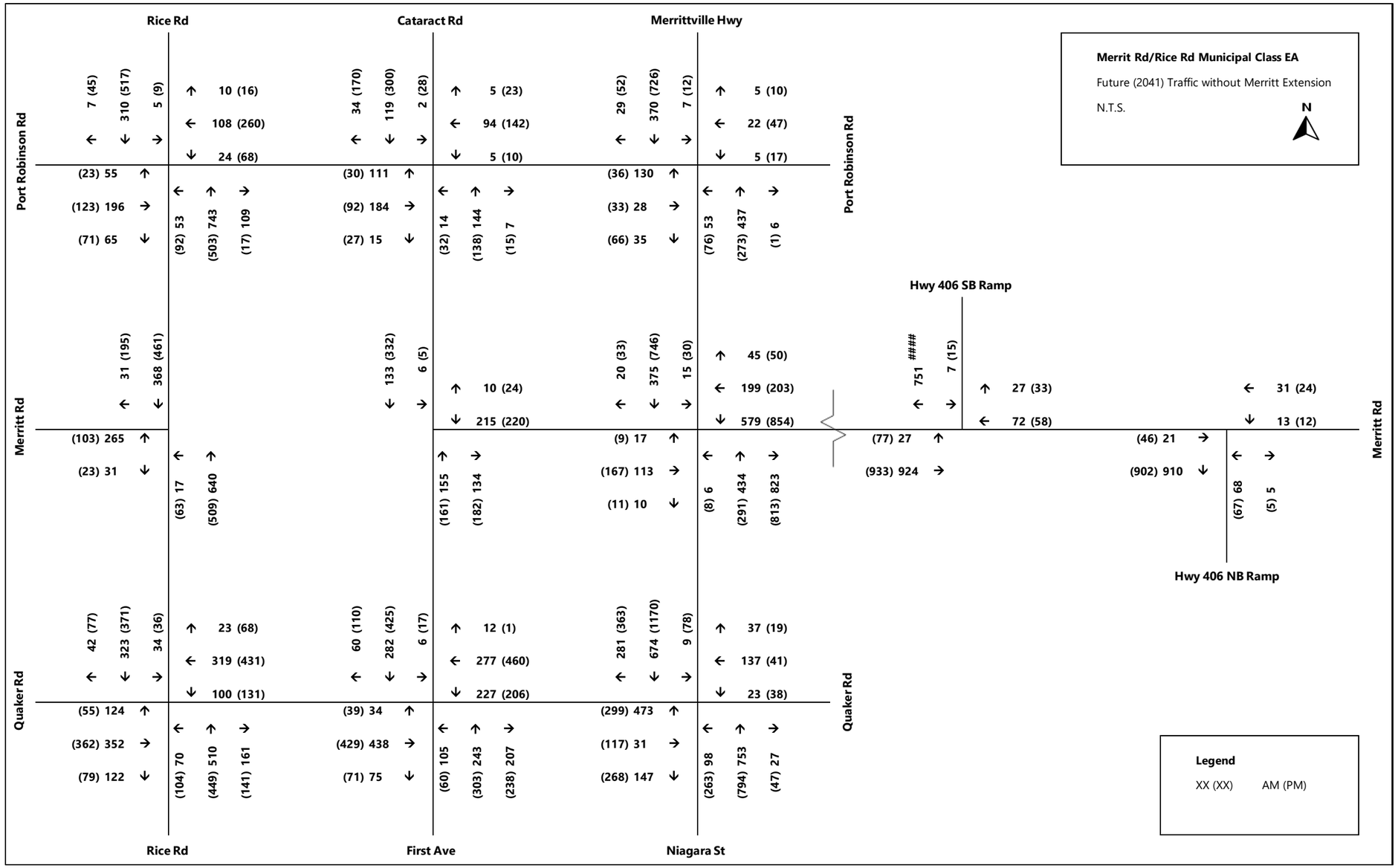


Figure 24: Future (2041) Traffic Volumes (Scenario 1)

8.1.1 2041 Conditions Link Capacity Analysis – Scenario 1

The future (2041) traffic volumes were forecasted as discussed in **Sections 4.2** and **Section 9.1.**

The link capacity analysis was undertaken with the methodology described in **Section 4.3**. As shown in **Table 51** and **Table 52**, the results demonstrate that the following links will be near or exceed capacity.

- Merritt Road east of Niagara Street – Merrittville Highway for eastbound and westbound traffic in the AM and PM peak hours
- Rice Road north of Merritt Road for northbound traffic in the AM

Table 51: 2041 Link Capacity Analysis – Scenario 1 – AM Peak Hour

Segment	Direction	# Of Lanes	Total Capacity (Vehicle/Hour/lane)	Volume (Vehicle/Hour)	Volume to Capacity Ratio (V/C)
Merritt Road (East of Niagara Street/Merrittville Highway	EB	1	850	951	1.12
Merritt Road (East of Niagara Street/Merrittville Highway	WB	1	850	823	0.97
Merritt Road (East of Cataract Road)	EB	1	500	140	0.28
Merritt Road (East of Cataract Road)	WB	1	500	225	0.45
Rice Road (North of Quaker Road)	NB	1	850	657	0.77
Rice Road (North of Quaker Road)	SB	1	850	399	0.47
Rice Road (North of Merritt Road)	NB	1	850	905	1.06
Rice Road (North of Merritt Road)	SB	1	850	399	0.47

Table 52: 2041 Link Capacity Analysis – Scenario 1 – PM Peak Hour

Segment	Direction	# Of Lanes	Total Capacity (Vehicle/Hour/lane)	Volume (Vehicle/Hour)	Volume to Capacity Ratio (V/C)
Merritt Road (East of Niagara Street/Merrittville Highway	EB	1	850	763	0.90
Merritt Road (East of Niagara Street/Merrittville Highway	WB	1	850	1107	1.30
Merritt Road (East of Cataract Road)	EB	1	500	141	0.28
Merritt Road (East of Cataract Road)	WB	1	500	244	0.49
Rice Road (North of Quaker Road)	NB	1	850	477	0.56
Rice Road (North of Quaker Road)	SB	1	850	484	0.57
Rice Road (North of Merritt Road)	NB	1	850	501	0.59
Rice Road (North of Merritt Road)	SB	1	850	656	0.77

8.1.2 2041 Intersection Analysis – Scenario 1

Signal Warrant Analysis:

Signal warrant analysis was conducted for the following four unsignalized intersections by the method described in **Section 4.6**.

- Rice Road / Quaker Road,
- Rice Road / Port Robinson Road,
- Merrittville Highway / Port Robinson Road, and
- Quaker Road / First Avenue – Cataract Road.

The analysis found that signals are expected to be justified for all four intersections – the detailed calculation sheets are provided in **Appendix I**. This scenario did not include evaluation of signalization of these intersections since it is the base condition evaluation. Signal warrant analysis results for this scenario are provided for information only. The future (2041) traffic volumes were forecasted as discussed in **Section 4.2** and **Section 9.1**. Other traffic volume related and signal timing inputs were unchanged from the existing conditions analysis.

Intersection Capacity Analysis:

The results of the traffic operations assessment in Synchro for signalized and unsignalized intersections are summarized in **Table 53** through **Table 63,** respectively.

For the signalized intersections,

- the westbound left movement on Niagara Street – Merrittville Highway at Merritt Road is a critical movement with a volume to capacity ratio of 1.06, LOS E and a 95th percentile queue length of 188 meters versus 66 meters of storage during the AM peak hour, and a volume to capacity ratio of 1.66, LOS F and a queue length of 313 meters in the PM peak hour. The eastbound approach is expected to have LOS D during the PM peak hour.
- At Niagara Street at Quaker Road, the eastbound left has a volume to capacity ratio of 1.49, a LOS F and a 95th percentile queue length of 182 meters versus 80 meters of available storage in the AM, and a volume to capacity ration of 0.90 and LOS D in the PM. The northbound left has a volume to capacity ratio of 0.90, LOS D and a 95th percentile queue length of 77 meters versus 75 meters of storage in the PM. The southbound through-right lane group in the PM is identified as critical with a volume to capacity ratio of 0.87 in the AM and a volume to capacity ratio of 1.48 and LOS F in the PM.

For the unsignalized intersections,

- For the intersection of Merrittville Highway at Port Robinson Road, the eastbound approach is expected to have a volume to capacity ratio of 1.76 and LOS F during the AM peak hour and a volume to capacity ratio of 1.01 and LOS F in the PM peak hour. The westbound approach is expected to have LOS E in the PM peak hour and LOS F in the PM peak hour. As noted in **Section 4.4**, this intersection is modelled with a highly conservative PHF; the future PHF may be higher, resulting in slightly better operating conditions, however it is unlikely that a higher PHF would result in acceptable operation for 2041 Scenario 1 conditions.
- For the intersection of Cataract Road at Port Robinson Road, minor operating problem, LOS D during the PM peak hour, is expected for the southbound approach.
- the intersection of Cataract Road at Merritt Road is expected to operate acceptably in this scenario and horizon year.

- At First Avenue/Cataract Road at Quaker Road, all movement have volume to capacity ratios greatater than 1.0 during one or both peak hours, and LOS F during both peak hours. During the AM peak hour, the EB volume to capacity ratio is 1.65, the westbound volume to capacity ratio is 1.59, the northbound volume to capacity ratio is 1.65 and the southbound volume to capacity ratio is 1.04. During the PM peak hour, the eastbound volume to capacity ratio is 1.63, the westbound volume to capacity ratio is 2.03, the northbound volume to capacity ratio is 1.77 and the southbound volume to capacity ratio is 1.65;
- Rice Road at Port Robinson Road has LOS D for the eastbound approach during the AM peak hour and LOS E for the westbound appraoch during the PM peak hour. The northbound approach has a volume to capacity ratio of 1.84 and LOS F in the AM peak hour and a volume to capacity ratio of 1.44 and LOS F during the PM peak hour. The southbound approach has a volume to capacity ratio of 1.33 and LOS F during the PM peak hour;
- The eastbound approach at Rice Road at Merritt Road is critical with a volume to capacity ratio of 1.65 and LOS F during the AM peak hour and a volume to capacity ratio of 0.92 and LOS E during the PM peak hour;
- All approaches to the intersection of Rice Road and Quaker Road have volume to capacity ratios grater than 1 during at least one peak hour and all are LOS F during both peak hours. The eastbound approach has volume to capacity ratios of 1.77 during the AM peak hour and 1.42 during the PM peak hour, the westbound approach has a volume to capacity ratio of 1.32 during the AM peak hour and 1.80 during the afternoon peak hour, the northobund approach has a volume to capacity ratio of 2.18 during the AM peak hour and 1.98 during the PM peak hour and the southbound approach has a volume to capacity ration of 1.18 during the AM peak hour and 1.38 during the PM peak hour.
- The intersection of Merritt Road at the Highway 406 Northbound ramp is expected to operate acceptably in this scenario.

For the MTO Highway 406 ramps,

- the southbound left turn at the intersection of Merritt Road at the Highway 406 Southbound ramp is expected to have a volume to capacity ratio of 0.95 and LOS E in the AM peak hour, and a volume to capacity ratio of 1.08 and LOS F in the PM peak hour;

As these points indicate, with 2041 forecast traffic, the existing road network is expected to have several operating problems due to increased travel demand from/to the Highway 406 ramps combined with high volumes along the Niagara Street – Merrittville Highway corridor and high travel demand between Quaker Road and Highway 406 ramps via Niagara Street.

The critical movements are illustrated in **Figure 25**. Synchro reports are compiled in **Appendix J**.

Table 53: 2041 Signalized Intersection Operations – Scenario 1 – Niagara Street/Merrittville Hwy and Merritt Road

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meter)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meter)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th percentile queue length (meter)	
EBLTR	0.49	34.0	C	39	0.59	35.9	D	52	832
WBL	1.06	76.5	E	#188	1.66	326.8	F	#313	65
WBTR	0.37	16.3	B	47	0.37	16.1	B	49	1297
NBLT	0.77	29.7	C	95	0.53	21.5	C	60	1026
NBR	0.61	2.0	A	0	0.62	2.1	A	0	1026
SBLTR	0.41	17.4	B	36	0.77	25.8	C	81	1027
Overall	-	-	**C**	-	-	-	**F**	-	-

Notes

#: 95th percentile volume exceeds capacity, a queue may be longer

Table 54: 2041 Signalized Intersection Operations – Scenario 1 – Niagara Street and Quaker Road

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBL	1.49	262.9	F	#182	1.09	111.0	F	#113	80
EBTR	0.33	8.5	A	19	0.90	46.5	D	103	825
WBL	0.07	23.7	C	9	0.49	49.2	D	#19	30
WBTR	0.35	24.2	C	41	0.16	19.6	B	15	481
NBL	0.40	12.4	B	13	0.90	52.8	D	#77	75
NBTR	0.56	16.0	B	70	0.65	21.1	C	87	404
SBL	0.03	7.6	A	2	0.29	10.1	B	11	65
SBT-TR	0.87	31.0	C	#100	1.48	247.1	F	254	1026
Overall	-	-	E	-	-	-	**F**	-	-

Notes

#: 95th percentile volume exceeds capacity, a queue may be longer

Table 55: 2041 Unsignalized Intersection Operations – Scenario 1 - Merritt Rd and Hwy 406 SB Ramp

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length	
EBL	0.02	7.5	A	1	0.05	7.4	A	1	100
EBT	0.66	0.0	-	0	0.57	0.0	-	0	1297
WBT	0.05	0.0	-	0	0.04	0.0	-	0	340
WBR	0.02	0.0	-	0	0.02	0.0	-	0	210
SBL	0.95	38.2	E	119	1.08	72.7	F	201	574
SBR	-	-	-	-	-	-	-	-	150

Table 56: 2041 Unsignalized Intersection Operations – Scenario 1 - Merrittville Hwy and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBLTR	1.76	421.9	F	141	1.01	136.7	F	57	834
WBLTR	0.26	35.2	E	7	0.72	94.6	F	29	681
NBLTR	0.07	1.8	A	2	0.10	3.2	A	3	1027
SBLTR	0.01	0.3	A	0	0.01	0.3	A	0	497

Table 57: 2041 Unsignalized Intersection Operations – Scenario 1 - Cataract Rd and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBLTR	0.49	13.2	B	-	0.29	12.1	B	-	839
WBLTR	0.18	9.8	A	-	0.34	12.8	B	-	838
NBLTR	0.27	10.5	B	-	0.34	12.0	B	-	991
SBLTR	0.25	10.2	B	-	0.80	26.5	D	-	524

Table 58: 2041 Unsignalized Intersection Operations – Scenario 1 - Cataract Rd and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
WBLR	0.35	11.0	B	-	0.43	13.1	B	-	832
NBTR	0.40	10.5	B	-	0.51	13.1	B	-	1030
SBLT	0.21	9.4	A	-	0.54	14.2	B	-	991

Table 59: 2041 Unsignalized Intersection Operations – Scenario 1 - First Ave/Cataract Rd and Quaker Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBLTR	1.65	329.7	F	-	1.63	319.8	F	-	822
WBLTR	1.59	300.9	F	-	2.03	495.5	F	-	825
NBLTR	1.65	329.0	F	-	1.77	380.1	F	-	402
SBLTR	1.04	90.2	F	-	1.65	326.4	F	-	1030

Table 60: 2041 Unsignalized Intersection Operations – Scenario 1 - Rice Rd and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBLTR	0.70	25.6	D	-	0.57	23.1	C	-	431
WBLTR	0.35	15.7	C	-	0.84	43.2	E	-	839
NBLTR	1.84	402.9	F	-	1.44	234.5	F	-	1037
SBLTR	0.69	24.9	C	-	1.33	188.8	F	-	467

Table 61: 2041 Unsignalized Intersection Operations – Scenario 1 - Rice Rd and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBLR	1.65	351.8	F	172	0.92	107.4	F	51	435
NBLT	0.02	0.5	A	1	0.09	2.2	A	2	1037
SBTR	0.27	0.0	-	0	0.45	0.0	-	0	1037

Table 62: 2041 Unsignalized Intersection Operations – Scenario 1 - Rice Rd and Quaker Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBLTR	1.77	381.0	F	-	1.42	228.5	F	-	441
WBLTR	1.32	187.7	F	-	1.80	392.4	F	-	822
NBLTR	2.18	560.1	F	-	1.98	471.1	F	-	400
SBLTR	1.18	135.5	F	-	1.38	212.9	F	-	1037

Table 63: 2041 Unsignalized Intersection Operations – Scenario 1 - Hwy 406 NB Ramp and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBT	0.01	0.0	-	0	0.03	0.0	-	0	340
EBR	0.61	0.0	-	0	0.63	0.0	-	0	200
WBL	0.01	7.3	A	0	0.01	7.3	A	0	65
WBT	0.02	0.0	-	0	0.02	0.0	-	0	198
NBL	0.09	9.3	A	2	0.09	9.6	A	2	501
NBR	-	-	-	-	-	-	-	-	180

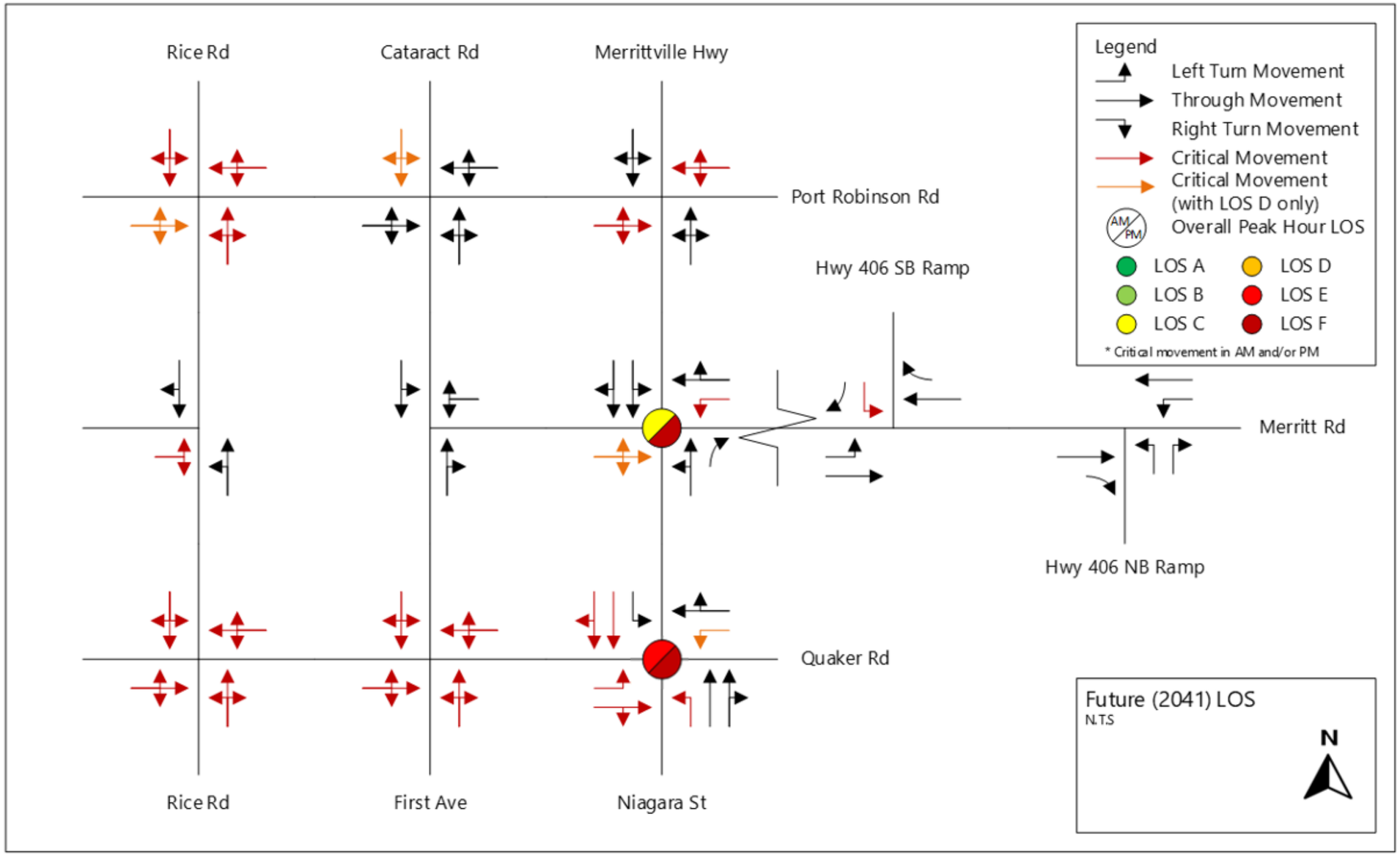


Figure 25: Future (2041) Intersection Operation Conditions (Scenario 1)

8.2 2041 Future Traffic Demand – Scenario 2

As described in **Section 9.1**, the inclusion of the Merritt Road extension between Cataract Road and Rice Road results in a further increase in traffic along Merritt Road from east of Rice Road to Highway 406. However, there will be a significant decrease in traffic along Quaker Road and with Niagara Street / Merrittville Highway compared to Scenario 1.

The Merritt Road extension offers more direct access to Highway 406, thereby alleviating congestion issues associated with the detoured turning movements.

A diversion analysis similar to that described in **Section 7.2** was conducted to estimate traffic diversions by applying percentage changes in modelled volumes to future Scenario 1 volumes. 2041 Future Total volumes were also estimated by applying calculated diversions to the 2041 Scenario 1 traffic volumes.

The diversion analysis for future traffic volumes with the Merritt Road extension is provided in **Appendix C.**

The forecasted traffic volumes are illustrated in **Figure 26.**

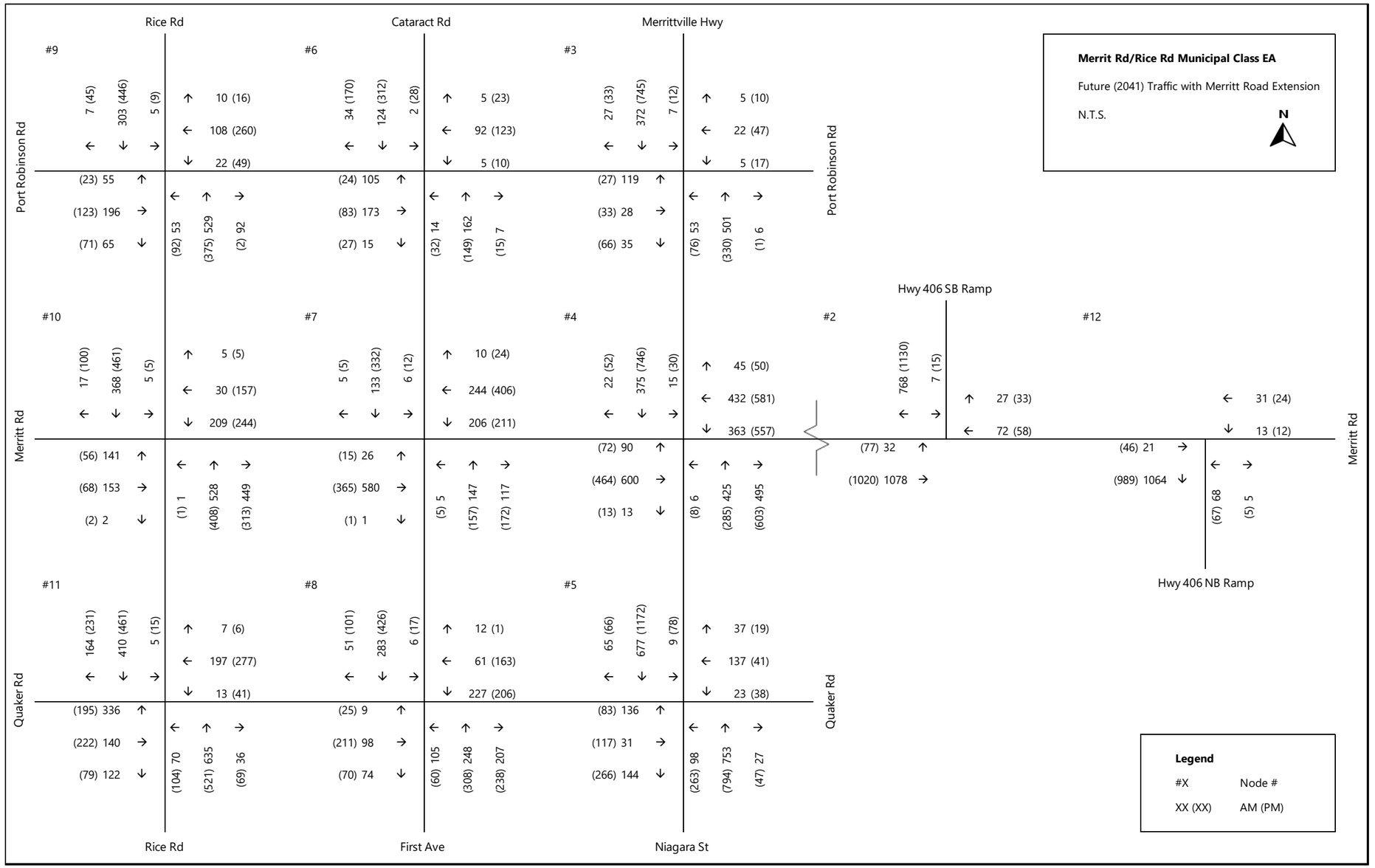


Figure 26: Future (2041) Traffic Volumes (Scenario 2)

8.2.1 2041 Conditions Link Capacity Analysis – Scenario 2

The future (2041) traffic volumes were forecasted, as discussed in **Section 4.2** and **Section 10.1.**

The link capacity analysis was undertaken with the methodology described in **Section 4.3**. The results summarized in **Table 64** and **Table 65** demonstrate that with the proposed right of way and geometric improvements, none of the study area segments will have traffic exceeding capacity by 2041, assuming that Rice Road is widened to four lanes between Quaker Road and Merritt Road.

Table 64: 2041 Link Capacity Analysis – Scenario 2 – AM Peak Hour

Segment	Direction	Lane Capacity	# Of Lanes	Total Capacity (Vehicle/Hour/lane)	Volume (Vehicle/Hour)	Volume to Capacity Ratio (V/C)
Merritt Road (East of Niagara Street/Merrittville Highway)	EB	850	2	1700	1110	0.65
Merritt Road (East of Niagara Street/Merrittville Highway)	WB	850	2	1700	840	0.49
Merritt Road (East of Cataract Road)	EB	850	1	850	703	0.83
Merritt Road (East of Cataract Road)	WB	850	1	850	460	0.54
Rice Road (North of Quaker Road)	NB	850	2	1700	978	0.58
Rice Road (North of Quaker Road)	SB	850	2	1700	579	0.34
Rice Road (North of Merritt Road)	NB	850	1	850	674	0.79
Rice Road (North of Merritt Road)	SB	850	1	850	390	0.46

Table 65: 2041 Link Capacity Analysis – Scenario 2 – PM Peak Hour

Segment	Direction	Lane Capacity	# Of Lanes	Total Capacity (Vehicle/Hour/lane)	Volume (Vehicle/Hour)	Volume to Capacity Ratio (V/C)
Merritt Road (East of Niagara Street/Merrittville Highway	EB	850	2	1700	1097	0.65
Merritt Road (East of Niagara Street/Merrittville Highway	WB	850	2	1700	1188	0.70
Merritt Road (East of Cataract Road)	EB	850	1	850	549	0.65
Merritt Road (East of Cataract Road)	WB	850	1	850	641	0.75
Rice Road (North of Quaker Road)	NB	850	2	1700	722	0.42
Rice Road (North of Quaker Road)	SB	850	2	1700	707	0.42
Rice Road (North of Merritt Road)	NB	850	1	850	469	0.55
Rice Road (North of Merritt Road)	SB	850	1	850	566	0.67

8.2.2 2041 Intersection Capacity Analysis – Scenario 2

Signal Warrant Analysis:

Signal warrant analyses were conducted for the following five intersections:

- Rice Road / Quaker Road,
- Rice Road / Merritt Road,
- Merritt Road / Cataract Road,
- Merrittville Highway / Port Robinson Road, and
- First Avenue/Cataract Road at Quaker Road.

A signal was justified for all the five intersections – the detailed calculation sheets are provided in **Appendix K.** Installation of traffic signals was assumed for 2031 at Rice Road at Quaker Road, Rice Road at Merritt Road and Rice Road at Port Robinson Road, therefore these three intersections are also assumed to have traffic signals in 2041. Similarly to the analysis for Scenario 2 for 2031, for the interesections of First Avenue/Cataract Road and Quaker Road, retention of the existing all-way stop control with lane configuraiton improvements was tested to determine if acceptable operation would result, however it was found that acceptable operation could not be achieved. Therefore, the following two intersections are recommended for signalization by 2041:

- First Avenue / Cataract Road/Quaker Road; and
- Cataract Road / Merritt Road.

Lane Configurations:

Following are the modifications to the Future (2041) road network, made based on the results of the signal warrant analysis, link capacity analyses, intersection capacity analyses, and consultation with the Region:

Rice Road between Quaker Road and Merritt Road

- Rice Road widened between Quaker Road and Merritt Road to four travel lanes to meet travel demand (**Section 10.1**)

Rice Road and Merritt Road

- Add a protected-permitted traffic signal phase for westbound left turns

Rice Road and Quaker Road

- Add a protected-permitted left turn phase for eastbound left turns

First Avenue/Cataract Road and Quaker Road

- Signalize intersection and add dedicated left turn lanes on each approach
- Provide a protected-permitted traffic signal phase for eastbound left turns

Cataract Road and Merritt Road

- Signalize intersection and add dedicated left-turn lanes at all approaches (or convert to a roundabout).

Merritt Road and Highway 406 Southbound ramp

- Discussed in **Section 10**.

The road network, along with lane configurations and intersection controls, is illustrated in **Figure 27,** assuming traffic signals are implemented.

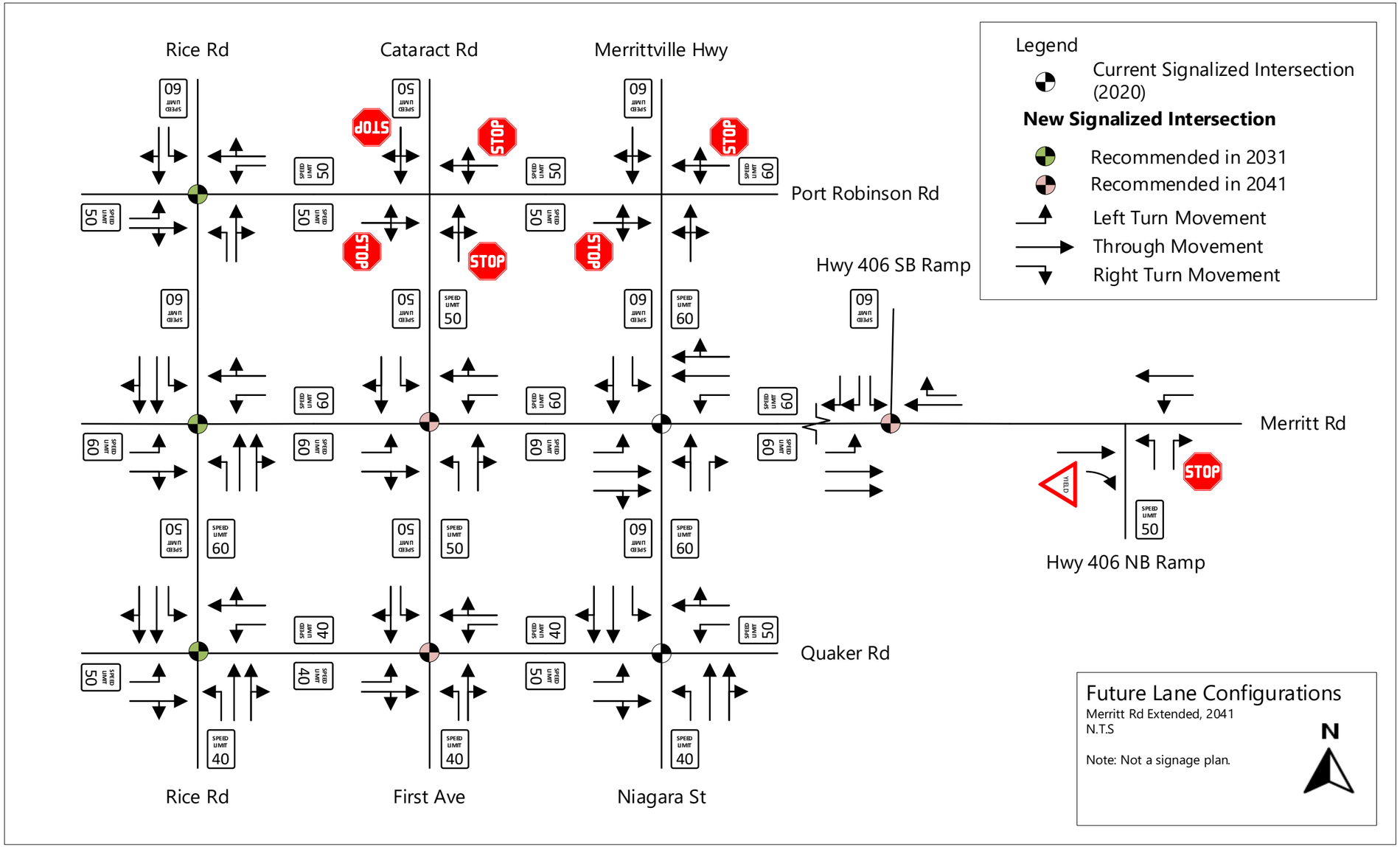


Figure 27: Future (2041) Lane Configurations and Intersection Controls (Scenario 2)

Intersection Capacity Analysis:

The results of the traffic operations assessment in Synchro for signalized and unsignalized intersections are summarized in **Table 66** and **Table 75.**

For the signalized intersections;

- At Niagara Street/Merrittville Highway and Merritt Road, the westbound left turn is expected to have minor operating problems during the AM peak hour, with a volume to capacity ratio of 0.93 and LOS D. With optimized splits during the PM peak hour, the westbound left turn is expected to have a volume to capacity ratio of 1.06, LOS E and a queue length of 149 meters. Since the westbound left turn volume is forecast to be 557 vehicles per hour for 2041, a second left turn lane may be considered to mitigate this issue in the future. Eastbound left turns, northbound through movements and southbound through and right turn movements are expected to have minor delays with LOS D during one of the peak hours.
- At Niagara Street and Quaker Road, with optimized splits, minor operating problems are expected for the PM peak hour, with the eastbound through and right turn lane group having a volume to capacity ratio of 1.02 and LOS E, the westbound left turn having LOS E, the northbound through movement having a volume to capacity ratio of 1.07, LOS F and a 95th percentile queue length of 88 meters versus 75 meters of storage and the southbound through movement having a volume to capacity ratio of 1.00 and LOS D. Given the high volume of southbound through vehicles and high demand for northbound left turns, addition of a southbound through lane through the intersection may be beneficial in future.
- If Cataract Road and Merritt Road is signalized by 2041, minor operating problems are expected, including an eastbound volume to capacity ratio of 0.91 and LOS D during the AM peak hour and LOS D during the afternoon peak hour.
- First Avenue/Cataract Road and Quaker Road would need to be signalized by 2041 with left turn lanes for each approach. With longer storage of 50 meters for the westbound left turnlane, and an eastbound protected-permitted left turn phase, all volume to capacity ratios will be below 1.00. The eastbound volume to capacity ratio will be slightly above the threshold of 0.85, at 0.87 during the PM peak hour, and the approach will have LOS D during both peak hours.
- With signalization and left turn lanes on each approach at Rice Road and Port Robinson Road, all volume to capacity ratios will be below 0.85 during each of the peak hours.. The westbound approach is expected to have LOS D in the PM peak hour and the eastbound approach is expected to have LOS D during the AM peak hour.
- At the intersection of Rice Road and Merritt Road, the westbound left turn is expected to have minor delays with LOS D during the AM peak hour, and the eastbound left, eastbound through/right and westbound left and westbound left turn movements are expected to have minor delays with LOS D in the PM peak;
- Rice Road and Quaker Road minor delays are expected for the westbound through and right turn with LOS D in the AM and PM peak hours;

The Merritt Road and Highway 406 southbound ramp was analyzed based on alternative traffic control. This analysis is discussed in detail in **Section 10**.

Figure 28 illustrates the critical movements for this scenario.

Synchro reports are compiled in **Appendix L**.

Table 66: 2041 Signalized Intersection Operations – Scenario 2 – Niagara Street/Merrittville Hwy and Merritt Road

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBL	0.40	30.2	C	27	0.47	38.8	D	25	90
EBTR	0.67	30.3	C	67	0.65	33.1	C	56	150
WBL	0.93	46.9	D	#89	1.06	71.9	E	#149	65
WBTR	0.32	13.1	B	35	0.40	12.8	B	46	1297
NBL	0.02	19.3	B	3	0.09	23.9	C	5	30
NBT	0.81	39.1	D	#117	0.58	29.4	C	68	1000
NBR	0.68	10.6	B	48	0.78	11.8	B	54	40
SBL	0.10	21.4	C	7	0.18	24.4	C	11	40
SBTR	0.40	22.1	C	40	0.84	35.3	D	93	1000
Overall	-	-	**C**	-	-	-	**C**	-	-

Notes

#: 95th percentile volume exceeds capacity, a queue may be longer

Table 67: 2041 Signalized Intersection Operations – Scenario 2 – Niagara Street and Quaker Road

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBL	0.57	33.7	C	38	0.36	33.9	C	27	80
EBTR	0.40	9.6	A	19	1.02	75.5	E	#114	825
WBL	0.10	22.7	C	9	0.59	66.5	E	#22	30
WBTR	0.46	24.9	C	41	0.18	22.1	C	16	481
NBL	0.28	8.2	A	13	1.07	98.5	F	#88	75
NBTR	0.55	13.0	B	70	0.58	16.2	B	73	404
SBL	0.02	6.7	A	2	0.28	8.4	A	10	65
SBTR	0.72	22.1	C	74	1.00	49.3	D	#166	1026
Overall	-	-	**B**	-	-	-	**E**	-	-

Notes

#: 95th percentile volume exceeds capacity, a queue may be longer

Table 68: 2041 Signalized Intersection Operations – Scenario 2 – Cataract Rd and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBL	0.07	15.4	B	8	0.07	15.1	B	m4	30
EBTR	0.91	43.7	D	157	0.81	37.4	D	94	824
WBL	0.78	31.0	C	#36	0.65	22.1	C	31	40
WBTR	0.30	11.6	B	36	0.63	22.3	C	76	681
NBL	0.01	28.0	C	m1	0.02	19.8	B	3	30
NBTR	0.564	31.0	C	m48	0.53	21.3	C	73	1030
SBL	0.03	24.0	C	4	0.04	20.0	B	6	30
SBTR	0.30	26/6	C	36	0.54	24.5	C	84	991
Overall	**0.76-**	**-**	**C**	**-**	**-**	**-**	**C**	**-**	**-**

Notes

#: 95th percentile volume exceeds capacity, a queue may be longer

m: Volume for the 95th percentile queue is metered by an upstream signal

Table 69: 2041 Signalized Intersection Operations – Scenario 2 – First Ave/Cataract Rd and Quaker Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBL	0.05	33.2	C	m4	0.11	24.3	C	m9	30
EBTR	0.73	45.3	D	45	0.87	50.5	D	#86	822
WBL	0.72	32.5	C	47	0.73	31.4	C	#42	30
WBTR	0.13	14.1	B	15	0.26	17.4	B	32	825
NBL	0.33	17.6	B	26	0.34	22.4	C	19	30
NBTR	0.63	18.9	B	94	0.79	28.0	C	#141	402
SBL	0.02	10.7	B	m1	0.10	11.5	B	m3	30
SBTR	0.45	13.5	B	m53	0.76	24.1	C	#140	1030
Overall	-	-	**C**	-	-	-	**C**	-	-

Notes

#: 95th percentile volume exceeds capacity, a queue may be longer

m: Volume for the 95th percentile queue is metered by an upstream signal

Table 70: 2041 Signalized Intersection Operations – Scenario 2 – Rice Rd and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBL	0.23	27.7	C	16	0.15	27.3	C	9	30
EBTR	0.77	43.8	D	62	0.52	28.6	C	40	431
WBL	0.18	28.3	C	9	0.24	28.7	C	15	30
WBTR	0.35	28.6	C	29	0.75	43.9	D	65	839
NBL	0.11	9.8	A	11	0.22	20.3	C	27	30
NBTR	0.67	17.0	B	135	0.39	20.2	C	84	887
SBL	0.02	9.4	A	2	0.02	9.1	A	3	30
SBTR	0.33	10.6	B	51	0.51	12.9	B	86	467
Overall	-	-	**C**	-	-	-	**C**	-	-

Table 71: 2041 Signalized Intersection Operations – Scenario 2 – Rice Rd and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBL	0.50	30.0	C	33	0.50	49.4	D	21	41
EBTR	0.38	25.8	C	33	0.37	39.2	D	23	435
WBL	0.78	46.2	D	51	0.78	49.5	D	73	80
WBTR	0.09	18.3	B	9	0.39	33.0	C	53	824
NBL	0.00	11.0	B	1	0.00	7.0	A	m0	80
NBTR	0.61	10.8	B	67	0.45	7.0	A	56	
SBL	0.03	11.8	B	m2	0.02	11.4	B	2	50.5
SBTR	0.25	11.6	B	40	0.37	11.7	B	45	
Overall	-	-	**B**	-	-	-	**B**	-	-

Notes

m: Volume for the 95th percentile queue is metered by an upstream signal

Table 72: 2041 Signalized Intersection Operations – Scenario 2 – Rice Rd and Quaker Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBL	0.74	24.7	C	60	0.68	29.3	C	37	90
EBTR	0.37	10.5	B	34	0.51	20.9	C	55	441
WBL	0.08	28.2	C	m2	0.20	27.9	C	14	40
WBTR	0.75	41.7	D	m40	0.78	46.3	D	72	822
NBL	0.40	30.0	C	25	0.45	23.8	C	31	90
NBTR	0.60	24.9	C	77	0.42	15.6	B	53	
SBL	0.4	20.2	C	3	0.05	15.7	B	m5	70
WBTR	053	21.1	C	59	0.46	15.2	B	64	
Overall	-	-	**C**	-	-	-	**C**	-	-

Notes

m: Volume for the 95th percentile queue is metered by an upstream signal

Table 73: 2041 Unsignalized Intersection Operations – Scenario 2 – Merrittville Hwy and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBLTR	1.89	488.6	F	142	0.98	134.2	F	53	838
WBLTR	0.29	40.8	E	9	0.81	120.9	F	34	681
NBLTR	0.07	1.8	A	2	0.10	3.0	A	3	1027
SBLTR	0.01	0.3	A	0	0.01	0.3	A	0	497

Table 74: 2041 Unsignalized Intersection Operations – Scenario 2 – Cataract Rd and Port Robinson Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBLTR	0.47	12.9	B	-	0.26	11.5	B	-	839
WBLTR	0.17	9.9	A	-	0.30	12.2	B	-	838
NBLTR	0.30	10.8	B	-	0.34	11.8	B	-	991
SBLTR	0.26	10.3	B	-	0.80	25.7	D	-	524

Table 75: 2041 Unsignalized Intersection Operations – Scenario 2 – Hwy 406 NB Ramp and Merritt Rd

Lane	Weekly Morning Peak Hour Performance Measures				Weekly Afternoon Peak Hour Performance Measures				Storage (meters)
	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	95th Percentile Queue Length (meters)	
EBT	0.01	0.0	-	0	0.03	0.0	-	0	340
EBR	0.71	0.0	-	0	0.69	0.0	-	0	200
WBL	0.01	7.3	A	0	0.01	7.3	A	0	65
WBT	0.02	0.0	-	0	0.02	0.0	-	0	198
NBLR	0.09	9.3	A	2	0.09	9.6	A	2	501/180

For the remaining unsignalized intersections;

- At Merritville Highway and Port Robinson Road, the eastbound left-through-right movement is critical in the AM and PM peak hours (v/c 1.89 and 0.98, LOS F). The Westbound left-through-right movement is also a critical movement in the AM peak hour with LOS E and in the PM peak hour with LOS F. As noted in **Section 4.4**, this intersection is modelled with a highly conservative PHF; tperformance may be better than forecast with a higher PHF in future. However it is expected that additional improvements such as signalization will be required at this intersection to manage traffic demand acceptably in the future; and
- For the intersection of Cataract Road and Port Robinson Road, with existing traffic control, minor delays are expected for the southbound approach, with LOS D in the PM peak hour.

For the MTO Highway 406 ramps,

- The Merritt Road and Highway 406 southbound ramp was analyzed based on alternative traffic control. This analysis is discussed in detail in **Section 12.1**.
- No issues were identified at the Merritt Road and Highway 406 Northbound Ramp.

The results reflect that the extension of Merritt Road between Cataract Road and Rice Road would allow rerouting the high travel demand from Quaker Road to Merritt Road. In addition, the extension would allow vehicles to access the Highway 406 ramps directly via Merritt Road in addition to via Niagara Street.

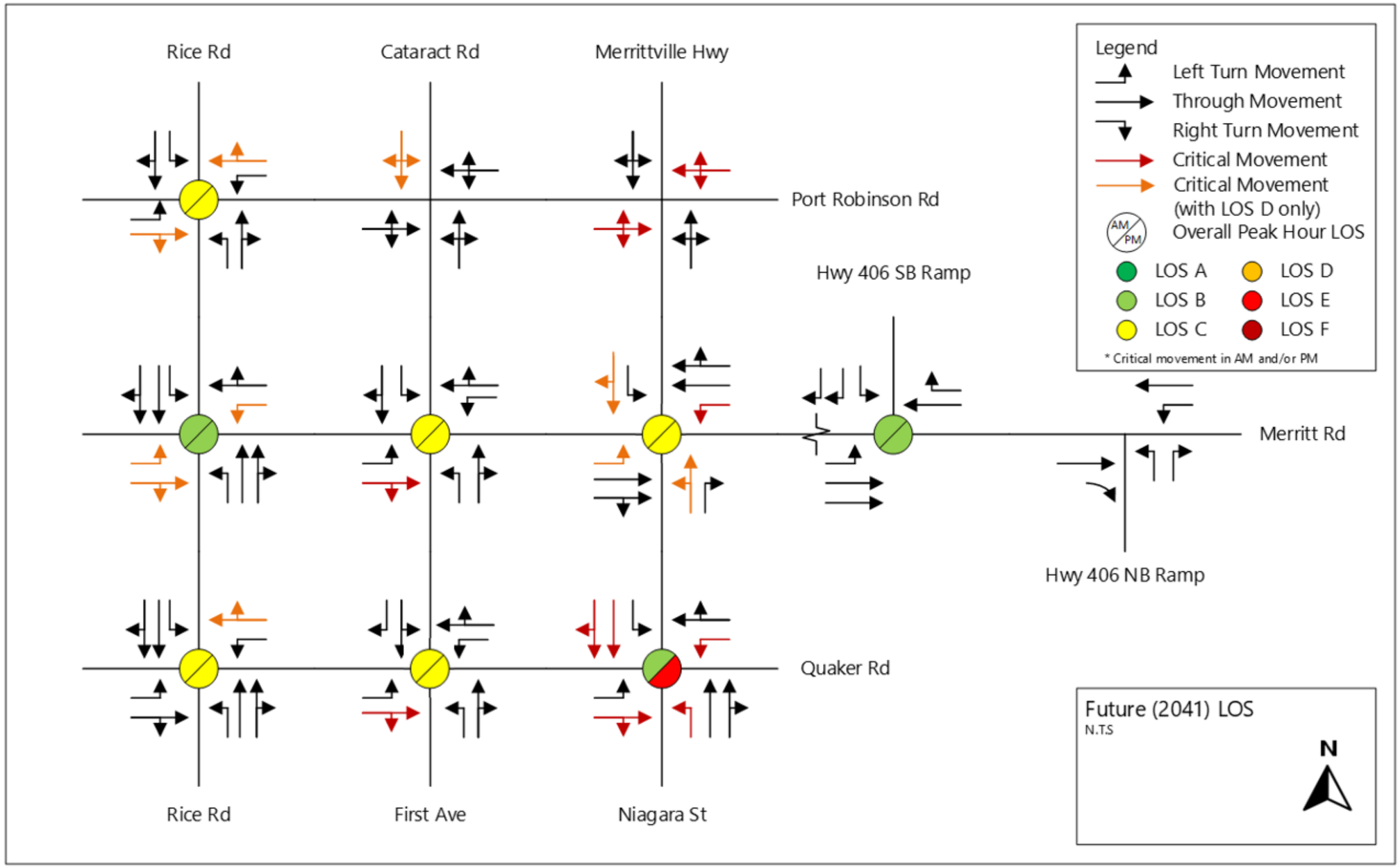


Figure 28: Future (2041) Intersection Operation Conditions (Scenario 2)

8.3 Turn Lane Storage – Scenario 2

Based on the 95th percentile queues calculated by Synchro, storage requirements are recommended for left and right turn lanes at the study intersections, reflective of anticipated traffic needs in the 2041 horizon year in **Table 76**. Per Regional practice, a minimum of 30 meter was used. In addition to the storage, a 10:1 taper is recommended.

Table 76: Left and Right Turn Lane Storage Requirements

Intersection	95th percentile queue	Recommended Storage
Rice Road / Quaker Road	EBL – 60 m WBL – 14 m NBL – 31 m SBL – 5 m	EBL – 60 m WBL – 30 m NBL – 40 m SBL – 30 m
Rice Road / Merritt Road	EBL – 33 m WBL – 73 m NBL – 1 m SBL – 45 m	EBL – 40 m WBL – 80 m NBL – 30 m SBL – 50 m
Cataract Road / Merritt Road	EBL – 8 m WBL – 36 m NBL – 3 m SBL – 6 m	EBL – 30 m WBL – 40 m NBL – 30 m SBL – 30 m
Niagara Street / Merrittville Highway / Merritt Road	EBL – 27m WBL – 149m NBL – 5m NBR – 48 m SBL – 11m	EBL – 30m WBL – 150m NBL – 30m NBR – 50 m SBL – 30m

9.0 Comparison of Performance Measures

Performance measures including link capacity analysis and intersection capacity analysis for Scenario 1 and Scenario 2 were compared as input to the study findings and recommendations.

9.1 2031 Comparison

9.1.1 Link Capacity Analysis

The results summarized in **Table 77** below demonstrate that under Scenario 1, Merritt Road in the PM peak hour will exceed capacity in the westbound direction by 2031.

The evaluation of link capacities for 2031 indicates a link capacity deficiency for Merritt Road east of Niagara Street/Merrittville Highway with the Scenario 1 road network. With the widening of Merritt Road to four lanes assumed in Scenario 2, this deficiency would be resolved. There are also links nearing capacity in Scenario 1, including Merritt Road east of Niagara Street/Merrittville Highway eastbound during the AM and PM peak hours, and Rice Road north of Merritt Road northbound in the AM peak hour. For Scenario 2, Rice Road north of Quaker Road is expected to approach capacity in the northbound direction during the PM peak hour.

Table 77: Comparison of the 2031 Link Capacity Analysis Results Under Scenario 1 and 2

Segment	Direction	Volume To Capacity Ratio AM Peak Period		Volume To Capacity Ratio PM Peak Period	
		Scenario 1	Scenario 2	Scenario 1	Scenario 2
Merritt Road (East of Niagara Street/Merrittville Highway)	EB	0.86	0.51	0.90	0.65
Merritt Road (East of Niagara Street/Merrittville Highway)	WB	0.79	0.41	1.04	0.70
Merritt Road (East of Cataract Road)	EB	0.20	0.67	0.28	0.65
Merritt Road (East of Cataract Road)	WB	0.37	0.45	0.38	0.75
Rice Road (North of Quaker Road)	NB	0.64	0.96	0.56	0.85
Rice Road (North of Quaker Road)	SB	0.39	0.57	0.48	0.83
Rice Road (North of Merritt Road)	NB	0.86	0.65	0.59	0.55
Rice Road (North of Merritt Road)	SB	0.39	0.38	0.64	0.67

9.1.2 Intersection Capacity Analysis

Intersection operations were modelled using Synchro 11 and the Highway Capacity Manual (HCM) 2000, published by the Transportation Research Board (TRB). The future (2031) traffic volumes for Scenario 2

were forecasted as discussed in **Section 4.2** and **Section 8.1**. Other traffic volume related and signal timing inputs were unchanged from the existing conditions analysis, with the exception of the proposed road widening and extension in Scenario 2.

Table 78 provides a summary of the critical movements for each intersection under Scenario 1 versus Scenario 2.

As indicated in the table, operating problems would be eliminated or significantly reduced by the improvement plans evaluated. For Cataract Road and Merritt Road, minor problems are expected in Scenario 2, but not in Scenario 1, because in Scenario 2, a fourth leg is added to the intersection. The problems indicated are relatively minor and all volume to capacity ratios will be less than 1.0, therefore operation is expected to be tolerable.

The results presented in **Table 78** confirm that the extension of Merritt Road between Cataract Road and Rice Road will relieve congestion at the Niagara Street and Quaker Road intersection. In addition, the extension would allow drivers to access the Highway 406 ramps directly via Merritt Road in addition to via Niagara Street. The aforementioned improvements will adequately service traffic in the 2031 horizon year.

Table 78: Comparison of 2031 Intersection Capacity Analysis Results Under Scenario 1 and 2

Intersection	Scenario (1 or 2)	Intersection Type		AM Peak Hour			PM Peak Hour		
		Signalized	Unsignalized	LOS	Critical Movements		LOS	Critical Movements	
					V/C	LOS		V/C	LOS
Niagara Street/Merrittville Hwy and Merritt Road	1	x		B	-	-	C	WBL (1.08)	WBL (E)
	2	x		C	-	-	B	-	-
Niagara Street and Quaker Road	1	x		C	EBL (1.05)	EBL (F)	D	EBL (0.93), SBTR (1.05)	EBL (E), SBTR (E)
	2	x		B	-	-	C	-	WBL (D)
Merrittville Hwy and Port Robinson Rd	1		x	-	EBLTR (0.85)	EBLTR (F)	-	-	-
	2		x	-	EBLTR (0.87)	EBLTR (F)	-	-	WBLTR (D)
Cataract Rd and Port Robinson Rd	1		x	-	-	-	-	-	-
	2		x	-	-	-	-	-	-
Cataract Rd and Merritt Rd	1		x	-	-	-	-	-	-
	2		x	-	EBLTR (0.96)	EBLTR (F)	-	WBTR (0.86)	EBLTR (D), WBL (D), WBTR (D)
First Ave/Cataract Rd and Quaker Rd	1		x	-	EBLTR (1.33), WBLTR (1.17), NBLTR (1.27), SBLTR (0.86)	EBLTR (F), WBLTR (F), NBLTR (F), SBLTR (E)	-	EBLTR (1.34), WBLTR (1.56), NBLTR (1.44), SBLTR (1.17)	EBLTR (F), WBLTR (F), NBLTR (F), SBLTR (F)
	2		x	-	-	-	-	SBLTR (0.92)	WBLTR (D), SBLTR (F)
Rice Rd and Port Robinson Rd	1		x	-	NBLTR (1.31)	NBLTR (F)	F	NBLTTR (1.05), SBLTR (1.00)	NBLTTR (F), SBLTR (F)
	2	x		B	-	EBLTR (D)	B	-	WBLTR(D)
Rice Rd and Merritt Rd	1		x	-	EBLR (0.93)	EBLR (F)	-		EBLR (E)
	2	x		B	-	WBL (D)	B	-	WBL (D)
Rice Rd and Quaker Rd	1		x	-	EBLTR (1.48), WBLTR (1.01), NBLTR (1.8), SBLTR (0.98)	EBLTR (F), WBLTR (F), NBLTR (F), SBLTR (F)	-	EBLTR (1.18), WBLTR (1.38), NBLTR (1.64), SBLTR (1.16)	EBLTR (F), WBLTR (F), NBLTR (F), SBLTR (F)
	2	x		C	-	WBTR (D)	B	EBL (0.86)	EBL (E)
Hwy 406 NB Ramp and Merritt Rd	1		x	-	-	-	-	-	-
	2		x	-	-	-	-	-	-

9.2 2041 Comparison

9.2.1 Link Capacity Analysis

The results summarized in **Table 79** demonstrate that Under Scenario 1, some links will exceed capacity by 2041. Merritt Road east of Niagara Street – Merrittville Highway will have a v/c ratio of 1.12 for eastbound traffic in the AM and a v/c ratio of 1.30 for westbound traffic in the PM, indicating a heavy commuter flow as a result of increased development in the study area. To a lesser extent, Rice Road north of Merritt Road will be over capacity, with a v/c ratio of 1.06 for northbound traffic in the AM, suggesting a commuter pattern. Lesser values were noted south of Merritt Road on Rice Road. In addition, the link of Merritt Road east of Niagara Street/Merrittvielle Highway will appraoch capacity in the eastbound direction during the PM peak hour and in the westbound direction in the AM peak hour.

However, with the proposed right of way and geometric improvements as proposed under Scenario 2, none of the study area segments will have traffic demand exceeding the critical threshold of 85% of capacity by 2041, assuming that Rice Road is widened to four lanes between Quaker Road and Merritt Road.

Table 79: Comparison of the 2041 Link Capacity Analysis Results Under Scenario 1 and 2

Segment	Direction	Volume To Capacity Ratio AM Peak Period		Volume To Capacity Ratio PM Peak Period	
		Scenario 1	Scenario 2	Scenario 1	Scenario 2
Merritt Road (East of Niagara Street/Merrittville Highway)	EB	1.12	0.65	0.90	0.65
Merritt Road (East of Niagara Street/Merrittville Highway)	WB	0.97	0.49	1.30	0.70
Merritt Road (East of Cataract Road)	EB	0.28	0.83	0.28	0.65
Merritt Road (East of Cataract Road)	WB	0.45	0.54	0.49	0.75
Rice Road (North of Quaker Road)	NB	0.77	0.58	0.56	0.42
Rice Road (North of Quaker Road)	SB	0.47	0.34	0.57	0.42
Rice Road (North of Merritt Road)	NB	1.06	0.79	0.59	0.55
Rice Road (North of Merritt Road)	SB	0.47	0.46	0.77	0.67

9.2.2 Intersection Capacity Analysis

Intersection operations were modelled using Synchro 11 and the Highway Capacity Manual (HCM) 2000, published by the Transportation Research Board (TRB).

The results presented in **Table 80** confirm that the extension of Merritt Road between Cataract Road and Rice Road relieves congestion at the Niagara Street and Quaker Road intersection by partially moving the high travel demand from Quaker Road to Merritt Road. In addition, the extension would allow vehicles to access the Highway 406 ramps directly via Merritt Road in addition to via Niagara Street.

The improvement package evaluated in Scenario 2 would result in improved operation for each intersection. Near or after 2041, additional improvements may be considered to further address remaining operating problems:

- For the intersection of Niagara Street/Merrittville Highway and Merritt Road, consider and evaluate the benefits of a second westbound left turn lane to accommodate the high forecast left turn volumes of 363 vehicles per hour during the AM peak hour and 557 vehicles per hour during the PM peak hour;
- For the intersection of Niagara Street and Quaker Road, consider an additional southbound through lane;
- For the intersection of Merrittville Highway and Port Robinson Road, consider signalizing; and
- For the intersection of First Avenue/Cataract Road and Quaker Road, include left turn lanes when installing a signal.

Table 80: Comparison of 2041 Intersection Capacity Analysis Results Under Scenario 1 and 2

Intersection	Scenario (1 or 2) *Splits Optimized	Intersection Type		AM Peak Hour			PM Peak Hour		
		Signalized	Unsignalized	LOS	Critical Movements		LOS	Critical Movements *Splits Optimized	
					V/C	LOS		V/C	LOS
Niagara Street/Merrittville Hwy and Merritt Road	1	x		C	WBL (1.06)	WBL (E)	F	WBL (1.66)	EBLTR (D), WBL (F)
	2	x		C	WBL (0.93)	WBL (D), NBT (D)	C	WBL (1.06)	EBL (D), WBL (E), SBLTR (D)
Niagara Street and Quaker Road	1	x		E	EBL (1.49), SBT-TR (0.87)	EBL (F)	F	EBL (1.09), EBTR (0.90), NBL (0.90), SBTR (1.48)	EBL (F), EBTR (D), WBL (D), NBL (D), SBTR (F)
	2	x		B	-	-	E	EBTR (1.02), NBL (1.07), SBTR (1.00)	EBTR (E), WBL (E), NBL (F), SBTR (D)
Merrittville Hwy and Port Robinson Rd	1		x	-	EBLTR (1.76)	EBLTR (F), WBLTR (E)	-	EBLTR (1.01)	EBLTR (F), WBLTR (F)
	2		x	-	EBLTR (1.89),	EBLTR (F), WBLTR (E)	-	EBLTR (0.98)	EBLTR (F), WBLTR (F)
Cataract Rd and Port Robinson Rd	1		x	-	-	-	-	-	SBLTR (D)
	2		x	-	-	-	-	-	SBLTR (D)
Cataract Rd and Merritt Rd	1		x	-	-	-	-	-	-
	2	x		C	EBTR (0.91)	EBTR (D)	C	-	EBTR (D)
First Ave/Cataract Rd and Quaker Rd	1		x	-	EBLTR (1.65), WBLTR (1.59), NBLTR (1.65), SBLTR (1.04)	EBLTR (F), WBLTR (F), NBLTR (F), SBLTR (F)	-	EBLTR (1.63), WBLTR (2.03), NBLTR (1.77), SBLTR (1.65)	EBLTR (F), WBLTR (F), NBLTR (F), SBLTR (F)
	2	x		C	-	EBTR (D)	C	EBLTR (0.87)	EBLTR (D)
Rice Rd and Port Robinson Rd	1		x	-	NBLTR (1.84)	EBLTR (D), NBLTR (F)	-	NBLTR (1.44), SBLTR (1.33)	WBLTR (E), NBLTR (F), SBLTR (F)
	2	x		C	-	EBTR (D)	C	-	WBTR (D)
Rice Rd and Merritt Rd	1		x	-	EBLR (1.65)	EBLR (F)	-	EBLR (0.92)	EBLR (F)
	2	x		B	-	WBL (D)	B	-	EBL (D), EBTR (D), WBL (D)
Rice Rd and Quaker Rd	1		x	-	EBLTR (1.77), WBLTR (1.32), NBLTR (2.18), SBLTR (1.18)	EBLTR (F), WBLTR (F), NBLTR (F), SBLTR (F)	-	EBLTR (1.42), WBLTR (1.80), NBLTR (1.98), SBLTR (1.38)	EBLTR (F), WBLTR (F), NBLTR (F), SBLTR (F)
	2	x		C	-	WBTR (D)	C	-	WBTR (D)
Hwy 406 NB Ramp and Merritt Rd	1		x	-	-	-	-	-	-
	2		x	-	-	-	-	-	-

10.0 Modifications to Highway 406 Interchange

The Highway 406 N-E/W ramp to Merritt Road is approximately 205 meters east of the existing intersection of Merritt Road and Grisdale Avenue. Grisdale Avenue provides one connection to a mixed-use area in the southeast quadrant of Merritt Road and Merrittville Highway/Niagara Street. The Highway 406 N-E/W ramp currently splits into a direct ramp to westbound Merritt Road which merges west of Grisdale Road, and the ramp to eastbound Merritt Road terminates in a stop-controlled intersection.

The results of the assessment indicated that future traffic operations along Merritt Road would require road widening to accommodate future traffic demand. In addition, with the direct ramp for the southbound to westbound movement from the 406 N-E/W ramp moved to the stop bar, the ramp terminal intersection will meet a signal warrant. Grisdale Road generates very low traffic demand however the close proximity Grisdale Road to the Highway 406 Off-Ramp, combined with a westbound shared left turn and through lane at the Merritt Road and Grisdale Road intersection may result in weaving and delay problems.

WSP and the Region staff met with the Ontario Ministry of Transportation (MTO) staff a few times in 2022 and to discuss existing and future conditions and the need for improvements. As a result, several geometric options were prepared to assess functionality and operations at the Grisdale Road intersection. Options for the provision of active transportation connectivity across the bridge to the east side of Highway 406, in view of Merritt Road future widening, were also discussed. A summary of the six proposed design options is provided below.

A detailed analysis of these design options and supporting traffic assessment can be found in a memorandum provided in **Appendix M** of this report.

Option-1: Under this option the Grisdale Road/Merritt Road intersection is Right-In/Right-Out (RIRO) only by providing a pork-chop island to restrict westbound left (WBL) and northbound left (NBL) movements. It should be noted that this type of treatment is not preferred as drivers may not comply with turn restrictions and potentially create greater safety concern.

Additionally, it is proposed that the existing exclusive eastbound left (EBL) turn lane carrying in-bound traffic to Highway 406 E/W-S On-Ramp be converted to a shared eastbound through-left (EBTL) to utilize existing capacity and avoid widening on the south side of Merritt Road.

Option-2: Like Option-1, the Grisdale Road/Merritt Road intersection is considered as RIRO only by providing a raised concrete median along Merritt Road extending up to Highway 406 westerly Off-Ramp. This configuration ensures that westbound left (WBL) and northbound left (NBL) movements are not permitted to/from Grisdale Road. Under existing conditions, the Highway 406 N-E/W Off-Ramp has an exclusive channelized southbound right (SBR) turn lane which serves as a free-flow deceleration lane and a single shared southbound right/left lane at the terminal.

In addition to limiting Grisdale Road/Merritt Road intersection as RIRO only, a minor modification to the Highway 406 N-E/W Off-Ramp is also proposed in this option, which is the signalization of the ramp terminal and removal of channelized southbound right (SBR) turn lane while extending the lane to the intersection adjacent to southbound left (SBL) turn lane. It is anticipated that this modification will reduce speed of vehicles exiting the highway onto Merritt Road and will potentially increase the overall safety of the roadway.

Like Option-1, the existing exclusive eastbound left (EBL) turn lane carrying in-bound traffic to Highway 406 E/W-S On-Ramp is proposed be converted to a shared eastbound through-left (EBTL).

Option-3: In this option, a WBL turn is permitted at Grisdale Road/Merritt Road intersection along with eastbound right (EBR) and northbound right (NBR) turning movements, in other words a RIRO plus WBL. Since NBL is again not permitted under this option, the median island and right-turn channel is designed to ensure that NBL is completely restricted. However, this option facilitates safer turn onto Grisdale Road from Merritt Road with a provision of a dedicated WBL turn lane.

Similar modification to Highway 406 N-E/W Off-Ramp as in Option-2 is proposed. However, two (2) dedicated SBR turn lane and an exclusive SBL turn lane is proposed along with signalization of ramp terminal.

Option-4: This option is an enhanced version of Option-3 where all proposed improvements are carried with the exception of maintain an exclusive EBL turn and providing an additional EBT lane at Highway 406 N-E/W Off-Ramp and E/W-S On-Ramp intersection at Merritt Road. To avoid impacts and widening of the existing bridge structure over the highway, it is intended to match eastbound lanes prior to bridge westerly abutment. However, this reconstruction of additional EBT lane will cause major impacts to vegetated area because of regrading of embankment on the south side of Merritt Road and relocation of guiderail as well.

Option-5: In this option, the proposed improvements and restriction for Grisdale Road from Option 3 are carried forward. However, the Highway 406 westerly ramps (N-E/W Off-Ramp and E/W-S On-Ramp) intersection at Merritt Road is proposed to be converted to a two (2) lane roundabout with an inscribed circle diameter (ICD) of 55m.

A roundabout at ramp terminal in not uncommon on 400 series highways (one of the examples situated closer to the study area is Highway 406 terminus at East Main Street [Regional Road 27]), however, a roundabout is not considered a feasible option due to major property impacts and higher cost of construction because of much larger footprint than any given signalized/unsignalized intersection.

From the above, it is inferred that design Options 3, 4 and 5 provide better solution which allows improved safety for WBL turning vehicles and flexibility of future operation at Grisdale Road intersection and are carried forward for traffic assessment.

Option-6: This option is a modified version of Option-4 in which an existing EBL turn is maintained and additional EBT lane is provided at Highway 406 N-E/W Off-Ramp and E/W-S On-Ramp intersection at Merritt Road., while matching eastbound lanes prior to bridge westerly abutment to avoid impacts and widening of the existing bridge structure over the highway. As mentioned under option 4, this reconstruction of additional EBT lane will have added impacts to vegetated area due to regrading embankment on the south side of Merritt Road and relocation of guiderail.

Due to low traffic volumes, it is also proposed to remove WBR turn channel and provide a short WBR turn lane instead at the intersection. Removing WBR turn lane over the bridge will be a cost-effective solution where a Multi-Use Path (MUP) could be provided without widening bridge structure. The MUP is provided over the bridge structure as per the MTO Bikeways Design Manual (March 2014). This design option was identified by MTO staff as the preferred option.

10.1 Recommended Option for Highway 406 Interchange

An Executive Review Meeting was held with MTO's senior management on March 21, 2023, to present the preferred Option 6 and receive MTO's approval. Option 6 was accepted in principle by MTO senior management during the meeting with provision of minor comments. The Project Team subsequently updated the Option 6 to address MTO Senior Management's comments. On May 23, 2023, the MTO staff confirmed that they have no more comments on Option 6, and the Project Team could proceed with

including the preferred Option 6 in the environmental assessment reporting. Key features of MTO approved preferred design of Merritt Road, east of Grisdale Road over Highway 406 overpass and up to Kottmeier Road are discussed below:

- Provision of a multi-use path on the south side, which would transition to the north side at Highway 406 off-ramp and on-ramp intersection. Provision of a traffic signal at Highway 406 off-ramp and on-ramp intersection. The multi-use path east of this intersection would be a raised facility. This option will provide safer pedestrian crossing at the proposed signalized intersection and not yielding at on-ramps.
- Maintaining an existing eastbound left turn and providing additional eastbound through lane at off-ramp and on-ramp intersection at Merritt Road., while matching eastbound lanes prior to bridge westerly abutment to avoid impacts and widening of the existing bridge structure over the highway.
- Permitting a westbound left turn at Grisdale Road/Merritt Road intersection along with eastbound right and northbound right turning movements, in other words a right-in right-out plus westbound left turn (left-in). Northbound left turn from Grisdale Road to Merritt Road is not permitted under this option. The median island and right-turn channel have been proposed to ensure that northbound left turn is completely restricted. This option would facilitate safer turn onto Grisdale Road from Merritt Road with a provision of a dedicated westbound left turn lane.
- Removal of westbound right turn channel (due to low traffic volumes) and provision of a short westbound right turn lane instead at the intersection. Removal of westbound right turn lane over the bridge will be a cost-effective solution where the MUP could be provided without widening bridge structure. Initially, a concrete median was proposed between the vehicular traffic lanes and the MUP. However, based on the feedback provided by MTO Executive Review Meeting (held March 21, 2023), the concrete median was removed from the proposed cross-section. Further, the multi-use path was proposed as a raised multi-use path.

Intersection performance based on 2041 forecast traffic volumes and this recommended design is summarized in **Table 81**.

Table 81: 2041 Signalized Intersection Operations – Scenario 2 – Hwy 406 SB Ramp and Merritt Rd and Merritt Road and Grisdale Avenue

Intersection	Weekday Morning Peak Hour Performance Measures			Weekday Afternoon Peak Hour Performance Measures		
	Maximum Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service	Maximum Volume to Capacity Ratio	Average Vehicle Delay (seconds)	Level of Service
Merritt Road & Highway 406 Southbound Ramp	0.71	21.3	C	0.69	22.0	C
Merritt Road & Grisdale Road	0.53	2.2	C	0.51	1.8	A

As **Table 81** indicates, volume to capacity ratios are below the MTO threshold of 0.75 for all movements, and delays are acceptable.

Figure 29 provides a cross-section showing the proposed lane configuration and multi-use path east of Highway 406 off-ramp and on-ramp intersection. **Figure 30** shows the plan view of the proposed design. A detailed memo describing all six (6) design options for Merritt Road at Grisdale Road and Highway 406 is provided in **Appendix M**.

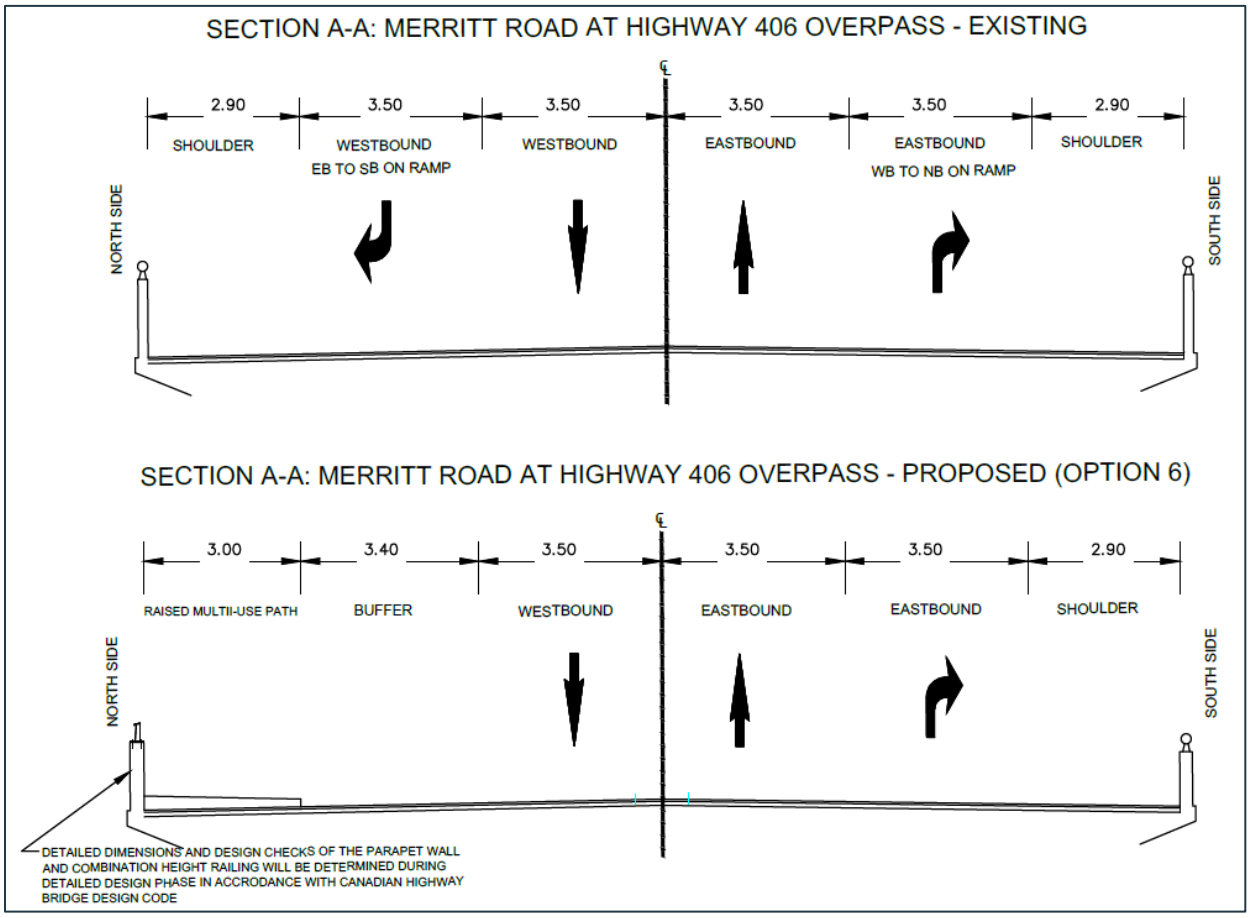


Figure 29: Proposed Cross-Section for Merritt Road at Highway 406 Overpass

10.2 Highway 406 Interchange Southbound Ramp 2031 Signal Warrant Analysis

At the time of the analysis of these improvements, analysis was limited to 2041 conditions, however it may be desirable to advance the work to 2031 to facilitate construction of active transportation infrastructure east of the Highway 406 southbound off-ramp.

To determine whether traffic signals are expected to be justified in with the recommended changes to lane configuration and 2031 forecast volumes, the weekday afternoon peak hour turning movement volume forecast was considered and Traffic Signal Justification 7 from "Ontario Traffic Manual for Traffic Signals" was applied. This method estimates average hourly volumes for turning movement volumes based on a peak hour forecast.

The following formula was applied:

$$AHV = \frac{PHV}{2}$$

Where:

AHV = Average hourly volume

PHV = Peak hour volume

To apply this analysis method, the AHV results are compared for the Minimum Vehicular Volume and Delay to Cross Traffic criteria for traffic signal justification. Each of these components have two sub criteria, and if both portions of one component are 100% satisfied, a traffic signal is justified. Alternatively, if each portion of the two components (ie all four parts) are satisfied 80% or more, a traffic signal is justified.

Calculations and analysis are summarized in **Table 80**.

Table 82: 2031 Signal Warrant Analysis – Merritt Road & Highway 406 SB Ramp Recommended Lane Configuration

Signal Warrant Component		**Applicable Threshold Volume** (vehicles/hour)	**2031 PM Peak Hour Volume (PHV)** (vehicles/hour)	**PHV / 2** (vehicles/hour)	**% Satisfied**
Minimum Vehicular Volume	Total Volume	900	2333	1167	100%
	Crossing Volume	255	1145	573	100%
Delay to Cross Traffic	Main Road	900	1188	594	66%
	Crossing Road	75	1145	573	100%

As **Table 82** indicates, with the change in lane configuration for the Highway 406 southbound off ramp, the Minimum Vehicular Volume justification is expected to be met in 2031, and a signal is therefore expected to be justified.

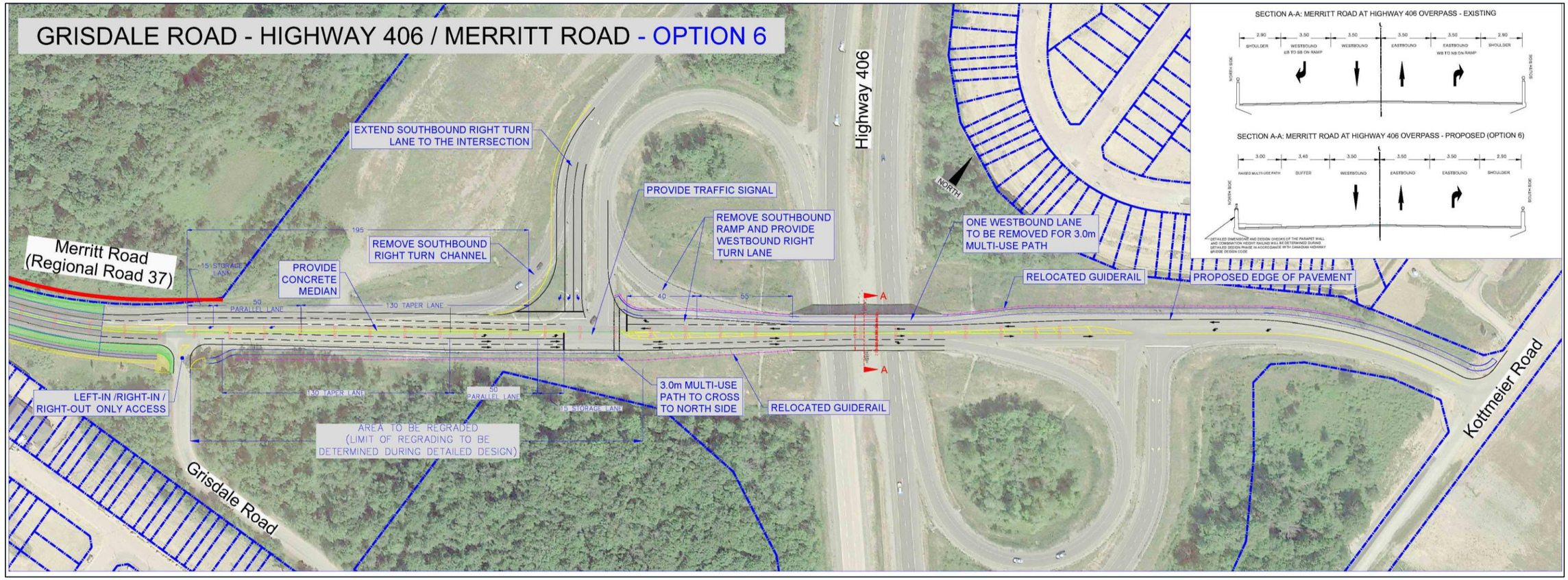


Figure 30: Proposed Design for Merritt Road at Highway 406 Overpass

11.0 Active Transportation Assessment

This section outlines existing active transportation conditions within the study area, a summary of current active transportation plans and policies for the study areas as well as the results of the multi-modal assessment LOS assessment undertaken for the existing road network for the 2020 base year. This section also outlines proposed active transportation under Scenario 2 conditions.

11.1 Existing Sustainable Transportation Modes

Sustainable transportation modes include transit, walking, and cycling. There are currently no sidewalks within the four segments. However, there are sidewalks directly south of Quaker Road on both sides of First Avenue and Niagara Street. These are located south of the study area. Paved shoulders in varying widths are provided for cyclists along some segments. The existing sidewalk and cycling infrastructure are shown in **Figure 31**.

There are three bus routes and four bus stop locations that can be found within the study area. Transit information for these buses can be found in **Table 81**.

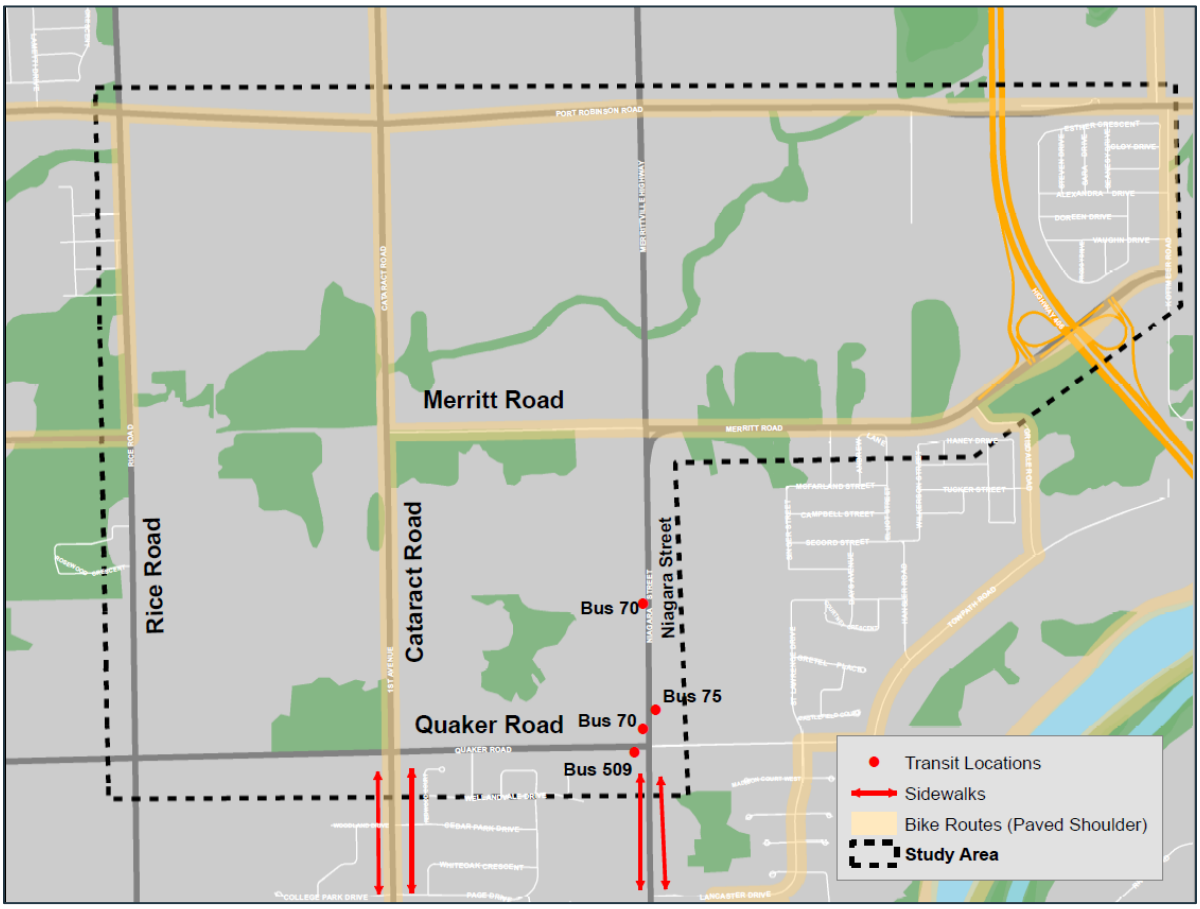


Figure 31: Sustainable Transportation Modes

Table 81: Existing Transit Information

Bus Number	Agency	Route Name	Service Days	Headway
Bus 70	Niagara Region Transit	St. Catharines to Welland	Monday to Saturday	• 1 hour
Bus 75	Niagara Region Transit	Welland to St. Catharines	Monday to Saturday	• 1 hour
Bus 509	Welland Transit	Niagara	Monday to Saturday	• Monday to Friday: Every 30 minutes between 6 AM to 6:27 PM and every 60 minutes until 10:27 PM. • Saturday: Every 60 minutes between 6:00 AM and 9:57 AM and every 30 minutes until 6:27 PM and 60 minutes until 9:27 PM
Bus 509	Welland Transit	Niagara	Sunday	• Every 60 minutes between 10 AM and 5:27 PM

11.2 Active Transportation Plans

A literature review was conducted to understand the current active transportation plans and policies in and around the study area by Niagara Region and nearby local municipalities.

11.2.1 Niagara Region

Merritt Road and Rice Road are currently not planned for future cycling facilities, as shown in a close-up of the Strategic Cycling Network Map from the Niagara Region Transportation Master Plan, as shown in **Figure 32**.

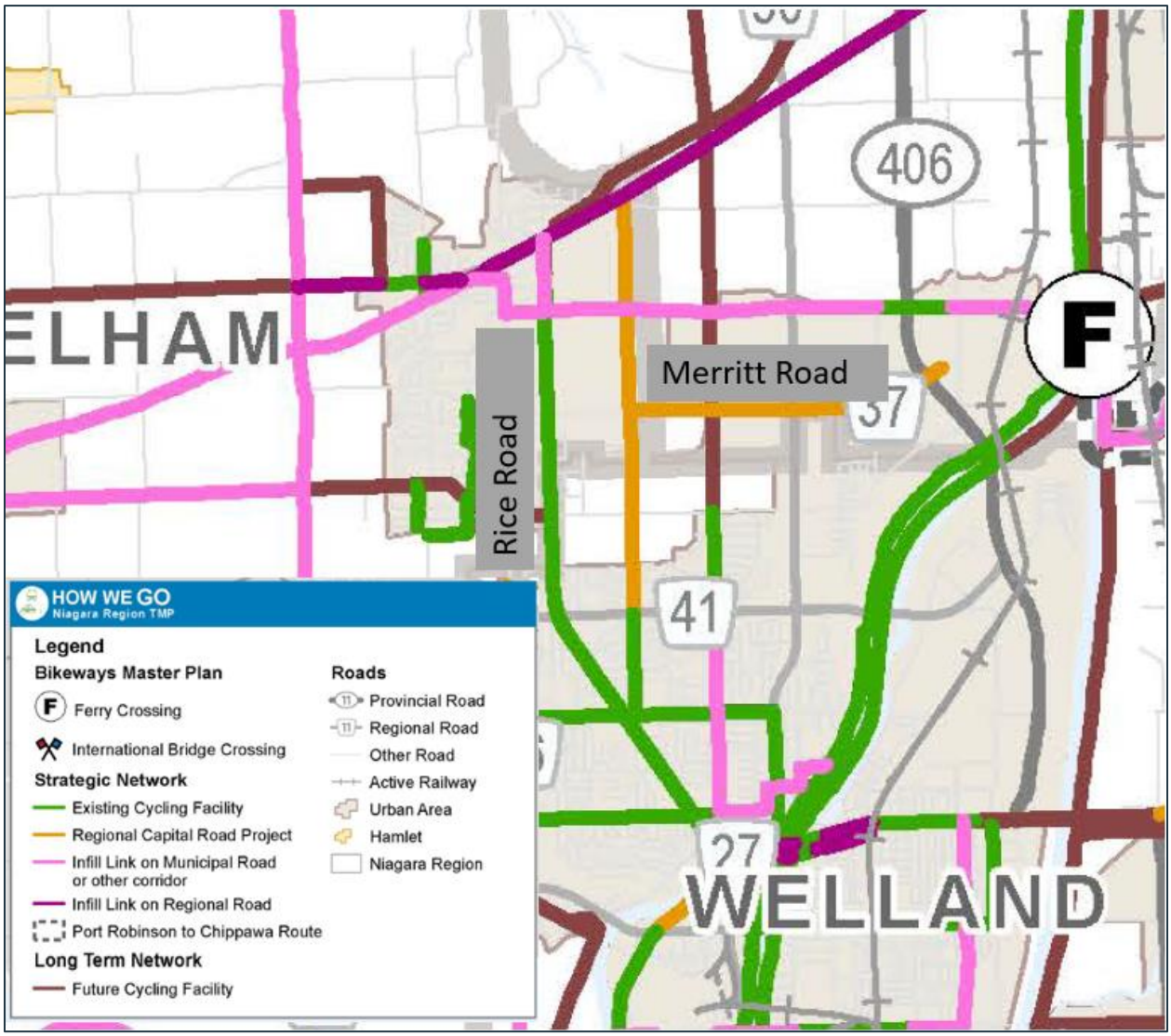


Figure 32: Planned Strategic Cycling Network Map Close-Up

11.2.2 City of Thorold

The City of Thorold has planned active transportation improvements for Merritt Road, as documented in the Thorold Transportation Master Plan.

The planned sidewalk network project details are shown in **Table 82**. Careful consideration should be given to the provision of a sidewalk on the north side of Merritt Road between Merrittville Highway/Niagara Street and Kottmeier Road, given the presence of two free-flow ramps at the Highway 406 interchange.

Table 82: Planned Sidewalk Network Project Details

Corridor	Side	From	To	Cost
Merritt Road	North	Cataract Road	Merrittville Highway	n/a
Merritt Road	South	Cataract Road	Merrittville Highway	n/a
Merritt Road	North	Merrittville Highway/Niagara Street	Kottmeier Road	n/a
Merritt Road	South	Merrittville Highway/Niagara Street	Kottmeier Road	n/a

The Region's TMP stated that these sidewalk projects are development dependent. The developers constructing new neighborhoods surrounding these streets are responsible for its development.

The planned cycling network project details are listed in the following table.

Table 83: Planned Cycling Network Project Details

Corridor	Limits	Implementation	Cost
Merritt Road (new road)	West City Limits to Cataract Road	Multi-use Trail	$252,000
Merritt Road	Cataract Road to Merrittville Highway/Niagara Street	Multi-use trail	$328,000
Merritt Road	Merrittville Highway/Niagara Street to Kottmeier Road	Multi-use trail	$732,000

11.2.3 Town of Pelham

The City of Pelham currently has an Active Transportation Committee, which will be involved in this study. This committee held a meeting on February 23, 2021, to provide input into the transportation assessment. They have offered the following comments for consideration:

- It is recommended that the potential impact of the proposed route into Pelham be considered.
- Pedestrian and cycling infrastructure should be included in the proposed route.
- The route should facilitate active transportation to existing routes in Pelham, such as the Steve Bauer Trail.
- The route should address projected growth and population increases in Pelham's new developments (i.e., the Merritt Road corridor).
- A traffic signal may be warranted at Rice Road and Merritt Road. This would benefit connectivity.

11.2.4 City of Welland

The City of Welland plans to run trails along Rice Road between Quaker Road and Woodlawn Road, which is directly south of the study area, as shown in **Figure 33**. The City of Welland is currently conducting a Bike and Trails Masterplan to provide more details regarding the trail network along Rice Road.

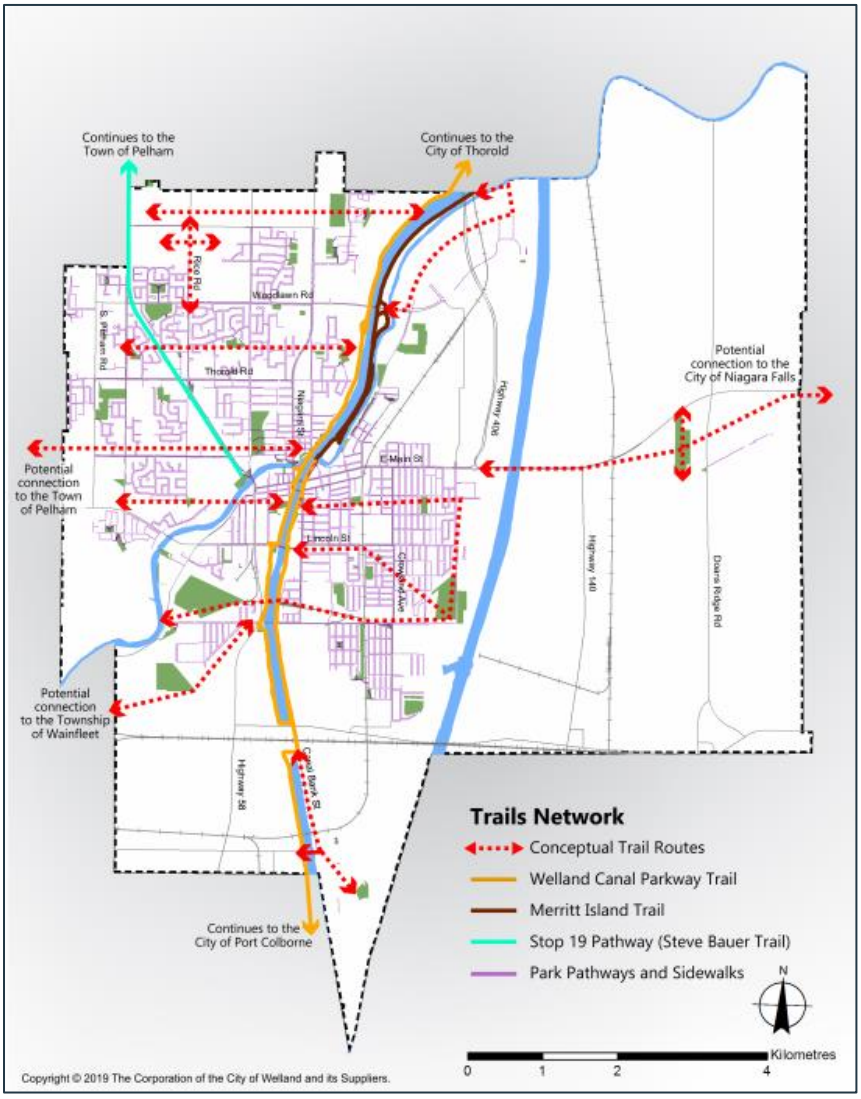


Figure 33: City of Welland Conceptual Trail Network (City of Welland Parks, Recreation, and Culture Master Plan)

11.3 Multi-Modal Level of Service Assessment

A Multi-Modal LOS Assessment was undertaken as per the methodology described in **Section 4.5**. The pedestrian and bicycle LOS are summarized in **Table 84** and **Table 85**, respectively. In all four study segments, no dedicated infrastructure for pedestrians and cyclists (i.e., sidewalks, bicycle lanes) was identified. Pavement shoulders were provided along the Segment 3 corridor. It is worth noting that any intersections adjacent to the four segments did not have the sufficient pedestrian infrastructure, such as clearly delineated crosswalks. The signalized intersection of Merritt Road and Merrittville Highway/Niagara Street does not currently have pedestrian signals or countdown timers. The lack of such pedestrian

infrastructure may lead to drivers' lack of attention toward pedestrians, particularly as this area develops and pedestrian activity increases.

Table 84: Existing Conditions (2020) Pedestrian Level of Service Summary

Segment	Direction	LOS	Note
Segment 1: Merritt Rd (Unopened) between Rice Rd and Cataract Rd	Eastbound	-	Unopened
	Westbound	-	Unopened
Segment 2: Merritt Rd (Municipal ROW) between Cataract Rd and Niagara St	Eastbound	F	-
	Westbound	F	-
Segment 3: Merritt Rd (Regional ROW) between Niagara St and Kottmeier Rd	Eastbound	E	-
	Westbound	E	-
Segment 4: Rice Rd between Quaker Rd and Merritt Rd (Unopened)	Northbound	F	-
	Southbound	F	-

Table 85: Existing Conditions (2020) Bicycle Level of Service Summary

Segment	Direction	LOS	Note
Segment 1: Merritt Rd (Unopened) between Rice Rd and Cataract Rd	Eastbound	-	Unopened
	Westbound	-	Unopened
Segment 2: Merritt Rd (Municipal ROW) between Cataract Rd and Niagara St	Eastbound	F	-
	Westbound	F	-
Segment 3: Merritt Rd (Regional ROW) between Niagara St and Kottmeier Rd	Eastbound	E	-
	Westbound	E	-
Segment 4: Rice Rd between Quaker Rd and Merritt Rd (Unopened)	Northbound	F	-
	Southbound	F	-

11.4 Active Transportation Under Scenario 2 Conditions

In conjunction with the road improvements identified as part of this study, active transportation facilities are recommended for pedestrians and cyclists along all four segments. These active transportation facilities were identified considering the Region's Draft Complete Streets Design Manual.

The following active transportation facilities were recommended on all four road segments:

Segment 1 – Merritt Road between Rice Road and Cataract Road

- 3.0 m multi-use path on the north side.

Segment 2 – Merritt Road between Cataract Road and Merrittville Highway/Niagara Street

- 3.0 m multi-use path on the north side.

Segment 3 – Merritt Road between Merrittville Highway/Niagara Street and Highway 406 Interchange

Merritt Road from Merrittville Highway /Niagara Street to Grisdale Road

- 1.8 m sidewalk on the south side
- 3.6 m separated two-way cycle track on the south side.

Merritt Road from Grisdale Road to Highway 406 Overpass/Kottmeier Road

- 3.0 m multi-use path on the south side, which would transition to the north side at Highway 406 off-ramp and on-ramp intersection.

Segment 4 – Rice Road between Quaker Road and Merritt Road

- 1.8 m sidewalk on the east side
- 3.0 m multi-use path on the west side.

The above active transportation network will be integrated with the surrounding active transportation with appropriate transitions. In addition, through consultation with the local municipalities, consideration will be given to providing enhancements to the existing transit within the study area in keeping with the anticipated development.

12.0 Summary of Key Findings and Recommendations

Detailed analysis was completed to assess existing and forecast future traffic conditions along Merrit Road and Rice Road within the study area and inform a design concept for the study area. The assessment included evaluating the existing traffic conditions for the 2020 base year as well as for the horizon years 2031 and 2041. Two road network scenarios were discussed for each of the future (2031 and 2041) horizon years. Descriptions of both scenarios are provided below.

Scenario 1 – Do Nothing

In Scenario 1, the traffic assessments for future 2031 and 2041 horizon years were undertaken on the exisiting road network for the 2020 base year. The assessments were completed assuming that no improvements were implemented for either future horizon year (i.e., no capacity improvements were undertaken, and Merritt Road was not extended to provide a connection between Cataract Road and Rice Road).

Scenario 2 – With Improvements

In Scenario 2, the future assessments for 2031 and 2041 hoirizon years were undertaken on the modified road network assuming road network improvements for each horizon year. The proposed improvements included the Merritt Road extension between Rice Road and Cataract Road, installation and optimizations of traffic signals and geometric improvements.

The proposed improvements for each future horizon year (2031 and 2041) considered the results of link capacity and intersection capacity analyses for Scenario 1 – Do Nothing, and consultation with the Region and the Ministry of Transportation (MTO).

