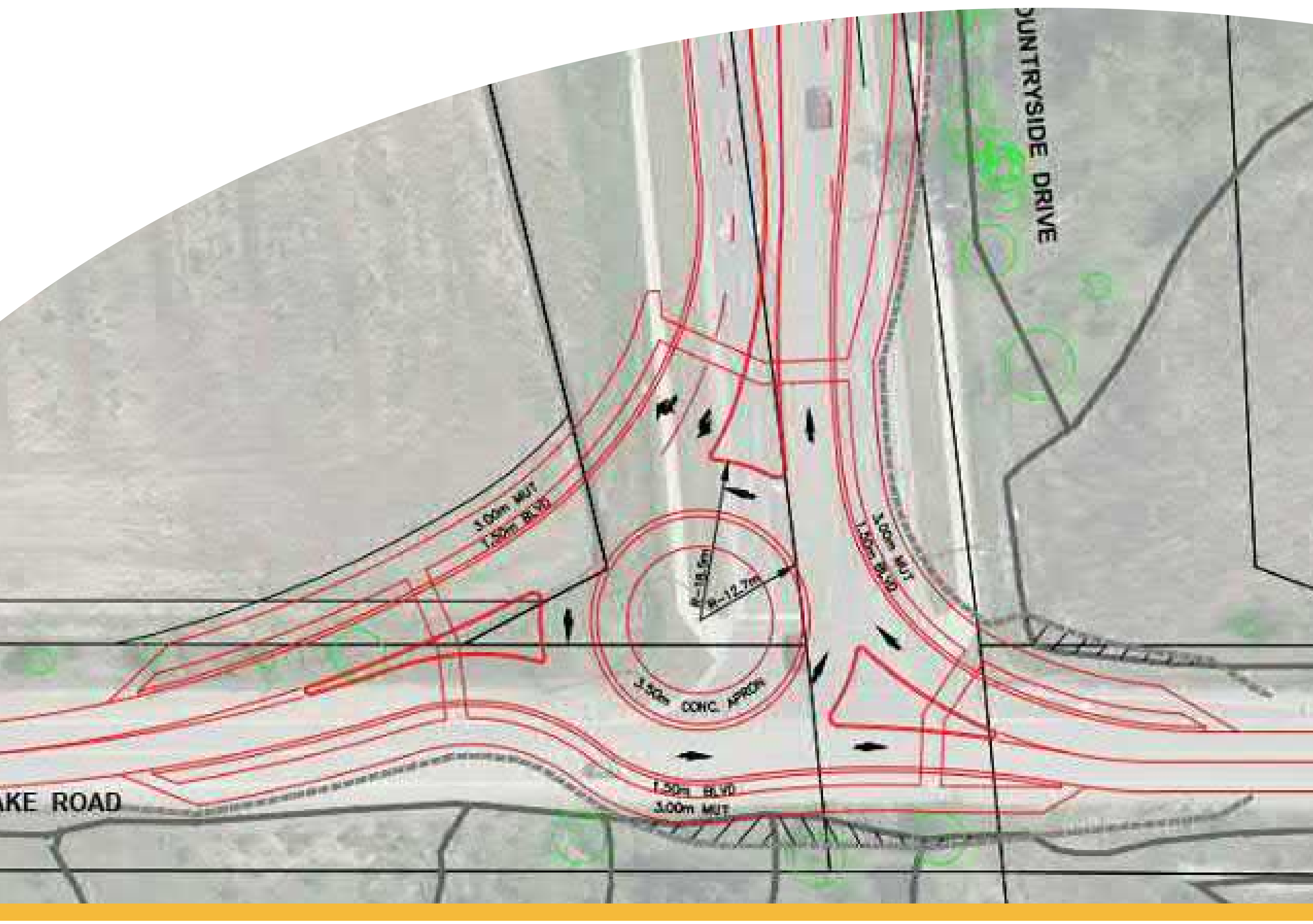
Heart Lake Road at Countryside Drive Schedule B Class Environmental Assesssment

Project Study Report - Volume II (Appendices)

December 2022



MTE File No: 47877-100

Appendix A

Function and Design Review

Function and Design Review of Heart Lake Road Corridor

City of Brampton

Final Report - November 2019

Stantec

Revision	Description	Author		Quality Check		Independent Review	
0A	Draft	I Hauzar F Tomeo	18/11/05				
0B	Draft – Rev 1	F Tomeo I Hauzar	19/02/07				
0C	Draft – Rev 2	I Hauzar	19/07/04				
0D	Final	B Orr	19/11/11	D Addley	19/11/28		

Prepared by ____________________________________

(signature)

Brandon Orr, BES, MCIP, RPP

Review by ____________________________________

(signature)

Diana Addley, MCIP, RPP

Table of Contents

1.0 INTRODUCTION 1.1

2.0 CONTEXT AND STUDY PROCESS 2.1
2.1 CONTEXT 2.1
2.2 STUDY PROCESS 2.1

3.0 TRANSPORTATION 3.1
3.1 TRAFFIC 3.1
3.2 SAFETY 3.24
3.3 SIGHT LINES 3.29
3.4 GEOMETRY 3.33
3.5 INFRASTRUCTURE CONDITIONS 3.33
3.6 SUMMARY 3.34

4.0 ECOLOGY AND ENVIRONMENT 4.1
4.1 BACKGROUND REVIEW 4.1
4.2 NATURAL HERITAGE FEATURES 4.2
4.3 WILDLIFE ROAD MORTALITY 4.2
4.4 MITIGATION MEASURES 4.7

5.0 CULTURAL HERITAGE 5.1
5.1 SITE HISTORY 5.1
5.2 SUMMARY OF EVALUATION 5.12
5.3 STATEMENT OF CULTURAL HERITAGE SIGNIFICANCE 5.12
5.4 HERITAGE ATTRIBUTES 5.13

6.0 EVALUATION OF ALTERNATIVES 6.1
6.1 ROAD CLASSIFICATION 6.1
6.2 CATEGORIES OF ALTERNATIVES 6.3
6.3 LIST OF ALTERNATIVES 6.3
6.4 EVALUATION CRITERIA 6.13
6.5 EVALUATION MATRIX 6.14

7.0 PREFERRED ALTERNATIVE 7.1
7.1 SHORT TERM 7.1
7.2 LONG TERM 7.1
7.3 ECO-PASSAGES 7.1
7.4 BUDGETARY COST ESTIMATES 7.7

8.0 CONCLUSION 8.1

LIST OF TABLES

Table 1: Existing | Major Roadways in Study Area....3.1
Table 2: Existing | Transit Routes....3.2
Table 3: Existing | Active Transportation Facilities....3.6
Table 4: Existing | Goods Movement Network Corridors....3.6
Table 5: Growth Areas along the Heart Lake Road Corridor....3.18
Table 6: Brampton Regional Model - Travel Demand Forecast at Future Horizons on Heart Lake Road – AM Peak....3.18
Table 7: Planned Infrastructure Improvements....3.20
Table 8: Total Yearly Collisions by Location....3.25
Table 9: Average Collision Rate by Survey Location....3.26
Table 10: Collision Classification by Intersection of Interest 2012 to 2017....3.26
Table 11: Collision Data 2017-2018....3.27
Table 12: Collision Type by Manoeuvre Type (Heart Lake Rd / Sandalwood Pkwy) | 2012-2017....3.27
Table 13: Total Collisions by Movements....3.28
Table 14: Recommended Improvements at the Heart Lake Rd and Sandalwood Parkway Intersection....3.29
Table 15: Crossing Sight Distance....3.30
Table 16: Left-Turning Departure Sight Triangles....3.31
Table 17: Species of Conservation Concern that may be Present within the Heart Lake Road Study Area....4.2
Table 18: Effectiveness of Mitigation Measures on Speed observed on Heart Lake Road....4.9
Table 19: Criteria of Ontario Regulation 9/06 Compliance....5.9
Table 20: Road Classification Criteria....6.2
Table 21: Assessment of Active Transportation Alternatives....6.9
Table 22: Assessment of Traffic Calming Alternatives....6.11
Table 23: Assessment of Wildlife Treatment Alternatives....6.13
Table 24: Evaluation Criteria and Factors Considered....6.14
Table 25: Evaluation of Traffic Calming Alternatives....6.18
Table 26: Evaluation of Wildlife Mortality Mitigation Alternatives....6.20

LIST OF FIGURES

Figure 1: Focus Study Area 1.2
Figure 2: Study Process 2.2
Figure 3: Existing | Land Use 3.3
Figure 4: Existing | Road Network 3.4
Figure 5: Existing | Transit Network 3.5
Figure 6: Existing | Active Transportation Network 3.7
Figure 7: Existing | Commercial Vehicle Routes 3.8
Figure 8 Existing | Weekday Traffic Volume Profile on Heart Lake Road 3.9
Figure 9: Existing | Select Link Analysis @ Heart Lake Rd south of Countryside Dr - Demand 2016 / Network 2016 AM Peak 3.10
Figure 10: Existing | Select Link Analysis @ Heart Lake Rd south of Countryside Dr - Demand 2016 / Network 2016 PM Peak 3.11
Figure 11: Existing | Turning Movement Volumes – Weekday AM Peak Hour 3.12
Figure 12: Existing | Turning Movement Volumes – Weekday PM Peak Hour 3.13
Figure 13: Existing | LOS and V/C Ratios – Weekday AM Peak Hour 3.15
Figure 14: Existing | LOS and V/C Ratios – Weekday PM Peak Hour 3.16
Figure 15: Heart Lake Road, in front of Garden Gallery 3.17
Figure 16: Population & Employment Projections 3.19
Figure 17: Future Situation – Select Link Analysis @ Heart Lake Rd south of Countryside Dr | 2041 AM Peak 3.21
Figure 18: Future Situation – Select Link Analysis @ Heart Lake Rd south of Countryside Dr | 2041 PM Peak 3.22
Figure 19: Planned Infrastructure Improvements 3.23
Figure 20: Total Number of Collisions by Location 3.24
Figure 21: Existing Conditions | Typical Cross-Section 3.33
Figure 22: Desirable Bicycle Facility Pre-Selection Nomograph 3.35
Figure 23 Ecologic and Environmental Characteristics 4.5
Figure 24: View Looking SE along Heart Lake Rd towards Sandalwood Pwy E 5.4
Figure 25: View looking NW along Heart Lake Rd showing wetland (right) and treed ridge (left) 5.5
Figure 26: View NW of Heart Lake Rd showing the Heart Lake Seventh Day Adventist Church (right) and treed ridge (left) 5.5
Figure 27: NW View of Heart Lake Rd showing the Lakeside Garden Gallery (right) 5.5
Figure 28: NW View of Heart Lake Rd showing wetland (right) and entrance to the Heart Lake Conservation Area (left) 5.5
Figure 29: Entrance to the Heart Lake 5.6
Figure 30: Example of split rail fences located along Conservation Area 5.6
Figure 31: NW View of Heart Lake Rd showing the lands within Metrus Developments (Residential) parcel on the right 5.6
Figure 32: SE View of Heart Lake Rd showing the lands within Metrus Developments (Residential) parcel on the left. Note the remnant tree lines and driveway. 5.6
Figure 33: NW View towards Countryside Dr showing the lands within Metrus Developments (Residential) parcel on the right 5.6
Figure 34: Example of Tree Ridge/High Ground in the Heart Lake Conservation Area on the west side of Heart Lake Road 5.7
Figure 35: NE View of Rolling Agricultural 5.7

Figure 36: NW View of Heart Lake Road showing Lands included in the Emery Developments (Residential) Parcel (right) ... 5.7
Figure 37: NW View of Heart Lake Rd showing Lands included in the Emery Developments (Residential) Parcel (right) and Khalsa School (far right) ... 5.7
Figure 38: East View from Heart Lake Rd showing Lands included in the Khalsa School Parcel ... 5.7
Figure 40: NW View of Heart Lake Rd ... 5.8
Figure 39: East View of the Khalsa School Parcel ... 5.8
Figure 41: Alternative 1.B | Two Lanes with Paved Shoulders and Rumble Strips ... 6.4
Figure 42: Alternative 1.C | Two Lanes with Separated Bike Lanes ... 6.4
Figure 43: Alternative 1.D | Two Lanes with Separated Bi-directional Multi-Use Path on one side ... 6.5
Figure 44: Alternative 1.E | Narrow Roadway with Shared Roadway Markings and Signs ... 6.5
Figure 45: Alternative 1.F | Hybrid Multi-Use Trail in Heart Lake Conservation Area ... 6.6
Figure 46: Alternative 1.G | One-way Operation with Separated Bike Lanes ... 6.6
Figure 47: Alternative 1.G | Proposed Road Network ... 6.7
Figure 48: Mini Roundabout Proposed at Access to HLCA ... 6.7
Figure 49: Roundabout at Countryside Option 1 (with encroachment on TRCA lands) ... 6.8
Figure 50: Roundabout at Countryside Option 2 (without encroachment on TRCA lands) ... 6.8
Figure 51: StormTech Chambers ... 7.2
Figure 52: Heart Lake Road | Proposed Longitudinal Profile ... 7.4
Figure 53: Cross-Sections of Proposed (2) Eco-Passages ... 7.6

LIST OF APPENDICES

APPENDIX A PUBLIC CONSULTATION ... A.1
APPENDIX B AGENCY CORRESPONDENCE ... B.1
APPENDIX C TURNING MOVEMENT COUNTS ... C.1
APPENDIX D SYNCHRO REPORTS ... D.1
APPENDIX E SANDALWOOD INTERSECTION/SAFETY REVIEW ... E.1
APPENDIX F GEOTECHNICAL REPORTS ... F.1
APPENDIX G HEART LAKE ROAD VOLUNTEER ECOLOGY MONITORING PROJECT, PHASES 1 AND 2 ... G.1
APPENDIX H COST ESTIMATES ... H.1

1.0 INTRODUCTION

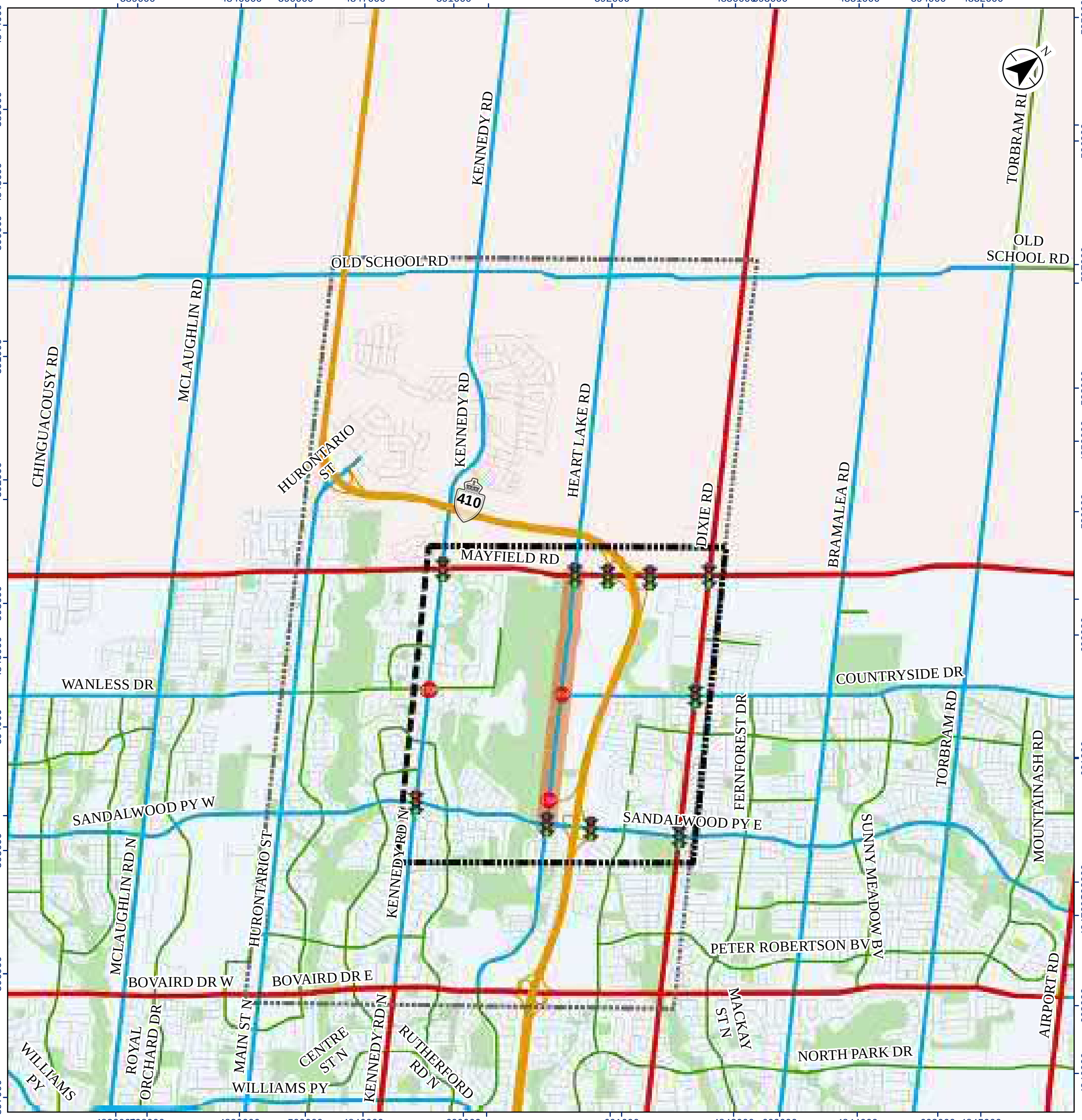
In response to concerns regarding wildlife mortality and traffic operations, the City of Brampton commissioned Stantec to undertake a function and design review of the Heart Lake Road corridor within the City of Brampton.

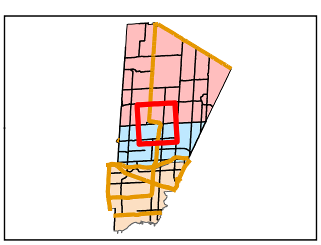
The focus of this study is the Heart Lake Road corridor between Sandalwood Parkway to a point just north of Mayfield Road; however, the assessment of the transportation network and recommendations from this study extend beyond this focus area. **Figure 1** shows the study corridor and area.

The Heart Lake Road Transportation Study will deliver on the following objectives:

- Assess the feasibility of preserving the existing rural/cultural landscape character of Heart Lake Road given its Official Plan designation and function as a Minor Arterial Road and relevant Secondary Plan policies.
- Assess the current roadway structure and long-term function of Heart Lake Road with the intent of identifying opportunities to safely accommodate active transportation, while meeting other transportation demands.
- Review the roadway operational mitigating measures that have already been implemented with the intent to preserve and enhance the unique cultural heritage landscape and existing wildlife habitat along Heart Lake Road (i.e. naturalization, natural area /wildlife signage, road closures for seasonal migration periods and monitoring) and recommend improvements/enhancements.
- Review the road infrastructure improvements planned along Heart Lake Road which are intended to deter wildlife from crossing the road (i.e. wildlife eco-passage culvert and wildlife fencing) and recommend additional measures to enhance the proposed works.
- Examine the implications on land use, development, and transportation of listing Heart Lake Road under the Ontario Heritage Act as a Cultural Heritage Landscape and make appropriate recommendations in this regard.

\\Cd1175-f01\01650\active\165001037\5 Technical Work\2 Map\Base_Map_PortraitV3.mxd Revised: 2019-02-08 By: bchannareddy





Legend

Extended Study Area

Study Area

Study Corridor

Parks

Municipality

Caledon

Brampton

Transportation

Provincial Highway

Regional Road

Arterial Road

Collector Road

Local Road

Ramp

Study Intersections

1-way Stop

Signalized

0 200 400 metres

1:61,607 (at original document size of 8.5x11)

Stantec

Project Location
Brampton, ON

165001037 REVA
Prepared by Brandon Orr on 2019-02-08

Client/Project
FUNCTION AND DESIGN REVIEW OF THE HEART LAKE ROAD CORRIDOR

Figure No.
1

Title
Focus Study Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.

2.0 CONTEXT AND STUDY PROCESS

2.1 CONTEXT

Historical evidence suggests that Heart Lake Road was a "corduroy log road" built in early to mid-1800s, traversing the Brampton Esker through wetlands, woodlands and wildlife habitat. In comparison to the majority of Brampton, very little active agriculture occurred along Heart Lake Road due to the significant natural constraints and unsuitable soil.

The largest land holding along the Heart Lake Road today is the Heart Lake Conservation Area (HLCA) owned by the Toronto and Region Conservation Authority (TRCA). Other development has been minimal, and comprises primarily older residential lots, a garden centre and a community organization headquarters. Between Heart Lake Road and Highway 410, previous agricultural lands are under application for development including employment, residential and institutional uses.

The primary concerns regarding Heart Lake Road relate to:

- Protection of the natural area adjacent to Heart Lake Road;
- Conservation of the cultural heritage landscape;
- Long range transportation planning; and
- Land use planning.

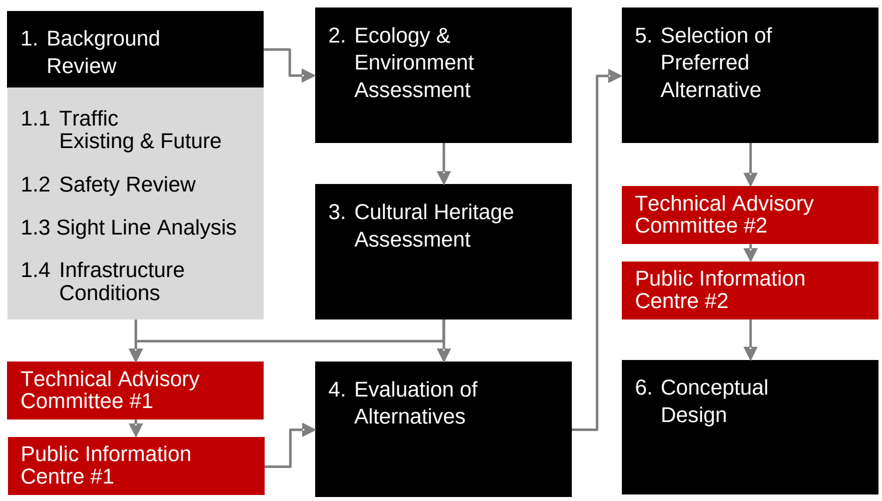
2.2 STUDY PROCESS

Figure 2 shows the process followed for this study, which includes two technical advisory committee (TAC) meetings and public information centres (PIC), each at the following milestones:

- After the background review, integrating components related to the ecological environment and cultural heritage; and
- After the evaluation of alternatives and selection of recommended alternative.

Copies of the information presented at PICs and associated notifications are provided in **Appendix A** of this report. Records correspondence with the TAC, including TRCA, are provided in **Appendix B**.

Figure 2: Study Process



3.0 TRANSPORTATION

3.1 TRAFFIC

3.1.1 Existing Conditions

3.1.1.1 Land Use

Figure 3 shows the current land use along the Heart Lake Road corridor under study and the extended study area.

It should be noted that the HLCA, under the jurisdiction of the TRCA, is located on the west side of Heart Lake Road. HLCA occupies 169 hectares and contains two kettle lakes, the headwaters for Spring Creek, a Provincially Significant Wetland Complex and one of the largest individual blocks of forest in the Etobicoke Creek watershed.

3.1.1.2 Transportation Network

The existing transportation network consists of various multimodal facilities to provide local and regional travel options. The following section details the road network, transit network, active transportation routes, and commercial vehicle routes.

Road Network

The road network around the Heart Lake Road corridor includes several major roadways that fall under Provincial, Regional, and municipal jurisdiction as summarized in **Table 1**. Highway 410, which is parallel and directly east of Heart Lake Road, provides regional connections as far north as the Bruce Peninsula, and the rest of the Greater Toronto and Hamilton Area to the south. Bovaird Drive is a 6-lane arterial roadway and Sandalwood Parkway is a 4-lane arterial with a short 6-lane section. Countryside Drive is a 4-lane arterial that connects to Heart Lake Road. Highway 410 off ramp connects directly to Heart Lake Road. Heart Lake Road is 2-lanes north of Sandalwood Parkway, and 4-lanes south of Sandalwood Parkway. Please refer to see **Figure 4** for a map of roadway hierarchy in relation to the study area.

Transit Services

The Heart Lake Road corridor study area is served by a mixture of local and regional bus services, primarily centred along Hurontario Street and Bovaird Drive. A portion of Heart Lake Road is serviced by Route 23 operated by Brampton Transit, between Bovaird Drive to Sandalwood Parkway. In general, most routes in the study area offer service all week with headways of 30 minutes or better during the peak periods with a few routes that operate at larger headways (50 minutes) and only provide weekday service (see **Table 2**). Please refer to **Figure 5** for a map of existing services in the study area.

Table 1: Existing | Major Roadways in Study Area

Roadway	# of Lanes	Type	Jurisdiction
Hurontario St.	4	Major Arterial	Brampton
Kennedy Rd.	4	Major Arterial	Brampton
Heart Lake Rd. (HLR)	2 lanes north of Sandalwood Parkway; 4 lanes south of Sandalwood Parkway	Minor Arterial	Brampton
Countryside Drive	4	Minor Arterial	Brampton
Dixie Rd.	4	Regional Major Arterial	Peel

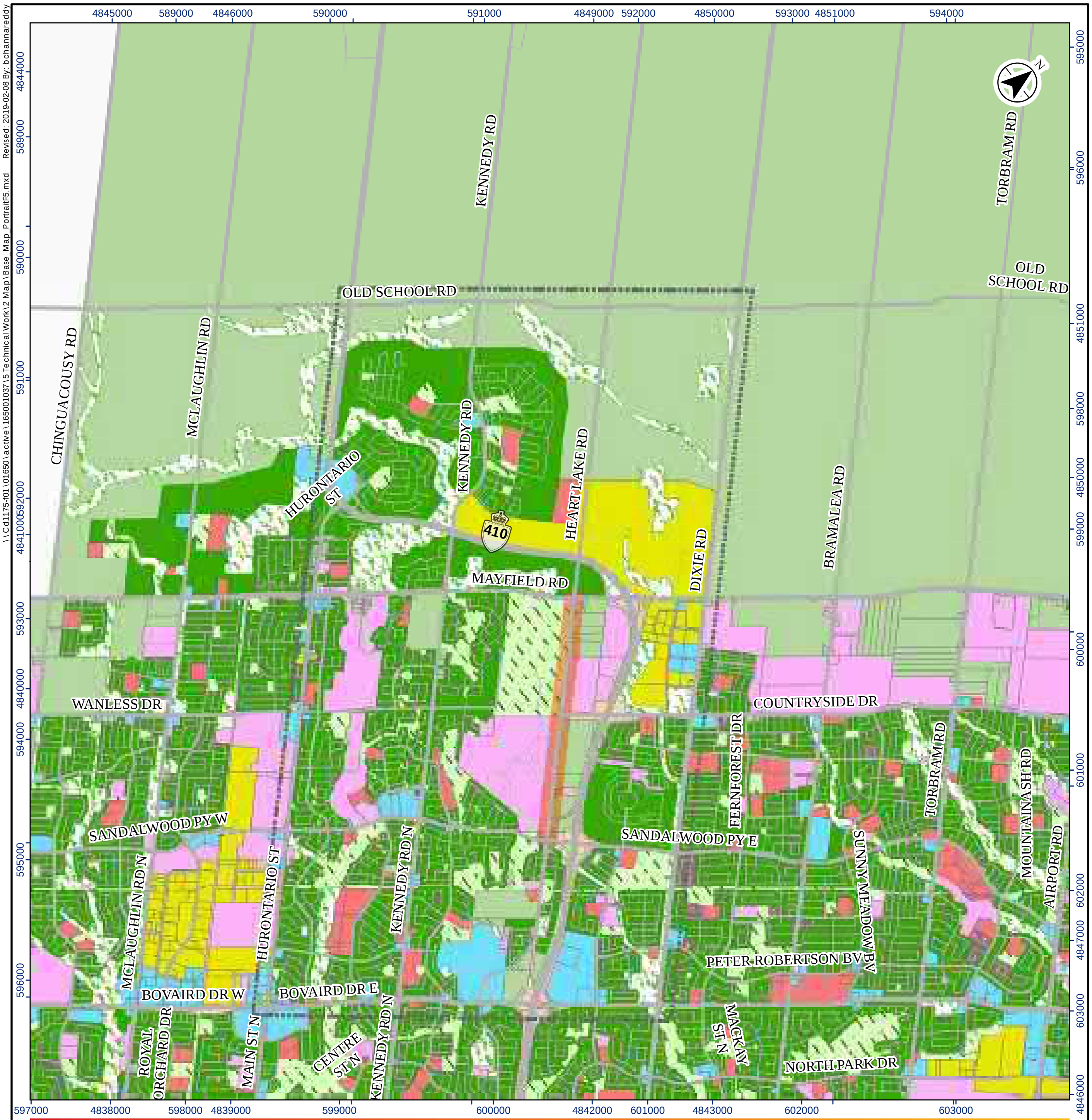
Table 1: Existing | Major Roadways in Study Area

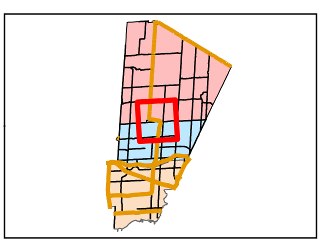
Roadway	# of Lanes	Type	Jurisdiction
Bovaird Dr.	6	Regional Major Arterial	Peel
Sandalwood Pkwy	East of HLR: 6 West of HLR: 4	Major Arterial	Brampton
Conservation Dr.	2	Collector	Brampton
Mayfield Rd.	4	Regional Major Arterial	Peel
Old School Rd.	2	Arterial	Caledon
Hwy 410	4	Highway	MTO

Table 2: Existing | Transit Routes

Route	Type	Days of Operation	Frequency (min)			
			AM	Mid-Day	PM	Off-Peak
2 – Main	Local	Mon-Sun	20	20	20	30
3 - McLaughlin	Local	Mon-Sun	15	30	10	25
5 - Bovaird	Local	Mon-Sun	10	20	15	30
7 - Kennedy	Local	Mon-Sun	7	15	7	20
17 – Howden	Local	Mon-Sun	20	40	20	40
18 - Dixie	Local	Mon-Sun	10	16	10	20
19 - Fernforest	Local	Mon-Sun	20	30	20	30
21 – Heart Lake	Local	Mon-Fri	50	N/A	50	50
23 - Sandalwood	Local	Mon-Sun	15	30	15	30
24 – Van Kirk	Local	Mon-Sun	30	30	30	60
32 – Father Tobin	Local	Mon-Sun	30	40	30	40
33 – Peter Robertson	Local	Mon-Sat	30	40	30	40
502 – Zum Main	BRT	Mon-Sun	8	10	8	20
505 – Zum Bovaird	BRT	Mon-Sun	14	20	15	20
37 – Orangeville/Brampton (GO)	Regional	Mon-Fri	50	N/A	50	N/A

\\Cd1175-f01\01650\active\165001037\5 Technical Work\2 Map\Base_Map_PortraitF5.mxd Revised: 2019-02-08 By: bchannareddy





Legend

Extended Study Area

Study Corridor

Transportation

Provincial Highway

Regional Road

Arterial Road

Collector Road

Local Road

Ramp

ZONING

Other

Agricultural

Commercial

Floodplain

Industrial

Institutional

Open Space

Public Ownership/Utilities

Residential

0 200 400

metres

1:61,607 (at original document size of 8.5x11)

Stantec

Project Location
Brampton, ON

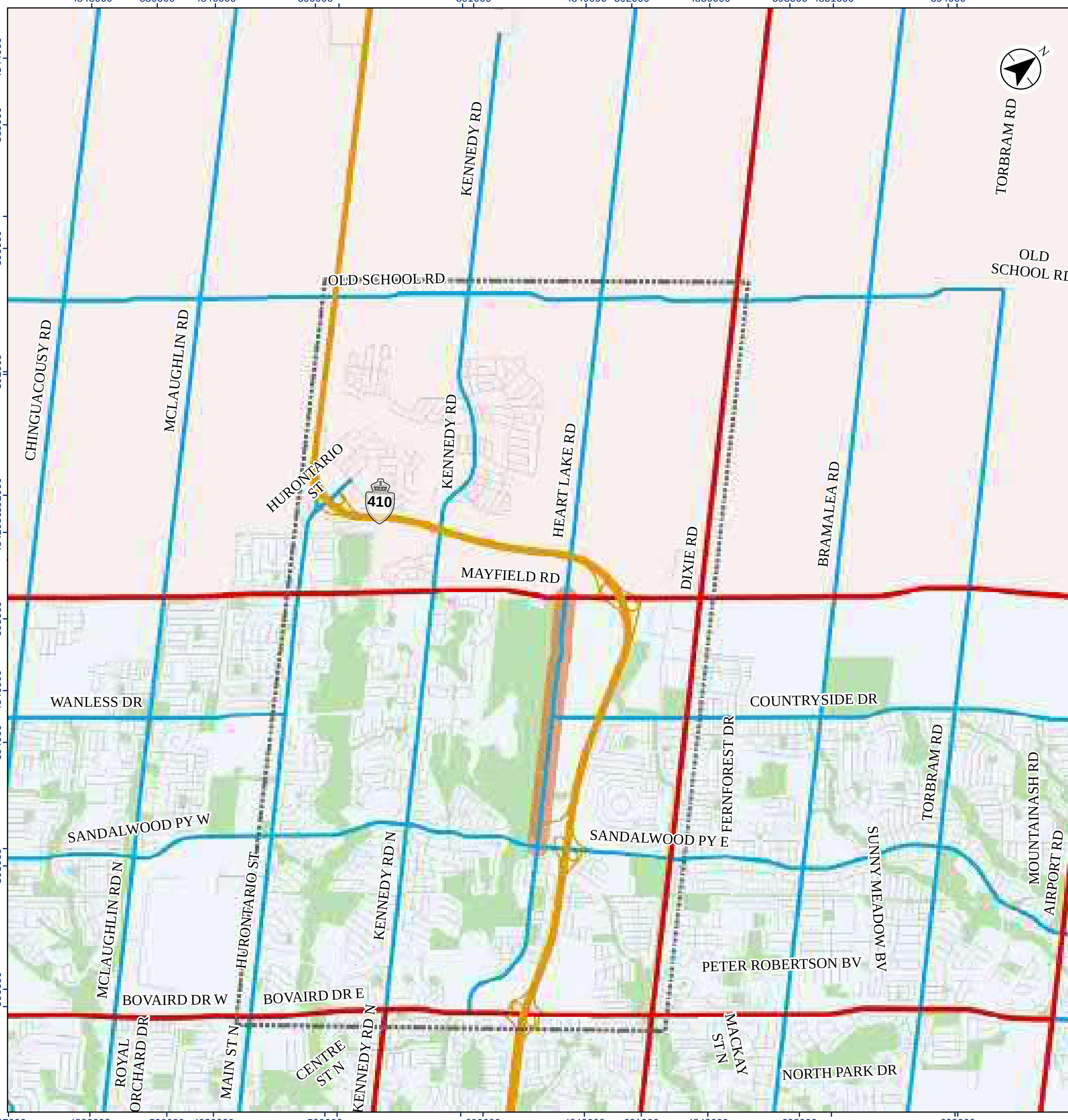
165001037 REVA
Prepared by Brandon Orr on 2019-02-08

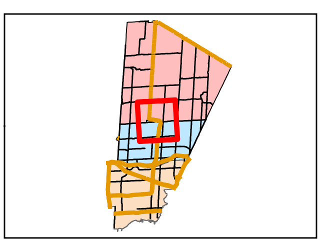
Client/Project
FUNCTION AND DESIGN REVIEW OF THE HEART LAKE ROAD CORRIDOR

Figure No.
3

Title
Existing Land Use

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.





0 200 400 metres

1:61,607 (at original document size of 8.5x11)

Stantec

Legend

Extended Study Area

Study Corridor

Parks

Municipality

Caledon

Brampton

Transportation

Provincial Highway

Regional Road

Arterial Road

Local Road

Ramp

Project Location
Brampton, ON

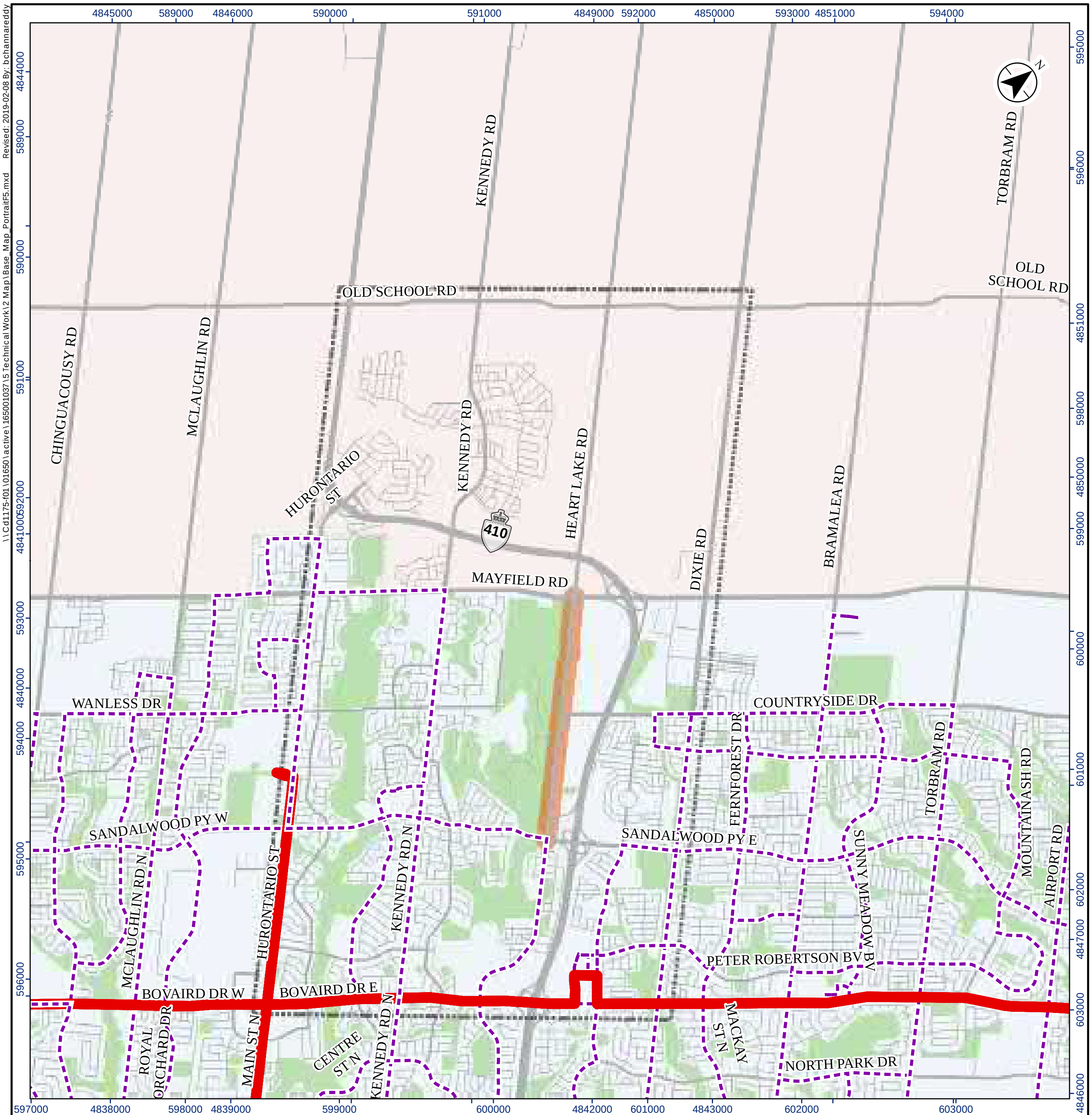
165001037 REVA
Prepared by Brandon Orr on 2019-02-08

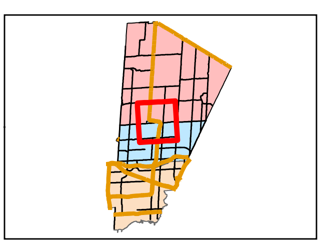
Client/Project
FUNCTION AND DESIGN REVIEW OF THE HEART LAKE ROAD CORRIDOR

Figure No.
4

Title
Existing Road Network

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.





Legend

- Extended Study Area
- Study Corridor
- Parks

Municipality

- Caledon
- Brampton

Transit

- Local
- Zum BRT

Transportation

- Provincial Highway
- Regional Road
- Arterial Road
- Collector Road
- Local Road
- Ramp

0 200 400
metres

1:61,607 (at original document size of 8.5x11)

Stantec

Project Location
Brampton, ON

165001037 REVA
Prepared by Brandon Orr on 2019-02-08

Client/Project
FUNCTION AND DESIGN REVIEW OF THE
HEART LAKE ROAD CORRIDOR

Figure No.
5

Title
Existing Transit Network

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016.
Imagery Date, 20XX.

Active Transportation

The study area includes numerous off-road cycling paths providing connections throughout the City of Brampton. The HLCA, which is adjacent to Heart Lake Road, is connected via the Esker Lake Trail which extends from the conservation area at its northern terminus to Copperfield Road in the south. There are limited connections from Heart Lake Road to other active transportation trails for cross-town or regional connections, however several other trails and cycling paths are in proximity to the corridor such as the boulevard paths on Countryside Drive and Sandalwood Parkway east of Highway 410 (summarized in **Table 3**). **Figure 6** shows a map of existing active transportation facilities in the study area.

Table 3: Existing | Active Transportation Facilities

Name	Type
Esker Lake Recreational Trail	Off-Road Trail (City)
Etobicoke Creek Recreational Trail	Off-Road Trail (City)
Chingacousy Recreational Trail	Off-Road Trail (City)
Flower City Recreational Trail	Off-Road Trail (City)
Kennedy Rd.	Boulevard Path (City)
Countryside Dr.	Boulevard Path (City)
Sandalwood Pkwy	Boulevard Path (City)
Bovaird Dr.	Boulevard Path (Region)

Commercial Vehicles

Goods movement in the area is provided via Highway 410 and regional roadways as summarized in **Table 4**. Most collector roads in the area have truck restrictions as well as several arterial roads such as Kennedy Road (North of Bovaird Drive), Heart Lake Road, Bramalea Road, Torbram Road, and Sandalwood Parkway (see **Figure 7**).

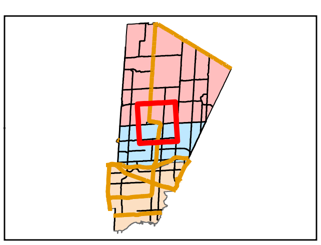
Table 4: Existing | Goods Movement Network Corridors

Corridor	Description	Type
Mayfield Rd.	Across the entire City	Primary Truck Route (Regional)
Dixie Rd.	Mayfield Rd. to south of Hwy 407	Primary Truck Route (Regional)
Bovaird Dr.	Across the entire City	Primary Truck Route (Regional)
Kennedy Rd.	Bovaird Dr. to south of Hwy 407	Primary Truck Route (City)
Hurontario St.	Mayfield Rd. to Bovaird Dr.	Potential City Truck Route

As noted on **Figure 7,** truck traffic is prohibited on Heart Lake Road between Mayfield Road and Bovaird Drive. However, we note the following two issues which makes truck prohibition difficult to apply implying that despite the restriction on Heart Lake Road, trucks still use the road:

- Truck traffic is currently allowed on Countryside Drive between Dixie Road and Heart Lake Road; however, this will change in the near future. A sign will be placed that states “No Heavy Trucks, Anytime” in the future; and
- The Lakeside Garden Gallery is a generator of truck traffic because of delivery needs. It should be noted that there is a traffic by-law provision (Consolidated Traffic By-law 93-93) in place that allows trucks to use a road that is prohibited to trucks providing that they are engaged in making a delivery to or a collection from a premise which cannot be reached any other way.

\\Cd1175-f01\01650\active\165001037\5 Technical Work\2 Map\Base_Map_PortraitF6.mxd Revised: 2019-02-08 By: bchannareddy



Legend

Extended Study Area

Study Corridor

Parks

Municipality

Caledon

Brampton

Transportation

Provincial Highway

Regional Road

Arterial Road

Collector Road

Local Road

Ramp

Pathways

Recreational Trail

Multi-Use Boulevard Pathway

On-Street Bike Lane

Bridge or Underpass

0 200 400 metres

1:61,607 (at original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.

Stantec

Project Location
Brampton, ON

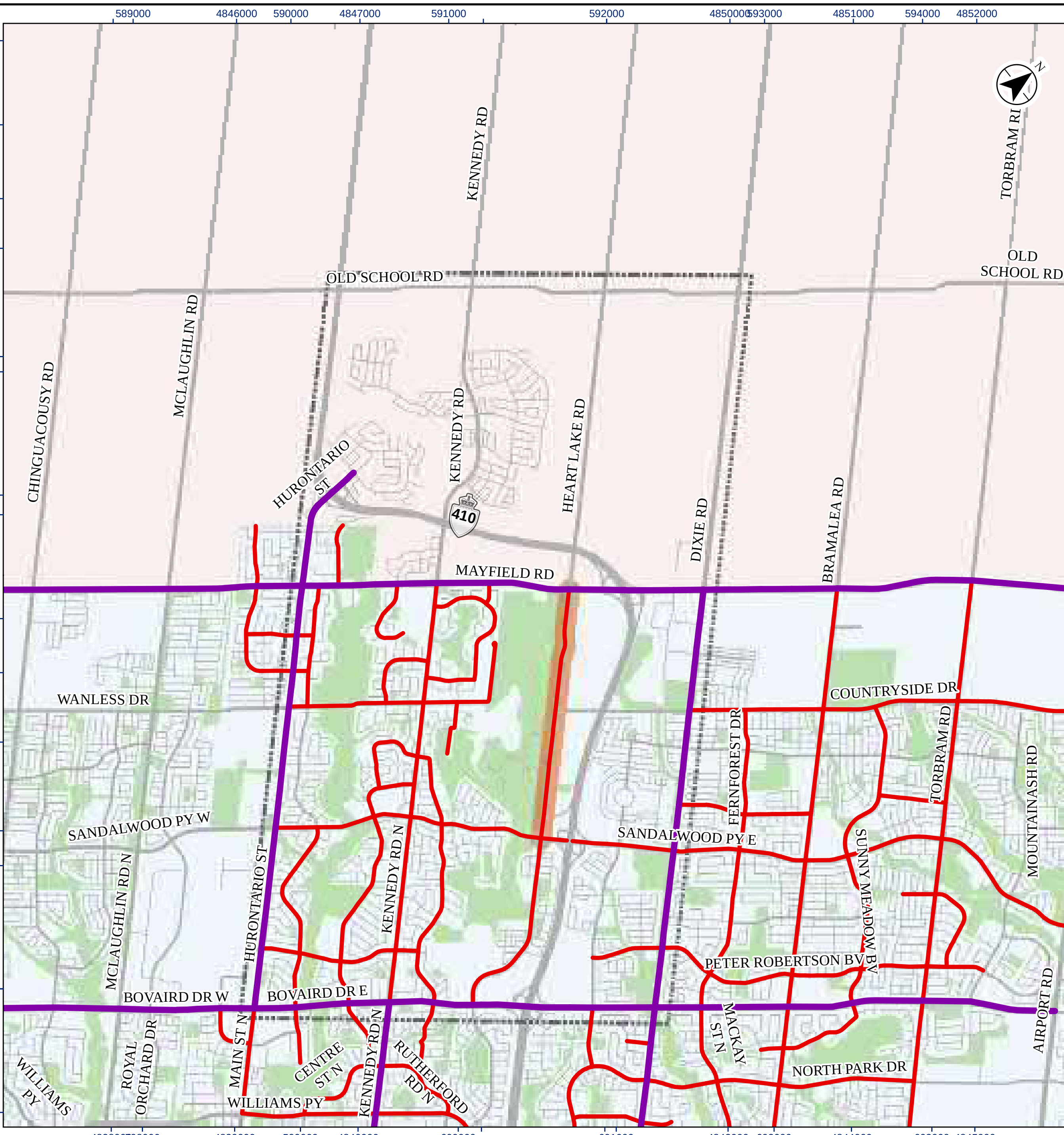
165001037 REVA
Prepared by Brandon Orr on 2019-02-08

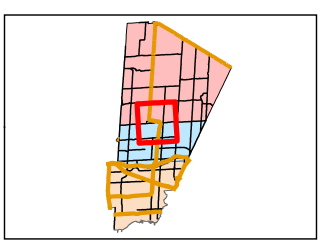
Client/Project
FUNCTION AND DESIGN REVIEW OF THE HEART LAKE ROAD CORRIDOR

Figure No.
6

Title
Existing Active Transportation Network

\\Cd1175-f01\01650\active\165001037\5 Technical Work\2 Map\Base_Map_PortraitV7.mxd Revised: 2019-02-08 By: bchannareddy





Legend

- Extended Study Area
- Study Corridor
- Parks
- Truck Routes
- Truck Restrictions

Municipality

- Caledon
- Brampton

Transportation

- Provincial Highway
- Regional Road
- Arterial Road
- Collector Road
- Local Road
- Ramp

0 200 400 metres

1:61,607 (at original document size of 8.5x11)

Stantec

Project Location
Brampton, ON

165001037 REVA
Prepared by Brandon Orr on 2019-02-08

Client/Project
FUNCTION AND DESIGN REVIEW OF THE HEART LAKE ROAD CORRIDOR

Figure No.
7

Title
Existing Commercial Vehicle Routes

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.

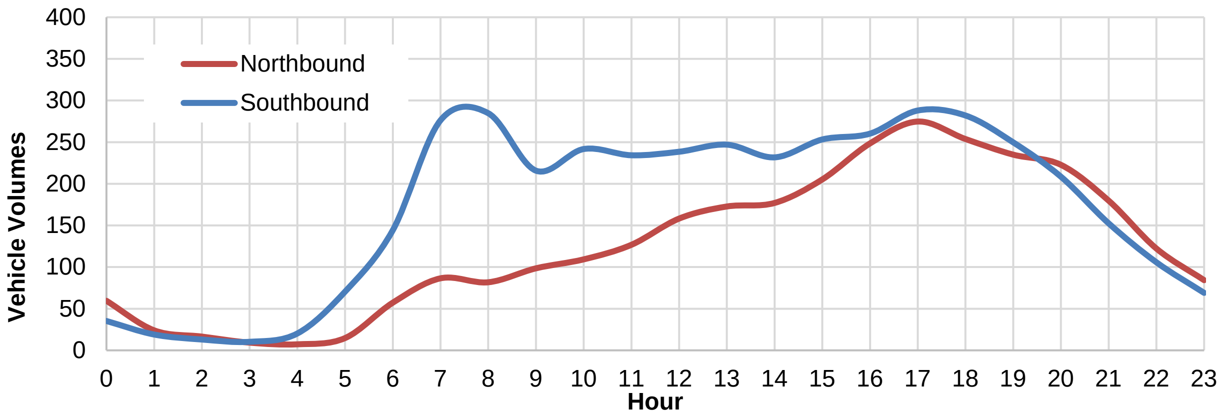
3.1.1.3 Travel Demand

Figure 9 and **Figure 10** show the path of drivers that are using Heart Lake Road and destined to/from a location south of Countryside Drive during the morning and afternoon weekday peak periods according to the regional travel demand model of the City of Brampton. It clearly shows that the travel demand on Heart Lake Road is in relation to trips from/to Countryside Drive. It also shows that people driving along Heart Lake Road travel up to King Street to the north (in Caledon) and beyond Highway 401 to the south.

3.1.1.4 Vehicular Traffic Conditions

Traffic Volumes

Figure 8 shows the hourly volume profile during a typical (24-hour) weekday between the Highway 410 off-ramp and Countryside Drive.



Note: Based on traffic counts conducted between July 27 and 29 + August 1, 2016

Figure 8 Existing | Weekday Traffic Volume Profile on Heart Lake Road

What emerges are the following:

- Although peaks are observed in the morning and in the afternoon, southbound traffic is relatively stable between 6:00 am and 7:00 pm, with volumes between 200 and 300 veh/hr;
- Northbound traffic peaks in the afternoon with volume exceeding 250 veh/hr;
- Maximum total volumes on Heart Lake Road are just over 500 veh/hr (pm peak hour); and
- Daily traffic is about 3,000 and 4,000 veh/day southbound and northbound respectively for a total of 7,000 veh/day.

In addition to what is shown in **Figure 8**, it is noted that 2% of vehicles travelling on Heart Lake Road are trucks. Despite this not being a large proportion, it remains problematic as heavy vehicles are currently prohibited on Heart Lake Road. Trucks making local deliveries are permitted to use Heart Lake Road (in accordance with city by-law) provided that they are engaged in making a delivery or collecting a load from a location that cannot be reached any other way.

Figure 11 and **Figure 12** show the turning movement volumes at the intersections within the study area. On the Heart Lake Road corridor, the peak directional traffic flows (southbound in the morning and more proportionate equivalently in the afternoon) are usually around 300 – 350 veh/h north of the Highway 410 off-ramp that connects to Sandalwood Parkway. Between this ramp and Sandalwood Parkway, southbound traffic flows are above 700 veh/h in the morning while in the afternoon they are in the range of 400 and 300 veh/h going southbound and northbound respectively. For reference the traffic counts used are provided in **Appendix C**.

Source: Brampton Emme Regional Model 2017

Figure 9: Existing | Select Link Analysis @ Heart Lake Rd south of Countryside Dr - Demand 2016 / Network 2016 AM Peak

Source: Brampton Emme Regional Model 2017

Figure 10: Existing | Select Link Analysis @ Heart Lake Rd south of Countryside Dr - Demand 2016 / Network 2016 PM Peak

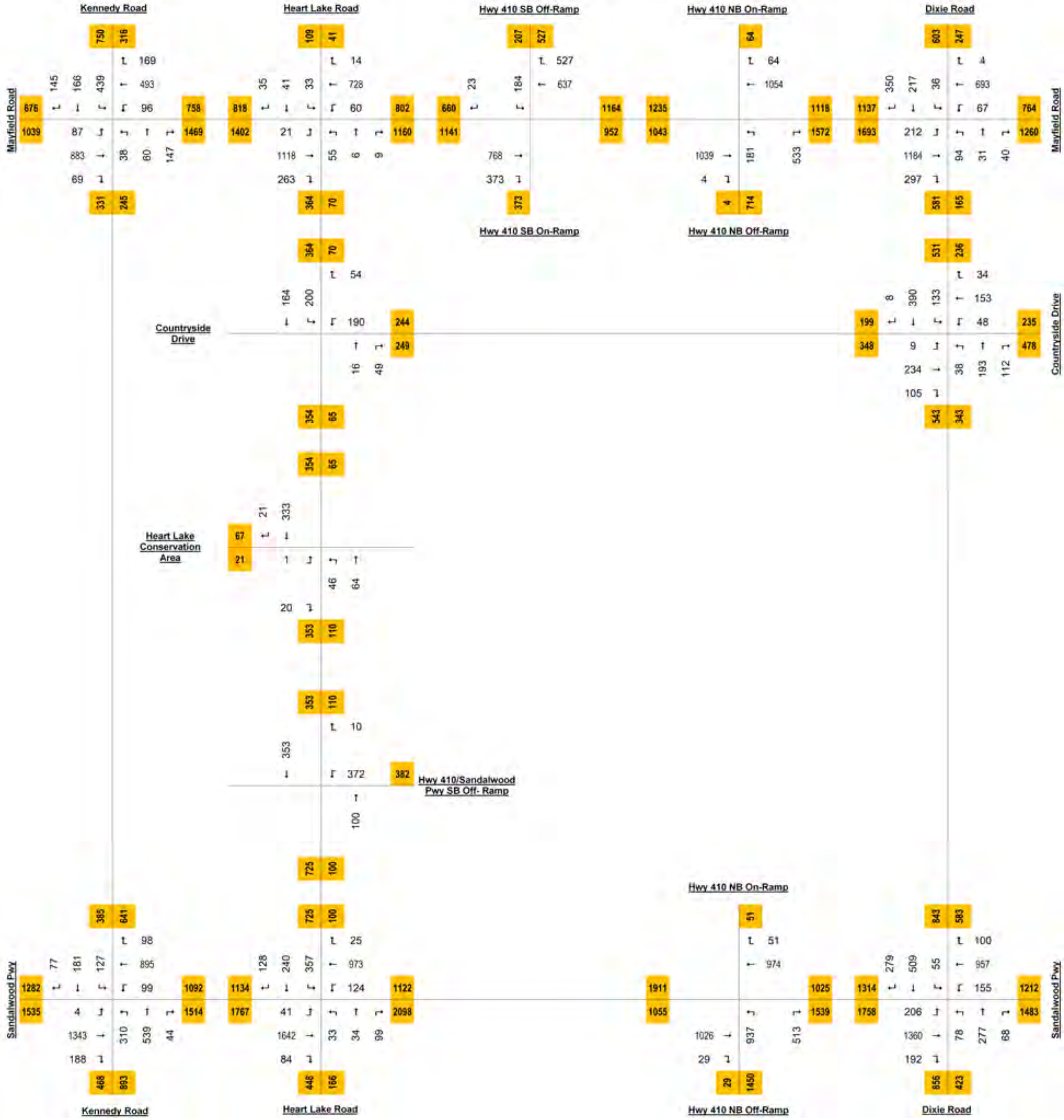


Figure 11: Existing | Turning Movement Volumes – Weekday AM Peak Hour

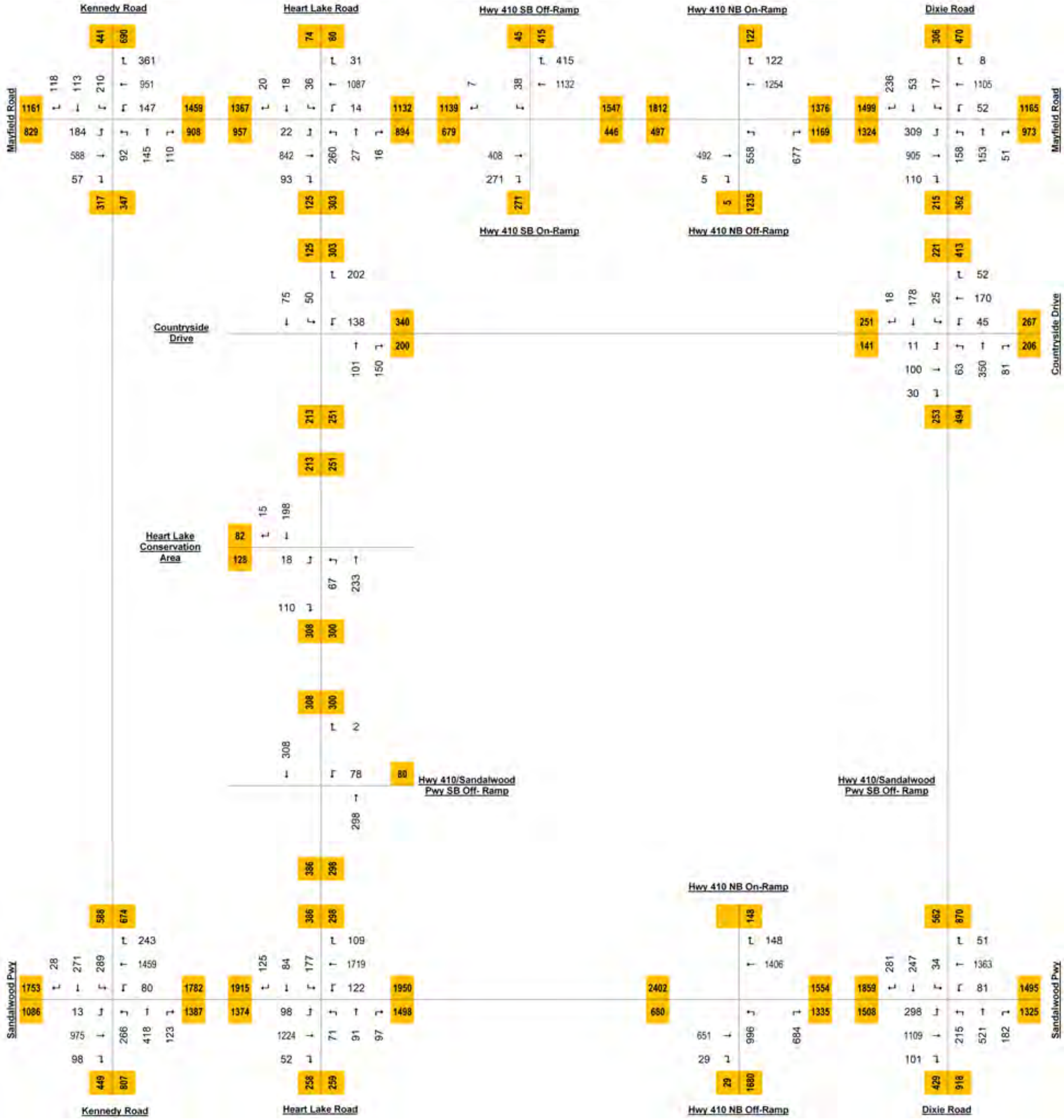


Figure 12: Existing | Turning Movement Volumes – Weekday PM Peak Hour

Traffic Operations

The quality of intersection operations at signalized and unsignalized intersections is evaluated in terms of level of service (LOS) and volume to capacity (v/c) as defined by the Highway Capacity Manual (HCM). LOS is evaluated on the basis of average control delay per vehicle and includes deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Capacity is evaluated in terms of ratio of demand flow to capacity with an at-capacity condition represented by a v/c ratio of 1.00 (i.e. volume demand equals capacity). For signalized intersections LOS ranges from LOS A for 10 seconds or less average delay to LOS F for average delay greater than 80 seconds. For unsignalized intersections, the LOS ranges from LOS A for 10 seconds or less average delay to LOS F for average delay greater than 50 seconds.

To assess the existing peak hour traffic conditions, a level of service analysis was undertaken for the study area intersections using Trafficware Synchro Software, which implements the methods of the 2000/2010 Highway Capacity Manual. The key parameters used in the analysis include:

- Existing lane configurations;
- Heavy vehicle percentages as derived from collected traffic count data;
- Calculated peak hour factors (PHFs). It is noted that this factor adjusts the hourly volumes to better represent conditions during the peak 15 minutes of intersection operations; and
- Synchro default values for all other inputs.

Figure 13 and **Figure 14** show the traffic conditions which are good on the Heart Lake Road corridor, with the exception of the intersection with Sandalwood Parkway whose capacity is limited during weekday peak periods. For reference, the Synchro reports are provided in **Appendix D**.

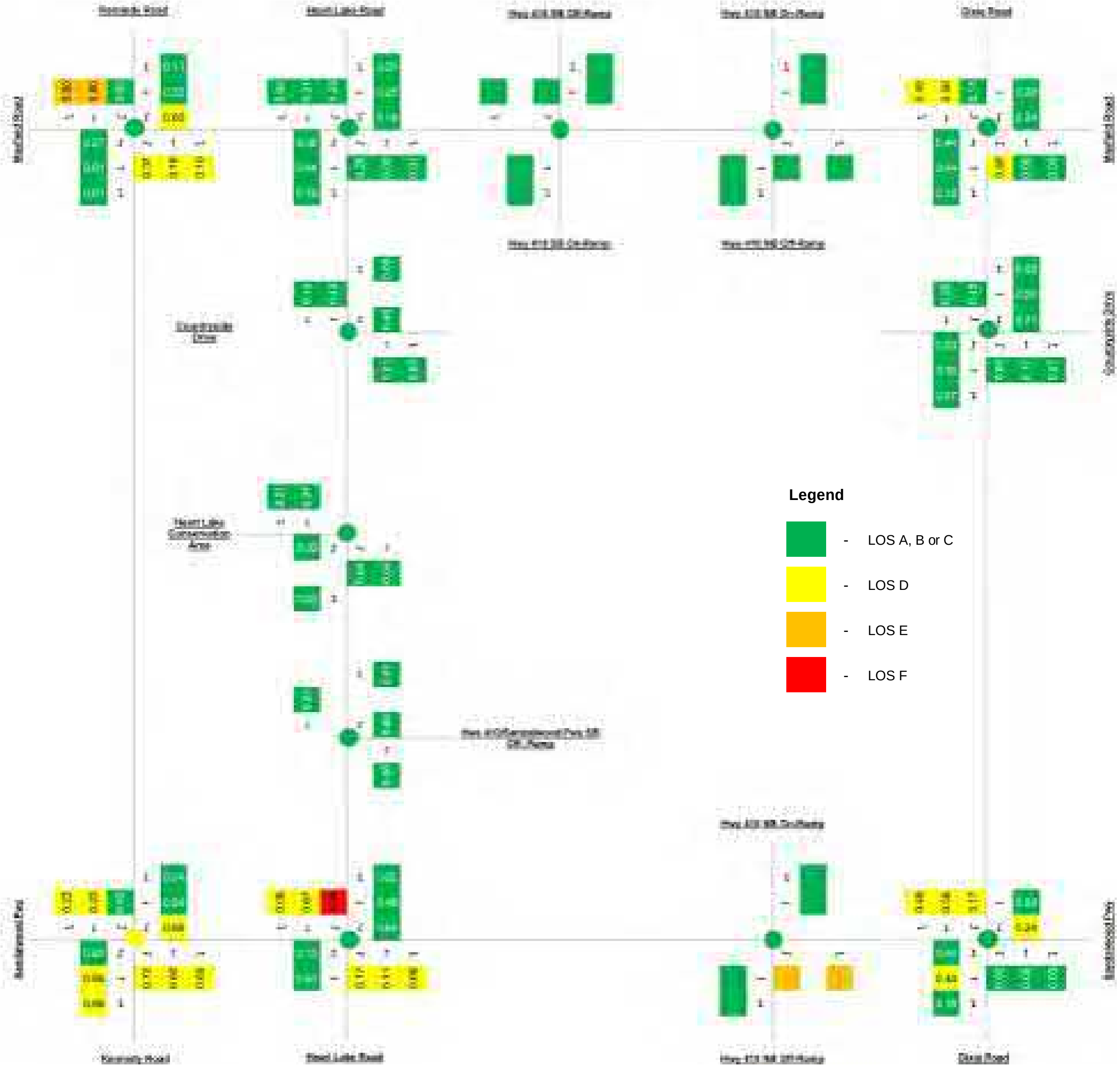


Figure 13: Existing | LOS and V/C Ratios – Weekday AM Peak Hour

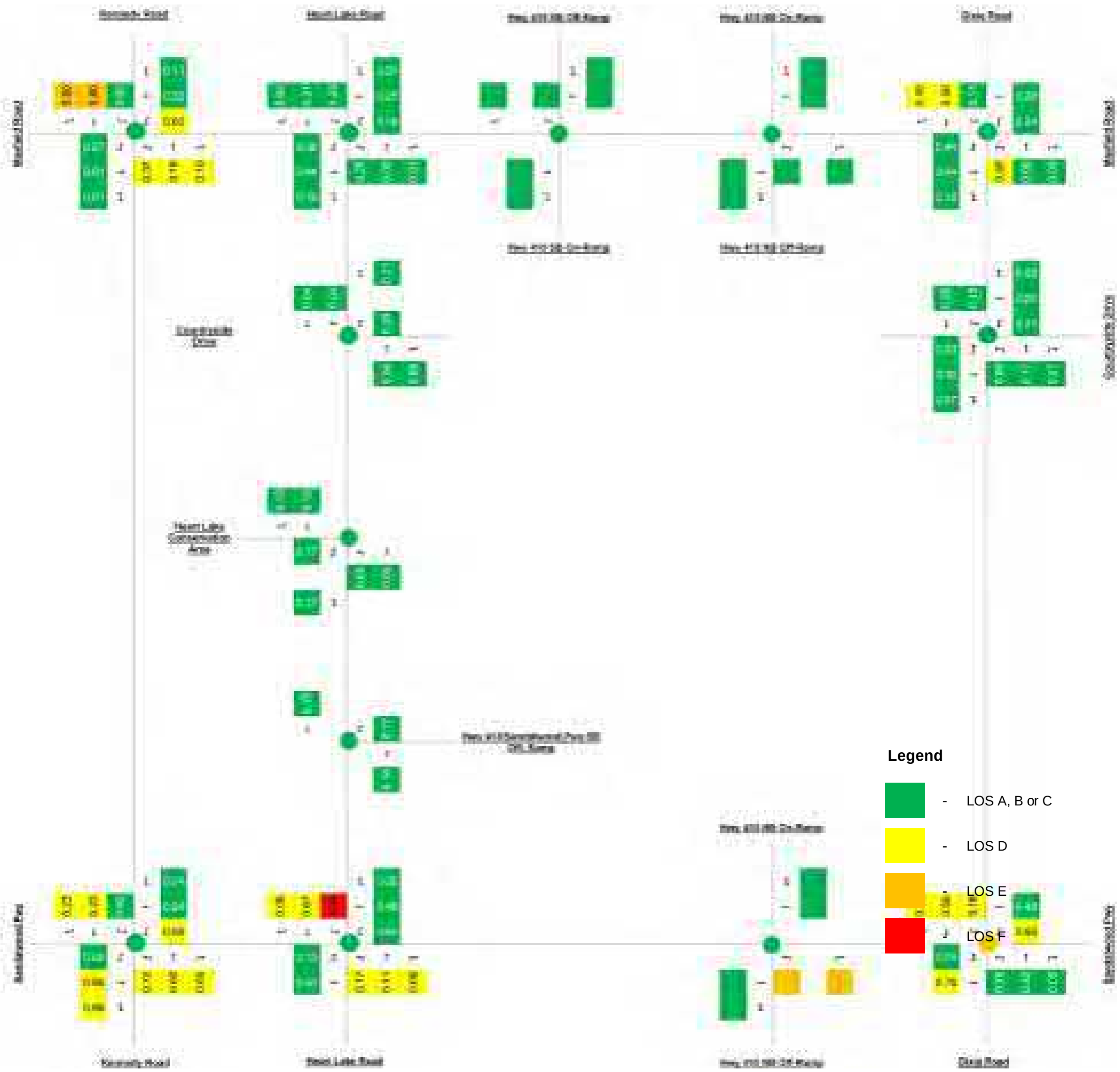
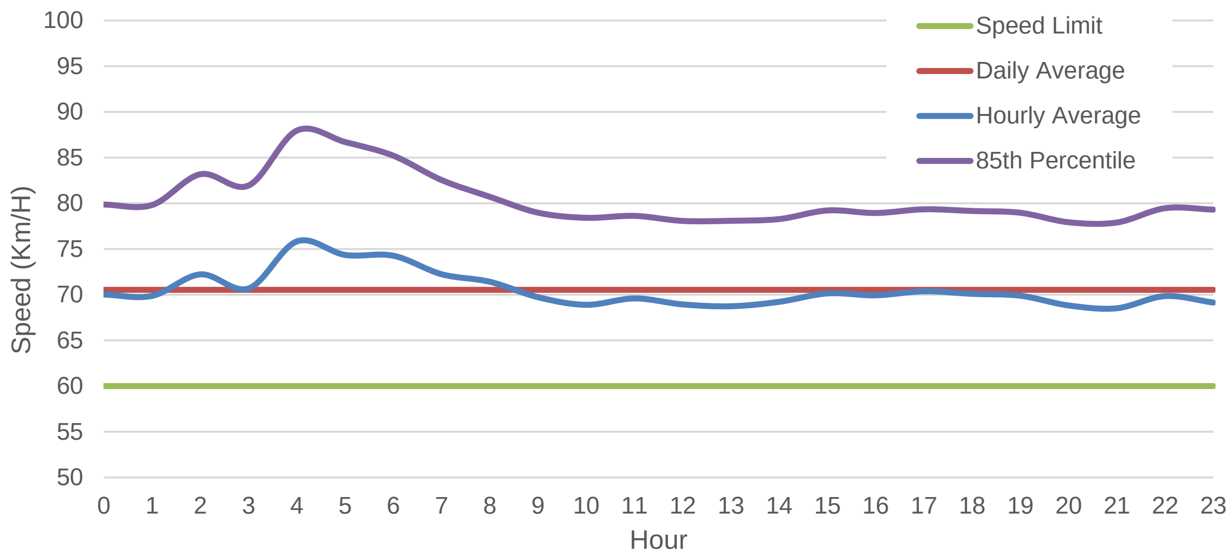


Figure 14: Existing | LOS and V/C Ratios – Weekday PM Peak Hour

3.1.1.5 Speed

Figure 15 summarizes the speeds observed on Heart Lake Road in front of the Garden Gallery in comparison to the posted speed (60 km/hr).



Source: City of Brampton, 2017

Figure 15: Heart Lake Road, in front of Garden Gallery

What emerges from **Figure 15**, including the analysis of observed speeds, are the following:

- The average observed speed is 70 km/h;
- The 85th percentage speed is 79 km/h; and
- The speed limit compliance is only 11%.

The reasons for the low rate of compliances are:

- The corridor is relatively straight which makes it easy to drive at high speed;
- There are not many intersections (or interferences) on the corridor which could reduce speeds; and
- The traffic lanes are wide, which makes it comfortable to drive at high speeds.

3.1.2 Future Conditions

3.1.2.1 Developments

Population and employment forecasts were prepared in February 2017 for the area surrounding the Heart Lake Road corridor. The forecasts were distributed into Small Geographic Units (SGUs), the most disaggregated geography available (see **Figure 16**). Although the magnitude of the development is significant, the anticipated transportation impacts are mostly along Hurontario Street, McLaughlin Road and Highway 410, and are not significant on the Heart Lake Road corridor.

Population and employment are expected to increase in the future, particularly in areas adjacent to Highway 410 and Heart Lake Road. The projected population and employment figures are summarized in **Table 5.**

Table 5: Growth Areas along the Heart Lake Road Corridor

SGU	Population (2011-2041)	Employment (2011-2041)
0327	1,342	175
0109	21	1,602
0326	0	46
0108	0	0
0208	5	0
1766	7,182	1,894
1769	106	1,937

Source: Hemson Consulting Ltd. 2017 & Brampton Emme Regional Model 2017

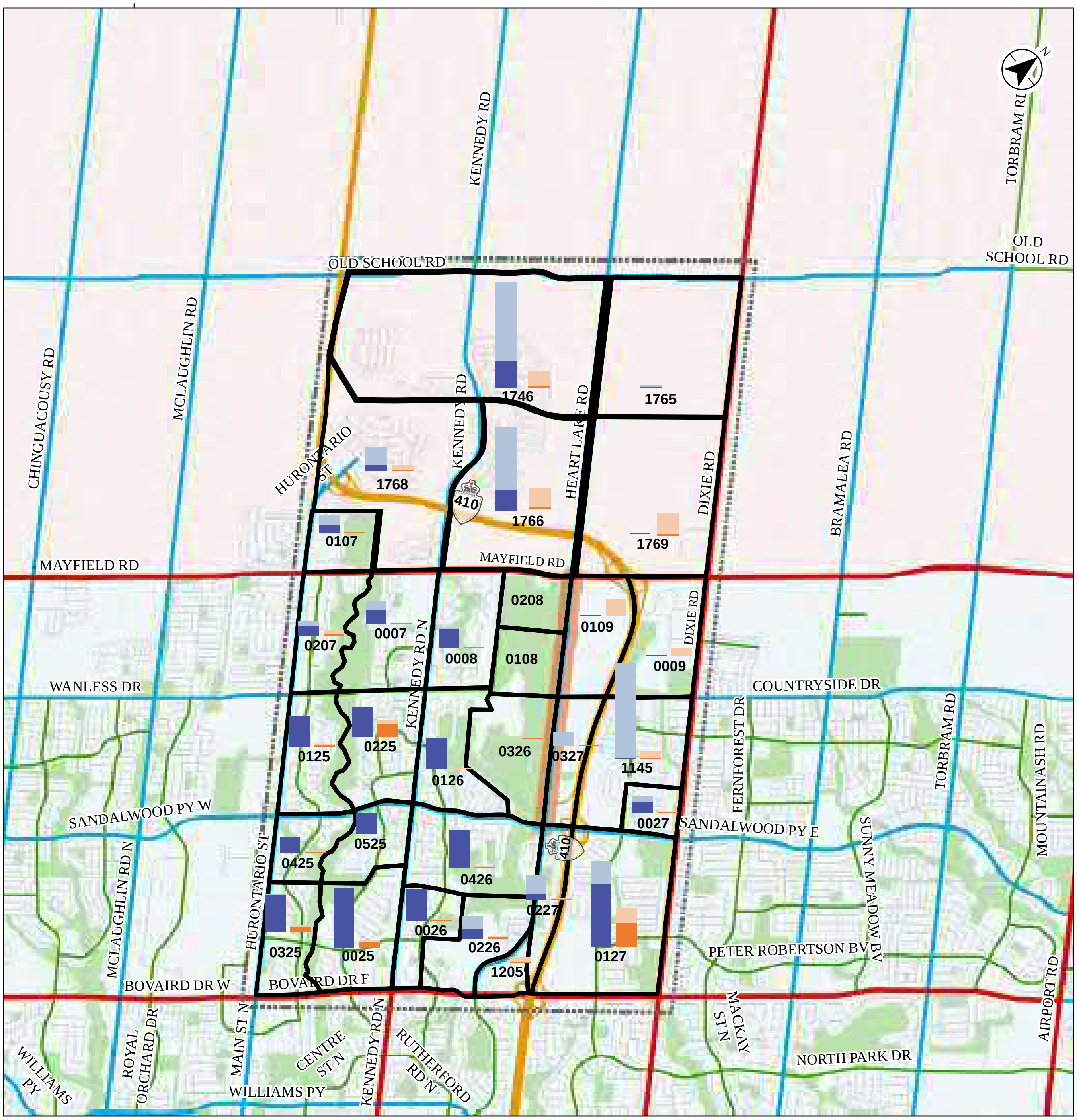
Table 6 shows traffic volumes forecasted by the City of Brampton's Regional Model for future horizon years on Heart Lake Road between Countryside Drive and Sandalwood Parkway. The focus is on the morning peak period as it is the period when we find mostly recurrent trips (work or study). This takes into consideration the population and employment growths shown previously.

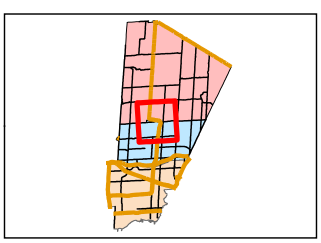
Table 6: Brampton Regional Model - Travel Demand Forecast at Future Horizons on Heart Lake Road – AM Peak

Link / AM Peak Hour Volumes	Horizon		
	2016	2031	2041
Heart Lake Rd, between Countryside Dr. and Sandalwood Pwy | Southbound	401	415	430
Heart Lake Rd, between Sandalwood Pwy and Countryside Dr | Northbound	263	429	472

Source: Brampton Emme Regional Model 2017

What emerges from **Table 6** is that the anticipated growth between 2016 and 2041 is not significant for trips travelling southbound, which is the direction of the peak in the morning. The growth is mostly in the opposite direction of the peak (northbound), where it grows more significantly. Since the anticipated growth is not significant for a road with an already relatively low traffic flow, it is assumed that traffic conditions will remain similar to the existing conditions in the future.





Legend

Study Area

Small Geographic Unit (SGU)

Study Corridor

Parks

Municipality

Caledon

Brampton

Transportation

Provincial Highway

Regional Road

Arterial Road

Local Road

Ramp

Population / Employment

1,000

Future Population (2041)

Existing Population (2011)

5,000

Future Employment (2041)

Existing Employment (2011)

0 200 400 metres

1:61,607 (at original document size of 8.5x11)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.

Project Location
Brampton, ON

165001037 REVA
Prepared by Brandon Orr on 2019-02-08

Client/Project
FUNCTION AND DESIGN REVIEW OF THE HEART LAKE ROAD CORRIDOR

Figure No.
16

Title
Population & Employment Projections

Figure 17 and **Figure 18** show the path of drivers who pass by Heart Lake Road just south of Countryside Drive during the morning and afternoon weekday peak periods according to the City of Brampton's Regional Model. It clearly shows that the travel demand on Heart Lake Road is in relation to trips from/to Countryside Drive. It also shows that people driving along Heart Lake Road travel up to King Street to the north (in Caledon) and beyond Highway 401 to the south.

3.1.2.2 Planned Improvements

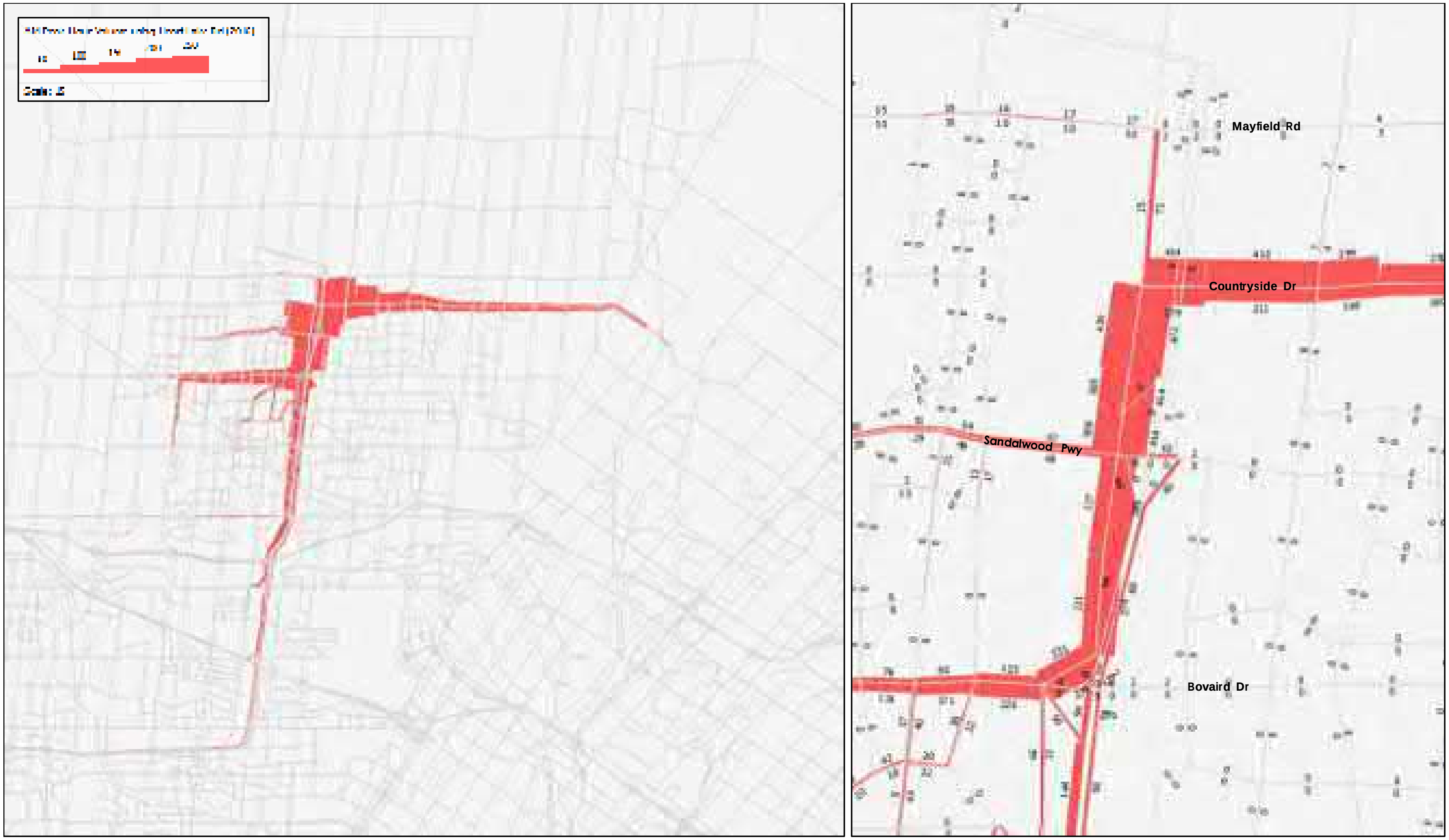
Based on the traffic demand forecast prepared for the 2015 Brampton Transportation Master Plan, several transportation improvements were identified for the area. These include a mixture of road widening, transit upgrades and active transportation routes. The list of improvements can be seen below in **Table 7**.

Table 7: Planned Infrastructure Improvements

Type	Corridor	Description	Timeframe
Road	Dixie Rd.	• Widening to 6-lanes • Mayfield Rd. to Countryside Dr.	As development warrants by 2041
Road	Sandalwood Pkwy	• Widening to 6-lanes between Hurontario and Heart Lake Road • Widening to 6-lanes between McLaughlin Rd and Hurontario	2024 2026
Road	Kennedy Rd.	• Widening to 6-lanes • Bovaird Dr. to Williams Pkwy	As development warrants by 2041
Transit	Zum – Bramalea Rd.	• BRT route along Bramalea Rd. between Bramalea GO station and Sandalwood Pkwy	2031
Transit	Higher Order Transit - Hurontario Street/Main Street	• Higher-Order transit to be determined along Hurontario St. between Mayfield Rd. and Brampton GO station	2031
Transit	Zum – Sandalwood Pkwy	• BRT route along Sandalwood Pkwy with terminals at Bovaird/Airport Rd., and Bovaird/Chingacousy Rd.	2031-2041
Transit	Zum – Kennedy Rd.	• BRT route along Kennedy Rd. between Steeles Ave. and Sandalwood Pkwy	2031-2041
Active Transportation	Various Trails	• Various off-road and on-road cycling facilities connecting to the existing network of trails and boulevard paths	Phasing to be determined until 2041

The expansion of Sandalwood Parkway and the addition of Zum will increase the capacity of the surrounding road network while simultaneously bringing high-quality transit to the footsteps of the study area. There will also be several active transportation connections between these improvements, connecting to the existing active transportation network and providing connections where there currently are missing links. Heart Lake Road is identified as a bicycle facility candidate for bicycle lane in the City of Brampton Transportation Master Plan.

Figure 19 shows of a map of the improvements listed above.

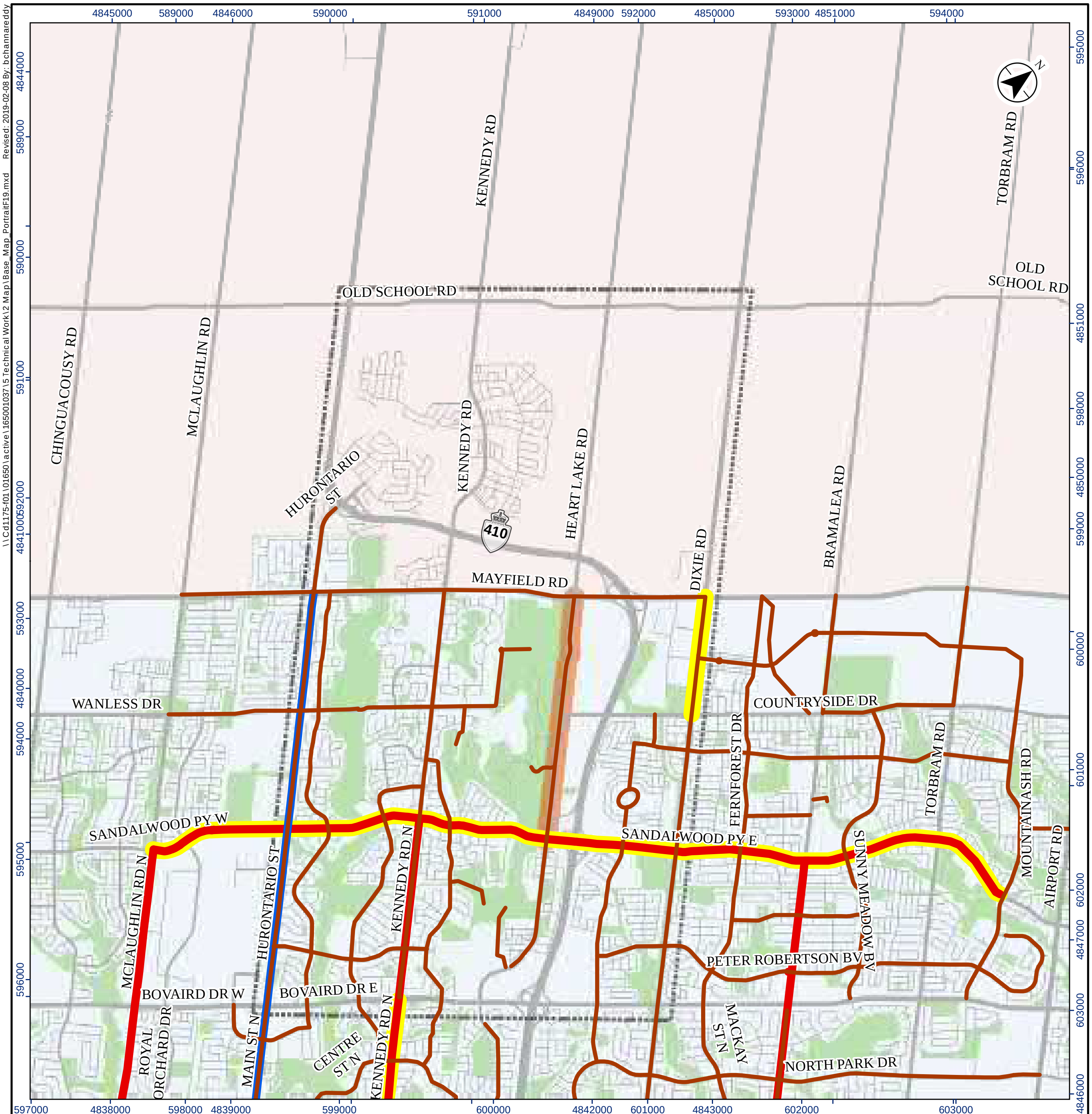


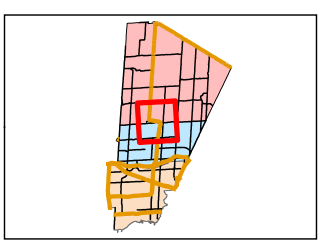
Source: Brampton Emme Regional Model 2017

Figure 17: Future Situation – Select Link Analysis @ Heart Lake Rd south of Countryside Dr | 2041 AM Peak

Source: Brampton Emme Regional Model 2017

Figure 18: Future Situation – Select Link Analysis @ Heart Lake Rd south of Countryside Dr | 2041 PM Peak





Legend

Extended Study Area

Study Corridor

Parks

Municipality

Caledon

Brampton

Future Improvements

Future Road Widening

Zum BRT

Higher Order Transit

Future Cycling Improvement

Transportation

Provincial Highway

Regional Road

Arterial Road

Collector Road

Local Road

Ramp

0 200 400 metres

1:61,607 (at original document size of 8.5x11)

Stantec

Project Location
Brampton, ON

165001037 REVA
Prepared by Brandon Orr on 2019-02-08

Client/Project
FUNCTION AND DESIGN REVIEW OF THE HEART LAKE ROAD CORRIDOR

Figure No.
19

Title
Planned Infrastructure Improvements

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.

3.2 SAFETY

This section presents the road safety assessment along the Heart Lake Road corridor, between Mayfield Road and Sandalwood Parkway, consisting of a collision analysis along the corridor and at several midblock locations.

The City of Brampton adopted a Vision Zero Road Safety Strategic Plan in 2018. In a Vision Zero jurisdiction, safety is prioritized over factors that traditionally influence transportation decision making, such as cost, vehicle speed, delay to vehicular traffic, and vehicular level of service. The framework of Vision Zero is that no loss of life or injury from a collision is considered acceptable plays into how to make Heart Lake Road safer for all roadway users; motorists and cyclists.

Collision data from 2011 to 2016 was provided by the City of Brampton. The data presents all reported collisions involving motorized vehicles, pedestrians and small vehicles like bicycles, in terms of collision type, severity and environmental state. The locations and total collision occurrences are illustrated in **Figure 20**.

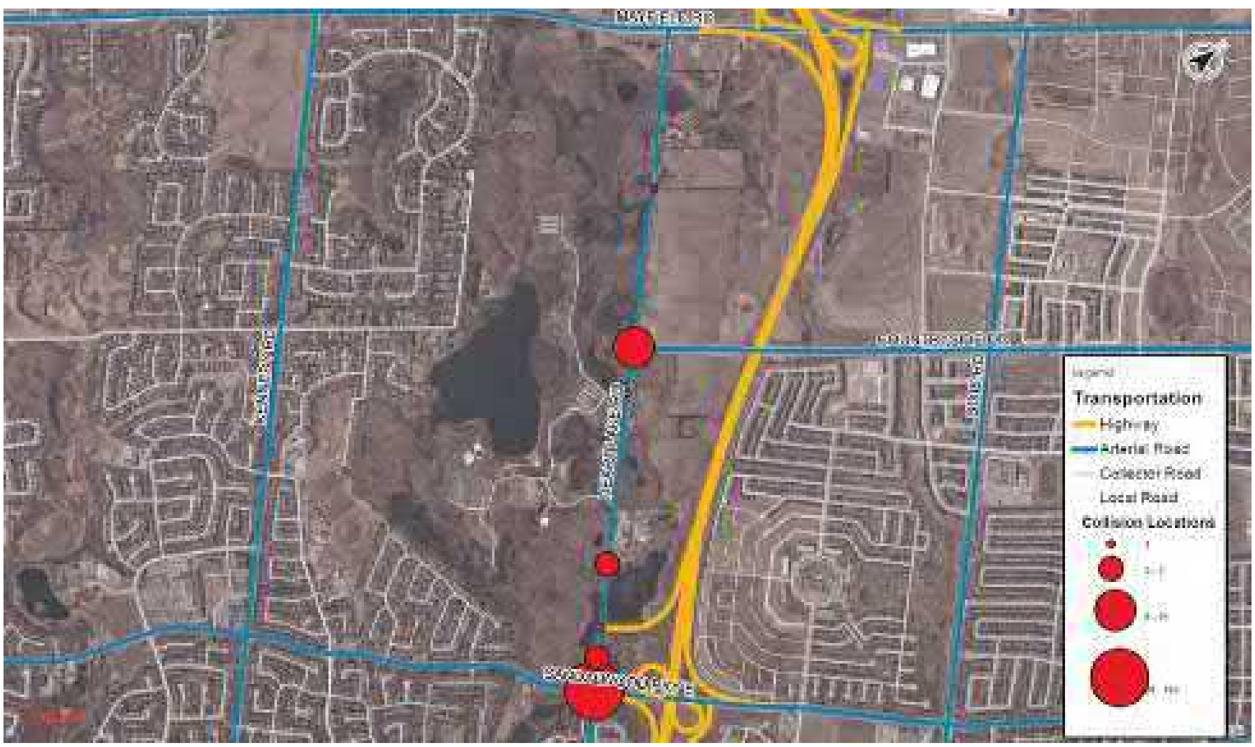


Figure 20: Total Number of Collisions by Location

3.2.1 Collision Frequency

Historical collision data for the study area, collected between 2012 and 2017, identified a total of 185 collisions over the six years, with an average 30 collisions per year (see **Table 8**).

As expected, the overwhelming majority of collisions occurred on the Heart Lake Road and Sandalwood Parkway intersection (157). A few collisions occurred at the Countryside Road intersection (20).

The breakdown of collision by year reveals generally consistent patterns, with 2013 representing the peak year with a total of 35 collisions. A very slight downward trend has been observed since.

Table 8: Total Yearly Collisions by Location

Intersection	2012	2013	2014	2015	2016	2017	Total
Heart Lake Rd. – Countryside Dr.	4			2	6	**8**	**20**
Heart Lake Rd. - Hwy 410 off-ramp			1				**1**
Heart Lake Rd. – Sandalwood Pkwy	22	34	29	28	20	**24**	**157**
Heart Lake Rd. between Hwy 410 off-ramp and private access			1		1		**2**
Heart Lake Rd. between Hwy 410 off-ramp and Sandalwood Pkwy	1	1					**2**
Heart Lake Rd. between Countryside Dr. and Mayfield Rd.				1		**1**	**2**
Heart Lake Rd. between Countryside Dr. and private access			1				**1**
Total	**27**	**35**	**32**	**31**	**27**	**33**	**185**

Since these intersections experience traffic demand at different scales, the collision reports must be compared on a common Collision Rate (CR). The most often metric for CRs is the number of collisions per million vehicles entered (MVE), which is defined as:

$$CR = \frac{C_{AV}}{\left(\frac{365 * V_{max} * 10}{1,000,000}\right)}$$

Where, C_{AV} = Average yearly collisions, and V_{max} = Peak hourly volume

A CR less than or equal to 1.0 is generally considered to reflect a normal propensity to collisions and represents an intersection with no significant issues aside from basic human error.

