DILLON CONSULTING

TOWN OF INGERSOLL

South West Ingersoll Secondary Plan

Transportation Assessment

September 2023 – 22-4365

Table of Contents

Figures

Tables

Appendices

1.0 Introduction

1.1 Purpose

This transportation report identifies the existing and planned multi-modal transportation issues and opportunities that will influence the development and investment within the South West Ingersoll Secondary Plan area. Issues and opportunities are identified through a review of existing transportation policies, and existing and forecast study area conditions. The area network performance is assessed and recommendations identified to mitigate issues, and maintain and enhance the efficiency and safety for all modes of travel.

1.2 Background

Ingersoll has a vibrant history as a small farming community on the banks of the Thames River. It is centrally located in southwest Ontario, accessible by Highway 401 and VIA Rail. It has a rich culture, quaint downtown, good employment opportunities and access to recreational and leisure activities, and is targeted for steady residential and employment growth. Of the 47,200 people and 21,100 job growth forecasted for Oxford County to 2046[1], 5,850 people and 3,160 jobs are projected for Ingersoll. After factoring out growth that can be accommodated within the existing Built-up Area and the Designated Greenfield Area, Hemson's Land Need Assessment identified a need for an additional 75 gross hectares for residential and 109 gross hectares for employment by 2039. To help support long term growth, a boundary adjustment (effective January 2021) brought ~630 hectares of land from South-West Oxford into the Town of Ingersoll, which is the subject of this Secondary Plan study. In order to support long term growth, a number of technical studies and analysis is required to justify the settlement boundary expansion, confirm the community vision, manage land use compatibility and guide sustainable development and infrastructure investment.

There are generally three areas that make up the Secondary Plan study area, as described below and presented in **Figure 1**:

- **East Side of Ingersoll**: Approximately 59 hectares located north of Highway 401, east of County Road 119 / Harris Street. Current uses include manufacturing (steel fabricator) agricultural uses, including existing livestock operation (dairy) and associated residential. Surrounding uses include residential to the north (Special Policy Area), Hall's Creek Environmental Protection Area and watercourse to the west, Highway 401 to the south and agricultural lands to the east;
- **West Side of Ingersoll**: Approximately 280 hectares located north of Highway 401, west of County Road 10 / Ingersoll Street South and the CAMI plant, south of the Thames River and east of the Five Points Provincially Significant Wetland. Current uses include a large storage lot to the south, CP Rail corridor to the north and a spur line bisecting the study area connecting the

[1] Growth forecast based on 2016 population and employment.

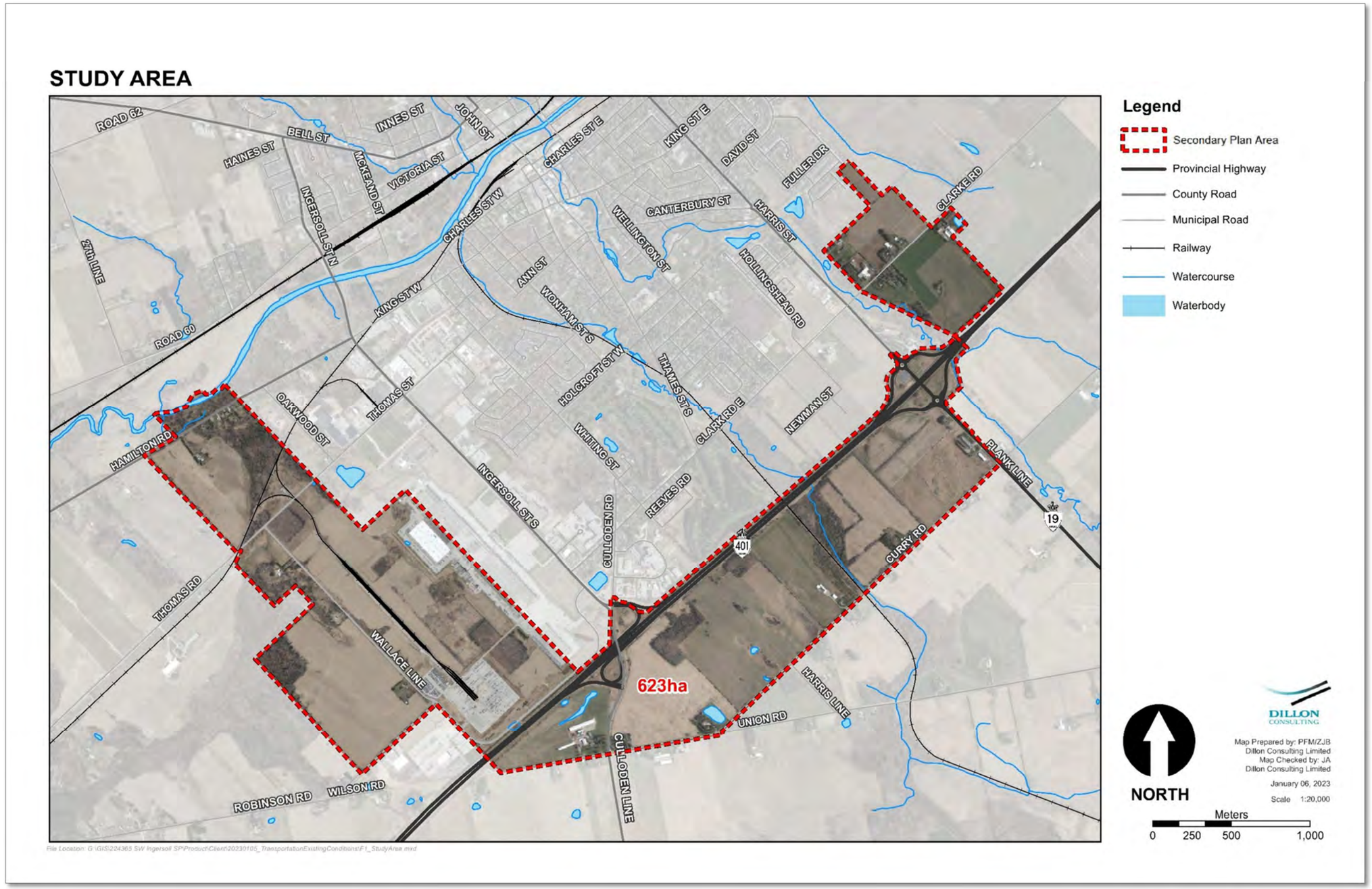
storage lot to the CP Rail corridor. There are agricultural uses west of Wallace Line and north of Thomas Road, several woodlots as well as some residential uses along King Street West. Surrounding uses include industry to the east (with a Special Policy Area between Thomas Road and the CP Rail corridor), and agricultural uses (including livestock operations) and a logistics company to the west; and

- **South Side of Ingersoll**: Approximately 280 hectares located south of Highway 401, north of Curry Road, east of Plank Line and west of Union Road. The land is currently predominately agricultural use, including livestock operations (chickens) with some associated residential. There is the Heslop Swamp Provincially Significant Wetland, watercourse and the CP Rail Line dissecting the Study Area, and a motel, storage facility and a large telecommunications tower towards Plank Line. Surrounding uses include industrial, agricultural uses and a golf course to the north of Highway 401, and agricultural uses to the east, south and west of the Study Area.

The Secondary Plan is intended to:

- Justify the settlement boundary expansion and address the remaining provincial policy requirements;
- Confirm a vision for the Study Area and identify alternative development concepts that would achieve the vision;
- Conduct a multi-disciplinary evaluation of the alternative development concepts and select the preferred alternative;
- Identify the required infrastructure, public facilities and policies needed to support and guide development; and
- Facilitate a collaborative, transparent and engaging process that supports good planning outcomes.

Figure 1: Study Area



2.0 Background Information and Development Policy Framework

The study area is located in the Town of Ingersoll in the County of Oxford. Therefore, the transportation components of the Secondary Plan will refer to, build on, and be subject to guidance from the following existing strategic policy documents:

- Town of Ingersoll Corporate Strategic Plan (2022)
- Oxford County Official Plan (2021);
- Oxford County Transportation Master Plan (2019);
- Oxford County Cycling Master Plan (2022); and
- Oxford County Trails Master Plan (2014).

The aforementioned policy framework documents are briefly described in below.

2.1 Town of Ingersoll Corporate Strategic Plan

The *Town of Ingersoll Corporate Strategic Plan* is a framework to guide Council and staff in the decision-making process and to direct resources to where they are needed to move the Town towards its desired future as envisioned by the community and articulated in the Plan.

The plan identifies the town's strategic pillars and goals and provides a prioritised action plan for achieving them. This includes the investment in recreational amenities and active transportation to respond to resident needs, with a specific action to develop more trails.

2.2 Oxford County Official Plan

The *Oxford County Official Plan* is a set of policies intended to guide settlement within the county, including extent, pattern, and type of settlement. It is also designed to manage the use of land and resources to maintain and/or improve the quality of the natural environment and the quality of life of residents.

The Official Plan identifies the county's development strategy, policies related to growth management and land use, and supporting elements including transportation policy. Specifically for the Town of Ingersoll, the strategic transportation policy approach is to "provide a safe and efficient multi-modal transportation system which moves people and goods into and through the Town while meeting the present and future needs of the Town". Relevant transportation policies for the South West Ingersoll Secondary Plan include:

- When traffic conditions warrant, intersection improvements in the form of jog eliminations, installation of traffic signals, and channelization construction will be undertaken at the intersections indicated on Schedule I-4;
- Bicycling shall be promoted and improvements initiated that enhance bicycling as a means of transportation;
- The provision of sidewalks in or adjacent to new development as follows:
    - on both sides of arterial and collector roads; and
    - on at least one side of local streets;
- The elimination or improvement to level railway crossings, as indicated on Schedule I-4; and
- The Town will actively pursue the maintenance and improvement of rail service sufficient to meet the needs of industrial uses within the Town.

2.3 Oxford County Transportation Master Plan

The *Oxford County 2019 Transportation Master Plan* (TMP) is a strategic transportation policy document for the County. It defines policies, programs and infrastructure required to accommodate anticipated growth in transportation demand to the year 2038 (and beyond).

The TMP presents a mode share target for the year 2038 and identifies key transportation strategies, including a road network strategy, active transportation strategy, people and goods movement strategy, and transportation system sustainability and new technology strategy, to reach the target mode share and accommodate anticipated future demand in the county. It also provides an implementation timeframe for specific tasks related to the various strategies. Relevant actions for the South West Ingersoll Secondary Plan include:

- Oxford Road 9 (within Ingersoll) is identified for a road urbanization in relation to new development/ future growth;
- Continue with the program to provide a wider asphalt platform with edge line on rural roads as part of regular resurfacing programs and incorporate cycling facilities as part of any urban road reconstruction; and
- Upgrade railway grade crossings (based on current Transport Canada regulations) as required in collaboration with Rail Authorities.

2.4 Oxford County Cycling Master Plan

The *Oxford County Cycling Master Plan* identifies a proposed cycling network, including the location, facility type and priority of the various projects, for the county based on major destinations and high demand routes. It also provides an implementation strategy for the proposed network, and highlights relevant design guidelines to guide the design of bicycle facilities in the County. The proposed cycling projects relevant to the South West Ingersoll Secondary Plan area are discussed in **Section 3.1.1.2** and illustrated in **Figure 2**.

2.5 Oxford County Trails Master Plan

The *Oxford County Trails Master Plan* contains objectives, a vision, and goals for the implementation of off-road trails and on-road cycling facilities in the County. It identifies gaps in the system and highlights opportunities for network improvements. The plan contains maps illustrating the proposed route network within the County, including location and facility type of the proposed trails, and identifies the level of priority of the various routes. The plan also provides a number of implementation tools to assist in implementing the trails network.

However, the proposed on-road cycling network within the Trails Master Plan has been superseded by the proposed cycling network in the Cycling Master Plan and the Trails Master Plan does not propose any off-road trails in or around the South West Ingersoll Secondary Plan area.

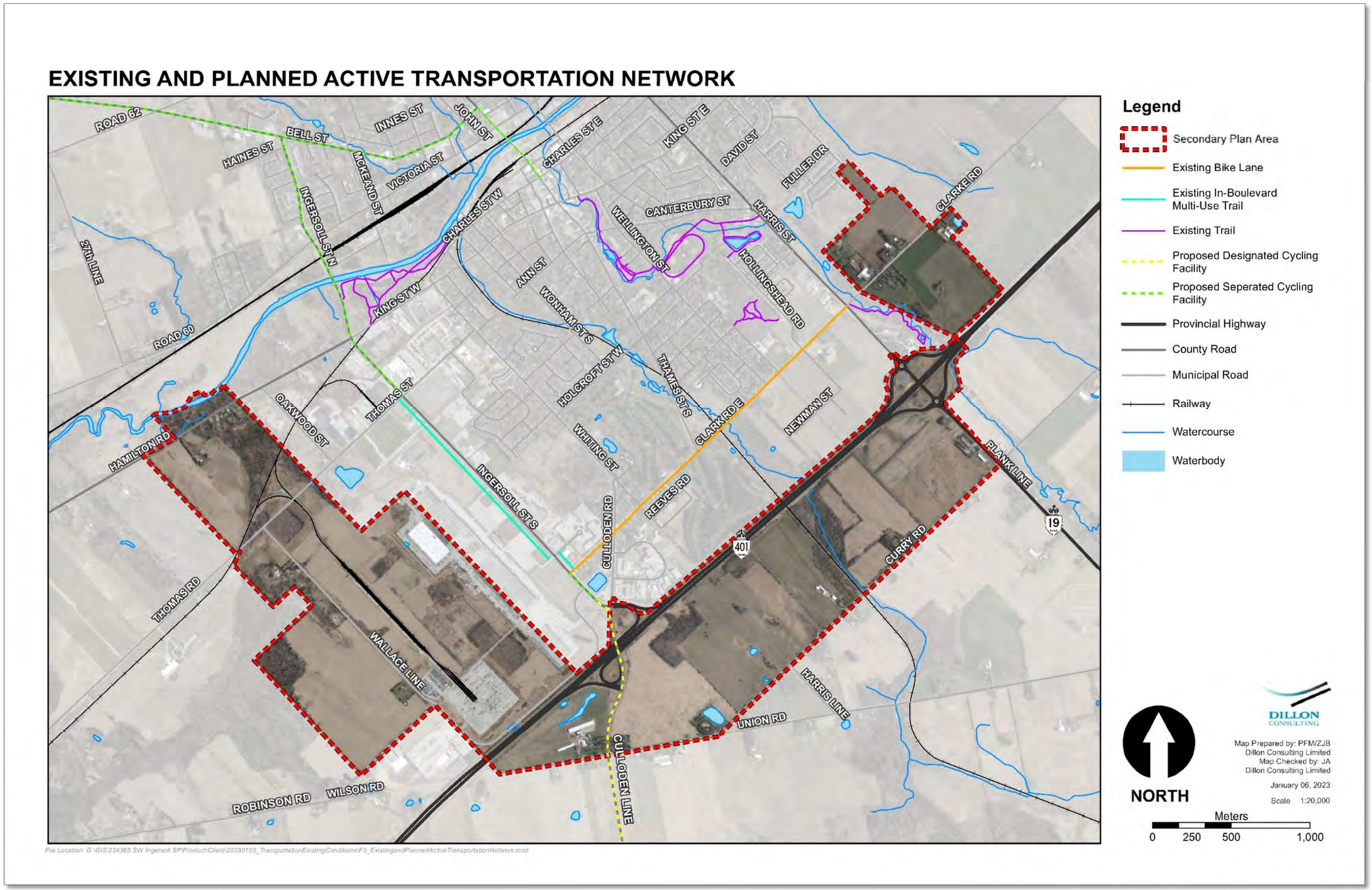
3.0 Existing Conditions

3.1 Existing Networks and Demands

3.1.1 Active Transportation

The South West Ingersoll Secondary Plan area contains a number of existing and planned Active Transportation (AT) facilities as illustrated in **Figure 2**.