12.1 Findings

Existing Conditions:

- Many segments of the study area transportation network do not have sidewalks. Some have paved/unpaved shoulders that are not wide enough for pedestrians. For the active transportation facilities, based on the York Region Multi-Modal Level of Assessment framework, all study area road segments were found to operate with LOS E or F for pedestrians. Sidewalks are located along First Avenue and Niagara Street south of Quaker Street, outside the study area. These sidewalks stop at Quaker Street and do not continue north.
- Existing cycling infrastructure consists of paved/unpaved shoulders of varying widths, and there is no cycling transportation infrastructure along Rice Road between Quaker Road and Merritt Road. For the active transportation facilities, based on the York Region Multi-Modal Level of Assessment framework, all segments were found to operate with LOS E or F for bicycle travel.
- There is limited transit within the study area, including four bus stops, all situated around Quaker Road and Niagara Street. For most of the day, the headway for these buses is 1 hour. There is no existing transit service running along Merritt Road or Rice Road.
- For network connectivity, it was noted that Port Robinson Road and Quaker Road within the study area provide connections between communities west of the study area and Highway 406 via First Avenue/Cataract Road or Niagara Street/Merrittville Highway. Due to the unopened road allowance for Merritt Road between Rice Road and Cataract Road/First Avenue, drivers who would otherwise travel directly along Merritt Road to or from the Highway 406 ramps must currently make a series of turns to follow these routes.
- Under existing traffic conditions, all links operate at an overall acceptable v/c ratio

- Under existing traffic conditions, there are significant delays and capacity deficiencies at the all-way stop controlled intersections of:
  - Rice Road and Quaker Road and
  - Quaker Road and Cataract Road
- There are minor operating problems at the intersections of
  - Rice Road and Port Robinson Road
  - Niagara Street/Merrittville Highway and Merritt Road
  - Merrittville Highway/Niagara Street and Quaker Road.

2031 Horizon Year – Scenario 1

- Identified active transportation improvements can be implemented in conjunction with other road network and intersection improvements.
- Scenario 1 assumes no improvements to the existing transportation network, therefore pedestrian and bicycle level of service, transit service and connectivity of the road network for vehicles will remain the same as in existing conditions.
- With no improvements to the network, all links will operate with an overall acceptable v/c ratio except Merritt Road east of Niagara Street/Merrittville Highway in the PM peak hour which will exceed capacity in the westbound direction.
- With no improvements to the network, the following intersections are expected to have operating problems:
  - Niagara Street/Merrittville Highway and Merritt Road
  - Niagara Street and Quaker Road
  - Merrittville Highway and Port Robinson Road
  - First Avenue/Cataract Road and Quaker Road
  - Rice Road and Port Robinson Road
  - Rice Road and Merritt Road
  - Rice Road and Quaker Road
- For information purposes, a signal warrant analysis was conducted for 2031 horizon year under Scenario 1 for the following intersections, which were all expected to meet signal warrants based on 2031 Scenario 1. However, this analysis was not considered in the intersection capacity analysis since Scenario 1 is based on the existing road network, lane configurations and traffic control:
  - Rice Road and Quaker Road
  - Rice Road and Port Robinson Road
  - Merrittville Highway and Port Robinson Road, and
  - Quaker Road and First Avenue – Cataract Road.

2031 Horizon Year – Scenario 2

- Drivers travelling bewteen the communities to the west of the study area and Highway 406 would have improved network connectivity with the construction of the unopened segment of Merritt Road bewteen Rice Road and Cataract Road/First Avenue.
- With the implementation of the proposed improvements, none of the study area segments will have traffic exceeding capacity by 2031 and will operate with an acceptable overall v/c ratio. Rice Road

between Quaker Road and Merritt Road will approach capacity (0.96) for northbound movements in the AM peak hour.

- With the implementation of proposed improvements, all signalized intersections will operate with an overall acceptable LOS and volume to capacity ratios for individual movements less than 1.00.
- The following intersections will have minor delay problems with one or more movements with LOS D:
  - Niagara Street and Quaker Road
  - Rice Road and Port Robinson Road
  - Rice Road and Merritt Road
- The following intersections will have movements with LOS E or F or movements with critical volume to capacity ratios between 0.85 and 0.99, considered to be tolerable operating problems as an interim condition:
  - Rice Road and Quaker Road
  - Merritt Road and Highway 406 Southbound Ramp
  - Merrittville Highway and Port Robinson Road
  - Cataract Road and Merritt Road
  - First Avenue/Cataract Road and Quaker Road
- Based on sensitivity analysis, the intersections of Rice Road and Merritt Road and Rice Road and Quaker Road would operate similarly without widening Rice Road in two lanes in each direction, therefore this widening could be deferred.
- A signal warrant analysis was conducted for 2031 horizon year under Scenario 2 for Rice Road and Quaker Road, Rice Road and Merritt Road, Merritt Road and Cataract Road, Merrittville Highway and Port Robinson Road, and Quaker Road and First Avenue. A signal is expected to be justified for all five intersections. However, tests of geometric improvements indicated that operation of some intersections is expected to be tolerable with lane configuration updates only, without signalization. Based on this analysis, signalization was assumed for Scenario 2 for 2031 for the following intersections:
  - Rice Road and Quaker Road
  - Rice Road and Merritt Road and
  - Quaker Road and First Avenue

2041 Horizon Year – Scenario 1

- Scenario 1 assumes no improvements to the existing transportation network, therefore pedestrian and bicycle level of service, transit service and connectivity of the road network for vehicles will remain the same as in existing conditions.
- Traffic volumes on Merritt Road are expected to increase during commuting peak periods as a result of increased development in this area. If no changes are made to the existing road infrastructure by 2041, the following links will exceed capacity and will operate with an overall v/c ratio of 1.00 or worse during one of the peak hours:
  - Merritt Road east of Niagara Street/Merrittville Highway eastbound and westbound
  - Rice Road north of Merritt Road northbound
- With no change to the existing road infrastructure, the following intersection will have minor delay problems with one or more movements with LOS D:
  - Cataract Road and Port Robinson Road

- The following intersections will have movements with LOS E or F or movements with critical volume to capacity ratios exceeding 0.85, including some volume to capacity ratios exceeding 1.00:
  - Niagara Street/Merrittville Highway and Merritt Road
  - Niagara Street and Quaker Road
  - Merrittville Highway and Port Robinson Road
  - First Avenue/Cataract Road and Quaker Road
  - Rice Road and Port Robinson Road
  - Rice Road and Merritt Road
  - Rice Road and Quaker Road
- For information purposes, a signal warrant analysis was conducted for 2041 horizon year under Scenario 1 for Rice Road / Quaker Road, Rice Road / Port Robinson Road, Merrittville Highway / Port Robinson Road, and Quaker Road / First Avenue – Cataract Road. A signal was justified for all four intersections by 2041. However, capacity analysis was based on existing traffic control for this scenario.

2041 Horizon Year – Scenario 2

- Active transportation improvemetns can be implemented in conjunction with road network and itnersection improvements
- Drivers travelling bewteen the communities to the west of the study area and Highway 406 would have improved network connectivity with the construction of the unopened segment of Merritt Road bewteen Rice Road and Cataract Road/First Avenue.
- With the proposed right of way and geometric improvements, none of the study area road links will have traffic exceeding capacity and each will operate with an overall acceptable v/c ratio.
- Signal warrant analysis was conducted for 2041 horizon year under Scenario 2 for Rice Road and Quaker Road, Rice Road and Merritt Road, Merritt Road and Cataract Road, Merrittville Highway and Port Robinson Road, and Quaker Road and First Avenue. A signal is expected to be justified for all five intersections by 2041. Capacity analysis was conducted assuming traffic signal operation at all intersections except Merrittville Highway and Port Robinson Road.
- With the implementation of the proposed right of way and geometric improvements, the Highway 406 Southbound and Highway 406 Northbound ramps at Merritt Road are expected to operate acceptably.
- The following intersections are expected to have minor delays problems, limited to one or more movements having LOS D:
  - Rice Road and Port Robinson Road
  - Rice Road and Merritt Road
  - Rice Road and Quaker Road
  - Cataract Road and Port Robinson Road
- The following intersections will have movements with LOS E or F or movements with critical volume to capacity ratios between 0.85 and 0.99, considered to be tolerable operating problems as an interim condition:
  - Cataract Road and Merritt Road
  - First Avenue/Cataract Road and Quaker Road

- The following intersections will have individual movements with volume to capacity ratios greater than 1.00 and may require further improvements:
  - Niagara Street/Merrittville Highway and Merritt Road will have a westbound volume to capacity ratio of 1.06 in the PM peak hour. This movement has a very high volume and dual left turn lanes may be required to address this capacity efficiency.
  - Niagara Street and Quaker Road is expected to have 3 lane group with volume to capacity ratios greater than 1.00 (eastbound through and right, northbound left and southbound through). The forecast southbound through volume is very high, and addition of one more southbound through lane through the intersection may address this issue.
  - Merrittville Highway and Port Robinson Road, if left unsignalized and without additional turning lanes will have a volume to capacity ratio of 1.89 for the eastbound approach. The addition of an eastbound left turn lane will provide some relief, however installation of signals, which is expected to be warranted in this scenario and horizon, would be a more effective solution.

12.2 Recommendations

Based on the study findings, in order to accommodate future vehicle traffic demands and forecast for 2031 and 2041 it is recommended that the following improvements be implemented:

General

- Monitor traffic volumes and patterns and confirm or adjust schedules for recommended improvements as required based on evolving patterns.
- During the detailed design, the safety related recommendations made in **Section 6.0** to be further evaluated and incorporated into the design where supported.
- Conduct further studies to investigate options for providing transit access to, from, and through the study area.

Improvements to Active Transportation Facilities:

- Undertake further investigation to explore options for improving walking infrastructure along Cataract Road, First Avenue, and Niagara Street for pedestrians to improve network connectivity in the study area.
- In conjunction with road network improvements, implement the following active transportation improvements:

Segment 1 – Merritt Road between Rice Road and Cataract Road

- 3.0 m multi-use path on the north side.

Segment 2 – Merritt Road between Cataract Road and Merrittville Highway/Niagara Street

- 3.0 m multi-use path on the north side.

Segment 3 – Merritt Road between Merrittville Highway/Niagara Street and Highway 406 Interchange

Merritt Road from Merrittville Highway /Niagara Street to Grisdale Road

- 1.8 m sidewalk on the south side
- 3.6 m separated two-way cycle track on the south side.

Merritt Road from Grisdale Road to Highway 406 Overpass/Kottmeier Road

- 3.0 m multi-use path on the south side, which would transition to the north side at Highway 406 off-ramp and on-ramp intersection.

Segment 4 – Rice Road between Quaker Road and Merritt Road

- 1.8 m sidewalk on the east side
- 3.0 m multi-use path on the west side

Improvements to enhance vehicular traffic operations by 2031:

- Extend Merritt Road between Rice Road and Cataract Road (Niagara Region).
- Widen Merritt Road between Niagara Street/Merrittville Highway and the Highway 406 interchange to a four-lane cross-section (Niagara Region).
- Add a westbound left turn lane and an eastbound left turn lane at the intersection of Merritt Road and Cataract Road (Niagara Region).
- At the Merrittville Highway / Niagara Street and Merritt Road intersection, add a second westbound through lane carrying through the intersection and terminating on the departing leg, a second eastbound through lane on the west approach, a dedicated eastbound left-turn, and convert northbound right channelized lane to a regular right turn lane (Niagara Region).
- Signalize the intersections of Rice Road and Merritt Road, and Rice Road and Quaker Road, and add dedicated left-turn lanes on all approaches as per the Niagara Region's policy for signalized intersection (Niagara Region).
- Signalize the intersection of the Highway 406 southbound ramp and Merritt Road, replace the channelized westbound and southbound right turn lanes with exclusive right turn lanes at the stop bar, and widen the ramp to add a second southbound right turn lane (Niagara Region). Construct Merritt Road improvements east of Niagara Street and Merrittville Highway and the construction of the MUP east of the Grisdale Road.
- Widening Rice Road between Quaker Road and Merritt Road to a four-lane cross-section could be done by 2031 (Niagara Region) or deferred to 2041.

Improvements to enhance vehicular traffic operations by 2041:

- Signalize the intersection of Merritt Road and Cataract Road (Niagara Region).
- At the intersection of Merritt Road at Rice Road, add a westbound protected-permitted left turn phase to the traffic signal operation (Niagara Region), and if Rice Road has not been widened by this time, construct the widening to two lanes in each direction.
- At Rice Road and Quaker Road, add an eastbound protected-permitted left turn phase to the traffic signal operation (Niagara Region) and if Rice Road has not been widened by this time, construct the widening to two lanes in each direction.
- Either signalize the intersection of First Avenue/Cataract Road and Quaker Road with left turn lanes on each approach or install a roundabout at the intersection (City of Thorold/City of Welland).

Improvements to enhance vehicular traffic operations beyond 2041:

- Consider a second westbound left turn lane for the intersection of Niagara Street/Merrittville Highway and Merritt Road to accommodate high forecast westbound left turn volumes (Niagara Region).
- Consider an addition southbound through lane through the intersection of Niagara Street and Quaker Road to accommodate high forecast southbound through volumes (City of Welland).

Recommended improvements to road segments and intersections are summarized in the tables below.

Table 86: Recommended Road Improvements

Road Segment	Timeline	Recommended Road Improvements
Segment 1: Merritt Road from Rice Road to Cataract Road	By 2031	• Extend Merritt Road between Rice Road and Cataract Road. • Add a 3.0 m multi-use path on the north side.
Segment 2: Merritt Road from Cataract Road to Merrittville Highway / Niagara Street	By 2031	• Add a 3.0 m multi-use path on the north side.
Segment 3: Merritt Road from Merrittville Highway / Niagara Street to Highway 406 Interchange / Kottmeier Road	By 2031	Merritt Road from Merrittville Highway / Niagara Street to Grisdale Road: • Widen roadway to a four-lane cross-section. • Add a 1.8 m sidewalk and a 3.6 m separated two-way cycle track on the south side. Merritt Road from Grisdale Road to Highway 406 Overpass / Kottmeier Road: • Add a 3.0 m multi-use path on the south side, which would transition to the north side at Highway 406 off-ramp and on-ramp intersection.
Segment 4: Rice Road from Quaker Road to Merritt Road	By 2041	• Widen roadway to a four-lane cross-section. • Add a 1.8 m sidewalk on the east side • Add a 3.0 m multi-use path on the west side

Table 87: Recommended Intersection Improvements

Intersection	Timeline	Recommended Intersection Improvements
Merritt Road and Cataract Road	By 2031	• Add a westbound left turn lane and an eastbound left turn lane
	By 2041	• Signalize the intersection.
Merrittville Highway / Niagara Street and Merritt Road intersection	By 2031	• Add a second westbound through lane carrying through the intersection and terminating on the departing leg, a second eastbound through lane on the west approach, a dedicated eastbound left-turn, and convert northbound right channelized lane to a regular right turn lane.
Rice Road and Merritt Road	By 2031	• Add dedicated left-turn lanes on all approaches.
	By 2041	• Add a westbound protected-permitted left turn phase to the traffic signal operation. • Add a northbound through lane and southbound through lane.
Rice Road and Quaker Road	By 2031	• Add dedicated left-turn lanes on all approaches.
	By 2041	• Add an eastbound protected-permitted left turn phase to the traffic signal operation (Niagara Region). • Add a northbound through lane and southbound through lane.
Highway 406 southbound ramp and Merritt Road	By 2031	• Signalize the intersection, replace the channelized westbound and southbound right turn lanes with exclusive right turn lanes at the stop bar, and widen the ramp to add a second southbound right turn lane.
First Avenue / Cataract Road and Quaker Road	By 2041	• Either signalize the intersection with left turn lanes on each approach or install a roundabout at the intersection (City of Thorold/City of Welland).
Niagara Street / Merrittville Highway and Merritt Road	Beyond 2041	• Consider a second westbound left turn lane to accommodate high forecast westbound left turn volumes.
Niagara Street and Quaker Road	Beyond 2041	• Consider an addition southbound through lane to accommodate high forecast southbound through volumes (City of Welland).

APPENDIX

A SIGNAL TIMING PLANS

Signal Code: 050QUK
Intersection: RR50 (NIAGARA ST.) & QUAKER RD.
Municipality: welland
Owner: Region
Last Modified: 1/24/2018 8:52:53 AM

Timing Parameters	NBD & SBD ADVANCE NIAGARA ST.	NBD & SBD THRU NIAGARA ST.	EBD & WBD THRU QUAKER RD.	n/a	n/a	n/a
Min Green	6	10	8	0	0	0
Walk	0	9	11	0	0	0
Ped Clearance	0	14	18	0	0	0
Vehicle Ext.	2.5	2.5	2.5	0	0	0
Max Green	15	35	25	0	0	0
Yellow	3	4.1	4.1	0	0	0
All Red	0	2.5	2.8	0	0	0

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

Installed On:
9/11/1995
Count Date:
7/14/2017

FA = Fully Actuated **SA = Semi Actuated** **FT = Fixed Time**

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

Copyright 2001 © Regional Niagara

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

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

Installed On:
1/29/2002
Count Date:
6/21/2016

FA = Fully Actuated **SA = Semi Actuated** **FT = Fixed Time**

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

Copyright 2001 © Regional Niagara

Signal Code: 054PRT
Intersection: RR54 (Rice Road) & Port Robinson Road
Municipality: pelham
Owner: region
Last Modified: 5/14/2021 9:21:43 AM

Timing Parameters	NBD & SBD THRU RICE	EBD & WBD THRU PORT ROBINSON	n/a	n/a	n/a	n/a
Min Green	10	8	0	0	0	0
Walk	11	11	0	0	0	0
Ped Clearance	19	19	0	0	0	0
Vehicle Ext.	2.5	2.5	0	0	0	0
Max Green	40	30	0	0	0	0
Yellow	4.1	4.1	0	0	0	0
All Red	2.9	2.7	0	0	0	0

		Offset
Minimum Cycle	31.8	0
Pedestrian Cycle	73.8	
Maximum Cycle	83.8	0
Operation	FA	

Installed On:
--/--/----
Count Date:
--/--/----

FA = Fully Actuated **SA = Semi Actuated** **FT = Fixed Time**

Close Window | Print Entry* | Refresh Entry

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

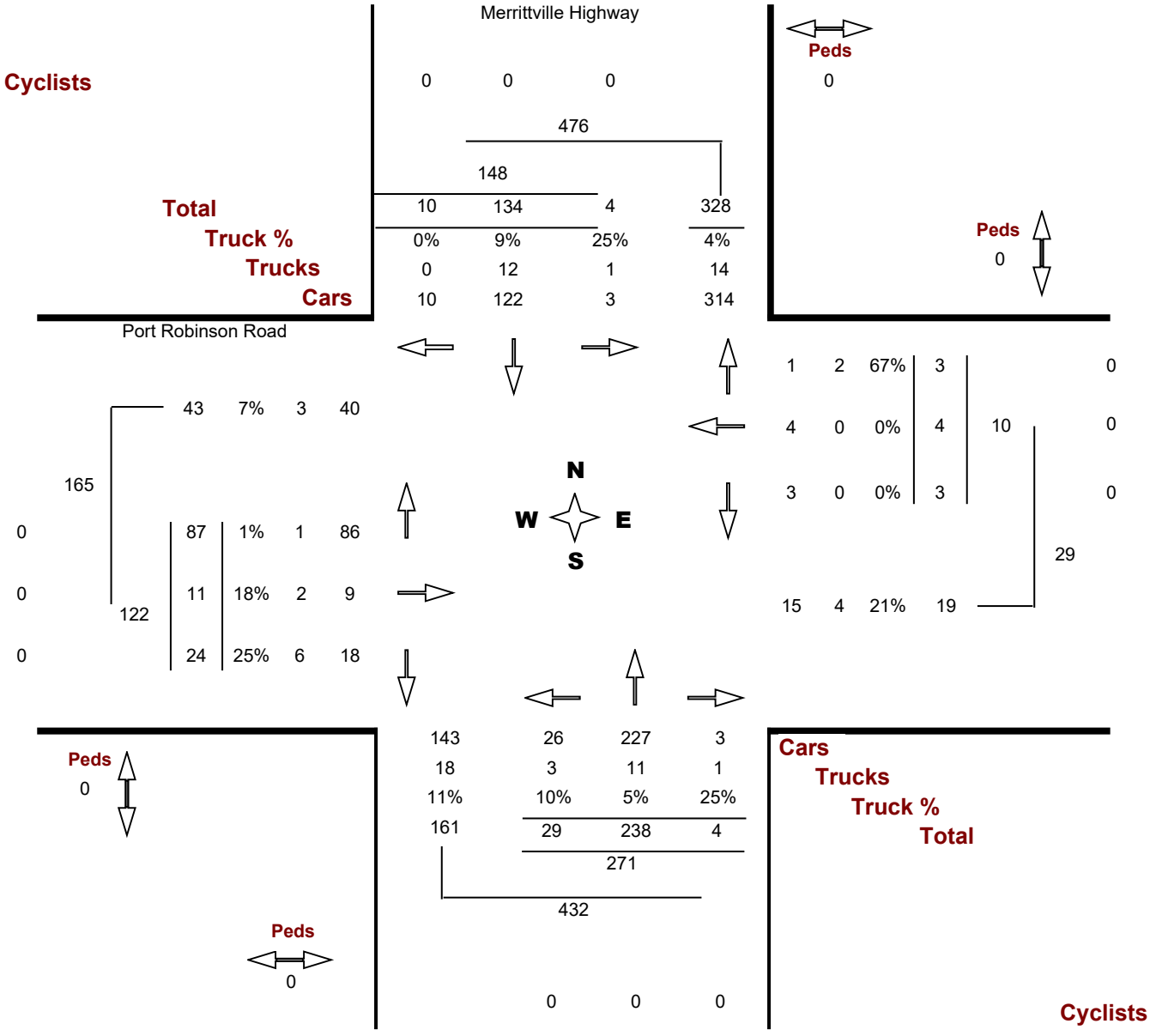
Copyright 2001 © Regional Niagara

APPENDIX

B TURNING MOVEMENT COUNT

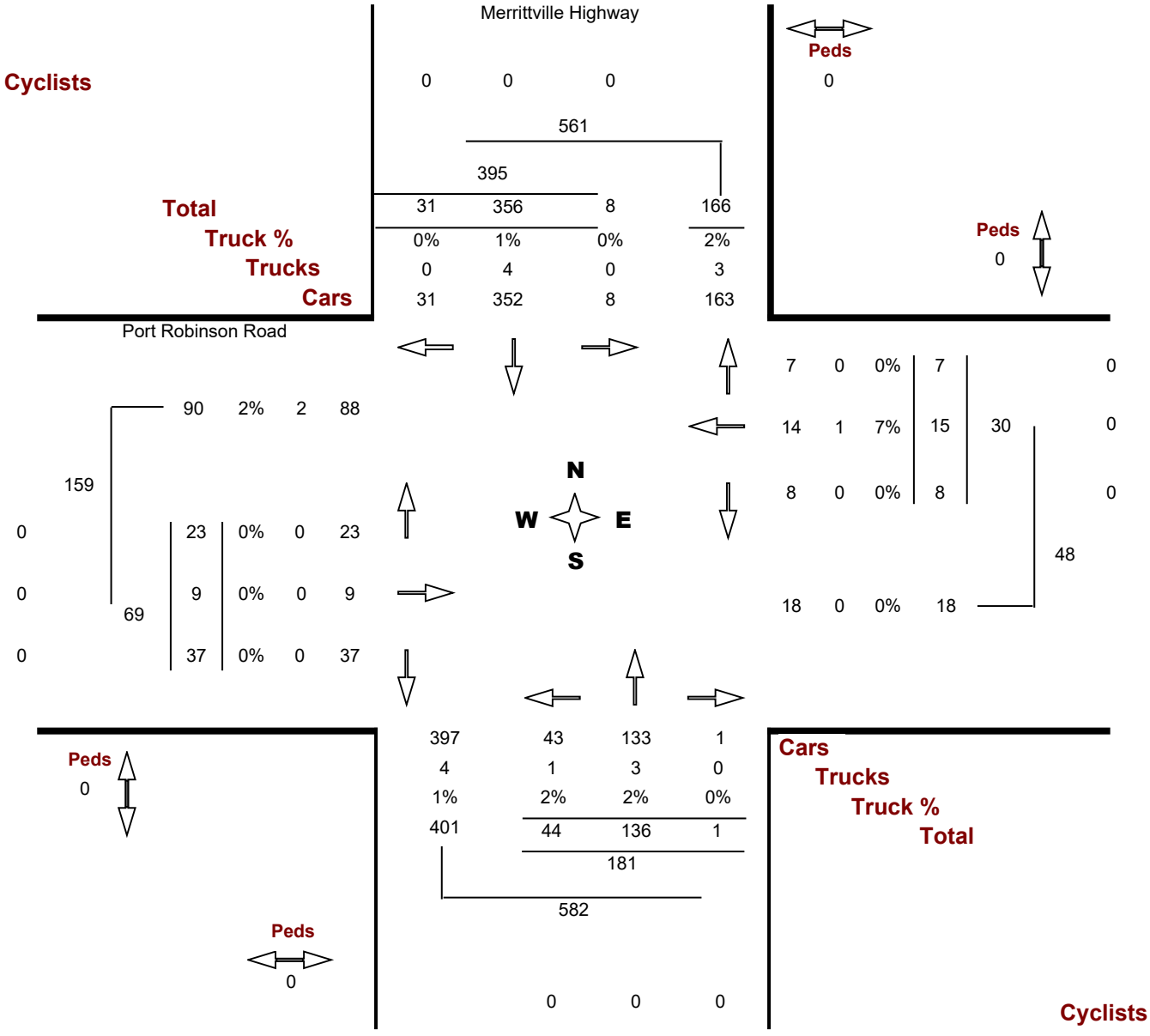
Turning Movements Report - AM Period

Location..... Merrittville Highway @ Port Robinson Road
GeoID..... 00425
Municipality. THOROLD
Count Date. Tuesday, 21 June, 2016
Traffic Cont.
Count Time. 07:00 AM — 09:00 AM
Major Dir..... North south
Peak Hour.. 07:45 AM — 08:45 AM



Turning Movements Report - PM Period

Location.....	Merrittville Highway @ Port Robinson Road	**GeoID.....**	00425
Municipality.	THOROLD	**Count Date.**	Tuesday, 21 June, 2016
Traffic Cont.		**Count Time.**	03:00 PM — 06:00 PM
Major Dir.....	North south	**Peak Hour..**	04:30 PM — 05:30 PM



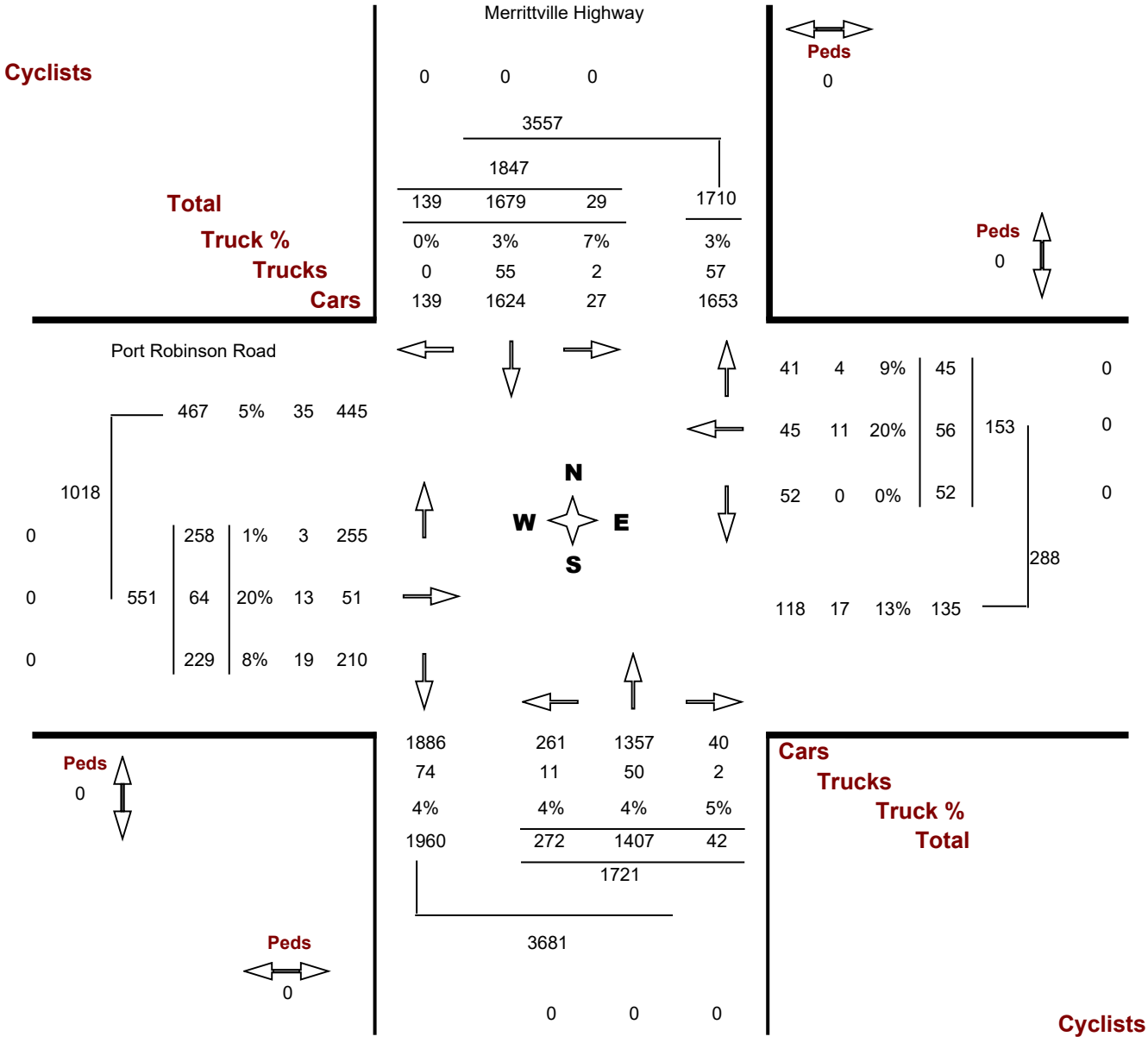
Turning Movement Count Report
Full Study

Location..... Merrittville Highway @ Port Robinson Road

Municipality..... THOROLD

GeoID..... 00425

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



Turning Movement Count - Details Report (15 min)

Location..... Merrittville Highway @ Port Robinson Road

Municipality..... THOROLD

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

		Merrittville Highway										Port Robinson Road									
		North Approach					South Approach					East Approach					West Approach				
Time Period		LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT
07:00	07:15	0	26	3	0	29	5	26	0	0	31	1	0	1	0	2	5	0	1	0	6
07:15	07:30	1	24	3	0	28	1	43	1	0	45	1	1	1	0	3	12	1	1	0	14
07:30	07:45	0	18	0	0	18	3	54	2	0	59	0	0	0	0	0	13	1	3	0	17
07:45	08:00	1	36	2	0	39	5	63	3	0	71	1	1	0	0	2	18	6	6	0	30
Hourly Total		2	104	8	0	114	14	186	6	0	206	3	2	2	0	7	48	8	11	0	67
08:00	08:15	2	31	4	0	37	2	59	0	0	61	1	0	2	0	3	16	2	3	0	21
08:15	08:30	0	30	2	0	32	13	67	0	0	80	0	3	1	0	4	26	0	8	0	34
08:30	08:45	1	37	2	0	40	9	49	1	0	59	1	0	0	0	1	27	3	7	0	37
08:45	09:00	0	28	2	0	30	7	50	2	0	59	3	2	2	0	7	8	2	12	0	22
Hourly Total		3	126	10	0	139	31	225	3	0	259	5	5	5	0	15	77	7	30	0	114
11:00	11:15	0	59	2	0	61	3	32	2	0	37	0	1	3	0	4	5	0	6	0	11
11:15	11:30	0	51	5	0	56	10	50	2	0	62	0	4	3	0	7	5	3	7	0	15
11:30	11:45	1	33	2	0	36	9	29	2	0	40	0	2	1	0	3	8	5	10	0	23
11:45	12:00	1	49	2	0	52	4	52	0	0	56	2	1	1	0	4	7	1	11	0	19
Hourly Total		2	192	11	0	205	26	163	6	0	195	2	8	8	0	18	25	9	34	0	68
12:00	12:15	2	44	5	0	51	9	41	0	0	50	6	3	3	0	12	4	2	6	0	12
12:15	12:30	1	42	4	0	47	8	47	6	0	61	3	2	1	0	6	5	8	13	0	26
12:30	12:45	2	58	2	0	62	8	37	1	0	46	1	2	3	0	6	5	0	7	0	12
12:45	13:00	1	47	7	0	55	10	51	2	0	63	2	0	2	0	4	7	2	5	0	14
Hourly Total		6	191	18	0	215	35	176	9	0	220	12	7	9	0	28	21	12	31	0	64
13:00	13:15	0	52	3	0	55	9	40	2	0	51	2	2	3	0	7	8	3	7	0	18
13:15	13:30	1	45	6	0	52	7	52	1	0	60	1	1	0	0	2	8	0	5	0	13
13:30	13:45	1	40	2	0	43	7	44	1	0	52	0	0	0	0	0	3	1	9	0	13
13:45	14:00	1	48	2	0	51	8	52	3	0	63	3	0	0	0	3	6	2	8	0	16
Hourly Total		3	185	13	0	201	31	188	7	0	226	6	3	3	0	12	25	6	29	0	60
15:00	15:15	0	59	2	0	61	18	42	1	0	61	3	2	0	0	5	7	0	5	0	12
15:15	15:30	2	59	5	0	66	12	50	0	0	62	0	1	0	0	1	4	2	6	0	12
15:30	15:45	0	48	11	0	59	12	44	3	0	59	3	2	4	0	9	4	1	13	0	18
15:45	16:00	1	69	4	0	74	6	38	1	0	45	3	2	1	0	6	5	1	8	0	14
Hourly Total		3	235	22	0	260	48	174	5	0	227	9	7	5	0	21	20	4	32	0	56
16:00	16:15	0	60	4	0	64	16	40	2	0	58	2	4	1	0	7	2	2	5	0	9

		Merrittville Highway										Port Robinson Road									
		North Approach					South Approach					East Approach					West Approach				
Time Period		LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT
16:15	16:30	1	88	12	0	101	4	51	1	0	56	0	2	2	0	4	1	2	6	0	9
16:30	16:45	0	89	4	0	93	8	31	0	0	39	2	3	3	0	8	7	1	7	0	15
16:45	17:00	2	111	15	0	128	13	32	0	0	45	2	2	0	0	4	4	0	9	0	13
Hourly Total		3	348	35	0	386	41	154	3	0	198	6	11	6	0	23	14	5	27	0	46
17:00	17:15	3	68	7	0	78	12	35	0	0	47	2	7	4	0	13	6	2	13	0	21
17:15	17:30	3	88	5	0	96	11	38	1	0	50	2	3	0	0	5	6	6	8	0	20
17:30	17:45	1	82	2	0	85	12	34	1	0	47	3	2	1	0	6	7	3	5	0	15
17:45	18:00	0	60	8	0	68	11	34	1	0	46	2	1	2	0	5	9	2	9	0	20
Hourly Total		7	298	22	0	327	46	141	3	0	190	9	13	7	0	29	28	13	35	0	76
Grand Total		29	1679	139	0	1847	272	1407	42	0	1721	52	56	45	0	153	258	64	229	0	551
Truck %		7%	3%	0%	0%	3%	4%	4%	5%	0%	4%	0%	20%	9%	0%	10%	1%	20%	8%	0%	6%

Ontario

INTERSECTION LAYOUT SHEET

Date: 2017-03-29 Day Wednesday Request # 179 Observer(s) Video

Gretch Code (LHRS O/S): 3486520000 Ramp # _____

Hwy # 406 Location Hwy 406 & Hwy 58 - Merrit Rd (East)

Reg/Mun Niagara Town/City Welland

Comments _____

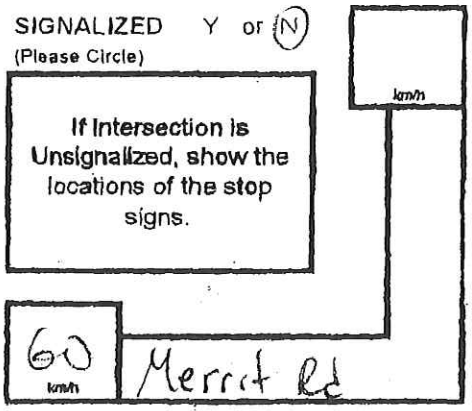
Segment 1 - AM or PM (Please Circle ONE) Weather _____

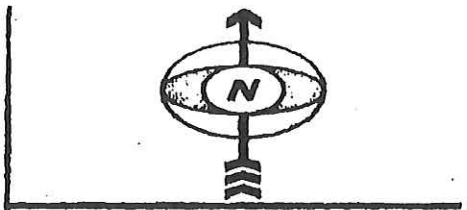
DATASETS
For office use only:

Edit File: _____
AM Peak: _____
PM Peak: _____
Processed by: _____

SIGNALIZED Y or (N)
(Please Circle)

If intersection is Unsignalized, show the locations of the stop signs.

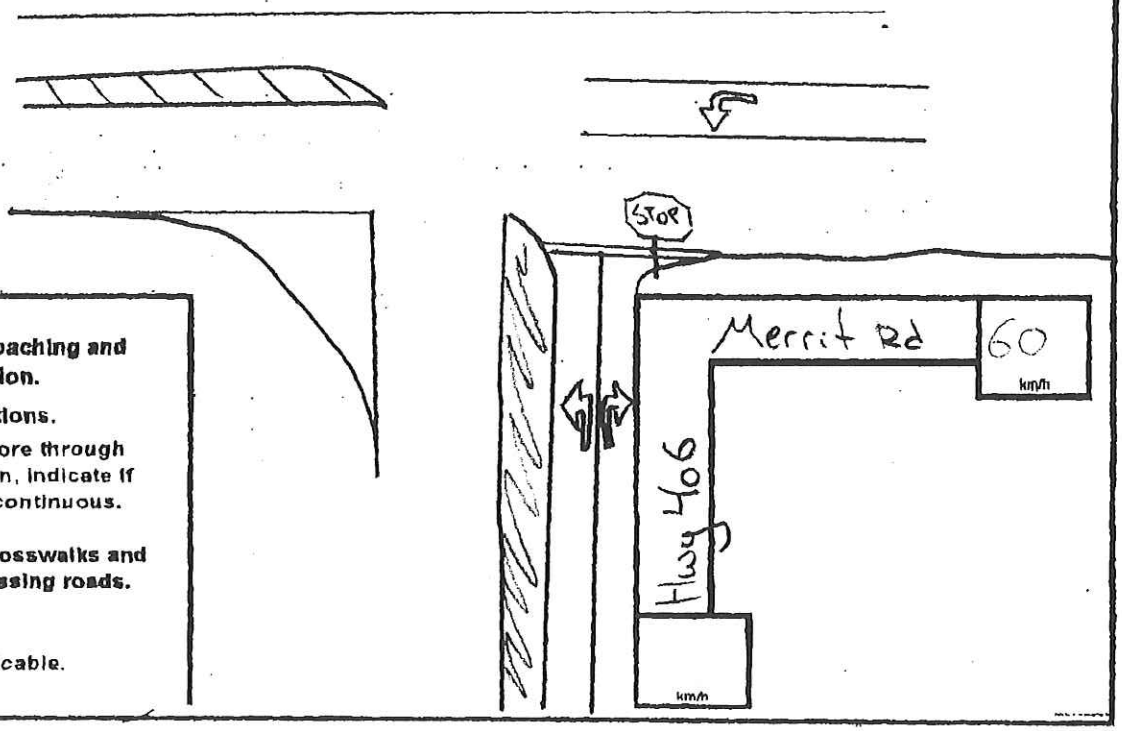




INDICATE LOCATION & DIRECTION OF STUDY VEHICLE

VEHICLE N S E W

1) **Show all lanes approaching and leaving the intersection.**
2) **Show all channelizations.**
3) **If there are two or more through lanes in one direction, indicate if these lanes are not continuous.**
4) **Show pedestrian crosswalks and sidewalks along crossing roads.**
5) **Show bicycle lanes.**
6) **Show ramp # if applicable.**

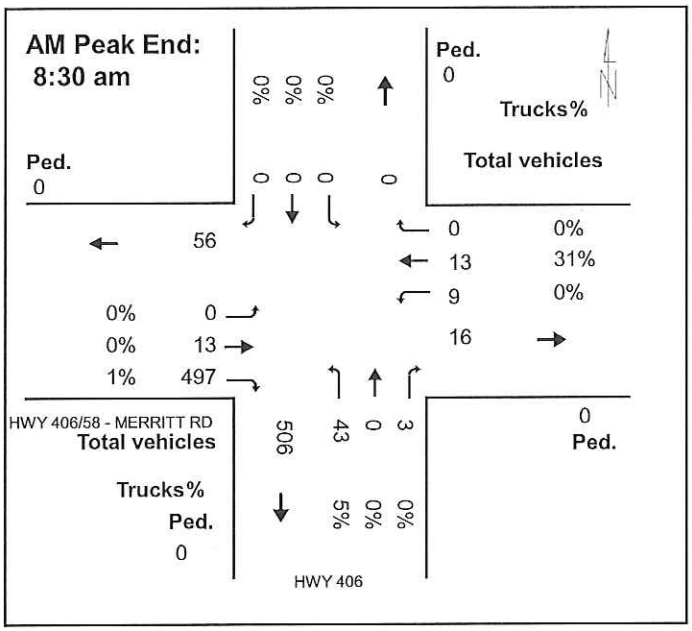


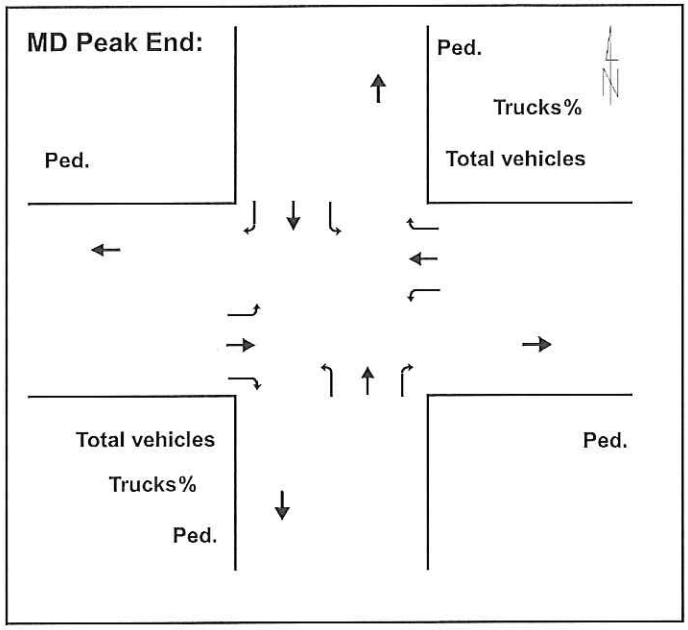
Ontario

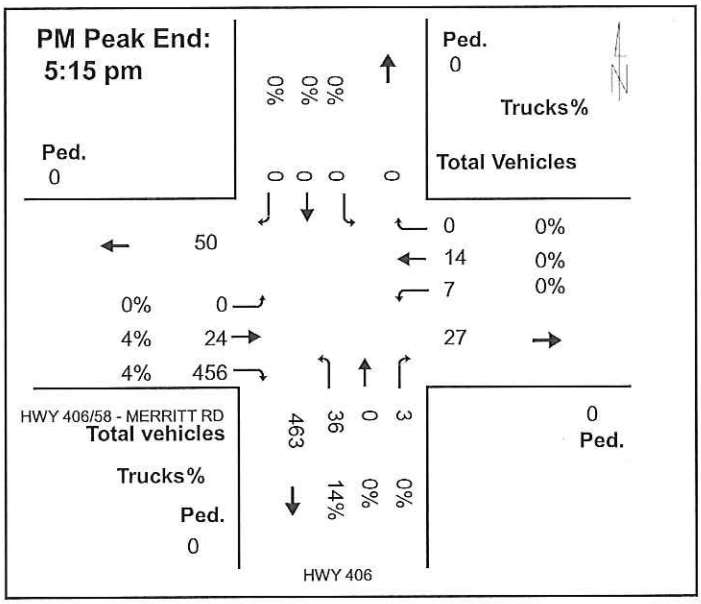
HWY 406 @ HWY 406/58 - MERRITT RD

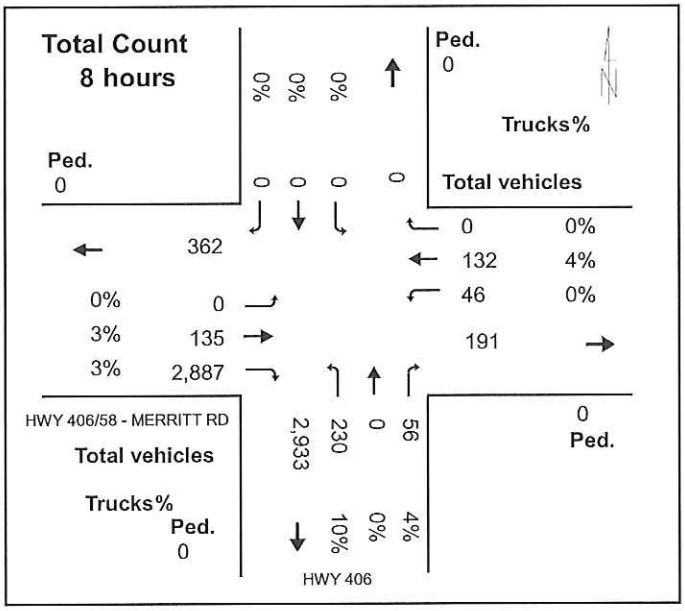
Central

Intersection ID:486520000(--E--) **Count Day: Wednesday** **Count Date: 29-Mar-2017**









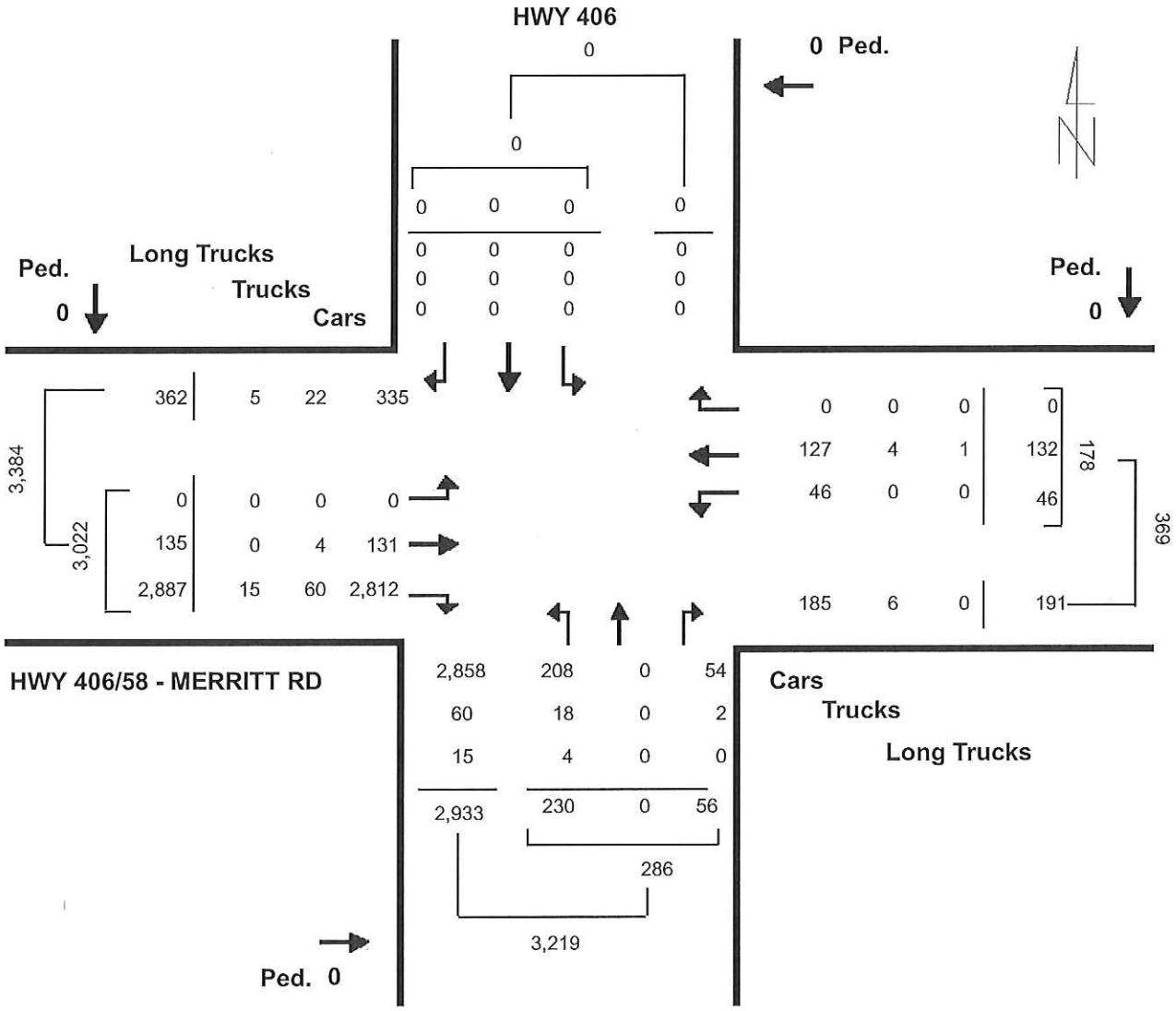
Traffic Engineering Software

COUNT TOTAL

HWY 406 @ HWY 406/58 - MERRITT RD

Central

Intersection ID:486520000(--E--) **Date: 29-Mar-2017**



15 MIN REPORT

Intersection ID:486520000(--E--) **HWY 406 @ HWY 406/58 - MERRITT RD** **Municipality: Central** **Date: 29-Mar-2017**

	NORTH APPROACH										EAST APPROACH										SOUTH APPROACH										WEST APPROACH										
Time	Cars			Trucks			Heavies			Ped	Cars			Trucks			Heavies			Ped	Cars			Trucks			Heavies			Ped	Cars			Trucks			Heavies			Ped	Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		
Period1																																									
6:15	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	51	0	0	0	0	0	1	0	56
6:30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0	46	0	0	0	0	0	1	0	53
6:45	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	3	0	5	0	0	0	0	0	0	0	0	3	70	0	0	0	0	0	0	0	83
7:00	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	9	0	2	0	0	0	0	0	0	0	0	10	52	0	0	0	0	0	0	0	75
7:15	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	1	85	0	0	2	0	0	0	0	96
7:30	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	8	0	2	0	0	0	0	0	0	0	0	2	85	0	0	1	0	0	1	0	102
7:45	0	0	0	0	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	2	116	0	0	1	0	0	0	0	132
8:00	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	9	0	1	1	0	0	0	0	0	0	0	7	111	0	0	0	0	0	1	0	134
8:15	0	0	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0	1	0	0	7	0	2	1	0	0	0	0	0	0	0	3	140	0	0	3	0	0	0	0	164
8:30	0	0	0	0	0	0	0	0	0	0	3	1	0	0	2	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	1	123	0	0	2	0	0	0	0	148
8:45	0	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	5	112	0	0	1	0	0	1	0	131
9:00	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	11	0	2	5	0	0	1	0	0	0	0	2	70	0	0	2	0	0	1	0	99
9:15	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	1	2	0	1	0	0	0	0	0	1	84	0	0	3	0	0	1	0	98
9:30	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	81	0	0	2	0	0	0	0	92
9:45	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	84	0	0	1	0	0	1	0	94
10:00	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	6	0	2	1	0	0	1	0	0	0	0	4	68	0	0	2	0	0	0	0	88
Period2																																									
15:15	0	0	0	0	0	0	0	0	0	0	1	8	0	0	0	0	0	0	0	0	9	0	1	0	0	1	0	0	0	0	0	5	84	0	0	7	0	0	1	0	117
15:30	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	4	0	5	1	0	0	0	0	0	0	0	5	104	0	0	3	0	0	2	0	130
15:45	0	0	0	0	0	0	0	0	0	0	5	6	0	0	0	0	0	0	0	0	7	0	1	1	0	0	0	0	0	0	0	4	108	0	1	3	0	0	1	0	137
16:00	0	0	0	0	0	0	0	0	0	0	3	6	0	0	0	0	0	0	0	0	5	0	6	0	0	0	0	0	0	0	0	7	78	0	0	1	0	0	0	0	106
16:15	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0	0	0	0	0	0	10	0	3	1	0	0	0	0	0	0	0	4	82	0	0	2	0	0	0	0	108
16:30	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	9	0	1	1	0	0	0	0	0	0	0	9	94	0	1	3	0	0	1	0	123
16:45	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	3	136	0	0	5	0	0	1	0	160
17:00	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	7	0	1	2	0	0	1	0	0	0	0	6	104	0	0	4	0	0	1	0	128
17:15	0	0	0	0	0	0	0	0	0	0	4	5	0	0	0	0	0	0	0	0	6	0	1	0	0	0	1	0	0	0	0	5	104	0	0	3	0	0	0	0	129
17:30	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	5	0	3	0	0	0	0	0	0	0	0	3	91	0	1	2	0	0	0	0	112
17:45	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	2	89	0	1	1	0	0	0	0	112
18:00	0	0	0	0	0	0	0	0	0	0	1	7	0	0	0	0	0	0	0	0	8	0	2	1	0	0	0	0	0	0	0	11	72	0	0	2	0	0	0	0	104
18:15	0	0	0	0	0	0	0	0	0	0	2	8	0	0	0	0	0	0	0	0	6	0	2	0	0	0	0	0	0	0	0	4	74	0	0	1	0	0	0	0	97
18:30	0	0	0	0	0	0	0	0	0	0	1	10	0	0	0	0	0	0	0	0	4	0	5	0	0	0	0	0	0	0	0	5	81	0	0	1	0	0	0	0	107
18:45	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	8	0	2	0	0	0	0	0	0	0	0	6	86	0	0	2	0	0	0	0	107
19:00	0	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0	5	0	1	0	0	0	0	0	0	0	0	4	47	0	0	0	0	0	0	0	64

Ontario

INTERSECTION LAYOUT SHEET

Date: 2017-03-29 Day: Wednesday Request #: 180 Observer(s): Video

Gretch Code (LHRS O/S): 4486520000 Ramp #: _____

Hwy #: 406 Location: Hwy 406 & Hwy 58 - Merrit Rd (West)

Reg/Mun: Niagara Town/City: Welland

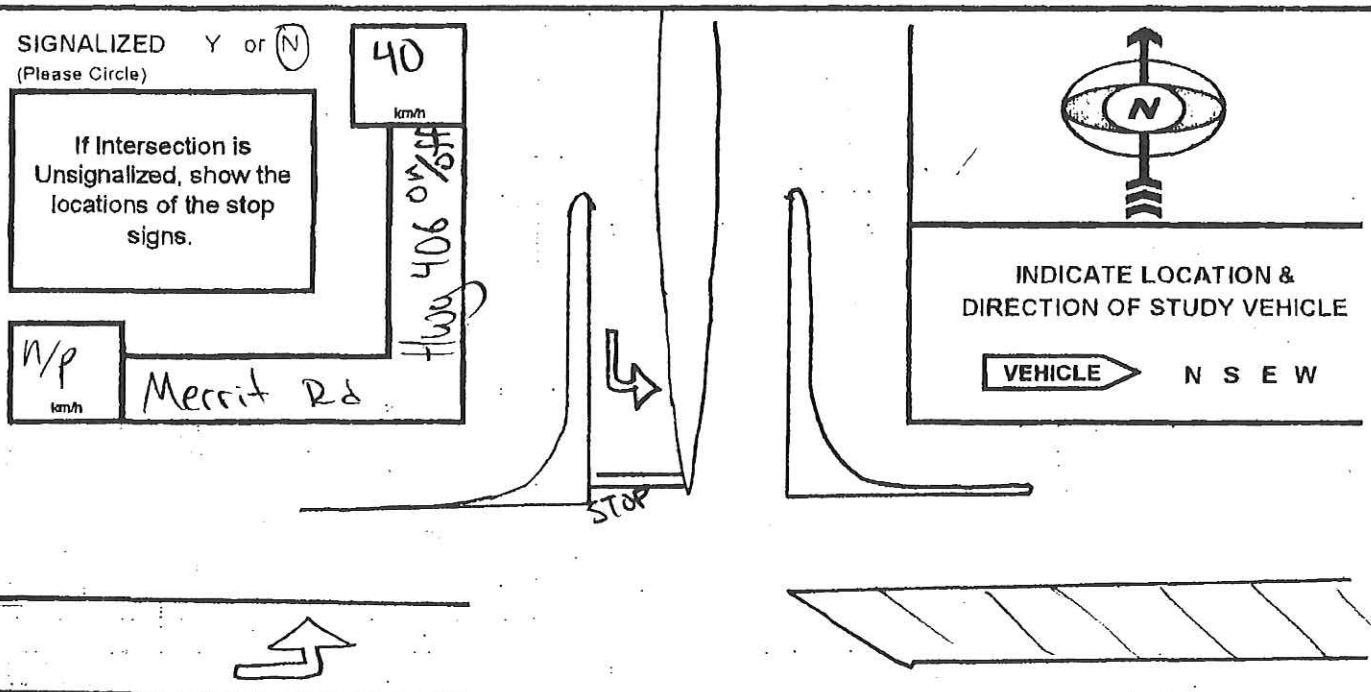
Comments: _____

Segment 1 - AM or PM (Please Circle **ONE**) Weather: _____

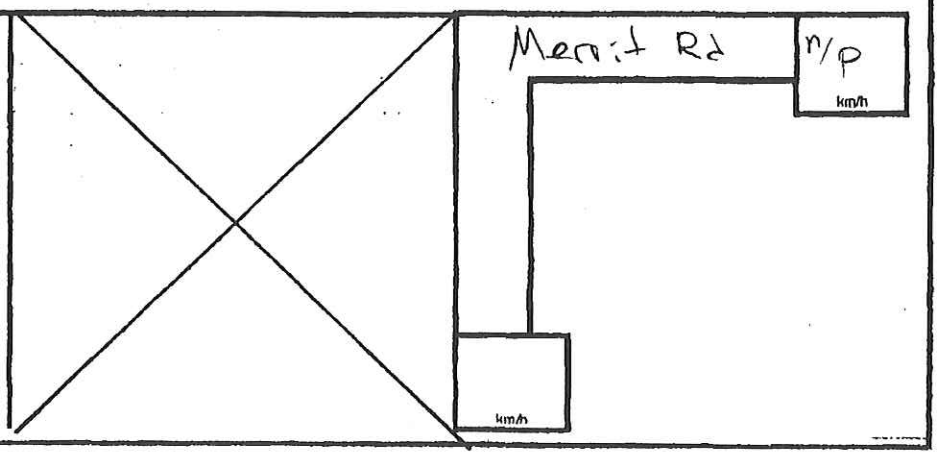
DATASETS
For office use only:
Edit File:
AM Peak:
PM Peak:
Processed by:

SIGNALIZED Y or (N)
(Please Circle)

If Intersection is Unsignalized, show the locations of the stop signs.



1) **Show all lanes approaching and leaving the intersection.**
2) **Show all channelizations.**
3) **If there are two or more through lanes in one direction, indicate if these lanes are not continuous.**
4) **Show predestrian crosswalks and sidewalks along crossing roads.**
5) **Show bicycle lanes.**
6) **Show ramp # if applicable.**

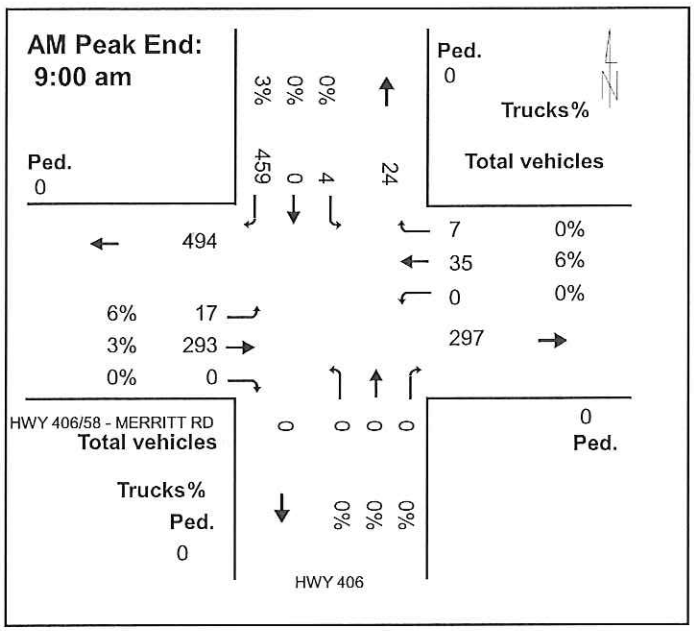


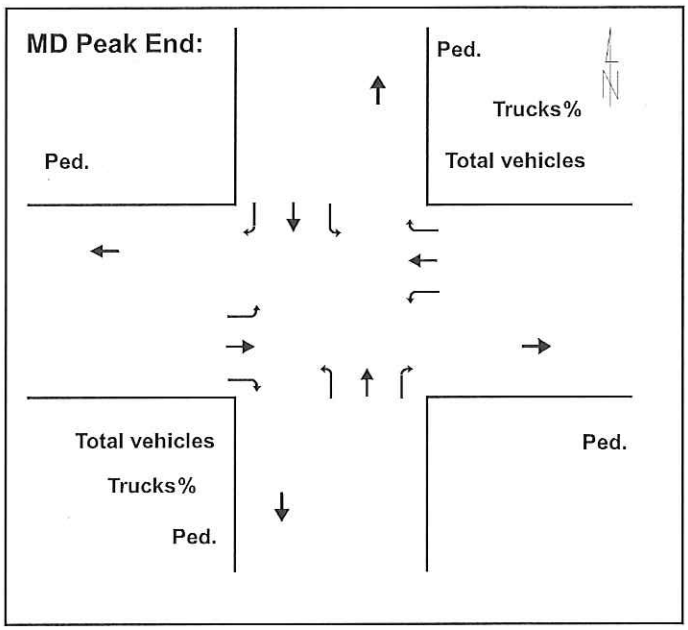
Ontario

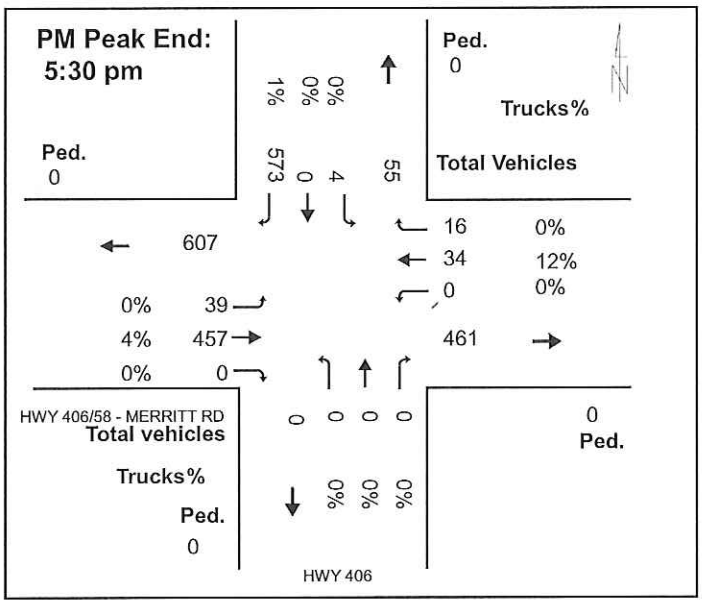
HWY 406 @ HWY 406/58 - MERRITT RD

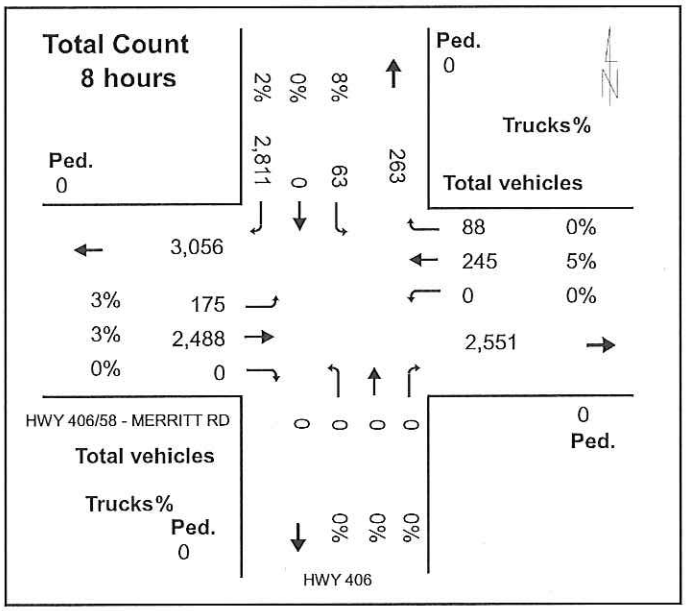
Central

Intersection ID:486520000(--W--) Count Day: Wednesday Count Date: 29-Mar-2017









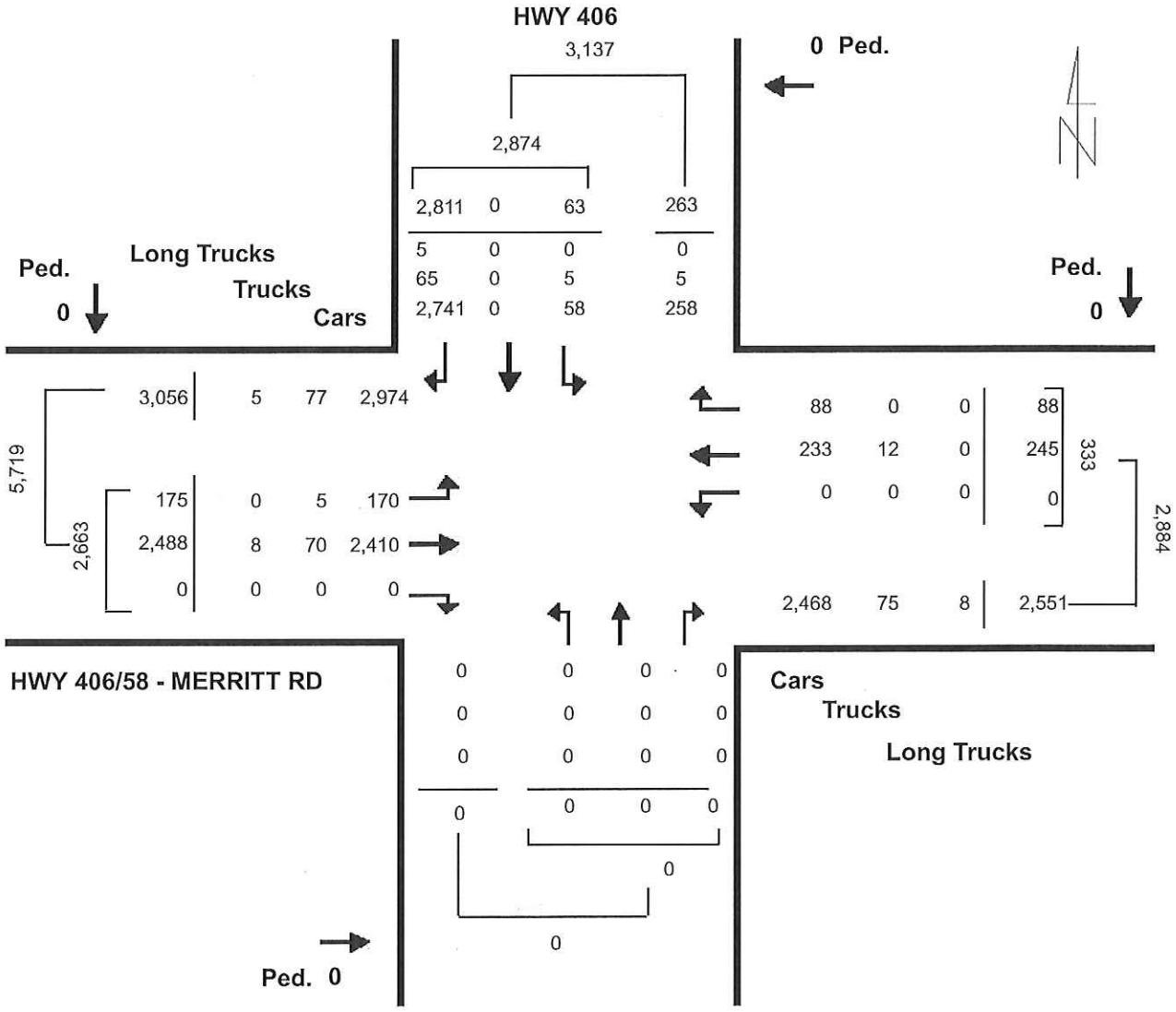
Traffic
Engineering
Software

COUNT TOTAL

HWY 406 @ HWY 406/58 - MERRITT RD

Central

Intersection ID:486520000(--W--) **Date: 29-Mar-2017**



15 MIN REPORT

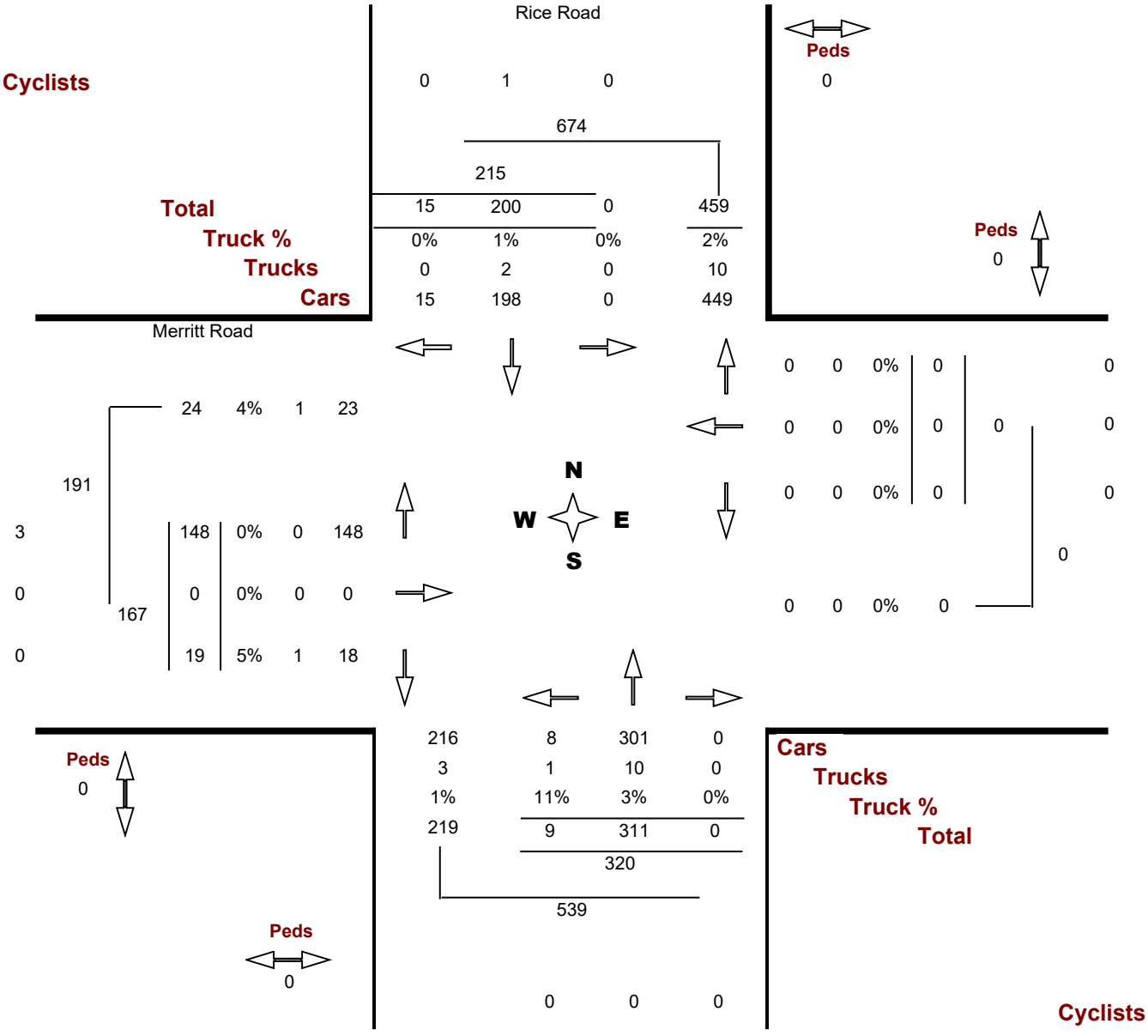
Intersection ID:486520000(--W--) **HWY 406 @ HWY 406/58 - MERRITT RD** **Municipality: Central** **Date: 29-Mar-2017**

	NORTH APPROACH										EAST APPROACH										SOUTH APPROACH										WEST APPROACH										
Time	Cars			Trucks			Heavies			Ped	Cars			Trucks			Heavies			Ped	Cars			Trucks			Heavies			Ped	Cars			Trucks			Heavies			Ped	Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		
Period1																																									
6:15	1	0	11	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	0	0	1	0	0	0	0	0	72
6:30	0	0	14	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	47	0	0	1	0	0	0	0	0	65
6:45	3	0	25	0	0	2	0	0	1	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	65	0	0	0	0	0	0	0	0	109
7:00	5	0	27	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	51	0	0	0	0	0	0	0	0	95
7:15	1	0	28	0	0	0	0	0	1	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	46	0	0	2	0	0	0	0	0	86
7:30	1	0	39	0	0	3	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	38	0	0	1	0	0	1	0	0	95
7:45	1	0	64	0	0	4	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	38	0	0	1	0	0	0	0	0	116
8:00	4	0	98	0	0	5	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	37	0	0	0	0	0	1	0	0	154
8:15	2	0	165	0	0	2	0	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	67	0	0	3	0	0	0	0	0	249
8:30	0	0	140	0	0	4	0	0	0	0	0	7	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	75	0	1	3	0	0	0	0	0	235
8:45	1	0	63	0	0	0	0	0	1	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	79	0	0	1	0	0	1	0	0	158
9:00	1	0	79	0	0	5	0	0	0	0	0	16	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	62	0	0	2	0	0	0	0	0	173
9:15	0	0	58	0	0	1	0	0	0	0	0	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	65	0	0	5	0	0	0	0	0	142
9:30	0	0	58	0	0	3	0	0	0	0	0	10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	73	0	1	3	0	0	0	0	0	155
9:45	0	0	45	1	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	73	0	1	2	0	0	0	0	0	129
10:00	3	0	43	0	0	5	0	0	0	0	0	7	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	69	0	0	1	0	0	0	0	0	139
Period2																																									
15:15	2	0	94	1	0	2	0	0	1	0	0	11	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	86	0	0	6	0	0	1	0	0	215
15:30	2	0	99	0	0	3	0	0	0	0	0	6	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	103	0	1	3	0	0	2	0	0	232
15:45	2	0	81	0	0	0	0	0	1	0	0	10	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	109	0	1	5	0	0	1	0	0	226
16:00	3	0	101	0	0	4	0	0	0	0	0	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	85	0	0	0	0	0	0	0	0	213
16:15	3	0	127	0	0	1	0	0	0	0	0	14	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	83	0	0	2	0	0	0	0	0	241
16:30	4	0	116	1	0	3	0	0	0	0	0	7	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	99	0	0	4	0	0	0	0	0	244
16:45	1	0	122	0	0	1	0	0	0	0	0	11	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	135	0	0	6	0	0	0	0	0	290
17:00	3	0	156	0	0	3	0	0	0	0	0	8	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	107	0	0	4	0	0	1	0	0	290
17:15	0	0	119	0	0	1	0	0	0	0	0	7	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	104	0	0	3	0	0	0	0	0	252
17:30	0	0	168	0	0	3	0	0	0	0	0	4	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	94	0	0	3	0	0	0	0	0	291
17:45	0	0	118	0	0	1	0	0	0	0	0	15	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	91	0	0	3	0	0	0	0	0	242
18:00	7	0	103	0	0	1	0	0	0	0	0	13	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	75	0	0	2	0	0	0	0	0	207
18:15	1	0	99	1	0	0	0	0	0	0	0	9	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	72	0	0	1	0	0	0	0	0	191
18:30	2	0	103	0	0	2	0	0	0	0	0	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	83	0	0	1	0	0	0	0	0	208
18:45	3	0	86	1	0	0	0	0	0	0	0	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	88	0	0	1	0	0	0	0	0	193
19:00	2	0	92	0	0	2	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	54	0	0	0	0	0	0	0	0	163

Turning Movements Report - AM Period

Location..... Merritt Road @ Rice Road
Municipality. PELHAM
Traffic Cont.
Major Dir..... None

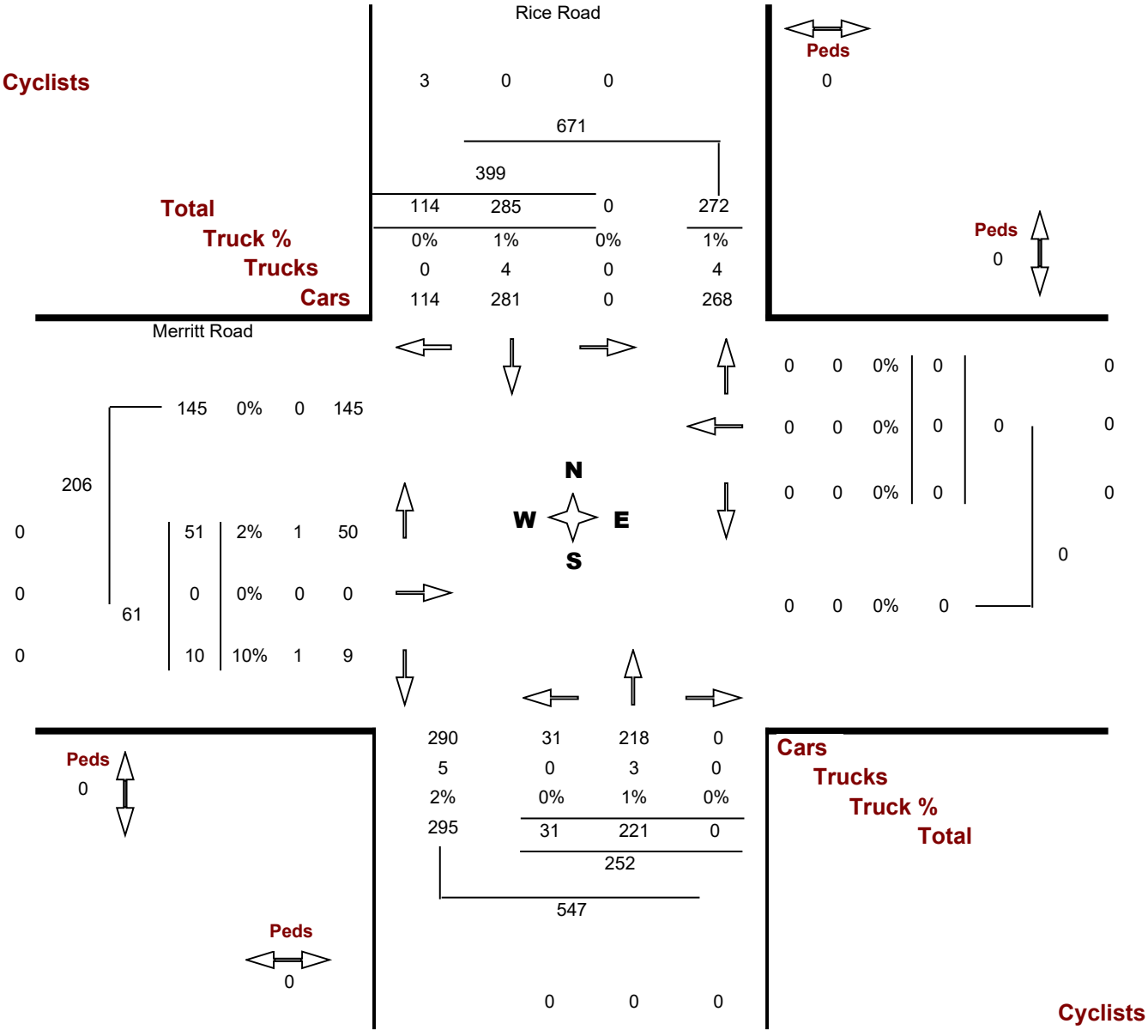
GeoID..... 04632
Count Date. Monday, 13 June, 2016
Count Time. 07:00 AM — 09:00 AM
Peak Hour.. 07:45 AM — 08:45 AM



Turning Movements Report - PM Period

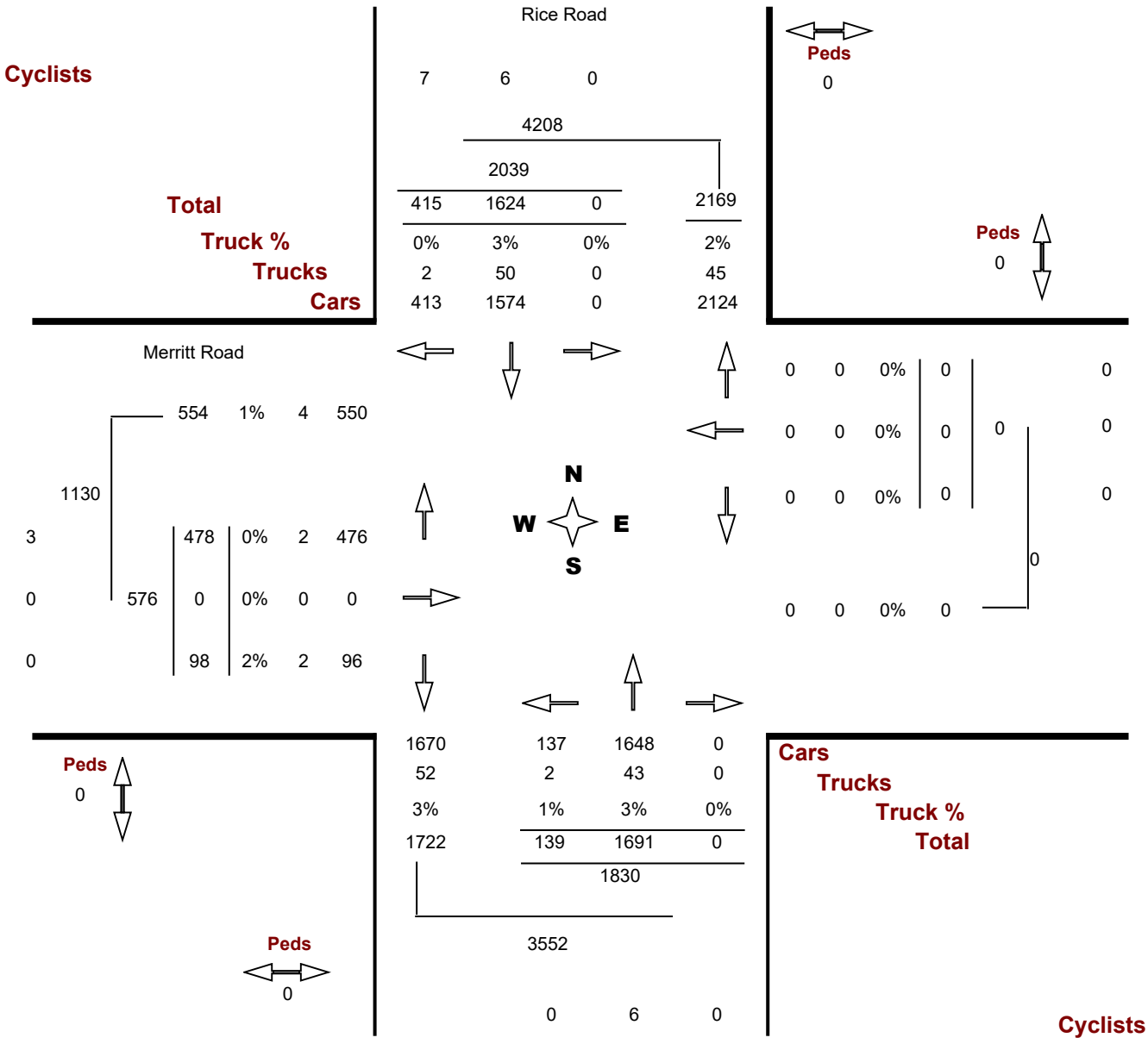
Location..... Merritt Road @ Rice Road
Municipality. PELHAM
Traffic Cont.
Major Dir..... None

GeoID..... 04632
Count Date. Monday, 13 June, 2016
Count Time. 03:00 PM — 06:00 PM
Peak Hour.. 04:15 PM — 05:15 PM



Turning Movement Count Report
Full Study

Location..... Merritt Road @ Rice Road
Municipality..... PELHAM
GeoID..... 04632
Count Date..... Monday, 13 June, 2016



Turning Movement Count - Details Report (15 min)

Location..... Merritt Road @ Rice Road

Municipality..... PELHAM

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

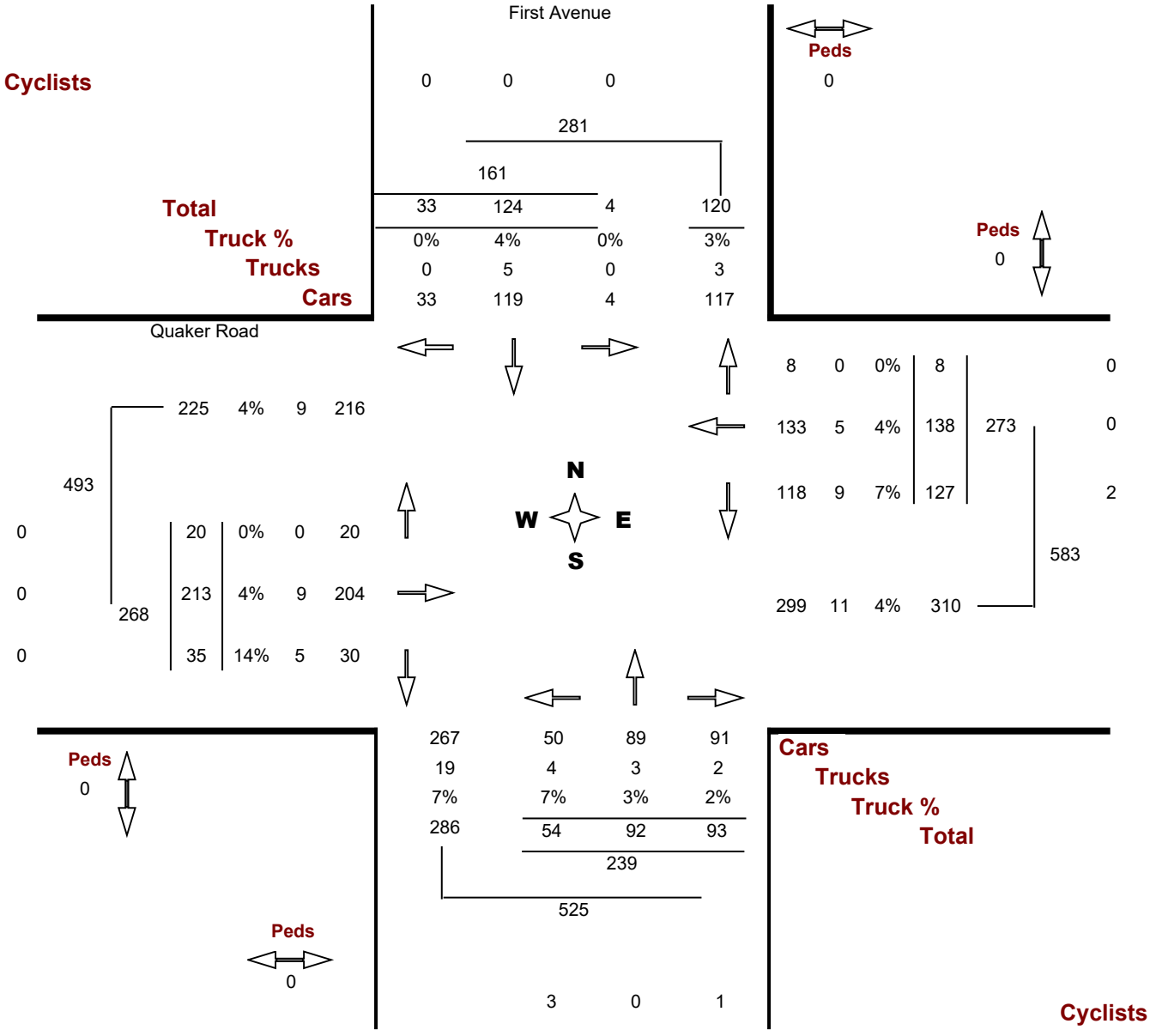
		Rice Road										Merritt Road									
		North Approach					South Approach					East Approach					West Approach				
Time Period		LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT
07:00	07:15	0	17	2	0	19	0	40	0	0	40	0	0	0	0	0	17	0	5	0	22
07:15	07:30	0	19	4	0	23	0	49	0	0	49	0	0	0	0	0	11	0	3	0	14
07:30	07:45	0	37	6	0	43	0	68	0	0	68	0	0	0	0	0	26	0	6	0	32
07:45	08:00	0	34	3	0	37	1	70	0	0	71	0	0	0	0	0	32	0	7	0	39
Hourly Total		0	107	15	0	122	1	227	0	0	228	0	0	0	0	0	86	0	21	0	107
08:00	08:15	0	43	0	0	43	4	79	0	0	83	0	0	0	0	0	41	0	4	0	45
08:15	08:30	0	77	7	0	84	3	80	0	0	83	0	0	0	0	0	32	0	5	0	37
08:30	08:45	0	46	5	0	51	1	82	0	0	83	0	0	0	0	0	43	0	3	0	46
08:45	09:00	0	45	7	0	52	2	54	0	0	56	0	0	0	0	0	19	0	3	0	22
Hourly Total		0	211	19	0	230	10	295	0	0	305	0	0	0	0	0	135	0	15	0	150
11:00	11:15	0	44	8	0	52	3	52	0	0	55	0	0	0	0	0	12	0	1	0	13
11:15	11:30	0	34	5	0	39	5	43	0	0	48	0	0	0	0	0	14	0	6	0	20
11:30	11:45	0	49	9	0	58	4	49	0	0	53	0	0	0	0	0	15	0	5	0	20
11:45	12:00	0	51	7	0	58	4	33	0	0	37	0	0	0	0	0	10	0	4	0	14
Hourly Total		0	178	29	0	207	16	177	0	0	193	0	0	0	0	0	51	0	16	0	67
12:00	12:15	0	42	14	0	56	4	49	0	0	53	0	0	0	0	0	7	0	3	0	10
12:15	12:30	0	36	11	0	47	2	48	0	0	50	0	0	0	0	0	12	0	4	0	16
12:30	12:45	0	43	12	0	55	4	47	0	0	51	0	0	0	0	0	10	0	0	0	10
12:45	13:00	0	38	11	0	49	7	40	0	0	47	0	0	0	0	0	8	0	2	0	10
Hourly Total		0	159	48	0	207	17	184	0	0	201	0	0	0	0	0	37	0	9	0	46
13:00	13:15	0	46	13	0	59	5	46	0	0	51	0	0	0	0	0	7	0	1	0	8
13:15	13:30	0	46	10	0	56	4	49	0	0	53	0	0	0	0	0	12	0	0	0	12
13:30	13:45	0	35	8	0	43	2	37	0	0	39	0	0	0	0	0	11	0	0	0	11
13:45	14:00	0	43	14	0	57	6	41	0	0	47	0	0	0	0	0	11	0	0	0	11
Hourly Total		0	170	45	0	215	17	173	0	0	190	0	0	0	0	0	41	0	1	0	42
15:00	15:15	0	52	15	0	67	5	52	0	0	57	0	0	0	0	0	6	0	2	0	8
15:15	15:30	0	59	16	0	75	3	52	0	0	55	0	0	0	0	0	5	0	1	0	6
15:30	15:45	0	73	9	0	82	6	65	0	0	71	0	0	0	0	0	12	0	5	0	17
15:45	16:00	0	81	17	0	98	8	57	0	0	65	0	0	0	0	0	11	0	2	0	13
Hourly Total		0	265	57	0	322	22	226	0	0	248	0	0	0	0	0	34	0	10	0	44
16:00	16:15	0	65	21	0	86	5	67	0	0	72	0	0	0	0	0	14	0	2	0	16

		Rice Road										Merritt Road									
		North Approach					South Approach					East Approach					West Approach				
Time Period		LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT
16:15	16:30	0	71	29	0	100	4	48	0	0	52	0	0	0	0	0	15	0	3	0	18
16:30	16:45	0	79	23	0	102	10	66	0	0	76	0	0	0	0	0	4	0	2	0	6
16:45	17:00	0	73	30	0	103	9	44	0	0	53	0	0	0	0	0	14	0	2	0	16
Hourly Total		0	288	103	0	391	28	225	0	0	253	0	0	0	0	0	47	0	9	0	56
17:00	17:15	0	62	32	0	94	8	63	0	0	71	0	0	0	0	0	18	0	3	0	21
17:15	17:30	0	72	23	0	95	4	45	0	0	49	0	0	0	0	0	20	0	3	0	23
17:30	17:45	0	64	30	0	94	9	41	0	0	50	0	0	0	0	0	9	0	4	0	13
17:45	18:00	0	48	14	0	62	7	35	0	0	42	0	0	0	0	0	0	0	7	0	7
Hourly Total		0	246	99	0	345	28	184	0	0	212	0	0	0	0	0	47	0	17	0	64
Grand Total		0	1624	415	0	2039	139	1691	0	0	1830	0	0	0	0	0	478	0	98	0	576
Truck %		0%	3%	0%	0%	3%	1%	3%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	2%	0%	1%

Turning Movements Report - AM Period

Location..... First Avenue @ Quaker Road
Municipality. WELLAND
Traffic Cont.
Major Dir..... None

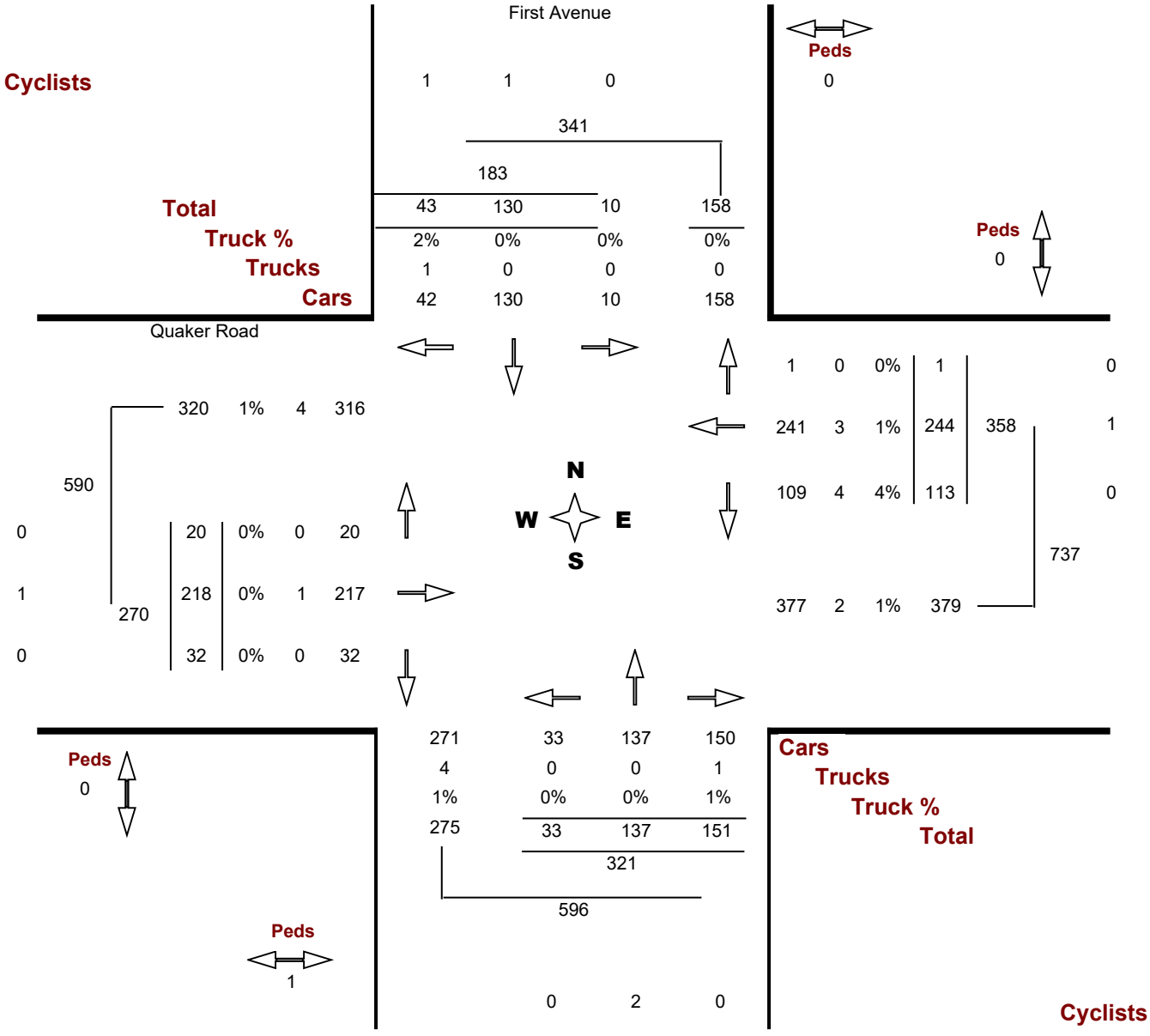
GeoID..... 07179
Count Date. Tuesday, 21 June, 2016
Count Time. 07:00 AM — 09:00 AM
Peak Hour.. 08:00 AM — 09:00 AM