MVE analysis of Heart Lake Road (see **Table 9**) suggests that the intersection of Heart Lake Road and Sandalwood Parkway experienced over the last 6 years an unusually high number of collisions on average.

Table 9: Average Collision Rate by Survey Location

Intersection	Total Collisions	Average Yearly Collisions	Peak Hour Volume	Collision Rate (C / MVE)
Heart Lake Rd. – Countryside Dr.	20	2.4	716	0.92
Heart Lake Rd.- Hwy 410 off-ramp	1	0.2	835	0.07
Heart Lake Rd. – Sandalwood Pkwy	157	26.6	3,969	1.84
Heart Lake Rd. between Hwy 410 off-ramp and private access	2	0.4	608	0.18
Heart Lake Rd. between Hwy 410 off-ramp and Sandalwood Pkwy	2	0.4	825	0.13
Heart Lake Rd. between Countryside Dr. and Mayfield Rd.	2	0.2	434	0.13
Heart Lake Rd. between Countryside Dr. and private access	1	0.2	464	0.12

3.2.2 Collision Classification

A review of the breakdown of collisions by type of impact observed at the surveyed locations (see **Table 10**) highlights that the majority of collisions were classified as either property damage (74%) or non-reportable (9%) (i.e. a minor collision resulting in damages worth less than $2,000) while only 16% of collisions resulted in injuries. No fatalities were reported during this period. Considering that only 16% of collisions over the past 5 years resulted in an injury, the area does not appear to present any abnormally high safety concerns. The following analysis nonetheless seeks to clarify the propensity for collisions, as illustrated by report collision types and geometric and environmental factors that might explain them.

Table 10: Collision Classification by Intersection of Interest 2012 to 2017

Intersection	Non-Fatal Injury	P.D. Only	Non-Reportable	Total
Heart Lake Rd. – Countryside Dr.		12		12
Heart Lake Rd. - Hwy 410 off-ramp		1		1
Heart Lake Rd.– Sandalwood Pkwy	25	94	14	133
Heart Lake Rd. between Hwy 410 off-ramp and private access		2		2
Heart Lake Rd. between Hwy 410 off-ramp and Sandalwood Pkwy		2		2
Heart Lake Rd. between Countryside Dr. and Mayfield Rd.		1		2
Heart Lake Rd. between Countryside Dr. and private access		1		1
Total	**25**	**113**	**14**	**153**
% of Collisions	**16%**	**74%**	**9%**	**100%**

3.2.2.1 Collision Data Follow-Up

A similar review of collision data by type of impact conducted on data collected during the study period (2017-2018) revealed similar trends. The majority of the collisions were classified as either property damage or non-reportable and the study area does not present abnormally high safety concerns.

Table 11: Collision Data 2017-2018

Intersection	Non-Fatal Injury	P.D. Only	Non-Reportable	Total
Heart Lake Rd. – Countryside Dr.		13		13
Heart Lake Rd. - Hwy 410 off-ramp		1		1
Heart Lake Rd.– Sandalwood Pkwy	6	39	1	46
Heart Lake Rd. between Hwy 410 off-ramp and private access		1		1
Heart Lake Rd. between Hwy 410 off-ramp and Sandalwood Pkwy	1	5		6
Total	7	59	1	67
% of Collisions	**10%**	**89%**	**1%**	**100%**

3.2.3 Collision Type

Analysis of collisions by type and movement suggests that over 75% of collisions were either rear-end, turning, or sideswipe related (see **Table 12**). These impact types are typically less dangerous than Angle or Approaching collisions which are usually accompanied by higher speeds and more direct physical impacts to vehicle occupants.

Table 12: Collision Type by Manoeuvre Type (Heart Lake Rd / Sandalwood Pkwy) | 2012-2017

Intersection	Angle	Approaching	Other	Rear end	Sideswipe	SMV other	Turning movement
Changing lanes			1	1	5	1	3
Going ahead	6	4		20	6	4	
Making "U" turn							1
Other						1	
Overtaking							
Pulling onto shoulder or toward curb			1				
Reversing	1		1				
Slowing or stopping	2			11			
Stopped				5	1		2
Turning left	4			1	2	2	37
Turning right	3			2	1	1	3
Total	**16**	**4**	**3**	**40**	**15**	**9**	**46**
% of Collisions	**12%**	**3%**	**2%**	**30%**	**11%**	**7%**	**35%**

Rear-end collisions mostly occurred when drivers follow too closely and are unable to react to deceleration quickly enough. Left-turn collisions occur into oncoming vehicles, with turning drivers executing improper turns. Typically, rear-end collisions occur when there is more congestion and higher volumes of traffic. This falls in line with our observations at the Heart Lake Road and Sandalwood Parkway intersection, where some of the southbound movements are approaching capacity.

We do note a relatively high occurrence of collisions when turning left. A review of turning collisions by movement reveals a very high proportion of westbound-left turning vehicles colliding with eastbound-through movements (see **Table 13**). All 26 of these collisions occurred at the Heart Lake Road and Sandalwood Parkway intersection.

Table 13: Total Collisions by Movements

Movements	EBT	EBU	EBL	NBT	NBR	SBT	SB-STOPPED	SBL	WBT	WBL	WBR
EBT										1	
EBL									1		1
EBR											
NBT					1						
NBU				1							
NBL				1		1					
NBR									1		
SB-OVERTAKING								1			
SB-STOPPED							1				
SBL	6			2							
SBR						1					
WBT		1	1								
WBU	1										
WB-STOPPED										1	
WBL	26							1			

Left turns generally occur in conflict with oncoming through movement in permissive traffic signal operations. The number of such collisions itself at this intersection is relatively small when compared to the high volume of vehicles (close to 1,766 during the AM peak hour) executing the two movements involved. As noted subsequently, a report was prepared for recommending improvements to increase safety at the intersection of Heart Lake Road and Sandalwood Parkway.

3.2.4 Heart Lake Road and Sandalwood Parkway Intersection

The City of Brampton through their network screening process has identified sites within their road network exhibiting higher than expected collision risk. One such intersection is Heart Lake Road and Sandalwood Parkway.

Appendix E presents the safety review prepared in 2014 at the intersection of Heart Lake Road and Sandalwood Parkway. From the safety review of Heart Lake Road/Sandalwood Parkway, a number of countermeasures and remedial treatments have been identified to specifically address one or more dominant collision types, or to rectify a potential hazard. A potential hazard is identified as a deficiency in safety, operations, and/or positive guidance at a location that may or may not be contributing to a specific collision concern.

The safety review that was conducted recommended both short-term and long-term improvements, as well as the rationale for their implementation.

Table 14 shows the recommended improvements at this intersection.

Table 14: Recommended Improvements at the Heart Lake Rd and Sandalwood Parkway Intersection

Intersection	Recommended Improvement	Rationale	Time Frame
Heart Lake Road / Sandalwood Parkway	Revised pedestrian curb ramp and orientation channels on the southeast corner to direct pedestrians to available east-west crosswalk	Improve guidance for visually impaired users	Short Term
	Provide tooled orientation channels on the northwest corner for north-south crossing	Improved guidance for visually impaired users	Long Term
	Review single point ramp on the northeast corner of the intersection to incorporate tooled orientation channels for east-west crossing	Improved guidance for visually impaired users	Long Term
	Replace CHEVRON ALIGNMENT (Wa-9) signs with white post mounted delineators as described in Section 4.3 OTM Book 11	Improved motorist comprehension of the road alignment (shift). Ensure compliance with the Ontario Traffic Manual	Short Term
	Implementation of stop bar detection for westbound left turn movements	Reduce collision potential between westbound left and eastbound through vehicles	Medium Term
	Request enforcement of eastbound operating speeds approaching the intersection	Reduce potential for eastbound rear end collision potential	Short Term

Source: Giffin Koerth, 2014

**The stop bar detection was proposed to address the conflict between for westbound left turn movements and eastbound through traffic during permissive signal phase.*

3.3 SIGHT LINES

A sight distance evaluation was undertaken along the Heart Lake Road corridor from Mayfield Road to Sandalwood Parkway. The evaluation of available and required sight distance is in conformance with the *Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (GDG)*, September 1999. To assure that adequate sight distances are available to drivers approaching potential conflict locations along the Heart Lake Road corridor, and to drivers departing from the stopped position turning on to the corridor, both stopping sight distances and turning sight distances must be assessed. A design speed of 80 km/h, 20 km/h above the posted speed limit along Heart Lake Road was used.

3.3.1 Stopping Sight Distance

Apart from the intersections with Mayfield Road and Sandalwood Parkway, no traffic control or yield exists along the north-south directions of Heart Lake Road, therefore, the required approaching sight distance along this section is evaluated using stopping sight distance. Stopping sight distance is the sum of the distance travelled during the perception and reaction time and the braking distance. To determine the minimum stopping sight distance relative to the design speed, *TAC Table 1.2.5.3 – Stopping Sight Distance for Automobiles and Trucks with Antilock Braking Systems* is used. With a design speed of 80 km/h, it is found that the minimum stopping sight distance is 115 m to 140 m.

The majority of the Heart Lake Road corridor horizontal alignment is very straight and provides excellent sight distances. Minimum stopping sight distances are met for most approaches to intersecting roads and driveways. An exception is noted at the northbound approach to the south Lakeside Garden Gallery access which has thick vegetation adjacent to it.

In both directions prior to the horizontal curve between Countryside Drive and Mayfield Road, signage is posted which warns drivers that the road curves ahead and that drivers should navigate the curve at a maximum of 60 km/h. The minimum stopping sight distance of 115 m would not be met around the curve due to the vegetation and road curvature which may result in hazardous conditions where drivers would not be given sufficient time to brake were an animal or object to be located along the curve. In addition, the recommended maximum speed of 60 km/h does not vary from the regular posted speed limit along Heart Lake Road and may not motivate drivers to reduce their speed while navigating around the curve.

The required stopping sight distance with a design speed of 70 km/h is 95 to 110 m. It is recommended to manage the vegetation along the west side of Heart Lake Road around the curve such that sufficient stopping sight distance can be provided.

3.3.2 Departure Sight Distance Triangles

In this section, sight distance triangles are evaluated for crossing, left-turning, and right-turning movements at the intersections within the Study area to assure that they meet the minimum requirements as outlined in *TAC Figure 2.3.3.2 – Departure Sight Triangles*. Evaluation of required sight triangles at stop-controlled and signalized intersections is conducted in the same manner. Departure sight distance requirements are not as stringent for signalized intersections because the movements are being controlled with traffic signals. The minimum sight distance required for stop-control intersections is recommended to be provided for signalized intersections in the event of a signal malfunction or if a driver on an opposing approach runs through a red light.

The intersections of Heart Lake Road with Mayfield Road and Sandalwood Parkway exceed two-lane cross sections, therefore, the departure sight triangles for these intersections are determined using *TAC Equation 2.3.1* which incorporates design speed, perception reaction time, and time to traverse the intersection. Left-turning and right-turning departure sight triangles are determined using *TAC Figure 2.3.3.4a* and *TAC Figure 2.3.3.4b.*

$$Equation\ 2.3.1 \quad D_1, D_2 = \frac{V(J+t)}{3.6}$$

A design speed (V) of 80 km/h is used in *TAC Equation 2.3.1*, with a perception reaction time (J) of 2 seconds. Variable t is the time in seconds to cross the intersecting roadway and is determined from *TAC Figure 2.3.3.3 – Assumed Acceleration Curves (Acceleration from Stop Control on Minor Road)*. The crossing distance includes the distance from the stop bar to the edge of the intersecting roadway, the width of the intersecting roadway, and the length of the crossing vehicle. A passenger car vehicle with a length of 5.6 m as shown in *TAC Table 1.2.4.1 – Design Dimensions for Passenger Cars* is used in the estimation of crossing distance.

Table 15: Crossing Sight Distance

Location on Heart Lake Road	Approach	Crossing Distance	Time (t)	Required Sight Distance	Requirement Met
Mayfield Rd.	North	48 m	8.25 s	228 m	Yes
	South	48 m	8.25 s	228 m	Yes
	East	43 m	7.5 s	211 m	No
	West	43 m	7.5 s	211 m	Yes
Sandalwood Pkwy	North	43 m	7.5 s	211 m	Yes
	South	46 m	8 s	222 m	Yes

Table 15: Crossing Sight Distance

Location on Heart Lake Road	Approach	Crossing Distance	Time (t)	Required Sight Distance	Requirement Met
	East	37 m	7.25 s	206 m	No
	West	37 m	7.25 s	206 m	Yes

Due to the embankments along Heart Lake Road north of Mayfield Road, sight distance for the east approach is not fully provided. It is noted, however, that departure sight distance requirements at signalized intersections are not as stringent as stop-control intersections and that drivers on the east approach would be able to slowly move forward to have a better sightline. Trees and other vegetation along Heart Lake Road north and south of Sandalwood Parkway obstruct sightlines from the stop bar of the east approach to Sandalwood Parkway/Heart Lake Road.

Sight distance at signalized intersections is assessed only for vehicles turning right on red phases and looking to the left for opposing vehicles. This is done because vehicles turning left and right at signalized intersections on protected phases can move freely and do not require gaps to accommodate acceleration time. The signalized intersections of Heart Lake Road with Mayfield Road and Sandalwood Parkway are not two-lane roadways, therefore, *TAC Table 2.3.3.4a* and *2.3.3.4b* are not applicable and *TAC Equation 2.3.3* is used to determine the required intersection sight distance (ISD).

$$Equation\ 2.3.3 \quad ISD = \frac{V_{major}\ x\ t_g}{3.6}$$

The time gap (t_g) is found from *TAC Table 2.3.3.2a* to be 6.5 seconds for a passenger car turning right. Adjustments are not required for the right turn on red movements since the additional width of the roadway does not affect the travelled distance to complete the right turn movement. Using a design speed (V_{major}) of 80 km/h, the required sight distance looking left for all right-turning movements is 144 m.

The required intersection sight distance for right-turning movements is provided at all road except for the east approach to Heart Lake Road/Highway 410 southbound off-ramp. Due to the alignment of the Heart Lake Road approach to the intersection at Sandalwood Parkway, sightlines looking left from the Highway 410 southbound off-ramp may be obstructed by vegetation requiring drivers to advance closer to Heart Lake Road for better sightlines. It is recommended to manage the vegetation along the south-east section of Heart Lake Road/Highway 410 southbound off-ramp such that the minimum 144 m sight distance can be provided.

Table 16: Left-Turning Departure Sight Triangles

Location on Heart Lake Road	Approach	Looking Towards	Required Distance	Meets Requirement
Countryside Dr.	East	Left	155 m	Yes
		Right	170 m – 250 m	Yes
HLCA Access	West	Left	155 m	Yes
		Right	170 m – 250 m	Yes
Highway 410 Southbound Off-Ramp	East	Left	155 m	No
		Right	170 m – 250 m	Yes

Left-turning departure sight triangles are provided along all approaches with the exception of the previously identified deficient sightline to the left of the east approach of Heart Lake Road/Highway 410 southbound Off-Ramp.

3.3.3 Recommendations to improve Sightlines

There are several opportunities to improve sightlines along the Heart Lake Road corridor from Mayfield Road to Sandalwood Parkway. These opportunities include:

1. Manage vegetation along the south of the south access to Lakeside Garden Gallery to provide adequate approaching and departing sight distance of 155 m;
2. Trim vegetation and reduce the posted speed limit to 50 km/h along the curve of Heart Lake Road between Mayfield Road and Countryside Drive to provide adequate stopping sight distance of 95 m; coupled with lane width reductions, speed cushions, will help to improve sightlines; and
3. Trim vegetation along the south-east section of Heart Lake Road/Highway 410 SB Off-Ramp to provide adequate turning sight distance of 155 m for vehicles departing from the stopped position from the Highway 410 southbound off-ramp.

3.4 GEOMETRY

Figure 21 shows a typical cross-section on Heart Lake Road just south of Countryside Drive where the existing eco-passage is located. This figure shows that currently traffic lanes have a width of 3.7 m, with very large shoulders, which is comparable to what is observed on highways. This geometry would explain why many vehicles travel at speeds higher than posted (60 km/hr) since wide traffic lanes encourage high speeds.

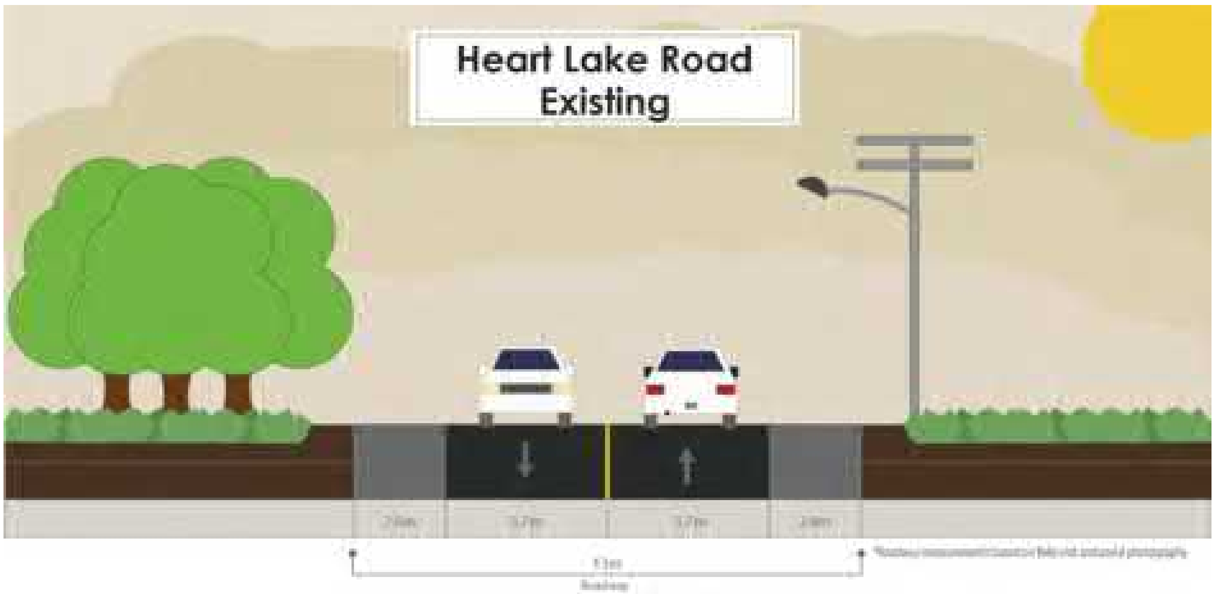


Figure 21: Existing Conditions | Typical Cross-Section

3.5 INFRASTRUCTURE CONDITIONS

Previous geotechnical investigations were completed in the area Engtec Consulting Inc. (Engtec) in August and November 2015. In addition, Stantec completed a geotechnical investigation in 2017 as part of this study, including the completion of six boreholes at various locations along Heart Lake Road within the study area (please refer to **Appendix F**). These reports take into consideration the possible addition of bicycle lanes on both sides of Heart Lake Road, potential intersection improvements and the addition of wildlife crossings.

Regarding the soils under the proposed crossing at station 0+800 (just north of the access to the HLCA), two boreholes were completed at this location as part of the 2017 investigation. These boreholes were advanced through the existing pavement structure to obtain the information on the thickness of the pavement structure of the existing road (240 mm and 245 mm), the thickness of the granular base/subbase (500 mm), and through the shoulders of the existing road. Subsurface conditions encountered below the granular base/subbase during drilling consisted of sandy silt to silty sand fill, extended to depths ranging from about 1.1 m to 4.7 m below the existing ground surface. Below the fill materials, peat deposits were encountered, and extended to depths ranging from about 1.9 m to 5.6 m below the existing ground surface. According to boreholes logs, the peat layer, which thickness varies from 1.1 m to 0.4 m, is at a depth of 3.3 m on the south side of Heart Lake Road, and at 2.6 m on the north side. The peat layer is generally highly compressible and will be subject to long term settlement and potentially to differential settlement, should additional loading be applied. Below the peat, silty sand deposits were encountered, and was noted to extend to the termination depths of the boreholes.

A borehole advanced at Station 0+300 (closer to Sandalwood Parkway) encountered a shallow peat layer (less than 1 m thickness) below the embankment fill and1.3 m under the ground level. Consolidation settlement of the peat should be expected because of the road widened to accommodate the new bike lanes. The amount of consolidation settlement will be dependent on the load produced by the new road embankment fill and the thickness of the compressible deposits. The anticipated road embankment will range in height from 1 m to 4 m.

The installation of concrete box culverts would increase the existing load of the road on the underlying soils below. As such, the peat layers would have to be removed on both locations and replace with class B controlled backfill. This would require an excavation starting from a depth of 4.4 m for the south side and going up to a depth of 3 m for the north side. It is considered that the excavation required for the removal of the peat layers, especially the shallow one, would not be difficult to perform.

Regarding the StormTech chambers, the removal of the peat layers is not required, because they will substantially decrease the existing load of the road on the underlying soils below. However, as mentioned above, as the removal of the peat layers doesn't appear to be complicated, we recommend the peat layer removal in order to eliminate any consolidation settlement later if road widening is required for the new bicycle lanes.

3.6 SUMMARY

The followings summarize the transportation issues and challenges noted on the Heart Lake Road corridor:

- Daily traffic on Heart Lake Road, between Countryside Drive and the Highway 410 off-ramp, is currently around 7,000 vehicles per day, 4,000 southbound and 3,000 northbound;
- The existing and forecasted traffic volumes do not justify widening of Heart Lake Road (additional traffic lanes), given that the theoretical capacity per lane for a typical two-lane rural roadway is 800 veh/h;
- The LOS for the intersections of Heart Lake Road and Mayfield Road, Countryside Drive and Sandalwood Parkway is generally A, B and C, with the exception of the left turn lane at Heart Lake Road and Sandalwood Parkway which is LOS F;
- Vehicles travelling on Heart Lake Road currently exceed the speed limit, which reduces safety on the corridor, given that higher speeds increase the probability and severity of collisions;
- Heart Lake Road is identified as a candidate for cycling infrastructure in the City's Transportation Master Plan, based on the guidance from the Ontario Traffic Manual Book 18: Cycling Facilities and specifically the Facility Selection Tool (described below) the appropriate bike facility for Heart Lake Road would include a designated cycling operating space (exclusive bike lane) or separated facility (buffered paved shoulder);
- Improvements are required at the intersection with Sandalwood Parkway to improve safety conditions (see **Table 14**);
- There is a need for active transportation facilities in the study area to support the City's Transportation Master Plan and reduce car mode share in the area;
- Heavy trucks are observed on Heart Lake Road despite being prohibited; and
- Road infrastructure conditions constrain the type of measures that can be put in place along the corridor.

Based on the Ontario Traffic Manual (OTM) Book 18, there is a three-step process to determining the type of bicycle facility to include within the existing roadway profile. Step One allows practitioners to pre-select the bicycle facility type based on the motor vehicle operating speed and the average daily traffic volume. This step is accomplished through the use of the "Desirable Bicycle Facility Pre-Selection Nomograph" as shown in **Figure 22**.

Step Two guides practitioners to make a more detailed look at site specific characteristics in order to determine the appropriateness of the pre-selected facility type. Practitioners use this step to critically evaluate the situation in order to select the most appropriate facility type. Step Three guides practitioners in documenting their rationale for their final decision.

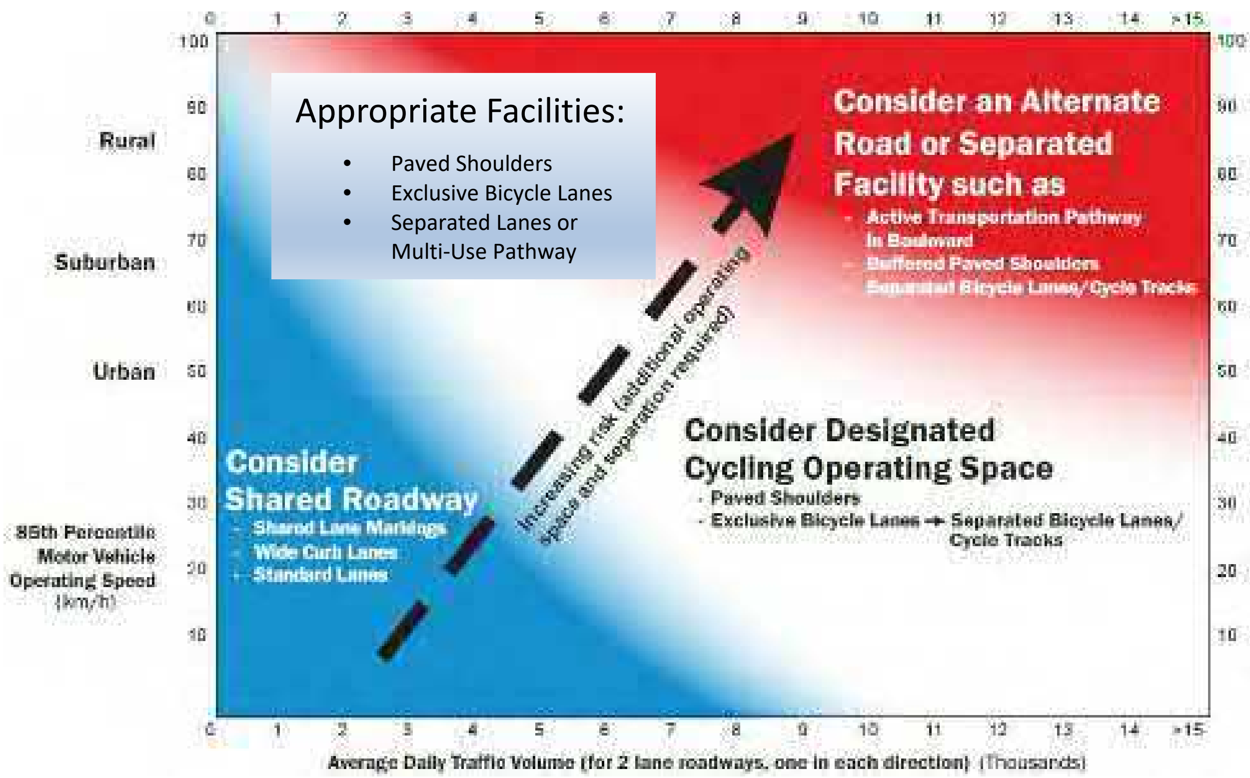


Figure 22: Desirable Bicycle Facility Pre-Selection Nomograph

4.0 ECOLOGY AND ENVIRONMENT

4.1 BACKGROUND REVIEW

Stantec completed a cursory review of the following information sources to gather a preliminary understanding of existing environmental conditions within the study area.

- 2015 Heart Lake Road Ecology Report;
- 2016 (Draft) Post Eco-Passage Installation Road Ecology Monitoring Report;
- Natural Heritage Information Centre (NHIC) database (retrieved March 16, 2017);
- Species at Risk in Ontario (SARO) List (updated October 1, 2015);
- Ministry of Natural Resources and Forestry (MNRF) Land Information Ontario (LIO) digital mapping of natural heritage features;
- Various wildlife atlases;
- TRCA flora and fauna data for Heart Lake Road Conservation Area;
- Ecological Land Classification data from TRCA;
- Ecological Land Classification data from TRCA;
- Heart Lake Volunteer Road Ecology Monitoring Project, Phase I (2011);
- Heart Lake Road Volunteer Road Ecology Monitoring Project - Phase II (2013);
- Heart Lake Road Volunteer Road Ecology Monitoring Project – (August 2014);
- Brampton Grow Green – Environmental Master Plan (2014);
- Staff Report – Supplementary Report: Heart Lake Mitigation Strategy, Brampton City Council April 22, 2015 (includes Appendix Recommendation Report: Heart Lake Mitigation Strategy P&IS April 13, 2015);
- 2015 Road Ecology and Turtle Population Study;
- Best Management Practices for Mitigating the Effects of Roads on Amphibian and Reptile Species at Risk in Ontario (MNRF 2016); and
- HLCA Master Plan (HLCA Master Plan Advisory Committee, 2006).

A search of the NHIC database revealed two recent records of Species at Risk in the area; Butternut and Eastern Meadowlark. **Table 17** shows a list of species of conservation concern that may also be present in the study area based on the information reviewed as part of this study:

Table 17: Species of Conservation Concern that may be Present within the Heart Lake Road Study Area

Species Common Name	Species Scientific Name	Provincial Rank	Federal Rank
Snapping Turtle	*Chelydra serpentina*	Special Concern	Special Concern
Eastern Milk Snake	*Lampropeltis triangulum*	None	Special Concern
Common Nighthawk	*Chordeiles minor*	Special Concern	Threatened
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened
Eastern Wood-Pewee	*Contopus virens*	Special Concern	No status, COSEWIC THR
Olive-sided Flycatcher	*Contopus cooperi*	Special Concern	Threatened
Barn Swallow	*Hirundo rustica*	Threatened	Threatened
Wood Thrush	*Hylocichla mustelina*	Special Concern	No Status, COSEWIC THR
Bobolink	*Dolichonyx oryzivorus*	Threatened	No Status, Threatened
Eastern Meadowlark	*Sturnella magna*	Threatened	No Status, Threatened
Little Brown Myotis	*Myotis lucifugus*	Endangered	Endangered
Northern Myotis	*Myotis septentrionalis*	Endangered	Endangered
Butternut	*Juglans cinereal*	Endangered	Endangered

4.2 NATURAL HERITAGE FEATURES

The study area section of Heart Lake Road is one of the largest and most diverse natural areas within the City of Brampton. HLCA which is owned by TRCA, is located on the west side of the road and comprises a diverse, 169-hectare ecosystem that includes; two kettle lakes, the headwaters for Spring Creek and a wetland complex. HLCA has one of the largest blocks of forest in the Etobicoke Creek watershed, and contains six provincially rare vegetation community types, Provincially Significant Wetlands (PSWs), the remaining portions of Brampton Buried Esker, an Environmentally Significant Woodland area and a bog designated as an Area of Natural and Scientific Interest. Over 40% of the HLCA is covered in forest, which is rare since most forests within Peel Region were cleared for agricultural purposes during the 19the century (City of Brampton 2014:11).

At least seventy-five species of birds nest within the HLCA, including 26 threatened bird species and a regionally significant heronry. There are also many herpetofauna and mammal species and more than 115 plant species, of which more than 50 species are classified as species of regional conservation concern (L1-L3; HLCA Master Plan, u.d).

4.3 WILDLIFE ROAD MORTALITY

4.3.1 Heart Lake Road Ecology Volunteer Monitoring Project

Heart Lake Road, between Sandalwood Parkway and Countryside Drive, is known as a “hotspot” for wildlife mortality. To address the issue of wildlife mortality on Heart Lake Road, TRCA collaborated with Ontario Road Ecology Group and the City of Brampton to create the Heart Lake Road Ecology Volunteer Monitoring Project (HLREMP) in 2011. In the first year of the project, volunteers monitored over a 25-week period from May to October with the goal of determining the species that were being impacted, and to record the number of wildlife-vehicle interactions (HLREMP 2011). In 2011, 1,239 wildlife road fatalities were documented, confirming that this stretch of road is experiencing high levels of wildlife mortality.

The HLREMP continued to conduct intensive surveys along Heart Lake Road in 2013 (HLREMP 2013), 2015 (HLREMP 2015) and 2016 (HLREMP 2016) and made modifications to the study design and objectives as their knowledge of the road ecology in the area increased. Supplemental research projects were also conducted, including a mock culvert and wildlife directional fencing study in 2013 (HLREMP 2013), and a turtle population study in 2014 (HLREMP 2014) and 2015 (HLREMP 2015).

Results from these studies have documented thousands of wildlife-vehicle collisions each year. More than 80% of the wildlife/vehicle collisions consisted of frogs/toads, and turtles comprised 5-8% of the mortality. Frogs and toads typically have limited movements; most remain within 1 km of their respective habitat. In early spring, Wood Frogs and Spring Peepers emerge and move from upland overwintering areas to breeding wetlands. Similar movements occur in late summer when young of the year move from wetlands to uplands areas. When a road bisects their seasonal habitat, high levels of road mortality can result, as is occurring along Heart Lake Road.

As noted in the 2013 HLREMP, wildlife fatalities reported on Heart Lake Road included 77 mammals, 60 birds, and 37 snake species, two of which were Eastern Milk Snake (a Species at Risk). In addition, more than 100 turtle fatalities were reported in 2013, including Snapping Turtle, which is a species of Special Concern both federally and provincially. Snapping Turtles are a long-lived species with delayed sexual maturity. The loss of even a few individuals can have population-level impacts. Vehicle collisions with turtles are a well-documented threat to turtle populations in Ontario (Ashley and Robinson 1996, Gibbs and Shriver 2002, COSEWIC 2008). Gibbs and Shriver (2002) recommend that roads with more than 100 to 200 vehicles/land/day can have substantial limitations on land turtles such as the Snapping Turtle.

The frog and turtle populations within the study area are of regional significance because they represent the most southerly location for several species in the Etobicoke Creek watershed including Wood Frog, Spring Peeper, Leopard Frog and Midland Painted Turtle. Furthermore, Snapping Turtle is only found at one other more southerly location within the watershed.

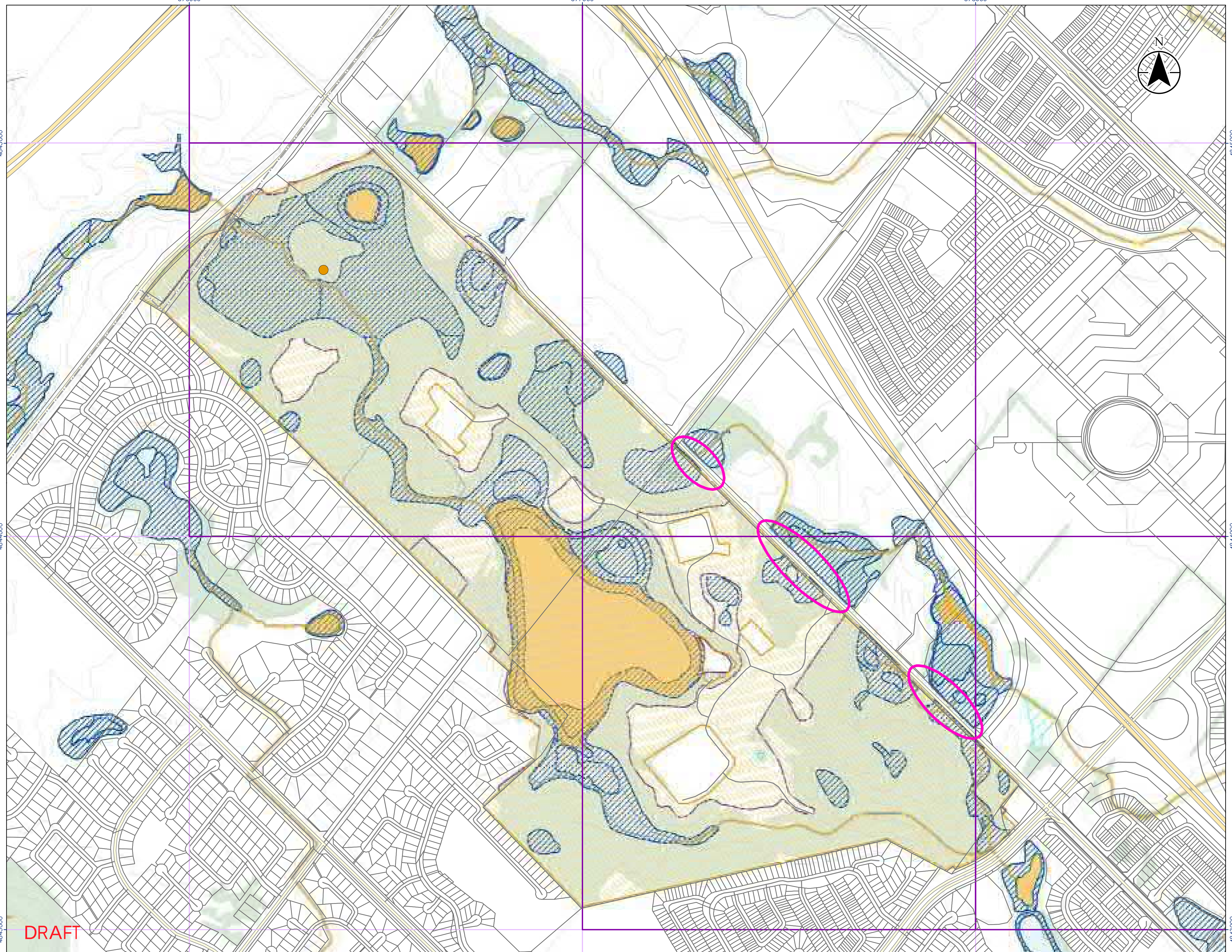
4.3.2 Road Mortality Hotspots

Identifying spatial hotspots of wildlife-vehicle collisions (WVC) and understanding the factors that influence the occurrence of hotspots are essential for designing appropriate road mitigation (Gunson and Teixeira 2015). In 2013, the HLREMP focused on mapping the locations of wildlife fatalities to identify 'hotspots' or sections of the road where the largest number of fatalities were occurring (HLREMP 2013). When a WVC was noted in the field, it was mapped to the nearest fixed location (which were flagged along the road at approximately 25 m increments). A figure was then created, which showed locations of all fatalities along the road and the frequency of occurrence. Each fixed location was placed into one of the following categories, representing the number of fatalities associated with the point:

- Category 1: 1 WVC
- Category 2: 2-42 WVC
- Category 3: 43-54 WVC
- Category 4: 55-71 WVC
- Category 5: 72-114 WVC

Sections of road where the highest number of mortalities were recorded (i.e. areas with clustering if category 4 and 5 points) are identified visually and grouped into three sections (“hotspots”), as shown on **Figure 23**. The identification of these sections of road will assist with the design and implementation of mitigation, noting that an eco-passage is already installed at the “hotspot” just south of Countryside Drive.

The reports related to Phases 1 and 2 of the HLREMP are provided in **Appendix G** of this report.



Stantec

Legend

- WVC Hotspots – TRCA (approximate location)
- Nesting Site
- Thermal Regime, Warm
- Highway
- Major Road
- Minor Road
- Watercourse (Permanent)
- Candidate ANSI, Earth Science
- Candidate ANSI, Life Science
- Conservation Area Administrative Boundary
- Thermal Regime, Warm
- Waterbody
- Wetland, Provincially Significant
- Wetland, Not evaluated per OWES
- Wooded Area
- Lot
- Municipal Boundary, Upper
- Municipal Boundary, Lower
- 1 km UTM Grid

0 0.5 Kilometres

1:10,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.

Project Location
City of Brampton

165001037 REVA
Prepared by AMW on 2017-04-25
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

Client/Project
FUNCTION AND DESIGN REVIEW OF THE HEART LAKE ROAD CORRIDOR

Figure No.
23

Title
Ecological & Environmental Characteristics

\\cd1175-f01\work_group\01650\active\165001037\5 Technical Work\2 Map\Drawing\Figures\Terrestrial\InternalMaps\165001037_figX_BackgroundDataReview_20170425.mxd Revised: 2017-04-25 By: awhite

4.4 MITIGATION MEASURES

There are many different mitigation measures to reduce the occurrence of WVCs and associated fatalities, which vary in cost, permanence, and effectiveness (Gunson and Schueler 2012). These include structures such as underpasses and fencing, wildlife crossing signs, and measures to reduce traffic volume and speed. Using the data that have been collected since 2011, many mitigation measures have been recommended by the HLREMP and the TRCA to reduce the incidence of wildlife road mortality. The City of Brampton has also developed a Heart Lake Road Mitigation Strategy in 2015.

4.4.1 Traffic Calming Measures

One of the mitigation measures suggested by the HLREMP to reduce road mortality was to install a three-way stop at the intersection of Countryside Drive and Heart Lake Road. In response to this suggestion, the City of Brampton assessed vehicle volume and speed data and determined that this intersection and the Heart Lake Road/southbound Highway 410 off ramp intersection did not warrant a three-way stop.

Seasonal road closures were also recommended to allow safe passage of wildlife during seasonal dispersal periods. This strategy has been used effectively by the City of Burlington to accommodate the dispersal of Jefferson Salamander. A road closure was a recommended option in the Heart Lake Road Mitigation Strategy. The strategy recommended a three-week closure in both spring and fall. The stretch of the road north of Sandalwood Parkway would remain open to local traffic, including commercial businesses, whereas a ‘hard’ closure would be used between the HLCA entrance and Countryside Drive.

The road closures were not implemented because local business owners expressed concern that the road closures would have a detrimental effect on their business revenue. It was also decided that nighttime closures were not a viable option due to enforcement and access for land owners. The installation of ‘speed cushions’ or other vertical deflections to slow down traffic were only recently endorsed for use in the City of Brampton because of concerns from emergency service providers.

Pavement markings (optical speed bars) and wildlife warning signs were recommended as part of the Heart Lake Road Mitigation Strategy and implemented with the goal of reducing the average speed of vehicles along Heart Lake Road and reducing the occurrence of WVCs.

4.4.2 Wildlife Signage

Wildlife signs are advantageous because they are relatively inexpensive and are easily deployed, however their effectiveness varies, and it is important to consider timing and placement of signs prior to deployment (Gunson and Schuler 2012). Wildlife signage is best used in combination with other mitigation measures such as traffic calming, fencing and crossing structures.

A variety of signs have been installed on Heart Lake Road to notify motorists of the dangers of WVC and to slow down traffic, including, “significant natural areas”, as well as wildlife crossing signs and solar operated flashing “seasonal wildlife crossing – reduce speed when flashing” signage. As noted, the efficacy of wildlife crossing signs is unknown, as studies have shown mixed results and most research has focused on deer crossing signs (Premo and Premo 1995, Hedlund et al. 2004, Found and Boyce 2011).

4.4.3 Wildlife Crossing Structures and Fencing

4.4.3.1 Crossing Structure

The MNRF's "Best Management Practices for Mitigating Effects of Roads on Amphibian and Reptile Species at Risk in Ontario" guidance document was prepared in 2016 and provides recommendations on the use of different type of structures, including design, location, spacing, retrofitting of existing culverts and installation and placement of fencing. According to this guide, the use of crossing structures combined with fencing is currently the most effective mitigation measure to reduce WVC for amphibians and reptiles. Crossing structures enhance connectivity by linking fragmented habitats and reduce mortality by directing wildlife away from the road. In addition, the placement of the structure, the construction material, dimensions, substrate, thermodynamics, and amount of natural light will influence the probability of the target species using the eco-passage.

A concrete box culvert was installed by the City of Brampton in April 2016 within one of the wildlife mortality hotspots, located approximately 100 m south of Countryside Drive, in one of the wildlife mortality hotspots. To encourage use of the culvert by amphibians and turtles, the bottom of the culvert was filled with a 10 cm layer of natural soil (HLREMP 2016 draft).

4.4.3.2 Fencing

Fencing should be used in conjunction with crossing structures to direct animals towards structure entrances and to prevent animals from gaining access to the road. Fencing can also be used as a standalone mitigation measure to prevent road mortality, but only if habitat connectivity is not a concern (i.e., areas where habitat is not bisected by the road) (MNRF 2016). The most important objective of fence design is to minimize the likelihood of animals breaching the fence (HLREMP 2016). Fencing should be designed so that animals cannot get under or over the fence, and regularly monitored and maintained so that there are no holes or access points. Fencing design must also consider the target species. For example, Snapping Turtles are good climbers, so an overhanging lip that extends away from the road is recommended for this species (MNRF 2016).

To support the crossing structure installed on Heart Lake Road, Animex one-way exclusionary fencing was installed on the east and west sides of Heart Lake Road, south of Countryside Drive for approximately 190 m and 140 m, respectively. Animex attaches to 45 cm high galvanized steel farm fencing with round posts. The section facing the wetland has a smooth interior and a 15 cm lip angled back to the wetland to discourage climbing. The opposite side of the fence has a textured grid to facilitate the return of animals to the wetland if they are trapped on the roadway. The ends of the fencing are curled back towards the wetland to re-direct animals that may have missed the eco-passage.

Road mortality monitoring in 2016 continued to record high mortality for amphibians and reptiles, but the mortality was concentrated in areas where mitigation has not been implemented. Preliminary data suggest that the installation of the eco-passage and installation of fencing was successful at reducing mortality in the area where mitigation was applied. Further efforts will be needed to reduce mortality on other sections of the road.

Temporary wildlife fencing was installed in the spring of 2018 and was effective in reducing the amount of wildlife mortality along Heart Lake Road. Areas that were not fenced, or where fencing stopped short, did continue to have turtle mortality. These areas are recommended to have an extension of the wildlife fencing in the future.

4.4.4 Turtle Nesting Mounds

One of the mechanisms behind turtle mortality is that roads are bisecting the turtles' seasonal habitat. Turtles are crossing the road to gain access to nesting sites and may use gravel shoulders as nesting sites. Creating alternative nesting habitat away from the road can be used as a mitigation tool to reduce mortality of nesting females and hatchlings. This method has been proven to be an effective conservation tool for Midland Painted Turtles and Snapping Turtles (Paterson et al. 2013).

To encourage nesting within the wetlands and discourage turtles from accessing Heart Lake Road, TRCA created artificial turtle nesting mounds in May 2016. Mounds were places on both sides of the mitigated section of road, inside the exclusionary fencing. The nesting mounds were not used in 2016, however, drought conditions experienced in that year may have rendered the wetlands that were adjacent to the mounds to be unsuitable for turtles, causing them to disperse elsewhere. Further monitoring will determine whether the artificial nesting mounds are an effective road mitigation tool.

4.4.5 Effectiveness of Mitigation Measures

Table 18 shows average and 85th percentile speeds observed on Heart Lake Road while the mitigation measures were in place. In general, it can be concluded that the effect is not significant.

Table 18: Effectiveness of Mitigation Measures on Speed observed on Heart Lake Road

Year	Speed	
	Average	**85th Percentile**
2013	64	77
2015	71	82
2016	70	80
2018	67	81

Source: City of Brampton, 2018

5.0 CULTURAL HERITAGE

The study area is currently not listed on the City of Brampton *Municipal Register of Cultural Heritage Resources* (2016) or designated under the *Ontario Heritage Act* (OHA). However, in 2014, the Brampton Heritage Board received a delegation from the public seeking the possible recognition of Heart Lake Road as a cultural heritage landscape. This recognition was not defined at the time and the City of Brampton is seeking additional clarification regarding what recognition options are available.

5.1 SITE HISTORY

5.1.1 Introduction

The study area is located in the former Township of Chinguacousy, now the City of Brampton, within the Regional Municipality of Peel. Heart Lake Road was originally a 19th century corduroy road and was constructed between the late 1820s to the mid-19th century. The following sections outline the historical development of the study area from the time of Euro-Canadian settlement to the 20th century.

5.1.2 Physiography

Heart Lake Road is located in the Peel Plain physiographic region of southern Ontario (Chapman and Putnam 1984: 113). The region is a level to undulating tract of clay soils, stretching across the Regional Municipalities of York, Peel and Halton. The general elevation of the region is 500 to 750 feet above sea level. The underlying geological material is till containing large amounts of shale and limestone. The water supply in the region has historically been a constraint to settlement, due to the density of the till, and the lack of thick beds of sand to serve as aquifers. This is combined with a high degree evaporated water from the deforested clay surface (Chapman and Putnam 1984: 174-175). The major watercourses that traverses the City, include the Credit River, Humber River, the Etobicoke Creek, Fletchers Creek, and Mimico Creek (City of Brampton 2013: 2.3).

The study area crosses one of the most Provincially and Regionally significant natural areas within the City of Brampton (City of Brampton 2015: 11). The Brampton Esker is a geologic formation and is designated a Regional Earth Science ANSI, that supports provincially significant wetlands and approximately eight lakes, including Heart Lake and Teapot Lake within the HLCA (City of Brampton 2015: 4). The esker extends 8 kilometers in a southeasterly direction from Heart Lake Road south to Bovaird Drive (City of Brampton 2013: 2.3). The sands and gravels of the Brampton Esker hold and purify water as it percolates downward, making the esker an aquifer and a groundwater resource. (Laing et al. 2014: 14). Within the exception of the study area and HLCA, most of the Brampton Esker had disappeared due to aggregate extraction (Laing et al. 2014: 57).

The HLCA, the largest greenspace within the City of Brampton is situated adjacent to the study area, occupies 169 hectares (417 acres) within the Etobicoke Creek watershed. The Etobicoke Creek watershed drains a total area of 211 square kilometers and has three distinct branches, the Main Branch, Little Etobicoke Creek watershed, and surficial geology of glacial till and river deposits. In addition, sections of Heart Lake Provincially Significant Wetland Complex, the Heart Lake Woodlands Environmentally Significant Area, and the Heart Lake Forest and Bog Area of Natural and Scientific Interest are found in the HLCA (HLCA Master Plan Advisory Committee; online). The main hydrological feature in the HLCA is the 16.5 ha kettle lake. It was formed 10,000 years ago when an ice block trapped under a melting glacier left a natural steep-sided depression (Laing et al. 2014: 13).

5.1.3 Historical Development

5.1.3.1 19th Century

The Township of Chinguacousy was surveyed in 1819 by land surveyor Richard Bristol (Laing et al. 2014: 19). The township was surveyed using the double-front system, with concessions running north-south. The system utilized 200 acre lots that were broken into 100-acre parcels, each fronting a concession road. Between every five lots an allowance was surveyed for a side road. Concessions were numbered east and west of Hurontario Street, which runs through the centre of the township (PAMA, Property Research in Peel; online). Hurontario Street was surveyed in 1818 and received its name from the points located at the ends of the route; Lake Huron and Lake Ontario (Heritage Mississauga, History Bytes; online). The route increased accessibility to the township and provided a connection to Dundas Street to the south.

Heart Lake Road is situated on Lots 14 to 17, in Concession 2 East and 3 East. When Heart Lake Road, originally Concession Road 2 East, was laid out by Bristol in 1819, he noted on the survey swamp areas located along the concession road (Laing et al. 2014: 5). The area surrounding Heart Lake Road, at the time of survey, was composed of swamp land and forested land that included species of cedar, hemlock, black ash, beech, maple, basswood, tamarack, and elm (Laing et al. 2014: 26).

Settlements in the township initially developed along Hurontario Street and waterways that provided the water power for mills. The study area, located with the Etobicoke Creek watershed, was the location of a few mills, but given the lack of reliable stream flow, as well as periodic flooding, mills did not thrive on the creek. This was particularly notable when compared to the rivers in the township (TRCA 1998: 21). As a result, the closest settlements near the study area, developed at road intersections, including Edmonton, Mayfield, and Brampton.

Business in the township was initially conveyed at the settlement of Salisbury in the inn operated by Martin Salisbury (Loverseed 1987: 39). The settlement of Brampton developed two kilometers from Salisbury southwest of the study area. In 1834, William Buffy built the first tavern, followed by Judge Scott who built the first store, as well as a pot ashery, distillery, and mill. In 1834, John Elliott laid out the settlement into village lots with the name of Brampton (Pope 1877: 87). The population of Brampton in 1837 was 18 (Loverseed 1987: 40).

The township grew steadily as settlers were attracted to farmland close to the growing markets of the Town of York (now the City of Toronto). In 1841, the population of the Township of Chinguacousy reached 3,721 (Pope 1877: 84). By 1846, the township included 74,977 acres of land, with 26,266 under cultivation. The township is noted in Smith's Canadian Gazetteer, as being one of the best settled townships in the Home District by 1846, with excellent land and many good farms (Smith 1846: 32). Heart Lake Road would have been opened as settlement increased on the adjacent lots and settlers completed their settlement duties which included clearing the portion of the road which fronted each property.

The earliest settler to clear the road in the study area was Richard Stinson in 1827 on the east half of Lot 16, Concession 2 East (Laing et al. 2014: 22). Due to the swampy areas, it is likely that once the rest of clearing was completed a corduroy road was constructed to pass over the soft wet ground. The construction of the corduroy roads during this period involved laying tree trunks side by side with earth dug from the side of the road and laid over top of the logs securing the logs and creating a ditch (Laing et al. 2014: 29).

Growth and increased accessibility to settlement came to township with the opening of Grand Trunk Railway (G.T.R.) line. This was furthered with construction of a station at Brampton in 1856. Brampton had been incorporated as a village three years prior and had a central location within the township. That same year, Hurontario Street had been planked from Port Credit through Brampton to Edmonton. Through the railway line farmers could distribute their agricultural goods to a larger market and access to the City of Toronto increased (Loverseed 1987: 43). This economic boom in Brampton brought entrepreneurs and industries to the village in the 1850s and 1860s. In 1860, Edward Dale started a flower nursery in the village, and became the largest employer in Brampton (City of Brampton; online). Market gardening developed as a large industry in Brampton and by the end of the 19th century it became known as the "Flower town of Canada" (City of Brampton; online).

In 1867, the County of Peel separated from York, becoming its own governing entity with Brampton as the county town (Loverseed 1987: 24). Brampton was officially incorporated as town in 1873, with John Haggert as the first mayor (City of Brampton; online). The Credit Valley Railway, was constructed from 1877 to 1879, connecting Toronto and Orangeville with a station in Brampton (Heritage Mississauga Railways in Mississauga; online). The line furthered development in Brampton but took away people and business from smaller communities in the township that witnessed a decline. The closest settlement to the study area was Mayfield, which was considered a small community when compared to Brampton. By 1877, it had a population of 50 including a schoolhouse, general store, post office, blacksmith shop, and hotel (Pope 1877: 91). The population of the township remained stable in the late 19th century, slightly decreasing from population of 6,397 in 1861, to 6,129 in 1871 (Pope 1877: 84).

5.1.3.2 20th Century

At the turn of the century the Township of Chinguacousy witnessed a change in settlement patterns as retired farmers began to move into the City and surrounding villages. This occurred along a shift in the specialization of agriculture and industries. It also characterized the greatest period of growth for Brampton during the 20th century occurred after the Second World War. With the construction of several major highways, and Brampton's proximity to the City of Toronto, the development of subdivisions and increased ownership of automobiles changed the landscape Brampton (City of Brampton; online).

Adjacent to the study area, Heart Lake Conservation Area (HLCA) was established in 1956 when the Metropolitan Toronto and Region Conservation Authority (MTRCA) purchased roughly150 acres of land from Allan Taylor (HCLA Master Plan Advisory Committee; online). The HCLA was formed to protect, conserve, and restore the valuable ecological features and functions of the site, while guiding the current and potential future public uses of the area (HCLA Master Plan Advisory Committee; online). The HCLA opened to the public in 1957 (Laing et al. 2014: 38). By 1982, nine additional tracts of land were purchased, for a total of nearly 425 acres, from T.B. Ingoldsby, H.C. Parkinson, M.J. Hunter, G. Rayner, the Township of Chingaucousy, Agrob. Investments Ltd., City of Brampton, the Regional Municipality of Peel, and the Ministry of the Environment (HLCA Master Plan Advisory Committee; online).

The City was incorporated in 1974 with the amalgamation of the former Town of Brampton, parts of the former Town of Mississauga, and the former Townships of Toronto Gore and Chinguacousy (City of Brampton 2013: 2.1). In the 1980s and 1990s subdivisions developed on farmlands surrounding the City, converting rural lands into an urban landscape. Adjacent to the study area, in the 1970s, the Village of Heart Lake was formed between Hurontario Road and Heart Lake Road (Laing et al. 2014: 39). The population of the City continued to grow into the 21st century, increasing from 433,806 in 2006, to 523,911 in 2011 (Statistics Canada; online).

5.1.4 Site Description

The study area is comprised of Heart Lake Road from Sandalwood Parkway East to Mayfield Road, including areas captured by current development proposals on the east side of the road, environmentally sensitive areas, and relevant portions of the adjacent transportation network. This area is broadly bordered by Highway 410 and recent residential development on the east, Sandalwood Parkway and residential development on the south, residential development on the west, including TRCA lands to the west, and Mayfield Road and agricultural land on the north. This section of Heart Lake Road is visually distinct from the surrounding lands since it is mostly bordered by natural areas that have not been used for residential development.

The study area is generally bordered by naturalized lands that exhibit a wide variety of ecology including wetlands, kettle lakes, treed ridges, forested areas, and rolling agricultural fields. The south end of the study area features wet lands on both sides of the road (**Figure 24**). In general, the west wide of the road (TRCA lands) feature higher ground with treed ridges and forested areas while the east side is mainly comprised of wet land (**Figure 25**). A church and a garden centre are located on the east side of the road (**Figure 26** and **Figure 27**). Both developments appear to be relatively recent and are not related to historical land use along Heart Lake Road.

The entrance to the Heart Lake Conservation area is located on the west side of the road, just north of the garden centre (**Figure 28**). The entrance features a triangular shaped driveway that is bordered by split rail fences (**Figure 29**). Split rail fencing is used intermittently along the west side of the road on the border of the TRCA lands (**Figure 30**).

The lands included in the Metrus Developments (residential) parcel are located south of Countryside Drive, east of Heart Lake Road. These lands consist of wet land and higher ground that appears to have once been used as agricultural fields (**Figure 31**, **Figure 32** and **Figure 33**). This parcel of land contains a remnant tree lined driveway that once led to a farmstead on the east side of Heart Lake Road (see **Figure 32**).

North of Countryside Drive, the landscape changes to be predominantly rolling agricultural fields on the east side of the road and undulating forested land on the west side (**Figure 34** and **Figure 35**). The lands within the Emery Developments (employment) parcel consist mainly of former agricultural land with rolling topography (**Figure 36** and **Figure 37**).

The Khalsa School parcel is located north of the Emery Developments parcel and south of an existing residential property. The Khalsa School parcel is mainly comprised of rolling agricultural land (**Figure 38** and **Figure 40**). The Starbright Developments (Employment) parcel is visible through the Khalsa School parcel. These lands appear to consist mainly of rolling agricultural fields divided by a water course and associated wet lands that cross the middle of the property parcel in a general southeast-northwest direction.

The north section of the study area is bordered by a forested area on the west side of the road and residential development on the east side (**Figure 39**). The residential development on the east side appears to date to the mid-20th century. A mid-century modern residence is located on the northwest corner of Heart Lake Road and Mayfield Road. This section of the study area also features numerous kettle lakes, which are located between the residential properties.

Figure 24: View Looking SE along Heart Lake Rd towards Sandalwood Pwy E

Figure 25: View looking NW along Heart Lake Rd showing wetland (right) and treed ridge (left)

Figure 26: View NW of Heart Lake Rd showing the Heart Lake Seventh Day Adventist Church (right) and treed ridge (left)

Figure 27: NW View of Heart Lake Rd showing the Lakeside Garden Gallery (right)

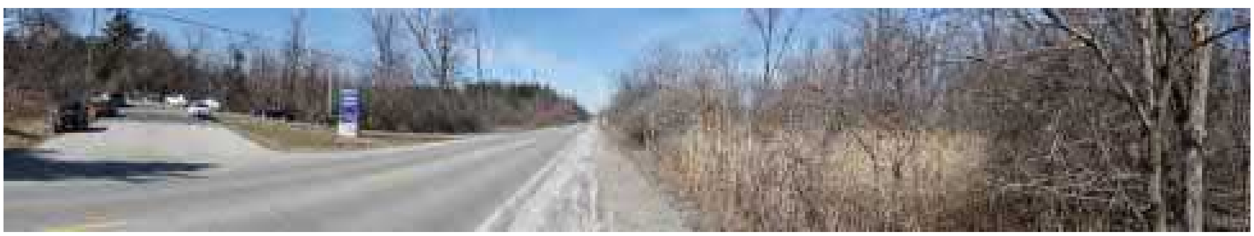


Figure 28:NW View of Heart Lake Rd showing wetland (right) and entrance to the Heart Lake Conservation Area (left)

Figure 29: Entrance to the Heart Lake

Figure 30: Example of split rail fences located along Conservation Area

Figure 31: NW View of Heart Lake Rd showing the lands within Metrus Developments (Residential) parcel on the right

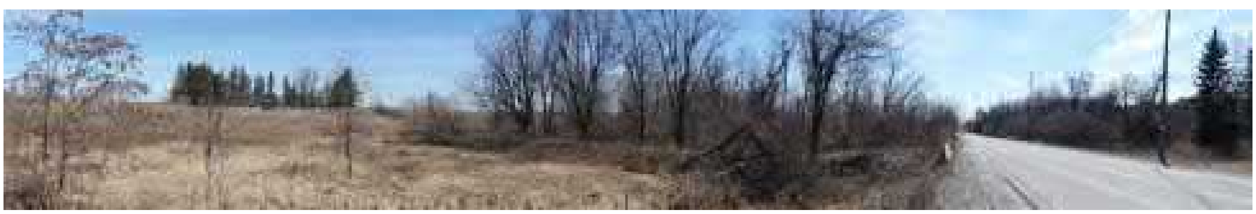


Figure 32: SE View of Heart Lake Rd showing the lands within Metrus Developments (Residential) parcel on the left. Note the remnant tree lines and driveway.

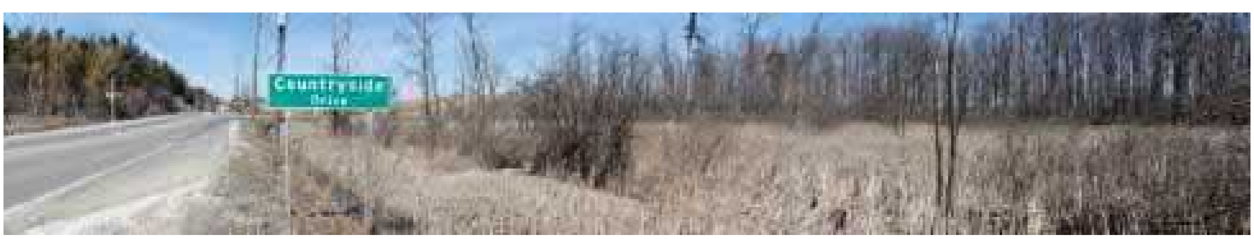


Figure 33: NW View towards Countryside Dr showing the lands within Metrus Developments (Residential) parcel on the right

Figure 34: Example of Tree Ridge/High Ground in the Heart Lake Conservation Area on the west side of Heart Lake Road

Figure 35: NE View of Rolling Agricultural

Figure 36: NW View of Heart Lake Road showing Lands included in the Emery Developments (Residential) Parcel (right)

Figure 37: NW View of Heart Lake Rd showing Lands included in the Emery Developments (Residential) Parcel (right) and Khalsa School (far right)

Figure 38: East View from Heart Lake Rd showing Lands included in the Khalsa School Parcel

Figure 40: East View of the Khalsa School Parcel

Figure 39: NW View of Heart Lake Rd

5.1.5 Heritage Evaluation

5.1.5.1 Ontario Regulation 9/06

The criteria for determining Cultural Heritage Value or Interest (CHVI) are defined by *Ontario Regulation 9/06* (O. Reg. 9/06) (Government of Ontario 2006b). If a property meets one or more of the below criteria than it merits designation under Part IV of the *Ontario Heritage Act*.

In order to identify CHVI at least one of the following criteria must be met:

1. The property has design value or physical value because it:
   a. is a rare, unique, representative or early example of a style, type, expression, material or construction method;
   b. displays a high degree of craftsmanship or artistic merit; and
   c. demonstrates a high degree of technical or scientific achievement.
2. The property has historical value or associative value because it:
   a. has direct associations with a theme, event, belief, person, activity, organization or institution that is significant to a community;
   b. yields, or has the potential to yield, information that contributes to an understanding of a community or culture; and
   c. demonstrates or reflects the work or ideas of an architect, artist, builder, designer or theorist who is significant to a community.
3. The property has contextual value because it:
   a. is important in defining, maintaining or supporting the character of an area;
   b. is physically, functionally, visually or historically linked to its surroundings; and
   c. is a landmark.

5.1.5.2 Evaluation According to *Ontario Regulation 9/06*

Table 19 identifies which criteria of *Ontario Regulation 9/06* are met (Government of Ontario 2006b).

Table 19: Criteria of Ontario Regulation 9/06 Compliance

Criteria of Ontario Reg. 9/06	Y/N
Is a rare, unique, representative or early example of a style, type, expression, material or construction method	N
Displays a high degree of craftsmanship or artistic merit	N
Demonstrates a high degree of technical or scientific achievement	N
Has direct associations with a theme, event, belief, person, activity, organization or institution that is significant to a community	Y
Yields, or has the potential to yield, information that contributes to an understanding of a community or culture	Y
Demonstrates or reflects the work or ideas of an architect, artist, builder, designer or theorist who is significant to a community	N
Is important in defining, maintaining or supporting the character of an area	Y
Is physically, functionally, visually or historically linked to its surroundings	Y
Is a landmark	Y

5.1.5.3 Design or Physical Value

Heart Lake Road does not illustrate or exemplify a style, type, expression, material or construction method. It is highly likely that this road was once a corduroy road. However, road improvements completed in the mid-20th century and in 1987 have removed evidence of this early road construction technique. The present physical conditions of Heart Lake Road, including two lanes of traffic, gravel shoulder, and ditching, are typical of other rural roads in the City of Brampton. Therefore, Heart Lake Road does not meet criterion 1.i of O. Reg. 9/06.

Heart Lake Road does not display a high degree of craftsmanship or artistic merit. The road has standard paving and shoulders and does not have details that are greater than normal quality or are that are implemented at an intensity above an industry standard. Therefore, Heart Lake Road does not meet criterion 1.ii of O. Reg. 9/06.

Heart Lake Road does not display a high degree of technical or scientific achievement. The existing conditions of the road evolved through time from an unimproved concession road in the 19th and early-mid 20th century to an improved road in the mid-20th century. It is likely that road improvements to Heart Lake Road were completed in response to the opening of the HLCA in 1957 since increased traffic along this section of the road was anticipated. The existing conditions of Heart Lake Road reflect the road improvements carried out in the mid-20thcentury. The construction methods used to improve the road do not display a high degree of technical expertise, adaptation of materials, forms, or spatial arrangements, or a breakthrough in design or construction techniques. Therefore, Heart Lake Road does not meet criterion 1.iii of O. Reg. 9/06.

5.1.5.4 Historic or Associative Value

Heart Lake Road is historically associated with the theme of early road building in the Town of Chinguacousy and has direct associations with the Heart Lake Conservation Area and the TRCA.

Regarding Euro-Canadian history, there were three successive attempts to settle the Heart Lake Road area. The first attempts were made by John Pettit Jr, George Coon, and Thomas Graham in 1819. All three landowners were unable to settle the land and returned their grants since the land was too swampy to settle, which made farming difficult if not impossible (City of Brampton 2014: 7-8). Richard Stinson successfully settled Concession 2E, east quarter of Lot 16 between 1823 and 1827. King's College (subsequently the University of Toronto) was granted a Crown patent for 200 acres in 1828. King's College subsequently subdivided the lot and sold it off during the mid-19th century. The swampy nature of Heart Lake Road, and the difficulties experienced by early settlers, support the claim that Heart Lake Road was originally constructed as a corduroy road. 19th century corduroy roads consisted of laying young trees (cut in similar size) side by side across a road to create a passable surface. This construction technique was reserved for areas with soft, swampy ground that could not be drained. While no direct evidence (i.e. archival photos, maps, or travelers accounts) exists to definitively prove that Heart Lake Road was a corduroy road, it is highly likely that this road construction technique was used here due to the undulating topography and historically documented swampy conditions.

In addition to the historical theme of early road building, Heart Lake Road is directly associated with the TRCA. The Heart Lake Conservation Area was formed in 1956 and was opened to the public in 1957. Mid-century improvements to Heart Lake Road were likely complete in response to the opening of the conservation area. Presently, Heart Lake Conservation Area is one of the largest natural green space areas in the City of Brampton. In relation to the Study Area, the entire west side of the Heart Lake Road between Sandalwood Parkway and Mayfield Road is owned and operated by the TRCA. Therefore, Heart Lake Road meets criterion 2.i of O. Reg. 9/06 due to the likelihood that Heart Lake Road is historically associated with the theme of early road construction, specifically corduroy roads, in the Township of Chinguacousy and the direct historical association with the TRCA.

Heart Lake Road has the potential to yield, information that contributes to an understanding of a community or culture. As identified in the draft listing report prepared by the City of Brampton, Heart Lake Road and its surrounding lands have archaeological potential and known archaeological sites related to the Paleo-Indian Period (10000-7000 BC), Archaic Period (7000-1000 BC), Initial Woodland Period (1000 BC to AD 700), and Late Woodland Period (AD 700-1651) are well documented in the area. Specifically, a high number of Indigenous campsites from the Archaic Period were discovered in the area by the TRCA during 2007 excavations of the Heart Lake Road Conservation Area, which has resulted in the area being dubbed "The Stopover Site" (2014). Therefore, Heart Lake Road meets criterion 2.ii of O. Reg. 9/06 due to the potential to yield archaeological information that will contribute to an understanding of Indigenous history in the area.

Heart Lake Road was an unimproved concession road until the mid-20th century when it was improved, likely in response to the opening of the Heart Lake Road Conservation Area in 1957. The road was subsequently rebuilt and paved in 1987 (City of Brampton 2014:11). Heart Lake Road evolved through time and does not reflect the work or ideas of a builder or theorist. Therefore, Heart Lake Road does not meet criterion 2.iii of O. Reg. 9/06.

5.1.5.5 Contextual Value

Heart Lake Road, between Sandalwood Parkway and Mayfield Road is important in maintaining and supporting the character of the surrounding landscape. Although improved and updated, Heart Lake Road still maintains its rural road cross section with two lanes of traffic, gravel shoulders, and ditches. As a rural road, Heart Lake Road supports and maintains the significant natural areas on the east and west sides of the road, which are now rare in the City of Brampton. Specifically, the Heart Lake Road Conservation Area, located on the west side of Heart Lake Road, is an Environmentally Significant Area (ESA), Provincially Significant Wetland (PSW), and Area of Natural and Scientific

Interest (ANSI). Heart Lake Conservation Area contains six provincially rare vegetative community types, the remaining portions of Brampton Buried Esker, and 26 species of threatened bird species, including the Barn Swallow and Trumpeter Swans. The Eastern Snapping Turtle and Eastern Milksnake are found at the Heart Lake Conservation Area; both are provincially and nationally designated species of Special Concern. Over 48% of the conservation area is covered with forest, which is rare since most forests within Peel Region were cleared for agricultural purposes during the 19th century (City of Brampton 2014:11). The rural setting of Heart Lake Road, including the TRCA lands on the west side of the road and mix of agricultural lands and forested kettle lakes on the east side of the road support and maintain the significant natural heritage value present along the road between Sandalwood Parkway and Mayfield Road. The continuing rural and relatively undeveloped setting of the road is unique in the City of Brampton, which has become increasingly urbanized. Accordingly, Heart Lake Road meets criterion 3.i of O. Reg. 9/06.

Heart Lake Road is functionally, visually, and historically linked to its surroundings. The road is functionally and historically linked to its surrounding context since it has been used as a rural road since the road was opened in 1819. With the exception of the physical condition of the road, which was improved in the mid-20th century and again in 1987, the surrounding context of Heart Lake Road has remained remarkably intact. Specifically, the forested lands on the west side of the road and the agricultural lands, kettle lakes, and wetlands on the east side of the road are rare within the City of Brampton. In addition, Heart Lake Road is visually linked to its surroundings. The rural character of the road, the conservation area on the west, and open rural/agricultural land on the east together create a unique roadscape that is primarily defined by its naturalized, undeveloped character. Accordingly, Heart Lake Road meets criterion 3.ii of O. Reg. 9/06.

Heart Lake Road acts as a landmark within the City of Brampton. The section of Heart Lake Road between Sandalwood Parkway and Mayfield is visually distinctive from surrounding roads. Heart Lake Road is bordered by development to the east, south, and west. Highway 410 borders Heart Lake Road to the north. Despite the surrounding development, Heart Lake Road retains its rural cross section and offers views to the adjacent natural heritage resources, including forests, kettle lakes, wetlands, and agricultural fields. The natural setting of Heart Lake Road is distinctive and is notable to those travelling along this section of the road. Heart Lake Road is a popular route for cyclists and the conservation area is a popular destination with more than five million visitors since it opened in 1957 (City of Brampton 2018). Therefore, Heart Lake Road meets criterion 3.iii of O. Reg. 9/06.

5.2 SUMMARY OF EVALUATION

Heart Lake Road, between Sandalwood Parkway and Mayfield Road met five criteria (2.i, 2.ii, 3.i, 3.ii, and 3.iii) of O. Reg. 9/06. Therefore, Heart Lake Road has CHVI for historical/associative and contextual reasons and may be considered for designation by the City of Brampton under Part IV of the *Ontario Heritage Act*.

5.3 STATEMENT OF CULTURAL HERITAGE SIGNIFICANCE

Heart Lake Road is a two-lane, rural road set in a significant natural setting that has strong historical associative value and contextual heritage value. Its historical value is related to its associations with early road building techniques in the City of Brampton and the TRCA through its connection to the Heart Lake Road Conservation Area. Heart Lake Road and its surrounding land has also yielded, and has potential to further yield, information regarding Indigenous land use and culture due to the archaeological potential of the area and high number of archaeological sites dating to the Archaic period.

Historically, there were three successive attempts to settle the Heart Lake Road area. The first attempts were made by John Pettit Jr, George Coon, and Thomas Graham in 1819. All three landowners were unable to settle the land and returned their grants since the land was too swampy to settle, which made farming difficult if not impossible (City of Brampton 2014: 7-8). Richard Stinson successfully settled Concession 2E, east quarter of Lot 16 between 1823 and 1827. King's College (subsequently the University of Toronto) was granted a Crown patent for 200 acres in 1828. King's College subsequently subdivided the lot and sold it off during the mid-19th century. The swampy nature of Heart Lake Road, and the difficulties experienced by early settlers, support the claim that Heart Lake Road was originally constructed as a corduroy road. 19th century corduroy roads consisted of laying young trees (cut in similar size) side by side across a road to create a passable surface. This construction technique was reserved for areas with soft, swampy ground that could not be drained. While no direct evidence (i.e. archival photos, maps, or travelers accounts) exists to definitively prove that Heart Lake Road was a corduroy road, it is highly likely that this road construction technique was used here due to the undulating topography and historically documented swampy conditions.

Heart Lake Road has direct, historical associations with the TRCA. The Heart Lake Conservation Area was formed in 1956 and was opened to the public in 1957. Mid-century improvements to Heart Lake Road were likely completed in response to the opening of the conservation area. Presently, Heart Lake Conservation Area is one of the largest natural green space areas in the City of Brampton. The entire west side of the Heart Lake Road between Sandalwood Parkway and Mayfield Road is owned and operated by the TRCA.

Heart Lake Road has the potential to yield information that contributes to an understanding of a community or culture. As identified in the draft listing report prepared by the City of Brampton, Heart Lake Road and its surrounding lands have archaeological potential and known archaeological sites related to the Paleo-Indian Period (10000-7000 BC), Archaic Period (7000-1000 BC), Initial Woodland Period (1000 BC to AD 700), and Late Woodland Period (AD 700-1651) are well documented in the area. Specifically, a high number of Indigenous campsites from the Archaic Period were discovered in the area by the TRCA during 2007 excavations of the Heart Lake Road Conservation Area, which has resulted in the area being dubbed "The Stopover Site" (City of Brampton 2014).

Heart Lake Road has contextual value since it maintains and supports the surrounding natural character of the area, is functionally, visually, and historically linked to its surroundings, and acts as a landmark. Heart Lake Road retains its rural cross section and is surrounded by significant natural land, including forested land on the west and agricultural land, kettle lakes, and wetland on the east. When considered together with its rare surroundings, Heart Lake Road is a unique roadscape within the City of Brampton.

Heart Lake Road, between Sandalwood Parkway and Mayfield Road is important in maintaining and supporting the character of the surrounding landscape. Although improved and updated, Heart Lake Road still maintains its rural road cross section with two lanes of traffic, gravel shoulders, and ditches. As a rural road, Heart Lake Road supports and maintains the significant natural areas on the east and west sides of the road, which are now rare in the City of Brampton. Specifically, the Heart Lake Road Conservation Area, located on the west side of Heart Lake Road, is an Environmentally Significant Area (ESA), Provincially Significant Wetland (PSW), and Area of Natural and Scientific Interest (ANSI). Heart Lake Conservation Area contains six provincially rare vegetative community types, the remaining portions of Brampton Buried Esker, and 26 species of threatened bird species, including the Barn Swallow and Trumpeter Swans. The Eastern Snapping Turtle and Eastern Milksnake are found at the Heart Lake Conservation Area; both are provincially and nationally designated species of Special Concern. Over 48% of the conservation area is covered with forest, which is rare since most forests within Peel Region were cleared for agricultural purposes during the 19th century (City of Brampton 2014:11). The rural setting of Heart Lake Road, including the TRCA lands on the west side of the road and mix of agricultural lands and forested land, and kettle lakes on the east side of the road support and maintain the significant natural heritage value present along the road between Sandalwood Parkway and Mayfield Road. The continuing rural and relatively undeveloped setting of the road is unique in the City of Brampton, which has become increasingly urbanized.

Heart Lake Road is functionally, visually, and historically linked to its surroundings. The road is functionally and historically linked to its surrounding context since it has been used as a rural road since the road was opened in 1819. With the exception of the physical condition of the road, which was improved in the mid-20th century and again in 1987, the surrounding context of Heart Lake Road has remained remarkably intact. Specifically, the forested lands on the west side of the road and the agricultural lands, kettle lakes, and wetlands on the east side of the road are rare within the City of Brampton. In addition, Heart Lake Road is visually linked to its surroundings. The rural character of the road, the conservation area on the west, and open rural/agricultural land on the east together create a unique roadscape that is primarily defined by its naturalized, undeveloped character.

Heart Lake Road acts as a landmark within the City of Brampton. The section of Heart Lake Road between Sandalwood Parkway and Mayfield is visually distinctive from surrounding roads. Heart Lake Road is bordered by development to the east, south, and west. Highway 410 borders Heart Lake Road to the north. Despite the surrounding development, Heart Lake Road retains its rural cross section and offers views to the adjacent natural heritage resources, including forests, kettle lakes, wetlands, and agricultural fields. The natural setting of Heart Lake Road is distinctive and is notable to those travelling along this section of the road. Heart Lake Road is a popular route for cyclists and the conservation area is a popular destination with more than five million visitors since it opened in 1957 (City of Brampton 2018).

5.4 HERITAGE ATTRIBUTES

Based on the evaluation of CHVI, the following heritage attributes were identified for Heart Lake Road between Sandalwood Parkway and Mayfield Road:

- Rural cross section of the road, including the width of the road, two lanes of traffic, and ditching (where present);
- Bend in the road to avoid TRCA wetland, approximately 500 m southeast of Mayfield Road;
- Intermittent presence of split rail and post-and-rail fencing along the roadside;
- Wood utility poles along the roadside;
- Natural topography of adjacent lands, including the remaining sections of the Brampton Buried Esker;
- Potential, and known, archaeological sites;
- Likely historical association with corduroy road construction techniques;
- Historical association with the Heart Lake Conservation Area and TRCA;
- Linear corridor views along Heart Lake Road, bordered by significant natural areas; and
- Natural setting of the roadscape, including forests, wetlands, and kettle lakes on the west side of the road and wetlands, agricultural fields, and kettle lakes on the east side of the road.

6.0 EVALUATION OF ALTERNATIVES

6.1 ROAD CLASSIFICATION

Table 20 presents the characteristics of roads in relation to their classification. Currently, Heart Lake Road is classified as an arterial road. According to **Table 20**, the main characteristics associated to minor arterials are the followings:

- Typical daily motor vehicle traffic volume (both directions) is between 8,000 and 20,000 vehicles per day;
- The minimum number of peak period lanes (excluding bicycle lanes) is two lanes;
- Flow is uninterrupted except at signals and crosswalks;
- The legal speed limit is between 40 and 60 km/h;
- There are generally no restrictions for heavy trucks;
- Wide curb lane or special facilities are desirable for cyclists.

Based on analysis presented in the previous chapters, the following issues and challenges are noted on Heart Lake Road:

- Heart Lake Road has CHVI for historical/associative and contextual reasons and may be considered for designation by the City of Brampton under Part IV of the Ontario Heritage Act;
- Heart Lake Road, between Sandalwood Parkway and Countryside Drive, is known as a “hotspot” for wildlife mortality;
- Daily traffic (both directions) is approximately 7,000 veh/day and is not expected to grow significantly;
- Vehicles travelling on Heart Lake Road currently exceed the speed limit, which reduces safety on the corridor;
- Heart Lake Road is identified as a candidate for bicycle lane in the latest City of Brampton Transportation Master Plan; and
- Heavy trucks are prohibited on Heart Lake Road.

Based on the above, it is recommended that Heart Lake Road, between Mayfield Road and Bovaird Drive, be classified as a collector road. An amendment should be made to Schedule B of the Official Plan to identify this recommended roadway classification.

The proposed road classification of Heart Lake Road makes it possible to develop alternatives capable of responding to issues and challenges listed above while being in line with road classification criteria shown in **Table 20**. A posted speed of 50 km/hr is then recommended along the corridor.

Table 20: Road Classification Criteria

Characteristic	Locals	Collectors	Minor Arterials	Major Arterials	Expressways
Traffic movement versus property access	Property access primary function	Traffic movement and property access of equal importance	Traffic movement primary consideration; some property access control	Traffic movement primary consideration; subject to property access control	Traffic movement primary consideration; no property access
Typical daily motor vehicle traffic volume (both directions)	<2,500	2,500 -8,000	8,000 - 20,000	> 20,000	> 40,000
Minimum number of peak period lanes (excluding bicycle lanes)	One (One-way streets) or two	One (one-way streets) or two	Two	Four	Four
Desirable connections	Locals, collectors	Locals, collectors, arterials	Collectors, arterials	Collectors, arterials, expressways	Major arterials, expressways
Flow characteristics	Interrupted flow	Interrupted flow	Uninterrupted except at signals and crosswalks	Uninterrupted except at signals and crosswalks	Free-flow (grade separated)
Legal speed limit, km/h	40 - 50	40 - 50	40 - 60	50 -602	80 - 100
Accommodation of pedestrians	Sidewalks on one or both sides	Sidewalks on both sides	Sidewalks on both sides	Sidewalks on both sides	Pedestrians prohibited
Accommodation of cyclists	Special facilities as required		Wide curb lane or special facilities desirable	Cyclists prohibited	
Surface transit	Generally not provided	Permitted	Preferred	Preferred	Express buses only
Surface transit daily passengers	Not applicable	<1,500	1,500 - 5,000	> 5,000	Not applicable
Heavy truck restrictions (e.g. seasonal or night time)	Restrictions preferred	Restrictions permitted	Generally no restrictions	Generally no restrictions	No restrictions
Typical spacing between traffic control devices[2], m	0 - 150	215 - 400	215 - 400	215 - 400	Not applicable
Typical right-of-way width, m	15- 22	20 - 27	204 -305	204 -455	> 455

Notes:
1. Private roads and lanes (public or private) are not part of this classification system.
2. A number of major arterial roads have speed limits which fall outside this range, as noted in Table 2: Speed Limit.
3. Traffic control devices refer to traffic control signals, pedestrian crossovers and 'Stop' signs.
4. 20 m rights-of-way exist on many downtown or older arterial roads. New arterial roads should have wider rights-of-way.
5. Wider rights-of-way (within the ranges given) are sometimes required to accommodate other facilities such as utilities, noise mitigation installations, bicycle facilities, and landscaping. For new streets, wider rights-of-way (upper end of ranges given) should be considered to accommodate such facilities.

Source: City of Toronto, Road Classification System, Summary Document, August 2013

6.2 CATEGORIES OF ALTERNATIVES

Based on findings made in Chapters 3, 4 and 5, the alternatives were divided into three (3) categories:

- Active transportation to increase the mobility of people with alternative modes to motorized vehicle;
- Traffic calming to increase safety on the corridor; and
- Wildlife treatment to reduce wildlife mortality.

All these alternatives should maintain the cultural heritage attributes described in Section 5.4.

6.3 LIST OF ALTERNATIVES

6.3.1 Development of Alternatives

The following alternatives were developed for each category:

1. Active transportation:
   - A. Do nothing;
   - B. Two Lanes with Paved Shoulders and Rumble Strips (**Figure 41**);
   - C. Two Lanes with Separated Bike Lanes (**Figure 42**);
   - D. Two Lanes with Separated Bi-directional Multi-Use Path on one side (**Figure 43**);
   - E. Narrow Roadway with Shared Roadway Markings and Signs (**Figure 44**);
   - F. Hybrid Multi-Use Trail in Heart Lake Conservation Area (**Figure 45**); and
   - G. One-way operation with Separated Bike Lanes (**Figure 46** and **Figure 47**).
2. Traffic calming:
   - A. Do nothing;
   - B. Stop control or mini roundabouts at intersections (Heart Lake Conservation Area/Access to new residential development) (see mini roundabout proposed at access to HLCA access in **Figure 48**
   - C. Speed cushions/lane narrowing with rumble strips;
   - D. Traffic deflection at Countryside Drive/One-way operation with separated bike lanes;
   - E. Roundabout at Countryside Option 1 (with encroachment on TRCA lands) (**Figure 49**); and
   - F. Roundabout at Countryside Option 2 (without encroachment on TRCA lands) (**Figure 50**).
3. Wildlife treatment:
   - A. Do nothing;
   - B. Maintain solar powered flashing amber lights;
   - C. Maintain pavement markings (optical speed bars);
   - D. Additional eco-passage tunnel(s);
   - E. Wildlife directional fencing; and
   - F. Turtle nesting mounts.

Figure 41: Alternative 1.B | Two Lanes with Paved Shoulders and Rumble Strips

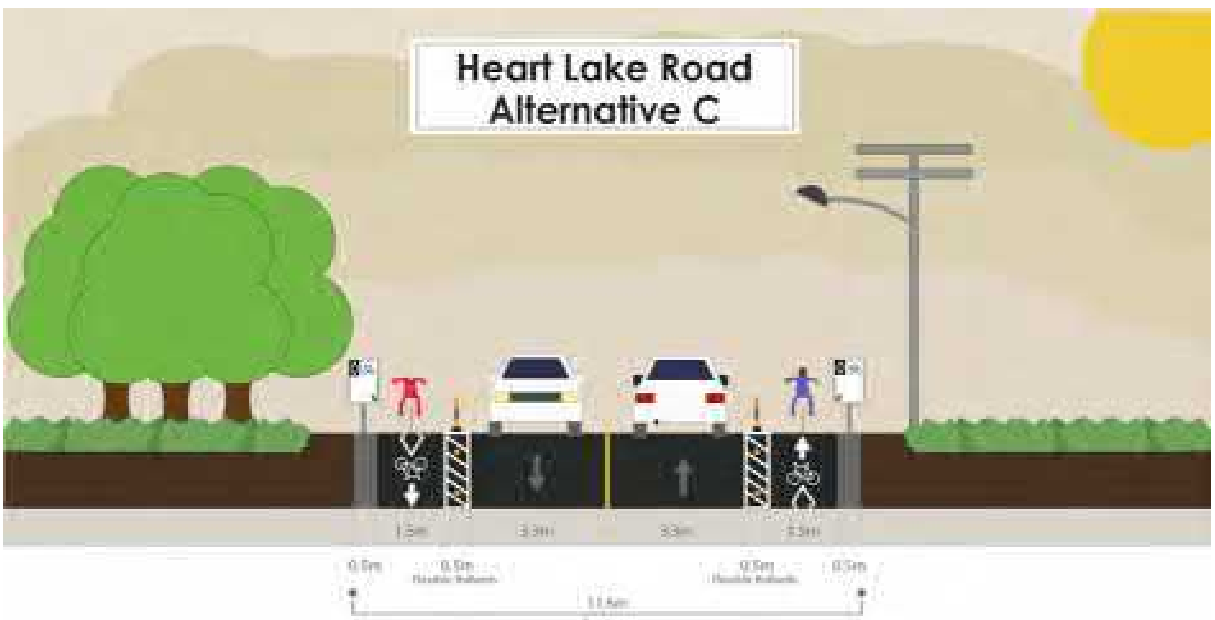


Figure 42: Alternative 1.C | Two Lanes with Separated Bike Lanes

Figure 43: Alternative 1.D | Two Lanes with Separated Bi-directional Multi-Use Path on one side

Figure 44: Alternative 1.E | Narrow Roadway with Shared Roadway Markings and Signs

Figure 45: Alternative 1.F | Hybrid Multi-Use Trail in Heart Lake Conservation Area

Figure 46: Alternative 1.G | One-way Operation with Separated Bike Lanes

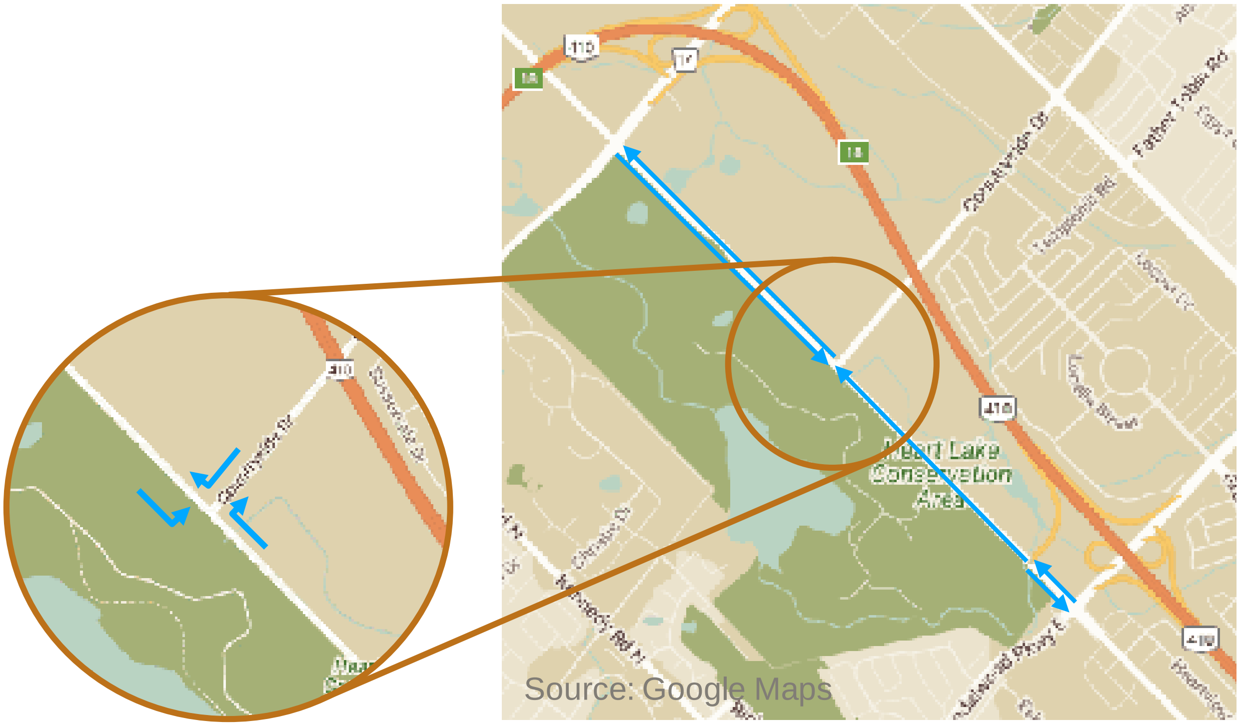


Figure 47: Alternative 1.G | Proposed Road Network

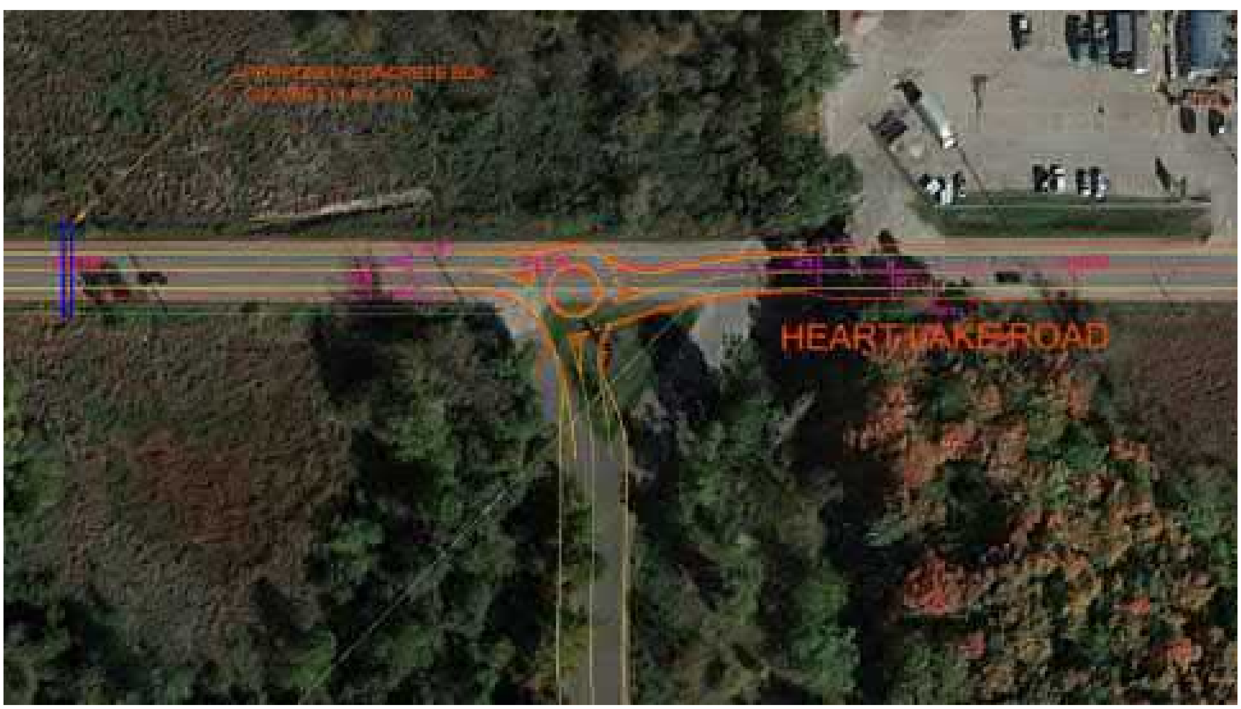


Figure 48: Mini Roundabout Proposed at Access to HLCA

Figure 49: Roundabout at Countryside Option 1 (with encroachment on TRCA lands)

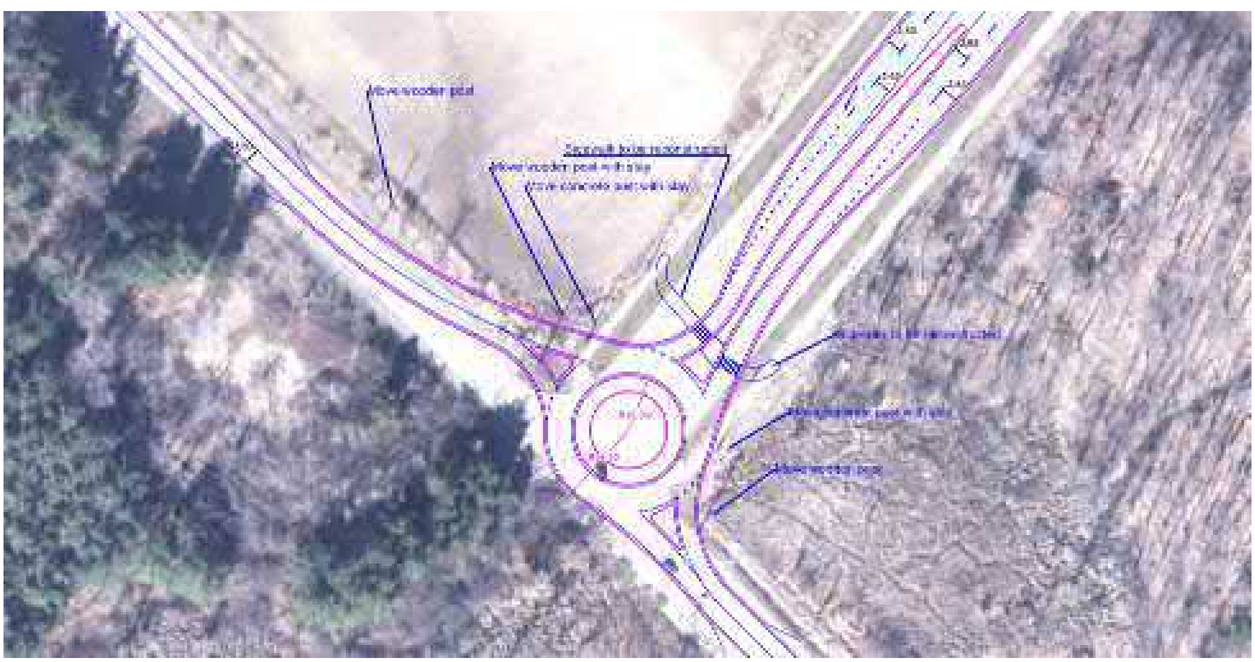


Figure 50: Roundabout at Countryside Option 2 (without encroachment on TRCA lands)

6.3.2 Screening of Alternatives

A screening evaluation process is used to identify feasible alternatives to be carried forward to a more detailed evaluation. The screening evaluation is generally based on a reasoned argument approach that considers the multi-modal transportation opportunities within the study area, and the social, cultural and natural environments, including potential impacts to significant environmental features.