Figure 2: Existing and Planned Active Transportation Network



3.1.1.1 Pedestrian Facilities

Within the study area, King Street West is the only road with consistent sidewalks on both sides. Clarke Road and Culloden Road (north of Samnah Crescent) have sidewalks on one side of the street, while Harris Street varies from zero to two sidewalks along its length. All other study area roads do not have sidewalks.

3.1.1.2 Cycling Facilities

There are no existing cycling facilities within the South West Ingersoll Secondary Plan Area. However, there are conventional bike lanes in both directions adjacent to the Secondary Plan Area along Clarke Road between Ingersoll Street and Plank Line, as illustrated in **Figure 2**. This cycling facility provides south Ingersoll with an east-west facility that connects local residential areas to employers, including the Cami assembly plant.

Additionally, there are a number of County cycling facilities that were recently planned as part of the Oxford County Cycling Master Plan (CMP). The CMP proposes 'separated' cycling facilities (i.e. In-boulevard multi-use pathways, or buffered bike lanes / buffered paved shoulders) along Ingersoll Street (County Road 10) and 'designated' cycling facilities (i.e. bike lanes / paved shoulders) along Culloden Line (County Road 10). These proposed cycling facilities will eventually connect the existing bike lanes along Clarke Road and a multi-use trail along Ingersoll Street (see **Section 3.1.1.3**) to the Secondary Plan Area south of Highway 401.

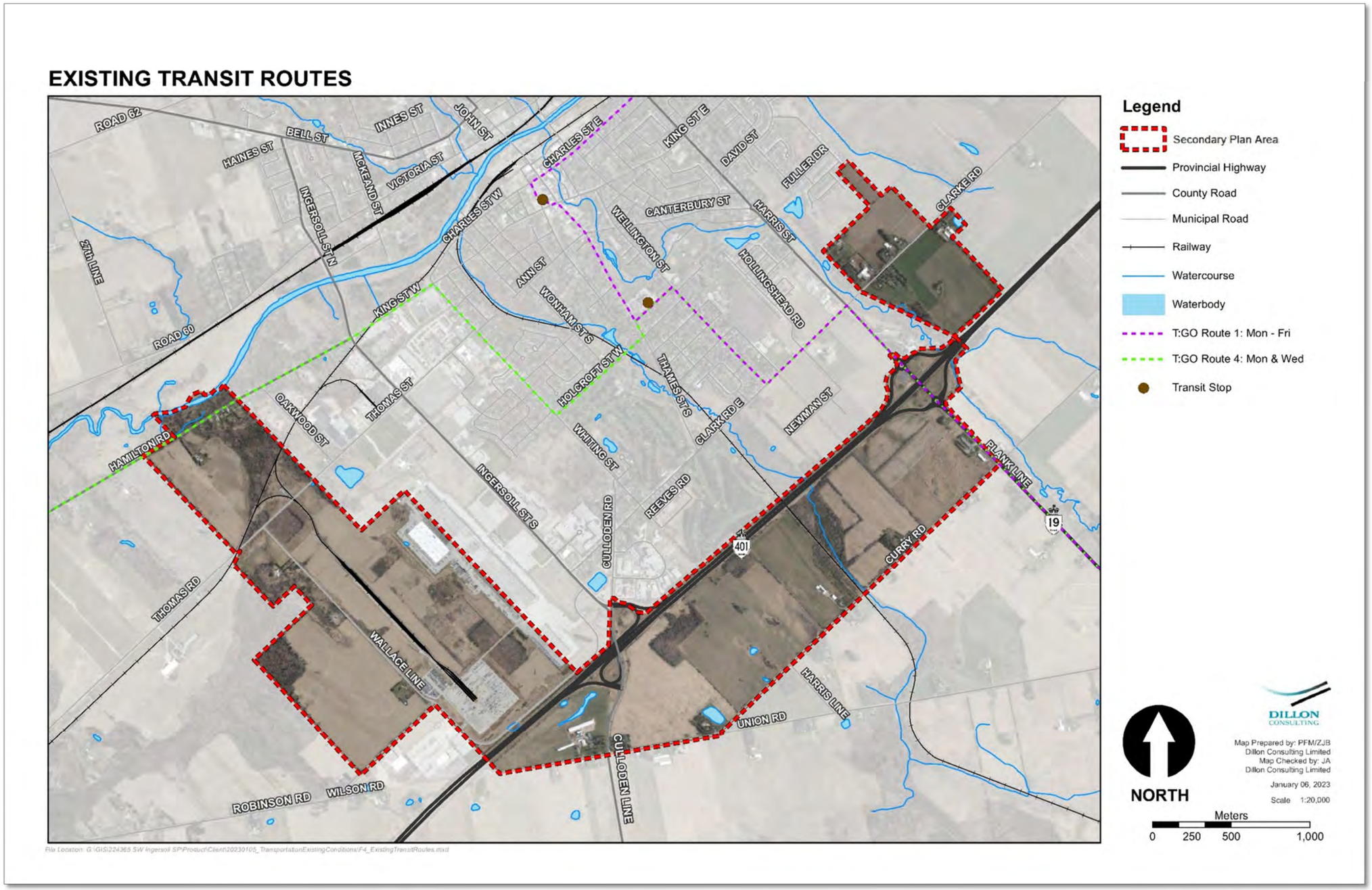
3.1.1.3 Multi-Use Facilities

There are no existing multi-use (cyclists and pedestrians) facilities within the South West Ingersoll Secondary Plan Area. However, there is an existing multi-use facility directly adjacent to the Secondary Plan Area along Ingersoll Street South between Clarke Road to Thomas Street, as illustrated in **Figure 2**. This multi-use trail, known locally as the Douglas Carr Memorial Trail, is a 1.5 km long paved multi-use trail that effectively connects the local residential areas to employers, including the Cami assembly plant. The trail is maintained year-round, including snow clearing, so it is an option for commuters regardless of the season.

3.1.2 Transit

The South West Ingersoll Secondary Plan area is not serviced by public transit. However, T:GO Inter-Community Transit Service, a regional transit service operated by the Town of Tillsonburg, has two routes (Route 1 and Route 4) that travel through the study area with stops within the Town of Ingersoll. The T:GO Inter-Community Transit routes passing through the South West Ingersoll Secondary Plan area are illustrated in **Figure 3**.

Figure 3: Existing Transit Routes



3.1.3 Streets

The existing roadway classifications (as per Schedule I-4 of the County of Oxford Official Plan) in and around the South West Ingersoll Secondary Plan area are illustrated in **Figure 4**.

Figure 4: Existing Roadway Classifications

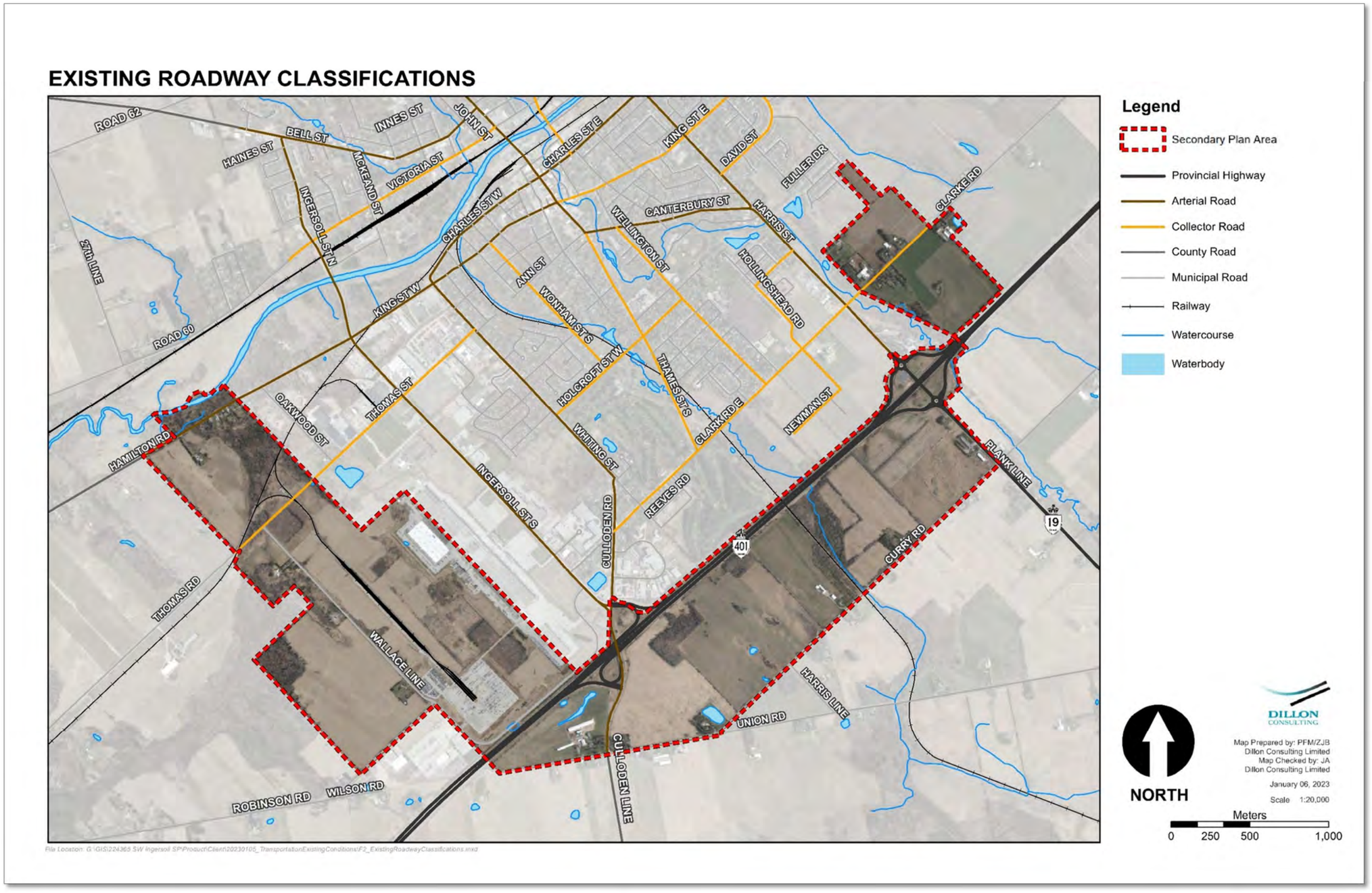


Table 1 summarizes the main roadways in and around the study area by their jurisdiction and functional classification as listed in Schedule I-4 of the County of Oxford Official Plan.

Table 1: Main Roadways by Jurisdiction and Functional Classifications In and Around the Study Area

Road	Jurisdiction	Road Classification
Highway 401	Ministry of Transportation, Ontario (MTO)	Provincial Freeway
Plank Line (Highway 19)	Ministry of Transportation, Ontario (MTO)	Provincial Highway
Harris Street / Plank Line (County Road 119)	Oxford County	Arterial
Culloden Line (County Road 10)	Oxford County	Arterial
King Street West (County Road 9)	Oxford County	Arterial
Ingersoll Street South (County Road 10)	Oxford County	Arterial
Culloden Road	Town of Ingersoll	Arterial
Clarke Road	Town of Ingersoll	Collector
Thomas Street / Thomas Road	Town of Ingersoll	Collector
Curry Road	Town of Ingersoll	Local
Union Road	Town of Ingersoll	Local
Wallace Line / Thompson Road	Town of Ingersoll	Local
Robinson Road	Town of Ingersoll	Local

Table 2 summarizes the characteristics of roadways in and around the study area.

Table 2: Main Roadway Characteristics In and Around the Study Area

Road	Number of Lanes within Study Area	Posted Speed Limit	On-Street Parking within Study Area*	Load Restrictions within Study Area
Highway 401	6	100 km/h	None	None
Plank Line (Highway 19)	2	80 km/h	None	None
Harris Street / Plank Line (County Road 119)	2	50-60 km/h	None	None
Culloden Line (County Road 10)	2	80 km/h	None	None
King Street West (County Road 9)	2	50 km/h	Permitted between Church Avenue and Mill Street	None
Ingersoll Street South (County Road 10)	2-4	50 km/h	None	None
Culloden Road	4	60 km/h	None	Trucks over 3 tonnes prohibited North of Clarke Road
Clarke Road	2	50 km/h	None	Trucks Prohibited between Ingersoll Street and Culloden Road
Thomas Street / Thomas Road	2	50 km/h	None	None
Curry Road	2	80 km/h	Permitted	5 tonnes per axle (Mar 1 - Apr 30)
Union Road	2	80 km/h	Permitted	5 tonnes per axle
Wallace Line / Thompson Road	2	50 km/h	Permitted on Wallace Line	None
Robinson Road	2	80 km/h	None	5 tonnes per axle (Mar 1 - Apr 30)

Notes: *Parking is prohibited between 3:00AM and 6:00AM during the winter months (December 1 to March 31)

Highway 401

Highway 401 is a 6-lane divided freeway spanning Ontario from Windsor to the provincial border with Quebec. It has paved shoulders and a median barrier. Highway 401 has two interchanges within Ingersoll; a partial cloverleaf (parclo A2) at County Road 10, and a double roundabout at County Road 119/Highway 19. The speed limit is 100km/h, and parking/stopping are prohibited.

Plank Line (Highway 19)
Plank Line is a 2-lane Provincial Highway. It travels from Highway 401 south into the town of Tillsonburg. North of Highway 401, Plank Line transitions to Harris Street. Plank line has a rural cross-section with variable paved and unpaved shoulders, and a posted speed limit of 80km/h. Parking is prohibited along the entire length of Plank Line.

Harris Street (County Road 119)
Harris Street is a 2-lane arterial running between Charles Street E/Beachville Road and Highway 401. It transitions to Pemberton Street north of Charles Street East and to Plank Line south of Highway 401. South of Canterbury Street, Harris Street has a rural cross-section with primarily unpaved shoulders and a speed limit of 60km/h. It transitions to an urban cross-section north of Canterbury Street, with sidewalks on one or both sides (varies along its length) and a speed limit of 50km/h. Parking is prohibited along the entire length of Harris Street.

Culloden Road/Line (County Road 10)
Culloden Road is a 4-lane arterial with an urban cross-section. It has sidewalks on the east side between Maple Lane and Samnah Crescent, and no sidewalks south of Samnah Crescent. Culloden Road has a posted speed limit of 60km/h, and both parking and stopping are prohibited along its entire length. Culloden Road travels over Highway 401 and transitions to Culloden Line, where it has a 2-lane rural cross-section with unpaved shoulders and a posted speed limit of 80km/h. Parking is prohibited along Culloden Line as well.

King Street West (County Road 9)
King Street is a 2-lane arterial that travels east/west through Ingersoll and connects to London to the west and Woodstock to the east. Within Ingersoll, King Street has an urban cross-section with sidewalks on both sides and a posted speed limit of 50 km/h. Parking is prohibited along a good portion of King Street, however is permitted between approximately Church Avenue and Mill Street.