Turning Movements Report - PM Period

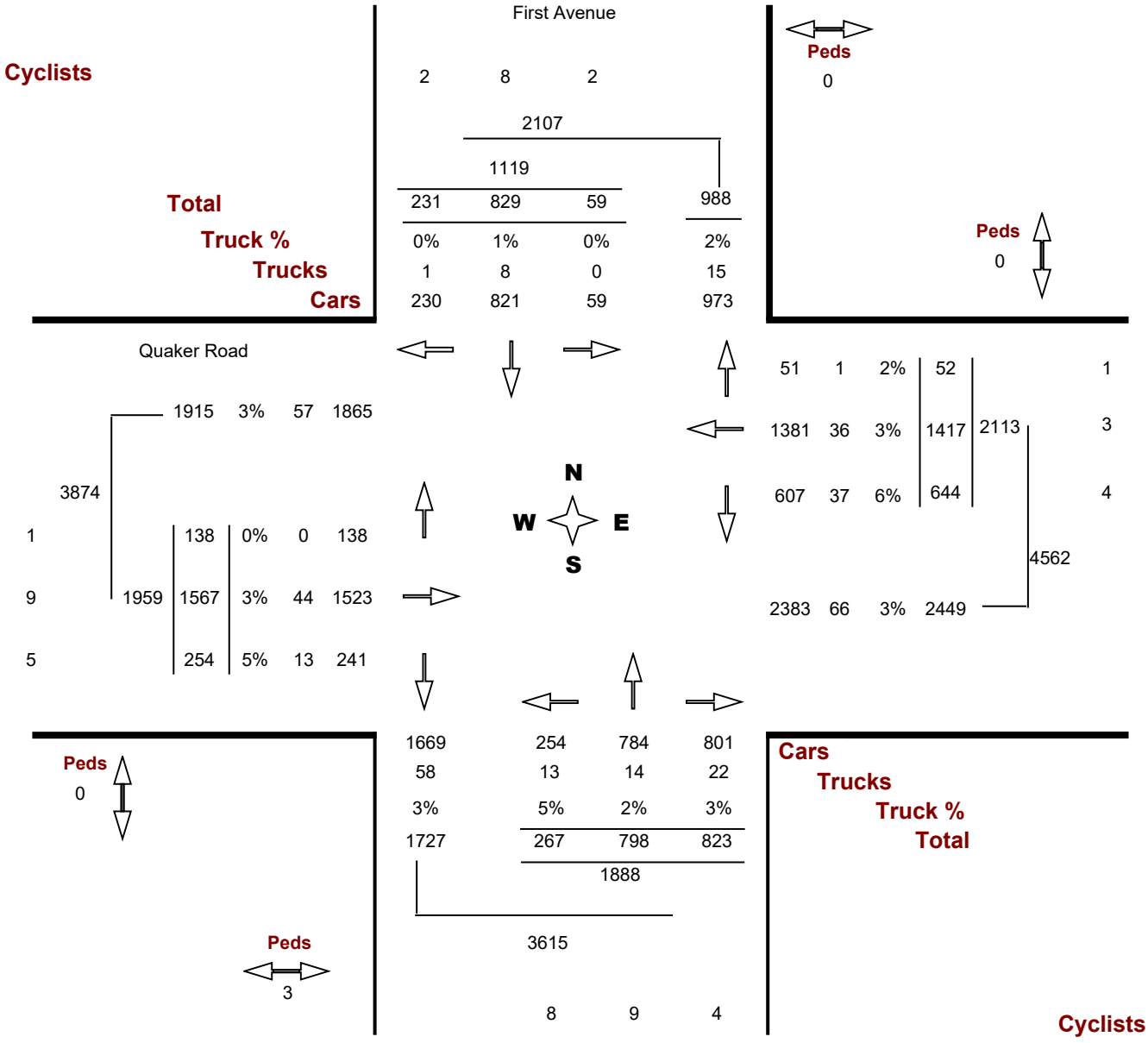
Location..... First Avenue @ Quaker Road
Municipality. WELLAND
Traffic Cont.
Major Dir..... None

GeoID..... 07179
Count Date. Tuesday, 21 June, 2016
Count Time. 03:00 PM — 06:00 PM
Peak Hour.. 05:00 PM — 06:00 PM



Turning Movement Count Report
Full Study

Location..... First Avenue @ Quaker Road
Municipality..... WELLAND
GeoID..... 07179
Count Date..... Tuesday, 21 June, 2016



Turning Movement Count - Details Report (15 min)

Location..... First Avenue @ Quaker Road

Municipality..... WELLAND

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

		First Avenue										Quaker Road									
		North Approach					South Approach					East Approach					West Approach				
Time Period		LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT
07:00	07:15	0	10	3	0	13	3	9	12	0	24	7	10	0	0	17	2	31	1	0	34
07:15	07:30	1	14	1	0	16	6	20	22	0	48	6	24	1	0	31	3	33	0	0	36
07:30	07:45	0	13	5	0	18	3	26	29	0	58	5	26	0	0	31	7	47	5	0	59
07:45	08:00	1	16	4	0	21	6	19	30	0	55	14	23	4	0	41	7	58	6	0	71
Hourly Total		2	53	13	0	68	18	74	93	0	185	32	83	5	0	120	19	169	12	0	200
08:00	08:15	0	26	3	0	29	1	31	25	0	57	19	24	2	0	45	5	56	1	0	62
08:15	08:30	1	34	12	0	47	13	22	20	0	55	42	34	2	0	78	2	45	7	0	54
08:30	08:45	2	27	9	0	38	22	22	20	0	64	29	50	2	0	81	5	49	11	0	65
08:45	09:00	1	37	9	0	47	18	17	28	0	63	37	30	2	0	69	8	63	16	0	87
Hourly Total		4	124	33	0	161	54	92	93	0	239	127	138	8	0	273	20	213	35	0	268
11:00	11:15	2	14	7	0	23	9	13	20	0	42	15	33	3	0	51	4	41	6	0	51
11:15	11:30	2	13	5	0	20	8	24	17	0	49	19	44	1	0	64	4	49	7	0	60
11:30	11:45	0	11	2	0	13	5	25	21	0	51	19	50	3	0	72	6	30	7	0	43
11:45	12:00	0	18	3	0	21	7	12	14	0	33	10	41	1	0	52	3	54	17	0	74
Hourly Total		4	56	17	0	77	29	74	72	0	175	63	168	8	0	239	17	174	37	0	228
12:00	12:15	0	23	4	0	27	9	21	32	0	62	12	37	2	0	51	2	51	9	0	62
12:15	12:30	2	20	7	0	29	8	25	32	0	65	8	41	1	0	50	2	67	5	0	74
12:30	12:45	3	16	3	0	22	4	31	35	0	70	16	39	3	0	58	8	56	6	0	70
12:45	13:00	1	20	9	0	30	12	21	13	0	46	13	33	6	0	52	1	39	4	0	44
Hourly Total		6	79	23	0	108	33	98	112	0	243	49	150	12	0	211	13	213	24	0	250
13:00	13:15	5	10	4	0	19	4	27	29	0	60	15	38	0	0	53	1	70	4	0	75
13:15	13:30	4	31	4	0	39	7	18	10	0	35	28	50	0	0	78	2	32	7	0	41
13:30	13:45	4	28	3	0	35	3	22	26	0	51	25	53	1	0	79	3	48	11	0	62
13:45	14:00	3	39	5	0	47	6	17	19	0	42	31	45	1	0	77	4	41	10	0	55
Hourly Total		16	108	16	0	140	20	84	84	0	188	99	186	2	0	287	10	191	32	0	233
15:00	15:15	1	26	10	0	37	6	20	19	0	45	13	41	2	0	56	4	44	16	0	64
15:15	15:30	1	32	11	0	44	15	45	31	0	91	16	52	1	0	69	9	39	9	0	57
15:30	15:45	2	28	7	0	37	11	45	34	0	90	16	48	2	0	66	6	60	14	0	80
15:45	16:00	2	32	10	0	44	11	33	26	0	70	21	55	3	0	79	7	51	16	0	74
Hourly Total		6	118	38	0	162	43	143	110	0	296	66	196	8	0	270	26	194	55	0	275
16:00	16:15	5	29	9	0	43	12	27	29	0	68	17	64	0	0	81	2	52	6	0	60

		First Avenue										Quaker Road									
		North Approach					South Approach					East Approach					West Approach				
Time Period		LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT
16:15	16:30	2	45	12	0	59	5	15	27	0	47	30	64	2	0	96	3	48	9	0	60
16:30	16:45	2	45	12	0	59	6	31	29	0	66	24	68	2	0	94	5	54	7	0	66
16:45	17:00	2	42	15	0	59	14	23	23	0	60	24	56	4	0	84	3	41	5	0	49
Hourly Total		11	161	48	0	220	37	96	108	0	241	95	252	8	0	355	13	195	27	0	235
17:00	17:15	1	37	8	0	46	8	24	31	0	63	27	58	0	0	85	5	47	9	0	61
17:15	17:30	6	31	10	0	47	6	31	30	0	67	25	59	1	0	85	8	47	8	0	63
17:30	17:45	1	30	17	0	48	12	38	47	0	97	29	69	0	0	98	6	66	7	0	79
17:45	18:00	2	32	8	0	42	7	44	43	0	94	32	58	0	0	90	1	58	8	0	67
Hourly Total		10	130	43	0	183	33	137	151	0	321	113	244	1	0	358	20	218	32	0	270
Grand Total		59	829	231	0	1119	267	798	823	0	1888	644	1417	52	0	2113	138	1567	254	0	1959
Truck %		0%	1%	0%	0%	1%	5%	2%	3%	0%	3%	6%	3%	2%	0%	4%	0%	3%	5%	0%	3%

Port Robinson Rd @ Cataract Rd

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 7:45:00
To: 8:45:00

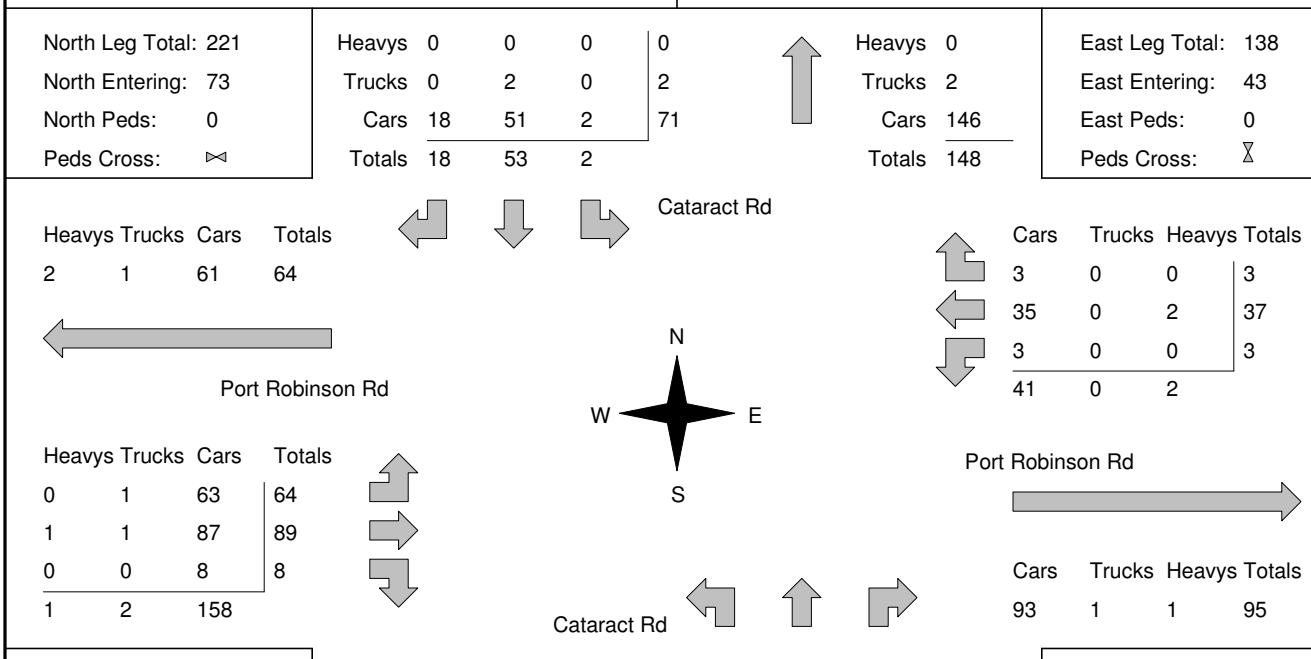
Municipality: Thorold
Site #: 0000000001
Intersection: Cataract Rd & Port Robinson Rd
TFR File #: 2
Count date: 25-Aug-2016

Weather conditions:
Rain am, Sunny mid, Cloudy pm

Person(s) who counted:
Marcus

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

Major Road: Cataract Rd runs N/S



Comments

Port Robinson Rd @ Cataract Rd

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 12:30:00
To: 13:30:00

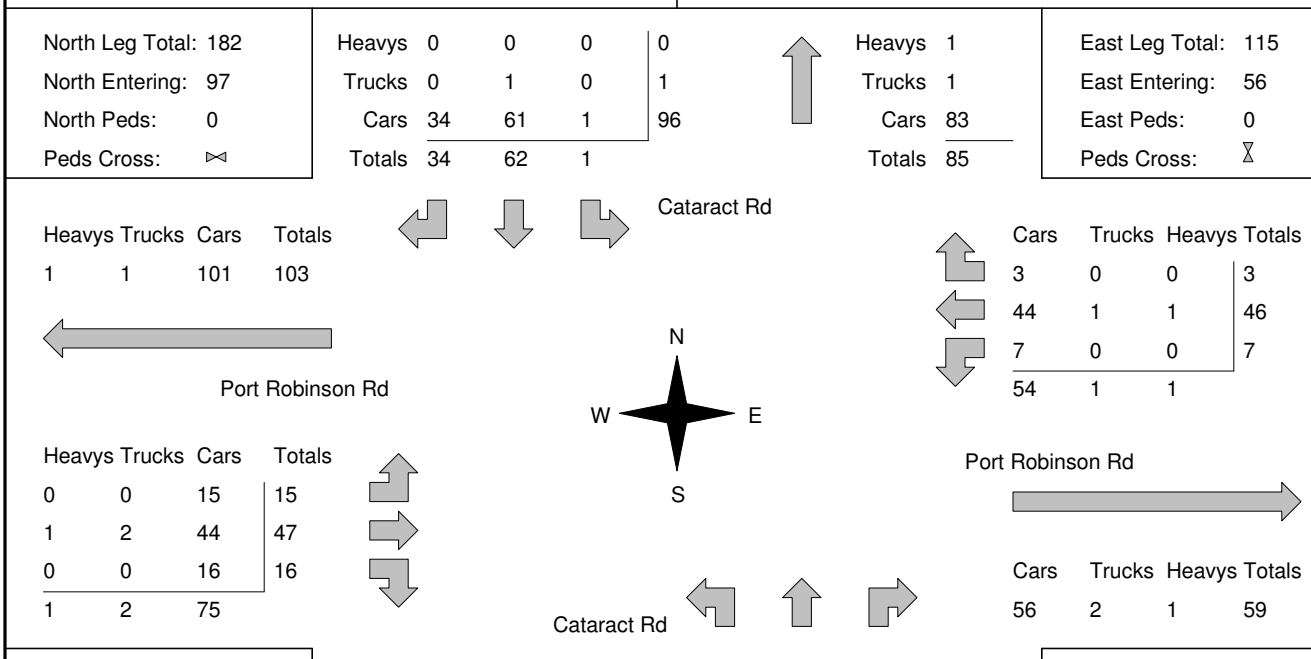
Municipality: Thorold
Site #: 0000000001
Intersection: Cataract Rd & Port Robinson Rd
TFR File #: 2
Count date: 25-Aug-2016

Weather conditions:
Rain am, Sunny mid, Cloudy pm

Person(s) who counted:
Marcus

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

Major Road: Cataract Rd runs N/S



Comments

Port Robinson Rd @ Cataract Rd

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:15:00
To: 17:15:00

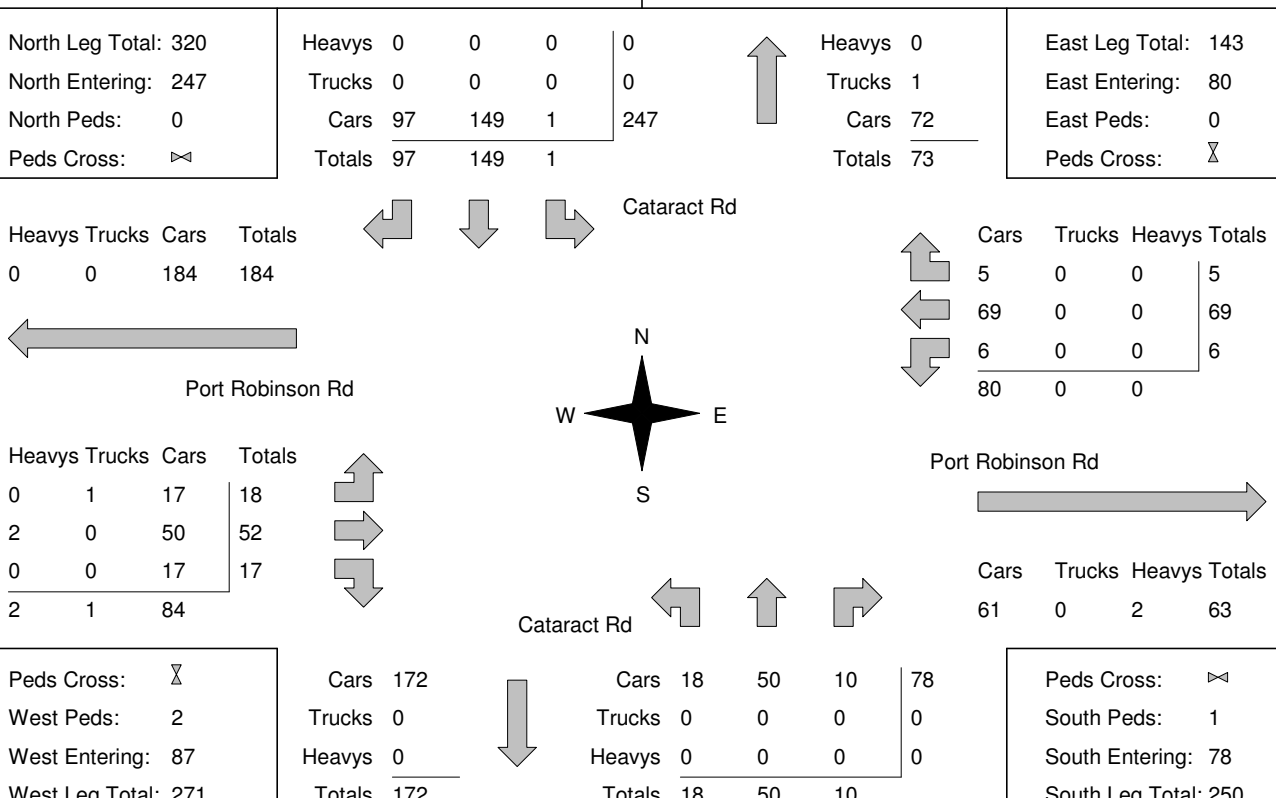
Municipality: Thorold
Site #: 0000000001
Intersection: Cataract Rd & Port Robinson Rd
TFR File #: 2
Count date: 25-Aug-2016

Weather conditions:
Rain am, Sunny mid, Cloudy pm

Person(s) who counted:
Marcus

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

Major Road: Cataract Rd runs N/S



Comments

Port Robinson Rd @ Cataract Rd

Total Count Diagram

Municipality: Thorold
Site #: 0000000001
Intersection: Cataract Rd & Port Robinson Rd
TFR File #: 2
Count date: 25-Aug-2016

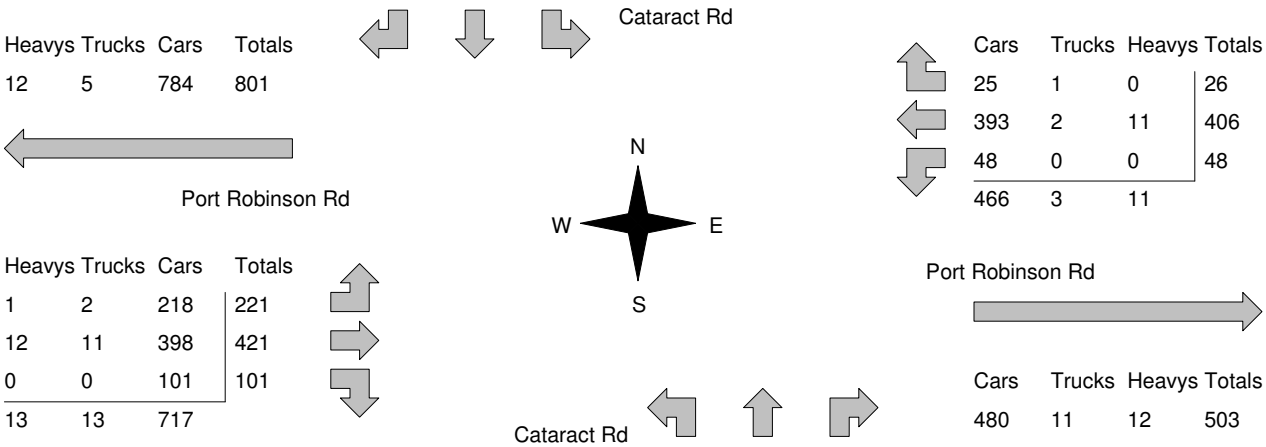
Weather conditions:
Rain am, Sunny mid, Cloudy pm

Person(s) who counted:
Marcus

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

Major Road: Cataract Rd runs N/S

North Leg Total:	1613			
North Entering:	907			
North Peds:	4			
Peds Cross:	⋈			
Heavys	0	0	0	0
Trucks	0	7	0	7
Cars	291	590	19	900
Totals	291	597	19	
Heavys	3			
Trucks	7			
Cars	696			
Totals	706			
East Leg Total:	983			
East Entering:	480			
East Peds:	4			
Peds Cross:	⧖			



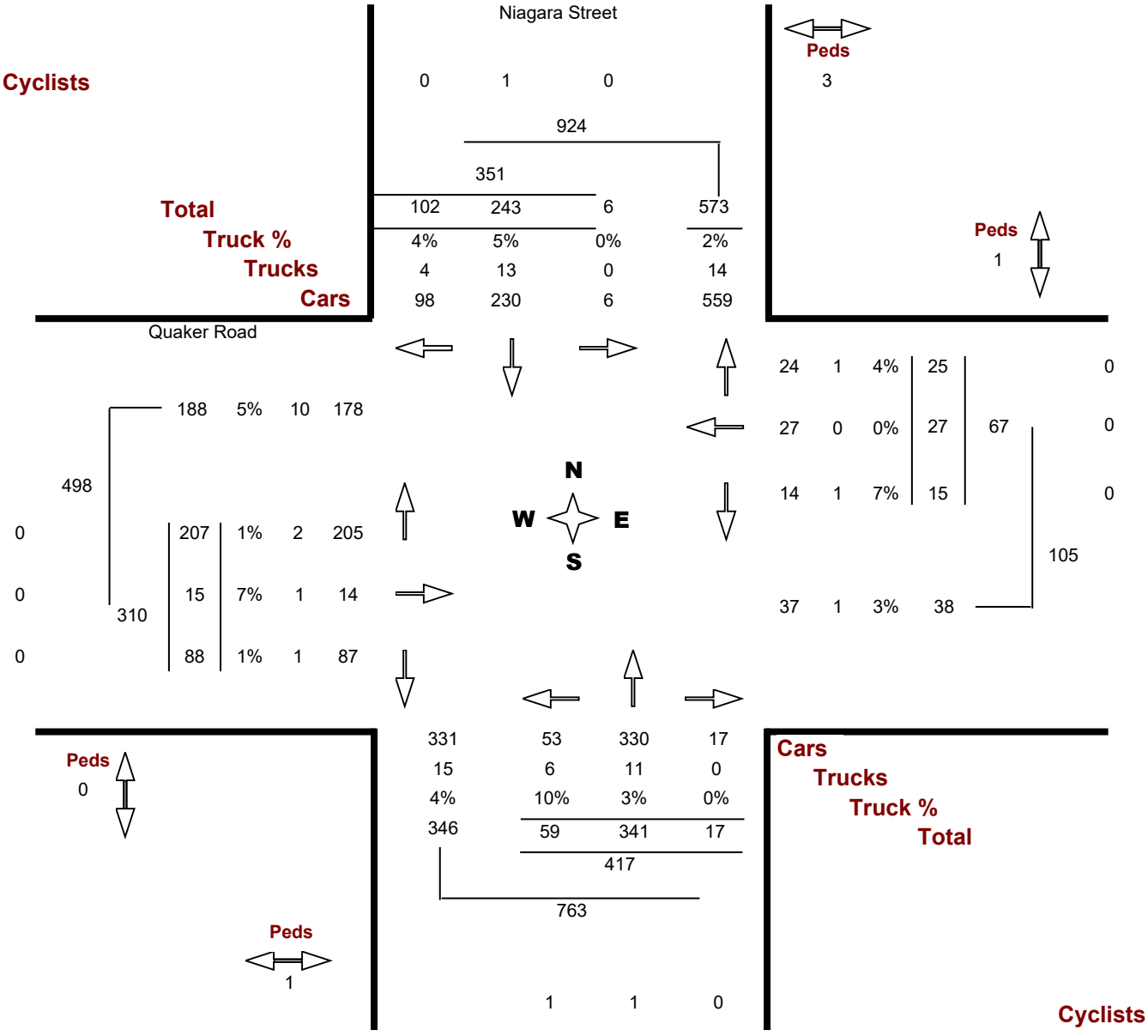
Peds Cross:	⧖			
West Peds:	7			
West Entering:	743			
West Leg Total:	1544			
Cars	739			
Trucks	7			
Heavys	0			
Totals	746			
Cars	100	453	63	616
Trucks	3	4	0	7
Heavys	1	2	0	3
Totals	104	459	63	
Peds Cross:	⋈			
South Peds:	4			
South Entering:	626			
South Leg Total:	1372			

Comments

Turning Movements Report - AM Period

Location..... Niagara Street @ Quaker Road
Municipality. WELLAND
Traffic Cont. Traffic signal
Major Dir..... None

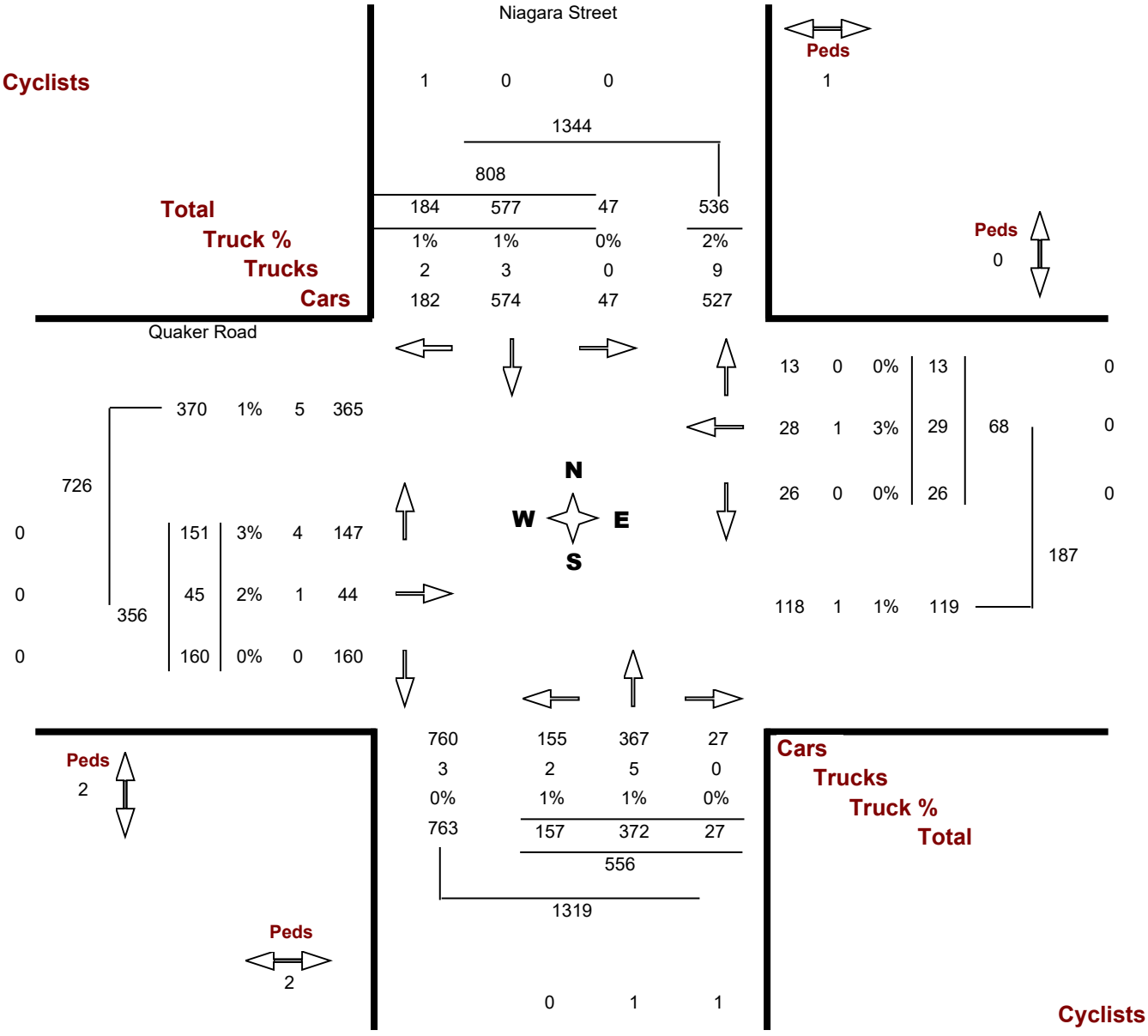
GeoID..... 00838
Count Date. Friday, 14 July, 2017
Count Time. 07:00 AM — 09:00 AM
Peak Hour.. 08:00 AM — 09:00 AM



Turning Movements Report - PM Period

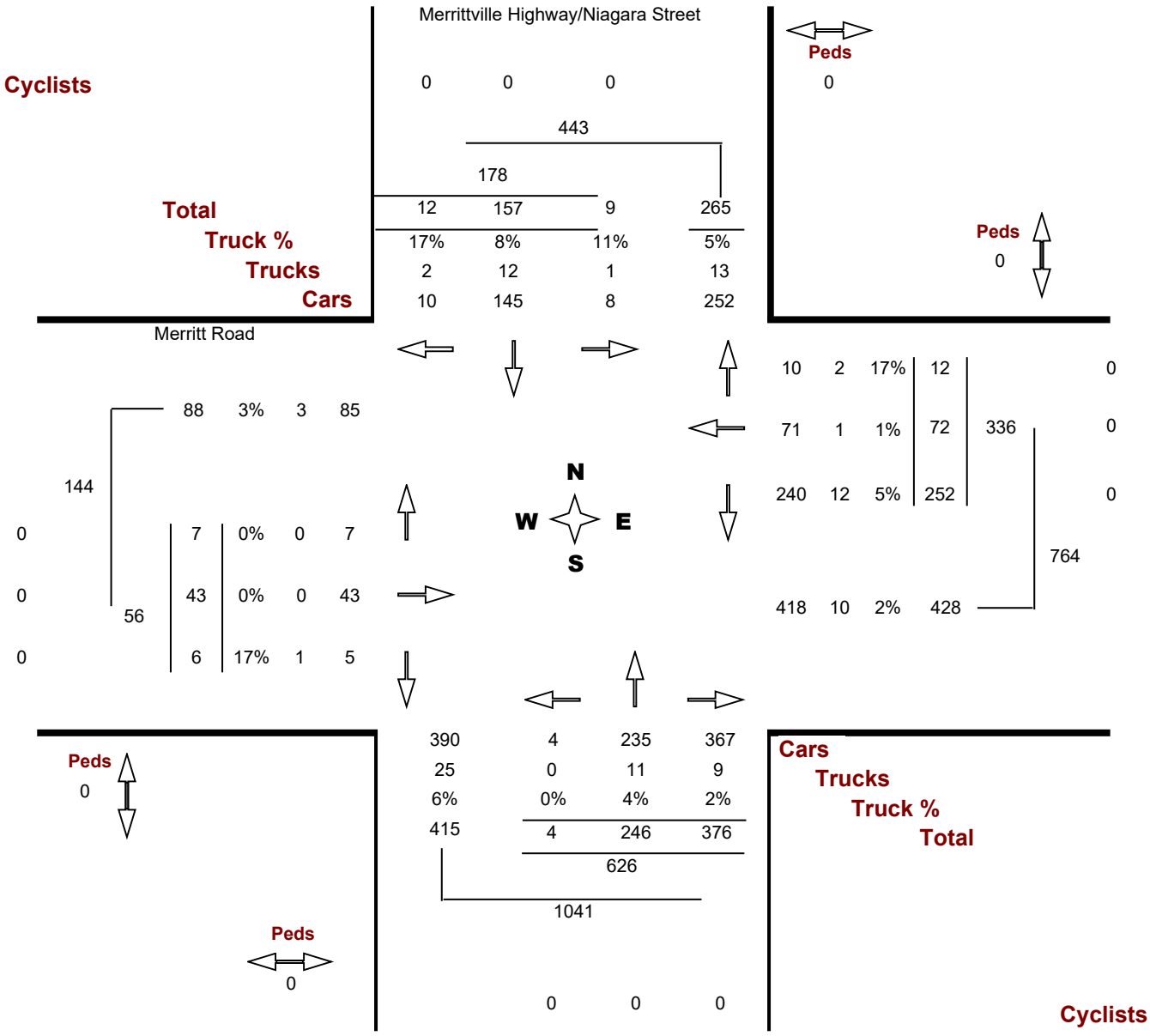
Location..... Niagara Street @ Quaker Road
Municipality. WELLAND
Traffic Cont. Traffic signal
Major Dir..... None

GeoID..... 00838
Count Date. Friday, 14 July, 2017
Count Time. 03:00 PM — 06:00 PM
Peak Hour.. 04:15 PM — 05:15 PM



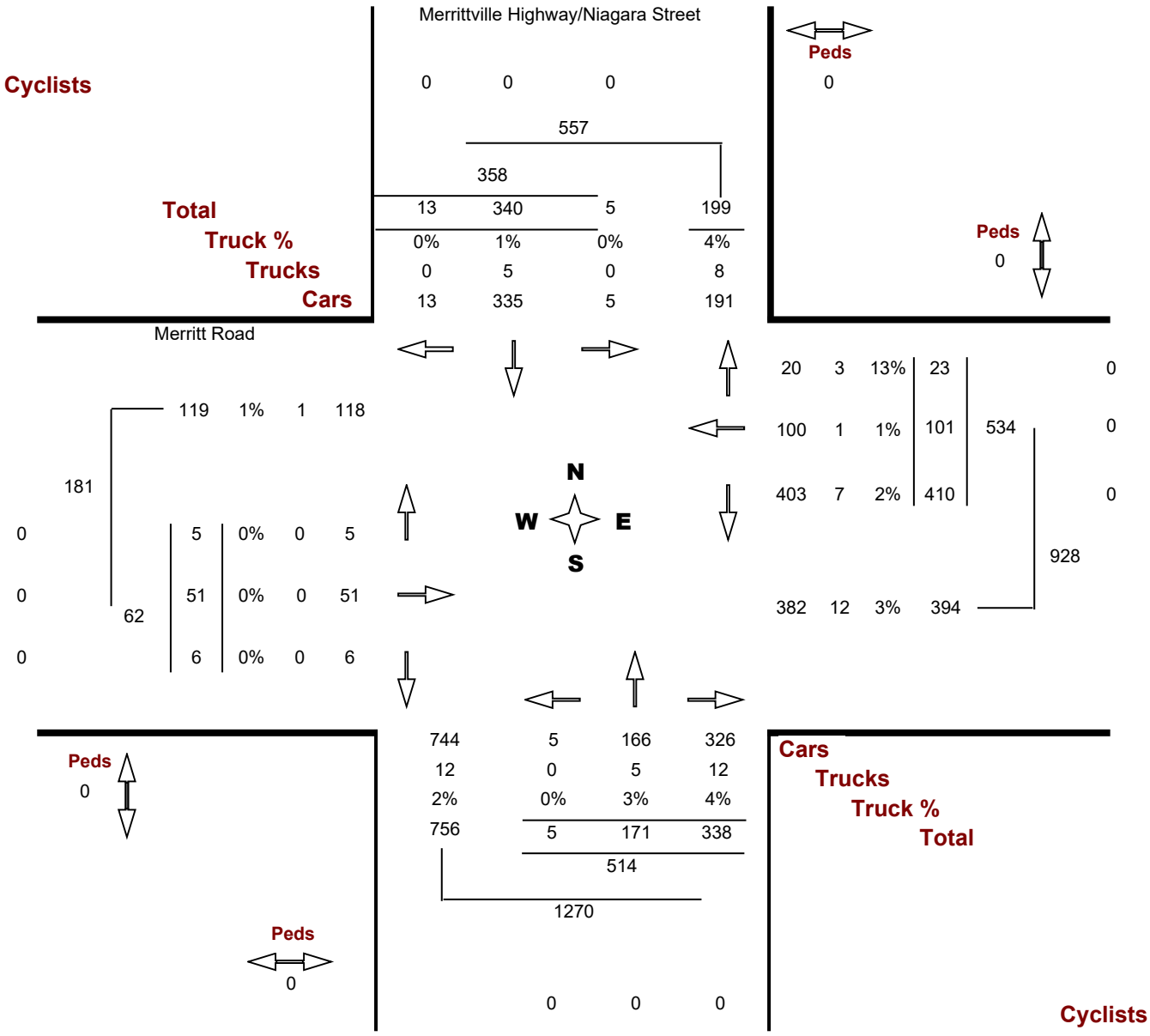
Turning Movements Report - AM Period

Location.....	Merritt Road @ Merrittville Highway/Niagara Street	**GeoID.....**	00424
Municipality.	WELLAND	**Count Date.**	Tuesday, 21 June, 2016
Traffic Cont.		**Count Time.**	07:00 AM — 09:00 AM
Major Dir.....	North south	**Peak Hour..**	07:45 AM — 08:45 AM



Turning Movements Report - PM Period

Location.....	Merritt Road @ Merrittville Highway/Niagara Street	**GeoID.....**	00424
Municipality.	WELLAND	**Count Date.**	Tuesday, 21 June, 2016
Traffic Cont.		**Count Time.**	03:00 PM — 06:00 PM
Major Dir.....	North south	**Peak Hour..**	04:30 PM — 05:30 PM



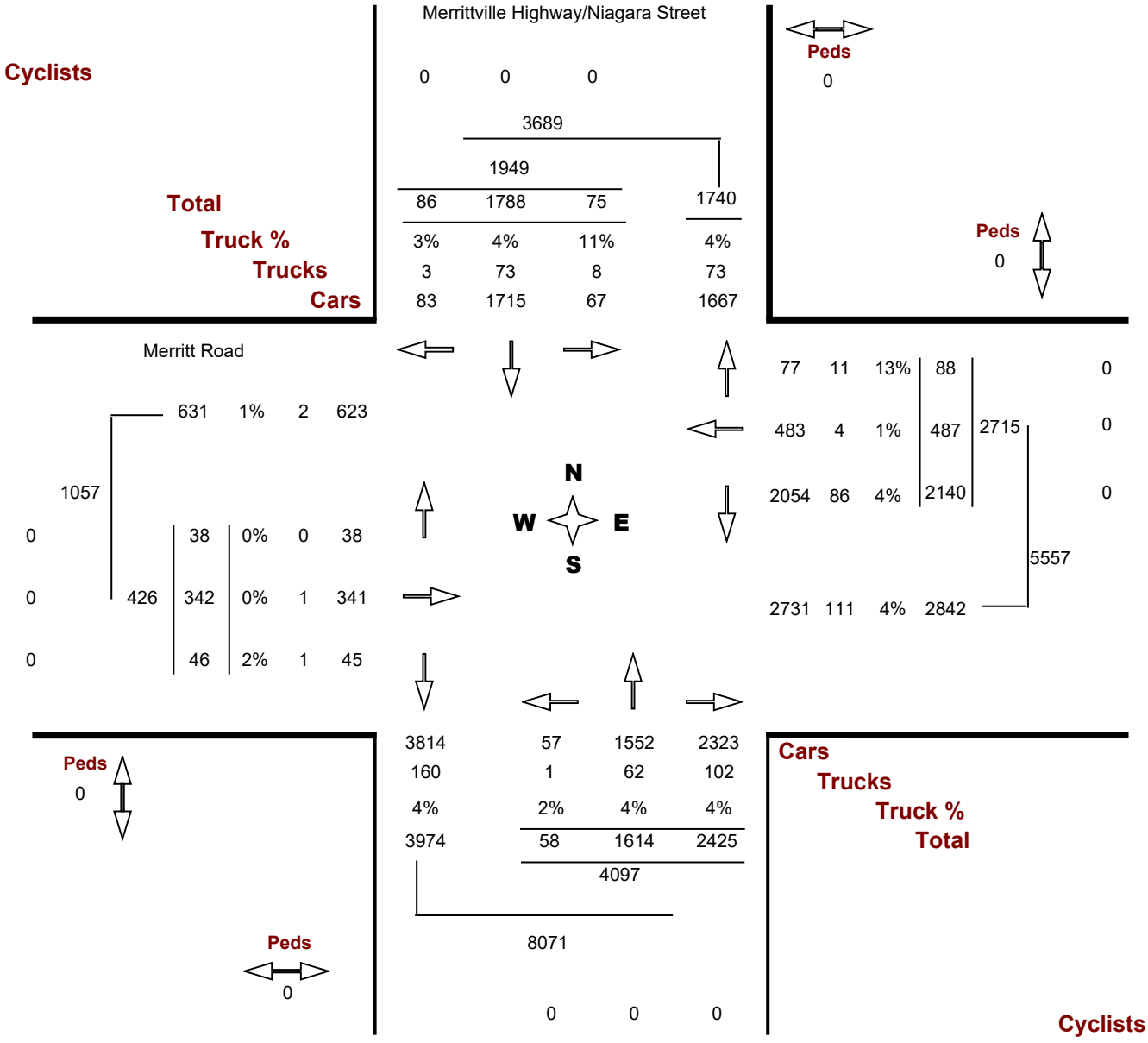
Turning Movement Count Report
Full Study

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

Municipality..... WELLAND

GeoID..... 00424

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



Turning Movement Count - Details Report (15 min)

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

Municipality..... WELLAND

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

		Merrittville Highway/Niagara Street										Merritt Road									
		North Approach					South Approach					East Approach					West Approach				
Time Period		LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT
07:00	07:15	2	23	0	0	25	1	36	70	0	107	9	4	1	0	14	0	9	1	0	10
07:15	07:30	2	23	2	0	27	1	42	84	0	127	28	6	0	0	34	2	8	0	0	10
07:30	07:45	3	21	2	0	26	1	58	87	0	146	37	7	2	0	46	1	6	4	0	11
07:45	08:00	2	32	4	0	38	0	65	106	0	171	52	11	4	0	67	1	13	2	0	16
Hourly Total		9	99	8	0	116	3	201	347	0	551	126	28	7	0	161	4	36	7	0	47
08:00	08:15	2	41	1	0	44	1	63	108	0	172	50	19	4	0	73	1	11	1	0	13
08:15	08:30	4	34	4	0	42	2	63	77	0	142	74	23	4	0	101	2	8	1	0	11
08:30	08:45	1	50	3	0	54	1	55	85	0	141	76	19	0	0	95	3	11	2	0	16
08:45	09:00	4	42	3	0	49	1	42	64	0	107	89	25	2	0	116	2	11	3	0	16
Hourly Total		11	167	11	0	189	5	223	334	0	562	289	86	10	0	385	8	41	7	0	56
11:00	11:15	1	55	2	0	58	1	53	55	0	109	54	10	0	0	64	0	5	2	0	7
11:15	11:30	2	51	1	0	54	2	42	56	0	100	47	7	1	0	55	0	8	2	0	10
11:30	11:45	4	52	3	0	59	1	47	59	0	107	39	7	0	0	46	0	8	0	0	8
11:45	12:00	3	50	3	0	56	2	52	65	0	119	50	8	0	0	58	0	7	3	0	10
Hourly Total		10	208	9	0	227	6	194	235	0	435	190	32	1	0	223	0	28	7	0	35
12:00	12:15	2	60	1	0	63	2	48	60	0	110	58	15	4	0	77	0	8	1	0	9
12:15	12:30	0	39	3	0	42	3	55	73	0	131	47	9	5	0	61	0	8	0	0	8
12:30	12:45	3	54	3	0	60	5	54	76	0	135	58	8	3	0	69	3	10	0	0	13
12:45	13:00	0	44	3	0	47	1	52	61	0	114	58	11	6	0	75	0	8	3	0	11
Hourly Total		5	197	10	0	212	11	209	270	0	490	221	43	18	0	282	3	34	4	0	41
13:00	13:15	1	58	3	0	62	3	43	61	0	107	52	4	0	0	56	4	12	0	0	16
13:15	13:30	3	48	4	0	55	1	48	74	0	123	53	20	2	0	75	1	8	1	0	10
13:30	13:45	1	60	0	0	61	3	64	79	0	146	74	15	2	0	91	0	11	3	0	14
13:45	14:00	1	57	4	0	62	1	51	65	0	117	77	24	2	0	103	1	2	2	0	5
Hourly Total		6	223	11	0	240	8	206	279	0	493	256	63	6	0	325	6	33	6	0	45
15:00	15:15	4	69	3	0	76	1	49	59	0	109	72	10	3	0	85	2	11	1	0	14
15:15	15:30	1	62	6	0	69	1	59	81	0	141	77	15	0	0	92	1	14	4	0	19
15:30	15:45	2	67	2	0	71	3	45	70	0	118	64	14	3	0	81	0	23	1	0	24
15:45	16:00	6	68	2	0	76	2	43	65	0	110	74	19	2	0	95	4	11	0	0	15
Hourly Total		13	266	13	0	292	7	196	275	0	478	287	58	8	0	353	7	59	6	0	72
16:00	16:15	3	72	2	0	77	4	47	69	0	120	89	19	3	0	111	2	11	2	0	15

		Merrittville Highway/Niagara Street										Merritt Road									
		North Approach					South Approach					East Approach					West Approach				
Time Period		LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT	LT	TH	RT	U-Turn	TOT
16:15	16:30	5	84	2	0	91	3	54	77	0	134	91	16	9	0	116	2	10	1	0	13
16:30	16:45	2	102	5	0	109	2	56	96	0	154	107	31	2	0	140	1	13	2	0	16
16:45	17:00	2	84	5	0	91	1	43	73	0	117	98	25	6	0	129	2	17	1	0	20
Hourly Total		12	342	14	0	368	10	200	315	0	525	385	91	20	0	496	7	51	6	0	64
17:00	17:15	1	91	1	0	93	0	41	79	0	120	90	22	6	0	118	0	6	1	0	7
17:15	17:30	0	63	2	0	65	2	31	90	0	123	115	23	9	0	147	2	15	2	0	19
17:30	17:45	5	73	5	0	83	2	63	99	0	164	98	19	1	0	118	0	13	0	0	13
17:45	18:00	3	59	2	0	64	4	50	102	0	156	83	22	2	0	107	1	26	0	0	27
Hourly Total		9	286	10	0	305	8	185	370	0	563	386	86	18	0	490	3	60	3	0	66
Grand Total		75	1788	86	0	1949	58	1614	2425	0	4097	2140	487	88	0	2715	38	342	46	0	426
Truck %		11%	4%	3%	0%	4%	2%	4%	4%	0%	4%	4%	1%	13%	0%	4%	0%	0%	2%	0%	0%

APPENDIX

C GROWTH RATE AND DIVERSION ANALYSIS

Growth Rate Analysis Methodology

- Historical traffic counts were obtained from the Region and from MTO ranging from 2016 to 2019 (pre-pandemic conditions).
- WSP was provided with the Niagara Region 2011 EMME link model outputs, as well as 2031 & 2041 horizon year EMME models for AM and PM peak periods.
- Link traffic volumes from the 2011 EMME assignment were compared with the 'Do-Nothing' 2031 and 2041 horizon year EMME assignments for AM and PM peak hours in order to estimate the annual traffic growth along corridors within the study area.
- Link growth rates were then applied to the updated existing traffic counts and traffic volumes were balanced.

Growth Rate Analysis Methodology

EMME Traffic Assignment

	2011		2031		2041	
	AM	PM	AM	PM	AM	PM
Eastbound						
Port Robinson Road	443	374	625	566	685	604
Merritt Road	145	32	97	59	127	78
Quaker Road	210	75	492	194	518	194
Westbound						
Port Robinson Road	5	49	29	33	38	43
Merritt Road	451	304	703	1019	814	1139
Quaker Road	85	163	124	206	129	242
Northbound						
Rice Road	164	164	310	333	330	376
Cataract Road	152	374	318	433	365	432
Niagara Street	173	236	268	364	317	461
Southbound						
Rice Road	168	272	193	156	228	153
Cataract Road	18	18	17	26	17	38
Niagara Street	37	196	8	259	33	397

→

Rounded Annual Growth Rates (Calculated)

	2011 - 2031 AGR		2031 - 2041 AGR	
	AM	PM	AM	PM
Eastbound				
Port Robinson Road	2%	2%	1%	1%
Merritt Road	-2%	3%	3%	3%
Quaker Road	4%	5%	1%	0%
Westbound				
Port Robinson Road	9%	-2%	3%	3%
Merritt Road	2%	6%	1%	1%
Quaker Road	2%	1%	0%	2%
Northbound				
Rice Road	3%	4%	1%	1%
Cataract Road	4%	1%	1%	0%
Niagara Street	2%	2%	2%	2%
Southbound				
Rice Road	1%	-3%	2%	0%
Cataract Road	0%	2%	0%	4%
Niagara Street	-7%	1%	15%	4%

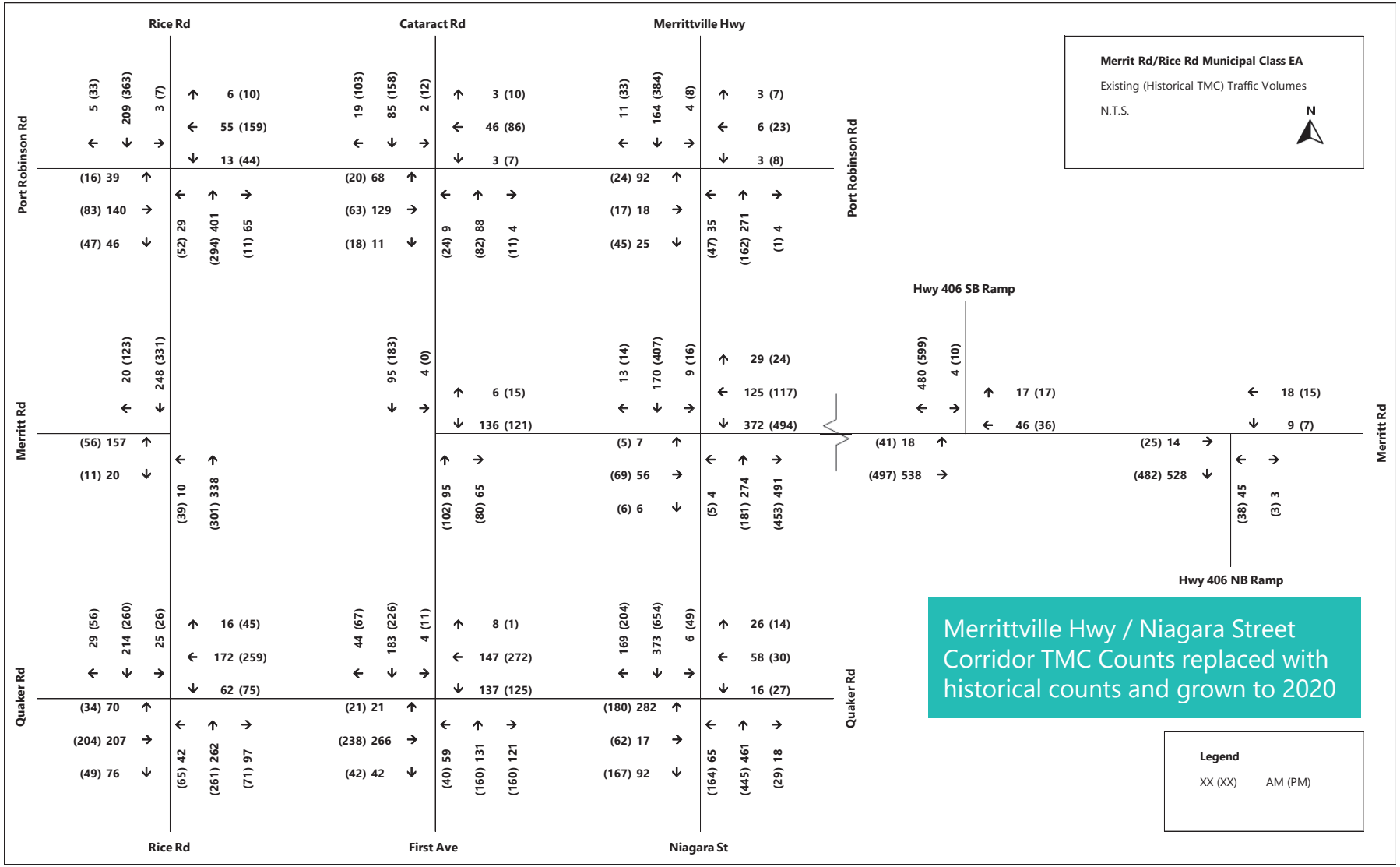
Growth Rate Analysis Methodology

Design Corridor Annual Growth Rates

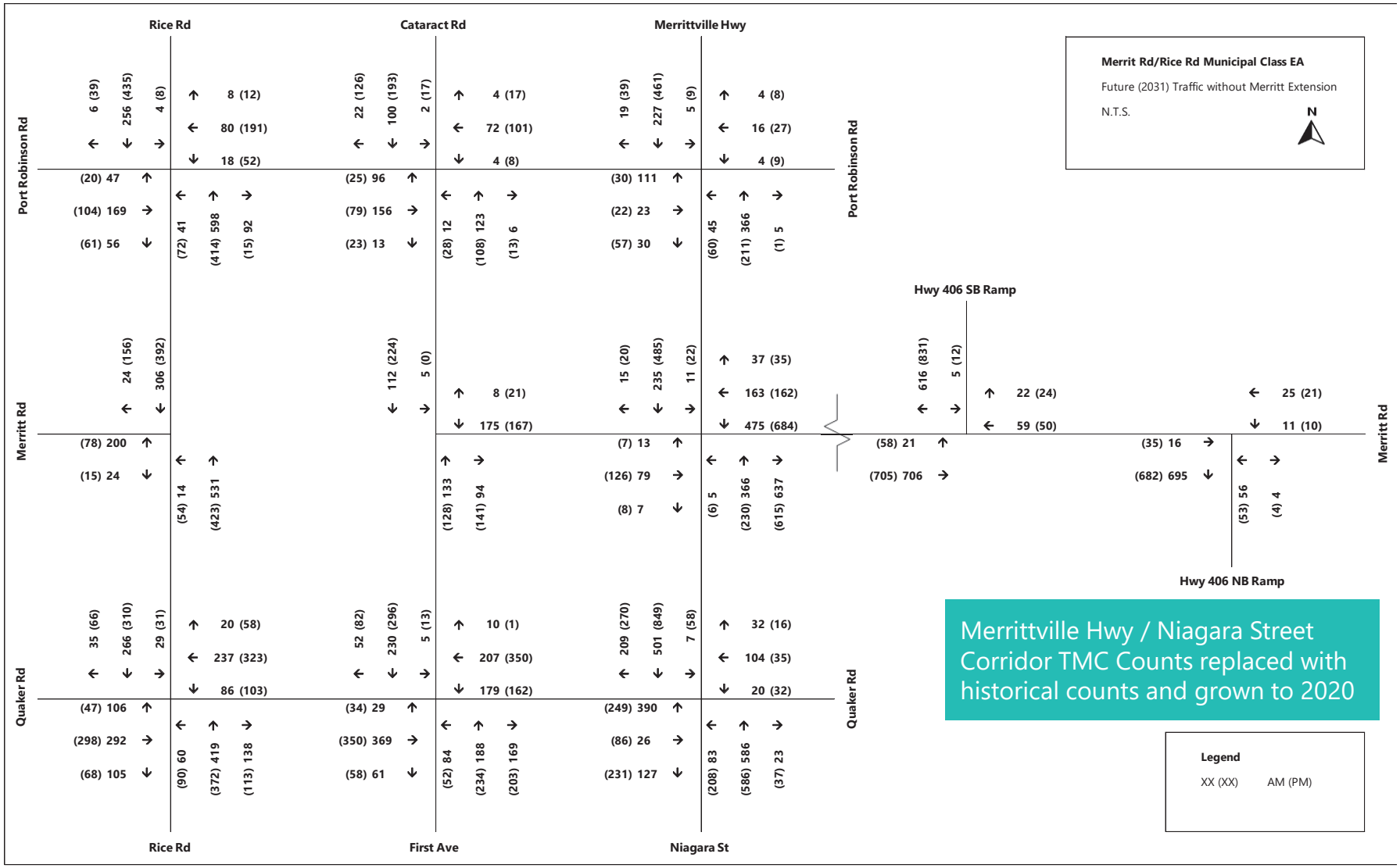
	2011 - 2031 AGR		2031 - 2041 AGR	
	AM	PM	AM	PM
Eastbound				
Port Robinson Road	2%	2%	1.5%	1.5%
Merritt Road	1.5%	3%	3%	3%
Quaker Road	3%	3%	1.5%	1.5%
Westbound				
Port Robinson Road	3%	1.5%	3%	3%
Merritt Road	2%	3%	2%	1.5%
Quaker Road	2%	1.5%	1.5%	2%
Northbound				
Rice Road	3%	3%	1.5%	1.5%
Cataract Road	3%	1.5%	1.5%	1.5%
Niagara Street	2%	2%	2%	2%
Southbound				
Rice Road	1.5%	1.5%	2%	1.5%
Cataract Road	1.5%	2%	1.5%	3%
Niagara Street	1.5%	1.5%	3%	3%

- It is noted that at a few locations the growth rates area significantly high and unrealistic.
- It was assumed that growth rates less than or equal to 0% to be conservatively rounded up to 1.5% and an upper bound of 3% is applied to more realistically reflect the anticipated growth of observed traffic counts

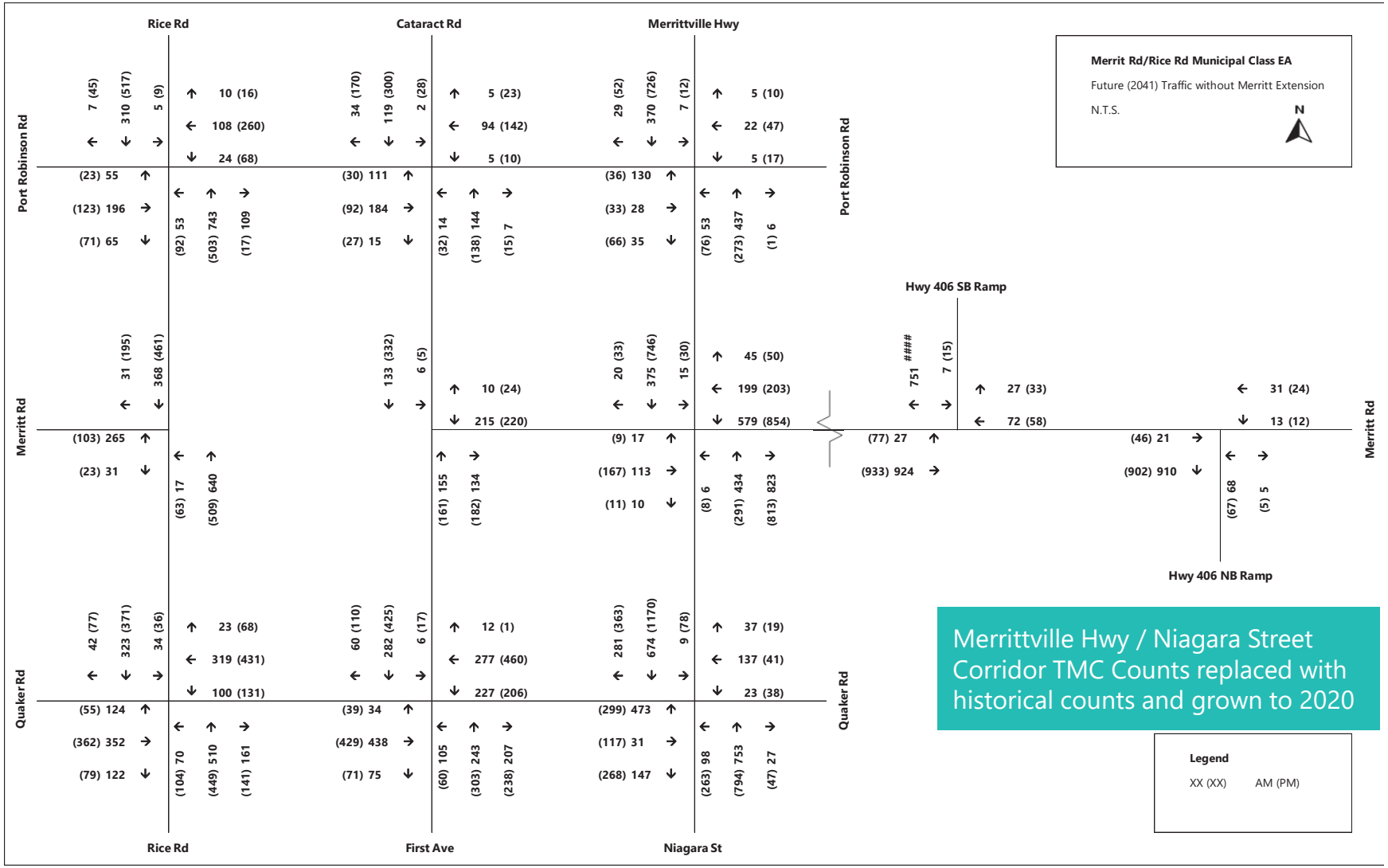
Existing TM Counts



2031 'Do Nothing'



2041 'Do Nothing'

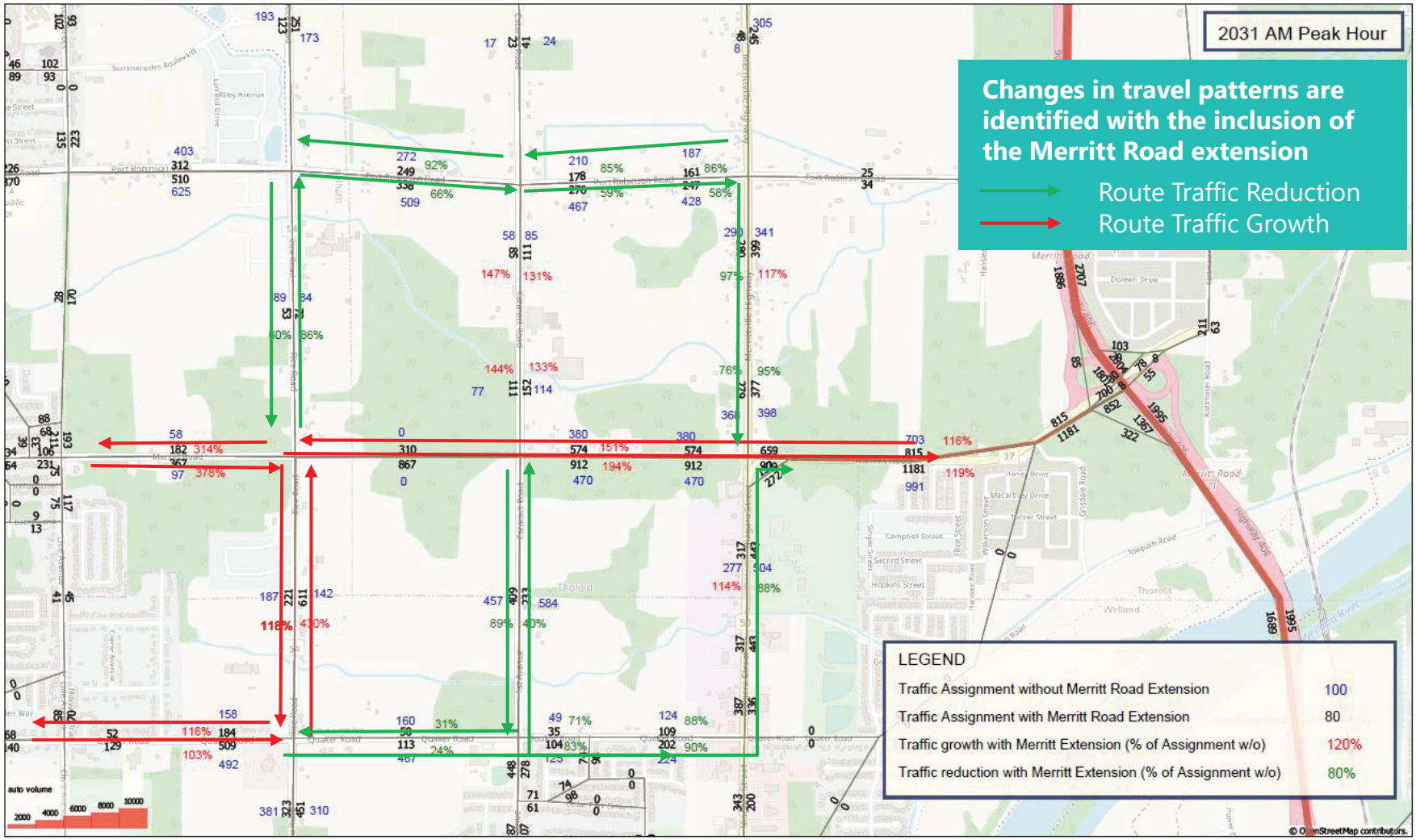


Travel Demand Forecasting Methodology

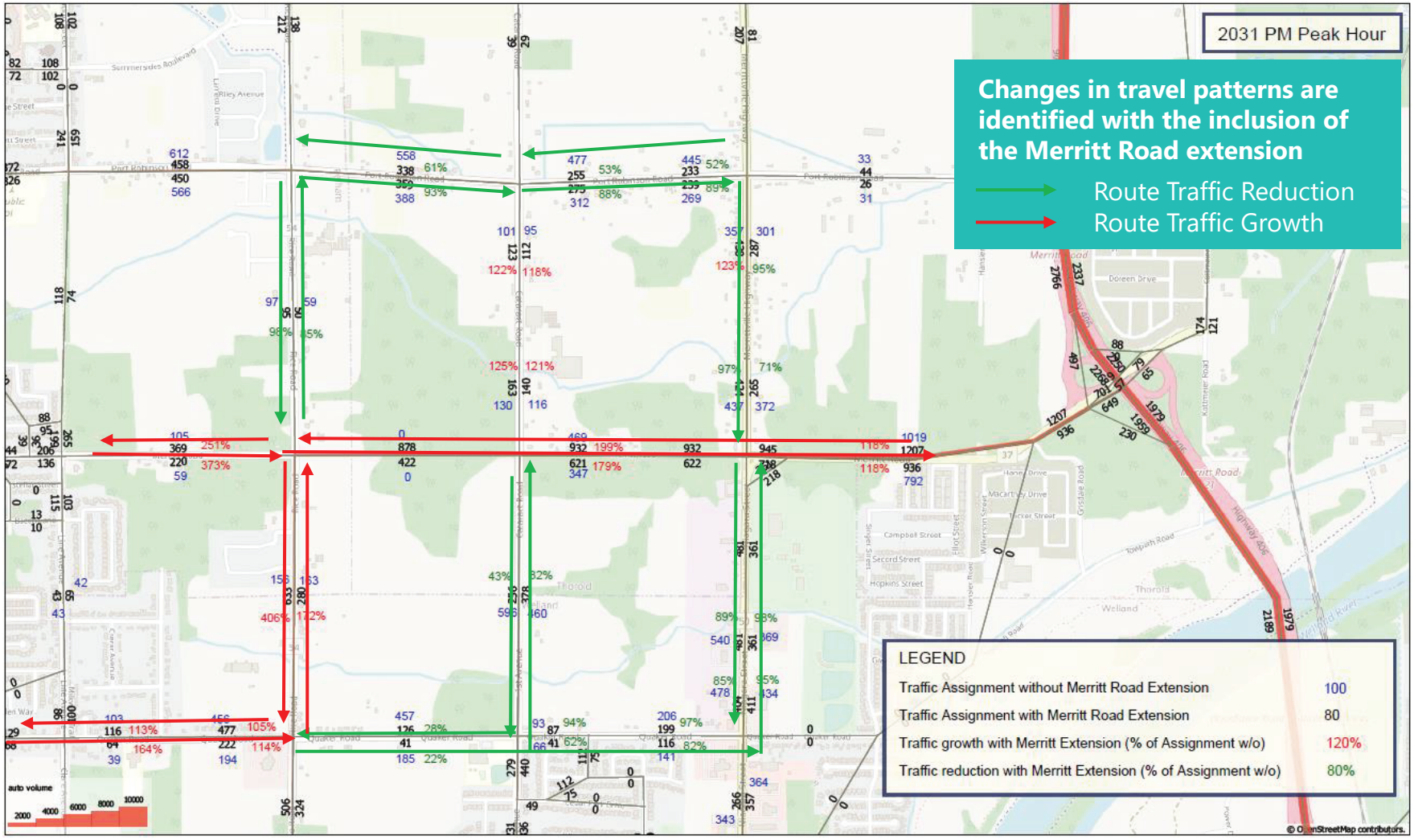
- Link traffic volumes from the 'do nothing' 2031 and 2041 horizon year assignments were compared with the traffic assignments from the Region's models, modified to include the proposed Merritt Road extension for AM and PM peak hours in order to assess the resulting traffic diversion along corridors within the study area.

- Percentage changes in traffic flow along the study area corridors with the proposed extension were measured and diversion routes were identified based on link traffic changes.

Changes in Travel Patterns – 2031 AM



Changes in Travel Patterns – 2031 PM

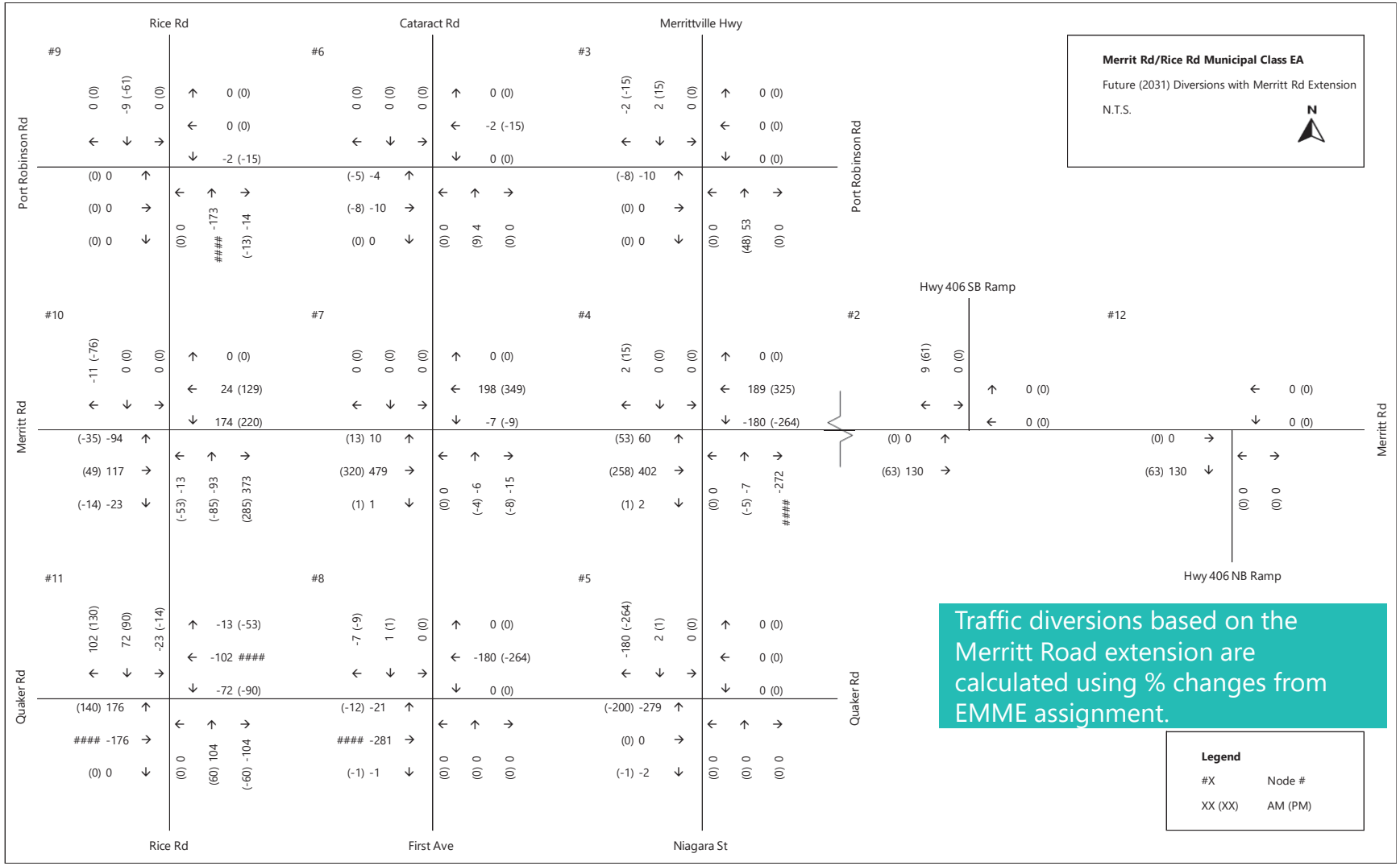


Travel Demand Forecasting Methodology

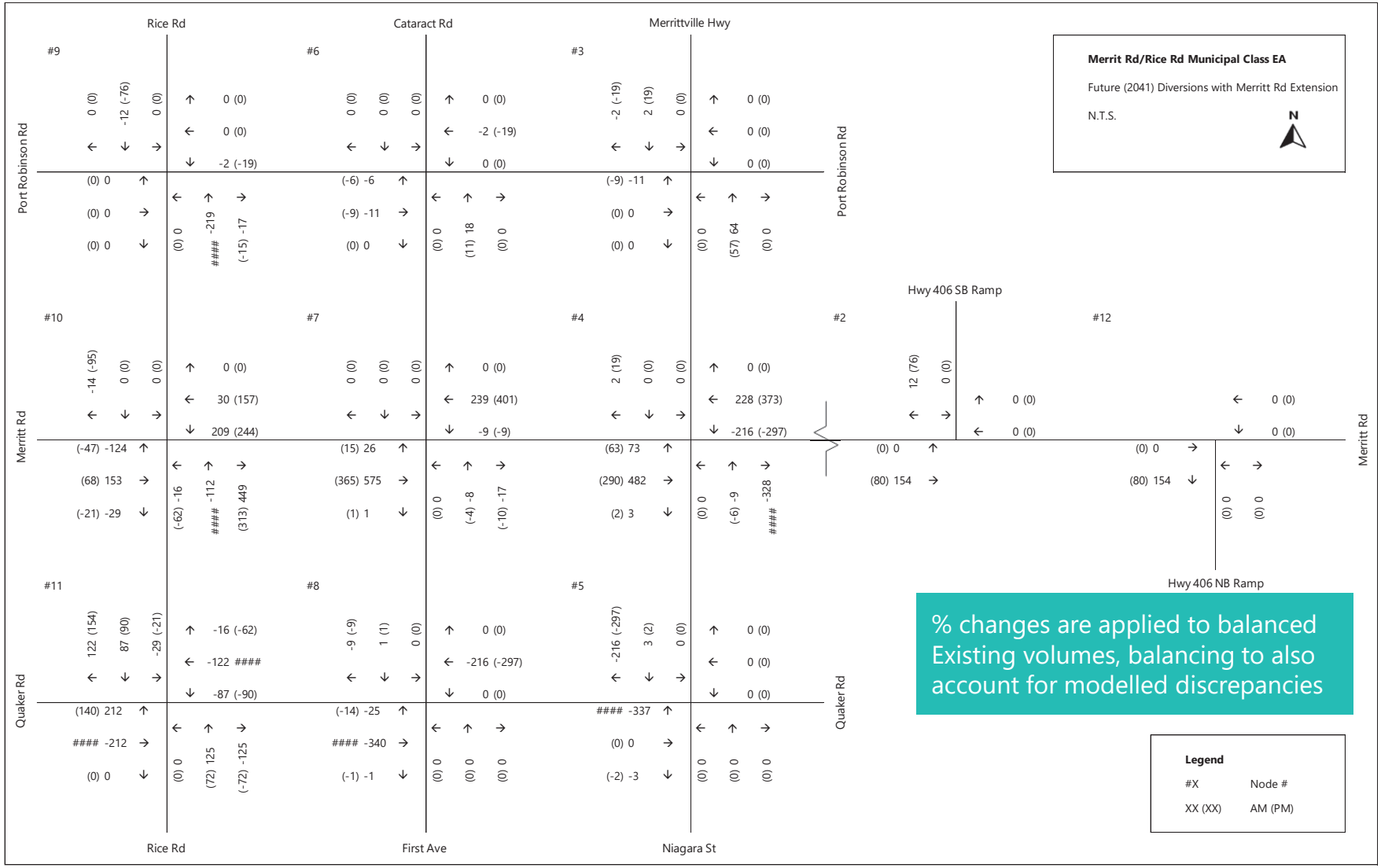
- Calculated percentage changes in traffic flow along the study area corridors with the proposed Merritt Road extension are used to estimate traffic diversions within the study area.

- Percentage changes are applied to updated future Do-Nothing volumes to estimate traffic diversions.

Merritt Extension Open – 2031 Diverted Traffic



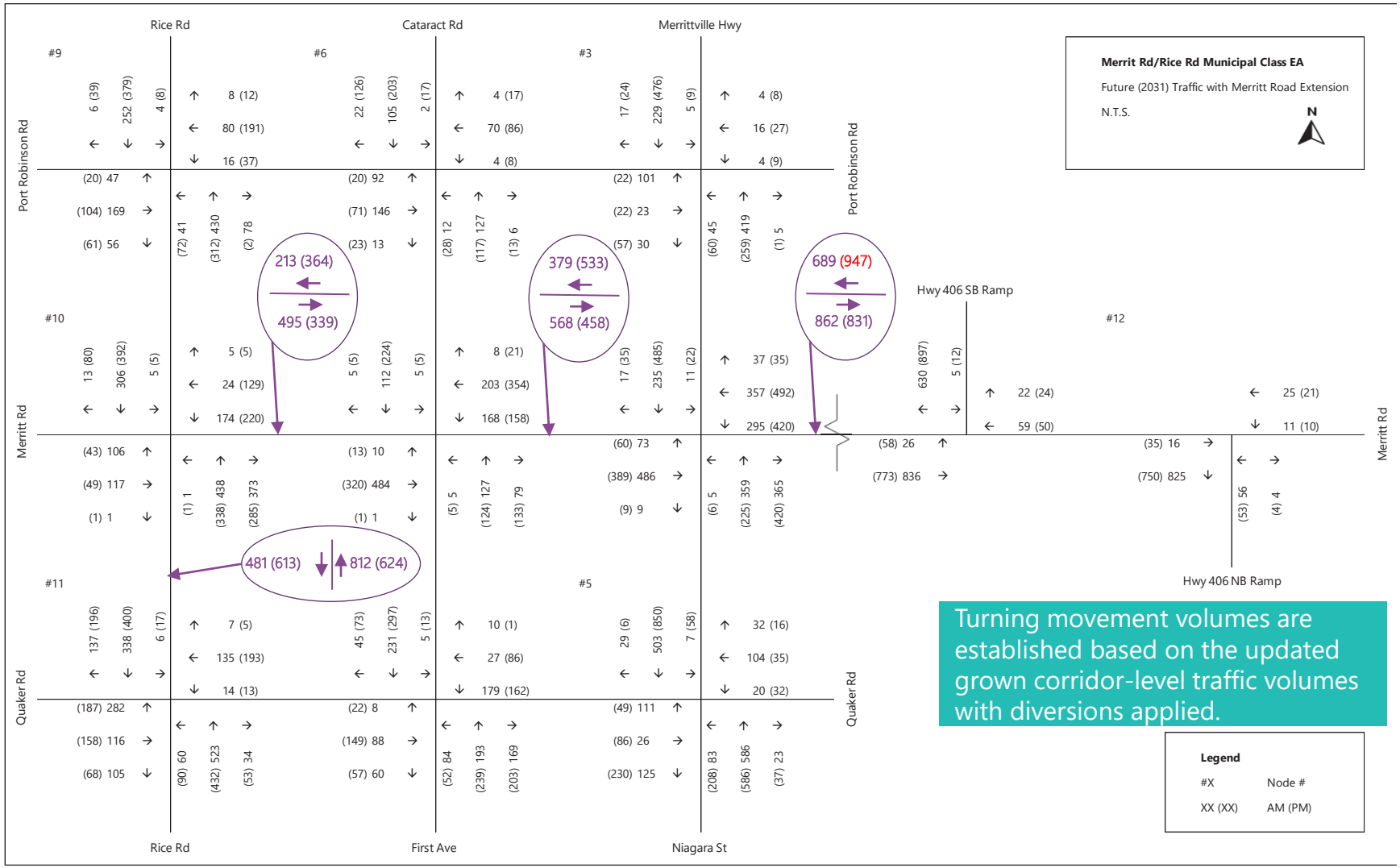
Merritt Extension Open – 2041 Diverted Traffic



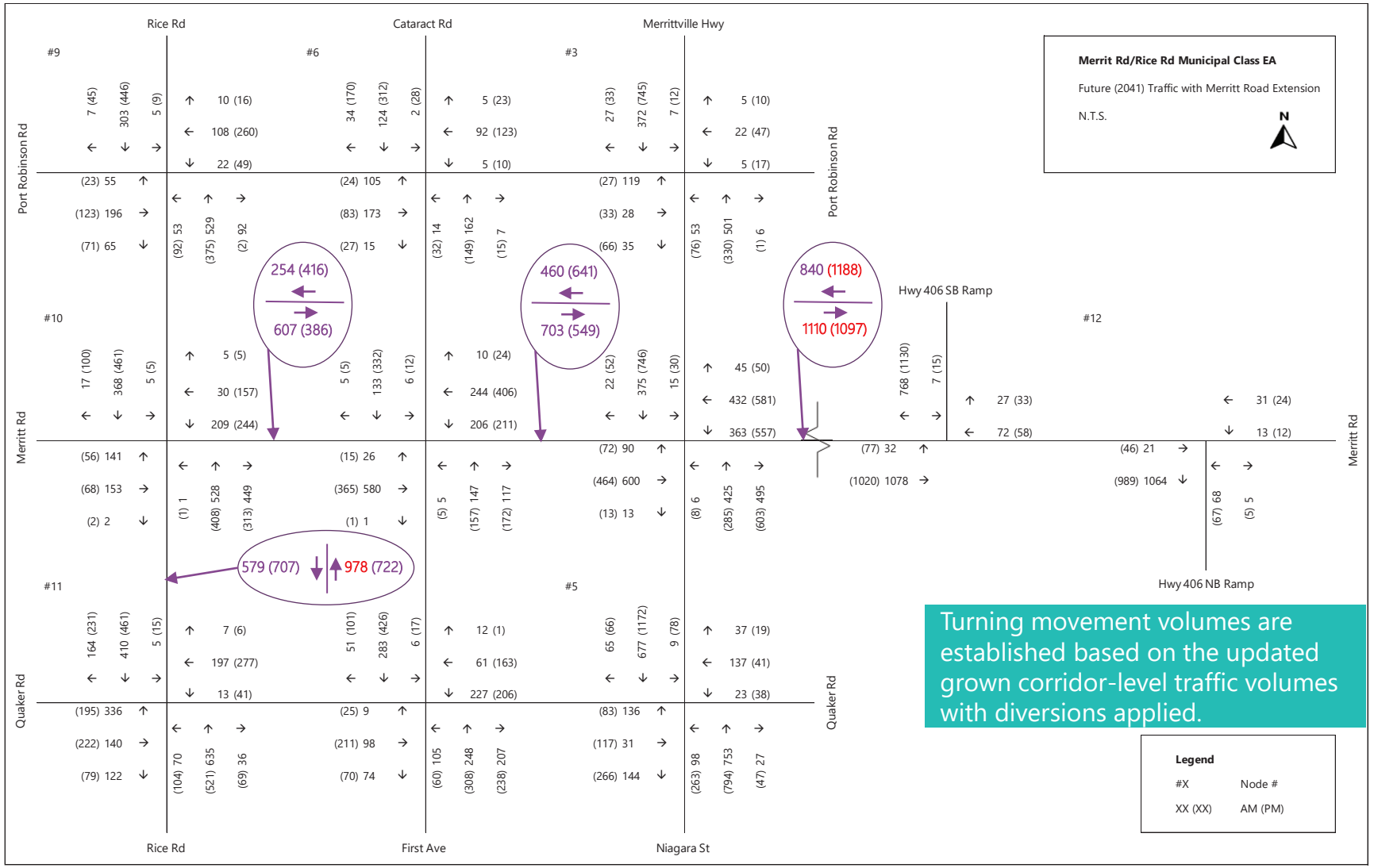
Travel Demand Forecasting & Future Conditions Assessment Methodology

- The Future 2031/2041 Total volumes were estimated by adding the diverted volumes to the future 2031/2041 Do-Nothing volumes, respectively.

Merritt Road Extension Open – 2031 Total Traffic



Merritt Road Extension Open – 2041 Total Traffic



APPENDIX

D GROWTH RATE ANALYSIS

Purpose

The purpose of the growth rate analysis was to forecast volumes from the 2020 existing conditions year to the 2031 and 2041 horizon years for the major roadways in the study. These major roadways include Rice Road, Cataract Road, and Niagara Street, Port Robinson Road, Merritt Road, and Quaker Road.

A set of growth rates was derived to forecast traffic from 2020 to 2031. Another set of growth rates were derived to forecast traffic from 2031 to 2041.

Data Collection

The Niagara Region EMME Transportation Model was used as the primary source in determining corridor growth rates. IBI Group provided Wood with link model outputs for the 2011 base year and the 2031 and 2041 horizon years for the AM and PM peak hour. The TMP network was used for the 2031 and 2041 horizon years. IBI Group provided these model outputs in GIS format. The version of the EMME model was the model developed for Niagara Region's 2017 Transportation Model Plan with adjustments to forecasted land use data to account for the change in population and employment due to the North West Secondary Plan. More details regarding this adjustment can be found in the *North West Secondary Plan Model Run (December 17, 2019)* – IBI Group.

The other data source that was used for this growth rate analysis was the Niagara Region land use forecasts. IBI Group provided Wood with 2011 base year and 2031 and 2041 horizon year land use data by the traffic zone geography that is used in the Niagara Region EMME Transportation Model.

Methodology

The following steps were used to determine the growth rates for Rice Road, Cataract Road, and Niagara Street, Port Robinson Road, Merritt Road, and Quaker Road:

1. Compare existing conditions (2020) balanced counts to the 2011 base year EMME assignment to understand how the trips are being assigned to the study area.
2. Compare link traffic volumes from the 2011 EMME assignment with the 'Do-Nothing' 2031 and 2041 horizon year EMME assignments for AM and PM peak hours in order to estimate the annual traffic growth along corridors within the study area. Link growth rates are then applied to the Existing Conditions volumes.
3. Calculate land use growth rates around the study area.

Data Analysis

Step 1: Compare Existing Conditions (2020) Balanced Counts to the 2011 base year EMME assignment.

Existing conditions (2020) balanced counts derived by growing historical turning movement counts by an annual rate of 1.5% were compared to the 2011 base year EMME assignment with to understand how the trips are being assigned to the study area. There are two major observations regarding the EMME assignment:

- The modelled volumes along Merritt Road and Quaker Road between Cataract Road and Niagara Street are in a similar magnitude in the AM and PM peak hours. The count volumes show that there should be significantly more trips along Quaker Road.
- The modelled volumes along Cataract Road and Niagara Street between Quaker Road and Merritt Road are in a similar magnitude in the AM and PM peak hours. The count volumes show that there should be significantly more trips along Niagara Street.

These observations suggest that the EMME trip assignment is not taking into consideration the actual road characterization of Merritt Road and Cataract Road. Those two roadways currently have a more rural characterization than Niagara Street and Quaker Road however the EMME trip assignment is treating Merritt Road and Cataract Road as having similar road characterizations.

The modelled inconsistencies observed are inconsequential, as the projected 2020 balanced historical turning movement counts will be used in the modelling scenarios for the traffic analyses.

The growth rates derived by comparing the 2011 base year EMME assignment to the 2031 and 2041 horizon year assignments will not be affected as they represent the compounded growth of the traffic along the corridors rather than the distribution of directional traffic along individual corridors.

Step 2: Calculate link growth rates for the northbound, southbound, eastbound, westbound directions for the AM and PM peak hours.

Link growth rates were calculated using volumes outputted from the Region's EMME Transportation Model as shown in Error! Reference source not found. for the AM and PM peak periods.

Table 1: 2011 – 2041 AM & PM Peak Hour Link Growth Rates

	2011 - 2031 AGR			2031 - 2041 AGR	
	AM	PM		AM	PM
Eastbound					
Port Robinson Road	2%	2%		1%	1%
Merritt Road	-2%	3%		3%	3%
Quaker Road	4%	5%		1%	0%
Westbound					
Port Robinson Road	9%	-2%		3%	3%
Merritt Road	2%	6%		1%	1%
Quaker Road	2%	1%		0%	2%
Northbound					
Rice Road	3%	4%		1%	1%
Cataract Road	4%	1%		1%	0%
Niagara Street	2%	2%		2%	2%
Southbound					
Rice Road	1%	-3%		2%	0%
Cataract Road	0%	2%		0%	4%
Niagara Street	-7%	1%		15%	4%

It is noted that at a few locations the growth rates area significantly high and unrealistic. It was assumed that growth rates less than or equal to 0% to be conservatively rounded up to 1.5% and an upper bound of 3% is applied to reflect the anticipated growth of observed traffic counts more realistically.

Table 2 shows the adjusted link growth rates for the AM and PM peak periods.

Table 2: Adjusted 2011 – 2041 AM & PM Peak Hour Link Growth Rates

	2011 - 2031 AGR		2031 - 2041 AGR	
	AM	PM	AM	PM
Eastbound				
Port Robinson Road	2%	2%	2%	2%
Merritt Road	2%	3%	3%	3%
Quaker Road	3%	3%	2%	2%
Westbound				
Port Robinson Road	3%	2%	3%	3%
Merritt Road	2%	3%	2%	2%
Quaker Road	2%	2%	2%	2%
Northbound				
Rice Road	3%	3%	2%	2%
Cataract Road	3%	2%	2%	2%
Niagara Street	2%	2%	2%	2%
Southbound				
Rice Road	2%	2%	2%	2%
Cataract Road	2%	2%	2%	3%
Niagara Street	2%	2%	3%	3%

Link growth rates are applied to the existing traffic counts and traffic volumes balanced to obtain Balanced Existing Conditions (2020) turning movement counts.

Step 3: Calculate land use growth rates around the study area.

Land use growth rates were calculated using land use forecast data which is an input to the Region's EMME Transportation Model as shown in **Table 3**. The land use forecast data were received from IBI Group on behalf of the Region in February 2021.

Table 3: Land Use Growth Rates

	Compound Annual Growth Rates (2011 – 2031)	Compound Annual Growth Rates (2031 – 2041)
Population	5%	2%
Employment Part-Time	2%	2%
Employment Full-Time	3%	2%

Land use growth rates are consistent with forecasted traffic volumes, as higher compound annual growth rates between 2011 and 2031 correspond with higher projected population and employment growth rates during the same period.

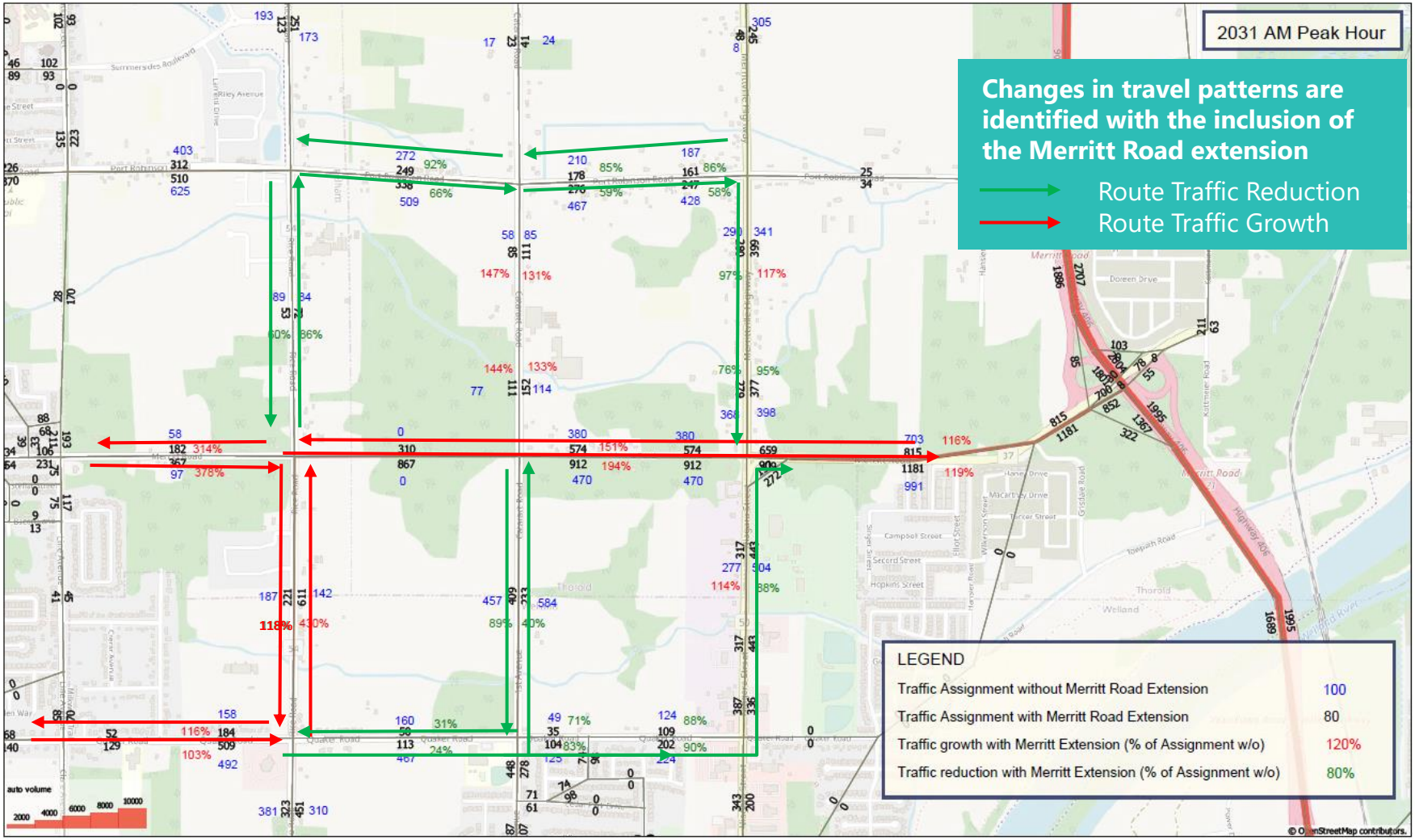
Phase 2 (Travel Demand Forecasting) Methodology

Travel Demand Forecasting Methodology

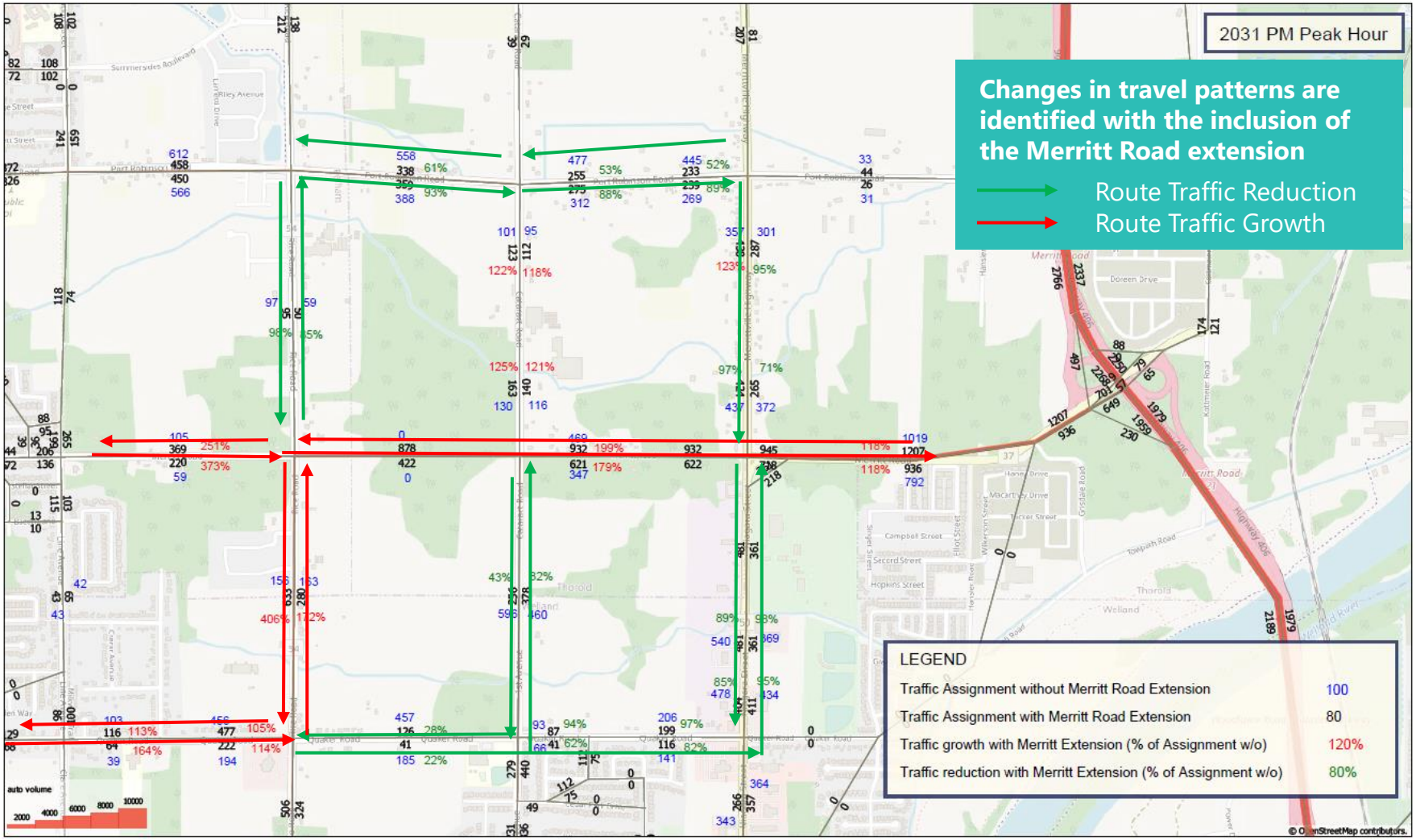
- Link traffic volumes from the 'do nothing' 2031 and 2041 horizon year assignments were compared with the traffic assignments from the Region's models, modified to include the proposed Merritt Road extension for AM and PM peak hours in order to assess the resulting traffic diversion along corridors within the study area.

- Percentage changes in traffic flow along the study area corridors with the proposed extension were measured and diversion routes were identified based on link traffic changes.