Three sets of assessments were conducted to examine potential solutions for each of the study objectives including enhancing active transportation, traffic calming and reducing wildlife mortality. **Table 21**, **Table 22** and **Table 23** present a description of each of the alternatives as well as results of screening evaluation.

Table 21: Assessment of Active Transportation Alternatives

Alternative	Description of Alternative	Results of Screening Evaluation	Alternative Carried Forward?
1.A Do Nothing	The Do Nothing alternative maintains existing operations along Heart Lake Road, with no provisions for cycling, walking, and does not conform to municipal transportation master plan vision.	This alternative is not being carried forward because it does not meet the study purpose or objective of reducing speed on Heart Lake Road or providing cycling infrastructure. No changes to the land use, natural or social environment adjacent to the study area.	• No
1.B Two Lanes with Paved Shoulders and Rumble Strips	Vehicular lane to be narrowed to 3.3 m with the introduction of a painted 0.5 m rumble strip buffer and 1.5 m paved shoulder for cycling with another 0.5 m of unpaved shoulder.	This alternative supports the study purpose of reducing speed on Heart Lake Road (by narrowing the vehicle lanes) and provides cycling infrastructure on the roadway to accommodate for future development needs. However, this solution only moderately addresses active transportation safety. No changes to the land use, natural or social environment adjacent to the study area.	• Yes; long term solution (dependent on future land development and cycling demand)
1.C Two Lanes with Separated Bike Lanes	Vehicular lane to be narrowed to 3.3 m and the addition of a 0.5 m buffer with flex bollards and 1.5 m paved dedicated bicycle lane and another 0.5 m of unpaved shoulder.	This alternative supports the study purpose of reducing speed on Heart Lake Road (through the use of flex bollards adjacent to the roadway) and provides cycling infrastructure on the roadway to support future development needs. This solution also provides enhanced improvements which addresses active transportation safety. No changes to the land use, natural or social environment adjacent to the study area.	• Yes; long term solution (dependent on future land development and cycling demand)
1.D Two Lanes with Separated Bi-directional Multi-Use Path on one side	Vehicular lane to be narrowed to 3.3 m and a 3.0 m bi-directional multi-use facility would be placed on either the east or west side of the roadway with a 0.5 m shoulder buffer. This would require the vehicular lanes to be shifted to the east of west side.	This alternative supports the study purpose of reducing speed on Heart Lake Road and provides cycling infrastructure on the roadway to provide for future development needs. This solution also provides enhanced improvements to active transportation safety. No changes to the land use, natural or social environment adjacent to the study area.	• Yes; long term solution (dependent on future land development and cycling demand)

Table 21: Assessment of Active Transportation Alternatives

Alternative	Description of Alternative	Results of Screening Evaluation	Alternative Carried Forward?
1.E Narrow Roadway with Shared Roadway Markings and Signs	Vehicular lane to be narrowed to 3.3 m and the overall paved width of the roadway gets narrowed with traffic calming measures along the roadway including speed cushions and mini-roundabouts.	This alternative supports the study purpose of reducing speed on Heart Lake Road and provides minor cycling infrastructure on the roadway. However, this solution provides only minor improvements to active transportation safety with cyclists operating in mixed-traffic. It relies on the effectiveness of traffic calming measures. No changes to the land use, natural or social environment adjacent to the study area.	• Yes; long term solution (dependent on future land development and cycling demand)
1.F Hybrid Multi-Use Trail in Heart Lake Conservation Area	Multi-use trail connections between existing boulevard paths along Countryside Drive and Sandalwood Parkway to connect to the existing internal trail within Heart Lake Road Conservation Area.	This alternative would enhance active transportation connections to and from the corridor to the Heart Lake Conservation Area which is the primary trip generator along the corridor currently. In terms of the roadway cross-section, this alternative will result in Heart Lake Road being mostly unchanged beyond intersection improvements at Heart Lake Road and Countryside Drive. No changes to the land use, natural or social environment adjacent to the study area.	• Yes; short term solution
1.G One-way operation with Separated Bike Lanes	Heart Lake Road operate as one-way going northbound between Sandalwood Parkway and Countryside Drive.	• Benefits – Provides a safer cycling environment along Heart Lake Road; – Prevents through traffic along Heart Lake Road between Sandalwood Parkway and Mayfield Road. • Inconvenient: – Vehicular accessibility to / from the Heart Lake Road Conservation Area is reduced: o Vehicles headed SB from the Conservation Area must head northbound and detour through Dixie Road, Kennedy Road, or Highway 410, causing significant delay; o Vehicles entering the Conservation Area from the north will need to use Highway 410 or detour through Sandalwood Parkway. – Detours will increase the distance travelled and vehicle emissions – Detours will exacerbate traffic operations at nearby intersections.	• No

Table 22: Assessment of Traffic Calming Alternatives

Alternative	Description of Alternative	Results of Screening Evaluation	Alternative Carried Forward?
2.A Do Nothing	Existing vehicular lane width of 3.5 m make it comfortable for cars and promote faster speeds. No cycling infrastructure in place.	This alternative does not satisfy the study objective and does not provide any measures to reduce traffic speed along the corridor. Existing speed limit compliance is currently 11%.	• No
2.B Stop control or mini roundabouts at intersections (Heart Lake Conservation Area/Access to New Residential Development)	Stop signs or traffic circle at Heart Lake Road and Conservation Area Entrance. Posted speed limit to 50 km/h.	This alternative could satisfy the study objectives if a traffic circle is the measure implemented at the intersections (and not a stop sign). A traffic circle would calm traffic at the Heart Lake Conservation Area entrance. A stop sign is not warranted here and would risk issues of non-compliance. Mini roundabouts should be considered for future major development accesses to Heart Lake Road.	• Yes • Sort-term: – Implement traffic circle at Heart Lake Conservation Entrance • Long-term: – Consider traffic circle at major development accesses to Heart Lake Road
2.C Speed cushions/ lane narrowing with rumble strips	Raised sections of the roadway designed to discourage motor vehicle drivers from travelling at excessive speeds. Reduce speed limit to 50 km/h. Existing vehicular lane width would be narrowed to 3.3 m along with rumble strips to give physical and auditory cues to drivers. Posted speed limit to 50 km/h. Speed cushions will need to include the installation of proper signage to ensure safety due to lack of street lighting along this roadway.	This alternative satisfies the study purpose of reducing the operating speed limit on the roadway and is a recognized measure. The roadway would need to be re-classified as a local collector road as speed cushions and lane narrowing are generally not recommended for rural arterial roadways.	• Yes; Short/Medium term solution • Short-term: – roadway would need to be re-classified as a local collector – Speed cushions implemented. • Medium-term: – Lane Narrowing
2.D Traffic Deflection at Countryside Drive/ one-way operation with separated bike lanes	Roadway would be closed to general traffic going south from Countryside Drive; would still allow local traffic and general traffic existing northbound. Change Heart Lake Road to one-way operation going northbound between Sandalwood Parkway and Countryside Drive	This alternative does not satisfy the study purpose in that it doesn't reduce traffic speed along the corridor. This alternative will effectively increase traffic volume on certain portions of the roadway and would have minimal impacts on travel speed, despite a potential reaction in the speed limit to 50 km/h.	• No

Table 22: Assessment of Traffic Calming Alternatives

Alternative	Description of Alternative	Results of Screening Evaluation	Alternative Carried Forward?
2.E Roundabout at Countryside Option 1	Convert the existing non-signalized intersection at Countryside Drive to a roundabout. Extends into the existing TRCA lands on the west portion of the intersection.	This alternative satisfies the study purpose in that it will reduce traffic speed along the corridor and dissuade trucks of using Heart Lake Road, without preventing them from maneuvering if required. However, TRCA lands will be impacted. As a result, this alternative is considered non-acceptable.	• No
2.F Roundabout at Countryside Option 2	Convert the existing non-signalized intersection at Countryside Drive to a roundabout. Does not impact TRCA lands.	This alternative satisfies the study purpose in that it will reduce traffic speed along the corridor and dissuade trucks of using Heart Lake Road, without preventing them from maneuvering if required. There are some property implications on the east side of Heart Lake Road and relocation of concrete electric poles This alternative does not impact TRCA lands and can be considered.	• Yes; long term solution

Table 23: Assessment of Wildlife Treatment Alternatives

Alternative	Description of Alternative	Results of Screening Evaluation	Alternative Carried Forward?
3.A Do Nothing	Continue with the existing wildlife mortality mitigation measures (including solar powered flashing amber lights, optical speed bars, eco-passage tunnels, wildlife directional fencing, and turtle nesting mounts) that have been implemented with little post-mitigation monitoring	This alternative does continue to implement wildlife mortality mitigation measures however their effectiveness is yet to be determined	• No
3.B Maintain Solar Powered Flashing Amber Lights	This alternative involves a solar operating flashing “seasonal wildlife crossing-reduce speed when flashing” signage	This alternative provides notification to drivers to reduce their speed due to the presence of wildlife crossing Heart Lake Road. Its effectiveness is yet to be determined. This option (alone) will continue to result in conflicts between wildlife and vehicles.	• Yes; short term solution
3.C Maintain Pavement Markings (optical speed bars)	Painted lines on the roadway meant to reduce the average speed of vehicles along Heart Lake Road.	This alternative has been implemented however its effectiveness in decreasing speed along Heart Lake Road is yet to be determined. This option (alone) will continue to result in conflicts between wildlife and vehicles.	• Yes; short term solution
3.D Additional Eco-Passage Tunnel(s)	Eco-passage tunnel or wildlife crossing are designed to provide a safe means for amphibians or reptiles to cross Heart Lake Road therefore avoiding traffic.	This alternative has been implemented adjacent to one of the identified wildlife fatality areas. Long term solution would include implementing additional eco-passage tunnels in adjacent identified hot spot locations.	• Yes; short term solution
3.E Wildlife Directional Fencing	Designed to provide a barrier from turtles from crossing the road.	This alternative assists with preventing wildlife from accessing the roadway and directs them to the existing eco-passage tunnel.	• Yes; short term solution
3.F Turtle Nesting Mounts	Man-made mound designed to create an alternative away from the road for both females and hatchlings.	This alternative assists with providing a safe area for females and hatchlings to nest. There are minor impacts to vegetation during the construction of the nesting mound.	• Yes; short term solution

6.3.3 Results of Screening

As noted in **Table 21, Table 22** and **Table 23,** the preliminary screening exercise identified several alternatives that warrant further/more detailed evaluation.

6.4 EVALUATION CRITERIA

Evaluation criteria have been developed based on existing conditions and background data, meetings with City officials and the TRCA. The evaluation criteria are independent variables, each of which may contribute a positive or negative influence on the overall suitability of an alternative.

The evaluation criteria for the assessment of transportation alternatives consist of three main categories:

- Multi-modal Transportation;
- Social and Cultural Environment;
- Natural Environment.

Within each of these three main categories, a number of criteria and factors were in the evaluation of transportation alternative options, as detailed in **Table 24**.

Table 24: Evaluation Criteria and Factors Considered

Category	Criteria	Factors Considered
Multi-modal transportation	Roadway geometrics	Satisfies desirable design criteria
	Access	Proximity to Community Facilities
	Traffic engineering	Impacts to Traffic Operations
	Speed	Reduce Speed km/hr
	Cycling	Attract cyclists to promote bicycle connectivity
	Safety	Improve safety for all road users
Social and Cultural Environment	Built cultural heritage features	Preserve Cultural Heritage Features
	Agricultural resources	Minimize impacts to agricultural lands
	Land use	Minimize impacts to existing residential/recreational properties
	Economic environment	Accommodate planned development and growth
Natural Environment	Designated natural areas	Minimize Impacts to Designated Natural Areas
	Wildlife and terrestrial habitat	Minimize impacts to wildlife
	vegetation	Minimize impacts to vegetation
	Surface water and drainage	Minimize Impacts to Surface Water and Ground Water

6.5 EVALUATION MATRIX

Table 24, Table 25 and **Table 26** present the detailed evaluation of alternatives. Each alternative was evaluated based on the following preference factors:

∗ Most preferred

✓ Moderately preferred

– Least preferred

× Fail

Table 25: Evaluation of Transportation Alternatives

Category	Criteria	Factors	Transportation Alternatives						
			1.A Do Nothing	1.B Two Lanes with Paved Shoulders and Rumble Strips	1.C Two Lanes with Separated Bike Lanes	1.D Two Lanes with Separated Bi-directional Multi-Use Path on one side	1.E Narrow Roadway with Shared Roadway Markings and Signs	1.F Hybrid Multi-Use Trail in Heart Lake Conservation Area	1.G One-way operation with Separated Bike Lanes
Multi-Modal Transportation	Roadway Geometry	Satisfies Desirable Design Criteria	– The existing vehicular lane widths of ~3.5m make the roadway more comfortable for cars and promote faster speeds	✓ Would require the vehicular lane to be narrowed to 3.3m and the addition of a painted 0.5m rumble strip buffer and 1.5m paved shoulder for cycling with and another 0.5m of unpaved shoulder. The existing un-paved shoulder would have to be partially paved. A 0.5m painted buffer would be required.	✓ Would require the vehicular lane to be narrowed to 3.3m and the addition of a 0.5m buffer with flexible bollards and 1.5m paved dedicated bicycle lane and another 0.5m of unpaved shoulder. The existing un-paved shoulder would have to be partially paved and flexible bollards would have to be installed. A 0.5m painted buffer would be required.	✓ Would require the vehicular lane to be narrowed to 3.3m and a 3.0m bi-directional multi-use facility would be placed on either the east or west side of the roadway with a 0.5m shoulder buffer. This would require the vehicular lanes to be shifted to the east or west side. A controlled crossing is required at Countryside Drive and future access to residential development.	✓ Would require the vehicular lane to be narrowed to 3.3m and the overall paved width of the roadway gets narrowed with traffic calming measures along the roadway including speed cushions and mini roundabouts. The rationale is to make the roadway feel less like a high-speed route and more like a slower local route.	∗ Would require appropriate multi-use trail connections between existing boulevard paths along Countryside Drive and Sandalwood Parkway to connect to the existing internal trail within the Heart Lake Conservation Area. Pedestrians would also be accommodated on the multi-use trail. Refurbishment of the existing trail/old access road entrance opposite Countryside Drive is required.	× Change Heart Lake Road to one-way operation going northbound between Sandalwood Parkway and Countryside Drive. This alternative will increase the travel distance from Heart Lake Road (north) to the Conservation Area by 1.8km, and from the Conservation Area to Heart Lake Road (south) by 4.0km.
	Access	Proximity to Community Facilities	✓ Existing vehicular access to facilities maintained. × Currently requires cyclists to share the roadway (ride with traffic) along Heart Lake Road which provides a direct access to the main Heart Lake Conservation Area Entrance and other properties along the corridor.	✓ Existing vehicular access to facilities maintained. – Would provide direct access to the main Heart Lake Conservation Area entrance off of Heart Lake Road. A cyclist will have to ride with traffic along Heart Lake Road to access the Conservation Area entrance.	✓ Existing vehicular access to facilities maintained. ✓ Would provide direct access to the main Heart Lake Conservation Area entrance off of Heart Lake Road. A cyclist will have to ride with traffic along Heart Lake Road to access the Conservation Area entrance.	✓ Existing vehicular access to facilities maintained. ✓ Would provide a direct access into the Heart Lake Conservation Area and reduce conflict points for active transportation road users if the multi-use facility were to be placed on the west side of the roadway.	✓ Existing vehicular access to facilities maintained. ✓ Would provide direct access to the main Heart Lake Conservation Area entrance off of Heart Lake Road and would require cyclists exiting towards the north and entering from south to cross one vehicular lane of traffic.	∗ Would provide a direct access into the Heart Lake Conservation Area and reduce conflict points via protected crossings for entering and exiting. – Does not provide continual/direct access to all destinations along Heart Lake Road. ∗ Trail could also accommodate pedestrians	× Vehicular access to destinations along Heart Lake Road will be limited to access from the south.
	Traffic	Impacts to Traffic Operations	× Maintain existing operations. Does not promote cycling or walking, does not conform with the municipal transportation master plan vision.	✓ Little to no impacts on traffic operations.	✓ Little to no impacts on traffic operations.	✓ Little to no impacts on traffic operations.	✓ May generate minor impacts on adjacent corridors by making the corridor less appealing for through vehicles.	✓ Little to no impacts on traffic operations. Conforms to municipal transportation master plan vision.	× Significant impacts to traffic operations, would require extra travel distance for vehicles to travel southbound from within the corridor. Would also generate impacts on adjacent corridors.
	Speed	Reduce Speed	– The roadway will maintain poor speed compliance with the existing compliance rate at 11%, indicating that only 11% of drivers travel at or below the posted speed limit. Heart Lake Road also includes advisory and warning signage which is meant to raise awareness/identify the wildlife crossing potential hazard.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for 3.3m vehicular lane widths. The rumble strip buffer will further reinforce narrow roadway cues even if visually, the corridor looks wide and rural.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for 3.3m vehicular lane widths. The physical flexible bollards will create a visual wall to make the roadway look more urban and less rural to promote slower speeds.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for 3.3m vehicular lane widths.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for 3.3m vehicular lane widths. The add. of traffic calming measures such as speed cushions and mini roundabouts are effective ways to reduce vehicular speed, volume and increase safety along roadways.	– The roadway will remain mostly unchanged beyond intersection improvements at Heart Lake Road and Countryside Drive that will have minor positive impacts on traffic speed.	– Increase in volume is forecasted on Countryside Drive eastbound due to forced right turns northbound at the intersection of Heart Lake Road and Countryside Drive. It also increases overall trip lengths for vehicles as it forces all vehicles to go northbound. – The option may increase speeding.

Table 26: Evaluation of Transportation Alternatives

Category	Criteria	Factors	Transportation Alternatives						
			1.A Do Nothing	1.B Two Lanes with Paved Shoulders and Rumble Strips	1.C Two Lanes with Separated Bike Lanes	1.D Two Lanes with Separated Bi-directional Multi-Use Path on one side	1.E Narrow Roadway with Shared Roadway Markings and Signs	1.F Hybrid Multi-Use Trail in Heart Lake Conservation Area	1.G One-way operation with Separated Bike Lanes
	Cycling	Attract Cyclists and Promote Bicycle Connectivity	– Currently no cycling infrastructure is in place.	– The signed route will connect with future and existing boulevard paths on Countryside Drive and Sandalwood Parkway. This facility type has a low attractiveness for cyclists.	* The separated bicycle lane will connect with existing boulevard paths on Countryside Drive and Sandalwood Parkway. This facility type has a high attractiveness for cyclists.	* The separated bi-directional multi-use trail will connect with existing boulevard paths on Countryside Drive and Sandalwood Parkway. This facility type has a high attractiveness for cyclists.	✓ The shared route will connect with existing boulevard paths on Countryside Drive and Sandalwood Parkway. This facility type will be attractive to cyclists based on the effectiveness of traffic calming measures.	* Direct internal connections to Heart Lake Conservation Area will be made to the existing boulevard paths on Countryside Drive and Sandalwood Parkway. A new section of the recreational trail through the Conservation Area lands will complete a gap in the Esker Lake Recreational Trail.	* The separated bi-directional multi-use trail will connect with existing boulevard paths on Countryside Drive and Sandalwood Parkway. This facility type has a high attractiveness for cyclists.
	Safety	Improve Safety for All Road Users	– The roadway will remain unchanged. Speed compliance will remain low and there are no traffic calming measures to help reduce the severity of collisions with vehicles or cyclists beyond the existing speed optical bars.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for the narrowed lanes. The lower speed limit will work towards reducing the severity of collisions and the paved shoulders will reduce conflicts between cyclists and vehicles.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for the narrowed lanes. The dedicated bicycle lanes with flexible bollards will significantly reduce conflicts between cyclists and vehicles by providing physical and visual cues separating the two modes.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for the narrowed lanes. The separated bi-directional multi-use path will significantly reduce conflicts between cyclists and vehicles by providing complete separation between the two modes.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for narrowed lanes. Traffic calming measures such as speed cushions and mini roundabouts will further reinforce reduced vehicular speeds. There is no dedicated space for cyclists on the roadway and existing conflicts will still remain.	– The roadway will remain mostly unchanged beyond intersection improvements at Heart Lake Road and Countryside Drive that will have minor positive impacts on traffic speed and collisions.	✓ One-way operation would allow cyclists to use the southbound lane for travel along the corridor, separated from traffic which would enhance cyclist safety greatly.
Social and Cultural Environment	Built Cultural Heritage Resources and Landscapes	Preserve Cultural Heritage Features	✓ Natural characteristics adjacent to the roadway remain intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact, comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands
	Agricultural Resources	Minimize Impacts to Agricultural Lands	* No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Road	* No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Rd	* No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Rd	* No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Rd	* No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Rd	* No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Rd	* No impacts to agricultural lands located north of Countryside Road/east of Heart Lake Rd
	Land Use	Minimize Impacts to Existing Residential/ Recreational Properties	* No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre * No impact to recreational facilities at Heart Lake Conservation Area	* No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre * No impact to recreational facilities at Heart Lake Conservation Area	* No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre * No impact to recreational facilities at Heart Lake Conservation Area	* No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre * No impact to recreational facilities at Heart Lake Conservation Area	* No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre * No impact to recreational facilities at Heart Lake Conservation Area	* No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre * Enhanced connections to existing recreational facilities at Heart Lake Conservation Area	× Significant impacts to existing facilities. Would require vehicles leaving the properties along the roadway to travel further to go south. × Would increase the distance vehicles accessing the corridor would have to travel.
	Economic Environment	Accommodate Planned Development and Growth	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	× Would require vehicles leaving the properties along Heart Lake Road to travel much further to go southbound. Would increase the distance vehicles accessing the corridor would have to travel.

Table 27: Evaluation of Transportation Alternatives

Category	Criteria	Factors	Transportation Alternatives 1.A Do Nothing	1.B Two Lanes with Paved Shoulders and Rumble Strips	1.C Two Lanes with Separated Bike Lanes	1.D Two Lanes with Separated Bi-directional Multi-Use Path on one side	1.E Narrow Roadway with Shared Roadway Markings and Signs	1.F Hybrid Multi-Use Trail in Heart Lake Conservation Area	1.G One-way operation with Separated Bike Lanes
Natural Environment	Designated Natural Areas	Minimize Impacts to Designated Natural Areas	* No impacts.	* Work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas	* Work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas	* Work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas	* Work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas	✓ Minor impacts to vegetated areas inside Heart Lake Conservation Area.	* Work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas
	Wildlife and Terrestrial Habitat	Minimize Impacts to Wildlife	* No impacts.	* Paved shoulders may deter turtle nesting sites that exist along gravel shoulders	* Paved shoulders may deter turtle nesting sites that exist along gravel shoulders	* Paved shoulder surface may deter turtle nesting sites that exist along gravel shoulders	* Continue to implement the wildlife signs, concrete box culvert (eco-passage), fencing, and artificial turtle nesting mounds	* Refurbishment to the existing trail/old access road entrance may remove some existing habitat within Heart Lake Conservation Area	* No impacts.
	Vegetation	Minimize Impacts to Vegetation	* No impacts to vegetation; no change to Right of Way	* No impacts to vegetation; no change to Right of Way	* No impacts to vegetation; no change to Right of Way	* No impacts to vegetation; no change to Right of Way	* No impacts to vegetation; no change to Right of Way	* Removal of old growth vegetation within the existing trail/old access road entrance	* No impacts to vegetation; no change to Right of Way
	Surface Water and Drainage	Minimize Impacts to Surface Water and Ground Water	– Salt and/or sand from road winter operations can cause changes in the water quality to neighbouring wetlands and potentially impact surface and groundwater * No change to paved portion of shoulder	– Salt and/or sand from road winter operations can cause changes in the water quality to neighbouring wetlands – Paving a portion of the shoulder would create greater impervious cover	– Salt and/or sand from road winter operations can cause changes in the water quality to neighbouring wetlands – Paving a portion of the shoulder would create greater impervious cover	– Salt and/or sand from road winter operations can cause changes in the water quality to neighbouring wetlands – Paving a portion of the shoulder would create greater impervious cover	– Salt and/or sand from road winter operations can cause changes in the water quality to neighbouring wetlands * No pavement increase to existing shoulder	* No salt or fluids originating from vehicles and salt distributing vehicles affect the existing trail/old access road entrance	– Salt and/or sand from road winter operations can cause changes in the water quality to neighbouring wetlands * No pavement increase to existing shoulder
Scoring	* Most Preferred		* 7	* 6	* 8	* 7	* 7	* 10	* 6
	✓ Moderately Preferred		✓ 3	✓ 7	✓ 6	✓ 8	✓ 9	✓ 4	✓ 2
	– Least Preferred		– 5	– 4	– 3	– 2	– 1	– 3	– 3
	× Fail		× 2	× 0	× 0	× 0	× 0	× 0	× 6

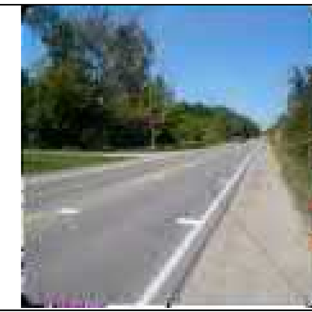
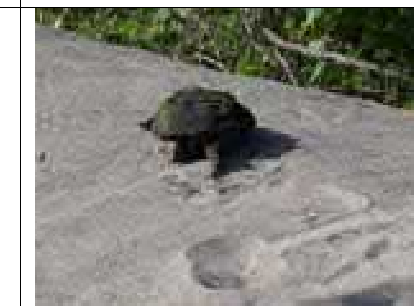
Table 28: Evaluation of Traffic Calming Alternatives

Category	Criteria	Factors	Traffic Calming Alternatives					
			2.A Do Nothing	2.B Stop Control or Mini Roundabouts at Intersections (Heart Lake Conservation Area/New Residential Development)	2.C Speed Cushions Lane Narrowing with Rumble Strips	2.D Traffic Deflection at Countryside Drive One-way operation with Separated Bike Lanes	2.E Roundabout at Countryside Option 1	2.F Roundabout at Countryside Option 2
Multi-Modal Transportation	Roadway Geometrics	Satisfies Desirable Design Criteria	– The existing vehicular lane widths of 3.5m make the roadway more comfortable for cars and promote faster speeds.	✓ Added stop signs or traffic circle to the Heart Lake Road and Conservation Area Entrance. Traffic circles consist of a raised island located in the centre of an intersection which requires vehicles to travel through the intersection and around the island. Traffic speed would have to be reduced to 50km/h and the roadway would have to be re-classified as either a collector or local roadway.	* Speed cushions are raised sections of the roadway designed to discourage motor vehicle drivers from travelling at excessive speeds. These are an acceptable measure for roadways with low volumes * To implement this measure on Heart Lake Road, the traffic speed would have to be reduced to 50km/h and the roadway would have to be re-classified as either a collector or local roadway. * Vehicular lane would be narrowed to 3.3m along with rumble strips to give physical and auditory cues to drivers that they should not use the wider shoulder. This would require a reduction in the speed limit as lane widths of 3m are recommended for roadways that operate at vehicular speeds of 50km/h or less.	– Roadway would be closed to general traffic going south from Countryside Drive but would still allow local traffic and general traffic exiting northbound. – Change Heart Lake Road to one-way operation going northbound between Sandalwood Parkway and Countryside Drive.	– Convert the existing non-signalized intersection at Countryside Drive to a roundabout. This would replace the existing free movement northbound and southbound approaches with yielding approaches going around a raised island. This option is less complex and extends onto the existing TRCA lands on the west portion of the intersection.	✓ Convert the existing non-signalized intersection at Countryside Drive to a roundabout. This would replace the existing free movement northbound and southbound approaches with yielding approaches going around a raised island. This option involves more complexity without impacting the TRCA lands but requires the relocation of hydro lines on the east side of the intersection.
	Traffic Calming	Reduce Speed	– The roadway will maintain poor speed compliance with the existing compliance rate at 11% and 85th percentile speeds at 80km/h despite the posted speed limit of 60km/h.	✓ The speed limit will be reduced to 50km/h to adhere to appropriate design speed standards for mini roundabouts. Traffic circles are effective at promoting speed reduction and reducing vehicular volume.	✓ The speed limit will be reduced to 50km/h to adhere to appropriate design speed standards for speed cushions. Speed cushions are highly effective at reducing speed and reducing vehicular volume. ✓ Case studies have found a relationship between narrower road widths and slower vehicular speeds, although a narrow roadway is not the only determining factor and their effectiveness depend on other factors including roadway curvature, roadside development, type of traffic control, among others. The rumble strip buffer will further reinforce narrow roadway cues even if visually, the corridor looks wide and rural.	– This may initially reduce traffic volume, however, deflecting traffic away from the corridor will not help reduce traffic speed along the corridor and may even promote higher speeds as there are few obstacles and vehicular interactions along the roadway. – It would effectively increase volume on certain portions of the roadway and would have minimal impacts on travel speed, despite a potential reduction in the speed limit to 50km/h. It may also increase overall trip length for vehicles as it forces all vehicles to go northbound with the nearest southbound route located far away east of Highway 410.	✓ The roundabout will physically require all vehicles to reduce their speed in order to pass around the raised island. This is highly effective compared to the existing north-south movements that are unimpeded and free-flowing.	✓ The roundabout will physically require all vehicles to reduce their speed in order to pass around the raised island. This is highly effective compared to the existing north-south movements that are unimpeded and free-flowing.
	Safety	Improve Safety for all Road Users	× Currently no cycling infrastructure is in place.	✓ A reduced speed limit and addition of a traffic circle will reduce speeds along the roadway and improve cyclist comfort.	✓ A reduced speed limit and addition of speed cushions will reduce speeds along the roadway and improve cyclist comfort. ✓ A narrower roadway will have some effect toward encouraging slower speeds with some minor improvement to cyclist comfort.	– Lower traffic volumes will improve cyclist comfort somewhat, but there would be little improvement to traffic speed. ✓ One-way operation would allow cyclists to use the southbound lane for travel along the corridor, separated from traffic which would enhance cyclist safety greatly.	✓ Slower vehicular operation through the Countryside Drive intersection along with a more direct line-of-sight for cyclists will greatly enhance safety.	✓ Slower vehicular operation through the Countryside Drive intersection along with a more direct line-of-sight for cyclists will greatly enhance safety.

Table 29: Evaluation of Traffic Calming Alternatives

Category	Criteria	Factors	Traffic Calming Alternatives					
			2.A Do Nothing	2.B Stop Control or Mini Roundabouts at Intersections (Heart Lake Conservation Area/New Residential Development)	2.C Speed Cushions Lane Narrowing with Rumble Strips	2.D Traffic Deflection at Countryside Drive One-way operation with Separated Bike Lanes	2.E Roundabout at Countryside Option 1	2.F Roundabout at Countryside Option 2
Social and Cultural	Built Cultural Heritage Resources and Landscapes	Preserve Cultural Heritage Features	✓ Natural character of the roadway remains intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural character of the roadway remains intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural character of the roadway remains intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural character of the roadway remains intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	× Requires vegetation adjacent to roadway to be removed to accommodate roundabout design × Encroaches on the TRCA lands	✓ Natural characteristics adjacent to the roadway remains intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands
Social and Cultural	Land Use	Minimize Impacts to Existing Residential/ Recreational Properties	✓ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre ✓ No impact to recreational facilities at Heart Lake Conservation Area	✓ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre * Would enhance access to the recreational facilities at Heart Lake Conservation Area by slowing traffic down at the access	✓ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre ✓ No impact to recreational facilities at Heart Lake Conservation Area	× Significant impacts to planned residential developments, and existing commercial and recreational facilities. Would prevent access to site along the roadway from the north. × One-way operation with separated bike lanes would result in large impacts to planned residential developments, and existing commercial and recreational facilities. Would require vehicles leaving the properties along the roadway to travel much further to go southbound.	✓ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre ✓ No impact to recreational facilities at Heart Lake Conservation Area	✓ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre ✓ No impact to recreational facilities at Heart Lake Conservation Area
Social and Cultural	Economic Environment	Accommodate Planned Development and Growth	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	× Significant impacts to planned residential developments, and existing commercial and recreational facilities. Would prevent access to site along the roadway from the north. Would increase the distance vehicles accessing the corridor would have to travel. × One-way operation with separated bike lanes would result in large impacts to planned residential developments, and existing commercial and recreational facilities. Would require vehicles leaving the properties along the roadway to travel much further to go southbound. Would increase the distance vehicles accessing the corridor would have to travel.	✓ Improved connections between the east and west sides of the roadway for planned industrial / employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	✓ Improved connections between the east and west sides of the roadway for planned industrial / employment development; Private School development; residential development within the Countryside Villages Secondary Plan area
Natural Environment	Designated Natural Areas	Minimize Impacts to Designated Natural Areas	✓ No impacts to designated natural areas.	✓ No impacts to designated natural areas.	✓ No impacts to designated natural areas.	✓ No impacts to designated natural areas.	× Impacts to lands associated with the Heart Lake Conservation Area	✓ Minor impact to lands in the northeast corner adjacent to the intersection of Countryside Dr and Heart Lake Rd, and remain outside of the wetland areas and TRCA lands
Natural Environment	Wildlife and Terrestrial Habitat	Minimize Impacts to Wildlife	✓ No impacts to wildlife.	✓ No impacts to wildlife.	✓ No impacts to wildlife.	✓ No impacts to wildlife.	✓ No impacts to wildlife anticipated.	✓ No impacts to wildlife anticipated.
Natural Environment	Vegetation	Minimize Impacts to Vegetation	✓ No impacts to vegetation.	✓ No impacts to vegetation.	✓ No impacts to vegetation.	✓ No impacts to vegetation.	– Impacts to vegetation; change to Right of Way at Heart Lake Rd.	✓ No impacts to vegetation; moderate change to Right of Way off Countryside Dr and Heart Lake Road.

Table 30: Evaluation of Wildlife Mortality Mitigation Alternatives

Criteria	Factors	Wildlife Mortality Mitigation Alternatives					
		3.A Do Nothing	3.B Maintain Solar Powered Flashing Amber Lights	3.C Maintain Pavement Markings (optical speed bars)	3.D Additional Eco-Passage Tunnel(s)	3.E Wildlife Directional Fencing	3.F Turtle Nesting Mounds
							
Designated Natural Areas	Minimize Impacts to Designated Natural Areas	✓ No effect to Designated Natural Areas Existing wildlife mortality mitigation measures have been recently implemented and there is little post-mitigation monitoring	× No effect to Designated Natural Areas	× No effect to Designated Natural Areas	* No effect to Designated Natural Areas * Provides connection to Designated Natural Areas and habitat	* No effect to Designated Natural Areas * Provides protection for turtles from crossing the road	* No effect to Designated Natural Areas * Provides a mitigation tool used to reduce mortality of nesting females and hatchlings
Terrestrial Habitat Design Factors	Minimize Impacts to Wildlife	– Effectiveness of the signage has not been determined	– Minimal impact on driver behaviour to slow down due to presence of wildlife habitat	× No effect to minimize impacts to wildlife	* Provides off road passage of turtles/frogs/snakes between vegetated areas	* Provides protection to turtles wishing to cross the roadway	* Proves a mitigation tool used to reduce mortality of nesting females and hatchlings
	Minimize Impacts to Vegetation	✓ No impact to vegetation that exists along Heart Lake Road	× No effect on Vegetation	× No effect on Vegetation	✓ Minor impact to vegetation at the entrance and exit	✓ Minor impact to vegetation along the roadway edge of pavement	✓ Minor impacts to vegetation during the construction of the turtle nesting mounds

7.0 PREFERRED ALTERNATIVE

Based on the assessment and evaluation of alternatives, a series of short term (i.e., recommended within 2 years) and long term (recommended within 5 to 10 years) solutions have been identified, as outlined below.

7.1 SHORT TERM

The short-term alternatives recommended over a 2-year horizon include the following:

- Transportation Improvements:
  - Narrow roadway including 3.3 m traffic lanes (**Figure 44**); and
  - Consider implementing a hybrid multi-use trail through Heart Lake Conservation Area with connections to the existing boulevard path at Heart Lake Road / countryside Drive.
- Traffic calming measures
  - Re-classify the road as a collector road;
  - Lower speed limit to 50 km/h;
  - Consider implementing solid yellow line for the full segment of Heart Lake Road south of Countryside Drive, in order to decrease speeding;
  - Implement speed cushions between Mayfield Road and the Highway 410 SB off-ramp; and
  - Install a traffic circle at the Conservation Area entrance (**Figure 48**).
- Wildlife mortality mitigation:
  - Maintain existing solar powered flashing amber lights;
  - Maintain and re-paint optical speed bars;
  - Install additional eco-passages tunnels at the two “hotspots” where passages are not already installed (**Figure 23**);
  - Permanently install wildlife directional fencing; and
  - Implement turtle nesting mounds.

7.2 LONG TERM

As noted, the long-term solutions are recommended for implementation within 5 to 10 years, as development occurs and needs increase. It should be noted that these recommendations are preliminary in nature and may be further reviewed and evaluated as part of future Municipal Class Environmental Assessment activities.

- Install a roundabout at the intersection of Countryside Drive (Option 2) (**Figure 50**); and
- Implement Alternative 1.C with separated bike lanes on Heart Lake Road (**Figure 42**).

7.3 ECO-PASSAGES

Figure 52 shows the proposed locations of two new eco-passages and the related longitudinal profile of Heart Lake Road.

Based on information provided from the geotechnical investigations on the corridor (please refer to **Appendix F**), it is concluded that eco-passages with concrete boxes 1.8 x 1.5 m^2 (similar to the existing eco-passage south of

Countryside Drive) are feasible but would require special measures to ensure a satisfactory lifespan. As a result, the use of StormTech chambers (**Figure 51**) is recommended.

As noted in Section 3.5, two boreholes were advanced north of the Heart Lake Conservation Area Access, each of which encountered a peat layer at varying depths and thickness. For alternatives with concrete box culverts, the peat layers identified at these locations would have to be removed and replaced with class B controlled backfill. This would require an excavation starting from the south side at a depth of 4.4 m to a depth of 3 m to the north side. Despite this not being mandatory with the StormTech chambers, the peat layer removal is recommended.

The concrete box culverts would slightly increase the existing load of the road on the underlying soils below, while the solution with the StormTech chambers substantially decreases it. It is unclear how the existing eco-passage was constructed; however, boreholes advanced in this area suggest that there was a peat layer beneath that was removed to accommodate the construction of the culvert.

Figure 53 shows the cross sections of the two new eco-passages proposed using the StormTech Chambers.

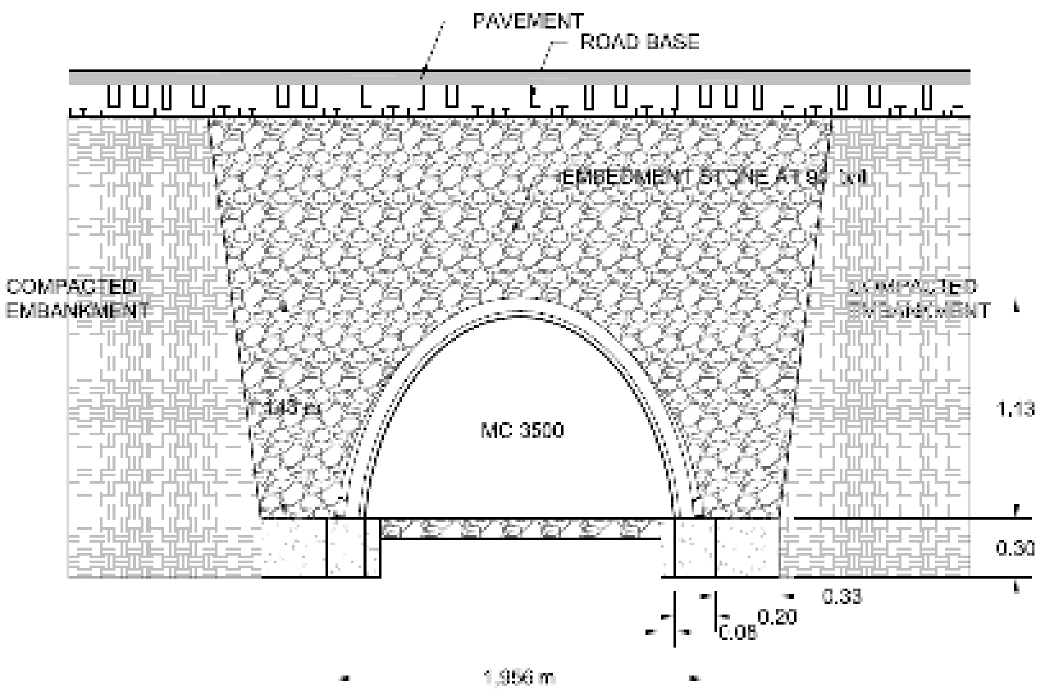


Figure 51: StormTech Chambers

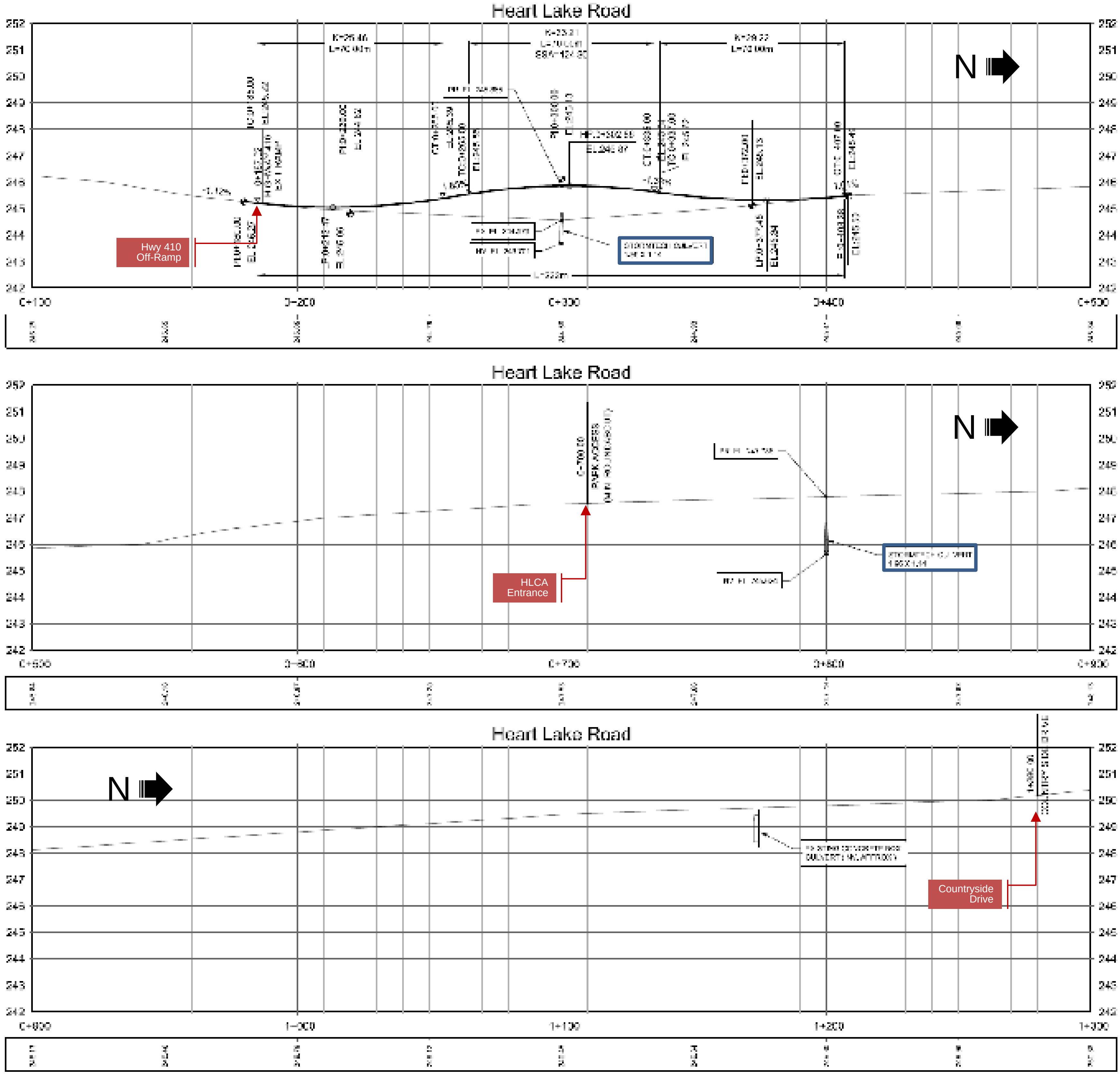
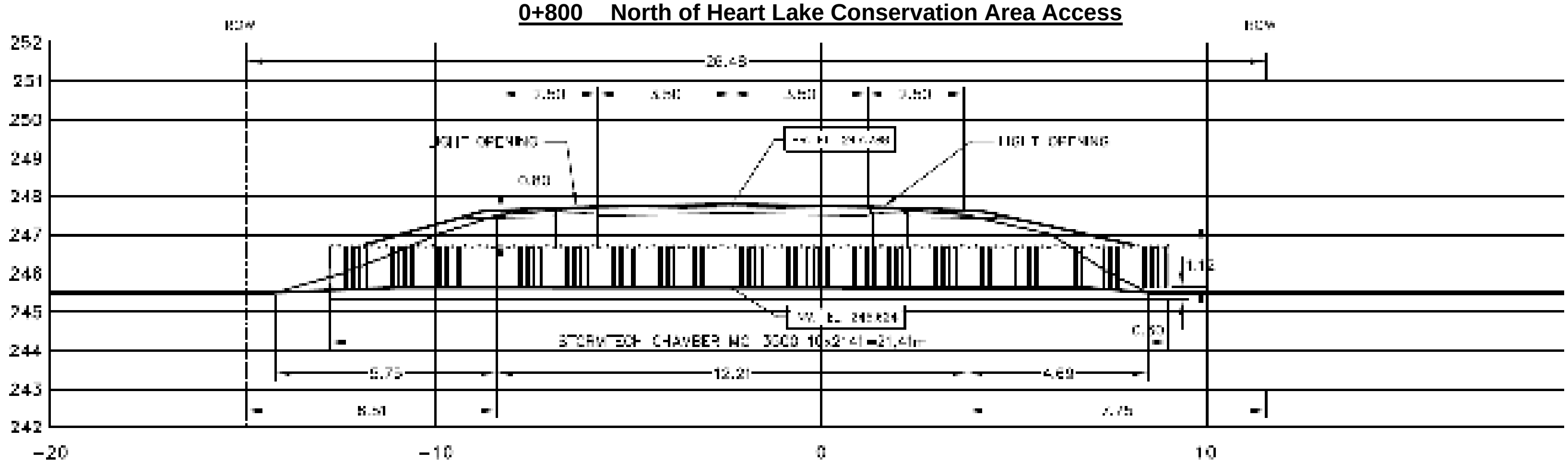


Figure 52: Heart Lake Road | Proposed Longitudinal Profile

0+800 North of Heart Lake Conservation Area Access



0+300 North of Highway 410 Off-Ramp

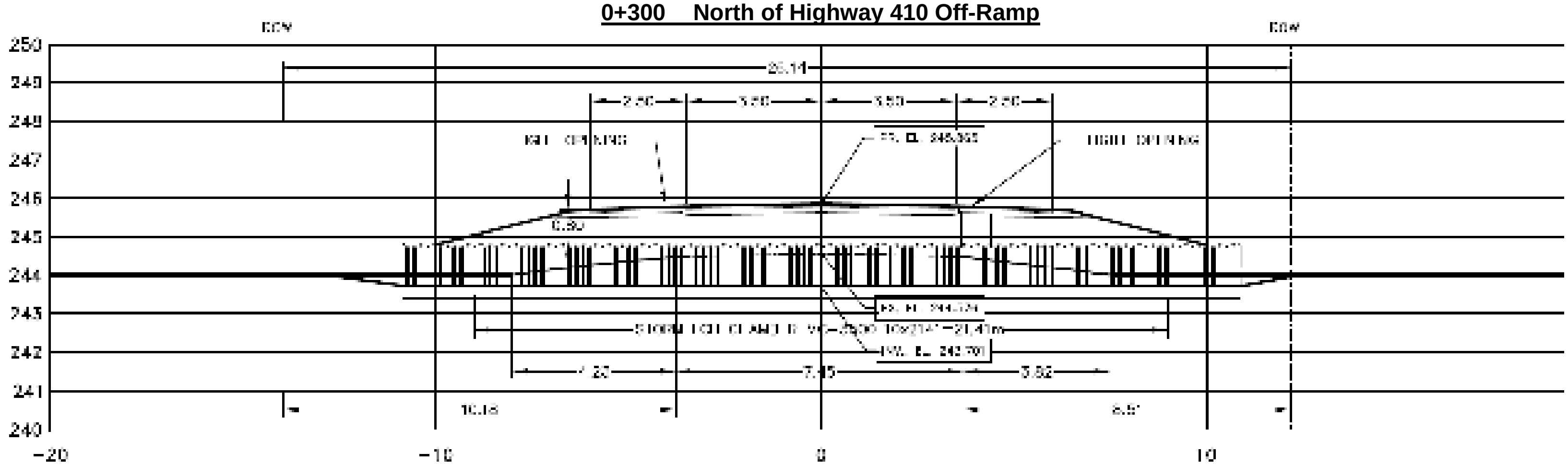


Figure 53: Cross-Sections of Proposed (2) Eco-Passages

7.4 BUDGETARY COST ESTIMATES

Appendix H provides the details associated to cost estimates, while the following sections summarize the costs per planning horizons with a 30% contingency.

7.4.1 Short Term

In the short term, the total cost for the recommended alternatives is approximately $ 1,425,000, which may be divided as follow:

- Traffic lane narrowing with rumble strips, between Sandalwood and Mayfield: $ 20,000
- The mini roundabout at the intersection with the Conservation Area access: $ 525,000
- The eco-passage at station 0+300 (north of Highway off-ramp): $ 280,000
- The eco-passage at station 0+800 (north of Heart Lake Conservation Area): $ 75,000
- Recreation rail connections through Heart Lake Conservation Area $ 525,000

The costs for the mini-roundabout include cost for lighting, while costs for the eco-passage include cost of fencing. The recreational trail connections include costs for planning, detailed design and construction.

7.4.2 Long Term

In the long term, the total cost for the recommended alternatives is approximately $ 1,750,000, which may be divided as follow:

- The roundabout at the intersection with Countryside Drive: $ 520,000
- Separated bicycle lanes between Sandalwood and Mayfield: $ 1,230,000

The costs for the roundabout include cost for lighting and relocation of concrete electric poles.

8.0 CONCLUSION

In response to concerns regarding wildlife mortality and traffic operations, the City of Brampton commissioned Stantec to undertake a function and design review of the Heart Lake Road corridor within the City of Brampton.

The focus of this study is the Heart Lake Road corridor between Sandalwood Parkway to a point just north of Mayfield Road, however, the assessment of the transportation network and recommendations from this study extend beyond this focus area.

The followings summarize the transportation issues and challenges noted on the Heart Lake Road corridor:

- Daily traffic on Heart Lake Road, between Countryside Drive and the Highway 410 off-ramp, is currently around 7,000 vehicles per day (i.e., 4,000 southbound and 3,000 northbound);
- The existing and forecasted traffic volumes do not justify widening of Heart Lake Road (additional traffic lanes), given that the theoretical capacity per lane for a typical two-lane rural roadway is 800 veh/h;
- Vehicles travelling on Heart Lake Road currently exceed the speed limit, which reduces safety on the corridor, given that higher speeds increase the probability and severity of collisions;
- Heart Lake Road is identified as a candidate for bicycle lane in the City of Brampton Transportation Master Plan;
- Improvements are required at the intersection with Sandalwood Parkway to improve safety conditions (see **Table 14**);
- Heavy trucks are observed on Heart Lake Road despite being prohibited; and
- Road infrastructure conditions constrain the type of measures that can be put in place along the corridor.

The study area section of Heart Lake Road is situated within one of the largest and most diverse natural areas within the City of Brampton. HLCA is located on the west side of the road and comprises a diverse, 169-hectare ecosystem having one of the largest blocks of forest in the Etobicoke Creek watershed, and contains six provincially rare vegetation community types, Provincially Significant Wetlands (PSWs), the remaining portions of Brampton Buried Esker, Environmentally Significant Woodland area and a bog designated as an Area of Natural and Scientific Interest. The section of Heart Lake Road, between Sandalwood Parkway and Countryside Drive, is known as a “hotspot” for wildlife mortality. Through the implementation of various mitigation measures such as traffic calming measures, wildlife signage, and wildlife fencing, the mortality rate of the wildlife is expected to decrease. Implementation of two new eco-passages will help to mitigate WVC occurrences and associated wildlife mortality Heart Lake Road.

Heart Lake Road was originally a corduroy road constructed between the late 1820s to the mid-19th century. Between Sandalwood Parkway and Mayfield Road, the roadway is important in maintaining and supporting the character of the surrounding landscape. Although improved and updated, Heart Lake Road still maintains its rural road cross section with two lanes of traffic, gravel shoulders, and ditches. In 2014, the Brampton Heritage Board received a delegation from the public seeking the possible recognition of Heart Lake Road as a cultural heritage landscape. This recognition was not defined at the time; however, it was evaluated as part of this study. The criteria for determining Cultural Heritage Value or Interest (CHVI) are defined by *Ontario Regulation 9/06* (O. Reg. 9/06) (Government of Ontario 2006b). If a property meets one or more of the prescribed criteria than it merits designation under Part IV of the *Ontario Heritage Act*. Heart Lake Road, between Sandalwood Parkway and Mayfield Road met five criteria (2.i, 2.ii, 3.i, 3.ii, and 3.iii) of O. Reg. 9/06. Therefore, Heart Lake Road has CHVI for historical/associative and contextual reasons and may be considered for designation by the City of Brampton under Part IV of the *Ontario Heritage Act*.

it is recommended that Heart Lake Road, between Mayfield Road and Bovaird Drive be classified as a collector road. An amendment should be made to Schedule B of the Official Plan to identify this recommended roadway classification.

As noted in Section 6.0, three categories of alternative solutions were screened and evaluated, including: Active Transportation; Traffic Calming; and, Wildlife Mortality Mitigation. An evaluation process was carried out to determine potential feasible alternatives that could be carried forward for more detailed evaluation. The evaluation was based on a comparative evaluation of each alternative considering multi-modal transportation, social and cultural environment, and natural environment criteria. Meetings with City officials, TAC and TRCA were also held to help to inform the evaluation. The evaluation was completed at a high level, using a reasoned argument approach. All alternatives were presented at a Public Information Centre for review and comment. Comments received during the course of this study were reviewed and considered by the project team, and assisted in identifying the short-term and long-term recommendations.

Following the evaluation process, the short-term alternatives recommended over a 2-year horizon include the following:

- Wildlife mortality mitigation:
  - Maintain existing solar powered flashing amber lights;
  - Maintain and re-paint optical speed bars;
  - Install (2) additional eco-passages tunnels at the two “hotspots” where passages are not already installed;
  - Permanently install wildlife directional fencing; and
  - Implement turtle nesting mounds.
- Traffic calming measures
  - Re-classify the road as a collector road;
  - Lower speed limit to 50 km/h;
  - Implement speed cushions between Mayfield Road and the Highway 401 SB off-ramp; and
  - Install a traffic circle at the Conservation Area entrance.
- Transportation Improvements:
  - Narrow roadway to include 3.3 m traffic lanes; and
  - Consider implementing a hybrid multi-use trail through Heart Lake Conservation Area with connections to the existing boulevard path at Heart Lake Road / countryside Drive.

The long-term alternatives recommended in the next 5 to 10 years, as development occurs and needs increase, include further study of the following:

- Install a roundabout at the intersection of Countryside Drive; and
- Implement alternative C with separated bike lanes on Heart Lake Road.

These recommended alternatives may be subject to further study under the Municipal Class Environmental Assessment planning and design process, which is approved under the Environmental Assessment Act. The TRCA will continue to be consulted as part of future planning and design activities.

APPENDIX A

Public Consultation

APPENDIX B

Agency Correspondence

APPENDIX C

Turning Movement Counts

APPENDIX D

Synchro Reports

APPENDIX E

Sandalwood Intersection/Safety Review

APPENDIX F

Geotechnical Reports

APPENDIX G

Heart Lake Road Volunteer Ecology Monitoring Project, Phases 1 and 2

APPENDIX H

Cost Estimates

APPENDIX A

Public Consultation

BRAMPTON
Flower City
brampton.ca

LET'S CONNECT

The City of Brampton is reviewing the function and design for Heart Lake Road between Sandalwood Parkway and Mayfield Road.

The Function and Design Review of the Heart Lake Road Corridor study will examine the road's long term role and function, and associated design requirements that address future multi-modal transportation demand, planned land use and development, protection of environment features and wildlife, and recognition of its unique cultural heritage.

Your input is important to the success of our study.

A number of public engagement and consultation activities will take place over the course of the study.

Please join us for our first event which will present the findings of the Background Review Study and a list of alternative solutions.

Date: **Thursday, November 2, 2017**
Time: **6:30 to 8:30 pm**
Location: **Loafer's Lake Recreation Centre – Auditorium (30 Loafer's Lake Lane, Brampton)**

If you have any questions or wish to be added to the study mailing list, please contact:

Nelson Cadete
Project Manager, Active Transportation
City of Brampton
2 Wellington Street West
Brampton ON L6Y 4R2
Phone: 905.874.2552 • Fax: 905.874.2099
Email: nelson.cadete@brampton.ca

Francois Tomeo, P. Eng., GDBA
Project Manager
Transportation Planning & Traffic Engineering
Stantec Consulting Ltd.
300-49 Bathurst Street
Toronto, ON M5V 2P2
Phone: 416-598-6685
francois.tomeo@stantec.com

311

www.brampton.ca

@CityBrampton

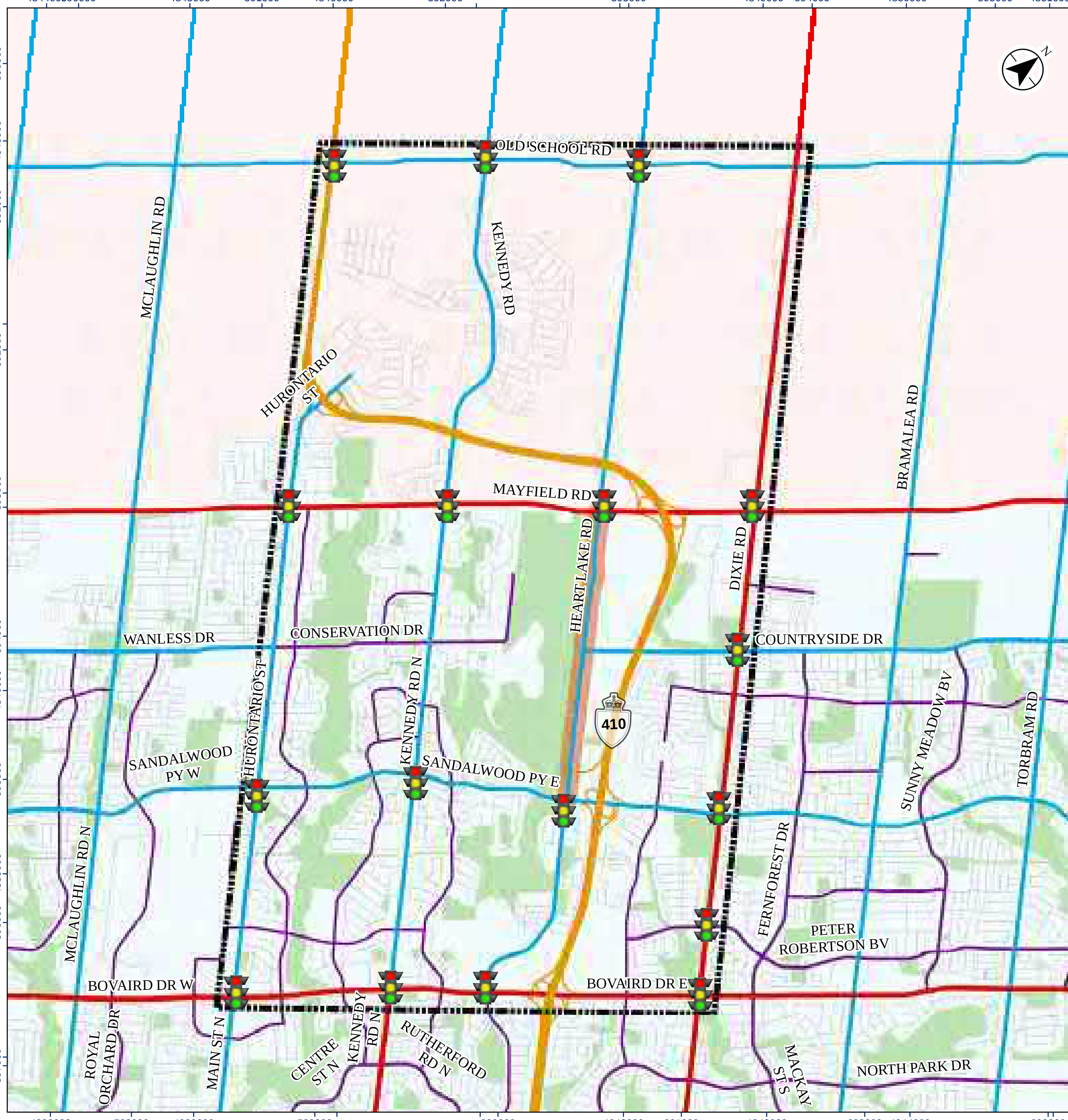
Heart Lake Road
Function and Design Review
Public Information Centre

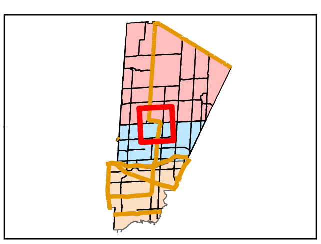
Date: Thursday, November 2, 2017

Time: 6:30 to 8:30 pm

Location: Loafer's Lake Recreation Centre – Auditorium
30 Loafer's Lake Lane, Brampton

Stantec





Legend

- Study Area
- Study Corridor
- Parks

Municipality

- Caledon
- Brampton
- Mississauga

Transportation

- Provincial Highway
- Regional Road
- Arterial Road
- Collector Road
- Local Road
- Ramp
- Major Intersection

0 200 400 metres

1:53,146 (at original document size of 8.5x11)

Stantec

Project Location
Brampton, ON

165001037 REVA
Prepared by Brandon Orr on 2017-10-19

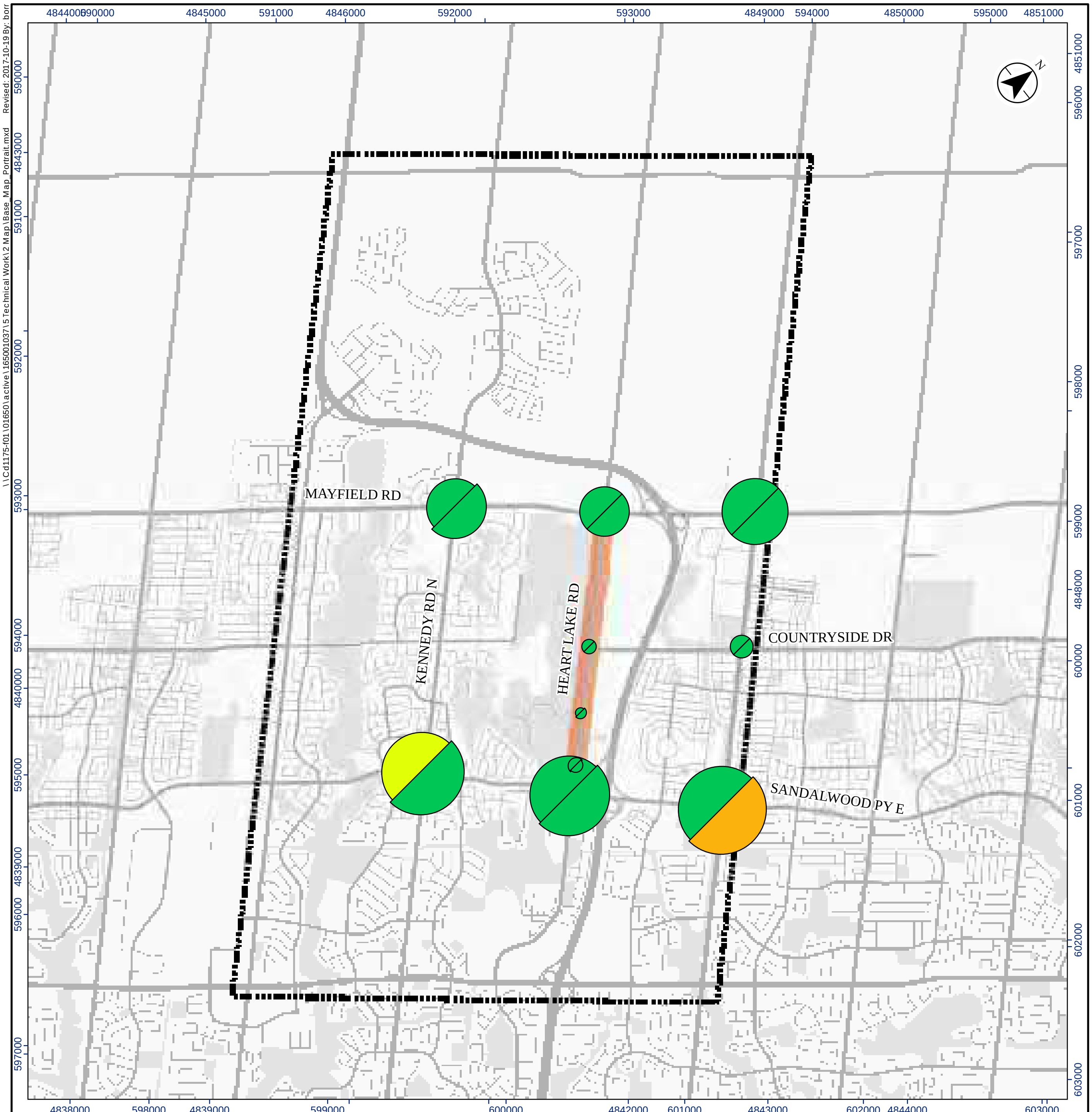
Client/Project
CITY OF BRAMPTON
HEART LAKE ROAD FUNCTION AND DESIGN REVIEW

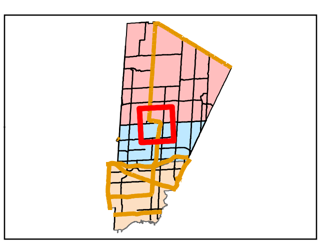
Figure No.
1

Title
Study Area

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.





Legend

Study Area

Study Corridor

Parks

Transportation

Provincial Highway

Regional Road

Arterial Road

Collector Road

Local Road

Ramp

Intersection Volume

4,500

400

Intersection Operations

AM Peak LOS

PM Peak LOS

LOS A, B or C

LOS D

LOS E

0 200 400 metres

1:53,146 (at original document size of 8.5x11)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.

Project Location: Brampton, ON

165001037 REVA

Prepared by Brandon Orr on 2017-10-19

Client/Project

CITY OF BRAMPTON

HEART LAKE ROAD FUNCTION AND DESIGN REVIEW

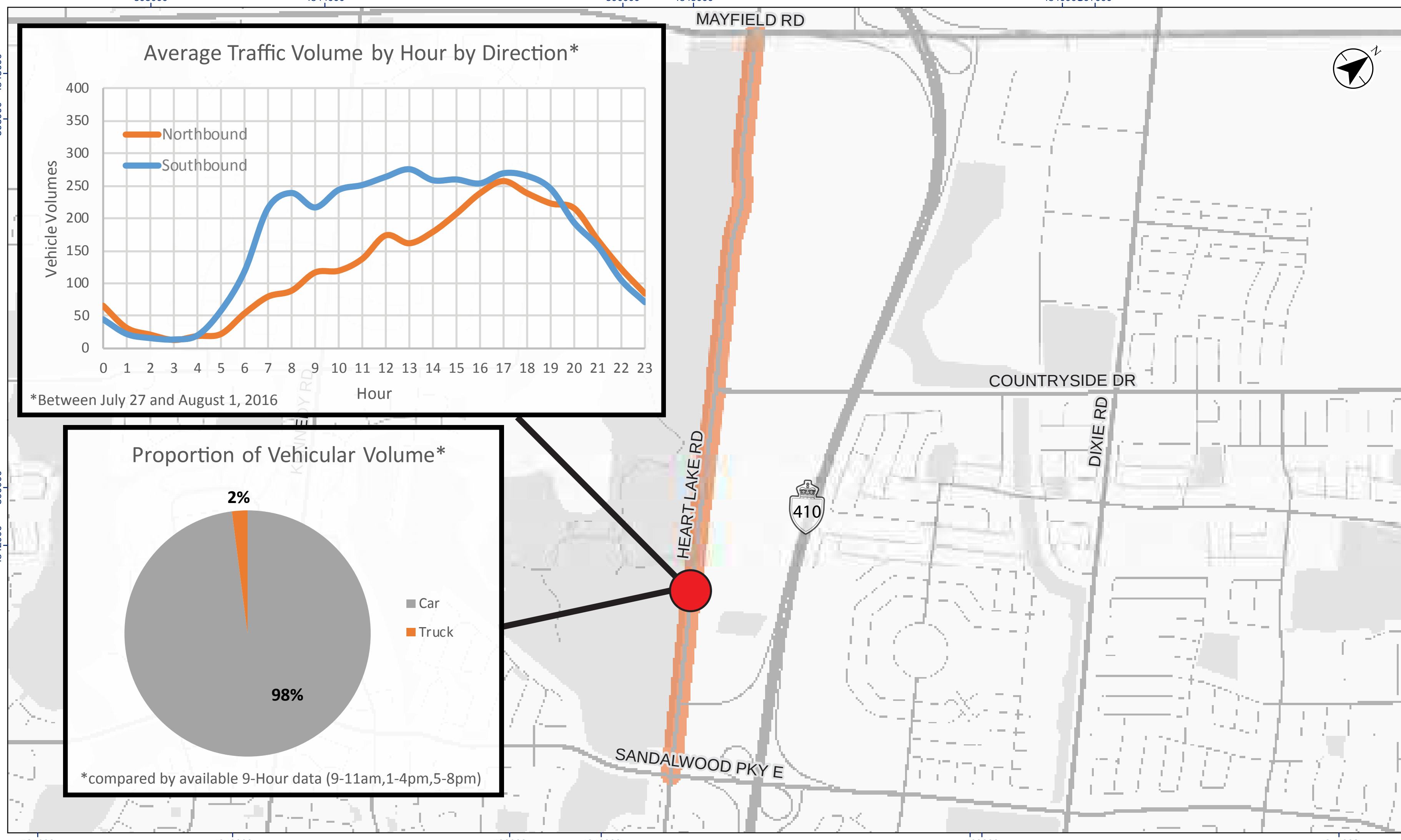
Figure No.

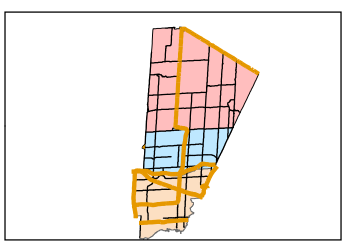
2

Title

Intersection Volumes and Operations Weekday AM and PM Peak Hours

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.





Legend

Study Corridor

Parks

Transportation

Provincial Highway

Regional Road

Arterial Road

Collector Road

Local Road

Ramp

0 200 400 metres

1:20,000 (At original document size of 8.5x11)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.

Stantec

Project Location
Municipality of

165001037 REVA
Prepared by Brandon Orr on 2017-10-20

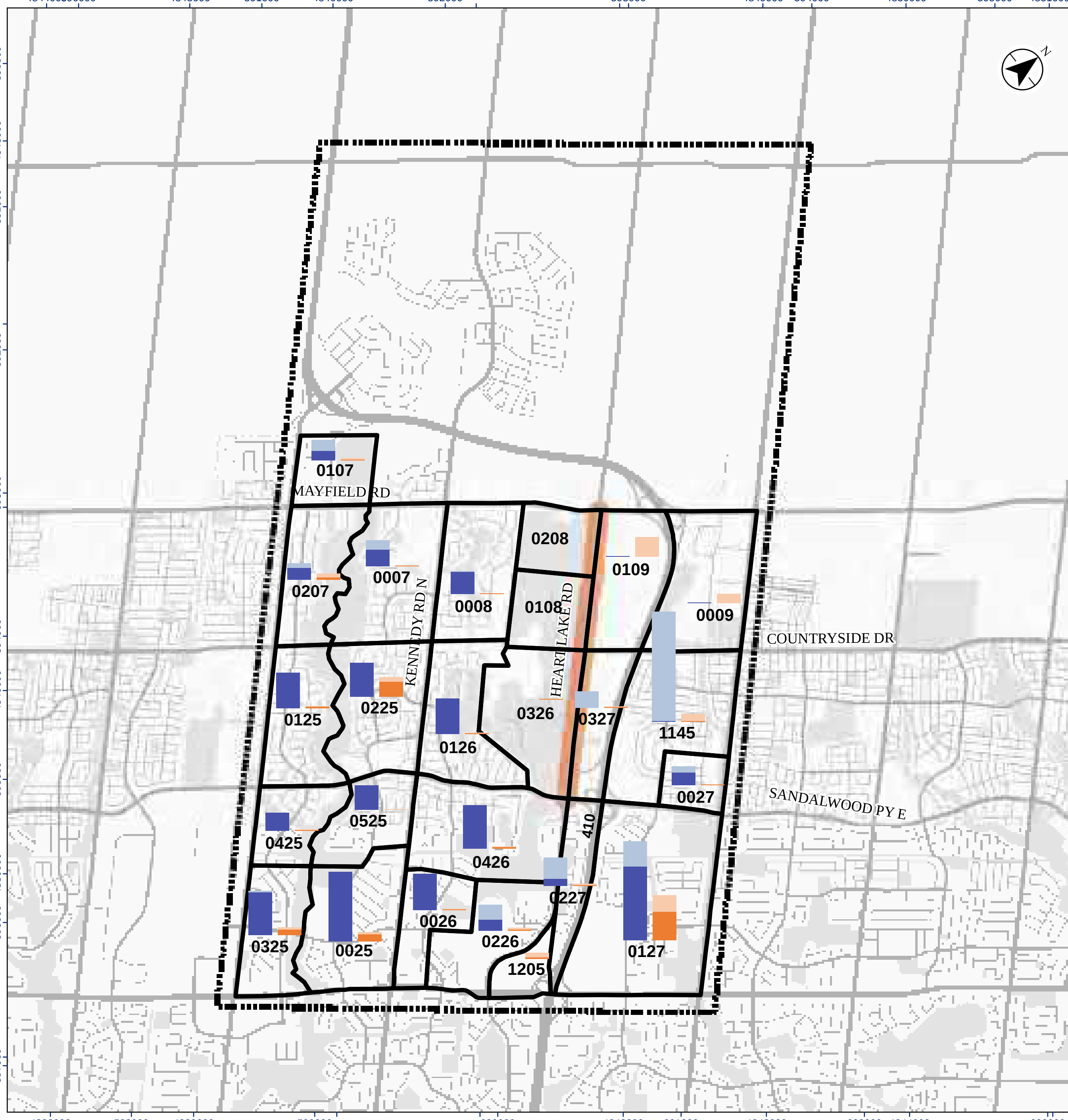
Client/Project
CITY OF BRAMPTON
HEART LAKE ROAD FUNCTION AND DESIGN REVIEW

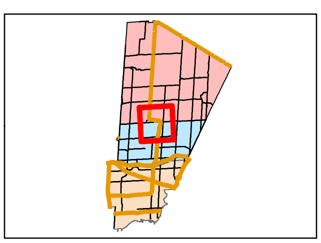
Figure No.
3

Title
Vehicular Volume Profile along Heart Lake Road

V:\01650\active\165001037\5 Technical Work\2 Map\Volume_Profile_Base.mxd Revised: 2017-10-20 By: borr

\\Cd1175-f01\01650\active\165001037\5 Technical Work\2 Map\Base_Map_Portrait.mxd Revised: 2017-10-19 By: borr





Legend

- Study Area
- Study Corridor
- Parks
- Small Geographic Unit (SGU)

3,000
- Future Population
- Existing Population

3,000
- Future Employment
- Existing Employment

Transportation

- Provincial Highway
- Regional Road
- Arterial Road
- Collector Road
- Local Road
- Ramp

0 200 400
metres

1:53,146 (at original document size of 8.5x11)

Stantec

Project Location
Brampton, ON

165001037 REVA
Prepared by Brandon Orr on 2017-10-19

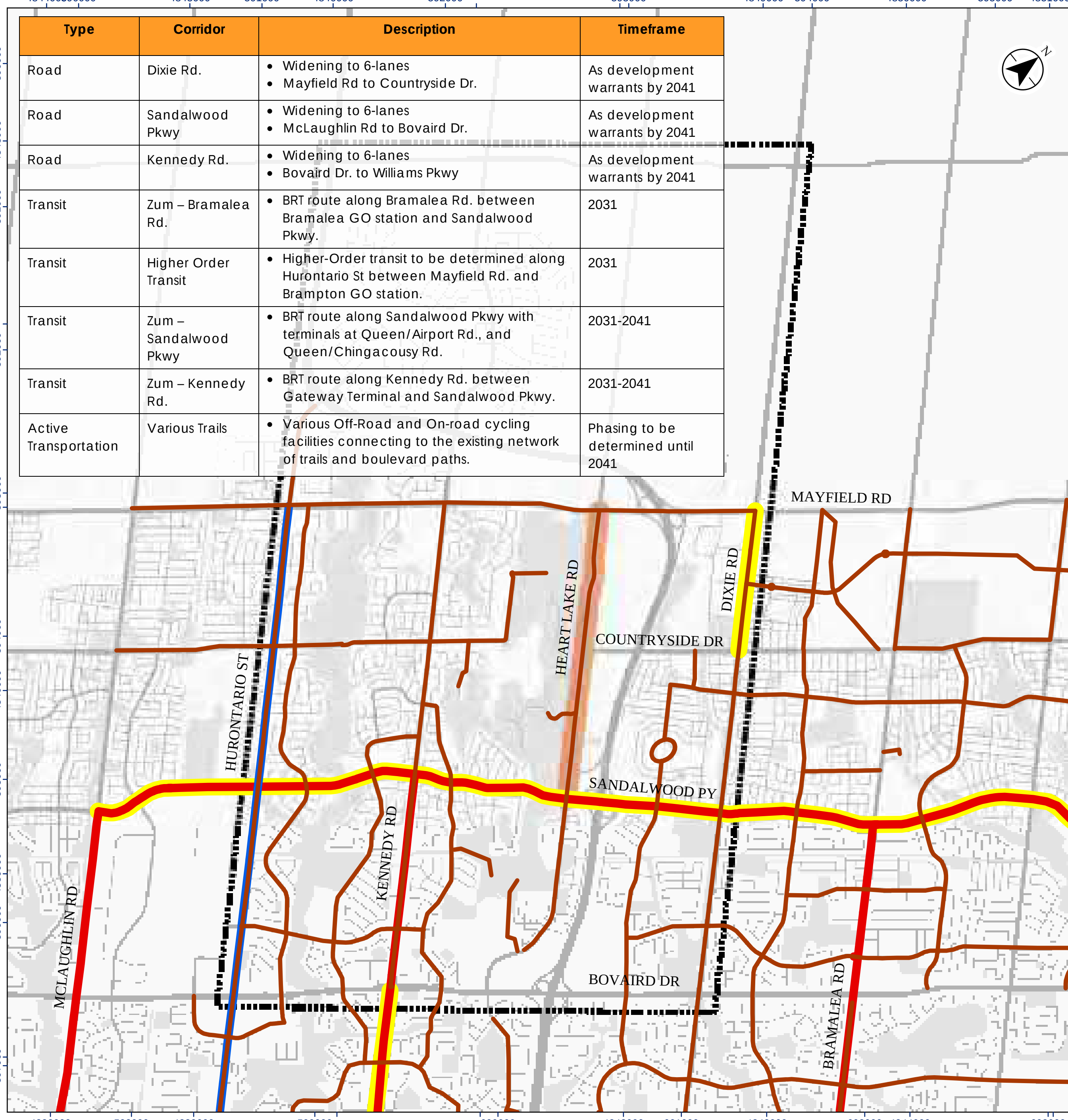
Client/Project
CITY OF BRAMPTON
HEART LAKE ROAD FUNCTION AND DESIGN REVIEW

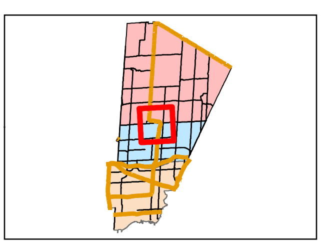
Figure No.
5

Title
Study Area Population & Employment Forecast

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.

Type	Corridor	Description	Timeframe
Road	Dixie Rd.	• Widening to 6-lanes • Mayfield Rd to Countryside Dr.	As development warrants by 2041
Road	Sandalwood Pkwy	• Widening to 6-lanes • McLaughlin Rd to Bovaird Dr.	As development warrants by 2041
Road	Kennedy Rd.	• Widening to 6-lanes • Bovaird Dr. to Williams Pkwy	As development warrants by 2041
Transit	Zum – Bramalea Rd.	• BRT route along Bramalea Rd. between Bramalea GO station and Sandalwood Pkwy.	2031
Transit	Higher Order Transit	• Higher-Order transit to be determined along Hurontario St between Mayfield Rd. and Brampton GO station.	2031
Transit	Zum – Sandalwood Pkwy	• BRT route along Sandalwood Pkwy with terminals at Queen/Airport Rd., and Queen/Chingacousy Rd.	2031-2041
Transit	Zum – Kennedy Rd.	• BRT route along Kennedy Rd. between Gateway Terminal and Sandalwood Pkwy.	2031-2041
Active Transportation	Various Trails	• Various Off-Road and On-road cycling facilities connecting to the existing network of trails and boulevard paths.	Phasing to be determined until 2041





Legend

Study Area
Study Corridor
Parks

Future Improvements

Future Road Widening
Zum BRT
Higher Order Transit
Future Cycling Improvement

Transportation

Provincial Highway
Regional Road
Arterial Road
Collector Road
Local Road
Ramp

0 200 400 metres

1:53,146 (at original document size of 8.5x11)

Stantec

Project Location: Brampton, ON

165001037 REVA

Prepared by Brandon Orr on 2017-10-19

Client/Project
CITY OF BRAMPTON
HEART LAKE ROAD FUNCTION AND DESIGN REVIEW

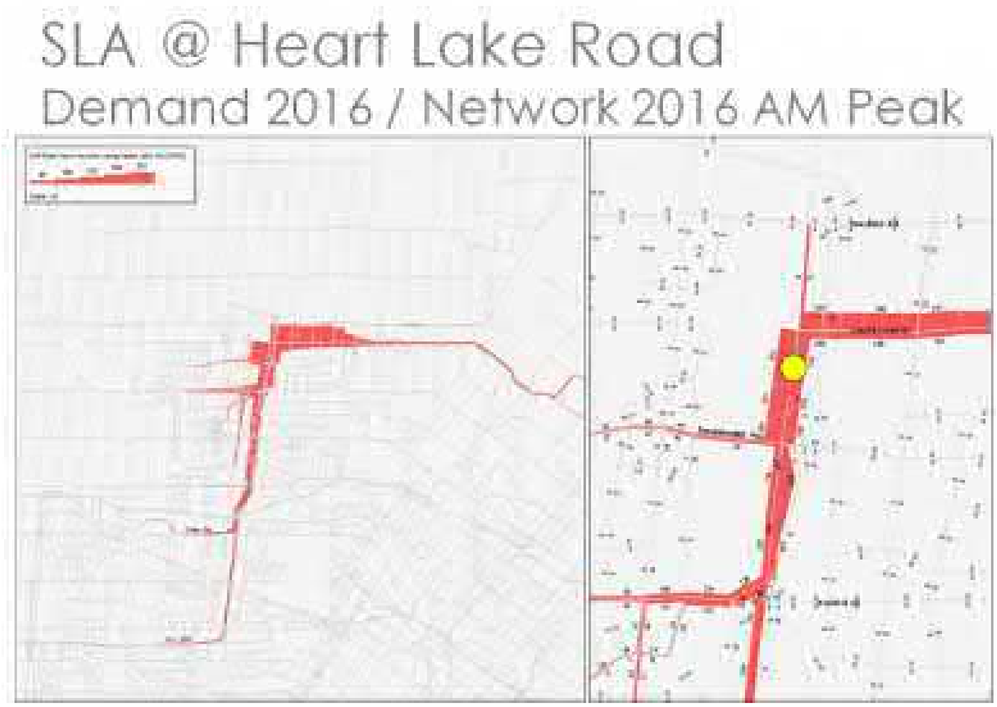
Figure No.
4

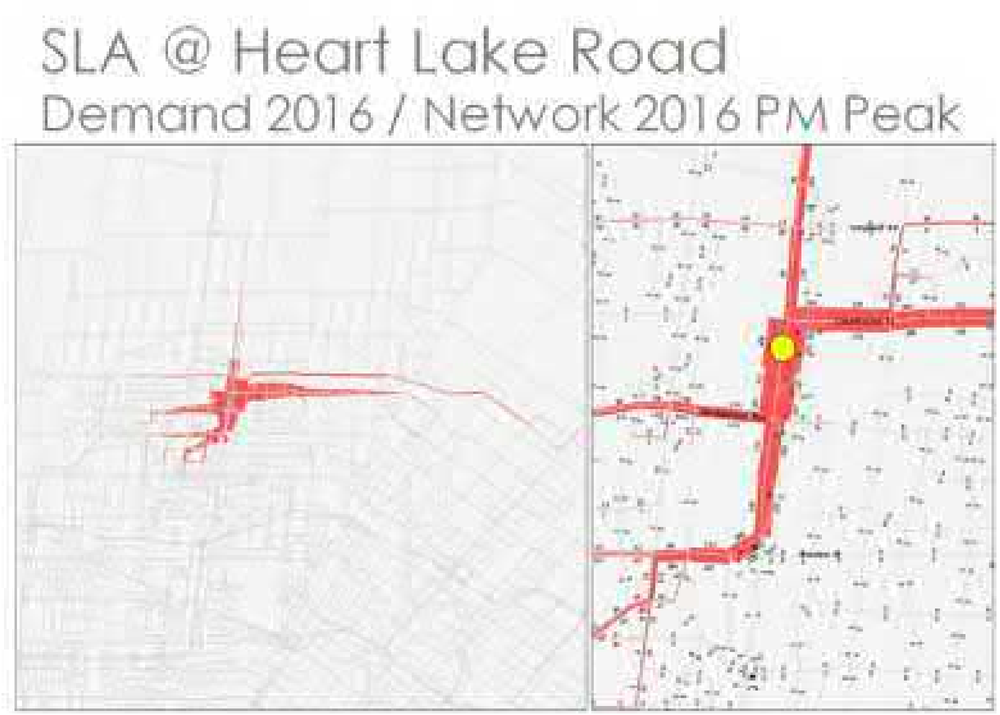
Title
Planned Future Improvements

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 20XX.

\\Cd1175-f01\01650\active\165001037\5 Technical Work\2 Map\Base_Map_Portrait.mxd Revised: 2017-10-19 By: borr

Travel Demand





Forecast

Link	Horizon					
	No changes on Network			Improved Network at Horizon		
	2021	2031	2041	2021	2031	2041
Southbound						
Heart Lake Rd, between Countryside Dr and Sandalwood Pwy	401	415	430	388	422	309
Northbound						
Heart Lake Rd, between Sandalwood Pwy and Countryside Dr	263	429	472	262	464	355

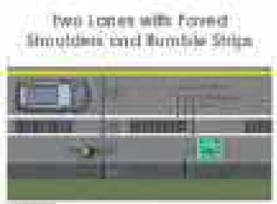
Alternatives

Bike Lane Alternatives

Alternative	Description
A	Do Nothing
B	Two Lanes with Paved Shoulders and Rumble Strips
C	Two Lanes with Separated Bike Lanes
D	Two Lanes with Separate Bi-directional Multi-Use Path on one Side
E	Narrow roadway and incorporate complete streets design
F	Hybrid Multi-Use Trail in Heart Lake Conservation Area
G	One-Way Road Operation with Separated Bike Lanes

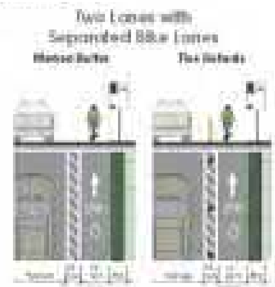
Alternative B

- One direction on both sides of the roadway
- Provides dedicated spaces for cyclists away from traffic
- Provides a buffer between vehicles and cyclists



Alternative C

- Similar to paved shoulders with added protection
- One direction on both sides of the roadway
- Provides dedicated spaces for cyclists away from traffic
- Provides a buffer (physical or marked buffer) between vehicles and cyclists

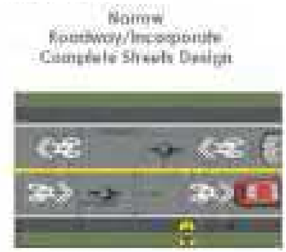


Alternative D

- Completely separated facility on one side of the roadway
- Bi-directional path, no need to cross the street to go the opposite direction
- Can be multi-use for cyclist and pedestrian use
- Provides a physical buffer between vehicles and the pathway

Alternative E

- Introduce roadway design elements that discourage high speed through traffic
- Reduce speed limit to 40km/h
- Narrow the roadway as a traffic calming measure
- Roadway to be shared with cyclists
- Reduce the environmental footprint of the roadway on the corridor

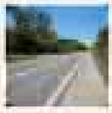


Alternatives B, C, D and E

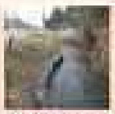
Alternatives

Mitigating Wildlife Mortality

PREVIOUSLY IMPLEMENTED OR CONSIDERED

Mitigation Measure	Image	Location	Effectiveness	Preliminary Evaluation / Comments
Natural Area / Wildlife Signage		Installed in 2016	Low	May serve as an educational/awareness tool and reduce speed
Solar-powered flashing amber lights to slow traffic		Installed in 2016	Low	May serve as an educational/awareness tool and reduce speed
Optical speed bars		Installed in 2016	Low	Not effective at speed reduction.
Wildlife crossing structure (concrete culvert)		Installed in 2016, 100 m south of Countryside Drive	High	Soils in some areas may not be suitable for culverts. Must be combined with fencing
Wildlife directional fencing		Installed in 2016 south of Countryside Drive, 190 m on the east side and 140 m on the west side	High, particularly when connected to a crossing opportunity	Maintenance required; populations may become isolated
Turtle nesting beaches		Within installed directional fencing	Low	Provides safe nesting locations but may take many years before they're used

POTENTIAL ADDITIONAL MITIGATION MEASURES

Mitigation Measure	Image	Location	Effectiveness	Preliminary Evaluation / Comments
Additional wildlife culverts		Hotspot locations 1 and 2	High	Must be in combination with directional fencing. Soils at these locations may not suitable for culverts. However, alternative installation methods can be considered
Extend exclusionary fencing		Hotspots 1 and 2, and along entire stretch of roadway where mortality has been documented	High	Recommended in combination with additional nesting beaches and eco-passages
Stop control at intersections		It is required to determine if/where they are warranted (based on MTO Guidelines) to make sure they ensure fluid and safe traffic conditions	Low to moderate	May reduce traffic speed but slow moving animals will also need to be excluded from the roadway
Speed cushions and rumble strips		It is required to determine if/where they would be required in order to act as effective traffic calming measures	Low to moderate	Will reduce traffic speed but slow moving animals will also need to be excluded from the road way. Carry forward for further analysis
Lane narrowing		It is required to determine if/where they would be required in order to act as effective traffic calming measures	Low	
Traffic detection at Mayfield road		If justified, at the intersection of Heart Lake Road and Mayfield Road	Low	May reduce traffic speed but unlikely to reduce wildlife-vehicle mortality unless combined with other mitigation
Turn restrictions			Low	
Permanent / seasonal road closure		Countryside to Sandalwood	High	Has been used effectively in other jurisdictions. There is an impact on local businesses. This option was previously screened out by the municipality

Heart Lake Wildlife Mortalities

PUBLIC INFORMATION CENTRE COMMENT SHEET[1]

Heart Lake Road Function and Design Review

Brampton, ON

1. Do you have any comments regarding the information and displays you have seen tonight? ***(use back of comment sheet if additional space required)***

OPTIONAL:

Name:

Email:

Address:

Please submit comments tonight or send by email or mail no later than Monday November 13, 2017 to:

Nelson Cadete
Project Manager - Active Transportation
City of Brampton
2 Wellington Street W, Brampton, ON, L6Y 4R2
Phone: (905) 874-2552
Email: nelson.cadete@brampton.ca

François Tomeo, P.Eng., GDBA
Project Manager – Planning & Traffic Engineering
Stantec Consulting Ltd.
300-49 Bathurst Street, Toronto, ON, M5V 2P2
Phone: (416) 598-6685
Email: francois.tomeo@stantec.com

[1] The information on this comment sheet is being gathered under the Municipal Freedom of Protection and Privacy Act and will be used to assist the City of Brampton with the subject study. Unless otherwise stated in your submission, any personal information such as name and address included in all submissions becomes part of the public record files for this project and can be released if requested to any person.

2017 11 17 Comments on Heart Lake Road Corridor PIC of Nov 2nd

By Dayle and David Laing, Brampton residents

Background:

The RFP that resulted in the engagement of Stantec to consult on the **"Function and Design Review of the Heart Lake Road Corridor"** was conceived by City of Brampton Council Minutes of April 22, 2015 to create the following **Heart Lake Road Mitigation Strategy:**

"3. That the Heart Lake Mitigation Strategy that identifies immediate, medium and long-term actions to conserve environmental and cultural heritage resources of Heart Lake Road while supporting employment, residential and institutional land uses, and addressing current / future transportation issues, be received; and,
4. That staff be directed to:
i. Continue to work with Ministry of Transportation to obtain approval of an intersection on Countryside Drive within the Highway 410 Permit Control Area east of Heart Lake Road, to facilitate future traffic from the new employment and residential plans of subdivision that abut Countryside Drive in order to protect the significant natural and cultural heritage resources of Heart Lake Road;
ii. Implement the proposed wildlife eco-passage culverts in partnership with (and funding support from) the Toronto and Region Conservation Authority and local developers; and,
iii. Undertake a Heart Lake Road Study subject to 2015 budget approval, to examine: long-term requirements for road infrastructure and management improvements necessary for development, natural and cultural heritage conservation and active transportation purposes; listing Heart Lake Road as a Cultural Heritage Landscape; and designating Heart Lake Road through the 2006 Official Plan Review to maintain a rural road cross-section; and,
5. That staff implement pavement markings along Heart Lake Road between Countryside Drive and Sandalwood Parkway in combination with warning signage focused on reducing speed through the three "hotspot" areas; and,
6. That this report and the P&IS report dated March 11, 2015 and Council's resolutions be forwarded to the Ministry of Transportation, Ministry of Natural Resources, Toronto and Region Conservation Authority, Etobicoke-Mimico Coalition and the Region of Peel.
Carried" – (Council Minutes, Apr 22, 2015)

This directive by Council was the culmination of years of TRCA's Heart Lake Road Ecology Monitoring Projects, 2011, 2013 and more recently 2014, 2016, David Laing's delegation of Report for City of Brampton Heritage Board April 15, 2014 (including a petition signed by 361 residents requesting Heart Lake Road to be listed as a Cultural Heritage Landscape), and City of Brampton's staff report on Heart Lake Road Mitigation to Planning Infrastructure Services on April 13, 2015.