Ingersoll Street South (County Road 10)
Ingersoll Street South is a 4-lane arterial running between King Street West and Culloden Road. North of King St West it transitions to a 2-lane road as Ingersoll Street North. Ingersoll Street South has an urban cross-section with no sidewalks and on-street parking prohibited along its entire length. It has a posted speed limit of 50km/h.

3.1.3.1 Key Intersections and Controls

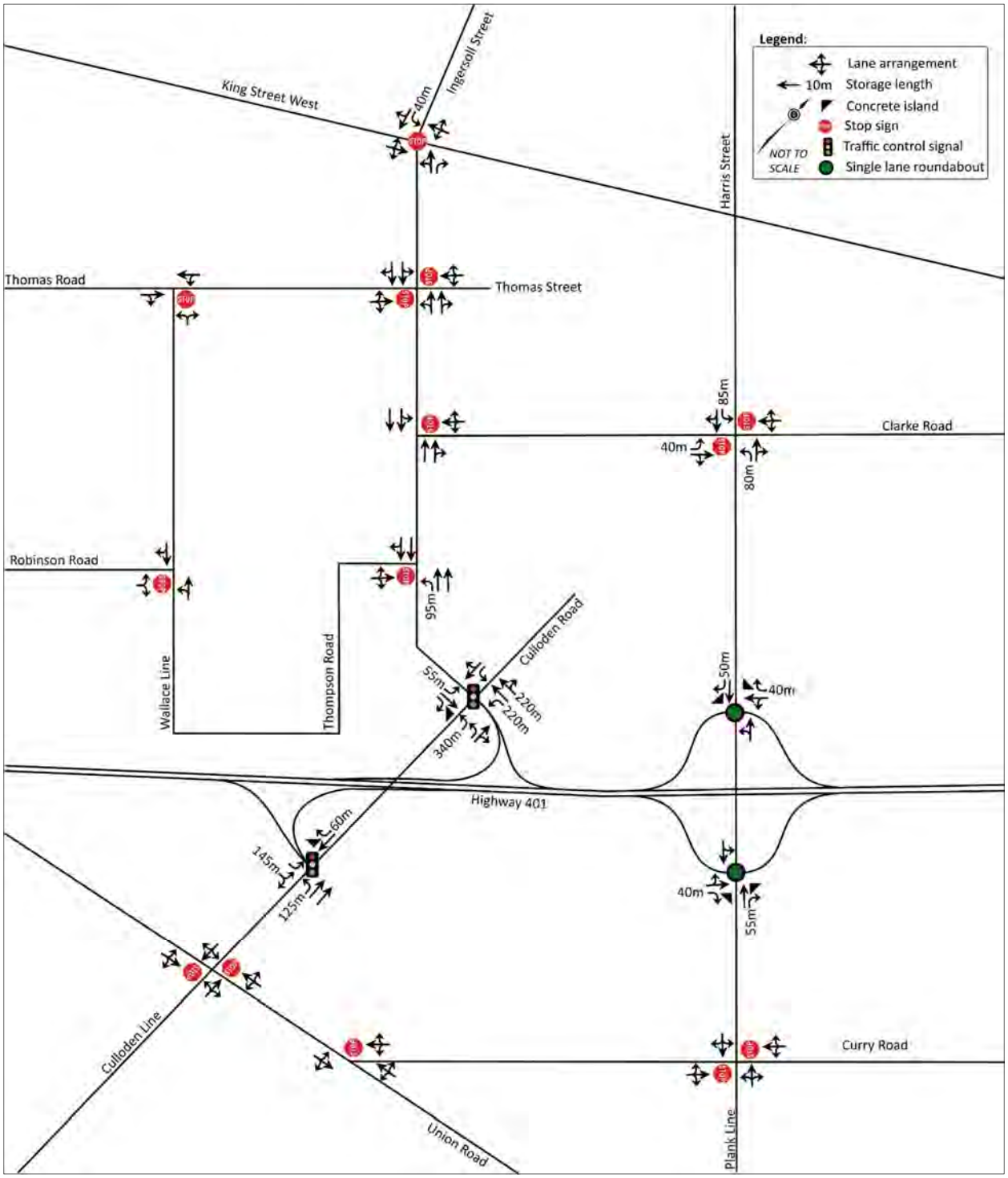
The key intersections that were assessed within and around the South West Ingersoll Secondary Plan area are as follows:

- Plank Line (Highway 19) & Highway 401 Westbound Ramps;
- Plank Line (Highway 19) & Highway 401 Eastbound Ramps;
- Culloden Line (County Road 10) & Highway 401 Eastbound Ramps;

- Culloden Line (County Road 10) & Ingersoll Street South / Highway 401 Westbound Ramps;
- Harris Street (County Road 119) & Clarke Road;
- Plank Line (Highway 19) & Curry Road;
- Curry Road & Union Road;
- Culloden Line (County Road 10) & Union Road;
- Ingersoll Street South (County Road 10) & Clarke Road;
- Ingersoll Street South (County Road 10) & Thompson Road;
- Ingersoll Street South (County Road 10) & Thomas Street;
- Ingersoll Street South (County Road 10) & King Street West (County Road 9);
- Thomas Road & Wallace Line; and
- Wallace Line & Robinson Road.

Figure 5 shows the existing (2022) traffic controls and lane arrangements at the key intersections in and around the South West Ingersoll Secondary Plan area.

Figure 5: Existing Intersection Traffic Control and Lane Configuration



3.1.3.2 Railway Crossings

The railway crossings that were assessed within and around the South West Ingersoll Secondary Plan area are as follows:

- King Street, east of Ingersoll Street South;
- Ingersoll Street South, south of King Street;
- Thomas Road, west of Wallace Line;
- Thomas Road, east of Wallace Line; and
- Curry Road, east of Plank Line.

All of the railway crossings are at-grade, and are operated by the Ontario Southland Rail line.

Road-rail crossing types are evaluated based on an Exposure Index[2]:

Exposure Index (EI) = Average Daily Traffic (ADT) x Number of Daily Trains

The thresholds for crossing types based on the exposure index are as follows:

- EI < 1,000 = Passive Crossing;
- EI 1,000 – 50,000 = Active Crossing, Flashing Lights and Bells;
- EI 50,000 – 200,000 = Active Crossing, Flashing Lights, Bells and Gate; and
- EI ≥ 200,000 = Grade Separated Crossing.

Dillon commissioned 24 hour traffic counts during October and November 2022. The 24 hour ATR counts collected motorcycle, automobile and heavy vehicle counts and speeds for a 24 hour period adjacent to each of the aforementioned road-rail crossings within the study area. **Table 3** summarizes the characteristics of each of the 24 hour traffic counts that were conducted.

Table 3: 24-Hour Traffic Count Characteristics

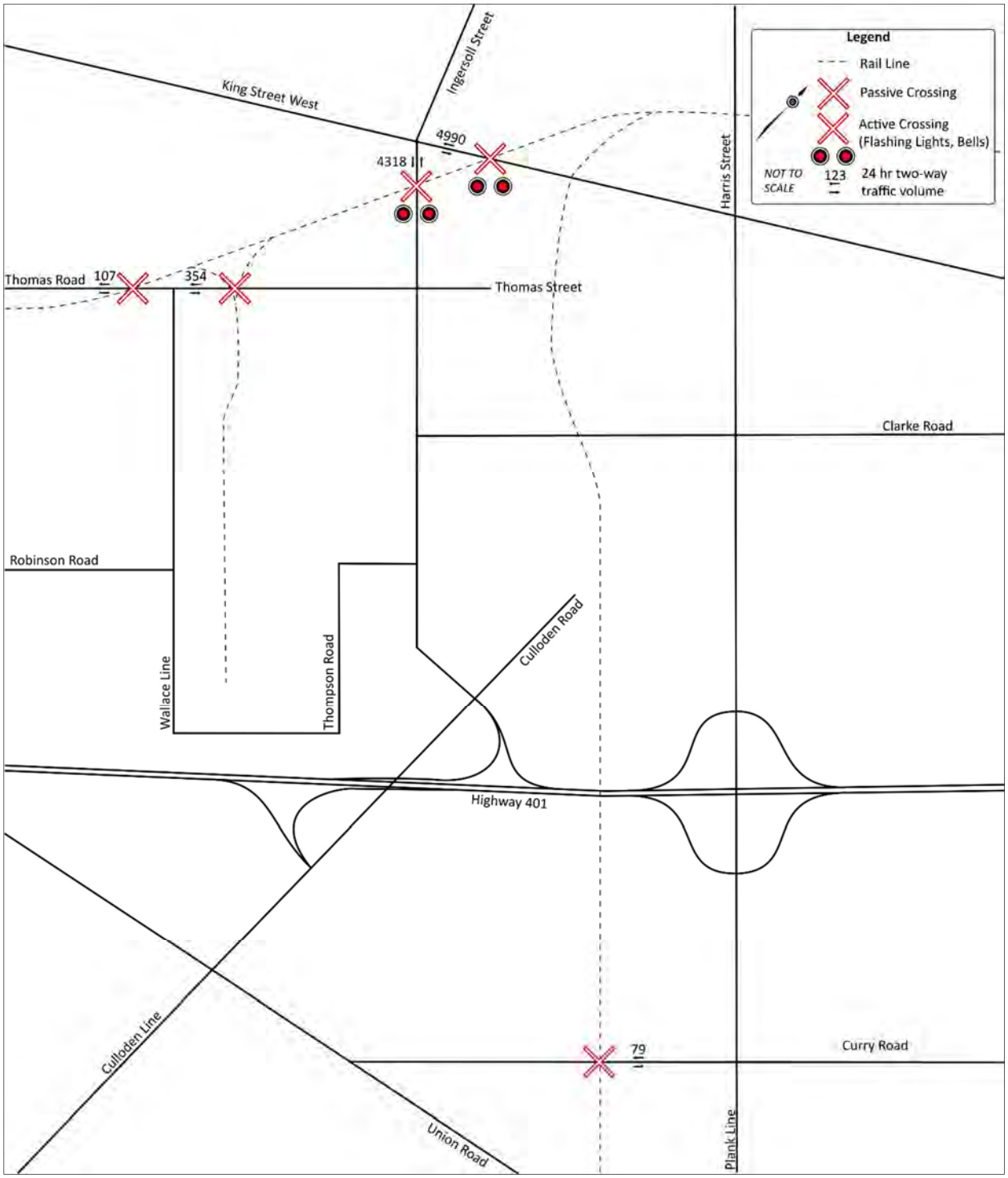
Count Location	Count Type	Date
Curry Road – 700m west of Plank Line	ATR	Thursday October 27 2022
King Street West – 100m east of Ingersoll Street South	ATR	Thursday October 6 2022
Ingersoll Street – 60m south of King Street West	ATR	Wednesday October 26 2022
Thomas Road – 380m west of Wallace Line	ATR	Wednesday November 2 2022
Thomas Road – 130m east of Wallace Line	ATR	Thursday October 20 2022

Notes: ATR = Automatic Traffic Recorder

Figure 6 shows the existing (2022) railway crossing types in and around the South West Ingersoll Secondary Plan area, along with the 24 hour vehicle volumes on the links adjacent to the railway crossings.

[2] Transport Canada, Grade Crossing Standards, January 2019.

Figure 6: Existing Railway Crossing Types



Notes: Unlabeled railway crossings were not assessed due to their location outside of the Secondary Plan analysis area.

Table 4 summarises the existing railway crossing review for each of the aforementioned road-rail crossings.

Table 4: Existing Railway Crossing Type Review

Railway Crossing Location	Crossing Type	Trains per Day*	ADT**	Exposure Index
Curry Road	Passive Crossing	4	79	316
King Street West	Active Crossing (Flashing Lights and Bells)	6	4,990	29,940
Ingersoll Street	Active Crossing (Flashing Lights and Bells)	6	4,318	25,908
Thomas Road west of Wallace Line	Passive Crossing	4	107	428
Thomas Road east of Wallace Line	Passive Crossing	8	354	2,832

Notes: *At the time of collection (October 2022), the General Motors CAMI Assembly plant was shut down for retooling. As a result, fewer trains that usual were operating.
** 24 hour traffic counts were conducted during October and November 2022

Based on the Exposure Indices displayed in **Table 4**, the road-rail crossing at Thomas Road east of Wallace Line is more than 2 times higher than the base line reference of 1,000. Therefore, this location should be upgraded to an active crossing with flashing lights and bells, similar to those at the railway crossings on King Street West and Ingersoll Street.

3.1.3.3 Travel Demands

Dillon commissioned peak hour traffic counts during October 2022. **Table 5** summarizes the characteristics of each of the traffic counts that were conducted.

Table 5: Existing Peak Hour Traffic Count Characteristics

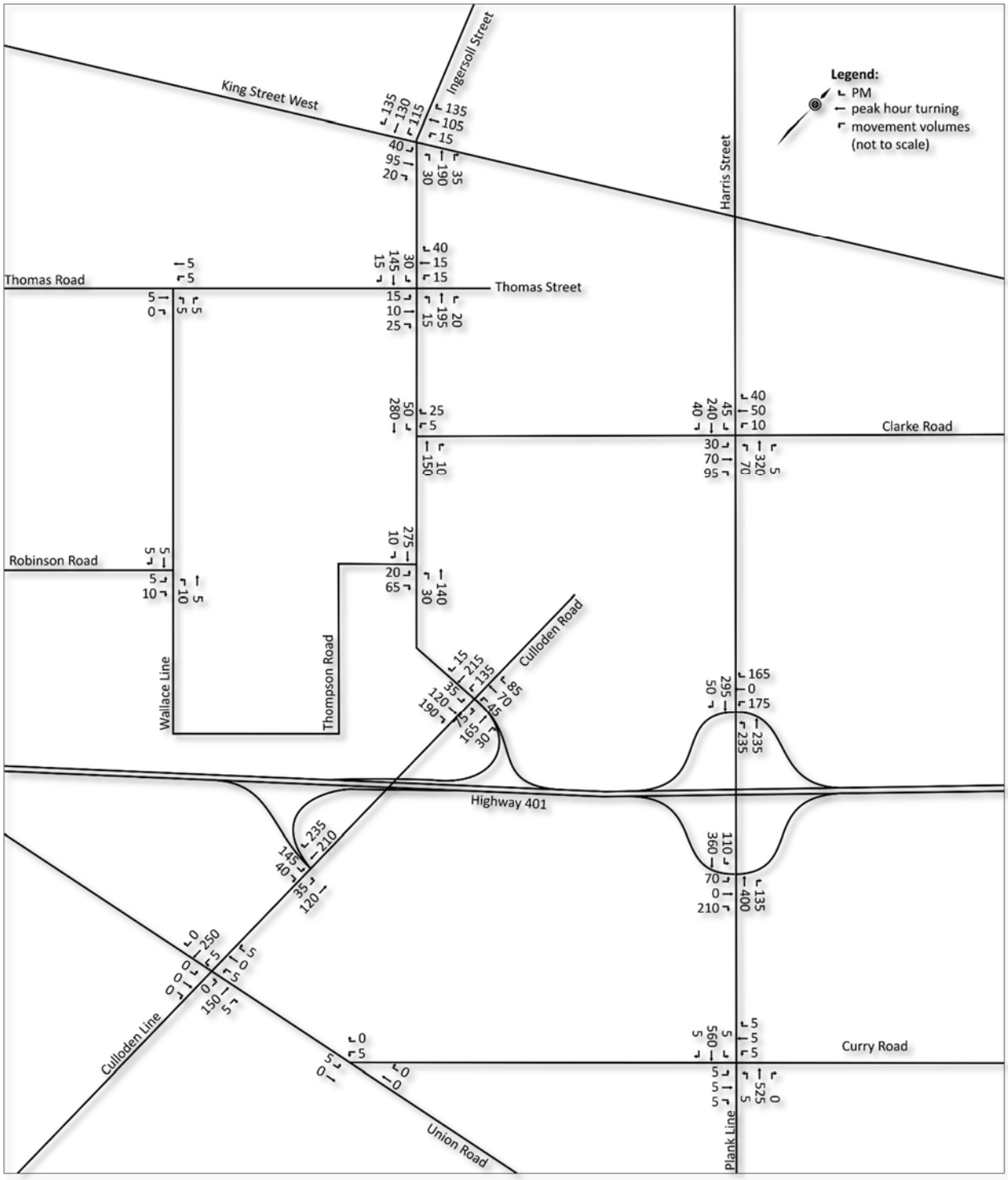
Count Location	Count Type	Date
Plank Line (Hwy 19) & Hwy 401 WB Ramps	TMC	Tuesday October 25 2022
Plank Line (Hwy 19) & Hwy 401 EB Ramps	TMC	Tuesday October 25 2022
Culloden Line (CR 10) & Hwy 401 EB Ramps	TMC	Tuesday October 25 2022
Culloden Line (CR 10) & Ingersoll Street South / Hwy 401 WB Ramps	TMC	Tuesday October 25 2022
Harris Street (CR 119) & Clarke Road	TMC	Tuesday October 25 2022
Plank Line (Hwy 19) & Curry Road	TMC	Tuesday October 25 2022
Curry Road & Union Road	TMC	Tuesday October 25 2022
Culloden Line (CR 10) & Union Road	TMC	Tuesday October 25 2022
Ingersoll Street South (CR 10) & Clarke Road	TMC	Tuesday October 25 2022
Ingersoll Street South (CR 10) & Thompson Road	TMC	Tuesday October 25 2022
Ingersoll Street South (CR 10) & Thomas Street	TMC	Tuesday October 25 2022
Ingersoll Street South (CR 10) & King Street West (CR 9)	TMC	Tuesday October 25 2022
Thomas Road & Wallace Line	TMC	Tuesday October 25 2022
Wallace Line & Robinson Road	TMC	Tuesday October 25 2022