Changes in Travel Patterns – 2031 AM



Changes in Travel Patterns – 2031 PM



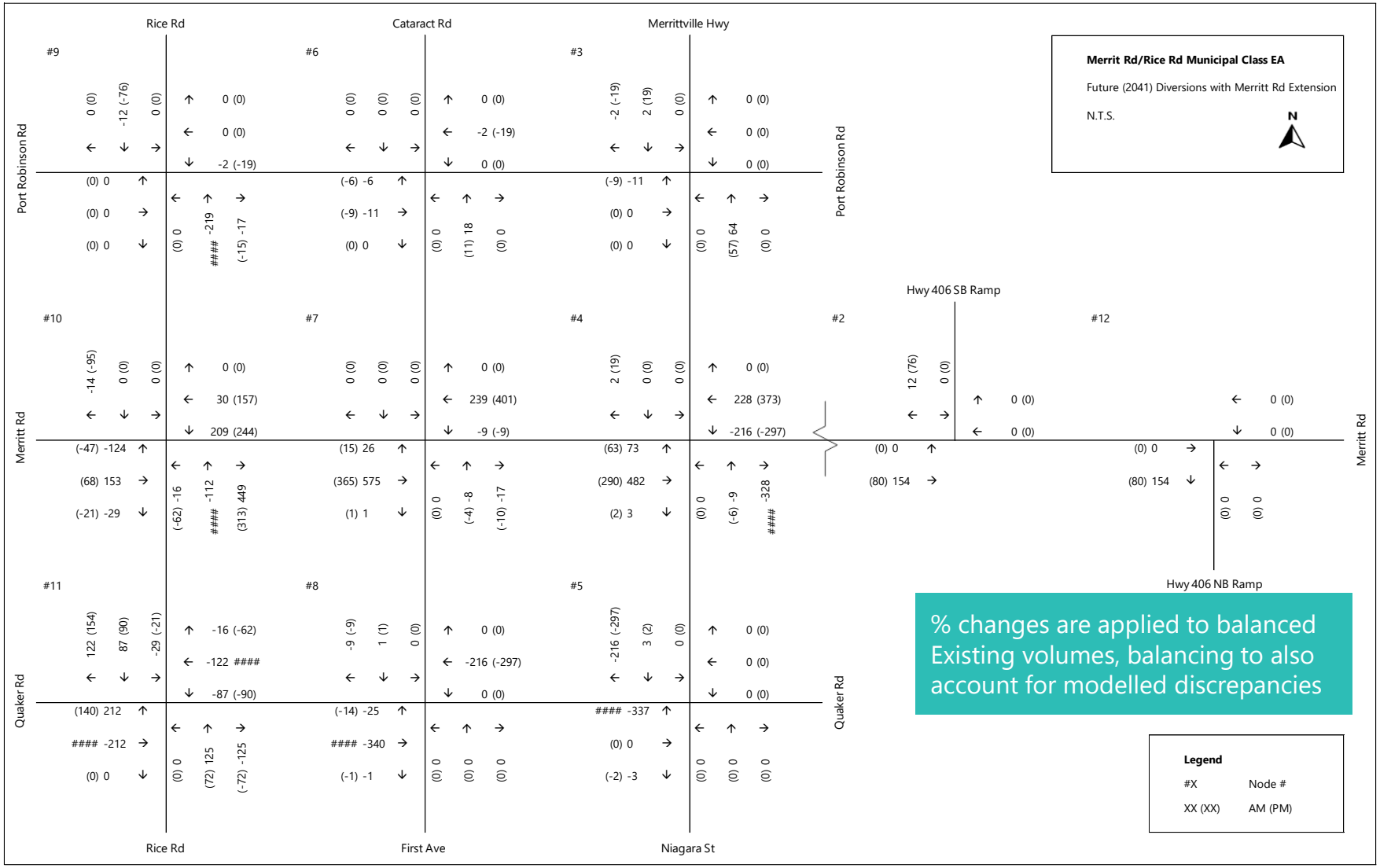
Travel Demand Forecasting Methodology

- Calculated percentage changes in traffic flow along the study area corridors with the proposed Merritt Road extension are used to estimate traffic diversions within the study area.

- Percentage changes are applied to updated future Do-Nothing volumes to estimate traffic diversions.

Merritt Extension Open – 2031 Diverted Traffic

Merritt Extension Open – 2041 Diverted Traffic



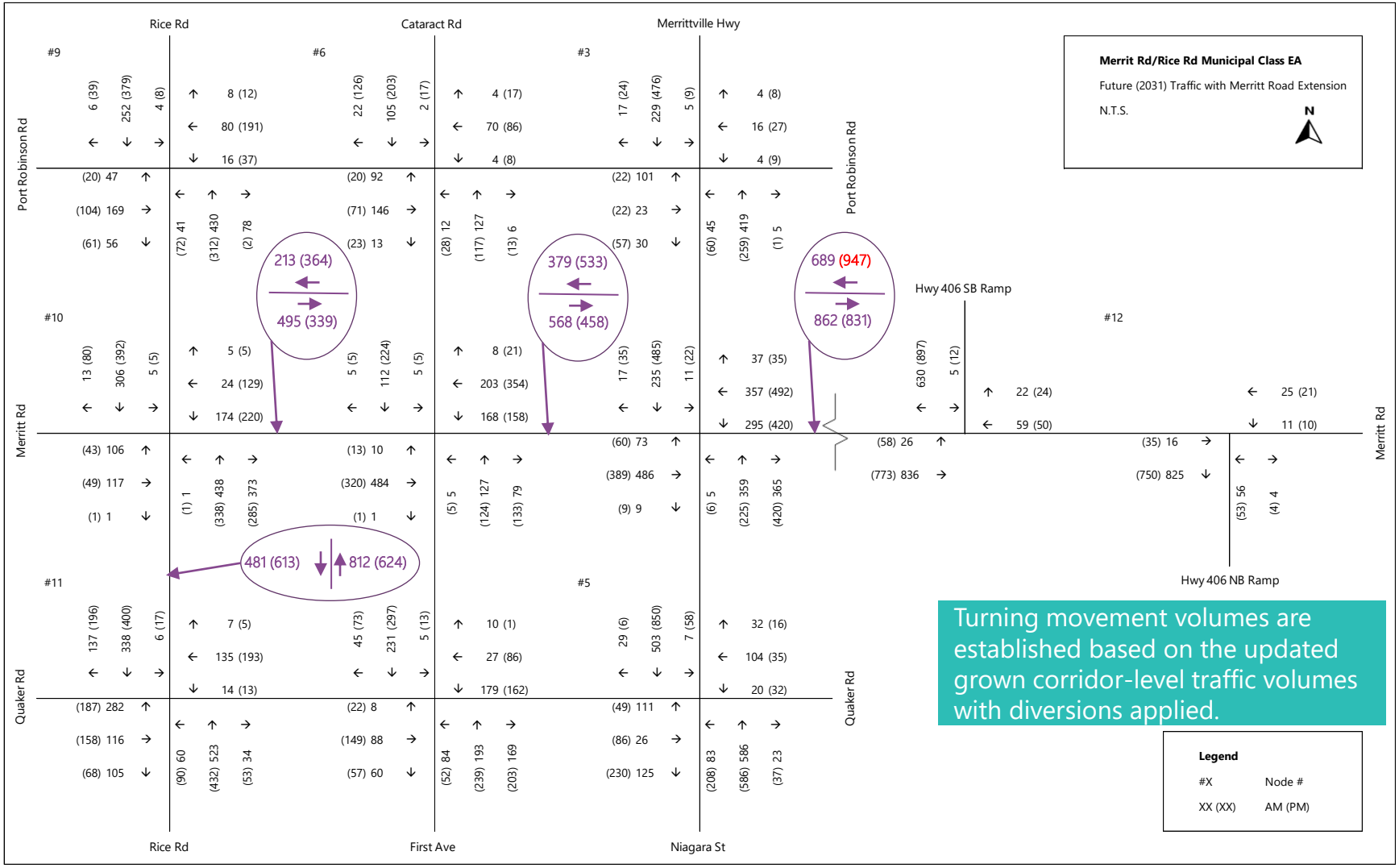
Travel Demand Forecasting & Future Conditions Assessment Methodology

- The Future 2031/2041 Total volumes were estimated by adding the diverted volumes to the future 2031/2041 Do-Nothing volumes, respectively.

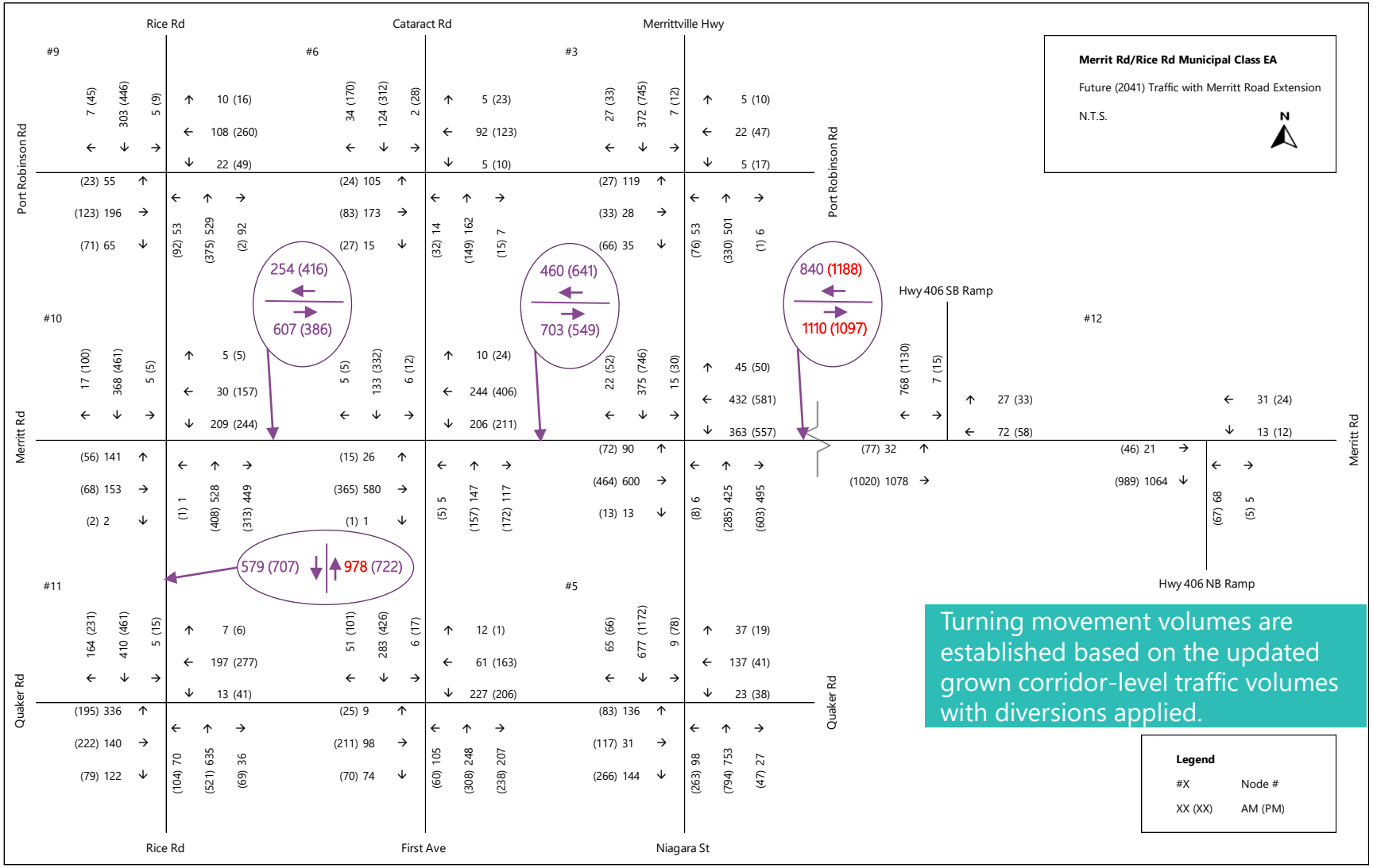
- As part of Phase 2, these forecasted volumes will be used to assess Future 2031/2041 Total conditions at link and intersection levels.

- A Lane Capacity of 850 vehicles/lane/hour will be assumed for corridors in the study area analysed at link levels.

Merritt Road Extension Open – 2031 Total Traffic



Merritt Road Extension Open – 2041 Total Traffic



woodplc.com

APPENDIX

E SIGNAL WARRANT CALCULATION

FUTURE (SCENARIO 1) 2031

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Merrittville Highway / Port Robinson Road

What is the direction of the Main Road street? North-South

When was the data collected? 2020-11-17

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	20	401	5	60	6	12	11	196	3	3	14	6	0
9:00	20	631	3	148	6	28	9	440	14	2	32	8	0
12:00	40	608	3	153	11	34	5	427	18	5	37	14	0
1:00	23	525	2	102	12	37	6	615	15	5	37	11	0
2:00	32	676	8	89	14	53	8	811	15	5	46	17	0
4:00	40	699	3	108	12	47	8	833	15	2	55	11	0
5:00	58	578	12	89	23	44	6	933	15	6	69	9	0
6:00	54	703	17	26	20	45	9	763	35	20	37	9	0
Total	**288**	**4,821**	**51**	**775**	**102**	**300**	**60**	**5,018**	**129**	**45**	**325**	**83**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									9,839

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road Count Date: 2020-11-17

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
1A	480	720	600	900	736	1,340	1,353	1,388	1,772	1,831	1,842	1,735		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	101	223	252	203	223	233	239	156		
	COMPLIANCE %				84	100	100	100	100	100	100	100	784	98

Free Flow Signal Justification 1:	Both 1A and 1B 100% Fulfilled each of 8 hours	Yes	No
	Lesser of 1A or 1B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
2A	480	720	600	900	635	1,117	1,101	1,186	1,550	1,597	1,603	1,580		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	77	182	194	143	140	164	164	82		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 2:	Both 2A and 2B 100% fulfilled each of 8 hours	Yes ☑	No ☐
	Lesser of 2A or 2B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 3: Combination

Combination Justification 1 and 2

Justification Satisfied 80% or More			Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	2:00	1,550	156	80	100 %	100 %
	4:00	1,597	167	80	100 %	
	5:00	1,603	155	80	100 %	
	6:00	1,580	91	80	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road Count Date: 2020-11-17

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000					
	> 7000	Not Justified				

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road Count Date: 2020-11-17

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%	☐	☑
	B	Crossing Volume	98	%		
2. Delay to Cross Traffic	A	Main Road	100	%	☑	☐
	B	Crossing Road	100	%		
3. Combination	A	Justificaton 1	98	%	☑	☐
	B	Justification 2	100	%		
4. 4-Hr Volume			100	%	☑	☐
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification not met		☐	☑
	B	Delay	Justification not met			

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Quaker Road / Niagara Street - Cataract Road

What is the direction of the Main Road street? East-West

When was the data collected? 2020-10-27

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Eastbound Approach			Minor Northbound Approach			Main Westbound Approach			Minor Southbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	79	147	84	12	264	54	5	93	41	79	124	4	0
9:00	83	186	244	36	328	54	20	154	66	158	290	10	0
12:00	71	152	258	20	264	42	10	187	66	158	131	5	0
1:00	54	186	167	22	349	65	8	167	99	237	184	7	0
2:00	42	167	223	14	299	49	16	208	17	632	252	5	0
4:00	108	169	383	29	510	64	10	219	66	237	276	12	0
5:00	54	170	188	25	342	63	15	281	66	435	376	15	0
6:00	83	190	223	22	488	88	18	272	8	395	304	13	0
Total	**573**	**1,366**	**1,769**	**180**	**2,845**	**478**	**102**	**1,581**	**429**	**2,331**	**1,936**	**70**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									2,947

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Quaker Road / Niagara Street - Cataract Road Count Date: 2020-10-27

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
1A	480	720	600	900	985	1,629	1,362	1,546	1,921	2,082	2,029	2,104		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	537	876	619	865	1,251	1,127	1,255	1,310		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 1:	Both 1A and 1B 100% Fulfilled each of 8 hours	Yes	No
	Lesser of 1A or 1B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
2A	480	720	600	900	449	752	743	681	671	955	774	794		
	COMPLIANCE %				93	100	100	100	100	100	100	100	793	99
2B	50	75	50	75	355	522	441	609	945	776	836	906		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 2:	Both 2A and 2B 100% fulfilled each of 8 hours	Yes ☐	No ☑
	Lesser of 2A or 2B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	4:00	955	603	128	100 %	100 %
	5:00	774	825	181	100 %	
	6:00	794	712	174	100 %	
	9:00	752	458	188	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Quaker Road / Niagara Street - Cataract Road Count Date: 2020-10-27

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Quaker Road / Niagara Street - Cataract Road Count Date: 2020-10-27

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%	☑	☐
	B	Crossing Volume	100	%		
2. Delay to Cross Traffic	A	Main Road	99	%	☐	☑
	B	Crossing Road	100	%		
3. Combination	A	Justificaton 1	100	%	☑	☐
	B	Justification 2	99	%		
4. 4-Hr Volume			100	%	☑	☐
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification not met		☐	☑
	B	Delay	Justification not met			

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Rice Road / Port Robinson Road

What is the direction of the Main Road street? North-South

When was the data collected? 2016-04-27

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	23	514	70	59	73	18	4	146	3	8	55	0	0
9:00	35	574	94	57	171	66	4	261	8	12	100	9	0
12:00	47	300	48	28	99	57	24	230	19	12	134	16	0
1:00	61	293	31	28	94	41	12	271	31	23	182	11	0
2:00	53	270	41	24	96	34	18	235	15	17	146	11	0
4:00	82	360	43	29	94	54	20	442	36	28	179	5	0
5:00	71	426	24	29	122	57	14	526	48	49	225	14	0
6:00	51	406	36	28	136	53	10	462	39	35	198	6	0
Total	**423**	**3,144**	**388**	**281**	**885**	**380**	**106**	**2,574**	**198**	**184**	**1,219**	**72**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									5,718

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Port Robinson Road

Count Date: 2016-04-27

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
	☑	☐	☐	☐										
1A	480	720	600	900	973	1,392	1,013	1,079	959	1,372	1,606	1,460		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	212	416	345	379	327	389	496	456		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours — Yes ☐ No ☐									
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
	☑	☐	☐	☐										
2A	480	720	600	900	761	976	668	700	632	983	1,109	1,004		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	139	241	174	233	186	236	303	260		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours — Yes ☐ No ☐									
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑ ☐	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑ ☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	4:00	983	212	121	100 %	100 %
	5:00	1,109	288	95	100 %	
	6:00	1,004	239	116	100 %	
	9:00	976	294	123	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Port Robinson Road

Count Date: 2016-04-27

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Rice Road / Port Robinson Road Count Date: 2016-04-27

Summary Results

Justification			Compliance	Signal Justified? YES	NO
1. Minimum Vehicular Volume	A	Total Volume	100 %		
	B	Crossing Volume	100 %	☑	☐
2. Delay to Cross Traffic	A	Main Road	100 %		
	B	Crossing Road	100 %	☑	☐
3. Combination	A	Justificaton 1	100 %		
	B	Justification 2	100 %	☑	☐
4. 4-Hr Volume			100 %	☑	☐
5. Collision Experience			0 %	☐	☑
6. Pedestrians	A	Volume	Justification not met		
	B	Delay	Justification not met	☐	☑

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Rice Road / Quaker Road

What is the direction of the Main Road street? North-South

When was the data collected? 2016-06-13

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	41	300	103	76	188	62	25	155	26	31	179	22	0
9:00	62	389	119	100	285	122	22	306	33	72	198	22	0
12:00	49	245	77	33	220	42	34	242	38	38	336	58	0
1:00	65	265	64	33	212	41	39	217	20	50	336	56	0
2:00	42	239	59	33	193	55	29	229	39	41	270	58	0
3:00	80	334	98	40	247	59	34	350	70	74	408	58	0
5:00	96	308	95	55	235	57	44	363	82	94	458	58	0
6:00	70	303	82	47	192	64	49	329	71	91	415	74	0
Total	**506**	**2,383**	**694**	**416**	**1,772**	**502**	**276**	**2,191**	**380**	**492**	**2,600**	**406**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									4,574

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Quaker Road Count Date: 2016-06-13

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
1A	480	720	600	900	1,208	1,731	1,412	1,398	1,287	1,850	1,945	1,786		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	559	800	728	728	650	884	957	882		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours — Yes ☐ No ☐									
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
2A	480	720	600	900	650	931	685	670	637	966	988	904		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	296	457	407	420	343	521	607	553		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours — Yes ☑ No ☐									
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 3: Combination

Combination Justification 1 and 2

		Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	NO ☐	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	NO ☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	3:00	966	539	125	100 %	100 %
	5:00	988	610	120	100 %	
	6:00	904	580	141	100 %	
	9:00	931	507	134	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Quaker Road

Count Date: 2016-06-13

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Rice Road / Quaker Road Count Date: 2016-06-13

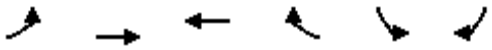
Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%	☑	☐
	B	Crossing Volume	100	%		
2. Delay to Cross Traffic	A	Main Road	100	%	☑	☐
	B	Crossing Road	100	%		
3. Combination	A	Justificaton 1	100	%	☑	☐
	B	Justification 2	100	%		
4. 4-Hr Volume			100	%	☑	☐
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification not met		☐	☑
	B	Delay	Justification not met			

APPENDIX

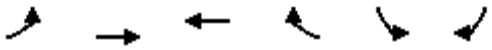
F SYNCHRO OUTPUT

FUTURE (SCENARIO 1) 2031



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	21	706	59	22	5	616
Future Volume (vph)	21	706	59	22	5	616
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	100.0			210.0	0.0	150.0
Storage Lanes	1			1	1	1
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1516	1642	1364	1438	1607	1396
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1516	1642	1364	1438	1607	1396
Link Speed (k/h)		60	50		60	
Link Distance (m)		1297.0	340.4		573.6	
Travel Time (s)		77.8	24.5		34.4	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Adj. Flow (vph)	26	861	72	27	6	751
Shared Lane Traffic (%)						
Lane Group Flow (vph)	26	861	72	27	6	751
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

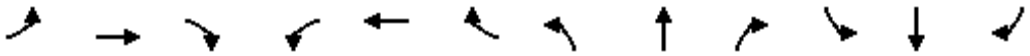
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 51.4%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	21	706	59	22	5	616
Future Volume (Veh/h)	21	706	59	22	5	616
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	26	861	72	27	6	751
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						20
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	72				985	72
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	72				985	72
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	98				98	24
cM capacity (veh/h)	1503				273	987

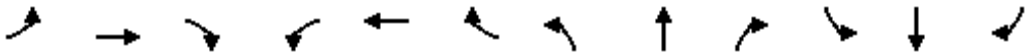
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	26	861	72	27	757
Volume Left	26	0	0	0	6
Volume Right	0	0	0	27	751
cSH	1503	1700	1700	1700	995
Volume to Capacity	0.02	0.51	0.04	0.02	0.76
Queue Length 95th (m)	0.4	0.0	0.0	0.0	57.7
Control Delay (s)	7.4	0.0	0.0	0.0	19.2
Lane LOS	A				C
Approach Delay (s)	0.2		0.0		19.2
Approach LOS					C

Intersection Summary			
Average Delay	8.4		
Intersection Capacity Utilization	51.4%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	111	23	30	4	16	4	45	366	5	5	227	19
Future Volume (vph)	111	23	30	4	16	4	45	366	5	5	227	19
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.975			0.978			0.998			0.990	
Flt Protected		0.967			0.992			0.995			0.999	
Satd. Flow (prot)	0	1433	0	0	1481	0	0	1522	0	0	1553	0
Flt Permitted		0.967			0.992			0.995			0.999	
Satd. Flow (perm)	0	1433	0	0	1481	0	0	1522	0	0	1553	0
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		838.4			681.4			1027.1			497.4	
Travel Time (s)		60.4			40.9			61.6			29.8	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Heavy Vehicles (%)	1%	44%	24%	0%	0%	67%	20%	9%	25%	25%	8%	0%
Adj. Flow (vph)	144	30	39	5	21	5	58	475	6	6	295	25
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	213	0	0	31	0	0	539	0	0	326	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

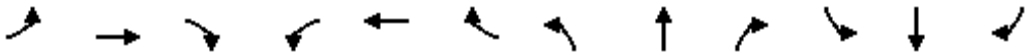
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 65.1%		ICU Level of Service C	
Analysis Period (min) 15			



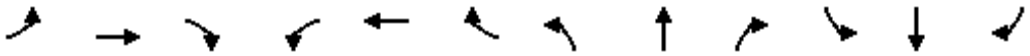
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	111	23	30	4	16	4	45	366	5	5	227	19
Future Volume (Veh/h)	111	23	30	4	16	4	45	366	5	5	227	19
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Hourly flow rate (vph)	144	30	39	5	21	5	58	475	6	6	295	25
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	929	916	308	968	926	478	320			481		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	929	916	308	968	926	478	320			481		
tC, single (s)	7.1	6.9	6.4	7.1	6.5	6.9	4.3			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.4	3.5	3.5	4.0	3.9	2.4			2.4		
p0 queue free %	35	86	94	97	92	99	95			99		
cM capacity (veh/h)	221	219	684	190	255	475	1145			972		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	213	31	539	326
Volume Left	144	5	58	6
Volume Right	39	5	6	25
cSH	252	260	1145	972
Volume to Capacity	0.85	0.12	0.05	0.01
Queue Length 95th (m)	51.9	3.0	1.2	0.1
Control Delay (s)	66.0	20.7	1.4	0.2
Lane LOS	F	C	A	A
Approach Delay (s)	66.0	20.7	1.4	0.2
Approach LOS	F	C		

Intersection Summary				
Average Delay	14.0			
Intersection Capacity Utilization	65.1%	ICU Level of Service	C	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	13	79	7	475	163	37	5	366	637	11	235	15
Future Volume (vph)	13	79	7	475	163	37	5	366	637	11	235	15
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	65.0		0.0	0.0		0.0	0.0		80.0
Storage Lanes	0		0	1		0	0		1	0		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95
Frt		0.991			0.972				0.850		0.991	
Flt Protected		0.993		0.950				0.999			0.998	
Satd. Flow (prot)	0	1646	0	1531	1551	0	0	1552	1396	0	2905	0
Flt Permitted		0.915		0.662				0.995			0.934	
Satd. Flow (perm)	0	1516	0	1067	1551	0	0	1546	1396	0	2719	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4			16				664		9	
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		831.7			1297.0			1025.7			1027.1	
Travel Time (s)		59.9			77.8			61.5			61.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	0%	17%	5%	1%	28%	0%	9%	3%	11%	9%	15%
Adj. Flow (vph)	14	82	7	495	170	39	5	381	664	11	245	16
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	103	0	495	209	0	0	386	664	0	272	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	Perm	NA	
Protected Phases		4		3	8			2			6	



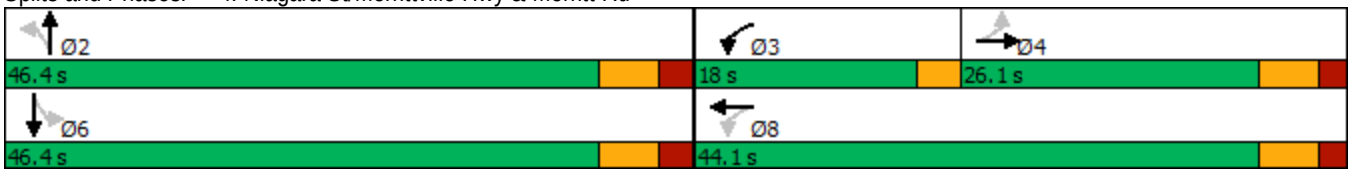
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2		Free	6		
Detector Phase	4	4		3	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		10.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		14.5	22.5		16.4	16.4		16.4	16.4	
Total Split (s)	26.1	26.1		18.0	44.1		46.4	46.4		46.4	46.4	
Total Split (%)	28.8%	28.8%		19.9%	48.7%		51.3%	51.3%		51.3%	51.3%	
Maximum Green (s)	20.0	20.0		15.0	38.0		40.0	40.0		40.0	40.0	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.0	2.0		0.0	2.0		2.3	2.3		2.3	2.3	
Lost Time Adjust (s)		0.0		0.0	0.0			0.0			0.0	
Total Lost Time (s)		6.1		3.0	6.1			6.4			6.4	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0		3.0	3.0		5.0	5.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flash Dont Walk (s)	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)		12.0		29.8	26.4			23.3	63.3		23.3	
Actuated g/C Ratio		0.19		0.47	0.42			0.37	1.00		0.37	
v/c Ratio		0.36		0.80	0.32			0.68	0.48		0.27	
Control Delay		29.3		27.1	14.0			24.6	1.2		15.0	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		29.3		27.1	14.0			24.6	1.2		15.0	
LOS		C		C	B			C	A		B	
Approach Delay		29.3			23.2			9.8			15.0	
Approach LOS		C			C			A			B	
Queue Length 50th (m)		10.7		41.6	14.0			39.1	0.0		11.6	
Queue Length 95th (m)		27.6		#128.4	36.0			72.0	0.0		21.2	
Internal Link Dist (m)		807.7			1273.0			1001.7			1003.1	
Turn Bay Length (m)				65.0								
Base Capacity (vph)		523		625	999			1026	1396		1808	
Starvation Cap Reductn		0		0	0			0	0		0	
Spillback Cap Reductn		0		0	0			0	0		0	
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.20		0.79	0.21			0.38	0.48		0.15	

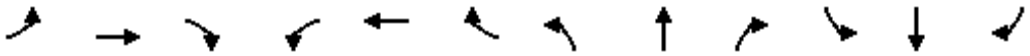
Intersection Summary			
Area Type:	Other		
Cycle Length: 90.5			
Actuated Cycle Length: 63.3			
Natural Cycle: 65			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.80			
Intersection Signal Delay: 15.8		Intersection LOS: B	
Intersection Capacity Utilization 70.9%		ICU Level of Service C	
Analysis Period (min) 15			

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

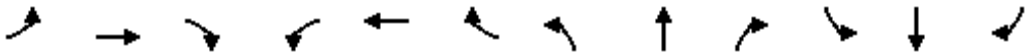
Queue shown is maximum after two cycles.

Splits and Phases: 4: Niagara St/Merrittville Hwy & Merritt Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	390	26	127	20	104	32	83	586	23	7	501	209
Future Volume (vph)	390	26	127	20	104	32	83	586	23	7	501	209
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0		0.0	30.0		0.0	75.0		0.0	65.0		30.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.875			0.964			0.994			0.956	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1545	1439	0	1516	1615	0	1397	3020	0	1607	2896	0
Flt Permitted	0.666			0.655			0.226			0.408		
Satd. Flow (perm)	1083	1439	0	1045	1615	0	332	3020	0	690	2896	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		134			17			5			81	
Link Speed (k/h)		50			50			40			60	
Link Distance (m)		825.4			480.8			403.8			1025.7	
Travel Time (s)		59.4			34.6			36.3			61.5	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	4%	12%	1%	6%	0%	4%	15%	6%	0%	0%	7%	4%
Adj. Flow (vph)	411	27	134	21	109	34	87	617	24	7	527	220
Shared Lane Traffic (%)												
Lane Group Flow (vph)	411	161	0	21	143	0	87	641	0	7	747	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	14.9	14.9		14.9	14.9		9.0	16.6		9.0	16.6	
Total Split (s)	31.9	31.9		31.9	31.9		18.0	41.6		18.0	41.6	
Total Split (%)	34.9%	34.9%		34.9%	34.9%		19.7%	45.5%		19.7%	45.5%	
Maximum Green (s)	25.0	25.0		25.0	25.0		15.0	35.0		15.0	35.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		3.0	4.1		3.0	4.1	
All-Red Time (s)	2.8	2.8		2.8	2.8		0.0	2.5		0.0	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.9	6.9		6.9	6.9		3.0	6.6		3.0	6.6	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		3.0	2.5		3.0	2.5	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	11.0	11.0		11.0	11.0			9.0			9.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			14.0			14.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	25.8	25.8		25.8	25.8		35.0	29.8		30.1	21.9	
Actuated g/C Ratio	0.36	0.36		0.36	0.36		0.49	0.42		0.42	0.31	
v/c Ratio	1.05	0.27		0.06	0.24		0.29	0.50		0.02	0.79	
Control Delay	87.9	7.4		20.1	18.9		11.0	16.1		8.1	26.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	87.9	7.4		20.1	18.9		11.0	16.1		8.1	26.7	
LOS	F	A		C	B		B	B		A	C	
Approach Delay		65.3			19.0			15.5			26.5	
Approach LOS		E			B			B			C	
Queue Length 50th (m)	~64.9	2.4		1.9	12.0		5.7	29.1		0.4	43.6	
Queue Length 95th (m)	#138.1	16.6		7.6	30.1		11.7	51.8		2.0	65.0	
Internal Link Dist (m)		801.4			456.8			379.8			1001.7	
Turn Bay Length (m)	80.0			30.0			75.0			65.0		
Base Capacity (vph)	392	607		379	596		395	1589		540	1510	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	1.05	0.27		0.06	0.24		0.22	0.40		0.01	0.49	

Intersection Summary			
Area Type:	Other		
Cycle Length: 91.5			
Actuated Cycle Length: 71			
Natural Cycle: 80			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.05			
Intersection Signal Delay: 32.4		Intersection LOS: C	
Intersection Capacity Utilization 79.1%		ICU Level of Service D	
Analysis Period (min) 15			

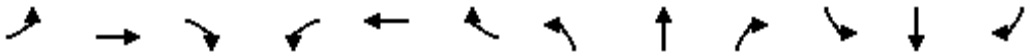
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

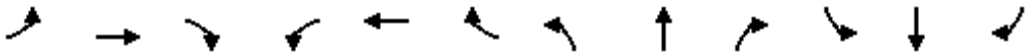
Queue shown is maximum after two cycles.

Splits and Phases: 5: Niagara St & Quaker Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	96	156	13	4	72	4	12	123	6	2	100	22
Future Volume (vph)	96	156	13	4	72	4	12	123	6	2	100	22
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.993			0.994			0.994			0.976	
Flt Protected		0.982			0.998			0.996			0.999	
Satd. Flow (prot)	0	1535	0	0	1477	0	0	1618	0	0	1573	0
Flt Permitted		0.982			0.998			0.996			0.999	
Satd. Flow (perm)	0	1535	0	0	1477	0	0	1618	0	0	1573	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		838.8			838.4			991.4			524.1	
Travel Time (s)		60.4			60.4			71.4			37.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	12%	0%	0%	15%	0%	11%	3%	0%	0%	6%	0%
Adj. Flow (vph)	104	170	14	4	78	4	13	134	7	2	109	24
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	288	0	0	86	0	0	154	0	0	135	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 43.8%		ICU Level of Service A	
Analysis Period (min) 15			



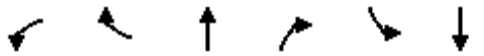
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	96	156	13	4	72	4	12	123	6	2	100	22
Future Volume (vph)	96	156	13	4	72	4	12	123	6	2	100	22
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	104	170	14	4	78	4	13	134	7	2	109	24

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	288	86	154	135
Volume Left (vph)	104	4	13	2
Volume Right (vph)	14	4	7	24
Hadj (s)	0.17	0.21	0.05	-0.02
Departure Headway (s)	5.0	5.3	5.1	5.1
Degree Utilization, x	0.40	0.13	0.22	0.19
Capacity (veh/h)	687	624	648	647
Control Delay (s)	11.2	9.0	9.6	9.3
Approach Delay (s)	11.2	9.0	9.6	9.3
Approach LOS	B	A	A	A

Intersection Summary				
Delay	10.1			
Level of Service	B			
Intersection Capacity Utilization	43.8%	ICU Level of Service	A	
Analysis Period (min)	15			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	175	8	133	94	5	112
Future Volume (vph)	175	8	133	94	5	112
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.994		0.944			
Flt Protected	0.954					0.998
Satd. Flow (prot)	1577	0	1557	0	0	1611
Flt Permitted	0.954					0.998
Satd. Flow (perm)	1577	0	1557	0	0	1611
Link Speed (k/h)	50		50			50
Link Distance (m)	831.7		1030.2			991.4
Travel Time (s)	59.9		74.2			71.4
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	17%	3%	2%	0%	5%
Adj. Flow (vph)	190	9	145	102	5	122
Shared Lane Traffic (%)						
Lane Group Flow (vph)	199	0	247	0	0	127
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.3		0.0			0.0
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24	14		14	24	
Sign Control	Stop		Stop			Stop

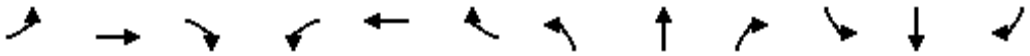
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 31.6%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Stop			Stop
Traffic Volume (vph)	175	8	133	94	5	112
Future Volume (vph)	175	8	133	94	5	112
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	190	9	145	102	5	122

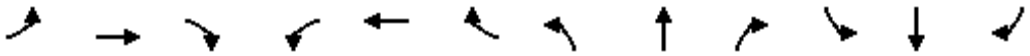
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total (vph)	199	247	127
Volume Left (vph)	190	0	5
Volume Right (vph)	9	102	0
Hadj (s)	0.19	-0.20	0.09
Departure Headway (s)	5.0	4.4	4.8
Degree Utilization, x	0.27	0.30	0.17
Capacity (veh/h)	678	784	704
Control Delay (s)	9.8	9.3	8.8
Approach Delay (s)	9.8	9.3	8.8
Approach LOS	A	A	A

Intersection Summary			
Delay	9.4		
Level of Service	A		
Intersection Capacity Utilization	31.6%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	369	61	179	207	10	84	188	169	5	230	52
Future Volume (vph)	29	369	61	179	207	10	84	188	169	5	230	52
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.982			0.997			0.948			0.976	
Flt Protected		0.997			0.978			0.991			0.999	
Satd. Flow (prot)	0	1580	0	0	1561	0	0	1523	0	0	1598	0
Flt Permitted		0.997			0.978			0.991			0.999	
Satd. Flow (perm)	0	1580	0	0	1561	0	0	1523	0	0	1598	0
Link Speed (k/h)		40			40			40			50	
Link Distance (m)		822.2			825.4			401.7			1030.2	
Travel Time (s)		74.0			74.3			36.2			74.2	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	4%	12%	9%	3%	0%	10%	3%	3%	0%	4%	0%
Adj. Flow (vph)	33	419	69	203	235	11	95	214	192	6	261	59
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	521	0	0	449	0	0	501	0	0	326	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

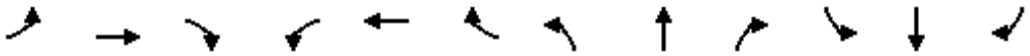
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 107.3%		ICU Level of Service G	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	29	369	61	179	207	10	84	188	169	5	230	52
Future Volume (vph)	29	369	61	179	207	10	84	188	169	5	230	52
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	33	419	69	203	235	11	95	214	192	6	261	59

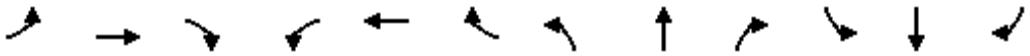
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	521	449	501	326
Volume Left (vph)	33	203	95	6
Volume Right (vph)	69	11	192	59
Hadj (s)	0.01	0.17	-0.12	-0.05
Departure Headway (s)	9.2	9.4	9.1	9.5
Degree Utilization, x	1.33	1.17	1.27	0.86
Capacity (veh/h)	396	388	403	365
Control Delay (s)	193.5	130.6	165.2	49.6
Approach Delay (s)	193.5	130.6	165.2	49.6
Approach LOS	F	F	F	E

Intersection Summary				
Delay	143.8			
Level of Service	F			
Intersection Capacity Utilization	107.3%	ICU Level of Service	G	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	47	169	56	18	80	8	41	598	92	4	256	6
Future Volume (vph)	47	169	56	18	80	8	41	598	92	4	256	6
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.972			0.989			0.983			0.997	
Flt Protected		0.991			0.992			0.997			0.999	
Satd. Flow (prot)	0	1543	0	0	1504	0	0	1607	0	0	1646	0
Flt Permitted		0.991			0.992			0.997			0.999	
Satd. Flow (perm)	0	1543	0	0	1504	0	0	1607	0	0	1646	0
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		431.2			838.8			1037.2			467.4	
Travel Time (s)		31.0			60.4			62.2			28.0	
Confl. Peds. (#/hr)	1		1	1		1	2					2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	9%	0%	23%	0%	83%	14%	2%	6%	0%	2%	20%
Adj. Flow (vph)	51	182	60	19	86	9	44	643	99	4	275	6
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	293	0	0	114	0	0	786	0	0	285	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

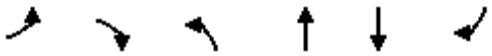
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 89.8%		ICU Level of Service E	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	47	169	56	18	80	8	41	598	92	4	256	6
Future Volume (vph)	47	169	56	18	80	8	41	598	92	4	256	6
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	51	182	60	19	86	9	44	643	99	4	275	6

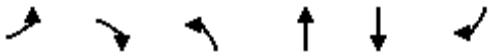
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	293	114	786	285
Volume Left (vph)	51	19	44	4
Volume Right (vph)	60	9	99	6
Hadj (s)	0.01	0.16	-0.01	0.03
Departure Headway (s)	6.9	7.6	6.0	6.6
Degree Utilization, x	0.56	0.24	1.31	0.52
Capacity (veh/h)	505	430	597	517
Control Delay (s)	18.2	13.0	172.5	16.6
Approach Delay (s)	18.2	13.0	172.5	16.6
Approach LOS	C	B	F	C

Intersection Summary				
Delay	99.5			
Level of Service	F			
Intersection Capacity Utilization	89.8%	ICU Level of Service	E	
Analysis Period (min)	15			



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	200	24	14	531	306	24
Future Volume (vph)	200	24	14	531	306	24
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.986				0.990	
Flt Protected	0.957			0.999		
Satd. Flow (prot)	1588	0	0	1619	1629	0
Flt Permitted	0.957			0.999		
Satd. Flow (perm)	1588	0	0	1619	1629	0
Link Speed (k/h)	50			60	60	
Link Distance (m)	434.7			1037.2	1037.2	
Travel Time (s)	31.3			62.2	62.2	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	0%	5%	20%	4%	3%	0%
Adj. Flow (vph)	233	28	16	617	356	28
Shared Lane Traffic (%)						
Lane Group Flow (vph)	261	0	0	633	384	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24	14	24			14
Sign Control	Stop			Free	Free	

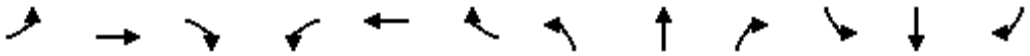
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 62.9%		ICU Level of Service B	
Analysis Period (min) 15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	200	24	14	531	306	24
Future Volume (Veh/h)	200	24	14	531	306	24
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	233	28	16	617	356	28
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1019	370	384			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1019	370	384			
tC, single (s)	6.4	6.2	4.3			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.4			
p0 queue free %	11	96	99			
cM capacity (veh/h)	261	669	1083			

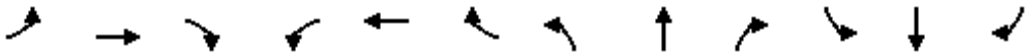
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	261	633	384
Volume Left	233	16	0
Volume Right	28	0	28
cSH	279	1083	1700
Volume to Capacity	0.93	0.01	0.23
Queue Length 95th (m)	67.0	0.3	0.0
Control Delay (s)	78.3	0.4	0.0
Lane LOS	F	A	
Approach Delay (s)	78.3	0.4	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	16.2		
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	106	292	105	86	237	20	60	419	138	29	266	35
Future Volume (vph)	106	292	105	86	237	20	60	419	138	29	266	35
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.972			0.992			0.970			0.986	
Flt Protected		0.990			0.988			0.995			0.996	
Satd. Flow (prot)	0	1527	0	0	1592	0	0	1572	0	0	1606	0
Flt Permitted		0.990			0.988			0.995			0.996	
Satd. Flow (perm)	0	1527	0	0	1592	0	0	1572	0	0	1606	0
Link Speed (k/h)		50			40			40			50	
Link Distance (m)		441.3			822.2			400.0			1037.2	
Travel Time (s)		31.8			74.0			36.0			74.7	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	9%	7%	3%	0%	6%	0%	12%	4%	0%	4%	2%	14%
Adj. Flow (vph)	118	324	117	96	263	22	67	466	153	32	296	39
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	559	0	0	381	0	0	686	0	0	367	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 94.1%		ICU Level of Service F	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	106	292	105	86	237	20	60	419	138	29	266	35
Future Volume (vph)	106	292	105	86	237	20	60	419	138	29	266	35
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	118	324	117	96	263	22	67	466	153	32	296	39

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	559	381	686	367
Volume Left (vph)	118	96	67	32
Volume Right (vph)	117	22	153	39
Hadj (s)	0.03	0.09	-0.05	0.01
Departure Headway (s)	9.5	9.6	9.5	9.6
Degree Utilization, x	1.48	1.01	1.80	0.98
Capacity (veh/h)	389	381	386	367
Control Delay (s)	254.5	82.1	393.0	72.3
Approach Delay (s)	254.5	82.1	393.0	72.3
Approach LOS	F	F	F	F

Intersection Summary			
Delay	235.7		
Level of Service	F		
Intersection Capacity Utilization	94.1%	ICU Level of Service	F
Analysis Period (min)	15		

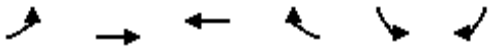
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	16	695	11	25	56	4
Future Volume (vph)	16	695	11	25	56	4
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		200.0	65.0		0.0	180.0
Storage Lanes		1	1		1	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1692	1396	1607	1128	1545	1438
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	1692	1396	1607	1128	1545	1438
Link Speed (k/h)	60			50	50	
Link Distance (m)	340.4			197.6	500.8	
Travel Time (s)	20.4			14.2	36.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	3%	0%	50%	4%	0%
Adj. Flow (vph)	18	790	13	28	64	5
Shared Lane Traffic (%)						
Lane Group Flow (vph)	18	790	13	28	64	5
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	16	695	11	25	56	4
Future Volume (Veh/h)	16	695	11	25	56	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	18	790	12	28	64	5
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						24
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			18		70	18
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			18		70	18
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		93	100
cM capacity (veh/h)			1612		923	1066

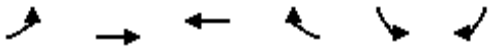
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	18	790	12	28	69
Volume Left	0	0	12	0	64
Volume Right	0	790	0	0	5
cSH	1700	1700	1612	1700	995
Volume to Capacity	0.01	0.46	0.01	0.02	0.07
Queue Length 95th (m)	0.0	0.0	0.2	0.0	1.7
Control Delay (s)	0.0	0.0	7.3	0.0	9.1
Lane LOS			A		A
Approach Delay (s)	0.0		2.2		9.1
Approach LOS					A

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	58	705	50	24	12	831
Future Volume (vph)	58	705	50	24	12	831
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	100.0			210.0	0.0	150.0
Storage Lanes	1			1	1	1
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1607	1627	1484	1438	1004	1424
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1607	1627	1484	1438	1004	1424
Link Speed (k/h)		60	50		60	
Link Distance (m)		1297.0	340.4		573.6	
Travel Time (s)		77.8	24.5		34.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Adj. Flow (vph)	60	734	52	25	13	866
Shared Lane Traffic (%)						
Lane Group Flow (vph)	60	734	52	25	13	866
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

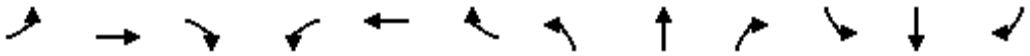
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 65.9%		ICU Level of Service C	
Analysis Period (min) 15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	58	705	50	24	12	831
Future Volume (Veh/h)	58	705	50	24	12	831
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	60	734	52	25	12	866
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						20
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	52				906	52
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	52				906	52
tC, single (s)	4.1				7.0	6.2
tC, 2 stage (s)						
tF (s)	2.2				4.0	3.3
p0 queue free %	96				95	15
cM capacity (veh/h)	1567				234	1019

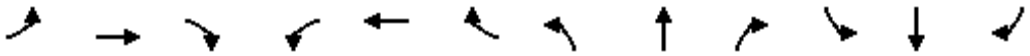
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	60	734	52	25	878
Volume Left	60	0	0	0	12
Volume Right	0	0	0	25	866
cSH	1567	1700	1700	1700	1033
Volume to Capacity	0.04	0.43	0.03	0.01	0.85
Queue Length 95th (m)	0.9	0.0	0.0	0.0	82.8
Control Delay (s)	7.4	0.0	0.0	0.0	24.7
Lane LOS	A				C
Approach Delay (s)	0.6		0.0		24.7
Approach LOS					C

Intersection Summary			
Average Delay	12.6		
Intersection Capacity Utilization	65.9%	ICU Level of Service	C
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	22	57	9	27	8	60	211	1	9	461	39
Future Volume (vph)	30	22	57	9	27	8	60	211	1	9	461	39
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.930			0.975						0.990	
Flt Protected		0.986			0.990			0.989			0.999	
Satd. Flow (prot)	0	1348	0	0	1348	0	0	1616	0	0	1658	0
Flt Permitted		0.986			0.990			0.989			0.999	
Satd. Flow (perm)	0	1348	0	0	1348	0	0	1616	0	0	1658	0
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		838.4			681.4			1027.1			497.4	
Travel Time (s)		60.4			40.9			61.6			29.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	41%	13%	0%	35%	0%	2%	4%	0%	0%	1%	0%
Adj. Flow (vph)	33	24	62	10	29	9	65	229	1	10	501	42
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	119	0	0	48	0	0	295	0	0	553	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

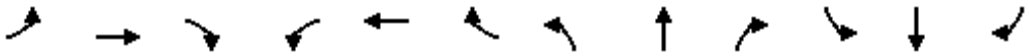
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 65.5%		ICU Level of Service C	
Analysis Period (min) 15			



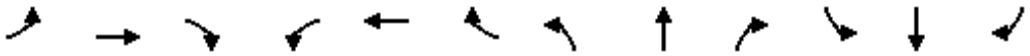
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	22	57	9	27	8	60	211	1	9	461	39
Future Volume (Veh/h)	30	22	57	9	27	8	60	211	1	9	461	39
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	24	62	10	29	9	65	229	1	10	501	42
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	925	902	522	976	922	230	543			230		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	925	902	522	976	922	230	543			230		
tC, single (s)	7.1	6.9	6.3	7.1	6.8	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.4	3.4	3.5	4.3	3.3	2.2			2.2		
p0 queue free %	84	89	88	94	87	99	94			99		
cM capacity (veh/h)	212	223	534	179	222	815	1026			1350		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	119	48	295	553
Volume Left	33	10	65	10
Volume Right	62	9	1	42
cSH	314	243	1026	1350
Volume to Capacity	0.38	0.20	0.06	0.01
Queue Length 95th (m)	13.0	5.5	1.5	0.2
Control Delay (s)	23.3	23.5	2.4	0.2
Lane LOS	C	C	A	A
Approach Delay (s)	23.3	23.5	2.4	0.2
Approach LOS	C	C		

Intersection Summary				
Average Delay	4.7			
Intersection Capacity Utilization	65.5%	ICU Level of Service	C	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	7	126	8	684	162	35	6	230	615	22	485	20
Future Volume (vph)	7	126	8	684	162	35	6	230	615	22	485	20
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	65.0		0.0	0.0		0.0	0.0		80.0
Storage Lanes	0		0	1		0	0		1	0		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95
Frt		0.992			0.973				0.850		0.994	
Flt Protected		0.998		0.950				0.999			0.998	
Satd. Flow (prot)	0	1675	0	1591	1599	0	0	1642	1396	0	3111	0
Flt Permitted		0.974		0.567				0.981			0.932	
Satd. Flow (perm)	0	1635	0	950	1599	0	0	1612	1396	0	2906	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			15				654		5	
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		831.7			1297.0			1025.7			1027.1	
Travel Time (s)		59.9			77.8			61.5			61.6	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	0%	1%	1%	12%	0%	3%	3%	38%	1%	0%
Adj. Flow (vph)	7	134	9	728	172	37	6	245	654	23	516	21
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	150	0	728	209	0	0	251	654	0	560	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	Perm	NA	
Protected Phases		4		3	8			2			6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2		Free	6		
Detector Phase	4	4		3	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		10.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		14.5	22.5		16.4	16.4		16.4	16.4	
Total Split (s)	26.1	26.1		18.0	44.1		46.4	46.4		46.4	46.4	
Total Split (%)	28.8%	28.8%		19.9%	48.7%		51.3%	51.3%		51.3%	51.3%	
Maximum Green (s)	20.0	20.0		15.0	38.0		40.0	40.0		40.0	40.0	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.0	2.0		0.0	2.0		2.3	2.3		2.3	2.3	
Lost Time Adjust (s)		0.0		0.0	0.0			0.0			0.0	
Total Lost Time (s)		6.1		3.0	6.1			6.4			6.4	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0		3.0	3.0		5.0	5.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flash Dont Walk (s)	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)		12.9		30.5	27.2			17.8	58.3		17.8	
Actuated g/C Ratio		0.22		0.52	0.47			0.31	1.00		0.31	
v/c Ratio		0.41		1.08	0.28			0.51	0.47		0.63	
Control Delay		25.8		77.3	10.2			22.4	1.1		21.9	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		25.8		77.3	10.2			22.4	1.1		21.9	
LOS		C		E	B			C	A		C	
Approach Delay		25.8			62.3			7.0			21.9	
Approach LOS		C			E			A			C	
Queue Length 50th (m)		14.4		~68.1	11.3			23.3	0.0		28.2	
Queue Length 95th (m)		32.7		#183.2	27.6			46.0	0.0		47.0	
Internal Link Dist (m)		807.7			1273.0			1001.7			1003.1	
Turn Bay Length (m)				65.0								
Base Capacity (vph)		597		671	1093			1138	1396		2053	
Starvation Cap Reductn		0		0	0			0	0		0	
Spillback Cap Reductn		0		0	0			0	0		0	
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.25		1.08	0.19			0.22	0.47		0.27	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90.5			
Actuated Cycle Length: 58.3			
Natural Cycle: 80			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.08			
Intersection Signal Delay: 31.7		Intersection LOS: C	
Intersection Capacity Utilization 97.7%		ICU Level of Service F	
Analysis Period (min) 15			

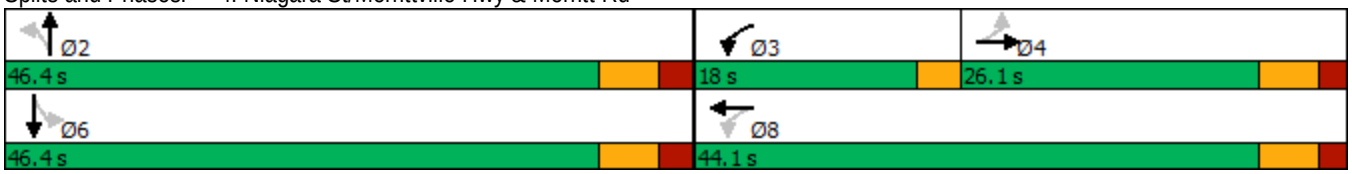
~ Volume exceeds capacity, queue is theoretically infinite.

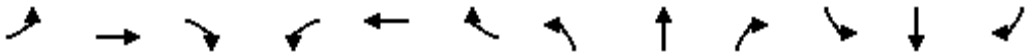
Queue shown is maximum after two cycles.

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

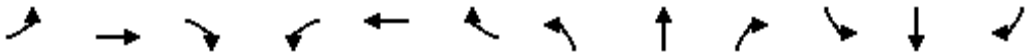
Queue shown is maximum after two cycles.

Splits and Phases: 4: Niagara St/Merrittville Hwy & Merritt Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	249	86	231	32	35	16	208	586	37	58	849	270
Future Volume (vph)	249	86	231	32	35	16	208	586	37	58	849	270
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0		0.0	30.0		0.0	75.0		0.0	65.0		30.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.891			0.952			0.991			0.964	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1560	1487	0	1607	1578	0	1591	3092	0	1607	3060	0
Flt Permitted	0.718			0.309			0.103			0.376		
Satd. Flow (perm)	1179	1487	0	523	1578	0	173	3092	0	636	3060	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		146			19			8			54	
Link Speed (k/h)		50			50			40			60	
Link Distance (m)		825.4			480.8			403.8			1025.7	
Travel Time (s)		59.4			34.6			36.3			61.5	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	3%	5%	0%	0%	3%	0%	1%	3%	3%	0%	1%	2%
Adj. Flow (vph)	290	100	269	37	41	19	242	681	43	67	987	314
Shared Lane Traffic (%)												
Lane Group Flow (vph)	290	369	0	37	60	0	242	724	0	67	1301	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	14.9	14.9		14.9	14.9		9.0	16.6		9.0	16.6	
Total Split (s)	31.9	31.9		31.9	31.9		18.0	41.6		18.0	41.6	
Total Split (%)	34.9%	34.9%		34.9%	34.9%		19.7%	45.5%		19.7%	45.5%	
Maximum Green (s)	25.0	25.0		25.0	25.0		15.0	35.0		15.0	35.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		3.0	4.1		3.0	4.1	
All-Red Time (s)	2.8	2.8		2.8	2.8		0.0	2.5		0.0	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.9	6.9		6.9	6.9		3.0	6.6		3.0	6.6	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		3.0	2.5		3.0	2.5	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	11.0	11.0		11.0	11.0			9.0			9.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			14.0			14.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	23.6	23.6		23.6	23.6		55.5	43.8		45.8	35.1	
Actuated g/C Ratio	0.26	0.26		0.26	0.26		0.62	0.49		0.51	0.39	
v/c Ratio	0.93	0.74		0.27	0.14		0.74	0.48		0.17	1.05	
Control Delay	69.5	27.7		32.1	19.6		32.2	17.2		8.6	68.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	69.5	27.7		32.1	19.6		32.2	17.2		8.6	68.0	
LOS	E	C		C	B		C	B		A	E	
Approach Delay		46.1			24.4			21.0			65.1	
Approach LOS		D			C			C			E	
Queue Length 50th (m)	49.1	35.5		5.1	5.4		24.5	44.1		4.3	~133.0	
Queue Length 95th (m)	#88.7	62.3		13.1	13.8		#48.6	57.9		8.6	#160.5	
Internal Link Dist (m)		801.4			456.8			379.8			1001.7	
Turn Bay Length (m)	80.0			30.0			75.0			65.0		
Base Capacity (vph)	331	523		146	457		347	1524		545	1236	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.88	0.71		0.25	0.13		0.70	0.48		0.12	1.05	

Intersection Summary			
Area Type:	Other		
Cycle Length: 91.5			
Actuated Cycle Length: 89.1			
Natural Cycle: 90			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.05			
Intersection Signal Delay: 46.0		Intersection LOS: D	
Intersection Capacity Utilization 90.8%		ICU Level of Service E	
Analysis Period (min) 15			

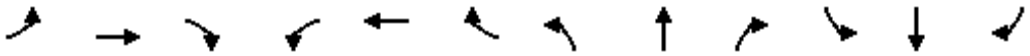
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

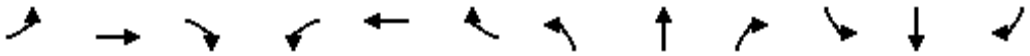
Queue shown is maximum after two cycles.

Splits and Phases: 5: Niagara St & Quaker Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	79	23	8	101	17	28	108	13	17	193	126
Future Volume (vph)	25	79	23	8	101	17	28	108	13	17	193	126
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.976			0.982			0.988			0.949	
Flt Protected		0.990			0.997			0.991			0.998	
Satd. Flow (prot)	0	1589	0	0	1507	0	0	1656	0	0	1533	0
Flt Permitted		0.990			0.997			0.991			0.998	
Satd. Flow (perm)	0	1589	0	0	1507	0	0	1656	0	0	1533	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		838.8			838.4			991.4			524.1	
Travel Time (s)		60.4			60.4			71.4			37.7	
Confl. Peds. (#/hr)			1	1			2					2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	3%	0%	14%	3%	50%	0%	0%	0%	92%	0%	0%
Adj. Flow (vph)	27	86	25	9	110	18	30	117	14	18	210	137
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	138	0	0	137	0	0	161	0	0	365	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 42.8%		ICU Level of Service A	
Analysis Period (min) 15			



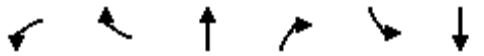
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	25	79	23	8	101	17	28	108	13	17	193	126
Future Volume (vph)	25	79	23	8	101	17	28	108	13	17	193	126
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	86	25	9	110	18	30	117	14	18	210	137

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	138	137	161	365
Volume Left (vph)	27	9	30	18
Volume Right (vph)	25	18	14	137
Hadj (s)	-0.02	0.10	-0.01	-0.14
Departure Headway (s)	5.5	5.6	5.2	4.8
Degree Utilization, x	0.21	0.21	0.23	0.49
Capacity (veh/h)	594	581	643	717
Control Delay (s)	9.9	10.1	9.7	12.2
Approach Delay (s)	9.9	10.1	9.7	12.2
Approach LOS	A	B	A	B

Intersection Summary				
Delay	10.9			
Level of Service	B			
Intersection Capacity Utilization	42.8%	ICU Level of Service	A	
Analysis Period (min)	15			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	167	21	128	141	0	224
Future Volume (vph)	167	21	128	141	0	224
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.985		0.929			
Flt Protected	0.957					
Satd. Flow (prot)	1581	0	1572	0	0	1675
Flt Permitted	0.957					
Satd. Flow (perm)	1581	0	1572	0	0	1675
Link Speed (k/h)	50		50			50
Link Distance (m)	831.7		1030.2			991.4
Travel Time (s)	59.9		74.2			71.4
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	0%	0%	0%	0%	1%
Adj. Flow (vph)	182	23	139	153	0	243
Shared Lane Traffic (%)						
Lane Group Flow (vph)	205	0	292	0	0	243
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.3		0.0			0.0
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24	14		14	24	
Sign Control	Stop		Stop			Stop

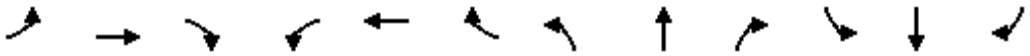
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 34.8%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Stop			Stop
Traffic Volume (vph)	167	21	128	141	0	224
Future Volume (vph)	167	21	128	141	0	224
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	182	23	139	153	0	243

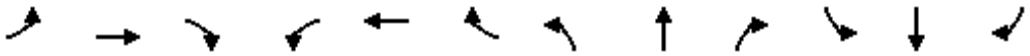
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total (vph)	205	292	243
Volume Left (vph)	182	0	0
Volume Right (vph)	23	153	0
Hadj (s)	0.13	-0.31	0.02
Departure Headway (s)	5.3	4.5	4.8
Degree Utilization, x	0.30	0.36	0.33
Capacity (veh/h)	632	768	705
Control Delay (s)	10.5	10.0	10.2
Approach Delay (s)	10.5	10.0	10.2
Approach LOS	B	A	B

Intersection Summary			
Delay	10.2		
Level of Service	B		
Intersection Capacity Utilization	34.8%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	34	350	58	162	350	1	52	234	203	13	296	82
Future Volume (vph)	34	350	58	162	350	1	52	234	203	13	296	82
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.982						0.944			0.972	
Flt Protected		0.996			0.984			0.995			0.998	
Satd. Flow (prot)	0	1578	0	0	1638	0	0	1582	0	0	1631	0
Flt Permitted		0.996			0.984			0.995			0.998	
Satd. Flow (perm)	0	1578	0	0	1638	0	0	1582	0	0	1631	0
Link Speed (k/h)		40			40			40			50	
Link Distance (m)		822.2			825.4			401.7			1030.2	
Travel Time (s)		74.0			74.3			36.2			74.2	
Confl. Peds. (#/hr)			1	1								
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	3%	19%	3%	1%	0%	0%	0%	1%	0%	0%	3%
Adj. Flow (vph)	39	398	66	184	398	1	59	266	231	15	336	93
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	503	0	0	583	0	0	556	0	0	444	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

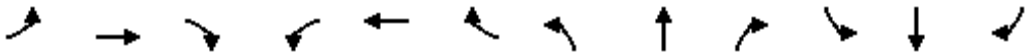
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	118.9%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	34	350	58	162	350	1	52	234	203	13	296	82
Future Volume (vph)	34	350	58	162	350	1	52	234	203	13	296	82
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	39	398	66	184	398	1	59	266	231	15	336	93

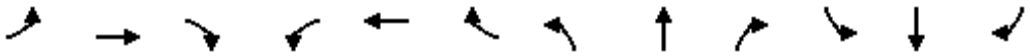
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	503	583	556	444
Volume Left (vph)	39	184	59	15
Volume Right (vph)	66	1	231	93
Hadj (s)	0.02	0.09	-0.22	-0.11
Departure Headway (s)	9.6	9.7	9.3	9.5
Degree Utilization, x	1.34	1.56	1.44	1.17
Capacity (veh/h)	384	386	396	385
Control Delay (s)	196.6	290.6	238.6	129.6
Approach Delay (s)	196.6	290.6	238.6	129.6
Approach LOS	F	F	F	F

Intersection Summary			
Delay	219.8		
Level of Service	F		
Intersection Capacity Utilization	118.9%	ICU Level of Service	H
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	104	61	52	191	12	72	414	15	8	435	39
Future Volume (vph)	20	104	61	52	191	12	72	414	15	8	435	39
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.955			0.993			0.996			0.989	
Flt Protected		0.995			0.990			0.993			0.999	
Satd. Flow (prot)	0	1590	0	0	1644	0	0	1628	0	0	1642	0
Flt Permitted		0.995			0.990			0.993			0.999	
Satd. Flow (perm)	0	1590	0	0	1644	0	0	1628	0	0	1642	0
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		431.2			838.8			1037.2			467.4	
Travel Time (s)		31.0			60.4			62.2			28.0	
Confl. Peds. (#/hr)	1		1	1		1	2					2
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	2%	0%	2%	1%	0%	0%	3%	9%	0%	2%	0%
Adj. Flow (vph)	21	108	64	54	199	13	75	431	16	8	453	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	193	0	0	266	0	0	522	0	0	502	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

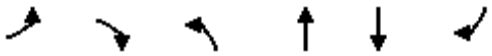
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 92.0%		ICU Level of Service F	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	20	104	61	52	191	12	72	414	15	8	435	39
Future Volume (vph)	20	104	61	52	191	12	72	414	15	8	435	39
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	21	108	64	54	199	12	75	431	16	8	453	41

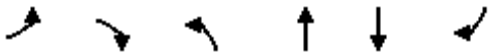
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	193	265	522	502
Volume Left (vph)	21	54	75	8
Volume Right (vph)	64	12	16	41
Hadj (s)	-0.16	0.03	0.06	-0.02
Departure Headway (s)	8.4	8.2	7.3	7.2
Degree Utilization, x	0.45	0.60	1.05	1.00
Capacity (veh/h)	407	429	503	502
Control Delay (s)	18.0	22.8	81.8	67.5
Approach Delay (s)	18.0	22.8	81.8	67.5
Approach LOS	C	C	F	F

Intersection Summary				
Delay	58.1			
Level of Service	F			
Intersection Capacity Utilization	92.0%	ICU Level of Service	F	
Analysis Period (min)	15			



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	78	15	54	423	392	156
Future Volume (vph)	78	15	54	423	392	156
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.978				0.961	
Flt Protected	0.960			0.994		
Satd. Flow (prot)	1540	0	0	1638	1603	0
Flt Permitted	0.960			0.994		
Satd. Flow (perm)	1540	0	0	1638	1603	0
Link Speed (k/h)	50			60	60	
Link Distance (m)	434.7			1037.2	1037.2	
Travel Time (s)	31.3			62.2	62.2	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Heavy Vehicles (%)	2%	9%	0%	3%	2%	0%
Adj. Flow (vph)	92	18	64	498	461	184
Shared Lane Traffic (%)						
Lane Group Flow (vph)	110	0	0	562	645	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24	14	24			14
Sign Control	Stop			Free	Free	

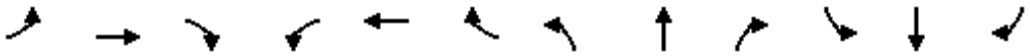
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 75.8%		ICU Level of Service D	
Analysis Period (min) 15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	78	15	54	423	392	156
Future Volume (Veh/h)	78	15	54	423	392	156
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	92	18	64	498	461	184
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1179	553	645			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1179	553	645			
tC, single (s)	6.4	6.3	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.2			
p0 queue free %	53	97	93			
cM capacity (veh/h)	196	519	950			

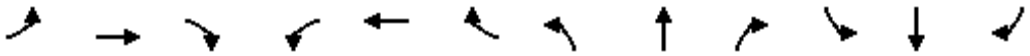
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	110	562	645
Volume Left	92	64	0
Volume Right	18	0	184
cSH	219	950	1700
Volume to Capacity	0.50	0.07	0.38
Queue Length 95th (m)	19.4	1.6	0.0
Control Delay (s)	37.1	1.8	0.0
Lane LOS	E	A	
Approach Delay (s)	37.1	1.8	0.0
Approach LOS	E		

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	75.8%	ICU Level of Service	D
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	47	298	68	103	323	58	90	372	113	31	310	66
Future Volume (vph)	47	298	68	103	323	58	90	372	113	31	310	66
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.978			0.984			0.973			0.978	
Flt Protected		0.994			0.989			0.992			0.996	
Satd. Flow (prot)	0	1571	0	0	1625	0	0	1578	0	0	1601	0
Flt Permitted		0.994			0.989			0.992			0.996	
Satd. Flow (perm)	0	1571	0	0	1625	0	0	1578	0	0	1601	0
Link Speed (k/h)		50			40			40			50	
Link Distance (m)		441.3			822.2			400.0			1037.2	
Travel Time (s)		31.8			74.0			36.0			74.7	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	6%	2%	0%	2%	0%	2%	4%	3%	4%	3%	2%
Adj. Flow (vph)	51	320	73	111	347	62	97	400	122	33	333	71
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	444	0	0	520	0	0	619	0	0	437	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 112.4%		ICU Level of Service H	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	47	298	68	103	323	58	90	372	113	31	310	66
Future Volume (vph)	47	298	68	103	323	58	90	372	113	31	310	66
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	51	320	73	111	347	62	97	400	122	33	333	71

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	444	520	619	437
Volume Left (vph)	51	111	97	33
Volume Right (vph)	73	62	122	71
Hadj (s)	0.00	-0.01	-0.03	-0.03
Departure Headway (s)	9.6	9.6	9.5	9.5
Degree Utilization, x	1.18	1.38	1.64	1.16
Capacity (veh/h)	380	386	381	381
Control Delay (s)	135.1	213.4	323.1	126.7
Approach Delay (s)	135.1	213.4	323.1	126.7
Approach LOS	F	F	F	F

Intersection Summary				
Delay	211.0			
Level of Service	F			
Intersection Capacity Utilization	112.4%	ICU Level of Service	H	
Analysis Period (min)	15			

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	35	682	10	21	53	4
Future Volume (vph)	35	682	10	21	53	4
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		200.0	65.0		0.0	180.0
Storage Lanes		1	1		1	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1627	1369	1607	1692	1422	1438
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	1627	1369	1607	1692	1422	1438
Link Speed (k/h)	60			50	50	
Link Distance (m)	340.4			197.6	500.8	
Travel Time (s)	20.4			14.2	36.1	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Heavy Vehicles (%)	4%	5%	0%	0%	13%	0%
Adj. Flow (vph)	42	812	12	25	63	5
Shared Lane Traffic (%)						
Lane Group Flow (vph)	42	812	12	25	63	5
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	35	682	10	21	53	4
Future Volume (Veh/h)	35	682	10	21	53	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	42	812	12	25	63	5
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						24
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			42		91	42
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			42		91	42
tC, single (s)			4.1		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			99		93	100
cM capacity (veh/h)			1580		876	1034

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	42	812	12	25	68
Volume Left	0	0	12	0	63
Volume Right	0	812	0	0	5
cSH	1700	1700	1580	1700	946
Volume to Capacity	0.02	0.48	0.01	0.01	0.07
Queue Length 95th (m)	0.0	0.0	0.2	0.0	1.8
Control Delay (s)	0.0	0.0	7.3	0.0	9.4
Lane LOS			A		A
Approach Delay (s)	0.0		2.4		9.4
Approach LOS					A

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

APPENDIX

G SIGNAL WARRANT CALCULATION

FUTURE (SCENARIO 2) 2031

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Merrittville Highway / Port Robinson Road

What is the direction of the Main Road street? North-South

When was the data collected? 2016-06-21

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural **Population < 10,000 AND Speed >= 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	40	403	4	59	9	19	3	630	54	31	43	3	0
9:00	60	488	5	99	23	48	7	763	27	50	38	9	0
12:00	40	744	6	40	37	76	6	553	54	16	49	10	0
1:00	120	740	9	238	32	86	8	597	81	14	65	9	0
2:00	60	717	7	119	14	29	7	637	63	16	32	9	0
4:00	60	910	11	178	32	48	11	590	45	13	22	9	0
5:00	60	1,348	18	119	51	57	9	522	27	9	27	8	0
6:00	140	1,154	11	178	60	67	10	478	27	18	70	10	0
Total	**580**	**6,503**	**70**	**1,030**	**258**	**428**	**60**	**4,769**	**378**	**166**	**346**	**68**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									11,272

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road

Count Date: 2016-06-21

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
	☑	☐	☐	☐	☐									
1A	480	720	600	900	1,299	1,615	1,628	1,997	1,708	1,928	2,254	2,223		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	165	266	227	443	218	302	270	403		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours					Yes		No		
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
	☑	☐	☐	☐	☐									
2A	480	720	600	900	1,134	1,349	1,401	1,554	1,490	1,626	1,983	1,820		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	133	186	104	316	167	223	178	266		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours					Yes		No		
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More			Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	☑	☐	YES ☐	NO ☑
Justification 2	Delay Cross Traffic	☑	☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	1:00	1,554	355	80	100 %	100 %
	4:00	1,626	258	80	100 %	
	5:00	1,983	226	80	100 %	
	6:00	1,820	305	80	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road

Count Date: 2016-06-21

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000					
	> 7000	Not Justified				

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road Count Date: 2016-06-21

Summary Results

Justification			Compliance	Signal Justified? YES	NO
1. Minimum Vehicular Volume	A	Total Volume	100 %		
	B	Crossing Volume	100 %		☑
2. Delay to Cross Traffic	A	Main Road	100 %		
	B	Crossing Road	100 %		☑
3. Combination	A	Justificaton 1	100 %		
	B	Justification 2	100 %		☑
4. 4-Hr Volume			100 %		☑
5. Collision Experience			0 %		☐
6. Pedestrians	A	Volume	Justification not met		
	B	Delay	Justification not met		☑

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Quaker Road / First Avenue - Cataract Road

What is the direction of the Main Road street? East-West

When was the data collected? 2016-06-21

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Eastbound Approach			Minor Northbound Approach			Main Westbound Approach			Minor Southbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	80	203	90	11	115	60	4	139	46	90	28	4	0
9:00	84	256	263	32	143	60	17	231	73	179	66	10	0
12:00	71	209	278	17	115	46	9	281	73	179	30	5	0
1:00	55	256	180	20	152	72	7	251	110	269	42	7	0
2:00	42	229	241	12	130	54	14	311	18	716	58	5	0
4:00	109	233	414	26	222	71	9	328	73	269	63	12	0
5:00	55	234	203	22	149	70	13	422	73	492	86	15	0
6:00	84	262	241	20	213	97	15	408	9	448	69	13	0
Total	**580**	**1,880**	**1,910**	**159**	**1,239**	**531**	**88**	**2,372**	**475**	**2,640**	**443**	**70**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									4,252

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Quaker Road / First Avenue - Cataract Road

Count Date: 2016-06-21

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
	☑	☐	☐	☐										
1A	480	720	600	900	869	1,414	1,314	1,420	1,830	1,827	1,833	1,879		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	307	490	393	562	975	662	833	860		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 1:	Both 1A and 1B 100% Fulfilled each of 8 hours	Yes	No
	Lesser of 1A or 1B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
	☑	☐	☐	☐										
2A	480	720	600	900	562	924	921	858	855	1,166	999	1,019		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	215	354	311	440	858	516	663	680		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 2:	Both 2A and 2B 100% fulfilled each of 8 hours	Yes	No
	Lesser of 2A or 2B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 3: Combination

Combination Justification 1 and 2

Justification Satisfied 80% or More				Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	☑	☐	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	☑	☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	4:00	1,166	343	85	100 %	100 %
	5:00	999	593	117	100 %	
	6:00	1,019	530	113	100 %	
	9:00	924	255	136	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Quaker Road / First Avenue - Cataract Road

Count Date: 2016-06-21

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Quaker Road / First Avenue - Cataract Road Count Date: 2016-06-21

Summary Results

Justification			Compliance	Signal Justified? YES	NO
1. Minimum Vehicular Volume	A	Total Volume	100 %		
	B	Crossing Volume	100 %	☑	☐
2. Delay to Cross Traffic	A	Main Road	100 %		
	B	Crossing Road	100 %	☑	☐
3. Combination	A	Justificaton 1	100 %		
	B	Justification 2	100 %	☑	☐
4. 4-Hr Volume			100 %	☑	☐
5. Collision Experience			0 %	☐	☑
6. Pedestrians	A	Volume	Justification not met		
	B	Delay	Justification not met	☐	☑

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Rice Road / Quaker Road

What is the direction of the Main Road street? North-South

When was the data collected? 2016-06-13

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 2 or more

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	39	420	58	257	127	74	10	172	106	6	122	7	0
9:00	60	545	67	339	192	146	9	338	137	14	135	7	0
12:00	47	344	43	111	148	51	13	268	156	7	229	18	0
1:00	63	372	36	111	142	49	15	240	81	10	229	18	0
2:00	41	335	33	111	130	66	11	253	162	8	184	18	0
3:00	77	469	55	134	166	70	13	387	286	14	278	18	0
5:00	93	432	53	187	158	68	17	401	336	18	312	18	0
6:00	68	425	46	158	129	76	19	363	293	18	283	23	0
Total	**489**	**3,343**	**389**	**1,408**	**1,191**	**598**	**107**	**2,422**	**1,557**	**95**	**1,773**	**127**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									5,765

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Quaker Road

Count Date: 2016-06-13

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
1A	480	720	600	900	1,398	1,988	1,435	1,366	1,352	1,968	2,094	1,900		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	593	832	564	559	517	681	762	686		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours					Yes		No		
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
2A	480	720	600	900	805	1,155	871	807	835	1,287	1,333	1,214		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	390	545	348	350	303	427	518	458		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours					Yes		No		
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	3:00	1,287	370	122	100 %	100 %
	5:00	1,333	413	115	100 %	
	6:00	1,214	362	136	100 %	
	9:00	1,155	676	149	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Quaker Road

Count Date: 2016-06-13

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Rice Road / Quaker Road Count Date: 2016-06-13

Summary Results

Justification			Compliance	Signal Justified? YES	NO
1. Minimum Vehicular Volume	A	Total Volume	100 %		
	B	Crossing Volume	100 %	☑	☐
2. Delay to Cross Traffic	A	Main Road	100 %		
	B	Crossing Road	100 %	☑	☐
3. Combination	A	Justificaton 1	100 %		
	B	Justification 2	100 %	☑	☐
4. 4-Hr Volume			100 %	☑	☐
5. Collision Experience			0 %	☐	☑
6. Pedestrians	A	Volume	Justification not met		
	B	Delay	Justification not met	☐	☑

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Rice Road / Merritt Road

What is the direction of the Main Road street? North-South

When was the data collected? 2016-06-13

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 2 or more

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural **Population < 10,000 AND Speed >= 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	1	289	309	107	31	1	0	277	222	17	115	0	0
9:00	2	438	611	162	61	1	0	306	158	174	149	0	0
12:00	1	338	212	128	51	2	0	520	169	278	90	0	0
1:00	1	325	204	171	46	3	0	520	95	296	93	0	0
2:00	1	297	277	111	49	2	0	417	11	296	88	0	0
3:00	1	379	293	209	77	3	0	630	106	383	115	0	0
5:00	1	361	285	252	83	5	0	708	95	487	114	0	0
6:00	1	295	318	183	71	5	0	641	179	487	93	0	0
Total	**8**	**2,723**	**2,508**	**1,322**	**469**	**22**	**0**	**4,019**	**1,034**	**2,419**	**857**	**0**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									6,741

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Merritt Road

Count Date: 2016-06-13

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
1A	480	720	600	900	1,369	2,062	1,788	1,752	1,548	2,195	2,391	2,274		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	271	547	549	608	546	786	941	840		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours					Yes		No		
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
2A	480	720	600	900	1,098	1,515	1,239	1,144	1,002	1,409	1,450	1,434		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	239	485	496	560	494	706	853	764		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours					Yes		No		
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	3:00	1,409	497	115	100 %	100 %
	5:00	1,450	601	115	100 %	
	6:00	1,434	580	115	100 %	
	9:00	1,515	323	115	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Merritt Road

Count Date: 2016-06-13

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merritt Road / First Ave - Cataract Road

Count Date: 2016-06-21

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
1A	480	720	600	900	1,470	2,033	1,569	1,807	1,696	2,238	1,889	2,075		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	1,018	1,316	1,045	1,295	1,200	1,596	1,223	1,449		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours					Yes		No		
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
2A	480	720	600	900	451	717	524	512	496	641	666	626		
	COMPLIANCE %				94	100	100	100	100	100	100	100	794	99
2B	50	75	50	75	561	783	592	785	679	1,124	816	1,074		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours					Yes		No		
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours					Yes ☐		No ☐		

Justification 3: Combination

Combination Justification 1 and 2

Justification Satisfied 80% or More				Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	☑	☐	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	☑	☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	4:00	641	806	229	100 %	100 %
	5:00	666	678	219	100 %	
	6:00	626	770	235	100 %	
	9:00	717	788	201	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merritt Road / First Ave - Cataract Road

Count Date: 2016-06-21

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Rice Road / Merritt Road Count Date: 2016-06-13

Summary Results

Justification			Compliance	Signal Justified? YES	NO
1. Minimum Vehicular Volume	A	Total Volume	100 %		
	B	Crossing Volume	100 %	☑	☐
2. Delay to Cross Traffic	A	Main Road	100 %		
	B	Crossing Road	100 %	☑	☐
3. Combination	A	Justificaton 1	100 %		
	B	Justification 2	100 %	☑	☐
4. 4-Hr Volume			100 %	☑	☐
5. Collision Experience			0 %	☐	☑
6. Pedestrians	A	Volume	Justification not met		
	B	Delay	Justification not met	☐	☑

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Merritt Road / First Ave - Cataract Road Count Date: 2016-06-21

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%		
	B	Crossing Volume	100	%	☑	☐
2. Delay to Cross Traffic	A	Main Road	99	%		
	B	Crossing Road	100	%	☐	☑
3. Combination	A	Justificaton 1	100	%		
	B	Justification 2	99	%	☑	☐
4. 4-Hr Volume			100	%	☑	☐
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification not met			
	B	Delay	Justification not met		☐	☑

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Merritt Road / First Ave - Cataract Road

What is the direction of the Main Road street? East-West

When was the data collected? 2016-06-21

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural **Population < 10,000 AND Speed >= 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Eastbound Approach			Minor Northbound Approach			Main Westbound Approach			Minor Southbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	0	126	187	6	409	1	9	130	0	93	461	48	0
9:00	0	190	369	19	508	1	14	144	0	206	558	24	0
12:00	0	147	128	10	409	1	5	244	0	173	404	48	0
1:00	0	141	123	12	541	1	4	244	0	233	437	72	0
2:00	0	129	167	7	464	1	4	195	0	206	466	56	0
4:00	0	165	177	15	790	1	4	296	0	319	432	40	0
5:00	0	157	172	13	530	1	5	332	0	272	382	24	0
6:00	0	128	192	12	756	2	5	301	0	306	350	24	0
Total	**0**	**1,184**	**1,514**	**94**	**4,406**	**9**	**51**	**1,885**	**0**	**1,807**	**3,490**	**336**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									3,068

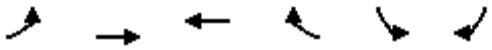
b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

APPENDIX

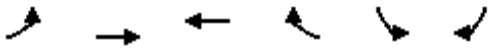
H SYNCHRO OUTPUT

FUTURE (SCENARIO 2) 2031



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	26	836	59	22	5	630
Future Volume (vph)	26	836	59	22	5	630
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0			210.0	0.0	150.0
Storage Lanes	1			1	1	1
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1516	1642	1364	1438	1607	1396
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1516	1642	1364	1438	1607	1396
Link Speed (k/h)		60	60		60	
Link Distance (m)		1297.0	340.4		573.6	
Travel Time (s)		77.8	20.4		34.4	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Adj. Flow (vph)	32	1020	72	27	6	768
Shared Lane Traffic (%)						
Lane Group Flow (vph)	32	1020	72	27	6	768
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		6.6	6.6		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

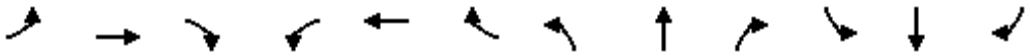
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 57.8%		ICU Level of Service B	
Analysis Period (min) 15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	26	836	59	22	5	630
Future Volume (Veh/h)	26	836	59	22	5	630
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	32	1020	72	27	6	768
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						20
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	72				1156	72
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	72				1156	72
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	98				97	22
cM capacity (veh/h)	1503				215	987

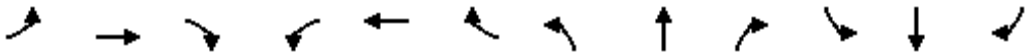
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	32	1020	72	27	774
Volume Left	32	0	0	0	6
Volume Right	0	0	0	27	768
cSH	1503	1700	1700	1700	995
Volume to Capacity	0.02	0.60	0.04	0.02	0.78
Queue Length 95th (m)	0.5	0.0	0.0	0.0	61.7
Control Delay (s)	7.4	0.0	0.0	0.0	20.1
Lane LOS	A				C
Approach Delay (s)	0.2		0.0		20.1
Approach LOS					C

Intersection Summary			
Average Delay	8.2		
Intersection Capacity Utilization	57.8%	ICU Level of Service	B
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	101	23	30	4	16	4	45	419	5	5	229	17
Future Volume (vph)	101	23	30	4	16	4	45	419	5	5	229	17
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.974			0.978			0.999			0.991	
Flt Protected		0.968			0.992			0.995			0.999	
Satd. Flow (prot)	0	1425	0	0	1481	0	0	1526	0	0	1554	0
Flt Permitted		0.968			0.992			0.995			0.999	
Satd. Flow (perm)	0	1425	0	0	1481	0	0	1526	0	0	1554	0
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		838.4			681.4			1027.1			497.4	
Travel Time (s)		60.4			40.9			61.6			29.8	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Heavy Vehicles (%)	1%	44%	24%	0%	0%	67%	20%	9%	25%	25%	8%	0%
Adj. Flow (vph)	131	30	39	5	21	5	58	544	6	6	297	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	200	0	0	31	0	0	608	0	0	325	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

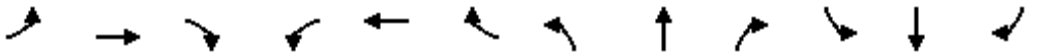
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 67.5%		ICU Level of Service C	
Analysis Period (min) 15			



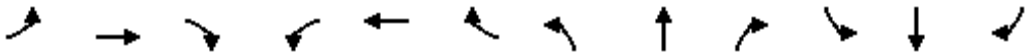
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	101	23	30	4	16	4	45	419	5	5	229	17
Future Volume (Veh/h)	101	23	30	4	16	4	45	419	5	5	229	17
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Hourly flow rate (vph)	131	30	39	5	21	5	58	544	6	6	297	22
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	998	986	308	1037	994	547	319			550		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	998	986	308	1037	994	547	319			550		
tC, single (s)	7.1	6.9	6.4	7.1	6.5	6.9	4.3			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.4	3.5	3.5	4.0	3.9	2.4			2.4		
p0 queue free %	33	85	94	97	91	99	95			99		
cM capacity (veh/h)	197	199	683	169	233	431	1146			914		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	200	31	608	325
Volume Left	131	5	58	6
Volume Right	39	5	6	22
cSH	229	236	1146	914
Volume to Capacity	0.87	0.13	0.05	0.01
Queue Length 95th (m)	53.5	3.4	1.2	0.2
Control Delay (s)	76.0	22.6	1.4	0.2
Lane LOS	F	C	A	A
Approach Delay (s)	76.0	22.6	1.4	0.2
Approach LOS	F	C		

Intersection Summary				
Average Delay	14.4			
Intersection Capacity Utilization	67.5%	ICU Level of Service	C	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	73	486	9	295	357	37	5	359	365	11	235	17
Future Volume (vph)	73	486	9	295	357	37	5	359	365	11	235	17
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	90.0		45.0	65.0		0.0	0.0		0.0	0.0		80.0
Storage Lanes	1		1	1		0	0		1	0		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	0.95
Frt		0.997			0.986				0.850		0.990	
Flt Protected	0.950			0.950				0.999			0.998	
Satd. Flow (prot)	1607	3195	0	1531	3060	0	0	1552	1396	0	2901	0
Flt Permitted	0.511			0.308				0.995			0.935	
Satd. Flow (perm)	864	3195	0	496	3060	0	0	1546	1396	0	2718	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			15				380		10	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		150.4			1297.0			1025.7			1027.1	
Travel Time (s)		9.0			77.8			61.5			61.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	0%	17%	5%	1%	28%	0%	9%	3%	11%	9%	15%
Adj. Flow (vph)	76	506	9	307	372	39	5	374	380	11	245	18
Shared Lane Traffic (%)												
Lane Group Flow (vph)	76	515	0	307	411	0	0	379	380	0	274	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4		3	8			2			6	



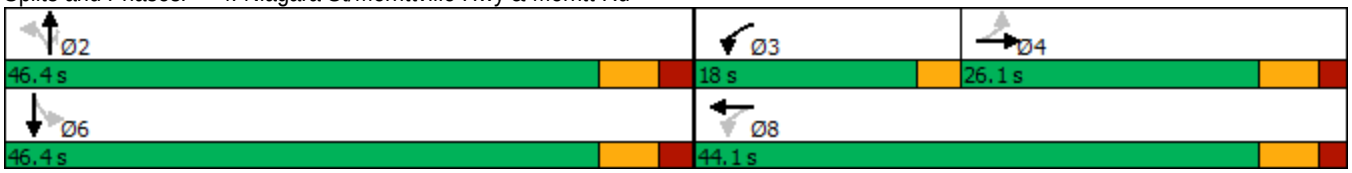
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2		2	6		
Detector Phase	4	4		3	8		2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		10.0	8.0		10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	22.5	22.5		14.5	22.5		16.4	16.4	16.4	16.4	16.4	
Total Split (s)	26.1	26.1		18.0	44.1		46.4	46.4	46.4	46.4	46.4	
Total Split (%)	28.8%	28.8%		19.9%	48.7%		51.3%	51.3%	51.3%	51.3%	51.3%	
Maximum Green (s)	20.0	20.0		15.0	38.0		40.0	40.0	40.0	40.0	40.0	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1	4.1	4.1	4.1	
All-Red Time (s)	2.0	2.0		0.0	2.0		2.3	2.3	2.3	2.3	2.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	
Total Lost Time (s)	6.1	6.1		3.0	6.1			6.4	6.4		6.4	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0		3.0	3.0		5.0	5.0	5.0	3.0	3.0	
Recall Mode	None	None		None	None		None	None	None	None	None	
Walk Time (s)	0.0	0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Flash Dont Walk (s)	0.0	0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Pedestrian Calls (#/hr)	0	0			0		0	0	0	0	0	
Act Effct Green (s)	18.0	18.0		38.0	34.8			27.9	27.9		27.9	
Actuated g/C Ratio	0.24	0.24		0.50	0.46			0.37	0.37		0.37	
v/c Ratio	0.37	0.67		0.70	0.29			0.67	0.50		0.27	
Control Delay	33.5	32.8		24.4	14.2			26.4	4.4		16.7	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay	33.5	32.8		24.4	14.2			26.4	4.4		16.7	
LOS	C	C		C	B			C	A		B	
Approach Delay		32.9			18.6			15.4			16.7	
Approach LOS		C			B			B			B	
Queue Length 50th (m)	9.3	36.1		26.0	17.7			47.3	0.0		14.4	
Queue Length 95th (m)	24.5	61.1		#61.0	34.3			74.4	15.1		22.6	
Internal Link Dist (m)		126.4			1273.0			1001.7			1003.1	
Turn Bay Length (m)	90.0			65.0								
Base Capacity (vph)	236	875		461	1597			845	935		1491	
Starvation Cap Reductn	0	0		0	0			0	0		0	
Spillback Cap Reductn	0	0		0	0			0	0		0	
Storage Cap Reductn	0	0		0	0			0	0		0	
Reduced v/c Ratio	0.32	0.59		0.67	0.26			0.45	0.41		0.18	

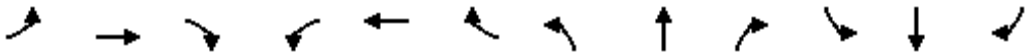
Intersection Summary			
Area Type:	Other		
Cycle Length: 90.5			
Actuated Cycle Length: 75.6			
Natural Cycle: 60			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.70			
Intersection Signal Delay: 20.9		Intersection LOS: C	
Intersection Capacity Utilization 71.2%		ICU Level of Service C	
Analysis Period (min) 15			

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

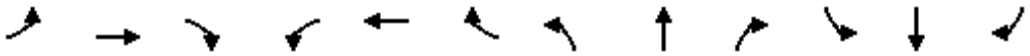
Queue shown is maximum after two cycles.