Consultant was hired to consider:

- Protection of the natural area adjacent to Heart Lake Road (Provincially Significant Wetlands, at risk/endangered wildlife, protection of water table)
- Conservation of the cultural heritage landscape (recommendation for official listing)
- Long range transportation planning (including vehicles, bicycles and pedestrians) now & until 2041
- Land use planning (including businesses (Heart Lake Conservation Area, Treetop Trekking, Lakeside Garden Gallery), Burnt Log residential community, and Emery commercial land)

All alternatives should address the above terms of reference, explaining how competing priorities will be considered and weighed. In our opinion, the options presented failed to address this adequately.

2017 11 17 Comments on Heart Lake Road Corridor PIC of Nov 2nd

By Dayle and David Laing, Brampton residents

General Comments:

- Public Information Centre was held at the same time as PIC for Sandalwood Parkway, giving rise to confusion amongst attending residents who thought they were only coming to see Sandalwood boards. Many did not know there were 2 events in the same room.
- Board maps and details were small and difficult to read and comprehend.
- Traffic Volume Study performed mid-summer Jul 27-Aug 1, 2016 does not reflect school bus, parents driving kids to school, nor usage outside typical vacation time
- 2% truck vehicle volume indicates trucks use road, despite current "no truck" signage – this low number is not consistent with our observation of much higher truck volume, where we have witnessed 4 trucks in a 5 minute time period
- June 7-13, 2014 traffic study conducted by TRCA:
    - Traffic counters: just S of Countryside; just N of 410 off-ramp N of Sandalwood
    - Av daily traffic weekdays: 5,435 vehicles
    - Av daily traffic weekends: 7,073 vehicles
    - 85% travelled est. av speed 78 km/hr, despite speed limit on Heart Lake Road: 60 km/hr
- Caledon residential and commercial development Mayfield to Old School Rd was not considered
- Traffic avoiding the #410 traffic jams was not considered
- Vehicles create run-off pollutants, vibration and noise pollution that endangers wildlife in the Provincially Significant Wetlands, as well as wildlife/vehicle collisions.
- **Heart Lake Road Wetland Complex is listed Provincially Significant Wetland #7 out of 2,260 wetlands**, according to the Ontario Wetland Evaluation System (OWES) by Ontario Ministry of Natural Resources and Forestry.
- As a MNR Class 2 Wetland, the objective is "to ensure no loss of wetland area or function of provincially significant wetlands (MNR Classes 1 to 3) in accordance with the Wetlands Policy Statement". (Heart Lake Master Plan, 2006)
- *"4.4.8.1The City shall require an EIS, in accordance with the Wetlands Policy Statement, where development is proposed upon lands within 120 metres of a provincially significant wetland. Such study will be subject to the approval of the City, conservation authority and the Ministry of Natural Resources. Development may be permitted adjacent to such wetlands or within/adjacent to non-provincially significant wetlands subject to the outcome of an EIS. The requirements of the EIS would address concerns related to development within/adjacent to such areas.*
  4.4.8.7 The City shall, in conjunction with secondary plans and related official plan amendments, require that subwatershed management studies consider all wetlands within the study area in the context of the terrestrial and aquatic ecosystems, their functions and how such wetlands will be accommodated within the development process". – (Heart Lake Master Plan, 2006)
- There is no consideration for studying the hydrology of the road wetland complex, which has been fluctuating recently in an unpredictable manner based on prior trends.

Alternative A – Do Nothing

- Option does not protect environmental features, prevent high vehicle-wildlife collisions, reduce speed of vehicles over the currently posted 60kph rate, address the unique cultural heritage, nor address the vehicle emission run-off that threaten the fragile ecosystem.

Alternatives B-D&F – Bike Route/Lanes/Multi-Use Trail

- These 4 options all require widening road allowance and filling in Provincially Significant Wetlands to achieve sufficient width for bike lanes/trails, which is not an acceptable option.

- No mention of lowering the speed limit from 60 to 40kph, which is needed for safe comfortable cycling whether the buffer is a rumble strip, marker buffer or marked buffer plus bollards
- Only Alternatives D&F consider pedestrian use (consider Burnt Log community residents that are otherwise relegated to vehicle use); the separated facility would need a wider road allowance
- Alternative F does leverage existing recreational trails through Heart Lake Conservation Area, only with TRCA approval. This will not create an AT network route suitable to road cyclists & commuters.
- new route from Countryside Drive into HLCA would not only require TRCA approval, it would need to climb a high elevation to the esker or cause the esker to be cut to reduce the extreme grade
- lower portion of HLCA trail converted from existing mountain bike path to multiuse suitable for road bikes is problematic due to fragile ecosystem, steep terrain and seasonal flooding in low lying areas.
- None of the options address wildlife/vehicle collisions

Alternative E – Narrow Roadway incorporating Complete Streets design

- Complete streets are designed to be safe and comfortable for all users, including pedestrians, bicyclists, transit riders, motorists, and individuals of all ages and capabilities.
- Cyclists sharing a lane with vehicles (especially trucks) is neither safe nor comfortable at 60kph and this option addresses neither reducing speed limit to 40kph, nor enforcement
- It is unclear how roadway can be narrowed further from existing 11.2m. The 7m Pavement width is already at minimum for rural arterial road.

Roundabout

- Roundabout is an acceptable treatment of this intersection
- Footprint is only minimally larger; land acquired from NE corner would not affect wetlands, which are located on west and southeast sides.
- Unclear whether extra cost is applicable if long term maintenance of traffic signals are considered
- Unclear on what basis traffic signals are not warranted – not explained on board

Wildlife Conservation

- Options seem to focus on what has already been tried or considered and no new options are presented.
- Most mitigation measures listed as low success; those rated high have limited success, due to only the 3rd best hotspot being suitable for culvert and fencing. Hotspots #1 & #2 were found to have unstable roadbed soil. Unclear how these can now be considered and what has changed in the analysis. Extreme measures such as heavy equipment pounding the roadbed to stabilize would not be acceptable for wildlife protection reasons.
- Exclusionary fencing along entire stretch of roadway is a preferred option, although will not work on its own without reducing traffic speed and volume. It will still not stop all vehicle/wildlife collisions.
- speed bumps/rumble strips should have been considered as part of this analysis, not carried forward for future consideration
- Traffic deflection at Mayfield will not likely work when Emery lands are developed and used by large trucks
- Unclear why turn restrictions considered as low effectiveness – this option would be preferred

Alternative G

- will prevent through traffic with some 2-way and some 1-way.

2017 11 17 Comments on Heart Lake Road Corridor PIC of Nov 2nd

By Dayle and David Laing, Brampton residents

- Opportunity to create an amazing road with bioswales to clean run-off water, native plants, a more beautiful route to help sell the new Burnt Log community and benefit the garden centre.
- Speeding traffic makes exiting the garden centre difficult now.
- A bike route within the existing road allowance will connect our network to Countryside multiuse path, and make cycling safer along the road.

Conclusions

- Alternative G meets some the requirements as outlined in the study terms of reference.
- Heart Lake Rd speed limit should be reduced to 40kph with speed cushions (spring-fall) to reduce through traffic, also reducing some of the traffic at Sandalwood/Heart Lake where the collision rate is high.
- A roundabout at Countryside is efficient and also slows the traffic.
- Permanent fencing (not the temporary snow fencing) will help the turtles, frogs and swans.
- The road should be listed as a Cultural Heritage Landscape, as was requested in 2014.
- If protecting the 7th most important Provincially Significant Wetland in the province is not important, then one could reasonably ask what is important and why do we have such classifications.
- A proper balance of competing interests and weighing all the options will be good for our neighbourhood, the businesses and the wildlife, and protect the last of the natural cultural gems in Brampton
- Study should address how competing interest should be rated and ranked

Suggested Alignment Proposal:

Stantec

Memo

To:	Nelson Cadete City of Brampton	From:	Brandon Orr Stantec Consulting Ltd.
File:	165001037	Date:	December 6, 2017

Reference: **Heart Lake Road Function and Design Review – PIC #1 Summary**

INTRODUCTION

The City of Brampton has initiated a Function and Design Review of Heart Lake Road between Sandalwood Parkway to a point just north of Mayfield Road. The objectives of the study are the following:

- Assess the feasibility of preserving the existing rural/cultural landscape character of Heart Lake Road;
- Assess the current roadway structure and long-term function with the intent of identifying opportunities to safely accommodate active transportation, while meeting other transportation demands;
- Review the roadway operational mitigating measures that have been implemented with the intent of preserving and enhancing the unique cultural heritage landscape and existing wildlife;
- Review the road infrastructure improvements planned along Heart Lake Road which are intended to deter wildlife from crossing the road;
- Examine the implications on land use, development, and transportation of listing Heart Lake Road as a Cultural Heritage Landscape; and
- Make appropriate recommendations for all the objectives.

As part of this study there is a consultation component to identify the needs and opportunities for the City. This memo highlights the various comments and feedback received through the first public information centre (PIC) held on November 2 at Leafer's Lake Recreation Centre between 6:30 – 8:30pm, including in-person, telephone, and email exchanges of completed comments received at the public consultation.

During the PIC 11 display boards were presented showing the existing and planned conditions along Heart Lake Rd and the surrounding area as well as a list of potential transportation and environmental alternatives for the corridor.

SUMMARY OF COMMENTS RECEIVED

58 people attended the PIC where, during the public information centre session and the days following, nine (9) written comments were received. The following summarises those comments:

- Stantec staff were reminded about the overarching background of the project including comments from city council meeting minutes from April 22, 2015 regarding the creation of a Heart Lake Road Mitigation Strategy which was the culmination of years of the Toronto Region and Conservation Authority's (TRCA) Heart Lake Road Ecology Monitoring projects between 2011-2016. The directive of the proposed strategy included:

    3. "That the Heart Lake Mitigation Strategy that identifies immediate, medium and long-term actions to conserve environmental and cultural heritage resources of Heart Lake Road while supporting employment, residential and institutional land uses, and addressing current / future transportation issues, be received; and,

4. "That staff be directed to: i. Continue to work with Ministry of Transportation to obtain approval of an intersection on Countryside Drive within the Highway 410 Permit Control Area east of Heart Lake Road, to facilitate future traffic from the new employment and residential plans of subdivision that abut Countryside Drive in order to protect the significant natural and cultural heritage resources of Heart Lake Road; ii. Implement the proposed wildlife eco-passage culverts in partnership with (and funding support from) the Toronto and Region Conservation Authority and local developers; and, iii. Undertake a Heart Lake Road Study subject to 2015 budget approval, to examine: long-term requirements for road infrastructure and management improvements necessary for development, natural and cultural heritage conservation and active transportation purposes; listing Heart Lake Road as a Cultural Heritage Landscape; and designating Heart Lake Road through the 2006 Official Plan Review to maintain a rural road cross-section; and,"

5. "That staff implement pavement markings along Heart Lake Road between Countryside Drive and Sandalwood Parkway in combination with warning signage focused on reducing speed through the three "hotspot" areas; and,"

6. "That this report and the P&IS report dated March 11, 2015 and Council's resolutions be forwarded to the Ministry of Transportation, Ministry of Natural Resources, Toronto and Region Conservation Authority, Etobicoke-Mimico Coalition and the Region of Peel. Carried"

One member of the public gave a very detailed response to the PIC and felt that most of the options presented had failed to address the study's priorities adequately and that Alternative G was their preferred alternative because of the following:

- Traffic Volume Study performed mid-summer Jul 27-Aug 1, 2016 does not reflect school bus, parents driving kids to school, nor usage outside typical vacation time;
- 2% truck vehicle volume indicates trucks use road, despite current "no truck" signage – this low number is not consistent with our observation of much higher truck volume, where we have witnessed 4 trucks in a 5-minute time period;
- Failed to adequately emphasise the lack of speed limit compliance on Heart Lake Road;
- Caledon residential and commercial development Mayfield to Old School Rd was not considered;
- Traffic avoiding the #410 traffic jams were not considered;
- Vehicles create run-off pollutants, vibration and noise pollution that endangers wildlife in the Provincially Significant Wetlands, as well as wildlife/vehicle collisions;
- The current study does not comply the Ministry of National Resources Class 2 Wetlands Policy Statement as outlined in the 2006 Heart Lake Master Plan;
- There is no consideration for studying the hydrology of the road wetland complex, which has been fluctuating recently in an unpredictable manner based on prior trends;
- Alternatives B-D & F all require widening road allowance and filling in Provincially Significant Wetlands to achieve sufficient width for bike lanes/trails, which is not an acceptable option and no mention of lowering speed limit to 40kph, and none address wildlife/vehicle collisions.

- Alternative F, although leveraging existing trails through Heart Lake Conservation Area, will not create an Active Transportation Network route suitable to road cyclists & commuters, it would also present considerable grade changes that may be difficult for some cyclists, and the existing trail is prone to seasonal flooding.
- Alternative E did not provide enough protection for cyclists and pedestrians from road traffic, did not include speed reduction to 40kph, and unsure about whether the road could be widened any further based on existing classification as a rural arterial road.
- Alternative G preferred as it will provide a separated facility for cyclists and reduce the number of vehicles on the roadway and reduce the number of conflicts with wildlife. Also presents opportunity to create bioswales to clean run-off water, native plants, and provide a more beautiful route.

The remaining comments provided by the public were general in nature including:

- A desire for enhanced active transportation facilities on Heart Lake Road, all comments mentioning active transportation facilities preferred a separated facility type;
- Recommendation to provide active transportation connections to Esker Lake Trail to promote their use for accessing the conservation area;
- Recommendation to address future traffic with Active Transportation and Transit instead of promoting the private automobile;
- Recommendation to implement traffic calming measures such as speed cushion and rumble strips;
- Preference for a roundabout at Heart Lake Road and Countryside Drive to act as a traffic calming measure, although more information regarding why signals or stops signs are not warranted;
- Heightened consideration for wildlife and the environment in the corridor as it is the 7th most important Provincially Significant Wetland in the province. This includes a preference for a greater degree of exclusionary fencing along the roadway and reduced traffic speeds;
- Desire for increased public awareness of the significance of the provincially significant wetland;
- Proper balance of competing interests and weighting for all options that consider the local neighbourhood, businesses, and the wildlife;
- Concerns about developments adjacent to the corridor and their environmental impacts on the corridor;

STANTEC CONSULTING LTD.

Brandon Orr, BES, MCIP, RPP
Transportation Planner

Phone: (416) 507-3487

Reference: Heart Lake Road Function and Design Review – PIC #1 Summary

Brandon.Orr@stantec.com

Attachment: Attachment

c. C.C.

Function and Design Review

of the Heart Lake Road Corridor

LET'S CONNECT

The City of Brampton is reviewing the function and design for Heart Lake Road between Sandalwood Parkway and Mayfield Road.

Your input is important

Please join us to see what is being recommended as the preferred solution.

Wednesday, May 16, 2018
6:30 to 8:30 pm

Loafer's Lake Recreation Centre Room 1
(30 Loafer's Lake Lane, Brampton)

About the study

We are examining:

- the long term role and function of Heart Lake Road
- design requirements that address the:
  - o future multi-modal transportation demand
  - o planned land use and development
  - o protection of environmental features and wildlife
  - o recognition of the unique cultural heritage of the study area

If you have any questions or wish to be added to the study mailing list, please contact:

Nelson Cadete, Project Manager, Active Transportation

City of Brampton
2 Wellington Street West
Brampton ON L6Y 4R2
Phone: 905.874.2552
Fax: 905.874.2099
Email: nelson.cadete@brampton.ca

Francois Tomeo, P. Eng., GDBA
Project Manager, Transportation Planning & Traffic Engineering

Stantec Consulting Ltd.
300-49 Bathurst Street
Toronto, ON M5V 2P2
Phone: 416-598-6685
Email: francois.tomeo@stantec.com

3-1-1 brampton.ca

BRAMPTON

18-0711

BRAMPTON Flower City LET'S CONNECT

Heart Lake Road
Function and Design Review
Public Information Centre

Date: Wednesday, May 16, 2018

Time: 6:30 to 8:30 pm

Location: Loafer's Lake Recreation Centre – Room 1
30 Loafer's Lake Lane, Brampton

Stantec

BRAMPTON Flower City brampton.ca

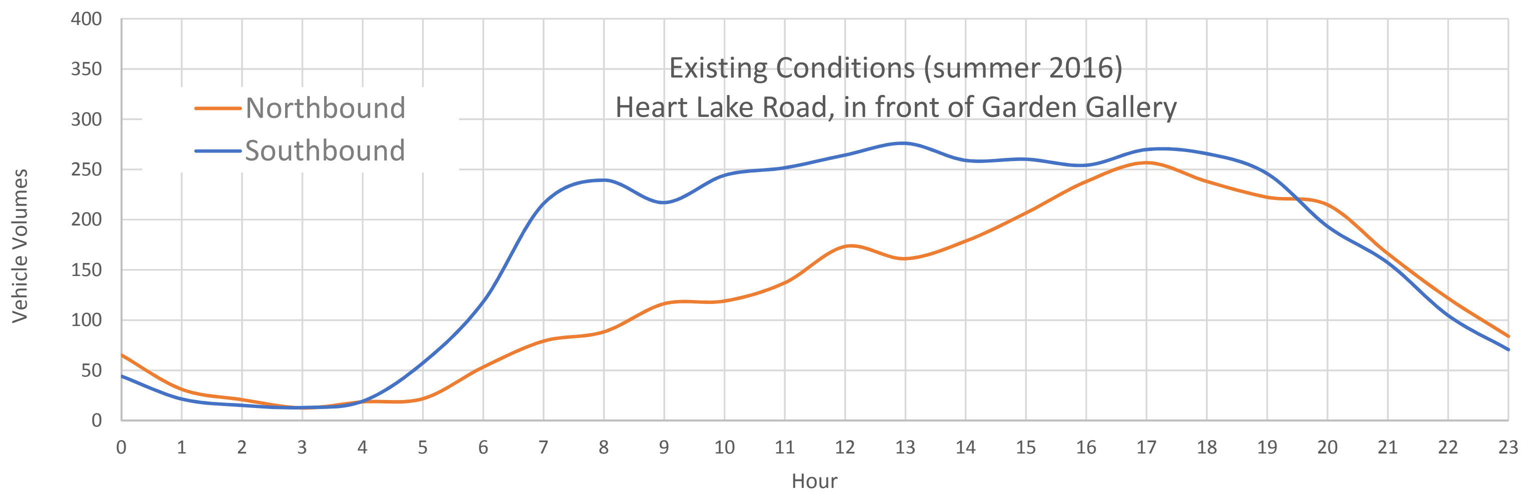
LET'S CONNECT

The Function and Design Review of the Heart Lake Road Corridor

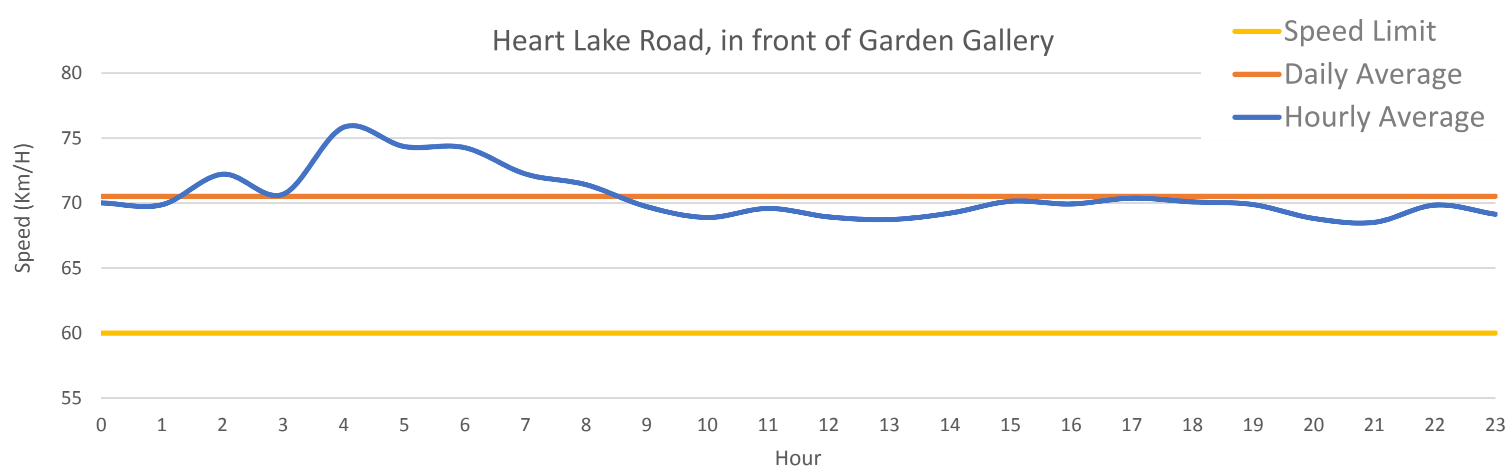
Key Issues and Challenges

MULTIMODAL TRANSPORTATION

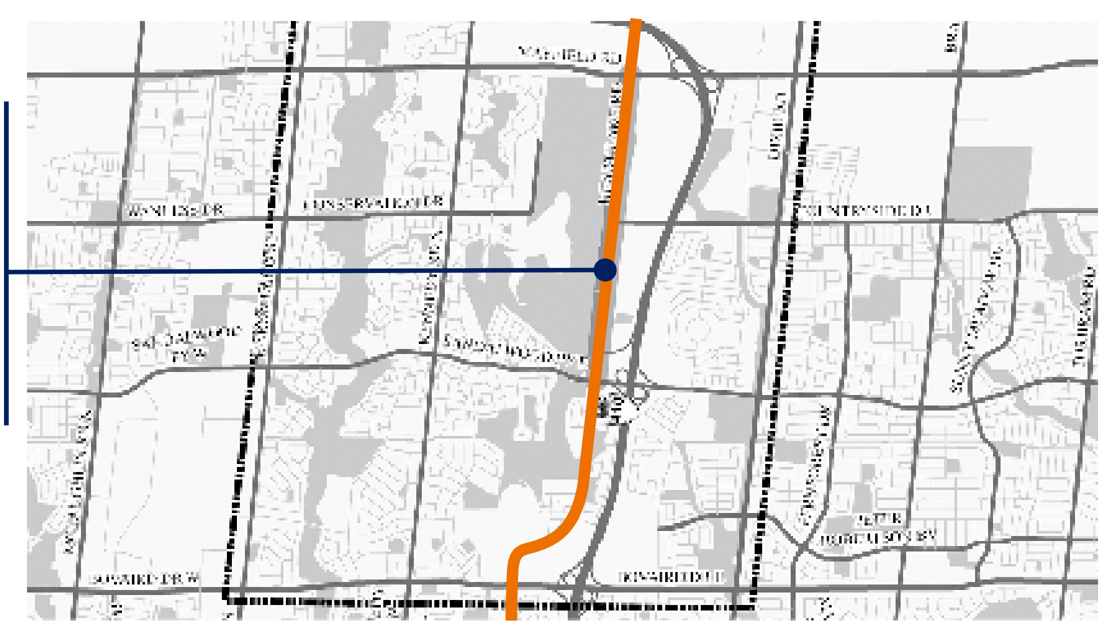
Existing and forecasted volumes do not justify widening



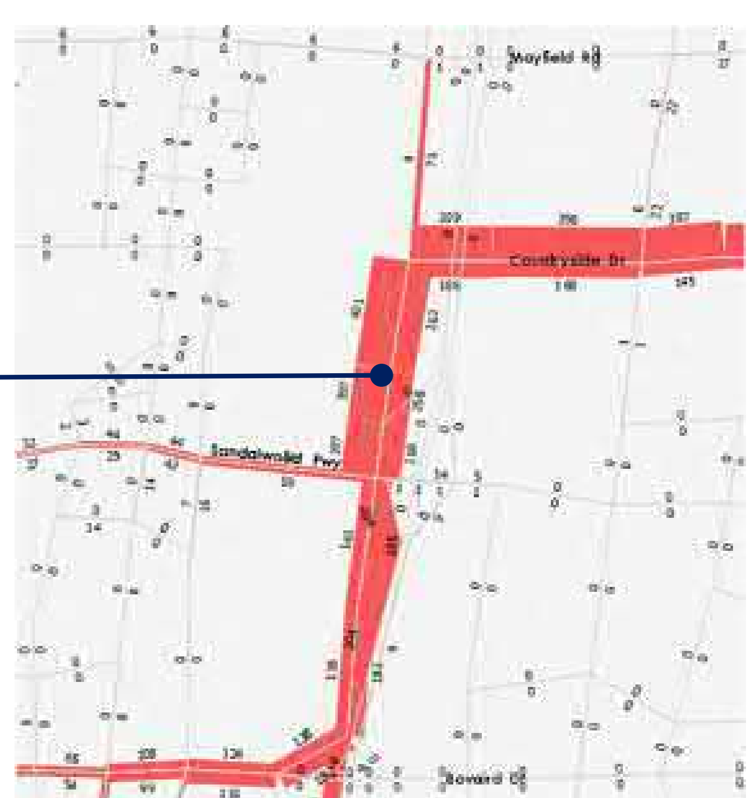
Existing Conditions: Vehicles exceed speed limits



Heart Lake Road is identified as a candidate for bicycle lane in the latest City of Brampton TMP (2015)



Vehicular travel demand on Heart Lake Road is concentrated between Countryside and Sandalwood



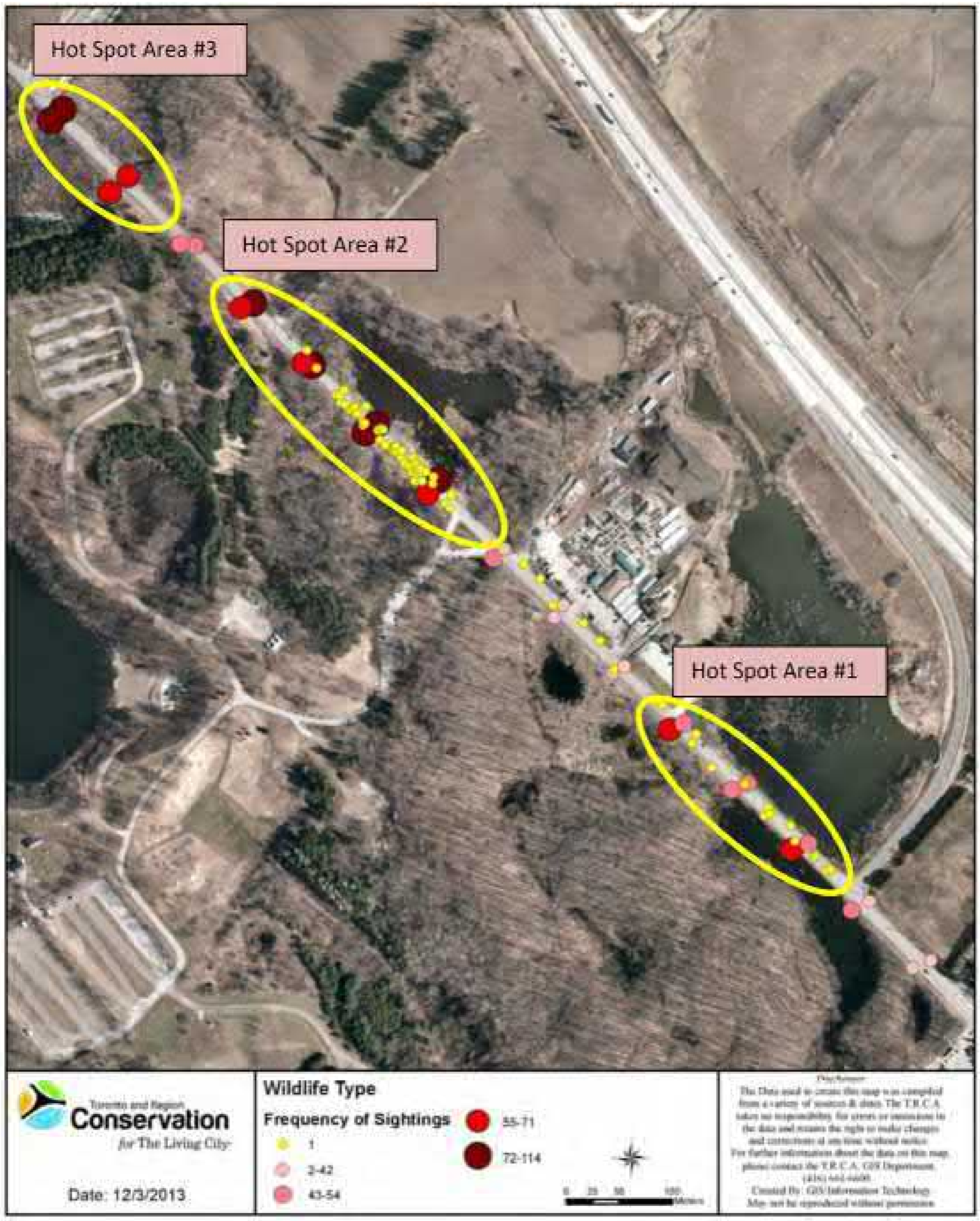
Stantec

BRAMPTON Flower City LET'S CONNECT

The Function and Design Review of the Heart Lake Road Corridor

Key Issues and Challenges

WILDLIFE MORTALITIES



CULTURAL HERITAGE

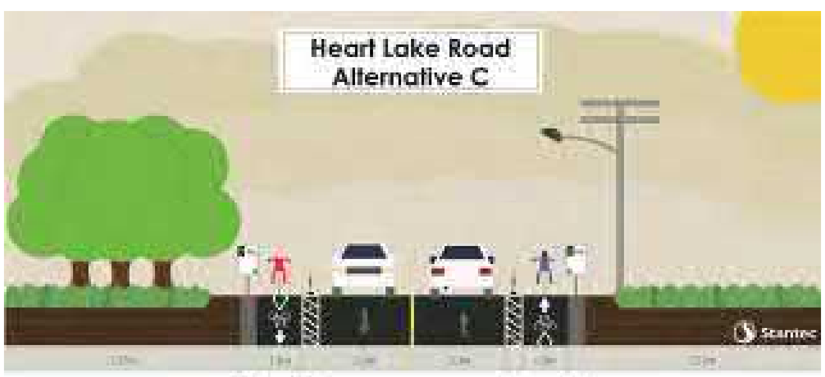
- Study area is not currently listed on the City's Municipal Register of Cultural Heritage Resources (2016) or designated under the Ontario Heritage Act (OHA)
- Brampton Heritage Board received a delegation from the public seeking the possible recognition of Heart Lake Road as a cultural heritage landscape; the recognition was not defined at the time
- Full Heritage Impact Assessment must be conducted for the study area
- Roadway crosses one of the most Provincially and Regionally significant natural areas within the City of Brampton; Heart Lake Road is visually distinct from the surrounding lands since it is mostly bordered by natural areas that have not been used for residential development

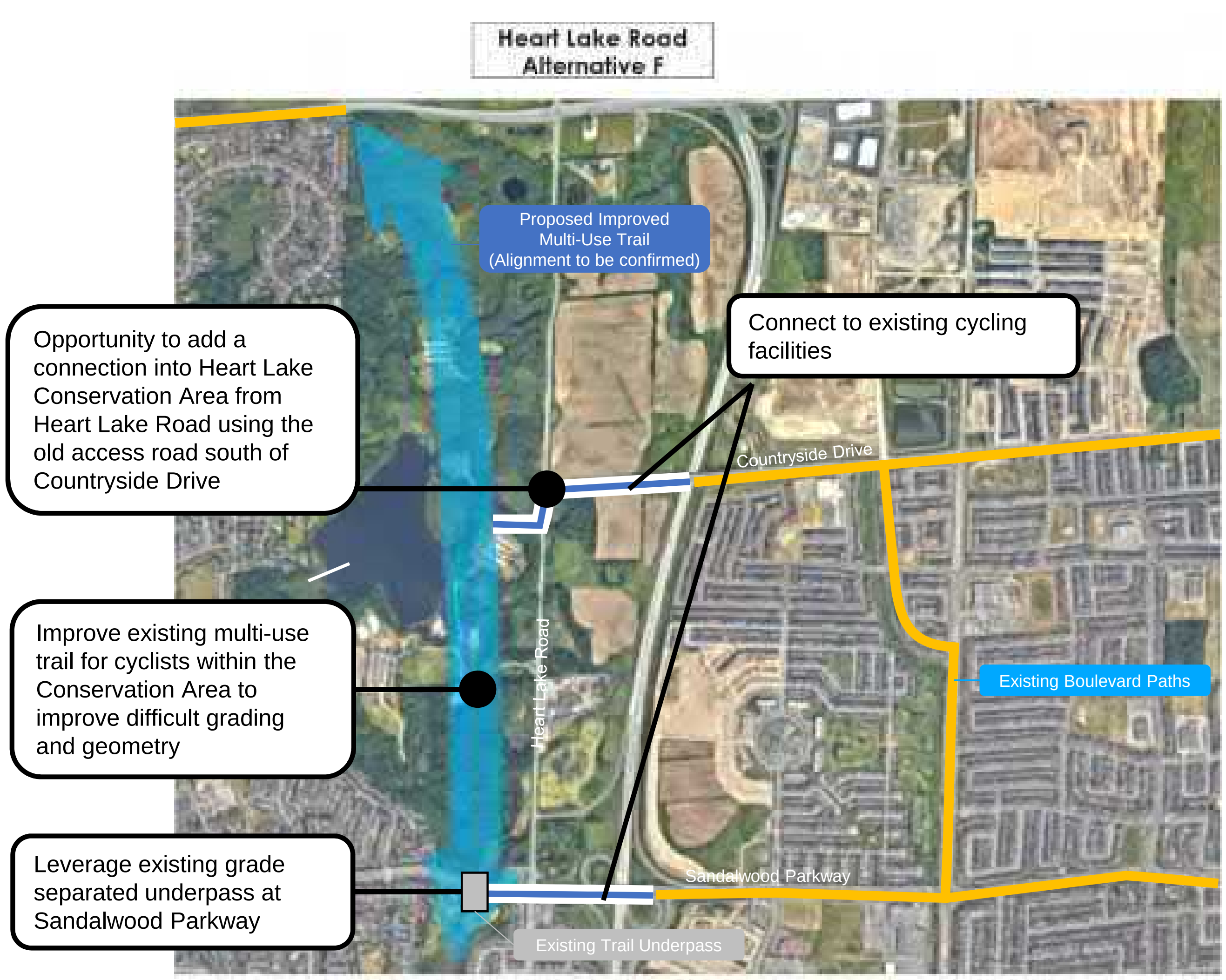
Stantec

The Function and Design Review of the Heart Lake Road Corridor

ALTERNATIVES

TRANSPORTATION ALTERNATIVES





Stantec

BRAMPTON Flower City brampton.ca LET'S CONNECT

The Function and Design Review of the Heart Lake Road Corridor

ALTERNATIVES

TRANSPORTATION ALTERNATIVES

TRAFFIC CALMING

Roundabout at Countryside

Stop control or traffic circles at intersections

Speed Cushions
Lane Narrowing with rumble strips

WILDLIFE MITIGATION

Wildlife crossing structure (concrete culvert)

Wildlife directional fencing

Turtle nesting beaches

Natural Area / Wildlife Signage

Stantec

BRAMPTON Flower City brampton.ca

LET'S CONNECT

The Function and Design Review of the Heart Lake Road Corridor

EVALUATION CRITERIA

Category	Criteria	Factor
Multi-Modal Transportation	Roadway geometry	Satisfies desirable design criteria
	Access	Proximity to community facilities
	Traffic	Impacts to traffic operations
	Traffic calming	Reduce speed
	Cycling	Attract cyclists and promote bicycle connectivity
	Safety	Improve safety for all road users
Social and Cultural Environment	Built cultural heritage resources and landscapes	Preserve cultural heritage features
	Agricultural resources	Minimize impacts to agricultural lands
	Land use	Minimize impacts to existing residential/ recreational properties
	Economic environment	Accommodate planned development and growth
Natural Environment	Designated natural areas	Minimize impacts to designated natural areas
	Wildlife and terrestrial habitat	Minimize impacts to wildlife
	Vegetation	Minimize impacts to vegetation
	Surface water and drainage	Minimize impacts to surface water and ground water
	Terrestrial habitat design factors	Minimize impacts to designated natural areas
		Minimize impacts to wildlife
		Minimize impacts to vegetation

Stantec

The Function and Design Review of the Heart Lake Road Corridor

EVALUATION OF TRANSPORTATION ALTERNATIVES

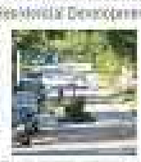
Category	Criteria	Factors	A Do Nothing	B Two Lanes with Paved Shoulders and Rumble Strips	C Two Lanes with Separated Bike Lanes	D Two Lanes with Separated Bi-directional Multi-Use Path on one side	E Narrow Roadway with Shared Bike Lanes	F Hybrid Multi-Use Trail in Heart Lake Conservation Area	G One way operation with Separated Bike Lanes
Multi-Modal Transportation	Roadway Geometry	Minimum Desirable Design Criteria	The existing vehicular lane widths of ~3.5m make the roadway more comfortable for cars and promote faster speeds	✓ Would require the vehicular lane to be narrowed to 3.3m and the addition of a painted 0.5m rumble strip buffer and 1.5m paved shoulder for cycling with and another 0.5m of unpaved shoulder. The existing un-paved shoulder would have to be partially paved. (MTO, 2013). A 0.5m painted buffer would be required.	✓ Would require the vehicular lane to be narrowed to 3.3m and the addition of a 0.5m buffer with flexible bollards and 1.5m paved dedicated bicycle lane and another 0.5m of unpaved shoulder. The existing un-paved shoulder would have to be partially paved and flexible bollards would have to be installed. (MTO, 2013). A 0.5m painted buffer would be required.	✓ Would require the vehicular lane to be narrowed to 3.3m and a 3.0m bi-directional multi-use facility would be placed on either the east or west side of the roadway with a 0.5m shoulder buffer. This would require the vehicular lanes to be shifted to the east or west side. (MTO, 2013). A controlled crossing is required at Countryside Drive and future access to residential development.	✓ Would require the vehicular lane to be narrowed to 3.3m and the overall paved width of the roadway gets narrowed with traffic calming measures along the roadway including speed cushions and traffic circles. The rationale is to make the roadway feel less like a high-speed route and more like a slower local route.	+ Would require appropriate multi-use trail connections between existing boulevard paths along Countryside Drive and Sandalwood Parkway to connect to the existing internal trail within the Heart Lake Conservation Area. Pedestrians would also be accommodated on the multi-use trail. Refurbishment of the existing trail/old access road entrance opposite Countryside Drive is required.	× Change Heart Lake Road to one-way operation going northbound between Sandalwood Parkway and Countryside Drive. This alternative will increase the travel distance from Heart Lake Road (north) to the Conservation Area by 1.8km, and from the Conservation Area to Heart Lake Road (south) by 4.0km.
	Access	Proximity to Community Facilities	✓ Existing vehicular access to facilities maintained. × Currently requires cyclists to share the roadway (ride with traffic) along Heart Lake Road which provides a direct access to the main Heart Lake Conservation Area Entrance and other properties along the corridor.	✓ Existing vehicular access to facilities maintained. – Would provide direct access to the main Heart Lake Conservation Area entrance off of Heart Lake Road. A cyclist will have to ride with traffic along Heart Lake Road to access the Conservation Area entrance.	✓ Existing vehicular access to facilities maintained. ✓ Would provide direct access to the main Heart Lake Conservation Area entrance off of Heart Lake Road. A cyclist will have to ride with traffic along Heart Lake Road to access the Conservation Area entrance.	✓ Existing vehicular access to facilities maintained. ✓ Would provide a direct access into the Heart Lake Conservation Area and reduce conflict points for active transportation road users if the multi-use facility were to be placed on the west side of the roadway.	✓ Existing vehicular access to facilities maintained. ✓ Would provide direct access to the main Heart Lake Conservation Area entrance off of Heart Lake Road and would require cyclists exiting towards the north and entering from south to cross one vehicular lane of traffic.	+ Would provide a direct access into the Heart Lake Conservation Area and reduce conflict points via protected crossings for entering and exiting. – Does not provide continual/direct access to all destinations along Heart Lake Road. + Trail could also accommodate pedestrians.	× Vehicular access to destinations along Heart Lake Road will be limited to access from the south.
	Traffic	Impacts to Traffic Operations	× Maintain existing operations. Does not promote cycling or walking, does not conform with the municipal transportation master plan vision.	✓ Little to no impacts on traffic operations.	✓ Little to no impacts on traffic operations.	✓ Little to no impacts on traffic operations.	✓ May generate minor impacts on adjacent corridors by making the corridor less appealing for through vehicles.	✓ Little to no impacts on traffic operations. Conforms to municipal transportation master plan vision.	× Significant impacts to traffic operations, would require considerable extra travel distance for vehicles to travel southbound from within the corridor. Would also generate impacts on adjacent corridors.
	Speed	Reduce Speed	– The roadway will maintain poor speed compliance with the existing compliance rate at 11% indicating that only 11% of drivers travel at or below the posted speed limit. Heart Lake Road also includes advisory and warning signage which is meant to raise awareness/identify the wildlife crossing potential hazard.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for 3.3m vehicular lane widths. The rumble strip buffer will further re-inforce narrow roadway cues even if visually, the corridor looks wide and rural.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for 3.3m vehicular lane widths. The physical flexible bollards will create a visual wall to make the roadway look more urban and less rural to promote slower speeds.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for 3.3m vehicular lane widths. (Columbia Pike Street Space Planning Task Force, 2005) (MTO, 2008) (MTO, 2013)	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for 3.3m vehicular lane widths. The addition of traffic calming measures such as speed cushions and traffic circles have been found to be effective ways to reduce vehicular speed, volume and increase safety along roadways.	– The roadway will remain mostly unchanged beyond intersection improvements at Heart Lake Road and Countryside Drive that will have minor positive impacts on traffic speed.	– Increase in volume is forecasted on Countryside Drive eastbound due to forced right turns northbound at the intersection of Heart Lake Road and Countryside Drive. It may also increase overall trip length for vehicles as it forces all vehicles to go northbound. – The option may increase speeding.
	Cycling	Attract Cyclists and Promote Bicycle Connectivity	– Currently no cycling infrastructure is in place.	– The signed route will connect with future and existing boulevard paths on Countryside Drive and Sandalwood Parkway. This facility type has a low attractiveness for cyclists.	+ The separated bicycle lane will connect with existing boulevard paths on Countryside Drive and Sandalwood Parkway. This facility type has a high attractiveness for cyclists.	+ The separated bi-directional multi-use trail will connect with existing boulevard paths on Countryside Drive and Sandalwood Parkway. This facility type has a high attractiveness for cyclists.	✓ The shared route will connect with existing boulevard paths on Countryside Drive and Sandalwood Parkway. This facility type will be attractive to cyclists based on the effectiveness of traffic calming measures.	+ Direct internal connections to Heart Lake Conservation Area will be made to the existing boulevard paths on Countryside Drive and Sandalwood Parkway. A new section of the recreational trail through the Conservation Area lands will complete a gap in the Etobicoke Lake Recreational Trail.	+ The separated bi-directional multi-use trail will connect with existing boulevard paths on Countryside Drive and Sandalwood Parkway. This facility type has a high attractiveness for cyclists.
	Safety	Improve Safety For All Road Users	– The roadway will remain unchanged. Speed compliance will remain low and there are no traffic calming measures to help reduce the severity of collisions with vehicles or cyclists beyond the existing speed optical bars.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for the narrowed lanes. The lower speed limit will work towards reducing the severity of collisions and the paved shoulders will reduce conflicts between cyclists and vehicles.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for the narrowed lanes. The dedicated bicycle lanes with flexible bollards will significantly reduce conflicts between cyclists and vehicles by providing physical and visual cues separating the two modes.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for the narrowed lanes. The separated bi-directional multi-use path will significantly reduce conflicts between cyclists and vehicles by providing complete separation between the two modes.	✓ The operating speeds will be reduced to 50km/h to adhere to appropriate design speed standards for narrowed lanes. Traffic calming measures such as speed cushions and traffic circles will further reinforce reduced vehicular speeds. There is no dedicated space for cyclists on the roadway and existing conflicts will still remain.	– The roadway will remain mostly unchanged beyond intersection improvements at Heart Lake Road and Countryside Drive that will have minor positive impacts on traffic speed and collisions.	✓ One-way operation would allow cyclists to use the southbound lane for travel along the corridor separated from traffic which would enhance cyclist safety greatly.
Social and Cultural Environment	Built Cultural Heritage Resources and Landscapes	Preserve Cultural Heritage Features	✓ Natural characteristics adjacent to the roadway remain intact, comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact, comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact, comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact, comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact, comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact, comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural characteristics adjacent to the roadway remain intact, comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands
	Agricultural Resources	Minimize Impacts to Agricultural Lands	+ No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Road	+ No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Rd	+ No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Rd	+ No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Rd	+ No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Rd	+ No impacts to agricultural lands located north of Countryside Road/east side of Heart Lake Rd	+ No impacts to agricultural lands located north of Countryside Road/east of Heart Lake Rd
	Land Use	Minimize Impacts to Existing Residential Recreational Properties	+ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre + No impact to recreational facilities at Heart Lake Conservation Area	+ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre + No impact to recreational facilities at Heart Lake Conservation Area	+ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre + No impact to recreational facilities at Heart Lake Conservation Area	+ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre + No impact to recreational facilities at Heart Lake Conservation Area	+ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre + No impact to recreational facilities at Heart Lake Conservation Area	+ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre + Enhanced connections to existing recreational facilities at Heart Lake Conservation Area	× Significant impacts to existing facilities. Would require vehicles leaving the properties along the roadway to travel much further to go southbound. × Would increase the distance vehicles accessing the corridor would have to travel.
	Economic Environment	Accommodate Planned Development and Growth	✓ No impact to planned industrial/employment development. Private School development, residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development. Private School development, residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development. Private School development, residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development. Private School development, residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development. Private School development, residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development. Private School development, residential development within the Countryside Villages Secondary Plan area	× Would require vehicles leaving the properties along Heart Lake Road to travel much further to go southbound. Would increase the distance vehicles accessing the corridor would have to travel.
Natural Environment	Designated Natural Areas	Minimize Impacts to Designated Natural Areas	+ No impacts	+ Work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas	+ Work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas	+ Work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas	+ Work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas	✓ Minor impacts to vegetated areas inside Heart Lake Conservation Area.	+ Work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas
	Wildlife and Terrestrial Habitat	Minimize Impacts to Wildlife	+ No impacts	+ Paved shoulders may deter turtle nesting sites that exist along gravel shoulders	+ Paved shoulders may deter turtle nesting sites that exist along gravel shoulders	+ Paved shoulder surface may deter turtle nesting sites that exist along gravel shoulders	+ Continue to implement the wildlife signs, concrete box culvert (ecopassage), fencing, and artificial turtle nesting mounds	+ Refurbishment to the existing trail/old access road entrance may remove some existing habitat within Heart Lake Conservation Area.	+ No impacts
	Vegetation	Minimize Impacts to Vegetation	+ No impacts to vegetation, no change to Right of Way	+ No impacts to vegetation, no change to Right of Way	+ No impacts to vegetation, no change to Right of Way	+ No impacts to vegetation, no change to Right of Way	+ No impacts to vegetation, no change to Right of Way	+ Removal of old growth vegetation within the existing trail/old access road entrance	+ No impacts to vegetation, no change to Right of Way
	Surface Water and Drainage	Minimize Impacts to Surface Water and Ground Water	– Salt and/or sand from road winter operations can cause changes in the water quality to neighboring wetlands and potentially impact surface and groundwater + No change to paved portion of shoulder	– Salt and/or sand from road winter operations can cause changes in the water quality to neighboring wetlands – Paving a portion of the shoulder would create greater impervious cover	– Salt and/or sand from road winter operations can cause changes in the water quality to neighboring wetlands – Paving a portion of the shoulder would create greater impervious cover	– Salt and/or sand from road winter operations can cause changes in the water quality to neighboring wetlands – Paving a portion of the shoulder would create greater impervious cover	– Salt and/or sand from road winter operations can cause changes in the water quality to neighboring wetlands + No pavement increase to existing shoulder	+ No salt or fluids originating from vehicles and salt distributing vehicles affect the existing trail/old access road entrance	– Salt and/or sand from road winter operations can cause changes in the water quality to neighboring wetlands + No pavement increase to existing shoulder
	Scoring								
	+ Most Preferred		+ 7	+ 6	+ 8	+ 7	+ 7	+ 10	+ 6
	✓ Moderately Preferred		✓ 3	✓ 7	✓ 6	✓ 8	✓ 9	✓ 4	✓ 2
	– Least Preferred		– 5	– 4	– 3	– 0	– 1	– 3	– 3
	× Fail		× 2	× 0	× 0	× 2	× 0	× 0	× 6
			17	17	17	17	17	17	17

BRAMPTON Flower City brampton.ca

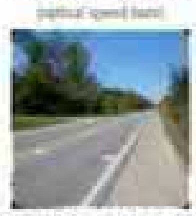
LET'S CONNECT

The Function and Design Review of the Heart Lake Road Corridor

EVALUATION OF TRAFFIC CALMING ALTERNATIVES

Category	Criteria	Factors	A Do Nothing	B Stop control or traffic circles at intersections (Heart Lake Conservation Area/New Residential Development)	C Speed Cushions Lane Narrowing with rumble strips	D Traffic Deflection at Countryside Drive One-way operation with Separated Bike Lanes	E Roundabout at Countryside Option 1	F Roundabout at Countryside Option 2
					 	 		
Multi-Modal Transportation	Roadway Geometrics	Satisfies Desirable Design Criteria	– The existing vehicular lane widths of 3.5m make the roadway more comfortable for cars and promote faster speeds.	✓ Added stop signs or traffic circle to the Heart Lake Road and Conservation Area Entrance. Traffic circles consist of a raised island located in the centre of an intersection which requires vehicles to travel through the intersection and around the island. Traffic speed would have to be reduced to 50km/h and the roadway would have to be re-classified as either a collector or local roadway.	• Speed cushions are raised sections of the roadway designed to discourage motor vehicle drivers from travelling at excessive speeds. These are an acceptable measure for roadways with low volumes (MTO, 2013). To implement this measure on Heart Lake Road, the traffic speed would have to be reduced to 50km/h and the roadway would have to be re-classified as either a collector or local roadway. • Vehicular lane would be narrowed to 3.3m along with rumble strips to give physical and auditory cues to drivers that they should not use the wider shoulder. (MTO, 2013). This would require a reduction in the speed limit as lane widths of 3m are recommended for roadways that operate at vehicular speeds of 50km/h or less.	– Roadway would be closed to general traffic going south from Countryside Drive, but would still allow local traffic and general traffic exiting northbound. – Change Heart Lake Road to one-way operation going northbound between Sandalwood Parkway and Countryside Drive.	– Convert the existing non-signalized intersection at Countryside Drive to a roundabout. This would replace the existing free movement northbound and southbound approaches with yielding approaches going around a raised island. This option is less complex and extends onto the existing TRCA lands on the west portion of the intersection.	✓ Convert the existing non-signalized intersection at Countryside Drive to a roundabout. This would replace the existing free movement northbound and southbound approaches with yielding approaches going around a raised island. This option involves more complexity without impacting the TRCA lands but requires the relocation of hydro lines on the east side of the intersection.
	Traffic Calming	Reduce Speed	– The roadway will maintain poor speed compliance with the existing compliance rate at 11% and 85th percentile speeds at 80km/h despite the posted speed limit of 60km/h.	✓ The speed limit will be reduced to 50km/h to adhere to appropriate design speed standards for traffic circles. Traffic circles are effective at promoting speed reduction and reducing vehicular volume. (Columbia Pike Street Space Planning Task Force, 2003) (MTO, 2006) (MTO, 2013)	✓ The speed limit will be reduced to 50km/h to adhere to appropriate design speed standards for speed cushions. Speed cushions are highly effective at reducing speed and reducing vehicular volume. ✓ Case studies have found a relationship between narrower road widths and slower vehicular speeds, although a narrow roadway is not the only determining factor and their effectiveness depend on other factors including roadway curvature, roadside development, type of traffic control, among others. The rumble strip buffer will further re-inforce narrow roadway cues even if visually, the corridor looks wide and rural	– This may initially reduce traffic volume, however, deflecting traffic away from the corridor will not help reduce traffic speed along the corridor and may even promote higher speeds as there are few obstacles and vehicular interactions along the roadway. – It would effectively increase volume on certain portions of the roadway and would have minimal impacts on travel speed, despite a potential reduction in the speed limit to 50km/h. It may also increase overall trip length for vehicles as it forces all vehicles to go northbound with the nearest southbound route located far away east of Highway 410.	✓ The roundabout will physically require all vehicles to reduce their speed in order to pass around the raised island. This is highly effective compared to the existing north-south movements that are unimpeded and free-flowing.	✓ The roundabout will physically require all vehicles to reduce their speed in order to pass around the raised island. This is highly effective compared to the existing north-south movements that are unimpeded and free-flowing.
	Safety	Improve Safety for all Road Users	× Currently no cycling infrastructure is in place	✓ A reduced speed limit and addition of a traffic circle will reduce speeds along the roadway and improve cyclist comfort	✓ A reduced speed limit and addition of speed cushions will reduce speeds along the roadway and improve cyclist comfort. ✓ A narrower roadway will have some effect toward encouraging slower speeds with some minor improvement to cyclist comfort	– Lower traffic volumes will improve cyclist comfort somewhat, but there would be little improvement to traffic speed. ✓ One-way operation would allow cyclists to use the southbound lane for travel along the corridor, separated from traffic which would enhance cyclist safety greatly.	✓ Slower vehicular operation through the Countryside Drive intersection along with a more direct line of sight for cyclists will greatly enhance safety.	✓ Slower vehicular operation through the Countryside Drive intersection along with a more direct line-of-sight for cyclists will greatly enhance safety.
Social and Cultural Environment	Built Cultural Heritage Resources and Landscapes	Preserve Cultural Heritage Features	✓ Natural character of the roadway remains intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural character of the roadway remains intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands	✓ Natural character of the roadway remains intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands.	✓ Natural character of the roadway remains intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands.	– Requires vegetation adjacent to roadway to be removed to accommodate roundabout design × Encroaches on the TRCA lands.	✓ Natural characteristics adjacent to the roadway remains intact; comprised of varied topography, wetlands, treed ridges, forested areas, and rolling agricultural lands.
	Land Use	Minimize Impacts to Existing Residential/ Recreational Properties	✓ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre ✓ No impact to recreational facilities at Heart Lake Conservation Area	✓ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre • Would enhance access to the recreational facilities at Heart Lake Conservation Area by slowing traffic down at the access	✓ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre. ✓ No impact to recreational facilities at Heart Lake Conservation Area	× Significant impacts to planned residential developments, and existing commercial and recreational facilities. Would prevent access to site along the roadway from the north. × One way operation with separated bike lanes would result in large impacts to planned residential developments, and existing commercial and recreational facilities. Would require vehicles leaving the properties along the roadway to travel much further to go southbound.	✓ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre ✓ No impact to recreational facilities at Heart Lake Conservation Area	✓ No impacts to residential developments planned in the Metrus Development north of Lakeside Garden Centre ✓ No impact to recreational facilities at Heart Lake Conservation Area
	Economic Environment	Accommodate Planned Development and Growth	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	✓ No impact to planned industrial/employment development; Private School development; residential development within the Countryside Villages Secondary Plan area	× Significant impacts to planned residential developments, and existing commercial and recreational facilities. Would prevent access to site along the roadway from the north. Would increase the distance vehicles accessing the corridor would have to travel. × One way operation with separated bike lanes would result in large impacts to planned residential developments, and existing commercial and recreational facilities. Would require vehicles leaving the properties along the roadway to travel much further to go southbound. Would increase the distance vehicles accessing the corridor would have to travel.	✓ Improved connections between the east and west sides of the roadway for planned industrial / employment development, Private School development, residential development within the Countryside Villages Secondary Plan area	✓ Improved connections between the east and west sides of the roadway for planned industrial / employment development, Private School development, residential development within the Countryside Villages Secondary Plan area
Natural Environment	Designated Natural Areas	Minimize Impacts to Designated Natural Areas	✓ No impacts to designated natural areas	✓ No impacts to designated natural areas	✓ No impacts to designated natural areas	✓ No impacts to designated natural areas	× Impacts to lands associated with the Heart Lake Conservation Area	✓ Minor impact to lands adjacent to the intersection of Countryside Dr and Heart Lake Rd
	Wildlife and Terrestrial Habitat	Minimize Impacts to Wildlife	✓ No impacts to wildlife	✓ No impacts to wildlife	✓ No impacts to wildlife	✓ No impacts to wildlife	✓ No impacts to wildlife anticipated.	✓ No impacts to wildlife anticipated.
	Vegetation	Minimize Impacts to Vegetation	✓ No impacts to vegetation	✓ No impacts to vegetation	✓ No impacts to vegetation	✓ No impacts to vegetation	– Impacts to vegetation, change to Right of Way at Heart Lake Rd	✓ No impacts to vegetation; moderate change to Right of Way off Countryside Dr and Heart Lake Road.

EVALUATION OF WILDLIFE MITIGATION ALTERNATIVES

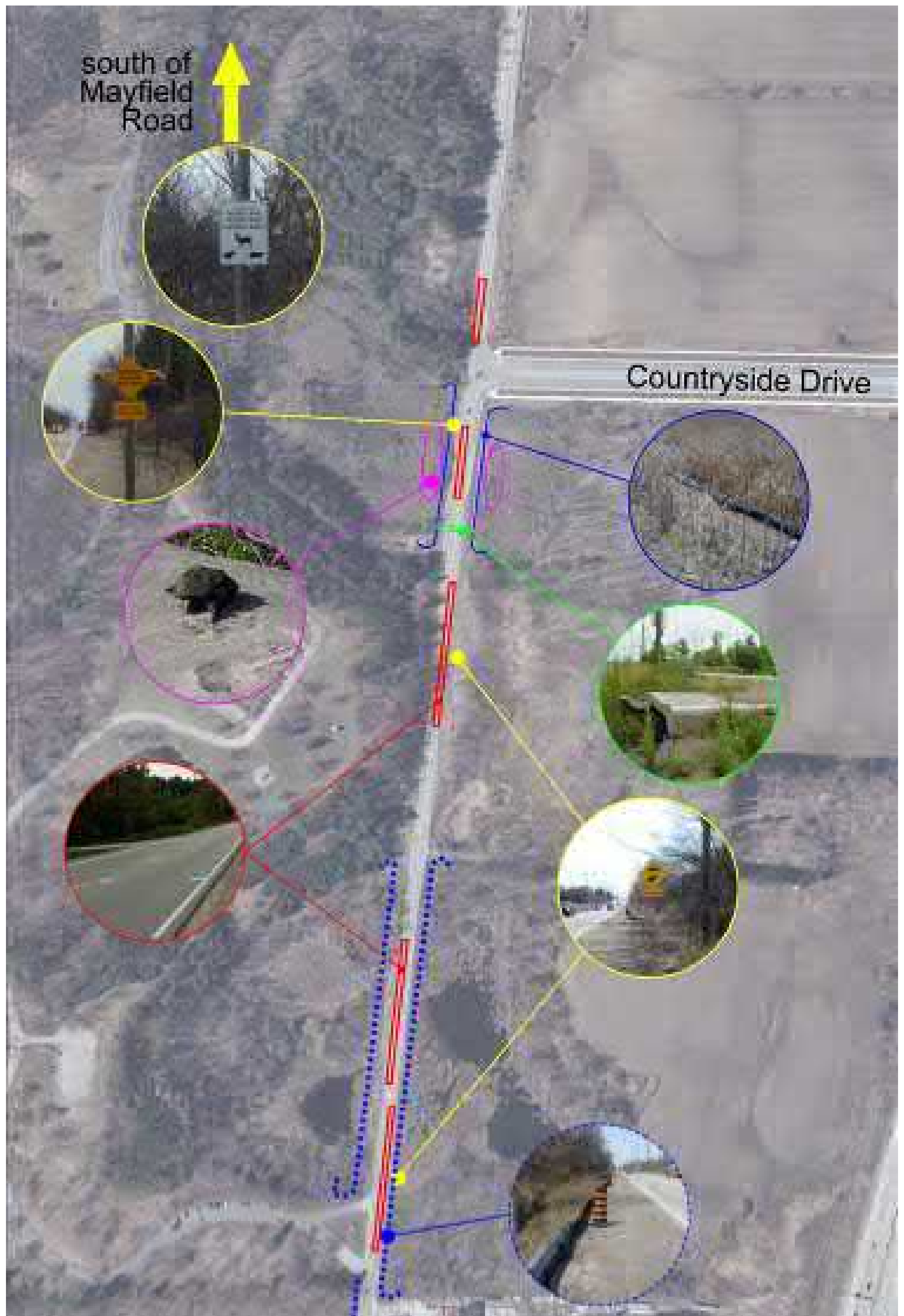
Category	Criteria	Factors	A Do Nothing	B Maintain Solar Powered Flashing Amber Lights	C Maintain Pavement Markings (optical speed bars)	D Additional Eco-Passage Tunnel(s)	E Wildlife Directional Fencing	F Turtle Nesting Mounds
								
	Designated Natural Areas	Minimize Impacts to Designated Natural Areas	✓ Existing wildlife mitigation measures have been recently implemented and there is little post-mitigation monitoring	× No effect to minimize impacts to Designated Natural Areas	× No effect to Designated Natural Areas	• Provides connection to Designated Natural Areas and habitat	• Provides protection for turtles from crossing the road.	• Provides a mitigation tool used to reduce mortality of nesting females and hatchlings.
	Terrestrial Habitat Design Factors	Minimize Impacts to Wildlife	– Current mitigation measures used to minimize impacts to wildlife have not been determined if the effectiveness of the signage is working	– Minimal impact on driver behaviour to slow down due to presence of wildlife habitat	× No effect to minimize impacts to wildlife	• Provides off-road passage of turtles/frogs/snakes between vegetated areas	• Provides protection to turtles wishing to cross the roadway.	• Proves a mitigation tool used to reduce mortality of nesting females and hatchlings
		Minimize Impacts to Vegetation	✓ No impact to vegetation that exists along Heart Lake Road	× No effect on Vegetation	× No effect on Vegetation	✓ Minor impact to vegetation at the entrance and exit	✓ Minor impact to vegetation along the roadway edge of pavement	✓ Minor impacts to vegetation during the construction of the turtle nesting mounds

Stantec

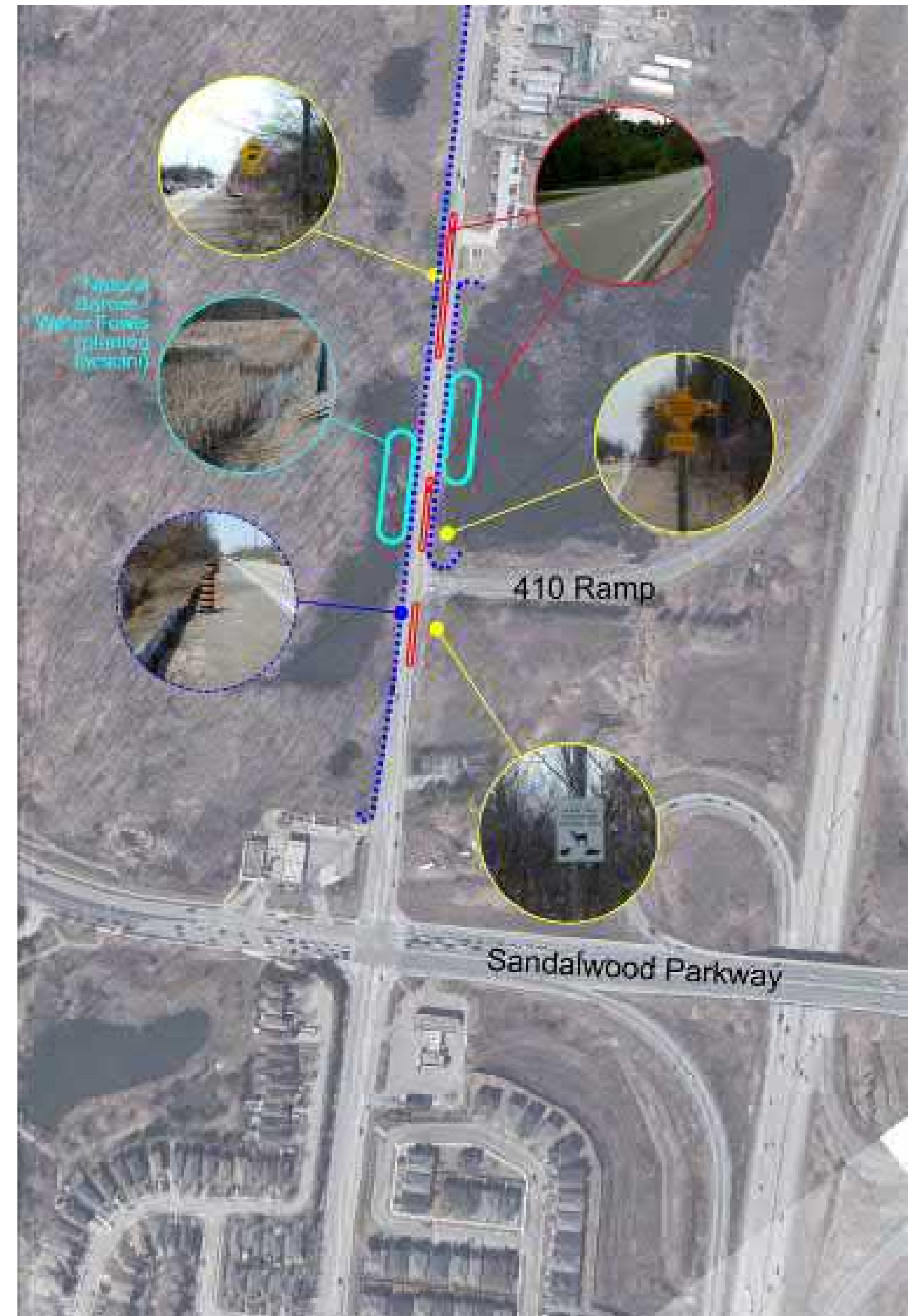
BRAMPTON Flower City brampton.ca LET'S CONNECT

The Function and Design Review of the Heart Lake Road Corridor

IMPLEMENTED MEASURES TO MITIGATE SPEED AND WILDLFE MORTALITY



SOUTH OF COUNTRYSIDE DRIVE



NORTH OF SANDALWOOD PARKWAY

Stantec

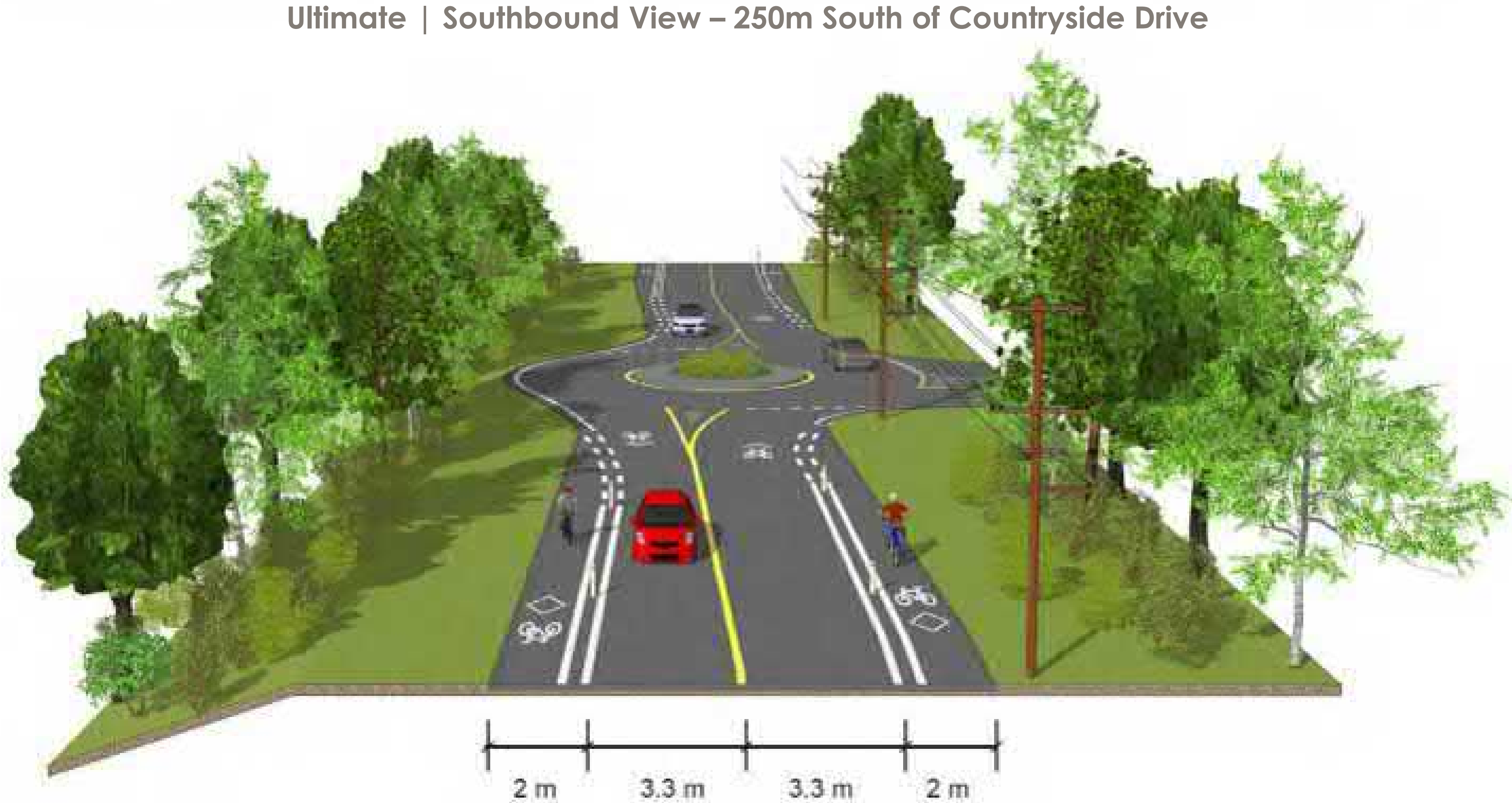
BRAMPTON Flower City brampton.ca LET'S CONNECT

The Function and Design Review of the Heart Lake Road Corridor

PREFERED ALTERNATIVES

Timeframe	Recommended Preferred Solutions
Short-Term (0-2 years)	Wildlife Mortality Mitigation: • Maintain existing solar powered flashing amber lights • Maintain and re-paint optical speed bars • Install (2) additional eco-passages tunnels • Install wildlife directional fencing • Implement turtle nesting mounds Traffic Calming: • Re-classify road as a local collector road • Lower speed limit to 50 km/h • Implement speed cushions between Mayfield Rd and the Hwy 410 SB off-ramp • Traffic circle at conservation entrance Transportation Improvement: • Implement a hybrid multi-use trail through Heart Lake Conservation Area with connections to the existing boulevard path at Heart Lake Rd/Countryside Drive
Ultimate	• Lane narrowing on Heart Lake Road • Roundabout at Countryside Drive • Traffic circles at future major development accesses to Heart Lake Road • Implement Alternative C with separated bike lanes

Ultimate | Southbound View – 250m South of Countryside Drive



Ultimate | Southbound View – Access to Heart Lake Conservation Area

Stantec

APPENDIX B

Agency Correspondence

Stantec

Memo

To:	File	From:	D.Addley and B.Orr
File:	165001037	Date:	November 29, 2019

Reference: Final Report – Function and Design Review of the Heart Lake Road Corridor Feasibility Study Sandalwood Parkway East to Mayfield Road Etobicoke Creek Watershed; City of Brampton; Regional Municipality of Peel

The attached has been prepared in response to the comments received from the Toronto Region Conservation Authority via letter dated March 28, 2019.

Attachment: Comment/Response Table

c. Nelson Cadete, City of Brampton

Comment and Response Table

Item	TRCA Comments (September 11, 2018)	TRCA Comments (March 28, 2019)	Response
1	It is staff understanding that the purpose of a feasibility study is to determine whether a project should move forward through an EA process or should be completely abandoned altogether. However, it appears that this study is not evaluating the feasibility of the proposed works, rather it is moving through the process of alternatives evaluation and selection as an EA study would. As such, please clarify why the project is not currently proceeding through an EA process instead.	It is staff understanding that a Schedule C Class EA study is proposed for measures to be implemented in the long-term (i.e. within 5 to 10 years). Proposed long-term measures include intersection improvements at Countryside Drive and Heart Lake Road, and active transportation along Heart Lake Road.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
2	To reiterate recommendations made within the Project Overview section of this letter, staff recommends that a comprehensive EA study be initiated for parts of the project that may require encroachments or impact on adjacent natural features and TRCA lands. These parts of the project include but are not limited to implementation of traffic circles, roundabouts, and trail and road upgrades for active transportation. As such, some of the identified short-term solutions, including a traffic circle at HLCA entrance and a hybrid multi-use trail (MUT) through HLCA, should not move forward without undergoing an EA process first. Please clearly identify the parts of the project that will proceed through an EA process, post feasibility study. Please also revise the Preferred Alternatives table so that the above named traffic circle and MUT are not implemented in the short-term prior to undergoing an EA process.	It is staff understanding that a Schedule C Class EA study is proposed for measures to be implemented in the long-term (i.e. within 5 to 10 years). Proposed long-term measures include intersection improvements at Countryside Drive and Heart Lake Road, and active transportation along Heart Lake Road.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
3	For all of the alternative evaluation tables (transportation, traffic calming and wildlife mortality mitigation), please clarify how each alternative is ranked and scored. For example, if each of the three ranking symbols were given a numeric value instead, then Alternative E appears to score higher than the preferred Alternative C for the ultimate transportation alternative. It is not clear how all of the alternatives are given an equal score of 17. It is also not clear why Alternative D was identified to have two categories that were ranked as fail. Please explain and review the ranking and scoring for all alternatives and tables. It is staff preference for the alternatives ranking and scoring process to consider the cumulative impacts of each alternative to the natural system, and to select an alternative with the least environmental impact. Please	It appears that the total equal score of 17 has been removed from Table 24 Evaluation of Transportation Alternatives. It is staff understanding that a Schedule C Class EA study is proposed for measures to be implemented in the long-term (i.e. within 5 to 10 years), including active transportation along Heart Lake Road.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.

Item	TRCA Comments (September 11, 2018)	TRCA Comments (March 28, 2019)	Response
	also see below for more comments regarding ranking and scoring of specific alternatives.		
Transportation Alternatives			
4	Staff notes that both short-term and ultimate preferred alternatives have been selected for active transportation and traffic calming. Particularly for active transportation, staff is concerned with the selection of both a short-term MUT route through HLCA and ultimate bike lanes along Heart Lake Road, as this not only creates a redundancy in the cycling network, but will also double the impact on the surrounding natural system. Staff requests that only one solution be selected to provide one active transportation route through the area. The route that is selected should be evaluated to have the least impact on the surrounding natural features. In addition, considering the potential degree of impact on highly sensitive natural features in the area, staff further requests that an active transportation route not be selected in the short-term without undergoing an EA process. Further consultation with the Ministry of Environment, Conservation and Parks (MOECP) may be required to confirm direction, notwithstanding TRCA staff recognizes that this particular project will follow the Municipal Class Environmental Assessment (MCEA) process.	It is staff understanding that a Schedule C Class EA study is proposed for measures to be implemented in the long-term (i.e. within 5 to 10 years), including active transportation along Heart Lake Road.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
5	Staff recommends that implementation of bicycle lanes along alternative parallel roads that would have fewer impacts to sensitive natural features also be considered as a separate alternative. These parallel roads may include Kennedy Road or Dixie Road. It is understood that cycling access into HLCA may still be achieved from these parallel roads via planned active transportation routes along Mayfield Road and Sandalwood Parkway.	It is staff understanding that a Schedule C Class EA study is proposed for measures to be implemented in the long-term (i.e. within 5 to 10 years), including active transportation along Heart Lake Road.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
6	Staff notes that both short-term and ultimate preferred alternatives have been selected for active transportation and traffic calming. Particularly for active transportation, staff is concerned with the selection of both a short-term MUT route through HLCA and ultimate bike lanes along Heart Lake Road, as this not only creates a redundancy in the cycling network, but will also double the impact on the surrounding natural system. Staff requests that only one solution be selected to provide one active transportation route through the area. The route that is selected should be evaluated to have the least impact on the surrounding	Not addressed. Staff continues to have concerns regarding the duplication of cycling alignments (i.e. implementation of both a MUT within HLCA and bike lanes along Heart Lake Road) within an area with highly sensitive natural features. Staff also understands that a EA study is proposed for active transportation along Heart Lake Road, but not the MUT through HLCA. It is staff expectation that the requirement for a redundant cycling route will be examined within this future EA study. Please continue to consult with TRCA staff at the EA stage.	Noted. The City will continue to engage with TRCA as part of subsequent planning and design activities.

Item	TRCA Comments (September 11, 2018)	TRCA Comments (March 28, 2019)	Response
	natural features. In addition, considering the potential degree of impact on highly sensitive natural features in the area, staff further requests that an active transportation route not be selected in the short-term without undergoing an EA process. Further consultation with the Ministry of Environment, Conservation and Parks (MOECP) may be required to confirm direction, notwithstanding TRCA staff recognizes that this particular project will follow the Municipal Class Environmental Assessment (MCEA) process.		
7	Staff notes that the lane and road widths identified within the conceptual cross-sections in the TAC materials and PIC2 display boards differ from one another. For example, vehicular lane widths for Alternatives B to G are identified to be 3.3 m wide in the PIC2 boards, but 3.0 m wide in the TAC materials. Please check all bicycle, buffer, road embankment and vehicular lane widths to ensure that the correct widths are identified on all materials. Please clarify what the correct widths are for each alternative. Once the correct widths have been established, please re-evaluate the alternatives ranking and scoring.	Staff understands further EA study will be undertaken for active transportation alternatives along Heart Lake Road. Please address at EA stage.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
8	It is not clear if any technical studies to characterize the existing baseline conditions of the natural features surrounding Heart Lake Road and HLCA have been completed, as none have been provided to TRCA staff so far for review: a. The conceptual cross-sections of the various alternatives do not adequately quantify the degree of impacts to adjacent natural features. Due to the proximity of sensitive natural features, all transportation alternatives should include a cross-section of the actual Heart Lake Road and adjacent features, with an overlay of the alternative footprint in order to better understand and evaluate the impact and encroachment of each alternative on the adjacent natural features. b. Please clarify if the existing 2.0 m grey areas beside the 3.5 m vehicular lanes in Alternative A (Do Nothing) represent a paved shoulder, unpaved (gravel) shoulder, or vegetated area or ditch. This baseline condition information is required to adequately evaluate the impact of the other alternatives on existing conditions. If the	a. Not addressed. Staff understands further EA study will be undertaken for active transportation alternatives along Heart Lake Road. Please address at EA stage. In addition, it is unclear how Figure 49 reflects the various alternatives carried forward in Table 20, considering that bike lanes are being proposed. It appears that true impacts to the adjacent features are not accurately shown within the cross-sections. Please clarify at future EA stage. b. Not addressed. Staff understands further EA study will be undertaken for active transportation alternatives along Heart Lake Road. Please address at EA stage. In particular, the cross-sections and figures appear to be conceptual, and do not appear to accurately depict impacts to adjacent natural features due to required grading. Please ensure that all impacts are considered at the EA stage. c. Not addressed. Staff understands that no EA study is proposed for the implementation of a hybrid MUT through HLCA. It is staff expectation	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.

Item	TRCA Comments (September 11, 2018)	TRCA Comments (March 28, 2019)	Response
	existing 2.0 m areas are vegetated under existing conditions, then it is still possible for impacts to Designated Natural Areas to occur even if the proposed alternative remains within the Right of Way. Staff notes that Alternatives B to E and G all indicate that "work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas". If the 2.0 m areas adjacent to the current 3.5 m vehicular lanes are vegetated, then please revise the text, rank and score of the above alternatives to more accurately reflect the impact on adjacent natural features. c. The natural areas within the northern section of HLCA consist of a number of PSWs within an undulating landscape. This heterogenic landscape may create complications and challenges during the construction of infrastructure. This landscape does not appear to be adequately characterized, and construction challenges do not appear to be considered in the alternatives evaluation process. Staff recommends that temporary construction impacts to PSWs and challenges also be considered and incorporated into the alternatives evaluation, particularly for Alternative F (Hybrid MUT in HLCA). Upon consideration, please revise the Designated Natural Areas text, rank and score for Alternative F accordingly.	that construction impacts to natural features will be evaluated, avoided, minimized, mitigated and compensated in future detailed design stages of the project.	
9.	Staff has concerns regarding the implications of an all-season MUT through HLCA. Please clarify if this MUT will require salt or sand for winter maintenance. Due to the highly sensitive nature of the features, inputs of salt and sand may create long-term cumulative negative impacts to features within HLCA. If required, please also revise the text, rank and score for Alternative F accordingly.	Not addressed. Table 24 Evaluation of Transportation Alternatives indicates that "no salt of fluids originating from vehicles and salt distributing vehicles affect the existing trail/ old access road entrance". However, please address original comment and clarify if salt for winter maintenance is required for a future all-season MUT. It is staff expectation that salt and sand impacts to natural features will be evaluated in future detailed design stages of the project.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
10	As there are sensitive natural features located around Heart Lake Road and within HLCA, the preferred alternative will need to maintain the runoff volume that is discharged into the features under the proposed conditions. Any increase in impervious area should be	Please continue to consult with TRCA staff to address this comment at the EA stage of this project. As articulated in our previous comment, staff has concerns that property/ space requirements needed to meet stormwater	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the

Item	TRCA Comments (September 11, 2018)	TRCA Comments (March 28, 2019)	Response
	minimized to the extent possible. Low Impact Development (LID) measures can be implemented to deal with additional runoff volume as a result of increased imperviousness. The preferred ultimate solution (Alternative C) has been identified to result in additional impervious area through the paving of the existing un-paved shoulder. The required MUT connections and upgrades required for the short-term solution (Alternative F) will also result in additional impervious area, which should be documented and considered in the alternatives evaluation table. Space requirements and the type of LID measures should also be considered and depicted within the alternative road cross-sections for alternatives that will result in additional impervious area. Please refer to the Low Impact Development Stormwater Management Planning and Design Guide (2010) for further information.	management criteria will encroach and result in impacts to adjacent natural features. At the EA stage, please also incorporate impacts to the Aquatic Habitat, in addition to Terrestrial Habitat, into the evaluation within the Natural Environment Category. Please note that increased paving and total impervious area will increase flows and impacts to the adjacent wetlands.	Municipal Class EA process, in consultation with TRCA.
11	Please note that different stormwater management options will need to be explored at the next planning process to achieve TRCA's water quantity, quality and water balance criteria. Please refer to the TRCA Stormwater Management Criteria (2012) for further information.	Please continue to consult with TRCA staff to address this comment at the EA stage of this project.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
Traffic Calming Alternatives			
12	Staff notes that a roundabout at Countryside Drive is proposed as an ultimate solution. There are two alternative options for a roundabout at Countryside Drive. Alternative E appears to have impacts to adjacent PSWs, ANSI and TRCA lands on the west side of Heart Lake Road. Alternative F appears to only have impacts on lands located north east of the intersection of Heart Lake Road and Countryside Drive. Please clarify which alternative has been selected as the preferred as both will have different impacts on adjacent lands. Please also clarify if the footprint of Alternative F will only impact the north east corner of the intersection, and remain outside of wetland areas and TRCA lands. Please note that PSWs are located on the west side of Heart Lake Road, and at the south east corner of the intersection of Heart Lake Road and Countryside Drive.	Addressed. It is staff understanding that Alternative F is selected as the long-term solution at the Heart Lake Road and Countryside Drive intersection. Staff also understands further EA study will be undertaken for intersection alternatives at this location. Please address this comment at the EA stage, and clarify if bike lanes are included within the roundabout. If bike lanes are included within the roundabout, additional impacts to adjacent natural features is likely. Please also refer to Comment #8 above regarding grading limits and true impacts to adjacent natural features.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
13	Further to Comment #12 above, please clarify why other alternatives are not being considered in addition to the roundabout options for the intersection at Countryside	Not addressed. Staff understands further EA study will be undertaken for intersection alternatives at this location. Please address at EA stage.	Noted. Subsequent planning and design for transportation modifications within the study

Item	TRCA Comments (September 11, 2018)	TRCA Comments (March 28, 2019)	Response
	Drive, such as a signalized T-intersection. Other intersection alternatives may be able to better avoid impacts to the adjacent PSW and TRCA lands than a roundabout. Please also present other intersection alternatives in addition to the roundabout options.		area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
14	Staff notes that cyclist safety for the traffic circle and roundabout alternatives (Alternatives B, E and F) was identified to be improved due to reduced vehicular speed limits. However, the conceptual image of a roundabout in the PIC2 display boards show that cyclists will have to transition from a separated bicycle lane and merge into vehicular traffic at the roundabouts and traffic circles. It is staff opinion that the shared roadway at the roundabouts and traffic circles, in addition to the need for users (both vehicular and cycling) to transition from separate to shared facilities, and the required turning movements (cars will be turning toward and into cycling traffic when turning into roundabouts and traffic circles) are safety concerns for cyclists. Please re-evaluate the safety of roundabouts and traffic circles for cyclists and revise the alternatives ranking and scoring accordingly.	Not addressed. Staff understands further EA study will be undertaken for intersection alternatives at this location. Please address at EA stage.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
Wildlife Mortality Mitigation Alternatives			
15	Please rename the title of the alternatives evaluation table from “wildlife mitigation” to “wildlife mortality mitigation”, as it is their mortality that is being mitigated by the proposed measures and not the wildlife itself. Please also revise any other references to “wildlife mitigation” accordingly as well.	Not addressed. “Wildlife mitigation” still referenced throughout text.	The text of the final report has been updated accordingly.
16		There appears to be a lack of discussion and design regarding the wildlife directional fencing that would be required to support the proposed dedicated wildlife crossings/ eco-passages in the Final Report. Please note that the directional fencing is critical to the success of the eco-passages. Please continue to consult with TRCA staff at the design stage of the eco-passages and wildlife directional fencing. Options to work with TRCA staff (as a fee for service) to assess mitigation and to monitor the measures are available as well.	Noted. The City will continue to consult with TRCA staff during the design stage of these features.
17		Staff notes that the Final Report does not contain any information regarding post project monitoring to assess the effectiveness of wildlife mortality mitigation measures, similar to what TRCA staff is currently undertaking for the eco-passage installed by the City of Brampton at Heart	Noted. The City will continue to consult with TRCA staff during the design stage of these features.

Item	TRCA Comments (September 11, 2018)	TRCA Comments (March 28, 2019)	Response
		Lake Road, just south of Countryside Drive. Please note that there are lessons that can be learned from the monitoring of this eco-passage that can benefit future eco-passage and directional fencing measures in the area. Please include post project monitoring of measures at the future design stage, and continue to consult with TRCA staff.	
18		The Final Report indicates that temporary wildlife fencing was installed in 2018, and that additional areas for fencing are recommended in the future. At future design stages, please identify these areas on a map and clarify if they are linked to current of future eco-passages.	Noted. The City will continue to consult with TRCA staff during the design stage of these features. Areas recommended for fencing will be mapped. Further, any links to current or future eco-passages will be noted.
Heart Lake Conservation Area Multi-Use Trail			
19		Staff understands that a hybrid MUT through HLCA is proposed as a short-term measure in lieu of an EA study. Staff acknowledges that a MUT through HLCA would be compliant with the direction of the HLCA Master Plan and TRCA Trail Strategy. Please continue to consult and work closely with TRCA staff on the planning and design of this MUT.	Noted. The City will continue to consult with TRCA staff during the planning and design stage of these features.
20		Please note that the HLCA Master Plan was approved by TRCA in 2006, which included a trail plan for the property. In 2017, TRCA staff completed a review of the HLCA trail system operations to address trail use, alignments, signage and other operational considerations. Trail projects have continued to be implemented between 2006 and 2018. Please contact TRCA for more information regarding the HLCA Master Plan.	Noted. The City will contact TRCA with respect to the HLCA Master Plan.
21		In the current draft TRCA Trail Strategy, TRCA staff has identified the Esker Lake Trail, which passes north-south through HLCA, as a trail of regional significance. As such, local trail and active transportation corridor connection opportunities should be planned and accommodated in this infrastructure improvement project in coordination with the Regional Municipality of Peel, the City of Brampton, the Town of Caledon and TRCA.	Noted. Future project planning will consider local and regional connection opportunities.
22		Winter operational requirements and responsibilities including trail maintenance and management needs to be considered at the planning stages of the proposed MUT through HLCA, particularly during the off-season when	Noted. The City will continue to consult with TRCA staff during subsequent planning and design stages.

Item	TRCA Comments (September 11, 2018)	TRCA Comments (March 28, 2019)	Response
		HLCA is officially closed from mid-October to late April. Further discussions between TRCA and City of Brampton staff are required to discuss these operational requirements and to develop necessary agreements	
23		Please note that timing of construction of any improvements should be scheduled when HLCA is closed or at times of low visitation to avoid impacts to the operation of the conservation area. Please ensure that this is coordinated with TRCA staff.	Noted. Construction activities will be timed in consultation and coordination with TRCA staff.
24		The short-term budget on page 7.5 of the Final Report does not include costs for improvements to the trail system at HLCA to accommodate the recommended MUT. These costs should include planning, detailed design, construction and post-construction monitoring costs. Please revise the budget accordingly.	A Class D cost estimate including planning, detailed design, and construction has been included in Section 7 of the report, as well as in Appendix H.
Heart Lake Conservation Area Traffic Circle			
25		Please note that there are often long lines of vehicles waiting to pay admission fees at the front gate of HLCA that extend onto Heart Lake Road and occasionally onto Sandalwood Parkway at peak times during HLCA's operating season. TRCA staff has concerns about the flow of traffic with the traffic circle being recommended as the only vehicular access to HLCA. Staff notes that Table 25 of the Final Report does not appear to identify any advantages of Option 2B (mini roundabout at HLCA) over Option 2C (speed cushions, lane narrowing with rumble strips). Option 2C may be more appropriate given the peak traffic flows at HLCA. Please continue to consult with TRCA staff on the appropriateness of a traffic circle at this location at the detailed design and permitting stages of this project. It is understood that the project design within the Feasibility Study Final Report may need to change at the design and permitting stage in order to fully address TRCA staff concerns regarding both the traffic circle into HLCA, as well as footprint and encroachment issues and impacts into the adjacent Natural Heritage System.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the Municipal Class EA process, in consultation with TRCA.
26		It is staff preference for there to be no encroachment onto TRCA lands to accommodate traffic circles due to highly sensitive natural features in the area. Please continue to consult with TRCA staff at design stages to ensure that TRCA lands are avoided.	Noted. Subsequent planning and design for transportation modifications within the study area will be completed in accordance with the

Item	TRCA Comments (September 11, 2018)	TRCA Comments (March 28, 2019)	Response
			Municipal Class EA process, in consultation with TRCA.
27		Please clarify if the costs for the traffic circle at the entrance of HLCA identified on page 7.5 of the Final Report including land securement and compensation costs.	The costs do not include land securement and compensation costs. More detailed cost estimates will be provided as part of subsequent planning for the preferred solution/design.
New Developments			
28		Increased pedestrian traffic into HLCA is expected due to the new residential development on the east side of Heart Lake Road. Please note that the planning and design of Heart Lake Road will need to incorporate safe pedestrian access into HLCA that should be separated from the main entrance to avoid pedestrian and vehicular interactions.	Noted.
29		Please clarify how new developments along Heart Lake Road will not increase use and traffic along Heart Lake Road, according to the results of the traffic modelling within the Final Report.	Section 3.1.2 identifies the forecasted future conditions along the corridor based on the City's land use forecasts. In this section we have identified a modest increase in Peak hour volumes along Heart Lake Road as summarized in Table 6. The volumes were obtained from the City's Regional Travel Demand Model which integrate with the land use forecasts. Most of the growth will occur north of Countryside Road or on the east side of Highway 410 which would have a more desirable north-south regional corridor via Dixie, as well as Highway 410 connections from Mayfield rather than proceeding to Sandalwood via Heart Lake Road. For the increases on Heart Lake Road these are explained by

Item	TRCA Comments (September 11, 2018)	TRCA Comments (March 28, 2019)	Response
			a portion of traffic that uses Countryside Drive to proceed east-west on Sandalwood and Bovaird. With the advent of traffic calming measures Heart Lake Road will become less desirable for these trips as well.

March 28, 2019 CFN 58700

BY E-MAIL ONLY (Nelson.Cadete@brampton.ca)

Nelson Cadete
City of Brampton
2 Wellington Street West
Brampton, ON L6Y 4R2

Dear Mr. Cadete:

Re: Final Report – Function and Design Review of the Heart Lake Road Corridor Feasibility Study, Sandalwood Parkway East to Mayfield Road
Etobicoke Creek Watershed; City of Brampton; Regional Municipality of Peel

Toronto and Region Conservation Authority (TRCA) staff received the Final Report (dated February 2019) for the above named project on February 13, 2019.

PROJECT OVERVIEW

It is our understanding that the Heart Lake Road Corridor Feasibility Study involves the examination of the long-term infrastructure requirements along Heart Lake Road, from Sandalwood Parkway to Mayfield Road, to accommodate future transportation demand and adjacent land use development while preserving the unique environment and character of the road. It is further understood that opportunities for active transportation, traffic calming and wildlife mortality mitigation will be examined as a part of this study.

In general, we are supportive of the City's overall goal of building out the active transportation network, and reduction of wildlife road mortality through implementation of traffic calming and other mitigation measures. We are particularly supportive of traffic calming and wildlife mortality mitigation measures that do not entail additional disturbance beyond the existing Heart Lake Road footprint, including speed cushions, turtle nesting mounds, reduced speed limit and lane narrowing.

However, given the presence of the Heart Lake Provincially Significant Wetland (PSW) Complex and the Brampton Buried Esker Area of Natural and Scientific Interest (ANSI) along this stretch of Heart Lake Road, it is our opinion that any proposal that involves new, replacement or expanded infrastructure should be examined through a formal environmental assessment (EA) process. It is our understanding that a further EA study will not be conducted for measures that are being proposed for implementation in the short-term (i.e. within 2 years). Proposed short-term measures include wildlife mortality mitigation measures including the installation of two new eco-passages, traffic calming measures including a traffic circle at Heart Lake Conservation Area (HLCA), and active transportation improvements including a hybrid multi-use trail (MUT) through HLCA with connections to an existing path at Heart Lake Road and Countryside Road. However, it is our understanding that a Schedule C Class EA study is proposed for measures to be implemented in the long-term (i.e. within 5 to 10 years). Proposed long-term measures include intersection improvements at Countryside Drive and Heart Lake Road, and active transportation along Heart Lake Road.

By copy of this letter to Tim Kocialek, we recommend that you work closely with City of Brampton engineering staff through the next stages of this project, and that you consult with us prior to the issuance of the Request for Proposal (RFP) for both the EA and detailed design work to ensure that our property and permitting issues can be addressed and are feasible.

PROJECT REVIEW

Although we are supportive in principle with the development of an active transportation network and measures to mitigate against wildlife mortality, we have some concerns related to the plans for the road which should be addressed within the future EA or in the pre-design stage. These concerns include:

- Impacts to the flow of traffic at the proposed traffic circle at the HLCA entrance. Please note that that there are often long lines of vehicles waiting to pay admission fees at the front gate of HLCA that extend onto Heart Lake Road and occasionally onto Sandalwood Parkway at peak times during HLCA's operating season. As such, a continuous flow of traffic around the proposed traffic circle at peak season may be impeded. This issue should be addressed at future planning stages of the project. Please see Comment #25 in **Appendix A** for further information.
- Impacts to the Natural Heritage System (NHS) does not appear to be adequately characterized and evaluated within the Final Report. Staff notes that the presented cross-sections within the Final Report do not appear to include additional disturbance to the NHS that will be required for grading for instance. Please see Comment #8 in **Appendix A** for further information.
- Future intersection configuration at Countryside Drive and Heart Lake Road. Staff understands that a EA study will be undertaken to look at intersection alternatives at this location. It is staff expectation that staff concerns including Comments #12, #13 and #14 in **Appendix A** will be addressed within the future EA study.