Notes: TMC = Turning Movement Counts

The TMC's collected automobile, heavy vehicle, cyclist, and pedestrian counts for the PM peak period (16:00 – 18:00) at the study area intersections. With reference to these counts, there is minimal existing pedestrian and cycling travel during the peak hour within the study area.

Figure 7 shows the existing peak hour vehicle demands at the key intersections in and around the South West Ingersoll Secondary Plan area, rounded to the nearest 5 vehicles. The peak hour counts were balanced wherever deemed appropriate.

Figure 7: Existing Traffic Volumes – PM Peak Hour



3.2 Existing Conditions Performance

3.2.1 Methodology

Level of service (LOS) and capacity analysis was completed using Trafficware's Synchro 11 software, which employs the 2000 Highway Capacity Manual (HCM 2000) methodology, and Transportation Research Laboratory's ARCADY 9. Only the PM peak hour has been assessed as it is the critical operating time period for the road network. Dillon incorporated existing traffic signal timing plans obtained from MTO to complete the analysis. Where possible, the signal timings were optimized during the analysis to improve intersection performance results.

3.2.2 Road Network Performance

Table 6, **Table 7** and **Table 8** display the results of the LOS and capacity analysis for signalized and unsignalized intersections. LOS, capacity, and delay are only given for the stop controlled movements at unsignalized intersections. The detailed Synchro and ARCADY operations reports for existing conditions are compiled in **Appendix A**.

Table 6: Existing: Overall Intersection Levels of Service – PM Peak Hour

Intersection	PM
	LOS
Culloden Road/Line @ Ingersoll Street/Highway 401 WB Ramps	A
Culloden Line @ Highway 401 EB Ramps	A
Wallace Line @ Thomas Road	A+
Wallace Line @ Robinson Road	A+
Ingersoll Street @ King Street W	B+
Ingersoll Street @ Thomas Street	B+
Ingersoll Street @ Clarke Road	A+
Ingersoll Street @ Thompson Road	B+
Union Road @ Culloden Line	B+
Union Road @ Curry Road	A+
Harris Street @ Clarke Road	D+
Harris Street/County Road 119 @ Highway 401 WB Ramps	A
Plank Line/Highway 19 @ Highway 401 EB Ramps	A
Plank Line/Highway 19 @ Curry Road	C+

Notes: +Unsignalized Intersection – Critical Movement

Table 7: Existing: Critical Movement, LOS and Capacity – PM Peak Hour (Signalized Intersections)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Culloden Road/Line @ Ingersoll Street/Highway 401 WB Ramps	EB left	0.18	B	15.4
	EB through	0.40	B	16.5
	EB right	0.15	A	0.2
	WB left	0.25	B	15.8
	WB through/right	0.17	B	15.0
	NB left	0.09	A	6.3
	NB through/right	0.23	A	6.9
	SB left	0.26	A	7.9
	SB through/right	0.28	A	7.7
	Overall	**0.32**	**A**	**8.7**
Culloden Line @ Highway 401 EB Ramps	EB approach	0.19	A	9.9
	NB left	0.12	A	7.8
	NB through	0.10	A	7.6
	SB through	0.35	A	8.7
	SB right	0.18	A	0.3
	Overall	**0.32**	**A**	**6.3**

Table 8: Existing: Critical Movement, LOS and Capacity – PM Peak Hour (Unsignalized Intersections)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Wallace Line @ Thomas Road	NB approach	0.01	A	8.7
Wallace Line @ Robinson Road	EB approach	0.02	A	8.6
Ingersoll Street @ King Street W	EB approach	0.29	B	11.6
	WB approach	0.43	B	12.6
	NB through	0.43	B	13.1
	NB right	0.06	A	7.8
	SB left	0.24	B	10.7
	SB through/right	0.29	B	10.7
Ingersoll Street @ Thomas Street	EB approach	0.09	B	11.7
	WB approach	0.12	B	11.7
Ingersoll Street @ Clarke Road	WB approach	0.03	A	9.3
Ingersoll Street @ Thompson Road	EB approach	0.12	B	10.6
Union Road @ Culloden Line	EB approach	0.00	A	0
	WB approach	0.02	B	10.6
Union Road @ Curry Road	SB approach	0.01	A	8.5
Harris Street @ Clarke Road	EB left	0.19	D	30.8
	EB through	0.43	C	20.3
	WB approach	0.36	C	23.9
Harris Street/County Road 119 @ Highway 401 WB Ramps*	WB approach	-	A	4.6
	NB approach	-	A	4.7
	SB approach	-	A	4.0
	Overall	**-**	**A**	**4.5**
Plank Line/Highway 19 @ Highway 401 EB Ramps*	EB approach	-	A	4.1
	NB approach	-	A	3.9
	SB approach	-	A	4.5
	Overall	**-**	**A**	**4.2**
Plank Line/Highway 19 @ Curry Road	EB approach	0.07	C	21.8
	WB approach	0.06	C	21.6

Notes: *Roundabout analysis conducted using ARCADY 9

Critical movements are identified as those with a volume to capacity (v/c) ratio of 0.85 and above and/or with a LOS F. There are presently no critical movements at any of the study intersections due to the low traffic volumes in the South West Ingersoll Secondary Plan area. There is limited demand on the local roads in the study area, including Wallace Line, Robinson Road, Union Road and Curry Road. Consequently, all movements operate at LOS B or better at all intersections between two local roads. Otherwise, no movement operates below a LOS D, and the greatest v/c ratio of any movement is 0.43. Ultimately, capacity and LOS are not presently of concern within the South West Ingersoll Secondary Plan area.

4.0 Future Background Conditions

This section provides an overview of the future background transportation conditions within the South West Ingersoll Secondary Plan area.

4.1 Forecasted Future Background Demand

4.1.1 Background Growth

The future conditions assessment was completed for 2046, the horizon year for the Oxford County Official Plan.

An average annual growth rate for background vehicle traffic volumes was estimated by considering the following data sources:

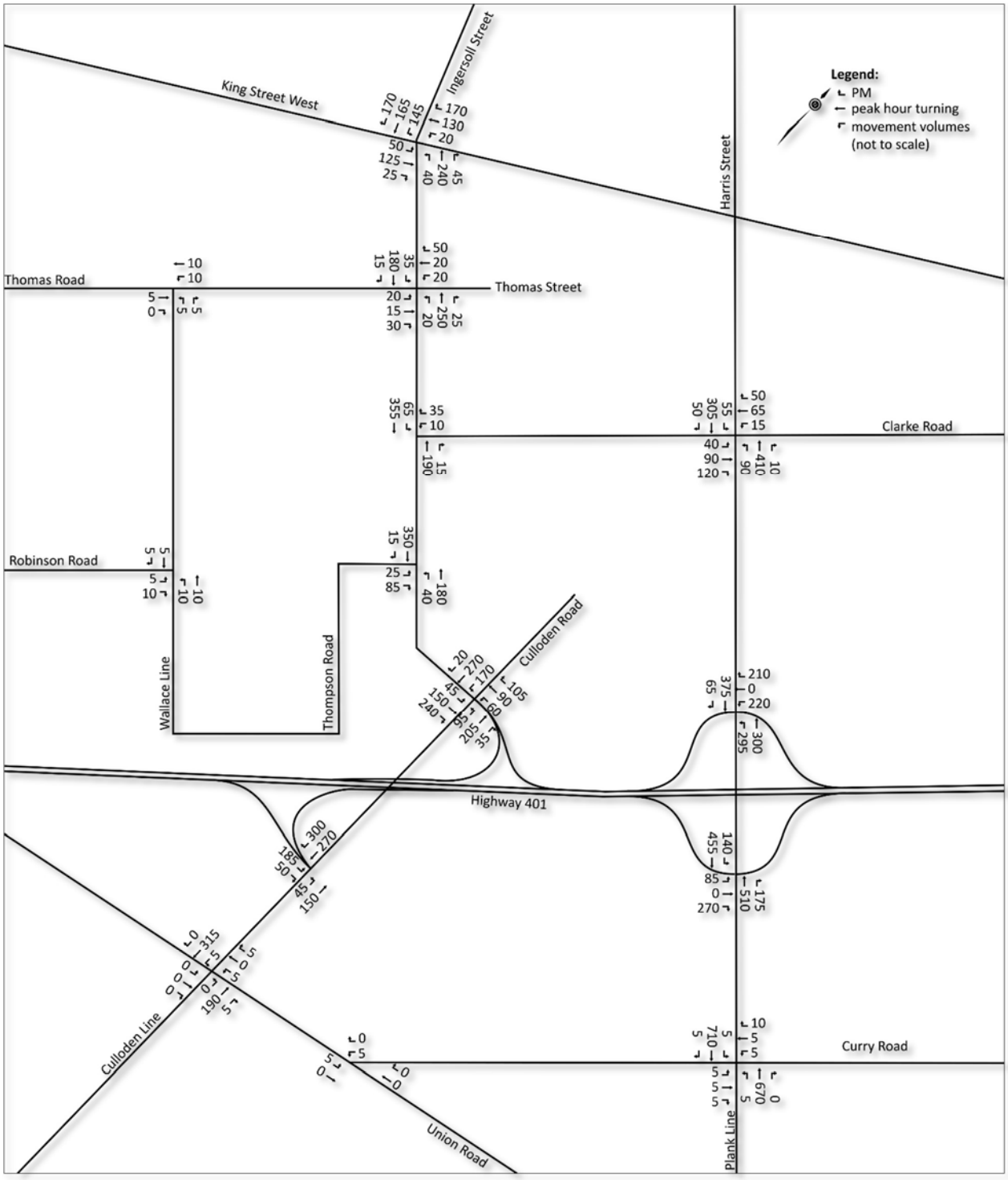
- The Oxford County Official Plan indicated a projected population growth of approximately 1.2% per year between 2016 and 2046;
- The Oxford County Official Plan indicated an employment growth rate of 1.0% per year between 2016 and 2046; and
- The 2016 Canadian Census showed a 1.4% annual growth rate for the Town of Ingersoll between 2016 and 2021.

A compound annual growth rate (CAGR) for background vehicle traffic volumes of 1% per annum was selected (for all auto movements) to project the 2046 future background traffic volumes. This growth rate is believed to be conservative as it only needs to account for growth outside of the Secondary Plan area. In reality much of the growth within the Town of Ingersoll will be occurring within the South West Ingersoll Secondary Plan area.

4.1.2 Future Background Volumes

Figure 8 shows the 2046 future background traffic demands at the key intersections in and around the South West Ingersoll study area with the assumed 1% annual growth rate applied.

Figure 8: Future Background (2046) Traffic Volumes – PM Peak Hour



4.2 Future Background Performance

4.2.1 Assumptions

The intersection analysis was completed based on the following assumptions:

- Signal splits were optimized under the assumption that signal timings will change in the coming years to allow the intersections to operate as efficiently as possible; and
- Peak Hour Factors (PHFs) were adjusted to 1.00 for all intersections given the intended purpose (establishing infrastructure requirements) of the analysis. A PHF of 1.00 implies that traffic levels are evenly spread out over the whole hour, which is the case for intersections that are near capacity within the peak hour.

4.2.2 Road Network Performance

4.2.2.1 Intersection Level of Service and Capacity Analysis

Table 9, **Table 10** and **Table 11** display the results of the LOS and capacity analysis for signalized and unsignalized intersections. LOS, capacity, and delay are only given for the stop-controlled movements at unsignalized intersections. The detailed Synchro and ARCADY operations reports for future background conditions are compiled in **Appendix B**.