Splits and Phases: 4: Niagara St/Merrittville Hwy & Merritt Rd





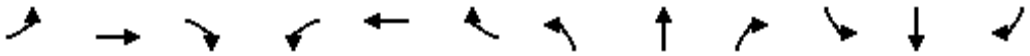
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	111	26	125	20	104	32	83	586	23	7	503	29
Future Volume (vph)	111	26	125	20	104	32	83	586	23	7	503	29
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0		0.0	30.0		0.0	75.0		0.0	65.0		30.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.875			0.964			0.994			0.992	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1545	1439	0	1516	1615	0	1397	3020	0	1607	2984	0
Flt Permitted	0.666			0.656			0.374			0.408		
Satd. Flow (perm)	1083	1439	0	1047	1615	0	550	3020	0	690	2984	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		132			17			5			7	
Link Speed (k/h)		50			50			40			60	
Link Distance (m)		825.4			480.8			403.8			1025.7	
Travel Time (s)		59.4			34.6			36.3			61.5	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	4%	12%	1%	6%	0%	4%	15%	6%	0%	0%	7%	4%
Adj. Flow (vph)	117	27	132	21	109	34	87	617	24	7	529	31
Shared Lane Traffic (%)												
Lane Group Flow (vph)	117	159	0	21	143	0	87	641	0	7	560	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	14.9	14.9		14.9	14.9		9.0	16.6		9.0	16.6	
Total Split (s)	31.9	31.9		31.9	31.9		18.0	41.6		18.0	41.6	
Total Split (%)	34.9%	34.9%		34.9%	34.9%		19.7%	45.5%		19.7%	45.5%	
Maximum Green (s)	25.0	25.0		25.0	25.0		15.0	35.0		15.0	35.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		3.0	4.1		3.0	4.1	
All-Red Time (s)	2.8	2.8		2.8	2.8		0.0	2.5		0.0	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.9	6.9		6.9	6.9		3.0	6.6		3.0	6.6	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		3.0	2.5		3.0	2.5	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	11.0	11.0		11.0	11.0			9.0			9.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			14.0			14.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	11.6	11.6		11.6	11.6		25.4	20.2		22.3	15.3	
Actuated g/C Ratio	0.24	0.24		0.24	0.24		0.53	0.42		0.47	0.32	
v/c Ratio	0.45	0.35		0.08	0.35		0.20	0.50		0.02	0.58	
Control Delay	24.6	8.6		18.7	18.9		6.6	11.9		5.7	17.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	24.6	8.6		18.7	18.9		6.6	11.9		5.7	17.6	
LOS	C	A		B	B		A	B		A	B	
Approach Delay		15.4			18.9			11.3			17.4	
Approach LOS		B			B			B			B	
Queue Length 50th (m)	9.0	1.9		1.5	9.4		2.8	16.0		0.3	21.7	
Queue Length 95th (m)	25.6	15.1		6.7	26.0		9.4	45.0		1.7	43.4	
Internal Link Dist (m)		801.4			456.8			379.8			1001.7	
Turn Bay Length (m)	80.0			30.0			75.0			65.0		
Base Capacity (vph)	618	878		597	929		587	2327		687	2300	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.19	0.18		0.04	0.15		0.15	0.28		0.01	0.24	

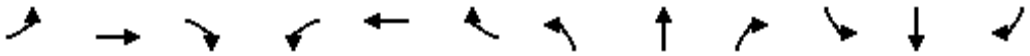
Intersection Summary			
Area Type:	Other		
Cycle Length: 91.5			
Actuated Cycle Length: 47.7			
Natural Cycle: 55			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.58			
Intersection Signal Delay: 14.7		Intersection LOS: B	
Intersection Capacity Utilization 60.2%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 5: Niagara St & Quaker Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	92	146	13	4	70	4	12	127	6	2	105	22
Future Volume (vph)	92	146	13	4	70	4	12	127	6	2	105	22
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.993			0.994			0.994			0.977	
Flt Protected		0.982			0.998			0.996			0.999	
Satd. Flow (prot)	0	1537	0	0	1478	0	0	1618	0	0	1574	0
Flt Permitted		0.982			0.998			0.996			0.999	
Satd. Flow (perm)	0	1537	0	0	1478	0	0	1618	0	0	1574	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		838.8			838.4			991.4			524.1	
Travel Time (s)		60.4			60.4			71.4			37.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	12%	0%	0%	15%	0%	11%	3%	0%	0%	6%	0%
Adj. Flow (vph)	100	159	14	4	76	4	13	138	7	2	114	24
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	273	0	0	84	0	0	158	0	0	140	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

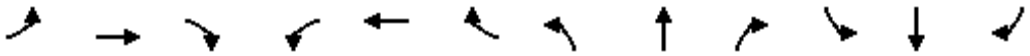
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 43.3%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	92	146	13	4	70	4	12	127	6	2	105	22
Future Volume (vph)	92	146	13	4	70	4	12	127	6	2	105	22
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	100	159	14	4	76	4	13	138	7	2	114	24

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	273	84	158	140
Volume Left (vph)	100	4	13	2
Volume Right (vph)	14	4	7	24
Hadj (s)	0.17	0.21	0.05	-0.02
Departure Headway (s)	5.0	5.3	5.1	5.0
Degree Utilization, x	0.38	0.12	0.22	0.20
Capacity (veh/h)	684	623	655	654
Control Delay (s)	10.9	9.0	9.5	9.3
Approach Delay (s)	10.9	9.0	9.5	9.3
Approach LOS	B	A	A	A

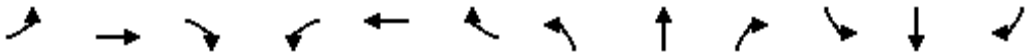
Intersection Summary				
Delay	10.0			
Level of Service	B			
Intersection Capacity Utilization	43.3%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	10	484	1	168	203	8	5	127	79	5	112	5
Future Volume (vph)	10	484	1	168	203	8	5	127	79	5	112	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	526	1	183	221	9	5	138	86	5	122	5

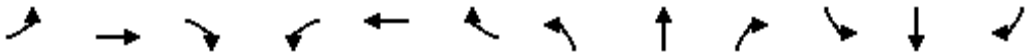
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	11	527	183	230	229	132
Volume Left (vph)	11	0	183	0	5	5
Volume Right (vph)	0	1	0	9	86	5
Hadj (s)	0.50	0.00	0.52	-0.02	-0.18	0.06
Departure Headway (s)	7.1	6.6	7.4	6.8	6.9	7.4
Degree Utilization, x	0.02	0.96	0.37	0.44	0.44	0.27
Capacity (veh/h)	488	527	477	516	495	451
Control Delay (s)	9.1	54.2	13.5	13.8	15.0	13.2
Approach Delay (s)	53.3		13.7		15.0	13.2
Approach LOS	F		B		C	B

Intersection Summary				
Delay	30.1			
Level of Service	D			
Intersection Capacity Utilization	62.4%	ICU Level of Service	B	
Analysis Period (min)	15			



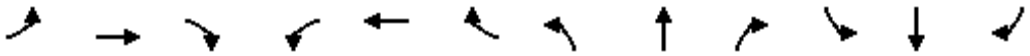
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	484	1	168	203	8	5	127	79	5	112	5
Future Volume (vph)	10	484	1	168	203	8	5	127	79	5	112	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	20.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	1		0	1		0	0		0	0		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.994			0.949			0.995	
Flt Protected	0.950			0.950				0.999			0.998	
Satd. Flow (prot)	1607	1692	0	1591	1670	0	0	1564	0	0	1606	0
Flt Permitted	0.950			0.950				0.999			0.998	
Satd. Flow (perm)	1607	1692	0	1591	1670	0	0	1564	0	0	1606	0
Link Speed (k/h)		60			60			50			50	
Link Distance (m)		824.0			681.3			1030.2			991.4	
Travel Time (s)		49.4			40.9			74.2			71.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	1%	0%	17%	0%	3%	2%	0%	5%	0%
Adj. Flow (vph)	11	526	1	183	221	9	5	138	86	5	122	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	11	527	0	183	230	0	0	229	0	0	132	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		6.6			6.6			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 62.4%		ICU Level of Service B	
Analysis Period (min) 15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	8	88	60	179	27	10	84	193	169	5	231	45
Future Volume (vph)	8	88	60	179	27	10	84	193	169	5	231	45
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		20.0	0.0		0.0
Storage Lanes	0		0	0		0	0		1	0		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.948			0.994				0.850		0.978	
Flt Protected		0.997			0.960			0.985			0.999	
Satd. Flow (prot)	0	1496	0	0	1497	0	0	1585	1396	0	1600	0
Flt Permitted		0.997			0.960			0.985			0.999	
Satd. Flow (perm)	0	1496	0	0	1497	0	0	1585	1396	0	1600	0
Link Speed (k/h)		40			40			40			50	
Link Distance (m)		822.2			825.4			401.7			1030.2	
Travel Time (s)		74.0			74.3			36.2			74.2	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	4%	12%	9%	3%	0%	10%	3%	3%	0%	4%	0%
Adj. Flow (vph)	9	100	68	203	31	11	95	219	192	6	263	51
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	177	0	0	245	0	0	314	192	0	320	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

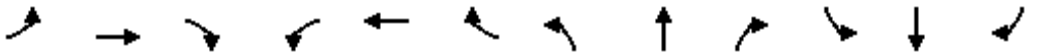
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 68.3%		ICU Level of Service C	
Analysis Period (min) 15			



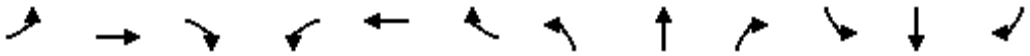
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	88	60	179	27	10	84	193	169	5	231	45
Future Volume (vph)	8	88	60	179	27	10	84	193	169	5	231	45
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	9	100	68	203	31	11	95	219	192	6	262	51

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	177	245	314	192	319
Volume Left (vph)	9	203	95	0	6
Volume Right (vph)	68	11	0	192	51
Hadj (s)	-0.10	0.27	0.24	-0.65	-0.04
Departure Headway (s)	6.8	7.0	6.9	6.0	6.4
Degree Utilization, x	0.34	0.47	0.60	0.32	0.57
Capacity (veh/h)	458	474	502	578	523
Control Delay (s)	13.2	16.1	18.3	10.5	17.4
Approach Delay (s)	13.2	16.1	15.4		17.4
Approach LOS	B	C	C		C

Intersection Summary				
Delay	15.7			
Level of Service	C			
Intersection Capacity Utilization	68.3%	ICU Level of Service	C	
Analysis Period (min)	15			



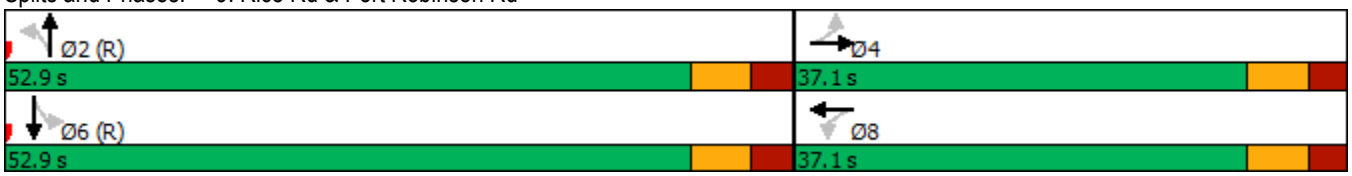
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	47	169	56	16	80	8	41	430	78	4	252	6
Future Volume (vph)	47	169	56	16	80	8	41	430	78	4	252	6
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00	1.00		1.00	1.00		1.00				1.00	
Frt		0.963			0.986			0.977			0.997	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1521	0	1307	1543	0	1410	1611	0	1607	1646	0
Flt Permitted	0.695			0.463			0.589			0.405		
Satd. Flow (perm)	1174	1521	0	636	1543	0	872	1611	0	685	1646	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		20			6			15			2	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		431.2			838.8			1037.2			467.4	
Travel Time (s)		31.0			60.4			62.2			28.0	
Confl. Peds. (#/hr)	1		1	1		1	2					2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	9%	0%	23%	0%	83%	14%	2%	6%	0%	2%	20%
Adj. Flow (vph)	51	182	60	17	86	9	44	462	84	4	271	6
Shared Lane Traffic (%)												
Lane Group Flow (vph)	51	242	0	17	95	0	44	546	0	4	277	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			6.6			6.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		

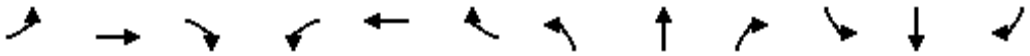


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	36.8	36.8		36.8	36.8		37.0	37.0		37.0	37.0	
Total Split (s)	37.1	37.1		37.1	37.1		52.9	52.9		52.9	52.9	
Total Split (%)	41.2%	41.2%		41.2%	41.2%		58.8%	58.8%		58.8%	58.8%	
Maximum Green (s)	30.3	30.3		30.3	30.3		45.9	45.9		45.9	45.9	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.7	2.7		2.7	2.7		2.9	2.9		2.9	2.9	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.8	6.8		6.8	6.8		7.0	7.0		7.0	7.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Flash Dont Walk (s)	19.0	19.0		19.0	19.0		19.0	19.0		19.0	19.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	18.2	18.2		18.2	18.2		58.0	58.0		58.0	58.0	
Actuated g/C Ratio	0.20	0.20		0.20	0.20		0.64	0.64		0.64	0.64	
v/c Ratio	0.22	0.75		0.13	0.30		0.08	0.52		0.01	0.26	
Control Delay	29.7	44.6		28.8	29.1		8.2	11.8		8.0	8.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	29.7	44.6		28.8	29.1		8.2	11.8		8.0	8.6	
LOS	C	D		C	C		A	B		A	A	
Approach Delay		42.0			29.0			11.5			8.6	
Approach LOS		D			C			B			A	
Queue Length 50th (m)	7.4	36.3		2.4	13.1		2.6	44.1		0.2	18.2	
Queue Length 95th (m)	15.4	55.4		7.3	23.5		8.2	87.7		1.7	37.9	
Internal Link Dist (m)		407.2			814.8			1013.2			443.4	
Turn Bay Length (m)												
Base Capacity (vph)	395	525		214	523		561	1043		441	1061	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.13	0.46		0.08	0.18		0.08	0.52		0.01	0.26	

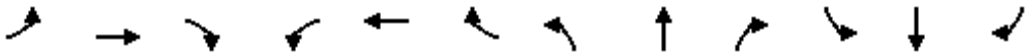
Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 75			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.75			
Intersection Signal Delay: 19.4		Intersection LOS: B	
Intersection Capacity Utilization 63.3%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 9: Rice Rd & Port Robinson Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	106	117	1	174	24	5	1	438	373	5	306	13
Future Volume (vph)	106	117	1	174	24	5	1	438	373	5	306	13
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	40.0		0.0	80.0		0.0	70.0		0.0	50.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.999			0.976			0.934			0.994	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1689	0	1607	1651	0	1339	2937	0	1607	3105	0
Flt Permitted	0.737			0.675			0.531			0.282		
Satd. Flow (perm)	1247	1689	0	1142	1651	0	749	2937	0	477	3105	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			5			330			7	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		434.7			824.0			1037.2			114.5	
Travel Time (s)		26.1			49.4			62.2			6.9	
Peak Hour Factor	0.86	0.92	0.86	0.92	0.92	0.92	0.86	0.86	0.92	0.92	0.86	0.86
Heavy Vehicles (%)	0%	0%	5%	0%	0%	0%	20%	4%	0%	0%	3%	0%
Adj. Flow (vph)	123	127	1	189	26	5	1	509	405	5	356	15
Shared Lane Traffic (%)												
Lane Group Flow (vph)	123	128	0	189	31	0	1	914	0	5	371	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	

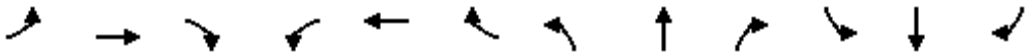


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	36.8	36.8		36.8	36.8		37.0	37.0		37.0	37.0	
Total Split (s)	36.8	36.8		36.8	36.8		47.0	47.0		47.0	47.0	
Total Split (%)	43.9%	43.9%		43.9%	43.9%		56.1%	56.1%		56.1%	56.1%	
Maximum Green (s)	30.0	30.0		30.0	30.0		40.0	40.0		40.0	40.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.7	2.7		2.7	2.7		2.9	2.9		2.9	2.9	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.8	6.8		6.8	6.8		7.0	7.0		7.0	7.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Flash Dont Walk (s)	19.0	19.0		19.0	19.0		19.0	19.0		19.0	19.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	18.8	18.8		18.8	18.8		51.2	51.2		51.2	51.2	
Actuated g/C Ratio	0.22	0.22		0.22	0.22		0.61	0.61		0.61	0.61	
v/c Ratio	0.44	0.34		0.74	0.08		0.00	0.48		0.02	0.20	
Control Delay	31.2	27.6		46.5	20.1		9.0	7.1		10.0	10.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	31.2	27.6		46.5	20.1		9.0	7.1		10.0	10.0	
LOS	C	C		D	C		A	A		A	B	
Approach Delay		29.4			42.8			7.1			10.0	
Approach LOS		C			D			A			B	
Queue Length 50th (m)	17.0	17.1		28.2	3.3		0.1	22.0		0.4	17.3	
Queue Length 95th (m)	26.9	27.6		44.2	8.6		0.7	41.3		m1.7	31.1	
Internal Link Dist (m)		410.7			800.0			1013.2			90.5	
Turn Bay Length (m)	40.0			80.0			70.0			50.0		
Base Capacity (vph)	446	605		408	594		457	1923		291	1900	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.28	0.21		0.46	0.05		0.00	0.48		0.02	0.20	

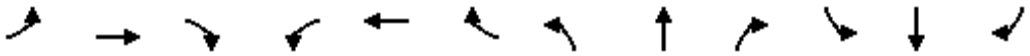
Intersection Summary			
Area Type:	Other		
Cycle Length: 83.8			
Actuated Cycle Length: 83.8			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 75			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.74			
Intersection Signal Delay: 15.4		Intersection LOS: B	
Intersection Capacity Utilization 54.8%		ICU Level of Service A	
Analysis Period (min) 15			

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 10: Rice Rd & Merritt Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	282	116	105	14	135	7	60	523	34	6	338	137
Future Volume (vph)	282	116	105	14	135	7	60	523	34	6	338	137
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	89.0		0.0	40.0		0.0	90.0		0.0	68.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor							1.00				0.99	
Frt		0.929			0.992			0.991			0.957	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1474	1495	0	1607	1588	0	1435	3070	0	1545	2898	0
Flt Permitted	0.397			0.606			0.404			0.350		
Satd. Flow (perm)	616	1495	0	1025	1588	0	610	3070	0	569	2898	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		81			3			8			74	
Link Speed (k/h)		50			40			40			50	
Link Distance (m)		441.3			822.2			400.0			1037.2	
Travel Time (s)		31.8			74.0			36.0			74.7	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	9%	7%	3%	0%	6%	0%	12%	4%	0%	4%	2%	14%
Adj. Flow (vph)	313	129	117	16	150	8	67	581	38	7	376	152
Shared Lane Traffic (%)												
Lane Group Flow (vph)	313	246	0	16	158	0	67	619	0	7	528	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

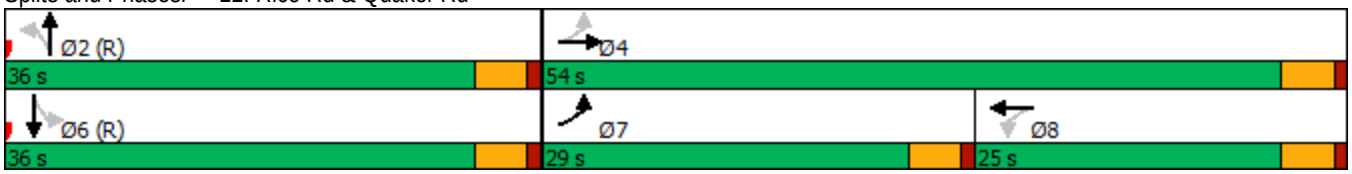


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	9.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	29.0	54.0		25.0	25.0		36.0	36.0		36.0	36.0	
Total Split (%)	32.2%	60.0%		27.8%	27.8%		40.0%	40.0%		40.0%	40.0%	
Maximum Green (s)	24.5	49.5		20.5	20.5		31.5	31.5		31.5	31.5	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)		7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0		0	0		0	0	
Act Effct Green (s)	40.8	40.8		14.0	14.0		40.2	40.2		40.2	40.2	
Actuated g/C Ratio	0.45	0.45		0.16	0.16		0.45	0.45		0.45	0.45	
v/c Ratio	0.64	0.34		0.10	0.63		0.25	0.45		0.03	0.40	
Control Delay	22.3	10.4		31.6	45.7		21.9	19.9		18.2	16.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	22.3	10.4		31.6	45.7		21.9	19.9		18.2	16.7	
LOS	C	B		C	D		C	B		B	B	
Approach Delay		17.1			44.4			20.1			16.7	
Approach LOS		B			D			C			B	
Queue Length 50th (m)	34.4	16.1		2.4	25.4		7.3	39.0		0.7	27.7	
Queue Length 95th (m)	48.0	27.2		7.5	41.8		19.3	60.3		3.7	45.6	
Internal Link Dist (m)		417.3			798.2			376.0			1013.2	
Turn Bay Length (m)	89.0			40.0			90.0			68.0		
Base Capacity (vph)	512	858		233	364		272	1375		254	1335	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.61	0.29		0.07	0.43		0.25	0.45		0.03	0.40	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 55			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.64			
Intersection Signal Delay: 20.5		Intersection LOS: C	

Intersection Capacity Utilization 61.2% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 11: Rice Rd & Quaker Rd



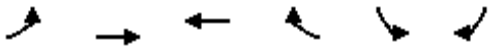
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	16	825	11	25	56	4
Future Volume (vph)	16	825	11	25	56	4
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		200.0	65.0		0.0	180.0
Storage Lanes		1	1		1	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1692	1396	1607	1128	1545	1438
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	1692	1396	1607	1128	1545	1438
Link Speed (k/h)	60			60	50	
Link Distance (m)	340.4			197.6	500.8	
Travel Time (s)	20.4			11.9	36.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	3%	0%	50%	4%	0%
Adj. Flow (vph)	18	938	13	28	64	5
Shared Lane Traffic (%)						
Lane Group Flow (vph)	18	938	13	28	64	5
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 65.5%		ICU Level of Service C	
Analysis Period (min) 15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	16	825	11	25	56	4
Future Volume (Veh/h)	16	825	11	25	56	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	18	938	12	28	64	5
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						24
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			18		70	18
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			18		70	18
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		93	100
cM capacity (veh/h)			1612		923	1066

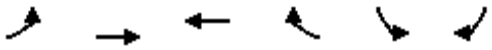
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	18	938	12	28	69
Volume Left	0	0	12	0	64
Volume Right	0	938	0	0	5
cSH	1700	1700	1612	1700	995
Volume to Capacity	0.01	0.55	0.01	0.02	0.07
Queue Length 95th (m)	0.0	0.0	0.2	0.0	1.7
Control Delay (s)	0.0	0.0	7.3	0.0	9.1
Lane LOS			A		A
Approach Delay (s)	0.0		2.2		9.1
Approach LOS					A

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	58	773	50	24	12	897
Future Volume (vph)	58	773	50	24	12	897
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0			210.0	0.0	150.0
Storage Lanes	1			1	1	1
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1607	1627	1484	1438	1004	1424
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1607	1627	1484	1438	1004	1424
Link Speed (k/h)		60	60		60	
Link Distance (m)		1297.0	340.4		573.6	
Travel Time (s)		77.8	20.4		34.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Adj. Flow (vph)	60	805	52	25	13	934
Shared Lane Traffic (%)						
Lane Group Flow (vph)	60	805	52	25	13	934
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		6.6	6.6		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

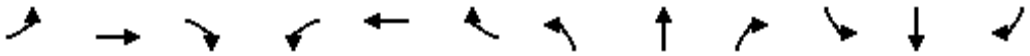
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 70.3%		ICU Level of Service C	
Analysis Period (min) 15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	58	773	50	24	12	897
Future Volume (Veh/h)	58	773	50	24	12	897
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	60	805	52	25	12	934
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						20
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	52				977	52
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	52				977	52
tC, single (s)	4.1				7.0	6.2
tC, 2 stage (s)						
tF (s)	2.2				4.0	3.3
p0 queue free %	96				94	8
cM capacity (veh/h)	1567				211	1019

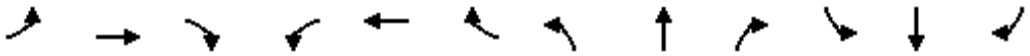
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	60	805	52	25	946
Volume Left	60	0	0	0	12
Volume Right	0	0	0	25	934
cSH	1567	1700	1700	1700	1032
Volume to Capacity	0.04	0.47	0.03	0.01	0.92
Queue Length 95th (m)	0.9	0.0	0.0	0.0	108.1
Control Delay (s)	7.4	0.0	0.0	0.0	32.3
Lane LOS	A				D
Approach Delay (s)	0.5		0.0		32.3
Approach LOS					D

Intersection Summary			
Average Delay	16.4		
Intersection Capacity Utilization	70.3%	ICU Level of Service	C
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	22	22	57	9	27	8	60	259	1	9	476	24
Future Volume (vph)	22	22	57	9	27	8	60	259	1	9	476	24
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.924			0.975						0.994	
Flt Protected		0.989			0.990			0.991			0.999	
Satd. Flow (prot)	0	1330	0	0	1348	0	0	1618	0	0	1664	0
Flt Permitted		0.989			0.990			0.991			0.999	
Satd. Flow (perm)	0	1330	0	0	1348	0	0	1618	0	0	1664	0
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		838.4			681.4			1027.1			497.4	
Travel Time (s)		60.4			40.9			61.6			29.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	41%	13%	0%	35%	0%	2%	4%	0%	0%	1%	0%
Adj. Flow (vph)	24	24	62	10	29	9	65	282	1	10	517	26
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	110	0	0	48	0	0	348	0	0	553	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

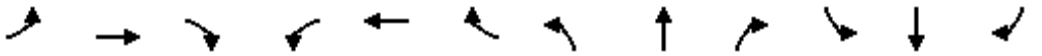
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 66.5%		ICU Level of Service C	
Analysis Period (min) 15			



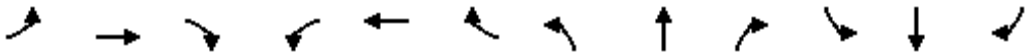
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	22	22	57	9	27	8	60	259	1	9	476	24
Future Volume (Veh/h)	22	22	57	9	27	8	60	259	1	9	476	24
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	24	24	62	10	29	9	65	282	1	10	517	26
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	986	963	530	1036	976	282	543			283		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	986	963	530	1036	976	282	543			283		
tC, single (s)	7.1	6.9	6.3	7.1	6.8	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.4	3.4	3.5	4.3	3.3	2.2			2.2		
p0 queue free %	87	88	88	94	86	99	94			99		
cM capacity (veh/h)	191	205	528	161	206	761	1026			1291		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	110	48	348	553
Volume Left	24	10	65	10
Volume Right	62	9	1	26
cSH	305	223	1026	1291
Volume to Capacity	0.36	0.22	0.06	0.01
Queue Length 95th (m)	12.1	6.0	1.5	0.2
Control Delay (s)	23.3	25.5	2.2	0.2
Lane LOS	C	D	A	A
Approach Delay (s)	23.3	25.5	2.2	0.2
Approach LOS	C	D		

Intersection Summary				
Average Delay	4.4			
Intersection Capacity Utilization	66.5%	ICU Level of Service	C	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	60	389	9	420	492	35	6	225	420	22	485	35
Future Volume (vph)	60	389	9	420	492	35	6	225	420	22	485	35
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	95.0		45.0	65.0		0.0	0.0		0.0	0.0		80.0
Storage Lanes	1		1	1		0	0		1	0		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	0.95
Frt		0.996			0.990				0.850		0.990	
Flt Protected	0.950			0.950				0.999			0.998	
Satd. Flow (prot)	1607	3201	0	1591	3128	0	0	1642	1396	0	3101	0
Flt Permitted	0.442			0.390				0.981			0.933	
Satd. Flow (perm)	748	3201	0	653	3128	0	0	1612	1396	0	2899	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			11				447		9	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		150.4			1297.0			1025.7			1027.1	
Travel Time (s)		9.0			77.8			61.5			61.6	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	0%	1%	1%	12%	0%	3%	3%	38%	1%	0%
Adj. Flow (vph)	64	414	10	447	523	37	6	239	447	23	516	37
Shared Lane Traffic (%)												
Lane Group Flow (vph)	64	424	0	447	560	0	0	245	447	0	576	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4		3	8			2			6	



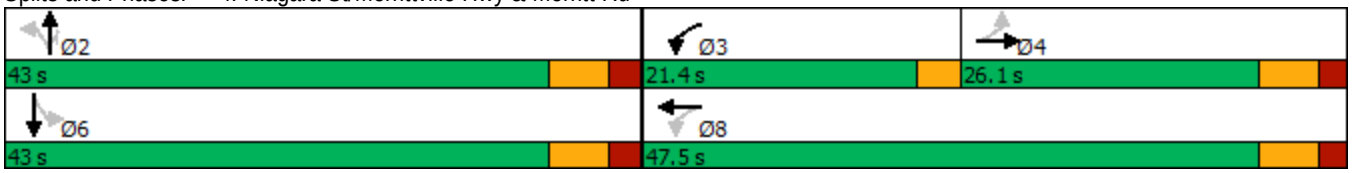
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2		2	6		
Detector Phase	4	4		3	8		2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		10.0	8.0		10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	22.5	22.5		14.5	22.5		16.4	16.4	16.4	16.4	16.4	
Total Split (s)	26.1	26.1		21.4	47.5		43.0	43.0	43.0	43.0	43.0	
Total Split (%)	28.8%	28.8%		23.6%	52.5%		47.5%	47.5%	47.5%	47.5%	47.5%	
Maximum Green (s)	20.0	20.0		18.4	41.4		36.6	36.6	36.6	36.6	36.6	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1	4.1	4.1	4.1	
All-Red Time (s)	2.0	2.0		0.0	2.0		2.3	2.3	2.3	2.3	2.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	
Total Lost Time (s)	6.1	6.1		3.0	6.1			6.4	6.4		6.4	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0		3.0	3.0		5.0	5.0	5.0	3.0	3.0	
Recall Mode	None	None		None	None		None	None	None	None	None	
Walk Time (s)	0.0	0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Flash Dont Walk (s)	0.0	0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Pedestrian Calls (#/hr)	0	0			0		0	0	0	0	0	
Act Effct Green (s)	16.8	16.8		40.4	37.3			21.0	21.0		21.0	
Actuated g/C Ratio	0.24	0.24		0.57	0.52			0.30	0.30		0.30	
v/c Ratio	0.36	0.56		0.74	0.34			0.52	0.62		0.67	
Control Delay	32.1	28.3		20.7	11.2			25.3	6.2		26.0	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay	32.1	28.3		20.7	11.2			25.3	6.2		26.0	
LOS	C	C		C	B			C	A		C	
Approach Delay		28.8			15.4			13.0			26.0	
Approach LOS		C			B			B			C	
Queue Length 50th (m)	7.3	26.6		32.7	20.7			28.1	0.0		36.1	
Queue Length 95th (m)	20.8	47.1		#80.8	40.4			48.6	18.3		52.9	
Internal Link Dist (m)		126.4			1273.0			1001.7			1003.1	
Turn Bay Length (m)	95.0			65.0								
Base Capacity (vph)	216	928		621	1880			854	949		1541	
Starvation Cap Reductn	0	0		0	0			0	0		0	
Spillback Cap Reductn	0	0		0	0			0	0		0	
Storage Cap Reductn	0	0		0	0			0	0		0	
Reduced v/c Ratio	0.30	0.46		0.72	0.30			0.29	0.47		0.37	

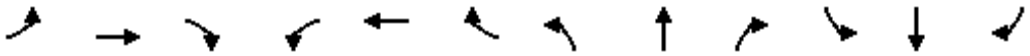
Intersection Summary			
Area Type:	Other		
Cycle Length: 90.5			
Actuated Cycle Length: 71.1			
Natural Cycle: 60			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.74			
Intersection Signal Delay: 19.4		Intersection LOS: B	
Intersection Capacity Utilization 84.5%		ICU Level of Service E	
Analysis Period (min) 15			

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

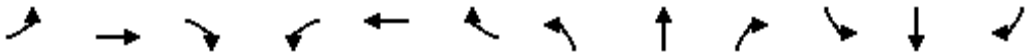
Queue shown is maximum after two cycles.

Splits and Phases: 4: Niagara St/Merrittville Hwy & Merritt Rd





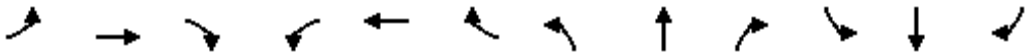
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	49	86	230	32	35	16	208	586	37	58	850	6
Future Volume (vph)	49	86	230	32	35	16	208	586	37	58	850	6
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0		0.0	30.0		0.0	75.0		0.0	65.0		30.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.891			0.952			0.991			0.999	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1560	1487	0	1607	1578	0	1591	3092	0	1607	3179	0
Flt Permitted	0.718			0.284			0.150			0.376		
Satd. Flow (perm)	1179	1487	0	480	1578	0	251	3092	0	636	3179	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		145			19			8			1	
Link Speed (k/h)		50			50			40			60	
Link Distance (m)		825.4			480.8			403.8			1025.7	
Travel Time (s)		59.4			34.6			36.3			61.5	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	3%	5%	0%	0%	3%	0%	1%	3%	3%	0%	1%	2%
Adj. Flow (vph)	57	100	267	37	41	19	242	681	43	67	988	7
Shared Lane Traffic (%)												
Lane Group Flow (vph)	57	367	0	37	60	0	242	724	0	67	995	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	14.9	14.9		14.9	14.9		9.0	16.6		9.0	16.6	
Total Split (s)	31.9	31.9		31.9	31.9		18.0	41.6		18.0	41.6	
Total Split (%)	34.9%	34.9%		34.9%	34.9%		19.7%	45.5%		19.7%	45.5%	
Maximum Green (s)	25.0	25.0		25.0	25.0		15.0	35.0		15.0	35.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		3.0	4.1		3.0	4.1	
All-Red Time (s)	2.8	2.8		2.8	2.8		0.0	2.5		0.0	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.9	6.9		6.9	6.9		3.0	6.6		3.0	6.6	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		3.0	2.5		3.0	2.5	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	11.0	11.0		11.0	11.0			9.0			9.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			14.0			14.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	17.0	17.0		17.0	17.0		48.1	36.7		39.2	28.2	
Actuated g/C Ratio	0.23	0.23		0.23	0.23		0.64	0.49		0.52	0.37	
v/c Ratio	0.22	0.82		0.35	0.16		0.62	0.48		0.16	0.84	
Control Delay	27.6	33.5		36.2	19.8		18.4	15.8		7.8	29.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	27.6	33.5		36.2	19.8		18.4	15.8		7.8	29.8	
LOS	C	C		D	B		B	B		A	C	
Approach Delay		32.7			26.1			16.4			28.4	
Approach LOS		C			C			B			C	
Queue Length 50th (m)	7.1	32.3		4.7	5.0		13.4	36.8		3.3	69.2	
Queue Length 95th (m)	16.5	62.0		13.4	13.8		37.9	57.9		8.6	99.0	
Internal Link Dist (m)		801.4			456.8			379.8			1001.7	
Turn Bay Length (m)	80.0			30.0			75.0			65.0		
Base Capacity (vph)	410	612		167	561		439	1633		596	1550	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.14	0.60		0.22	0.11		0.55	0.44		0.11	0.64	

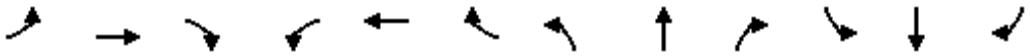
Intersection Summary			
Area Type:	Other		
Cycle Length: 91.5			
Actuated Cycle Length: 75.5			
Natural Cycle: 50			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.84			
Intersection Signal Delay: 24.5		Intersection LOS: C	
Intersection Capacity Utilization 81.7%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 5: Niagara St & Quaker Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	71	23	8	86	17	28	117	13	17	203	126
Future Volume (vph)	20	71	23	8	86	17	28	117	13	17	203	126
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.973			0.980			0.989			0.951	
Flt Protected		0.991			0.996			0.991			0.998	
Satd. Flow (prot)	0	1588	0	0	1489	0	0	1658	0	0	1538	0
Flt Permitted		0.991			0.996			0.991			0.998	
Satd. Flow (perm)	0	1588	0	0	1489	0	0	1658	0	0	1538	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		838.8			838.4			991.4			524.1	
Travel Time (s)		60.4			60.4			71.4			37.7	
Confl. Peds. (#/hr)			1	1			2					2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	3%	0%	14%	3%	50%	0%	0%	0%	92%	0%	0%
Adj. Flow (vph)	22	77	25	9	93	18	30	127	14	18	221	137
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	124	0	0	120	0	0	171	0	0	376	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

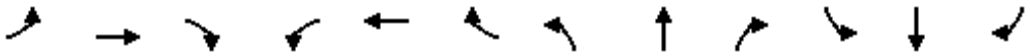
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 41.7%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	20	71	23	8	86	17	28	117	13	17	203	126
Future Volume (vph)	20	71	23	8	86	17	28	117	13	17	203	126
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	77	25	9	93	18	30	127	14	18	221	137

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	124	120	171	376
Volume Left (vph)	22	9	30	18
Volume Right (vph)	25	18	14	137
Hadj (s)	-0.04	0.11	-0.01	-0.13
Departure Headway (s)	5.4	5.6	5.1	4.7
Degree Utilization, x	0.19	0.19	0.24	0.49
Capacity (veh/h)	593	577	660	732
Control Delay (s)	9.7	9.9	9.7	12.2
Approach Delay (s)	9.7	9.9	9.7	12.2
Approach LOS	A	A	A	B

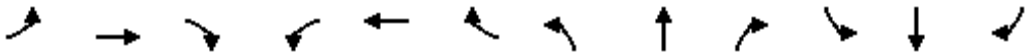
Intersection Summary			
Delay	10.9		
Level of Service	B		
Intersection Capacity Utilization	41.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	13	320	1	158	354	21	5	124	133	5	224	5
Future Volume (vph)	13	320	1	158	354	21	5	124	133	5	224	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	14	348	1	172	385	23	5	135	145	5	243	5

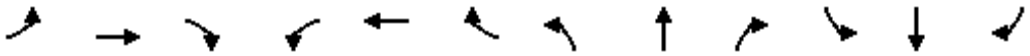
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	14	349	172	408	285	253
Volume Left (vph)	14	0	172	0	5	5
Volume Right (vph)	0	1	0	23	145	5
Hadj (s)	0.50	0.00	0.52	-0.04	-0.30	0.01
Departure Headway (s)	8.5	7.9	8.2	7.6	7.5	7.9
Degree Utilization, x	0.03	0.77	0.39	0.86	0.59	0.55
Capacity (veh/h)	402	436	427	464	432	423
Control Delay (s)	10.5	31.6	15.1	40.7	20.8	20.2
Approach Delay (s)	30.8		33.1		20.8	20.2
Approach LOS	D		D		C	C

Intersection Summary				
Delay	28.0			
Level of Service	D			
Intersection Capacity Utilization	56.6%	ICU Level of Service		B
Analysis Period (min)	15			



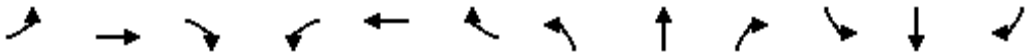
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	13	320	1	158	354	21	5	124	133	5	224	5
Future Volume (vph)	13	320	1	158	354	21	5	124	133	5	224	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	20.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	1		0	1		0	0		0	0		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.992			0.931			0.997	
Flt Protected	0.950			0.950				0.999			0.999	
Satd. Flow (prot)	1607	1692	0	1591	1678	0	0	1573	0	0	1669	0
Flt Permitted	0.950			0.950				0.999			0.999	
Satd. Flow (perm)	1607	1692	0	1591	1678	0	0	1573	0	0	1669	0
Link Speed (k/h)		60			60			50			50	
Link Distance (m)		824.0			681.3			1030.2			991.4	
Travel Time (s)		49.4			40.9			74.2			71.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	1%	0%
Adj. Flow (vph)	14	348	1	172	385	23	5	135	145	5	243	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	14	349	0	172	408	0	0	285	0	0	253	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		6.6			6.6			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 56.6%		ICU Level of Service B	
Analysis Period (min) 15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	22	149	57	162	86	1	52	239	203	13	297	73
Future Volume (vph)	22	149	57	162	86	1	52	239	203	13	297	73
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		20.0	0.0		0.0
Storage Lanes	0		0	0		0	0		1	0		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.966							0.850		0.974	
Flt Protected		0.995			0.969			0.991			0.998	
Satd. Flow (prot)	0	1524	0	0	1602	0	0	1676	1424	0	1635	0
Flt Permitted		0.995			0.969			0.991			0.998	
Satd. Flow (perm)	0	1524	0	0	1602	0	0	1676	1424	0	1635	0
Link Speed (k/h)		40			40			40			50	
Link Distance (m)		822.2			825.4			401.7			1030.2	
Travel Time (s)		74.0			74.3			36.2			74.2	
Confl. Peds. (#/hr)			1	1								
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	3%	19%	3%	1%	0%	0%	0%	1%	0%	0%	3%
Adj. Flow (vph)	25	169	65	184	98	1	59	272	231	15	338	83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	259	0	0	283	0	0	331	231	0	436	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

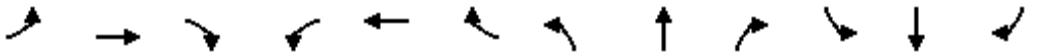
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 78.1%		ICU Level of Service D	
Analysis Period (min) 15			



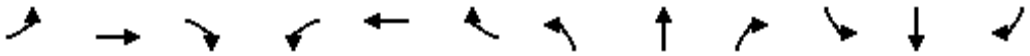
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	22	149	57	162	86	1	52	239	203	13	297	73
Future Volume (vph)	22	149	57	162	86	1	52	239	203	13	297	73
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	25	169	65	184	98	1	59	272	231	15	338	83

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	259	283	331	231	436
Volume Left (vph)	25	184	59	0	15
Volume Right (vph)	65	1	0	231	83
Hadj (s)	-0.02	0.17	0.09	-0.68	-0.10
Departure Headway (s)	8.4	8.4	8.2	7.4	7.6
Degree Utilization, x	0.60	0.66	0.75	0.47	0.92
Capacity (veh/h)	406	404	425	459	436
Control Delay (s)	23.2	26.4	31.0	15.7	52.2
Approach Delay (s)	23.2	26.4	24.7		52.2
Approach LOS	C	D	C		F

Intersection Summary				
Delay	32.6			
Level of Service	D			
Intersection Capacity Utilization	78.1%	ICU Level of Service	D	
Analysis Period (min)	15			



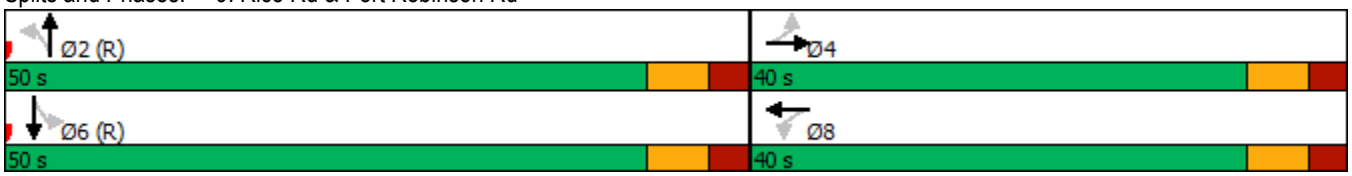
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	104	61	37	191	12	72	312	2	8	379	39
Future Volume (vph)	20	104	61	37	191	12	72	312	2	8	379	39
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00	0.99		1.00	1.00		1.00				1.00	
Frt		0.944			0.991			0.999			0.986	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1565	0	1576	1659	0	1607	1640	0	1607	1635	0
Flt Permitted	0.509			0.609			0.487			0.563		
Satd. Flow (perm)	860	1565	0	1009	1659	0	823	1640	0	952	1635	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		38			4						8	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		431.2			838.8			919.0			467.4	
Travel Time (s)		31.0			60.4			55.1			28.0	
Confl. Peds. (#/hr)	1		1	1		1	2					2
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	2%	0%	2%	1%	0%	0%	3%	9%	0%	2%	0%
Adj. Flow (vph)	21	108	64	39	199	13	75	325	2	8	395	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	21	172	0	39	212	0	75	327	0	8	436	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		

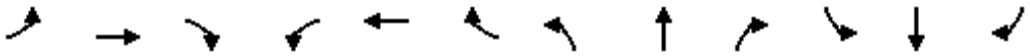


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	36.8	36.8		36.8	36.8		37.0	37.0		37.0	37.0	
Total Split (s)	40.0	40.0		40.0	40.0		50.0	50.0		50.0	50.0	
Total Split (%)	44.4%	44.4%		44.4%	44.4%		55.6%	55.6%		55.6%	55.6%	
Maximum Green (s)	33.2	33.2		33.2	33.2		43.0	43.0		43.0	43.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.7	2.7		2.7	2.7		2.9	2.9		2.9	2.9	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.8	6.8		6.8	6.8		7.0	7.0		7.0	7.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Flash Dont Walk (s)	19.0	19.0		19.0	19.0		19.0	19.0		19.0	19.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	16.3	16.3		16.3	16.3		59.9	59.9		59.9	59.9	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.67	0.67		0.67	0.67	
v/c Ratio	0.14	0.55		0.21	0.70		0.14	0.30		0.01	0.40	
Control Delay	30.4	31.5		32.0	45.5		7.6	8.1		6.9	8.9	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	30.4	31.5		32.0	45.5		7.6	8.1		6.9	8.9	
LOS	C	C		C	D		A	A		A	A	
Approach Delay		31.3			43.4			8.0			8.9	
Approach LOS		C			D			A			A	
Queue Length 50th (m)	3.1	21.0		5.8	34.0		4.2	20.8		0.4	29.5	
Queue Length 95th (m)	8.6	36.9		13.4	51.9		11.8	42.0		2.2	58.7	
Internal Link Dist (m)		407.2			814.8			895.0			443.4	
Turn Bay Length (m)												
Base Capacity (vph)	317	601		372	614		547	1091		633	1090	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.07	0.29		0.10	0.35		0.14	0.30		0.01	0.40	

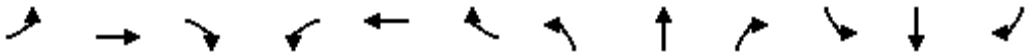
Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 75			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.70			
Intersection Signal Delay: 18.7		Intersection LOS: B	
Intersection Capacity Utilization 75.1%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 9: Rice Rd & Port Robinson Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	43	49	1	220	129	5	1	338	285	5	392	80
Future Volume (vph)	43	49	1	220	129	5	1	338	285	5	392	80
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	40.0		0.0	80.0		0.0	70.0		0.0	50.0		50.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.997			0.995			0.934			0.975	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1576	1684	0	1607	1683	0	1607	2952	0	1607	3083	0
Flt Permitted	0.665			0.722			0.444			0.365		
Satd. Flow (perm)	1103	1684	0	1221	1683	0	751	2952	0	617	3083	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			2			310			39	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		434.7			824.0			1037.2			118.2	
Travel Time (s)		26.1			49.4			62.2			7.1	
Peak Hour Factor	0.85	0.92	0.85	0.92	0.92	0.92	0.85	0.85	0.92	0.92	0.85	0.85
Heavy Vehicles (%)	2%	0%	9%	0%	0%	0%	0%	3%	0%	0%	2%	0%
Adj. Flow (vph)	51	53	1	239	140	5	1	398	310	5	461	94
Shared Lane Traffic (%)												
Lane Group Flow (vph)	51	54	0	239	145	0	1	708	0	5	555	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	

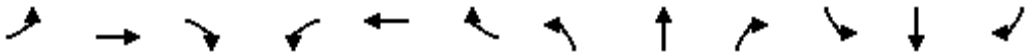


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	36.8	36.8		36.8	36.8		37.0	37.0		37.0	37.0	
Total Split (s)	36.8	36.8		36.8	36.8		47.0	47.0		47.0	47.0	
Total Split (%)	43.9%	43.9%		43.9%	43.9%		56.1%	56.1%		56.1%	56.1%	
Maximum Green (s)	30.0	30.0		30.0	30.0		40.0	40.0		40.0	40.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.7	2.7		2.7	2.7		2.9	2.9		2.9	2.9	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.8	6.8		6.8	6.8		7.0	7.0		7.0	7.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Flash Dont Walk (s)	19.0	19.0		19.0	19.0		19.0	19.0		19.0	19.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	21.3	21.3		21.3	21.3		48.7	48.7		48.7	48.7	
Actuated g/C Ratio	0.25	0.25		0.25	0.25		0.58	0.58		0.58	0.58	
v/c Ratio	0.18	0.13		0.77	0.34		0.00	0.38		0.01	0.31	
Control Delay	23.2	21.6		44.7	25.5		11.0	6.5		10.6	11.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	23.2	21.6		44.7	25.5		11.0	6.5		10.6	11.8	
LOS	C	C		D	C		B	A		B	B	
Approach Delay		22.4			37.5			6.5			11.8	
Approach LOS		C			D			A			B	
Queue Length 50th (m)	6.4	6.5		35.4	18.6		0.1	14.9		0.5	27.3	
Queue Length 95th (m)	12.2	12.9		52.6	29.1		0.8	28.6		m1.4	44.0	
Internal Link Dist (m)		410.7			800.0			1013.2			94.2	
Turn Bay Length (m)	40.0			80.0			70.0			50.0		
Base Capacity (vph)	394	603		437	603		436	1845		358	1807	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.13	0.09		0.55	0.24		0.00	0.38		0.01	0.31	

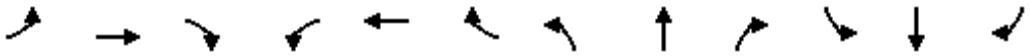
Intersection Summary			
Area Type:	Other		
Cycle Length: 83.8			
Actuated Cycle Length: 83.8			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 75			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.77			
Intersection Signal Delay: 15.9		Intersection LOS: B	
Intersection Capacity Utilization 57.1%		ICU Level of Service B	
Analysis Period (min) 15			

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 10: Rice Rd & Merritt Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	187	158	68	13	193	5	90	432	53	17	400	196
Future Volume (vph)	187	158	68	13	193	5	90	432	53	17	400	196
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	89.0		0.0	40.0		0.0	90.0		90.0	68.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor							1.00				0.99	
Frt		0.955			0.996			0.984			0.951	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1542	0	1607	1653	0	1576	3044	0	1545	2955	0
Flt Permitted	0.514			0.464			0.385			0.447		
Satd. Flow (perm)	870	1542	0	785	1653	0	638	3044	0	727	2955	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		31			2			19			122	
Link Speed (k/h)		50			40			40			50	
Link Distance (m)		441.3			822.2			400.0			1037.2	
Travel Time (s)		31.8			74.0			36.0			74.7	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	6%	2%	0%	2%	0%	2%	4%	3%	4%	3%	2%
Adj. Flow (vph)	201	170	73	14	208	5	97	465	57	18	430	211
Shared Lane Traffic (%)												
Lane Group Flow (vph)	201	243	0	14	213	0	97	522	0	18	641	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

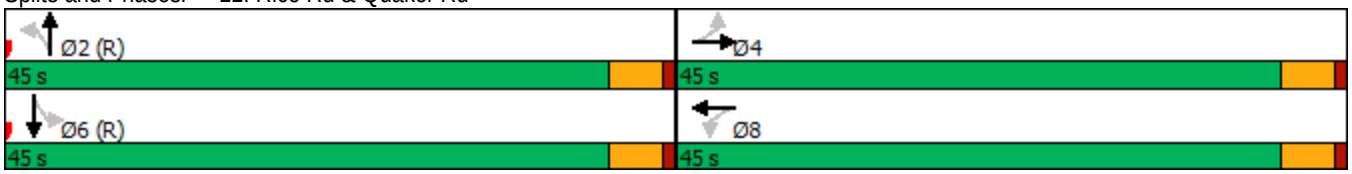


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	45.0	45.0		45.0	45.0		45.0	45.0		45.0	45.0	
Total Split (%)	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	40.5	40.5		40.5	40.5		40.5	40.5		40.5	40.5	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	24.3	24.3		24.3	24.3		56.7	56.7		56.7	56.7	
Actuated g/C Ratio	0.27	0.27		0.27	0.27		0.63	0.63		0.63	0.63	
v/c Ratio	0.86	0.55		0.07	0.48		0.24	0.27		0.04	0.34	
Control Delay	60.7	27.7		20.6	29.1		11.9	9.0		9.8	8.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	60.7	27.7		20.6	29.1		11.9	9.0		9.8	8.0	
LOS	E	C		C	C		B	A		A	A	
Approach Delay		42.7			28.6			9.4			8.0	
Approach LOS		D			C			A			A	
Queue Length 50th (m)	33.1	31.4		1.8	30.7		6.5	18.1		1.1	18.9	
Queue Length 95th (m)	50.3	44.3		5.2	41.7		20.3	36.6		4.9	39.9	
Internal Link Dist (m)		417.3			798.2			376.0			1013.2	
Turn Bay Length (m)	89.0			40.0			90.0			68.0		
Base Capacity (vph)	391	710		353	744		401	1924		457	1906	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.51	0.34		0.04	0.29		0.24	0.27		0.04	0.34	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 45			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.86			
Intersection Signal Delay: 18.8		Intersection LOS: B	

Intersection Capacity Utilization 61.9% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 11: Rice Rd & Quaker Rd



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	35	750	10	21	53	4
Future Volume (vph)	35	750	10	21	53	4
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		200.0	65.0		0.0	180.0
Storage Lanes		1	1		1	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1627	1369	1607	1692	1422	1438
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	1627	1369	1607	1692	1422	1438
Link Speed (k/h)	60			60	50	
Link Distance (m)	340.4			197.6	500.8	
Travel Time (s)	20.4			11.9	36.1	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Heavy Vehicles (%)	4%	5%	0%	0%	13%	0%
Adj. Flow (vph)	42	893	12	25	63	5
Shared Lane Traffic (%)						
Lane Group Flow (vph)	42	893	12	25	63	5
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 60.4%		ICU Level of Service B	
Analysis Period (min) 15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	35	750	10	21	53	4
Future Volume (Veh/h)	35	750	10	21	53	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	42	893	12	25	63	5
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						24
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			42		91	42
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			42		91	42
tC, single (s)			4.1		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			99		93	100
cM capacity (veh/h)			1580		876	1034

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	42	893	12	25	68
Volume Left	0	0	12	0	63
Volume Right	0	893	0	0	5
cSH	1700	1700	1580	1700	946
Volume to Capacity	0.02	0.53	0.01	0.01	0.07
Queue Length 95th (m)	0.0	0.0	0.2	0.0	1.8
Control Delay (s)	0.0	0.0	7.3	0.0	9.4
Lane LOS			A		A
Approach Delay (s)	0.0		2.4		9.4
Approach LOS					A

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	60.4%	ICU Level of Service	B
Analysis Period (min)	15		

APPENDIX

SIGNAL WARRANT CALCULATION

FUTURE (SCENARIO 1) 2041

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Merrittville Highway / Port Robinson Road

What is the direction of the Main Road street? North-South

When was the data collected? 2020-11-17

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	24	488	6	73	7	15	12	239	4	4	15	7	0
9:00	24	769	4	180	7	34	11	537	16	2	36	9	0
12:00	48	741	4	186	12	42	5	521	22	5	41	17	0
1:00	28	640	2	124	14	45	7	749	18	5	41	13	0
2:00	39	824	10	109	16	64	9	988	18	5	51	20	0
4:00	48	852	4	131	14	57	9	1,015	18	2	62	13	0
5:00	70	705	16	109	26	53	7	1,137	18	7	77	11	0
6:00	65	856	22	32	23	55	11	930	41	23	41	11	0
Total	**345**	**5,876**	**68**	**943**	**119**	**365**	**70**	**6,115**	**155**	**53**	**364**	**101**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									11,991

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road Count Date: 2020-11-17

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
1A	480	720	600	900	895	1,628	1,643	1,686	2,153	2,224	2,236	2,109		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	121	268	302	242	265	278	283	184		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 1:	Both 1A and 1B 100% Fulfilled each of 8 hours	Yes	No
	Lesser of 1A or 1B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
2A	480	720	600	900	773	1,360	1,341	1,444	1,888	1,945	1,953	1,925		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	92	218	232	170	165	195	193	96		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 2:	Both 2A and 2B 100% fulfilled each of 8 hours	Yes ☑	No ☐
	Lesser of 2A or 2B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	2:00	1,888	189	80	100 %	100 %
	4:00	1,945	202	80	100 %	
	5:00	1,953	188	80	100 %	
	6:00	1,925	109	80	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road Count Date: 2020-11-17

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000					
	> 7000	Not Justified				

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road Count Date: 2020-11-17

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%	☑	☐
	B	Crossing Volume	100	%		
2. Delay to Cross Traffic	A	Main Road	100	%	☑	☐
	B	Crossing Road	100	%		
3. Combination	A	Justificaton 1	100	%	☑	☐
	B	Justification 2	100	%		
4. 4-Hr Volume			100	%	☑	☐
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification not met		☐	☑
	B	Delay	Justification not met			

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Quaker Road / Niagara Street - Cataract Road

What is the direction of the Main Road street? East-West

When was the data collected? 2020-10-27

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Eastbound Approach			Minor Northbound Approach			Main Westbound Approach			Minor Southbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	96	163	92	14	322	66	6	102	50	88	151	4	0
9:00	101	205	270	41	400	66	24	170	80	175	353	11	0
12:00	86	168	285	22	322	51	12	207	80	175	159	6	0
1:00	66	205	185	25	426	79	9	185	120	263	225	8	0
2:00	51	184	247	15	365	60	19	229	20	700	307	5	0
4:00	131	187	424	33	622	78	13	241	80	263	336	13	0
5:00	66	188	208	28	417	77	18	310	80	481	458	16	0
6:00	101	210	247	25	596	107	21	301	10	438	370	14	0
Total	**697**	**1,511**	**1,957**	**202**	**3,470**	**584**	**122**	**1,746**	**520**	**2,581**	**2,358**	**77**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									3,256

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Quaker Road / Niagara Street - Cataract Road Count Date: 2020-10-27

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
	☑	☐	☐	☐										
1A	480	720	600	900	1,154	1,896	1,572	1,795	2,202	2,419	2,347	2,439		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	644	1,046	735	1,025	1,453	1,343	1,477	1,549		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours					Yes		No		
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
	☑	☐	☐	☐										
2A	480	720	600	900	510	850	838	770	749	1,076	870	890		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	423	616	519	714	1,080	917	967	1,058		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours					Yes ☑		No ☐		
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	4:00	1,076	732	101	100 %	100 %
	5:00	870	955	151	100 %	
	6:00	890	822	145	100 %	
	9:00	850	539	157	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Quaker Road / Niagara Street - Cataract Road Count Date: 2020-10-27

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Quaker Road / Niagara Street - Cataract Road Count Date: 2020-10-27

Summary Results

Justification			Compliance	Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100 %	☑	☐
	B	Crossing Volume	100 %		
2. Delay to Cross Traffic	A	Main Road	100 %	☑	☐
	B	Crossing Road	100 %		
3. Combination	A	Justificaton 1	100 %	☑	☐
	B	Justification 2	100 %		
4. 4-Hr Volume			100 %	☑	☐
5. Collision Experience			0 %	☐	☑
6. Pedestrians	A	Volume	Justification not met	☐	☑
	B	Delay	Justification not met		

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Rice Road / Port Robinson Road

What is the direction of the Main Road street? North-South

When was the data collected? 2016-04-27

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	29	627	86	71	85	22	4	178	4	9	67	0	0
9:00	43	700	115	69	201	80	4	319	10	15	122	11	0
12:00	57	366	59	33	116	69	24	281	23	15	163	19	0
1:00	75	358	38	33	110	50	12	330	38	28	222	13	0
2:00	65	330	50	29	113	41	18	286	19	21	178	13	0
4:00	100	439	53	36	110	66	20	539	44	34	218	6	0
5:00	88	519	29	36	143	69	14	641	59	60	274	17	0
6:00	63	495	44	33	160	64	10	563	48	43	241	8	0
Total	**520**	**3,834**	**475**	**340**	**1,038**	**461**	**106**	**3,137**	**244**	**225**	**1,485**	**87**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									6,971

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Port Robinson Road

Count Date: 2016-04-27

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
	☑	☐	☐	☐										
1A	480	720	600	900	1,182	1,689	1,225	1,308	1,161	1,665	1,949	1,772		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	255	499	415	457	394	470	599	549		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 1:	Both 1A and 1B 100% Fulfilled each of 8 hours	Yes	No
	Lesser of 1A or 1B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
	☑	☐	☐	☐										
2A	480	720	600	900	927	1,190	810	851	768	1,195	1,350	1,223		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	166	285	211	284	227	288	370	317		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 2:	Both 2A and 2B 100% fulfilled each of 8 hours	Yes	No
	Lesser of 2A or 2B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑ ☐	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑ ☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	4:00	1,195	258	81	100 %	100 %
	5:00	1,350	351	80	100 %	
	6:00	1,223	291	80	100 %	
	9:00	1,190	350	82	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Port Robinson Road

Count Date: 2016-04-27

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Rice Road / Port Robinson Road Count Date: 2016-04-27

Summary Results

Justification			Compliance	Signal Justified? YES	NO
1. Minimum Vehicular Volume	A	Total Volume	100 %		
	B	Crossing Volume	100 %	☑	☐
2. Delay to Cross Traffic	A	Main Road	100 %		
	B	Crossing Road	100 %	☑	☐
3. Combination	A	Justificaton 1	100 %		
	B	Justification 2	100 %	☑	☐
4. 4-Hr Volume			100 %	☑	☐
5. Collision Experience			0 %	☐	☑
6. Pedestrians	A	Volume	Justification not met		
	B	Delay	Justification not met	☐	☑

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Rice Road / Quaker Road

What is the direction of the Main Road street? North-South

When was the data collected? 2016-06-13

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	50	347	125	93	209	68	28	189	31	38	198	27	0
9:00	76	450	145	122	316	135	24	372	41	88	219	27	0
12:00	60	284	93	40	244	47	37	295	46	47	372	71	0
1:00	80	307	77	40	235	45	42	265	24	62	372	68	0
2:00	52	276	72	40	214	61	31	279	48	50	298	71	0
3:00	98	387	119	48	273	65	37	426	85	90	451	71	0
5:00	118	357	115	67	261	63	48	442	100	115	507	71	0
6:00	86	351	99	57	213	70	54	400	87	112	459	90	0
Total	**620**	**2,759**	**846**	**507**	**1,964**	**554**	**301**	**2,668**	**463**	**602**	**2,876**	**497**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									5,427

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision | GO TO Justification:

Intersection: Rice Road / Quaker Road | Count Date: 2016-06-13

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
1A	480	720	600	900	1,404	2,016	1,636	1,617	1,493	2,151	2,263	2,077		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	633	908	820	822	735	999	1,083	1,000		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours ☑ Yes ☐ No Lesser of 1A or 1B at least 80% fulfilled each of 8 hours ☑ Yes ☐ No									

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☑	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
2A	480	720	600	900	770	1,108	815	796	758	1,152	1,180	1,077		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	340	526	459	474	388	590	689	628		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours ☑ Yes ☐ No Lesser of 2A or 2B at least 80% fulfilled each of 8 hours ☑ Yes ☐ No									

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More			Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	NO ☐	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	NO ☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	3:00	1,152	612	87	100 %	100 %
	5:00	1,180	693	83	100 %	
	6:00	1,077	661	101	100 %	
	9:00	1,108	573	95	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision | GO TO Justification:

Intersection: Rice Road / Quaker Road Count Date: 2016-06-13

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Quaker Road Count Date: 2016-06-13

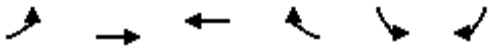
Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%	☑	☐
	B	Crossing Volume	100	%		
2. Delay to Cross Traffic	A	Main Road	100	%	☑	☐
	B	Crossing Road	100	%		
3. Combination	A	Justificaton 1	100	%	☑	☐
	B	Justification 2	100	%		
4. 4-Hr Volume			100	%	☑	☐
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification not met		☐	☑
	B	Delay	Justification not met			

APPENDIX

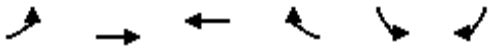
J SYNCHRO OUTPUT

FUTURE (SCENARIO 1) 2041



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	27	924	72	27	7	751
Future Volume (vph)	27	924	72	27	7	751
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	100.0			210.0	0.0	150.0
Storage Lanes	1			1	1	1
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1516	1642	1364	1438	1607	1396
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1516	1642	1364	1438	1607	1396
Link Speed (k/h)		60	50		60	
Link Distance (m)		1297.0	340.4		573.6	
Travel Time (s)		77.8	24.5		34.4	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Adj. Flow (vph)	33	1127	88	33	9	916
Shared Lane Traffic (%)						
Lane Group Flow (vph)	33	1127	88	33	9	916
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

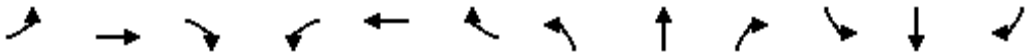
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 62.8%		ICU Level of Service B	
Analysis Period (min) 15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	27	924	72	27	7	751
Future Volume (Veh/h)	27	924	72	27	7	751
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	33	1127	88	33	9	916
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						20
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	88				1281	88
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	88				1281	88
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	98				95	5
cM capacity (veh/h)	1483				180	968

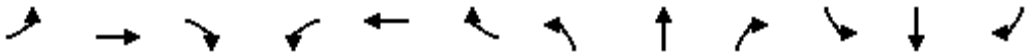
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	33	1127	88	33	925
Volume Left	33	0	0	0	9
Volume Right	0	0	0	33	916
cSH	1483	1700	1700	1700	977
Volume to Capacity	0.02	0.66	0.05	0.02	0.95
Queue Length 95th (m)	0.5	0.0	0.0	0.0	119.0
Control Delay (s)	7.5	0.0	0.0	0.0	38.2
Lane LOS	A				E
Approach Delay (s)	0.2		0.0		38.2
Approach LOS					E

Intersection Summary			
Average Delay	16.1		
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	28	35	5	22	5	53	437	6	7	370	29
Future Volume (vph)	130	28	35	5	22	5	53	437	6	7	370	29
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.976			0.980			0.998			0.990	
Flt Protected		0.967			0.993			0.995			0.999	
Satd. Flow (prot)	0	1434	0	0	1499	0	0	1522	0	0	1553	0
Flt Permitted		0.967			0.993			0.995			0.999	
Satd. Flow (perm)	0	1434	0	0	1499	0	0	1522	0	0	1553	0
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		838.4			681.4			1027.1			497.4	
Travel Time (s)		60.4			40.9			61.6			29.8	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Heavy Vehicles (%)	1%	44%	24%	0%	0%	67%	20%	9%	25%	25%	8%	0%
Adj. Flow (vph)	169	36	45	6	29	6	69	568	8	9	481	38
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	250	0	0	41	0	0	645	0	0	528	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

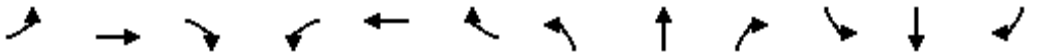
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 80.4%		ICU Level of Service D	
Analysis Period (min) 15			



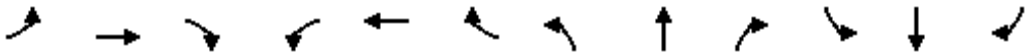
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	28	35	5	22	5	53	437	6	7	370	29
Future Volume (Veh/h)	130	28	35	5	22	5	53	437	6	7	370	29
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Hourly flow rate (vph)	169	36	45	6	29	6	69	568	8	9	481	38
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1248	1232	500	1291	1247	572	519			576		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1248	1232	500	1291	1247	572	519			576		
tC, single (s)	7.1	6.9	6.4	7.1	6.5	6.9	4.3			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.4	3.5	3.5	4.0	3.9	2.4			2.4		
p0 queue free %	0	73	91	94	82	99	93			99		
cM capacity (veh/h)	120	135	529	97	161	415	961			893		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	250	41	645	528
Volume Left	169	6	69	9
Volume Right	45	6	8	38
cSH	142	160	961	893
Volume to Capacity	1.76	0.26	0.07	0.01
Queue Length 95th (m)	140.8	7.4	1.8	0.2
Control Delay (s)	421.9	35.2	1.8	0.3
Lane LOS	F	E	A	A
Approach Delay (s)	421.9	35.2	1.8	0.3
Approach LOS	F	E		

Intersection Summary				
Average Delay	73.9			
Intersection Capacity Utilization	80.4%	ICU Level of Service	D	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	17	113	10	579	199	45	6	434	823	15	375	20
Future Volume (vph)	17	113	10	579	199	45	6	434	823	15	375	20
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	65.0		0.0	0.0		0.0	0.0		80.0
Storage Lanes	0		0	1		0	0		1	0		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95
Frt		0.991			0.972				0.850		0.993	
Flt Protected		0.994		0.950				0.999			0.998	
Satd. Flow (prot)	0	1647	0	1531	1551	0	0	1552	1396	0	2912	0
Flt Permitted		0.929		0.565				0.993			0.930	
Satd. Flow (perm)	0	1539	0	910	1551	0	0	1543	1396	0	2714	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4			16				819		7	
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		831.7			1297.0			1025.7			1027.1	
Travel Time (s)		59.9			77.8			61.5			61.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	0%	17%	5%	1%	28%	0%	9%	3%	11%	9%	15%
Adj. Flow (vph)	18	118	10	603	207	47	6	452	857	16	391	21
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	146	0	603	254	0	0	458	857	0	428	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	Perm	NA	
Protected Phases		4		3	8			2			6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2		Free	6		
Detector Phase	4	4		3	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		10.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		14.5	22.5		16.4	16.4		16.4	16.4	
Total Split (s)	26.1	26.1		18.0	44.1		46.4	46.4		46.4	46.4	
Total Split (%)	28.8%	28.8%		19.9%	48.7%		51.3%	51.3%		51.3%	51.3%	
Maximum Green (s)	20.0	20.0		15.0	38.0		40.0	40.0		40.0	40.0	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.0	2.0		0.0	2.0		2.3	2.3		2.3	2.3	
Lost Time Adjust (s)		0.0		0.0	0.0			0.0			0.0	
Total Lost Time (s)		6.1		3.0	6.1			6.4			6.4	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0		3.0	3.0		5.0	5.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flash Dont Walk (s)	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)		14.0		35.7	32.5			28.4	73.8		28.4	
Actuated g/C Ratio		0.19		0.48	0.44			0.38	1.00		0.38	
v/c Ratio		0.49		1.06	0.37			0.77	0.61		0.41	
Control Delay		34.0		76.5	16.3			29.7	2.0		17.4	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		34.0		76.5	16.3			29.7	2.0		17.4	
LOS		C		E	B			C	A		B	
Approach Delay		34.0			58.7			11.7			17.4	
Approach LOS		C			E			B			B	
Queue Length 50th (m)		17.6		~75.7	20.8			52.9	0.0		21.2	
Queue Length 95th (m)		38.8		#187.8	46.6			95.3	0.0		35.9	
Internal Link Dist (m)		807.7			1273.0			1001.7			1003.1	
Turn Bay Length (m)				65.0								
Base Capacity (vph)		431		570	828			859	1396		1516	
Starvation Cap Reductn		0		0	0			0	0		0	
Spillback Cap Reductn		0		0	0			0	0		0	
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.34		1.06	0.31			0.53	0.61		0.28	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90.5			
Actuated Cycle Length: 73.8			
Natural Cycle: 90			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.06			
Intersection Signal Delay: 28.4		Intersection LOS: C	
Intersection Capacity Utilization 88.5%		ICU Level of Service E	
Analysis Period (min) 15			

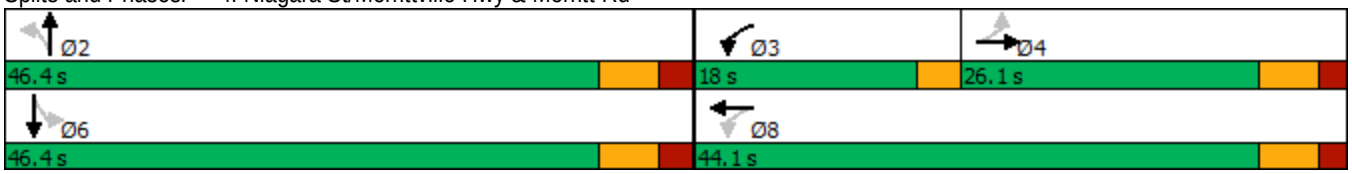
~ Volume exceeds capacity, queue is theoretically infinite.

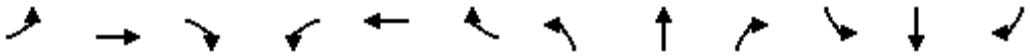
Queue shown is maximum after two cycles.

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

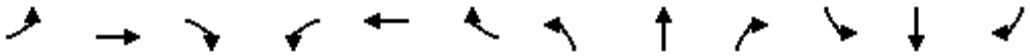
Queue shown is maximum after two cycles.

Splits and Phases: 4: Niagara St/Merrittville Hwy & Merritt Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	473	31	147	23	137	37	98	753	27	9	674	281
Future Volume (vph)	473	31	147	23	137	37	98	753	27	9	674	281
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0		0.0	30.0		0.0	75.0		0.0	65.0		30.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.876			0.968			0.995			0.956	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1545	1440	0	1516	1624	0	1397	3023	0	1607	2896	0
Flt Permitted	0.642			0.639			0.146			0.337		
Satd. Flow (perm)	1044	1440	0	1020	1624	0	215	3023	0	570	2896	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		155			15			4			81	
Link Speed (k/h)		50			50			40			60	
Link Distance (m)		825.4			480.8			403.8			1025.7	
Travel Time (s)		59.4			34.6			36.3			61.5	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	4%	12%	1%	6%	0%	4%	15%	6%	0%	0%	7%	4%
Adj. Flow (vph)	498	33	155	24	144	39	103	793	28	9	709	296
Shared Lane Traffic (%)												
Lane Group Flow (vph)	498	188	0	24	183	0	103	821	0	9	1005	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	14.9	14.9		14.9	14.9		9.0	16.6		9.0	16.6	
Total Split (s)	31.9	31.9		31.9	31.9		18.0	41.6		18.0	41.6	
Total Split (%)	34.9%	34.9%		34.9%	34.9%		19.7%	45.5%		19.7%	45.5%	
Maximum Green (s)	25.0	25.0		25.0	25.0		15.0	35.0		15.0	35.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		3.0	4.1		3.0	4.1	
All-Red Time (s)	2.8	2.8		2.8	2.8		0.0	2.5		0.0	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.9	6.9		6.9	6.9		3.0	6.6		3.0	6.6	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		3.0	2.5		3.0	2.5	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	11.0	11.0		11.0	11.0			9.0			9.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			14.0			14.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	25.6	25.6		25.6	25.6		44.1	38.8		38.7	30.5	
Actuated g/C Ratio	0.32	0.32		0.32	0.32		0.55	0.49		0.48	0.38	
v/c Ratio	1.49	0.33		0.07	0.35		0.40	0.56		0.03	0.87	
Control Delay	262.9	8.5		23.7	24.2		12.4	16.0		7.6	31.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	262.9	8.5		23.7	24.2		12.4	16.0		7.6	31.0	
LOS	F	A		C	C		B	B		A	C	
Approach Delay		193.2			24.2			15.6			30.8	
Approach LOS		F			C			B			C	
Queue Length 50th (m)	~120.6	4.0		2.9	21.9		6.8	40.4		0.6	71.0	
Queue Length 95th (m)	#181.6	19.4		8.8	40.6		13.4	70.0		2.3	#100.4	
Internal Link Dist (m)		801.4			456.8			379.8			1001.7	
Turn Bay Length (m)	80.0			30.0			75.0			65.0		
Base Capacity (vph)	334	567		326	530		346	1627		514	1344	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	1.49	0.33		0.07	0.35		0.30	0.50		0.02	0.75	

Intersection Summary			
Area Type:	Other		
Cycle Length: 91.5			
Actuated Cycle Length: 79.9			
Natural Cycle: 120			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.49			
Intersection Signal Delay: 64.7		Intersection LOS: E	
Intersection Capacity Utilization 94.9%		ICU Level of Service F	
Analysis Period (min) 15			

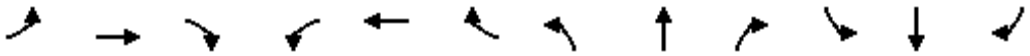
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

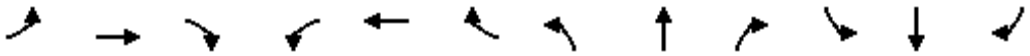
Queue shown is maximum after two cycles.

Splits and Phases: 5: Niagara St & Quaker Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	111	184	15	5	94	5	14	144	7	2	119	34
Future Volume (vph)	111	184	15	5	94	5	14	144	7	2	119	34
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.994			0.994			0.994			0.970	
Flt Protected		0.982			0.998			0.996			0.999	
Satd. Flow (prot)	0	1536	0	0	1476	0	0	1618	0	0	1567	0
Flt Permitted		0.982			0.998			0.996			0.999	
Satd. Flow (perm)	0	1536	0	0	1476	0	0	1618	0	0	1567	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		838.8			838.4			991.4			524.1	
Travel Time (s)		60.4			60.4			71.4			37.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	12%	0%	0%	15%	0%	11%	3%	0%	0%	6%	0%
Adj. Flow (vph)	121	200	16	5	102	5	15	157	8	2	129	37
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	337	0	0	112	0	0	180	0	0	168	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 49.5%		ICU Level of Service A	
Analysis Period (min) 15			



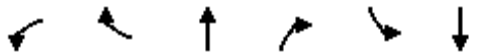
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	111	184	15	5	94	5	14	144	7	2	119	34
Future Volume (vph)	111	184	15	5	94	5	14	144	7	2	119	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	121	200	16	5	102	5	15	157	8	2	129	37

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	337	112	180	168
Volume Left (vph)	121	5	15	2
Volume Right (vph)	16	5	8	37
Hadj (s)	0.17	0.21	0.05	-0.05
Departure Headway (s)	5.2	5.6	5.5	5.4
Degree Utilization, x	0.49	0.18	0.27	0.25
Capacity (veh/h)	654	580	594	606
Control Delay (s)	13.2	9.8	10.5	10.2
Approach Delay (s)	13.2	9.8	10.5	10.2
Approach LOS	B	A	B	B

Intersection Summary				
Delay	11.5			
Level of Service	B			
Intersection Capacity Utilization	49.5%	ICU Level of Service	A	
Analysis Period (min)	15			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	215	10	155	134	6	133
Future Volume (vph)	215	10	155	134	6	133
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.994		0.937			
Flt Protected	0.954					0.998
Satd. Flow (prot)	1577	0	1546	0	0	1611
Flt Permitted	0.954					0.998
Satd. Flow (perm)	1577	0	1546	0	0	1611
Link Speed (k/h)	50		50			50
Link Distance (m)	831.7		1030.2			991.4
Travel Time (s)	59.9		74.2			71.4
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	17%	3%	2%	0%	5%
Adj. Flow (vph)	234	11	168	146	7	145
Shared Lane Traffic (%)						
Lane Group Flow (vph)	245	0	314	0	0	152
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.3		0.0			0.0
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24	14		14	24	
Sign Control	Stop		Stop			Stop

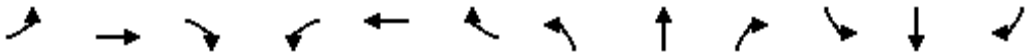
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 38.0%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Stop			Stop
Traffic Volume (vph)	215	10	155	134	6	133
Future Volume (vph)	215	10	155	134	6	133
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	234	11	168	146	7	145

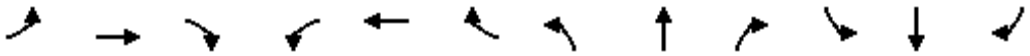
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total (vph)	245	314	152
Volume Left (vph)	234	0	7
Volume Right (vph)	11	146	0
Hadj (s)	0.19	-0.24	0.09
Departure Headway (s)	5.2	4.6	5.1
Degree Utilization, x	0.35	0.40	0.21
Capacity (veh/h)	646	754	665
Control Delay (s)	11.0	10.5	9.4
Approach Delay (s)	11.0	10.5	9.4
Approach LOS	B	B	A

Intersection Summary			
Delay	10.5		
Level of Service	B		
Intersection Capacity Utilization	38.0%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	34	438	75	227	277	12	105	243	207	6	282	60
Future Volume (vph)	34	438	75	227	277	12	105	243	207	6	282	60
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.982			0.997			0.950			0.977	
Flt Protected		0.997			0.978			0.991			0.999	
Satd. Flow (prot)	0	1580	0	0	1563	0	0	1527	0	0	1599	0
Flt Permitted		0.997			0.978			0.991			0.999	
Satd. Flow (perm)	0	1580	0	0	1563	0	0	1527	0	0	1599	0
Link Speed (k/h)		40			40			40			50	
Link Distance (m)		822.2			825.4			401.7			1030.2	
Travel Time (s)		74.0			74.3			36.2			74.2	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	4%	12%	9%	3%	0%	10%	3%	3%	0%	4%	0%
Adj. Flow (vph)	39	498	85	258	315	14	119	276	235	7	320	68
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	622	0	0	587	0	0	630	0	0	395	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

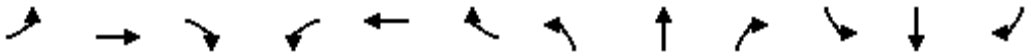
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 129.9%		ICU Level of Service H	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	34	438	75	227	277	12	105	243	207	6	282	60
Future Volume (vph)	34	438	75	227	277	12	105	243	207	6	282	60
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	39	498	85	258	315	14	119	276	235	7	320	68

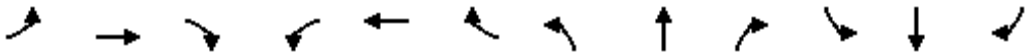
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	622	587	630	395
Volume Left (vph)	39	258	119	7
Volume Right (vph)	85	14	235	68
Hadj (s)	0.01	0.17	-0.11	-0.04
Departure Headway (s)	9.6	9.7	9.5	9.5
Degree Utilization, x	1.65	1.59	1.65	1.04
Capacity (veh/h)	380	373	385	382
Control Delay (s)	329.7	300.9	329.0	90.2
Approach Delay (s)	329.7	300.9	329.0	90.2
Approach LOS	F	F	F	F

Intersection Summary				
Delay	279.6			
Level of Service	F			
Intersection Capacity Utilization	129.9%	ICU Level of Service	H	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	196	65	24	108	10	53	743	109	5	310	7
Future Volume (vph)	55	196	65	24	108	10	53	743	109	5	310	7
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.972			0.990			0.984			0.997	
Flt Protected		0.991			0.992			0.997			0.999	
Satd. Flow (prot)	0	1543	0	0	1512	0	0	1608	0	0	1646	0
Flt Permitted		0.991			0.992			0.997			0.999	
Satd. Flow (perm)	0	1543	0	0	1512	0	0	1608	0	0	1646	0
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		431.2			838.8			1037.2			467.4	
Travel Time (s)		31.0			60.4			62.2			28.0	
Confl. Peds. (#/hr)	1		1	1		1	2					2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	9%	0%	23%	0%	83%	14%	2%	6%	0%	2%	20%
Adj. Flow (vph)	59	211	70	26	116	11	57	799	117	5	333	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	340	0	0	153	0	0	973	0	0	346	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

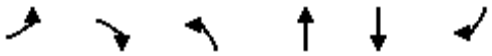
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	106.8%	ICU Level of Service	G
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	55	196	65	24	108	10	53	743	109	5	310	7
Future Volume (vph)	55	196	65	24	108	10	53	743	109	5	310	7
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	59	211	70	26	116	11	57	799	117	5	333	8

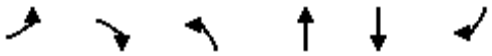
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	340	153	973	346
Volume Left (vph)	59	26	57	5
Volume Right (vph)	70	11	117	8
Hadj (s)	0.01	0.16	-0.01	0.03
Departure Headway (s)	7.4	8.3	6.8	7.2
Degree Utilization, x	0.70	0.35	1.84	0.69
Capacity (veh/h)	466	388	534	481
Control Delay (s)	25.6	15.7	402.9	24.9
Approach Delay (s)	25.6	15.7	402.9	24.9
Approach LOS	D	C	F	C

Intersection Summary			
Delay	227.2		
Level of Service	F		
Intersection Capacity Utilization	106.8%	ICU Level of Service	G
Analysis Period (min)	15		



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	265	31	17	640	368	31
Future Volume (vph)	265	31	17	640	368	31
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.986				0.990	
Flt Protected	0.957			0.999		
Satd. Flow (prot)	1588	0	0	1618	1630	0
Flt Permitted	0.957			0.999		
Satd. Flow (perm)	1588	0	0	1618	1630	0
Link Speed (k/h)	50			60	60	
Link Distance (m)	434.7			1037.2	1037.2	
Travel Time (s)	31.3			62.2	62.2	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	0%	5%	20%	4%	3%	0%
Adj. Flow (vph)	308	36	20	744	428	36
Shared Lane Traffic (%)						
Lane Group Flow (vph)	344	0	0	764	464	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24	14	24			14
Sign Control	Stop			Free	Free	

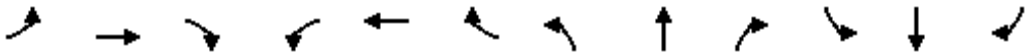
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 76.1%		ICU Level of Service D	
Analysis Period (min) 15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	265	31	17	640	368	31
Future Volume (Veh/h)	265	31	17	640	368	31
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	308	36	20	744	428	36
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1230	446	464			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1230	446	464			
tC, single (s)	6.4	6.2	4.3			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.4			
p0 queue free %	0	94	98			
cM capacity (veh/h)	194	606	1009			

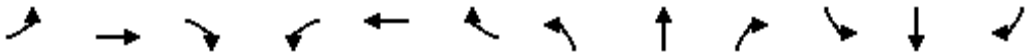
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	344	764	464
Volume Left	308	20	0
Volume Right	36	0	36
cSH	209	1009	1700
Volume to Capacity	1.65	0.02	0.27
Queue Length 95th (m)	171.7	0.5	0.0
Control Delay (s)	351.8	0.5	0.0
Lane LOS	F	A	
Approach Delay (s)	351.8	0.5	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	77.2		
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	124	352	122	100	319	23	70	510	161	34	323	42
Future Volume (vph)	124	352	122	100	319	23	70	510	161	34	323	42
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.972			0.993			0.971			0.986	
Flt Protected		0.990			0.989			0.995			0.996	
Satd. Flow (prot)	0	1527	0	0	1592	0	0	1573	0	0	1606	0
Flt Permitted		0.990			0.989			0.995			0.996	
Satd. Flow (perm)	0	1527	0	0	1592	0	0	1573	0	0	1606	0
Link Speed (k/h)		50			40			40			50	
Link Distance (m)		441.3			822.2			400.0			1037.2	
Travel Time (s)		31.8			74.0			36.0			74.7	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	9%	7%	3%	0%	6%	0%	12%	4%	0%	4%	2%	14%
Adj. Flow (vph)	138	391	136	111	354	26	78	567	179	38	359	47
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	665	0	0	491	0	0	824	0	0	444	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	112.4%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	124	352	122	100	319	23	70	510	161	34	323	42
Future Volume (vph)	124	352	122	100	319	23	70	510	161	34	323	42
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	138	391	136	111	354	26	78	567	179	38	359	47

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	665	491	824	444
Volume Left (vph)	138	111	78	38
Volume Right (vph)	136	26	179	47
Hadj (s)	0.03	0.09	-0.05	0.01
Departure Headway (s)	9.6	9.7	9.5	9.6
Degree Utilization, x	1.77	1.32	2.18	1.18
Capacity (veh/h)	380	380	385	380
Control Delay (s)	381.0	187.7	560.1	135.5
Approach Delay (s)	381.0	187.7	560.1	135.5
Approach LOS	F	F	F	F

Intersection Summary			
Delay	357.7		
Level of Service	F		
Intersection Capacity Utilization	112.4%	ICU Level of Service	H
Analysis Period (min)	15		

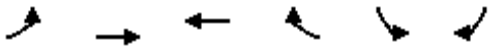
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	21	910	13	31	68	5
Future Volume (vph)	21	910	13	31	68	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		200.0	65.0		0.0	180.0
Storage Lanes		1	1		1	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1692	1396	1607	1128	1545	1438
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	1692	1396	1607	1128	1545	1438
Link Speed (k/h)	60			50	50	
Link Distance (m)	340.4			197.6	500.8	
Travel Time (s)	20.4			14.2	36.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	3%	0%	50%	4%	0%
Adj. Flow (vph)	24	1034	15	35	77	6
Shared Lane Traffic (%)						
Lane Group Flow (vph)	24	1034	15	35	77	6
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 71.2%		ICU Level of Service C	
Analysis Period (min) 15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	21	910	13	31	68	5
Future Volume (Veh/h)	21	910	13	31	68	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	24	1034	15	35	77	6
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						24
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			24		89	24
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			24		89	24
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		91	99
cM capacity (veh/h)			1604		898	1058

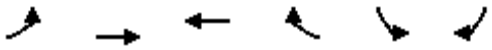
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	24	1034	15	35	83
Volume Left	0	0	15	0	77
Volume Right	0	1034	0	0	6
cSH	1700	1700	1604	1700	968
Volume to Capacity	0.01	0.61	0.01	0.02	0.09
Queue Length 95th (m)	0.0	0.0	0.2	0.0	2.1
Control Delay (s)	0.0	0.0	7.3	0.0	9.3
Lane LOS			A		A
Approach Delay (s)	0.0		2.2		9.3
Approach LOS					A

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	71.2%	ICU Level of Service	C
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	933	58	33	15	1049
Future Volume (vph)	77	933	58	33	15	1049
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	100.0			210.0	0.0	150.0
Storage Lanes	1			1	1	1
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1607	1627	1484	1438	1004	1424
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1607	1627	1484	1438	1004	1424
Link Speed (k/h)		60	50		60	
Link Distance (m)		1297.0	340.4		573.6	
Travel Time (s)		77.8	24.5		34.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Adj. Flow (vph)	80	972	60	34	16	1093
Shared Lane Traffic (%)						
Lane Group Flow (vph)	80	972	60	34	16	1093
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

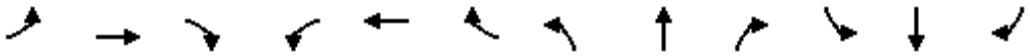
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 80.5%		ICU Level of Service D	
Analysis Period (min) 15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	77	933	58	33	15	1049
Future Volume (Veh/h)	77	933	58	33	15	1049
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	80	972	60	34	16	1093
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						20
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	60				1192	60
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	60				1192	60
tC, single (s)	4.1				7.0	6.2
tC, 2 stage (s)						
tF (s)	2.2				4.0	3.3
p0 queue free %	95				89	0
cM capacity (veh/h)	1556				151	1008

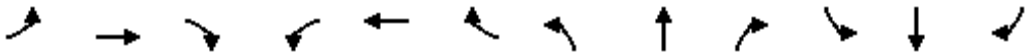
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	80	972	60	34	1109
Volume Left	80	0	0	0	16
Volume Right	0	0	0	34	1093
cSH	1556	1700	1700	1700	1023
Volume to Capacity	0.05	0.57	0.04	0.02	1.08
Queue Length 95th (m)	1.2	0.0	0.0	0.0	201.1
Control Delay (s)	7.4	0.0	0.0	0.0	72.7
Lane LOS	A				F
Approach Delay (s)	0.6		0.0		72.7
Approach LOS					F

Intersection Summary			
Average Delay	36.0		
Intersection Capacity Utilization	80.5%	ICU Level of Service	D
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	36	33	66	17	47	10	76	273	1	12	726	52
Future Volume (vph)	36	33	66	17	47	10	76	273	1	12	726	52
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.934			0.981						0.991	
Flt Protected		0.987			0.989			0.989			0.999	
Satd. Flow (prot)	0	1340	0	0	1342	0	0	1616	0	0	1660	0
Flt Permitted		0.987			0.989			0.989			0.999	
Satd. Flow (perm)	0	1340	0	0	1342	0	0	1616	0	0	1660	0
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		838.4			681.4			1027.1			497.4	
Travel Time (s)		60.4			40.9			61.6			29.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	41%	13%	0%	35%	0%	2%	4%	0%	0%	1%	0%
Adj. Flow (vph)	39	36	72	18	51	11	83	297	1	13	789	57
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	147	0	0	80	0	0	381	0	0	859	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

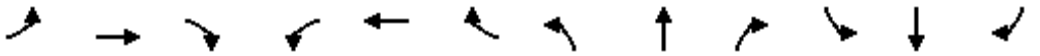
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 86.4%		ICU Level of Service E	
Analysis Period (min) 15			



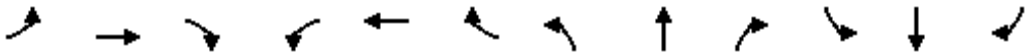
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	36	33	66	17	47	10	76	273	1	12	726	52
Future Volume (Veh/h)	36	33	66	17	47	10	76	273	1	12	726	52
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	39	36	72	18	51	11	83	297	1	13	789	57
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1344	1308	818	1397	1336	298	846			298		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1344	1308	818	1397	1336	298	846			298		
tC, single (s)	7.1	6.9	6.3	7.1	6.8	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.4	3.4	3.5	4.3	3.3	2.2			2.2		
p0 queue free %	50	70	80	73	56	99	90			99		
cM capacity (veh/h)	78	118	360	67	117	747	791			1275		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	147	80	381	859
Volume Left	39	18	83	13
Volume Right	72	11	1	57
cSH	146	111	791	1275
Volume to Capacity	1.01	0.72	0.10	0.01
Queue Length 95th (m)	56.9	29.4	2.7	0.2
Control Delay (s)	136.7	94.6	3.2	0.3
Lane LOS	F	F	A	A
Approach Delay (s)	136.7	94.6	3.2	0.3
Approach LOS	F	F		

Intersection Summary				
Average Delay	19.8			
Intersection Capacity Utilization	86.4%	ICU Level of Service	E	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	167	11	854	203	50	8	291	813	30	746	33
Future Volume (vph)	9	167	11	854	203	50	8	291	813	30	746	33
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0		0.0	65.0		0.0	0.0		0.0	0.0		80.0
Storage Lanes	0		0	1		0	0		1	0		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95
Frt		0.992			0.970				0.850		0.994	
Flt Protected		0.998		0.950				0.999			0.998	
Satd. Flow (prot)	0	1675	0	1591	1591	0	0	1642	1396	0	3116	0
Flt Permitted		0.974		0.464				0.969			0.930	
Satd. Flow (perm)	0	1635	0	777	1591	0	0	1593	1396	0	2903	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			17				852		6	
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		831.7			1297.0			1025.7			1027.1	
Travel Time (s)		59.9			77.8			61.5			61.6	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	0%	1%	1%	12%	0%	3%	3%	38%	1%	0%
Adj. Flow (vph)	10	178	12	909	216	53	9	310	865	32	794	35
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	200	0	909	269	0	0	319	865	0	861	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	Perm	NA	
Protected Phases		4		3	8			2			6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2		Free	6		
Detector Phase	4	4		3	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		10.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		14.5	22.5		16.4	16.4		16.4	16.4	
Total Split (s)	26.1	26.1		18.0	44.1		46.4	46.4		46.4	46.4	
Total Split (%)	28.8%	28.8%		19.9%	48.7%		51.3%	51.3%		51.3%	51.3%	
Maximum Green (s)	20.0	20.0		15.0	38.0		40.0	40.0		40.0	40.0	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.0	2.0		0.0	2.0		2.3	2.3		2.3	2.3	
Lost Time Adjust (s)		0.0		0.0	0.0			0.0			0.0	
Total Lost Time (s)		6.1		3.0	6.1			6.4			6.4	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0		3.0	3.0		5.0	5.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flash Dont Walk (s)	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)		15.6		37.2	34.0			28.9	75.7		28.9	
Actuated g/C Ratio		0.21		0.49	0.45			0.38	1.00		0.38	
v/c Ratio		0.59		1.66	0.37			0.53	0.62		0.77	
Control Delay		35.9		326.8	16.1			21.6	2.1		25.8	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		35.9		326.8	16.1			21.6	2.1		25.8	
LOS		D		F	B			C	A		C	
Approach Delay		35.9			255.9			7.3			25.8	
Approach LOS		D			F			A			C	
Queue Length 50th (m)		25.6		~195.2	22.9			34.3	0.0		54.9	
Queue Length 95th (m)		52.0		#312.9	49.1			59.7	0.0		80.7	
Internal Link Dist (m)		807.7			1273.0			1001.7			1003.1	
Turn Bay Length (m)				65.0								
Base Capacity (vph)		443		546	824			860	1396		1571	
Starvation Cap Reductn		0		0	0			0	0		0	
Spillback Cap Reductn		0		0	0			0	0		0	
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.45		1.66	0.33			0.37	0.62		0.55	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90.5			
Actuated Cycle Length: 75.7			
Natural Cycle: 110			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.66			
Intersection Signal Delay: 99.2		Intersection LOS: F	
Intersection Capacity Utilization 124.6%		ICU Level of Service H	
Analysis Period (min) 15			

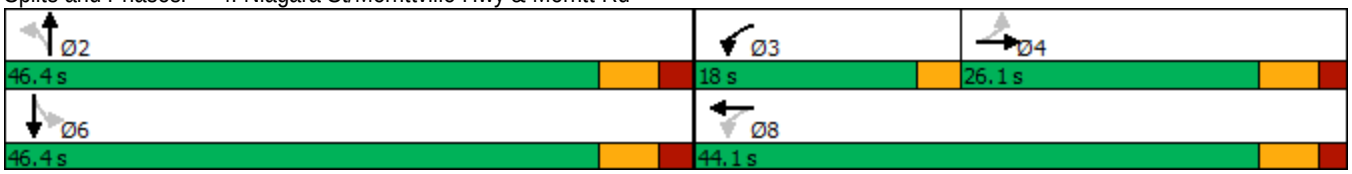
~ Volume exceeds capacity, queue is theoretically infinite.

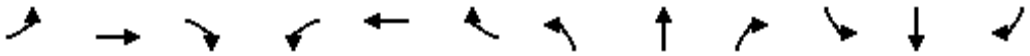
Queue shown is maximum after two cycles.

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

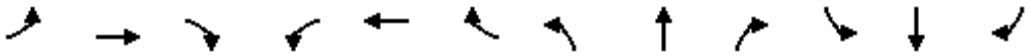
Queue shown is maximum after two cycles.

Splits and Phases: 4: Niagara St/Merrittville Hwy & Merritt Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	299	117	268	38	41	19	263	794	47	78	1170	363
Future Volume (vph)	299	117	268	38	41	19	263	794	47	78	1170	363
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0		0.0	30.0		0.0	75.0		0.0	65.0		30.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.896			0.953			0.992			0.964	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1560	1493	0	1607	1580	0	1591	3096	0	1607	3061	0
Flt Permitted	0.711			0.195			0.104			0.260		
Satd. Flow (perm)	1168	1493	0	330	1580	0	174	3096	0	440	3061	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		124			22			8			52	
Link Speed (k/h)		50			50			40			60	
Link Distance (m)		825.4			480.8			403.8			1025.7	
Travel Time (s)		59.4			34.6			36.3			61.5	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	3%	5%	0%	0%	3%	0%	1%	3%	3%	0%	1%	2%
Adj. Flow (vph)	348	136	312	44	48	22	306	923	55	91	1360	422
Shared Lane Traffic (%)												
Lane Group Flow (vph)	348	448	0	44	70	0	306	978	0	91	1782	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	14.9	14.9		14.9	14.9		9.0	16.6		9.0	16.6	
Total Split (s)	31.9	31.9		31.9	31.9		18.0	41.6		18.0	41.6	
Total Split (%)	34.9%	34.9%		34.9%	34.9%		19.7%	45.5%		19.7%	45.5%	
Maximum Green (s)	25.0	25.0		25.0	25.0		15.0	35.0		15.0	35.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		3.0	4.1		3.0	4.1	
All-Red Time (s)	2.8	2.8		2.8	2.8		0.0	2.5		0.0	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.9	6.9		6.9	6.9		3.0	6.6		3.0	6.6	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		3.0	2.5		3.0	2.5	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	11.0	11.0		11.0	11.0			9.0			9.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			14.0			14.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	25.0	25.0		25.0	25.0		56.6	44.2		46.2	35.0	
Actuated g/C Ratio	0.27	0.27		0.27	0.27		0.62	0.48		0.50	0.38	
v/c Ratio	1.09	0.90		0.49	0.16		0.90	0.65		0.29	1.48	
Control Delay	111.0	46.5		49.2	19.6		52.8	21.1		10.1	247.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	111.0	46.5		49.2	19.6		52.8	21.1		10.1	247.1	
LOS	F	D		D	B		D	C		B	F	
Approach Delay		74.7			31.0			28.7			235.6	
Approach LOS		E			C			C			F	
Queue Length 50th (m)	~69.7	57.0		6.5	6.3		37.5	67.7		5.9	~228.9	
Queue Length 95th (m)	#112.5	#103.0		#18.8	15.4		#77.1	86.8		11.1	#253.8	
Internal Link Dist (m)		801.4			456.8			379.8			1001.7	
Turn Bay Length (m)	80.0			30.0			75.0			65.0		
Base Capacity (vph)	319	498		90	447		339	1498		449	1202	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	1.09	0.90		0.49	0.16		0.90	0.65		0.20	1.48	

Intersection Summary			
Area Type:	Other		
Cycle Length: 91.5			
Actuated Cycle Length: 91.5			
Natural Cycle: 130			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.48			
Intersection Signal Delay: 133.0		Intersection LOS: F	
Intersection Capacity Utilization 112.4%		ICU Level of Service H	
Analysis Period (min) 15			

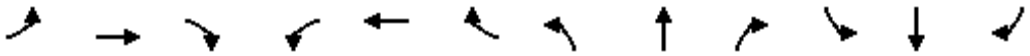
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

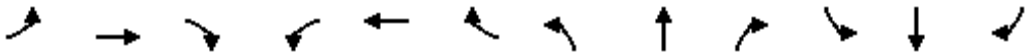
Queue shown is maximum after two cycles.