Please see **Appendix A** for detailed comments on the Final Report, and ensure that these are included in an appendix for future reference. Please continue to consult with TRCA staff regarding future EA studies and at detailed design for permit requirements under Ontario Regulation 166/06. Please note that TRCA staff previously provided comments on the Technical Advisory Committee (TAC) materials in a letter dated September 11, 2018. Staff notes that all appendices, including Appendix H Response of TRCA to PIC #2 and TAC #2, are missing from the Final Report.

Should you have any questions, please contact me at extension 5266 or at alister@trca.on.ca.

Regards,

Annette Lister
Planner, Infrastructure Planning and Permits
Development and Engineering Services

BY E-MAIL

cc:

Brampton:	Tim Kocialek, Manager, Engineering (tim.kocialek@brampton.ca)
	John Fantin, Supervisor, Engineering CADD (john.fantin@brampton.ca)
MNRF:	Mark Heaton, Management Biologist (mark.heaton@ontario.ca)
TRCA:	Sharon Lingertat, Senior Planner, Infrastructure Planning and Permits
	Quentin Hanchard, Associate Director, Development Planning and Permits
	Victoria Kramkowski, Government and Community Relations Specialist, Peel Watersheds
	Vince D'Elia, Senior Project Manager, Etobicoke-Mimico Creek
	Doug Miller, Senior Manager, Conservation Parks
	Deanna Cheriton, Supervisor, Greenspace Conservation

APPENDIX A: TRCA COMMENTS

ITEM	**TRCA COMMENTS ON TAC MATERIALS** (September 11, 2018) * No proponent response to TRCA comments provided in Appendix H of the Final Report	**TRCA COMMENTS** (March 26, 2019)
Environmental Assessment Study		
1.	It is staff understanding that the purpose of a feasibility study is to determine whether a project should move forward through an EA process or should be completely abandoned altogether. However, it appears that this study is not evaluating the feasibility of the proposed works, rather it is moving through the process of alternatives evaluation and selection as an EA study would. As such, please clarify why the project is not currently proceeding through an EA process instead.	It is staff understanding that a Schedule C Class EA study is proposed for measures to be implemented in the long-term (i.e. within 5 to 10 years). Proposed long-term measures include intersection improvements at Countryside Drive and Heart Lake Road, and active transportation along Heart Lake Road.
2.	To reiterate recommendations made within the Project Overview section of this letter, staff recommends that a comprehensive EA study be initiated for parts of the project that may require encroachments or impact on adjacent natural features and TRCA lands. These parts of the project include but are not limited to implementation of traffic circles, roundabouts, and trail and road upgrades for active transportation. As such, some of the identified short-term solutions, including a traffic circle at HLCA entrance and a hybrid multi-use trail (MUT) through HLCA, should not move forward without undergoing an EA process first. Please clearly identify the parts of the project that will proceed through an EA process, post feasibility study. Please also revise the Preferred Alternatives table so that the above named traffic circle and MUT are not implemented in the short-term prior to undergoing an EA process.	It is staff understanding that a Schedule C Class EA study is proposed for measures to be implemented in the long-term (i.e. within 5 to 10 years). Proposed long-term measures include intersection improvements at Countryside Drive and Heart Lake Road, and active transportation along Heart Lake Road.
3.	For all of the alternative evaluation tables (transportation, traffic calming and wildlife mortality mitigation), please clarify how each alternative is ranked and scored. For example, if each of the three ranking symbols were given a numeric value instead, then Alternative E appears to score higher than the preferred Alternative C for the ultimate transportation alternative. It is not clear how all of the alternatives are given an equal score of 17. It is also not clear why Alternative D was identified to have two categories that were ranked as fail. Please explain and review the ranking and scoring for all alternatives and tables. It is staff preference for the alternatives ranking and scoring process to consider the cumulative impacts of each alternative to the natural system, and to select an alternative with the least environmental impact. Please also see below for more comments regarding ranking and scoring of specific alternatives.	It appears that the total equal score of 17 has been removed from Table 24 Evaluation of Transportation Alternatives. It is staff understanding that a Schedule C Class EA study is proposed for measures to be implemented in the long-term (i.e. within 5 to 10 years), including active transportation along Heart Lake Road.
Transportation Alternatives		
4.	Staff notes that Alternative A (Do Nothing) does not conform with the municipal transportation master plan vision. However, please note that TRCA staff had limited involvement in the City's 2015 Transportation Master Plan (TMP) Update, and were only provided the opportunity to	It is staff understanding that a Schedule C Class EA study is proposed for measures to be

ITEM	TRCA COMMENTS ON TAC MATERIALS **(**September 11, 2018**)** *** No proponent response to TRCA comments provided in Appendix H of the Final Report**	TRCA COMMENTS **(**March 26, 2019**)**
	comment on the report when it was in its final stage of review. Therefore, staff did not have the opportunity to comment on development of active transportation facilities along Heart Lake Road at the TMP stage. In a letter response to the final 2015 TMP Update report dated October 29, 2015, staff has indicated that the locations of the active transportation facilities were difficult to identify due to the scale of the map and has noted that proposed active transportation facilities will need to meet TRCA's LCP.	implemented in the long-term (i.e. within 5 to 10 years), including active transportation along Heart Lake Road.
5.	Staff recommends that implementation of bicycle lanes along alternative parallel roads that would have fewer impacts to sensitive natural features also be considered as a separate alternative. These parallel roads may include Kennedy Road or Dixie Road. It is understood that cycling access into HLCA may still be achieved from these parallel roads via planned active transportation routes along Mayfield Road and Sandalwood Parkway.	It is staff understanding that a Schedule C Class EA study is proposed for measures to be implemented in the long-term (i.e. within 5 to 10 years), including active transportation along Heart Lake Road.
6.	Staff notes that both short-term and ultimate preferred alternatives have been selected for active transportation and traffic calming. Particularly for active transportation, staff is concerned with the selection of both a short-term MUT route through HLCA and ultimate bike lanes along Heart Lake Road, as this not only creates a redundancy in the cycling network, but will also double the impact on the surrounding natural system. Staff requests that only one solution be selected to provide one active transportation route through the area. The route that is selected should be evaluated to have the least impact on the surrounding natural features. In addition, considering the potential degree of impact on highly sensitive natural features in the area, staff further requests that an active transportation route not be selected in the short-term without undergoing an EA process. Further consultation with the Ministry of Environment, Conservation and Parks (MOECP) may be required to confirm direction, notwithstanding TRCA staff recognizes that this particular project will follow the Municipal Class Environmental Assessment (MCEA) process.	Not addressed. Staff continues to have concerns regarding the duplication of cycling alignments (i.e. implementation of both a MUT within HLCA and bike lanes along Heart Lake Road) within an area with highly sensitive natural features. Staff also understands that a EA study is proposed for active transportation along Heart Lake Road, but not the MUT through HLCA. It is staff expectation that the requirement for a redundant cycling route will be examined within this future EA study. Please continue to consult with TRCA staff at the EA stage.
7.	Staff notes that the lane and road widths identified within the conceptual cross-sections in the TAC materials and PIC2 display boards differ from one another. For example, vehicular lane widths for Alternatives B to G are identified to be 3.3 m wide in the PIC2 boards, but 3.0 m wide in the TAC materials. Please check all bicycle, buffer, road embankment and vehicular lane widths to ensure that the correct widths are identified on all materials. Please clarify what the correct widths are for each alternative. Once the correct widths have been established, please re-evaluate the alternatives ranking and scoring.	Staff understands further EA study will be undertaken for active transportation alternatives along Heart Lake Road. Please address at EA stage.

ITEM	TRCA COMMENTS ON TAC MATERIALS **(**September 11, 2018**)** *** No proponent response to TRCA comments provided in Appendix H of the Final Report**	TRCA COMMENTS **(**March 26, 2019**)**
8.	It is not clear if any technical studies to characterize the existing baseline conditions of the natural features surrounding Heart Lake Road and HLCA have been completed, as none have been provided to TRCA staff so far for review: a. The conceptual cross-sections of the various alternatives do not adequately quantify the degree of impacts to adjacent natural features. Due to the proximity of sensitive natural features, all transportation alternatives should include a cross-section of the actual Heart Lake Road and adjacent features, with an overlay of the alternative footprint in order to better understand and evaluate the impact and encroachment of each alternative on the adjacent natural features. b. Please clarify if the existing 2.0 m grey areas beside the 3.5 m vehicular lanes in Alternative A (Do Nothing) represent a paved shoulder, unpaved (gravel) shoulder, or vegetated area or ditch. This baseline condition information is required to adequately evaluate the impact of the other alternatives on existing conditions. If the existing 2.0 m areas are vegetated under existing conditions, then it is still possible for impacts to Designated Natural Areas to occur even if the proposed alternative remains within the Right of Way. Staff notes that Alternatives B to E and G all indicate that “work will not occur outside of the Right of Way therefore no impact to Designated Natural Areas”. If the 2.0 m areas adjacent to the current 3.5 m vehicular lanes are vegetated, then please revise the text, rank and score of the above alternatives to more accurately reflect the impact on adjacent natural features. c. The natural areas within the northern section of HLCA consist of a number of PSWs within an undulating landscape. This heterogenic landscape may create complications and challenges during the construction of infrastructure. This landscape does not appear to be adequately characterized, and construction challenges do not appear to be considered in the alternatives evaluation process. Staff recommends that temporary construction impacts to PSWs and challenges also be considered and incorporated into the alternatives evaluation, particularly for Alternative F (Hybrid MUT in HLCA). Upon consideration, please revise the Designated Natural Areas text, rank and score for Alternative F accordingly.	a. Not addressed. Staff understands further EA study will be undertaken for active transportation alternatives along Heart Lake Road. Please address at EA stage. In addition, it is unclear how Figure 49 reflects the various alternatives carried forward in Table 20, considering that bike lanes are being proposed. It appears that true impacts to the adjacent features are not accurately shown within the cross-sections. Please clarify at future EA stage. b. Not addressed. Staff understands further EA study will be undertaken for active transportation alternatives along Heart Lake Road. Please address at EA stage. In particular, the cross-sections and figures appear to be conceptual, and do not appear to accurately depict impacts to adjacent natural features due to required grading. Please ensure that all impacts are considered at the EA stage. c. Not addressed. Staff understands that no EA study is proposed for the implementation of a hybrid MUT through HLCA. It is staff expectation that construction impacts to natural features will be evaluated, avoided, minimized, mitigated and compensated in future detailed design stages of the project.
9.	Staff has concerns regarding the implications of an all-season MUT through HLCA. Please clarify	Not addressed. Table 24 Evaluation of

ITEM	TRCA COMMENTS ON TAC MATERIALS **(**September 11, 2018**)** *** No proponent response to TRCA comments provided in Appendix H of the Final Report**	TRCA COMMENTS **(**March 26, 2019**)**
	if this MUT will require salt or sand for winter maintenance. Due to the highly sensitive nature of the features, inputs of salt and sand may create long-term cumulative negative impacts to features within HLCA. If required, please also revise the text, rank and score for Alternative F accordingly.	Transportation Alternatives indicates that "no salt of fluids originating from vehicles and salt distributing vehicles affect the existing trail/ old access road entrance". However, please address original comment and clarify if salt for winter maintenance is required for a future all-season MUT. It is staff expectation that salt and sand impacts to natural features will be evaluated in future detailed design stages of the project.
10.	As there are sensitive natural features located around Heart Lake Road and within HLCA, the preferred alternative will need to maintain the runoff volume that is discharged into the features under the proposed conditions. Any increase in impervious area should be minimized to the extent possible. Low Impact Development (LID) measures can be implemented to deal with additional runoff volume as a result of increased imperviousness. The preferred ultimate solution (Alternative C) has been identified to result in additional impervious area through the paving of the existing un-paved shoulder. The required MUT connections and upgrades required for the short-term solution (Alternative F) will also result in additional impervious area, which should be documented and considered in the alternatives evaluation table. Space requirements and the type of LID measures should also be considered and depicted within the alternative road cross-sections for alternatives that will result in additional impervious area. Please refer to the Low Impact Development Stormwater Management Planning and Design Guide (2010) for further information.	Please continue to consult with TRCA staff to address this comment at the EA stage of this project. As articulated in our previous comment, staff has concerns that property/ space requirements needed to meet stormwater management criteria will encroach and result in impacts to adjacent natural features. At the EA stage, please also incorporate impacts to the Aquatic Habitat, in addition to Terrestrial Habitat, into the evaluation within the Natural Environment Category. Please note that increased paving and total impervious area will increase flows and impacts to the adjacent wetlands.
11.	Please note that different stormwater management options will need to be explored at the next planning process to achieve TRCA's water quantity, quality and water balance criteria. Please refer to the TRCA Stormwater Management Criteria (2012) for further information.	Please continue to consult with TRCA staff to address this comment at the EA stage of this project.
Traffic Calming Alternatives		
12.	Staff notes that a roundabout at Countryside Drive is proposed as an ultimate solution. There are two alternative options for a roundabout at Countryside Drive. Alternative E appears to have	Addressed. It is staff understanding that Alternative F is selected as the

ITEM	TRCA COMMENTS ON TAC MATERIALS (September 11, 2018) * No proponent response to TRCA comments provided in Appendix H of the Final Report	TRCA COMMENTS (March 26, 2019)
	impacts to adjacent PSWs, ANSI and TRCA lands on the west side of Heart Lake Road. Alternative F appears to only have impacts on lands located north east of the intersection of Heart Lake Road and Countryside Drive. Please clarify which alternative has been selected as the preferred as both will have different impacts on adjacent lands. Please also clarify if the footprint of Alternative F will only impact the north east corner of the intersection, and remain outside of wetland areas and TRCA lands. Please note that PSWs are located on the west side of Heart Lake Road, and at the south east corner of the intersection of Heart Lake Road and Countryside Drive.	long-term solution at the Heart Lake Road and Countryside Drive intersection. Staff also understands further EA study will be undertaken for intersection alternatives at this location. Please address this comment at the EA stage, and clarify if bike lanes are included within the roundabout. If bike lanes are included within the roundabout, additional impacts to adjacent natural features is likely. Please also refer to Comment #8 above regarding grading limits and true impacts to adjacent natural features.
13.	Further to Comment #12 above, please clarify why other alternatives are not being considered in addition to the roundabout options for the intersection at Countryside Drive, such as a signalized T-intersection. Other intersection alternatives may be able to better avoid impacts to the adjacent PSW and TRCA lands than a roundabout. Please also present other intersection alternatives in addition to the roundabout options.	Not addressed. Staff understands further EA study will be undertaken for intersection alternatives at this location. Please address at EA stage.
14.	Staff notes that cyclist safety for the traffic circle and roundabout alternatives (Alternatives B, E and F) was identified to be improved due to reduced vehicular speed limits. However, the conceptual image of a roundabout in the PIC2 display boards show that cyclists will have to transition from a separated bicycle lane and merge into vehicular traffic at the roundabouts and traffic circles. It is staff opinion that the shared roadway at the roundabouts and traffic circles, in addition to the need for users (both vehicular and cycling) to transition from separate to shared facilities, and the required turning movements (cars will be turning toward and into cycling traffic when turning into roundabouts and traffic circles) are safety concerns for cyclists. Please re-evaluate the safety of roundabouts and traffic circles for cyclists and revise the alternatives ranking and scoring accordingly.	Not addressed. No response provided. Staff understands further EA study will be undertaken for roundabout implementation. Please address at EA stage.
Wildlife Mortality Mitigation Alternatives		
15.	Please rename the title of the alternatives evaluation table from “wildlife mitigation” to “wildlife mortality mitigation”, as it is their mortality that is being mitigated by the proposed measures and not the wildlife itself. Please also revise any other references to “wildlife mitigation” accordingly as well.	Not addressed. “Wildlife mitigation” still referenced throughout text.

ITEM	NEW TRCA COMMENTS ON FINAL REPORT (March 26, 2019)	PROPONENT RESPONSE
Wildlife Mortality Mitigation Measures		
16.	There appears to be a lack of discussion and design regarding the wildlife directional fencing that would be required to support the proposed dedicated wildlife crossings/ eco-passages in the Final Report. Please note that the directional fencing is critical to the success of the eco-passages. Please continue to consult with TRCA staff at the design stage of the eco-passages and wildlife directional fencing. Options to work with TRCA staff (as a fee for service) to assess mitigation and to monitor the measures are available as well.	
17.	Staff notes that the Final Report does not contain any information regarding post project monitoring to assess the effectiveness of wildlife mortality mitigation measures, similar to what TRCA staff is currently undertaking for the eco-passage installed by the City of Brampton at Heart Lake Road, just south of Countryside Drive. Please note that there are lessons that can be learned from the monitoring of this eco-passage that can benefit future eco-passage and directional fencing measures in the area. Please include post project monitoring of measures at the future design stage, and continue to consult with TRCA staff.	
18.	The Final Report indicates that temporary wildlife fencing was installed in 2018, and that additional areas for fencing are recommended in the future. At future design stages, please identify these areas on a map and clarify if they are linked to current of future eco-passages.	
Heart Lake Conservation Area Multi-Use Trail		
19.	Staff understands that a hybrid MUT through HLCA is proposed as a short-term measure in lieu of an EA study. Staff acknowledges that a MUT through HLCA would be compliant with the direction of the HLCA Master Plan and TRCA Trail Strategy. Please continue to consult and work closely with TRCA staff on the planning and design of this MUT.	
20.	Please note that the HLCA Master Plan was approved by TRCA in 2006, which included a trail plan for the property. In 2017, TRCA staff completed a review of the HLCA trail system operations to address trail use, alignments, signage and other operational considerations. Trail projects have continued to be implemented between 2006 and 2018. Please contact TRCA for more information regarding the HLCA Master Plan.	
21.	In the current draft TRCA Trail Strategy, TRCA staff has identified the Esker Lake Trail, which passes north-south through HLCA, as a trail of regional significance. As such, local trail and active transportation corridor connection opportunities should be planned and accommodated in this infrastructure improvement project in coordination with the Regional Municipality of Peel, the City of Brampton, the Town of Caledon and TRCA.	
22.	Winter operational requirements and responsibilities including trail maintenance and management needs to be considered at the planning stages of the proposed MUT through HLCA, particularly during the off-season when HLCA is officially closed from mid-October to late April. Further discussions between TRCA and City of Brampton staff are required to discuss these operational requirements and to develop necessary agreements	
23.	Please note that timing of construction of any improvements should be scheduled when HLCA is closed or at times of low visitation to avoid impacts to the operation of the conservation area. Please ensure that this is coordinated with TRCA staff.	
24.	The short-term budget on page 7.5 of the Final Report does not include costs for improvements to the trail system at HLCA to accommodate the recommended MUT. These costs should include planning, detailed design, construction and post-construction monitoring costs. Please revise the budget accordingly.	

ITEM	NEW TRCA COMMENTS ON FINAL REPORT (March 26, 2019)	PROPONENT RESPONSE
Heart Lake Conservation Area Traffic Circle		
25.	Please note that there are often long lines of vehicles waiting to pay admission fees at the front gate of HLCA that extend onto Heart Lake Road and occasionally onto Sandalwood Parkway at peak times during HLCA's operating season. TRCA staff has concerns about the flow of traffic with the traffic circle being recommended as the only vehicular access to HLCA. Staff notes that Table 25 of the Final Report does not appear to identify any advantages of Option 2B (mini roundabout at HLCA) over Option 2C (speed cushions, lane narrowing with rumble strips). Option 2C may be more appropriate given the peak traffic flows at HLCA. Please continue to consult with TRCA staff on the appropriateness of a traffic circle at this location at the detailed design and permitting stages of this project. It is understood that the project design within the Feasibility Study Final Report may need to change at the design and permitting stage in order to fully address TRCA staff concerns regarding both the traffic circle into HLCA, as well as footprint and encroachment issues and impacts into the adjacent Natural Heritage System.	
26.	It is staff preference for there to be no encroachment onto TRCA lands to accommodate traffic circles due to highly sensitive natural features in the area. Please continue to consult with TRCA staff at design stages to ensure that TRCA lands are avoided.	
27.	Please clarify if the costs for the traffic circle at the entrance of HLCA identified on page 7.5 of the Final Report include land securement and compensation costs.	
New Developments		
28.	Increased pedestrian traffic into HLCA is expected due to the new residential development on the east side of Heart Lake Road. Please note that the planning and design of Heart Lake Road will need to incorporate safe pedestrian access into HLCA that should be separated from the main entrance to avoid pedestrian and vehicular interactions.	
29.	Please clarify how new developments along Heart Lake Road will not increase use and traffic along Heart Lake Road, according to the results of the traffic modelling within the Final Report.	

Stantec

Meeting Minutes

TAC Meeting #2

The Function and Design Review of the Heart Lake Road Corridor
Stantec File 165001037

Date/Time:	May 3, 2018 / 1:00 PM	
Place:	City of Brampton 2 Wellington Street West, Brampton, ON Boardroom 2E	
Next Meeting:		
Attendees:	Nelson Cadete	City of Brampton
	Henrik Zbogar	City of Brampton
	Ghaz Mohammed	City of Brampton
	Katharine McCarter	TRCA
	Leilani Lee-Yates	TRCA
	Brennan Paul	TRCA
	Doug Milles	TRCA
	Stavroula Kassaris	City of Brampton
	Mark Heaton	MNRF
	Marc Dupuis-Desormeaux	
	Leila Sotondeh	TRCA
	Caroline Mugo	TRCA
	Mario Goolsaarran	City of Brampton
	Dayle Laing	
	David Laing	
	John Fautin	City of Brampton
	Francois Tomeo	Stantec
	Irene Hauzar	Stantec
Distribution:	Project Team	

Item: **Action:**

PRESENTATION OF ALTERNATIVES AND EVALUATION

Stantec presented the development and evaluation of the three following categories of alternatives:

- Active transportation;
- Traffic calming;
- Wildlife mortality mitigation.

Item:	Action:
REVIEW OF ALTERNATIVES UNDER CONSIDERATION	
1. A request was made to revisit the Terms of Reference regarding the cultural heritage components of the study. Document the findings that the cultural heritage assessment recommended for Heart Lake Road. In addition, the Terms of Reference also considers how pedestrians will be accommodated in this study and needs to be documented.	Stantec
2. Lands adjacent to Heart Lake Road are planned for development. There is associated traffic impacts in which there is a need to reduce speed by implementing traffic measures such as roundabouts, traffic circles etc.	
EVALUATION OF ALTERNATIVES	
1. Provide details regarding how the options were ranked; how the preferred alternative was determined.	Stantec
2. Consider how the first vision (sustainability and the environment) outlined at the 2040 Vision for the City of Brampton can be applied to the Heart Lake Road study.	Stantec
3. Include a discussion about the importance of the Brampton's ravines and valleylands as part of the discussion for the PIC.	Stantec
4. Include the planned development called "Burnt Log" at the southeast corner of Countryside Drive and Heart Lake Road as part of the how connections to the Heart Lake Conservation Area need to be enhanced.	Stantec
5. Lands north of Countryside include employment and industrial which will be tied into cultural heritage considerations.	
PREFERRED ALTERNATIVE	
1. Alternative C has been identified as the Preferred Alternative. Alternative C has no impact to drainage along Heart Lake Road. A future EA is recommended to help determine the environmental impacts for this alternative.	
2. There are two ecopassages proposed along Heart Lake Road, which will require additional engineering to determine what structural elements are needed to support the roadway with the introduction of the ecopassages.	

Item:	Action:
3. Short term solutions include changing the roadway designation to local collector roadway. The lane width of Heart Lake Road will be changed to 3 m, with a 1.5 m for a bike lane.	
4. Hybrid cross section of Heart Lake Road will be developed and circulated (combination of rural and urban road). Need to identify how much property will be required from developers.	
5. MTO has been part of the TAC and have been included on all materials. MTO has stated they will not be considering a partial interchange at Countryside.	
6. The lane widths and suggested speed limits are shown as part of the evaluation of alternatives.	
7. Countryside connections should include Heart Lake Road by using the existing route or the preferred route. Need to identify if there will be any additional roadwork that will be needed.	Stantec
8. Develop a map that shows the improvements suggested within the entire corridor.	Stantec
9. Develop a cross section for Alternative C.	Stantec
10. Request for bore hole locations and report was made.	Stantec
11. Memo to be circulated to TAC members that describe the evaluation of alternatives.	Stantec
12. Suggestion for the inclusion of an interpretive plaque that discusses the cultural heritage aspect of Heart Lake Road be included where pedestrians and cyclists can access it.	
PIC #2	
13. Tentatively scheduled for Wednesday May 16, 6:30 PM to 8:30 PM at Loafer's Lane Recreation Centre, Room 1,30 Loafer's Lake Lane, Brampton, ON.	To confirm by City

The meeting adjourned at 3:00 PM. The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

STANTEC CONSULTING LTD.

Irene Hauzar, MCIP, RPP, AICP
Senior Environmental Planner
Phone: (416) 507-3494
Irene.Hauzar@stantec.com

APPENDIX C

Turning Movement Counts

Signalized Interesections

0	10	A
10	20	B
20	35	C
35	55	D
55	80	E
80	1000	F

Heart Lake Road Turning Movement Count

PEAK HOUR TRAFFIC VOLUME LEVELS

\\cd1175-f01\01650\active\165001037\5 Technical Work\3 Traffic Analysis\[165001037_HeartLakeRd_Volumes_r2.xlsx]Turn Table

Movement / AM Peak Hour (7:30-8:30 AM)

Intersection	Index	Movement	EID	PED Movement	Cars	Trucks	Total Vehicles - Existing	Total Vehicles - Balanced	Pedestrians	Cyclists	Delay	V/C	Intersection V/C	Heavy Vehicle %
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	10101	NBL	101NBL		37	1	38	38			48.7	0.37	C	2.63%
	10102	NBT	101NBT	SC	54	6	60	60			42.7	0.16	C	10.00%
	10103	NBR	101NBR		143	4	147	147			42	0.1	C	2.72%
101	10104	SBL	101SBL		429	10	439	439			31.6	0.65	C	2.28%
	10105	SBT	101SBT	NC	164	2	166	166			63.1	0.8	C	1.20%
Kennedy Rd @ Mayfield Rd	10106	SBR	101SBR		133	12	145	145			63.1	0.8	C	8.28%
	10107	EBL	101EBL		75	12	87	87			24.7	0.27	C	13.79%
	10108	EBT	101EBT	WC	848	35	883	883	3		29.2	0.61	C	3.96%
	10109	EBR	101EBR		61	8	69	69			29.2	0.61	C	11.59%
	10110	WBL	101WBL		93	3	96	96			42.7	0.6	C	3.13%
	10111	WBT	101WBT	EC	442	51	493	493			23.9	0.33	C	10.34%
	10112	WBR	101WBR		156	13	169	169			21.3	0.11	C	7.69%
	10301	NBL	103NBL		301	9	310	310			44.8	0.72	D	3.00%
	10302	NBT	103NBT	SC	507	32	539	539			45.9	0.6	D	6.00%
	10303	NBR	103NBR		24	0	24	44			45.9	0.6	D	1.00%
103	10304	SBL	103SBL		124	3	127	127			31.1	0.42	D	2.00%
	10305	SBT	103SBT	NC	179	2	181	181			36.8	0.23	D	1.00%
Kennedy Rd @ Sandalwood Pkwy E	10306	SBR	103SBR		51	26	77	77			36.8	0.23	D	34.00%
	10307	EBL	103EBL		4	0	4	4			21.5	0.02	D	9.00%
	10308	EBT	103EBT	WC	1132	11	1143	1343			51.5	0.96	D	1.00%
	10309	EBR	103EBR		179	9	188	188			51.5	0.96	D	5.00%
	10310	WBL	103WBL		98	1	99	99			46.9	0.69	D	1.00%
	10311	WBT	103WBT	EC	877	18	895	895			22.9	0.54	D	2.00%
	10312	WBR	103WBR		91	7	98	98			22.9	0.54	D	7.00%
	10401	NBL	104NBL		98	5	103	55			25.5	0.26	B	4.85%
	10402	NBT	104NBT	SC	12		12	6			23.4	0.02	B	
	10403	NBR	104NBR		18		18	9			23.3	0.01	B	
104	10404	SBL	104SBL		33		33	33			30.9	0.23	B	
	10405	SBT	104SBT	NC	77	1	78	41			30.3	0.21	B	1.28%
Heart Lake Rd @ Mayfield Rd	10406	SBR	104SBR		42		42	35			28.7	0.02	B	
	10407	EBL	104EBL		20	1	21	21			8.7	0.06	B	4.76%
	10408	EBT	104EBT	WC	1055	63	1118	1118			11	0.44	B	5.64%
	10409	EBR	104EBR		494	11	505	263			9.3	0.16	B	2.18%
	10410	WBL	104WBL		113	3	116	60			6.2	0.19	B	2.59%
	10411	WBT	104WBT	EC	641	87	728	728			6.1	0.25	B	11.95%
	10412	WBR	104WBR		10	4	14	14			5.1	0.01	B	28.57%
	10501	NBL	105NBL											
	10502	NBT	105NBT	SC	38	2	40	16				0.01		6.00%
	10503	NBR	105NBR		117	1	118	49				0.03		1.00%
105	10504	SBL	105SBL		249		249	200				0.13	A	
	10505	SBT	105SBT	NC	200	4	204	164			5	0.13	A	2.00%
Heart Lake Rd @ Countryside Dr	10506	SBR	105SBR											
	10507	EBL	105EBL											
	10508	EBT	105EBT	WC										
	10509	EBR	105EBR											
	10510	WBL	105WBL		233	2	235	190			21	0.46	C	1.00%
	10511	WBT	105WBT	EC										
	10512	WBR	105WBR		66	1	67	54			9	0.05	A	1.00%
	10601	NBL	106NBL											
	10602	NBT	106NBT	SC	123	4	127	100				0.06		3.00%
	10603	NBR	106NBR											
106	10604	SBL	106SBL											
	10605	SBT	106SBT	NC	412	8	420	353				0.21		2.00%
Heart Lake Rd @ 410 SB Exit	10606	SBR	106SBR											
	10607	EBL	106EBL											
	10608	EBT	106EBT	WC										
	10609	EBR	106EBR											
	10610	WBL	106WBL		376	4	380	372			23	0.66	C	1.00%
	10611	WBT	106WBT	EC										
	10612	WBR	106WBR		13		13	10			9	0.01	A	
	10701	NBL	107NBL		46	5	50	33			39.3	0.17	C	9.00%
	10702	NBT	107NBT	SC	51	1	52	34			41.9	0.11	C	1.00%
	10703	NBR	107NBR		96	3	99	99			41.4	0.06	C	3.00%
107	10704	SBL	107SBL		353	4	357	357			107.2	1.05	C	1.00%
	10705	SBT	107SBT	NC	235	5	240	240			50.1	0.67	C	2.00%
Heart Lake Rd @ Sandalwood Pkwy E	10706	SBR	107SBR		123	5	128	128			39.2	0.08	C	4.00%
	10707	EBL	107EBL		67		67	41			11.1	0.13	C	
	10708	EBT	107EBT	WC	1725	17	1742	1642			18.6	0.61	C	1.00%
	10709	EBR	107EBR		73	11	84	84					C	13.00%
	10710	WBL	107WBL		122	2	124	124			23.5	0.64	C	2.00%
	10711	WBT	107WBT	EC	934	39	973	973			15.2	0.48	C	4.00%
	10712	WBR	107WBR		37	2	39	25			10.5	0.02	C	5.00%
	10801	NBL	108NBL		87	7	94	94			37	0.5	B	7.60%
	10802	NBT	108NBT	SC	29	2	31	31			30	0.08	B	6.10%
	10803	NBR	108NBR		34	6	40	40			29.6	0.03	B	16.20%
108	10804	SBL	108SBL		22	14	36	36			31.2	0.17	B	39.50%
	10805	SBT	108SBT	NC	212	5	217	217			36.2	0.56	B	2.10%
Dixie Rd @ Mayfield Rd	10806	SBR	108SBR		344	6	350	350			35	0.49	B	1.70%
	10807	EBL	108EBL		192	20	212	212			8.6	0.44	B	9.20%
	10808	EBT	108EBT	WC	1098	86	1184	1184			12.6	0.44	B	7.30%
	10809	EBR	108EBR		294	3	297	297			10.7	0.18	B	1.00%
	10810	WBL	108WBL		57	10	67	67			8.9	0.24	B	15.40%
	10811	WBT	108WBT	EC	594	99	693	693			11.9	0.28	B	14.30%
	10812	WBR	108WBR		3	1	4	4					B	33.30%
	10901	NBL	109NBL		29		29	38			6.3	0.06	B	
	10902	NBT	109NBT	SC	108	2	110	193	5		6.9	0.17	B	1.82%
	10903	NBR	109NBR		79	7	86	112			24.6	0.07	B	8.14%
109	10904	SBL	109SBL		99	3	102	133			7.2	0.18	B	2.94%
	10905	SBT	109SBT	NC	295	5	300	390	1		8.3	0.35	B	1.67%
Dixie Rd @ Countryside Dr	10906	SBR	109SBR		3		3	8					B	
	10907	EBL	109EBL		7		7	9			24.3	0.03	B	
	10908	EBT	109EBT	WC	195		195	234	1	1	26.1	0.3	B	
	10909	EBR	109EBR		63	2	65	105			24.6	0.07	B	3.08%
	10910	WBL	109WBL		35	2	37	48			26	0.21	B	5.41%
	10911	WBT	109WBT	EC	91		91	153		1	25.4	0.2	B	
	10912	WBR	109WBR		26		26	34			24.2	0.02	B	
	11001	NBL	110NBL		75	3	78	78			30.5	0.28	C	3.80%
	11002	NBT	110NBT	SC	293	14	307	277	32		30	0.22	C	4.60%
	11003	NBR	110NBR		65	3	68	68			27.9	0.05	C	4.40%
110	11004	SBL	110SBL		75	3	78	55			36.6	0.18	C	3.80%
	11005	SBT	110SBT	NC	607	22	629	509	11		40.7	0.5	C	3.50%
Dixie Rd @ Sandalwood Pkwy E	11006	SBR	110SBR		349	10	359	279			37.6	0.26	C	2.80%
	11007	EBL	110EBL		247	9	256	206			34	0.74	C	3.50%
	11008	EBT	110EBT	WC	1327	33	1360	1360	33		37.6	0.76	C	2.40%
	11009	EBR	110EBR		214	8	222	192					C	3.60%
	11010	WBL	110WBL		149	6	155	155			38.1	0.66	C	3.90%
	11011	WBT	110WBT	EC	928	29	957	957	33		27.6	0.48	C	3.00%
	11012	WBR	110WBR		118	4	122	100					C	3.30%
	11101	NBL	111NBL		57	1	58	46			4	0.04	A	1.00%
	11102	NBT	111NBT	SC	81	1	82	64			4	0.04	A	1.00%
	11103	NBR	111NBR											
111	11104	SBL	111SBL											
	11105	SBT	111SBT	NC	238	2	240	333				0.21		1.00%
Heart Lake Rd @ Private Rd	11106	SBR	111SBR		15		15	21				0.21		
	11107	EBL	111EBL		1		1	1			11	0.03	B	
	11108	EBT	111EBT	WC							11	0.03	B	
	11109	EBR	111EBR		19	1	20	20			11	0.03	B	7.00%
	11110	WBL	111WBL											
	11111	WBT	111WBT	EC										
	11112	WBR	111WBR											
	11201	NBL	112NBL											
	11202	NBT	112NBT	SC			110	110						
	11203	NBR	112NBR											
112	11204	SBL	112SBL											
	11205	SBT	112SBT	NC			353	353						
Heart Lake Rd ATR	11206	SBR	112SBR											
	11207	EBL	112EBL											
*Balance to this ATR	11208	EBT	112EBT	WC										
	11209	EBR	112EBR											
	11210	WBL	112WBL											
	11211	WBT	112WBT	EC										
	11212	WBR	112WBR											

PM Peak Hour (4:45-5:45 PM) / 2041 Annual Growth / 2041 Total Growth

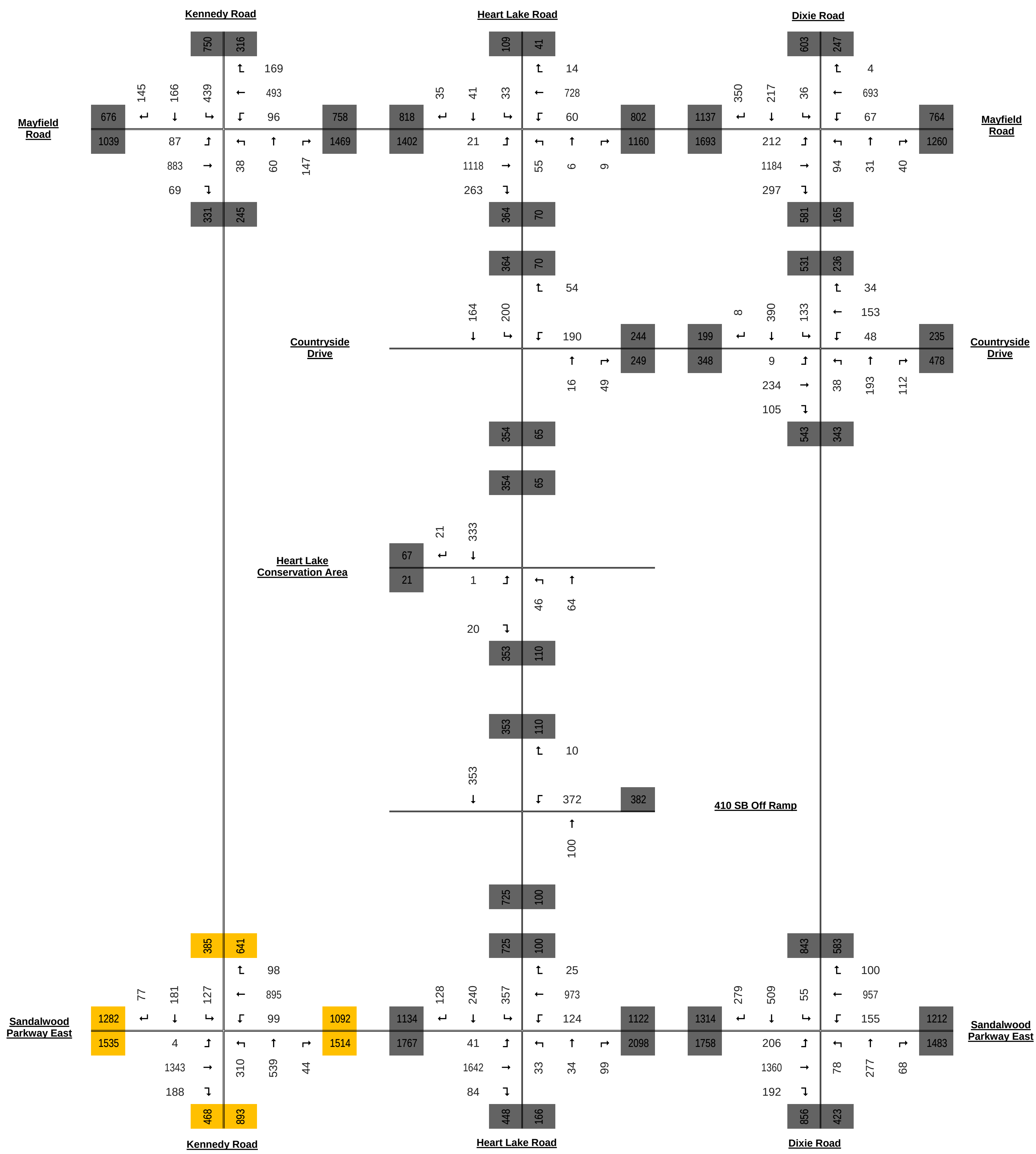
Index	Cars	Trucks	Total Vehicles - Existing	Total Vehicles - Balanced	Pedestrians	Cyclists	Delay	V/C	Intersection LOS	Heavy Vehicle %	2041 Annual Growth AM Peak	2041 Annual Growth PM Peak	2041 Total Growth AM Peak	2041 Total Growth PM Peak
1	15	16	17	18	19	20	21	22	23	24	31	32	33	34
10101	92		92	92			48.7	0.37	C		4.00%	4.00%	166.58%	166.58%
10102	144	1	145	145		1	42.7	0.16	C	0.69%	4.00%	4.00%	166.58%	166.58%
10103	109	1	110	110			42	0.1	C	0.91%	4.00%	4.00%	166.58%	166.58%
10104	208	2	210	210			31.6	0.65	C	0.95%	3.50%	3.00%	136.32%	109.38%
10105	113		113	113		1	63.1	0.8	C		3.50%	3.00%	136.32%	109.38%
10106	116	2	118	118			63.1	0.8	C	1.69%	3.50%	3.00%	136.32%	109.38%
10107	184		184	184			24.7	0.27	C		1.00%	1.50%	28.24%	45.09%
10108	564	24	588	588	7		29.2	0.61	C	4.08%	1.00%	1.50%	28.24%	45.09%
10109	53	4	57	57			29.2	0.61	C	7.02%	1.00%	1.50%	28.24%	45.09%
10110	146	1	147	147			42.7	0.6	C	0.68%	1.00%	1.50%	28.24%	45.09%
10111	935	16	951	951			23.9	0.33	C	1.68%	1.00%	1.50%	28.24%	45.09%
10112	358	3	361	361			21.3	0.11	C	0.83%	1.00%	1.50%	28.24%	45.09%
10301	266		266	266			44.8	0.72	D			2.50%		85.39%
10302	410	8	418	418			45.9	0.6	D	2.00%		2.50%		85.39%
10303	122	1	123	123			45.9	0.6	D	1.00%		2.50%		85.39%
10304	280	9	289	289			31.1	0.42	D	3.00%	3.50%	3.00%	136.32%	109.38%
10305	268	3	271	271			36.8	0.23	D	1.00%	3.50%	3.00%	136.32%	109.38%
10306	20	8	28	28			36.8	0.23	D	27.00%	3.50%	3.00%	136.32%	109.38%
10307	12	1	13	13			21.5	0.02	D	5.00%	1.00%	0.50%	28.24%	13.28%
10308	965	10	975	975			51.5	0.96	D	1.00%	1.00%	0.50%	28.24%	13.28%
10309	90	8	98	98			51.5	0.96	D	8.00%	1.00%	0.50%	28.24%	13.28%
10310	64	1	65	80			46.9	0.69	D	2.00%	1.00%	0.50%	28.24%	13.28%
10311	1197	12	1209	1459			22.9	0.54	D	1.00%	1.00%	0.50%	28.24%	13.28%
10312	216	7	223	243			22.9	0.54	D	3.00%	1.00%	0.50%	28.24%	13.28%
10401	273	4	277	260			25.5	0.26	B	1.30%	2.00%	3.00%	64.06%	109.38%
10402	28		28	27			23.4	0.02	B		2.00%	3.00%	64.06%	109.38%
10403	15	1	16	16			23.3	0.01	B	9.10%	2.00%	3.00%	64.06%	109.38%
10404	33	3	36	36			30.9	0.23	B	7.40%	3.50%	7.50%	136.32%	509.83%
10405	25	1	26	18			30.3	0.21	B	3.80%	3.50%	7.50%	136.32%	509.83%
10406	26	1	27	20			28.7	0.02	B	4.80%	3.50%	7.50%	136.32%	509.83%
10407	21	1	22	22			8.7	0.06	B	3.20%	1.50%	1.50%	45.09%	45.09%
10408	766	76	842	842			11	0.44	B	9.00%	1.50%	1.50%	45.09%	45.09%
10409	125	8	133	93			9.3	0.16	B	6.10%	1.50%	1.50%	45.09%	45.09%
10410	20	1	21	14			6.2	0.19	B	5.40%		0.50%		13.28%
10411	1052	35	1087	1087			6.1	0.25	B	3.20%		0.50%		13.28%
10412	30	1	31	31			5.1	0.01	B	2.40%		0.50%		13.28%
10501											3.50%	2.00%	136.32%	64.06%
10502	112	1	113	101				0.06		1.00%	3.50%	2.00%	136.32%	64.06%
10503	169		169	150				0.09			3.50%	2.00%	136.32%	64.06%
10504	61	1	62	50				0.04	A	2.00%	2.00%	0.50%	64.06%	13.28%
10505	103	2	105	75			3	0.04	A	2.00%	2.00%	0.50%	64.06%	13.28%
10506											2.00%	0.50%	64.06%	13.28%
10507														
10508														
10509														
10510	190	2	192	138			12	0.2	B	1.00%		1.00%		28.24%
10511												1.00%		28.24%
10512	242		242	202			10	0.21	A			1.00%		28.24%
10601											0.50%	1.50%	13.28%	45.09%
10602	170	3	173	298				0.18		2.00%	0.50%	1.50%	13.28%	45.09%
10603								0.18			0.50%	1.50%	13.28%	45.09%
10604								0.18			-100.00%	-100.00%	-100.00%	-100.00%
10605	225	2	227	308				0.18		1.00%	-100.00%	-100.00%	-100.00%	-100.00%
10606											-100.00%	-100.00%	-100.00%	-100.00%
10607														
10608														
10609														
10610	78		78	78			14	0.17	B		2.50%	2.00%	85.39%	64.06%
10611											2.50%	2.00%	85.39%	64.06%
10612	1		1	2			10		A		2.50%	2.00%	85.39%	64.06%
10701	65	6	71	71			39.3	0.17	C	8.00%		0.50%		13.28%
10702	91		91	91			41.9	0.11	C			0.50%		13.28%
10703	94	3	97	97			41.4	0.06	C	3.00%		0.50%		13.28%
10704	197	2	199	177			107.2	1.05	C	1.00%		-1.00%		-22.22%
10705	92	2	94	84			50.1	0.67	C	2.00%		-1.00%		-22.22%
10706	136	3	139	125			39.2	0.08	C	2.00%		-1.00%		-22.22%
10707	79	1	80	98			11.1	0.13	C	1.00%	1.00%	1.00%	28.24%	28.24%
10708	1200	24	1224	1224			18.6	0.61	C	2.00%	1.00%	1.00%	28.24%	28.24%
10709	48	4	52	52					C	8.00%	1.00%	1.00%	28.24%	28.24%
10710	122		122	122			23.5	0.64	C		2.50%	1.00%	85.39%	28.24%
10711	1801	18	1819	1719			15.2	0.48	C	1.00%	2.50%	1.00%	85.39%	28.24%
10712	88	2	90	109			10.5	0.02	C	2.00%	2.50%	1.00%	85.39%	28.24%
10801	154	4	158	158			37	0.5	B	2.80%	4.50%	5.50%	200.54%	281.34%
10802	153		153	153			30	0.08	B		4.50%	5.50%	200.54%	281.34%
10803	49	2	51	51			29.6	0.03	B	3.70%	4.50%	5.50%	200.54%	281.34%
10804	15	2	17	17			31.2	0.17	B	14.30%	1.00%	3.50%	28.24%	136.32%
10805	51	2	53	53			36.2	0.56	B	3.60%	1.00%	3.50%	28.24%	136.32%
10806	218	18	236	236			35	0.49	B	7.80%	1.00%	3.50%	28.24%	136.32%
10807	306	3	309	309			8.6	0.44	B	0.90%	2.00%		64.06%	
10808	821	84	905	905			12.6	0.44	B	9.30%	2.00%		64.06%	
10809	109	1	110	110			10.7	0.18	B	0.90%	2.00%		64.06%	
10810	51	1	52	52			8.9	0.24	B	2.20%	1.00%	2.50%	28.24%	85.39%
10811	1028	77	1105	1105			11.9	0.28	B	7.00%	1.00%	2.50%	28.24%	85.39%
10812	7	1	8	8					B	12.50%	1.00%	2.50%	28.24%	85.39%
10901	35		35	63			6.3	0.06	B		1.50%	2.00%	45.09%	64.06%
10902	225	7	232	350	37		6.9	0.17	B	3.02%	1.50%	2.00%	45.09%	64.06%
10903	47	5	52	81			24.6	0.07	B	9.62%	1.50%	2.00%	45.09%	64.06%
10904	19		19	25			7.2	0.18	B		2.50%	3.50%	85.39%	136.32%
10905	133	4	137	178	2		8.3	0.35	B	2.92%	2.50%	3.50%	85.39%	136.32%
10906	12		12	18					B		2.50%	3.50%	85.39%	136.32%
10907	7		7	11			24.3	0.03	B		2.50%	2.00%	85.39%	64.06%
10908	70		70	100			26.1	0.3	B		2.50%	2.00%	85.39%	64.06%
10909	16	1	17	30			24.6	0.07	B	5.88%	2.50%	2.00%	85.39%	64.06%
10910	29	1	30	45			26	0.21	B	3.33%	1.50%	3.00%	45.09%	109.38%
10911	106	1	107	170			25.4	0.2	B	0.93%	1.50%	3.00%	45.09%	109.38%
10912	33		33	52			24.2	0.02	B		1.50%	3.00%	45.09%	109.38%
11001	213	2	215	215			30.5	0.28	C	0.90%	1.00%	2.00%	28.24%	64.06%
11002	512	9	521	521	25		30	0.22	C	1.70%	1.00%	2.00%	28.24%	64.06%
11003	182		182	182			27.9	0.05	C		1.00%	2.00%	28.24%	64.06%
11004	34		34	34			36.6	0.18	C		2.00%	3.50%	64.06%	136.32%
11005	239	8	247	247	14		40.7	0.5	C	3.20%	2.00%	3.50%	64.06%	136.32%
11006	277	4	281	281			37.6	0.26	C	1.40%	2.00%	3.50%	64.06%	136.32%
11007	294	4	298	298			34	0.74	C	1.30%	3.00%	0.50%	109.38%	13.28%
11008	1092	17	1109	1109	21		37.6	0.76	C	1.50%	3.00%	0.50%	109.38%	13.28%
11009	99	2	101	101					C	2.00%	3.00%	0.50%	109.38%	13.28%
11010	80	1	81	81			38.1	0.66	C	1.20%	2.00%	3.00%	64.06%	109.38%
11011	1348	15	1363	1363	28		27.6	0.48	C	1.10%	2.00%	3.00%	64.06%	109.38%
11012	51		51	51					C		2.00%	3.00%	64.06%	109.38%
11101	61		61	67			2	0.05	A		3.50%	2.00%	136.32%	64.06%
11102	209	2	211	233			2	0.05	A	1.00%	3.50%	2.00%	136.32%	64.06%
11103											3.50%	2.00%	136.32%	64.06%
11104											-100.00%	-100.00%	-100.00%	-100.00%
11105	226	2	228	198				0.13		1.00%	-100.00%	-100.00%	-100.00%	-100.00%
11106	15		15	15				0.13			-100.00%	-100.00%	-100.00%	-100.00%
11107	18		18	18			11	0.17	B					
11108							11	0.17	B					
11109	127		127	110			11	0.17	B					
11110														
11111														
11112														
11201														
11202			300	300										
11203														
11204														
11205			308	308										
11206														
11207														
11208														
11209														
11210														
11211														
11212														

Forecast 2041 Alternative G (Without Improvements)

Index	2041 AM Peak Hour: Total Vehicles - Unbalanced	Total Vehicles - Balanced	Change from 2016	Delay	V/C	Intersection LOS	2041 PM Peak Hour: Total Vehicles - Unbalanced	Total Vehicles - Balanced	Change from 2016	Delay	V/C	Intersection LOS
1	35	36	37	38	39	40	41	42	43	44	45	46
10101	101	101	63	523	1.91	F	245	245	153	1613.7	4.38	F
10102	160	160	100	46.1	0.39	F	387	387	242	114.6	1.05	F
10103	392	392	245	85.8	0.95	F	293	293	183	56.6	0.65	F
10104	1037	1037	598	289.1	1.55	F	440	440	230	177.4	1.26	F
10105	392	392	226	409.4	1.77	F	237	237	124	234.1	1.36	F
10106	343	343	198	409.4	1.77	F	247	247	129	234.1	1.36	F
10107	112	112	25	36.7	0.48	F	267	267	83	902.8	2.87	F
10108	1132	1132	249	42.5	0.84	F	853	853	265	22	0.51	F
10109	88	88	19	42.5	0.84	F	83	83	26	22	0.51	F
10110	123	123	27	550.5	2.02	F	213	213	66	75.7	0.94	F
10111	632	632	139	30.2	0.45	F	1380	1380	429	27.6	0.74	F
10112	217	217	48	25.6	0.14	F	524	524	163	19.5	0.32	F
10301	310	310		144.4	1.15	F	493	493	227	341.8	1.64	F
10302	539	539		46.8	0.61	F	775	775	357	72.1	0.98	F
10303	44	44		46.8	0.61	F	228	228	105	72.1	0.98	F
10304	300	300	173	82.6	0.98	F	605	605	316	884.4	2.85	F
10305	428	428	247	43.9	0.6	F	567	567	296	43.2	0.62	F
10306	182	182	105	43.9	0.6	F	59	59	31	43.2	0.62	F
10307	5	5	1	22	0.05	F	15	15	2	30.1	0.28	F
10308	1722	1722	379	148.3	1.23	F	1104	1104	129	35.6	0.78	F
10309	241	241	53	148.3	1.23	F	111	111	13	35.6	0.78	F
10310	127	127	28	79.6	0.88	F	91	91	11	30.3	0.54	F
10311	1148	1148	253	26.6	0.69	F	1653	1653	194	73.8	1.06	F
10312	126	126	28	26.6	0.69	F	275	275	32	73.8	1.06	F
10401	90	191	136	46.9	0.7	B	544	544	284	115	1.15	C
10402	10	21	15	32.3	0.05	B	57	57	30	15.8	0.08	C
10403	15	32	23	32	0.02	B	34	34	18	15.4	0.02	C
10404	78	78	45	44.7	0.41	B	220	220	184	31.3	0.63	C
10405	97	107	66	44.2	0.42	B	110	110	92	23.7	0.22	C
10406	83	83	48	39.9	0.05	B	122	122	102	23.1	0.14	C
10407	30	30	9	10	0.08	B	32	32	10	16.3	0.21	C
10408	1622	1622	504	14.4	0.57	B	1222	1222	380	18.9	0.6	C
10409	382	423	160	11.4	0.26	B	135	135	42	14.2	0.09	C
10410	60	66	6	11.2	0.35	B	16	16	2	12.7	0.11	C
10411	728	728		7.8	0.24	B	1231	1231	144	14	0.48	C
10412	14	14		6.6	0.01	B	35	35	4	10.5	0.02	C
10501												
10502	38		-16				166		-101			
10503	116	172	123				246	510	360			
10504	328	597	397	9.4	0.42	A	57	261	211	9.5	0.25	A
10505	269		-164				85		-75			
10506												
10507												
10508												
10509												
10510	190		-190				177		-138			
10511												
10512	54	244	190	9.3	0.22	A	259	635	433	12.8	0.58	B
10601												
10602	113	133	33				432	432	134			
10603												
10604												
10605			-353						-308			
10606												
10607												
10608												
10609												
10610	690	725	353	26.8	0.84	D	128	300	222	17.1	0.5	C
10611												
10612	19	127	117	9.5	0.14	A	3	60	58	11.2	0.09	B
10701	33	33		38.9	0.17	D	80	80	9	37.8	0.31	D
10702	34	34		41.5	0.11	D	103	121	30	44.7	0.47	D
10703	99	99		41.1	0.06	D	110	110	13	40	0.07	D
10704	357	357		104.9	1.05	D	138	138	-39	37.4	0.47	D
10705	240	240		49.5	0.66	D	65	65	-19	40.3	0.23	D
10706	128	128		38.9	0.08	D	97	97	-28	38.6	0.06	D
10707	53	53	12	24.2	0.35	D	126	148	50	46	0.77	D
10708	2106	2106	464	23	0.78	D	1570	1570	346	16.5	0.58	D
10709	108	108	24	23	0.78	D	67	67	15	16.5	0.58	D
10710	230	230	106	217.5	1.34	D	156	156	34	23.3	0.7	D
10711	1804	1804	831	30.8	0.91	D	2205	2205	486	80.2	1.11	D
10712	46	46	21	11.4	0.03	D	140	164	55	11.9	0.14	D
10801	283	283	189	179.3	1.25	D	603	603	445	146.8	1.21	E
10802	93	93	62	28.4	0.18	D	583	583	430	37	0.77	E
10803	120	120	80	27.4	0.09	D	194	194	143	23.4	0.13	E
10804	46	46	10	28.6	0.17	D	40	40	23	28.5	0.33	E
10805	278	278	61	33	0.52	D	125	125	72	23.8	0.17	E
10806	449	449	99	39	0.7	D	558	558	322	40.3	0.79	E
10807	348	348	136	62.5	0.99	D	309	309		435.2	1.85	E
10808	1942	1942	758	23.8	0.79	D	905	905		27	0.46	E
10809	487	487	190	16.5	0.34	D	110	110		22.1	0.07	E
10810	86	86	19	24.4	0.58	D	96	96	44	20.1	0.33	E
10811	889	889	196	17.4	0.4	D	2049	2049	944	66.5	1.04	E
10812	5	5	1	17.4	0.4	D	15	15	7	66.5	1.04	E
10901	55	55	17.3	11.1	0.22	B	103	103	40	8.1	0.2	B
10902	280	280	87	10	0.26	B	574	574	224	11	0.52	B
10903	162	162	50.2	23.1	0.11	B	133	133	52	7	0.09	B
10904	246	246	113.4	12.2	0.4	B	58	58	33.3	7.6	0.14	B
10905	723	723	333	16.9	0.7	B	421	421	242.9	9.7	0.42	B
10906	15	15	7	16.9	0.7	B	43	43	25	9.7	0.42	B
10907	17	17	7.9	22.7	0.05	B	18	18	7	24.3	0.08	B
10908	434	434	200	25.9	0.44	B	164	164	64	24.9	0.2	B
10909	195	195	90	23.5	0.15	B	49	49	19	23.8	0.03	B
10910	70	70	21.9	25.8	0.31	B	94	94	49	27.3	0.35	B
10911	222	222	69	23.9	0.22	B	356	356	186	26.9	0.43	B
10912	49	49	15.2	22.5	0.03	B	109	109	57	24.1	0.07	B
11001	100	100	22	39.2	0.58	F	353	353	138	101.1	1.06	F
11002	355	355	78	30	0.27	F	855	855	334	31.2	0.58	F
11003	87	87	19	27.4	0.06	F	299	299	117	26.3	0.26	F
11004	90	90	35	38	0.3	F	80	80	46	42.4	0.47	F
11005	835	835	326	48	0.78	F	584	584	337	40.2	0.54	F
11006	458	458	179	50.8	0.74	F	664	664	383	146.7	1.18	F
11007	431	431	225	763	2.58	F	338	338	40	470.3	1.92	F
11008	2848	2848	1488	381	1.74	F	1256	1256	147	41.9	0.76	F
11009	402	402	210	381	1.74	F	114	114	13	41.9	0.76	F
11010	254	254	99	84.5	0.94	F	170	170	89	41.5	0.71	F
11011	1570	1570	613	37.7	0.8	F	2854	2854	1491	260	1.48	F
11012	164	164	64	37.7	0.8	F	107	107	56	260	1.48	F
11101	109	109	63	3.4	0.07	A	110	110	43	2.1	0.07	A
11102	151	151	87				382	382	149			
11103												
11104												
11105			-333						-198			
11106			-21						-15			
11107	1	21	20	11.3	0.04	B	18	128	110	16.7	0.29	C
11108												
11109	20		-20				110		-110			
11110												
11111												
11112												
11201												
11202	110	110					300	300				
11203												
11204												
11205	353	353					308	308				
11206												
11207												
11208												
11209												
11210												
11211												
11212												

	Index																															
Figure Title	100000	AM Peak Hour (7	AM Peak Hour (7	AM Peak Hour	AM Peak Hour (	AM Peak Hour (7:	AM Peak Ho	AM Peak Ho	AM Peak Ho	AM Peak Ho	AM Peak Hour	PM Peak H	PM Peak H	PM Peak Hour (	PM Peak Hour (4:	PM Peak Hour (4:	PM Peak Ho	PM Peak Ho	PM Peak Ho	PM Peak Ho	PM Peak Hour	2041 Annual G	2041 Annual G	2041 Annual G	2041 Annual Growth	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
Figure Subtitle	100001	Cars	Trucks	Total Vehicles -	Total Vehicles -	Pedestrians	Cyclists	Delay	V/C	Intersection	Heavy Vehicle	Cars	Trucks	Total Vehicles -	Total Vehicles - B	Pedestrians	Cyclists	Delay	V/C	Intersection	Heavy Vehicle	AM Peak	PM Peak	AM Peak	PM Peak	Total Vehicles - Balanced	Delay	V/C	Intersection LOS	Total Vehicles - Balanced	Delay	V/C	Intersection LOS
	100002																															
Figure Number	100003																															
	100004																															
	100005																															
	100006																															
	100007																															

Heart Lake Road Turning Movement Count



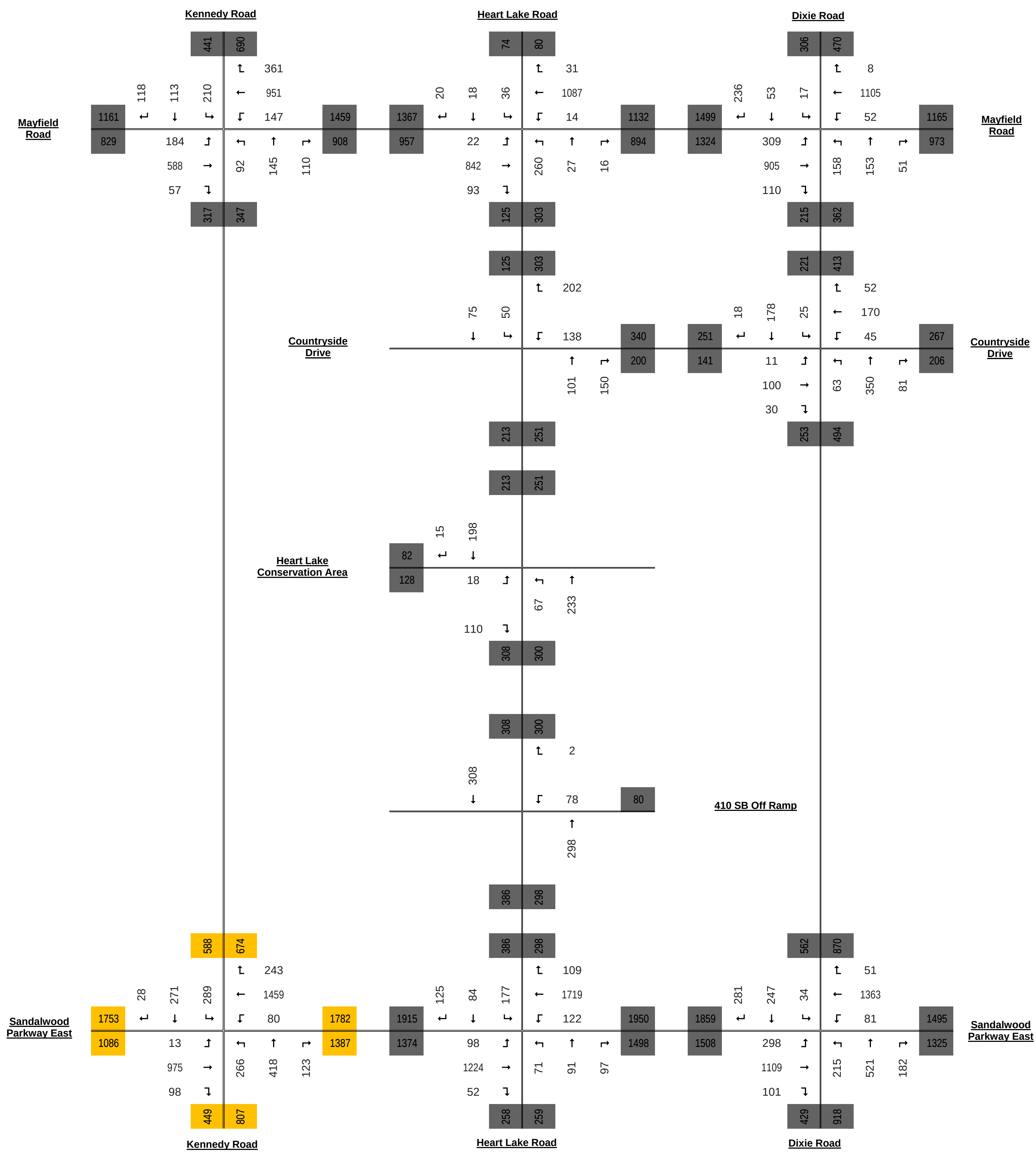
Legend

- Vehicle Totals

- No Intervening Intersection

- Intervening Intersection

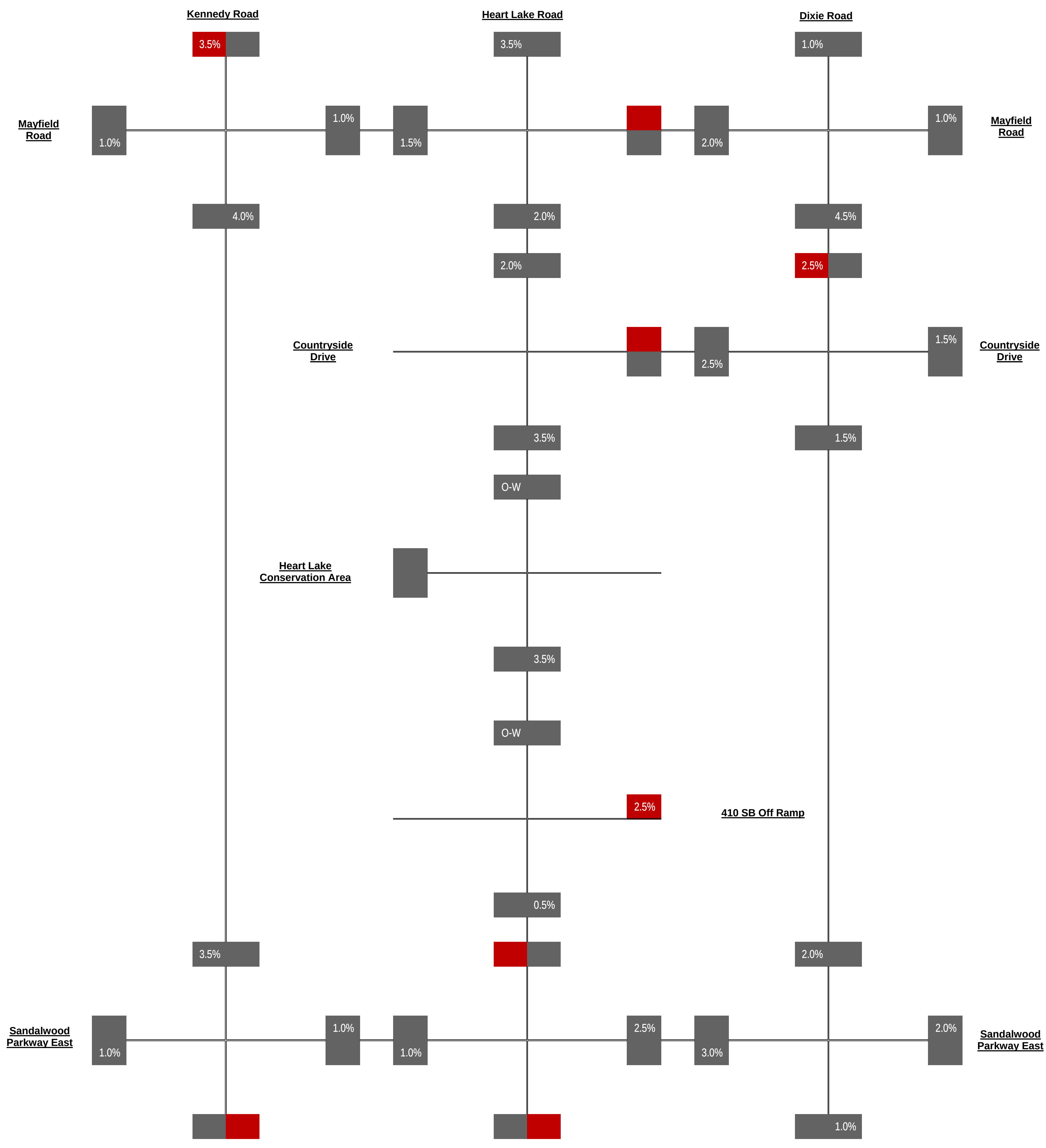
Heart Lake Road Turning Movement Count



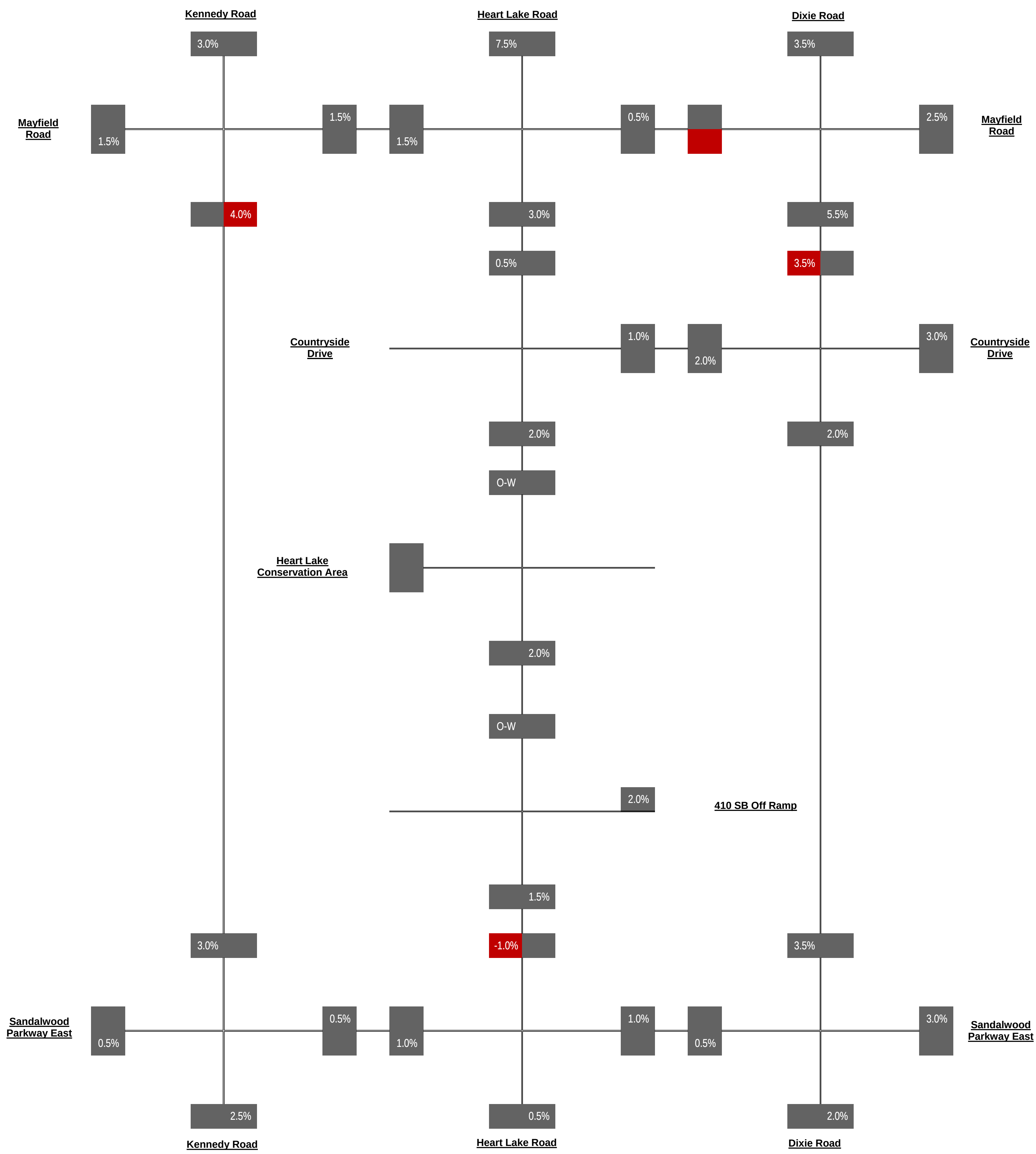
Legend

- Vehicle Totals
- No Intersections Inbetween
- Intersections Inbetween

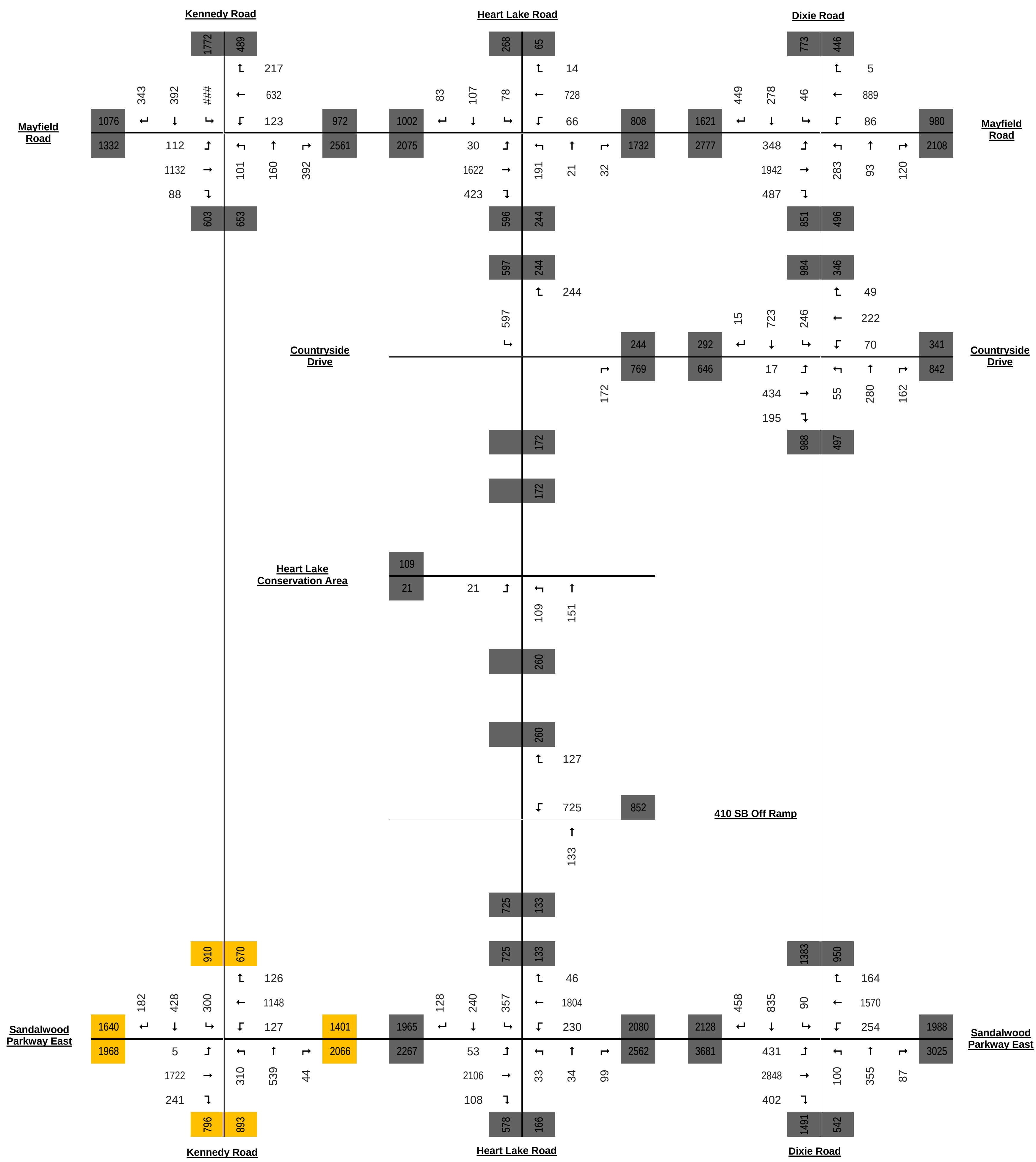
> All percentages rounded up to nearest 0.5%
> Highlighted if rounded to 0% from negative, or if rounded down due to high projected growth (when counted volumes significantly exceed EMME volumes for existing)



> All percentages rounded up to nearest 0.5%
> Highlighted if rounded to 0% from negative, or if rounded down due to high projected growth (when counted volumes significantly exceed EMME volumes for existing)



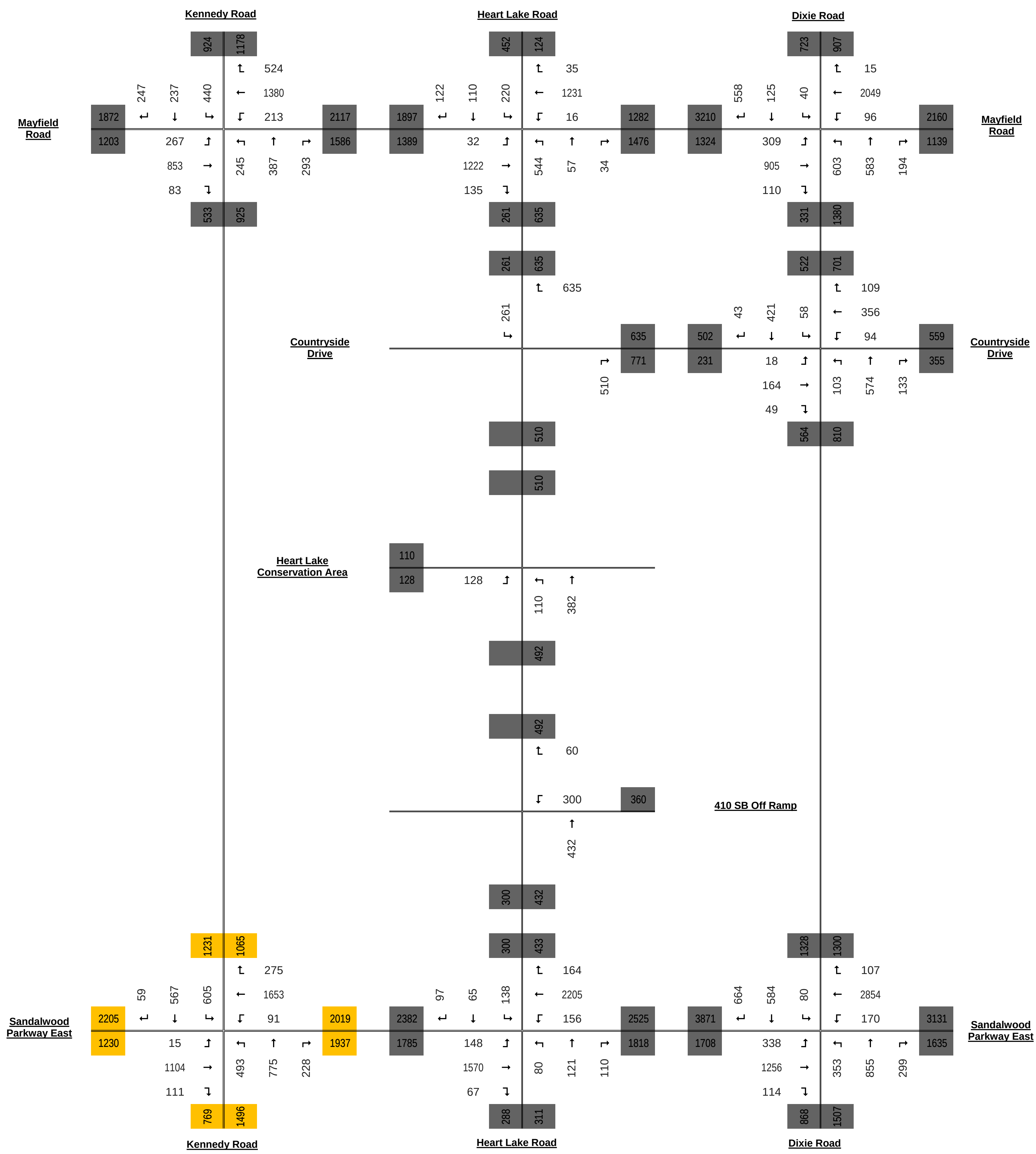
Heart Lake Road Turning Movement Count



Legend

- Vehicle Totals
- No Intervening Intersection
- Intervening Intersection

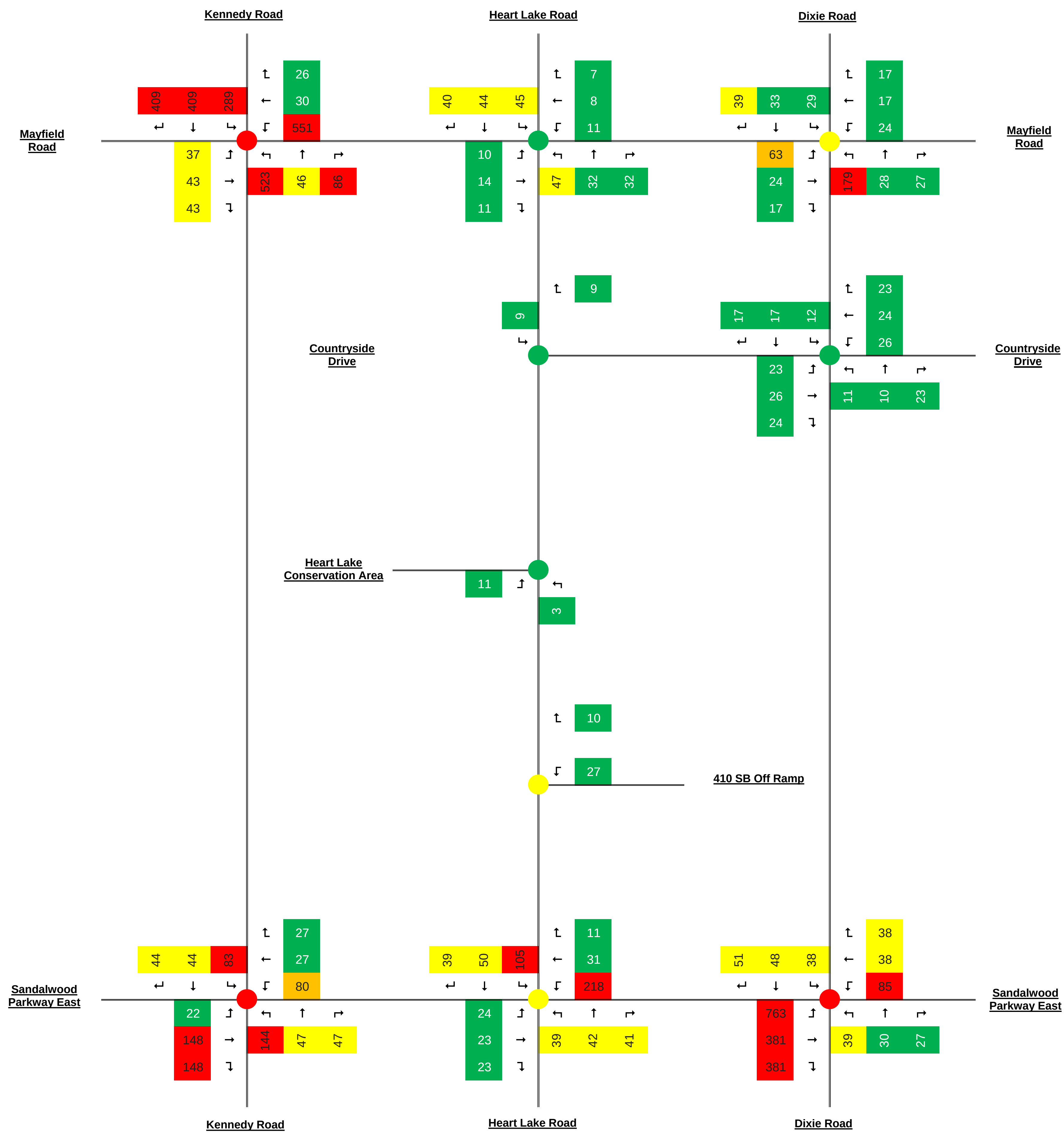
Heart Lake Road Turning Movement Count



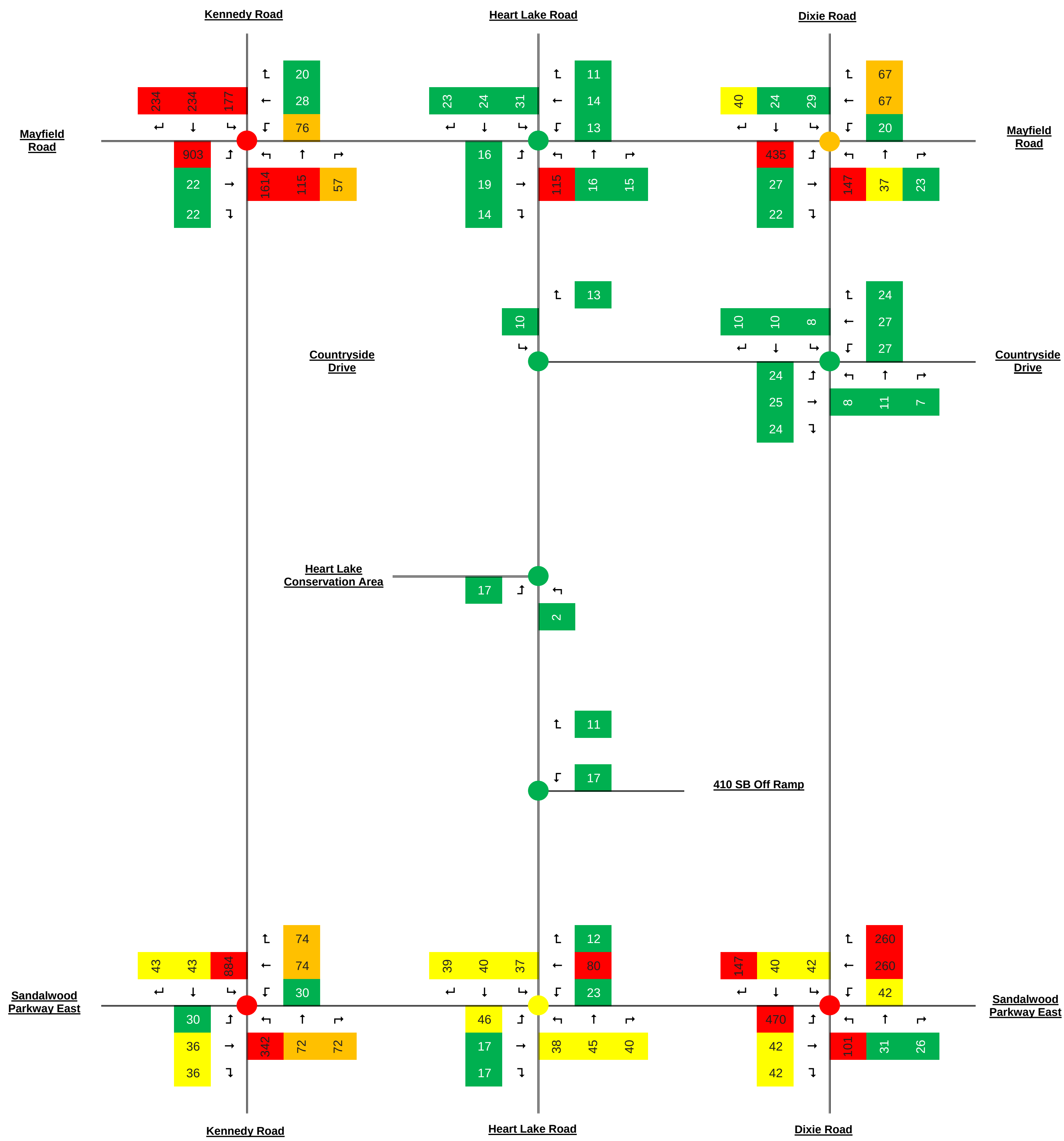
Legend

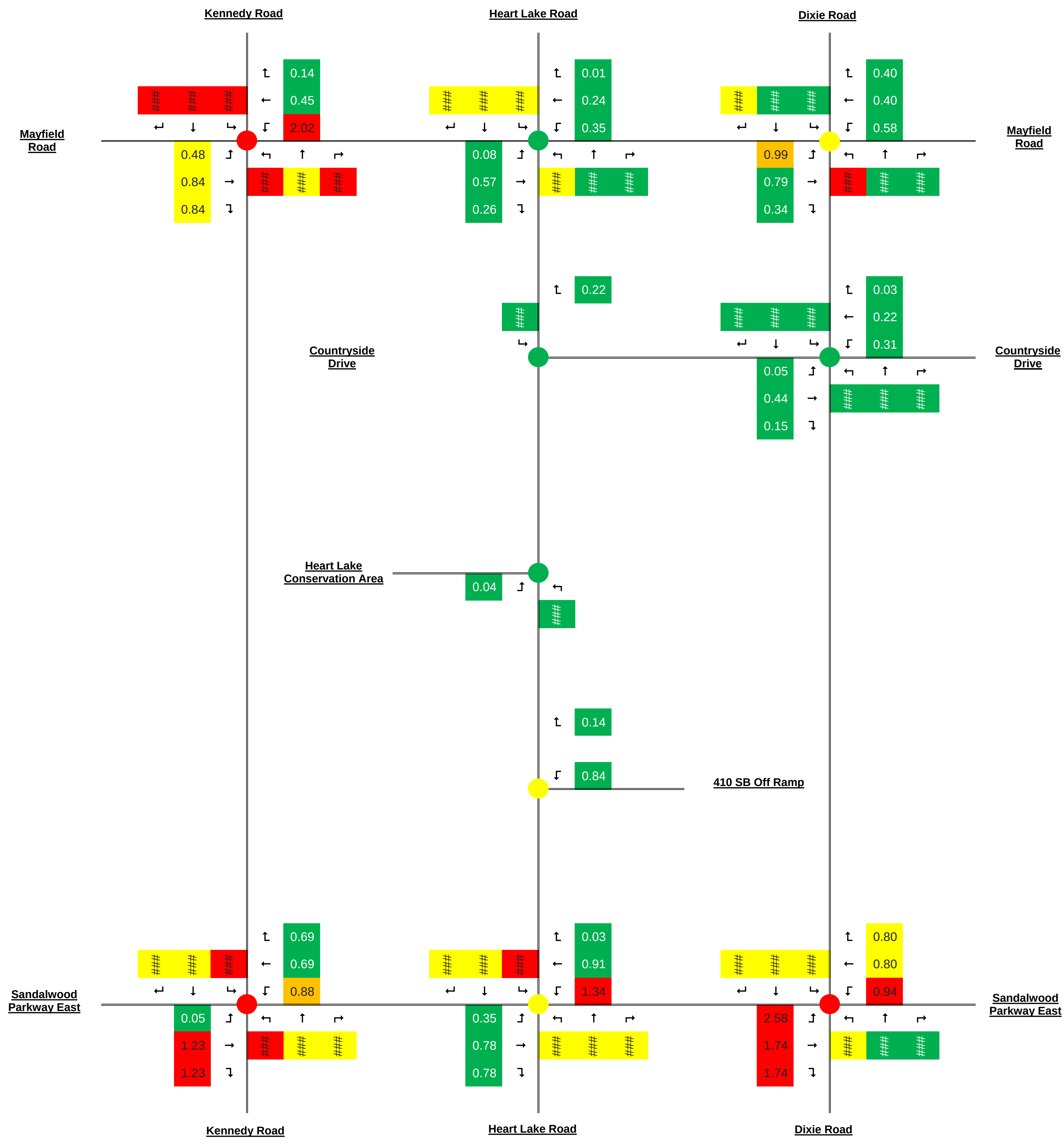
- Vehicle Totals
- No Intervening Intersection
- Intervening Intersection

Heart Lake Road Turning Movement Count



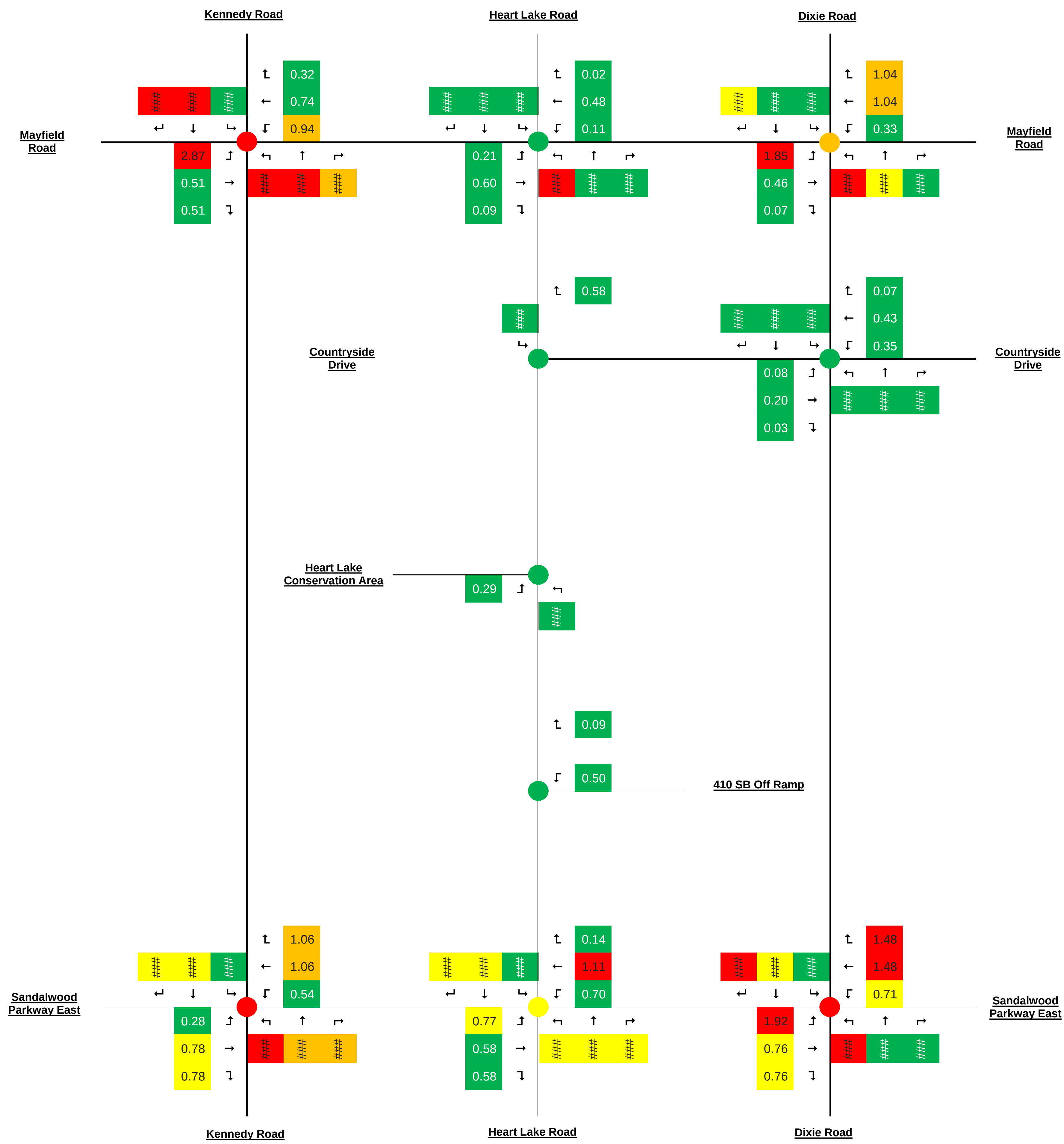
Heart Lake Road Turning Movement Count



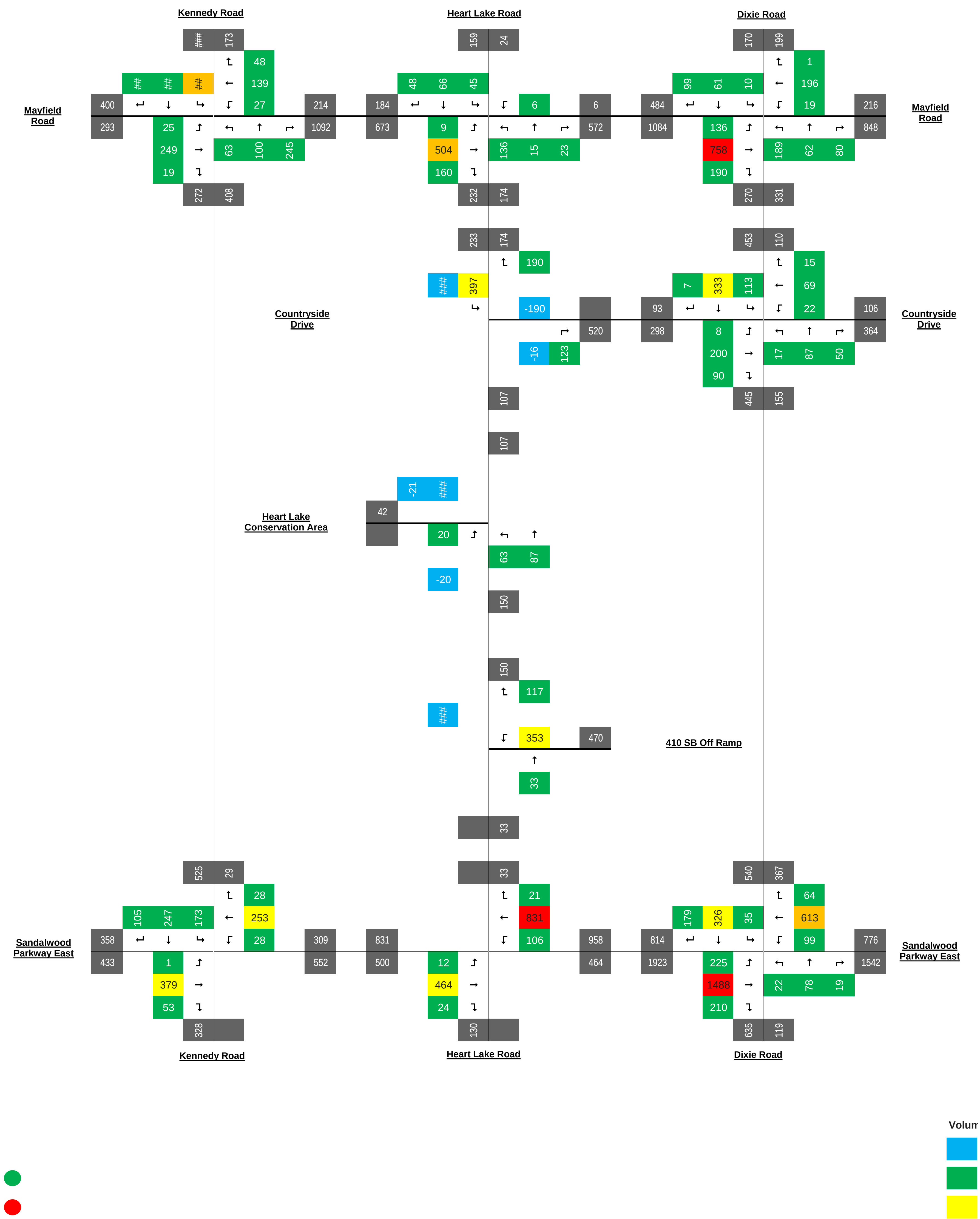


Kennedy Road
Heart Lake Road
Dixie Road
Mayfield Road
Mayfield Road
0.14
0.45
2.02
0.48
0.84
0.84
0.01
0.24
0.35
0.08
0.57
0.26
0.40
0.40
0.58
0.99
0.79
0.34
Countryside Drive
0.22
0.03
0.22
0.31
0.05
0.44
0.15
Countryside Drive
Heart Lake Conservation Area
0.04
0.14
0.84
410 SB Off Ramp
Sandalwood Parkway East
0.69
0.69
0.88
0.05
1.23
1.23
0.03
0.91
1.34
0.35
0.78
0.78
0.80
0.80
0.94
2.58
1.74
1.74
Sandalwood Parkway East
Kennedy Road
Heart Lake Road
Dixie Road