Table 9: Future Background (2046): Overall Intersection Levels of Service – PM Peak Hour

Intersection	Existing	2046 FB
	LOS	
Culloden Road/Line @ Ingersoll Street/Highway 401 WB Ramps	A	A
Culloden Line @ Highway 401 EB Ramps	A	A
Wallace Line @ Thomas Road	A+	A+
Wallace Line @ Robinson Road	A+	A+
Ingersoll Street @ King Street W	B+	C+
Ingersoll Street @ Thomas Street	B+	B+
Ingersoll Street @ Clarke Road	A+	A+
Ingersoll Street @ Thompson Road	B+	B+
Union Road @ Culloden Line	B+	B+
Union Road @ Curry Road	A+	A+
Harris Street @ Clarke Road	D+	F+
Harris Street/County Road 119 @ Highway 401 WB Ramps	A	A
Plank Line/Highway 19 @ Highway 401 EB Ramps	A	A
Plank Line/Highway 19 @ Curry Road	C+	D+

Notes: +Unsignalized Intersection – Critical Movement

Table 10: Future Background (2046): Critical Movement, LOS and Capacity – PM Peak Hour (Signalized Intersections)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Culloden Road/Line @ Ingersoll Street/Highway 401 WB Ramps	EB left	0.19	B	16.9
	EB through	0.40	B	18.0
	EB right	0.17	A	0.3
	WB left	0.27	B	17.4
	WB through/right	0.18	B	16.5
	NB left	0.11	A	6.8
	NB through/right	0.25	A	7.5
	SB left	0.30	A	8.8
	SB through/right	0.32	A	8.5
	Overall	**0.34**	**A**	**9.6**
Culloden Line @ Highway 401 EB Ramps	EB approach	0.17	B	11.5
	NB left	0.14	B	10.7
	NB through	0.11	B	10.4
	SB through	0.38	B	12.1
	SB right	0.21	A	0.3
	Overall	**0.33**	**A**	**8.1**

Table 11: Future Background (2046): Critical Movement, LOS and Capacity – PM Peak Hour (Unsignalized Intersections)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Wallace Line @ Thomas Road	NB approach	0.01	A	8.8
Wallace Line @ Robinson Road	EB approach	0.01	A	8.6
Ingersoll Street @ King Street W	EB approach	0.38	B	13.8
	WB approach	0.54	C	16.1
	NB through	0.55	C	17.1
	NB right	0.08	B	8.5
	SB left	0.30	B	12.3
	SB through	0.38	B	12.9
Ingersoll Street @ Thomas Street	EB approach	0.12	B	12.7
	WB approach	0.16	B	12.8
Ingersoll Street @ Clarke Road	WB approach	0.06	A	9.9
Ingersoll Street @ Thompson Road	EB approach	0.17	B	11.6
Union Road @ Culloden Line	EB approach	0.00	A	0
	WB approach	0.02	B	11.0
Union Road @ Curry Road	SB approach	0.01	A	8.4
Harris Street @ Clarke Road	EB left	0.35	F	52.1
	EB through	0.61	D	30.9
	WB approach	0.59	E	43.0
Harris Street/County Road 119 @ Highway 401 WB Ramps*	WB approach	-	A	5.7
	NB approach	-	A	5.7
	SB approach	-	A	4.9
	Overall	**-**	**A**	**5.5**
Plank Line/Highway 19 @ Highway 401 EB Ramps*	EB approach	-	A	4.7
	NB approach	-	A	4.6
	SB approach	-	A	5.5
	Overall	**-**	**A**	**4.9**
Plank Line/Highway 19 @ Curry Road	EB approach	0.09	D	29.6
	WB approach	0.10	D	25.5

Notes: *Roundabout analysis conducted using ARCADY 9

Critical movements are identified as those with a volume to capacity (v/c) ratio of 0.85 and above and/or with a LOS F. The only critical movement under future background conditions is the eastbound left at the intersection of Harris Street and Clarke Road. However, no mitigation is proposed under future background conditions as the movements delay (52.1 seconds) only exceed the threshold for becoming critical by 2.1 seconds and the movement has a low v/c ratio of 0.35. All other movements at study intersections operate at a LOS D or better. Ultimately, capacity and LOS are not of concern at the study intersections under future background conditions within the South West Ingersoll Secondary Plan area.

5.0 Proposed Development Concept

This section introduces and provides an overview of the proposed development concept of the South West Ingersoll Secondary Plan area and future transportation network.

5.1 Proposed Development

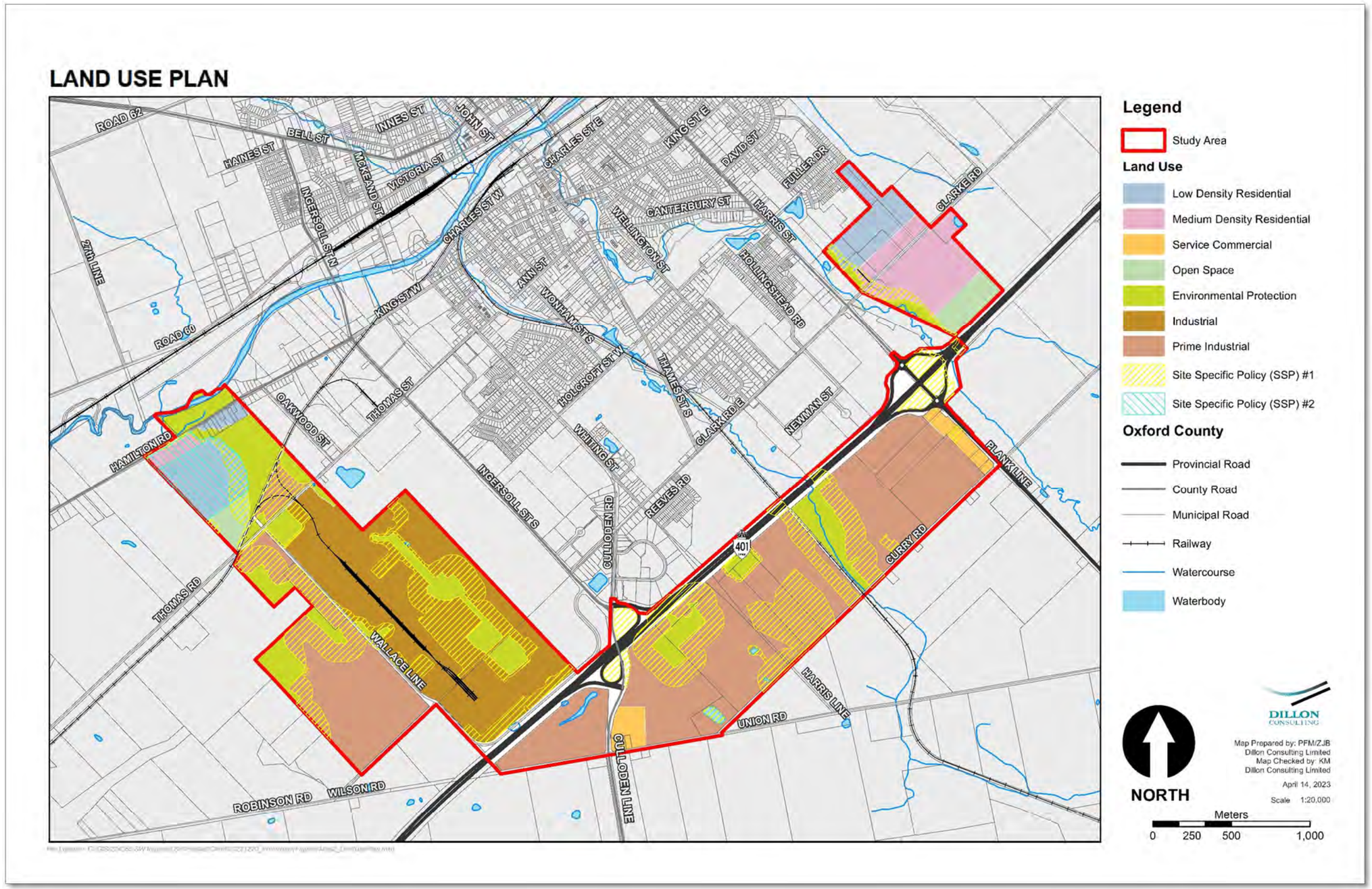
The proposed development is approximately 623 hectares that was subdivided into three development blocks, East of Ingersoll (east of Harris Street), South of Ingersoll (south of Highway 401), and West of Ingersoll (west of Ingersoll Street and north of Highway 401). **Figure 9** presents the South West Ingersoll Land Use Plan.

The proposed development blocks are broken down by land use and the proposed number of residential units and jobs at full build out in **Table 12**.

Table 12: Proposed Land Use Composition by Development Block

Development Block	Land Use	Residential Units	Jobs
East of Ingersoll	Low Density Residential	200	-
	Medium Density Residential	761	-
Sub-total: East of Ingersoll		***960***	***0***
South of Ingersoll	Prime Industrial	-	2,215
	Service Commercial	-	429
Sub-total: South of Ingersoll		***0***	***2,643***
West of Ingersoll	Low Density Residential	250	-
	Medium Density Residential	90	-
	Prime Industrial	-	2,290
Sub-total: West of Ingersoll		***340***	***2,290***
Total		**1,301**	**4,933**

Figure 9: Land Use Plan



5.2 Transportation Network

Proposed modifications to the existing transportation network are included as part of the proposed development concept. **Figure 10** and **Figure 11** presents the proposed Transportation Network and Proposed Public Realm Improvements and Active Transportation Network as part of this development concept.

Capital cost estimates are compiled in **Appendix H**.

Figure 10: Proposed Transportation Network

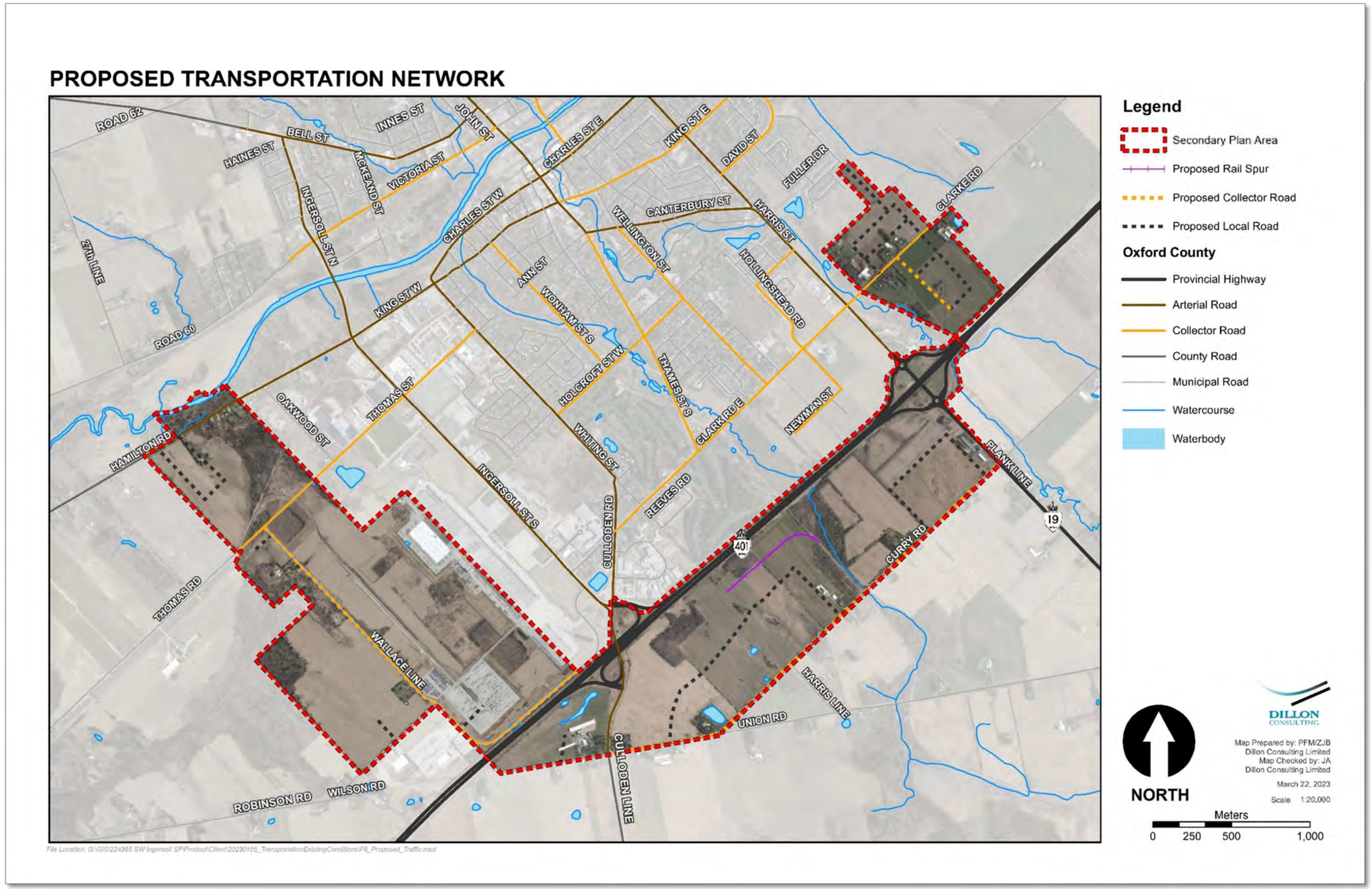
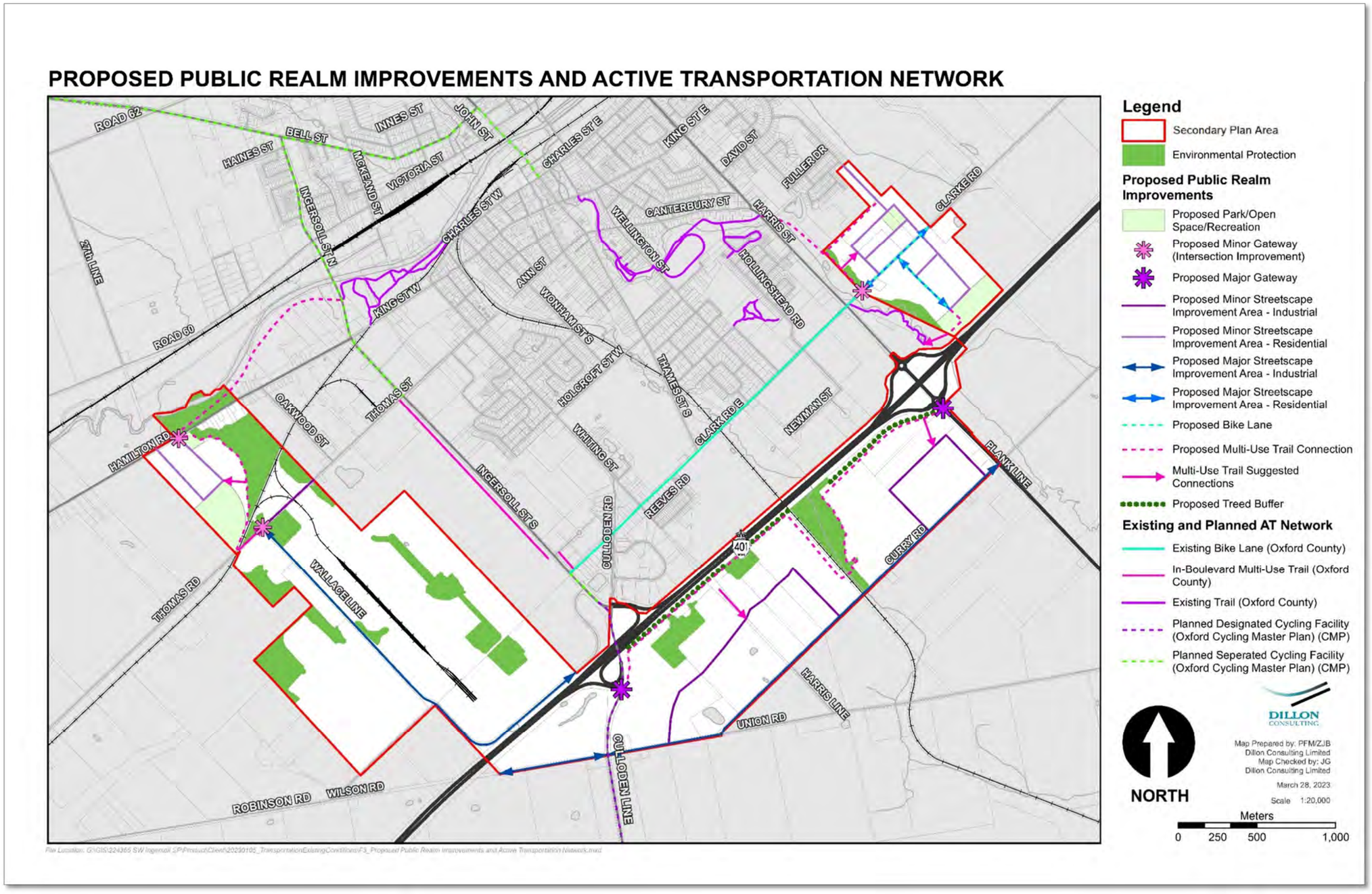


Figure 11: Proposed Public Realm Improvements and Active Transportation Network



6.0 Site Generated Trips

Each of the development blocks within the proposed development concept will generate and attract new vehicle trips.