Splits and Phases: 5: Niagara St & Quaker Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	92	27	10	142	23	32	138	15	28	300	170
Future Volume (vph)	30	92	27	10	142	23	32	138	15	28	300	170
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.976			0.982			0.989			0.954	
Flt Protected		0.990			0.997			0.991			0.997	
Satd. Flow (prot)	0	1589	0	0	1508	0	0	1658	0	0	1531	0
Flt Permitted		0.990			0.997			0.991			0.997	
Satd. Flow (perm)	0	1589	0	0	1508	0	0	1658	0	0	1531	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		838.8			838.4			991.4			524.1	
Travel Time (s)		60.4			60.4			71.4			37.7	
Confl. Peds. (#/hr)			1	1			2					2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	3%	0%	14%	3%	50%	0%	0%	0%	92%	0%	0%
Adj. Flow (vph)	33	100	29	11	154	25	35	150	16	30	326	185
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	162	0	0	190	0	0	201	0	0	541	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 58.5%		ICU Level of Service B	
Analysis Period (min) 15			



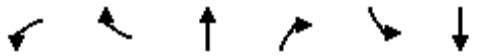
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	30	92	27	10	142	23	32	138	15	28	300	170
Future Volume (vph)	30	92	27	10	142	23	32	138	15	28	300	170
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	100	29	11	154	25	35	150	16	30	326	185

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	162	190	201	541
Volume Left (vph)	33	11	35	30
Volume Right (vph)	29	25	16	185
Hadj (s)	-0.02	0.10	-0.01	-0.11
Departure Headway (s)	6.4	6.5	6.0	5.3
Degree Utilization, x	0.29	0.34	0.34	0.80
Capacity (veh/h)	501	504	539	541
Control Delay (s)	12.1	12.8	12.0	26.5
Approach Delay (s)	12.1	12.8	12.0	26.5
Approach LOS	B	B	B	D

Intersection Summary				
Delay	19.3			
Level of Service	C			
Intersection Capacity Utilization	58.5%	ICU Level of Service	B	
Analysis Period (min)	15			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	220	24	161	182	5	332
Future Volume (vph)	220	24	161	182	5	332
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.987		0.928			
Flt Protected	0.957					0.999
Satd. Flow (prot)	1584	0	1570	0	0	1673
Flt Permitted	0.957					0.999
Satd. Flow (perm)	1584	0	1570	0	0	1673
Link Speed (k/h)	50		50			50
Link Distance (m)	831.7		1030.2			991.4
Travel Time (s)	59.9		74.2			71.4
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	0%	0%	0%	0%	1%
Adj. Flow (vph)	239	26	175	198	5	361
Shared Lane Traffic (%)						
Lane Group Flow (vph)	265	0	373	0	0	366
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.3		0.0			0.0
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24	14		14	24	
Sign Control	Stop		Stop			Stop

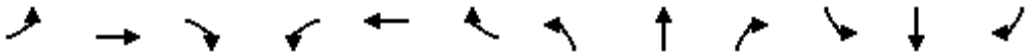
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 44.8%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Stop			Stop
Traffic Volume (vph)	220	24	161	182	5	332
Future Volume (vph)	220	24	161	182	5	332
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	239	26	175	198	5	361

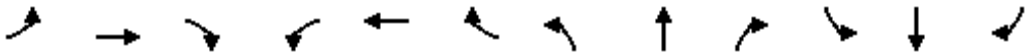
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total (vph)	265	373	366
Volume Left (vph)	239	0	5
Volume Right (vph)	26	198	0
Hadj (s)	0.14	-0.32	0.02
Departure Headway (s)	5.9	5.0	5.3
Degree Utilization, x	0.43	0.51	0.54
Capacity (veh/h)	567	687	654
Control Delay (s)	13.3	13.1	14.2
Approach Delay (s)	13.3	13.1	14.2
Approach LOS	B	B	B

Intersection Summary			
Delay	13.6		
Level of Service	B		
Intersection Capacity Utilization	44.8%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	39	429	71	206	460	1	60	303	238	17	425	110
Future Volume (vph)	39	429	71	206	460	1	60	303	238	17	425	110
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.982						0.947			0.973	
Flt Protected		0.996			0.985			0.995			0.998	
Satd. Flow (prot)	0	1577	0	0	1640	0	0	1588	0	0	1633	0
Flt Permitted		0.996			0.985			0.995			0.998	
Satd. Flow (perm)	0	1577	0	0	1640	0	0	1588	0	0	1633	0
Link Speed (k/h)		40			40			40			50	
Link Distance (m)		822.2			825.4			401.7			1030.2	
Travel Time (s)		74.0			74.3			36.2			74.2	
Confl. Peds. (#/hr)			1	1								
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	3%	19%	3%	1%	0%	0%	0%	1%	0%	0%	3%
Adj. Flow (vph)	44	488	81	234	523	1	68	344	270	19	483	125
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	613	0	0	758	0	0	682	0	0	627	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

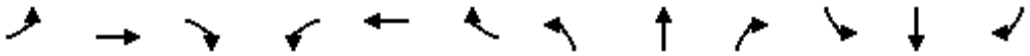
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	144.6%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	39	429	71	206	460	1	60	303	238	17	425	110
Future Volume (vph)	39	429	71	206	460	1	60	303	238	17	425	110
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	44	488	81	234	523	1	68	344	270	19	483	125

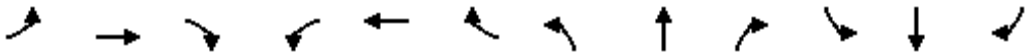
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	613	758	682	627
Volume Left (vph)	44	234	68	19
Volume Right (vph)	81	1	270	125
Hadj (s)	0.02	0.09	-0.21	-0.10
Departure Headway (s)	9.6	9.7	9.4	9.5
Degree Utilization, x	1.63	2.03	1.77	1.65
Capacity (veh/h)	379	379	389	384
Control Delay (s)	319.8	495.5	380.1	326.4
Approach Delay (s)	319.8	495.5	380.1	326.4
Approach LOS	F	F	F	F

Intersection Summary				
Delay	386.4			
Level of Service	F			
Intersection Capacity Utilization	144.6%	ICU Level of Service	H	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	123	71	68	260	16	92	503	17	9	517	45
Future Volume (vph)	23	123	71	68	260	16	92	503	17	9	517	45
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.956			0.994			0.996			0.989	
Flt Protected		0.995			0.990			0.993			0.999	
Satd. Flow (prot)	0	1591	0	0	1646	0	0	1629	0	0	1642	0
Flt Permitted		0.995			0.990			0.993			0.999	
Satd. Flow (perm)	0	1591	0	0	1646	0	0	1629	0	0	1642	0
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		431.2			838.8			1037.2			467.4	
Travel Time (s)		31.0			60.4			62.2			28.0	
Confl. Peds. (#/hr)	1		1	1		1	2					2
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	2%	0%	2%	1%	0%	0%	3%	9%	0%	2%	0%
Adj. Flow (vph)	24	128	74	71	271	17	96	524	18	9	539	47
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	226	0	0	359	0	0	638	0	0	595	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

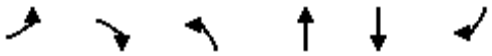
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	112.0%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	23	123	71	68	260	16	92	503	17	9	517	45
Future Volume (vph)	23	123	71	68	260	16	92	503	17	9	517	45
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	24	128	74	71	271	17	96	524	18	9	539	47

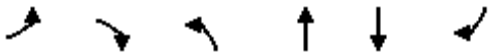
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	226	359	638	595
Volume Left (vph)	24	71	96	9
Volume Right (vph)	74	17	18	47
Hadj (s)	-0.16	0.03	0.06	-0.01
Departure Headway (s)	9.0	8.5	8.1	8.1
Degree Utilization, x	0.57	0.84	1.44	1.33
Capacity (veh/h)	382	411	455	456
Control Delay (s)	23.1	43.2	234.5	188.8
Approach Delay (s)	23.1	43.2	234.5	188.8
Approach LOS	C	E	F	F

Intersection Summary			
Delay	155.5		
Level of Service	F		
Intersection Capacity Utilization	112.0%	ICU Level of Service	H
Analysis Period (min)	15		



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	103	23	63	509	461	195
Future Volume (vph)	103	23	63	509	461	195
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.975				0.960	
Flt Protected	0.961			0.995		
Satd. Flow (prot)	1535	0	0	1639	1601	0
Flt Permitted	0.961			0.995		
Satd. Flow (perm)	1535	0	0	1639	1601	0
Link Speed (k/h)	50			60	60	
Link Distance (m)	434.7			1037.2	1037.2	
Travel Time (s)	31.3			62.2	62.2	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Heavy Vehicles (%)	2%	9%	0%	3%	2%	0%
Adj. Flow (vph)	121	27	74	599	542	229
Shared Lane Traffic (%)						
Lane Group Flow (vph)	148	0	0	673	771	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24	14	24			14
Sign Control	Stop			Free	Free	

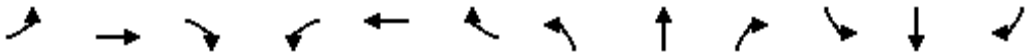
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 89.8%		ICU Level of Service E	
Analysis Period (min) 15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	103	23	63	509	461	195
Future Volume (Veh/h)	103	23	63	509	461	195
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	121	27	74	599	542	229
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1404	656	771			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1404	656	771			
tC, single (s)	6.4	6.3	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.2			
p0 queue free %	14	94	91			
cM capacity (veh/h)	141	453	853			

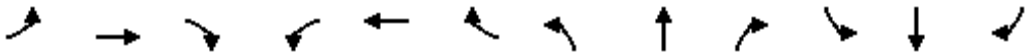
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	148	673	771
Volume Left	121	74	0
Volume Right	27	0	229
cSH	161	853	1700
Volume to Capacity	0.92	0.09	0.45
Queue Length 95th (m)	50.9	2.2	0.0
Control Delay (s)	107.4	2.2	0.0
Lane LOS	F	A	
Approach Delay (s)	107.4	2.2	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	10.9		
Intersection Capacity Utilization	89.8%	ICU Level of Service	E
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	362	79	131	431	68	104	449	141	36	371	77
Future Volume (vph)	55	362	79	131	431	68	104	449	141	36	371	77
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.978			0.985			0.973			0.978	
Flt Protected		0.994			0.990			0.993			0.996	
Satd. Flow (prot)	0	1571	0	0	1627	0	0	1579	0	0	1601	0
Flt Permitted		0.994			0.990			0.993			0.996	
Satd. Flow (perm)	0	1571	0	0	1627	0	0	1579	0	0	1601	0
Link Speed (k/h)		50			40			40			50	
Link Distance (m)		441.3			822.2			400.0			1037.2	
Travel Time (s)		31.8			74.0			36.0			74.7	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	6%	2%	0%	2%	0%	2%	4%	3%	4%	3%	2%
Adj. Flow (vph)	59	389	85	141	463	73	112	483	152	39	399	83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	533	0	0	677	0	0	747	0	0	521	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	137.8%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	55	362	79	131	431	68	104	449	141	36	371	77
Future Volume (vph)	55	362	79	131	431	68	104	449	141	36	371	77
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	59	389	85	141	463	73	112	483	152	39	399	83

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	533	677	747	521
Volume Left (vph)	59	141	112	39
Volume Right (vph)	85	73	152	83
Hadj (s)	0.01	0.00	-0.03	-0.03
Departure Headway (s)	9.6	9.6	9.5	9.5
Degree Utilization, x	1.42	1.80	1.98	1.38
Capacity (veh/h)	386	381	383	387
Control Delay (s)	228.5	392.4	471.1	212.9
Approach Delay (s)	228.5	392.4	471.1	212.9
Approach LOS	F	F	F	F

Intersection Summary			
Delay	343.1		
Level of Service	F		
Intersection Capacity Utilization	137.8%	ICU Level of Service	H
Analysis Period (min)	15		

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	46	902	12	24	67	5
Future Volume (vph)	46	902	12	24	67	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		200.0	65.0		0.0	180.0
Storage Lanes		1	1		1	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1627	1369	1607	1692	1422	1438
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	1627	1369	1607	1692	1422	1438
Link Speed (k/h)	60			50	50	
Link Distance (m)	340.4			197.6	500.8	
Travel Time (s)	20.4			14.2	36.1	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Heavy Vehicles (%)	4%	5%	0%	0%	13%	0%
Adj. Flow (vph)	55	1074	14	29	80	6
Shared Lane Traffic (%)						
Lane Group Flow (vph)	55	1074	14	29	80	6
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 70.6%		ICU Level of Service C	
Analysis Period (min) 15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	46	902	12	24	67	5
Future Volume (Veh/h)	46	902	12	24	67	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	55	1074	14	29	80	6
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						24
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			55		112	55
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			55		112	55
tC, single (s)			4.1		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			99		91	99
cM capacity (veh/h)			1563		851	1018

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	55	1074	14	29	86
Volume Left	0	0	14	0	80
Volume Right	0	1074	0	0	6
cSH	1700	1700	1563	1700	915
Volume to Capacity	0.03	0.63	0.01	0.02	0.09
Queue Length 95th (m)	0.0	0.0	0.2	0.0	2.4
Control Delay (s)	0.0	0.0	7.3	0.0	9.6
Lane LOS			A		A
Approach Delay (s)	0.0		2.4		9.6
Approach LOS					A

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	15		

APPENDIX

K SIGNAL WARRANT CALCULATION

FUTURE (SCENARIO 2) 2041

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Merritt Road / First Ave - Cataract Road

What is the direction of the Main Road street? East-West

When was the data collected? 2016-06-21

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural **Population < 10,000 AND Speed >= 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Eastbound Approach			Minor Northbound Approach			Main Westbound Approach			Minor Southbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	7	126	187	9	467	1	22	130	12	93	490	48	0
9:00	9	190	369	26	580	1	34	144	8	206	593	24	0
12:00	3	147	128	14	467	1	13	244	9	173	430	48	0
1:00	3	141	123	16	618	1	9	244	5	233	464	72	0
2:00	3	129	167	10	530	1	10	195	1	206	496	56	0
4:00	4	165	177	21	902	1	9	296	6	319	459	40	0
5:00	5	157	172	18	605	1	12	332	5	272	406	24	0
6:00	4	128	192	16	864	2	12	301	9	306	372	24	0
Total	**38**	**1,184**	**1,514**	**129**	**5,031**	**9**	**122**	**1,885**	**54**	**1,807**	**3,709**	**336**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									3,068

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merritt Road / First Ave - Cataract Road

Count Date: 2016-06-21

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
1A	480	720	600	900	1,590	2,185	1,675	1,929	1,803	2,396	2,010	2,229		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	1,108	1,430	1,132	1,403	1,298	1,741	1,327	1,583		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 1:	Both 1A and 1B 100% Fulfilled each of 8 hours	Yes	No
	Lesser of 1A or 1B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
2A	480	720	600	900	483	754	543	525	506	655	683	646		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	592	825	653	866	745	1,241	895	1,185		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100

Free Flow Signal Justification 2:	Both 2A and 2B 100% fulfilled each of 8 hours	Yes	No
	Lesser of 2A or 2B at least 80% fulfilled each of 8 hours	Yes ☑	No ☐

Justification 3: Combination

Combination Justification 1 and 2

Justification Satisfied 80% or More				Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	☑	☐	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	☑	☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	4:00	655	923	224	100 %	100 %
	5:00	683	702	213	100 %	
	6:00	646	881	227	100 %	
	9:00	754	823	187	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merritt Road / First Ave - Cataract Road

Count Date: 2016-06-21

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Merritt Road / First Ave - Cataract Road Count Date: 2016-06-21

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%		
	B	Crossing Volume	100	%		
2. Delay to Cross Traffic	A	Main Road	100	%		
	B	Crossing Road	100	%		
3. Combination	A	Justificaton 1	100	%		
	B	Justification 2	100	%		
4. 4-Hr Volume			100	%		
5. Collision Experience			0	%		
6. Pedestrians	A	Volume	Justification not met			
	B	Delay	Justification not met			

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Merrittville Highway / Port Robinson Road

What is the direction of the Main Road street? North-South

When was the data collected? 2020-11-17

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural **Population < 10,000 AND Speed >= 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	51	414	5	71	11	22	4	900	66	58	75	4	0
9:00	76	501	6	119	28	55	9	1,088	33	94	66	11	0
12:00	51	763	7	48	45	88	8	789	66	30	85	13	0
1:00	152	759	11	286	39	99	10	851	99	26	113	11	0
2:00	76	736	8	143	17	33	9	909	77	30	56	11	0
4:00	76	934	13	214	39	55	14	842	55	24	38	12	0
5:00	76	1,384	21	143	62	66	12	745	33	17	47	10	0
6:00	177	1,185	13	214	73	77	13	682	33	34	122	13	0
Total	**735**	**6,676**	**83**	**1,238**	**314**	**495**	**80**	**6,807**	**462**	**313**	**602**	**85**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									13,483

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road Count Date: 2020-11-17

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
1A	480	720	600	900	1,681	2,086	1,991	2,457	2,105	2,317	2,615	2,637		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	242	372	308	574	290	382	344	533		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours — Yes ☐ No ☐									
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
2A	480	720	600	900	1,439	1,714	1,683	1,883	1,815	1,934	2,271	2,104		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	205	278	163	500	230	278	221	459		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours — Yes ☐ No ☐									
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑ NO ☐	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑ NO ☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	1:00	1,883	424	80	100 %	100 %
	4:00	1,934	308	80	100 %	
	5:00	2,271	270	80	100 %	
	6:00	2,104	364	80	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road

Count Date: 2020-11-17

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000					
	> 7000	Not Justified				

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Merrittville Highway / Port Robinson Road Count Date: 2020-11-17

Summary Results

Justification			Compliance		Signal Justified? YES	NO
1. Minimum Vehicular Volume	A	Total Volume	100	%		
	B	Crossing Volume	100	%	☑	☐
2. Delay to Cross Traffic	A	Main Road	100	%		
	B	Crossing Road	100	%	☑	☐
3. Combination	A	Justificaton 1	100	%		
	B	Justification 2	100	%	☑	☐
4. 4-Hr Volume			100	%	☑	☐
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification not met			
	B	Delay	Justification not met		☐	☑

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Quaker Road / First Ave - Cataract Road

What is the direction of the Main Road street? East-West

When was the data collected? 2016-06-21

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural **Population < 10,000 AND Speed >= 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Eastbound Approach			Minor Northbound Approach			Main Westbound Approach			Minor Southbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	100	267	106	12	163	74	6	170	63	114	54	5	0
9:00	105	336	309	36	202	74	23	283	101	227	126	12	0
12:00	89	275	326	20	163	57	11	345	101	227	57	6	0
1:00	68	336	212	22	215	89	9	308	152	341	80	8	0
2:00	53	302	282	14	185	67	18	381	25	908	109	6	0
4:00	137	306	485	29	314	88	12	402	101	341	119	14	0
5:00	68	308	238	25	211	86	17	517	101	624	163	17	0
6:00	105	344	282	22	301	120	20	500	13	568	132	16	0
Total	**725**	**2,475**	**2,239**	**180**	**1,754**	**655**	**115**	**2,906**	**657**	**3,348**	**839**	**84**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									5,381

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Quaker Road / First Ave - Cataract Road

Count Date: 2016-06-21

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
1A	480	720	600	900	1,132	1,834	1,676	1,840	2,349	2,347	2,376	2,423		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	421	677	529	756	1,288	905	1,127	1,158		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours — Yes ☐ No ☐									
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	4:00	5:00	6:00		
2A	480	720	600	900	712	1,157	1,147	1,084	1,061	1,442	1,249	1,265		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	288	466	409	578	1,106	684	860	891		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours — Yes ☐ No ☐									
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 3: Combination

Combination Justification 1 and 2

Justification Satisfied 80% or More				Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	☑	☐	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	☑	☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	4:00	1,442	474	80	100 %	100 %
	5:00	1,249	805	80	100 %	
	6:00	1,265	715	80	100 %	
	9:00	1,157	365	87	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Quaker Road / First Ave - Cataract Road

Count Date: 2016-06-21

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Quaker Road / First Ave - Cataract Road Count Date: 2016-06-21

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%		
	B	Crossing Volume	100	%		
2. Delay to Cross Traffic	A	Main Road	100	%		
	B	Crossing Road	100	%		
3. Combination	A	Justificaton 1	100	%		
	B	Justification 2	100	%		
4. 4-Hr Volume			100	%		
5. Collision Experience			0	%		
6. Pedestrians	A	Volume	Justification not met			
	B	Delay	Justification not met			

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Rice Road / Merritt Road

What is the direction of the Main Road street? North-South

When was the data collected? 2016-06-13

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 2 or more

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural **Population < 10,000 AND Speed >= 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	1	349	340	93	78	2	9	333	233	21	158	4	0
9:00	2	528	671	141	153	2	14	368	167	209	206	5	0
12:00	1	408	233	111	129	3	5	625	178	334	124	6	0
1:00	1	392	224	148	115	5	4	625	100	355	128	3	0
2:00	1	358	304	96	123	5	4	501	11	355	121	6	0
3:00	1	457	322	182	192	6	4	758	111	460	158	10	0
5:00	1	435	313	219	209	11	5	851	100	585	157	12	0
6:00	1	355	349	160	178	10	5	771	189	585	128	11	0
Total	**8**	**3,282**	**2,754**	**1,150**	**1,178**	**44**	**51**	**4,833**	**1,089**	**2,905**	**1,180**	**57**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									8,115

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Merritt Road

Count Date: 2016-06-13

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
1A	480	720	600	900	1,620	2,465	2,156	2,101	1,886	2,660	2,899	2,743		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	355	716	707	755	706	1,008	1,193	1,073		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours					Yes ☐		No ☐		
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
2A	480	720	600	900	1,265	1,750	1,449	1,345	1,179	1,653	1,706	1,670		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	272	556	575	632	575	834	1,013	923		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours					Yes ☐		No ☐		
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours					Yes ☑		No ☐		

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	3:00	1,653	628	115	100 %	100 %
	5:00	1,706	754	115	100 %	
	6:00	1,670	724	115	100 %	
	9:00	1,750	420	115	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Merritt Road

Count Date: 2016-06-13

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000					
	> 7000	Not Justified				

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Rice Road / Merritt Road Count Date: 2016-06-13

Summary Results

Justification			Compliance	Signal Justified? YES	NO
1. Minimum Vehicular Volume	A	Total Volume	100 %		
	B	Crossing Volume	100 %	☑	☐
2. Delay to Cross Traffic	A	Main Road	100 %		
	B	Crossing Road	100 %	☑	☐
3. Combination	A	Justificaton 1	100 %		
	B	Justification 2	100 %	☑	☐
4. 4-Hr Volume			100 %	☑	☐
5. Collision Experience			0 %	☐	☑
6. Pedestrians	A	Volume	Justification not met		
	B	Delay	Justification not met	☐	☑

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Rice Road / Quaker Road

What is the direction of the Main Road street? North-South

When was the data collected? 2016-06-13

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 2 or more

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Rural Population < 10,000 AND Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	46	507	75	268	178	86	9	208	127	14	178	7	0
9:00	70	658	87	353	269	169	8	410	164	31	197	7	0
12:00	55	415	56	116	208	59	12	324	186	17	335	18	0
1:00	74	449	46	116	200	56	13	292	97	22	335	18	0
2:00	48	404	43	116	183	77	10	307	194	18	268	18	0
3:00	90	566	71	140	233	81	12	469	343	32	406	18	0
5:00	109	521	69	195	222	79	15	487	403	41	456	18	0
6:00	79	513	59	165	181	88	17	441	350	40	413	23	0
Total	**571**	**4,031**	**507**	**1,469**	**1,674**	**695**	**94**	**2,938**	**1,864**	**215**	**2,587**	**127**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		0%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									6,969

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		0%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Quaker Road

Count Date: 2016-06-13

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
1A	480	720	600	900	1,702	2,423	1,800	1,717	1,685	2,461	2,614	2,369		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	730	1,027	752	746	679	911	1,011	910		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours — Yes ☐ No ☐									
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	12:00	1:00	2:00	3:00	5:00	6:00		
2A	480	720	600	900	972	1,396	1,049	970	1,005	1,551	1,603	1,459		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	460	654	467	472	402	578	692	617		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours — Yes ☐ No ☐									
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More		Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	3:00	1,551	456	115	100 %	100 %
	5:00	1,603	515	115	100 %	
	6:00	1,459	476	115	100 %	
	9:00	1,396	792	115	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Rice Road / Quaker Road

Count Date: 2016-06-13

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision | GO TO Justification:

Intersection: Rice Road / Quaker Road Count Date: 2016-06-13

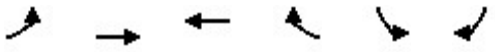
Summary Results

Justification			Compliance	Signal Justified? YES	NO
1. Minimum Vehicular Volume	A	Total Volume	100 %		
	B	Crossing Volume	100 %	☑	☐
2. Delay to Cross Traffic	A	Main Road	100 %		
	B	Crossing Road	100 %	☑	☐
3. Combination	A	Justificaton 1	100 %		
	B	Justification 2	100 %	☑	☐
4. 4-Hr Volume			100 %	☑	☐
5. Collision Experience			0 %	☐	☑
6. Pedestrians	A	Volume	Justification not met		
	B	Delay	Justification not met	☐	☑

APPENDIX

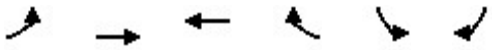
L SYNCHRO OUTPUT

FUTURE (SCENARIO 2) 2041



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	1078	72	27	7	768
Future Volume (vph)	32	1078	72	27	7	768
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0			210.0	0.0	150.0
Storage Lanes	1			1	1	1
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1516	1642	1364	1438	1607	1396
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1516	1642	1364	1438	1607	1396
Link Speed (k/h)		60	60		60	
Link Distance (m)		1297.0	340.4		573.6	
Travel Time (s)		77.8	20.4		34.4	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Adj. Flow (vph)	39	1315	88	33	9	937
Shared Lane Traffic (%)						
Lane Group Flow (vph)	39	1315	88	33	9	937
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		6.6	6.6		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

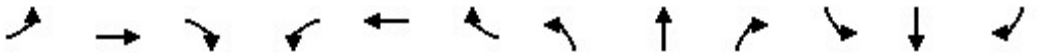
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	32	1078	72	27	7	768
Future Volume (Veh/h)	32	1078	72	27	7	768
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	39	1315	88	33	9	937
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						20
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	88				1481	88
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	88				1481	88
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	97				93	3
cM capacity (veh/h)	1483				136	968

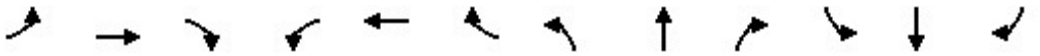
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	39	1315	88	33	946
Volume Left	39	0	0	0	9
Volume Right	0	0	0	33	937
cSH	1483	1700	1700	1700	977
Volume to Capacity	0.03	0.77	0.05	0.02	0.97
Queue Length 95th (m)	0.6	0.0	0.0	0.0	129.3
Control Delay (s)	7.5	0.0	0.0	0.0	42.4
Lane LOS	A				E
Approach Delay (s)	0.2		0.0		42.4
Approach LOS					E

Intersection Summary			
Average Delay	16.7		
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	119	28	35	5	22	5	53	501	6	7	372	27
Future Volume (vph)	119	28	35	5	22	5	53	501	6	7	372	27
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.974			0.980			0.999			0.991	
Flt Protected		0.968			0.993			0.995			0.999	
Satd. Flow (prot)	0	1425	0	0	1499	0	0	1526	0	0	1554	0
Flt Permitted		0.968			0.993			0.995			0.999	
Satd. Flow (perm)	0	1425	0	0	1499	0	0	1526	0	0	1554	0
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		838.4			681.4			1027.1			497.4	
Travel Time (s)		60.4			40.9			61.6			29.8	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Heavy Vehicles (%)	1%	44%	24%	0%	0%	67%	20%	9%	25%	25%	8%	0%
Adj. Flow (vph)	155	36	45	6	29	6	69	651	8	9	483	35
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	236	0	0	41	0	0	728	0	0	527	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

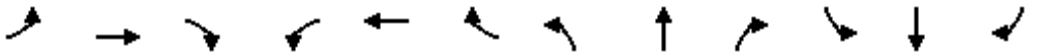
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 83.4%		ICU Level of Service E	
Analysis Period (min) 15			



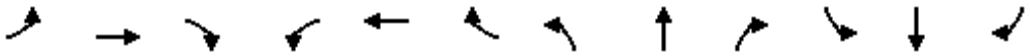
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	119	28	35	5	22	5	53	501	6	7	372	27
Future Volume (Veh/h)	119	28	35	5	22	5	53	501	6	7	372	27
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Hourly flow rate (vph)	155	36	45	6	29	6	69	651	8	9	483	35
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1332	1316	500	1374	1329	655	518			659		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1332	1316	500	1374	1329	655	518			659		
tC, single (s)	7.1	6.9	6.4	7.1	6.5	6.9	4.3			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.4	3.5	3.5	4.0	3.9	2.4			2.4		
p0 queue free %	0	70	91	93	80	98	93			99		
cM capacity (veh/h)	103	120	529	82	144	369	962			829		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	236	41	728	527
Volume Left	155	6	69	9
Volume Right	45	6	8	35
cSH	125	141	962	829
Volume to Capacity	1.89	0.29	0.07	0.01
Queue Length 95th (m)	141.7	8.6	1.8	0.3
Control Delay (s)	488.6	40.8	1.8	0.3
Lane LOS	F	E	A	A
Approach Delay (s)	488.6	40.8	1.8	0.3
Approach LOS	F	E		

Intersection Summary				
Average Delay	77.3			
Intersection Capacity Utilization	83.4%	ICU Level of Service	E	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	90	600	13	363	432	45	6	425	495	15	375	22
Future Volume (vph)	90	600	13	363	432	45	6	425	495	15	375	22
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	90.0		0.0	65.0		0.0	30.0		40.0	40.0		0.0
Storage Lanes	1		0	1		0	1		1	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	0.95	0.95
Frt		0.997			0.986				0.850		0.992	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	3193	0	1531	3060	0	1607	1552	1396	1448	2916	0
Flt Permitted	0.470			0.256			0.490			0.312		
Satd. Flow (perm)	795	3193	0	412	3060	0	829	1552	1396	475	2916	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			18				410		7	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		150.4			1297.0			1025.7			1027.1	
Travel Time (s)		9.0			77.8			61.5			61.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	0%	17%	5%	1%	28%	0%	9%	3%	11%	9%	15%
Adj. Flow (vph)	94	625	14	378	450	47	6	443	516	16	391	23
Shared Lane Traffic (%)												
Lane Group Flow (vph)	94	639	0	378	497	0	6	443	516	16	414	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4		3	8			2			6	



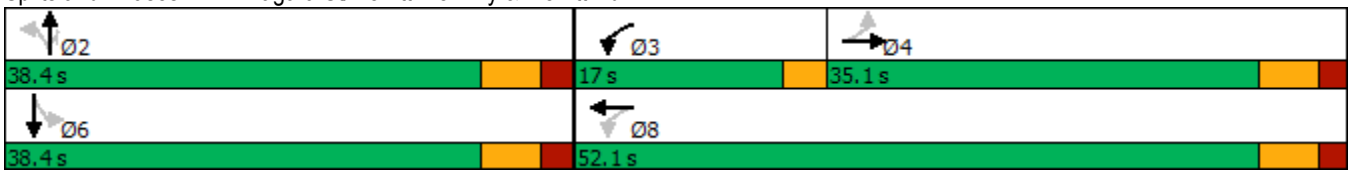
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2		2	6		
Detector Phase	4	4		3	8		2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		10.0	8.0		10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	35.1	35.1		13.0	35.1		35.4	35.4	35.4	35.4	35.4	
Total Split (s)	35.1	35.1		17.0	52.1		38.4	38.4	38.4	38.4	38.4	
Total Split (%)	38.8%	38.8%		18.8%	57.6%		42.4%	42.4%	42.4%	42.4%	42.4%	
Maximum Green (s)	29.0	29.0		14.0	46.0		32.0	32.0	32.0	32.0	32.0	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1	4.1	4.1	4.1	
All-Red Time (s)	2.0	2.0		0.0	2.0		2.3	2.3	2.3	2.3	2.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.1	6.1		3.0	6.1		6.4	6.4	6.4	6.4	6.4	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0		3.0	3.0		5.0	5.0	5.0	3.0	3.0	
Recall Mode	None	None		None	None		None	None	None	None	None	
Walk Time (s)	9.0	9.0			9.0		11.0	11.0	11.0	11.0	11.0	
Flash Dont Walk (s)	15.0	15.0			15.0		18.0	18.0	18.0	18.0	18.0	
Pedestrian Calls (#/hr)	0	0			0		0	0	0	0	0	
Act Effct Green (s)	25.1	25.1		45.4	42.3		29.9	29.9	29.9	29.9	29.9	
Actuated g/C Ratio	0.30	0.30		0.54	0.50		0.35	0.35	0.35	0.35	0.35	
v/c Ratio	0.40	0.67		0.93	0.32		0.02	0.81	0.68	0.10	0.40	
Control Delay	30.2	30.3		46.9	13.1		19.3	39.1	10.6	21.4	22.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	30.2	30.3		46.9	13.1		19.3	39.1	10.6	21.4	22.1	
LOS	C	C		D	B		B	D	B	C	C	
Approach Delay		30.3			27.7			23.8			22.1	
Approach LOS		C			C			C			C	
Queue Length 50th (m)	12.5	49.0		37.5	24.3		0.7	66.7	12.3	1.8	26.7	
Queue Length 95th (m)	26.5	66.7		#88.8	34.5		3.2	#117.2	47.5	6.5	40.1	
Internal Link Dist (m)		126.4			1273.0			1001.7			1003.1	
Turn Bay Length (m)	90.0			65.0			30.0		40.0	40.0		
Base Capacity (vph)	274	1105		407	1686		316	591	785	180	1116	
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	
Reduced v/c Ratio	0.34	0.58		0.93	0.29		0.02	0.75	0.66	0.09	0.37	

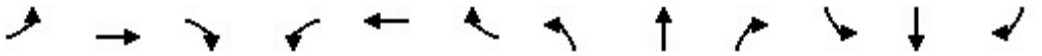
Intersection Summary			
Area Type:	Other		
Cycle Length: 90.5			
Actuated Cycle Length: 84.8			
Natural Cycle: 85			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.93			
Intersection Signal Delay: 26.3		Intersection LOS: C	
Intersection Capacity Utilization 78.3%		ICU Level of Service D	
Analysis Period (min) 15			

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

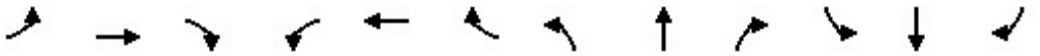
Queue shown is maximum after two cycles.

Splits and Phases: 4: Niagara St/Merrittville Hwy & Merritt Rd





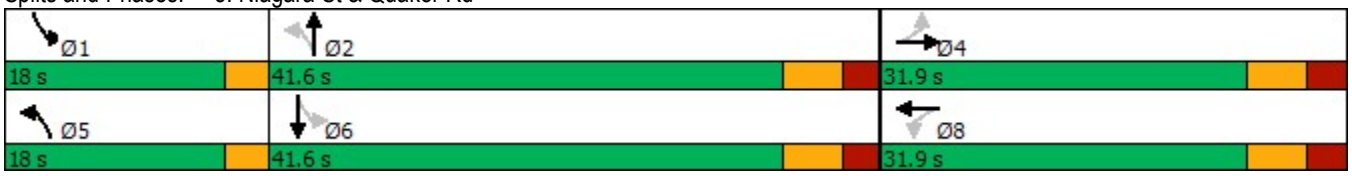
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	31	144	23	137	37	98	753	27	9	677	65
Future Volume (vph)	136	31	144	23	137	37	98	753	27	9	677	65
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0		0.0	30.0		0.0	75.0		0.0	65.0		30.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.877			0.968			0.995			0.987	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1545	1441	0	1516	1624	0	1397	3023	0	1607	2972	0
Flt Permitted	0.642			0.641			0.254			0.342		
Satd. Flow (perm)	1044	1441	0	1023	1624	0	374	3023	0	579	2972	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		152			15			4			13	
Link Speed (k/h)		50			50			40			60	
Link Distance (m)		825.4			480.8			403.8			1025.7	
Travel Time (s)		59.4			34.6			36.3			61.5	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	4%	12%	1%	6%	0%	4%	15%	6%	0%	0%	7%	4%
Adj. Flow (vph)	143	33	152	24	144	39	103	793	28	9	713	68
Shared Lane Traffic (%)												
Lane Group Flow (vph)	143	185	0	24	183	0	103	821	0	9	781	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	

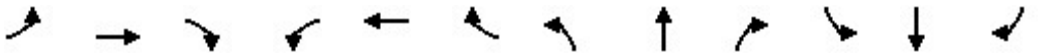


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	14.9	14.9		14.9	14.9		9.0	16.6		9.0	16.6	
Total Split (s)	31.9	31.9		31.9	31.9		18.0	41.6		18.0	41.6	
Total Split (%)	34.9%	34.9%		34.9%	34.9%		19.7%	45.5%		19.7%	45.5%	
Maximum Green (s)	25.0	25.0		25.0	25.0		15.0	35.0		15.0	35.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		3.0	4.1		3.0	4.1	
All-Red Time (s)	2.8	2.8		2.8	2.8		0.0	2.5		0.0	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.9	6.9		6.9	6.9		3.0	6.6		3.0	6.6	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		3.0	2.5		3.0	2.5	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	11.0	11.0		11.0	11.0			9.0			9.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			14.0			14.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	14.7	14.7		14.7	14.7		35.4	30.1		30.6	22.1	
Actuated g/C Ratio	0.24	0.24		0.24	0.24		0.58	0.49		0.50	0.36	
v/c Ratio	0.57	0.40		0.10	0.46		0.28	0.55		0.02	0.72	
Control Delay	33.7	9.6		22.7	24.9		8.2	13.0		6.7	22.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	33.7	9.6		22.7	24.9		8.2	13.0		6.7	22.1	
LOS	C	A		C	C		A	B		A	C	
Approach Delay		20.1			24.6			12.4			21.9	
Approach LOS		C			C			B			C	
Queue Length 50th (m)	14.3	2.9		2.1	16.1		4.1	26.3		0.3	38.3	
Queue Length 95th (m)	37.9	19.3		8.8	40.6		13.4	70.0		2.3	73.8	
Internal Link Dist (m)		801.4			456.8			379.8			1001.7	
Turn Bay Length (m)	80.0			30.0			75.0			65.0		
Base Capacity (vph)	475	738		465	747		495	1978		616	1868	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.30	0.25		0.05	0.24		0.21	0.42		0.01	0.42	

Intersection Summary			
Area Type:	Other		
Cycle Length: 91.5			
Actuated Cycle Length: 61.1			
Natural Cycle: 60			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.72			
Intersection Signal Delay: 18.0		Intersection LOS: B	
Intersection Capacity Utilization 67.3%		ICU Level of Service C	
Analysis Period (min) 15			

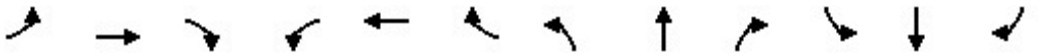
Splits and Phases: 5: Niagara St & Quaker Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	173	15	5	92	5	14	162	7	2	124	34
Future Volume (vph)	105	173	15	5	92	5	14	162	7	2	124	34
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.993			0.994			0.995			0.971	
Flt Protected		0.982			0.998			0.996			0.999	
Satd. Flow (prot)	0	1535	0	0	1477	0	0	1620	0	0	1568	0
Flt Permitted		0.982			0.998			0.996			0.999	
Satd. Flow (perm)	0	1535	0	0	1477	0	0	1620	0	0	1568	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		838.8			838.4			991.4			524.1	
Travel Time (s)		60.4			60.4			71.4			37.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	12%	0%	0%	15%	0%	11%	3%	0%	0%	6%	0%
Adj. Flow (vph)	114	188	16	5	100	5	15	176	8	2	135	37
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	318	0	0	110	0	0	199	0	0	174	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

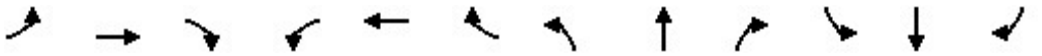
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 49.6%		ICU Level of Service A	
Analysis Period (min) 15			



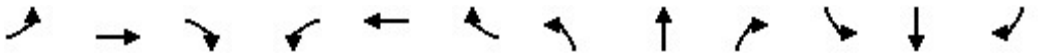
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	105	173	15	5	92	5	14	162	7	2	124	34
Future Volume (vph)	105	173	15	5	92	5	14	162	7	2	124	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	114	188	16	5	100	5	15	176	8	2	135	37

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	318	110	199	174
Volume Left (vph)	114	5	15	2
Volume Right (vph)	16	5	8	37
Hadj (s)	0.17	0.21	0.05	-0.05
Departure Headway (s)	5.3	5.7	5.4	5.4
Degree Utilization, x	0.47	0.17	0.30	0.26
Capacity (veh/h)	642	573	602	609
Control Delay (s)	12.9	9.9	10.8	10.3
Approach Delay (s)	12.9	9.9	10.8	10.3
Approach LOS	B	A	B	B

Intersection Summary				
Delay	11.4			
Level of Service	B			
Intersection Capacity Utilization	49.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	26	580	1	206	244	10	5	147	117	6	133	5
Future Volume (vph)	26	580	1	206	244	10	5	147	117	6	133	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	20.0		0.0	20.0		0.0	20.0		0.0	20.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.994			0.934			0.995	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1692	0	1591	1670	0	1607	1541	0	1607	1606	0
Flt Permitted	0.590			0.158			0.662			0.476		
Satd. Flow (perm)	998	1692	0	265	1670	0	1120	1541	0	805	1606	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					4			44			2	
Link Speed (k/h)		60			60			50			50	
Link Distance (m)		824.0			681.3			1030.2			991.4	
Travel Time (s)		49.4			40.9			74.2			71.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	1%	0%	17%	0%	3%	2%	0%	5%	0%
Adj. Flow (vph)	28	630	1	224	265	11	5	160	127	7	145	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	28	631	0	224	276	0	5	287	0	7	150	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	

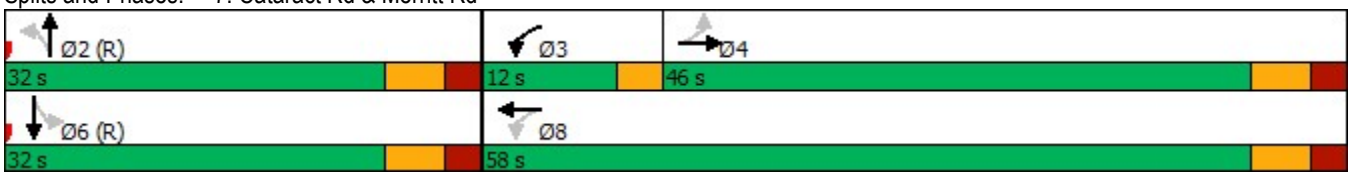


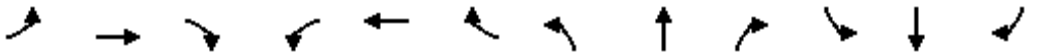
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		3	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		6.0	10.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	29.6	29.6		9.0	29.6		29.6	29.6		29.6	29.6	
Total Split (s)	46.0	46.0		12.0	58.0		32.0	32.0		32.0	32.0	
Total Split (%)	51.1%	51.1%		13.3%	64.4%		35.6%	35.6%		35.6%	35.6%	
Maximum Green (s)	39.4	39.4		9.0	51.4		25.4	25.4		25.4	25.4	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.5	2.5		0.0	2.5		2.5	2.5		2.5	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.6	6.6		3.0	6.6		6.6	6.6		6.6	6.6	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	9.0	9.0			9.0		9.0	9.0		9.0	9.0	
Flash Dont Walk (s)	14.0	14.0			14.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)	36.9	36.9		52.5	48.9		27.9	27.9		27.9	27.9	
Actuated g/C Ratio	0.41	0.41		0.58	0.54		0.31	0.31		0.31	0.31	
v/c Ratio	0.07	0.91		0.78	0.30		0.01	0.56		0.03	0.30	
Control Delay	15.4	43.7		31.0	11.6		28.0	31.0		24.0	26.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	15.4	43.7		31.0	11.6		28.0	31.0		24.0	26.6	
LOS	B	D		C	B		C	C		C	C	
Approach Delay		42.5			20.3			30.9			26.5	
Approach LOS		D			C			C			C	
Queue Length 50th (m)	2.7	94.8		16.0	22.4		0.7	45.3		0.9	20.2	
Queue Length 95th (m)	7.6	#157.2		#36.3	36.2		m0.7	m47.5		4.1	36.1	
Internal Link Dist (m)		800.0			657.3			1006.2			967.4	
Turn Bay Length (m)	20.0			20.0			20.0			20.0		
Base Capacity (vph)	436	740		287	955		347	508		249	499	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.06	0.85		0.78	0.29		0.01	0.56		0.03	0.30	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 80			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.91			
Intersection Signal Delay: 31.9		Intersection LOS: C	
Intersection Capacity Utilization 76.1%		ICU Level of Service D	
Analysis Period (min) 15			

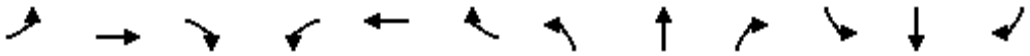
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: Cataract Rd & Merritt Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	98	74	227	61	12	105	248	207	6	283	51
Future Volume (vph)	9	98	74	227	61	12	105	248	207	6	283	51
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.935			0.975			0.932			0.977	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1472	0	1474	1609	0	1461	1531	0	1607	1599	0
Flt Permitted	0.703			0.324			0.456			0.343		
Satd. Flow (perm)	1189	1472	0	503	1609	0	701	1531	0	580	1599	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		38			14			62			13	
Link Speed (k/h)		40			40			40			50	
Link Distance (m)		822.2			825.4			401.7			1030.2	
Travel Time (s)		74.0			74.3			36.2			74.2	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	4%	12%	9%	3%	0%	10%	3%	3%	0%	4%	0%
Adj. Flow (vph)	10	111	84	258	69	14	119	282	235	7	322	58
Shared Lane Traffic (%)												
Lane Group Flow (vph)	10	195	0	258	83	0	119	517	0	7	380	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		6.6			6.6			6.6			6.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		3	8		2	2		6	6	
Switch Phase												

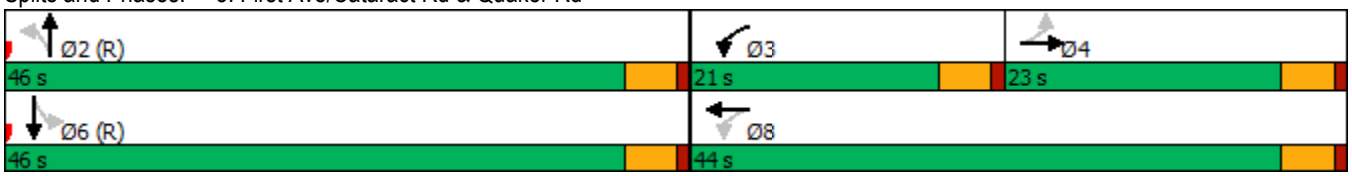


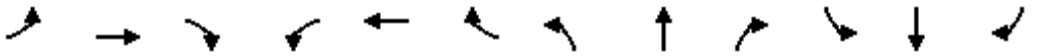
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	22.5	22.5		9.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	23.0	23.0		21.0	44.0		46.0	46.0		46.0	46.0	
Total Split (%)	25.6%	25.6%		23.3%	48.9%		51.1%	51.1%		51.1%	51.1%	
Maximum Green (s)	18.5	18.5		16.5	39.5		41.5	41.5		41.5	41.5	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	7.0	7.0			7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)	14.3	14.3		34.1	34.1		46.9	46.9		46.9	46.9	
Actuated g/C Ratio	0.16	0.16		0.38	0.38		0.52	0.52		0.52	0.52	
v/c Ratio	0.05	0.73		0.72	0.13		0.33	0.63		0.02	0.45	
Control Delay	33.2	45.3		32.5	14.1		17.6	18.9		10.7	13.5	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	33.2	45.3		32.5	14.1		17.6	18.9		10.7	13.5	
LOS	C	D		C	B		B	B		B	B	
Approach Delay		44.7			28.0			18.6			13.4	
Approach LOS		D			C			B			B	
Queue Length 50th (m)	1.5	25.7		31.7	7.3		11.8	55.4		0.7	39.4	
Queue Length 95th (m)	m4.2	45.4		47.2	14.8		25.9	94.0		m1.4	m53.2	
Internal Link Dist (m)		798.2			801.4			377.7			1006.2	
Turn Bay Length (m)												
Base Capacity (vph)	244	332		368	714		365	826		302	838	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.04	0.59		0.70	0.12		0.33	0.63		0.02	0.45	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.73			
Intersection Signal Delay: 22.8		Intersection LOS: C	
Intersection Capacity Utilization 71.2%		ICU Level of Service C	
Analysis Period (min) 15			

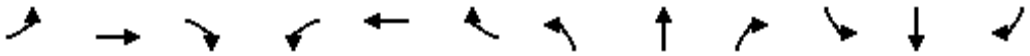
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: First Ave/Cataract Rd & Quaker Rd





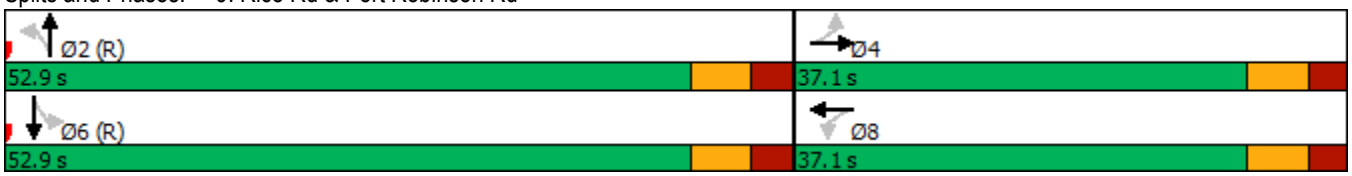
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	196	65	22	108	10	53	529	92	5	303	7
Future Volume (vph)	55	196	65	22	108	10	53	529	92	5	303	7
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00	0.99		1.00	1.00		1.00				1.00	
Frt		0.963			0.987			0.978			0.996	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1518	0	1307	1555	0	1410	1613	0	1607	1644	0
Flt Permitted	0.676			0.416			0.551			0.312		
Satd. Flow (perm)	1142	1518	0	572	1555	0	816	1613	0	528	1644	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		20			6			14			2	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		431.2			838.8			886.5			467.4	
Travel Time (s)		31.0			60.4			53.2			28.0	
Confl. Peds. (#/hr)	1		1	1		1	2					2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	9%	0%	23%	0%	83%	14%	2%	6%	0%	2%	20%
Adj. Flow (vph)	59	211	70	24	116	11	57	569	99	5	326	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	59	281	0	24	127	0	57	668	0	5	334	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		

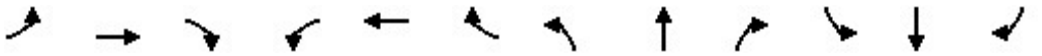


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	36.8	36.8		36.8	36.8		37.0	37.0		37.0	37.0	
Total Split (s)	37.1	37.1		37.1	37.1		52.9	52.9		52.9	52.9	
Total Split (%)	41.2%	41.2%		41.2%	41.2%		58.8%	58.8%		58.8%	58.8%	
Maximum Green (s)	30.3	30.3		30.3	30.3		45.9	45.9		45.9	45.9	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.7	2.7		2.7	2.7		2.9	2.9		2.9	2.9	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.8	6.8		6.8	6.8		7.0	7.0		7.0	7.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Flash Dont Walk (s)	19.0	19.0		19.0	19.0		19.0	19.0		19.0	19.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	20.7	20.7		20.7	20.7		55.5	55.5		55.5	55.5	
Actuated g/C Ratio	0.23	0.23		0.23	0.23		0.62	0.62		0.62	0.62	
v/c Ratio	0.23	0.77		0.18	0.35		0.11	0.67		0.02	0.33	
Control Delay	27.7	43.8		28.3	28.6		9.8	17.0		9.4	10.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	27.7	43.8		28.3	28.6		9.8	17.0		9.4	10.6	
LOS	C	D		C	C		A	B		A	B	
Approach Delay		41.0			28.5			16.4			10.6	
Approach LOS		D			C			B			B	
Queue Length 50th (m)	8.3	42.6		3.4	17.6		3.7	66.7		0.3	25.0	
Queue Length 95th (m)	16.3	61.6		9.0	28.8		11.2	135.0		2.1	51.4	
Internal Link Dist (m)		407.2			814.8			862.5			443.4	
Turn Bay Length (m)												
Base Capacity (vph)	384	524		192	527		503	1000		325	1014	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.15	0.54		0.13	0.24		0.11	0.67		0.02	0.33	

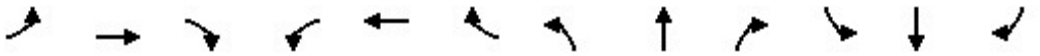
Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 80			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.77			
Intersection Signal Delay: 21.7		Intersection LOS: C	
Intersection Capacity Utilization 79.3%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 9: Rice Rd & Port Robinson Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	141	153	2	209	30	5	1	528	449	5	368	17
Future Volume (vph)	141	153	2	209	30	5	1	528	449	5	368	17
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	40.0		0.0	80.0		0.0	70.0		0.0	50.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.998			0.980			0.934			0.993	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1687	0	1607	1658	0	1339	2937	0	1607	3103	0
Flt Permitted	0.732			0.651			0.493			0.204		
Satd. Flow (perm)	1238	1687	0	1101	1658	0	695	2937	0	345	3103	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			5			320			7	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		434.7			824.0			1037.2			150.7	
Travel Time (s)		26.1			49.4			62.2			9.0	
Peak Hour Factor	0.86	0.92	0.86	0.92	0.92	0.92	0.86	0.86	0.92	0.92	0.86	0.86
Heavy Vehicles (%)	0%	0%	5%	0%	0%	0%	20%	4%	0%	0%	3%	0%
Adj. Flow (vph)	164	166	2	227	33	5	1	614	488	5	428	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	164	168	0	227	38	0	1	1102	0	5	448	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	

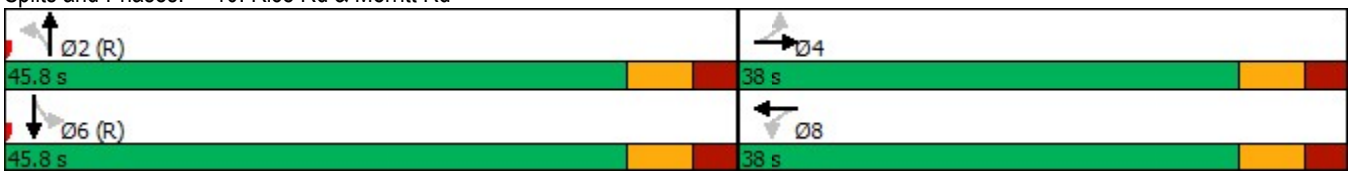


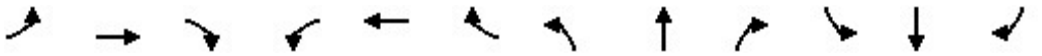
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	36.8	36.8		36.8	36.8		37.0	37.0		37.0	37.0	
Total Split (s)	38.0	38.0		38.0	38.0		45.8	45.8		45.8	45.8	
Total Split (%)	45.3%	45.3%		45.3%	45.3%		54.7%	54.7%		54.7%	54.7%	
Maximum Green (s)	31.2	31.2		31.2	31.2		38.8	38.8		38.8	38.8	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.7	2.7		2.7	2.7		2.9	2.9		2.9	2.9	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.8	6.8		6.8	6.8		7.0	7.0		7.0	7.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Flash Dont Walk (s)	19.0	19.0		19.0	19.0		19.0	19.0		19.0	19.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	22.1	22.1		22.1	22.1		47.9	47.9		47.9	47.9	
Actuated g/C Ratio	0.26	0.26		0.26	0.26		0.57	0.57		0.57	0.57	
v/c Ratio	0.50	0.38		0.78	0.09		0.00	0.61		0.03	0.25	
Control Delay	30.0	25.8		46.2	18.3		11.0	10.8		11.8	11.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	30.0	25.8		46.2	18.3		11.0	10.8		11.8	11.6	
LOS	C	C		D	B		B	B		B	B	
Approach Delay		27.9			42.2			10.8			11.6	
Approach LOS		C			D			B			B	
Queue Length 50th (m)	22.1	21.7		33.5	3.9		0.1	38.6		0.4	24.0	
Queue Length 95th (m)	32.5	32.5		50.6	9.3		0.8	67.1		m1.5	40.0	
Internal Link Dist (m)		410.7			800.0			1013.2			126.7	
Turn Bay Length (m)	40.0			80.0			70.0			50.0		
Base Capacity (vph)	460	628		409	620		397	1815		197	1776	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.36	0.27		0.56	0.06		0.00	0.61		0.03	0.25	

Intersection Summary			
Area Type:	Other		
Cycle Length: 83.8			
Actuated Cycle Length: 83.8			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 75			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 17.5		Intersection LOS: B	
Intersection Capacity Utilization 70.1%		ICU Level of Service C	
Analysis Period (min) 15			

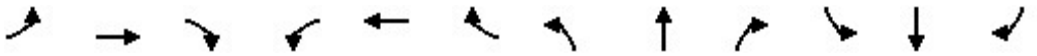
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 10: Rice Rd & Merritt Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	336	140	122	13	197	7	70	635	36	5	410	164
Future Volume (vph)	336	140	122	13	197	7	70	635	36	5	410	164
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	89.0		0.0	40.0		0.0	90.0		0.0	68.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor							1.00				0.99	
Frt		0.930			0.995			0.992			0.957	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1474	1496	0	1607	1591	0	1435	3072	0	1545	2899	0
Flt Permitted	0.316			0.581			0.320			0.260		
Satd. Flow (perm)	490	1496	0	983	1591	0	483	3072	0	423	2899	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		77			2			7			73	
Link Speed (k/h)		50			40			40			50	
Link Distance (m)		441.3			822.2			149.3			1037.2	
Travel Time (s)		31.8			74.0			13.4			74.7	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	9%	7%	3%	0%	6%	0%	12%	4%	0%	4%	2%	14%
Adj. Flow (vph)	373	156	136	14	219	8	78	706	40	6	456	182
Shared Lane Traffic (%)												
Lane Group Flow (vph)	373	292	0	14	227	0	78	746	0	6	638	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

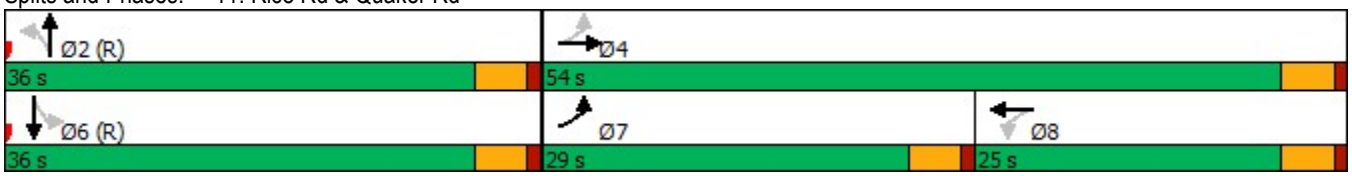


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	9.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	29.0	54.0		25.0	25.0		36.0	36.0		36.0	36.0	
Total Split (%)	32.2%	60.0%		27.8%	27.8%		40.0%	40.0%		40.0%	40.0%	
Maximum Green (s)	24.5	49.5		20.5	20.5		31.5	31.5		31.5	31.5	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)		7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0		0	0		0	0	
Act Effct Green (s)	45.0	45.0		17.0	17.0		36.0	36.0		36.0	36.0	
Actuated g/C Ratio	0.50	0.50		0.19	0.19		0.40	0.40		0.40	0.40	
v/c Ratio	0.74	0.37		0.08	0.75		0.40	0.60		0.04	0.53	
Control Delay	24.7	10.5		28.2	41.7		30.0	24.9		20.2	21.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	24.7	10.5		28.2	41.7		30.0	24.9		20.2	21.1	
LOS	C	B		C	D		C	C		C	C	
Approach Delay		18.5			40.9			25.4			21.0	
Approach LOS		B			D			C			C	
Queue Length 50th (m)	39.2	19.7		1.9	34.1		9.8	54.0		0.7	39.5	
Queue Length 95th (m)	60.2	33.8		m2.4	m40.0		24.8	76.8		3.3	59.1	
Internal Link Dist (m)		417.3			798.2			125.3			1013.2	
Turn Bay Length (m)	89.0			40.0			90.0			68.0		
Base Capacity (vph)	512	857		223	363		193	1234		169	1204	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.73	0.34		0.06	0.63		0.40	0.60		0.04	0.53	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.75			
Intersection Signal Delay: 23.8		Intersection LOS: C	

Intersection Capacity Utilization 71.4% ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 11: Rice Rd & Quaker Rd



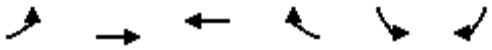
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	21	1064	13	31	68	5
Future Volume (vph)	21	1064	13	31	68	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		200.0	65.0		0.0	180.0
Storage Lanes		1	1		1	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1692	1396	1607	1128	1545	1438
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	1692	1396	1607	1128	1545	1438
Link Speed (k/h)	60			60	50	
Link Distance (m)	340.4			197.6	500.8	
Travel Time (s)	20.4			11.9	36.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	3%	0%	50%	4%	0%
Adj. Flow (vph)	24	1209	15	35	77	6
Shared Lane Traffic (%)						
Lane Group Flow (vph)	24	1209	15	35	77	6
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 81.5%		ICU Level of Service D	
Analysis Period (min) 15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	21	1064	13	31	68	5
Future Volume (Veh/h)	21	1064	13	31	68	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	24	1209	15	35	77	6
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						24
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			24		89	24
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			24		89	24
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		91	99
cM capacity (veh/h)			1604		898	1058

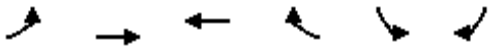
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	24	1209	15	35	83
Volume Left	0	0	15	0	77
Volume Right	0	1209	0	0	6
cSH	1700	1700	1604	1700	968
Volume to Capacity	0.01	0.71	0.01	0.02	0.09
Queue Length 95th (m)	0.0	0.0	0.2	0.0	2.1
Control Delay (s)	0.0	0.0	7.3	0.0	9.3
Lane LOS			A		A
Approach Delay (s)	0.0		2.2		9.3
Approach LOS					A

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1020	58	33	15	1130
Future Volume (vph)	77	1020	58	33	15	1130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0			210.0	0.0	150.0
Storage Lanes	1			1	1	1
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1607	1627	1484	1438	1004	1424
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1607	1627	1484	1438	1004	1424
Link Speed (k/h)		60	60		60	
Link Distance (m)		1297.0	340.4		573.6	
Travel Time (s)		77.8	20.4		34.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Adj. Flow (vph)	80	1063	60	34	16	1177
Shared Lane Traffic (%)						
Lane Group Flow (vph)	80	1063	60	34	16	1177
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		6.6	6.6		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

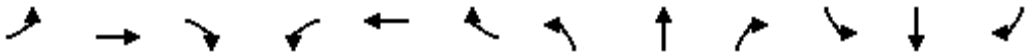
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	77	1020	58	33	15	1130
Future Volume (Veh/h)	77	1020	58	33	15	1130
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	80	1062	60	34	16	1177
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						20
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	60				1282	60
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	60				1282	60
tC, single (s)	4.1				7.0	6.2
tC, 2 stage (s)						
tF (s)	2.2				4.0	3.3
p0 queue free %	95				88	0
cM capacity (veh/h)	1556				132	1008

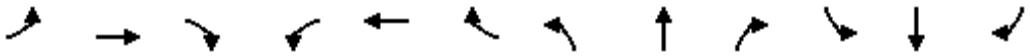
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	80	1062	60	34	1193
Volume Left	80	0	0	0	16
Volume Right	0	0	0	34	1177
cSH	1556	1700	1700	1700	1022
Volume to Capacity	0.05	0.62	0.04	0.02	1.17
Queue Length 95th (m)	1.2	0.0	0.0	0.0	261.3
Control Delay (s)	7.4	0.0	0.0	0.0	102.7
Lane LOS	A				F
Approach Delay (s)	0.5		0.0		102.7
Approach LOS					F

Intersection Summary			
Average Delay	50.7		
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	27	33	66	17	47	10	76	330	1	12	745	33
Future Volume (vph)	27	33	66	17	47	10	76	330	1	12	745	33
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.929			0.981						0.994	
Flt Protected		0.990			0.989			0.991			0.999	
Satd. Flow (prot)	0	1323	0	0	1342	0	0	1618	0	0	1664	0
Flt Permitted		0.990			0.989			0.991			0.999	
Satd. Flow (perm)	0	1323	0	0	1342	0	0	1618	0	0	1664	0
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		838.4			681.4			1027.1			497.4	
Travel Time (s)		60.4			40.9			61.6			29.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	41%	13%	0%	35%	0%	2%	4%	0%	0%	1%	0%
Adj. Flow (vph)	29	36	72	18	51	11	83	359	1	13	810	36
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	137	0	0	80	0	0	443	0	0	859	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

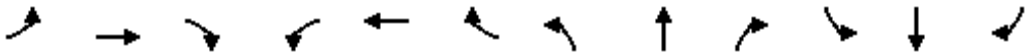
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 87.3%		ICU Level of Service E	
Analysis Period (min) 15			



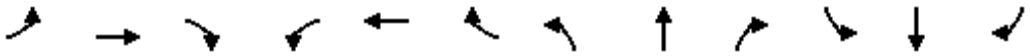
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	27	33	66	17	47	10	76	330	1	12	745	33
Future Volume (Veh/h)	27	33	66	17	47	10	76	330	1	12	745	33
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	29	36	72	18	51	11	83	359	1	13	810	36
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1416	1380	828	1470	1398	360	846			360		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1416	1380	828	1470	1398	360	846			360		
tC, single (s)	7.1	6.9	6.3	7.1	6.8	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.4	3.4	3.5	4.3	3.3	2.2			2.2		
p0 queue free %	56	66	80	69	52	98	90			99		
cM capacity (veh/h)	66	106	355	57	107	689	791			1210		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	137	80	443	859
Volume Left	29	18	83	13
Volume Right	72	11	1	36
cSH	139	99	791	1210
Volume to Capacity	0.98	0.81	0.10	0.01
Queue Length 95th (m)	53.4	33.6	2.7	0.2
Control Delay (s)	134.2	120.9	3.0	0.3
Lane LOS	F	F	A	A
Approach Delay (s)	134.2	120.9	3.0	0.3
Approach LOS	F	F		

Intersection Summary				
Average Delay	19.5			
Intersection Capacity Utilization	87.3%	ICU Level of Service	E	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	72	464	13	557	581	50	8	285	603	30	746	52
Future Volume (vph)	72	464	13	557	581	50	8	285	603	30	746	52
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	90.0		0.0	65.0		0.0	30.0		40.0	40.0		0.0
Storage Lanes	1		0	1		0	1		1	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	0.95	0.95
Frt		0.996			0.988				0.850		0.990	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	3201	0	1591	3117	0	1607	1642	1396	1165	3153	0
Flt Permitted	0.397			0.307			0.178			0.465		
Satd. Flow (perm)	672	3201	0	514	3117	0	301	1642	1396	570	3153	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			15				558		8	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		150.4			1297.0			1025.7			1027.1	
Travel Time (s)		9.0			77.8			61.5			61.6	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	0%	1%	1%	12%	0%	3%	3%	38%	1%	0%
Adj. Flow (vph)	77	494	14	593	618	53	9	303	641	32	794	55
Shared Lane Traffic (%)												
Lane Group Flow (vph)	77	508	0	593	671	0	9	303	641	32	849	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4		3	8			2			6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2		2	6		
Detector Phase	4	4		3	8		2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		10.0	8.0		10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	30.1	30.1		13.0	30.1		35.4	35.4	35.4	35.4	35.4	
Total Split (s)	30.1	30.1		24.0	54.1		36.4	36.4	36.4	36.4	36.4	
Total Split (%)	33.3%	33.3%		26.5%	59.8%		40.2%	40.2%	40.2%	40.2%	40.2%	
Maximum Green (s)	24.0	24.0		21.0	48.0		30.0	30.0	30.0	30.0	30.0	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1	4.1	4.1	4.1	
All-Red Time (s)	2.0	2.0		0.0	2.0		2.3	2.3	2.3	2.3	2.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.1	6.1		3.0	6.1		6.4	6.4	6.4	6.4	6.4	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0		3.0	3.0		5.0	5.0	5.0	3.0	3.0	
Recall Mode	None	None		None	None		None	None	None	None	None	
Walk Time (s)	9.0	9.0			9.0		11.0	11.0	11.0	11.0	11.0	
Flash Dont Walk (s)	15.0	15.0			15.0		18.0	18.0	18.0	18.0	18.0	
Pedestrian Calls (#/hr)	0	0			0		0	0	0	0	0	
Act Effct Green (s)	20.5	20.5		47.9	44.7		26.9	26.9	26.9	26.9	26.9	
Actuated g/C Ratio	0.24	0.24		0.57	0.53		0.32	0.32	0.32	0.32	0.32	
v/c Ratio	0.47	0.65		1.06	0.40		0.09	0.58	0.78	0.18	0.84	
Control Delay	38.8	33.1		71.9	12.8		23.9	29.4	11.8	24.4	35.3	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	38.8	33.1		71.9	12.8		23.9	29.4	11.8	24.4	35.3	
LOS	D	C		E	B		C	C	B	C	D	
Approach Delay		33.9			40.5			17.5			34.9	
Approach LOS		C			D			B			C	
Queue Length 50th (m)	11.1	40.3		~85.3	33.7		1.0	41.6	9.9	3.8	67.5	
Queue Length 95th (m)	24.9	56.4		#148.6	46.1		4.7	68.3	53.9	11.0	92.6	
Internal Link Dist (m)		126.4			1273.0			1001.7			1003.1	
Turn Bay Length (m)	90.0			65.0			30.0		40.0	40.0		
Base Capacity (vph)	193	922		562	1798		108	590	858	204	1137	
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	
Reduced v/c Ratio	0.40	0.55		1.06	0.37		0.08	0.51	0.75	0.16	0.75	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90.5			
Actuated Cycle Length: 84.3			
Natural Cycle: 90			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.06			
Intersection Signal Delay: 32.2		Intersection LOS: C	
Intersection Capacity Utilization 88.7%		ICU Level of Service E	
Analysis Period (min) 15			

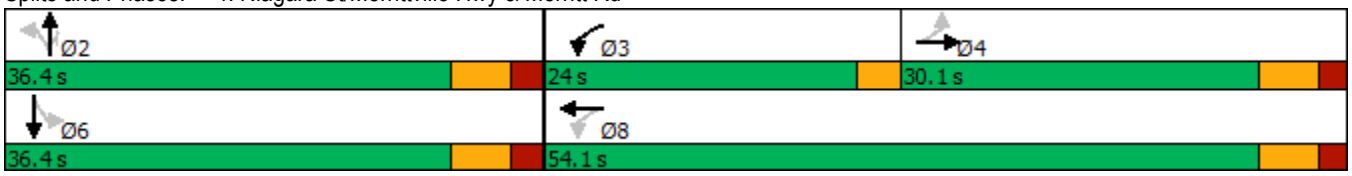
~ Volume exceeds capacity, queue is theoretically infinite.

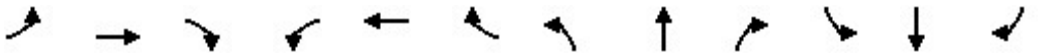
Queue shown is maximum after two cycles.

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

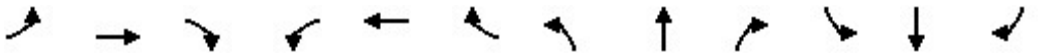
Queue shown is maximum after two cycles.

Splits and Phases: 4: Niagara St/Merrittville Hwy & Merritt Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	83	117	266	38	41	19	263	794	47	78	1172	66
Future Volume (vph)	83	117	266	38	41	19	263	794	47	78	1172	66
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0		0.0	30.0		0.0	75.0		0.0	65.0		30.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.896			0.953			0.992			0.992	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1560	1493	0	1607	1580	0	1591	3096	0	1607	3155	0
Flt Permitted	0.711			0.188			0.088			0.270		
Satd. Flow (perm)	1168	1493	0	318	1580	0	147	3096	0	457	3155	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		117			22			10			8	
Link Speed (k/h)		50			50			40			60	
Link Distance (m)		825.4			480.8			403.8			1025.7	
Travel Time (s)		59.4			34.6			36.3			61.5	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	3%	5%	0%	0%	3%	0%	1%	3%	3%	0%	1%	2%
Adj. Flow (vph)	97	136	309	44	48	22	306	923	55	91	1363	77
Shared Lane Traffic (%)												
Lane Group Flow (vph)	97	445	0	44	70	0	306	978	0	91	1440	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	10.0		4.5	10.0	
Minimum Split (s)	14.9	14.9		14.9	14.9		9.0	16.6		9.0	16.6	
Total Split (s)	28.2	28.2		28.2	28.2		15.0	54.3		9.0	48.3	
Total Split (%)	30.8%	30.8%		30.8%	30.8%		16.4%	59.3%		9.8%	52.8%	
Maximum Green (s)	21.3	21.3		21.3	21.3		12.0	47.7		6.0	41.7	
Yellow Time (s)	4.1	4.1		4.1	4.1		3.0	4.1		3.0	4.1	
All-Red Time (s)	2.8	2.8		2.8	2.8		0.0	2.5		0.0	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.9	6.9		6.9	6.9		3.0	6.6		3.0	6.6	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		3.0	2.5		3.0	2.5	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)	11.0	11.0		11.0	11.0			9.0			9.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			14.0			14.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	21.3	21.3		21.3	21.3		60.3	49.5		51.2	41.7	
Actuated g/C Ratio	0.23	0.23		0.23	0.23		0.66	0.54		0.56	0.46	
v/c Ratio	0.36	1.02		0.59	0.18		1.07	0.58		0.28	1.00	
Control Delay	33.9	75.5		66.5	22.1		98.5	16.2		8.4	49.3	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	33.9	75.5		66.5	22.1		98.5	16.2		8.4	49.3	
LOS	C	E		E	C		F	B		A	D	
Approach Delay		68.0			39.2			35.8			46.9	
Approach LOS		E			D			D			D	
Queue Length 50th (m)	14.4	~63.4		6.9	6.7		~45.4	59.4		5.2	128.1	
Queue Length 95th (m)	27.2	#113.6		#21.8	16.4		#87.7	72.7		9.7	#166.4	
Internal Link Dist (m)		801.4			456.8			379.8			1001.7	
Turn Bay Length (m)	80.0			30.0			75.0			65.0		
Base Capacity (vph)	271	437		74	384		286	1679		331	1442	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.36	1.02		0.59	0.18		1.07	0.58		0.27	1.00	

Intersection Summary			
Area Type:	Other		
Cycle Length: 91.5			
Actuated Cycle Length: 91.5			
Natural Cycle: 90			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.07			
Intersection Signal Delay: 45.8		Intersection LOS: D	
Intersection Capacity Utilization 102.1%		ICU Level of Service G	
Analysis Period (min) 15			

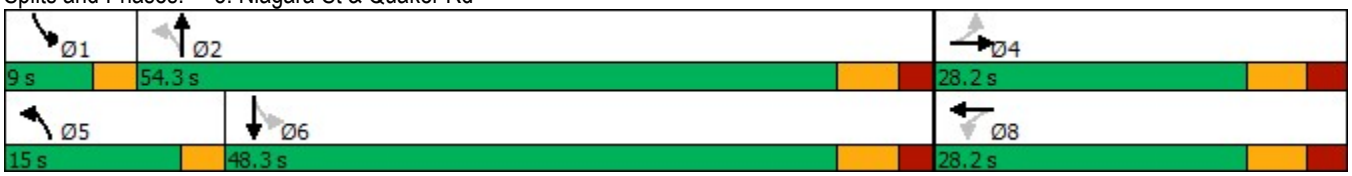
~ Volume exceeds capacity, queue is theoretically infinite.

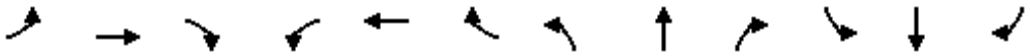
Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

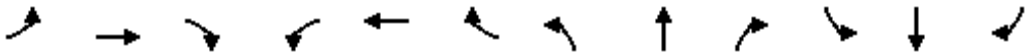
Splits and Phases: 5: Niagara St & Quaker Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	24	83	27	10	123	23	32	149	15	28	312	170
Future Volume (vph)	24	83	27	10	123	23	32	149	15	28	312	170
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.973			0.980			0.990			0.955	
Flt Protected		0.991			0.997			0.992			0.997	
Satd. Flow (prot)	0	1587	0	0	1494	0	0	1661	0	0	1534	0
Flt Permitted		0.991			0.997			0.992			0.997	
Satd. Flow (perm)	0	1587	0	0	1494	0	0	1661	0	0	1534	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		838.8			838.4			991.4			524.1	
Travel Time (s)		60.4			60.4			71.4			37.7	
Confl. Peds. (#/hr)			1	1			2					2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	3%	0%	14%	3%	50%	0%	0%	0%	92%	0%	0%
Adj. Flow (vph)	26	90	29	11	134	25	35	162	16	30	339	185
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	145	0	0	170	0	0	213	0	0	554	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

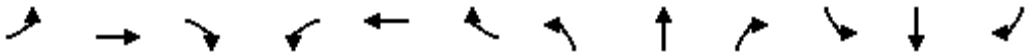
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 55.7%		ICU Level of Service B	
Analysis Period (min) 15			



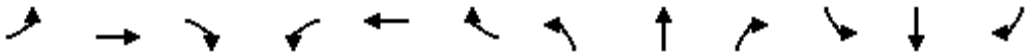
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	24	83	27	10	123	23	32	149	15	28	312	170
Future Volume (vph)	24	83	27	10	123	23	32	149	15	28	312	170
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	26	90	29	11	134	25	35	162	16	30	339	185

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	145	170	213	554
Volume Left (vph)	26	11	35	30
Volume Right (vph)	29	25	16	185
Hadj (s)	-0.04	0.11	-0.01	-0.10
Departure Headway (s)	6.4	6.4	5.8	5.2
Degree Utilization, x	0.26	0.30	0.34	0.80
Capacity (veh/h)	509	504	559	674
Control Delay (s)	11.5	12.2	11.8	25.7
Approach Delay (s)	11.5	12.2	11.8	25.7
Approach LOS	B	B	B	D

Intersection Summary				
Delay	18.9			
Level of Service	C			
Intersection Capacity Utilization	55.7%	ICU Level of Service	B	
Analysis Period (min)	15			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	365	1	211	406	24	5	157	172	12	332	5
Future Volume (vph)	15	365	1	211	406	24	5	157	172	12	332	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	20.0		0.0	20.0		0.0	20.0		0.0	20.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.992			0.922			0.998	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1692	0	1591	1678	0	1607	1560	0	1607	1672	0
Flt Permitted	0.495			0.267			0.440			0.449		
Satd. Flow (perm)	837	1692	0	447	1678	0	744	1560	0	760	1672	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					5			65			1	
Link Speed (k/h)		60			60			50			50	
Link Distance (m)		824.0			681.3			1030.2			991.4	
Travel Time (s)		49.4			40.9			74.2			71.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	1%	0%
Adj. Flow (vph)	16	397	1	229	441	26	5	171	187	13	361	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	16	398	0	229	467	0	5	358	0	13	366	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	

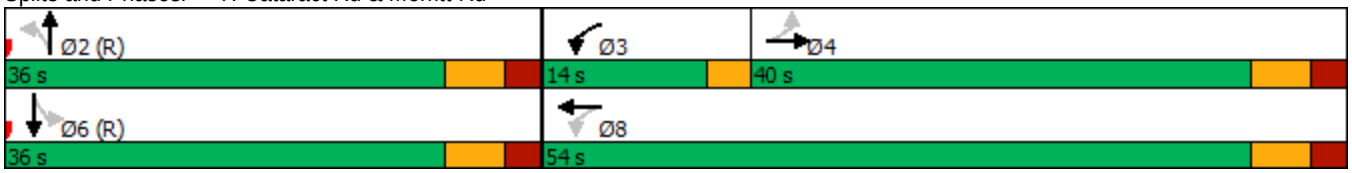


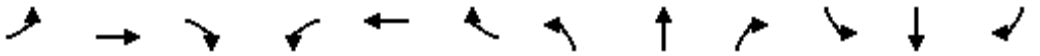
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		3	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		6.0	10.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	29.6	29.6		10.5	29.6		29.6	29.6		29.6	29.6	
Total Split (s)	40.0	40.0		14.0	54.0		36.0	36.0		36.0	36.0	
Total Split (%)	44.4%	44.4%		15.6%	60.0%		40.0%	40.0%		40.0%	40.0%	
Maximum Green (s)	33.4	33.4		11.0	47.4		29.4	29.4		29.4	29.4	
Yellow Time (s)	4.1	4.1		3.0	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.5	2.5		0.0	2.5		2.5	2.5		2.5	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.6	6.6		3.0	6.6		6.6	6.6		6.6	6.6	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	9.0	9.0			9.0		9.0	9.0		9.0	9.0	
Flash Dont Walk (s)	14.0	14.0			14.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)	26.2	26.2		43.6	40.0		36.8	36.8		36.8	36.8	
Actuated g/C Ratio	0.29	0.29		0.48	0.44		0.41	0.41		0.41	0.41	
v/c Ratio	0.07	0.81		0.65	0.63		0.02	0.53		0.04	0.54	
Control Delay	15.1	37.4		22.1	22.3		19.8	21.3		20.0	25.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	15.1	37.4		22.1	22.3		19.8	21.3		20.0	25.4	
LOS	B	D		C	C		B	C		B	C	
Approach Delay		36.5			22.2			21.2			25.2	
Approach LOS		D			C			C			C	
Queue Length 50th (m)	2.2	63.6		22.5	58.6		0.5	37.3		1.4	47.2	
Queue Length 95th (m)	m4.0	94.1		30.9	75.9		3.0	72.6		5.6	84.2	
Internal Link Dist (m)		800.0			657.3			1006.2			967.4	
Turn Bay Length (m)	20.0			20.0			20.0			20.0		
Base Capacity (vph)	310	627		356	886		304	676		311	684	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.05	0.63		0.64	0.53		0.02	0.53		0.04	0.54	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 70			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.81			
Intersection Signal Delay: 25.8		Intersection LOS: C	
Intersection Capacity Utilization 70.0%		ICU Level of Service C	
Analysis Period (min) 15			

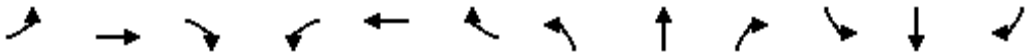
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: Cataract Rd & Merritt Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	211	70	206	163	1	60	308	238	17	426	101
Future Volume (vph)	25	211	70	206	163	1	60	308	238	17	426	101
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		0.99		1.00								
Frt		0.962			0.999			0.935			0.971	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1512	0	1560	1673	0	1607	1575	0	1607	1633	0
Flt Permitted	0.640			0.239			0.246			0.229		
Satd. Flow (perm)	1083	1512	0	392	1673	0	416	1575	0	387	1633	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		18						56			17	
Link Speed (k/h)		40			40			40			50	
Link Distance (m)		822.2			825.4			401.7			1030.2	
Travel Time (s)		74.0			74.3			36.2			74.2	
Confl. Peds. (#/hr)			1	1								
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	3%	19%	3%	1%	0%	0%	0%	1%	0%	0%	3%
Adj. Flow (vph)	28	240	80	234	185	1	68	350	270	19	484	115
Shared Lane Traffic (%)												
Lane Group Flow (vph)	28	320	0	234	186	0	68	620	0	19	599	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		6.6			6.6			6.6			6.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4		3	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	22.5	22.5		9.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	27.8	27.8		17.2	45.0		45.0	45.0		45.0	45.0	
Total Split (%)	30.9%	30.9%		19.1%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	23.3	23.3		12.7	40.5		40.5	40.5		40.5	40.5	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	7.0	7.0			7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)	21.2	21.2		37.9	37.9		43.1	43.1		43.1	43.1	
Actuated g/C Ratio	0.24	0.24		0.42	0.42		0.48	0.48		0.48	0.48	
v/c Ratio	0.11	0.87		0.73	0.26		0.34	0.79		0.10	0.76	
Control Delay	24.3	50.5		31.4	17.4		22.4	28.0		11.5	24.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	24.3	50.5		31.4	17.4		22.4	28.0		11.5	24.1	
LOS	C	D		C	B		C	C		B	C	
Approach Delay		48.4			25.2			27.5			23.7	
Approach LOS		D			C			C			C	
Queue Length 50th (m)	4.0	50.3		25.3	19.2		7.5	84.4		2.2	79.8	
Queue Length 95th (m)	m9.3	#86.3		#41.9	32.1		18.6	#141.3		m2.9	#140.1	
Internal Link Dist (m)		798.2			801.4			377.7			1006.2	
Turn Bay Length (m)												
Base Capacity (vph)	280	404		330	752		199	783		185	791	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.10	0.79		0.71	0.25		0.34	0.79		0.10	0.76	

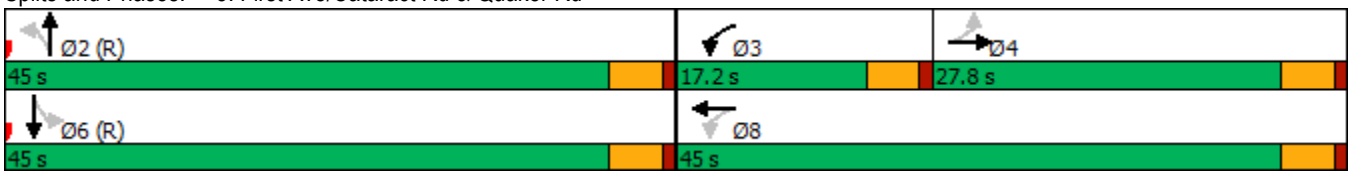
Intersection Summary

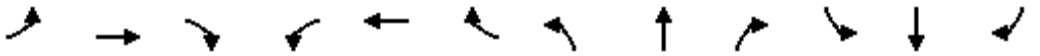
Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 29.4 Intersection LOS: C
Intersection Capacity Utilization 81.6% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

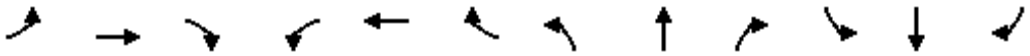
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: First Ave/Cataract Rd & Quaker Rd





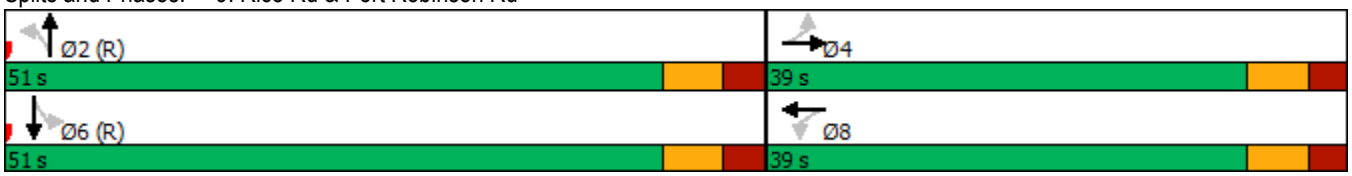
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	123	71	49	260	16	92	375	2	9	446	45
Future Volume (vph)	23	123	71	49	260	16	92	375	2	9	446	45
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00	0.99		1.00	1.00		1.00				1.00	
Frt		0.945			0.991			0.999			0.986	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1566	0	1576	1659	0	1607	1640	0	1607	1635	0
Flt Permitted	0.402			0.571			0.418			0.505		
Satd. Flow (perm)	679	1566	0	946	1659	0	706	1640	0	854	1635	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		36			4						8	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		431.2			838.8			886.5			467.4	
Travel Time (s)		31.0			60.4			53.2			28.0	
Confl. Peds. (#/hr)	1		1	1		1	2					2
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	2%	0%	2%	1%	0%	0%	3%	9%	0%	2%	0%
Adj. Flow (vph)	24	128	74	51	271	17	96	391	2	9	465	47
Shared Lane Traffic (%)												
Lane Group Flow (vph)	24	202	0	51	288	0	96	393	0	9	512	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		

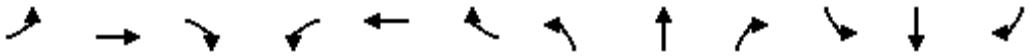


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	36.8	36.8		36.8	36.8		37.0	37.0		37.0	37.0	
Total Split (s)	39.0	39.0		39.0	39.0		51.0	51.0		51.0	51.0	
Total Split (%)	43.3%	43.3%		43.3%	43.3%		56.7%	56.7%		56.7%	56.7%	
Maximum Green (s)	32.2	32.2		32.2	32.2		44.0	44.0		44.0	44.0	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.7	2.7		2.7	2.7		2.9	2.9		2.9	2.9	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.8	6.8		6.8	6.8		7.0	7.0		7.0	7.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Flash Dont Walk (s)	19.0	19.0		19.0	19.0		19.0	19.0		19.0	19.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	20.6	20.6		20.6	20.6		55.6	55.6		55.6	55.6	
Actuated g/C Ratio	0.23	0.23		0.23	0.23		0.62	0.62		0.62	0.62	
v/c Ratio	0.15	0.52		0.24	0.75		0.22	0.39		0.02	0.51	
Control Delay	27.3	28.6		28.7	43.9		20.3	20.2		9.1	12.9	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	27.3	28.6		28.7	43.9		20.3	20.2		9.1	12.9	
LOS	C	C		C	D		C	C		A	B	
Approach Delay		28.5			41.6			20.2			12.8	
Approach LOS		C			D			C			B	
Queue Length 50th (m)	3.4	25.0		7.2	46.0		10.1	52.6		0.5	43.7	
Queue Length 95th (m)	8.9	40.4		15.0	65.0		27.4	84.2		2.9	86.2	
Internal Link Dist (m)		407.2			814.8			862.5			443.4	
Turn Bay Length (m)												
Base Capacity (vph)	242	583		338	596		436	1013		527	1013	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.10	0.35		0.15	0.48		0.22	0.39		0.02	0.51	

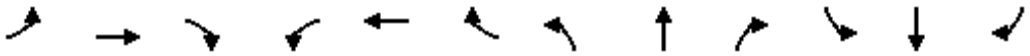
Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 75			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.75			
Intersection Signal Delay: 23.5		Intersection LOS: C	
Intersection Capacity Utilization 82.7%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 9: Rice Rd & Port Robinson Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	56	68	2	244	157	5	1	408	313	5	461	100
Future Volume (vph)	56	68	2	244	157	5	1	408	313	5	461	100
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	40.0		0.0	80.0		0.0	70.0		0.0	50.0		50.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.996			0.996			0.938			0.973	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1576	1681	0	1607	1685	0	1607	2963	0	1607	3077	0
Flt Permitted	0.646			0.478			0.382			0.306		
Satd. Flow (perm)	1071	1681	0	809	1685	0	646	2963	0	518	3077	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			2			212			31	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		434.7			824.0			1037.2			150.7	
Travel Time (s)		26.1			49.4			62.2			9.0	
Peak Hour Factor	0.85	0.92	0.85	0.92	0.92	0.92	0.85	0.85	0.92	0.92	0.85	0.85
Heavy Vehicles (%)	2%	0%	9%	0%	0%	0%	0%	3%	0%	0%	2%	0%
Adj. Flow (vph)	66	74	2	265	171	5	1	480	340	5	542	118
Shared Lane Traffic (%)												
Lane Group Flow (vph)	66	76	0	265	176	0	1	820	0	5	660	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	

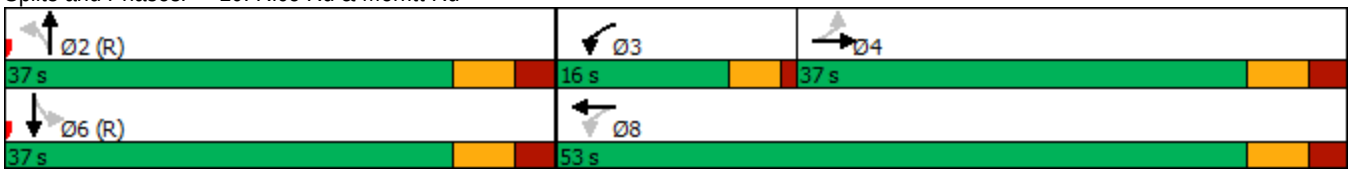


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		3	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		5.0	8.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	36.8	36.8		9.5	36.8		37.0	37.0		37.0	37.0	
Total Split (s)	37.0	37.0		16.0	53.0		37.0	37.0		37.0	37.0	
Total Split (%)	41.1%	41.1%		17.8%	58.9%		41.1%	41.1%		41.1%	41.1%	
Maximum Green (s)	30.2	30.2		11.5	46.2		30.0	30.0		30.0	30.0	
Yellow Time (s)	4.1	4.1		3.5	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.7	2.7		1.0	2.7		2.9	2.9		2.9	2.9	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.8	6.8		4.5	6.8		7.0	7.0		7.0	7.0	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5		3.0	2.5		2.5	2.5		2.5	2.5	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	11.0	11.0			11.0		11.0	11.0		11.0	11.0	
Flash Dont Walk (s)	19.0	19.0			19.0		19.0	19.0		19.0	19.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)	11.0	11.0		26.4	24.1		52.1	52.1		52.1	52.1	
Actuated g/C Ratio	0.12	0.12		0.29	0.27		0.58	0.58		0.58	0.58	
v/c Ratio	0.50	0.37		0.78	0.39		0.00	0.45		0.02	0.37	
Control Delay	49.4	39.2		49.5	33.0		7.0	7.0		11.4	11.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	49.4	39.2		49.5	33.0		7.0	7.0		11.4	11.7	
LOS	D	D		D	C		A	A		B	B	
Approach Delay		43.9			42.9			7.0			11.7	
Approach LOS		D			D			A			B	
Queue Length 50th (m)	10.9	12.0		49.8	32.5		0.1	37.8		0.4	30.2	
Queue Length 95th (m)	20.9	23.3		73.4	52.6		m0.2	55.8		2.2	44.7	
Internal Link Dist (m)		410.7			800.0			1013.2			126.7	
Turn Bay Length (m)	40.0			80.0			70.0			50.0		
Base Capacity (vph)	359	565		339	865		373	1805		299	1794	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.18	0.13		0.78	0.20		0.00	0.45		0.02	0.37	

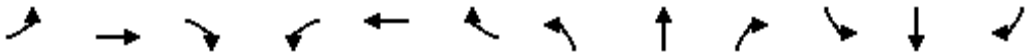
Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 85			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 18.7		Intersection LOS: B	
Intersection Capacity Utilization 59.7%		ICU Level of Service B	
Analysis Period (min) 15			

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 10: Rice Rd & Merritt Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	195	222	79	41	277	6	104	521	69	15	461	231
Future Volume (vph)	195	222	79	41	277	6	104	521	69	15	461	231
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	89.0		0.0	40.0		0.0	90.0		90.0	68.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor							1.00				0.99	
Frt		0.961			0.997			0.982			0.950	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1607	1549	0	1607	1654	0	1576	3038	0	1545	2952	0
Flt Permitted	0.260			0.564			0.303			0.359		
Satd. Flow (perm)	440	1549	0	954	1654	0	502	3038	0	584	2952	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		26			1			20			123	
Link Speed (k/h)		50			40			40			50	
Link Distance (m)		441.3			822.2			149.3			1037.2	
Travel Time (s)		31.8			74.0			13.4			74.7	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	6%	2%	0%	2%	0%	2%	4%	3%	4%	3%	2%
Adj. Flow (vph)	210	239	85	44	298	6	112	560	74	16	496	248
Shared Lane Traffic (%)												
Lane Group Flow (vph)	210	324	0	44	304	0	112	634	0	16	744	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

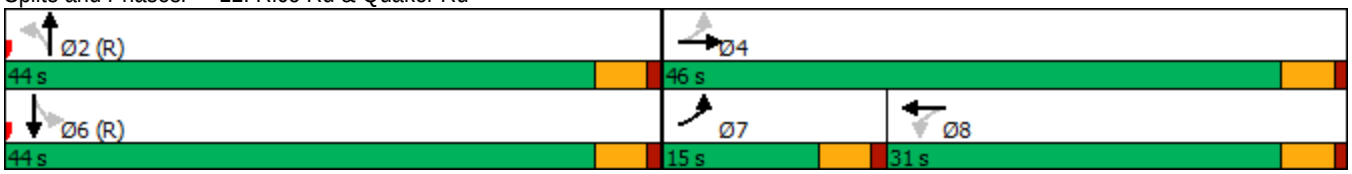


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	9.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	15.0	46.0		31.0	31.0		44.0	44.0		44.0	44.0	
Total Split (%)	16.7%	51.1%		34.4%	34.4%		48.9%	48.9%		48.9%	48.9%	
Maximum Green (s)	10.5	41.5		26.5	26.5		39.5	39.5		39.5	39.5	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)		7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0		0	0		0	0	
Act Effct Green (s)	36.0	36.0		21.1	21.1		45.0	45.0		45.0	45.0	
Actuated g/C Ratio	0.40	0.40		0.23	0.23		0.50	0.50		0.50	0.50	
v/c Ratio	0.68	0.51		0.20	0.78		0.45	0.42		0.05	0.48	
Control Delay	29.3	20.9		27.9	46.3		23.8	15.6		15.7	15.2	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	29.3	20.9		27.9	46.3		23.8	15.6		15.7	15.2	
LOS	C	C		C	D		C	B		B	B	
Approach Delay		24.2			43.9			16.9			15.2	
Approach LOS		C			D			B			B	
Queue Length 50th (m)	24.2	37.2		6.1	48.9		12.1	34.0		1.5	36.8	
Queue Length 95th (m)	36.6	55.0		13.9	72.0		31.3	52.7		m4.5	64.2	
Internal Link Dist (m)		417.3			798.2			125.3			1013.2	
Turn Bay Length (m)	89.0			40.0			90.0			68.0		
Base Capacity (vph)	312	728		280	487		250	1527		291	1536	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.67	0.45		0.16	0.62		0.45	0.42		0.05	0.48	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 21.9		Intersection LOS: C	

Intersection Capacity Utilization 71.1% ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 11: Rice Rd & Quaker Rd



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	46	989	12	24	67	5
Future Volume (vph)	46	989	12	24	67	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		200.0	65.0		0.0	180.0
Storage Lanes		1	1		1	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1627	1369	1607	1692	1422	1438
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	1627	1369	1607	1692	1422	1438
Link Speed (k/h)	60			60	50	
Link Distance (m)	340.4			197.6	500.8	
Travel Time (s)	20.4			11.9	36.1	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Heavy Vehicles (%)	4%	5%	0%	0%	13%	0%
Adj. Flow (vph)	55	1177	14	29	80	6
Shared Lane Traffic (%)						
Lane Group Flow (vph)	55	1177	14	29	80	6
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 76.5%		ICU Level of Service D	
Analysis Period (min) 15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	46	989	12	24	67	5
Future Volume (Veh/h)	46	989	12	24	67	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	55	1177	14	29	80	6
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						24
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			55		112	55
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			55		112	55
tC, single (s)			4.1		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			99		91	99
cM capacity (veh/h)			1563		851	1018

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	55	1177	14	29	86
Volume Left	0	0	14	0	80
Volume Right	0	1177	0	0	6
cSH	1700	1700	1563	1700	915
Volume to Capacity	0.03	0.69	0.01	0.02	0.09
Queue Length 95th (m)	0.0	0.0	0.2	0.0	2.4
Control Delay (s)	0.0	0.0	7.3	0.0	9.6
Lane LOS			A		A
Approach Delay (s)	0.0		2.4		9.6
Approach LOS					A

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	76.5%	ICU Level of Service	D
Analysis Period (min)	15		

APPENDIX

M INTERCHNAGE REDESIGN MEMORANDUM

MEMO

TO: Kashif Hussain (MTO)

FROM: Mir Ahsan Talpur, M.Env.Sc., EP (WSP)

CC: Maged Elmadhoon (Niagara Region)

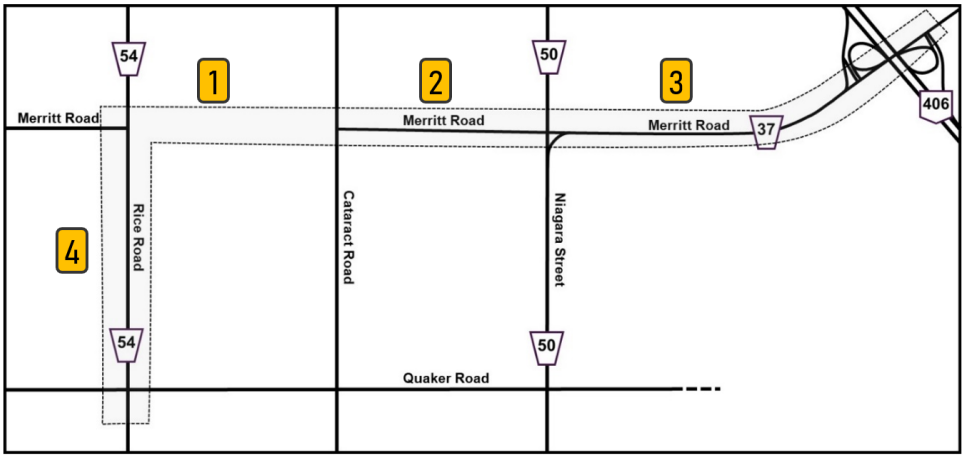
SUBJECT: IM20103036 – Merritt Road & Rice Road EA, Niagara Region

RE: Merritt Road, Grisdale Road & Highway 406 Interchange Design Options

DATE: May 25, 2023

1 INTRODUCTION

The Regional Municipality of Niagara (Niagara Region) is undertaking a Schedule 'C' Municipal Class Environmental Assessment Study (Class EA / the Study) for improvements to Merritt Road and Rice Road in the Town of Pelham, the City of Thorold, and the City of Welland. The study area is shown in the exhibit below.



The Study aims to determine and address future transportation needs of the surrounding community for all road users. For such, Niagara Region has retained WSP E&I Canada Limited (Formerly Wood Environment & Infrastructure Solutions) to undertake the Study which is being conducted in accordance with the Ontario Environmental Assessment Act (EAA) requirements for a Schedule 'C' Project (Phases 1-4) as outlined in the Municipal Engineers Association's Class EA document (Municipal Engineers Association, 2000 as amended in 2011 and 2015).

This study is building on the recommendations of the Niagara Region's Transportation Master Plan (TMP), which included the following:

- Extension of Merritt Road between Regional Road 54 (Rice Road) and Cataract Road;
- Capacity improvements of Merritt Road from Cataract Road to Highway 406; and,

WSP E&I Canada Limited
3450 Harvester Road, Suite 100
Burlington, ON L7N 3W5
Canada
T+ 1-905-335-2353
wsp.com

- Capacity improvements to Regional Road 54 (Rice Road) from 200 meters north of Merritt Road to Quaker Road.

The study will address active transportation needs by providing dedicated pedestrian and cyclist infrastructure that is safe, attractive, conforms to a complete streets approach, and compatible with the changing land use in the three local municipalities.

2 PURPOSE

The purpose of this memo is to identify and document future condition requirements in the vicinity of Highway 406 interchange at Merritt Road. Based on the traffic assessment undertaken as part of this Class EA study, it is recommended to widen Merritt Road to 4-lanes up to Highway 406. As a result, 2 eastbound and westbound through lanes are proposed at Grisdale Road intersection which is located ±205m west of Highway 406 westerly N-E/W Off-Ramp. It is noted that Grisdale Road provides a minor access to/from Merritt Road and generate very low traffic demand. Since the traffic volume to/from Grisdale Road are low, they are of lesser concern as compared to close proximity of Grisdale Road intersection with Highway 406 Off-Ramp which raises safety concerns due to shared existing westbound left (WBL) with westbound through (WBT) under existing condition.