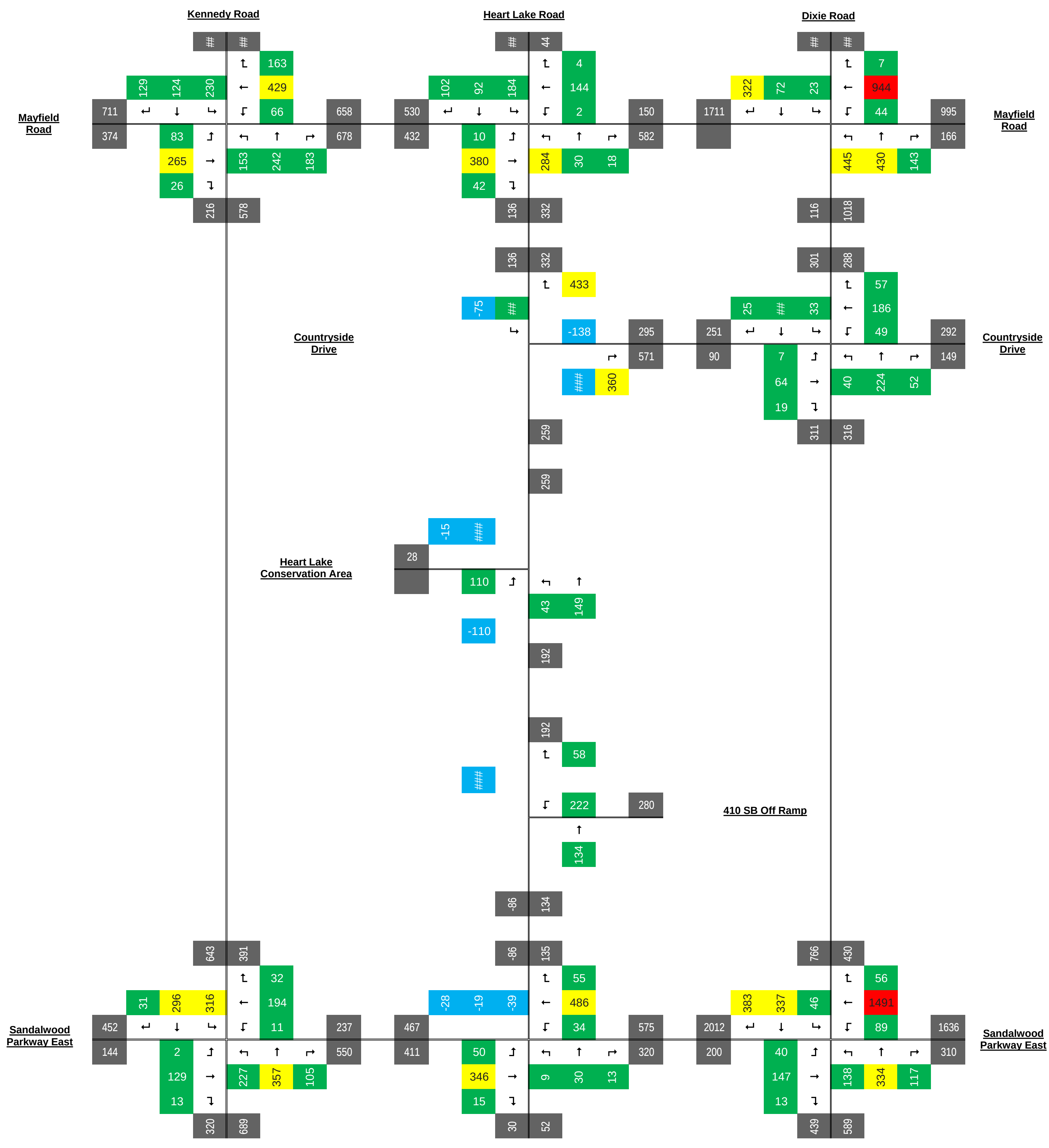
Heart Lake Road Turning Movement Count



Heart Lake Road Turning Movement Count



Heart Lake Road Turning Movement Count



Legend

- Vehicle Totals
- No Intervening Intersection
- Intervening Intersection

		42	0				0										
			60 Minute Counts														
Int Number			DATE	TIME	INTID	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
101		0			101	245	387	293	440	237	247	267	853	83	213	1380	524
102		0			102	0	0	0	0	0	0	0	0	0	0	0	0
103		0			103	493	775	228	605	567	59	15	1104	111	91	1653	275
104		0			104	544	57	34	220	110	122	32	1222	135	16	1231	35
105		0			105	0	0	510	261	0	0	0	0	0	0	0	635
106		0			106	0	432	0	0	0	0	0	0	0	300	0	60
107		0			107	80	121	110	138	65	97	148	1570	67	156	2205	164
108		0			108	603	583	194	40	125	558	309	905	110	96	2049	15
109		0			109	103	574	133	58	421	43	18	164	49	94	356	109
110		0			110	353	855	299	80	584	664	338	1256	114	170	2854	107
111	#N/A				111	110	382	0	0	0	0	128	0	0	0	0	0

APPENDIX D

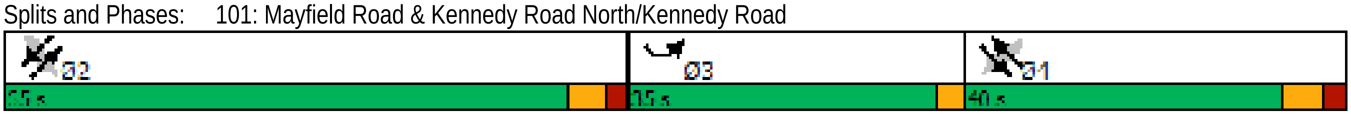
Synchro Reports

Lane Group	SEL	SET	NWL	NWT	NWR	NEL	NET	SWL	SWT	SWR
Lane Configurations										
Traffic Volume (vph)	439	166	38	60	147	87	883	96	493	169
Future Volume (vph)	439	166	38	60	147	87	883	96	493	169
Lane Group Flow (vph)	439	311	38	60	147	87	952	96	493	169
Turn Type	pm+pt	NA	Perm	NA	Perm	Perm	NA	Perm	NA	Perm
Protected Phases	3	4		4			2		2	
Permitted Phases	4		4		4	2		2		2
Detector Phase	3	4	4	4	4	2	2	2	2	2
Switch Phase										
Minimum Initial (s)	5.0	8.0	8.0	8.0	8.0	25.0	25.0	25.0	25.0	25.0
Minimum Split (s)	8.0	31.8	31.8	31.8	31.8	31.3	31.3	31.3	31.3	31.3
Total Split (s)	35.0	40.0	40.0	40.0	40.0	65.0	65.0	65.0	65.0	65.0
Total Split (%)	25.0%	28.6%	28.6%	28.6%	28.6%	46.4%	46.4%	46.4%	46.4%	46.4%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.8	2.8	2.8	2.8	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	0.0
Total Lost Time (s)	3.0	6.8	6.8	6.8	6.8	6.3	6.3	6.3	6.3	6.3
Lead/Lag	Lead	Lag	Lag	Lag	Lag					
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes					
Recall Mode	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.62	0.82	0.37	0.16	0.33	0.27	0.61	0.60	0.33	0.22
Control Delay	27.5	62.7	55.9	43.7	9.0	28.2	30.7	49.2	25.5	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.5	62.7	55.9	43.7	9.0	28.2	30.7	49.2	25.5	4.2
Queue Length 50th (m)	70.2	66.3	8.0	12.0	0.6	13.7	94.8	18.2	42.1	0.0
Queue Length 95th (m)	96.5	98.6	18.7	23.7	16.3	27.6	121.6	#45.2	57.6	12.4
Internal Link Dist (m)		493.9		1200.7			613.8		728.2	
Turn Bay Length (m)	100.0				100.0	90.0		150.0		130.0
Base Capacity (vph)	740	454	126	444	510	322	1556	160	1492	773
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.59	0.69	0.30	0.14	0.29	0.27	0.61	0.60	0.33	0.22

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 131.3
Natural Cycle: 75
Control Type: Semi Act-Uncoord
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 101: Mayfield Road & Kennedy Road North/Kennedy Road



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	439	166	145	38	60	147	87	883	69	96	493	169
Future Volume (vph)	439	166	145	38	60	147	87	883	69	96	493	169
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.8		6.8	6.8	6.8	6.3	6.3		6.3	6.3	6.3
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.93		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1789	1700		1768	1746	1585	1601	3452		1772	3318	1512
Flt Permitted	0.72	1.00		0.27	1.00	1.00	0.42	1.00		0.19	1.00	1.00
Satd. Flow (perm)	1352	1700		494	1746	1585	716	3452		356	3318	1512
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	439	166	145	38	60	147	87	883	69	96	493	169
RTOR Reduction (vph)	0	23	0	0	0	114	0	4	0	0	0	93
Lane Group Flow (vph)	439	288	0	38	60	33	87	948	0	96	493	76
Confl. Peds. (#/hr)			3	3								
Heavy Vehicles (%)	2%	1%	8%	3%	10%	3%	14%	4%	12%	3%	10%	8%
Turn Type	pm+pt	NA		Perm	NA	Perm	Perm	NA		Perm	NA	Perm
Protected Phases	3	4			4			2			2	
Permitted Phases	4			4		4	2			2		2
Actuated Green, G (s)	56.1	27.7		27.7	27.7	27.7	59.0	59.0		59.0	59.0	59.0
Effective Green, g (s)	56.1	27.7		27.7	27.7	27.7	59.0	59.0		59.0	59.0	59.0
Actuated g/C Ratio	0.43	0.21		0.21	0.21	0.21	0.45	0.45		0.45	0.45	0.45
Clearance Time (s)	3.0	6.8		6.8	6.8	6.8	6.3	6.3		6.3	6.3	6.3
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Lane Grp Cap (vph)	672	358		104	368	334	321	1552		160	1492	679
v/s Ratio Prot	c0.14	c0.17			0.03			c0.27			0.15	
v/s Ratio Perm	0.14			0.08		0.02	0.12			0.27		0.05
v/c Ratio	0.65	0.80		0.37	0.16	0.10	0.27	0.61		0.60	0.33	0.11
Uniform Delay, d1	28.5	49.2		44.2	42.3	41.7	22.6	27.4		27.2	23.3	20.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.1	14.0		4.5	0.4	0.3	2.1	1.8		15.5	0.6	0.3
Delay (s)	31.6	63.1		48.7	42.7	42.0	24.7	29.2		42.7	23.9	21.3
Level of Service	C	E		D	D	D	C	C		D	C	C
Approach Delay (s)		44.6			43.2			28.8			25.7	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	33.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	131.2	Sum of lost time (s)	16.1
Intersection Capacity Utilization	95.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	SEL	SET	NWL	NWT	NEL	NET	SWL	SWT
Lane Configurations								
Traffic Volume (vph)	127	181	310	539	4	1343	99	895
Future Volume (vph)	127	181	310	539	4	1343	99	895
Lane Group Flow (vph)	127	258	310	583	4	1531	99	993
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	pm+pt	NA
Protected Phases	3	8	7	4		2	1	6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	7	4	2	2	1	6
Switch Phase								
Minimum Initial (s)	5.0	8.0	5.0	8.0	8.0	8.0	5.0	8.0
Minimum Split (s)	8.0	40.0	8.0	40.0	36.0	36.0	8.0	36.0
Total Split (s)	16.0	49.0	12.0	45.0	69.0	69.0	10.0	79.0
Total Split (%)	11.4%	35.0%	8.6%	32.1%	49.3%	49.3%	7.1%	56.4%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	0.0	2.0	0.0	2.0	2.0	2.0	0.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.0	3.0	6.0	6.0	6.0	3.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	Max	None	Max	None	None	None	None
v/c Ratio	0.41	0.26	0.69	0.60	0.02	0.96	0.67	0.54
Control Delay	30.1	30.2	42.5	46.0	22.0	51.7	43.3	23.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.1	30.2	42.5	46.0	22.0	51.7	43.3	23.4
Queue Length 50th (m)	20.2	21.0	55.6	67.6	0.6	194.5	11.8	85.4
Queue Length 95th (m)	33.1	31.6	79.1	85.7	2.8	#242.1	#32.3	102.8
Internal Link Dist (m)		1159.4		354.2		240.5		84.0
Turn Bay Length (m)	70.0		100.0		75.0		85.0	
Base Capacity (vph)	320	999	451	974	187	1597	147	1834
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	0.40	0.26	0.69	0.60	0.02	0.96	0.67	0.54

Intersection Summary

Cycle Length: 140

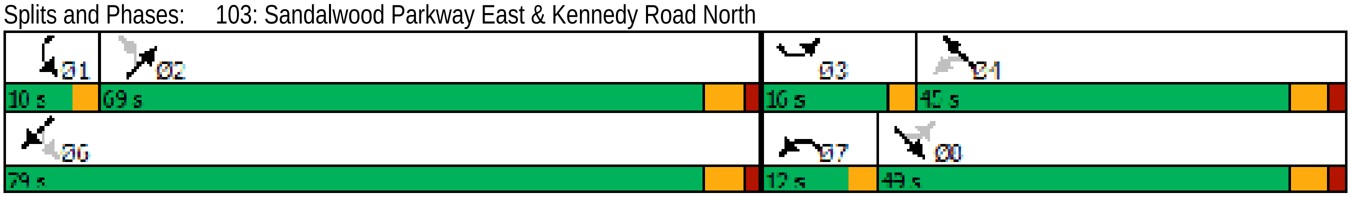
Actuated Cycle Length: 140

Natural Cycle: 105

Control Type: Semi Act-Uncoord

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 103: Sandalwood Parkway East & Kennedy Road North



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	127	181	77	310	539	44	4	1343	188	99	895	98
Future Volume (vph)	127	181	77	310	539	44	4	1343	188	99	895	98
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		3.0	6.0		6.0	6.0		3.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.96		1.00	0.99		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3145		1772	3417		1674	3530		1807	3509	
Flt Permitted	0.25	1.00		0.59	1.00		0.24	1.00		0.06	1.00	
Satd. Flow (perm)	479	3145		1105	3417		417	3530		115	3509	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	127	181	77	310	539	44	4	1343	188	99	895	98
RTOR Reduction (vph)	0	33	0	0	4	0	0	8	0	0	6	0
Lane Group Flow (vph)	127	225	0	310	579	0	4	1523	0	99	987	0
Heavy Vehicles (%)	2%	1%	34%	3%	6%	1%	9%	1%	5%	1%	2%	7%
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		pm+pt	NA	
Protected Phases	3	8		7	4			2		1	6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	55.0	43.0		48.8	39.8		63.0	63.0		73.0	73.0	
Effective Green, g (s)	55.0	43.0		48.8	39.8		63.0	63.0		73.0	73.0	
Actuated g/C Ratio	0.39	0.31		0.35	0.28		0.45	0.45		0.52	0.52	
Clearance Time (s)	3.0	6.0		3.0	6.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	302	965		428	971		187	1588		144	1829	
v/s Ratio Prot	c0.04	0.07		c0.05	0.17			c0.43		c0.03	0.28	
v/s Ratio Perm	0.13			c0.21			0.01			0.32		
v/c Ratio	0.42	0.23		0.72	0.60		0.02	0.96		0.69	0.54	
Uniform Delay, d1	29.1	36.2		37.5	43.2		21.4	37.3		30.7	22.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.0	0.6		7.3	2.7		0.1	14.3		16.2	0.6	
Delay (s)	31.1	36.8		44.8	45.9		21.5	51.5		46.9	22.9	
Level of Service	C	D		D	D		C	D		D	C	
Approach Delay (s)		34.9			45.5			51.4			25.1	
Approach LOS		C			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	41.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	33	41	35	55	6	9	21	1118	263	60	728	14
Future Volume (vph)	33	41	35	55	6	9	21	1118	263	60	728	14
Lane Group Flow (vph)	33	41	35	55	6	9	21	1118	263	60	728	14
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases		8		7	4			2		1	6	
Permitted Phases	8		8	4		4	2		2	6		6
Detector Phase	8	8	8	7	4	4	2	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	5.0	8.0	8.0	12.0	12.0	12.0	5.0	12.0	12.0
Minimum Split (s)	39.9	39.9	39.9	8.0	39.9	39.9	35.7	35.7	35.7	8.0	35.7	35.7
Total Split (s)	41.0	41.0	41.0	9.0	50.0	50.0	81.0	81.0	81.0	9.0	90.0	90.0
Total Split (%)	29.3%	29.3%	29.3%	6.4%	35.7%	35.7%	57.9%	57.9%	57.9%	6.4%	64.3%	64.3%
Yellow Time (s)	4.0	4.0	4.0	3.0	4.0	4.0	4.6	4.6	4.6	3.0	4.6	4.6
All-Red Time (s)	2.9	2.9	2.9	0.0	2.9	2.9	2.1	2.1	2.1	0.0	2.1	2.1
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	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	3.0	6.9	6.9	6.7	6.7	6.7	3.0	6.7	6.7
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes		
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
v/c Ratio	0.15	0.14	0.11	0.18	0.01	0.02	0.05	0.39	0.25	0.15	0.23	0.02
Control Delay	33.4	32.6	2.0	22.8	24.5	0.1	11.9	12.4	2.4	6.2	6.9	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.4	32.6	2.0	22.8	24.5	0.1	11.9	12.4	2.4	6.2	6.9	0.0
Queue Length 50th (m)	3.8	4.6	0.0	4.9	0.6	0.0	1.5	35.7	0.0	2.7	15.7	0.0
Queue Length 95th (m)	12.4	14.2	1.5	14.6	3.6	0.0	5.0	48.2	10.0	6.6	22.9	0.0
Internal Link Dist (m)		409.0			470.2			258.4			1347.7	
Turn Bay Length (m)	215.0		130.0	210.0		110.0	180.0		280.0	160.0		160.0
Base Capacity (vph)	807	1060	943	312	1294	1117	635	4736	1544	402	4619	1249
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.04	0.04	0.18	0.00	0.01	0.03	0.24	0.17	0.15	0.16	0.01

Intersection Summary

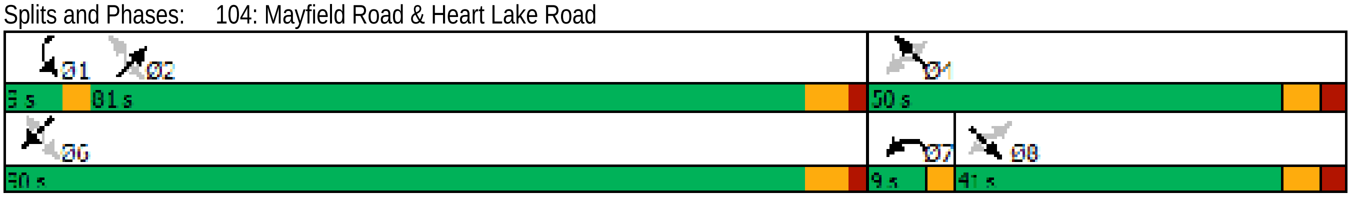
Cycle Length: 140

Actuated Cycle Length: 67

Natural Cycle: 95

Control Type: Actuated-Uncoordinated

Splits and Phases: 104: Mayfield Road & Heart Lake Road



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	33	41	35	55	6	9	21	1118	263	60	728	14
Future Volume (vph)	33	41	35	55	6	9	21	1118	263	60	728	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.9	6.9	6.9	3.0	6.9	6.9	6.7	6.7	6.7	3.0	6.7	6.7
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	1902	1633	1738	1921	1633	1738	4948	1601	1772	4683	1266
Flt Permitted	0.75	1.00	1.00	0.51	1.00	1.00	0.36	1.00	1.00	0.20	1.00	1.00
Satd. Flow (perm)	1448	1902	1633	939	1921	1633	665	4948	1601	379	4683	1266
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	33	41	35	55	6	9	21	1118	263	60	728	14
RTOR Reduction (vph)	0	0	31	0	0	7	0	0	128	0	0	5
Lane Group Flow (vph)	33	41	4	55	6	2	21	1118	135	60	728	9
Heavy Vehicles (%)	0%	1%	0%	5%	0%	0%	5%	6%	2%	3%	12%	29%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases		8		7	4			2		1	6	
Permitted Phases	8		8	4		4	2		2	6		6
Actuated Green, G (s)	7.1	7.1	7.1	13.2	13.2	13.2	36.3	36.3	36.3	43.7	43.7	43.7
Effective Green, g (s)	7.1	7.1	7.1	13.2	13.2	13.2	36.3	36.3	36.3	43.7	43.7	43.7
Actuated g/C Ratio	0.10	0.10	0.10	0.19	0.19	0.19	0.51	0.51	0.51	0.62	0.62	0.62
Clearance Time (s)	6.9	6.9	6.9	3.0	6.9	6.9	6.7	6.7	6.7	3.0	6.7	6.7
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	145	191	164	210	359	305	342	2547	824	321	2902	784
v/s Ratio Prot		0.02		c0.01	0.00			c0.23		0.01	c0.16	
v/s Ratio Perm	0.02		0.00	c0.04		0.00	0.03		0.08	0.10		0.01
v/c Ratio	0.23	0.21	0.02	0.26	0.02	0.01	0.06	0.44	0.16	0.19	0.25	0.01
Uniform Delay, d1	29.2	29.1	28.6	24.1	23.4	23.3	8.6	10.7	9.1	5.6	6.0	5.1
Progression 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
Incremental Delay, d2	1.7	1.2	0.1	1.4	0.0	0.0	0.2	0.3	0.2	0.6	0.1	0.0
Delay (s)	30.9	30.3	28.7	25.5	23.4	23.3	8.7	11.0	9.3	6.2	6.1	5.1
Level of Service	C	C	C	C	C	C	A	B	A	A	A	A
Approach Delay (s)		30.0			25.0			10.6			6.1	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	10.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	70.5	Sum of lost time (s)	19.6
Intersection Capacity Utilization	52.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	190	54	16	49	200	164
Future Volume (Veh/h)	190	54	16	49	200	164
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	190	54	16	49	200	164
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	580	16			65	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	580	16			65	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	54	95			87	
cM capacity (veh/h)	416	1066			1550	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1
Volume Total	190	54	16	49	364
Volume Left	190	0	0	0	200
Volume Right	0	54	0	49	0
cSH	416	1066	1700	1700	1550
Volume to Capacity	0.46	0.05	0.01	0.03	0.13
Queue Length 95th (m)	16.3	1.1	0.0	0.0	3.1
Control Delay (s)	20.7	8.6	0.0	0.0	4.7
Lane LOS	C	A			A
Approach Delay (s)	18.0		0.0		4.7
Approach LOS	C				

Intersection Summary			
Average Delay	9.1		
Intersection Capacity Utilization	43.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	372	10	100	0	0	353
Future Volume (Veh/h)	372	10	100	0	0	353
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	372	10	100	0	0	353
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			243			
pX, platoon unblocked						
vC, conflicting volume	453	100			100	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	453	100			100	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	34	99			100	
cM capacity (veh/h)	566	961			1505	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	372	10	100	353
Volume Left	372	0	0	0
Volume Right	0	10	0	0
cSH	566	961	1700	1700
Volume to Capacity	0.66	0.01	0.06	0.21
Queue Length 95th (m)	33.6	0.2	0.0	0.0
Control Delay (s)	22.7	8.8	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	22.3		0.0	0.0
Approach LOS	C			

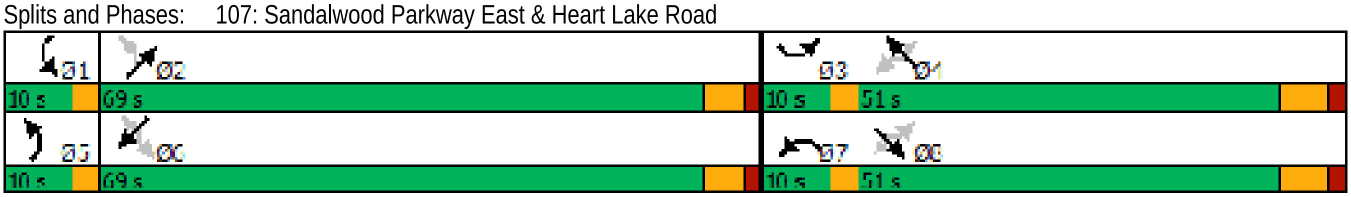
Intersection Summary			
Average Delay	10.2		
Intersection Capacity Utilization	45.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	357	240	128	33	34	99	41	1642	124	973	25
Future Volume (vph)	357	240	128	33	34	99	41	1642	124	973	25
Lane Group Flow (vph)	357	240	128	33	34	99	41	1726	124	973	25
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA	Perm
Protected Phases	3	8		7	4		5	2	1	6	
Permitted Phases	8		8	4		4	2		6		6
Detector Phase	3	8	8	7	4	4	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	5.0	8.0	8.0	5.0	8.0	8.0	5.0	40.0	5.0	40.0	40.0
Minimum Split (s)	8.0	50.0	50.0	8.0	50.0	50.0	8.0	46.0	8.0	46.0	46.0
Total Split (s)	10.0	51.0	51.0	10.0	51.0	51.0	10.0	69.0	10.0	69.0	69.0
Total Split (%)	7.1%	36.4%	36.4%	7.1%	36.4%	36.4%	7.1%	49.3%	7.1%	49.3%	49.3%
Yellow Time (s)	3.0	5.0	5.0	3.0	5.0	5.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	7.0	7.0	3.0	7.0	7.0	3.0	6.0	3.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	None	Max	Max
v/c Ratio	1.00	0.65	0.31	0.13	0.11	0.30	0.11	0.61	0.62	0.47	0.03
Control Delay	87.9	52.0	8.7	29.8	40.1	10.0	9.3	19.5	28.2	16.5	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	87.9	52.0	8.7	29.8	40.1	10.0	9.3	19.5	28.2	16.5	0.0
Queue Length 50th (m)	65.7	48.1	0.0	5.0	6.1	0.0	2.9	90.0	9.3	67.2	0.0
Queue Length 95th (m)	#107.2	72.1	14.0	11.6	14.1	12.4	7.9	120.8	#33.5	96.5	0.0
Internal Link Dist (m)		218.7			433.6			149.1		637.0	
Turn Bay Length (m)	200.0		150.0			85.0	150.0		190.0		
Base Capacity (vph)	357	727	684	260	734	673	386	2838	199	2076	951
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.00	0.33	0.19	0.13	0.05	0.15	0.11	0.61	0.62	0.47	0.03

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 114.6
Natural Cycle: 115
Control Type: Semi Act-Uncoord
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 107: Sandalwood Parkway East & Heart Lake Road



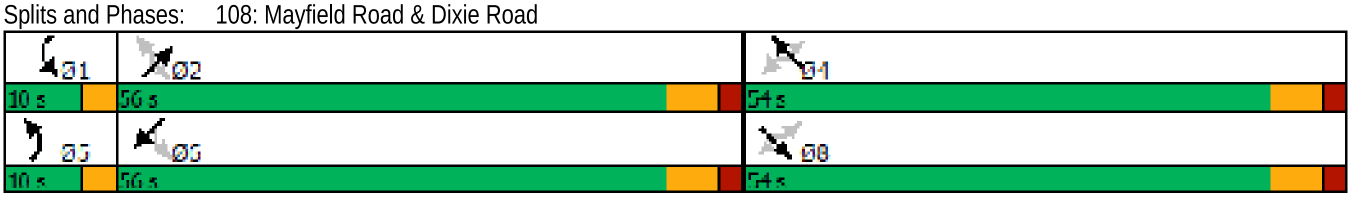
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	357	240	128	33	34	99	41	1642	84	124	973	25
Future Volume (vph)	357	240	128	33	34	99	41	1642	84	124	973	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	7.0	7.0	3.0	7.0	7.0	3.0	6.0		3.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91		1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1807	1883	1570	1674	1902	1585	1825	5125		1789	3510	1555
Flt Permitted	0.64	1.00	1.00	0.47	1.00	1.00	0.25	1.00		0.08	1.00	1.00
Satd. Flow (perm)	1211	1883	1570	820	1902	1585	473	5125		150	3510	1555
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	357	240	128	33	34	99	41	1642	84	124	973	25
RTOR Reduction (vph)	0	0	104	0	0	83	0	3	0	0	0	11
Lane Group Flow (vph)	357	240	24	33	34	16	41	1723	0	124	973	14
Heavy Vehicles (%)	1%	2%	4%	9%	1%	3%	0%	1%	13%	2%	4%	5%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		5	2		1	6	
Permitted Phases	8		8	4		4	2			6		6
Actuated Green, G (s)	29.4	22.4	22.4	23.4	19.4	19.4	68.8	64.8		74.8	67.8	67.8
Effective Green, g (s)	29.4	22.4	22.4	23.4	19.4	19.4	68.8	64.8		74.8	67.8	67.8
Actuated g/C Ratio	0.25	0.19	0.19	0.20	0.17	0.17	0.59	0.55		0.64	0.58	0.58
Clearance Time (s)	3.0	7.0	7.0	3.0	7.0	7.0	3.0	6.0		3.0	6.0	6.0
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Lane Grp Cap (vph)	339	359	300	192	314	262	323	2833		193	2030	899
v/s Ratio Prot	c0.06	0.13		0.01	0.02		0.00	0.34		c0.04	0.28	
v/s Ratio Perm	c0.20		0.02	0.03		0.01	0.07			c0.37		0.01
v/c Ratio	1.05	0.67	0.08	0.17	0.11	0.06	0.13	0.61		0.64	0.48	0.02
Uniform Delay, d1	43.7	44.0	38.9	38.4	41.6	41.2	10.7	17.6		13.9	14.4	10.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	63.5	6.1	0.2	0.9	0.3	0.2	0.4	1.0		9.6	0.8	0.0
Delay (s)	107.2	50.1	39.2	39.3	41.9	41.4	11.1	18.6		23.5	15.2	10.5
Level of Service	F	D	D	D	D	D	B	B		C	B	B
Approach Delay (s)		76.3			41.1			18.5			16.0	
Approach LOS		E			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	29.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	117.2	Sum of lost time (s)	19.0
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT
Lane Configurations											
Traffic Volume (vph)	36	217	350	94	31	40	212	1184	297	67	693
Future Volume (vph)	36	217	350	94	31	40	212	1184	297	67	693
Lane Group Flow (vph)	36	217	350	94	31	40	212	1184	297	67	697
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA
Protected Phases		8			4		5	2		1	6
Permitted Phases	8		8	4		4	2		2	6	
Detector Phase	8	8	8	4	4	4	5	2	2	1	6
Switch Phase											
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	5.0	38.0	38.0	5.0	38.0
Minimum Split (s)	54.0	54.0	54.0	54.0	54.0	54.0	8.0	56.0	56.0	8.0	56.0
Total Split (s)	54.0	54.0	54.0	54.0	54.0	54.0	10.0	56.0	56.0	10.0	56.0
Total Split (%)	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	8.3%	46.7%	46.7%	8.3%	46.7%
Yellow Time (s)	4.6	4.6	4.6	4.6	4.6	4.6	3.0	4.6	4.6	3.0	4.6
All-Red Time (s)	2.3	2.3	2.3	2.3	2.3	2.3	0.0	2.3	2.3	0.0	2.3
Lost Time Adjust (s)	0.0	0.0	0.0	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	6.9	6.9	3.0	6.9	6.9	3.0	6.9
Lead/Lag							Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max
v/c Ratio	0.17	0.56	0.68	0.50	0.08	0.12	0.42	0.43	0.29	0.21	0.28
Control Delay	31.2	38.3	17.8	41.3	28.9	3.9	9.1	13.8	2.5	7.6	12.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.2	38.3	17.8	41.3	28.9	3.9	9.1	13.8	2.5	7.6	12.8
Queue Length 50th (m)	4.9	31.9	15.7	13.6	4.1	0.0	10.5	40.1	0.0	3.0	21.0
Queue Length 95th (m)	12.2	51.3	41.2	27.2	10.5	3.9	24.4	61.8	11.8	9.0	34.3
Internal Link Dist (m)		363.8			1219.0			1347.7			595.2
Turn Bay Length (m)	175.0		220.0	210.0		135.0	240.0		150.0	230.0	
Base Capacity (vph)	518	965	937	472	929	752	501	2736	1033	318	2455
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.22	0.37	0.20	0.03	0.05	0.42	0.43	0.29	0.21	0.28

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 92.1
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 108: Mayfield Road & Dixie Road



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	36	217	350	94	31	40	212	1184	297	67	693	4
Future Volume (vph)	36	217	350	94	31	40	212	1184	297	67	693	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.9	6.9	6.9	6.9	6.9	6.9	3.0	6.9	6.9	3.0	6.9	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1304	1883	1601	1690	1812	1408	1674	4902	1617	1587	4592	
Flt Permitted	0.74	1.00	1.00	0.52	1.00	1.00	0.36	1.00	1.00	0.21	1.00	
Satd. Flow (perm)	1011	1883	1601	921	1812	1408	640	4902	1617	342	4592	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	36	217	350	94	31	40	212	1184	297	67	693	4
RTOR Reduction (vph)	0	0	189	0	0	32	0	0	132	0	0	0
Lane Group Flow (vph)	36	217	161	94	31	8	212	1184	165	67	697	0
Heavy Vehicles (%)	40%	2%	2%	8%	6%	16%	9%	7%	1%	15%	14%	33%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		8	4		4	2		2	6		
Actuated Green, G (s)	19.0	19.0	19.0	19.0	19.0	19.0	58.4	51.4	51.4	55.4	49.9	
Effective Green, g (s)	19.0	19.0	19.0	19.0	19.0	19.0	58.4	51.4	51.4	55.4	49.9	
Actuated g/C Ratio	0.20	0.20	0.20	0.20	0.20	0.20	0.63	0.55	0.55	0.60	0.54	
Clearance Time (s)	6.9	6.9	6.9	6.9	6.9	6.9	3.0	6.9	6.9	3.0	6.9	
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lane Grp Cap (vph)	207	385	328	188	371	288	481	2718	896	278	2471	
v/s Ratio Prot		c0.12			0.02		c0.03	0.24		0.01	0.15	
v/s Ratio Perm	0.04		0.10	0.10		0.01	c0.24		0.10	0.13		
v/c Ratio	0.17	0.56	0.49	0.50	0.08	0.03	0.44	0.44	0.18	0.24	0.28	
Uniform Delay, d1	30.4	33.1	32.6	32.6	29.8	29.5	7.3	12.1	10.2	8.0	11.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.8	3.1	2.4	4.3	0.2	0.1	1.3	0.5	0.5	0.9	0.3	
Delay (s)	31.2	36.2	35.0	37.0	30.0	29.6	8.6	12.6	10.7	8.9	11.9	
Level of Service	C	D	C	D	C	C	A	B	B	A	B	
Approach Delay (s)		35.2			33.9			11.8			11.7	
Approach LOS		D			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	92.7	Sum of lost time (s)	16.8
Intersection Capacity Utilization	85.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	SEL	SET	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	133	390	38	193	112	9	234	105	48	153	34
Future Volume (vph)	133	390	38	193	112	9	234	105	48	153	34
Lane Group Flow (vph)	133	398	38	193	112	9	234	105	48	153	34
Turn Type	Perm	NA	Perm	NA	custom	Perm	NA	Perm	Perm	NA	Perm
Protected Phases		1		1			2			2	
Permitted Phases	1		1		2	2		2	2		2
Detector Phase	1	1	1	1	2	2	2	2	2	2	2
Switch Phase											
Minimum Initial (s)	30.0	30.0	30.0	30.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Minimum Split (s)	36.6	36.6	36.6	36.6	35.2	35.2	35.2	35.2	35.2	35.2	35.2
Total Split (s)	53.6	53.6	53.6	53.6	35.2	35.2	35.2	35.2	35.2	35.2	35.2
Total Split (%)	60.4%	60.4%	60.4%	60.4%	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%
Yellow Time (s)	4.2	4.2	4.2	4.2	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.4	2.4	2.4	2.4	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.6	6.6	6.6	6.6	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Lead/Lag	Lead	Lead	Lead	Lead	Lag	Lag	Lag	Lag	Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	None	None	None	None	None	None	None
v/c Ratio	0.18	0.35	0.06	0.17	0.28	0.03	0.30	0.25	0.21	0.20	0.09
Control Delay	8.6	9.4	8.0	8.0	6.9	23.1	26.3	6.9	26.6	25.1	6.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.6	9.4	8.0	8.0	6.9	23.1	26.3	6.9	26.6	25.1	6.4
Queue Length 50th (m)	6.6	22.1	1.7	9.4	0.0	1.0	14.0	0.0	5.4	8.9	0.0
Queue Length 95th (m)	18.4	50.0	6.7	23.7	10.3	4.1	22.2	10.0	13.0	15.4	4.6
Internal Link Dist (m)		1219.0		1436.4			1345.4			805.1	
Turn Bay Length (m)	150.0		190.0			150.0		140.0	80.0		150.0
Base Capacity (vph)	723	1145	591	1147	620	456	1325	633	401	1325	608
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.18	0.35	0.06	0.17	0.18	0.02	0.18	0.17	0.12	0.12	0.06

Intersection Summary
Cycle Length: 88.8
Actuated Cycle Length: 77.4
Natural Cycle: 75
Control Type: Semi Act-Uncoord

Splits and Phases: 109: Countryside Drive & Dixie Road

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	133	390	8	38	193	112	9	234	105	48	153	34
Future Volume (vph)	133	390	8	38	193	112	9	234	105	48	153	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.6	6.6		6.6	6.6	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	1878		1824	1883	1512	1823	3650	1560	1733	3650	1598
Flt Permitted	0.64	1.00		0.51	1.00	1.00	0.65	1.00	1.00	0.61	1.00	1.00
Satd. Flow (perm)	1187	1878		971	1883	1512	1257	3650	1560	1106	3650	1598
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	133	390	8	38	193	112	9	234	105	48	153	34
RTOR Reduction (vph)	0	1	0	0	0	88	0	0	83	0	0	27
Lane Group Flow (vph)	133	397	0	38	193	24	9	234	22	48	153	7
Confl. Peds. (#/hr)			1	1			1		5	5		1
Heavy Vehicles (%)	3%	2%	0%	0%	2%	8%	0%	0%	3%	5%	0%	0%
Turn Type	Perm	NA		Perm	NA	custom	Perm	NA	Perm	Perm	NA	Perm
Protected Phases		1			1			2			2	
Permitted Phases	1			1		2	2		2	2		2
Actuated Green, G (s)	47.2	47.2		47.2	47.2	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Effective Green, g (s)	47.2	47.2		47.2	47.2	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Actuated g/C Ratio	0.61	0.61		0.61	0.61	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Clearance Time (s)	6.6	6.6		6.6	6.6	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	723	1145		592	1148	320	266	773	330	234	773	338
v/s Ratio Prot		c0.21			0.10			c0.06			0.04	
v/s Ratio Perm	0.11			0.04		0.02	0.01		0.01	0.04		0.00
v/c Ratio	0.18	0.35		0.06	0.17	0.07	0.03	0.30	0.07	0.21	0.20	0.02
Uniform Delay, d1	6.6	7.5		6.1	6.6	24.4	24.2	25.7	24.4	25.1	25.1	24.1
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.8		0.2	0.3	0.2	0.1	0.5	0.2	0.9	0.3	0.1
Delay (s)	7.2	8.3		6.3	6.9	24.6	24.3	26.1	24.6	26.0	25.4	24.2
Level of Service	A	A		A	A	C	C	C	C	C	C	C
Approach Delay (s)		8.0			12.6			25.6			25.3	
Approach LOS		A			B			C			C	

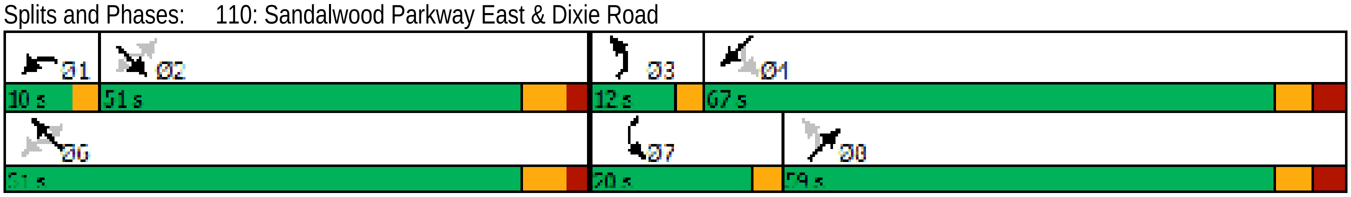
Intersection Summary			
HCM 2000 Control Delay	16.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	77.4	Sum of lost time (s)	13.8
Intersection Capacity Utilization	95.0%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	SWL	SWT
Lane Configurations										
Traffic Volume (vph)	55	509	279	78	277	68	206	1360	155	957
Future Volume (vph)	55	509	279	78	277	68	206	1360	155	957
Lane Group Flow (vph)	55	509	279	78	277	68	206	1552	155	1057
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases		2		1	6		3	8	7	4
Permitted Phases	2		2	6		6	8		4	
Detector Phase	2	2	2	1	6	6	3	8	7	4
Switch Phase										
Minimum Initial (s)	39.0	39.0	39.0	5.0	39.0	39.0	5.0	39.7	5.0	39.7
Minimum Split (s)	46.0	46.0	46.0	8.0	46.0	46.0	8.0	47.4	8.0	47.4
Total Split (s)	51.0	51.0	51.0	10.0	61.0	61.0	12.0	59.0	20.0	67.0
Total Split (%)	36.4%	36.4%	36.4%	7.1%	43.6%	43.6%	8.6%	42.1%	14.3%	47.9%
Yellow Time (s)	4.6	4.6	4.6	3.0	4.6	4.6	3.0	4.0	3.0	4.0
All-Red Time (s)	2.4	2.4	2.4	0.0	2.4	2.4	0.0	3.7	0.0	3.7
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.0	7.0	7.0	3.0	7.0	7.0	3.0	7.7	3.0	7.7
Lead/Lag	Lag	Lag	Lag	Lead			Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	None	Max
v/c Ratio	0.18	0.50	0.47	0.27	0.22	0.12	0.70	0.77	0.65	0.48
Control Delay	38.1	42.0	10.6	28.6	30.4	4.3	30.8	37.8	38.1	27.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.1	42.0	10.6	28.6	30.4	4.3	30.8	37.8	38.1	27.3
Queue Length 50th (m)	10.2	54.8	8.3	12.1	24.6	0.0	24.1	117.8	21.0	65.4
Queue Length 95th (m)	20.6	70.8	30.6	22.1	34.5	6.6	#39.4	140.5	42.0	77.2
Internal Link Dist (m)		1436.4			503.2			672.7		108.5
Turn Bay Length (m)	120.0		120.0	125.0		125.0	150.0		130.0	
Base Capacity (vph)	339	1144	645	290	1390	643	294	2028	277	2208
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.44	0.43	0.27	0.20	0.11	0.70	0.77	0.56	0.48

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 135
Natural Cycle: 110
Control Type: Semi Act-Uncoord
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 110: Sandalwood Parkway East & Dixie Road



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	55	509	279	78	277	68	206	1360	192	155	957	100
Future Volume (vph)	55	509	279	78	277	68	206	1360	192	155	957	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0	7.0	3.0	7.0	7.0	3.0	7.7		3.0	7.7	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.91		1.00	0.91	
Frpb, ped/bikes	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.99		1.00	1.00	
Flpb, ped/bikes	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1705	3510	1501	1747	3476	1487	1754	5002		1755	5007	
Flt Permitted	0.58	1.00	1.00	0.32	1.00	1.00	0.22	1.00		0.07	1.00	
Satd. Flow (perm)	1044	3510	1501	594	3476	1487	406	5002		129	5007	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	55	509	279	78	277	68	206	1360	192	155	957	100
RTOR Reduction (vph)	0	0	166	0	0	43	0	13	0	0	9	0
Lane Group Flow (vph)	55	509	113	78	277	25	206	1539	0	155	1048	0
Confl. Peds. (#/hr)	33		33	33		33	11		32	32		11
Heavy Vehicles (%)	4%	4%	3%	4%	5%	4%	4%	2%	4%	4%	3%	3%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases		2		1	6		3	8		7	4	
Permitted Phases	2		2	6		6	8			4		
Actuated Green, G (s)	39.0	39.0	39.0	49.0	49.0	49.0	63.4	54.4		71.3	59.3	
Effective Green, g (s)	39.0	39.0	39.0	49.0	49.0	49.0	63.4	54.4		71.3	59.3	
Actuated g/C Ratio	0.29	0.29	0.29	0.36	0.36	0.36	0.47	0.40		0.53	0.44	
Clearance Time (s)	7.0	7.0	7.0	3.0	7.0	7.0	3.0	7.7		3.0	7.7	
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	301	1014	433	275	1261	539	280	2015		235	2199	
v/s Ratio Prot		c0.15		c0.01	0.08		c0.05	c0.31		c0.07	0.21	
v/s Ratio Perm	0.05		0.08	0.09		0.02	0.30			0.28		
v/c Ratio	0.18	0.50	0.26	0.28	0.22	0.05	0.74	0.76		0.66	0.48	
Uniform Delay, d1	36.0	39.9	36.9	29.3	29.8	27.9	22.4	34.8		29.4	26.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	0.8	0.7	1.2	0.2	0.1	11.6	2.8		8.7	0.7	
Delay (s)	36.6	40.7	37.6	30.5	30.0	27.9	34.0	37.6		38.1	27.6	
Level of Service	D	D	D	C	C	C	C	D		D	C	
Approach Delay (s)		39.4			29.7			37.2			28.9	
Approach LOS		D			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	34.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	135.0	Sum of lost time (s)	20.7
Intersection Capacity Utilization	124.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	1	20	46	64	333	21
Future Volume (Veh/h)	1	20	46	64	333	21
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1	20	46	64	333	21
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	500	344	354			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	500	344	354			
tC, single (s)	6.4	6.3	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.2			
p0 queue free %	100	97	96			
cM capacity (veh/h)	514	688	1210			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	21	110	354
Volume Left	1	46	0
Volume Right	20	0	21
cSH	677	1210	1700
Volume to Capacity	0.03	0.04	0.21
Queue Length 95th (m)	0.7	0.8	0.0
Control Delay (s)	10.5	3.6	0.0
Lane LOS	B	A	
Approach Delay (s)	10.5	3.6	0.0
Approach LOS	B		

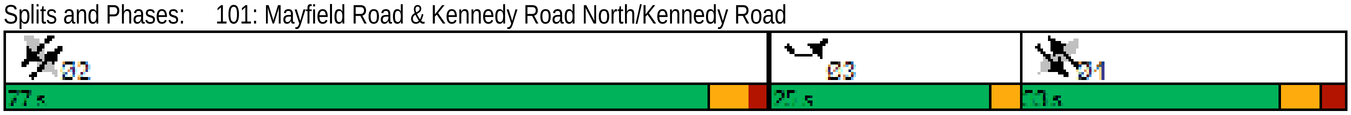
Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	38.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	SEL	SET	NWL	NWT	NWR	NEL	NET	SWL	SWT	SWR
Lane Configurations										
Traffic Volume (vph)	210	113	92	145	110	184	588	147	951	361
Future Volume (vph)	210	113	92	145	110	184	588	147	951	361
Lane Group Flow (vph)	210	231	92	145	110	184	645	147	951	361
Turn Type	pm+pt	NA	Perm	NA	Perm	Perm	NA	Perm	NA	Perm
Protected Phases	3	4		4			2		2	
Permitted Phases	4		4		4	2		2		2
Detector Phase	3	4	4	4	4	2	2	2	2	2
Switch Phase										
Minimum Initial (s)	5.0	8.0	8.0	8.0	8.0	31.3	31.3	31.3	31.3	31.3
Minimum Split (s)	8.0	31.8	31.8	31.8	31.8	37.6	37.6	37.6	37.6	37.6
Total Split (s)	25.0	33.0	33.0	33.0	33.0	77.0	77.0	77.0	77.0	77.0
Total Split (%)	18.5%	24.4%	24.4%	24.4%	24.4%	57.0%	57.0%	57.0%	57.0%	57.0%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.8	2.8	2.8	2.8	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	0.0
Total Lost Time (s)	3.0	6.8	6.8	6.8	6.8	6.3	6.3	6.3	6.3	6.3
Lead/Lag	Lead	Lag	Lag	Lag	Lag					
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes					
Recall Mode	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.44	0.71	0.77	0.45	0.30	0.72	0.33	0.37	0.47	0.34
Control Delay	31.5	54.9	89.1	51.9	10.3	41.6	16.2	20.7	18.5	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.5	54.9	89.1	51.9	10.3	41.6	16.2	20.7	18.5	2.5
Queue Length 50th (m)	34.2	43.0	20.3	30.2	0.0	31.1	41.2	18.8	68.6	0.0
Queue Length 95th (m)	51.8	70.5	#44.8	50.2	14.4	#76.4	58.7	37.6	93.8	13.3
Internal Link Dist (m)		493.9		1200.7			613.8		728.2	
Turn Bay Length (m)	100.0				100.0	90.0		150.0		130.0
Base Capacity (vph)	521	389	146	396	424	255	1947	394	2012	1067
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.59	0.63	0.37	0.26	0.72	0.33	0.37	0.47	0.34

Intersection Summary

Cycle Length: 135
Actuated Cycle Length: 126.3
Natural Cycle: 90
Control Type: Semi Act-Uncoord
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 101: Mayfield Road & Kennedy Road North/Kennedy Road



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	210	113	118	92	145	110	184	588	57	147	951	361
Future Volume (vph)	210	113	118	92	145	110	184	588	57	147	951	361
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.8		6.8	6.8	6.8	6.3	6.3		6.3	6.3	6.3
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		0.99	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.92		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1807	1736		1813	1902	1617	1825	3454		1807	3579	1617
Flt Permitted	0.59	1.00		0.37	1.00	1.00	0.24	1.00		0.37	1.00	1.00
Satd. Flow (perm)	1125	1736		703	1902	1617	456	3454		703	3579	1617
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	210	113	118	92	145	110	184	588	57	147	951	361
RTOR Reduction (vph)	0	29	0	0	0	91	0	5	0	0	0	158
Lane Group Flow (vph)	210	202	0	92	145	19	184	640	0	147	951	203
Confl. Peds. (#/hr)			7	7								
Heavy Vehicles (%)	1%	0%	2%	0%	1%	1%	0%	4%	7%	1%	2%	1%
Turn Type	pm+pt	NA		Perm	NA	Perm	Perm	NA		Perm	NA	Perm
Protected Phases	3	4			4			2			2	
Permitted Phases	4			4		4	2			2		2
Actuated Green, G (s)	39.1	21.5		21.5	21.5	21.5	71.0	71.0		71.0	71.0	71.0
Effective Green, g (s)	39.1	21.5		21.5	21.5	21.5	71.0	71.0		71.0	71.0	71.0
Actuated g/C Ratio	0.31	0.17		0.17	0.17	0.17	0.56	0.56		0.56	0.56	0.56
Clearance Time (s)	3.0	6.8		6.8	6.8	6.8	6.3	6.3		6.3	6.3	6.3
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Lane Grp Cap (vph)	443	295		119	324	275	256	1943		395	2013	909
v/s Ratio Prot	c0.07	0.12			0.08			0.19			0.27	
v/s Ratio Perm	0.08			c0.13		0.01	c0.40			0.21		0.13
v/c Ratio	0.47	0.68		0.77	0.45	0.07	0.72	0.33		0.37	0.47	0.22
Uniform Delay, d1	34.0	49.2		50.0	47.0	43.9	20.3	14.8		15.3	16.4	13.8
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.7	8.2		29.9	2.1	0.2	16.0	0.5		2.7	0.8	0.6
Delay (s)	35.7	57.4		79.9	49.1	44.2	36.2	15.3		17.9	17.2	14.4
Level of Service	D	E		E	D	D	D	B		B	B	B
Approach Delay (s)		47.1			55.7			19.9			16.6	
Approach LOS		D			E			B			B	

Intersection Summary			
HCM 2000 Control Delay	26.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	126.2	Sum of lost time (s)	16.1
Intersection Capacity Utilization	95.9%	ICU Level of Service	F
Analysis Period (min)	15		

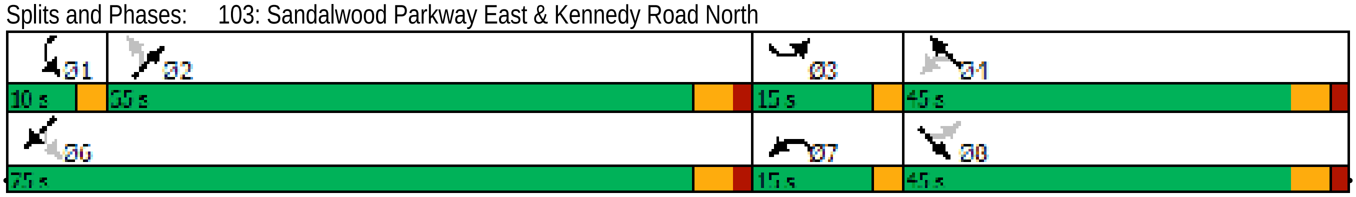
c Critical Lane Group

Lane Group	SEL	SET	NWL	NWT	NEL	NET	SWL	SWT
Lane Configurations								
Traffic Volume (vph)	289	271	266	418	13	975	80	1459
Future Volume (vph)	289	271	266	418	13	975	80	1459
Lane Group Flow (vph)	289	299	266	541	13	1073	80	1702
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	pm+pt	NA
Protected Phases	3	8	7	4		2	1	6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	7	4	2	2	1	6
Switch Phase								
Minimum Initial (s)	5.0	8.0	5.0	8.0	8.0	8.0	5.0	8.0
Minimum Split (s)	8.0	40.0	8.0	40.0	36.0	36.0	8.0	36.0
Total Split (s)	15.0	45.0	15.0	45.0	65.0	65.0	10.0	75.0
Total Split (%)	11.1%	33.3%	11.1%	33.3%	48.1%	48.1%	7.4%	55.6%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	0.0	2.0	0.0	2.0	2.0	2.0	0.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.0	3.0	6.0	6.0	6.0	3.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	None	None	None	None	None	None	None
v/c Ratio	0.98	0.39	0.63	0.70	0.21	0.62	0.31	0.87
Control Delay	80.8	40.3	36.2	45.8	30.9	25.2	15.1	29.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.8	40.3	36.2	45.8	30.9	25.2	15.1	29.2
Queue Length 50th (m)	~49.6	29.2	43.6	55.7	1.6	88.4	7.1	155.1
Queue Length 95th (m)	#86.5	41.2	64.3	73.0	7.3	121.4	15.4	214.2
Internal Link Dist (m)		1159.4		354.2		240.5		84.0
Turn Bay Length (m)	70.0		100.0		75.0		85.0	
Base Capacity (vph)	295	1164	423	1173	64	1789	258	2088
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	0.98	0.26	0.63	0.46	0.20	0.60	0.31	0.82

Intersection Summary

Cycle Length: 135
Actuated Cycle Length: 118.1
Natural Cycle: 95
Control Type: Semi Act-Uncoord
~ 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: 103: Sandalwood Parkway East & Kennedy Road North



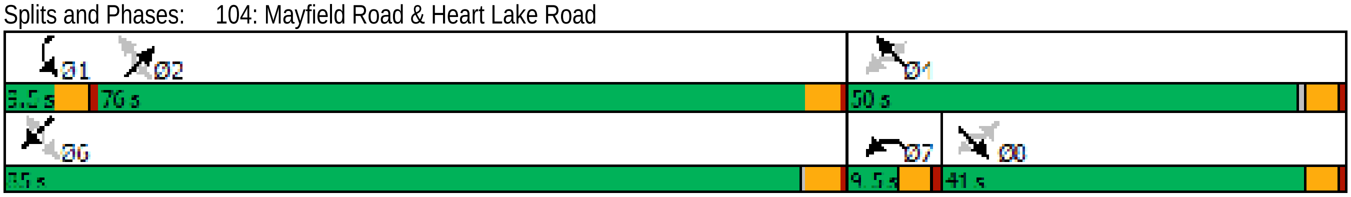
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	289	271	28	266	418	123	13	975	98	80	1459	243
Future Volume (vph)	289	271	28	266	418	123	13	975	98	80	1459	243
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		3.0	6.0		6.0	6.0		3.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.99		1.00	0.97		1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1772	3479		1825	3464		1738	3542		1789	3527	
Flt Permitted	0.25	1.00		0.51	1.00		0.07	1.00		0.16	1.00	
Satd. Flow (perm)	467	3479		971	3464		128	3542		294	3527	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	289	271	28	266	418	123	13	975	98	80	1459	243
RTOR Reduction (vph)	0	6	0	0	22	0	0	5	0	0	9	0
Lane Group Flow (vph)	289	293	0	266	519	0	13	1068	0	80	1693	0
Heavy Vehicles (%)	3%	1%	27%	0%	2%	1%	5%	1%	8%	2%	1%	3%
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		pm+pt	NA	
Protected Phases	3	8		7	4			2		1	6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	37.9	25.8		37.9	25.8		57.4	57.4		65.8	65.8	
Effective Green, g (s)	37.9	25.8		37.9	25.8		57.4	57.4		65.8	65.8	
Actuated g/C Ratio	0.32	0.22		0.32	0.22		0.48	0.48		0.55	0.55	
Clearance Time (s)	3.0	6.0		3.0	6.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	282	756		397	752		61	1712		230	1955	
v/s Ratio Prot	c0.10	0.08		0.07	0.15			0.30		0.02	c0.48	
v/s Ratio Perm	c0.22			0.15			0.10			0.18		
v/c Ratio	1.02	0.39		0.67	0.69		0.21	0.62		0.35	0.87	
Uniform Delay, d1	36.4	39.7		32.6	42.8		17.6	22.7		15.5	22.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	60.1	0.7		5.7	3.5		3.6	1.0		1.9	4.7	
Delay (s)	96.5	40.4		38.3	46.2		21.3	23.7		17.4	27.4	
Level of Service	F	D		D	D		C	C		B	C	
Approach Delay (s)		68.0			43.6			23.6			26.9	
Approach LOS		E			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	34.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	118.7	Sum of lost time (s)	18.0
Intersection Capacity Utilization	104.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	36	18	20	260	27	16	22	842	93	14	1087	31
Future Volume (vph)	36	18	20	260	27	16	22	842	93	14	1087	31
Lane Group Flow (vph)	36	18	20	260	27	16	22	842	93	14	1087	31
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases		8		7	4			2		1	6	
Permitted Phases	8		8	4		4	2		2	6		6
Detector Phase	8	8	8	7	4	4	2	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	5.0	8.0	8.0	12.0	12.0	12.0	5.0	12.0	12.0
Minimum Split (s)	37.5	37.5	37.5	9.5	37.5	37.5	33.5	33.5	33.5	9.5	33.5	33.5
Total Split (s)	41.0	41.0	41.0	9.5	50.0	50.0	76.0	76.0	76.0	9.5	85.0	85.0
Total Split (%)	30.1%	30.1%	30.1%	7.0%	36.8%	36.8%	55.9%	55.9%	55.9%	7.0%	62.5%	62.5%
Yellow Time (s)	3.5	3.5	3.5	3.5	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	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	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	4.5	4.5	4.5	4.5
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes		
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
v/c Ratio	0.12	0.05	0.05	0.65	0.05	0.03	0.10	0.39	0.12	0.04	0.44	0.04
Control Delay	20.9	20.2	0.2	25.2	12.9	1.0	12.1	10.3	3.6	7.6	9.0	1.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.9	20.2	0.2	25.2	12.9	1.0	12.1	10.3	3.6	7.6	9.0	1.9
Queue Length 50th (m)	2.4	1.2	0.0	14.1	1.3	0.0	1.0	15.4	0.0	0.6	21.0	0.0
Queue Length 95th (m)	9.9	6.0	0.0	#50.7	6.3	0.8	5.5	32.8	6.7	2.6	30.8	1.9
Internal Link Dist (m)		409.0			470.2			258.4			1347.7	
Turn Bay Length (m)	215.0		130.0	210.0		110.0	180.0		280.0	225.0		225.0
Base Capacity (vph)	1135	1488	1269	399	1751	1370	468	4812	1541	362	5092	1601
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.01	0.02	0.65	0.02	0.01	0.05	0.17	0.06	0.04	0.21	0.02

Intersection Summary
Cycle Length: 136
Actuated Cycle Length: 46.3
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 104: Mayfield Road & Heart Lake Road



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	36	18	20	260	27	16	22	842	93	14	1087	31
Future Volume (vph)	36	18	20	260	27	16	22	842	93	14	1087	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1706	1847	1555	1807	1921	1498	1772	4812	1541	1738	5092	1601
Flt Permitted	0.78	1.00	1.00	0.42	1.00	1.00	0.25	1.00	1.00	0.24	1.00	1.00
Satd. Flow (perm)	1408	1847	1555	793	1921	1498	467	4812	1541	444	5092	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	36	18	20	260	27	16	22	842	93	14	1087	31
RTOR Reduction (vph)	0	0	18	0	0	11	0	0	55	0	0	15
Lane Group Flow (vph)	36	18	2	260	27	5	22	842	38	14	1087	16
Heavy Vehicles (%)	7%	4%	5%	1%	0%	9%	3%	9%	6%	5%	3%	2%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases		8		7	4			2		1	6	
Permitted Phases	8		8	4		4	2		2	6		6
Actuated Green, G (s)	5.1	5.1	5.1	16.6	16.6	16.6	21.0	21.0	21.0	26.2	26.2	26.2
Effective Green, g (s)	5.1	5.1	5.1	16.6	16.6	16.6	21.0	21.0	21.0	26.2	26.2	26.2
Actuated g/C Ratio	0.10	0.10	0.10	0.32	0.32	0.32	0.41	0.41	0.41	0.51	0.51	0.51
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	138	181	153	391	615	480	189	1950	624	242	2575	809
v/s Ratio Prot		0.01		c0.09	0.01			0.17		0.00	c0.21	
v/s Ratio Perm	0.03		0.00	c0.12		0.00	0.05		0.02	0.03		0.01
v/c Ratio	0.26	0.10	0.01	0.66	0.04	0.01	0.12	0.43	0.06	0.06	0.42	0.02
Uniform Delay, d1	21.6	21.3	21.1	14.2	12.1	12.0	9.6	11.1	9.4	6.8	8.0	6.4
Progression 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
Incremental Delay, d2	2.1	0.5	0.1	5.6	0.1	0.0	0.6	0.3	0.1	0.2	0.2	0.0
Delay (s)	23.7	21.8	21.1	19.8	12.2	12.0	10.2	11.4	9.5	7.0	8.3	6.4
Level of Service	C	C	C	B	B	B	B	B	A	A	A	A
Approach Delay (s)		22.5			18.7			11.2			8.2	
Approach LOS		C			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	11.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	51.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	138	202	101	150	50	75
Future Volume (Veh/h)	138	202	101	150	50	75
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	138	202	101	150	50	75
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	276	101			251	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	276	101			251	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	80	79			96	
cM capacity (veh/h)	689	960			1314	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1
Volume Total	138	202	101	150	125
Volume Left	138	0	0	0	50
Volume Right	0	202	0	150	0
cSH	689	960	1700	1700	1314
Volume to Capacity	0.20	0.21	0.06	0.09	0.04
Queue Length 95th (m)	5.2	5.6	0.0	0.0	0.8
Control Delay (s)	11.5	9.7	0.0	0.0	3.3
Lane LOS	B	A			A
Approach Delay (s)	10.5		0.0		3.3
Approach LOS	B				

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	27.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	78	2	298	0	0	308
Future Volume (Veh/h)	78	2	298	0	0	308
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	78	2	298	0	0	308
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			243			
pX, platoon unblocked	0.98	0.98			0.98	
vC, conflicting volume	606	298			298	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	588	274			274	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	83	100			100	
cM capacity (veh/h)	462	750			1275	

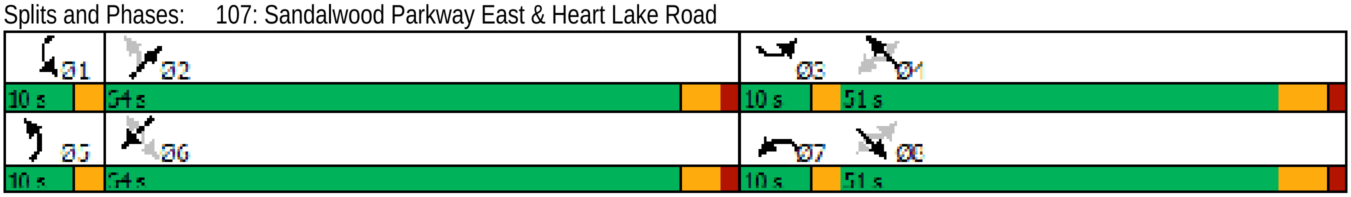
Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	78	2	298	308
Volume Left	78	0	0	0
Volume Right	0	2	0	0
cSH	462	750	1700	1700
Volume to Capacity	0.17	0.00	0.18	0.18
Queue Length 95th (m)	4.2	0.1	0.0	0.0
Control Delay (s)	14.4	9.8	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	14.3		0.0	0.0
Approach LOS	B			

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	27.2%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	177	84	125	71	91	97	98	1224	122	1719	109
Future Volume (vph)	177	84	125	71	91	97	98	1224	122	1719	109
Lane Group Flow (vph)	177	84	125	71	91	97	98	1276	122	1719	109
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA	Perm
Protected Phases	3	8		7	4		5	2	1	6	
Permitted Phases	8		8	4		4	2		6		6
Detector Phase	3	8	8	7	4	4	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	5.0	8.0	8.0	5.0	8.0	8.0	5.0	40.0	5.0	40.0	40.0
Minimum Split (s)	8.0	50.0	50.0	8.0	50.0	50.0	8.0	46.0	8.0	46.0	46.0
Total Split (s)	10.0	51.0	51.0	10.0	51.0	51.0	10.0	64.0	10.0	64.0	64.0
Total Split (%)	7.4%	37.8%	37.8%	7.4%	37.8%	37.8%	7.4%	47.4%	7.4%	47.4%	47.4%
Yellow Time (s)	3.0	5.0	5.0	3.0	5.0	5.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	7.0	7.0	3.0	7.0	7.0	3.0	6.0	3.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	None	Max	Max
v/c Ratio	0.56	0.33	0.38	0.23	0.40	0.36	0.49	0.44	0.38	0.85	0.12
Control Delay	40.2	45.2	11.1	31.9	47.5	12.4	19.2	13.9	9.4	24.3	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.2	45.2	11.1	31.9	47.5	12.4	19.2	13.9	9.4	24.3	4.3
Queue Length 50th (m)	27.1	14.5	0.0	10.2	15.8	0.0	5.3	47.1	6.6	131.3	2.2
Queue Length 95th (m)	44.6	27.9	14.6	20.6	29.7	13.0	17.9	61.5	13.3	175.6	9.5
Internal Link Dist (m)		218.7			433.6			149.1		637.0	
Turn Bay Length (m)	200.0		150.0			85.0	150.0		190.0		
Base Capacity (vph)	316	803	754	309	819	732	200	2871	317	2033	936
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.56	0.10	0.17	0.23	0.11	0.13	0.49	0.44	0.38	0.85	0.12

Intersection Summary
Cycle Length: 135
Actuated Cycle Length: 103.1
Natural Cycle: 135
Control Type: Semi Act-Uncoord

Splits and Phases: 107: Sandalwood Parkway East & Heart Lake Road



HCM Signalized Intersection Capacity Analysis
107: Sandalwood Parkway East & Heart Lake Road

07/11/2019

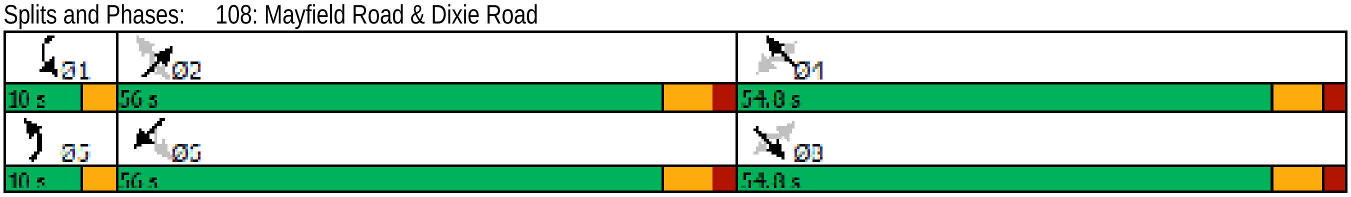
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	177	84	125	71	91	97	98	1224	52	122	1719	109
Future Volume (vph)	177	84	125	71	91	97	98	1224	52	122	1719	109
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	7.0	7.0	3.0	7.0	7.0	3.0	6.0		3.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91		1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1807	1883	1601	1690	1921	1585	1807	5098		1825	3614	1601
Flt Permitted	0.63	1.00	1.00	0.70	1.00	1.00	0.07	1.00		0.17	1.00	1.00
Satd. Flow (perm)	1197	1883	1601	1250	1921	1585	131	5098		326	3614	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	177	84	125	71	91	97	98	1224	52	122	1719	109
RTOR Reduction (vph)	0	0	108	0	0	85	0	3	0	0	0	36
Lane Group Flow (vph)	177	84	17	71	91	12	98	1273	0	122	1719	73
Heavy Vehicles (%)	1%	2%	2%	8%	0%	3%	1%	2%	8%	0%	1%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		5	2		1	6	
Permitted Phases	8		8	4		4	2			6		6
Actuated Green, G (s)	21.2	14.2	14.2	18.4	12.8	12.8	65.0	58.0		65.0	58.0	58.0
Effective Green, g (s)	21.2	14.2	14.2	18.4	12.8	12.8	65.0	58.0		65.0	58.0	58.0
Actuated g/C Ratio	0.20	0.14	0.14	0.18	0.12	0.12	0.63	0.56		0.63	0.56	0.56
Clearance Time (s)	3.0	7.0	7.0	3.0	7.0	7.0	3.0	6.0		3.0	6.0	6.0
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Lane Grp Cap (vph)	285	257	219	245	236	195	195	2848		305	2019	894
v/s Ratio Prot	c0.04	0.04		0.02	0.05		c0.03	0.25		0.03	c0.48	
v/s Ratio Perm	c0.08		0.01	0.04		0.01	0.28			0.22		0.05
v/c Ratio	0.62	0.33	0.08	0.29	0.39	0.06	0.50	0.45		0.40	0.85	0.08
Uniform Delay, d1	36.8	40.5	39.1	36.7	41.9	40.2	17.8	13.5		8.5	19.3	10.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.8	1.6	0.3	1.4	2.2	0.3	4.2	0.5		1.8	4.8	0.2
Delay (s)	42.6	42.0	39.4	38.0	44.1	40.5	22.0	14.0		10.3	24.0	10.8
Level of Service	D	D	D	D	D	D	C	B		B	C	B
Approach Delay (s)		41.5			41.1			14.6			22.4	
Approach LOS		D			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	22.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	103.8	Sum of lost time (s)	19.0
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT
Lane Configurations											
Traffic Volume (vph)	17	53	236	158	153	51	309	905	110	52	1105
Future Volume (vph)	17	53	236	158	153	51	309	905	110	52	1105
Lane Group Flow (vph)	17	53	236	158	153	51	309	905	110	52	1113
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA
Protected Phases		8			4		5	2		1	6
Permitted Phases	8		8	4		4	2		2	6	
Detector Phase	8	8	8	4	4	4	5	2	2	1	6
Switch Phase											
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	5.0	44.9	44.9	5.0	44.9
Minimum Split (s)	47.9	47.9	47.9	47.9	47.9	47.9	8.0	51.8	51.8	8.0	51.8
Total Split (s)	54.8	54.8	54.8	54.8	54.8	54.8	10.0	56.0	56.0	10.0	56.0
Total Split (%)	45.4%	45.4%	45.4%	45.4%	45.4%	45.4%	8.3%	46.4%	46.4%	8.3%	46.4%
Yellow Time (s)	4.6	4.6	4.6	4.6	4.6	4.6	3.0	4.6	4.6	3.0	4.6
All-Red Time (s)	2.3	2.3	2.3	2.3	2.3	2.3	0.0	2.3	2.3	0.0	2.3
Lost Time Adjust (s)	0.0	0.0	0.0	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	6.9	6.9	3.0	6.9	6.9	3.0	6.9
Lead/Lag							Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max
v/c Ratio	0.08	0.15	0.55	0.59	0.40	0.14	0.82	0.33	0.11	0.11	0.42
Control Delay	29.5	30.3	16.4	42.7	34.7	6.9	28.6	12.2	2.9	6.0	13.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.5	30.3	16.4	42.7	34.7	6.9	28.6	12.2	2.9	6.0	13.6
Queue Length 50th (m)	2.2	7.1	10.4	23.3	21.7	0.0	15.5	28.0	0.0	2.2	36.1
Queue Length 95th (m)	7.1	15.7	29.8	40.9	37.1	6.4	#51.6	43.0	7.3	6.8	54.3
Internal Link Dist (m)		363.8			1219.0			1347.7			595.2
Turn Bay Length (m)	175.0		220.0	210.0		125.0	240.0		150.0	230.0	
Base Capacity (vph)	586	973	872	710	1012	857	376	2714	960	466	2646
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.05	0.27	0.22	0.15	0.06	0.82	0.33	0.11	0.11	0.42

Intersection Summary
Cycle Length: 120.8
Actuated Cycle Length: 91.1
Natural Cycle: 110
Control Type: Semi Act-Uncoord
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 108: Mayfield Road & Dixie Road



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	17	53	236	158	153	51	309	905	110	52	1105	8
Future Volume (vph)	17	53	236	158	153	51	309	905	110	52	1105	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.9	6.9	6.9	6.9	6.9	6.9	3.0	6.9	6.9	3.0	6.9	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1601	1847	1512	1772	1921	1570	1807	4812	1617	1789	4894	
Flt Permitted	0.66	1.00	1.00	0.72	1.00	1.00	0.21	1.00	1.00	0.30	1.00	
Satd. Flow (perm)	1112	1847	1512	1347	1921	1570	402	4812	1617	562	4894	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	17	53	236	158	153	51	309	905	110	52	1105	8
RTOR Reduction (vph)	0	0	129	0	0	41	0	0	48	0	0	0
Lane Group Flow (vph)	17	53	107	158	153	10	309	905	62	52	1113	0
Heavy Vehicles (%)	14%	4%	8%	3%	0%	4%	1%	9%	1%	2%	7%	13%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		8	4		4	2		2	6		
Actuated Green, G (s)	18.0	18.0	18.0	18.0	18.0	18.0	58.4	51.4	51.4	55.4	49.9	
Effective Green, g (s)	18.0	18.0	18.0	18.0	18.0	18.0	58.4	51.4	51.4	55.4	49.9	
Actuated g/C Ratio	0.20	0.20	0.20	0.20	0.20	0.20	0.64	0.56	0.56	0.60	0.54	
Clearance Time (s)	6.9	6.9	6.9	6.9	6.9	6.9	3.0	6.9	6.9	3.0	6.9	
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lane Grp Cap (vph)	218	362	296	264	377	308	363	2697	906	413	2663	
v/s Ratio Prot		0.03			0.08		c0.06	0.19		0.01	0.23	
v/s Ratio Perm	0.02		0.07	c0.12		0.01	c0.48		0.04	0.07		
v/c Ratio	0.08	0.15	0.36	0.60	0.41	0.03	0.85	0.34	0.07	0.13	0.42	
Uniform Delay, d1	30.1	30.5	31.9	33.6	32.2	29.8	8.1	10.9	9.2	7.4	12.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	0.4	1.6	5.4	1.5	0.1	18.6	0.3	0.1	0.3	0.5	
Delay (s)	30.4	30.9	33.5	39.0	33.7	29.9	26.7	11.2	9.4	7.7	12.8	
Level of Service	C	C	C	D	C	C	C	B	A	A	B	
Approach Delay (s)		32.9			35.5			14.7			12.6	
Approach LOS		C			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	18.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	91.7	Sum of lost time (s)	16.8
Intersection Capacity Utilization	84.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	SEL	SET	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	25	178	63	350	81	11	100	30	45	170	52
Future Volume (vph)	25	178	63	350	81	11	100	30	45	170	52
Lane Group Flow (vph)	25	196	63	350	81	11	100	30	45	170	52
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases		1		1			2			2	
Permitted Phases	1		1		1	2		2	2		2
Detector Phase	1	1	1	1	1	2	2	2	2	2	2
Switch Phase											
Minimum Initial (s)	36.6	36.6	36.6	36.6	36.6	12.0	12.0	12.0	12.0	12.0	12.0
Minimum Split (s)	43.2	43.2	43.2	43.2	43.2	35.2	35.2	35.2	35.2	35.2	35.2
Total Split (s)	53.6	53.6	53.6	53.6	53.6	35.2	35.2	35.2	35.2	35.2	35.2
Total Split (%)	60.4%	60.4%	60.4%	60.4%	60.4%	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%
Yellow Time (s)	4.2	4.2	4.2	4.2	4.2	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.4	2.4	2.4	2.4	2.4	3.2	3.2	3.2	3.2	3.2	3.2
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.6	6.6	6.6	6.6	6.6	7.2	7.2	7.2	7.2	7.2	7.2
Lead/Lag	Lead	Lead	Lead	Lead	Lead	Lag	Lag	Lag	Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	None	None	None	None	None	None
v/c Ratio	0.04	0.16	0.08	0.29	0.08	0.05	0.16	0.11	0.21	0.28	0.17
Control Delay	5.6	5.7	5.8	6.8	1.7	25.7	26.6	6.6	28.7	28.1	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.6	5.7	5.8	6.8	1.7	25.7	26.6	6.6	28.7	28.1	9.5
Queue Length 50th (m)	1.0	8.0	2.6	16.6	0.0	1.2	5.7	0.0	5.0	10.0	0.0
Queue Length 95th (m)	3.6	17.3	7.2	32.1	4.1	4.8	11.3	4.3	12.7	17.3	7.6
Internal Link Dist (m)		1219.0		1436.4			1345.4			805.1	
Turn Bay Length (m)	150.0		190.0			150.0		140.0	120.0		150.0
Base Capacity (vph)	688	1201	791	1212	992	453	1340	567	457	1328	618
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.16	0.08	0.29	0.08	0.02	0.07	0.05	0.10	0.13	0.08

Intersection Summary
Cycle Length: 88.8
Actuated Cycle Length: 76.6
Natural Cycle: 80
Control Type: Semi Act-Uncoord

Splits and Phases: 109: Countryside Drive & Dixie Road

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	25	178	18	63	350	81	11	100	30	45	170	52
Future Volume (vph)	25	178	18	63	350	81	11	100	30	45	170	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.6	6.6		6.6	6.6	6.6	7.2	7.2	7.2	7.2	7.2	7.2
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	1844		1825	1865	1484	1821	3650	1476	1725	3614	1596
Flt Permitted	0.55	1.00		0.63	1.00	1.00	0.64	1.00	1.00	0.69	1.00	1.00
Satd. Flow (perm)	1059	1844		1219	1865	1484	1235	3650	1476	1251	3614	1596
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	25	178	18	63	350	81	11	100	30	45	170	52
RTOR Reduction (vph)	0	3	0	0	0	28	0	0	25	0	0	43
Lane Group Flow (vph)	25	193	0	63	350	53	11	100	5	45	170	9
Confl. Peds. (#/hr)							2		37	37		2
Heavy Vehicles (%)	0%	3%	0%	0%	3%	10%	0%	0%	6%	3%	1%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases		1			1			2			2	
Permitted Phases	1			1		1	2		2	2		2
Actuated Green, G (s)	49.8	49.8		49.8	49.8	49.8	12.9	12.9	12.9	12.9	12.9	12.9
Effective Green, g (s)	49.8	49.8		49.8	49.8	49.8	12.9	12.9	12.9	12.9	12.9	12.9
Actuated g/C Ratio	0.65	0.65		0.65	0.65	0.65	0.17	0.17	0.17	0.17	0.17	0.17
Clearance Time (s)	6.6	6.6		6.6	6.6	6.6	7.2	7.2	7.2	7.2	7.2	7.2
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	689	1200		793	1214	966	208	615	248	210	609	269
v/s Ratio Prot		0.10			c0.19			0.03			c0.05	
v/s Ratio Perm	0.02			0.05		0.04	0.01		0.00	0.04		0.01
v/c Ratio	0.04	0.16		0.08	0.29	0.05	0.05	0.16	0.02	0.21	0.28	0.03
Uniform Delay, d1	4.8	5.2		4.9	5.7	4.8	26.7	27.2	26.5	27.4	27.7	26.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.3		0.2	0.6	0.1	0.2	0.3	0.1	1.1	0.5	0.1
Delay (s)	4.9	5.5		5.1	6.3	4.9	26.9	27.4	26.6	28.5	28.3	26.7
Level of Service	A	A		A	A	A	C	C	C	C	C	C
Approach Delay (s)		5.4			6.0			27.2			28.0	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	13.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	76.5	Sum of lost time (s)	13.8
Intersection Capacity Utilization	97.4%	ICU Level of Service	F
Analysis Period (min)	15		

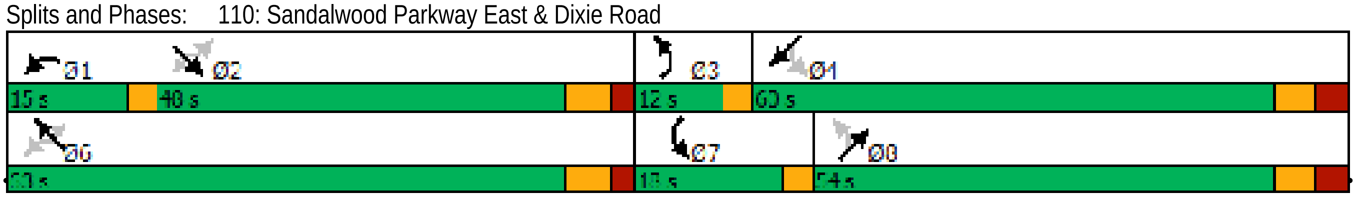
c Critical Lane Group

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	SWL	SWT
Lane Configurations										
Traffic Volume (vph)	281	247	34	215	521	182	298	1109	81	1363
Future Volume (vph)	281	247	34	215	521	182	298	1109	81	1363
Lane Group Flow (vph)	281	247	34	215	521	182	298	1210	81	1414
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases		2		1	6		3	8	7	4
Permitted Phases	2		2	6		6	8		4	
Detector Phase	2	2	2	1	6	6	3	8	7	4
Switch Phase										
Minimum Initial (s)	39.0	39.0	39.0	5.0	39.0	39.0	5.0	39.7	5.0	39.7
Minimum Split (s)	46.0	46.0	46.0	8.0	46.0	46.0	8.0	47.4	8.0	47.4
Total Split (s)	48.0	48.0	48.0	15.0	63.0	63.0	12.0	54.0	18.0	60.0
Total Split (%)	35.6%	35.6%	35.6%	11.1%	46.7%	46.7%	8.9%	40.0%	13.3%	44.4%
Yellow Time (s)	4.6	4.6	4.6	3.0	4.6	4.6	3.0	4.0	3.0	4.0
All-Red Time (s)	2.4	2.4	2.4	0.0	2.4	2.4	0.0	3.7	0.0	3.7
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.0	7.0	7.0	3.0	7.0	7.0	3.0	7.7	3.0	7.7
Lead/Lag	Lag	Lag	Lag	Lead			Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	None	Max
v/c Ratio	1.07	0.23	0.06	0.41	0.35	0.24	1.54	0.63	0.33	0.71
Control Delay	119.5	35.9	0.2	26.4	27.9	4.1	294.8	36.2	20.7	37.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	119.5	35.9	0.2	26.4	27.9	4.1	294.8	36.2	20.7	37.1
Queue Length 50th (m)	~76.1	23.9	0.0	32.8	45.5	0.0	~84.3	87.6	9.9	106.0
Queue Length 95th (m)	#127.1	34.2	0.0	49.4	58.6	12.8	#139.3	105.3	17.9	121.6
Internal Link Dist (m)		1436.4			503.2			672.7		108.5
Turn Bay Length (m)	120.0		120.0	125.0		125.0	150.0		130.0	
Base Capacity (vph)	263	1076	549	527	1484	752	193	1908	299	2003
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.07	0.23	0.06	0.41	0.35	0.24	1.54	0.63	0.27	0.71

Intersection Summary

Cycle Length: 135
Actuated Cycle Length: 135
Natural Cycle: 110
Control Type: Semi Act-Uncoord
~ 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: 110: Sandalwood Parkway East & Dixie Road



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	281	247	34	215	521	182	298	1109	101	81	1363	51
Future Volume (vph)	281	247	34	215	521	182	298	1109	101	81	1363	51
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0	7.0	3.0	7.0	7.0	3.0	7.7		3.0	7.7	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.91		1.00	0.91	
Frpb, ped/bikes	1.00	1.00	0.96	1.00	1.00	0.95	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	0.98	1.00	1.00	0.99	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1794	3544	1555	1790	3579	1557	1807	5059		1806	5161	
Flt Permitted	0.46	1.00	1.00	0.55	1.00	1.00	0.09	1.00		0.13	1.00	
Satd. Flow (perm)	867	3544	1555	1043	3579	1557	177	5059		247	5161	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	281	247	34	215	521	182	298	1109	101	81	1363	51
RTOR Reduction (vph)	0	0	24	0	0	107	0	7	0	0	3	0
Lane Group Flow (vph)	281	247	10	215	521	75	298	1203	0	81	1411	0
Confl. Peds. (#/hr)	28		21	21		28	14		25	25		14
Heavy Vehicles (%)	0%	3%	1%	1%	2%	0%	1%	2%	2%	1%	1%	0%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases		2		1	6		3	8		7	4	
Permitted Phases	2		2	6		6	8			4		
Actuated Green, G (s)	41.0	41.0	41.0	56.0	56.0	56.0	59.7	50.7		62.9	52.3	
Effective Green, g (s)	41.0	41.0	41.0	56.0	56.0	56.0	59.7	50.7		62.9	52.3	
Actuated g/C Ratio	0.30	0.30	0.30	0.41	0.41	0.41	0.44	0.38		0.47	0.39	
Clearance Time (s)	7.0	7.0	7.0	3.0	7.0	7.0	3.0	7.7		3.0	7.7	
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	263	1076	472	499	1484	645	186	1899		237	1999	
v/s Ratio Prot		0.07		c0.04	0.15		c0.11	0.24		c0.03	0.27	
v/s Ratio Perm	c0.32		0.01	0.14		0.05	c0.60			0.13		
v/c Ratio	1.07	0.23	0.02	0.43	0.35	0.12	1.60	0.63		0.34	0.71	
Uniform Delay, d1	47.0	35.2	32.9	26.3	27.1	24.3	29.7	34.5		22.3	34.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	74.8	0.2	0.0	1.3	0.3	0.2	294.6	1.6		1.8	2.1	
Delay (s)	121.8	35.4	33.0	27.6	27.4	24.5	324.3	36.2		24.1	37.0	
Level of Service	F	D	C	C	C	C	F	D		C	D	
Approach Delay (s)		78.5			26.8			93.1			36.3	
Approach LOS		E			C			F			D	

Intersection Summary			
HCM 2000 Control Delay	58.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.27		
Actuated Cycle Length (s)	135.0	Sum of lost time (s)	20.7
Intersection Capacity Utilization	136.0%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	18	110	67	233	198	15
Future Volume (Veh/h)	18	110	67	233	198	15
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	18	110	67	233	198	15
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	572	206	213			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	572	206	213			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	87	95			
cM capacity (veh/h)	461	840	1369			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	128	300	213
Volume Left	18	67	0
Volume Right	110	0	15
cSH	753	1369	1700
Volume to Capacity	0.17	0.05	0.13
Queue Length 95th (m)	4.3	1.1	0.0
Control Delay (s)	10.8	2.1	0.0
Lane LOS	B	A	
Approach Delay (s)	10.8	2.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	112	1132	123	632	217	101	160	392	1037	392
Future Volume (vph)	112	1132	123	632	217	101	160	392	1037	392
Lane Group Flow (vph)	112	1220	123	632	217	101	160	392	1037	735
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA
Protected Phases		2		2			4		3	4
Permitted Phases	2		2		2	4		4	4	
Detector Phase	2	2	2	2	2	4	4	4	3	4
Switch Phase										
Minimum Initial (s)	25.0	25.0	25.0	25.0	25.0	8.0	8.0	8.0	5.0	8.0
Minimum Split (s)	31.3	31.3	31.3	31.3	31.3	31.8	31.8	31.8	8.0	31.8
Total Split (s)	65.0	65.0	65.0	65.0	65.0	40.0	40.0	40.0	35.0	40.0
Total Split (%)	46.4%	46.4%	46.4%	46.4%	46.4%	28.6%	28.6%	28.6%	25.0%	28.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	2.3	2.3	2.3	2.3	2.3	2.8	2.8	2.8	0.0	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.3	6.3	6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8
Lead/Lag						Lag	Lag	Lag	Lead	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	None	None	None	None	None
v/c Ratio	0.48	0.84	2.05	0.45	0.29	1.91	0.39	0.95	1.48	1.73
Control Delay	38.4	42.7	549.7	30.5	4.1	499.2	48.1	79.1	251.8	369.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.4	42.7	549.7	30.5	4.1	499.2	48.1	79.1	251.8	369.2
Queue Length 50th (m)	20.6	144.5	~49.0	60.2	0.0	~39.4	34.5	88.6	~283.3	~272.7
Queue Length 95th (m)	39.2	172.0	#72.2	75.7	13.8	#74.3	54.3	#146.3	#355.5	#342.5
Internal Link Dist (m)		613.9		728.0			1200.6			493.9
Turn Bay Length (m)	90.0		150.0		130.0			100.0	100.0	
Base Capacity (vph)	231	1451	60	1391	759	53	414	413	699	425
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.48	0.84	2.05	0.45	0.29	1.91	0.39	0.95	1.48	1.73

Intersection Summary

Cycle Length: 140

Actuated Cycle Length: 140

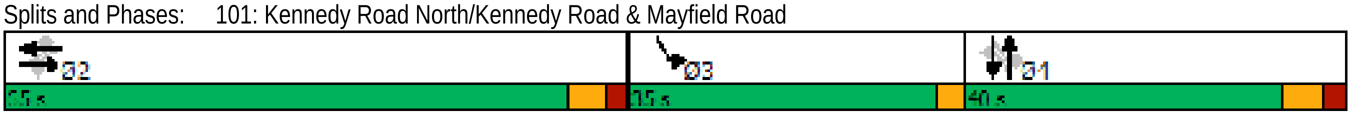
Natural Cycle: 75

Control Type: Semi Act-Uncoord

~ 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: 101: Kennedy Road North/Kennedy Road & Mayfield Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	112	1132	88	123	632	217	101	160	392	1037	392	343
Future Volume (vph)	112	1132	88	123	632	217	101	160	392	1037	392	343
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3	6.3		6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1601	3453		1772	3318	1512	1772	1746	1585	1789	1700	
Flt Permitted	0.33	1.00		0.08	1.00	1.00	0.12	1.00	1.00	0.58	1.00	
Satd. Flow (perm)	551	3453		146	3318	1512	225	1746	1585	1100	1700	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	112	1132	88	123	632	217	101	160	392	1037	392	343
RTOR Reduction (vph)	0	4	0	0	0	126	0	0	37	0	22	0
Lane Group Flow (vph)	112	1216	0	123	632	91	101	160	355	1037	713	0
Confl. Peds. (#/hr)							3					3
Heavy Vehicles (%)	14%	4%	12%	3%	10%	8%	3%	10%	3%	2%	1%	8%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases		2			2			4		3	4	
Permitted Phases	2			2		2	4		4	4		
Actuated Green, G (s)	58.7	58.7		58.7	58.7	58.7	33.2	33.2	33.2	65.2	33.2	
Effective Green, g (s)	58.7	58.7		58.7	58.7	58.7	33.2	33.2	33.2	65.2	33.2	
Actuated g/C Ratio	0.42	0.42		0.42	0.42	0.42	0.24	0.24	0.24	0.47	0.24	
Clearance Time (s)	6.3	6.3		6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lane Grp Cap (vph)	231	1447		61	1391	633	53	414	375	669	403	
v/s Ratio Prot		0.35			0.19			0.09		c0.35	0.42	
v/s Ratio Perm	0.20			c0.84		0.06	c0.45		0.22	0.37		
v/c Ratio	0.48	0.84		2.02	0.45	0.14	1.91	0.39	0.95	1.55	1.77	
Uniform Delay, d1	29.6	36.4		40.6	29.2	25.1	53.4	44.8	52.5	34.2	53.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	7.1	6.0		509.9	1.1	0.5	469.6	1.3	33.3	254.9	356.0	
Delay (s)	36.7	42.5		550.5	30.2	25.6	523.0	46.1	85.8	289.1	409.4	
Level of Service	D	D		F	C	C	F	D	F	F	F	
Approach Delay (s)		42.0			95.0			143.7			339.0	
Approach LOS		D			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	178.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.86		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	16.1
Intersection Capacity Utilization	140.3%	ICU Level of Service	H
Analysis Period (min)	15		