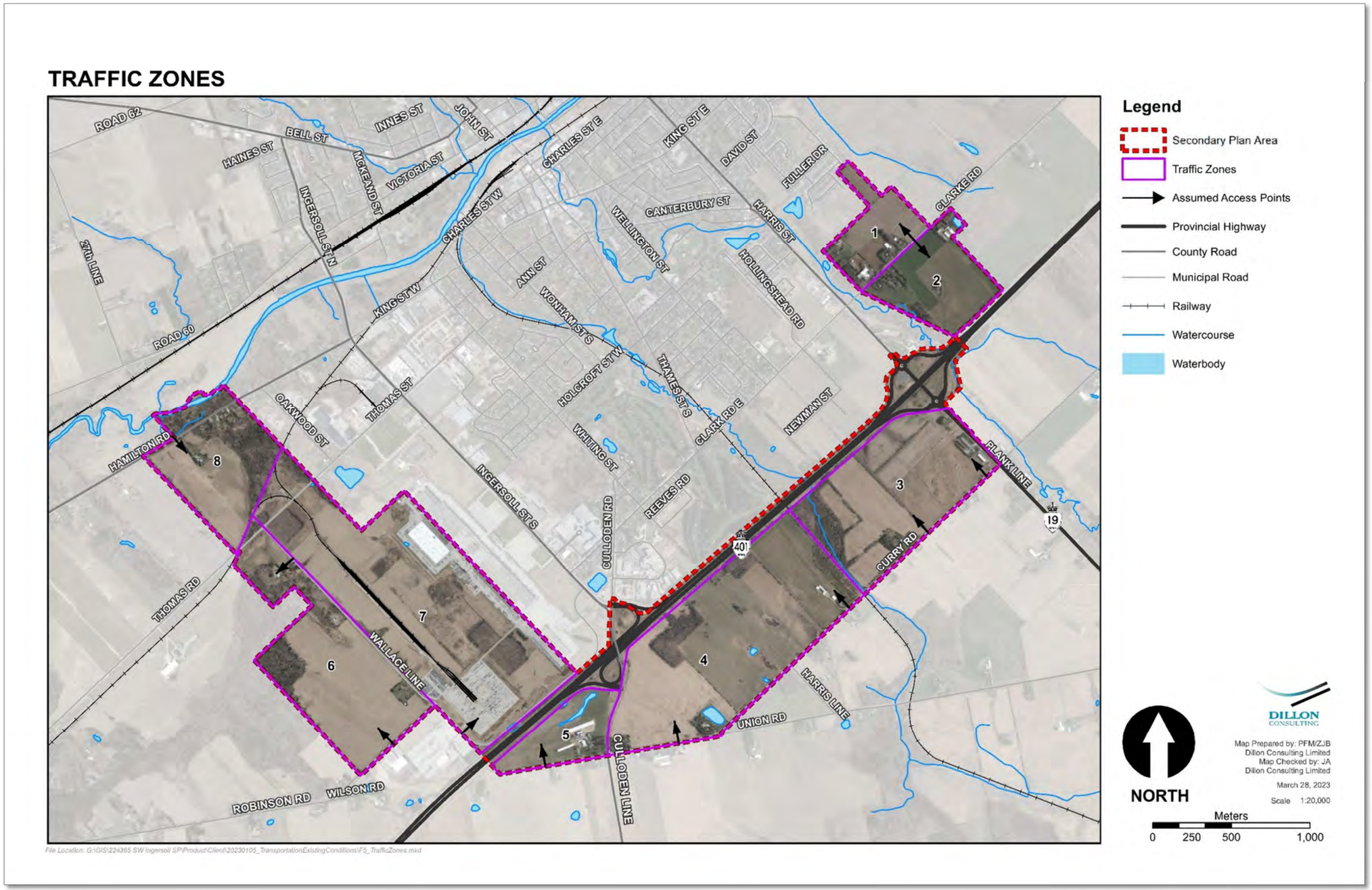
For ease of analysis, the South West Ingersoll Secondary Plan area was subdivided into eight Traffic Analysis Zones based on the existing transportation network, access points, physical barriers and the proposed development concept. The Traffic Zones and assumed access points are displayed in **Figure 12.** It should be noted that no direct access onto Culloden Line (County Road 10) or Plank Line (Highway 19) is being proposed.

The Traffic Zones are broken down by land use and the proposed number of residential units and jobs at full build out in **Table 13**.

Table 13: Proposed Land Use Composition by Traffic Zone

Traffic Zone	Land Use	Residential Units	Jobs
1	Low Density Residential	200	-
	Medium Density Residential	152	-
2	Low Density Residential	-	-
	Medium Density Residential	609	-
3	Prime Industrial	-	443
	Service Commercial	-	300
4	Prime Industrial	-	1,108
	Service Commercial	-	129
5	Prime Industrial	-	665
6	Prime Industrial	-	916
7	Prime Industrial	-	1,145
8	Low Density Residential	250	-
	Medium Density Residential	90	-
	Prime Industrial	-	229
Total		**1,301**	**4,933**

Figure 12: Traffic Zones and Assumed Access



6.1 Trip Generation

Dillon used the Institute of Transportation Engineers (ITE) Trip Generation Manual, 11th Edition, to estimate the vehicle trips generated by the proposed development. The rates used were for land uses that were assumed to be closest to the proposed development land use classifications. The trip generation rates used are summarized in **Table 14**.

Table 14: Vehicle Trip Generation Rates by Land Use Type – PM Peak Hour

Land Use Classification	Unit	PM Peak Hour Rate	Split		Source
			In	Out	
Low density residential	Vehicle trips per dwelling unit	0.99	64%	36%	ITE 11th Ed, Land Use 210 – *Single family detached housing*
Medium density residential	Vehicle trips per dwelling unit	0.61	62%	38%	ITE 11th Ed, Land Use 215 – *Single family attached housing*
Prime industrial	Vehicle trips per employee	0.42	50%	50%	ITE 11th Ed, Land Use 130 – *Industrial Park*
Service commercial*	Vehicle trips per employee	1.22	37%	63%	ITE 11th Ed, Land Use 932 – *High Turnover Restaurant* ITE 11th Ed, Land Use 943 – *Automobile parts & service centre* ITE 11th Ed, Land Use 710 - *General office building*

Notes: *The service commercial trip generation rate was created as a combination of the three identified land uses

The final PM peak hour generated trips by land use for each of the traffic zones are shown in **Table 15**.

Table 15: Person Trips by Traffic Zone and Land Use – PM Peak Hour

Traffic Zone	Residential		Industrial		Commercial		Total	
	In	Out	In	Out	In	Out	In	Out
1	184	107	0	0	0	0	184	107
2	230	141	0	0	0	0	230	141
3	0	0	93	93	186	179	279	272
4	0	0	233	233	80	77	312	309
5	0	0	140	140	0	0	140	140
6	0	0	192	192	0	0	192	192
7	0	0	240	240	0	0	240	240
8	192	110	48	48	0	0	241	158
Total	607	358	946	946	266	256	**1,819**	**1,560**

6.2 Trip Distribution

To determine the trip distribution for the South West Ingersoll study area, Dillon considered existing travel conditions, looking at percentage of vehicles entering and exiting the study area in each direction. Intersection turning movement counts were used as a guide in determining general travel patterns of vehicles within Ingersoll. The assumed trip distribution for trips originating in/destined to the study area is shown in **Table 16**.

Table 16: Trip Distribution based on Existing Travel Patterns

Direction of Travel	Proportion of Trips
North	25%
South	25%
East	35%
West	15%

6.3 Trip Assignment

The assignment of site trips to the road network was assumed to follow existing traffic patterns and using the most efficient and direct route into and out of each traffic zone. **Table 17** shows the distribution of trips to specific routes as used for the assignment.

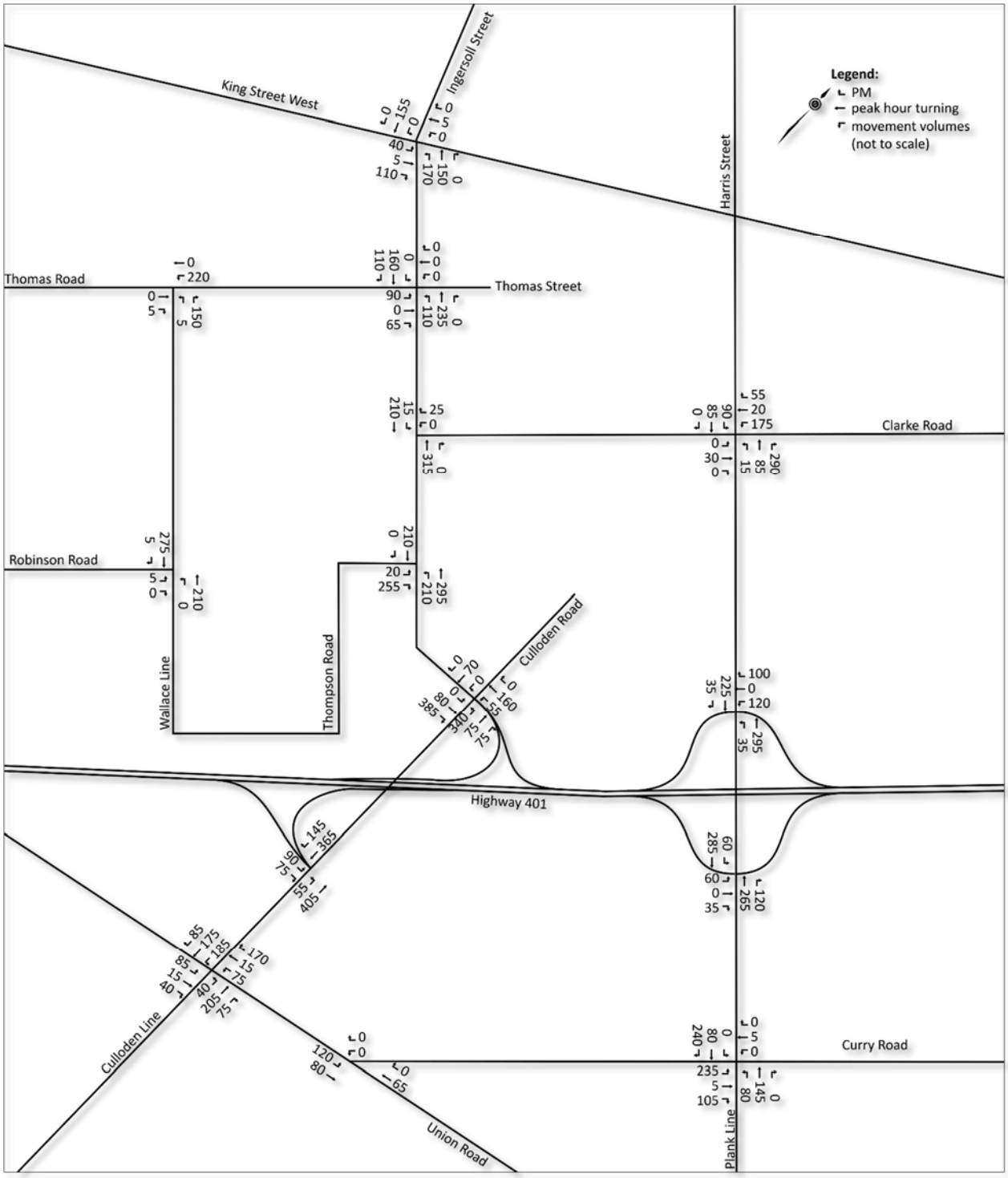
Table 17: Site Trip Directional Distribution by likely Travel Route

Traffic Zone	Travel Route	Distribution			
		North	East	South	West
		15%	45%	5%	35%
1 & 2	North via Ingersoll Street	15%			
	North via Harris Street	85%			
	North via Culloden Road	0%			
	East via Clarke Road		5%		
	East via Highway 401 at Plank Line		95%		
	East via Highway 401 at Culloden Road		0%		
	East via Curry Road		0%		
	South via Culloden Road			10%	
	South via Plank Line			90%	
	West via Thomas Road				0%
	West via Robinson Road				0%
	West via Highway 401 at Plank Line				100%
	West via Highway 401 at Culloden Road				0%
3	North via Ingersoll Street	10%			
	North via Harris Street	80%			
	North via Culloden Road	10%			
	East via Clarke Road		0%		
	East via Highway 401 at Plank Line		95%		
	East via Highway 401 at Culloden Road		0%		
	East via Curry Road		5%		
	South via Culloden Road			20%	
	South via Plank Line			80%	
	West via Thomas Road				0%
	West via Robinson Road				0%
	West via Highway 401 at Plank Line				80%
	West via Highway 401 at Culloden Road				20%
4	North via Ingersoll Street	20%			
	North via Harris Street	30%			
	North via Culloden Road	50%			
	East via Clarke Road		0%		
	East via Highway 401 at Plank Line		70%		
	East via Highway 401 at Culloden Road		25%		
	East via Curry Road		5%		
	South via Culloden Road			50%	
	South via Plank Line			50%	
	West via Thomas Road				0%
	West via Robinson Road				0%
	West via Highway 401 at Plank Line				0%
	West via Highway 401 at Culloden Road				100%

Traffic Zone	Travel Route	Distribution			
		North	East	South	West
		15%	45%	5%	35%
5	North via Ingersoll Street	30%			
	North via Harris Street	20%			
	North via Culloden Road	50%			
	East via Clarke Road		0%		
	East via Highway 401 at Plank Line		0%		
	East via Highway 401 at Culloden Road		100%		
	East via Curry Road		0%		
	South via Culloden Road			80%	
	South via Plank Line			20%	
	West via Thomas Road				0%
	West via Robinson Road				0%
	West via Highway 401 at Plank Line				0%
	West via Highway 401 at Culloden Road				100%
6 & 7	North via Ingersoll Street	100%			
	North via Harris Street	0%			
	North via Culloden Road	0%			
	East via Clarke Road		0%		
	East via Highway 401 at Plank Line		0%		
	East via Highway 401 at Culloden Road		100%		
	East via Curry Road		0%		
	South via Culloden Road			80%	
	South via Plank Line			20%	
	West via Thomas Road				5%
	West via Robinson Road				5%
	West via Highway 401 at Plank Line				0%
	West via Highway 401 at Culloden Road				90%
8	North via Ingersoll Street	100%			
	North via Harris Street	0%			
	North via Culloden Road	0%			
	East via Clarke Road		0%		
	East via Highway 401 at Plank Line		0%		
	East via Highway 401 at Culloden Road		90%		
	East via Curry Road		0%		
	South via Culloden Road		10%		
	South via Plank Line			80%	
	West via Thomas Road			20%	
	West via Robinson Road				0%
	West via Highway 401 at Plank Line				0%
	West via Highway 401 at Culloden Road				10%
	North via Ingersoll Street				90%

Based on the assumptions outlined in **Table 17**, the traffic volumes generated by the proposed development concept were assigned to the network. This is shown in **Figure 13.**