To discuss future needs and potential improvements within the study area, WSP and the Region staff met virtually with the Ontario Ministry of Transportation (MTO) staff on January 17, 2022, and presented existing conditions, need for improvements and design Options 1, 2 and 3 which are later discussed in detail in sections below. The minutes of this meeting are provided as **Attachment A**. During the meeting, MTO staff suggested project team to develop an option providing an additional eastbound through (EBT) lane while maintaining existing eastbound left (EBL) turn lane at Highway 406 N-E/W Off-Ramp and E/W-S On-Ramp intersection at Merritt Road, referred as Option-4. The MTO staff also inquired about provision of active transportation connectivity across the bridge to the east side of Highway 406. Minutes of that meeting are included as an attachment to this memo for reference purposes. Furthermore, MTO staff in an email (dated January 26, 2022) requested the project team to assess provision of a roundabout at Highway 406 N-E/W Off-Ramp and E/W-S On-Ramp intersection at Merritt Road. WSP design team has prepared a 2-lane roundabout, referred as Option-5 in this memo.

After initial review of the memo by MTO, a follow-up meeting was arranged with the project team attended by WSP, Region and MTO staff on March 22, 2022, to discuss and receive feedback for design options 1 through 5 presented in the memo. During the meeting, MTO staff requested project team to determine feasibility of providing active transportation on the north side of the structure, having pedestrian crossing at the proposed signalized Highway 406 N-E/W Off-Ramp and E/W-S On-Ramp intersection at Merritt Road while removing channelized WBR turn and provide a short WBR turn lane at the intersection. This option is referred as Option 6 in the memo. WSP shared updated version of this memo with MTO (with Option 6) on April 13, 2022. MTO subsequently provided several rounds of comments on Option 6. An Executive Review Meeting was held with MTO's senior management on March 21, 2023, to present the preferred Option 6 and receive MTO's approval. Option 6 was accepted in principle by MTO senior management during the meeting with provision of minor comments.
The Project Team subsequently updated the Option 6 to address MTO Senior Management's comments.
On May 23, 2023, the MTO staff confirmed that they have no more comments on Option 6, and the Project Team could proceed with including the preferred Option 6 in the environmental assessment reporting. The current version of the memo incorporates MTO's comments.

3 DESIGN OPTIONS

To address future demand considering safety concerns noted above, WSP project team has prepared several geometric options to assess functionality and operations at Grisdale Road intersection in view of Merritt Road future widening. Details of these options are provided below, whereas illustrations and supporting traffic assessment report are provided as **Attachment B** and **Attachment C** respectively.

Option-1:

Under this option the Grisdale Road/Merritt Road intersection is Right-In/Right-Out (RIRO) only by providing a pork-chop island to restrict westbound left (WBL) and northbound left (NBL) movements. It should be noted that this type of treatment is not preferred as drivers may not comply with turn restrictions and potentially create greater safety concern.

Additionally, it is proposed that the existing exclusive eastbound left (EBL) turn lane carrying in-bound traffic to Highway 406 E/W-S On-Ramp be converted to a shared eastbound through-left (EBTL) to utilize existing capacity and avoid widening on the south side of Merritt Road.

Option-2:

Like Option-1, the Grisdale Road/Merritt Road intersection is considered as RIRO only by providing a raised concrete median along Merritt Road extending up to Highway 406 westerly Off-Ramp. This configuration ensures that westbound left (WBL) and northbound left (NBL) movements are not permitted to/from Grisdale Road. Under existing conditions, the Highway 406 N-E/W Off-Ramp has an exclusive channelized southbound right (SBR) turn lane which serves as a free-flow deceleration lane and a single shared southbound right/left lane at the terminal.

In addition to limiting Grisdale Road/Merritt Road intersection as RIRO only, a minor modification to the Highway 406 N-E/W Off-Ramp is also proposed in this option, which is the signalization of the ramp terminal and removal of channelized southbound right (SBR) turn lane while extending the lane to the intersection adjacent to southbound left (SBL) turn lane. It is anticipated that this modification will reduce speed of vehicles exiting the highway onto Merritt Road and will potentially increase the overall safety of the roadway.

Like Option-1, the existing exclusive eastbound left (EBL) turn lane carrying in-bound traffic to Highway 406 E/W-S On-Ramp is proposed be converted to a shared eastbound through-left (EBTL).

Option-3:

In this option, a WBL turn is permitted at Grisdale Road/Merritt Road intersection along with eastbound right (EBR) and northbound right (NBR) turning movements, in other words a RIRO plus WBL. Since NBL is again not permitted under this option, the median island and right-turn channel is designed to ensure that NBL is completely restricted. However, this option facilitates safer turn onto Grisdale Road from Merritt Road with a provision of a dedicated WBL turn lane.

Similar modification to Highway 406 N-E/W Off-Ramp as in Option-2 is proposed. However, two (2) dedicated SBR turn lane and an exclusive SBL turn lane is proposed along with signalization of ramp terminal.

Option-4:

This option is an enhanced version of Option-3 where all proposed improvements are carried with the exception of maintain an exclusive EBL turn and providing an additional EBT lane at Highway 406 N-E/W Off-Ramp and E/W-S On-Ramp intersection at Merritt Road. To avoid impacts and widening of the existing bridge structure over the

highway, it is intended to match eastbound lanes prior to bridge westerly abutment. However, this reconstruction of additional EBT lane will cause major impacts to vegetated area because of regrading of embankment on the south side of Merritt Road and relocation of guiderail as well.

Option-5:

In this option, the proposed improvements and restriction for Grisdale Road from Option 3 are carried forward. However, the Highway 406 westerly ramps (N-E/W Off-Ramp and E/W-S On-Ramp) intersection at Merritt Road is proposed to be converted to a two (2) lane roundabout with an inscribed circle diameter (ICD) of 55m.

A roundabout at ramp terminal in not uncommon on 400 series highways (one of the examples situated closer to the study area is Highway 406 terminus at East Main Street [Regional Road 27]), however, a roundabout is not considered a feasible option due to major property impacts and higher cost of construction because of much larger footprint than any given signalized/unsignalized intersection.

From the above, it is inferred that design Options 3, 4 and 5 provide better solution which allows improved safety for WBL turning vehicles and flexibility of future operation at Grisdale Road intersection and are carried forward for traffic assessment.

Option-6:

This option is a modified version of Option-4 in which an existing EBL turn is maintained and additional EBT lane is provided at Highway 406 N-E/W Off-Ramp and E/W-S On-Ramp intersection at Merritt Road., while matching eastbound lanes prior to bridge westerly abutment to avoid impacts and widening of the existing bridge structure over the highway. As mentioned under option 4, this reconstruction of additional EBT lane will have added impacts to vegetated area due to regrading embankment on the south side of Merritt Road and relocation of guiderail. In this option, a WBL turn is permitted at Grisdale Road/Merritt Road intersection along with eastbound right (EBR) and northbound right (NBR) turning movements, in other words a RIRO plus WBL. Since NBL is again not permitted under this option, the median island and right-turn channel is designed to ensure that NBL is completely restricted. This option would facilitate safer turn onto Grisdale Road from Merritt Road with a provision of a dedicated WBL turn lane.

Due to low traffic volumes, it is also proposed to remove WBR turn channel and provide a short WBR turn lane instead at the intersection. Removing WBR turn lane over the bridge will be a cost-effective solution where a Multi-Use Path (MUP) could be provided without widening bridge structure. Initially, a concrete median the MUP was proposed between the vehicular traffic lanes and the MUP, however, based on the Executive Review Meeting (held March 21, 2023), the concrete median was removed from the proposed cross-section. Further, the MUP was proposed as a raised MUP.

Provision of a raised MUP will require adjustment to the existing parapet wall and replacement of the railing system to accommodate the raised MUP. Detailed dimensions and design checks of the parapet wall and combination height railing will need to be determined during detailed design phase. In addition, a structural evaluation of the exterior girder will be required during detailed design phase to determine whether it can take the additional dead load from the raised MUP. The maintenance of the widened Merritt Road and the MUP would be Niagara Region's responsibility.

This option also provides safer pedestrian crossing at the proposed signalized intersection and not yielding at On-Ramps. For traffic assessment, 50 pedestrians/hour are assumed to be crossing at the intersection.

The design of the taper (length and configuration) for the left turn to Grisdale Road has been designed as per the MTO design supplement Exhibit 9-R (see below). Whereases due to constraint of the existing bridge, the proposed westbound right turn lane length is 95m (40m parallel with 55m taper), which is substandard to the MTO design standard in accordance with TAC Supplement Exhibit 9-J (60m parallel and 70m taper).

Exhibit 9-R
DECELERATION LENGTH FOR LEFT-TURN LANES, 2-LANES AND 4-LANE HIGHWAYS
FLAT GRADE 2% OR LESS

Design Speed (km/h)	Deceleration Length		Horizontal Curve to Smooth Taper R (m)
	Taper (m)	Parallel (m)	
50	85	20	500
60	100	30	750
70	115	40	1000
80	130	50	1200
90	145	60	1500
100	160	70	2000
110	170	80	2500

Design Criteria

All design changes /elements presented in the table below are designed in accordance with the TAC's G*eometric Design Guide for Canadian Roads* (2017). In addition, design criteria based on MTO's template is provided in **Attachment G**.

Items	Existing	Proposed
Minimum Radius at the Right-Turn Lanes	22.0 m	22.0 m
Through-Lane (Inner) Width at Bridge Structure	3.5 m	3.5 m
Through-Lane (Outer)/Right-Turn Lane Width at Bridge Structure	3.5 m	3.5 m
Right-Turn Lane (Parallel)	-	40 m
Right-Turn (Taper)	-	55 m
Shoulder Width	2.9 m	2.9 m
Median Width (where applicable)	-	1.5 m

Based on the TAC guidelines ***Section 9.4.2.4 – Cross Roadway Intersection Spacing Adjacent to Interchanges***, it is determined that the intersection spacing between the Highway 406 off-ramps and the nearest intersection is adequate. Figure 9.4.2 from the TAC guide is included below for reference.

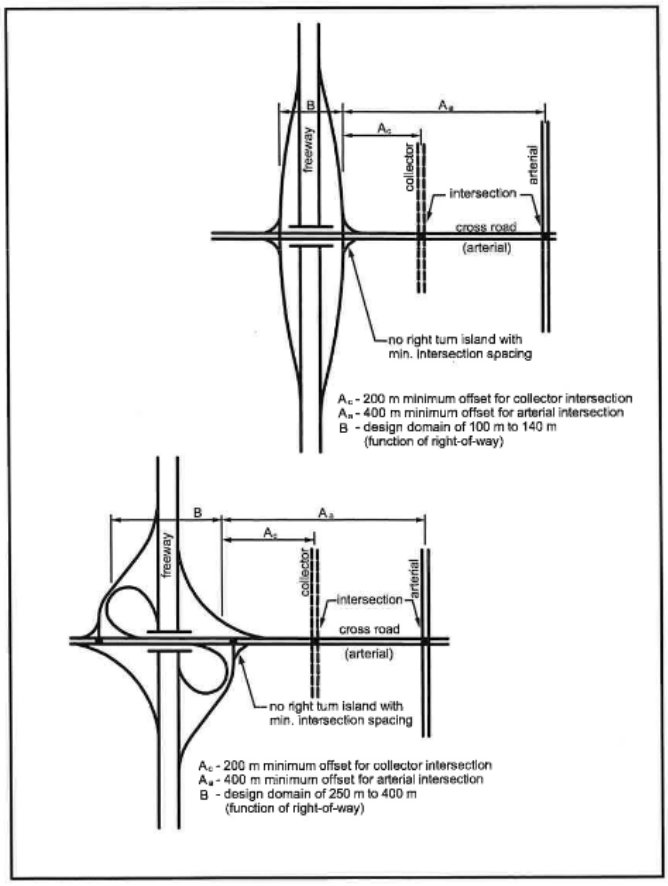


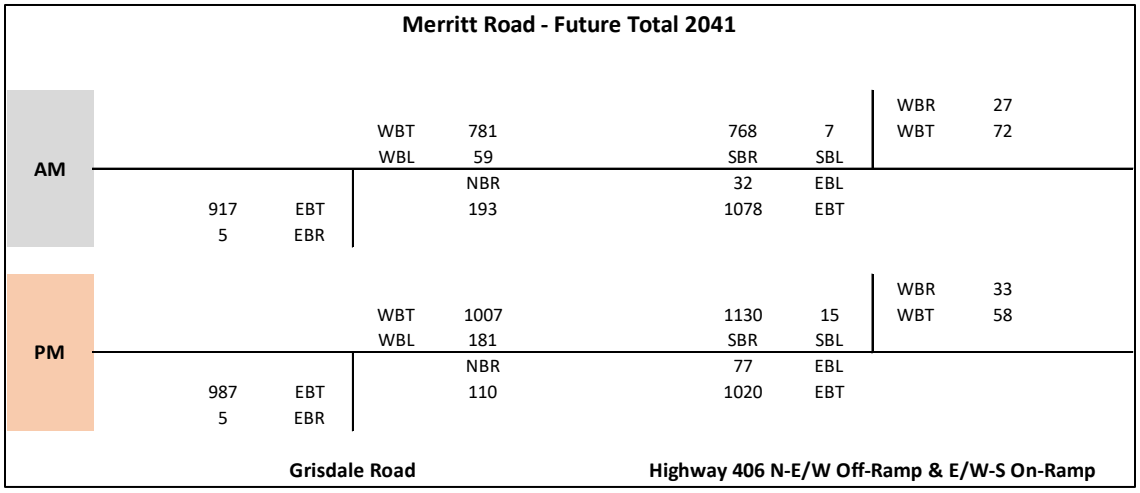
Figure 9.4.2: Cross Road Intersection Spacing Adjacent to Interchanges

4 TRAFFIC ASSESSMENT

WSP staff has performed a traffic assessment of design options 3, 4, 5 and 6 using Synchro software. Under Options 3, 4 and 6, two scenarios are assessed for Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp:

- **Permitted / Protected** EB/WB movements
- **Split Phase** EB/WB movements

It should be noted that the Grisdale Road traffic demand is extracted from Merritt Meadows Development Traffic Impact Study by Paradigm. These traffic volumes are then forecasted to Future Total 2041 using a compound annual growth rate of 2%. The future total 2041 volumes are shown in figure below and results of the assessment are summarized in tables below.



OPTION 3 – Future Total 2041

Intersection	AM			PM		
	Delay	V/C	LOS	Delay	V/C	LOS
Merritt Rd at Hwy 406 SB Ramp **Permitted /Protected** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp	19.3	0.68	B	20.7	0.68	C
Merritt Rd at Grisdale Rd	2.2	0.53	A	1.8	0.51	A

OPTION 3 – Future Total 2041

Intersection	AM			PM		
	Delay	V/C	LOS	Delay	V/C	LOS
Merritt Rd at Hwy 406 SB Ramp **Split Phase** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp	21.7	0.72	C	23.3	0.72	C
Merritt Rd at Grisdale Rd	2.2	0.53	A	1.8	0.51	A

OPTION 4 – Future Total 2041

Intersection	AM			PM		
	Delay	V/C	LOS	Delay	V/C	LOS
Merritt Rd at Hwy 406 SB Ramp **Permitted /Protected** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp	19.2	0.64	B	19.9	0.62	B
Merritt Rd at Grisdale Rd	2.2	0.53	A	1.8	0.51	A

OPTION 4 – Future Total 2041

Intersection	AM			PM		
	Delay	V/C	LOS	Delay	V/C	LOS
Merritt Rd at Hwy 406 SB Ramp **Split Phase** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp	21.3	0.71	C	22.0	0.69	C
Merritt Rd at Grisdale Rd	2.2	0.53	A	1.8	0.51	A

OPTION 5 – Future Total 2041

Intersection	AM			PM		
	Delay	V/C	LOS	Delay	V/C	LOS
Merritt Rd at Hwy 406 SB Ramp **(Roundabout)**	-	0.61	B	-	0.86	E
Merritt Rd at Grisdale Rd	2.2	0.53	A	1.8	0.51	A

OPTION 6 – Future Total 2041

Intersection	AM			PM		
	Delay	V/C	LOS	Delay	V/C	LOS
Merritt Rd at Hwy 406 SB Ramp **Permitted /Protected** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp *(assumed 50 pedestrians per hour crossing at the intersection)*	19.2	0.64	B	19.9	0.62	B
Merritt Rd at Grisdale Rd	2.2	0.53	A	1.8	0.51	A

OPTION 6 – Future Total 2041

Intersection	AM			PM		
	Delay	V/C	LOS	Delay	V/C	LOS
Merritt Rd at Hwy 406 SB Ramp **Split Phase** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp *(assumed 50 pedestrians per hour crossing at the intersection)*	21.3	0.71	C	22.0	0.69	C
Merritt Rd at Grisdale Rd	2.2	0.53	C	1.8	0.51	A

Based on the assessment results it is noted that both intersections will operate well within capacity during AM & PM Peak periods under Future Total 2041 conditions.

5 QUEUEING ANALYSIS

WSP staff has also performed a 5-run simulation using SimTraffic for these options to determine WBL turn lane queuing at Grisdale Road and determined that the 95th percentile queue length for WBL does not exceed proposed storage length. The results of the simulation for each option are summarized below. Refer to **Attachment D** for detailed results of the Queuing Analysis.

95th Percentile Queue Length for WBL at Merritt Rd at Grisdale Rd – Future Total 2041

Scenario	AM	PM	Provided Storage (m)
OPTION 3 – **Permitted/Protected** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp	18.0	39.5	75.0
OPTION 3 – **Split Phase** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp	18.9	35.1	75.0
OPTION 4 – **Permitted/Protected** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp	13.1	31.5	75.0
OPTION 4 – **Split Phase** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp	18.2	35.5	75.0
OPTION 5 – **Roundabout**	15.9	37.6	75.0
OPTION 6 – **Permitted/Protected** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp	14.1	32.4	75.0
OPTION 6 – **Split Phase** EB/WB movements at Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp	19.9	30.0	75.0

6 SIGNAL WARRANT ANALYSIS

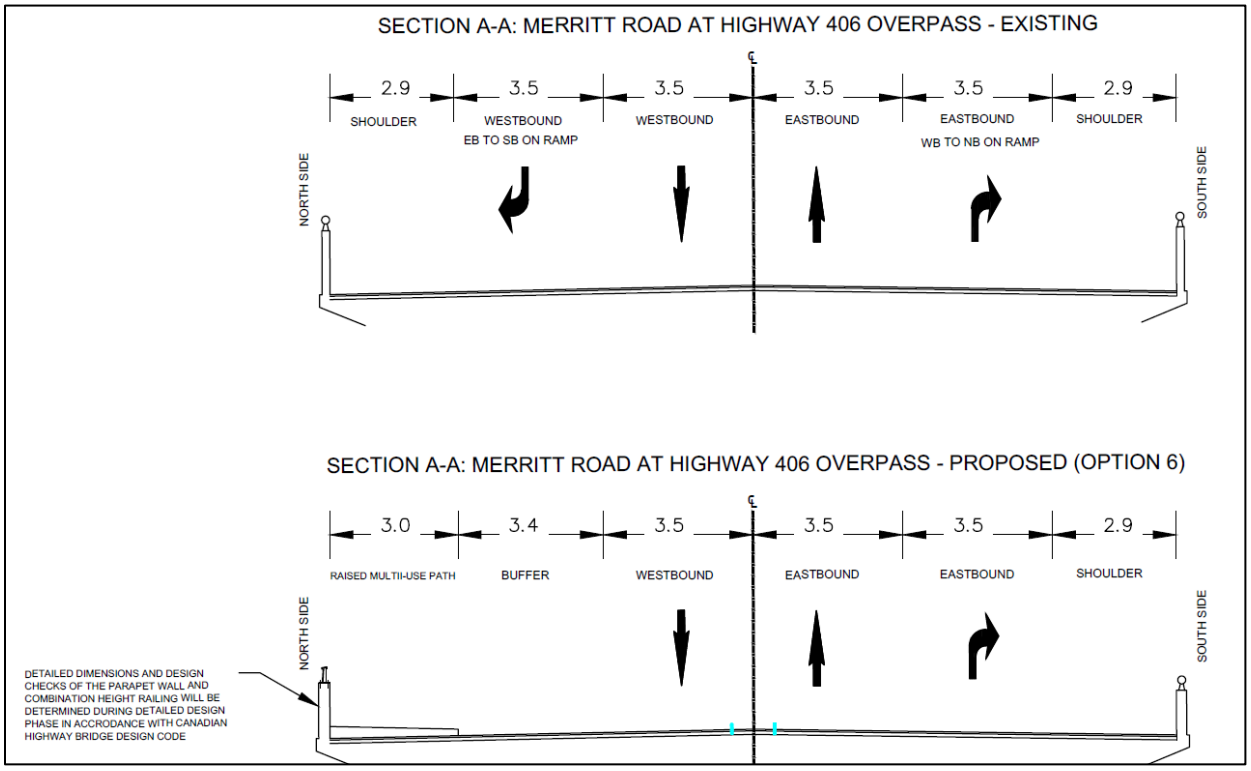
A Traffic Signal Warrant/Justification analysis was also undertaken for the Merritt Road / Highway 406 Westerly Ramps intersection for future (2041) horizon year. The results suggest that a signal is warranted based on the Minimum Vehicular Volume (Justification 1) and 4-Hr Volume (Justification 4). To ensure the safety of the pedestrians crossing the intersection to get to the Multi-Use Pathway extension to the east of the bridge, a traffic signal is recommended. The Traffic Signal Warrant spreadsheets can be found as **Attachment E.**

7 RECOMMENDATION

Based on the detailed assessment undertaken to assess the future condition requirements in the vicinity of Highway 406 interchange at Merritt Road, the WSP Staff makes the following recommendations:

- **Option 6** is recommended as the preferred option in terms of traffic safety, constructability, and cost-effectiveness. This option maintains the existing EBL turn lane and provides an additional EBT lane at Highway 406 N-E/W Off-Ramp and E/W-S On-Ramp intersection at Merritt Road, while matching eastbound lanes prior to bridge westerly abutment to avoid impacts and widening of the existing bridge structure over the highway. This option eliminates the need to widen the existing bridge structure through the removal of WBR turn channel and provision of a short WBR turn lane instead at the intersection. It should be noted that minor impacts to vegetated area are anticipated due to re-grading embankment on the south side of Merritt Road and

relocation of guiderail. In this option, a WBL turn is permitted at Grisdale Road/Merritt Road intersection along with eastbound right (EBR) and northbound right (NBR) turning movements, in other words a RIRO plus WBL. Since NBL is again not permitted under this option, the median island and right-turn channel is designed to ensure that NBL is completely restricted. This option would facilitate safer turn onto Grisdale Road from Merritt Road with a provision of a dedicated WBL turn lane. A MUP is also provided on the north side of the bridge structure as per the *MTO Bikeways Design Manual (March 2014)*. The existing and proposed cross-section at the bridge structure are shown in the figure below.



- It is also recommended to implement a traffic Signal at the Merritt Road / Highway 406 Westerly Ramps intersection to ensure pedestrian safety crossing the bride to get to the Multi-Use Pathway on the north side of the bridge.

Option 6 was accepted in principle by MTO senior management during the Executive Review Meeting (held March 21, 2023) with provision of minor comments. The Project Team subsequently updated the Option 6 to address MTO Senior Management's comments. On May 23, 2023, the MTO staff confirmed that they have no more comments on Option 6, and the Project Team could proceed with including the preferred Option 6 in the environmental assessment reporting.

Provision of a raised MUP will require adjustment to the existing parapet wall and replacement of the railing system to accommodate the raised MUP. Detailed dimensions and design checks of the parapet wall and combination height railing will need to be determined during detailed design phase. In addition, a structural evaluation of the exterior girder will be required during detailed design phase to determine whether it can take the additional dead load from the raised MUP.

A detailed illustration of option 6 is shown in the figure below.

GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD - OPTION 6

EXTEND SOUTHBOUND RIGHT TURN LANE TO THE INTERSECTION

PROVIDE TRAFFIC SIGNAL

REMOVE SOUTHBOUND RAMP AND PROVIDE WESTBOUND RIGHT TURN LANE

ONE WESTBOUND LANE TO BE REMOVED FOR 3.0m MULTI-USE PATH

RELOCATED GUIDERAIL

PROPOSED EDGE OF PAVEMENT

REMOVE SOUTHBOUND RIGHT TURN CHANNEL

PROVIDE CONCRETE MEDIAN

195

15 STORAGE LANE

50 PARALLEL LANE

130 TAPER LANE

40

55

A

A

130 TAPER LANE

50 PARALLEL LANE

15 STORAGE LANE

3.0m MULTI-USE PATH TO CROSS TO NORTH SIDE

RELOCATED GUIDERAIL

LEFT-IN /RIGHT-IN / RIGHT-OUT ONLY ACCESS

AREA TO BE REGRADED (LIMIT OF REGRADING TO BE DETERMINED DURING DETAILED DESIGN)

Merritt Road (Regional Road 37)

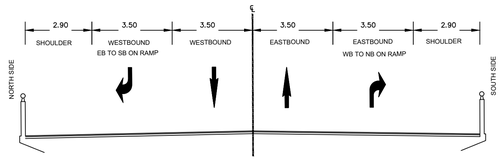
Highway 406

NORTH

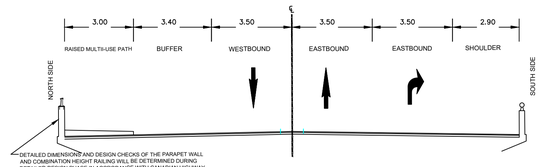
Grisdale Road

Kottmeier Road

SECTION A-A: MERRITT ROAD AT HIGHWAY 406 OVERPASS - EXISTING



SECTION A-A: MERRITT ROAD AT HIGHWAY 406 OVERPASS - PROPOSED (OPTION 6)



DETAILED DIMENSIONING AND DESIGN CHECKS OF THE PARAPET WALL AND COMBINATION HEIGHT RAILING WILL BE DETERMINED DURING DETAILED DESIGN PHASE IN ACCRODANCE WITH CANADIAN HIGHWAY BRIDGE DESIGN CODE

8 CONCLUSION

Active Transportation:

As noted in section 2 of this memo, the MTO staff has inquired project team regarding continuation of proposed active transportation to the east side of Highway 406. WSP has prepared exhibits based on the recommended Option-3 illustrating continuation of active transportation facility across the bridge structure to the east side of Highway 406 and are provided as Option-3b, 3c and 3d, which identifies need for widening exiting structure ±3m on the south side to accommodate a multi-use path across the bridge. Options '3c and 3d' are prepared for Ministry's consideration showing modifications to easterly E/W-N On-Ramp by providing a shared eastbound through right under Option 3c and a dedicated eastbound right with short taper under Option 3d. Both options suggest need for elimination of spiral on-ramp entry.

Active transportation under Option 6 is noted as preferred solution where active transportation is continued up to Highway 406 westerly ramps and crosses at the proposed signalized intersection. It will continue to the east by removing WBR turn over the structure, hence, eliminating need for bridge widening.

Grisdale Road and Highway 406 N-E/W Off-Ramp & E/W-S On-Ramp:

Based on the geometric and operational details along with supporting traffic assessment, it is concluded that the **Option-6** is considered as the best possible solution in view of traffic safety, constructability, and cost-effectiveness. An illustration of turning template for the preferred option based on WB-20 is included as **Attachment F** for reference purposes.

Attachments:

Attachment A – Minutes of Meeting with MTO on January 17, 2022
Attachment B – Design Options 1 through 6
Attachment C – Traffic Assessment Results (Synchro Analysis)
Attachment D – Queueing Analysis Results (SimTraffic Simulation)
Attachment E – Traffic Signal Warrant Analysis
Attachment F – Turning Templates for Preferred Option
Attachment G – Design Criteria
Attachment H – Minutes of the MTO Executive Review Meeting held on March 21, 2023

ATTACHMENT

A MINUTES OF MEETING WITH MTO – JANUARY 17, 2022

Meeting Minutes

Date: Tuesday, January 17, 2022, 1:00 PM **Meeting at:** Microsoft Teams
File No.: IM20103036
Subject/purpose: Merritt Road/Rice Road MCEA – Meeting to discuss design options for Merritt Rd over Highway 406 bridge

Attendees:

Maged Elmadhoon, Niagara Region
Sulaf Alkarawi, Niagara Region
Cam Milne, Niagara Region
Frank Tassone, Niagara Region
Samera Fares (MTO)
Martin (MTO)
Kashif Hussain (MTO)
Jason Lee (MTO)
Calvin Fong (MTO)
Samira Farahani (MTO)
Jordan Lee (MTO)
Eric Hakomaki (MTO)
Dermot Dusauzay (MTO)
Kaitlyn Greto (MTO)
Muhammad Khan, Wood
Mir Ahsan Talpur, Wood

Items Discussed:

1. Purpose of Meeting

The purpose of this meeting was to discuss with the Ministry of Transportation (MTO) the design options for Merritt Rd over Highway 406 bridge

2. Design Options for Merritt Rd at Highway 406 Bridge

The following three design options were presented:

Option 1: This option involves right-in and right-out access for vehicles on Grisdale Road and changing the left turn lane on Highway 406 ramp to shared Thru-left turn lane. It was noted that there are concerns associated with this option as the road users on Grisdale Rd may not comply and make left turn on Merritt Rd.

MTO staff inquired whether the bike tracks on Merritt Rd will be extended over Highway 406 bridge. The Study Team clarified that the current options consider ending the bike tracks at Grisdale Rd. The Environmental Study Report will note that the future extension

of bike tracks along Grisdale Rd to Welland Canal should be evaluated via a separate undertaking.

MTO staff inquired whether the topography of Merritt Rd and its impacts on the right in/right-out access on Grisdale Rd were reviewed. The Study Team responded that the topography and sightline distances were reviewed for this option, and it was confirmed that there will not be sight-line concerns. Changes to vertical profile are not being proposed.

Option 2: This option involves extending median along Merritt Road to Highway 406 N-E/W Off-Ramp, restricting access at Grisdale Road as Right-In/Right-Out only, and providing traffic signals at the ramp terminal. In order to make left turn, the traffic will need to use other roads, such as, Quaker Rd or Eastman Gateway.

Option 3: This option allows for traffic from Merritt Rd to make a left turn (westbound left) onto Grisdale Road, also allowing Right-In/Right-Out while a left turn off Grisdale Road (northbound left) onto Merritt Road will not be permitted. The existing right turn channel on southbound ramp on Highway 406 bridge will be replaced with two right turn lanes at the ramp terminal along with adjacent to southbound left turn lane, eliminating existing free flowing southbound channelized right turn lane.

Wood staff noted that drawings of design options will be provided to the MTO for detailed review and comment.

3. Open Discussion

Question: Did you do any split-phase analysis?
Response: No, a permitted-protected phase analysis was completed, which shows an intersection LOS B during Future 2041 AM and PM Peak hours

Question: How will the cyclists access the subdivision on the east side of the Highway 406 bridge?
Response: The Niagara Region will be willing to accommodate bike tracks across the bridge if the adequate space is available over the structure

Question: What is the proposed design speed?
Response: The proposed design speed is 70 km/h and the posted speed limit is 60 km/hm. The existing posted speed limit is 60 km/h.

Continued…

Question: Is there a raised median being proposed at the Grisdale Rd and Merritt Rd intersection?
Response: The first option excludes the raised median. The second option provides raised median up to the interchange. Third option provides a raised median, with left-in access to Grisdale Rd. The option 3 is preferred as it provides access, which is similar to redesigned Montrose Rd interchange. The option 1 is not preferred because of the potential safety concerns that the road users may use the intersection to make left turn on Merritt Rd.

Comment: MTO staff thinks that this project is different from Montrose Rd as there is future development being planned to the south side.
Response: The Niagara Region staff clarified that the Niagara Region has not received any development applications at this time. The Niagara Region staff raised the question whether the existing configuration of Highway 406 interchange intended to be a long-term configuration? MTO staff noted that the current configuration of the interchange was provided following the construction of the interchange as there were traffic issues at the interchange.

The Niagara Region staff noted that there have been six rear-end collisions at Grisdale Road since 2016. The turning movements from Grisdale Rd to Merritt Rd are very low.

Question: MTO staff asked that Wood to evaluate an option to provide two through lanes while maintaining dedicated eastbound left turn lane.
Response: Wood can look into providing additional through lane and potential active transportation facility over the structure, however, widening of bridge would be required. Further, based on the traffic analysis, the opposing traffic to left turn volumes (westbound through) at the westerly off ramp are low which may not require a dedicated left turn lane. Wood to complete the sensitivity analysis for Grisdale Road and Split Phasing Analysis at N-E/W Off-Ramp terminal for future horizon 2041 (**Action Item**).

Question: Is the median being provided as far as the Niagara Street, and whether the access will be provided to Eastman Gateway? In that case, everyone in that subdivision will use Eastman Gateway.
Response: The median extends to Niagara Street, however, full-access will be maintained at Eastman Gateway.

MTO suggested contacting the local municipality to confirm if there are any development applications for the lands on the south side of Grisdale Road.

Continued…

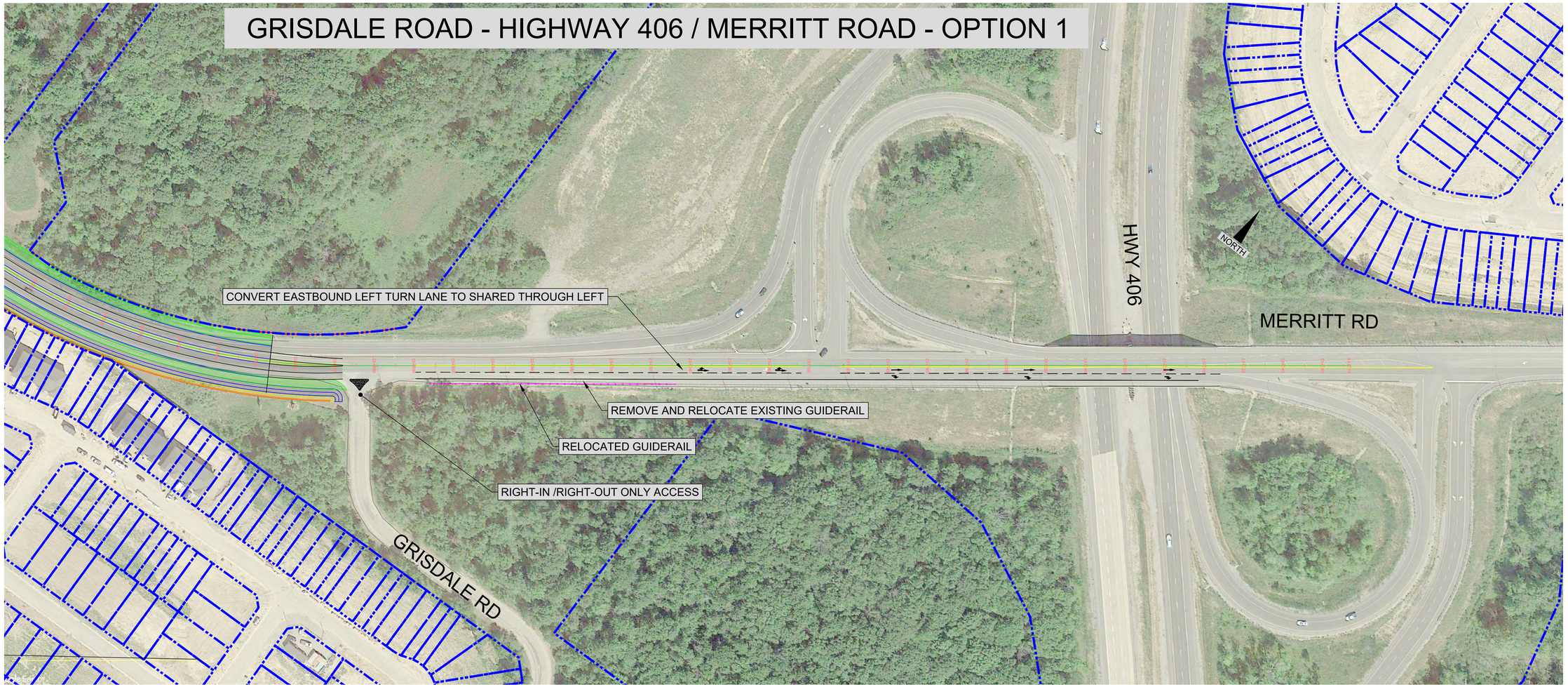
Comment: The MTO staff noted that the area residents would be concerned when they find out that there is no active transportation facility being provided across the bridge. The MTO added that the Niagara Region should take the responsibility for not providing active transpiration infrastructure over the bridge.
Response: The Niagara Region is willing to provide the active transportation infrastructure over the bridge, however there is not enough space on the bridge. Maged noted that the Study Team will look into the provision of active transportation infrastructure across Highway 406 bridge (**Action Item**).

Maged requested that the Study Team would appreciate MTO's expedited review as the Study Team would like to complete the EA study in early spring. MTO staff noted that once design options have been provided to the MTO, the staff will review those options and provide comments and confirm the need for another meeting.

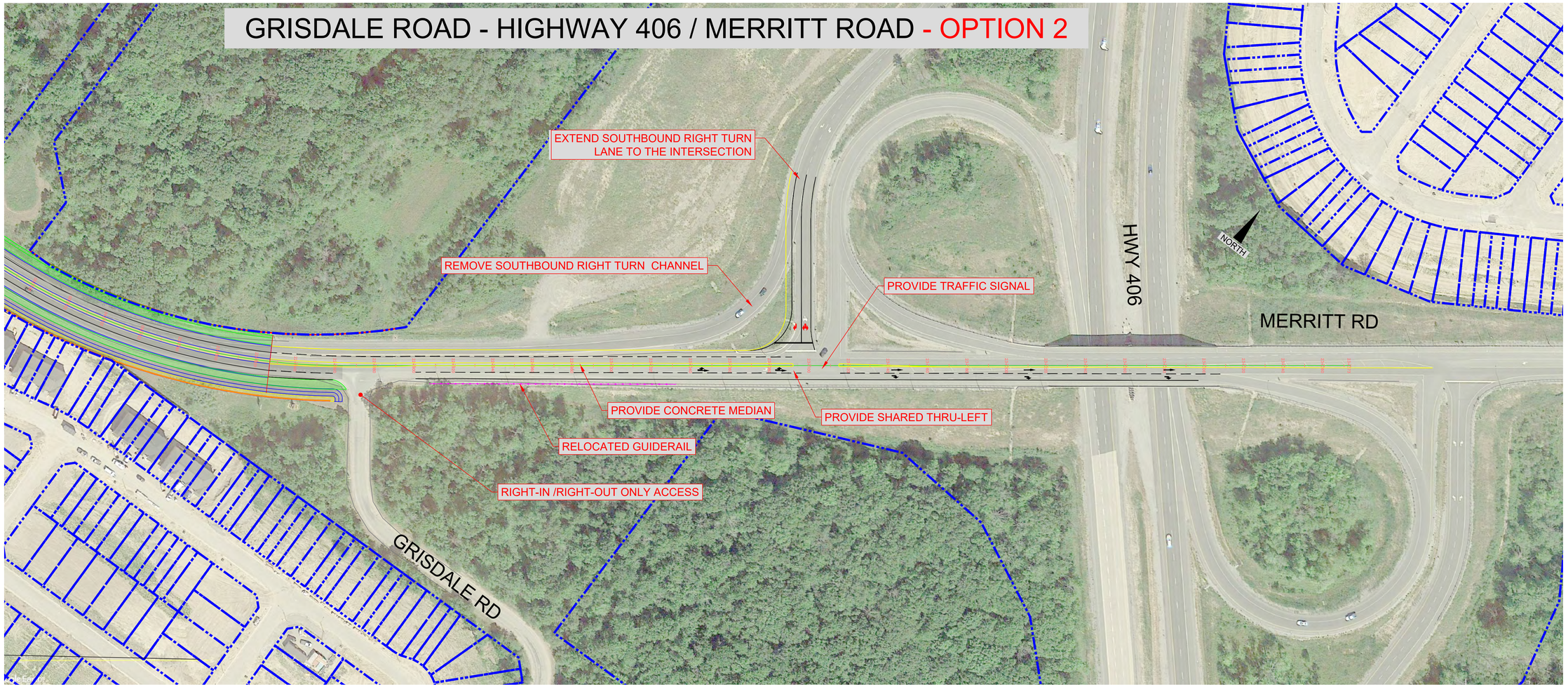
ATTACHMENT

B DESIGN OPTIONS 1 - 6

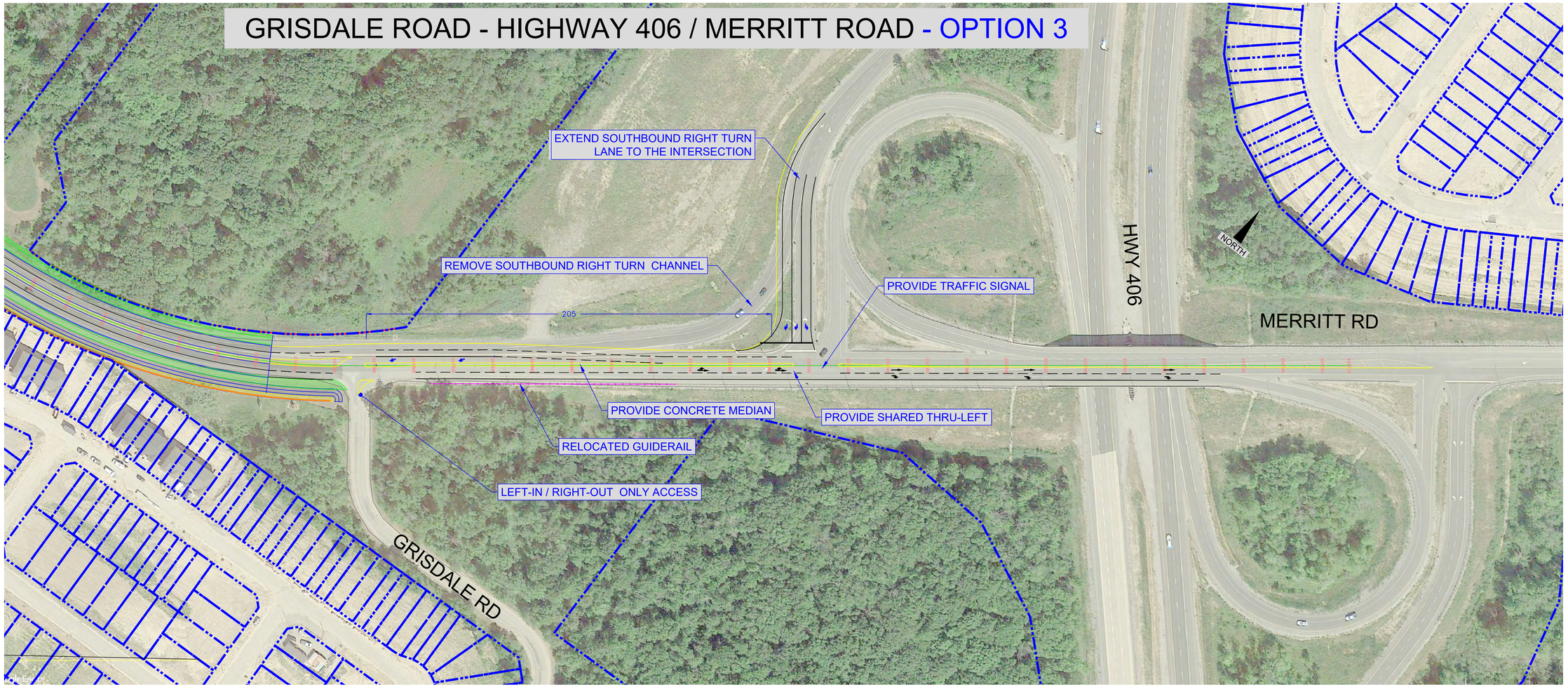
GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD - OPTION 1



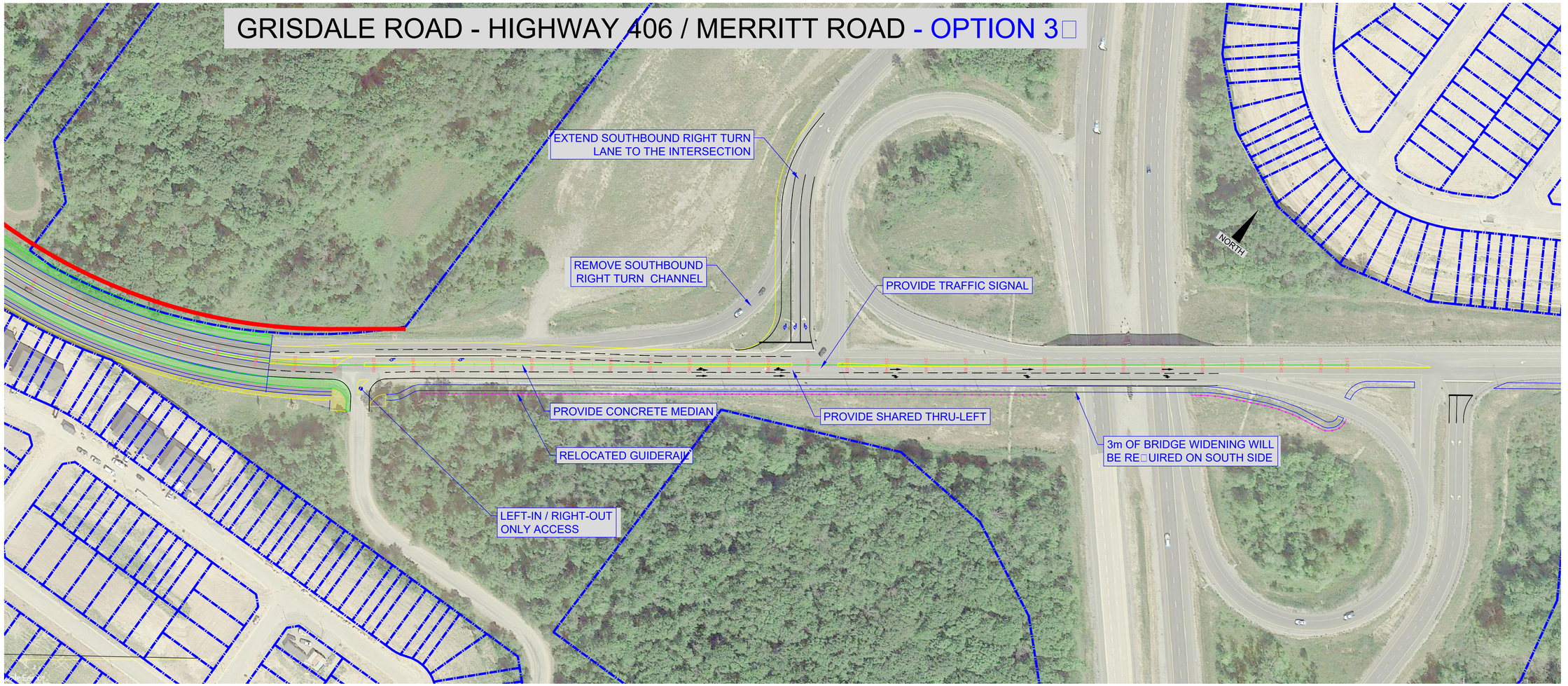
GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD - OPTION 2



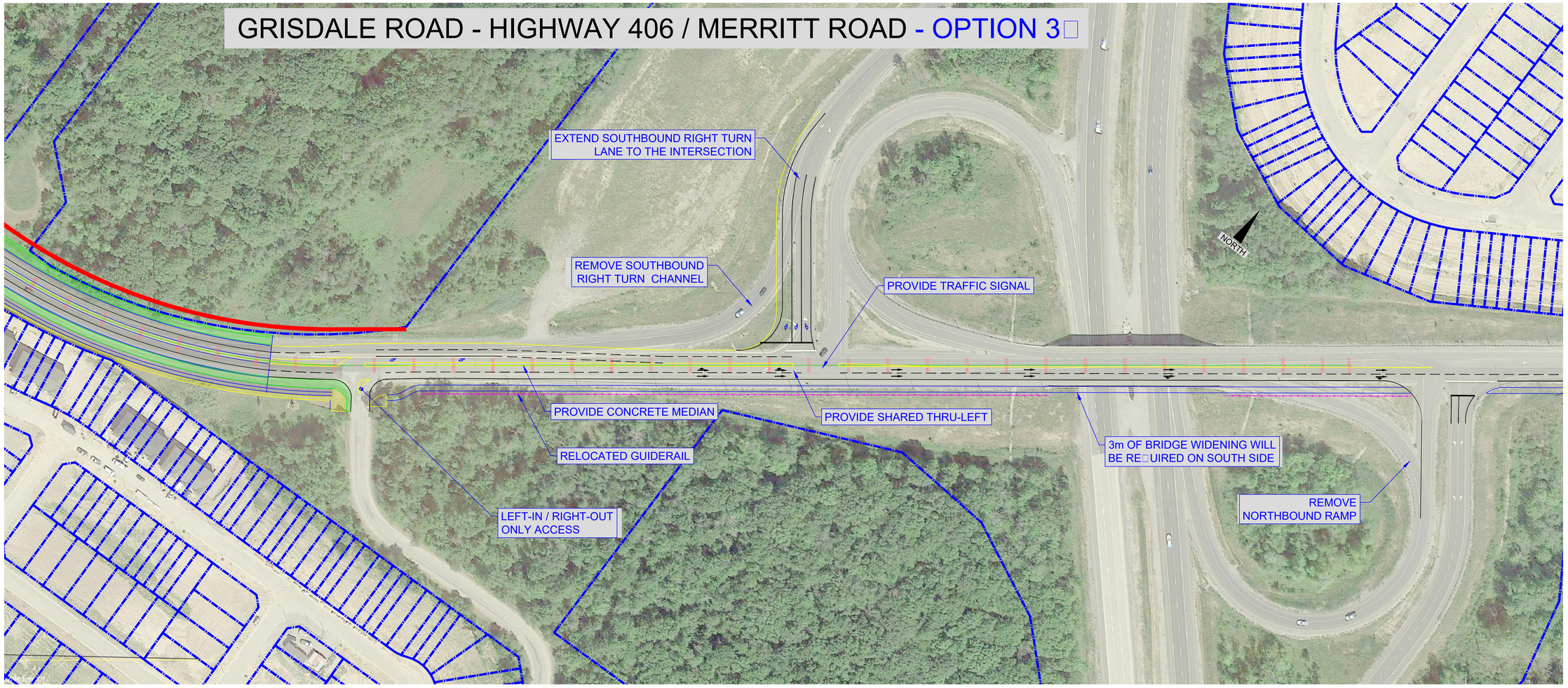
GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD - OPTION 3



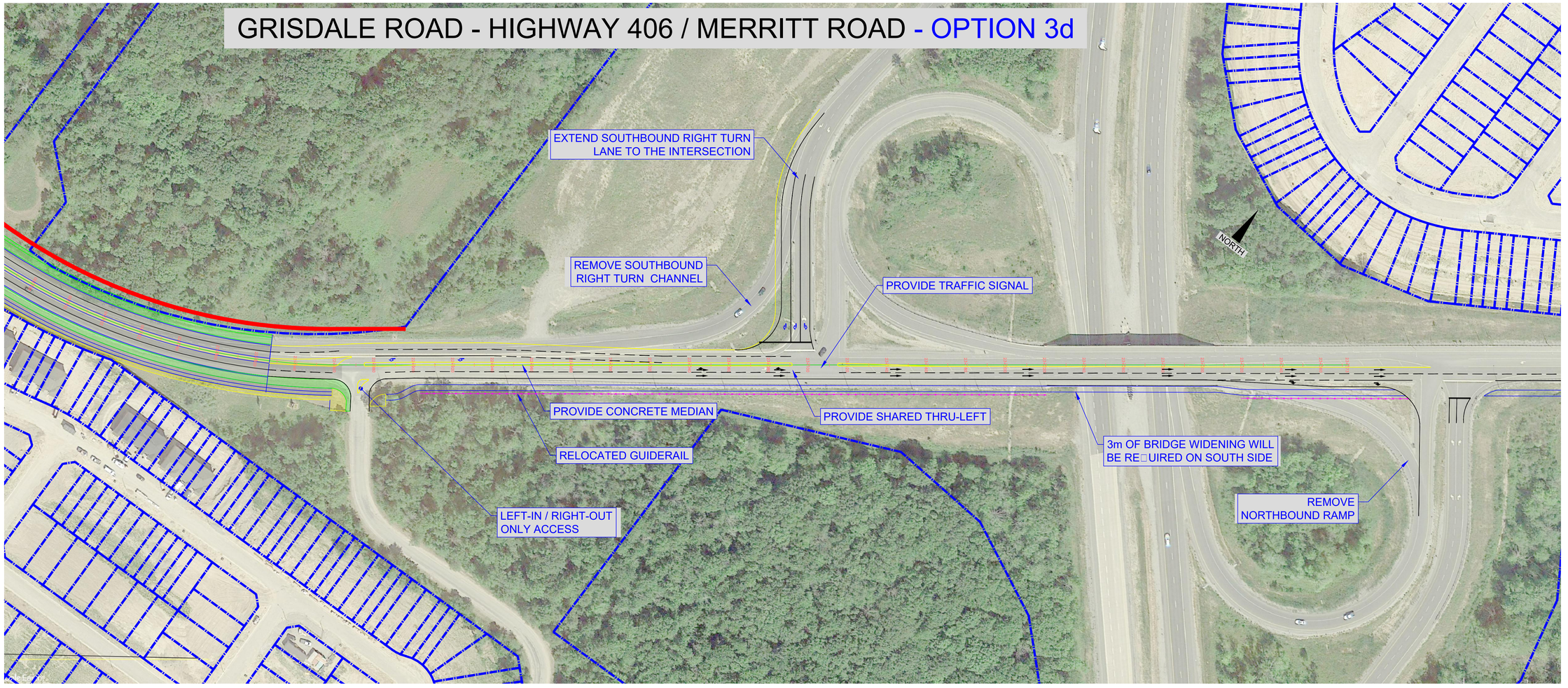
GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD - OPTION 3



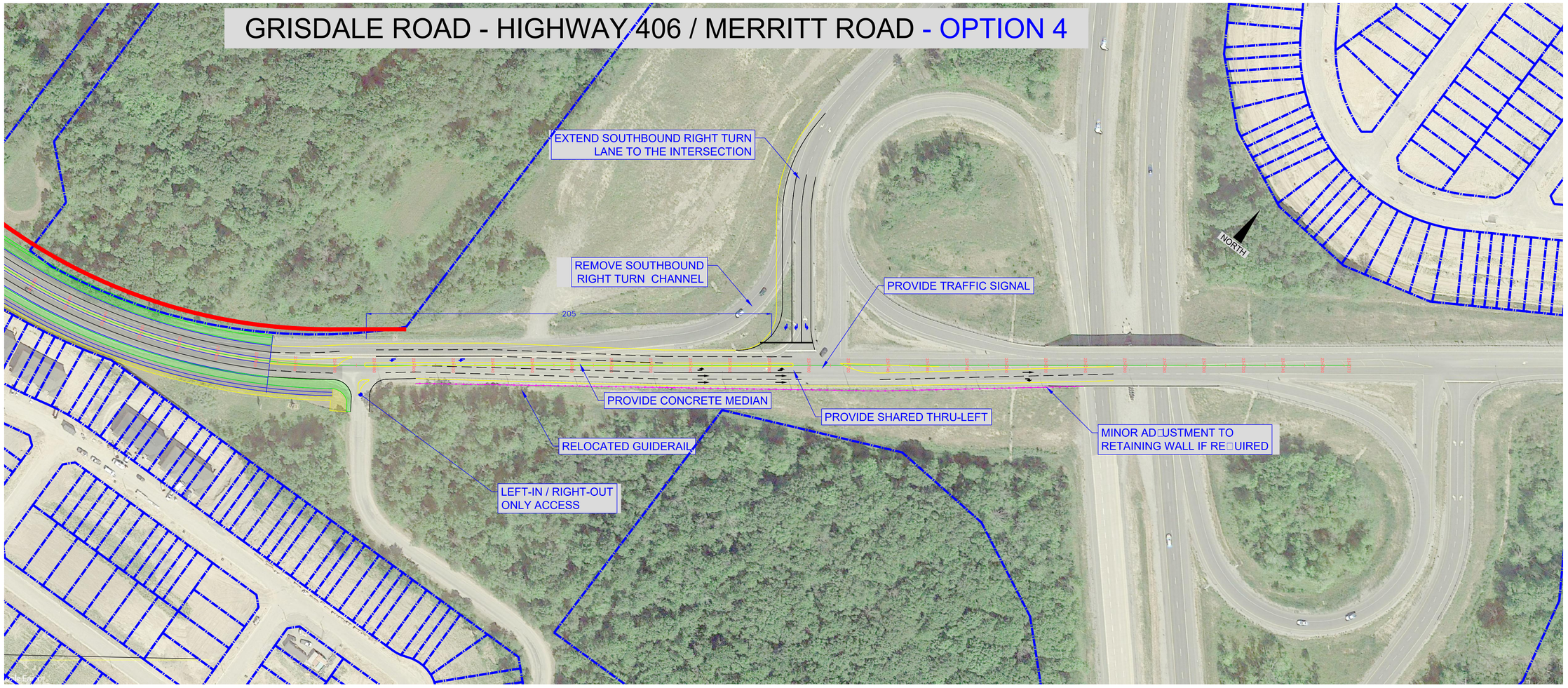
GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD - OPTION 3



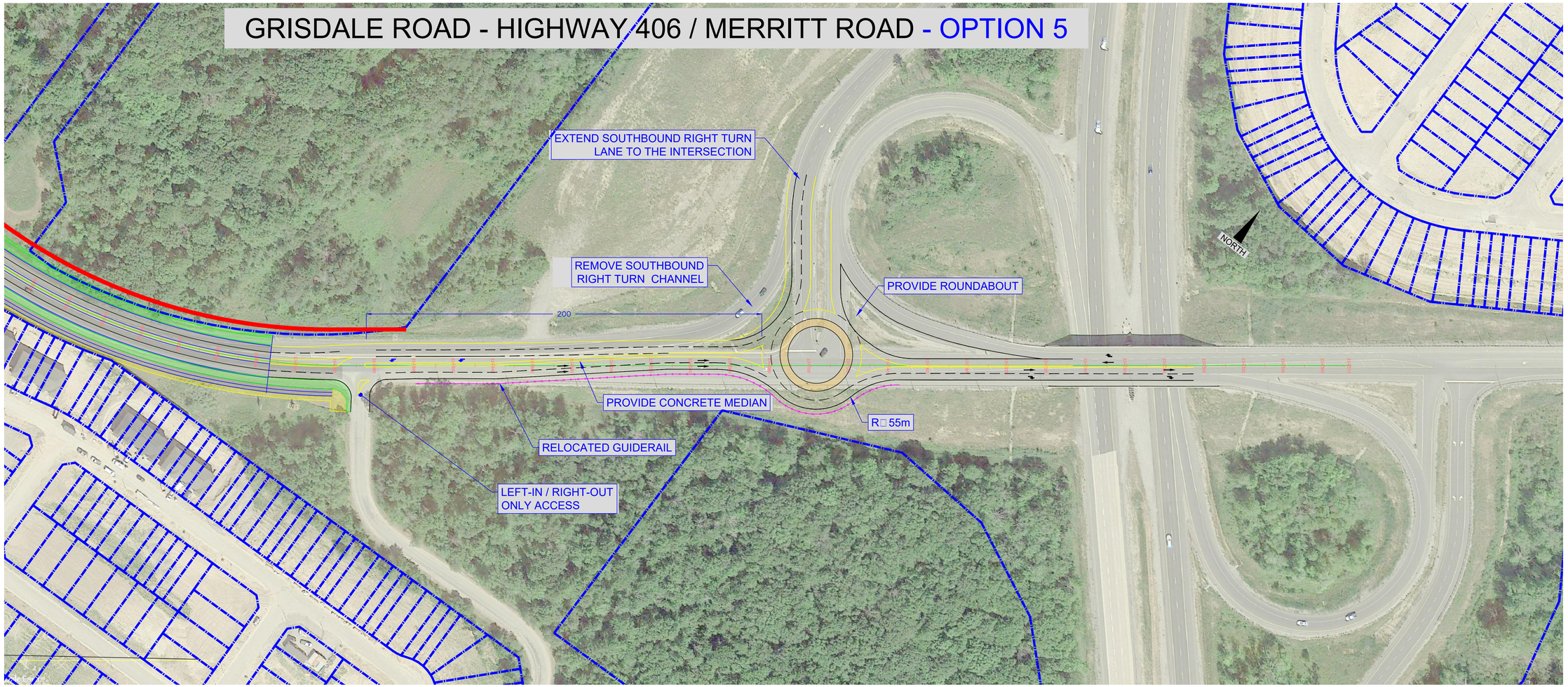
GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD - OPTION 3d



GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD - OPTION 4



GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD - OPTION 5



GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD - OPTION 6

EXTEND SOUTHBOUND RIGHT TURN LANE TO THE INTERSECTION

PROVIDE TRAFFIC SIGNAL

REMOVE SOUTHBOUND RAMP AND PROVIDE WESTBOUND RIGHT TURN LANE

ONE WESTBOUND LANE TO BE REMOVED FOR 3.0m MULTI-USE PATH

RELOCATED GUIDERAIL

PROPOSED EDGE OF PAVEMENT

REMOVE SOUTHBOUND RIGHT TURN CHANNEL

PROVIDE CONCRETE MEDIAN

195

15 STORAGE LANE

50 PARALLEL LANE

130 TAPER LANE

40

55

A

A

130 TAPER LANE

50 PARALLEL LANE

15 STORAGE LANE

3.0m MULTI-USE PATH TO CROSS TO NORTH SIDE

RELOCATED GUIDERAIL

LEFT-IN /RIGHT-IN / RIGHT-OUT ONLY ACCESS

AREA TO BE REGRADED (LIMIT OF REGRADING TO BE DETERMINED DURING DETAILED DESIGN)

Merritt Road (Regional Road 37)

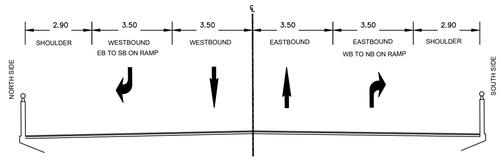
Highway 406

NORTH

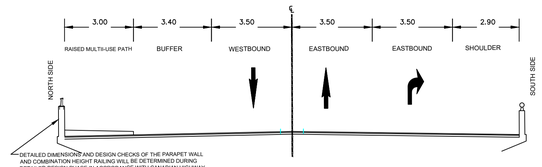
Grisdale Road

Kottmeier Road

SECTION A-A: MERRITT ROAD AT HIGHWAY 406 OVERPASS - EXISTING

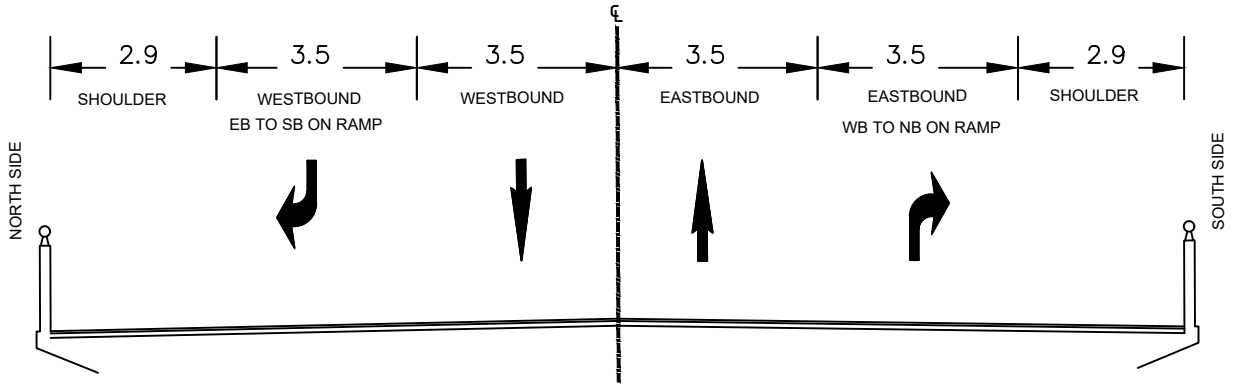


SECTION A-A: MERRITT ROAD AT HIGHWAY 406 OVERPASS - PROPOSED (OPTION 6)

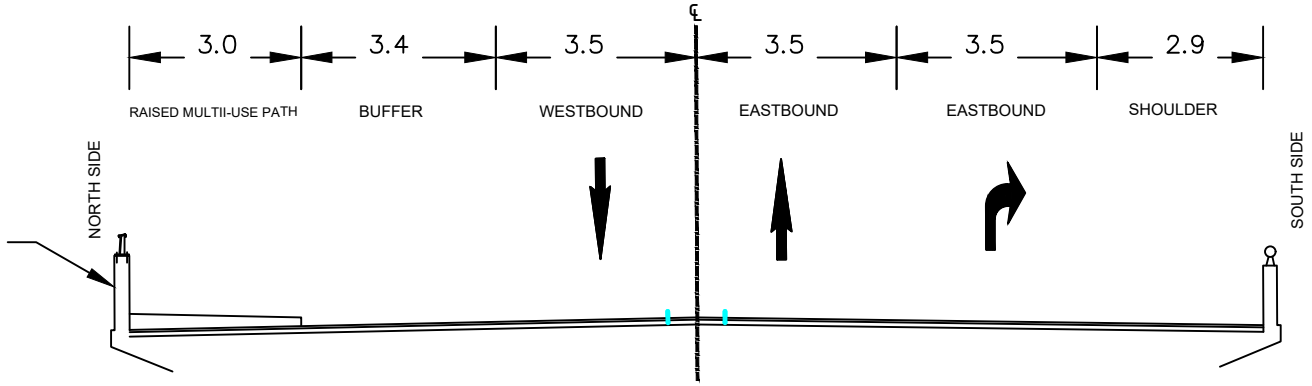


DETAILED DIMENSIONING AND DESIGN CHECKS OF THE PARAPET WALL AND COMBINATION HEIGHT RAILING WILL BE DETERMINED DURING DETAILED DESIGN PHASE IN ACCRODANCE WITH CANADIAN HIGHWAY BRIDGE DESIGN CODE

SECTION A-A: MERRITT ROAD AT HIGHWAY 406 OVERPASS - EXISTING



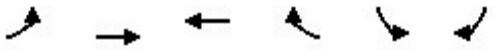
SECTION A-A: MERRITT ROAD AT HIGHWAY 406 OVERPASS - PROPOSED (OPTION 6)



FILENAME: S:\PLANNING DWGS\CA0002253.5346 – Merritt Road\MTO Interchange\Cross-sections\Cross-section (option 6).dwg
DATE: 1 May 2023

ATTACHMENT

C TRAFFIC ASSESSMENT RESULTS (SYNCHRO ANALYSIS

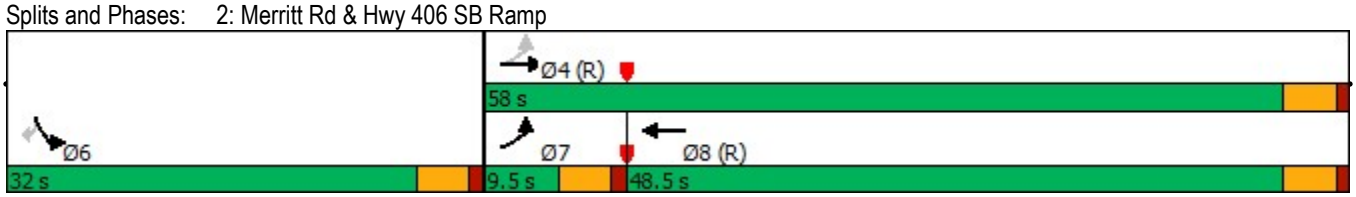


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	1078	72	27	7	768
Future Volume (vph)	32	1078	72	27	7	768
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0			210.0	0.0	150.0
Storage Lanes	0			1	1	2
Taper Length (m)	2.5				2.5	
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	0.88
Frt				0.850		0.850
Flt Protected		0.999			0.950	
Satd. Flow (prot)	0	3115	1364	1438	1607	2457
Flt Permitted		0.945			0.950	
Satd. Flow (perm)	0	2946	1364	1438	1607	2457
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				33		937
Link Speed (k/h)		60	60		60	
Link Distance (m)		216.0	340.4		573.6	
Travel Time (s)		13.0	20.4		34.4	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Adj. Flow (vph)	39	1315	88	33	9	937
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1354	88	33	9	937
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	pm+pt	NA	NA	Free	Prot	Perm
Protected Phases	7	4	8		6	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	4			Free		6
Detector Phase	7	4	8		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	9.5	22.5	22.5		22.5	22.5
Total Split (s)	9.5	58.0	48.5		32.0	32.0
Total Split (%)	10.6%	64.4%	53.9%		35.6%	35.6%
Maximum Green (s)	5.0	53.5	44.0		27.5	27.5
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		4.5	4.5		4.5	4.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	C-Max	C-Max		Max	Max
Act Effct Green (s)		53.5	53.5	90.0	27.5	27.5
Actuated g/C Ratio		0.59	0.59	1.00	0.31	0.31
v/c Ratio		0.77	0.11	0.02	0.02	0.67
Control Delay		17.6	8.4	0.0	22.1	4.4
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		17.6	8.4	0.0	22.1	4.4
LOS		B	A	A	C	A
Approach Delay		17.6	6.1		4.6	
Approach LOS		B	A		A	
Queue Length 50th (m)		85.1	6.1	0.0	1.1	0.0
Queue Length 95th (m)		93.4	11.1	0.0	4.0	6.4
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)				210.0		150.0
Base Capacity (vph)		1751	810	1438	491	1401
Starvation Cap Reductn		0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0
Reduced v/c Ratio		0.77	0.11	0.02	0.02	0.67

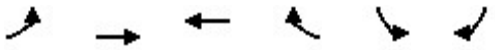
Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBT, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.77			
Intersection Signal Delay: 11.9		Intersection LOS: B	
Intersection Capacity Utilization 48.4%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 2: Merritt Rd & Hwy 406 SB Ramp



Lane Group	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	1354	88	33	9	937
v/c Ratio	0.77	0.11	0.02	0.02	0.67
Control Delay	17.6	8.4	0.0	22.1	4.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.6	8.4	0.0	22.1	4.4
Queue Length 50th (m)	85.1	6.1	0.0	1.1	0.0
Queue Length 95th (m)	93.4	11.1	0.0	4.0	6.4
Internal Link Dist (m)	192.0	316.4		549.6	
Turn Bay Length (m)			210.0		150.0
Base Capacity (vph)	1751	810	1438	491	1401
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.77	0.11	0.02	0.02	0.67

Intersection Summary



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	1078	72	27	7	768
Future Volume (vph)	32	1078	72	27	7	768
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5	4.5	4.0	4.5	4.5
Lane Util. Factor		0.95	1.00	1.00	1.00	0.88
Frt		1.00	1.00	0.85	1.00	0.85
Flt Protected		1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)		3113	1364	1438	1607	2457
Flt Permitted		0.94	1.00	1.00	0.95	1.00
Satd. Flow (perm)		2946	1364	1438	1607	2457
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	39	1315	88	33	9	937
RTOR Reduction (vph)	0	0	0	0	0	651
Lane Group Flow (vph)	0	1354	88	33	9	286
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Turn Type	pm+pt	NA	NA	Free	Prot	Perm
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		6
Actuated Green, G (s)		53.5	53.5	90.0	27.5	27.5
Effective Green, g (s)		53.5	53.5	90.0	27.5	27.5
Actuated g/C Ratio		0.59	0.59	1.00	0.31	0.31
Clearance Time (s)		4.5	4.5		4.5	4.5
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1751	810	1438	491	750
v/s Ratio Prot			0.06		0.01	
v/s Ratio Perm		c0.46		0.02		c0.12
v/c Ratio		0.77	0.11	0.02	0.02	0.38
Uniform Delay, d1		13.7	7.9	0.0	21.8	24.6
Progression Factor		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		2.2	0.3	0.0	0.1	1.5
Delay (s)		15.9	8.2	0.0	21.9	26.0
Level of Service		B	A	A	C	C
Approach Delay (s)		15.9	6.0		26.0	
Approach LOS		B	A		C	

Intersection Summary			
HCM 2000 Control Delay	19.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	48.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

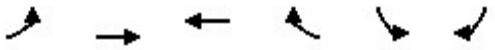
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1105	5	59	781	0	193
Future Volume (vph)	1105	5	59	781	0	193
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		0.0	75.0		0.0	0.0
Storage Lanes		0	1		0	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Frt	0.999					0.865
Flt Protected			0.950			
Satd. Flow (prot)	3148	0	1576	3151	0	1435
Flt Permitted			0.950			
Satd. Flow (perm)	3148	0	1576	3151	0	1435
Link Speed (k/h)	60			60	50	
Link Distance (m)	1070.4			216.0	379.7	
Travel Time (s)	64.2			13.0	27.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1201	5	64	849	0	210
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1206	0	64	849	0	210
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		

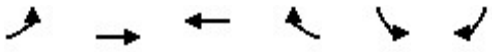
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1105	5	59	781	0	193
Future Volume (Veh/h)	1105	5	59	781	0	193
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1201	5	64	849	0	210
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				216		
pX, platoon unblocked						
vC, conflicting volume			1206		1756	603
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1206		1756	603
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			89		100	52
cM capacity (veh/h)			574		68	442

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	801	405	64	424	424	210
Volume Left	0	0	64	0	0	0
Volume Right	0	5	0	0	0	210
cSH	1700	1700	574	1700	1700	442
Volume to Capacity	0.47	0.24	0.11	0.25	0.25	0.48
Queue Length 95th (m)	0.0	0.0	2.8	0.0	0.0	19.0
Control Delay (s)	0.0	0.0	12.1	0.0	0.0	20.3
Lane LOS			B			C
Approach Delay (s)	0.0		0.8			20.3
Approach LOS						C

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	1078	72	27	7	768
Future Volume (vph)	32	1078	72	27	7	768
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0			210.0	0.0	150.0
Storage Lanes	0			1	1	2
Taper Length (m)	2.5				2.5	
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	0.88
Frt				0.850		0.850
Flt Protected		0.999			0.950	
Satd. Flow (prot)	0	3115	1364	1438	1607	2457
Flt Permitted		0.999			0.950	
Satd. Flow (perm)	0	3115	1364	1438	1607	2457
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				33		937
Link Speed (k/h)		60	60		60	
Link Distance (m)		216.0	340.4		573.6	
Travel Time (s)		13.0	20.4		34.4	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Adj. Flow (vph)	39	1315	88	33	9	937
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1354	88	33	9	937
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Split	NA	NA	Free	Prot	Perm
Protected Phases	4	4	8		6	



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases				Free		6
Detector Phase	4	4	8		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		4.5	4.5
Minimum Split (s)	9.5	9.5	9.5		9.0	9.0
Total Split (s)	35.5	35.5	10.5		14.0	14.0
Total Split (%)	59.2%	59.2%	17.5%		23.3%	23.3%
Maximum Green (s)	31.0	31.0	6.0		9.5	9.5
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		4.5	4.5		4.5	4.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	Max		Max	Max
Act Effct Green (s)		31.0	6.0	60.0	9.5	9.5
Actuated g/C Ratio		0.52	0.10	1.00	0.16	0.16
v/c Ratio		0.84	0.65	0.02	0.04	0.80
Control Delay		18.9	51.2	0.0	21.9	8.3
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		18.9	51.2	0.0	21.9	8.3
LOS		B	D	A	C	A
Approach Delay		18.9	37.3		8.5	
Approach LOS		B	D		A	
Queue Length 50th (m)		61.3	9.6	0.0	0.9	0.0
Queue Length 95th (m)		73.5	#24.3	0.0	3.8	8.5
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)				210.0		150.0
Base Capacity (vph)		1609	136	1438	254	1177
Starvation Cap Reductn		0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0
Reduced v/c Ratio		0.84	0.65	0.02	0.04	0.80

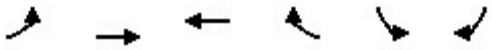
Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 4:EBTL, Start of Green			
Natural Cycle: 55			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.84			
Intersection Signal Delay: 15.8		Intersection LOS: B	
Intersection Capacity Utilization 47.9%		ICU Level of Service A	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 2: Merritt Rd & Hwy 406 SB Ramp

Lane Group	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	1354	88	33	9	937
v/c Ratio	0.84	0.65	0.02	0.04	0.80
Control Delay	18.9	51.2	0.0	21.9	8.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	18.9	51.2	0.0	21.9	8.3
Queue Length 50th (m)	61.3	9.6	0.0	0.9	0.0
Queue Length 95th (m)	73.5	#24.3	0.0	3.8	8.5
Internal Link Dist (m)	192.0	316.4		549.6	
Turn Bay Length (m)			210.0		150.0
Base Capacity (vph)	1609	136	1438	254	1177
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.84	0.65	0.02	0.04	0.80

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	1078	72	27	7	768
Future Volume (vph)	32	1078	72	27	7	768
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5	4.5	4.0	4.5	4.5
Lane Util. Factor		0.95	1.00	1.00	1.00	0.88
Frt		1.00	1.00	0.85	1.00	0.85
Flt Protected		1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)		3113	1364	1438	1607	2457
Flt Permitted		1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)		3113	1364	1438	1607	2457
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	39	1315	88	33	9	937
RTOR Reduction (vph)	0	0	0	0	0	789
Lane Group Flow (vph)	0	1354	88	33	9	148
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Turn Type	Split	NA	NA	Free	Prot	Perm
Protected Phases	4	4	8		6	
Permitted Phases				Free		6
Actuated Green, G (s)		31.0	6.0	60.0	9.5	9.5
Effective Green, g (s)		31.0	6.0	60.0	9.5	9.5
Actuated g/C Ratio		0.52	0.10	1.00	0.16	0.16
Clearance Time (s)		4.5	4.5		4.5	4.5
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1608	136	1438	254	389
v/s Ratio Prot		c0.43	c0.06		0.01	
v/s Ratio Perm				0.02		c0.06
v/c Ratio		0.84	0.65	0.02	0.04	0.38
Uniform Delay, d1		12.4	26.0	0.0	21.4	22.6
Progression Factor		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		5.5	21.4	0.0	0.3	2.8
Delay (s)		17.9	47.4	0.0	21.6	25.4
Level of Service		B	D	A	C	C
Approach Delay (s)		17.9	34.5		25.4	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	21.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

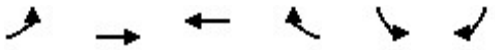
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1105	5	59	781	0	193
Future Volume (vph)	1105	5	59	781	0	193
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		0.0	75.0		0.0	0.0
Storage Lanes		0	1		0	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Frt	0.999					0.865
Flt Protected			0.950			
Satd. Flow (prot)	3148	0	1576	3151	0	1435
Flt Permitted			0.950			
Satd. Flow (perm)	3148	0	1576	3151	0	1435
Link Speed (k/h)	60			60	50	
Link Distance (m)	1070.4			216.0	379.7	
Travel Time (s)	64.2			13.0	27.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1201	5	64	849	0	210
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1206	0	64	849	0	210
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1105	5	59	781	0	193
Future Volume (Veh/h)	1105	5	59	781	0	193
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1201	5	64	849	0	210
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				216		
pX, platoon unblocked						
vC, conflicting volume			1206		1756	603
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1206		1756	603
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			89		100	52
cM capacity (veh/h)			574		68	442

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	801	405	64	424	424	210
Volume Left	0	0	64	0	0	0
Volume Right	0	5	0	0	0	210
cSH	1700	1700	574	1700	1700	442
Volume to Capacity	0.47	0.24	0.11	0.25	0.25	0.48
Queue Length 95th (m)	0.0	0.0	2.8	0.0	0.0	19.0
Control Delay (s)	0.0	0.0	12.1	0.0	0.0	20.3
Lane LOS			B			C
Approach Delay (s)	0.0		0.8			20.3
Approach LOS						C

Intersection Summary				
Average Delay	2.2			
Intersection Capacity Utilization	53.0%	ICU Level of Service		A
Analysis Period (min)	15			

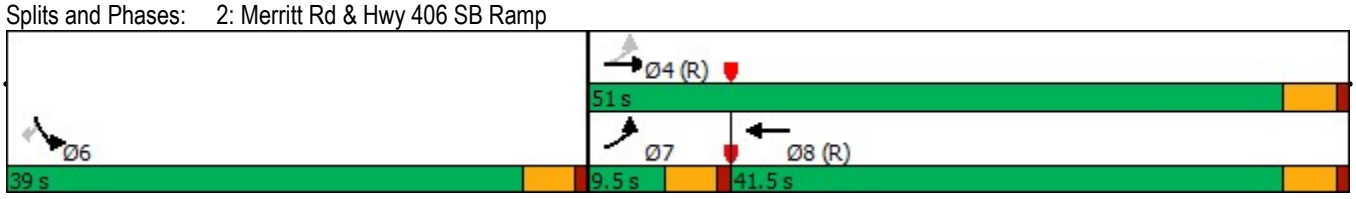


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1020	58	33	15	1130
Future Volume (vph)	77	1020	58	33	15	1130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0			210.0	0.0	150.0
Storage Lanes	0			1	1	2
Taper Length (m)	2.5				2.5	
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	0.88
Frt				0.850		0.850
Flt Protected		0.997			0.950	
Satd. Flow (prot)	0	3090	1484	1438	1004	2506
Flt Permitted		0.926			0.950	
Satd. Flow (perm)	0	2870	1484	1438	1004	2506
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				34		1177
Link Speed (k/h)		60	60		60	
Link Distance (m)		216.0	340.4		573.6	
Travel Time (s)		13.0	20.4		34.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Adj. Flow (vph)	80	1063	60	34	16	1177
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1143	60	34	16	1177
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	pm+pt	NA	NA	Free	Prot	Perm
Protected Phases	7	4	8		6	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	4			Free		6
Detector Phase	7	4	8		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	9.5	9.5	9.5		9.5	9.5
Total Split (s)	9.5	51.0	41.5		39.0	39.0
Total Split (%)	10.6%	56.7%	46.1%		43.3%	43.3%
Maximum Green (s)	5.0	46.5	37.0		34.5	34.5
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		4.5	4.5		4.5	4.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	C-Max	C-Max		Max	Max
Act Effct Green (s)		46.5	46.5	90.0	34.5	34.5
Actuated g/C Ratio		0.52	0.52	1.00	0.38	0.38
v/c Ratio		0.77	0.08	0.02	0.04	0.70
Control Delay		21.9	11.4	0.0	17.9	3.8
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		21.9	11.4	0.0	17.9	3.8
LOS		C	B	A	B	A
Approach Delay		21.9	7.3		4.0	
Approach LOS		C	A		A	
Queue Length 50th (m)		79.2	5.0	0.0	1.7	0.0
Queue Length 95th (m)		105.8	11.0	0.0	5.7	13.1
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)				210.0		150.0
Base Capacity (vph)		1482	766	1438	384	1686
Starvation Cap Reductn		0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0
Reduced v/c Ratio		0.77	0.08	0.02	0.04	0.70

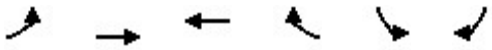
Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBT, Start of Green			
Natural Cycle: 40			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.77			
Intersection Signal Delay: 12.6		Intersection LOS: B	
Intersection Capacity Utilization 54.6%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 2: Merritt Rd & Hwy 406 SB Ramp



Lane Group	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	1143	60	34	16	1177
v/c Ratio	0.77	0.08	0.02	0.04	0.70
Control Delay	21.9	11.4	0.0	17.9	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	21.9	11.4	0.0	17.9	3.8
Queue Length 50th (m)	79.2	5.0	0.0	1.7	0.0
Queue Length 95th (m)	105.8	11.0	0.0	5.7	13.1
Internal Link Dist (m)	192.0	316.4		549.6	
Turn Bay Length (m)			210.0		150.0
Base Capacity (vph)	1482	766	1438	384	1686
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.77	0.08	0.02	0.04	0.70

Intersection Summary



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1020	58	33	15	1130
Future Volume (vph)	77	1020	58	33	15	1130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5	4.5	4.0	4.5	4.5
Lane Util. Factor		0.95	1.00	1.00	1.00	0.88
Frt		1.00	1.00	0.85	1.00	0.85
Flt Protected		1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)		3088	1484	1438	1004	2506
Flt Permitted		0.93	1.00	1.00	0.95	1.00
Satd. Flow (perm)		2869	1484	1438	1004	2506
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	80	1062	60	34	16	1177
RTOR Reduction (vph)	0	0	0	0	0	726
Lane Group Flow (vph)	0	1143	60	34	16	451
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Turn Type	pm+pt	NA	NA	Free	Prot	Perm
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		6
Actuated Green, G (s)		46.5	46.5	90.0	34.5	34.5
Effective Green, g (s)		46.5	46.5	90.0	34.5	34.5
Actuated g/C Ratio		0.52	0.52	1.00	0.38	0.38
Clearance Time (s)		4.5	4.5		4.5	4.5
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1482	766	1438	384	960
v/s Ratio Prot			0.04		0.02	
v/s Ratio Perm		c0.40		0.02		c0.18
v/c Ratio		0.77	0.08	0.02	0.04	0.47
Uniform Delay, d1		17.5	11.0	0.0	17.4	20.9
Progression Factor		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		2.5	0.2	0.0	0.2	1.7
Delay (s)		20.0	11.2	0.0	17.6	22.5
Level of Service		C	B	A	B	C
Approach Delay (s)		20.0	7.1		22.5	
Approach LOS		C	A		C	

Intersection Summary			
HCM 2000 Control Delay	20.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

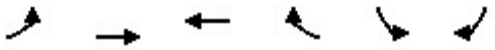
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1092	5	181	1007	0	110
Future Volume (vph)	1092	5	181	1007	0	110
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		0.0	75.0		0.0	0.0
Storage Lanes		0	1		0	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Frt	0.999					0.865
Flt Protected			0.950			
Satd. Flow (prot)	3148	0	1576	3151	0	1435
Flt Permitted			0.950			
Satd. Flow (perm)	3148	0	1576	3151	0	1435
Link Speed (k/h)	60			60	50	
Link Distance (m)	1069.8			216.0	379.7	
Travel Time (s)	64.2			13.0	27.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1187	5	197	1095	0	120
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1192	0	197	1095	0	120
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		

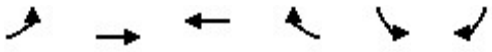
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1092	5	181	1007	0	110
Future Volume (Veh/h)	1092	5	181	1007	0	110
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1187	5	197	1095	0	120
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				216		
pX, platoon unblocked						
vC, conflicting volume			1192		2131	596
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1192		2131	596
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			66		100	73
cM capacity (veh/h)			581		28	447

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	791	401	197	548	548	120
Volume Left	0	0	197	0	0	0
Volume Right	0	5	0	0	0	120
cSH	1700	1700	581	1700	1700	447
Volume to Capacity	0.47	0.24	0.34	0.32	0.32	0.27
Queue Length 95th (m)	0.0	0.0	11.3	0.0	0.0	8.2
Control Delay (s)	0.0	0.0	14.3	0.0	0.0	16.0
Lane LOS			B			C
Approach Delay (s)	0.0		2.2			16.0
Approach LOS						C

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1020	58	33	15	1130
Future Volume (vph)	77	1020	58	33	15	1130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	0.0			210.0	0.0	150.0
Storage Lanes	0			1	1	2
Taper Length (m)	2.5				2.5	
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	0.88
Frt				0.850		0.850
Flt Protected		0.997			0.950	
Satd. Flow (prot)	0	3090	1484	1438	1004	2506
Flt Permitted		0.997			0.950	
Satd. Flow (perm)	0	3090	1484	1438	1004	2506
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				34		1177
Link Speed (k/h)		60	60		60	
Link Distance (m)		216.0	340.4		573.6	
Travel Time (s)		13.0	20.4		34.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Adj. Flow (vph)	80	1063	60	34	16	1177
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1143	60	34	16	1177
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Split	NA	NA	Free	Prot	Perm
Protected Phases	4	4	8		6	



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases				Free		6
Detector Phase	4	4	8		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	9.5	9.5	9.5		9.5	9.5
Total Split (s)	31.2	31.2	9.5		19.3	19.3
Total Split (%)	52.0%	52.0%	15.8%		32.2%	32.2%
Maximum Green (s)	26.7	26.7	5.0		14.8	14.8
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		4.5	4.5		4.5	4.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	None		Max	Max
Act Effct Green (s)		26.7	5.0	60.0	18.6	18.6
Actuated g/C Ratio		0.44	0.08	1.00	0.31	0.31
v/c Ratio		0.83	0.49	0.02	0.05	0.74
Control Delay		21.7	41.5	0.0	18.1	5.0
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		21.7	41.5	0.0	18.1	5.0
LOS		C	D	A	B	A
Approach Delay		21.7	26.5		5.2	
Approach LOS		C	C		A	
Queue Length 50th (m)		55.0	6.5	0.0	1.4	0.0
Queue Length 95th (m)		#83.8	#19.2	0.0	5.3	14.6
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)				210.0		150.0
Base Capacity (vph)		1375	123	1438	311	1588
Starvation Cap Reductn		0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0
Reduced v/c Ratio		0.83	0.49	0.02	0.05	0.74

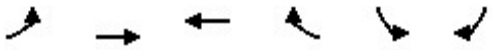
Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 4:EBTL, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.83			
Intersection Signal Delay: 13.8		Intersection LOS: B	
Intersection Capacity Utilization 54.6%		ICU Level of Service A	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 2: Merritt Rd & Hwy 406 SB Ramp

Lane Group	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	1143	60	34	16	1177
v/c Ratio	0.83	0.49	0.02	0.05	0.74
Control Delay	21.7	41.5	0.0	18.1	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	21.7	41.5	0.0	18.1	5.0
Queue Length 50th (m)	55.0	6.5	0.0	1.4	0.0
Queue Length 95th (m)	#83.8	#19.2	0.0	5.3	14.6
Internal Link Dist (m)	192.0	316.4		549.6	
Turn Bay Length (m)			210.0		150.0
Base Capacity (vph)	1375	123	1438	311	1588
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.83	0.49	0.02	0.05	0.74

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1020	58	33	15	1130
Future Volume (vph)	77	1020	58	33	15	1130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5	4.5	4.0	4.5	4.5
Lane Util. Factor		0.95	1.00	1.00	1.00	0.88
Frt		1.00	1.00	0.85	1.00	0.85
Flt Protected		1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)		3088	1484	1438	1004	2506
Flt Permitted		1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)		3088	1484	1438	1004	2506
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	80	1062	60	34	16	1177
RTOR Reduction (vph)	0	0	0	0	0	812
Lane Group Flow (vph)	0	1143	60	34	16	365
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Turn Type	Split	NA	NA	Free	Prot	Perm
Protected Phases	4	4	8		6	
Permitted Phases				Free		6
Actuated Green, G (s)		24.9	3.0	60.0	18.6	18.6
Effective Green, g (s)		24.9	3.0	60.0	18.6	18.6
Actuated g/C Ratio		0.41	0.05	1.00	0.31	0.31
Clearance Time (s)		4.5	4.5		4.5	4.5
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1281	74	1438	311	776
v/s Ratio Prot		c0.37	c0.04		0.02	
v/s Ratio Perm				0.02		c0.15
v/c Ratio		0.89	0.81	0.02	0.05	0.47
Uniform Delay, d1		16.3	28.2	0.0	14.5	16.7
Progression Factor		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		9.7	46.8	0.0	0.3	2.0
Delay (s)		26.0	75.0	0.0	14.8	18.8
Level of Service		C	E	A	B	B
Approach Delay (s)		26.0	47.9		18.7	
Approach LOS		C	D		B	

Intersection Summary			
HCM 2000 Control Delay	23.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

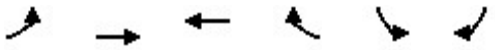
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1092	5	181	1007	0	110
Future Volume (vph)	1092	5	181	1007	0	110
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		0.0	75.0		0.0	0.0
Storage Lanes		0	1		0	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Frt	0.999					0.865
Flt Protected			0.950			
Satd. Flow (prot)	3148	0	1576	3151	0	1435
Flt Permitted			0.950			
Satd. Flow (perm)	3148	0	1576	3151	0	1435
Link Speed (k/h)	60			60	50	
Link Distance (m)	1069.8			216.0	379.7	
Travel Time (s)	64.2			13.0	27.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1187	5	197	1095	0	120
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1192	0	197	1095	0	120
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		

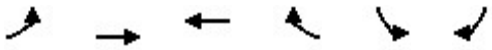
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1092	5	181	1007	0	110
Future Volume (Veh/h)	1092	5	181	1007	0	110
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1187	5	197	1095	0	120
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				216		
pX, platoon unblocked						
vC, conflicting volume			1192		2131	596
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1192		2131	596
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			66		100	73
cM capacity (veh/h)			581		28	447

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	791	401	197	548	548	120
Volume Left	0	0	197	0	0	0
Volume Right	0	5	0	0	0	120
cSH	1700	1700	581	1700	1700	447
Volume to Capacity	0.47	0.24	0.34	0.32	0.32	0.27
Queue Length 95th (m)	0.0	0.0	11.3	0.0	0.0	8.2
Control Delay (s)	0.0	0.0	14.3	0.0	0.0	16.0
Lane LOS			B			C
Approach Delay (s)	0.0		2.2			16.0
Approach LOS						C

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		



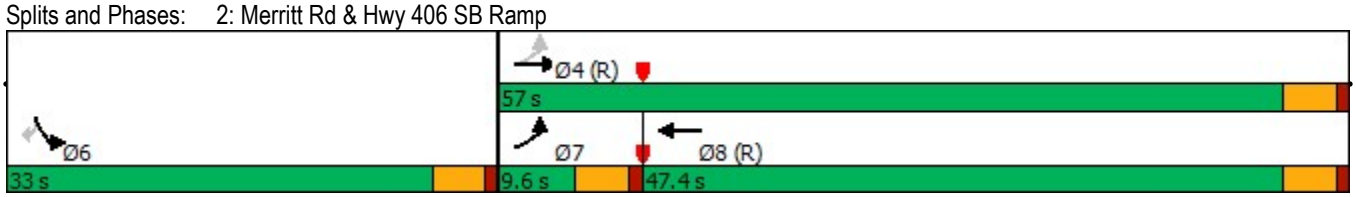
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	1078	72	27	7	768
Future Volume (vph)	32	1078	72	27	7	768
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0			210.0	0.0	150.0
Storage Lanes	1			1	1	2
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	0.88
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1516	3121	1364	1438	1607	2457
Flt Permitted	0.636				0.950	
Satd. Flow (perm)	1015	3121	1364	1438	1607	2457
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				33		937
Link Speed (k/h)		60	60		60	
Link Distance (m)		216.0	340.4		573.6	
Travel Time (s)		13.0	20.4		34.4	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Adj. Flow (vph)	39	1315	88	33	9	937
Shared Lane Traffic (%)						
Lane Group Flow (vph)	39	1315	88	33	9	937
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	pm+pt	NA	NA	Free	Prot	Perm
Protected Phases	7	4	8		6	

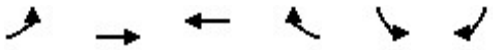


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	4			Free		6
Detector Phase	7	4	8		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	9.5	9.5	9.5		9.5	9.5
Total Split (s)	9.6	57.0	47.4		33.0	33.0
Total Split (%)	10.7%	63.3%	52.7%		36.7%	36.7%
Maximum Green (s)	5.1	52.5	42.9		28.5	28.5
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5		4.5	4.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	C-Max	C-Max		Max	Max
Act Effct Green (s)	52.5	52.5	46.7	90.0	28.5	28.5
Actuated g/C Ratio	0.58	0.58	0.52	1.00	0.32	0.32
v/c Ratio	0.06	0.72	0.12	0.02	0.02	0.66
Control Delay	8.3	16.4	13.1	0.0	21.4	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.3	16.4	13.1	0.0	21.4	4.3
LOS	A	B	B	A	C	A
Approach Delay		16.2	9.6		4.4	
Approach LOS		B	A		A	
Queue Length 50th (m)	2.7	79.5	8.2	0.0	1.1	0.0
Queue Length 95th (m)	6.0	87.4	15.0	0.0	4.0	6.3
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)	80.0			210.0		150.0
Base Capacity (vph)	620	1820	708	1438	508	1418
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.72	0.12	0.02	0.02	0.66

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBT, Start of Green			
Natural Cycle: 45			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.72			
Intersection Signal Delay: 11.3		Intersection LOS: B	
Intersection Capacity Utilization 44.0%		ICU Level of Service A	
Analysis Period (min) 15			

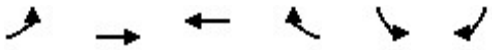
Splits and Phases: 2: Merritt Rd & Hwy 406 SB Ramp





Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	39	1315	88	33	9	937
v/c Ratio	0.06	0.72	0.12	0.02	0.02	0.66
Control Delay	8.3	16.4	13.1	0.0	21.4	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.3	16.4	13.1	0.0	21.4	4.3
Queue Length 50th (m)	2.7	79.5	8.2	0.0	1.1	0.0
Queue Length 95th (m)	6.0	87.4	15.0	0.0	4.0	6.3
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)	80.0			210.0		150.0
Base Capacity (vph)	620	1820	708	1438	508	1418
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.72	0.12	0.02	0.02	0.66

Intersection Summary



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	1078	72	27	7	768
Future Volume (vph)	32	1078	72	27	7	768
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5	4.5	4.5	4.0	4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	0.88
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1516	3121	1364	1438	1607	2457
Flt Permitted	0.64	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1015	3121	1364	1438	1607	2457
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	39	1315	88	33	9	937
RTOR Reduction (vph)	0	0	0	0	0	640
Lane Group Flow (vph)	39	1315	88	33	9	297
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Turn Type	pm+pt	NA	NA	Free	Prot	Perm
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		6
Actuated Green, G (s)	52.5	52.5	44.9	90.0	28.5	28.5
Effective Green, g (s)	52.5	52.5	44.9	90.0	28.5	28.5
Actuated g/C Ratio	0.58	0.58	0.50	1.00	0.32	0.32
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	609	1820	680	1438	508	778
v/s Ratio Prot	0.00	c0.42	0.06		0.01	
v/s Ratio Perm	0.04			0.02		c0.12
v/c Ratio	0.06	0.72	0.13	0.02	0.02	0.38
Uniform Delay, d1	8.1	13.5	12.1	0.0	21.1	23.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.0	2.5	0.4	0.0	0.1	1.4
Delay (s)	8.2	16.0	12.5	0.0	21.2	25.3
Level of Service	A	B	B	A	C	C
Approach Delay (s)		15.8	9.1		25.3	
Approach LOS		B	A		C	

Intersection Summary			
HCM 2000 Control Delay	19.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	44.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

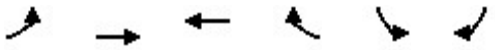
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1105	5	59	781	0	193
Future Volume (vph)	1105	5	59	781	0	193
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		0.0	75.0		0.0	0.0
Storage Lanes		0	1		0	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Frt	0.999					0.865
Flt Protected			0.950			
Satd. Flow (prot)	3148	0	1576	3151	0	1435
Flt Permitted			0.950			
Satd. Flow (perm)	3148	0	1576	3151	0	1435
Link Speed (k/h)	60			60	50	
Link Distance (m)	1070.4			216.0	379.7	
Travel Time (s)	64.2			13.0	27.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1201	5	64	849	0	210
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1206	0	64	849	0	210
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		

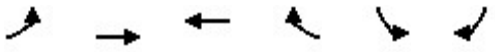
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1105	5	59	781	0	193
Future Volume (Veh/h)	1105	5	59	781	0	193
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1201	5	64	849	0	210
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				216		
pX, platoon unblocked						
vC, conflicting volume			1206		1756	603
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1206		1756	603
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			89		100	52
cM capacity (veh/h)			574		68	442

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	801	405	64	424	424	210
Volume Left	0	0	64	0	0	0
Volume Right	0	5	0	0	0	210
cSH	1700	1700	574	1700	1700	442
Volume to Capacity	0.47	0.24	0.11	0.25	0.25	0.48
Queue Length 95th (m)	0.0	0.0	2.8	0.0	0.0	19.0
Control Delay (s)	0.0	0.0	12.1	0.0	0.0	20.3
Lane LOS			B			C
Approach Delay (s)	0.0		0.8			20.3
Approach LOS						C