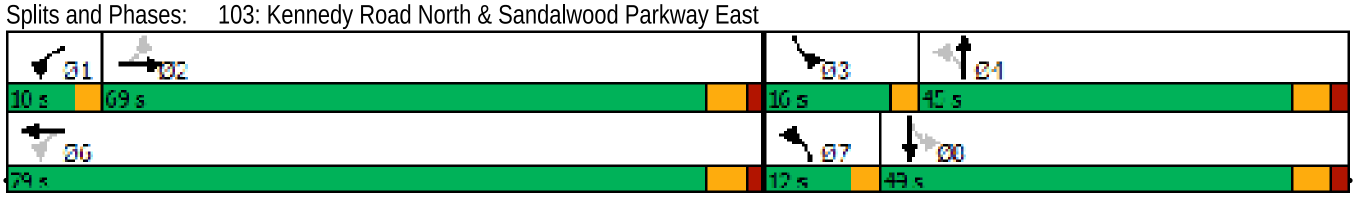
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	5	1722	127	1148	310	539	300	428
Future Volume (vph)	5	1722	127	1148	310	539	300	428
Lane Group Flow (vph)	5	1963	127	1274	310	583	300	610
Turn Type	Perm	NA	pm+pt	NA	pm+pt	NA	pm+pt	NA
Protected Phases		2	1	6	7	4	3	8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	3	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	5.0	8.0	5.0	8.0
Minimum Split (s)	36.0	36.0	8.0	36.0	8.0	40.0	8.0	40.0
Total Split (s)	69.0	69.0	10.0	79.0	12.0	45.0	16.0	49.0
Total Split (%)	49.3%	49.3%	7.1%	56.4%	8.6%	32.1%	11.4%	35.0%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	2.0	2.0	0.0	2.0	0.0	2.0	0.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	3.0	6.0	3.0	6.0	3.0	6.0
Lead/Lag	Lag	Lag	Lead		Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
v/c Ratio	0.05	1.23	0.86	0.69	1.10	0.61	0.95	0.61
Control Delay	23.4	143.2	70.9	27.4	117.6	46.6	71.4	40.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	143.2	70.9	27.4	117.6	46.6	71.4	40.9
Queue Length 50th (m)	0.7	~324.6	17.0	123.6	~63.9	67.6	53.3	64.4
Queue Length 95th (m)	3.4	#363.3	#51.1	146.8	#121.3	85.7	#103.0	82.8
Internal Link Dist (m)		240.4		84.0		354.2		1159.5
Turn Bay Length (m)	75.0		85.0		100.0		70.0	
Base Capacity (vph)	108	1597	147	1834	282	956	317	999
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	1.23	0.86	0.69	1.10	0.61	0.95	0.61

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Natural Cycle: 145
Control Type: Semi Act-Uncoord
~ 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: 103: Kennedy Road North & Sandalwood Parkway East



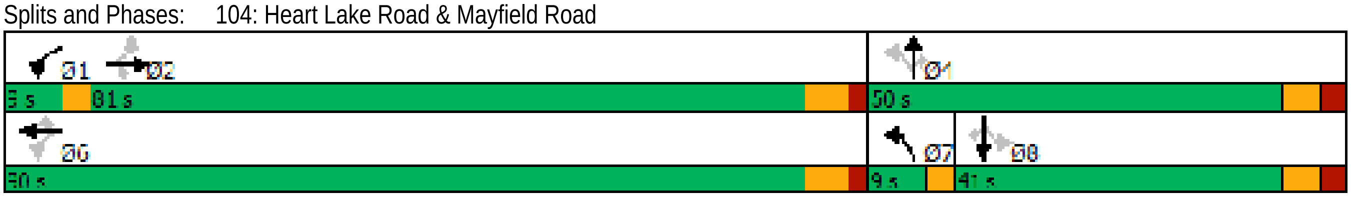
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	1722	241	127	1148	126	310	539	44	300	428	182
Future Volume (vph)	5	1722	241	127	1148	126	310	539	44	300	428	182
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		3.0	6.0		3.0	6.0		3.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.98		1.00	0.99		1.00	0.99		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1674	3530		1807	3508		1772	3417		1789	3146	
Flt Permitted	0.14	1.00		0.06	1.00		0.30	1.00		0.25	1.00	
Satd. Flow (perm)	239	3530		115	3508		563	3417		470	3146	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	1722	241	127	1148	126	310	539	44	300	428	182
RTOR Reduction (vph)	0	8	0	0	6	0	0	4	0	0	34	0
Lane Group Flow (vph)	5	1955	0	127	1268	0	310	579	0	300	576	0
Heavy Vehicles (%)	9%	1%	5%	1%	2%	7%	3%	6%	1%	2%	1%	34%
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	63.0	63.0		73.0	73.0		48.0	39.0		55.0	43.0	
Effective Green, g (s)	63.0	63.0		73.0	73.0		48.0	39.0		55.0	43.0	
Actuated g/C Ratio	0.45	0.45		0.52	0.52		0.34	0.28		0.39	0.31	
Clearance Time (s)	6.0	6.0		3.0	6.0		3.0	6.0		3.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	107	1588		144	1829		270	951		307	966	
v/s Ratio Prot		c0.55		c0.04	0.36		c0.07	0.17		c0.09	0.18	
v/s Ratio Perm	0.02			0.41			c0.32			0.29		
v/c Ratio	0.05	1.23		0.88	0.69		1.15	0.61		0.98	0.60	
Uniform Delay, d1	21.6	38.5		35.1	25.1		43.5	43.9		37.5	41.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	109.8		44.5	1.5		100.8	2.9		45.1	2.7	
Delay (s)	22.0	148.3		79.6	26.6		144.4	46.8		82.6	43.9	
Level of Service	C	F		E	C		F	D		F	D	
Approach Delay (s)		148.0			31.4			80.6			56.6	
Approach LOS		F			C			F			E	

Intersection Summary			
HCM 2000 Control Delay	88.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.17		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	113.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
Future Volume (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
Lane Group Flow (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		8
Detector Phase	2	2	2	1	6	6	7	4	4	8	8	8
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	5.0	12.0	12.0	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	35.7	35.7	35.7	8.0	35.7	35.7	8.0	39.9	39.9	39.9	39.9	39.9
Total Split (s)	81.0	81.0	81.0	9.0	90.0	90.0	9.0	50.0	50.0	41.0	41.0	41.0
Total Split (%)	57.9%	57.9%	57.9%	6.4%	64.3%	64.3%	6.4%	35.7%	35.7%	29.3%	29.3%	29.3%
Yellow Time (s)	4.6	4.6	4.6	3.0	4.6	4.6	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.1	2.1	2.1	0.0	2.1	2.1	0.0	2.9	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	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.7	6.7	6.7	3.0	6.7	6.7	3.0	6.9	6.9	6.9	6.9	6.9
Lead/Lag	Lag	Lag	Lag	Lead			Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes			Yes	Yes	Yes
Recall Mode	Min	Min	Min	None	Min	Min	None	None	None	None	None	None
v/c Ratio	0.08	0.57	0.38	0.30	0.24	0.02	0.61	0.05	0.08	0.41	0.42	0.29
Control Delay	11.0	14.8	2.1	8.9	7.9	0.1	46.5	37.9	4.8	53.6	51.7	13.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.0	14.8	2.1	8.9	7.9	0.1	46.5	37.9	4.8	53.6	51.7	13.1
Queue Length 50th (m)	2.4	67.8	0.0	3.6	18.7	0.0	32.8	3.4	0.0	14.7	20.2	0.0
Queue Length 95th (m)	6.9	89.7	11.6	8.5	27.6	0.0	57.0	10.0	3.9	30.2	38.2	12.9
Internal Link Dist (m)		258.3			1347.7			470.2			409.0	
Turn Bay Length (m)	180.0		280.0	160.0		160.0	210.0		110.0	215.0		130.0
Base Capacity (vph)	482	3596	1279	223	3702	1012	313	825	731	485	646	610
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.45	0.33	0.30	0.20	0.01	0.61	0.03	0.04	0.16	0.17	0.14

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 105.1
Natural Cycle: 95
Control Type: Actuated-Uncoordinated

Splits and Phases: 104: Heart Lake Road & Mayfield Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
Future Volume (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.7	6.7	6.7	3.0	6.7	6.7	3.0	6.9	6.9	6.9	6.9	6.9
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1738	4948	1601	1772	4683	1266	1738	1921	1633	1825	1902	1633
Flt Permitted	0.36	1.00	1.00	0.10	1.00	1.00	0.57	1.00	1.00	0.74	1.00	1.00
Satd. Flow (perm)	665	4948	1601	190	4683	1266	1038	1921	1633	1429	1902	1633
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
RTOR Reduction (vph)	0	0	179	0	0	5	0	0	25	0	0	72
Lane Group Flow (vph)	30	1622	244	66	728	9	191	21	7	78	107	11
Heavy Vehicles (%)	5%	6%	2%	3%	12%	29%	5%	0%	0%	0%	1%	0%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		8
Actuated Green, G (s)	60.7	60.7	60.7	68.2	68.2	68.2	23.4	23.4	23.4	14.1	14.1	14.1
Effective Green, g (s)	60.7	60.7	60.7	68.2	68.2	68.2	23.4	23.4	23.4	14.1	14.1	14.1
Actuated g/C Ratio	0.58	0.58	0.58	0.65	0.65	0.65	0.22	0.22	0.22	0.13	0.13	0.13
Clearance Time (s)	6.7	6.7	6.7	3.0	6.7	6.7	3.0	6.9	6.9	6.9	6.9	6.9
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	383	2854	923	190	3035	820	272	427	363	191	254	218
v/s Ratio Prot		c0.33		c0.01	0.16		c0.04	0.01			0.06	
v/s Ratio Perm	0.05		0.15	0.21		0.01	c0.11		0.00	0.05		0.01
v/c Ratio	0.08	0.57	0.26	0.35	0.24	0.01	0.70	0.05	0.02	0.41	0.42	0.05
Uniform Delay, d1	9.9	14.0	11.1	8.9	7.7	6.6	37.1	32.2	31.9	41.7	41.8	39.7
Progression 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
Incremental Delay, d2	0.2	0.4	0.3	2.3	0.1	0.0	9.9	0.1	0.0	3.0	2.4	0.2
Delay (s)	10.0	14.4	11.4	11.2	7.8	6.6	46.9	32.3	32.0	44.7	44.2	39.9
Level of Service	B	B	B	B	A	A	D	C	C	D	D	D
Approach Delay (s)		13.8			8.0			43.7			43.0	
Approach LOS		B			A			D			D	

Intersection Summary			
HCM 2000 Control Delay	16.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	105.2	Sum of lost time (s)	19.6
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	244	0	172	597	0
Future Volume (Veh/h)	0	244	0	172	597	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	244	0	172	597	0
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	1194	0			172	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1194	0			172	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	78			58	
cM capacity (veh/h)	120	1088			1417	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	244	172	597
Volume Left	0	0	597
Volume Right	244	172	0
cSH	1088	1700	1417
Volume to Capacity	0.22	0.10	0.42
Queue Length 95th (m)	6.0	0.0	15.0
Control Delay (s)	9.3	0.0	9.4
Lane LOS	A		A
Approach Delay (s)	9.3	0.0	9.4
Approach LOS	A		

Intersection Summary			
Average Delay	7.8		
Intersection Capacity Utilization	50.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	725	127	133	0	0	0
Future Volume (Veh/h)	725	127	133	0	0	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	725	127	133	0	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			243			
pX, platoon unblocked						
vC, conflicting volume	133	133			133	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	133	133			133	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	16	86			100	
cM capacity (veh/h)	863	922			1464	

Direction, Lane #	WB 1	WB 2	NB 1
Volume Total	725	127	133
Volume Left	725	0	0
Volume Right	0	127	0
cSH	863	922	1700
Volume to Capacity	0.84	0.14	0.08
Queue Length 95th (m)	69.8	3.3	0.0
Control Delay (s)	26.8	9.5	0.0
Lane LOS	D	A	
Approach Delay (s)	24.2		0.0
Approach LOS	C		

Intersection Summary			
Average Delay	20.9		
Intersection Capacity Utilization	53.8%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Traffic Volume (vph)	53	2106	230	1804	46	33	34	99	357	240	128
Future Volume (vph)	53	2106	230	1804	46	33	34	99	357	240	128
Lane Group Flow (vph)	53	2214	230	1804	46	33	34	99	357	240	128
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2	1	6		7	4		3	8	
Permitted Phases	2		6		6	4		4	8		8
Detector Phase	5	2	1	6	6	7	4	4	3	8	8
Switch Phase											
Minimum Initial (s)	5.0	40.0	5.0	40.0	40.0	5.0	8.0	8.0	5.0	8.0	8.0
Minimum Split (s)	8.0	46.0	8.0	46.0	46.0	8.0	50.0	50.0	8.0	50.0	50.0
Total Split (s)	10.0	69.0	10.0	69.0	69.0	10.0	51.0	51.0	10.0	51.0	51.0
Total Split (%)	7.1%	49.3%	7.1%	49.3%	49.3%	7.1%	36.4%	36.4%	7.1%	36.4%	36.4%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	0.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.0	3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Max	None	Max	Max	None	None	None	None	None	None
v/c Ratio	0.30	0.78	1.30	0.90	0.05	0.13	0.11	0.30	1.00	0.65	0.31
Control Delay	12.9	23.9	196.8	31.3	1.1	29.8	40.1	10.0	87.9	52.0	8.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.9	23.9	196.8	31.3	1.1	29.8	40.1	10.0	87.9	52.0	8.7
Queue Length 50th (m)	3.8	135.0	~49.7	185.4	0.0	5.0	6.1	0.0	65.7	48.1	0.0
Queue Length 95th (m)	9.6	178.2	#104.1	#270.9	1.9	11.6	14.1	12.4	#107.2	72.1	14.0
Internal Link Dist (m)		149.0		637.0			433.6			218.7	
Turn Bay Length (m)	150.0		190.0					85.0	200.0		150.0
Base Capacity (vph)	181	2838	177	2008	923	261	734	673	357	727	684
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.78	1.30	0.90	0.05	0.13	0.05	0.15	1.00	0.33	0.19

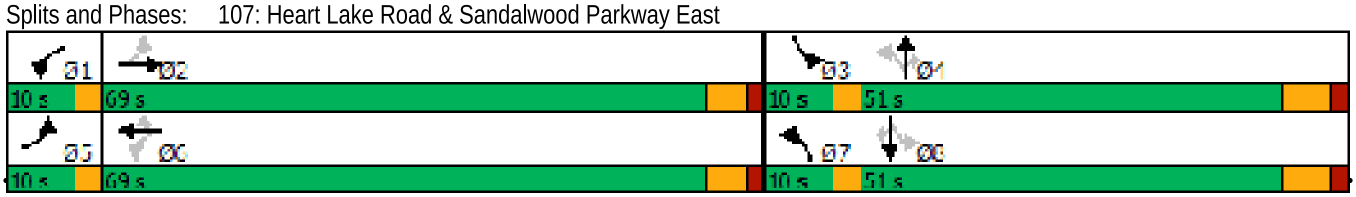
Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 114.6
Natural Cycle: 135
Control Type: Semi Act-Uncoord

~ 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: 107: Heart Lake Road & Sandalwood Parkway East



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	53	2106	108	230	1804	46	33	34	99	357	240	128
Future Volume (vph)	53	2106	108	230	1804	46	33	34	99	357	240	128
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	5125		1789	3510	1555	1674	1902	1585	1807	1883	1570
Flt Permitted	0.06	1.00		0.06	1.00	1.00	0.47	1.00	1.00	0.64	1.00	1.00
Satd. Flow (perm)	120	5125		115	3510	1555	826	1902	1585	1211	1883	1570
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	53	2106	108	230	1804	46	33	34	99	357	240	128
RTOR Reduction (vph)	0	3	0	0	0	20	0	0	83	0	0	103
Lane Group Flow (vph)	53	2211	0	230	1804	26	33	34	16	357	240	25
Heavy Vehicles (%)	0%	1%	13%	2%	4%	5%	9%	1%	3%	1%	2%	4%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6		6	4		4	8		8
Actuated Green, G (s)	69.6	64.1		72.6	65.6	65.6	23.4	19.4	19.4	29.4	22.4	22.4
Effective Green, g (s)	69.6	64.1		72.6	65.6	65.6	23.4	19.4	19.4	29.4	22.4	22.4
Actuated g/C Ratio	0.60	0.55		0.62	0.56	0.56	0.20	0.17	0.17	0.25	0.19	0.19
Clearance Time (s)	3.0	6.0		3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	152	2819		172	1976	875	195	316	263	341	362	301
v/s Ratio Prot	0.02	0.43		c0.08	0.51		0.01	0.02		c0.06	0.13	
v/s Ratio Perm	0.19			c0.75		0.02	0.03		0.01	c0.20		0.02
v/c Ratio	0.35	0.78		1.34	0.91	0.03	0.17	0.11	0.06	1.05	0.66	0.08
Uniform Delay, d1	21.3	20.7		31.8	22.9	11.3	38.0	41.2	40.9	43.4	43.6	38.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.9	2.3		185.7	7.9	0.1	0.9	0.3	0.2	61.5	5.9	0.2
Delay (s)	24.2	23.0		217.5	30.8	11.4	38.9	41.5	41.1	104.9	49.5	38.9
Level of Service	C	C		F	C	B	D	D	D	F	D	D
Approach Delay (s)		23.0			51.0			40.7			74.9	
Approach LOS		C			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	41.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.31		
Actuated Cycle Length (s)	116.5	Sum of lost time (s)	19.0
Intersection Capacity Utilization	97.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
108: Dixie Road & Mayfield Road

07/11/2019

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Traffic Volume (vph)	348	1942	487	86	889	283	93	120	46	278	449
Future Volume (vph)	348	1942	487	86	889	283	93	120	46	278	449
Lane Group Flow (vph)	348	1942	487	86	894	283	93	120	46	278	449
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6		4			8	
Permitted Phases	2		2	6		4		4	8		8
Detector Phase	5	2	2	1	6	4	4	4	8	8	8
Switch Phase											
Minimum Initial (s)	5.0	38.0	38.0	5.0	38.0	12.0	12.0	12.0	12.0	12.0	12.0
Minimum Split (s)	8.0	56.0	56.0	8.0	56.0	54.0	54.0	54.0	54.0	54.0	54.0
Total Split (s)	10.0	56.0	56.0	10.0	56.0	54.0	54.0	54.0	54.0	54.0	54.0
Total Split (%)	8.3%	46.7%	46.7%	8.3%	46.7%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%
Yellow Time (s)	3.0	4.6	4.6	3.0	4.6	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	0.0	2.3	2.3	0.0	2.3	2.3	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	0.0	0.0
Total Lost Time (s)	3.0	6.9	6.9	3.0	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Lead/Lag	Lead	Lag	Lag	Lead	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes						
Recall Mode	None	Max	Max	None	Max	None	None	None	None	None	None
v/c Ratio	1.10	0.87	0.50	0.53	0.45	0.92	0.15	0.21	0.14	0.42	0.66
Control Delay	103.2	35.0	5.9	28.4	24.2	70.4	24.8	5.1	25.1	29.4	21.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	103.2	35.0	5.9	28.4	24.2	70.4	24.8	5.1	25.1	29.4	21.7
Queue Length 50th (m)	~54.0	143.9	7.9	8.7	49.6	54.5	12.8	0.0	6.3	42.5	44.2
Queue Length 95th (m)	#112.4	#182.1	31.3	#20.3	62.6	#99.6	23.1	10.6	13.9	63.0	75.5
Internal Link Dist (m)		1347.7			595.1		1219.0			363.7	
Turn Bay Length (m)	240.0		150.0	230.0		210.0		135.0	175.0		220.0
Base Capacity (vph)	317	2237	969	161	2003	365	758	659	400	788	779
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.10	0.87	0.50	0.53	0.45	0.78	0.12	0.18	0.12	0.35	0.58

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 113.2

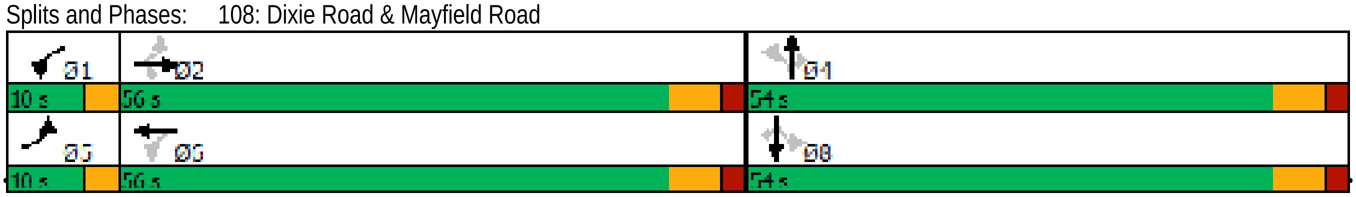
Natural Cycle: 120

Control Type: Semi Act-Uncoord

~ 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: 108: Dixie Road & Mayfield Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	348	1942	487	86	889	5	283	93	120	46	278	449
Future Volume (vph)	348	1942	487	86	889	5	283	93	120	46	278	449
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.9	6.9	3.0	6.9		6.9	6.9	6.9	6.9	6.9	6.9
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1674	4902	1617	1587	4592		1690	1812	1408	1304	1883	1601
Flt Permitted	0.25	1.00	1.00	0.08	1.00		0.49	1.00	1.00	0.70	1.00	1.00
Satd. Flow (perm)	447	4902	1617	133	4592		874	1812	1408	956	1883	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	348	1942	487	86	889	5	283	93	120	46	278	449
RTOR Reduction (vph)	0	0	232	0	1	0	0	0	78	0	0	122
Lane Group Flow (vph)	348	1942	255	86	893	0	283	93	42	46	278	327
Heavy Vehicles (%)	9%	7%	1%	15%	14%	33%	8%	6%	16%	40%	2%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			4			8	
Permitted Phases	2		2	6			4		4	8		8
Actuated Green, G (s)	58.7	51.7	51.7	55.5	50.1		39.9	39.9	39.9	39.9	39.9	39.9
Effective Green, g (s)	58.7	51.7	51.7	55.5	50.1		39.9	39.9	39.9	39.9	39.9	39.9
Actuated g/C Ratio	0.52	0.45	0.45	0.49	0.44		0.35	0.35	0.35	0.35	0.35	0.35
Clearance Time (s)	3.0	6.9	6.9	3.0	6.9		6.9	6.9	6.9	6.9	6.9	6.9
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	306	2227	734	133	2021		306	635	493	335	660	561
v/s Ratio Prot	c0.07	0.40		0.03	0.19			0.05			0.15	
v/s Ratio Perm	c0.52		0.16	0.28			c0.32		0.03	0.05		0.20
v/c Ratio	1.14	0.87	0.35	0.65	0.44		0.92	0.15	0.09	0.14	0.42	0.58
Uniform Delay, d1	24.1	28.1	20.1	21.7	22.1		35.5	25.3	24.7	25.2	28.2	30.2
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	93.8	5.1	1.3	13.9	0.7		33.5	0.2	0.2	0.4	0.9	2.4
Delay (s)	117.9	33.1	21.4	35.5	22.8		69.0	25.5	24.9	25.6	29.1	32.5
Level of Service	F	C	C	D	C		E	C	C	C	C	C
Approach Delay (s)		41.7			24.0			50.2			30.9	
Approach LOS		D			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	37.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	113.8	Sum of lost time (s)	16.8
Intersection Capacity Utilization	101.8%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Traffic Volume (vph)	17	434	195	70	222	49	55	280	162	246	723
Future Volume (vph)	17	434	195	70	222	49	55	280	162	246	723
Lane Group Flow (vph)	17	434	195	70	222	49	55	280	162	246	738
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	custom	Perm	NA
Protected Phases		2			2			1			1
Permitted Phases	2		2	2		2	1		2	1	
Detector Phase	2	2	2	2	2	2	1	1	2	1	1
Switch Phase											
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	30.0	30.0	12.0	30.0	30.0
Minimum Split (s)	35.2	35.2	35.2	35.2	35.2	35.2	36.6	36.6	35.2	36.6	36.6
Total Split (s)	35.2	35.2	35.2	35.2	35.2	35.2	53.6	53.6	35.2	53.6	53.6
Total Split (%)	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%	60.4%	60.4%	39.6%	60.4%	60.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.2	4.2	4.0	4.2	4.2
All-Red Time (s)	3.2	3.2	3.2	3.2	3.2	3.2	2.4	2.4	3.2	2.4	2.4
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	7.2	6.6	6.6
Lead/Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lag	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	Max	None	Max	Max
v/c Ratio	0.05	0.44	0.35	0.31	0.22	0.10	0.22	0.26	0.31	0.40	0.70
Control Delay	21.9	26.3	6.5	27.5	23.7	7.3	13.7	11.2	5.6	14.0	18.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.9	26.3	6.5	27.5	23.7	7.3	13.7	11.2	5.6	14.0	18.8
Queue Length 50th (m)	1.8	27.6	1.5	8.1	13.2	0.0	4.1	21.7	0.0	20.9	79.7
Queue Length 95th (m)	6.0	39.2	14.6	18.2	21.0	6.8	11.4	36.6	11.9	38.9	125.7
Internal Link Dist (m)		1345.4			805.1			1436.4			1219.0
Turn Bay Length (m)	150.0		140.0	80.0		150.0	190.0			150.0	
Base Capacity (vph)	394	1225	643	283	1225	569	251	1061	615	616	1059
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.35	0.30	0.25	0.18	0.09	0.22	0.26	0.26	0.40	0.70

Intersection Summary
Cycle Length: 88.8
Actuated Cycle Length: 83.8
Natural Cycle: 75
Control Type: Semi Act-Uncoord

Splits and Phases: 109: Dixie Road & Countryside Drive

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	17	434	195	70	222	49	55	280	162	246	723	15
Future Volume (vph)	17	434	195	70	222	49	55	280	162	246	723	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	7.2	6.6	6.6	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1823	3650	1559	1734	3650	1598	1824	1883	1512	1772	1878	
Flt Permitted	0.61	1.00	1.00	0.46	1.00	1.00	0.23	1.00	1.00	0.59	1.00	
Satd. Flow (perm)	1176	3650	1559	845	3650	1598	445	1883	1512	1093	1878	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	17	434	195	70	222	49	55	280	162	246	723	15
RTOR Reduction (vph)	0	0	132	0	0	36	0	0	118	0	1	0
Lane Group Flow (vph)	17	434	63	70	222	13	55	280	44	246	737	0
Confl. Peds. (#/hr)	1		5	5		1	1					1
Heavy Vehicles (%)	0%	0%	3%	5%	0%	0%	0%	2%	8%	3%	2%	0%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	custom	Perm	NA	
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		2	1		
Actuated Green, G (s)	22.7	22.7	22.7	22.7	22.7	22.7	47.2	47.2	22.7	47.2	47.2	
Effective Green, g (s)	22.7	22.7	22.7	22.7	22.7	22.7	47.2	47.2	22.7	47.2	47.2	
Actuated g/C Ratio	0.27	0.27	0.27	0.27	0.27	0.27	0.56	0.56	0.27	0.56	0.56	
Clearance Time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	7.2	6.6	6.6	
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lane Grp Cap (vph)	318	989	422	229	989	433	250	1061	410	616	1059	
v/s Ratio Prot		c0.12			0.06			0.15			c0.39	
v/s Ratio Perm	0.01		0.04	0.08		0.01	0.12		0.03	0.23		
v/c Ratio	0.05	0.44	0.15	0.31	0.22	0.03	0.22	0.26	0.11	0.40	0.70	
Uniform Delay, d1	22.6	25.2	23.2	24.2	23.7	22.4	9.1	9.3	22.9	10.3	13.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.7	0.3	1.6	0.2	0.1	2.0	0.6	0.2	1.9	3.8	
Delay (s)	22.7	25.9	23.5	25.8	23.9	22.5	11.1	10.0	23.1	12.2	16.9	
Level of Service	C	C	C	C	C	C	B	A	C	B	B	
Approach Delay (s)		25.1			24.1			14.4			15.7	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	83.7	Sum of lost time (s)	13.8
Intersection Capacity Utilization	110.7%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	431	2848	254	1570	100	355	87	90	835	458
Future Volume (vph)	431	2848	254	1570	100	355	87	90	835	458
Lane Group Flow (vph)	431	3250	254	1734	100	355	87	90	835	458
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8	7	4	1	6			2	
Permitted Phases	8		4		6		6	2		2
Detector Phase	3	8	7	4	1	6	6	2	2	2
Switch Phase										
Minimum Initial (s)	5.0	39.7	5.0	39.7	5.0	39.0	39.0	39.0	39.0	39.0
Minimum Split (s)	8.0	47.4	8.0	47.4	8.0	46.0	46.0	46.0	46.0	46.0
Total Split (s)	12.0	59.0	20.0	67.0	10.0	61.0	61.0	51.0	51.0	51.0
Total Split (%)	8.6%	42.1%	14.3%	47.9%	7.1%	43.6%	43.6%	36.4%	36.4%	36.4%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	0.0	3.7	0.0	3.7	0.0	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	7.7	3.0	7.7	3.0	7.0	7.0	7.0	7.0	7.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes			Yes	Yes	Yes
Recall Mode	None	Max	None	Max	None	None	None	None	None	None
v/c Ratio	2.51	1.74	0.93	0.80	0.56	0.27	0.14	0.30	0.78	0.80
Control Delay	714.2	364.3	75.8	37.9	38.8	30.4	5.9	40.0	49.6	38.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	714.2	364.3	75.8	37.9	38.8	30.4	5.9	40.0	49.6	38.4
Queue Length 50th (m)	~169.3	~453.6	49.2	139.7	15.7	32.3	0.0	17.4	100.9	69.8
Queue Length 95th (m)	#229.9	#473.9	#97.4	157.7	26.9	43.5	10.1	31.6	123.2	111.0
Internal Link Dist (m)		672.8		108.5		503.2			1436.4	
Turn Bay Length (m)	150.0		130.0		125.0		125.0	120.0		120.0
Base Capacity (vph)	172	1867	273	2156	177	1357	633	308	1117	592
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	2.51	1.74	0.93	0.80	0.56	0.26	0.14	0.29	0.75	0.77

Intersection Summary

Cycle Length: 140

Actuated Cycle Length: 138.3

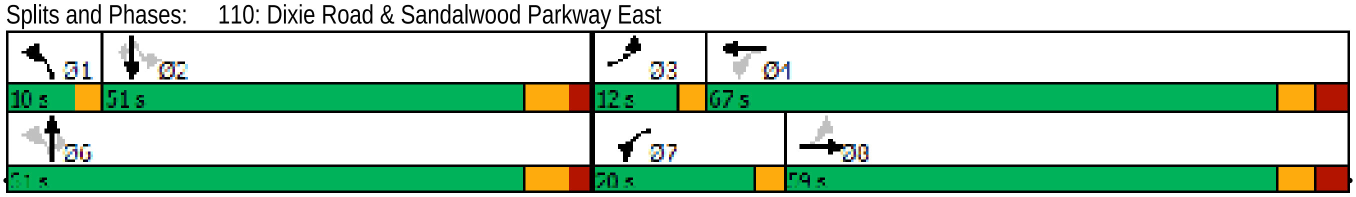
Natural Cycle: 150

Control Type: Semi Act-Uncoord

~ 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: 110: Dixie Road & Sandalwood Parkway East



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	431	2848	402	254	1570	164	100	355	87	90	835	458
Future Volume (vph)	431	2848	402	254	1570	164	100	355	87	90	835	458
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	7.7		3.0	7.7		3.0	7.0	7.0	7.0	7.0	7.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00		1.00	1.00	0.95	1.00	1.00	0.95
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	0.98		1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1755	5001		1755	5007		1754	3476	1485	1709	3510	1500
Flt Permitted	0.08	1.00		0.07	1.00		0.14	1.00	1.00	0.54	1.00	1.00
Satd. Flow (perm)	144	5001		136	5007		252	3476	1485	970	3510	1500
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	431	2848	402	254	1570	164	100	355	87	90	835	458
RTOR Reduction (vph)	0	13	0	0	9	0	0	0	54	0	0	118
Lane Group Flow (vph)	431	3237	0	254	1725	0	100	355	33	90	835	340
Confl. Peds. (#/hr)	11		32	32		11	33		33	33		33
Heavy Vehicles (%)	4%	2%	4%	4%	3%	3%	4%	5%	4%	4%	4%	3%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8		7	4		1	6			2	
Permitted Phases	8			4			6		6	2		2
Actuated Green, G (s)	60.3	51.3		71.3	59.3		52.3	52.3	52.3	42.3	42.3	42.3
Effective Green, g (s)	60.3	51.3		71.3	59.3		52.3	52.3	52.3	42.3	42.3	42.3
Actuated g/C Ratio	0.44	0.37		0.52	0.43		0.38	0.38	0.38	0.31	0.31	0.31
Clearance Time (s)	3.0	7.7		3.0	7.7		3.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	167	1855		269	2146		171	1314	561	296	1073	458
v/s Ratio Prot	c0.17	0.65		c0.12	0.34		c0.03	0.10			c0.24	
v/s Ratio Perm	c0.95			0.37			0.19		0.02	0.09		0.23
v/c Ratio	2.58	1.74		0.94	0.80		0.58	0.27	0.06	0.30	0.78	0.74
Uniform Delay, d1	34.4	43.5		43.9	34.4		31.5	29.8	27.3	36.7	43.7	43.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	728.6	337.5		40.7	3.3		7.7	0.2	0.1	1.2	4.2	7.6
Delay (s)	763.0	381.0		84.5	37.7		39.2	30.0	27.4	38.0	48.0	50.8
Level of Service	F	F		F	D		D	C	C	D	D	D
Approach Delay (s)		425.7			43.7			31.3			48.2	
Approach LOS		F			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	228.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.69		
Actuated Cycle Length (s)	138.3	Sum of lost time (s)	20.7
Intersection Capacity Utilization	164.8%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	21	0	109	151	0	0
Future Volume (Veh/h)	21	0	109	151	0	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	21	0	109	151	0	0
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	369	0	0			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	369	0	0			
tC, single (s)	6.4	6.3	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.2			
p0 queue free %	96	100	93			
cM capacity (veh/h)	593	1070	1630			

Direction, Lane #	EB 1	NB 1
Volume Total	21	260
Volume Left	21	109
Volume Right	0	0
cSH	593	1630
Volume to Capacity	0.04	0.07
Queue Length 95th (m)	0.8	1.5
Control Delay (s)	11.3	3.4
Lane LOS	B	A
Approach Delay (s)	11.3	3.4
Approach LOS	B	

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	24.0%	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	1	2>	0	1	2	1	1	1	1	1	1>	0
Traffic Volume (vph)	112	1132	88	123	632	217	101	160	392	1037	392	343
Future Volume (vph)	112	1132	88	123	632	217	101	160	392	1037	392	343
Lane Group Flow (vph)	112	1220	0	123	632	217	101	160	392	1037	735	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases		2			2			4		3	4	
Permitted Phases	2			2		2	4		4	4		
Detector Phase	2	2		2	2	2	4	4	4	3	4	
Switch Phase												
Minimum Initial (s)	25.0	25.0		25.0	25.0	25.0	8.0	8.0	8.0	5.0	8.0	
Minimum Split (s)	31.3	31.3		31.3	31.3	31.3	31.8	31.8	31.8	8.0	31.8	
Total Split (s)	65.0	65.0		65.0	65.0	65.0	40.0	40.0	40.0	35.0	40.0	
Total Split (%)	46.4%	46.4%		46.4%	46.4%	46.4%	28.6%	28.6%	28.6%	25.0%	28.6%	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	2.3	2.3		2.3	2.3	2.3	2.8	2.8	2.8	0.0	2.8	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.3	6.3		6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8	
Lead/Lag							Lag	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	
Recall Mode	Max	Max		Max	Max	Max	None	None	None	None	None	
v/c Ratio	0.48	0.84		2.05	0.45	0.29	1.94	0.39	0.95	1.48	1.73	
Control Delay	38.4	42.7		549.7	30.5	4.1	515.3	48.1	79.1	251.8	369.2	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	38.4	42.7		549.7	30.5	4.1	515.3	48.1	79.1	251.8	369.2	
Queue Length 50th (m)	20.6	144.5		~49.0	60.2	0.0	~39.5	34.5	88.6	~283.3	~272.7	
Queue Length 95th (m)	39.2	172.0		#72.2	75.7	13.8	#74.4	54.3	#146.3	#355.5	#342.5	
Internal Link Dist (m)		613.9			728.0			1200.6			493.9	
Turn Bay Length (m)	90.0			150.0		130.0			100.0	100.0		
Base Capacity (vph)	231	1451		60	1391	759	52	414	413	699	425	
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.48	0.84		2.05	0.45	0.29	1.94	0.39	0.95	1.48	1.73	

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Natural Cycle: 75
Control Type: Semi Act-Uncoord
~ 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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	2>	0	1	2	1	1	1	1	1	1>	0
Traffic Volume (vph)	112	1132	88	123	632	217	101	160	392	1037	392	343
Future Volume (vph)	112	1132	88	123	632	217	101	160	392	1037	392	343
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3	6.3		6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1601	3453		1772	3318	1512	1772	1746	1585	1789	1700	
Flt Permitted	0.33	1.00		0.08	1.00	1.00	0.12	1.00	1.00	0.58	1.00	
Satd. Flow (perm)	551	3453		146	3318	1512	225	1746	1585	1100	1700	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	112	1132	88	123	632	217	101	160	392	1037	392	343
RTOR Reduction (vph)	0	4	0	0	0	126	0	0	37	0	22	0
Lane Group Flow (vph)	112	1216	0	123	632	91	101	160	355	1037	713	0
Confl. Peds. (#/hr)							3					3
Heavy Vehicles (%)	14%	4%	12%	3%	10%	8%	3%	10%	3%	2%	1%	8%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases		2			2			4		3	4	
Permitted Phases	2			2		2	4		4	4		
Actuated Green, G (s)	58.7	58.7		58.7	58.7	58.7	33.2	33.2	33.2	65.2	33.2	
Effective Green, g (s)	58.7	58.7		58.7	58.7	58.7	33.2	33.2	33.2	65.2	33.2	
Actuated g/C Ratio	0.42	0.42		0.42	0.42	0.42	0.24	0.24	0.24	0.47	0.24	
Clearance Time (s)	6.3	6.3		6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lane Grp Cap (vph)	231	1447		61	1391	633	53	414	375	669	403	
v/s Ratio Prot		0.35			0.19			0.09		c0.35	0.42	
v/s Ratio Perm	0.20			c0.84		0.06	c0.45		0.22	0.37		
v/c Ratio	0.48	0.84		2.02	0.45	0.14	1.91	0.39	0.95	1.55	1.77	
Uniform Delay, d1	29.6	36.4		40.6	29.2	25.1	53.4	44.8	52.5	34.2	53.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	7.1	6.0		509.9	1.1	0.5	469.6	1.3	33.3	254.9	356.0	
Delay (s)	36.7	42.5		550.5	30.2	25.6	523.0	46.1	85.8	289.1	409.4	
Level of Service	D	D		F	C	C	F	D	F	F	F	
Approach Delay (s)		42.0			95.0			143.7			339.0	
Approach LOS		D			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	178.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.86		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	16.1
Intersection Capacity Utilization	140.3%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	2>	0	1	2>	0	1	2>	0	1	2>	0
Traffic Volume (vph)	5	1722	241	127	1148	126	310	539	44	300	428	182
Future Volume (vph)	5	1722	241	127	1148	126	310	539	44	300	428	182
Lane Group Flow (vph)	5	1963	0	127	1274	0	310	583	0	300	610	0
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		
Detector Phase	2	2		1	6		7	4		3	8	
Switch Phase												
Minimum Initial (s)	8.0	8.0		5.0	8.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	36.0	36.0		8.0	36.0		8.0	40.0		8.0	40.0	
Total Split (s)	69.0	69.0		10.0	79.0		12.0	45.0		16.0	49.0	
Total Split (%)	49.3%	49.3%		7.1%	56.4%		8.6%	32.1%		11.4%	35.0%	
Yellow Time (s)	4.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	2.0	2.0		0.0	2.0		0.0	2.0		0.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		3.0	6.0		3.0	6.0		3.0	6.0	
Lead/Lag	Lag	Lag		Lead			Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	Max		None	Max	
v/c Ratio	0.05	1.23		0.86	0.69		1.10	0.61		0.95	0.61	
Control Delay	23.4	143.2		70.9	27.4		117.6	46.6		71.4	40.9	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	23.4	143.2		70.9	27.4		117.6	46.6		71.4	40.9	
Queue Length 50th (m)	0.7	~324.6		17.0	123.6		~63.9	67.6		53.3	64.4	
Queue Length 95th (m)	3.4	#363.3		#51.1	146.8		#121.3	85.7		#103.0	82.8	
Internal Link Dist (m)		240.4			84.0			354.2			1159.5	
Turn Bay Length (m)	75.0			85.0			100.0			70.0		
Base Capacity (vph)	108	1597		147	1834		282	956		317	999	
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	1.23		0.86	0.69		1.10	0.61		0.95	0.61	

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Natural Cycle: 145
Control Type: Semi Act-Uncoord
~ 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.

HCM Signalized Intersection Capacity Analysis
103: Kennedy Road North & Sandalwood Parkway East   05/03/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	2>	0	1	2>	0	1	2>	0	1	2>	0
Traffic Volume (vph)	5	1722	241	127	1148	126	310	539	44	300	428	182
Future Volume (vph)	5	1722	241	127	1148	126	310	539	44	300	428	182
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		3.0	6.0		3.0	6.0		3.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.98		1.00	0.99		1.00	0.99		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1674	3530		1807	3508		1772	3417		1789	3146	
Flt Permitted	0.14	1.00		0.06	1.00		0.30	1.00		0.25	1.00	
Satd. Flow (perm)	239	3530		115	3508		563	3417		470	3146	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	1722	241	127	1148	126	310	539	44	300	428	182
RTOR Reduction (vph)	0	8	0	0	6	0	0	4	0	0	34	0
Lane Group Flow (vph)	5	1955	0	127	1268	0	310	579	0	300	576	0
Heavy Vehicles (%)	9%	1%	5%	1%	2%	7%	3%	6%	1%	2%	1%	34%
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	63.0	63.0		73.0	73.0		48.0	39.0		55.0	43.0	
Effective Green, g (s)	63.0	63.0		73.0	73.0		48.0	39.0		55.0	43.0	
Actuated g/C Ratio	0.45	0.45		0.52	0.52		0.34	0.28		0.39	0.31	
Clearance Time (s)	6.0	6.0		3.0	6.0		3.0	6.0		3.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	107	1588		144	1829		270	951		307	966	
v/s Ratio Prot		c0.55		c0.04	0.36		c0.07	0.17		c0.09	0.18	
v/s Ratio Perm	0.02			0.41			c0.32			0.29		
v/c Ratio	0.05	1.23		0.88	0.69		1.15	0.61		0.98	0.60	
Uniform Delay, d1	21.6	38.5		35.1	25.1		43.5	43.9		37.5	41.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	109.8		44.5	1.5		100.8	2.9		45.1	2.7	
Delay (s)	22.0	148.3		79.6	26.6		144.4	46.8		82.6	43.9	
Level of Service	C	F		E	C		F	D		F	D	
Approach Delay (s)		148.0			31.4			80.6			56.6	
Approach LOS		F			C			F			E	

Intersection Summary			
HCM 2000 Control Delay	88.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio		1.17	
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization		113.8% ICU Level of Service	H
Analysis Period (min)	15		

c   Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3	1	1	3	1	1	1	1	1	1	1
Traffic Volume (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
Future Volume (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
Lane Group Flow (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		8
Detector Phase	2	2	2	1	6	6	7	4	4	8	8	8
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	5.0	12.0	12.0	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	35.7	35.7	35.7	8.0	35.7	35.7	8.0	39.9	39.9	39.9	39.9	39.9
Total Split (s)	81.0	81.0	81.0	9.0	90.0	90.0	9.0	50.0	50.0	41.0	41.0	41.0
Total Split (%)	57.9%	57.9%	57.9%	6.4%	64.3%	64.3%	6.4%	35.7%	35.7%	29.3%	29.3%	29.3%
Yellow Time (s)	4.6	4.6	4.6	3.0	4.6	4.6	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.1	2.1	2.1	0.0	2.1	2.1	0.0	2.9	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	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.7	6.7	6.7	3.0	6.7	6.7	3.0	6.9	6.9	6.9	6.9	6.9
Lead/Lag	Lag	Lag	Lag	Lead			Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes			Yes	Yes	Yes
Recall Mode	Min	Min	Min	None	Min	Min	None	None	None	None	None	None
v/c Ratio	0.08	0.57	0.38	0.30	0.24	0.02	0.61	0.05	0.08	0.41	0.42	0.29
Control Delay	11.0	14.8	2.1	8.9	7.9	0.1	46.5	37.9	4.8	53.6	51.7	13.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.0	14.8	2.1	8.9	7.9	0.1	46.5	37.9	4.8	53.6	51.7	13.1
Queue Length 50th (m)	2.4	67.8	0.0	3.6	18.7	0.0	32.8	3.4	0.0	14.7	20.2	0.0
Queue Length 95th (m)	6.9	89.7	11.6	8.5	27.6	0.0	57.0	10.0	3.9	30.2	38.2	12.9
Internal Link Dist (m)		258.3			1347.7			470.2			409.0	
Turn Bay Length (m)	180.0		280.0	160.0		160.0	210.0		110.0	215.0		130.0
Base Capacity (vph)	482	3596	1279	223	3702	1012	313	825	731	485	646	610
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.45	0.33	0.30	0.20	0.01	0.61	0.03	0.04	0.16	0.17	0.14

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 105.1
Natural Cycle: 95
Control Type: Actuated-Uncoordinated

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3	1	1	3	1	1	1	1	1	1	1
Traffic Volume (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
Future Volume (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.7	6.7	6.7	3.0	6.7	6.7	3.0	6.9	6.9	6.9	6.9	6.9
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1738	4948	1601	1772	4683	1266	1738	1921	1633	1825	1902	1633
Flt Permitted	0.36	1.00	1.00	0.10	1.00	1.00	0.57	1.00	1.00	0.74	1.00	1.00
Satd. Flow (perm)	665	4948	1601	190	4683	1266	1038	1921	1633	1429	1902	1633
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	30	1622	423	66	728	14	191	21	32	78	107	83
RTOR Reduction (vph)	0	0	179	0	0	5	0	0	25	0	0	72
Lane Group Flow (vph)	30	1622	244	66	728	9	191	21	7	78	107	11
Heavy Vehicles (%)	5%	6%	2%	3%	12%	29%	5%	0%	0%	0%	1%	0%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		8
Actuated Green, G (s)	60.7	60.7	60.7	68.2	68.2	68.2	23.4	23.4	23.4	14.1	14.1	14.1
Effective Green, g (s)	60.7	60.7	60.7	68.2	68.2	68.2	23.4	23.4	23.4	14.1	14.1	14.1
Actuated g/C Ratio	0.58	0.58	0.58	0.65	0.65	0.65	0.22	0.22	0.22	0.13	0.13	0.13
Clearance Time (s)	6.7	6.7	6.7	3.0	6.7	6.7	3.0	6.9	6.9	6.9	6.9	6.9
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	383	2854	923	190	3035	820	272	427	363	191	254	218
v/s Ratio Prot		c0.33		c0.01	0.16		c0.04	0.01			0.06	
v/s Ratio Perm	0.05		0.15	0.21		0.01	c0.11		0.00	0.05		0.01
v/c Ratio	0.08	0.57	0.26	0.35	0.24	0.01	0.70	0.05	0.02	0.41	0.42	0.05
Uniform Delay, d1	9.9	14.0	11.1	8.9	7.7	6.6	37.1	32.2	31.9	41.7	41.8	39.7
Progression 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
Incremental Delay, d2	0.2	0.4	0.3	2.3	0.1	0.0	9.9	0.1	0.0	3.0	2.4	0.2
Delay (s)	10.0	14.4	11.4	11.2	7.8	6.6	46.9	32.3	32.0	44.7	44.2	39.9
Level of Service	B	B	B	B	A	A	D	C	C	D	D	D
Approach Delay (s)		13.8			8.0			43.7			43.0	
Approach LOS		B			A			D			D	

Intersection Summary				
HCM 2000 Control Delay	16.9	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio		0.61		
Actuated Cycle Length (s)	105.2	Sum of lost time (s)	19.6	
Intersection Capacity Utilization		67.4% ICU Level of Service		C
Analysis Period (min)	15			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
105: Heart Lake Road & Countryside Drive 05/03/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes				0		1		0	1	1	0	
Traffic Volume (veh/h)				0		244		0	172	597	0	
Future Volume (Veh/h)				0		244		0	172	597	0	
Sign Control				Stop				Free			Free	
Grade				0%				0%			0%	
Peak Hour Factor				1.00		1.00		1.00	1.00	1.00	1.00	
Hourly flow rate (vph)				0		244		0	172	597	0	
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				1194		0				172		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol				1194		0				172		
tC, single (s)				6.4		6.2				4.1		
tC, 2 stage (s)												
tF (s)				3.5		3.3				2.2		
p0 queue free %				100		78				58		
cM capacity (veh/h)				120		1088				1417		

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	244	172	597
Volume Left	0	0	597
Volume Right	244	172	0
cSH	1088	1700	1417
Volume to Capacity	0.22	0.10	0.42
Queue Length 95th (m)	6.0	0.0	15.0
Control Delay (s)	9.3	0.0	9.4
Lane LOS	A		A
Approach Delay (s)	9.3	0.0	9.4
Approach LOS	A		

Intersection Summary
Average Delay 7.8
Intersection Capacity Utilization 50.4% ICU Level of Service
A
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
106: Heart Lake Road & 410 SB Exit   05/03/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes				1		1		1	0	0	0	
Traffic Volume (veh/h)				725		127		133	0	0	0	
Future Volume (Veh/h)				725		127		133	0	0	0	
Sign Control				Stop				Free			Free	
Grade				0%				0%			0%	
Peak Hour Factor				1.00		1.00		1.00	1.00	1.00	1.00	
Hourly flow rate (vph)				725		127		133	0	0	0	
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								243				
pX, platoon unblocked												
vC, conflicting volume				133		133				133		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol				133		133				133		
tC, single (s)				6.4		6.2				4.1		
tC, 2 stage (s)												
tF (s)				3.5		3.3				2.2		
p0 queue free %				16		86				100		
cM capacity (veh/h)				863		922				1464		

Direction, Lane #	WB 1	WB 2	NB 1
Volume Total	725	127	133
Volume Left	725	0	0
Volume Right	0	127	0
cSH	863	922	1700
Volume to Capacity	0.84	0.14	0.08
Queue Length 95th (m)	69.8	3.3	0.0
Control Delay (s)	26.8	9.5	0.0
Lane LOS	D	A	
Approach Delay (s)	24.2		0.0
Approach LOS	C		

Intersection Summary
Average Delay   20.9
Intersection Capacity Utilization   53.8% 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	1	3>	0	1	2	1	1	1	1	1	1	1
Traffic Volume (vph)	53	2106	108	230	1804	46	33	34	99	357	240	128
Future Volume (vph)	53	2106	108	230	1804	46	33	34	99	357	240	128
Lane Group Flow (vph)	53	2214	0	230	1804	46	33	34	99	357	240	128
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6		6	4		4	8		8
Detector Phase	5	2		1	6	6	7	4	4	3	8	8
Switch Phase												
Minimum Initial (s)	5.0	40.0		5.0	40.0	40.0	5.0	8.0	8.0	5.0	8.0	8.0
Minimum Split (s)	8.0	46.0		8.0	46.0	46.0	8.0	50.0	50.0	8.0	50.0	50.0
Total Split (s)	10.0	69.0		10.0	69.0	69.0	10.0	51.0	51.0	10.0	51.0	51.0
Total Split (%)	7.1%	49.3%		7.1%	49.3%	49.3%	7.1%	36.4%	36.4%	7.1%	36.4%	36.4%
Yellow Time (s)	3.0	4.0		3.0	4.0	4.0	3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	0.0	2.0		0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.0		3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Max		None	Max	Max	None	None	None	None	None	None
v/c Ratio	0.30	0.78		1.30	0.90	0.05	0.13	0.11	0.30	1.00	0.65	0.31
Control Delay	12.9	23.9		196.8	31.3	1.1	29.8	40.1	10.0	87.9	52.0	8.7
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.9	23.9		196.8	31.3	1.1	29.8	40.1	10.0	87.9	52.0	8.7
Queue Length 50th (m)	3.8	135.0		~49.7	185.4	0.0	5.0	6.1	0.0	65.7	48.1	0.0
Queue Length 95th (m)	9.6	178.2		#104.1	#270.9	1.9	11.6	14.1	12.4	#107.2	72.1	14.0
Internal Link Dist (m)		149.0			637.0			433.6			218.7	
Turn Bay Length (m)	150.0			190.0					85.0	200.0		150.0
Base Capacity (vph)	181	2838		177	2008	923	261	734	673	357	727	684
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.78		1.30	0.90	0.05	0.13	0.05	0.15	1.00	0.33	0.19

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 114.6
Natural Cycle: 135
Control Type: Semi Act-Uncoord
~ 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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3>	0	1	2	1	1	1	1	1	1	1
Traffic Volume (vph)	53	2106	108	230	1804	46	33	34	99	357	240	128
Future Volume (vph)	53	2106	108	230	1804	46	33	34	99	357	240	128
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	5125		1789	3510	1555	1674	1902	1585	1807	1883	1570
Flt Permitted	0.06	1.00		0.06	1.00	1.00	0.47	1.00	1.00	0.64	1.00	1.00
Satd. Flow (perm)	120	5125		115	3510	1555	826	1902	1585	1211	1883	1570
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	53	2106	108	230	1804	46	33	34	99	357	240	128
RTOR Reduction (vph)	0	3	0	0	0	20	0	0	83	0	0	103
Lane Group Flow (vph)	53	2211	0	230	1804	26	33	34	16	357	240	25
Heavy Vehicles (%)	0%	1%	13%	2%	4%	5%	9%	1%	3%	1%	2%	4%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6		6	4		4	8		8
Actuated Green, G (s)	69.6	64.1		72.6	65.6	65.6	23.4	19.4	19.4	29.4	22.4	22.4
Effective Green, g (s)	69.6	64.1		72.6	65.6	65.6	23.4	19.4	19.4	29.4	22.4	22.4
Actuated g/C Ratio	0.60	0.55		0.62	0.56	0.56	0.20	0.17	0.17	0.25	0.19	0.19
Clearance Time (s)	3.0	6.0		3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	152	2819		172	1976	875	195	316	263	341	362	301
v/s Ratio Prot	0.02	0.43		c0.08	0.51		0.01	0.02		c0.06	0.13	
v/s Ratio Perm	0.19			c0.75		0.02	0.03		0.01	c0.20		0.02
v/c Ratio	0.35	0.78		1.34	0.91	0.03	0.17	0.11	0.06	1.05	0.66	0.08
Uniform Delay, d1	21.3	20.7		31.8	22.9	11.3	38.0	41.2	40.9	43.4	43.6	38.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.9	2.3		185.7	7.9	0.1	0.9	0.3	0.2	61.5	5.9	0.2
Delay (s)	24.2	23.0		217.5	30.8	11.4	38.9	41.5	41.1	104.9	49.5	38.9
Level of Service	C	C		F	C	B	D	D	D	F	D	D
Approach Delay (s)		23.0			51.0			40.7			74.9	
Approach LOS		C			D			D			E	

Intersection Summary

HCM 2000 Control Delay	41.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio		1.31	
Actuated Cycle Length (s)	116.5	Sum of lost time (s)	19.0
Intersection Capacity Utilization		97.4% ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3	1	1	3>	0	1	1	1	1	1	1
Traffic Volume (vph)	348	1942	487	86	889	5	283	93	120	46	278	449
Future Volume (vph)	348	1942	487	86	889	5	283	93	120	46	278	449
Lane Group Flow (vph)	348	1942	487	86	894	0	283	93	120	46	278	449
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			4			8	
Permitted Phases	2		2	6			4		4	8		8
Detector Phase	5	2	2	1	6		4	4	4	8	8	8
Switch Phase												
Minimum Initial (s)	5.0	38.0	38.0	5.0	38.0		12.0	12.0	12.0	12.0	12.0	12.0
Minimum Split (s)	8.0	56.0	56.0	8.0	56.0		54.0	54.0	54.0	54.0	54.0	54.0
Total Split (s)	10.0	56.0	56.0	10.0	56.0		54.0	54.0	54.0	54.0	54.0	54.0
Total Split (%)	8.3%	46.7%	46.7%	8.3%	46.7%		45.0%	45.0%	45.0%	45.0%	45.0%	45.0%
Yellow Time (s)	3.0	4.6	4.6	3.0	4.6		4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	0.0	2.3	2.3	0.0	2.3		2.3	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	0.0	0.0
Total Lost Time (s)	3.0	6.9	6.9	3.0	6.9		6.9	6.9	6.9	6.9	6.9	6.9
Lead/Lag	Lead	Lag	Lag	Lead	Lag							
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes							
Recall Mode	None	Max	Max	None	Max		None	None	None	None	None	None
v/c Ratio	0.96	0.78	0.47	0.48	0.40		1.24	0.18	0.25	0.17	0.52	0.76
Control Delay	56.8	26.1	5.1	22.0	18.9		171.7	27.4	5.8	27.8	33.8	27.6
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.8	26.1	5.1	22.0	18.9		171.7	27.4	5.8	27.8	33.8	27.6
Queue Length 50th (m)	27.7	106.1	5.8	5.7	36.5		~64.2	12.8	0.0	6.3	42.5	44.2
Queue Length 95th (m)	#103.5	#174.7	30.0	19.3	60.1		#105.4	23.3	10.8	14.1	63.4	75.9
Internal Link Dist (m)		1347.7			595.1			1219.0			363.7	
Turn Bay Length (m)	240.0		150.0	230.0			210.0		135.0	175.0		220.0
Base Capacity (vph)	364	2474	1026	179	2217		374	839	716	442	871	842
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.78	0.47	0.48	0.40		0.76	0.11	0.17	0.10	0.32	0.53

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 102.5
Natural Cycle: 120
Control Type: Semi Act-Uncoord
~ 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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3	1	1	3>	0	1	1	1	1	1	1
Traffic Volume (vph)	348	1942	487	86	889	5	283	93	120	46	278	449
Future Volume (vph)	348	1942	487	86	889	5	283	93	120	46	278	449
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.9	6.9	3.0	6.9		6.9	6.9	6.9	6.9	6.9	6.9
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1674	4902	1617	1587	4592		1690	1812	1408	1304	1883	1601
Flt Permitted	0.27	1.00	1.00	0.08	1.00		0.45	1.00	1.00	0.70	1.00	1.00
Satd. Flow (perm)	472	4902	1617	133	4592		808	1812	1408	956	1883	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	348	1942	487	86	889	5	283	93	120	46	278	449
RTOR Reduction (vph)	0	0	212	0	1	0	0	0	86	0	0	135
Lane Group Flow (vph)	348	1942	275	86	893	0	283	93	34	46	278	314
Heavy Vehicles (%)	9%	7%	1%	15%	14%	33%	8%	6%	16%	40%	2%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			4			8	
Permitted Phases	2		2	6			4		4	8		8
Actuated Green, G (s)	58.8	51.7	51.7	55.6	50.1		29.0	29.0	29.0	29.0	29.0	29.0
Effective Green, g (s)	58.8	51.7	51.7	55.6	50.1		29.0	29.0	29.0	29.0	29.0	29.0
Actuated g/C Ratio	0.57	0.50	0.50	0.54	0.49		0.28	0.28	0.28	0.28	0.28	0.28
Clearance Time (s)	3.0	6.9	6.9	3.0	6.9		6.9	6.9	6.9	6.9	6.9	6.9
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	352	2460	811	149	2233		227	510	396	269	530	450
v/s Ratio Prot	c0.07	0.40		0.03	0.19			0.05			0.15	
v/s Ratio Perm	c0.50		0.17	0.28			c0.35		0.02	0.05		0.20
v/c Ratio	0.99	0.79	0.34	0.58	0.40		1.25	0.18	0.09	0.17	0.52	0.70
Uniform Delay, d1	17.8	21.2	15.4	16.0	16.9		37.0	28.0	27.2	27.9	31.2	33.1
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	44.7	2.7	1.1	8.4	0.5		142.3	0.4	0.2	0.6	1.8	5.9
Delay (s)	62.5	23.8	16.5	24.4	17.4		179.3	28.4	27.4	28.6	33.0	39.0
Level of Service	E	C	B	C	B		F	C	C	C	C	D
Approach Delay (s)		27.4			18.0			114.2			36.2	
Approach LOS		C			B			F			D	

Intersection Summary

HCM 2000 Control Delay	35.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	103.0	Sum of lost time (s)	16.8
Intersection Capacity Utilization	101.8%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	2	1	1	2	1	1	1	1	1	1>	0
Traffic Volume (vph)	17	434	195	70	222	49	55	280	162	246	723	15
Future Volume (vph)	17	434	195	70	222	49	55	280	162	246	723	15
Lane Group Flow (vph)	17	434	195	70	222	49	55	280	162	246	738	0
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	custom	Perm	NA	
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		2	1		
Detector Phase	2	2	2	2	2	2	1	1	2	1	1	
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	30.0	30.0	12.0	30.0	30.0	
Minimum Split (s)	35.2	35.2	35.2	35.2	35.2	35.2	36.6	36.6	35.2	36.6	36.6	
Total Split (s)	35.2	35.2	35.2	35.2	35.2	35.2	53.6	53.6	35.2	53.6	53.6	
Total Split (%)	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%	60.4%	60.4%	39.6%	60.4%	60.4%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.2	4.2	4.0	4.2	4.2	
All-Red Time (s)	3.2	3.2	3.2	3.2	3.2	3.2	2.4	2.4	3.2	2.4	2.4	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	7.2	6.6	6.6	
Lead/Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lag	Lead	Lead	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	None	None	None	None	None	Max	Max	None	Max	Max	
v/c Ratio	0.05	0.44	0.35	0.31	0.22	0.10	0.22	0.26	0.31	0.40	0.70	
Control Delay	21.9	26.3	6.5	27.5	23.7	7.3	13.8	11.2	5.6	14.0	18.8	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	21.9	26.3	6.5	27.5	23.7	7.3	13.8	11.2	5.6	14.0	18.8	
Queue Length 50th (m)	1.8	27.6	1.5	8.1	13.2	0.0	4.1	21.7	0.0	20.9	79.7	
Queue Length 95th (m)	6.0	39.2	14.6	18.2	21.0	6.8	11.5	36.6	11.9	38.9	125.7	
Internal Link Dist (m)		1345.4			805.1			1436.4			1219.0	
Turn Bay Length (m)	150.0		140.0	80.0		150.0	190.0			150.0		
Base Capacity (vph)	394	1225	643	283	1225	569	250	1061	615	616	1059	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.04	0.35	0.30	0.25	0.18	0.09	0.22	0.26	0.26	0.40	0.70	

Intersection Summary
Cycle Length: 88.8
Actuated Cycle Length: 83.8
Natural Cycle: 75
Control Type: Semi Act-Uncoord

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	2	1	1	2	1	1	1	1	1	1>	0
Traffic Volume (vph)	17	434	195	70	222	49	55	280	162	246	723	15
Future Volume (vph)	17	434	195	70	222	49	55	280	162	246	723	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	7.2	6.6	6.6	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1823	3650	1559	1734	3650	1598	1824	1883	1512	1772	1878	
Flt Permitted	0.61	1.00	1.00	0.46	1.00	1.00	0.23	1.00	1.00	0.59	1.00	
Satd. Flow (perm)	1176	3650	1559	845	3650	1598	445	1883	1512	1093	1878	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	17	434	195	70	222	49	55	280	162	246	723	15
RTOR Reduction (vph)	0	0	132	0	0	36	0	0	118	0	1	0
Lane Group Flow (vph)	17	434	63	70	222	13	55	280	44	246	737	0
Confl. Peds. (#/hr)	1		5	5		1	1					1
Heavy Vehicles (%)	0%	0%	3%	5%	0%	0%	0%	2%	8%	3%	2%	0%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	custom	Perm	NA	
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		2	1		
Actuated Green, G (s)	22.7	22.7	22.7	22.7	22.7	22.7	47.2	47.2	22.7	47.2	47.2	
Effective Green, g (s)	22.7	22.7	22.7	22.7	22.7	22.7	47.2	47.2	22.7	47.2	47.2	
Actuated g/C Ratio	0.27	0.27	0.27	0.27	0.27	0.27	0.56	0.56	0.27	0.56	0.56	
Clearance Time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	7.2	6.6	6.6	
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lane Grp Cap (vph)	318	989	422	229	989	433	250	1061	410	616	1059	
v/s Ratio Prot		c0.12			0.06			0.15			c0.39	
v/s Ratio Perm	0.01		0.04	0.08		0.01	0.12		0.03	0.23		
v/c Ratio	0.05	0.44	0.15	0.31	0.22	0.03	0.22	0.26	0.11	0.40	0.70	
Uniform Delay, d1	22.6	25.2	23.2	24.2	23.7	22.4	9.1	9.3	22.9	10.3	13.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.7	0.3	1.6	0.2	0.1	2.0	0.6	0.2	1.9	3.8	
Delay (s)	22.7	25.9	23.5	25.8	23.9	22.5	11.1	10.0	23.1	12.2	16.9	
Level of Service	C	C	C	C	C	C	B	A	C	B	B	
Approach Delay (s)		25.1			24.1			14.4			15.7	
Approach LOS		C			C			B			B	

Intersection Summary

HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.61	
Actuated Cycle Length (s)	83.7	Sum of lost time (s)	13.8
Intersection Capacity Utilization		110.7% ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3>	0	1	3>	0	1	2	1	1	2	1
Traffic Volume (vph)	431	2848	402	254	1570	164	100	355	87	90	835	458
Future Volume (vph)	431	2848	402	254	1570	164	100	355	87	90	835	458
Lane Group Flow (vph)	431	3250	0	254	1734	0	100	355	87	90	835	458
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8		7	4		1	6			2	
Permitted Phases	8			4			6		6	2		2
Detector Phase	3	8		7	4		1	6	6	2	2	2
Switch Phase												
Minimum Initial (s)	5.0	39.7		5.0	39.7		5.0	39.0	39.0	39.0	39.0	39.0
Minimum Split (s)	8.0	47.4		8.0	47.4		8.0	46.0	46.0	46.0	46.0	46.0
Total Split (s)	12.0	59.0		20.0	67.0		10.0	61.0	61.0	51.0	51.0	51.0
Total Split (%)	8.6%	42.1%		14.3%	47.9%		7.1%	43.6%	43.6%	36.4%	36.4%	36.4%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	0.0	3.7		0.0	3.7		0.0	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	7.7		3.0	7.7		3.0	7.0	7.0	7.0	7.0	7.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes			Yes	Yes	Yes
Recall Mode	None	Max		None	Max		None	None	None	None	None	None
v/c Ratio	2.52	1.74		0.93	0.80		0.57	0.27	0.14	0.30	0.78	0.80
Control Delay	720.7	364.3		75.8	37.9		39.5	30.4	5.9	40.0	49.6	38.6
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	720.7	364.3		75.8	37.9		39.5	30.4	5.9	40.0	49.6	38.6
Queue Length 50th (m)	~169.7	~453.6		49.2	139.7		15.7	32.3	0.0	17.4	100.9	70.0
Queue Length 95th (m)	#230.4	#473.9		#97.4	157.7		26.9	43.5	10.1	31.6	123.2	111.3
Internal Link Dist (m)		672.8			108.5			503.2			1436.4	
Turn Bay Length (m)	150.0			130.0			125.0		125.0	120.0		120.0
Base Capacity (vph)	171	1867		273	2156		174	1357	633	308	1117	592
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	0
Reduced v/c Ratio	2.52	1.74		0.93	0.80		0.57	0.26	0.14	0.29	0.75	0.77

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 138.3
Natural Cycle: 150
Control Type: Semi Act-Uncoord
~ 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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3>	0	1	3>	0	1	2	1	1	2	1
Traffic Volume (vph)	431	2848	402	254	1570	164	100	355	87	90	835	458
Future Volume (vph)	431	2848	402	254	1570	164	100	355	87	90	835	458
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	7.7		3.0	7.7		3.0	7.0	7.0	7.0	7.0	7.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00		1.00	1.00	0.95	1.00	1.00	0.95
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	0.98		1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1755	5001		1755	5007		1754	3476	1485	1709	3510	1500
Flt Permitted	0.08	1.00		0.07	1.00		0.14	1.00	1.00	0.54	1.00	1.00
Satd. Flow (perm)	144	5001		136	5007		252	3476	1485	970	3510	1500
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	431	2848	402	254	1570	164	100	355	87	90	835	458
RTOR Reduction (vph)	0	13	0	0	9	0	0	0	54	0	0	117
Lane Group Flow (vph)	431	3237	0	254	1725	0	100	355	33	90	835	341
Confl. Peds. (#/hr)	11		32	32		11	33		33	33		33
Heavy Vehicles (%)	4%	2%	4%	4%	3%	3%	4%	5%	4%	4%	4%	3%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8		7	4		1	6			2	
Permitted Phases	8			4			6		6	2		2
Actuated Green, G (s)	60.3	51.3		71.3	59.3		52.3	52.3	52.3	42.3	42.3	42.3
Effective Green, g (s)	60.3	51.3		71.3	59.3		52.3	52.3	52.3	42.3	42.3	42.3
Actuated g/C Ratio	0.44	0.37		0.52	0.43		0.38	0.38	0.38	0.31	0.31	0.31
Clearance Time (s)	3.0	7.7		3.0	7.7		3.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	167	1855		269	2146		171	1314	561	296	1073	458
v/s Ratio Prot	c0.17	0.65		c0.12	0.34		c0.03	0.10			c0.24	
v/s Ratio Perm	c0.95			0.37			0.19		0.02	0.09		0.23
v/c Ratio	2.58	1.74		0.94	0.80		0.58	0.27	0.06	0.30	0.78	0.74
Uniform Delay, d1	34.4	43.5		43.9	34.4		31.5	29.8	27.3	36.7	43.7	43.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	728.6	337.5		40.7	3.3		7.7	0.2	0.1	1.2	4.2	7.7
Delay (s)	763.0	381.0		84.5	37.7		39.2	30.0	27.4	38.0	48.0	50.8
Level of Service	F	F		F	D		D	C	C	D	D	D
Approach Delay (s)		425.7			43.7			31.3			48.3	
Approach LOS		F			D			C			D	

Intersection Summary

HCM 2000 Control Delay	228.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio		1.69	
Actuated Cycle Length (s)	138.3	Sum of lost time (s)	20.7
Intersection Capacity Utilization		164.8% ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
111: Heart Lake Road & Heart Lake Conservation Area 05/03/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes	1		0				0	<1			0	0
Traffic Volume (veh/h)	21		0				109	151			0	0
Future Volume (Veh/h)	21		0				109	151			0	0
Sign Control	Stop							Free			Free	
Grade	0%							0%			0%	
Peak Hour Factor	1.00		1.00				1.00	1.00			1.00	1.00
Hourly flow rate (vph)	21		0				109	151			0	0
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	369		0				0					
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	369		0				0					
tC, single (s)	6.4		6.3				4.1					
tC, 2 stage (s)												
tF (s)	3.5		3.4				2.2					
p0 queue free %	96		100				93					
cM capacity (veh/h)	593		1070				1630					

Direction, Lane #	EB 1	NB 1
Volume Total	21	260
Volume Left	21	109
Volume Right	0	0
cSH	593	1630
Volume to Capacity	0.04	0.07
Queue Length 95th (m)	0.8	1.5
Control Delay (s)	11.3	3.4
Lane LOS	B	A
Approach Delay (s)	11.3	3.4
Approach LOS	B	

Intersection Summary
Average Delay 4.0
Intersection Capacity Utilization 24.0% ICU Level of Service A
Analysis Period (min) 15

Queues

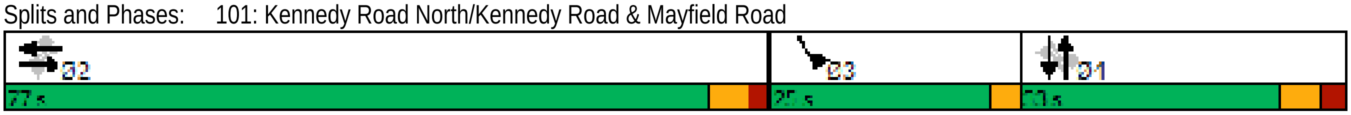
101: Kennedy Road North/Kennedy Road & Mayfield Road

07/11/2019

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	267	853	213	1380	524	245	387	293	440	237
Future Volume (vph)	267	853	213	1380	524	245	387	293	440	237
Lane Group Flow (vph)	267	936	213	1380	524	245	387	293	440	484
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA
Protected Phases		2		2			4		3	4
Permitted Phases	2		2		2	4		4	4	
Detector Phase	2	2	2	2	2	4	4	4	3	4
Switch Phase										
Minimum Initial (s)	31.3	31.3	31.3	31.3	31.3	8.0	8.0	8.0	5.0	8.0
Minimum Split (s)	37.6	37.6	37.6	37.6	37.6	31.8	31.8	31.8	8.0	31.8
Total Split (s)	77.0	77.0	77.0	77.0	77.0	33.0	33.0	33.0	25.0	33.0
Total Split (%)	57.0%	57.0%	57.0%	57.0%	57.0%	24.4%	24.4%	24.4%	18.5%	24.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	2.3	2.3	2.3	2.3	2.3	2.8	2.8	2.8	0.0	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.3	6.3	6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8
Lead/Lag						Lag	Lag	Lag	Lead	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	None	None	None	None	None
v/c Ratio	2.87	0.52	0.94	0.74	0.48	4.30	1.05	0.73	1.23	1.33
Control Delay	888.1	22.0	77.9	27.9	2.9	1537.9	112.0	43.0	157.6	205.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	888.1	22.0	77.9	27.9	2.9	1537.9	112.0	43.0	157.6	205.2
Queue Length 50th (m)	~90.3	75.6	47.4	134.1	0.0	~110.3	~103.2	43.1	~116.4	~147.6
Queue Length 95th (m)	#141.0	92.1	#96.5	158.7	15.0	#148.2	#160.3	73.4	#176.4	#209.7
Internal Link Dist (m)		613.9		728.1			1200.6			493.9
Turn Bay Length (m)	90.0		150.0		130.0			100.0	100.0	
Base Capacity (vph)	93	1814	227	1874	1096	57	369	402	359	364
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	2.87	0.52	0.94	0.74	0.48	4.30	1.05	0.73	1.23	1.33

Intersection Summary
Cycle Length: 135
Actuated Cycle Length: 135
Natural Cycle: 80
Control Type: Semi Act-Uncoord
~ 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: 101: Kennedy Road North/Kennedy Road & Mayfield Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	267	853	83	213	1380	524	245	387	293	440	237	247
Future Volume (vph)	267	853	83	213	1380	524	245	387	293	440	237	247
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3	6.3		6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.92	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1825	3454		1807	3579	1617	1825	1902	1617	1807	1735	
Flt Permitted	0.09	1.00		0.23	1.00	1.00	0.15	1.00	1.00	0.15	1.00	
Satd. Flow (perm)	178	3454		434	3579	1617	293	1902	1617	290	1735	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	267	853	83	213	1380	524	245	387	293	440	237	247
RTOR Reduction (vph)	0	5	0	0	0	250	0	0	89	0	27	0
Lane Group Flow (vph)	267	931	0	213	1380	274	245	387	204	440	457	0
Confl. Peds. (#/hr)							7					7
Heavy Vehicles (%)	0%	4%	7%	1%	2%	1%	0%	1%	1%	1%	0%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases		2			2			4		3	4	
Permitted Phases	2			2		2	4		4	4		
Actuated Green, G (s)	70.7	70.7		70.7	70.7	70.7	26.2	26.2	26.2	48.2	26.2	
Effective Green, g (s)	70.7	70.7		70.7	70.7	70.7	26.2	26.2	26.2	48.2	26.2	
Actuated g/C Ratio	0.52	0.52		0.52	0.52	0.52	0.19	0.19	0.19	0.36	0.19	
Clearance Time (s)	6.3	6.3		6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lane Grp Cap (vph)	93	1808		227	1874	846	56	369	313	350	336	
v/s Ratio Prot		0.27			0.39			0.20		c0.20	0.26	
v/s Ratio Perm	c1.50			0.49		0.17	c0.84		0.13	0.24		
v/c Ratio	2.87	0.51		0.94	0.74	0.32	4.38	1.05	0.65	1.26	1.36	
Uniform Delay, d1	32.1	21.0		30.1	24.9	18.4	54.4	54.4	50.2	40.4	54.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	870.7	1.1		45.6	2.6	1.0	1559.3	60.2	6.4	137.0	179.7	
Delay (s)	902.8	22.0		75.7	27.6	19.5	1613.7	114.6	56.6	177.4	234.1	
Level of Service	F	C		E	C	B	F	F	E	F	F	
Approach Delay (s)		217.5			30.4			493.3			207.1	
Approach LOS		F			C			F			F	

Intersection Summary			
HCM 2000 Control Delay	188.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	2.88		
Actuated Cycle Length (s)	135.0	Sum of lost time (s)	16.1
Intersection Capacity Utilization	128.5%	ICU Level of Service	H
Analysis Period (min)	15		

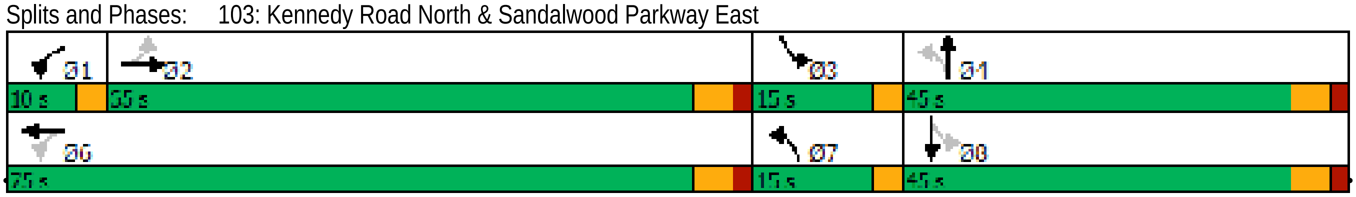
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	15	1104	91	1653	493	775	605	567
Future Volume (vph)	15	1104	91	1653	493	775	605	567
Lane Group Flow (vph)	15	1215	91	1928	493	1003	605	626
Turn Type	Perm	NA	pm+pt	NA	pm+pt	NA	pm+pt	NA
Protected Phases		2	1	6	7	4	3	8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	3	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	5.0	8.0	5.0	8.0
Minimum Split (s)	36.0	36.0	8.0	36.0	8.0	40.0	8.0	40.0
Total Split (s)	65.0	65.0	10.0	75.0	15.0	45.0	15.0	45.0
Total Split (%)	48.1%	48.1%	7.4%	55.6%	11.1%	33.3%	11.1%	33.3%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	2.0	2.0	0.0	2.0	0.0	2.0	0.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	3.0	6.0	3.0	6.0	3.0	6.0
Lead/Lag	Lag	Lag	Lead		Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None
v/c Ratio	0.28	0.78	0.54	1.06	1.59	0.98	2.79	0.62
Control Delay	40.9	36.6	27.2	72.7	304.4	70.7	835.3	44.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.9	36.6	27.2	72.7	304.4	70.7	835.3	44.2
Queue Length 50th (m)	2.3	131.3	10.6	~273.1	~134.1	126.2	~240.3	69.3
Queue Length 95th (m)	9.0	157.0	18.8	#312.0	#196.7	#167.9	#306.5	87.7
Internal Link Dist (m)		240.5		84.0		354.2		1159.5
Turn Bay Length (m)	75.0		85.0		100.0		70.0	
Base Capacity (vph)	54	1553	170	1812	311	1020	217	1010
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	0.78	0.54	1.06	1.59	0.98	2.79	0.62

Intersection Summary

Cycle Length: 135
Actuated Cycle Length: 135
Natural Cycle: 135
Control Type: Semi Act-Uncoord
~ 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: 103: Kennedy Road North & Sandalwood Parkway East



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	1104	111	91	1653	275	493	775	228	605	567	59
Future Volume (vph)	15	1104	111	91	1653	275	493	775	228	605	567	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		3.0	6.0		3.0	6.0		3.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.99		1.00	0.98		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1738	3542		1789	3527		1825	3464		1772	3478	
Flt Permitted	0.07	1.00		0.09	1.00		0.25	1.00		0.10	1.00	
Satd. Flow (perm)	124	3542		162	3527		480	3464		191	3478	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	1104	111	91	1653	275	493	775	228	605	567	59
RTOR Reduction (vph)	0	6	0	0	10	0	0	20	0	0	6	0
Lane Group Flow (vph)	15	1209	0	91	1918	0	493	983	0	605	620	0
Heavy Vehicles (%)	5%	1%	8%	2%	1%	3%	0%	2%	1%	3%	1%	27%
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	59.0	59.0		69.0	69.0		51.0	39.0		51.0	39.0	
Effective Green, g (s)	59.0	59.0		69.0	69.0		51.0	39.0		51.0	39.0	
Actuated g/C Ratio	0.44	0.44		0.51	0.51		0.38	0.29		0.38	0.29	
Clearance Time (s)	6.0	6.0		3.0	6.0		3.0	6.0		3.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	54	1547		167	1802		300	1000		212	1004	
v/s Ratio Prot		0.34		0.03	c0.54		0.15	0.28		c0.25	0.18	
v/s Ratio Perm	0.12			0.25			0.47			c0.82		
v/c Ratio	0.28	0.78		0.54	1.06		1.64	0.98		2.85	0.62	
Uniform Delay, d1	24.3	32.5		24.1	33.0		37.7	47.7		37.3	41.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.8	3.1		6.3	40.8		304.1	24.4		847.1	1.6	
Delay (s)	30.1	35.6		30.3	73.8		341.8	72.1		884.4	43.2	
Level of Service	C	D		C	E		F	E		F	D	
Approach Delay (s)		35.5			71.8			161.0			456.6	
Approach LOS		D			E			F			F	

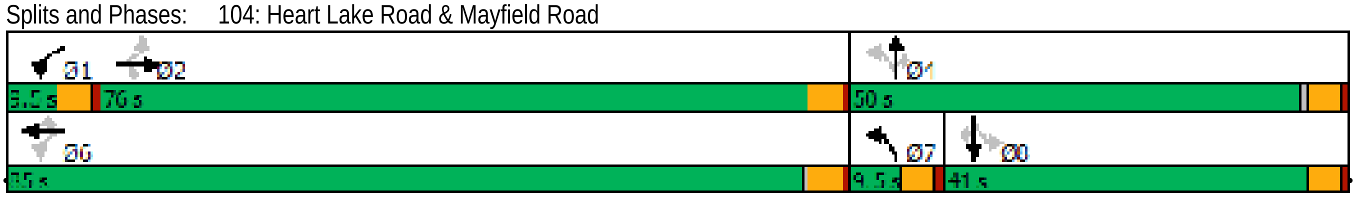
Intersection Summary			
HCM 2000 Control Delay	165.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.87		
Actuated Cycle Length (s)	135.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	141.7%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
Future Volume (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
Lane Group Flow (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		8
Detector Phase	2	2	2	1	6	6	7	4	4	8	8	8
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	5.0	12.0	12.0	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	33.5	33.5	33.5	9.5	33.5	33.5	9.5	37.5	37.5	37.5	37.5	37.5
Total Split (s)	76.0	76.0	76.0	9.5	85.0	85.0	9.5	50.0	50.0	41.0	41.0	41.0
Total Split (%)	55.9%	55.9%	55.9%	7.0%	62.5%	62.5%	7.0%	36.8%	36.8%	30.1%	30.1%	30.1%
Yellow Time (s)	3.5	3.5	3.5	3.5	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	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	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	4.5	4.5	4.5	4.5
Lead/Lag	Lag	Lag	Lag	Lead			Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes			Yes	Yes	Yes
Recall Mode	Min	Min	Min	None	Min	Min	None	None	None	None	None	None
v/c Ratio	0.20	0.58	0.18	0.07	0.51	0.04	1.11	0.07	0.05	0.62	0.22	0.25
Control Delay	20.9	19.1	4.0	12.7	15.2	2.6	102.5	18.7	4.2	36.3	26.5	12.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.9	19.1	4.0	12.7	15.2	2.6	102.5	18.7	4.2	36.3	26.5	12.1
Queue Length 50th (m)	2.3	38.6	0.0	1.0	38.2	0.0	~60.4	4.1	0.0	23.3	10.3	3.4
Queue Length 95th (m)	10.9	80.9	9.9	4.7	66.9	3.1	#196.0	14.9	3.9	60.8	29.3	18.1
Internal Link Dist (m)		258.4			1347.6			470.1			409.0	
Turn Bay Length (m)	180.0		280.0	225.0		225.0	210.0		110.0	215.0		130.0
Base Capacity (vph)	316	4182	1357	216	4611	1454	488	1194	949	638	911	809
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.29	0.10	0.07	0.27	0.02	1.11	0.05	0.04	0.34	0.12	0.15

Intersection Summary

Cycle Length: 136
Actuated Cycle Length: 80.2
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
~ 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: 104: Heart Lake Road & Mayfield Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
Future Volume (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	4812	1541	1738	5092	1601	1807	1921	1498	1706	1847	1555
Flt Permitted	0.20	1.00	1.00	0.13	1.00	1.00	0.57	1.00	1.00	0.72	1.00	1.00
Satd. Flow (perm)	364	4812	1541	241	5092	1601	1087	1921	1498	1292	1847	1555
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
RTOR Reduction (vph)	0	0	77	0	0	18	0	0	21	0	0	61
Lane Group Flow (vph)	32	1222	58	16	1231	17	544	57	13	220	110	61
Heavy Vehicles (%)	3%	9%	6%	5%	3%	2%	1%	0%	9%	7%	4%	5%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		8
Actuated Green, G (s)	35.2	35.2	35.2	41.2	41.2	41.2	32.4	32.4	32.4	22.5	22.5	22.5
Effective Green, g (s)	35.2	35.2	35.2	41.2	41.2	41.2	32.4	32.4	32.4	22.5	22.5	22.5
Actuated g/C Ratio	0.43	0.43	0.43	0.50	0.50	0.50	0.39	0.39	0.39	0.27	0.27	0.27
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	155	2050	656	147	2539	798	473	753	587	351	503	423
v/s Ratio Prot		c0.25		0.00	c0.24		c0.08	0.03			0.06	
v/s Ratio Perm	0.09		0.04	0.05		0.01	c0.38		0.01	0.17		0.04
v/c Ratio	0.21	0.60	0.09	0.11	0.48	0.02	1.15	0.08	0.02	0.63	0.22	0.14
Uniform Delay, d1	14.9	18.2	14.1	12.0	13.7	10.5	25.4	15.7	15.4	26.4	23.2	22.8
Progression 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
Incremental Delay, d2	1.4	0.7	0.1	0.7	0.3	0.0	89.5	0.1	0.0	4.9	0.5	0.3
Delay (s)	16.3	18.9	14.2	12.7	14.0	10.5	115.0	15.8	15.4	31.3	23.7	23.1
Level of Service	B	B	B	B	B	B	F	B	B	C	C	C
Approach Delay (s)		18.4			13.9			100.7			27.2	
Approach LOS		B			B			F			C	

Intersection Summary			
HCM 2000 Control Delay	31.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	82.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	635	0	510	261	0
Future Volume (Veh/h)	0	635	0	510	261	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	635	0	510	261	0
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	522	0			510	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	522	0			510	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	42			75	
cM capacity (veh/h)	389	1091			1055	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	635	510	261
Volume Left	0	0	261
Volume Right	635	510	0
cSH	1091	1700	1055
Volume to Capacity	0.58	0.30	0.25
Queue Length 95th (m)	27.4	0.0	6.8
Control Delay (s)	12.8	0.0	9.5
Lane LOS	B		A
Approach Delay (s)	12.8	0.0	9.5
Approach LOS	B		

Intersection Summary			
Average Delay	7.5		
Intersection Capacity Utilization	52.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	300	60	432	0	0	0
Future Volume (Veh/h)	300	60	432	0	0	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	300	60	432	0	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			243			
pX, platoon unblocked	0.95	0.95			0.95	
vC, conflicting volume	432	432			432	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	376	376			376	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	50	91			100	
cM capacity (veh/h)	594	637			1134	

Direction, Lane #	WB 1	WB 2	NB 1
Volume Total	300	60	432
Volume Left	300	0	0
Volume Right	0	60	0
cSH	594	637	1700
Volume to Capacity	0.50	0.09	0.25
Queue Length 95th (m)	19.9	2.2	0.0
Control Delay (s)	17.1	11.2	0.0
Lane LOS	C	B	
Approach Delay (s)	16.1		0.0
Approach LOS	C		

Intersection Summary			
Average Delay	7.3		
Intersection Capacity Utilization	46.0%	ICU Level of Service	A
Analysis Period (min)	15		

107: Heart Lake Road & Sandalwood Parkway East

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Traffic Volume (vph)	148	1570	156	2205	164	80	121	110	138	65	97
Future Volume (vph)	148	1570	156	2205	164	80	121	110	138	65	97
Lane Group Flow (vph)	148	1637	156	2205	164	80	121	110	138	65	97
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2	1	6		7	4		3	8	
Permitted Phases	2		6		6	4		4	8		8
Detector Phase	5	2	1	6	6	7	4	4	3	8	8
Switch Phase											
Minimum Initial (s)	5.0	40.0	5.0	40.0	40.0	5.0	8.0	8.0	5.0	8.0	8.0
Minimum Split (s)	8.0	46.0	8.0	46.0	46.0	8.0	50.0	50.0	8.0	50.0	50.0
Total Split (s)	10.0	64.0	10.0	64.0	64.0	10.0	51.0	51.0	10.0	51.0	51.0
Total Split (%)	7.4%	47.4%	7.4%	47.4%	47.4%	7.4%	37.8%	37.8%	7.4%	37.8%	37.8%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	0.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.0	3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Max	None	Max	Max	None	None	None	None	None	None
v/c Ratio	0.75	0.58	0.68	1.10	0.18	0.24	0.48	0.36	0.42	0.23	0.30
Control Delay	42.2	16.6	26.7	78.6	6.8	31.6	48.7	11.3	35.4	42.6	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.2	16.6	26.7	78.6	6.8	31.6	48.7	11.3	35.4	42.6	10.9
Queue Length 50th (m)	11.8	69.7	9.2	~248.2	6.9	11.6	21.4	0.0	20.6	11.1	0.0
Queue Length 95th (m)	#43.0	90.1	#33.4	#305.8	17.3	22.6	37.5	13.6	35.3	22.5	12.8
Internal Link Dist (m)		149.1		637.0			433.6			218.7	
Turn Bay Length (m)	150.0		190.0					85.0	200.0		150.0
Base Capacity (vph)	197	2826	231	2001	922	328	807	729	325	791	728
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.58	0.68	1.10	0.18	0.24	0.15	0.15	0.42	0.08	0.13

Intersection Summary

Cycle Length: 135

Actuated Cycle Length: 104.8

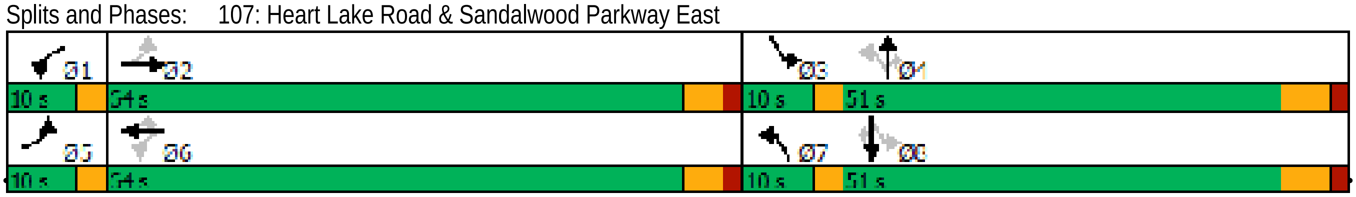
Natural Cycle: 145

Control Type: Semi Act-Uncoord

~ 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: 107: Heart Lake Road & Sandalwood Parkway East



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	148	1570	67	156	2205	164	80	121	110	138	65	97
Future Volume (vph)	148	1570	67	156	2205	164	80	121	110	138	65	97
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1807	5098		1825	3614	1601	1690	1921	1585	1807	1883	1601
Flt Permitted	0.07	1.00		0.10	1.00	1.00	0.71	1.00	1.00	0.61	1.00	1.00
Satd. Flow (perm)	131	5098		187	3614	1601	1271	1921	1585	1169	1883	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	148	1570	67	156	2205	164	80	121	110	138	65	97
RTOR Reduction (vph)	0	3	0	0	0	36	0	0	95	0	0	82
Lane Group Flow (vph)	148	1634	0	156	2205	128	80	121	15	138	65	15
Heavy Vehicles (%)	1%	2%	8%	0%	1%	2%	8%	0%	3%	1%	2%	2%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6		6	4		4	8		8
Actuated Green, G (s)	65.0	58.0		65.0	58.0	58.0	19.8	14.3	14.3	22.8	15.8	15.8
Effective Green, g (s)	65.0	58.0		65.0	58.0	58.0	19.8	14.3	14.3	22.8	15.8	15.8
Actuated g/C Ratio	0.62	0.55		0.62	0.55	0.55	0.19	0.14	0.14	0.22	0.15	0.15
Clearance Time (s)	3.0	6.0		3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	192	2808		224	1990	881	260	260	215	295	282	240
v/s Ratio Prot	c0.05	0.32		0.05	c0.61		0.02	0.06		c0.03	0.03	
v/s Ratio Perm	0.42			0.38		0.08	0.04		0.01	c0.07		0.01
v/c Ratio	0.77	0.58		0.70	1.11	0.14	0.31	0.47	0.07	0.47	0.23	0.06
Uniform Delay, d1	26.2	15.6		11.9	23.6	11.5	36.4	42.0	39.7	35.0	39.4	38.4
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	19.8	0.9		11.4	56.6	0.3	1.4	2.7	0.3	2.4	0.9	0.2
Delay (s)	46.0	16.5		23.3	80.2	11.9	37.8	44.7	40.0	37.4	40.3	38.6
Level of Service	D	B		C	F	B	D	D	D	D	D	D
Approach Delay (s)		19.0			72.3			41.3			38.4	
Approach LOS		B			E			D			D	