Figure 13: Site Generated Traffic Volumes – PM Peak Hour



7.0 Total Future Conditions

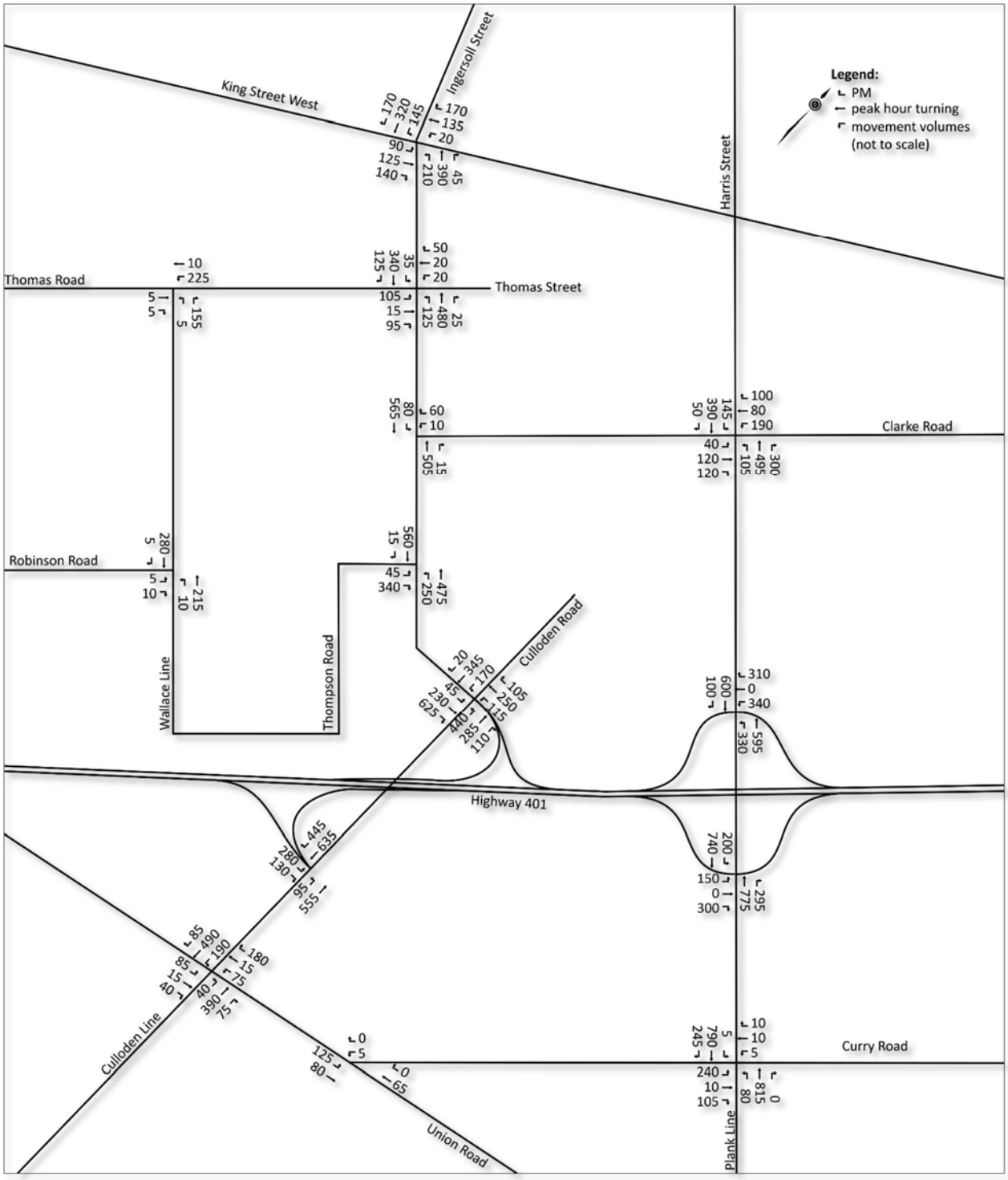
This section provides an overview of the total future transportation conditions within the South West Ingersoll Secondary Plan area and identifies the necessary infrastructure improvements required to support the development of the South West Ingersoll Secondary Plan area.

7.1 Forecasted Total Future Demand

The total future conditions combine the anticipated future background traffic growth and the site trips generated by the proposed South West Ingersoll Secondary Plan development concept.

The combined future total anticipated traffic in shown in **Figure 14.**

Figure 14: Total Future (2046) Traffic Volumes – PM Peak Hour



7.2 Total Future Performance

7.2.1 Assumptions

The intersection analysis was completed based on the following assumptions:

- Signal splits were optimized under the assumption that signal timings will change in the coming years to allow the intersections to operate as efficiently as possible; and
- Peak Hour Factors (PHFs) were adjusted to 1.00 for all intersections given the intended purpose (establishing infrastructure requirements) of the analysis. A PHF of 1.00 implies that traffic levels are evenly spread out over the whole hour, which is the case for intersections that are near capacity within the peak hour.

7.2.2 Road Network Performance

7.2.2.1 Intersection Level of Service and Capacity Analysis

Table 18 and **Table 19** display the results of the LOS and capacity analysis for the total future unmitigated conditions. **Table 18** displays the overall unmitigated intersection LOS for the PM peak hour, while **Table 19** displays the unmitigated results of the LOS and capacity analysis for signalized and unsignalized intersections for the PM peak hour. LOS, capacity, and delay are only given for the stop-controlled movements at unsignalized intersections.

The detailed Synchro and ARCADY operations reports for the unmitigated total future conditions can be found in **Appendix C**.

Table 18: Total Future (2046): Overall Intersection Levels of Service – PM Peak Hour (Unmitigated)

Intersection	2046 FB	2046 TF Unmitigated
	LOS	
Culloden Road/Line @ Ingersoll Street/Highway 401 WB Ramps	A	B
Culloden Line @ Highway 401 EB Ramps	A	B
Wallace Line @ Thomas Road	A+	A+
Wallace Line @ Robinson Road	A+	B+
Ingersoll Street @ King Street W	C+	F+
Ingersoll Street @ Thomas Street	B+	F+
Ingersoll Street @ Clarke Road	A+	B+
Ingersoll Street @ Thompson Road	B+	F+
Union Road @ Culloden Line	B+	F+
Union Road @ Curry Road	A+	A+
Harris Street @ Clarke Road	F+	F+
Harris Street/County Road 119 @ Highway 401 WB Ramps	A	B
Plank Line/Highway 19 @ Highway 401 EB Ramps	A	A
Plank Line/Highway 19 @ Curry Road	D+	F+

Notes: +Unsignalized Intersection – Critical Movement

Table 19: Total Future (2046): Critical Movement, LOS and Capacity – PM Peak Hour (Unmitigated)

Intersection	Movement	2046 FB			2046 TF - Unmitigated		
		v/c	LOS	Delay *(s/veh)*	v/c	LOS	Delay *(s/veh)*
Culloden Road/Line @ Ingersoll Street/Highway 401 WB Ramps	EB left	0.19	B	16.9	0.22	C	20.8
	EB through	0.40	B	18.0	0.59	C	24.5
	EB right	0.17	A	0.3	0.41	A	0.8
	WB left	0.27	B	17.4	0.50	C	23.5
	WB through/right	0.18	B	16.5	0.39	C	21.4
	NB left	0.11	A	6.8	0.42	A	8.7
	NB through/right	0.25	A	7.5	0.38	A	8.5
	SB left	0.30	A	8.8	0.31	A	9.3
	SB through/right	0.32	A	8.5	0.36	A	9.0
	Overall	**0.34**	**A**	**9.6**	**0.53**	**B**	**10.7**
Culloden Line @ Highway 401 EB Ramps	EB approach	0.19	B	11.7	0.28	B	13.3
	NB left	0.15	B	10.5	0.61	C	20.1
	NB through	0.12	B	10.4	0.37	B	11.4
	SB through	0.41	B	12.3	0.81	C	20.6
	SB right	0.23	B	11.1	0.30	A	0.5
	Overall	**0.31**	**B**	**12.7**	**0.62**	**B**	**12.6**
Wallace Line @ Thomas Road	NB approach	0.01	A	8.8	0.15	A	9.1
Wallace Line @ Robinson Road	EB approach	0.01	A	8.6	0.02	B	10.7
Ingersoll Street @ King Street W	EB approach	0.38	B	13.8	0.87	E	48.3
	WB approach	0.54	C	16.1	0.80	E	38.8
	NB through/left	0.55	C	17.1	1.54	F	279.9
	NB right	0.08	B	8.5	0.10	B	11.1
	SB left	0.30	B	12.3	0.38	B	17.1
	SB through/right	0.38	B	12.9	1.03	F	81.4
Ingersoll Street @ Thomas Street	EB approach	0.12	B	12.7	0.97	F	99.7
	WB approach	0.16	B	12.8	0.42	D	33.3
Ingersoll Street @ Clarke Road	WB approach	0.06	A	9.9	0.12	B	12.2
Ingersoll Street @ Thompson Road	EB approach	0.17	B	11.6	0.91	F	55.9
Union Road @ Culloden Line	EB approach	0.00	A	0	3.11	F	Err
	WB approach	0.02	B	11.0	1.97	F	509
Union Road @ Curry Road	SB approach	0.01	A	8.4	0.09	A	4.9
Harris Street @ Clarke Road	EB left	0.35	F	52.1	Err	F	Err
	EB through/right	0.61	D	30.9	1.96	F	518
	WB approach	0.59	E	43.0	Err	F	Err
Harris Street/County Road 119 @ Highway 401 WB Ramps*	WB approach	-	A	5.7	-	B	12.5
	NB approach	-	A	5.7	-	B	12.0
	SB approach	-	A	4.9	-	A	9.3
	Overall	**-**	**A**	**5.5**	**-**	**B**	**11.3**
Plank Line/Highway 19 @ Highway 401 EB Ramps*	EB approach	-	A	4.7	-	A	7.5
	NB approach	-	A	4.6	-	A	8.8
	SB approach	-	A	5.5	-	B	11.7
	Overall	**-**	**A**	**4.9**	**-**	**A**	**9.7**
Plank Line/Highway 19 @ Curry Road	EB approach	0.09	D	29.6	Err	F	Err
	WB approach	0.10	D	25.5	0.64	F	185.7

Notes: *Roundabout analysis conducted using ARCADY 9
"Err" indicates a delay or v/c ratio that is too high to be accurately calculated.

7.2.3 Intersection Improvements

As noted in **Table 19**, the following intersections are expected to experience a poor level of service under future total conditions and will require mitigation strategies:

- Ingersoll Street @ King Street West;
- Ingersoll Street @ Thomas Street;
- Ingersoll Street @ Thompson Road;
- Union Road @ Culloden Line;
- Harris Street @ Clarke Road; and
- Plank Line @ Curry Road.

7.2.3.1 Ingersoll Street and King Street West

The intersection of Ingersoll Street at King Street West is a four legged, all-way stop controlled intersection. The east and west approaches on King Street West provide a single shared turning/through lane, while the north approach on Ingersoll Street has a dedicated left turn lane and a shared through/right turn lane and the south approach on Ingersoll Street has a dedicated right turn lane and a shared through/left turn lane. With the existing infrastructure and lane arrangements, the intersection of Ingersoll Street and King Street West is expected to perform poorly under 2046 future total conditions, will all four approaches close too or above capacity with a LOS F.

Based on the forecasted traffic volumes, it is recommended that the existing stop-controlled intersection be upgraded to a signalized intersection. The requirement for traffic signal control was assessed using 'Justification 7 – Projected Volumes' from the Ontario Traffic Manual (OTM) signal warrant guidelines[3]. The analysis indicates that signals are warranted at the intersection of Ingersoll Street and King Street West.

The signal warrant analysis worksheets can be found in **Appendix D**.

Table 20 displays the results of the LOS and capacity analysis for the total future conditions at the intersection of Ingersoll Street and King Street West after the traffic control mechanism was upgraded to signalization.

[3] Ontario Traffic Manual Book 12 – Traffic Signals, March 2012.

Table 20: Total Future (2046): Ingersoll Street and King Street West – PM Peak Hour (Mitigated – Signalization)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Ingersoll Street @ King Street W	EB approach	0.93	D	54.4
	WB approach	0.57	C	21.8
	NB through/left	0.82	C	20.3
	NB right	0.03	A	55.6
	SB left	0.39	B	10.1
	SB through	0.38	A	8.1
	Overall	**0.85**	**C**	**23.2**

The detailed Synchro operations reports for the mitigated (signalization) total future conditions can be found in **Appendix E**.

To further accommodate the increased volume of northbound traffic turning left, it is recommended that the existing northbound lane configuration is updated. The existing northbound shared through/left turn lane should be converted to a designated left turn lane, and the existing right turn lane should become a shared through/right turn lane.

Table 21 displays the results of the LOS and capacity analysis for the total future conditions at the intersection of Ingersoll Street and King Street West after the traffic control mechanism was upgraded to signalization and lane modifications were applied.

Table 21: Total Future (2046): Ingersoll Street and King Street West – PM Peak Hour (Mitigated – Signalization + Lane Modification)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Ingersoll Street @ King Street W	EB approach	0.70	B	18.8
	WB approach	0.46	B	13.4
	NB left	0.49	B	11.5
	NB through/right	0.47	A	9.4
	SB left	0.35	A	9.3
	SB through	0.45	A	9.1
	Overall	**0.57**	**B**	**12.0**

The detailed Synchro operations reports for the mitigated (signalization + lane modifications) total future conditions can be found in **Appendix F**.

Capital cost estimates are compiled in **Appendix H**.

7.2.3.2 Ingersoll Street and Thomas Street

The intersection of Ingersoll Street and Thomas Street is a four-legged, two-way stop controlled intersection, with stop control on Thomas Street. The east and west approaches on Thomas Street provide a single shared turning/through lane, while the north and south approaches on Ingersoll Street each have a through/left and a through/right lane. With the existing infrastructure and configuration, the intersection of Ingersoll Street and Thomas Street is expected to perform poorly under 2046 future total conditions, will the eastbound approach over capacity with a LOS F.

Based on the forecasted traffic volumes, it is recommended that the existing stop-controlled intersection be upgraded to a signalized intersection. The requirement for traffic signal control was assessed using 'Justification 7 – Projected Volumes' from the Ontario Traffic Manual (OTM) signal warrant guidelines[4]. The analysis indicates that signals are warranted at the intersection of Ingersoll Street and Thomas Street.

The signal warrant analysis worksheets can be found in **Appendix D**.

Table 22 displays the results of the LOS and capacity analysis for the total future conditions at the intersection of Ingersoll Street and Thomas Street after the traffic control mechanism was upgraded to signalization.

Table 22: Total Future (2046): Plank Line and Curry Road – PM Peak Hour (Mitigated – Signalization)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Ingersoll Street @ Thomas Street	EB approach	0.46	B	14.2
	WB approach	0.15	B	12.3
	NB approach	0.43	A	6.2
	SB approach	0.28	A	5.2
	Overall	**0.44**	**A**	**7.4**

The detailed Synchro operations reports for the mitigated (signalization) total future conditions can be found in **Appendix E**.

Capital cost estimates are compiled in **Appendix H**.

7.2.3.3 Ingersoll Street and Thompson Road

The intersection of Ingersoll Street and Thompson Road is a three-legged, two-way stop-controlled intersection, with stop control on Thompson Road. The eastbound approach on Thompson Road provides a shared left-and-right-turn lane, while the northbound approach on Ingersoll Street has an auxiliary left turn lane and two through lanes and the southbound approach on Ingersoll Street has a

[4] Ontario Traffic Manual Book 12 – Traffic Signals, March 2012.

through lane and a through/right lane. With the existing infrastructure and lane arrangements, the intersection of Ingersoll Street and Thompson Road is expected to perform poorly under 2046 future total conditions, will the stop-controlled approach over capacity with a LOS F.
Based on the forecasted traffic volumes, it is recommended that the existing stop-controlled intersection be upgraded to a signalized intersection. The requirement for traffic signal control was assessed using 'Justification 7 – Projected Volumes' from the Ontario Traffic Manual (OTM) signal warrant guidelines[5]. The analysis indicates that signals are not warranted at the intersection of Ingersoll Street and Thompson Road. Projected volumes signal warrant analysis (Justification 7), is considered to be extremely conservative as the justification must be satisfied to 120%. The intersection should be reassessed for signal eligibility closer to the horizon year.