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		



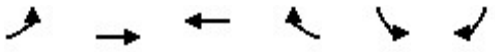
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	1078	72	27	7	768
Future Volume (vph)	32	1078	72	27	7	768
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0			210.0	0.0	150.0
Storage Lanes	1			1	1	2
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	0.88
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1516	3121	1364	1438	1607	2457
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1516	3121	1364	1438	1607	2457
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				33		937
Link Speed (k/h)		60	60		60	
Link Distance (m)		216.0	340.4		573.6	
Travel Time (s)		13.0	20.4		34.4	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Adj. Flow (vph)	39	1315	88	33	9	937
Shared Lane Traffic (%)						
Lane Group Flow (vph)	39	1315	88	33	9	937
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Split	NA	NA	Free	Prot	Perm
Protected Phases	4	4	8		6	



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases				Free		6
Detector Phase	4	4	8		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	9.5	9.5	9.5		9.5	9.5
Total Split (s)	35.0	35.0	10.0		15.0	15.0
Total Split (%)	58.3%	58.3%	16.7%		25.0%	25.0%
Maximum Green (s)	30.5	30.5	5.5		10.5	10.5
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5		4.5	4.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	Max		Max	Max
Act Effct Green (s)	30.5	30.5	5.5	60.0	10.5	10.5
Actuated g/C Ratio	0.51	0.51	0.09	1.00	0.18	0.18
v/c Ratio	0.05	0.83	0.70	0.02	0.03	0.78
Control Delay	7.8	18.6	59.3	0.0	21.0	7.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.8	18.6	59.3	0.0	21.0	7.5
LOS	A	B	E	A	C	A
Approach Delay		18.3	43.2		7.6	
Approach LOS		B	D		A	
Queue Length 50th (m)	2.0	59.4	9.6	0.0	0.8	0.0
Queue Length 95th (m)	5.2	71.4	#25.7	0.0	3.7	8.4
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)	80.0			210.0		150.0
Base Capacity (vph)	770	1586	125	1438	281	1203
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.83	0.70	0.02	0.03	0.78

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 4:EBTL, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.83			
Intersection Signal Delay: 15.4		Intersection LOS: B	
Intersection Capacity Utilization 44.0%		ICU Level of Service A	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

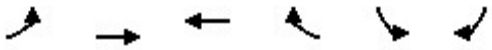
Splits and Phases: 2: Merritt Rd & Hwy 406 SB Ramp



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	39	1315	88	33	9	937
v/c Ratio	0.05	0.83	0.70	0.02	0.03	0.78
Control Delay	7.8	18.6	59.3	0.0	21.0	7.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.8	18.6	59.3	0.0	21.0	7.5
Queue Length 50th (m)	2.0	59.4	9.6	0.0	0.8	0.0
Queue Length 95th (m)	5.2	71.4	#25.7	0.0	3.7	8.4
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)	80.0			210.0		150.0
Base Capacity (vph)	770	1586	125	1438	281	1203
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.83	0.70	0.02	0.03	0.78

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	1078	72	27	7	768
Future Volume (vph)	32	1078	72	27	7	768
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5	4.5	4.5	4.0	4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	0.88
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1516	3121	1364	1438	1607	2457
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1516	3121	1364	1438	1607	2457
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	39	1315	88	33	9	937
RTOR Reduction (vph)	0	0	0	0	0	773
Lane Group Flow (vph)	39	1315	88	33	9	164
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Turn Type	Split	NA	NA	Free	Prot	Perm
Protected Phases	4	4	8		6	
Permitted Phases				Free		6
Actuated Green, G (s)	30.5	30.5	5.5	60.0	10.5	10.5
Effective Green, g (s)	30.5	30.5	5.5	60.0	10.5	10.5
Actuated g/C Ratio	0.51	0.51	0.09	1.00	0.18	0.18
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	770	1586	125	1438	281	429
v/s Ratio Prot	0.03	c0.42	c0.06		0.01	
v/s Ratio Perm				0.02		c0.07
v/c Ratio	0.05	0.83	0.70	0.02	0.03	0.38
Uniform Delay, d1	7.4	12.5	26.5	0.0	20.5	21.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	5.2	28.3	0.0	0.2	2.6
Delay (s)	7.6	17.7	54.7	0.0	20.7	24.5
Level of Service	A	B	D	A	C	C
Approach Delay (s)		17.4	39.8		24.4	
Approach LOS		B	D		C	

Intersection Summary			
HCM 2000 Control Delay	21.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	44.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

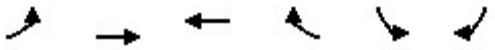
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1105	5	59	781	0	193
Future Volume (vph)	1105	5	59	781	0	193
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		0.0	75.0		0.0	0.0
Storage Lanes		0	1		0	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Frt	0.999					0.865
Flt Protected			0.950			
Satd. Flow (prot)	3148	0	1576	3151	0	1435
Flt Permitted			0.950			
Satd. Flow (perm)	3148	0	1576	3151	0	1435
Link Speed (k/h)	60			60	50	
Link Distance (m)	1070.4			216.0	379.7	
Travel Time (s)	64.2			13.0	27.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1201	5	64	849	0	210
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1206	0	64	849	0	210
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		

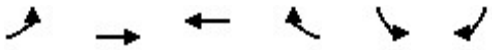
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1105	5	59	781	0	193
Future Volume (Veh/h)	1105	5	59	781	0	193
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1201	5	64	849	0	210
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				216		
pX, platoon unblocked						
vC, conflicting volume			1206		1756	603
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1206		1756	603
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			89		100	52
cM capacity (veh/h)			574		68	442

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	801	405	64	424	424	210
Volume Left	0	0	64	0	0	0
Volume Right	0	5	0	0	0	210
cSH	1700	1700	574	1700	1700	442
Volume to Capacity	0.47	0.24	0.11	0.25	0.25	0.48
Queue Length 95th (m)	0.0	0.0	2.8	0.0	0.0	19.0
Control Delay (s)	0.0	0.0	12.1	0.0	0.0	20.3
Lane LOS			B			C
Approach Delay (s)	0.0		0.8			20.3
Approach LOS						C

Intersection Summary				
Average Delay	2.2			
Intersection Capacity Utilization	53.0%	ICU Level of Service		A
Analysis Period (min)	15			



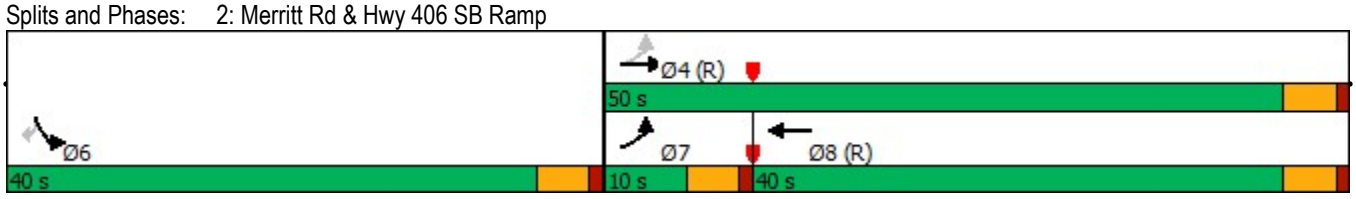
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1020	58	33	15	1130
Future Volume (vph)	77	1020	58	33	15	1130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0			210.0	0.0	150.0
Storage Lanes	1			1	1	2
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	0.88
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1607	3091	1484	1438	1004	2506
Flt Permitted	0.639				0.950	
Satd. Flow (perm)	1081	3091	1484	1438	1004	2506
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				34		1177
Link Speed (k/h)		60	60		60	
Link Distance (m)		216.0	340.4		573.6	
Travel Time (s)		13.0	20.4		34.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Adj. Flow (vph)	80	1063	60	34	16	1177
Shared Lane Traffic (%)						
Lane Group Flow (vph)	80	1063	60	34	16	1177
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	pm+pt	NA	NA	Free	Prot	Perm
Protected Phases	7	4	8		6	

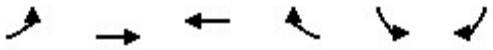


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	4			Free		6
Detector Phase	7	4	8		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	9.5	9.5	9.5		9.5	9.5
Total Split (s)	10.0	50.0	40.0		40.0	40.0
Total Split (%)	11.1%	55.6%	44.4%		44.4%	44.4%
Maximum Green (s)	5.5	45.5	35.5		35.5	35.5
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5		4.5	4.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	C-Max	C-Max		Max	Max
Act Effct Green (s)	45.5	45.5	37.5	90.0	35.5	35.5
Actuated g/C Ratio	0.51	0.51	0.42	1.00	0.39	0.39
v/c Ratio	0.14	0.68	0.10	0.02	0.04	0.69
Control Delay	12.3	19.6	17.9	0.0	17.3	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.3	19.6	17.9	0.0	17.3	3.7
LOS	B	B	B	A	B	A
Approach Delay		19.1	11.4		3.9	
Approach LOS		B	B		A	
Queue Length 50th (m)	6.8	69.4	6.4	0.0	1.7	0.0
Queue Length 95th (m)	14.0	91.3	14.2	0.0	5.6	12.9
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)	80.0			210.0		150.0
Base Capacity (vph)	578	1562	618	1438	396	1701
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.68	0.10	0.02	0.04	0.69

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBT, Start of Green			
Natural Cycle: 50			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.69			
Intersection Signal Delay: 11.3		Intersection LOS: B	
Intersection Capacity Utilization 54.6%		ICU Level of Service A	
Analysis Period (min) 15			

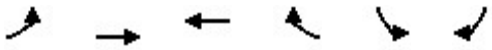
Splits and Phases: 2: Merritt Rd & Hwy 406 SB Ramp





Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	80	1063	60	34	16	1177
v/c Ratio	0.14	0.68	0.10	0.02	0.04	0.69
Control Delay	12.3	19.6	17.9	0.0	17.3	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.3	19.6	17.9	0.0	17.3	3.7
Queue Length 50th (m)	6.8	69.4	6.4	0.0	1.7	0.0
Queue Length 95th (m)	14.0	91.3	14.2	0.0	5.6	12.9
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)	80.0			210.0		150.0
Base Capacity (vph)	578	1562	618	1438	396	1701
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.68	0.10	0.02	0.04	0.69

Intersection Summary



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1020	58	33	15	1130
Future Volume (vph)	77	1020	58	33	15	1130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5	4.5	4.5	4.0	4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	0.88
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1607	3091	1484	1438	1004	2506
Flt Permitted	0.64	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1081	3091	1484	1438	1004	2506
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	80	1062	60	34	16	1177
RTOR Reduction (vph)	0	0	0	0	0	713
Lane Group Flow (vph)	80	1063	60	34	16	464
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Turn Type	pm+pt	NA	NA	Free	Prot	Perm
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		6
Actuated Green, G (s)	45.5	45.5	36.6	90.0	35.5	35.5
Effective Green, g (s)	45.5	45.5	36.6	90.0	35.5	35.5
Actuated g/C Ratio	0.51	0.51	0.41	1.00	0.39	0.39
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	572	1562	603	1438	396	988
v/s Ratio Prot	0.01	c0.34	0.04		0.02	
v/s Ratio Perm	0.06			0.02		c0.19
v/c Ratio	0.14	0.68	0.10	0.02	0.04	0.47
Uniform Delay, d1	11.7	16.8	16.5	0.0	16.8	20.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	2.4	0.3	0.0	0.2	1.6
Delay (s)	11.8	19.2	16.8	0.0	17.0	21.9
Level of Service	B	B	B	A	B	C
Approach Delay (s)		18.7	10.8		21.8	
Approach LOS		B	B		C	

Intersection Summary			
HCM 2000 Control Delay	19.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

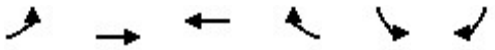
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1092	5	181	1007	0	110
Future Volume (vph)	1092	5	181	1007	0	110
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		0.0	75.0		0.0	0.0
Storage Lanes		0	1		0	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Frt	0.999					0.865
Flt Protected			0.950			
Satd. Flow (prot)	3148	0	1576	3151	0	1435
Flt Permitted			0.950			
Satd. Flow (perm)	3148	0	1576	3151	0	1435
Link Speed (k/h)	60			60	50	
Link Distance (m)	1069.8			216.0	379.7	
Travel Time (s)	64.2			13.0	27.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1187	5	197	1095	0	120
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1192	0	197	1095	0	120
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		

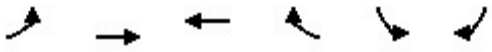
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1092	5	181	1007	0	110
Future Volume (Veh/h)	1092	5	181	1007	0	110
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1187	5	197	1095	0	120
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				216		
pX, platoon unblocked						
vC, conflicting volume			1192		2131	596
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1192		2131	596
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			66		100	73
cM capacity (veh/h)			581		28	447

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	791	401	197	548	548	120
Volume Left	0	0	197	0	0	0
Volume Right	0	5	0	0	0	120
cSH	1700	1700	581	1700	1700	447
Volume to Capacity	0.47	0.24	0.34	0.32	0.32	0.27
Queue Length 95th (m)	0.0	0.0	11.3	0.0	0.0	8.2
Control Delay (s)	0.0	0.0	14.3	0.0	0.0	16.0
Lane LOS			B			C
Approach Delay (s)	0.0		2.2			16.0
Approach LOS						C

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		



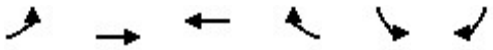
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1020	58	33	15	1130
Future Volume (vph)	77	1020	58	33	15	1130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0			210.0	0.0	150.0
Storage Lanes	1			1	1	2
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	0.88
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1607	3091	1484	1438	1004	2506
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1607	3091	1484	1438	1004	2506
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				34		1177
Link Speed (k/h)		60	60		60	
Link Distance (m)		216.0	340.4		573.6	
Travel Time (s)		13.0	20.4		34.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Adj. Flow (vph)	80	1063	60	34	16	1177
Shared Lane Traffic (%)						
Lane Group Flow (vph)	80	1063	60	34	16	1177
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Split	NA	NA	Free	Prot	Perm
Protected Phases	4	4	8		6	



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases				Free		6
Detector Phase	4	4	8		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	9.5	9.5	9.5		9.5	9.5
Total Split (s)	30.1	30.1	9.5		20.4	20.4
Total Split (%)	50.2%	50.2%	15.8%		34.0%	34.0%
Maximum Green (s)	25.6	25.6	5.0		15.9	15.9
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5		4.5	4.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	C-Max	C-Max	None		Max	Max
Act Effct Green (s)	25.6	25.6	5.0	60.0	19.7	19.7
Actuated g/C Ratio	0.43	0.43	0.08	1.00	0.33	0.33
v/c Ratio	0.12	0.81	0.49	0.02	0.05	0.73
Control Delay	11.0	21.3	41.5	0.0	17.2	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.0	21.3	41.5	0.0	17.2	4.6
LOS	B	C	D	A	B	A
Approach Delay		20.6	26.5		4.8	
Approach LOS		C	C		A	
Queue Length 50th (m)	5.1	51.2	6.5	0.0	1.3	0.0
Queue Length 95th (m)	11.8	#74.8	#19.2	0.0	5.1	14.2
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)	80.0			210.0		150.0
Base Capacity (vph)	685	1318	123	1438	330	1613
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.81	0.49	0.02	0.05	0.73

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 4:EBTL, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.81			
Intersection Signal Delay: 13.1		Intersection LOS: B	
Intersection Capacity Utilization 54.6%		ICU Level of Service A	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

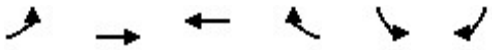
Splits and Phases: 2: Merritt Rd & Hwy 406 SB Ramp



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	80	1063	60	34	16	1177
v/c Ratio	0.12	0.81	0.49	0.02	0.05	0.73
Control Delay	11.0	21.3	41.5	0.0	17.2	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.0	21.3	41.5	0.0	17.2	4.6
Queue Length 50th (m)	5.1	51.2	6.5	0.0	1.3	0.0
Queue Length 95th (m)	11.8	#74.8	#19.2	0.0	5.1	14.2
Internal Link Dist (m)		192.0	316.4		549.6	
Turn Bay Length (m)	80.0			210.0		150.0
Base Capacity (vph)	685	1318	123	1438	330	1613
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.81	0.49	0.02	0.05	0.73

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1020	58	33	15	1130
Future Volume (vph)	77	1020	58	33	15	1130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5	4.5	4.5	4.0	4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	0.88
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1607	3091	1484	1438	1004	2506
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1607	3091	1484	1438	1004	2506
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	80	1062	60	34	16	1177
RTOR Reduction (vph)	0	0	0	0	0	791
Lane Group Flow (vph)	80	1063	60	34	16	386
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Turn Type	Split	NA	NA	Free	Prot	Perm
Protected Phases	4	4	8		6	
Permitted Phases				Free		6
Actuated Green, G (s)	23.8	23.8	3.0	60.0	19.7	19.7
Effective Green, g (s)	23.8	23.8	3.0	60.0	19.7	19.7
Actuated g/C Ratio	0.40	0.40	0.05	1.00	0.33	0.33
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	637	1226	74	1438	329	822
v/s Ratio Prot	0.05	c0.34	c0.04		0.02	
v/s Ratio Perm				0.02		c0.15
v/c Ratio	0.13	0.87	0.81	0.02	0.05	0.47
Uniform Delay, d1	11.5	16.6	28.2	0.0	13.8	16.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	8.4	46.8	0.0	0.3	1.9
Delay (s)	11.9	25.0	75.0	0.0	14.0	17.9
Level of Service	B	C	E	A	B	B
Approach Delay (s)		24.1	47.9		17.9	
Approach LOS		C	D		B	

Intersection Summary			
HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

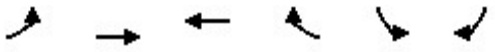
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1092	5	181	1007	0	110
Future Volume (vph)	1092	5	181	1007	0	110
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		0.0	75.0		0.0	0.0
Storage Lanes		0	1		0	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Frt	0.999					0.865
Flt Protected			0.950			
Satd. Flow (prot)	3148	0	1576	3151	0	1435
Flt Permitted			0.950			
Satd. Flow (perm)	3148	0	1576	3151	0	1435
Link Speed (k/h)	60			60	50	
Link Distance (m)	1069.8			216.0	379.7	
Travel Time (s)	64.2			13.0	27.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1187	5	197	1095	0	120
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1192	0	197	1095	0	120
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1092	5	181	1007	0	110
Future Volume (Veh/h)	1092	5	181	1007	0	110
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1187	5	197	1095	0	120
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				216		
pX, platoon unblocked						
vC, conflicting volume			1192		2131	596
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1192		2131	596
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			66		100	73
cM capacity (veh/h)			581		28	447

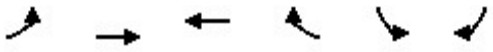
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	791	401	197	548	548	120
Volume Left	0	0	197	0	0	0
Volume Right	0	5	0	0	0	120
cSH	1700	1700	581	1700	1700	447
Volume to Capacity	0.47	0.24	0.34	0.32	0.32	0.27
Queue Length 95th (m)	0.0	0.0	11.3	0.0	0.0	8.2
Control Delay (s)	0.0	0.0	14.3	0.0	0.0	16.0
Lane LOS			B			C
Approach Delay (s)	0.0		2.2			16.0
Approach LOS						C

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	1078	72	27	7	768
Future Volume (vph)	32	1078	72	27	7	768
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0			210.0	0.0	150.0
Storage Lanes	0			1	1	1
Taper Length (m)	2.5				2.5	
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	0.95
Frt				0.850	0.853	0.850
Flt Protected		0.999			0.999	
Satd. Flow (prot)	0	3115	1364	1438	1400	1326
Flt Permitted		0.999			0.999	
Satd. Flow (perm)	0	3115	1364	1438	1400	1326
Link Speed (k/h)		60	60		60	
Link Distance (m)		216.0	340.4		573.6	
Travel Time (s)		13.0	20.4		34.4	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	6%	3%	24%	0%	0%	3%
Adj. Flow (vph)	39	1315	88	33	9	937
Shared Lane Traffic (%)						50%
Lane Group Flow (vph)	0	1354	88	33	478	468
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Sign Control		Yield	Yield		Yield	

Intersection Summary			
Area Type:	Other		
Control Type: Roundabout			
Intersection Capacity Utilization	61.0%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Right Turn Channelized				MOYes		
Traffic Volume (veh/h)	32	1078	72	27	7	768
Future Volume (veh/h)	32	1078	72	27	7	768
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	39	1315	88	33	9	937
Approach Volume (veh/h)		1354	88		946	
Crossing Volume (veh/h)		9	39		88	
High Capacity (veh/h)		1375	1343		1293	
High v/c (veh/h)		0.98	0.07		0.73	
Low Capacity (veh/h)		1152	1123		1078	
Low v/c (veh/h)		1.17	0.08		0.88	

Intersection Summary			
Maximum v/c High	0.98		
Maximum v/c Low	1.17		
Intersection Capacity Utilization	61.0%	ICU Level of Service	B

Intersection	
Intersection Delay, s/veh	90.0
Intersection LOS	F

Approach	EB	WB	SB
Entry Lanes	2	1	2
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	1354	121	946
Demand Flow Rate, veh/h	1395	142	974
Vehicles Circulating, veh/h	9	41	109
Vehicles Exiting, veh/h	1074	1363	41
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	133.7	4.7	38.4
Approach LOS	F	A	E

Lane	Left	Left	Bypass	Left	Right
Designated Moves	LT	T	R	L	TR
Assumed Moves	LT	T	R	L	TR
RT Channelized			Yield		
Lane Util	1.000	1.000		0.009	0.991
Critical Headway, s	5.193	5.193		5.193	5.193
Entry Flow, veh/h	1395	109	33	9	965
Cap Entry Lane, veh/h	1120	1085	1085	1013	1013
Entry HV Adj Factor	0.970	0.806	1.000	1.000	0.971
Flow Entry, veh/h	1354	88	33	9	937
Cap Entry, veh/h	1087	875	1085	1013	984
V/C Ratio	1.246	0.101	0.030	0.009	0.952
Control Delay, s/veh	133.7	5.1	3.6	3.6	38.7
LOS	F	A	A	A	E
95th %tile Queue, veh	45	0	0	0	16

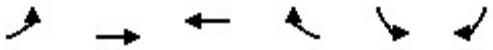
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1105	5	59	781	0	193
Future Volume (vph)	1105	5	59	781	0	193
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		0.0	75.0		0.0	0.0
Storage Lanes		0	1		0	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Frt	0.999					0.865
Flt Protected			0.950			
Satd. Flow (prot)	3148	0	1576	3151	0	1435
Flt Permitted			0.950			
Satd. Flow (perm)	3148	0	1576	3151	0	1435
Link Speed (k/h)	60			60	50	
Link Distance (m)	1070.4			216.0	379.7	
Travel Time (s)	64.2			13.0	27.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1201	5	64	849	0	210
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1206	0	64	849	0	210
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1105	5	59	781	0	193
Future Volume (Veh/h)	1105	5	59	781	0	193
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1201	5	64	849	0	210
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1206		1756	603
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1206		1756	603
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			89		100	52
cM capacity (veh/h)			574		68	442

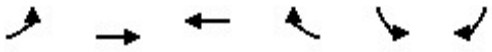
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	801	405	64	424	424	210
Volume Left	0	0	64	0	0	0
Volume Right	0	5	0	0	0	210
cSH	1700	1700	574	1700	1700	442
Volume to Capacity	0.47	0.24	0.11	0.25	0.25	0.48
Queue Length 95th (m)	0.0	0.0	2.8	0.0	0.0	19.0
Control Delay (s)	0.0	0.0	12.1	0.0	0.0	20.3
Lane LOS			B			C
Approach Delay (s)	0.0		0.8			20.3
Approach LOS						C

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1020	58	33	15	1130
Future Volume (vph)	77	1020	58	33	15	1130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	80.0			210.0	0.0	150.0
Storage Lanes	0			1	1	1
Taper Length (m)	2.5				2.5	
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected		0.997			0.950	
Satd. Flow (prot)	0	3090	1484	1438	1004	1424
Flt Permitted		0.997			0.950	
Satd. Flow (perm)	0	3090	1484	1438	1004	1424
Link Speed (k/h)		60	60		60	
Link Distance (m)		216.0	340.4		573.6	
Travel Time (s)		13.0	20.4		34.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	4%	14%	0%	60%	1%
Adj. Flow (vph)	80	1063	60	34	16	1177
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1143	60	34	16	1177
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.3	3.3		3.3	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)	24			14	24	14
Sign Control		Yield	Yield		Yield	

Intersection Summary			
Area Type:	Other		
Control Type: Roundabout			
Intersection Capacity Utilization 86.0%		ICU Level of Service E	
Analysis Period (min) 15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Right Turn Channelized				MOYes		
Traffic Volume (veh/h)	77	1020	58	33	15	1130
Future Volume (veh/h)	77	1020	58	33	15	1130
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	80	1063	60	34	16	1177
Approach Volume (veh/h)		1143	60		1193	
Crossing Volume (veh/h)		16	80		60	
High Capacity (veh/h)		1367	1301		1321	
High v/c (veh/h)		0.84	0.05		0.90	
Low Capacity (veh/h)		1146	1085		1104	
Low v/c (veh/h)		1.00	0.06		1.08	

Intersection Summary				
Maximum v/c High		0.90		
Maximum v/c Low		1.08		
Intersection Capacity Utilization		86.0%	ICU Level of Service	E

Intersection	
Intersection Delay, s/veh	75.4
Intersection LOS	F

Approach	EB	WB	SB
Entry Lanes	2	1	2
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	1143	94	1193
Demand Flow Rate, veh/h	1186	102	1215
Vehicles Circulating, veh/h	26	80	68
Vehicles Exiting, veh/h	1257	1132	80
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	69.9	4.2	86.3
Approach LOS	F	A	F

Lane	Left	Left	Bypass	Left	Right
Designated Moves	LT	T	R	L	TR
Assumed Moves	LT	T	R	L	TR
RT Channelized			Yield		
Lane Util	1.000	1.000		0.021	0.979
Critical Headway, s	5.193	5.193		5.193	5.193
Entry Flow, veh/h	1186	68	34	26	1189
Cap Entry Lane, veh/h	1101	1043	1043	1056	1056
Entry HV Adj Factor	0.964	0.877	1.000	0.615	0.990
Flow Entry, veh/h	1143	60	34	16	1177
Cap Entry, veh/h	1061	915	1043	650	1045
V/C Ratio	1.077	0.065	0.033	0.025	1.126
Control Delay, s/veh	69.9	4.5	3.7	5.8	87.4
LOS	F	A	A	A	F
95th %tile Queue, veh	26	0	0	0	31

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1092	5	181	1007	0	110
Future Volume (vph)	1092	5	181	1007	0	110
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)		0.0	75.0		0.0	0.0
Storage Lanes		0	1		0	1
Taper Length (m)			2.5		2.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Frt	0.999					0.865
Flt Protected			0.950			
Satd. Flow (prot)	3148	0	1576	3151	0	1435
Flt Permitted			0.950			
Satd. Flow (perm)	3148	0	1576	3151	0	1435
Link Speed (k/h)	60			60	50	
Link Distance (m)	1069.8			216.0	379.7	
Travel Time (s)	64.2			13.0	27.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1187	5	197	1095	0	120
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1192	0	197	1095	0	120
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.16	1.16	1.16	1.16	1.16	1.16
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1092	5	181	1007	0	110
Future Volume (Veh/h)	1092	5	181	1007	0	110
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1187	5	197	1095	0	120
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1192		2131	596
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1192		2131	596
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			66		100	73
cM capacity (veh/h)			581		28	447

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	791	401	197	548	548	120
Volume Left	0	0	197	0	0	0
Volume Right	0	5	0	0	0	120
cSH	1700	1700	581	1700	1700	447
Volume to Capacity	0.47	0.24	0.34	0.32	0.32	0.27
Queue Length 95th (m)	0.0	0.0	11.3	0.0	0.0	8.2
Control Delay (s)	0.0	0.0	14.3	0.0	0.0	16.0
Lane LOS			B			C
Approach Delay (s)	0.0		2.2			16.0
Approach LOS						C

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		

ATTACHMENT

D QUEUEING ANALYSIS RESULTS (SIMTRAFFIC SIMULATION)

SimTraffic Simulation Summary
Future (2041) AM

03/02/2023

Summary of All Intervals

Start Time	6:50
End Time	8:00
Total Time (min)	70
Time Recorded (min)	60
# of Intervals	2
# of Recorded Intervals	1
Vehs Entered	5658
Vehs Exited	5643
Starting Vehs	428
Ending Vehs	443
Travel Distance (km)	16959
Travel Time (hr)	449.4
Total Delay (hr)	119.9
Total Stops	11828
Fuel Used (l)	1348.4

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Vehs Entered	5658
Vehs Exited	5643
Starting Vehs	428
Ending Vehs	443
Travel Distance (km)	16959
Travel Time (hr)	449.4
Total Delay (hr)	119.9
Total Stops	11828
Fuel Used (l)	1348.4

Intersection: 2: Merritt Rd & Hwy 406 SB Ramp

Movement	EB	EB	WB	SB	SB	SB
Directions Served	LT	T	T	L	R	R
Maximum Queue (m)	78.4	100.3	22.3	6.4	45.4	37.1
Average Queue (m)	46.1	71.0	6.3	0.2	21.7	21.1
95th Queue (m)	77.5	101.4	16.4	2.1	35.1	32.8
Link Distance (m)	202.0	202.0	326.7	564.3		
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)					150.0	150.0
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 29: Grisdale Rd & Merritt Rd

Movement	EB	WB	NB
Directions Served	TR	L	R
Maximum Queue (m)	6.9	22.9	42.2
Average Queue (m)	0.2	7.4	21.6
95th Queue (m)	2.3	18.0	37.1
Link Distance (m)	1055.6		369.9
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)		75.0	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Zone Summary

Zone wide Queuing Penalty: 0

SimTraffic Simulation Summary
Future (2041) AM

03/02/2023

Summary of All Intervals

Start Time	6:50
End Time	8:00
Total Time (min)	70
Time Recorded (min)	60
# of Intervals	2
# of Recorded Intervals	1
Vehs Entered	5653
Vehs Exited	5637
Starting Vehs	436
Ending Vehs	452
Travel Distance (km)	16752
Travel Time (hr)	450.4
Total Delay (hr)	123.6
Total Stops	12155
Fuel Used (l)	1339.4

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Vehs Entered	5653
Vehs Exited	5637
Starting Vehs	436
Ending Vehs	452
Travel Distance (km)	16752
Travel Time (hr)	450.4
Total Delay (hr)	123.6
Total Stops	12155
Fuel Used (l)	1339.4

Queuing and Blocking Report
Future (2041) AM

03/02/2023

Intersection: 2: Merritt Rd & Hwy 406 SB Ramp

Movement	EB	EB	WB	SB	SB	SB
Directions Served	LT	T	T	L	R	R
Maximum Queue (m)	94.0	112.6	35.2	6.9	36.0	29.7
Average Queue (m)	46.9	70.9	17.3	0.4	21.4	20.1
95th Queue (m)	79.7	103.1	31.2	3.0	31.6	28.4
Link Distance (m)	202.0	202.0	326.7	564.3		
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)					150.0	150.0
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 29: Grisdale Rd & Merritt Rd

Movement	WB	NB
Directions Served	L	R
Maximum Queue (m)	28.0	41.7
Average Queue (m)	8.8	23.1
95th Queue (m)	18.9	40.2
Link Distance (m)		369.9
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	75.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 0

SimTraffic Simulation Summary
Future (2041) PM

03/02/2023

Summary of All Intervals

Start Time	6:50
End Time	8:00
Total Time (min)	70
Time Recorded (min)	60
# of Intervals	2
# of Recorded Intervals	1
Vehs Entered	6986
Vehs Exited	6911
Starting Vehs	557
Ending Vehs	632
Travel Distance (km)	20391
Travel Time (hr)	634.4
Total Delay (hr)	237.3
Total Stops	15459
Fuel Used (l)	1691.6

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Vehs Entered	6986
Vehs Exited	6911
Starting Vehs	557
Ending Vehs	632
Travel Distance (km)	20391
Travel Time (hr)	634.4
Total Delay (hr)	237.3
Total Stops	15459
Fuel Used (l)	1691.6

Intersection: 2: Merritt Rd & Hwy 406 SB Ramp

Movement	EB	EB	WB	SB	SB	SB
Directions Served	LT	T	T	L	R	R
Maximum Queue (m)	102.6	111.4	41.4	25.8	43.4	47.7
Average Queue (m)	55.7	71.3	7.9	2.1	31.2	30.9
95th Queue (m)	92.7	106.8	22.3	12.2	45.3	45.8
Link Distance (m)	202.0	202.0	326.7	564.3		
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)					150.0	150.0
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 28: Grisdale Rd & Merritt Rd

Movement	WB	NB
Directions Served	L	R
Maximum Queue (m)	60.2	27.6
Average Queue (m)	18.1	12.3
95th Queue (m)	39.5	20.7
Link Distance (m)		369.9
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	75.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 0

SimTraffic Simulation Summary
Future (2041) PM

03/02/2023

Summary of All Intervals

Start Time	6:50
End Time	8:00
Total Time (min)	70
Time Recorded (min)	60
# of Intervals	2
# of Recorded Intervals	1
Vehs Entered	6780
Vehs Exited	6721
Starting Vehs	534
Ending Vehs	593
Travel Distance (km)	19734
Travel Time (hr)	605.6
Total Delay (hr)	220.7
Total Stops	15130
Fuel Used (l)	1633.5

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Vehs Entered	6780
Vehs Exited	6721
Starting Vehs	534
Ending Vehs	593
Travel Distance (km)	19734
Travel Time (hr)	605.6
Total Delay (hr)	220.7
Total Stops	15130
Fuel Used (l)	1633.5

Intersection: 2: Merritt Rd & Hwy 406 SB Ramp

Movement	EB	EB	WB	SB	SB	SB
Directions Served	LT	T	T	L	R	R
Maximum Queue (m)	94.1	103.8	39.6	22.1	45.8	43.3
Average Queue (m)	53.5	73.4	16.5	4.5	31.5	28.7
95th Queue (m)	81.2	101.5	32.3	17.2	43.7	41.6
Link Distance (m)	202.0	202.0	326.7	564.3		
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)					150.0	150.0
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 28: Grisdale Rd & Merritt Rd

Movement	WB	NB
Directions Served	L	R
Maximum Queue (m)	48.0	29.0
Average Queue (m)	17.7	12.9
95th Queue (m)	35.1	21.1
Link Distance (m)		369.9
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	75.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 0

SimTraffic Simulation Summary
Future (2041) AM

03/02/2023

Summary of All Intervals

Start Time	6:50
End Time	8:00
Total Time (min)	70
Time Recorded (min)	60
# of Intervals	2
# of Recorded Intervals	1
Vehs Entered	5880
Vehs Exited	5863
Starting Vehs	470
Ending Vehs	487
Travel Distance (km)	17504
Travel Time (hr)	482.1
Total Delay (hr)	141.1
Total Stops	12793
Fuel Used (l)	1401.1

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Vehs Entered	5880
Vehs Exited	5863
Starting Vehs	470
Ending Vehs	487
Travel Distance (km)	17504
Travel Time (hr)	482.1
Total Delay (hr)	141.1
Total Stops	12793
Fuel Used (l)	1401.1

Intersection: 2: Merritt Rd & Hwy 406 SB Ramp

Movement	EB	EB	EB	WB	SB	SB	SB
Directions Served	L	T	T	T	L	R	R
Maximum Queue (m)	9.3	106.3	130.7	27.2	7.0	43.5	41.0
Average Queue (m)	3.6	47.4	75.5	6.5	0.5	22.4	20.5
95th Queue (m)	10.3	81.8	109.5	20.4	3.3	35.2	34.0
Link Distance (m)		202.0	202.0	326.7	564.3		
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)	80.0					150.0	150.0
Storage Blk Time (%)		0					
Queuing Penalty (veh)		0					

Intersection: 29: Grisdale Rd & Merritt Rd

Movement	WB	NB
Directions Served	L	R
Maximum Queue (m)	15.2	42.8
Average Queue (m)	6.0	22.2
95th Queue (m)	13.1	37.9
Link Distance (m)		369.9
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	75.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 0

SimTraffic Simulation Summary
Future (2041) AM

03/02/2023

Summary of All Intervals

Start Time	6:50
End Time	8:00
Total Time (min)	70
Time Recorded (min)	60
# of Intervals	2
# of Recorded Intervals	1
Vehs Entered	5790
Vehs Exited	5771
Starting Vehs	463
Ending Vehs	482
Travel Distance (km)	17271
Travel Time (hr)	470.6
Total Delay (hr)	133.2
Total Stops	12724
Fuel Used (l)	1372.1

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Vehs Entered	5790
Vehs Exited	5771
Starting Vehs	463
Ending Vehs	482
Travel Distance (km)	17271
Travel Time (hr)	470.6
Total Delay (hr)	133.2
Total Stops	12724
Fuel Used (l)	1372.1

Intersection: 2: Merritt Rd & Hwy 406 SB Ramp

Movement	EB	EB	EB	WB	SB	SB	SB
Directions Served	L	T	T	T	L	R	R
Maximum Queue (m)	9.3	88.7	133.0	32.8	14.2	38.2	36.5
Average Queue (m)	3.4	47.6	70.1	14.7	0.9	22.9	20.3
95th Queue (m)	9.8	80.3	105.5	29.7	5.6	32.4	31.0
Link Distance (m)		202.0	202.0	326.7	564.3		
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)	80.0					150.0	150.0
Storage Blk Time (%)		0					
Queuing Penalty (veh)		0					

Intersection: 29: Grisdale Rd & Merritt Rd

Movement	WB	NB
Directions Served	L	R
Maximum Queue (m)	27.6	48.1
Average Queue (m)	8.4	19.5
95th Queue (m)	18.2	33.0
Link Distance (m)		369.9
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	75.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 0

SimTraffic Simulation Summary
Future (2041) PM

03/02/2023

Summary of All Intervals

Start Time	6:50
End Time	8:00
Total Time (min)	70
Time Recorded (min)	60
# of Intervals	2
# of Recorded Intervals	1
Vehs Entered	6848
Vehs Exited	6823
Starting Vehs	555
Ending Vehs	580
Travel Distance (km)	20161
Travel Time (hr)	620.4
Total Delay (hr)	227.5
Total Stops	15611
Fuel Used (l)	1660.8

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Vehs Entered	6848
Vehs Exited	6823
Starting Vehs	555
Ending Vehs	580
Travel Distance (km)	20161
Travel Time (hr)	620.4
Total Delay (hr)	227.5
Total Stops	15611
Fuel Used (l)	1660.8

Intersection: 2: Merritt Rd & Hwy 406 SB Ramp

Movement	EB	EB	EB	WB	SB	SB	SB
Directions Served	L	T	T	T	L	R	R
Maximum Queue (m)	82.2	108.5	130.3	33.7	25.8	48.6	45.4
Average Queue (m)	12.2	54.5	76.1	8.3	5.4	30.8	28.5
95th Queue (m)	36.0	89.2	111.9	21.5	18.0	44.7	41.5
Link Distance (m)		202.0	202.0	326.7	564.3		
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)	80.0					150.0	150.0
Storage Blk Time (%)	0	1					
Queuing Penalty (veh)	0	0					

Intersection: 28: Grisdale Rd & Merritt Rd

Movement	WB	NB
Directions Served	L	R
Maximum Queue (m)	46.0	48.9
Average Queue (m)	18.2	16.5
95th Queue (m)	31.5	31.6
Link Distance (m)		369.9
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	75.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 0

SimTraffic Simulation Summary
Future (2041) PM

03/02/2023

Summary of All Intervals

Start Time	6:50
End Time	8:00
Total Time (min)	70
Time Recorded (min)	60
# of Intervals	2
# of Recorded Intervals	1
Vehs Entered	6956
Vehs Exited	6906
Starting Vehs	536
Ending Vehs	586
Travel Distance (km)	20329
Travel Time (hr)	645.4
Total Delay (hr)	250.0
Total Stops	15821
Fuel Used (l)	1697.6

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Vehs Entered	6956
Vehs Exited	6906
Starting Vehs	536
Ending Vehs	586
Travel Distance (km)	20329
Travel Time (hr)	645.4
Total Delay (hr)	250.0
Total Stops	15821
Fuel Used (l)	1697.6

Intersection: 2: Merritt Rd & Hwy 406 SB Ramp

Movement	EB	EB	EB	WB	SB	SB	SB
Directions Served	L	T	T	T	L	R	R
Maximum Queue (m)	29.1	92.7	125.5	30.3	32.4	49.4	49.2
Average Queue (m)	11.5	59.7	81.3	12.8	3.0	31.9	28.3
95th Queue (m)	21.7	92.1	116.0	26.9	14.8	49.1	44.6
Link Distance (m)		202.0	202.0	326.7	564.3		
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)	80.0					150.0	150.0
Storage Blk Time (%)		0					
Queuing Penalty (veh)		0					

Intersection: 28: Grisdale Rd & Merritt Rd

Movement	WB	NB
Directions Served	L	R
Maximum Queue (m)	53.2	40.4
Average Queue (m)	18.5	16.6
95th Queue (m)	35.5	30.7
Link Distance (m)		369.9
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	75.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 0

SimTraffic Simulation Summary
Future (2041) AM

03/02/2023

Summary of All Intervals

Start Time	6:50
End Time	8:00
Total Time (min)	70
Time Recorded (min)	60
# of Intervals	2
# of Recorded Intervals	1
Vehs Entered	5623
Vehs Exited	5713
Starting Vehs	496
Ending Vehs	406
Travel Distance (km)	17199
Travel Time (hr)	473.9
Total Delay (hr)	139.1
Total Stops	11218
Fuel Used (l)	1380.8

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Vehs Entered	5623
Vehs Exited	5713
Starting Vehs	496
Ending Vehs	406
Travel Distance (km)	17199
Travel Time (hr)	473.9
Total Delay (hr)	139.1
Total Stops	11218
Fuel Used (l)	1380.8

Intersection: 2: Merritt Rd & Hwy 406 SB Ramp

Movement	EB	EB	WB	SB	SB
Directions Served	LT		T	L	R
Maximum Queue (m)	215.3	209.4	22.6	7.1	25.3
Average Queue (m)	63.5	41.3	0.8	1.3	5.4
95th Queue (m)	214.3	177.4	7.4	5.5	15.8
Link Distance (m)	200.9	200.9	319.1	557.4	
Upstream Blk Time (%)	9	2			
Queuing Penalty (veh)	60	10			
Storage Bay Dist (m)					150.0
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 29: Grisdale Rd & Merritt Rd

Movement	EB	EB	WB	NB
Directions Served	T	TR	L	R
Maximum Queue (m)	125.9	104.7	21.5	46.9
Average Queue (m)	20.1	13.9	6.8	16.6
95th Queue (m)	82.4	63.9	15.9	31.1
Link Distance (m)	1055.6	1055.6		369.9
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)			75.0	
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 70

SimTraffic Simulation Summary
Future (2041) PM

03/02/2023

Summary of All Intervals

Start Time	6:50
End Time	8:00
Total Time (min)	70
Time Recorded (min)	60
# of Intervals	2
# of Recorded Intervals	1
Vehs Entered	6812
Vehs Exited	6680
Starting Vehs	501
Ending Vehs	633
Travel Distance (km)	19926
Travel Time (hr)	590.5
Total Delay (hr)	202.4
Total Stops	13242
Fuel Used (l)	1623.6

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Vehs Entered	6812
Vehs Exited	6680
Starting Vehs	501
Ending Vehs	633
Travel Distance (km)	19926
Travel Time (hr)	590.5
Total Delay (hr)	202.4
Total Stops	13242
Fuel Used (l)	1623.6

Intersection: 2: Merritt Rd & Hwy 406 SB Ramp

Movement	EB	EB	WB	SB	SB
Directions Served	LT		T	L	R
Maximum Queue (m)	177.6	121.3	22.6	18.5	134.7
Average Queue (m)	16.3	4.0	1.6	2.6	19.0
95th Queue (m)	75.1	40.0	10.3	11.9	67.3
Link Distance (m)	200.9	200.9	319.1	557.4	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)					150.0
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 28: Grisdale Rd & Merritt Rd

Movement	WB	NB
Directions Served	L	R
Maximum Queue (m)	46.6	22.2
Average Queue (m)	20.3	10.5
95th Queue (m)	37.6	18.4
Link Distance (m)		369.9
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	75.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 0

ATTACHMENT

E TRAFFIC SIGNAL WARRANT ANALYSIS

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merritt Road / Highway 406 westerly ramps intersection Count Date: 2022

Justification 1: Minimum Vehicle Volumes

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☐	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☑	7:00	8:00	9:00	10:00	15:00	16:00	17:00	18:00		
1A	480	720	600	900	1,984	1,984	1,984	1,984	2,333	2,333	2,333	2,333		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	180	255	180	255	775	775	775	775	1,145	1,145	1,145	1,145		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Restricted Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours — Yes ☑ No ☐									
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours — Yes ☑ No ☐									

Justification 2: Delay to Cross Traffic

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☐	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☑	7:00	8:00	9:00	10:00	15:00	16:00	17:00	18:00		
2A	480	720	600	900	1,209	1,209	1,209	1,209	1,188	1,188	1,188	1,188		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	17	17	17	17	25	25	25	25		
	COMPLIANCE %				23	23	23	23	33	33	33	33	224	28
Restricted Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours — Yes ☐ No ☑									
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours — Yes ☐ No ☑									

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More			Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	NO ☐	YES ☐	NO ☑
Justification 2	Delay Cross Traffic	YES ☐	NO ☑		NOT JUSTIFIED

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	7:00	1,209	775	135	100 %	100 %
	8:00	1,209	775	135	100 %	
	9:00	1,209	775	135	100 %	
	10:00	1,209	775	135	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Merritt Road / Highway 406 westerly ramps intersection Count Date: 2022

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Merritt Road / Highway 406 westerly ramps intersection

What is the direction of the Main Road street? East-West

When was the data collected? 2022

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 2 or more

b.- Number of lanes on the Minor Road? 2 or more

c.- How many approaches? 3

d.- What is the operating environment? Urban **Population >= 10,000 AND Speed < 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Eastbound Approach			Minor Northbound Approach			Main Westbound Approach			Minor Southbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
7:00	32	1,078						72	27	7		768	10
8:00	32	1,078						72	27	7		768	10
9:00	32	1,078						72	27	7		768	10
10:00	32	1,078						72	27	7		768	10
15:00	77	1,020						58	33	15		1,130	10
16:00	77	1,020						58	33	15		1,130	10
17:00	77	1,020						58	33	15		1,130	10
18:00	77	1,020						58	33	15		1,130	10
Total	**436**	**8,392**	**0**	**0**	**0**	**0**	**0**	**520**	**240**	**88**	**0**	**7,592**	**80**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	
13-24	
25-36	

* Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume									
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		50%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									6,411

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds									
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		50%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Merritt Road / Highway 406 westerly ramps intersecti Count Date: 2022

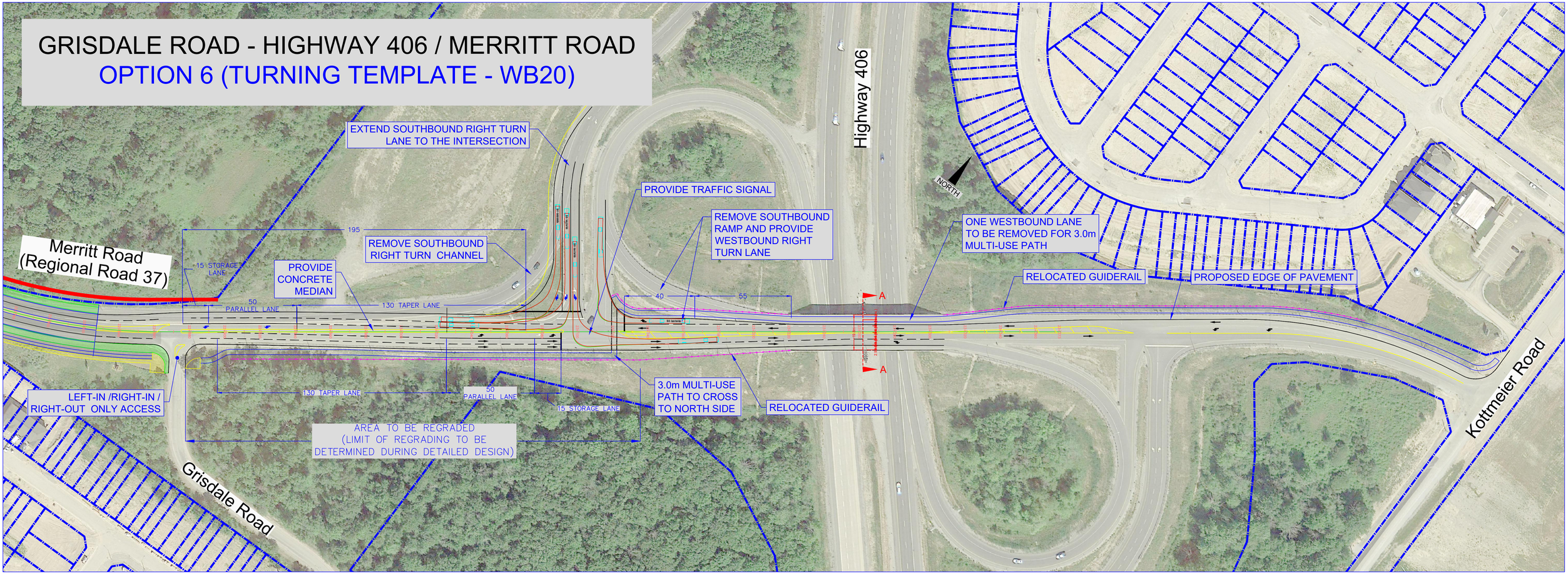
Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%	☑	☐
	B	Crossing Volume	100	%		
2. Delay to Cross Traffic	A	Main Road	100	%	☐	☑
	B	Crossing Road	28	%		
3. Combination	A	Justificaton 1	100	%	☐	☑
	B	Justification 2	28	%		
4. 4-Hr Volume			100	%	☑	☐
5. Collision Experience			0	%	☐	☑
6. Pedestrians	A	Volume	Justification not met		☐	☑
	B	Delay	Justification not met			

ATTACHMENT

F TURNING TEMPLATE FOR PREFERRED OPTION

GRISDALE ROAD - HIGHWAY 406 / MERRITT ROAD
OPTION 6 (TURNING TEMPLATE - WB20)



ATTACHMENT

G DESIGN CRITERIA

Ministry of Transportation
Ministère des Transports

Ontario

DESIGN CRITERIA

Group Work Project No.	GWP xxxx-xx-xx	Highway No. 406	Page 1 of 5
Work Project No(s).	WP xxxx-xx-xx		Date: 24-05-2023
	WP xxxx-xx-xx		

Asset Work Type xx

Length 780 m

Location Merritt Rd / Hwy 406 (Overpass) between Grisdale Rd and Kottmeier Rd

Municipal Jurisdictions	City of Thorold, Niagara Region
Geographic Township(s)	xx
County of	xx

Recommended by:

Signature:

Printed Name and Title:

Date:

Recommended by:

Signature:

Printed Name and Title:

Date:

Approved by:

Signature:

Printed Name and Title:

Date:

Standards Table: Merritt Road at Highway 406

Design Year: 2031		Superelevation Maximum Rate for Determining the Radius: 6%		
	Present Conditions	Design Standards	Reference (Design Standards)	Proposed Standards
Functional Highway Classification	RAU80	UAU80	MTO design supplement 2020 (Exhibit 2-G)	UAU80
Minimum Stopping Sight Distance (m)	>105	105	TAC 2017 (2.5.3: Table 2.5.2)	>105
Crest: Minimum "K" factor for Stopping Sight Distance	TBD[1]	N/A	TAC 2017 (3.3.3.3: Table 3.3.2)	TBD[1]
Sag: Minimum "K" factor for Stopping Sight Distance	TBD[1]	N/A	TAC 2017 (3.3.3.4: Table 3.3.4)	TBD[1]
Grades Maximum (%)	TBD[1]	N/A	TAC 2017 (3.3.2.4: Table 3.3.1)	TBD[1]
Radius Minimum (m)	Tangent	290	TAC 2017 (Table 3.2.8)	Tangent
Lane Widths (m)	4 x 3.50 m	3.0 m – 3.70 m	TAC 2017 (4.2.2)	3 x 3.50 m
Shoulder Width (Left / Right) (m)	2.9 / 2.9	N/A	TAC 2017 (4.4.2)	1.2 / 2.9
Multi-Use Path (m)	N/A	3.0 m – 6.00 m	TAC 2017 (5.3.1.4: Table 5.3.5)	3.0 m
Shoulder Rounding (m)	N/A	N/A	N/A	N/A
Median Width (m)	1.00 - 3.7 (Flushed)	1.50 – 2.0 (Concrete) 1.00 – 4.00 (Flushed)	TAC 2017 (4.5.3)	1.50 - 2.0 (Concrete) 1.00 – 4.00 (Flushed)
R.O.W. Width - nominal (m)	19.8			19.8
Posted Speed - prevailing (km/h)	60 km/h	60 km/h		60 km/h
Miscellaneous	N/A	N/A	N/A	N/A

Notes:

1. Vertical profile to match existing and will be determined during detailed design.

Interchange Standards Table: Interchange Name: Highway 406 N - Merritt Road E/W Ramp

	Ramp Name	Present Conditions	Design Standards	Reference (Design Standards)	Proposed Standards
Crossing Road Design Speed (km/h)		80 km/h	80 km/h	MTO design supplement 2020 (10.6.2.1)	80 km/h
Ramp Design Speed (km/h)		80 km/h	80 km/h	MTO design supplement 2020 (10.6.2.1: Exhibit 10-D)	80 km/h
Sight Distance Requirement for Stopping, Crossing and Turning Movements at the Crossing Road (m)		See Note 1	130	TAC 2017 (2.5.3: Table 2.5.2)	See Note 1
Crest: Minimum “K” factor for Stopping Sight Distance		See Note 1	26	TAC 2017 (3.3.3.3: Table 3.3.2)	See Note 1
Sag: Minimum “K” factor for Stopping Sight Distance		See Note 1	30	TAC 2017 (3.3.3.4: Table 3.3.4)	See Note 1
Grades Maximum (%)		See Note 1	6%	TAC 2017 (3.3.2.4: Table 3.3.1)	See Note 1
Radius Minimum (m)		250 m	130 m	MTO design supplement 2020 (10.6.2.1: Exhibit 10-D	250 m
Superelevation Maximum Rate (%)		0.06 m/m	0.06 m/m	MTO design supplement 2020 (10.6.2.1: Exhibit 10-D)	0.06 m/m
Lane Widths (m)		2 x 4.8 m	4.8 m	TAC 2017 (10.6.2.5)	3 x 4.8 m [2]
Shoulder Width (Left / Right) (m)		1.0 m left 3.0 m right	1.0 m Left 2.5 m Right	MTO design supplement 2020 (Section 4.4.2)	1.0 m Left 3.0 m Right
Shoulder Rounding (m)		0.5 m (min)	0.5 m	TAC 2017 (4.4.5)	0.5 m
Sight Distance at Exit Terminal (m)		See Note 3	-	-	See Note 3
Exit Terminal Speed-Change Lane Length (m)		See Note 3	-	-	See Note 3
Sight Distance at Entrance Terminal (m)		See Note 3	-	-	See Note 3
Entrance Terminal Speed-Change Lane Length (m)		See Note 3	-	-	See Note 3

Notes:

1. Proposed work is limited to intersection tie-in. Existing ramp profile to be maintained.
2. Existing two lanes (left/ right turn lanes) will be converted to 2 right and 1 left turning lanes approaching intersection at Merritt Road.
3. Existing entrance and exit terminal and speed-change lanes to be maintained.

DESIGN CRITERIA

Standards Table: Highway 406 (Beaverdams Road to Robinson Road)

Design Year: 20232031		Superelevation Maximum Rate for Determining the Radius: Not Available		
	Present Conditions	Design Standards	Reference (Design Standards)	Proposed Standards [1]
Functional Highway Classification	RFD120	RFD120	RFD120	RFD120
Minimum Stopping Sight Distance (m)	245 m	250	TAC 2017 (2.5.3: Table 2.5.2)	245 m
Crest: Minimum "K" factor for Stopping Sight Distance	120 m	95	TAC 2017 (3.3.3.3: Table 3.3.2)	120 m
Sag: Minimum "K" factor for Stopping Sight Distance	60 m	63	TAC 2017 (3.3.3.4: Table 3.3.4)	60 m
Grades Maximum (%)	3%	5%	TAC 2017 (3.3.2.4: Table 3.3.1)	3%
Radius Minimum (m)	1800 m	750	TAC 2017 (Table 3.2.6)	1800 m
Lane Widths (m)	2 X 3.75 m	3.75	MTO design supplement 2020 (Exhibit 4-A)	2 X 3.75 m
Shoulder Width (Left / Right) (m)	Right – 3.0 m Left – 1.5 m	3.0	MTO design supplement 2020 (Exhibit 4-J)	Right – 3.0 m Left – 1.5 m
Shoulder Rounding (m)	1.5 m	1.0	MTO RDM 2.3.3	1.5 m
Median Width (m)	22 m	N/A	N/A	22 m
R.O.W. Width - nominal (m)	N/A	N/A	N/A	N/A
Posted Speed - prevailing (km/h)	100 km/h	100 km/h	N/A	100 km/h
Miscellaneous	N/A	N/A	N/A	N/A

Notes:

1. The existing conditions for Highway 406 will be maintained. No changes are proposed to Highway 406 mainline. Existing information listed in this table was provided to the Niagara Region by the Ministry of Transportation.

Traffic:

Remarks:

Remarks Applicable to the Project

Subject	Applicable to the Project	
	Yes	No *
1. Project Purpose and Scope	X	
2. Design Year	X	
3. Related Studies and Adjacent Projects		X
4. Environmental Assessment	X	
5. Pavement	X	
6. Cross-Fall	X	
7. Superelevation		X
8. Drainage	X	
9. Roadside Safety	X	
10. Signing	X	
11. Illumination	X	
12. Traffic Signals	X	
13. Commercial Entrances		X
14. Intersections	X	
15. Structures	X	
16. Pavement Widening on Curves		X
17. Passing Lanes and Truck Climbing Lanes		X
18. Fencing		X
19. Active Transportation Infrastructure	X	
20. Property Requirements		X
21. Railway Crossings		X
22. Utilities and Pipelines	X	
23. Construction Staging	X	
24. Legal Agreements and Approvals	X	
25. Miscellaneous		X

* No indicates: Not applicable to this project as there will be no work completed related to the topic.

1. Project Purpose and Scope

Scope of Work

As part of the Municipal Class Environmental Assessment Study for Merritt Road and Rice Road, the Regional Municipality of Niagara is proposing to introduce a multi-use path to Merritt Road, east of Grisdale Road over Highway 406 interchange located in the City of Thorold. As a result of provision of this active transportation facility, the following change are proposed to the interchange to address any potential safety concerns to the multi-use path users:

- Removal of southbound right turn channel to Merritt Road.
- Removal of southbound right turn ramp to Highway 406.
- Provision of a traffic signal on the intersection of Highway 406 southbound ramp and Merritt Road.
- Modification of the Grisdale Road / Merritt Road intersection to left-in / right-out only access.
- Provision of a concrete median from Grisdale Road to the intersection of Highway 406 southbound ramp and Merritt Road.
- Relocation of guiderails to accommodate the above design changes.

Horizontal Alignment

Existing horizontal alignment on Merritt Road and ramps will be maintained.

Vertical Alignment

Existing vertical alignment on Merritt Road will be maintained but will be further explored during detailed design stage.

2. Design Year

2031

3. Related Studies and Adjacent Projects

N/A

4. Environmental Assessment

The proposed works are being recommended as part of Niagara Region’s Municipal Class Environmental Assessment Study for improvements to Merritt Road and Rice Road.

5. Pavement

Removal and resurface of existing westbound shoulder and lane is required in order to construct proposed MUP and buffer.

Removal of southbound right turn channel at ramp and constructing 2 southbound right and 1 left turning lanes approaching intersection at Merritt Road are required.

6. Cross-fall

Existing cross-fall will be maintained. This will be further explored in detail design stage.

7. Superelevation

Existing superelevation will be maintained.

8. Drainage

Stormwater Management Report will be provided to the Ministry of Transportation as part of the Environmental Assessment Report review package.

9. Roadside Safety

Roadside safety improvements will be reviewed during detail design stage.

10. Signing

Existing signing and signing improvements will be reviewed in accordance with Ontario Traffic Manual during detail design stage.

11. Illumination

Existing and proposed lighting system will be reviewed during detailed design stage.

12. Traffic Signals

A new Traffic signal will be introduced at Merritt Road and Highway 406 southbound ramp intersection.

13. Commercial Entrance

N/A

14. Intersections

- Highway 406 Ramp/ Merritt Road intersection to be signalized. Modifications to the on/off ramps are proposed including the following:
    - Existing two lane exit ramp (left/right turn lanes) from Hwy 406 to Merritt Road will be modified at the approach to Merritt Road as follows:
        - Removal of existing southbound right turn channelization
        - Reconfigure approaching lanes to Merritt Road to include 2 right turn and 1 left turn lanes.
    - Removal of Merritt Rd E – Hwy 406 S Channelized Ramp, and provision of a single westbound right turn lane. Ramp entrance for both Merritt Rd EB and WB traffic will be via the signalized intersection. Due to constraint of the existing bridge, the proposed westbound right turn lane length is 95m (40m parallel with 55m taper), which is substandard to the MTO design standard in accordance with TAC Supplement Exhibit 9-J (60m parallel and 70m taper).
- New islands at Grisdale Road intersection which will restrict to left-in / right-out only access.

15. Structures

Existing structure will be maintained. Lane configuration on the structure will be modified to accommodate the proposed condition.

16. Pavement Widening on Curves

N/A

17. Passing Lanes / Truck Climbing Lanes

N/A

18. Fencing

N/A

19. Active Transportation Infrastructures

Proposed multi-use path along Merritt Road, from Grisdale Road to Kottmeir Road

20. Property Requirements

N/A

21. Railway Crossing

N/A

22. Utilities and Pipelines

Any utility relocation will be confirmed and coordinated during detailed design phase.

23. Construction Staging

Construction staging will be completed accordance with OTM Book 7 “Temporary Conditions”.

Construction staging plan will be discussed further during detailed design stage.

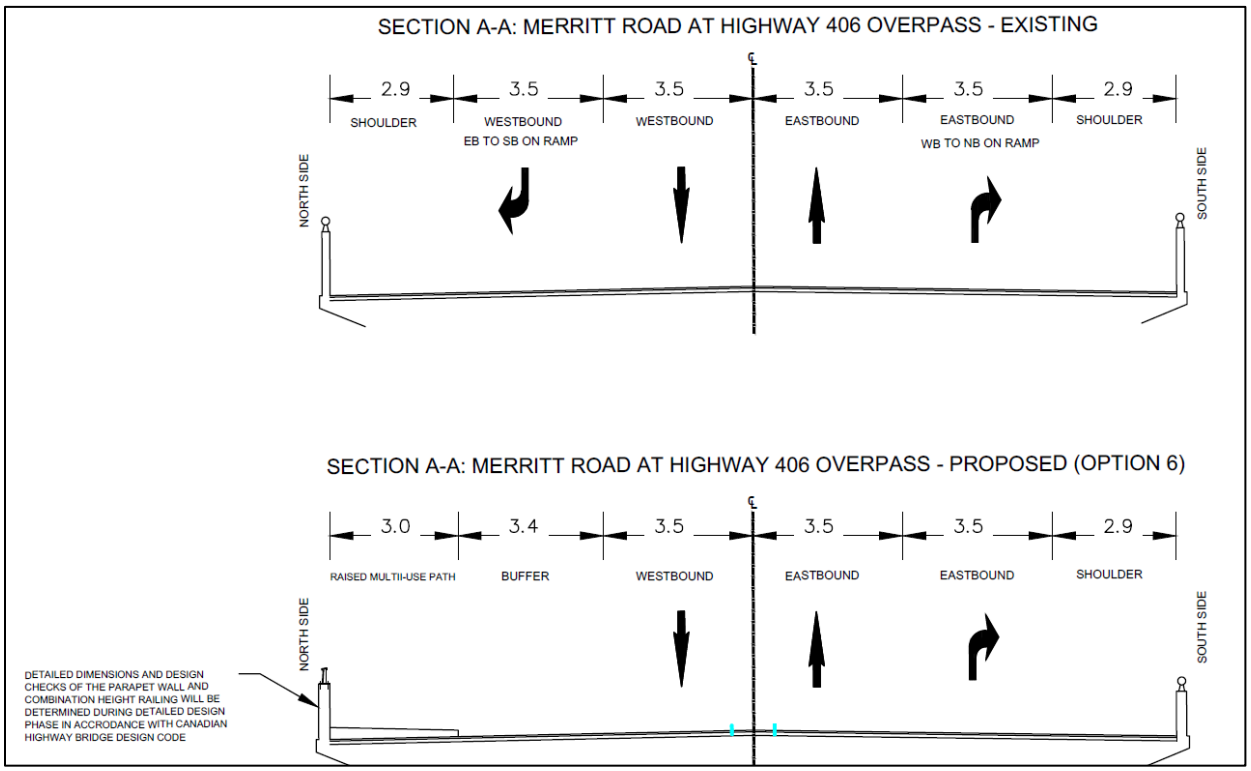
24. Legal Agreements and Approvals

An MTO Encroachment Permit will be obtained by the Niagara Region, prior to implementing the proposed changes.

25. Miscellaneous

N/A

Typical Road Sections



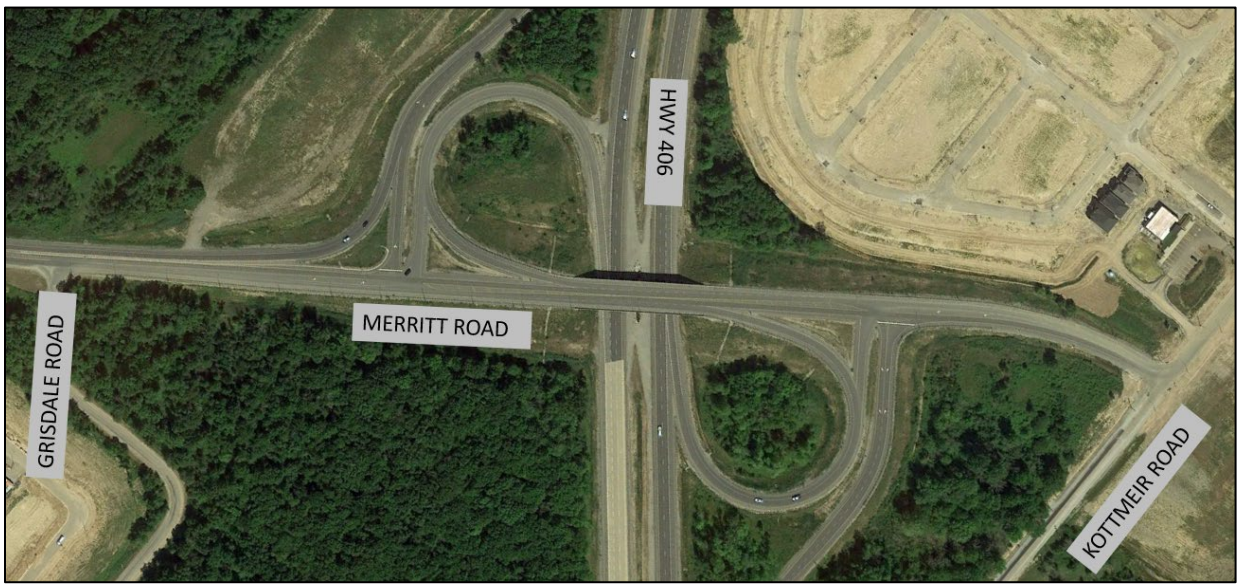
Typical Structure Sections

N/A

Interchange Sketch

N/A

Location Map



ATTACHMENT

H MTO EXECUTIVE REVIEW MEETING (MARCH 21, 2023)

MEETING NOTES

JOB TITLE	Merritt Road-Rice Road – Schedule 'C' Municipal Class Environmental Assessment		
PROJECT NUMBER	IM20103036	**DATE**	21 March 2023
TIME	1:00 PM	**VENUE**	MS Teams
SUBJECT	Ministry of Transportation Executive Review Meeting		
CLIENT	Regional Municipality of Niagara		

ATTENDEES			
Name	**Company**	**Phone**	**Email**
Maged Elmadhoon	Niagara Region		maged.elmadhoon@niagararegion.ca
Scott Fraser	Niagara Region		scott.fraser@niagararegion.ca
Frank Tassone	Niagara Region		frank.tassone@niagararegion.ca
Felix Wong	WSP E&I Canada Limited		felix.wong@wsp.com
Kari Fellows	WSP E&I Canada Limited		kari.fellows@wsp.com
Mir Ahsan Talpur	WSP E&I Canada Limited		mir.talpur@wsp.com
Kashif Hussain	Ministry of Transportation		kashif.hussain@ontario.ca

ADDITIONAL DISTRIBUTION			
Name	**Company**	**Phone**	**Email**
Other MTO Attendees	MTO		

MATTERS ARISING	**ACTION**
1.0 PURPOSE OF THE MEETING	
1.1 The purpose of the meeting was to seek Ministry of Transportation's approval of the preferred design for Merritt Road at Grisdale Road and Highway 406 interchange developed as part of Niagara Region's Municipal Class Environmental Assessment for Merritt Road and Rice Road in the Town of Pelham, the City of Thorold and the City of Welland. The Study Team presented the following information to MTO staff.	
2.0 PREFERRED DESIGN FOR MERRITT ROAD AT GRISDALE ROAD AND HIGHWAY 406	
The study team provided a Presentation, documenting the project background and the preferred design of Merritt Road at Highway 406. A copy of the presentation is attached. The Study Team noted that the preferred design for Merritt Road at Grisdale Road and Highway 406 interchange was identified in consultation with MTO staff, and comments received from MTO were addressed. The Study Team highlighted the following key features of the preferred design:	

2.1	The existing Merritt Road / Grisdale Road intersection is proposed to be converted into a left-in / right-in / right-out only access intersection. Two eastbound lanes and one left turn lane for Highway 406 southbound traffic are being proposed. In addition, there is a traffic signal being proposed at the west ramp intersection. The 2041 forecast for the west ramp intersection of Highway 406 and Merritt Road indicates that a traffic signal is warranted based on Minimum Vehicular Volume with proposed lane configuration.	
2.2	The two-way cycle-track along Merritt Road is proposed to transition to a multi-use path to the east of Grisdale Road. The multi-use path is proposed to cross to the north side of the interchange at the traffic signal to provide a safe pedestrian crossing, and continue as active transportation facility up to Kottmeier Road.	
2.3	Due to low traffic volumes, and to accommodate the multi-use path on the bridge, the existing westbound right turn channel is proposed to be removed, and a short westbound right turn lane will be provided at the intersection.	
2.4	Due to constraint of the existing bridge, the proposed westbound right turn lane length is 95m (40m parallel with 55m taper), which is substandard to the MTO design standard in accordance with TAC Supplement Exhibit 9-J (60m parallel and 70m taper).	
3.0	**QUESTIONS / ANSWERS**	
Following the presentation, the Study Team invited MTO staff to ask any questions or share any comments. MTO staff did not raise any significant questions or comments about the recommended design. The following summarizes questions from MTO staff and Study Team's responses:		
3.1	MTO staff noted that the concrete median barriers between active transportation facilities and vehicular traffic lanes often pose challenges from maintenance point of view for MTO as well as the local municipalities. MTO staff questioned how was the requirement identified for the concrete median barrier? — The Study Team noted the multi-use path across Highway 406 interchange was identified in accordance with *MTO Bikeways Design Manual (March 2014)*. — MTO staff noted that the concrete barrier may not be required based on MTO standard. It was suggested that the Study Team review *Ontario Traffic Manual - Book 18 - Cycling Facilities (June 2021)* and *MTO Bikeways Design Manual (March 2014)* to confirm whether a concrete barrier or a separation buffer would be appropriate between the multi-use path and the vehicular traffic lanes (**Action Item**). — The Study Team noted that the multi-use path will be considered as an on-road two way cycling facility as there is no curb or grade difference to the path.	WSP
3.2	MTO staff inquired how will the multiuse path be transitioned to Kottmeier Road? — The Study Team responded that initially the cycling path was proposed until Grisdale Road along Merritt Road, where the cyclists would have been directed to use Grisdale Road. Based on MTO staff's feedback, the Study Team identified a safe active transportation facility across Highway 406 interchange that would end at Kottmeier Road. Any future active transportation facility along Kottmeier Road may be identified via a separate assignment in future.	
3.3	MTO staff sought clarification on whether any design changes were proposed east of Highway 406 northbound off ramp. — Study Team clarified that no design changes were proposed east of Highway 406 northbound off ramp. Study Team will update the design to remove any excessive linework to avoid confusion (**Action Item**).	WSP

These minutes are considered to be accurate recording of all items discussed. Written notice of discrepancies, errors or omission must be given within seven (7) days, otherwise the minutes will be accepted as written.

Ministry of Transportation Executive Review Meeting

Municipal Class Environmental Assessment Study for Merritt Road and Rice Road in Pelham, Thorold and Welland

March 21, 2023

MOVING ROADS FORWARD

CONNECTING MORE PEOPLE TO MORE POSSIBILITIES

Niagara Region

Agenda

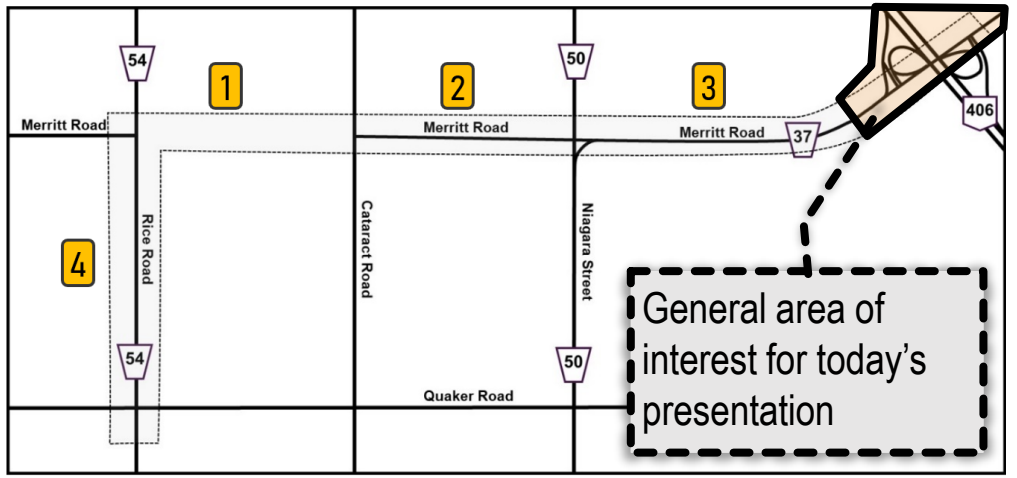
Meeting Objective: Seek Ministry of Transportation's approval of the recommended design for Merritt Rd at Grisdale Rd and Hwy 406 developed as part of Niagara Region's Merritt Rd - Rice Rd Municipal Class EA

Presentation Outline:

- Merritt Rd and Rice Rd Municipal Class EA – Overview and Existing Conditions
- Merritt Rd at Grisdale Rd and Hwy 406 – Existing Conditions
- Preferred Design for Merritt Rd (Segment 3) West of Hwy 406
- Preferred Design for Merritt Rd at Grisdale Rd and Hwy 406
- Consideration of MTO Staff Feedback into the Identification of Preferred Design
- Next Steps

Merritt Rd and Rice Rd Municipal Class EA – Overview and Existing Conditions

- Building upon the recommendations of the Niagara Region Transportation Master Plan (2017).
- Capacity improvements and active transportation facilities are required to accommodate future growth a result of proposed developments in the Town of Pelham, the City of Thorold and the City of Welland.



Segment 1: Merritt Rd (Rice Rd - Cataract Rd)
- Unopened road allowance
- Located within the Town of Pelham and City of Thorold.

Segment 2: Merritt Rd (Cataract Rd - Merrittville Hwy / Niagara St)
- Minor arterial roadway
- Posted Speed Limit: 50km/h
- Located within City of Thorold

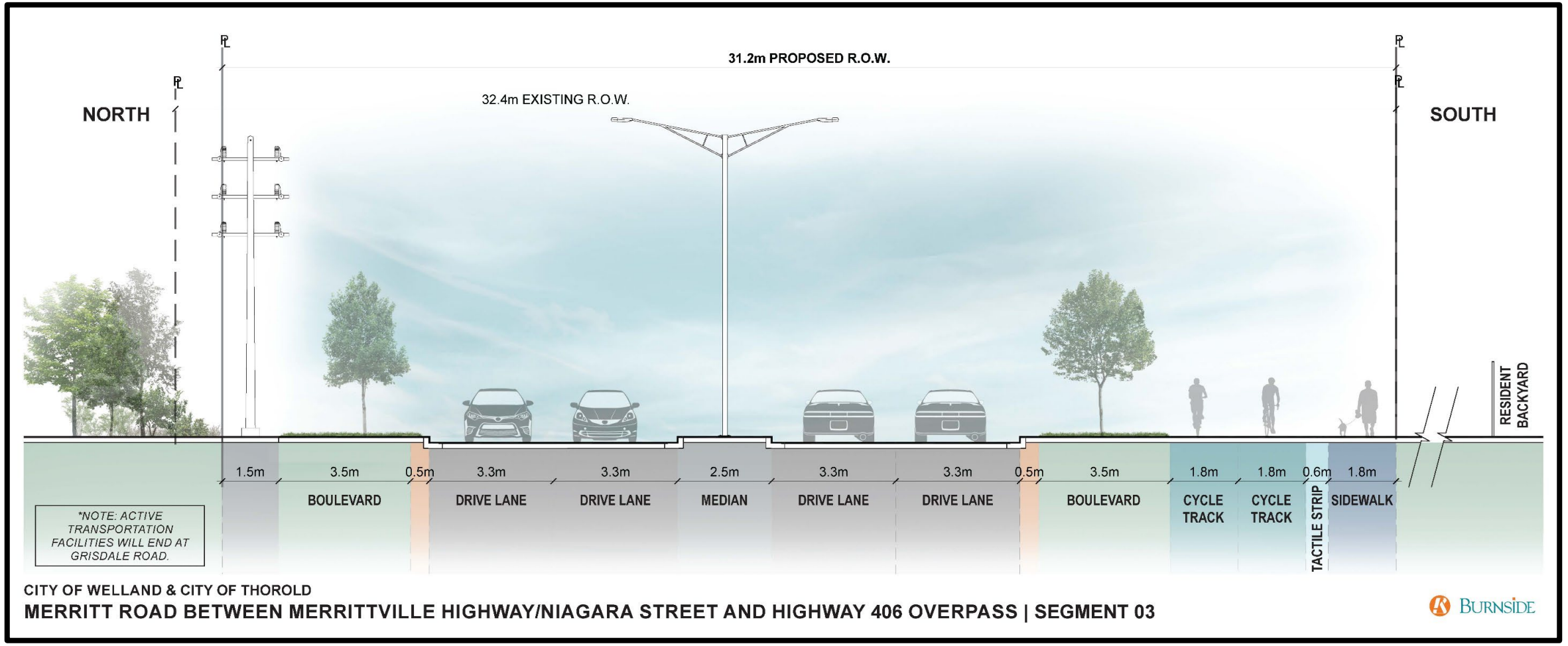
Segment 3: Merritt Rd (Merrittville Hwy / Niagara St - Hwy 406)
- Minor arterial roadway
- Posted Speed Limit: 60km/h
- Located within the City of Thorold

Segment 4: Rice Road (200 m north of Merritt Rd - Quaker Rd)
- Minor arterial roadway
- Posted Speed Limit: 50km/h
- Located in the Town of Pelham and the City of Welland

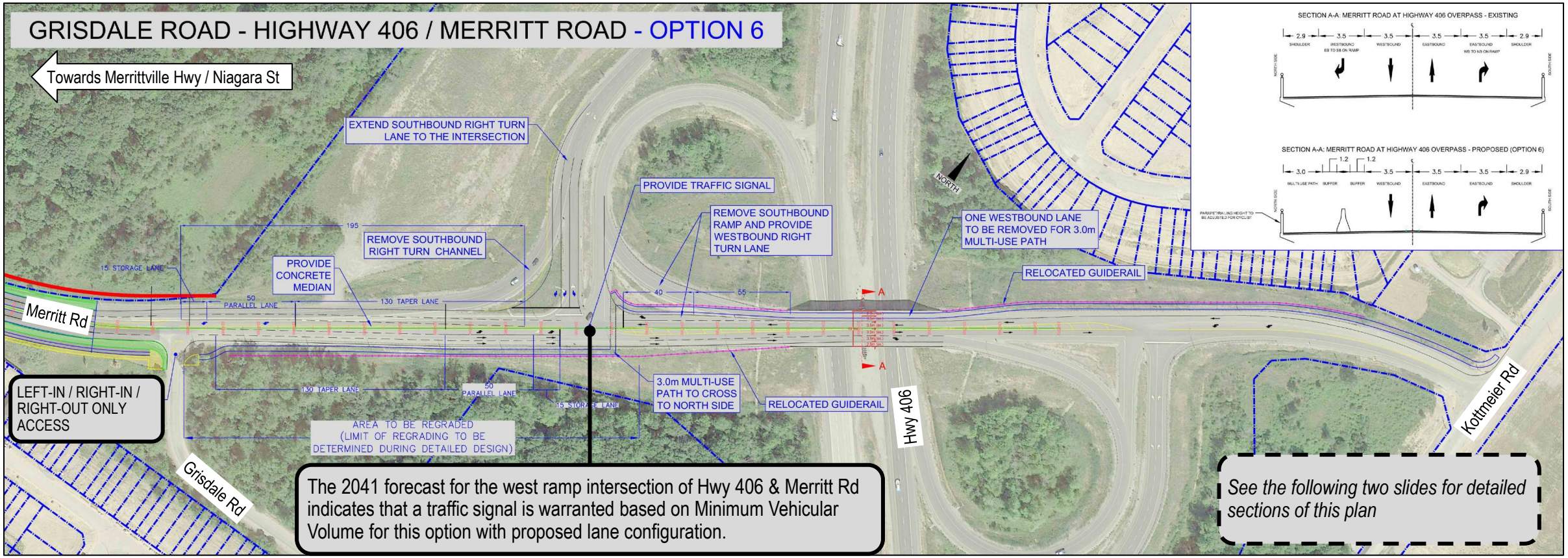
Merritt Rd at Grisdale Rd and Hwy 406 – Existing Conditions

Preferred Design for Merritt Rd (Segment 3) West of Hwy 406

- Four 3.3 m drive lanes separated by a 2.5 m median
- 1.8 m sidewalk on the south side
- A 3.6 m separated two-way cycle track on the south side



Preferred Design for Merritt Rd at Grisdale Rd and Hwy 406

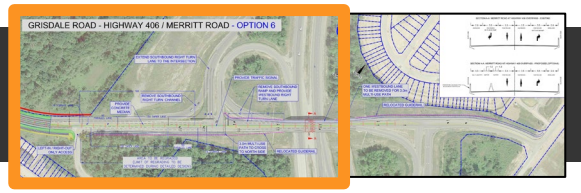


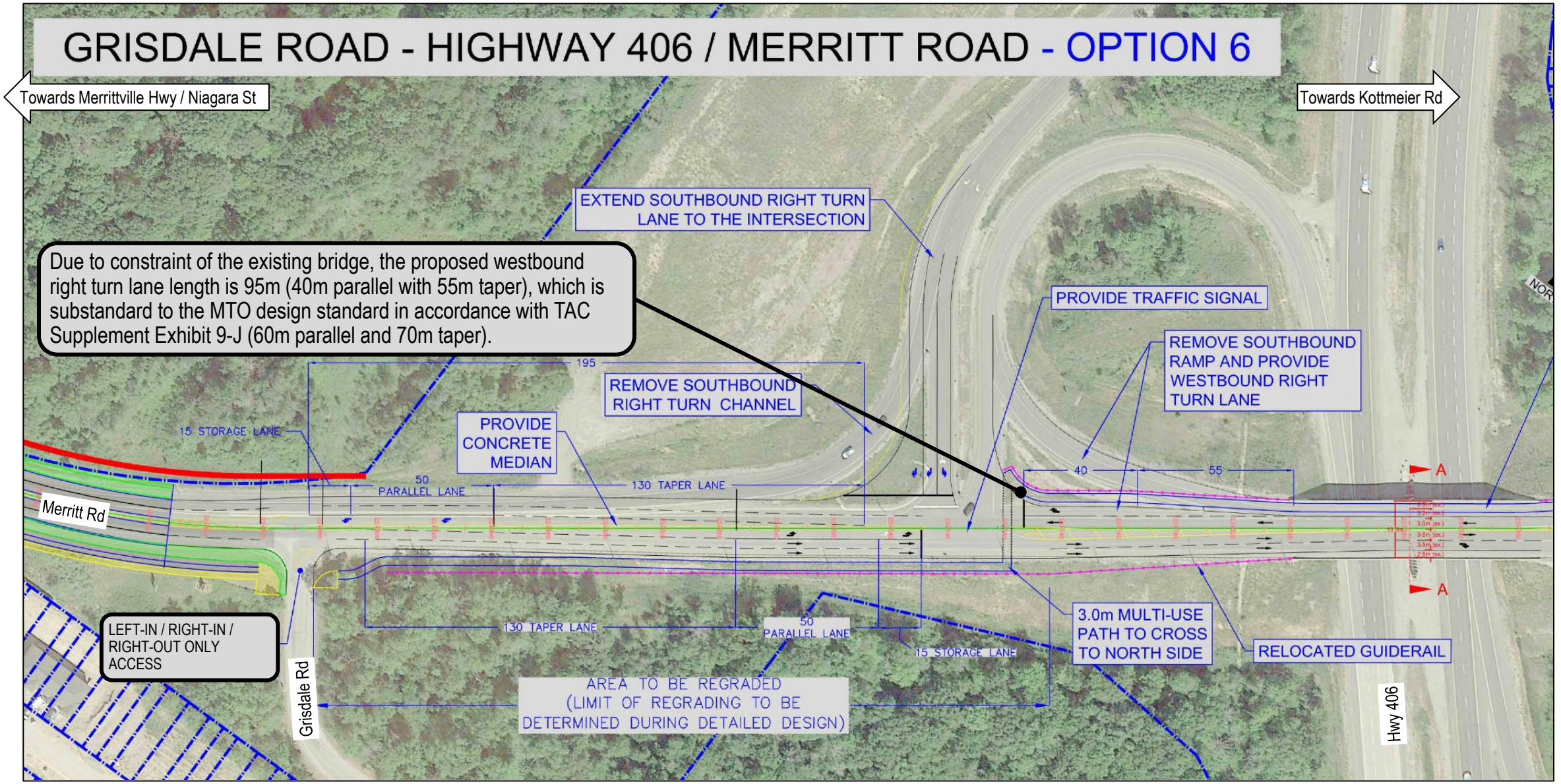
MOVING ROADS FORWARD

CONNECTING MORE PEOPLE TO MORE POSSIBILITIES

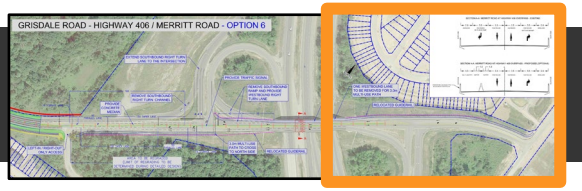
Niagara Region

Preferred Design for Merritt Rd at Grisdale Rd and Hwy 406





Preferred Design for Merritt Rd at Grisdale Rd and Hwy 406



Towards Grisdale Rd

NORTH

ONE WESTBOUND LANE
TO BE REMOVED FOR 3.0m
MULTI-USE PATH

RELOCATED GUIDERAIL

Hwy 406

Kottmeier Rd

SECTION A-A: MERRITT ROAD AT HIGHWAY 406 OVERPASS - EXISTING

2.9 SHOULDER | 3.5 WESTBOUND (EB TO SB ON RAMP) | 3.5 WESTBOUND | 3.5 EASTBOUND | 3.5 EASTBOUND (WB TO NB ON RAMP) | 2.9 SHOULDER

NORTH SIDE / SOUTH SIDE

SECTION A-A: MERRITT ROAD AT HIGHWAY 406 OVERPASS - PROPOSED (OPTION 6)

3.0 MULTI-USE PATH | 1.2 BUFFER | 1.2 BUFFER | 3.5 WESTBOUND | 3.5 EASTBOUND | 3.5 EASTBOUND | 2.9 SHOULDER

PARAPET/RAILING HEIGHT TO BE ADJUSTED FOR CYCLIST

NORTH SIDE / SOUTH SIDE

Consideration of MTO Staff Feedback into the Identification of Preferred Design

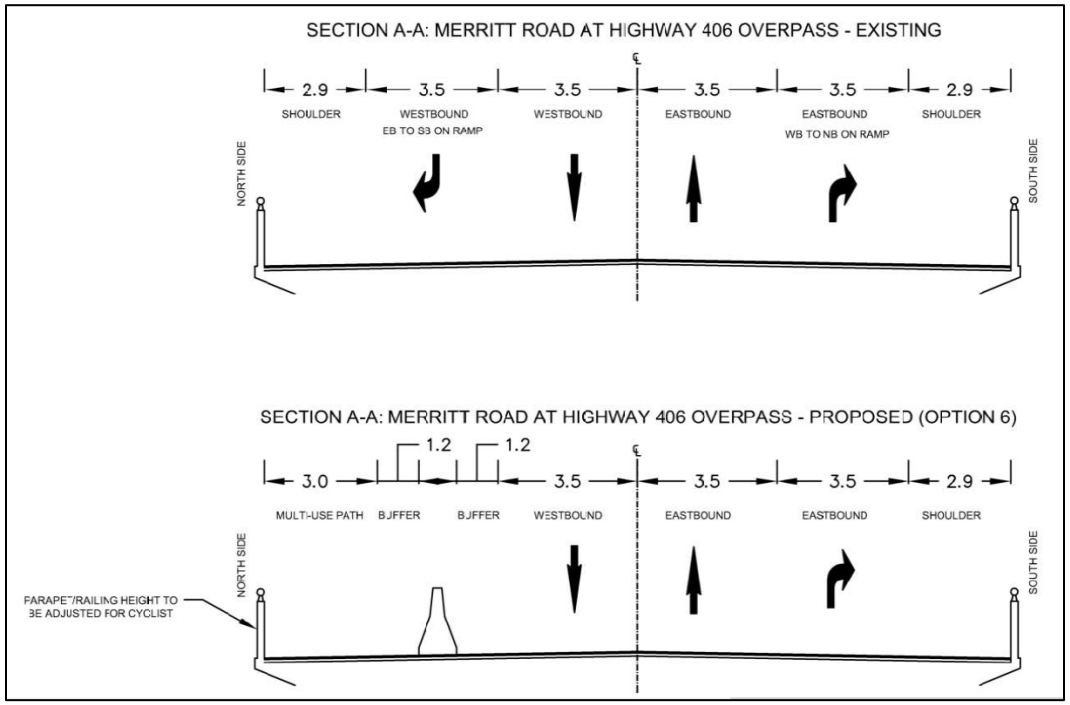
A total of six (6) design options were identified. The design presented herein was identified as preferred in consultation with MTO staff in terms of traffic safety, constructability and cost effectiveness.

The preferred design will provide a continuous active transportation connection (MUP) between Grisdale Rd and Kottmeier Rd.

The preferred design will provide safer pedestrian crossing at the proposed signalized intersection.

Due to low traffic volumes, the existing westbound right turn channel will be removed, and a short westbound right turn lane will be provided at the intersection.

A roundabout option was also identified, but it was not considered as feasible option due to significant property impacts and higher cost of construction.



Design Criteria: Standards Table: Merritt Rd at Hwy 406

DESIGN CRITERIA

Group Work Project No. GWP xxxx-xx-xx Highway No. 406 Page 2 of 9
Work Project No(s). WP xxxx-xx-xx Date: Mar 9, 2023
WP xxxx-xx-xx

Standards Table: Merritt Road at Highway 406

Design Year: 2031		Superelevation Maximum Rate for Determining the Radius: 6%		
	Present Conditions	Design Standards	Reference (Design Standards)	Proposed Standards
Functional Highway Classification	RAU80	UAU80	MTO design supplement 2020 (Exhibit 2-G)	UAU80
Minimum Stopping Sight Distance (m)	>105	105	TAC 2017 (2.5.3: Table 2.5.2)	>105
Crest: Minimum "K" factor for Stopping Sight Distance	TBD[1]	N/A	TAC 2017 (3.3.3.3: Table 3.3.2)	TBD[1]
Sag: Minimum "K" factor for Stopping Sight Distance	TBD[1]	N/A	TAC 2017 (3.3.3.4: Table 3.3.4)	TBD[1]
Grades Maximum (%)	TBD[1]	N/A	TAC 2017 (3.3.2.4: Table 3.3.1)	TBD[1]
Radius Minimum (m)	Tangent	290	TAC 2017 (Table 3.2.8)	Tangent
Lane Widths (m)	4 x 3.50 m	3.0 m – 3.70 m	TAC 2017 (4.2.2)	3 x 3.50 m
Shoulder Width (Left / Right) (m)	2.9 / 2.9	N/A	TAC 2017 (4.4.2)	1.2 / 2.9
Multi-Use Path (m)	N/A	3.0 m – 6.00 m	TAC 2017 (5.3.1.4: Table 5.3.5)	3.0 m
Shoulder Rounding (m)	N/A	N/A	N/A	N/A
Median Width (m)	1.00 - 3.7 (Flushed)	1.50 – 2.0 (Concrete) 1.00 – 4.00 (Flushed)	TAC 2017 (4.5.3)	1.50 - 2.0 (Concrete) 1.00 – 4.00 (Flushed)
R.O.W. Width - nominal (m)	19.8			19.8
Posted Speed - prevailing (km/h)	60 km/h	60 km/h		60 km/h
Miscellaneous	N/A	N/A	N/A	N/A

Notes:

1. Vertical profile to match existing and will be determined during detailed design.

Design Criteria: Interchange Standards Table: Highway 406 N – Merritt Road E/W Ramp

DESIGN CRITERIA

Group Work Project No. GWP xxxx-xx-xx Highway No. 406 Page 3 of 9
Work Project No(s). WP xxxx-xx-xx Date: Mar 9, 2023
WP xxxx-xx-xx

Interchange Standards Table: Interchange Name: Highway 406 N - Merritt Road E/W Ramp

	Ramp Name	Present Conditions	Design Standards	Reference (Design Standards)	Proposed Standards
Crossing Road Design Speed (km/h)	X	80 km/h	80 km/h	MTO design supplement 2020 (10.6.2.1)	80 km/h
Ramp Design Speed (km/h)		80 km/h	80 km/h	MTO design supplement 2020 (10.6.2.1: Exhibit 10-D)	80 km/h
Sight Distance Requirement for Stopping, Crossing and Turning Movements at the Crossing Road (m)		See Note 1	130	TAC 2017 (2.5.3: Table 2.5.2)	See Note 1
Crest: Minimum "K" factor for Stopping Sight Distance		See Note 1	26	TAC 2017 (3.3.3.3: Table 3.3.2)	See Note 1
Sag: Minimum "K" factor for Stopping Sight Distance		See Note 1	30	TAC 2017 (3.3.3.4: Table 3.3.4)	See Note 1
Grades Maximum (%)		See Note 1	6%	TAC 2017 (3.3.2.4: Table 3.3.1)	See Note 1
Radius Minimum (m)		250 m	130 m	MTO design supplement 2020 (10.6.2.1: Exhibit 10-D	250 m
Superelevation Maximum Rate (%)		0.06 m/m	0.06 m/m	MTO design supplement 2020 (10.6.2.1: Exhibit 10-D)	0.06 m/m
Lane Widths (m)		2 x 4.8 m	4.8 m	TAC 2017 (10.6.2.5)	3 x 4.8 m [2]
Shoulder Width (Left / Right) (m)		1.0 m left 3.0 m right	1.0 m Left 2.5 m Right	MTO design supplement 2020 (Section 4.4.2)	1.0 m Left 3.0 m Right
Shoulder Rounding (m)		0.5 m (min)	0.5 m	TAC 2017 (4.4.5)	0.5 m
Sight Distance at Exit Terminal (m)		See Note 3	-	-	See Note 3
Exit Terminal Speed-Change Lane Length (m)		See Note 3	-	-	See Note 3
Sight Distance at Entrance Terminal (m)		See Note 3	-	-	See Note 3
Entrance Terminal Speed-Change Lane Length (m)		See Note 3	-	-	See Note 3

Notes:

1. Proposed work is limited to intersection tie-in. Existing ramp profile to be maintained.
2. Existing two lanes (left/ right turn lanes) will be converted to 2 right and 1 left turning lanes approaching intersection at Merritt Road.
3. Existing entrance and exit terminal and speed-change lanes to be maintained.

Design Criteria: Hwy 406 (Beaverdams Rd to Robinson Rad)

DESIGN CRITERIA

Group Work Project No. GWP xxxx-xx-xx Highway No. 406 Page 4 of 9
Work Project No(s). WP xxxx-xx-xx Date: Mar 9, 2023
WP xxxx-xx-xx

Standards Table: Highway 406 (Beaverdams Road to Robinson Road)

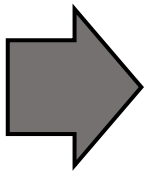
Design Year: 20232031		Superelevation Maximum Rate for Determining the Radius: Not Available		
	Present Conditions	Design Standards	Reference (Design Standards)	Proposed Standards [1]
Functional Highway Classification	RFD120	RFD120	RFD120	RFD120
Minimum Stopping Sight Distance (m)	245 m	250	TAC 2017 (2.5.3: Table 2.5.2)	245 m
Crest: Minimum "K" factor for Stopping Sight Distance	120 m	95	TAC 2017 (3.3.3.3: Table 3.3.2)	120 m
Sag: Minimum "K" factor for Stopping Sight Distance	60 m	63	TAC 2017 (3.3.3.4: Table 3.3.4)	60 m
Grades Maximum (%)	3%	5%	TAC 2017 (3.3.2.4: Table 3.3.1)	3%
Radius Minimum (m)	1800 m	750	TAC 2017 (Table 3.2.6)	1800 m
Lane Widths (m)	2 X 3.75 m	3.75	MTO design supplement 2020 (Exhibit 4-A)	2 X 3.75 m
Shoulder Width (Left / Right) (m)	Right – 3.0 m Left – 1.5 m	3.0	MTO design supplement 2020 (Exhibit 4-J)	Right – 3.0 m Left – 1.5 m
Shoulder Rounding (m)	1.5 m	1.0	MTO RDM 2.3.3	1.5 m
Median Width (m)	22 m	N/A	N/A	22 m
R.O.W. Width - nominal (m)	N/A	N/A	N/A	N/A
Posted Speed - prevailing (km/h)	100 km/h	100 km/h	N/A	100 km/h
Miscellaneous	N/A	N/A	N/A	N/A

Notes:

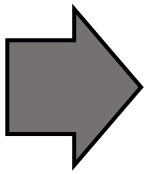
1. The existing conditions for Highway 406 will be maintained. No changes are proposed to Highway 406 mainline. Existing information listed in this table was provided to the Niagara Region by the Ministry of Transportation.

Next Steps

Complete Environmental Study Report and initiate 30-day public review in Spring / Summer 2023



Initiate Detailed Design process (*timing to be determined*



Continue to consult with MTO during detailed design process