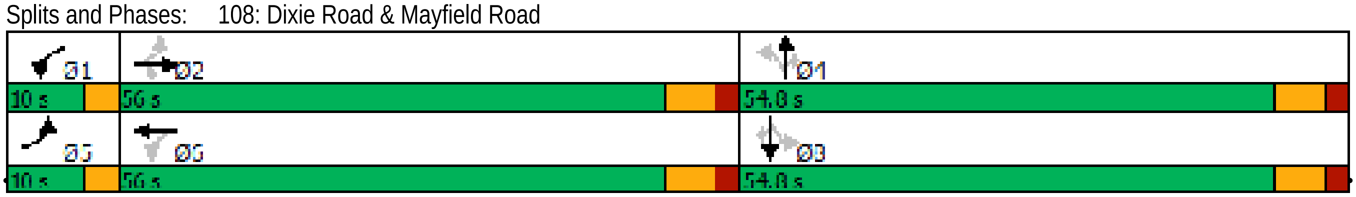
Intersection Summary			
HCM 2000 Control Delay	48.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	105.3	Sum of lost time (s)	19.0
Intersection Capacity Utilization	101.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Traffic Volume (vph)	309	905	110	96	2049	603	583	194	40	125	558
Future Volume (vph)	309	905	110	96	2049	603	583	194	40	125	558
Lane Group Flow (vph)	309	905	110	96	2064	603	583	194	40	125	558
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6		4			8	
Permitted Phases	2		2	6		4		4	8		8
Detector Phase	5	2	2	1	6	4	4	4	8	8	8
Switch Phase											
Minimum Initial (s)	5.0	44.9	44.9	5.0	44.9	12.0	12.0	12.0	12.0	12.0	12.0
Minimum Split (s)	8.0	51.8	51.8	8.0	51.8	47.9	47.9	47.9	47.9	47.9	47.9
Total Split (s)	10.0	56.0	56.0	10.0	56.0	54.8	54.8	54.8	54.8	54.8	54.8
Total Split (%)	8.3%	46.4%	46.4%	8.3%	46.4%	45.4%	45.4%	45.4%	45.4%	45.4%	45.4%
Yellow Time (s)	3.0	4.6	4.6	3.0	4.6	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	0.0	2.3	2.3	0.0	2.3	2.3	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	0.0	0.0
Total Lost Time (s)	3.0	6.9	6.9	3.0	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Lead/Lag	Lead	Lag	Lag	Lead	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes						
Recall Mode	None	Max	Max	None	Max	None	None	None	None	None	None
v/c Ratio	1.80	0.46	0.15	0.31	1.04	1.21	0.77	0.26	0.33	0.17	0.82
Control Delay	402.4	27.2	4.6	17.5	66.0	144.0	39.6	4.9	34.5	24.4	35.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	402.4	27.2	4.6	17.5	66.0	144.0	39.6	4.9	34.5	24.4	35.5
Queue Length 50th (m)	~86.5	52.1	0.0	10.2	~178.0	~160.2	108.9	1.3	6.0	17.4	84.3
Queue Length 95th (m)	#137.8	63.4	9.9	18.5	#205.3	#223.4	149.9	14.4	15.7	29.7	#135.4
Internal Link Dist (m)		1347.6			595.2		1218.9			363.8	
Turn Bay Length (m)	240.0		150.0	230.0		210.0		125.0	175.0		220.0
Base Capacity (vph)	172	1955	722	306	1990	500	761	733	123	732	682
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.80	0.46	0.15	0.31	1.04	1.21	0.77	0.26	0.33	0.17	0.82

Intersection Summary

Cycle Length: 120.8
Actuated Cycle Length: 120.8
Natural Cycle: 120
Control Type: Semi Act-Uncoord
~ 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: 108: Dixie Road & Mayfield Road



HCM Signalized Intersection Capacity Analysis
108: Dixie Road & Mayfield Road

07/11/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	309	905	110	96	2049	15	603	583	194	40	125	558
Future Volume (vph)	309	905	110	96	2049	15	603	583	194	40	125	558
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.9	6.9	3.0	6.9		6.9	6.9	6.9	6.9	6.9	6.9
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1807	4812	1617	1789	4894		1772	1921	1570	1601	1847	1512
Flt Permitted	0.08	1.00	1.00	0.25	1.00		0.68	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	155	4812	1617	462	4894		1262	1921	1570	311	1847	1512
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	309	905	110	96	2049	15	603	583	194	40	125	558
RTOR Reduction (vph)	0	0	65	0	1	0	0	0	111	0	0	83
Lane Group Flow (vph)	309	905	45	96	2063	0	603	583	83	40	125	475
Heavy Vehicles (%)	1%	9%	1%	2%	7%	13%	3%	0%	4%	14%	4%	8%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			4			8	
Permitted Phases	2		2	6			4		4	8		8
Actuated Green, G (s)	56.1	49.1	49.1	56.1	49.1		47.9	47.9	47.9	47.9	47.9	47.9
Effective Green, g (s)	56.1	49.1	49.1	56.1	49.1		47.9	47.9	47.9	47.9	47.9	47.9
Actuated g/C Ratio	0.46	0.41	0.41	0.46	0.41		0.40	0.40	0.40	0.40	0.40	0.40
Clearance Time (s)	3.0	6.9	6.9	3.0	6.9		6.9	6.9	6.9	6.9	6.9	6.9
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	167	1955	657	291	1989		500	761	622	123	732	599
v/s Ratio Prot	c0.11	0.19		0.02	0.42			0.30			0.07	
v/s Ratio Perm	c0.75		0.03	0.13			c0.48		0.05	0.13		0.31
v/c Ratio	1.85	0.46	0.07	0.33	1.04		1.21	0.77	0.13	0.33	0.17	0.79
Uniform Delay, d1	30.4	26.2	21.9	18.7	35.8		36.4	31.6	23.2	25.3	23.6	32.1
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	404.8	0.8	0.2	1.4	30.6		110.4	5.5	0.2	3.2	0.2	8.2
Delay (s)	435.2	27.0	22.1	20.1	66.5		146.8	37.0	23.4	28.5	23.8	40.3
Level of Service	F	C	C	C	E		F	D	C	C	C	D
Approach Delay (s)		121.9			64.4			83.1			36.8	
Approach LOS		F			E			F			D	

Intersection Summary			
HCM 2000 Control Delay	79.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.55		
Actuated Cycle Length (s)	120.8	Sum of lost time (s)	16.8
Intersection Capacity Utilization	125.1%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Traffic Volume (vph)	18	164	49	94	356	109	103	574	133	58	421
Future Volume (vph)	18	164	49	94	356	109	103	574	133	58	421
Lane Group Flow (vph)	18	164	49	94	356	109	103	574	133	58	464
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA
Protected Phases		2			2			1			1
Permitted Phases	2		2	2		2	1		1	1	
Detector Phase	2	2	2	2	2	2	1	1	1	1	1
Switch Phase											
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	36.6	36.6	36.6	36.6	36.6
Minimum Split (s)	35.2	35.2	35.2	35.2	35.2	35.2	43.2	43.2	43.2	43.2	43.2
Total Split (s)	35.2	35.2	35.2	35.2	35.2	35.2	53.6	53.6	53.6	53.6	53.6
Total Split (%)	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%	60.4%	60.4%	60.4%	60.4%	60.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.2	4.2	4.2	4.2	4.2
All-Red Time (s)	3.2	3.2	3.2	3.2	3.2	3.2	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	6.6	6.6	6.6
Lead/Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.08	0.20	0.13	0.35	0.43	0.24	0.20	0.52	0.14	0.14	0.42
Control Delay	23.5	24.5	7.9	28.8	27.4	6.4	10.0	12.5	2.3	9.7	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.5	24.5	7.9	28.8	27.4	6.4	10.0	12.5	2.3	9.7	10.9
Queue Length 50th (m)	2.0	9.6	0.0	10.9	22.1	0.0	5.7	40.7	0.0	3.1	29.6
Queue Length 95th (m)	6.4	16.2	6.9	22.1	32.4	10.0	16.6	84.6	7.0	10.3	63.1
Internal Link Dist (m)		1345.4			805.1			1436.4			1218.9
Turn Bay Length (m)	150.0		140.0	120.0		150.0	190.0			150.0	
Base Capacity (vph)	367	1297	553	417	1285	637	515	1112	939	424	1103
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.13	0.09	0.23	0.28	0.17	0.20	0.52	0.14	0.14	0.42

Intersection Summary
Cycle Length: 88.8
Actuated Cycle Length: 79.1
Natural Cycle: 80
Control Type: Semi Act-Uncoord

Splits and Phases: 109: Dixie Road & Countryside Drive

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	164	49	94	356	109	103	574	133	58	421	43
Future Volume (vph)	18	164	49	94	356	109	103	574	133	58	421	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	6.6	6.6	6.6	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.96	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1822	3650	1475	1728	3614	1596	1825	1865	1484	1825	1844	
Flt Permitted	0.54	1.00	1.00	0.65	1.00	1.00	0.45	1.00	1.00	0.37	1.00	
Satd. Flow (perm)	1033	3650	1475	1179	3614	1596	864	1865	1484	710	1844	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	164	49	94	356	109	103	574	133	58	421	43
RTOR Reduction (vph)	0	0	38	0	0	84	0	0	54	0	4	0
Lane Group Flow (vph)	18	164	11	94	356	25	103	574	79	58	460	0
Confl. Peds. (#/hr)	2		37	37		2						
Heavy Vehicles (%)	0%	0%	6%	3%	1%	0%	0%	3%	10%	0%	3%	0%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		
Actuated Green, G (s)	18.0	18.0	18.0	18.0	18.0	18.0	47.2	47.2	47.2	47.2	47.2	
Effective Green, g (s)	18.0	18.0	18.0	18.0	18.0	18.0	47.2	47.2	47.2	47.2	47.2	
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23	0.23	0.60	0.60	0.60	0.60	0.60	
Clearance Time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lane Grp Cap (vph)	235	831	336	268	823	363	516	1114	886	424	1101	
v/s Ratio Prot		0.04			c0.10			c0.31			0.25	
v/s Ratio Perm	0.02		0.01	0.08		0.02	0.12		0.05	0.08		
v/c Ratio	0.08	0.20	0.03	0.35	0.43	0.07	0.20	0.52	0.09	0.14	0.42	
Uniform Delay, d1	24.0	24.7	23.7	25.6	26.1	23.9	7.3	9.2	6.8	7.0	8.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	0.2	0.1	1.7	0.8	0.2	0.9	1.7	0.2	0.7	1.2	
Delay (s)	24.3	24.9	23.8	27.3	26.9	24.1	8.1	11.0	7.0	7.6	9.7	
Level of Service	C	C	C	C	C	C	A	B	A	A	A	
Approach Delay (s)		24.6			26.4			9.9			9.5	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	15.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	79.0	Sum of lost time (s)	13.8
Intersection Capacity Utilization	113.4%	ICU Level of Service	H
Analysis Period (min)	15		

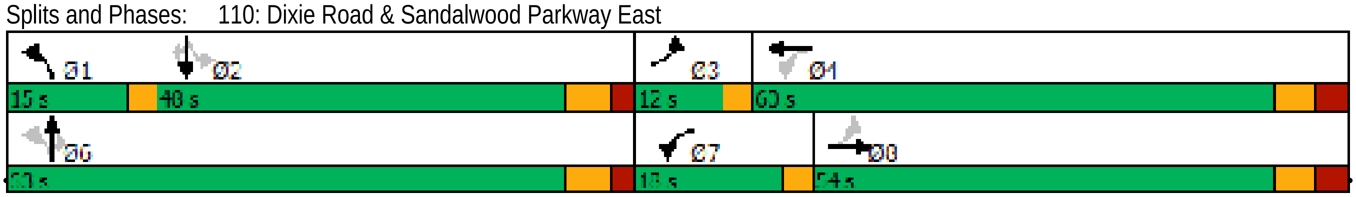
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	338	1256	170	2854	353	855	299	80	584	664
Future Volume (vph)	338	1256	170	2854	353	855	299	80	584	664
Lane Group Flow (vph)	338	1370	170	2961	353	855	299	80	584	664
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8	7	4	1	6			2	
Permitted Phases	8		4		6		6	2		2
Detector Phase	3	8	7	4	1	6	6	2	2	2
Switch Phase										
Minimum Initial (s)	5.0	39.7	5.0	39.7	5.0	39.0	39.0	39.0	39.0	39.0
Minimum Split (s)	8.0	47.4	8.0	47.4	8.0	46.0	46.0	46.0	46.0	46.0
Total Split (s)	12.0	54.0	18.0	60.0	15.0	63.0	63.0	48.0	48.0	48.0
Total Split (%)	8.9%	40.0%	13.3%	44.4%	11.1%	46.7%	46.7%	35.6%	35.6%	35.6%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	0.0	3.7	0.0	3.7	0.0	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	7.7	3.0	7.7	3.0	7.0	7.0	7.0	7.0	7.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes			Yes	Yes	Yes
Recall Mode	None	Max	None	Max	None	None	None	None	None	None
v/c Ratio	1.86	0.76	0.70	1.48	1.01	0.58	0.38	0.47	0.54	1.14
Control Delay	429.7	42.0	42.2	250.0	82.2	32.3	8.2	49.1	41.5	116.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	429.7	42.0	42.2	250.0	82.2	32.3	8.2	49.1	41.5	116.9
Queue Length 50th (m)	~111.4	109.4	24.2	~368.1	~60.0	83.8	10.4	16.0	62.9	~162.5
Queue Length 95th (m)	#166.9	126.4	46.9	#390.9	#120.0	102.6	29.4	31.9	79.9	#230.3
Internal Link Dist (m)		672.7		108.6		503.1			1436.4	
Turn Bay Length (m)	150.0		130.0		125.0		125.0	120.0		120.0
Base Capacity (vph)	182	1793	260	2003	349	1484	779	170	1076	580
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.86	0.76	0.65	1.48	1.01	0.58	0.38	0.47	0.54	1.14

Intersection Summary

Cycle Length: 135
Actuated Cycle Length: 135
Natural Cycle: 150
Control Type: Semi Act-Uncoord
~ 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: 110: Dixie Road & Sandalwood Parkway East



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	338	1256	114	170	2854	107	353	855	299	80	584	664
Future Volume (vph)	338	1256	114	170	2854	107	353	855	299	80	584	664
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	7.7		3.0	7.7		3.0	7.0	7.0	7.0	7.0	7.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.95	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.99	1.00	1.00
Frt	1.00	0.99		1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1807	5059		1807	5161		1803	3579	1557	1807	3544	1555
Flt Permitted	0.08	1.00		0.08	1.00		0.28	1.00	1.00	0.30	1.00	1.00
Satd. Flow (perm)	160	5059		150	5161		534	3579	1557	563	3544	1555
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	338	1256	114	170	2854	107	353	855	299	80	584	664
RTOR Reduction (vph)	0	8	0	0	3	0	0	0	134	0	0	109
Lane Group Flow (vph)	338	1362	0	170	2958	0	353	855	165	80	584	555
Confl. Peds. (#/hr)	14		25	25		14	21		28	28		21
Heavy Vehicles (%)	1%	2%	2%	1%	1%	0%	1%	2%	0%	0%	3%	1%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8		7	4		1	6			2	
Permitted Phases	8			4			6		6	2		2
Actuated Green, G (s)	56.6	47.6		64.3	52.3		56.0	56.0	56.0	41.0	41.0	41.0
Effective Green, g (s)	56.6	47.6		64.3	52.3		56.0	56.0	56.0	41.0	41.0	41.0
Actuated g/C Ratio	0.42	0.35		0.48	0.39		0.41	0.41	0.41	0.30	0.30	0.30
Clearance Time (s)	3.0	7.7		3.0	7.7		3.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	176	1783		239	1999		334	1484	645	170	1076	472
v/s Ratio Prot	c0.13	0.27		0.07	c0.57		c0.09	0.24			0.16	
v/s Ratio Perm	c0.67			0.27			0.34		0.11	0.14		c0.36
v/c Ratio	1.92	0.76		0.71	1.48		1.06	0.58	0.26	0.47	0.54	1.18
Uniform Delay, d1	35.8	38.7		29.7	41.4		36.1	30.4	25.9	38.2	39.2	47.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	434.5	3.2		11.7	218.6		65.0	0.9	0.4	4.3	1.0	99.7
Delay (s)	470.3	41.9		41.5	260.0		101.1	31.2	26.3	42.4	40.2	146.7
Level of Service	F	D		D	F		F	C	C	D	D	F
Approach Delay (s)		126.7			248.1			46.6			93.6	
Approach LOS		F			F			D			F	

Intersection Summary			
HCM 2000 Control Delay	154.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.51		
Actuated Cycle Length (s)	135.0	Sum of lost time (s)	20.7
Intersection Capacity Utilization	162.7%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	128	0	110	382	0	0
Future Volume (Veh/h)	128	0	110	382	0	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	128	0	110	382	0	0
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	602	0	0			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	602	0	0			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	71	100	93			
cM capacity (veh/h)	435	1091	1636			

Direction, Lane #	EB 1	NB 1
Volume Total	128	492
Volume Left	128	110
Volume Right	0	0
cSH	435	1636
Volume to Capacity	0.29	0.07
Queue Length 95th (m)	8.5	1.5
Control Delay (s)	16.7	2.1
Lane LOS	C	A
Approach Delay (s)	16.7	2.1
Approach LOS	C	

Intersection Summary			
Average Delay	5.1		
Intersection Capacity Utilization	39.9%	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	1	2>	0	1	2	1	1	1	1	1	1>	0
Traffic Volume (vph)	267	853	83	213	1380	524	245	387	293	440	237	247
Future Volume (vph)	267	853	83	213	1380	524	245	387	293	440	237	247
Lane Group Flow (vph)	267	936	0	213	1380	524	245	387	293	440	484	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases		2			2			4		3	4	
Permitted Phases	2			2		2	4		4	4		
Detector Phase	2	2		2	2	2	4	4	4	3	4	
Switch Phase												
Minimum Initial (s)	31.3	31.3		31.3	31.3	31.3	8.0	8.0	8.0	5.0	8.0	
Minimum Split (s)	37.6	37.6		37.6	37.6	37.6	31.8	31.8	31.8	8.0	31.8	
Total Split (s)	77.0	77.0		77.0	77.0	77.0	33.0	33.0	33.0	25.0	33.0	
Total Split (%)	57.0%	57.0%		57.0%	57.0%	57.0%	24.4%	24.4%	24.4%	18.5%	24.4%	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	2.3	2.3		2.3	2.3	2.3	2.8	2.8	2.8	0.0	2.8	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.3	6.3		6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8	
Lead/Lag							Lag	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	
Recall Mode	Max	Max		Max	Max	Max	None	None	None	None	None	
v/c Ratio	2.87	0.52		0.94	0.74	0.48	4.38	1.05	0.73	1.23	1.33	
Control Delay	888.1	22.0		77.9	27.9	2.9	1572.7	112.0	43.0	157.6	205.2	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	888.1	22.0		77.9	27.9	2.9	1572.7	112.0	43.0	157.6	205.2	
Queue Length 50th (m)	~90.3	75.6		47.4	134.1	0.0	~110.5	~103.2	43.1	~116.4	~147.6	
Queue Length 95th (m)	#141.0	92.1		#96.5	158.7	15.0	#148.5	#160.3	73.4	#176.4	#209.7	
Internal Link Dist (m)		613.9			728.1			1200.6			493.9	
Turn Bay Length (m)	90.0			150.0		130.0			100.0	100.0		
Base Capacity (vph)	93	1814		227	1874	1096	56	369	402	359	364	
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Reduced v/c Ratio	2.87	0.52		0.94	0.74	0.48	4.38	1.05	0.73	1.23	1.33	

Intersection Summary
Cycle Length: 135
Actuated Cycle Length: 135
Natural Cycle: 80
Control Type: Semi Act-Uncoord
~ 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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	2>	0	1	2	1	1	1	1	1	1>	0
Traffic Volume (vph)	267	853	83	213	1380	524	245	387	293	440	237	247
Future Volume (vph)	267	853	83	213	1380	524	245	387	293	440	237	247
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3	6.3		6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.92	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1825	3454		1807	3579	1617	1825	1902	1617	1807	1735	
Flt Permitted	0.09	1.00		0.23	1.00	1.00	0.15	1.00	1.00	0.15	1.00	
Satd. Flow (perm)	178	3454		434	3579	1617	293	1902	1617	290	1735	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	267	853	83	213	1380	524	245	387	293	440	237	247
RTOR Reduction (vph)	0	5	0	0	0	250	0	0	89	0	27	0
Lane Group Flow (vph)	267	931	0	213	1380	274	245	387	204	440	457	0
Confl. Peds. (#/hr)							7					7
Heavy Vehicles (%)	0%	4%	7%	1%	2%	1%	0%	1%	1%	1%	0%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases		2			2			4		3	4	
Permitted Phases	2			2		2	4		4	4		
Actuated Green, G (s)	70.7	70.7		70.7	70.7	70.7	26.2	26.2	26.2	48.2	26.2	
Effective Green, g (s)	70.7	70.7		70.7	70.7	70.7	26.2	26.2	26.2	48.2	26.2	
Actuated g/C Ratio	0.52	0.52		0.52	0.52	0.52	0.19	0.19	0.19	0.36	0.19	
Clearance Time (s)	6.3	6.3		6.3	6.3	6.3	6.8	6.8	6.8	3.0	6.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lane Grp Cap (vph)	93	1808		227	1874	846	56	369	313	350	336	
v/s Ratio Prot		0.27			0.39			0.20		c0.20	0.26	
v/s Ratio Perm	c1.50			0.49		0.17	c0.84		0.13	0.24		
v/c Ratio	2.87	0.51		0.94	0.74	0.32	4.38	1.05	0.65	1.26	1.36	
Uniform Delay, d1	32.1	21.0		30.1	24.9	18.4	54.4	54.4	50.2	40.4	54.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	870.7	1.1		45.6	2.6	1.0	1559.3	60.2	6.4	137.0	179.7	
Delay (s)	902.8	22.0		75.7	27.6	19.5	1613.7	114.6	56.6	177.4	234.1	
Level of Service	F	C		E	C	B	F	F	E	F	F	
Approach Delay (s)		217.5			30.4			493.3			207.1	
Approach LOS		F			C			F			F	

Intersection Summary

HCM 2000 Control Delay	188.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	2.88		
Actuated Cycle Length (s)	135.0	Sum of lost time (s)	16.1
Intersection Capacity Utilization	128.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	2>	0	1	2>	0	1	2>	0	1	2>	0
Traffic Volume (vph)	15	1104	111	91	1653	275	493	775	228	605	567	59
Future Volume (vph)	15	1104	111	91	1653	275	493	775	228	605	567	59
Lane Group Flow (vph)	15	1215	0	91	1928	0	493	1003	0	605	626	0
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		
Detector Phase	2	2		1	6		7	4		3	8	
Switch Phase												
Minimum Initial (s)	8.0	8.0		5.0	8.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	36.0	36.0		8.0	36.0		8.0	40.0		8.0	40.0	
Total Split (s)	65.0	65.0		10.0	75.0		15.0	45.0		15.0	45.0	
Total Split (%)	48.1%	48.1%		7.4%	55.6%		11.1%	33.3%		11.1%	33.3%	
Yellow Time (s)	4.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	2.0	2.0		0.0	2.0		0.0	2.0		0.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		3.0	6.0		3.0	6.0		3.0	6.0	
Lead/Lag	Lag	Lag		Lead			Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	None		None	None	
v/c Ratio	0.28	0.78		0.54	1.06		1.59	0.98		2.79	0.62	
Control Delay	40.9	36.6		27.2	72.7		304.4	70.7		835.3	44.2	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	40.9	36.6		27.2	72.7		304.4	70.7		835.3	44.2	
Queue Length 50th (m)	2.3	131.3		10.6	~273.1		~134.1	126.2		~240.3	69.3	
Queue Length 95th (m)	9.0	157.0		18.8	#312.0		#196.7	#167.9		#306.5	87.7	
Internal Link Dist (m)		240.5			84.0			354.2			1159.5	
Turn Bay Length (m)	75.0			85.0			100.0			70.0		
Base Capacity (vph)	54	1553		170	1812		311	1020		217	1010	
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	0.78		0.54	1.06		1.59	0.98		2.79	0.62	

Intersection Summary
Cycle Length: 135
Actuated Cycle Length: 135
Natural Cycle: 135
Control Type: Semi Act-Uncoord
~ 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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	2>	0	1	2>	0	1	2>	0	1	2>	0
Traffic Volume (vph)	15	1104	111	91	1653	275	493	775	228	605	567	59
Future Volume (vph)	15	1104	111	91	1653	275	493	775	228	605	567	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		3.0	6.0		3.0	6.0		3.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.99		1.00	0.98		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1738	3542		1789	3527		1825	3464		1772	3478	
Flt Permitted	0.07	1.00		0.09	1.00		0.25	1.00		0.10	1.00	
Satd. Flow (perm)	124	3542		162	3527		480	3464		191	3478	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	1104	111	91	1653	275	493	775	228	605	567	59
RTOR Reduction (vph)	0	6	0	0	10	0	0	20	0	0	6	0
Lane Group Flow (vph)	15	1209	0	91	1918	0	493	983	0	605	620	0
Heavy Vehicles (%)	5%	1%	8%	2%	1%	3%	0%	2%	1%	3%	1%	27%
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	59.0	59.0		69.0	69.0		51.0	39.0		51.0	39.0	
Effective Green, g (s)	59.0	59.0		69.0	69.0		51.0	39.0		51.0	39.0	
Actuated g/C Ratio	0.44	0.44		0.51	0.51		0.38	0.29		0.38	0.29	
Clearance Time (s)	6.0	6.0		3.0	6.0		3.0	6.0		3.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	54	1547		167	1802		300	1000		212	1004	
v/s Ratio Prot		0.34		0.03	c0.54		0.15	0.28		c0.25	0.18	
v/s Ratio Perm	0.12			0.25			0.47			c0.82		
v/c Ratio	0.28	0.78		0.54	1.06		1.64	0.98		2.85	0.62	
Uniform Delay, d1	24.3	32.5		24.1	33.0		37.7	47.7		37.3	41.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.8	3.1		6.3	40.8		304.1	24.4		847.1	1.6	
Delay (s)	30.1	35.6		30.3	73.8		341.8	72.1		884.4	43.2	
Level of Service	C	D		C	E		F	E		F	D	
Approach Delay (s)		35.5			71.8			161.0			456.6	
Approach LOS		D			E			F			F	

Intersection Summary

HCM 2000 Control Delay	165.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.87		
Actuated Cycle Length (s)	135.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	141.7%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3	1	1	3	1	1	1	1	1	1	1
Traffic Volume (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
Future Volume (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
Lane Group Flow (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		8
Detector Phase	2	2	2	1	6	6	7	4	4	8	8	8
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	5.0	12.0	12.0	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	33.5	33.5	33.5	9.5	33.5	33.5	9.5	37.5	37.5	37.5	37.5	37.5
Total Split (s)	76.0	76.0	76.0	9.5	85.0	85.0	9.5	50.0	50.0	41.0	41.0	41.0
Total Split (%)	55.9%	55.9%	55.9%	7.0%	62.5%	62.5%	7.0%	36.8%	36.8%	30.1%	30.1%	30.1%
Yellow Time (s)	3.5	3.5	3.5	3.5	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	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	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	4.5	4.5	4.5	4.5
Lead/Lag	Lag	Lag	Lag	Lead			Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes			Yes	Yes	Yes
Recall Mode	Min	Min	Min	None	Min	Min	None	None	None	None	None	None
v/c Ratio	0.20	0.58	0.18	0.07	0.51	0.04	1.11	0.07	0.05	0.62	0.22	0.25
Control Delay	20.9	19.1	4.0	12.7	15.2	2.6	102.5	18.7	4.2	36.3	26.5	12.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.9	19.1	4.0	12.7	15.2	2.6	102.5	18.7	4.2	36.3	26.5	12.1
Queue Length 50th (m)	2.3	38.6	0.0	1.0	38.2	0.0	~60.4	4.1	0.0	23.3	10.3	3.4
Queue Length 95th (m)	10.9	80.9	9.9	4.7	66.9	3.1	#196.0	14.9	3.9	60.8	29.3	18.1
Internal Link Dist (m)		258.4			1347.6			470.1			409.0	
Turn Bay Length (m)	180.0		280.0	225.0		225.0	210.0		110.0	215.0		130.0
Base Capacity (vph)	316	4182	1357	216	4611	1454	488	1194	949	638	911	809
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.29	0.10	0.07	0.27	0.02	1.11	0.05	0.04	0.34	0.12	0.15

Intersection Summary
Cycle Length: 136
Actuated Cycle Length: 80.2
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
~ 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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3	1	1	3	1	1	1	1	1	1	1
Traffic Volume (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
Future Volume (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	4812	1541	1738	5092	1601	1807	1921	1498	1706	1847	1555
Flt Permitted	0.20	1.00	1.00	0.13	1.00	1.00	0.57	1.00	1.00	0.72	1.00	1.00
Satd. Flow (perm)	364	4812	1541	241	5092	1601	1087	1921	1498	1292	1847	1555
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	32	1222	135	16	1231	35	544	57	34	220	110	122
RTOR Reduction (vph)	0	0	77	0	0	18	0	0	21	0	0	61
Lane Group Flow (vph)	32	1222	58	16	1231	17	544	57	13	220	110	61
Heavy Vehicles (%)	3%	9%	6%	5%	3%	2%	1%	0%	9%	7%	4%	5%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		8
Actuated Green, G (s)	35.2	35.2	35.2	41.2	41.2	41.2	32.4	32.4	32.4	22.5	22.5	22.5
Effective Green, g (s)	35.2	35.2	35.2	41.2	41.2	41.2	32.4	32.4	32.4	22.5	22.5	22.5
Actuated g/C Ratio	0.43	0.43	0.43	0.50	0.50	0.50	0.39	0.39	0.39	0.27	0.27	0.27
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	155	2050	656	147	2539	798	473	753	587	351	503	423
v/s Ratio Prot		c0.25		0.00	c0.24		c0.08	0.03			0.06	
v/s Ratio Perm	0.09		0.04	0.05		0.01	c0.38		0.01	0.17		0.04
v/c Ratio	0.21	0.60	0.09	0.11	0.48	0.02	1.15	0.08	0.02	0.63	0.22	0.14
Uniform Delay, d1	14.9	18.2	14.1	12.0	13.7	10.5	25.4	15.7	15.4	26.4	23.2	22.8
Progression 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
Incremental Delay, d2	1.4	0.7	0.1	0.7	0.3	0.0	89.5	0.1	0.0	4.9	0.5	0.3
Delay (s)	16.3	18.9	14.2	12.7	14.0	10.5	115.0	15.8	15.4	31.3	23.7	23.1
Level of Service	B	B	B	B	B	B	F	B	B	C	C	C
Approach Delay (s)		18.4			13.9			100.7			27.2	
Approach LOS		B			B			F			C	

Intersection Summary			
HCM 2000 Control Delay	31.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	82.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes				0		1		0	1	1	0	
Traffic Volume (veh/h)				0		635		0	510	261	0	
Future Volume (Veh/h)				0		635		0	510	261	0	
Sign Control				Stop				Free			Free	
Grade				0%				0%			0%	
Peak Hour Factor				1.00		1.00		1.00	1.00	1.00	1.00	
Hourly flow rate (vph)				0		635		0	510	261	0	
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				522		0				510		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol				522		0				510		
tC, single (s)				6.4		6.2				4.1		
tC, 2 stage (s)												
tF (s)				3.5		3.3				2.2		
p0 queue free %				100		42				75		
cM capacity (veh/h)				389		1091				1055		

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	635	510	261
Volume Left	0	0	261
Volume Right	635	510	0
cSH	1091	1700	1055
Volume to Capacity	0.58	0.30	0.25
Queue Length 95th (m)	27.4	0.0	6.8
Control Delay (s)	12.8	0.0	9.5
Lane LOS	B		A
Approach Delay (s)	12.8	0.0	9.5
Approach LOS	B		

Intersection Summary
Average Delay 7.5
Intersection Capacity Utilization 52.7% ICU Level of Service
A
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
106: Heart Lake Road & 410 SB Exit 05/03/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes				1		1		1	0	0	0	
Traffic Volume (veh/h)				300		60		432	0	0	0	
Future Volume (Veh/h)				300		60		432	0	0	0	
Sign Control				Stop				Free			Free	
Grade				0%				0%			0%	
Peak Hour Factor				1.00		1.00		1.00	1.00	1.00	1.00	
Hourly flow rate (vph)				300		60		432	0	0	0	
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								243				
pX, platoon unblocked				0.95		0.95				0.95		
vC, conflicting volume				432		432				432		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol				376		376				376		
tC, single (s)				6.4		6.2				4.1		
tC, 2 stage (s)												
tF (s)				3.5		3.3				2.2		
p0 queue free %				50		91				100		
cM capacity (veh/h)				594		637				1134		

Direction, Lane #	WB 1	WB 2	NB 1
Volume Total	300	60	432
Volume Left	300	0	0
Volume Right	0	60	0
cSH	594	637	1700
Volume to Capacity	0.50	0.09	0.25
Queue Length 95th (m)	19.9	2.2	0.0
Control Delay (s)	17.1	11.2	0.0
Lane LOS	C	B	
Approach Delay (s)	16.1		0.0
Approach LOS	C		

Intersection Summary			
Average Delay	7.3		
Intersection Capacity Utilization		46.0%	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	1	3>	0	1	2	1	1	1	1	1	1	1
Traffic Volume (vph)	148	1570	67	156	2205	164	80	121	110	138	65	97
Future Volume (vph)	148	1570	67	156	2205	164	80	121	110	138	65	97
Lane Group Flow (vph)	148	1637	0	156	2205	164	80	121	110	138	65	97
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6		6	4		4	8		8
Detector Phase	5	2		1	6	6	7	4	4	3	8	8
Switch Phase												
Minimum Initial (s)	5.0	40.0		5.0	40.0	40.0	5.0	8.0	8.0	5.0	8.0	8.0
Minimum Split (s)	8.0	46.0		8.0	46.0	46.0	8.0	50.0	50.0	8.0	50.0	50.0
Total Split (s)	10.0	64.0		10.0	64.0	64.0	10.0	51.0	51.0	10.0	51.0	51.0
Total Split (%)	7.4%	47.4%		7.4%	47.4%	47.4%	7.4%	37.8%	37.8%	7.4%	37.8%	37.8%
Yellow Time (s)	3.0	4.0		3.0	4.0	4.0	3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	0.0	2.0		0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.0		3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Max		None	Max	Max	None	None	None	None	None	None
v/c Ratio	0.75	0.58		0.68	1.10	0.18	0.24	0.48	0.36	0.42	0.23	0.30
Control Delay	42.2	16.6		26.7	78.6	6.8	31.6	48.7	11.3	35.4	42.6	10.9
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.2	16.6		26.7	78.6	6.8	31.6	48.7	11.3	35.4	42.6	10.9
Queue Length 50th (m)	11.8	69.7		9.2	~248.2	6.9	11.6	21.4	0.0	20.6	11.1	0.0
Queue Length 95th (m)	#43.0	90.1		#33.4	#305.8	17.3	22.6	37.5	13.6	35.3	22.5	12.8
Internal Link Dist (m)		149.1			637.0			433.6			218.7	
Turn Bay Length (m)	150.0			190.0					85.0	200.0		150.0
Base Capacity (vph)	197	2826		231	2001	922	328	807	729	325	791	728
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.58		0.68	1.10	0.18	0.24	0.15	0.15	0.42	0.08	0.13

Intersection Summary
Cycle Length: 135
Actuated Cycle Length: 104.8
Natural Cycle: 145
Control Type: Semi Act-Uncoord
~ 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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3>	0	1	2	1	1	1	1	1	1	1
Traffic Volume (vph)	148	1570	67	156	2205	164	80	121	110	138	65	97
Future Volume (vph)	148	1570	67	156	2205	164	80	121	110	138	65	97
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1807	5098		1825	3614	1601	1690	1921	1585	1807	1883	1601
Flt Permitted	0.07	1.00		0.10	1.00	1.00	0.71	1.00	1.00	0.61	1.00	1.00
Satd. Flow (perm)	131	5098		187	3614	1601	1271	1921	1585	1169	1883	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	148	1570	67	156	2205	164	80	121	110	138	65	97
RTOR Reduction (vph)	0	3	0	0	0	36	0	0	95	0	0	82
Lane Group Flow (vph)	148	1634	0	156	2205	128	80	121	15	138	65	15
Heavy Vehicles (%)	1%	2%	8%	0%	1%	2%	8%	0%	3%	1%	2%	2%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6		6	4		4	8		8
Actuated Green, G (s)	65.0	58.0		65.0	58.0	58.0	19.8	14.3	14.3	22.8	15.8	15.8
Effective Green, g (s)	65.0	58.0		65.0	58.0	58.0	19.8	14.3	14.3	22.8	15.8	15.8
Actuated g/C Ratio	0.62	0.55		0.62	0.55	0.55	0.19	0.14	0.14	0.22	0.15	0.15
Clearance Time (s)	3.0	6.0		3.0	6.0	6.0	3.0	7.0	7.0	3.0	7.0	7.0
Vehicle Extension (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	192	2808		224	1990	881	260	260	215	295	282	240
v/s Ratio Prot	c0.05	0.32		0.05	c0.61		0.02	0.06		c0.03	0.03	
v/s Ratio Perm	0.42			0.38		0.08	0.04		0.01	c0.07		0.01
v/c Ratio	0.77	0.58		0.70	1.11	0.14	0.31	0.47	0.07	0.47	0.23	0.06
Uniform Delay, d1	26.2	15.6		11.9	23.6	11.5	36.4	42.0	39.7	35.0	39.4	38.4
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	19.8	0.9		11.4	56.6	0.3	1.4	2.7	0.3	2.4	0.9	0.2
Delay (s)	46.0	16.5		23.3	80.2	11.9	37.8	44.7	40.0	37.4	40.3	38.6
Level of Service	D	B		C	F	B	D	D	D	D	D	D
Approach Delay (s)		19.0			72.3			41.3			38.4	
Approach LOS		B			E			D			D	

Intersection Summary

HCM 2000 Control Delay	48.9	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio		0.93		
Actuated Cycle Length (s)	105.3	Sum of lost time (s)	19.0	
Intersection Capacity Utilization		101.0% ICU Level of Service		G
Analysis Period (min)	15			

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3	1	1	3>	0	1	1	1	1	1	1
Traffic Volume (vph)	309	905	110	96	2049	15	603	583	194	40	125	558
Future Volume (vph)	309	905	110	96	2049	15	603	583	194	40	125	558
Lane Group Flow (vph)	309	905	110	96	2064	0	603	583	194	40	125	558
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			4			8	
Permitted Phases	2		2	6			4		4	8		8
Detector Phase	5	2	2	1	6		4	4	4	8	8	8
Switch Phase												
Minimum Initial (s)	5.0	44.9	44.9	5.0	44.9		12.0	12.0	12.0	12.0	12.0	12.0
Minimum Split (s)	8.0	51.8	51.8	8.0	51.8		47.9	47.9	47.9	47.9	47.9	47.9
Total Split (s)	10.0	56.0	56.0	10.0	56.0		54.8	54.8	54.8	54.8	54.8	54.8
Total Split (%)	8.3%	46.4%	46.4%	8.3%	46.4%		45.4%	45.4%	45.4%	45.4%	45.4%	45.4%
Yellow Time (s)	3.0	4.6	4.6	3.0	4.6		4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	0.0	2.3	2.3	0.0	2.3		2.3	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	0.0	0.0
Total Lost Time (s)	3.0	6.9	6.9	3.0	6.9		6.9	6.9	6.9	6.9	6.9	6.9
Lead/Lag	Lead	Lag	Lag	Lead	Lag							
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes							
Recall Mode	None	Max	Max	None	Max		None	None	None	None	None	None
v/c Ratio	1.80	0.46	0.15	0.31	1.04		1.21	0.77	0.26	0.33	0.17	0.82
Control Delay	402.4	27.2	4.6	17.5	66.0		144.0	39.6	4.9	34.5	24.4	35.5
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	402.4	27.2	4.6	17.5	66.0		144.0	39.6	4.9	34.5	24.4	35.5
Queue Length 50th (m)	~86.5	52.1	0.0	10.2	~178.0		~160.2	108.9	1.3	6.0	17.4	84.3
Queue Length 95th (m)	#137.8	63.4	9.9	18.5	#205.3		#223.4	149.9	14.4	15.7	29.7	#135.4
Internal Link Dist (m)		1347.6			595.2			1218.9			363.8	
Turn Bay Length (m)	240.0		150.0	230.0			210.0		125.0	175.0		220.0
Base Capacity (vph)	172	1955	722	306	1990		500	761	733	123	732	682
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	1.80	0.46	0.15	0.31	1.04		1.21	0.77	0.26	0.33	0.17	0.82

Intersection Summary
Cycle Length: 120.8
Actuated Cycle Length: 120.8
Natural Cycle: 120
Control Type: Semi Act-Uncoord
~ 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.

HCM Signalized Intersection Capacity Analysis
108: Dixie Road & Mayfield Road 05/03/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3	1	1	3>	0	1	1	1	1	1	1
Traffic Volume (vph)	309	905	110	96	2049	15	603	583	194	40	125	558
Future Volume (vph)	309	905	110	96	2049	15	603	583	194	40	125	558
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.9	6.9	3.0	6.9		6.9	6.9	6.9	6.9	6.9	6.9
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1807	4812	1617	1789	4894		1772	1921	1570	1601	1847	1512
Flt Permitted	0.08	1.00	1.00	0.25	1.00		0.68	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	155	4812	1617	462	4894		1262	1921	1570	311	1847	1512
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	309	905	110	96	2049	15	603	583	194	40	125	558
RTOR Reduction (vph)	0	0	65	0	1	0	0	0	111	0	0	83
Lane Group Flow (vph)	309	905	45	96	2063	0	603	583	83	40	125	475
Heavy Vehicles (%)	1%	9%	1%	2%	7%	13%	3%	0%	4%	14%	4%	8%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			4			8	
Permitted Phases	2		2	6			4		4	8		8
Actuated Green, G (s)	56.1	49.1	49.1	56.1	49.1		47.9	47.9	47.9	47.9	47.9	47.9
Effective Green, g (s)	56.1	49.1	49.1	56.1	49.1		47.9	47.9	47.9	47.9	47.9	47.9
Actuated g/C Ratio	0.46	0.41	0.41	0.46	0.41		0.40	0.40	0.40	0.40	0.40	0.40
Clearance Time (s)	3.0	6.9	6.9	3.0	6.9		6.9	6.9	6.9	6.9	6.9	6.9
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	167	1955	657	291	1989		500	761	622	123	732	599
v/s Ratio Prot	c0.11	0.19		0.02	0.42			0.30			0.07	
v/s Ratio Perm	c0.75		0.03	0.13			c0.48		0.05	0.13		0.31
v/c Ratio	1.85	0.46	0.07	0.33	1.04		1.21	0.77	0.13	0.33	0.17	0.79
Uniform Delay, d1	30.4	26.2	21.9	18.7	35.8		36.4	31.6	23.2	25.3	23.6	32.1
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	404.8	0.8	0.2	1.4	30.6		110.4	5.5	0.2	3.2	0.2	8.2
Delay (s)	435.2	27.0	22.1	20.1	66.5		146.8	37.0	23.4	28.5	23.8	40.3
Level of Service	F	C	C	C	E		F	D	C	C	C	D
Approach Delay (s)		121.9			64.4			83.1			36.8	
Approach LOS		F			E			F			D	

Intersection Summary			
HCM 2000 Control Delay	79.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.55		
Actuated Cycle Length (s)	120.8	Sum of lost time (s)	16.8
Intersection Capacity Utilization	125.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	2	1	1	2	1	1	1	1	1	1>	0
Traffic Volume (vph)	18	164	49	94	356	109	103	574	133	58	421	43
Future Volume (vph)	18	164	49	94	356	109	103	574	133	58	421	43
Lane Group Flow (vph)	18	164	49	94	356	109	103	574	133	58	464	0
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		
Detector Phase	2	2	2	2	2	2	1	1	1	1	1	
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	36.6	36.6	36.6	36.6	36.6	
Minimum Split (s)	35.2	35.2	35.2	35.2	35.2	35.2	43.2	43.2	43.2	43.2	43.2	
Total Split (s)	35.2	35.2	35.2	35.2	35.2	35.2	53.6	53.6	53.6	53.6	53.6	
Total Split (%)	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%	60.4%	60.4%	60.4%	60.4%	60.4%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.2	4.2	4.2	4.2	4.2	
All-Red Time (s)	3.2	3.2	3.2	3.2	3.2	3.2	2.4	2.4	2.4	2.4	2.4	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	6.6	6.6	6.6	
Lead/Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lead	Lead	Lead	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	None	None	None	None	None	Max	Max	Max	Max	Max	
v/c Ratio	0.08	0.20	0.13	0.35	0.43	0.24	0.20	0.52	0.14	0.14	0.42	
Control Delay	23.5	24.5	7.9	28.8	27.4	6.4	10.0	12.5	2.3	9.7	10.9	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	23.5	24.5	7.9	28.8	27.4	6.4	10.0	12.5	2.3	9.7	10.9	
Queue Length 50th (m)	2.0	9.6	0.0	10.9	22.1	0.0	5.7	40.7	0.0	3.1	29.6	
Queue Length 95th (m)	6.4	16.2	6.9	22.1	32.4	10.0	16.6	84.6	7.0	10.3	63.1	
Internal Link Dist (m)		1345.4			805.1			1436.4			1218.9	
Turn Bay Length (m)	150.0		140.0	120.0		150.0	190.0			150.0		
Base Capacity (vph)	366	1297	553	417	1285	637	515	1112	939	424	1103	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.05	0.13	0.09	0.23	0.28	0.17	0.20	0.52	0.14	0.14	0.42	

Intersection Summary
Cycle Length: 88.8
Actuated Cycle Length: 79.1
Natural Cycle: 80
Control Type: Semi Act-Uncoord

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	2	1	1	2	1	1	1	1	1	1>	0
Traffic Volume (vph)	18	164	49	94	356	109	103	574	133	58	421	43
Future Volume (vph)	18	164	49	94	356	109	103	574	133	58	421	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	6.6	6.6	6.6	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.96	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1822	3650	1475	1728	3614	1596	1825	1865	1484	1825	1844	
Flt Permitted	0.54	1.00	1.00	0.65	1.00	1.00	0.45	1.00	1.00	0.37	1.00	
Satd. Flow (perm)	1033	3650	1475	1179	3614	1596	864	1865	1484	710	1844	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	164	49	94	356	109	103	574	133	58	421	43
RTOR Reduction (vph)	0	0	38	0	0	84	0	0	54	0	4	0
Lane Group Flow (vph)	18	164	11	94	356	25	103	574	79	58	460	0
Confl. Peds. (#/hr)	2		37	37		2						
Heavy Vehicles (%)	0%	0%	6%	3%	1%	0%	0%	3%	10%	0%	3%	0%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		
Actuated Green, G (s)	18.0	18.0	18.0	18.0	18.0	18.0	47.2	47.2	47.2	47.2	47.2	
Effective Green, g (s)	18.0	18.0	18.0	18.0	18.0	18.0	47.2	47.2	47.2	47.2	47.2	
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23	0.23	0.60	0.60	0.60	0.60	0.60	
Clearance Time (s)	7.2	7.2	7.2	7.2	7.2	7.2	6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lane Grp Cap (vph)	235	831	336	268	823	363	516	1114	886	424	1101	
v/s Ratio Prot		0.04			c0.10			c0.31			0.25	
v/s Ratio Perm	0.02		0.01	0.08		0.02	0.12		0.05	0.08		
v/c Ratio	0.08	0.20	0.03	0.35	0.43	0.07	0.20	0.52	0.09	0.14	0.42	
Uniform Delay, d1	24.0	24.7	23.7	25.6	26.1	23.9	7.3	9.2	6.8	7.0	8.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	0.2	0.1	1.7	0.8	0.2	0.9	1.7	0.2	0.7	1.2	
Delay (s)	24.3	24.9	23.8	27.3	26.9	24.1	8.1	11.0	7.0	7.6	9.7	
Level of Service	C	C	C	C	C	C	A	B	A	A	A	
Approach Delay (s)		24.6			26.4			9.9			9.5	
Approach LOS		C			C			A			A	

Intersection Summary

HCM 2000 Control Delay	15.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.49	
Actuated Cycle Length (s)	79.0	Sum of lost time (s)	13.8
Intersection Capacity Utilization		113.4% ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3>	0	1	3>	0	1	2	1	1	2	1
Traffic Volume (vph)	338	1256	114	170	2854	107	353	855	299	80	584	664
Future Volume (vph)	338	1256	114	170	2854	107	353	855	299	80	584	664
Lane Group Flow (vph)	338	1370	0	170	2961	0	353	855	299	80	584	664
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8		7	4		1	6			2	
Permitted Phases	8			4			6		6	2		2
Detector Phase	3	8		7	4		1	6	6	2	2	2
Switch Phase												
Minimum Initial (s)	5.0	39.7		5.0	39.7		5.0	39.0	39.0	39.0	39.0	39.0
Minimum Split (s)	8.0	47.4		8.0	47.4		8.0	46.0	46.0	46.0	46.0	46.0
Total Split (s)	12.0	54.0		18.0	60.0		15.0	63.0	63.0	48.0	48.0	48.0
Total Split (%)	8.9%	40.0%		13.3%	44.4%		11.1%	46.7%	46.7%	35.6%	35.6%	35.6%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	0.0	3.7		0.0	3.7		0.0	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	7.7		3.0	7.7		3.0	7.0	7.0	7.0	7.0	7.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes			Yes	Yes	Yes
Recall Mode	None	Max		None	Max		None	None	None	None	None	None
v/c Ratio	1.87	0.76		0.70	1.48		1.02	0.58	0.38	0.47	0.54	1.14
Control Delay	436.1	42.0		42.2	250.0		85.4	32.3	8.2	49.1	41.5	116.9
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	436.1	42.0		42.2	250.0		85.4	32.3	8.2	49.1	41.5	116.9
Queue Length 50th (m)	~112.0	109.4		24.2	~368.1		~61.0	83.8	10.4	16.0	62.9	~162.5
Queue Length 95th (m)	#167.5	126.4		46.9	#390.9		#121.0	102.6	29.4	31.9	79.9	#230.3
Internal Link Dist (m)		672.7			108.6			503.1			1436.4	
Turn Bay Length (m)	150.0			130.0			125.0		125.0	120.0		120.0
Base Capacity (vph)	181	1793		260	2003		345	1484	779	170	1076	580
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	0
Reduced v/c Ratio	1.87	0.76		0.65	1.48		1.02	0.58	0.38	0.47	0.54	1.14

Intersection Summary
Cycle Length: 135
Actuated Cycle Length: 135
Natural Cycle: 150
Control Type: Semi Act-Uncoord
~ 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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	3>	0	1	3>	0	1	2	1	1	2	1
Traffic Volume (vph)	338	1256	114	170	2854	107	353	855	299	80	584	664
Future Volume (vph)	338	1256	114	170	2854	107	353	855	299	80	584	664
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	7.7		3.0	7.7		3.0	7.0	7.0	7.0	7.0	7.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.95	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.99	1.00	1.00
Frt	1.00	0.99		1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1807	5059		1807	5161		1803	3579	1557	1807	3544	1555
Flt Permitted	0.08	1.00		0.08	1.00		0.28	1.00	1.00	0.30	1.00	1.00
Satd. Flow (perm)	160	5059		150	5161		534	3579	1557	563	3544	1555
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	338	1256	114	170	2854	107	353	855	299	80	584	664
RTOR Reduction (vph)	0	8	0	0	3	0	0	0	134	0	0	109
Lane Group Flow (vph)	338	1362	0	170	2958	0	353	855	165	80	584	555
Confl. Peds. (#/hr)	14		25	25		14	21		28	28		21
Heavy Vehicles (%)	1%	2%	2%	1%	1%	0%	1%	2%	0%	0%	3%	1%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8		7	4		1	6			2	
Permitted Phases	8			4			6		6	2		2
Actuated Green, G (s)	56.6	47.6		64.3	52.3		56.0	56.0	56.0	41.0	41.0	41.0
Effective Green, g (s)	56.6	47.6		64.3	52.3		56.0	56.0	56.0	41.0	41.0	41.0
Actuated g/C Ratio	0.42	0.35		0.48	0.39		0.41	0.41	0.41	0.30	0.30	0.30
Clearance Time (s)	3.0	7.7		3.0	7.7		3.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	176	1783		239	1999		334	1484	645	170	1076	472
v/s Ratio Prot	c0.13	0.27		0.07	c0.57		c0.09	0.24			0.16	
v/s Ratio Perm	c0.67			0.27			0.34		0.11	0.14		c0.36
v/c Ratio	1.92	0.76		0.71	1.48		1.06	0.58	0.26	0.47	0.54	1.18
Uniform Delay, d1	35.8	38.7		29.7	41.4		36.1	30.4	25.9	38.2	39.2	47.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	434.5	3.2		11.7	218.6		65.0	0.9	0.4	4.3	1.0	99.7
Delay (s)	470.3	41.9		41.5	260.0		101.1	31.2	26.3	42.4	40.2	146.7
Level of Service	F	D		D	F		F	C	C	D	D	F
Approach Delay (s)		126.7			248.1			46.6			93.6	
Approach LOS		F			F			D			F	

Intersection Summary			
HCM 2000 Control Delay	154.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.51		
Actuated Cycle Length (s)	135.0	Sum of lost time (s)	20.7
Intersection Capacity Utilization	162.7%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
111: Heart Lake Road & Heart Lake Conservation Area 05/03/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes	1		0				0	<1			0	0
Traffic Volume (veh/h)	128		0				110	382			0	0
Future Volume (Veh/h)	128		0				110	382			0	0
Sign Control	Stop							Free			Free	
Grade	0%							0%			0%	
Peak Hour Factor	1.00		1.00				1.00	1.00			1.00	1.00
Hourly flow rate (vph)	128		0				110	382			0	0
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	602		0				0					
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	602		0				0					
tC, single (s)	6.4		6.2				4.1					
tC, 2 stage (s)												
tF (s)	3.5		3.3				2.2					
p0 queue free %	71		100				93					
cM capacity (veh/h)	435		1091				1636					

Direction, Lane #	EB 1	NB 1
Volume Total	128	492
Volume Left	128	110
Volume Right	0	0
cSH	435	1636
Volume to Capacity	0.29	0.07
Queue Length 95th (m)	8.5	1.5
Control Delay (s)	16.7	2.1
Lane LOS	C	A
Approach Delay (s)	16.7	2.1
Approach LOS	C	

Intersection Summary
Average Delay 5.1
Intersection Capacity Utilization 39.9% ICU Level of Service A
Analysis Period (min) 15

APPENDIX E

Sandalwood Intersection/Safety Review

I4-1

BRAMPTON
Flower City
brampton.ca

Report
Committee of Council
Committee of the Council of
The Corporation of the City of Brampton

COMMITTEE OF COUNCIL
DATE: May 14, 2014

Date: April 28, 2014

File: T35 SAFE

Subject: **In-Service Safety Review – Various Signalized Intersections (Wards 1, 2, 3, 7, 9 and 10)**

Contact: Nelson Cadete, Traffic Operations Supervisor, Traffic Engineering Services, Maintenance and Operations, 905-874-2552

Overview:

- **Planning and Infrastructure Services staff identified the need to conduct intersection safety reviews at the following signalized intersections:**
  - **Queen Street East and Chapel Street/Theatre Lane (Wards 1 and 3);**
  - **Heart Lake Road and Sandalwood Parkway (Wards 2 and 9);**
  - **MacKay Street South and North Park Drive (Ward 7); and,**
  - **Peter Robertson Boulevard and Torbram Road (Wards 9 and 10).**
- **Giffin Koerth Incorporated was retained to conduct the safety reviews at the four subject signalized intersections. Safety reviews are conducted to examine the safety performance of an intersection, identify engineering-related factors leading to an increased collision risk and to recommend solutions to these problems.**
- **Within this report, several countermeasures are identified and grouped by short term, medium term and long term actions.**
- **This report summarizes these initiatives and provides an update on the implementation of these measures.**

Recommendations:

1. **THAT** the report from Nelson Cadete, Traffic Operations Supervisor, Maintenance and Operations Division, dated April 28, 2014, to the Committee of Council Meeting of May 14, 2014, re: **In-Service Safety Review – Various Signalized Intersections** be received; and,

2. **THAT** staff implement the collision reduction measures outlined within this report.

Background:

Planning and Infrastructure Services staff has identified the following signalized intersections that have experienced more than expected number of collisions when compared to other similar intersections within the City:

- Queen Street East and Chapel Street/Theatre Lane (Wards 1 and 3);
- Heart Lake Road and Sandalwood Parkway (Wards 2 and 9);
- MacKay Street South and North Park Drive (Ward 7); and,
- Peter Robertson Boulevard and Torbram Road (Wards 9 and 10).

These intersections were identified by comparing collision statistics at similar intersections throughout the city to develop a number of collisions that can be expected to occur for each of the following classifications and then comparing the actual collision totals to the expected values.

A safety review was conducted at the four subject intersections by an independent Transportation Engineering Consultant.

Current Situation:

The objectives of intersection safety reviews are to examine the safety performance of an intersection, to identify engineering-related factors leading to an increased collision risk and to recommend solutions to these problems. Giffin Koerth Incorporated was retained to conduct the safety reviews at the four subject signalized intersections.

The following table (**Table 1: Dominant Collision Trends and Contributing Factors**) summarizes safety-related characteristics identified during the study that are contributing to a specific collision pattern and key in the development of appropriate corrective measures:

Table 1: Dominant Collision Trends and Contributing Factors

Int.	Dominant Collision Trends	Contributing Factors
Queen Street East /Chapel Street/Theatre Lane	Westbound rear end collisions	• Significant difference in operating speed along Queen Street, east and west of the intersection. This is attributed to the subject intersection being the first for westbound traffic where the cross-section does not include exclusive turn lanes and where on-street parking is introduced. • The westbound shared left turn/through lane and on-street parking west of the intersection require westbound drivers to weave at the approach to the intersection and then again after the intersection. • The size and location of the "Rose Theatre Brampton" guide sign provides little advance warning. • Municipal parking information signs are non-standard and provide too much information (i.e. pricing) and may be taking driver's attention away from the aforementioned challenges at the intersection. • The standard street name sign blades may not be providing sufficient advance notice for the prevailing operating speeds.
Heart Lake Road and Sandalwood Parkway	Eastbound rear end collisions	• The vertical alignment of Sandalwood Parkway through the intersection limits the forward visibility for eastbound traffic reacting to a downstream queue of slowing vehicles turning into the fuel station (southeast corner) and the subsequent Highway 410 on ramp.
	Westbound left turning traffic and opposing eastbound through traffic	• Westbound left turning vehicles may be misled into assuming that the eastbound curb lane is a dedicated right turn lane that leads into the channelized right turn. The eastbound curb lane accommodates both right tuning and through traffic, however a right turn channel island remains in place from the previous intersection configuration (prior to the extension of Sandalwood Parkway). • The view of approaching vehicles in the curb lane from the westbound left turn lane may be occluded by eastbound vehicles in Lanes 1 and 2. The east-west vertical alignment through the intersection exacerbates these sight line issues. • Faster moving vehicles in the eastbound curb lane may surprise westbound left turn vehicles that are tracking and selecting a gap in slower moving vehicles in Lane 1 and 2. • The development of the third lane approximately 100 m west of the intersection allows these speed differentials during the off peak periods.

Table 1: Dominant Collision Trends and Contributing Factors (continued)

Int.	Dominant Collision Trends	Contributing Factors
MacKay St. S./ North Park Dr.	No dominant collision trend identified.	Not applicable.
Peter Robertson Blvd./ Torbram Rd.	Right angle and left turn opposing collisions in all directions.	▪ The westbound advance street name sign is not present for the westbound approach. ▪ For the east/west approaches to the intersection, there is a significant variation in the length of traffic signal green time when a pedestrian pushes the push button versus times when it is not pushed. This variation in green time may be leading to an expectancy violation for frequent users of the intersection.

The safety review also identified a number of potential hazards that may not be contributing to a specific collision concern however are deficiencies in safety, operations and positive guidance at the subject intersections. **Table 2: Potential Hazards** below provides a summary of the potential hazards at each location:

Table 2: Potential Hazards

Intersection	Potential Hazard
Queen Street East and Chapel Street/Theatre Lane	• No orientation channels (for visually impaired) provided at the intersection. ▪ Damaged pedestrian button information placards. • Pedestrian toe trip hazards were identified on the south west corner associated with paving stones that had settled at a different elevation that the surrounding concrete.
Heart Lake Road and Sandalwood Parkway	• Pedestrian curb ramp and orientation channels on the southeast corner, do not direct pedestrian to available east-west crosswalk • No orientation channels (for visually impaired) provided on the northwest corner for north-south crossing and northeast corner for the east/west crossing. • Damaged pedestrian button information placards. • Improper use of CHEVRON ALIGMENT signs to designate a lane drop. These signs are intended to designate sharp curves or turns.

Table 2: Potential Hazards (continued)

Intersection	Potential Hazard
MacKay Street South and North Park Drive	• No orientation channels (for visually impaired) provided on the southwest corner for east-west crossing • No orientation channels (for visually impaired) provided on the northeast corner for either crossing • Damaged pedestrian button information placards • As you approach the intersection, the visibility of the southbound signal heads are impeded by mature tree growth on the inside cure approach to the intersection.
Peter Robertson Boulevard and Torbram Road	• There were no potential hazards identified at the intersection.

Taking into consideration the consultant's recommendations, staff recommends the following corrective measures at the subject intersections. The measures have been categorized into the following improvement strategies based on the urgency of implementation:

- **Immediate Actions** include countermeasures that should be implemented soon after the road agency is made aware of the issues. Examples include requests for speed enforcement and sight line obstructions.
- **Short-Term Actions** include relatively inexpensive countermeasures that could be implemented in the short-term, and that could be funded from operational or maintenance budgets. Examples include adding or upgrading signs, re-marking faded pavement markings, and correcting potential hazards (i.e. toe trip hazards).
- **Medium-Term Actions** include relatively more expensive countermeasures that may require design work and possibly the acquisition of right-of-way. Examples include the provision of a left-turn lane, removing major road-side obstacles, and installing a new signal.
- **Long-Term Actions** include relatively expensive countermeasures that may require long-term planning, design, and extensive public consultation. Examples include twinning a road segment, providing grade separation, or re-aligning a road.

Table 3: Recommended Countermeasures and Remedial Treatments

Collision Trend/Safety Issue		Recommended Improvements	Rationale	Time Frame
Queen Street East and Chapel Street/Theatre Lane	Westbound rear end collisions	Delineate the beginning of the westbound on-street parking on the far side of the intersection and post a westbound lane ends sign.	Provide advance warning for lane drop that occurs due to on-street parking.	Short Term
		Implement dedicated eastbound and westbound left turn lanes and a westbound right turn lane. See Figure 1 attached.	Supplement the lane drop configuration of the far side of the intersection and reduce rear end and sideswipe collisions.	Medium Term
		Request speed enforcement for westbound traffic approaching the intersection.	Increase perception-reaction times for intersection and lane drop.	Immediate Action
		Improve westbound theatre and parking related guide signs.	Reduce reading and comprehension times for westbound motorists.	Short term
	Pedestrian toe trip hazards	Address the toe trip hazard on the southwest corner.	Reduce trip and fall hazards for pedestrians	Short term
Heart Lake Road and Sandalwood Parkway	Eastbound rear end collisions	Request speed enforcement for eastbound traffic approaching the intersection.	Reduce potential for eastbound rear end collisions.	Immediate Action
		Reconstruction of intersection and/or the approaches to reduce the vertical grades.	Improve visibility through the intersection.	Long Term (20+ years)
	Westbound left turning traffic and opposing eastbound through traffic	Implement stop bar detection for westbound left turn movements.	Reduce collision potential between westbound left and eastbound through vehicles.	Short term
	Misaligned pedestrian curb ramp/crosswalk	Re-align south crosswalk to properly accommodate east/west pedestrians.	Improve guidance for visually impaired users.	Short term

Table 3: Recommended Countermeasures and Remedial Treatments (continued)

Collision Trend/Safety Issue		Recommended Improvements	Rationale	Time Frame
Heart Lake Rd. and Sandalwood Pkwy.	Improper use of CHEVRON ALIGMENT signs to designate a lane drop	Replace CHEVRON ALIGNMENT signs with white post mounted delineators.	Improve motorist comprehension of the road alignment (shift) Compliance with OTM.	Short term
Peter Robertson Blvd. and Torbram Rd.	Right angle and left turn opposing collisions in all directions.	Modify the minimum side street signal green phase to 34 seconds for a vehicle call.	Improve consistency of side street green phase under varied operating conditions	Completed
MacKay St. S. and North Park Dr.	MacKay Street South and North Park Drive - visibility of the southbound signal heads	Install southbound tertiary signal head on the southeast corner of the intersection.	Improve southbound visibility of traffic signal control presence and status on the approach to the intersection.	Completed
All Intersections	Missing orientation channels provided at the intersection	Reconstruct the surface of all pedestrian approaches to incorporate orientation channels at crosswalks.	Improve guidance for visually impaired users.	Short Term
	Damaged pedestrian button information placards.	Replace placards.	Provide positive guidance for pedestrians.	Short Term

Two of the aforementioned mitigating measures have been completed as an intersection improvement under the existing maintenance contract for the City's traffic control signals. The request for speed enforcement on Queen Street East and Sandalwood Parkway has been identified as an immediate action item.

The corrective measures identified within the "Short Term" time frame will be implemented over the course of the Spring/Summer (2014) and the date of completion will be dependent on the complexity of the improvement.

The reconstruction of Heart Lake Road and Sandalwood Parkway to eliminate the vertical grades has been identified as a "Long Term" measure. The intersection was reconstructed in 2009. There a number of topographical and property constraints in the immediate vicinity of the intersection including Highway 410, a watercourse, and established residential and commercial uses. The extent of the existing vertical grade change and potential impacts on the existing uses creates a condition, where full reconstruction costs could be well in excess of a 1 or 2 million dollars and would be a long term improvement in the order of 20+ years. For this reason, more economical and near term improvements are proposed.

At the intersection of Queen Street East and Chapel Street/Theatre Lane, staff recommends modifying the eastbound and westbound lane configuration to include exclusive left turn lanes. Figure 1 attached, illustrates the recommended improvement. The introduction of the exclusive left turn lanes will minimize the number of vehicles having to unexpectedly stop or weave at the intersection. The exclusive lanes also provide the opportunity to introduce advance left turns for eastbound and westbound traffic in the future, if required. This intersection improvement has been identified as a "Medium Term" measure as public consultation is required with downtown stakeholders.

Corporate Implications:

Financial Implications:

All costs associated to the immediate action items, the short term mitigating measures and the intersection improvements at Queen Street East and Chapel Street/Theatre Lane will be funded by the Departmental Operating Budget.

Other Implications:

The intersection improvements recommended for Queen Street East and Chapel Street/Theatre Lane will impact the number of available on-street parking along the south side of the road (an approximate loss of 3 parking spaces). Prior to implementation, staff will consult the appropriate downtown stakeholders (including Brampton Downtown Development Corporation and the Office of the Central Area).

Strategic Plan:

This report achieves the Growth Management Priority of the Strategic Plan by improving the roadway network to move people more efficiently.

I4-9

Conclusion:

The recommended mitigating measures contained within this report will improve the safety and efficiency of the subject intersections. Staff will ensure that all corrective measures are implemented within the time frames outlined above.

Nelson Cadete,
Supervisor, Traffic Operations
Roads Maintenance and Operations

J.J. Pitushka, P.Eng.,
Executive Director,
Maintenance and Operations

Appendices:

Figure 1: Improvement Alternate – Queen Street East and Chapel Street/Theatre Lane

Report authored by: Nelson Cadete, Traffic Operations Supervisor, Maintenance and Operations Division

CPISC
MB
Date 23 5 19

I4-10

CITY OF BRAMPTON

Date: January, 2014
Drawn By: K.Cadete

N.T.S.

FIGURE 1
In-Service Safety Review - Improvement Alternative
Queen Street East and Chapel Street/Theatre Lane
T35SAFE

APPENDIX F

Geotechnical Reports

Geotechnical Investigation Report

Heart Lake Road Corridor
Sandalwood Parkway to Mayfield Road
Brampton, Ontario

Prepared for:
City of Brampton
2 Wellington Street West
Brampton, ON L6Y 4R2

Prepared by:
Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo, ON N2L 0A4

Project No. 165001037

December 1, 2017

Table of Contents

1.0 INTRODUCTION **1**

2.0 SITE DESCRIPTION **1**

3.0 PROJECT DESCRIPTION **1**

4.0 BACKGROUND INFORMATION **2**

5.0 METHOD OF INVESTIGATION **2**
5.1 PREPARATORY SERVICES 2
5.2 GENERAL INVESTIGATION PROGRAM & PROCEDURES 3
5.3 GEOTECHNICAL LABORATORY TESTING PROGRAM 3

6.0 SUBSURFACE CONDITIONS **4**
6.1 OVERVIEW 4
6.2 SUMMARY 4
6.2.1 Overburden 4
6.2.2 Groundwater 7

7.0 DISCUSSION AND RECOMMENDATIONS **7**
7.1 OVERVIEW 7
7.2 ROAD EMBANKMENT FILL 8
7.3 PRELIMINARY PAVEMENT DESIGN FOR BIKE LANES 10
7.4 BIKE TRAILS AND BOARDWALK 11
7.5 WILDLIFE CROSSINGS 11
7.6 RECOMMENDATIONS FOR ADDITIONAL GEOTECHNICAL INVESTIGATION 11

8.0 CONSTRUCTION **12**
8.1 EXCAVATIONS 12
8.2 REUSE OF EXCAVATED MATERIAL 12

9.0 CLOSURE **14**

LIST OF TABLES

Table 5.1: Geotechnical Laboratory Testing Program 3
Table 6.1: Grain Size Distribution of the Sand With Silt and Gravel Fill 5
Table 6.2: Grain Size Distribution of the Clay with Sand Till 6
Table 6.3: Atterberg Limits of the Sandy Clay Till 6
Table 7.1: Preliminary Consolidation Estimates 8
Table 7.2: Overview of Light Weight Fill Options 9
Table 7.3: Recommended Pavement Structure 10

LIST OF APPENDICES

APPENDIX A Statement of General Conditions

APPENDIX B Key Plan
Borehole Location Plan

APPENDIX C Symbols and Terms Used on the Borehole Records
Stantec Borehole Records
Engtec Borehole Records

APPENDIX D Drawings from Previous Geotechnical Investigation Reports

APPENDIX E Laboratory Testing Results

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by the City of Brampton to undertake a 30% design of the Heart Lake Road Corridor Improvement between Sandalwood Parkway and Mayfield Road in Brampton, Ontario. The improvements will likely comprise construction of bike lanes adjacent to the road. Wildlife crossings may also be added.

This report presents the results of the geotechnical investigation to support 30% design at this site. The scope of the field program did not include any environmental or hydrogeological testing. Additional geotechnical investigation is recommended to support final design.

Use of this report is subject to the Statement of General Conditions provided in **Appendix A**.

2.0 SITE DESCRIPTION

The study area for the road improvements is along the Heart Lake Road Corridor between Sandalwood Parkway and Mayfield Road. For the purposes of this report descriptions will be given assuming Heart Lake Road runs in a north-south direction. A Key Plan showing the location of the site is provided in Drawing 1 in **Appendix B**.

Heart Lake Road is a two-lane asphalt paved road with gravel shoulders. The Heart Lake Road corridor is bounded by the Heart Lake Conservation area on the west, and primarily undeveloped or agricultural land on the east. There are also a few commercial or residential properties on the east side of the road. A number of low-lying marshy areas are adjacent to the road, particularly in the south-most two thirds of the area investigated. Based on a review of aerial satellite imagery low lying marshy areas encompassed approximately 50% to 60% of the land areas adjacent to Hart Lake Road within the project limits.

3.0 PROJECT DESCRIPTION

As noted in Section 1 above the project design is still in the initial stages and is at the 30% design phase. The proposed project may include the addition of bike lanes on both the east and west sides of Hart Drive, potential intersection improvements and the addition of wild life crossings.

The bike lanes will likely be constructed on the edge of the existing road embankments which will require widening in the order of 3.0 m to accommodate the new lanes. The existing embankment is approximately 1.0 m to 4.0 m higher than the surrounding grades, however the topographic elevations of the site were not available at the time of preparation of this report.

4.0 BACKGROUND INFORMATION

Geotechnical reports were prepared by Engtec Consulting Inc. (Engtec) in 2015 for proposed wildlife crossing culverts. The reports were completed under Engtec Project Number ET15-1135A, and were dated August 25 and November 19, 2015.

The August 25, 2015 report investigated soil and groundwater conditions at one proposed wildlife crossing culvert located about 60 m north of the Heart Lake Conservation Area entrance. The November 19, 2015 report investigated soil and groundwater conditions at three proposed wildlife crossing culvert locations between the Heart Lake Conservation Area entrance and Counrtyside Drive.

The Engtec boreholes were advanced on the travelled lanes or gravel shoulders of Heart Lake Road. The boreholes typically encountered pavement structure and approximately 1 to 5 m of sandy silt/silty sand fill typically overlying peat. The peat was recorded as being up to 1.5 m thick. Approximately 2 m of organic silt was encountered below the peat in the boreholes from the August 25, 2015 report. Native deposits ranging from silty sand to clay till were encountered below the fill, peat, and organic silt. Some of the native soils were very soft based on the results of Standard Penetration Tests (SPTs).

The borehole logs from the above-noted Engtec investigations are provided in **Appendix C**. The approximate locations of the boreholes from the August 25, 2015 report are shown on the Borehole Location Plan in **Appendix B**. The Engtec drawing showing the location of the boreholes from their November 19 report is provided in **Appendix D**.

Conceptual site plan drawings, plan and profile drawings, and existing topographic survey information were not available at the time of preparation of this report.

5.0 METHOD OF INVESTIGATION

5.1 PREPARATORY SERVICES

The following preparatory services were undertaken in advance of the drilling program:

- Site visits were undertaken to: identify the preferred locations for the intended boreholes; confirm any access and mobilization constraints associated with the intended investigation borehole locations; and, meet the utility locate companies (see below).
- Proposed borehole locations were provided to the client and property owners, including the TRCA, for approval;
- Ontario One-Call was contacted to identify the locations of all public utilities in the area of the planned investigation boreholes.
- A private utility locate company was retained to scan the investigation hole locations and mark any buried utilities identified.

5.2 GENERAL INVESTIGATION PROGRAM & PROCEDURES

The following field procedures were employed during the geotechnical investigation:

- Six boreholes (BH01-17 through BH06-17) were advanced on November 8 and 9, 2017, using a track-mounted CME 55 drill rig operated by Geo-Environmental Drilling Inc. Boreholes locations are shown on the Borehole Location Plan provided in **Appendix B**.
- The boreholes were advanced near the toe of the existing embankment and/or on the travelled lanes of the road, near the granular shoulders.
- Standard Penetration Tests were conducted in the boreholes in accordance with the methods described in ASTM D1586;
- Soil samples were collected from the boreholes at regular 0.76 and 1.5 m intervals using split spoon samplers. The soils were logged (visually classified), including texture and composition of materials.
- Shelby tube samples were taken of selected organic or soft soil deposits encountered in the boreholes;
- The groundwater conditions in the open boreholes were recorded at the time of and immediately following completion of the drilling program.
- The boreholes were backfilled with a mixture of the auger spoils and granular bentonite, to provide a low-permeability backfill consistent with the requirements of O.Reg. 903, as amended. Boreholes drilled in the travelled lanes of the road were capped with well-compacted asphalt cold patch.

5.3 GEOTECHNICAL LABORATORY TESTING PROGRAM

The geotechnical laboratory testing program completed on samples obtained from the investigation is outlined in Table 5.1 below.

Table 5.1: Geotechnical Laboratory Testing Program

Laboratory Test	Sampling Frequency/Number
ASTM D2216 - Moisture Content	Select samples obtained from the boreholes
ASTM D422/D – Grain Size/Hydrometer	3
ASTM D4318 – Atterberg Limits	1
ASTM D2435M (modified) – Consolidation Analysis	1

The laboratory test results are summarized in the text of this report. The results of moisture content tests are also shown on the borehole logs in **Appendix C**. The results of grain size analysis, Atterberg limits, and consolidation testing are provided in **Appendix E**.

Classification of the soil samples encountered in the investigation (and as referenced in the geotechnical report) will be in accordance with ASTM D2487 “Standard Test Method for Classification of Soils for Engineering Purposes”, consistent with the Unified Soil Classification System.

6.0 SUBSURFACE CONDITIONS

6.1 OVERVIEW

The various soil strata and groundwater conditions, encountered in the investigation are summarized in the sections below.

The soils have been classified in accordance with the Unified Soil Classification System, with minor modifications consistent with the methods of the MTO, including the removal of the descriptions “lean” and “fat” with reference to clay soils, and including a “Medium” category with respect to plasticity. Reference is also made to the Canadian Foundation Engineering Manual (4th Edition – 2006) where used for purposes of description and classification.

6.2 SUMMARY

Two boreholes (BH01-17 and BH06-17) were completed on the road, with the remaining boreholes completed adjacent to the road. In general, the boreholes on the road encountered pavement structure and road embankment fill. Buried peat was encountered below the embankment fill in BH01-17. Boreholes adjacent to the road encountered fill, topsoil or organic clay/peat at ground surface. The native mineral soils encountered below the fill, topsoil, and peat generally ranged from clay with sand till to sandy silt till.

The borehole records are included in **Appendix C** and the results of the results of the geotechnical laboratory testing, as reported herein, are included in **Appendix E**.

6.2.1 Overburden

6.2.1.1 Pavement Structure

Pavement structure was encountered at ground surface at boreholes BH01-17 and BH06-17, which were completed on the travelled lanes of Heart Lake Road. At BH01-17 the pavement structure comprised 140 mm of asphaltic concrete overlying 220 mm of granular fill. At BH06-17 the pavement structure comprised 430 mm of asphalt.

It is noted that the boreholes completed during the previous investigations by Engtec encountered 240 to 245 mm of asphalt and 200 to 700 mm of granular fill materials.

6.2.1.2 Fill

Fill was encountered below the pavement structure in BH01-17 and BH06-17. Possible fill was also encountered adjacent to the road in BH03-17.

At BH01-17 and BH06-17 the fill is 0.4 to 0.8 m thick and comprised sand with silt and gravel. A particle size distribution test was conducted on a sample of the fill from BH06-17. The results are summarized below in Table 6.1, and are also provided on Figure 1 in **Appendix E**.

Table 6.1: Grain Size Distribution of the Sand With Silt and Gravel Fill

Borehole No.	Sample No.	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH06-17	SS1	0.3	40	51	7	2

SPT N-values ranging from 8 to 34 blows per 300 mm penetration of a split spoon sampler indicated that the fill in BH01-17 and BH06-17 has a variable loose to dense relative density. Moisture contents of 4 to 12%, indicate the fill is damp to wet.

Possible fill at BH03-17 ranged from sandy clay to silty sand, and extended to a depth of 2.3 m below existing grades. This deposit is loose to compact based on SPT N-values of 6 to 14.

It is noted that fill below the pavement structure in the Engtec boreholes extended up to 4.7 m below the road surface. The fill composition described by Engtec is generally consistent with the fill encountered in BH01-17 and BH06-17. The lower portions of the deep fill became loose based on the SPT results reported by Engtec.

6.2.1.3 Peat and Other Organic Soils

A deposit of silty clay with organics was encountered at ground surface in BH05-17 and extended to 0.7 m depth. This deposit was soft based on a SPT N-value of 2; and, Wetter Than the Plastic Limit, based on a moisture content of 47%.

Peat was encountered below the fill at 1.2 m depth in BH01-17; and below the silty clay with organics at 0.7 m depth in BH05-17. The peat deposit is black and fibrous with moisture contents of over 100%. The peat was 0.7 to 1.0 m thick in the boreholes for the current investigation.

A sample of the peat from BH05-17 was submitted for consolidation testing (ASTM D2435M modified for stress and load duration) at the Golder Associates Geotechnical Laboratory located in Mississauga, ON. The results of the consolidation testing are provided in **Appendix E**. The results indicate that the coefficient of Consolidation (vertical) varied from 1.95×10^{-3} to 1.27×10^{-2} cm^2/s; and the coefficient of volume compressibility varied from 9.65×10^{-4} to 1.70×10^{-3} m^2/kN.

Peat is also identified at depths of 1.1 to 4.7 m below ground surface under road fill in boreholes BH1, BH2, BH101, BH102, BH301, and BH302 from the Engtec investigations. These peat deposits were measured to range in thickness from 0.8 m to 1.6 m thick.

The Engtec investigations also identified organic silt (marl) below the peat in BH1 and BH2. This deposit was measured to be 2.0 to 2.1 m thick, and was comprised of silt with trace sand and shells; and, was very loose based on SPT N-values of 1 to 3; and very wet based on moisture contents of over 70%.

6.2.1.4 Silty Clay (CL)

Silty Clay was encountered below the peat at 1.4 m depth in BH05-17. This deposit extended below the termination depth of the borehole. The silty clay was firm based on SPT N-values of 4; and about the plastic limit based on moisture contents of 11 to 13%.

It is noted that silty clay was also encountered below road fill and peat at 5.6 m depth in Engtec boreholes 301 and 302. At that location, the silty clay extended to depths more than 12 m below grade and was very soft.

6.2.1.5 Clay with Sand (CL) Till

Clay with sand till was encountered below the fill and peat in boreholes BH01-17 through BH04-17. Where it was encountered, this deposit extended below the termination depths of the boreholes.

A grain size analyses was completed on a sample of the clay with sand till. The results are summarized below in Table 6.2, and are also shown on Figure 1 in **Appendix E**.

Table 6.2: Grain Size Distribution of the Clay with Sand Till

Borehole No.	Sample No.	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH01-17	SS5	2.9	4	23	41	32

Atterberg Limits tests were also completed on a portion of the samples referenced above. The results of the tests are summarized below in Table 6.3.

Table 6.3: Atterberg Limits of the Sandy Clay Till

Borehole No.	Sample No.	Depth (m)	Liquid Limit	Plastic Limit	Plasticity Index
BH01-17	SS5	2.9	25	13	12

The results of the Atterberg Limits tests are illustrated on Figure 2 in **Appendix E**.

SPT N-values for the clay with sand till ranging from 4 to 16 indicates this deposit has a firm to stiff consistency. Moisture contents of the sandy clay till ranged from 10 to 18%, indicating the material ranges from about the plastic limit to wetter than plastic limit.

6.2.1.6 Sandy Silt with Gravel (SM) Till

A deposit of sandy silt with gravel till was encountered below the pavement structure and fill in BH06-17 at 0.8 m depth. This deposit extended below the termination depth of the borehole. SPT N-values of 12 to 41 indicate that the sandy silt with gravel till is compact to dense. A 1.2 m thick sand seam was encountered within the sandy silt with gravel deposit at 2.3 m depth.

6.2.2 Groundwater

Free groundwater was encountered at 2.0 m depth in BH03-17, 2.7 m depth in BH04-17, and 2.6 m depth in BH05-17. The groundwater is present in seams within the clay with sand till and silty clay deposits. It should also be expected that groundwater may be perched in peat deposits above the silty clay and glacial till. Seasonal fluctuations in the groundwater levels should be expected.

7.0 DISCUSSION AND RECOMMENDATIONS

7.1 OVERVIEW

The geotechnical investigation was undertaken to support a 30% design of the Heart Lake Road Corridor Improvement between Sandalwood Parkway and Mayfield Road in Brampton, Ontario. The improvements will likely include construction of bike lanes adjacent to the road. Wildlife crossings may also be added.

As noted in Section 3.0 above, site plans, plan and profile drawings and site elevations were not available at the time of preparation of this report. In this regard, it has been assumed that the implementation of the bike lanes will include road widening in the order of 3.0 m with a maximum embankment height of 4.0 m. The wildlife crossings will be constructed at the grade of the adjacent land areas at the toe of the road embankment.

Two boreholes (BH01-17 and BH06-17) were completed on the road, with the remaining boreholes completed adjacent to the road. In general, the boreholes on the road encountered pavement structure and road embankment fill. Buried peat was encountered below the embankment fill in BH01-17. Boreholes adjacent to the road encountered fill, topsoil or organic clay/peat at ground surface. The native mineral soils encountered below the fill, topsoil, and peat generally ranged from clay with sand till to sandy silt till.

The peat deposits were 0.7 to 1.6 m thick where encountered. Previous geotechnical investigations also encountered marl and very soft clay deposits below the peat. Based on a review of aerial satellite imagery low lying marshy areas encompassed approximately 50% to 60% of the land areas adjacent to Hart Lake Road within the project limits. In this regard, it is anticipated that organic soils will be encountered within these areas.

Groundwater is present in seams within the clay with sand till and silty clay deposits. It should also be expected that groundwater may be perched in peat deposits above the silty clay and glacial till. Seasonal fluctuations in the groundwater levels should be expected.

Consolidation settlement of the peat, marl, and soft clay should be expected where the road is widened to accommodate the new bike lanes. The amount of consolidation settlement, and time consolidation will occur over, will be dependent on the load produced by the new road embankment fill and the thickness of the compressible deposits. As noted above it is anticipated that the road embankment will range in height from 1 m to 4 m.

Although not initially intended, consideration can be made to relocating the proposed bike lanes onto trails and/or board walks adjacent to the road embankment at the existing ground surface elevations. The implementation of trails and board walks would impose less environmental impact and would require less overall effort than widening the existing road embankment.

7.2 ROAD EMBANKMENT FILL

It is understood that widening will be required to allow for construction of new bike lanes with embankments ranging from 1 m to 4 m in height. Where road widening occurs over low-lying marshy areas containing organic soils, consolidation settlement of the organic soils should be expected if they are left in-place. The amount of consolidation settlement, and time consolidation will occur over, will be dependent on the load produced by the new road embankment fill and the thickness of the compressible deposits.

Based on the results of consolidation testing conducted on peat deposits, the following preliminary estimates are provided for amount of settlement for various peat thicknesses and changes in overlying fill thicknesses. The following tables assume the new overlying fill has a unit weight of approximately20 kN/m^3.

Table 7.1: Preliminary Consolidation Estimates

Load Increase	Estimated Settlement/Time for 90% Settlement/Time for 99% Settlement	
	1 m of peat	2 m of peat
1 m grade increase	~65 mm/>25 days/>50 days	~130 mm/>100 days/>220 days
2 m grade increase	~110 mm/>40 days/>80 days	~220 mm/>160 days/>330 days
4 m grade increase	~165 mm/>55 days/>110 days	~330 mm/>210 days/>430 days

It is noted that the estimates above are based on primary consolidation settlement. Secondary consolidation settlement will also occur over a substantially longer period of time.

The consolidation settlement can be eliminated by subexcavating the existing peat from below the new embankment fill. It is anticipated that this option may not be feasible as the peat is present under the existing road embankment. Attempts of subexcavate the peat from below the existing road embankment slopes would require significant subexcavation, and likely require closure of the road. It is noted that significant excavation would likely be required in the low-lying marsh areas in order to create temporary excavation slopes conforming with Ontario Regulations. We refer to Section 8.1 of this report for additional information on temporary excavation slopes.

Preloading can be conducted to reduce the effect of consolidation settlement on the new pavements over the widened area. Preloading involves the placement of fill and monitoring of settlement over a period of time to allow for consolidation of the underlying soils. The preloading period can be accelerated by adding a surcharge load of additional fill above the finished grade of the road embankment. A settlement monitoring program is recommended if preloading is done to determine the time rate and magnitude of settlement has occurred in the embankments, and when it is suitable to construct the new pavements. This option will not eliminate consolidation, as secondary consolidation would be expected over a significantly longer period of time, resulting in increased need for pavement rehabilitation.

The amount of consolidation settlement can be reduced by reducing the amount of load increase produced by the new embankment fill. Theoretically, if a light weight fill material were utilized for the road widening, and the existing road embankment was subexcavated such that the weight of existing fill removed over any point was equivalent to the weight of the new (thicker) light weight fill placed over that point, there would be no net increase in load, and therefore no consolidation settlement. The following information on light weight fill is provided for consideration.

Table 7.2: Overview of Light Weight Fill Options

Material	Typical Unit Weight	Relative Material Cost	Remarks
Extruded Polystyrene (XPS)	0.5-1.0 kN/m^3	More expensive than EPS	Higher stiffness and thermal conductivity than EPS. Improved surface roughness. Most expensive option.
Expanded Polystyrene (EPS)	0.5-1.0 kN/m^3	Relatively Expensive	Excellent thermal performance. High compressive strength. Impervious to moisture. Recyclable
Blast Furnace Slag	11.5 – 14.5 kN/m^3	Relatively Lower Cost to Other Light Weight Fill Options	Lightweight compacted density. High angle of internal friction. Approval generally required from local environmental agency.
Tire Derived Aggregate (TDA)	8 kN/m^3	Relatively Lower Cost to Other Light Weight Fill Options	Good thermal insulation. High permeability. Absorbs vibration. Relatively newer technology.
Light Weight Foam Concrete	5 – 6 kN/m^3	Moderate Cost	Good thermal insulation. Low permeability. Flowable material. Relatively newer technology.

If these materials are considered, the effect of these materials on embankment slope stability must be analysed. As well, the potential effects of these materials on the adjacent wetlands must be considered from an environmental perspective.

Where new road embankment fill is placed against the existing embankment fill, the existing road embankment must first be stripped of vegetation and surficial organic soils. The stripped surface should be inspected by geotechnical personnel to identify any areas were additional subexcavation is required. The existing slope must be benched during placement of new fill to improve the connection of the new fill against existing fill. If the new embankment fill comprises soil, it should be placed in maximum 300 mm thick lifts compacted to at least 95% standard Proctor maximum dry density. The side slopes of the embankments should be maximum 3 horizontal to 1 vertical where there are no organic soils or soft clay deposits below the embankment. Where organic soils or soft clay do existing below proposed embankments, the required safe slope of the embankment must be determined through global stability analysis.

7.3 PRELIMINARY PAVEMENT DESIGN FOR BIKE LANES

As noted previously in the report the orientation and location of the bike lanes has not been finalized. If the bike lanes are to be constructed adjacent to the existing pavement structure the bike lane pavement structure should be designed to match the pavement structure of the travel lanes on Hart Lake Road. Understanding that a detailed pavement assessment has not been completed a preliminary pavement design based on the conditions encountered in the boreholes for this investigation, and considering the subsoil conditions encountered are provided in Table 7.3 below:

Table 7.3: Recommended Pavement Structure

Pavement Layer	Pavement Structure
Asphalt	
Surface	50 mm OPSS HL-1 or SP12.5 FC2
Binder	150 mm OPSS HL8 or SP 19.0
Granular	
Base	150 mm OPSS Granular A
Subbase	450 mm OPSS Type II Granular B

Prior to placement of the new pavement structure, the subgrade surface should be proof rolled and compacted to achieve a minimum of 95% SPMDD. Soft, wet, and/or disturbed materials should be sub-excavated to a depth of 0.5 m and replaced with OPSS Select Subgrade material compacted to 98% Standard Proctor maximum dry density, or thickened subbase.

The granular base and sub-base layers should be compacted in maximum lifts of 300 mm to achieve 100% SPMDD. Where soft subgrade conditions exist, lift thicknesses can be increased provided that adequate compaction is maintained.

The base and top course asphalt materials should be placed in single lifts to a maximum thickness of 75 mm and should be compacted to achieve the level of compaction specified in OPSS 310. Where the new asphalt is placed adjacent to existing asphalt, it is recommended that the existing asphalt be milled such that the cold joints against the existing asphalt of each layer are offset by at least 100 mm.

Proper drainage of the pavement structure must be provided in order to provide satisfactory performance. Due to the low permeability of the prevailing soils (clay with sand till) continuous sub-drains should be connected to catch basins, where catch basins are available. Where ditches are present beside the road, the bottom of the pavement granulars should slope at 2% towards the ditches to allow subsurface drainage.

7.4 BIKE TRAILS AND BOARDWALK

Although not initially intended, consideration can be made to relocating the proposed bike lanes onto trails and/or board walks adjacent to the road embankment at the existing ground surface elevations. The implementation of trails and board walks would impose less impact to the surrounding lands and would reduce the requirement to import significant volumes of fill to construct the road embankment.

The bike trails can be supported on a combination of asphalt pavements placed on the sound native soils and boardwalks supported on specialized foundations such as micro piles or helical piers. These types of foundations are typically proprietary technologies and would need to be reviewed by and/or design by a specialized contractor.

7.5 WILDLIFE CROSSINGS

It is understood that additional wildlife crossing culverts may be designed as part of the road improvements. The recommendations of the previous Engtec reports should be considered when designing wildlife crossings in the areas investigated by Engtec. Location-specific geotechnical investigations should be undertaken for any new proposed wildlife crossings. Details regarding additional geotechnical investigations are provided in 7.5 of this report.

7.6 RECOMMENDATIONS FOR ADDITIONAL GEOTECHNICAL INVESTIGATION

Additional geotechnical investigation is recommended to support final design.

Additional boreholes are recommended for the final design such that borehole spacing along the proposed bike paths is a maximum of 150 m.

It is recommended that additional investigation be conducted below proposed road widenings where those widenings will be over low-lying and/or marshy areas, and where the widening will result in additional loads on the existing soils. The purpose of those investigations should be to determine the potential for settlement and the timeline for consolidation settlement to occur, to allow the widening and pavements to be designed accordingly. Investigations must also be conducted to assess the global stability of any additional fill slopes placed over areas of organic soils. This investigation may require the use of specialized small drillrigs and/or hand drilling techniques to allow access into the marshy areas adjacent to the road.

Additional investigation is recommended if wildlife crossings are proposed at locations where borehole data is not currently available. This is particularly important as wildlife crossings are typically located where there is low-lying land adjacent to the road, and low-lying land can be indicative of the presence of organic soils. Design of wildlife crossing structures must take into account the presence of any organic soils.

8.0 CONSTRUCTION

8.1 EXCAVATIONS

All side slopes for temporary open-cut excavations should meet the requirements of the Occupational Health and Safety Act Regulations for Construction Projects (OH&S Act).

- The surficial fill materials as well as the native non-organic soil deposits can be considered Type 3 soils. In accordance with OHSA, these soils can be excavated to a maximum 1:1 (Horizontal: Vertical) slope from the base of excavation where workers enter the trench. Steeper excavations would require an engineered support system.
- Where peat and/or groundwater seepage are encountered in the excavation these must be considered Type 4 soils. The OH&S Act requires that excavations in Type 4 soils be excavated to a maximum of 3:1 (Horizontal: Vertical) slope where workers enter the trench. If the 3:1 slope cannot be achieved, a temporary support system must be provided to permit workers to enter the excavation.
- Where temporary excavations expose existing utilities, those utilities must be properly supported.
- Temporary excavations steeper than those noted above may be utilized provided a trench box is used to protect workers. The design and use of the trench box must meet the requirements Part 234 of Ontario Regulation 213/91.
- Some sloughing and caving must be anticipated for excavations in the fill materials and native silty sand soils, particularly where excess moisture (precipitation, ground surface runoff and the groundwater table) is present.

8.2 REUSE OF EXCAVATED MATERIAL

Existing Pavement Structure Components

Granular material from the existing pavement structure, including road shoulders, may be stockpiled and tested to determine if the material is suitable for re-use as OPSS Granular 'B' in any new pavement structures. If gradation results indicate that the existing granular material are not suitable for re-use in the new pavement structure, they may be utilized as road embankment fill (unless low weight fill is to be used), or as backfill for trenches or structures.

The existing asphaltic concrete should be removed from site, or subject to approval of the City of Brampton milled and mixed as RAP in the OPSS Granular 'B'. The asphaltic concrete should not be re-used in the road embankment fill or as backfill for trenches or structures.

Existing Fill Materials

Existing fill materials were encountered in the majority of the boreholes, and typically comprised sand with silt and gravel. These soils will not be suitable for use in pavement structure or other applications where free draining soil is required. The existing fill may be suitable for use as road embankment fill (unless low weight fill is to be used), or as backfill for trenches.

Peat, Other Organic Soils, and Soft Clay

Where excavated, peat, other organic soils, and soft clay will not be suitable for re-use as road fill or backfill, and should be removed from site.

Clay with Sand Till and Silty Clay

The native deposits of clay with sand till and silty clay should not be used in any applications where free-draining soils are needed. These materials may be suitable for use as road embankment fill (unless low weight fill is to be used), or as backfill for trenches. Drier portions of these materials may need additional effort and/or thinner lifts to allow proper break-down of any “blocky” portions and close all inter-lump voids. Failure to ensure no voids are left between lumps in the fill will result in settlement over time.

9.0 CLOSURE

Use of this report is subject to the Statement of General Conditions provided in **Appendix A**. It is the responsibility of the Client and its agents to review the conditions and to notify Stantec Consulting Ltd. should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report
- Basis of the report
- Standard of care
- Interpretation of site conditions
- Varying or unexpected site conditions
- Planning, design or construction

Respectfully submitted,

STANTEC CONSULTING LTD.

Original signed by

Jeff Dietz, P. Eng.
Senior Geotechnical Engineer
(519) 585-3446
jeff.dietz@stantec.com

Original signed by

Peter Healy, C.E.T.
Senior Associate, Geotechnical Engineering:
(705)719-1813
peter.healy@stantec.com

m:\active\1650\165001037 - heart lake road\reports\rpt_165001037_geotech_heart-lake-road_20171130.docx