The signal warrant analysis worksheets can be found in **Appendix D**.

To improve operations without signalization it is recommended that the eastbound approach be reconfigured to provide a principal right turn lane and an auxiliary left-turn lane. The eastbound right-turn lane will operate at a LOS B, and the eastbound left turn will continue to operate at a LOS F, however the v/c ratio would be reduced from 0.91 to 0.42.

Table 23 displays the results of the LOS and capacity analysis for the total future conditions where the additional lane modifications have been applied.

Table 23: Total Future (2046): Ingersoll Street and Thompson Road – PM Peak Hour (Lane Modification)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Ingersoll Street @ Thompson Road	EB left EB right	0.42 0.49	F B	61.7 15.0

The detailed Synchro operations reports for the mitigated (lane modifications) total future conditions can be found in **Appendix G**.

Capital cost estimates are compiled in **Appendix H**.

7.2.3.4 Union Road and Culloden Line

The intersection of Union Road and Culloden Line is a four-legged, two-way stop-controlled intersection, with stop control on Union Road. All approaches provide a shared turning/through lane. With the existing infrastructure and lane arrangements, the intersection of Union Road with Culloden Line is expected to perform poorly under 2046 future total conditions, with both of the stop-controlled approaches over capacity with a LOS F.

[5] Ontario Traffic Manual Book 12 – Traffic Signals, March 2012.

Based on the forecasted traffic volumes, it is recommended that the existing stop-controlled intersection be upgraded to a signalized intersection. The requirement for traffic signal control was assessed using 'Justification 7 – Projected Volumes' from the Ontario Traffic Manual (OTM) signal warrant guidelines[6]. The analysis indicates that signals are warranted at the intersection of Union Road and Culloden Line.

The signal warrant analysis worksheets can be found in **Appendix D**.

Table 24 displays the results of the LOS and capacity analysis for the total future conditions at the intersection of Union Road and Culloden Line after the traffic control mechanism was upgraded to signalization.

Table 24: Total Future (2046): Union Road and Culloden Line – PM Peak Hour (Mitigated – Signalization)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Union Road @ Culloden Line	EB approach	0.73	D	44.0
	WB approach	0.64	C	34.1
	NB approach	0.44	A	6.2
	SB approach	0.77	B	13.1
	Overall	**0.76**	**B**	**17.0**

The detailed Synchro operations reports for the mitigated (signalization) total future conditions can be found in **Appendix E**.

To further accommodate the increased traffic volumes traveling to and from Union Road, it is recommended that auxiliary left-turn lanes, both northbound and southbound, be constructed on Culloden Line. The addition of the left-turn lanes not only improve traffic operations but also improve safety at the intersection by providing physical separation between the left turning vehicles that are slowing or stopped and the through traffic at the approach to the intersection.

Table 25 displays the results of the LOS and capacity analysis for the total future conditions at the intersection of Union Road and Culloden Line after the traffic control mechanism was upgraded to signalization and lane modifications were applied.

[6] Ontario Traffic Manual Book 12 – Traffic Signals, March 2012.

Table 25: Total Future (2046): Union Road and Culloden Line – PM Peak Hour (Mitigated – Signalization + Lane Modification)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Union Road @ Culloden Line	EB approach	0.43	B	17.8
	WB approach	0.38	B	17.1
	NB left	0.10	A	4.8
	NB through/right	0.43	A	6.8
	SB left	0.37	A	7.3
	SB through/right	0.53	A	7.8
	Overall	**0.50**	**A**	**9.7**

The detailed Synchro operations reports for the mitigated (signalization + lane modifications) total future conditions can be found in **Appendix F**.

Capital cost estimates are compiled in **Appendix H**.

7.2.3.5 Harris Street and Clarke Road

The intersection of Harris Street and Clarke Road is a four legged, two-way stop controlled intersection, with stop control on Clarke Road. The west approach on Clarke Road provides a single shared turning/ through lane while the other three approaches have an auxiliary left turn lane and a through/ right turn lane. With the existing infrastructure and lane arrangements, the intersection of Harris Street and Clarke Road is expected to perform poorly under 2046 future total conditions, with both of the stop controlled approaches over capacity with a LOS F.

Based on the forecasted traffic volumes, it is recommended that the existing stop-controlled intersection be upgraded to a signalized intersection. The requirement for traffic signal control was assessed using 'Justification 7 – Projected Volumes' from the Ontario Traffic Manual (OTM) signal warrant guidelines[7]. The analysis indicates that signals are warranted at the intersection of Harris Street and Clarke Road.

The signal warrant analysis worksheets can be found in **Appendix D**.

Table 26 displays the results of the LOS and capacity analysis for the total future conditions at the intersection of Harris Street and Clarke Road after the traffic control mechanism was upgraded to signalization.

[7] Ontario Traffic Manual Book 12 – Traffic Signals, March 2012.

Table 26: Total Future (2046): Harris Street and Clarke Road – PM Peak Hour (Mitigated – Signalization)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Harris Street @ Clarke Road	EB left	0.13	C	21.7
	EB through/right	0.37	C	23.9
	WB approach	1.02	F	84.9
	NB left	0.25	B	16.0
	NB through/right	0.93	D	41.4
	SB left	0.73	C	31.4
	SB through/right	0.41	B	11.7
	Overall	**1.01**	**D**	**38.5**

The detailed Synchro operations reports for the mitigated (signalization) total future conditions can be found in **Appendix E**.

To further accommodate the increased traffic volumes traveling to and from the proposed residential development east of Harris Street, it is recommended that an auxiliary westbound left-turn lane be constructed on Clarke Road and an auxiliary northbound right-turn lane be constructed on Harris Street. The addition of the auxiliary turn lanes not only improves traffic operations but also improve safety at the intersection by providing physical separation between the turning vehicles that are slowing or stopped and the through traffic at the approach to the intersection.

Table 27 displays the results of the LOS and capacity analysis for the total future conditions at the intersection of Harris Street and Clarke Road after the traffic control mechanism was upgraded to signalization and lane modifications were applied.

Table 27: Total Future (2046): Harris Street and Clarke Road – PM Peak Hour (Mitigated – Signalization + Lane Modification)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Harris Street @ Clarke Road	EB left	0.17	C	22.5
	EB through/right	0.55	C	25.9
	WB left	0.61	B	19.9
	WB through/right	0.20	B	15.3
	NB left	0.29	B	16.0
	NB through	0.68	C	21.7
	NB right	0.19	B	13.9
	SB left	0.46	B	11.5
	SB through/right	0.46	B	11.6
	Overall	**0.69**	**B**	**17.3**

The detailed Synchro operations reports for the mitigated (signalization+ lane modifications) total future conditions can be found in **Appendix F**.

Capital cost estimates are compiled in **Appendix H**.

7.2.3.6 Plank Line and Curry Road

The intersection of Plank Line and Curry Road is a four legged, two-way stop controlled intersection, with stop control on Curry Road. All approaches provide a shared turning/through lane. With the existing infrastructure and lane arrangements, the intersection of Plank Line and Curry Road is expected to perform poorly under 2046 future total conditions, with the eastbound approach over capacity and both the eastbound and westbound approach operating at LOS F.

Based on the forecasted traffic volumes, it is recommended that the existing stop-controlled intersection be upgraded to a signalized intersection. The requirement for traffic signal control was assessed using 'Justification 7 – Projected Volumes' from the Ontario Traffic Manual (OTM) signal warrant guidelines[8]. The analysis indicates that signals are warranted at the intersection of Plank Line and Curry Road.

The signal warrant analysis worksheets can be found in **Appendix D**.

Table 28 displays the results of the LOS and capacity analysis for the total future conditions at the intersection of Plank Line and Curry Road after the traffic control mechanism was upgraded to signalization.

Table 28: Total Future (2046): Plank Line and Curry Road – PM Peak Hour (Mitigated – Signalization)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Plank Line/Highway 19 @ Curry Road	EB approach	1.15	F	136.9
	WB approach	0.05	C	28.7
	NB approach	0.85	B	18.7
	SB approach	0.83	B	16.6
	Overall	**0.92**	**D**	**36.0**

The detailed Synchro operations reports for the mitigated (signalization) total future conditions can be found in **Appendix E**.

To further accommodate the increased traffic volumes traveling to and from Curry Road, it is it is recommended that an auxiliary eastbound left-turn lane be constructed on Curry Road and an auxiliary southbound right-turn lane be constructed on Plank Line. The addition of the turn lanes not only improve traffic operations but also improve safety at the intersection by providing physical separation between the turning vehicles that are slowing or stopped and the through traffic at the approach to the intersection.

[8] Ontario Traffic Manual Book 12 – Traffic Signals, March 2012.

Table 29 displays the results of the LOS and capacity analysis for the total future conditions at the intersection of Plank Line and Curry Road after the traffic control mechanism was upgraded to signalization and lane modifications were applied.

Table 29: Total Future (2046): Plank Line and Curry Road – PM Peak Hour (Mitigated – Signalization + Lane Modification)

Intersection	Movement	v/c	LOS	Delay *(s/veh)*
Plank Line/Highway 19 @ Curry Road	EB left	0.70	C	26.5
	EB through/right	0.09	B	17.4
	WB approach	0.04	B	17.1
	NB left	0.31	A	9.0
	NB through/right	0.75	B	13.1
	SB through/left	0.72	B	12.4
	SB right	0.15	A	5.5
	Overall	**0.73**	**B**	**13.6**

The detailed Synchro operations reports for the mitigated (signalization + lane modifications) total future conditions can be found in **Appendix F**.

Capital cost estimates are compiled in **Appendix H**.

7.2.3.7 Additional Recommendations

The intersection of Union Road and Curry Road is a skewed three legged, two-way stop controlled intersection, with stop control on Curry Road. All approaches have a single shared through/turn lane. With the existing configuration in place, the intersection of Union Road and Curry Road is expected to perform sufficiently under 2046 future total conditions, will the stop controlled approach operating at a LOS A. However, under 2046 future total conditions that main traffic movements are between Union Road west of the intersection and Curry Road. As a result, relocating the stop sign from the approach on Curry Road to the westbound approach on Union Road will reduce unnecessary delays for the highest volume movements and will maintain the LOS A on the stop controlled approach.

Alternatively, the westbound approach on Union Road could be dead ended. This modification would serve the same purpose as relocating the stop sign but would have the added benefit of eliminating all turning movements form the intersection, thus improving safely, and reducing cut-through traffic on Union Road east of Curry Road.

7.2.4 Railway Crossing Exposure Index

Railway crossing infrastructure was re-assessed under 2046 total future conditions. Dillon estimated the ADT volumes by assuming that the PM peak hour traffic volumes will account for 10% of the daily traffic

volumes[9]. The volume of trains per day has not been increased from the 2022 volumes provided by Ontario Southland Rail line. As a result, the 2046 exposure indices presented in **Table 30**, reflect a best-case scenario.

Table 30: Total Future (2046): Railway Crossing Type Review

Railway Crossing Location	Existing Crossing Type	Trains per Day	ADT	Exposure Index	Recommended Crossing Type
Curry Road	Passive Crossing	4	6,880	27,520	Active Crossing (flashing lights and bells)
King Street West	Active Crossing (Flashing Lights and Bells)	6	6,470	38,820	Active Crossing (flashing lights and bells)
Ingersoll Street	Active Crossing (Flashing Lights and Bells)	6	11,260	67,560	Active Crossing (flashing lights, bells, and gate)
Thomas Road west of Wallace Line	Passive Crossing	4	200	800	Passive Crossing
Thomas Road east of Wallace Line	Passive Crossing	8	3,950	31,600	Active Crossing (flashing lights and bells)

Acknowledging that fewer trains than usual were operating when existing conditions were collected (due to the General Motors CAMI Assembly plant shut down) and to capture the potential growth in rail operations, a railway crossing sensitivity test was conducted. The existing number of trains per day was increased by 50%. **Table 31** displays the results of the railway crossing sensitivity test.

Table 31: Total Future (2046): Railway Crossing Type Sensitivity Test

Railway Crossing Location	Existing Crossing Type	Trains per Day	ADT	Exposure Index	Recommended Crossing Type
Curry Road	Passive Crossing	6	6,880	41,280	Active Crossing (flashing lights and bells)
King Street West	Active Crossing (Flashing Lights and Bells)	9	6,470	58,230	Active Crossing (flashing lights bells and gate)
Ingersoll Street	Active Crossing (Flashing Lights and Bells)	9	11,260	101,340	Active Crossing (flashing lights bells and gate)
Thomas Road west of Wallace Line	Passive Crossing	6	200	1,200	Active Crossing (flashing lights and bells)
Thomas Road east of Wallace Line	Passive Crossing	12	3,950	47,400	Active Crossing (flashing lights and bells)

[9] 10% is a conservative estimate based on size, urban form and physical location of Ingersoll.

Based on the Exposure Indices displayed in **Table 30** and **Table 31**, it is recommended that all existing railway crossings are upgraded. The crossings located on Curry Road and Thomas Road (both east and west of Wallace line) are currently passive crossings. Based on the estimated exposure indices, they should be upgraded to active crossings with flashing lights and bells. The crossings on Ingersoll Street and King Street West are currently active crossings with flashing lights and bells. Based on the estimated exposure indices, they be upgraded to active crossings with flashing lights, bells and gates.

Capital cost estimates are compiled in **Appendix H**.

8.0 Conclusions and Recommendations

This section summarizes the findings of this transportation report and highlights Dillon's recommendations for an efficient and safe future road network.

A summary of the LOS analysis in each scenario is provided in **Table 32**.

Table 32: Overall Intersection Levels of Service – PM Peak Hour

Intersection	Existing	2046 FB	2046 TF Unmitigated	2046 TF Mitigated
	LOS			
Culloden Road/Line @ Ingersoll Street/Highway 401 WB Ramps	A	A	B	B
Culloden Line @ Highway 401 EB Ramps	A	A	B	B
Wallace Line @ Thomas Road	A+	A+	A+	A+
Wallace Line @ Robinson Road	A+	A+	B+	B+
Ingersoll Street @ King Street W	B+	C+	F+	B
Ingersoll Street @ Thomas Street	B+	B+	F+	A
Ingersoll Street @ Clarke Road	A+	A+	B+	B+
Ingersoll Street @ Thompson Road	B+	B+	F+	F+
Union Road @ Culloden Line	B+	B+	F+	A
Union Road @ Curry Road	A+	A+	A+	A+
Harris Street @ Clarke Road	D+	F+	F+	B
Harris Street/County Road 119 @ Highway 401 WB Ramps	A	A	B	B
Plank Line/Highway 19 @ Highway 401 EB Ramps	A	A	A	A
Plank Line/Highway 19 @ Curry Road	C+	D+	F+	B

Notes: +Unsignalized Intersection – Critical Movement

Based on the transportation assessment that was carried out, it is concluded that:

- **Existing Conditions**: All study area intersections are currently operating at acceptable levels of service.
- **Future Background Conditions**: All study area intersections are forecast to operate at acceptable levels of service and v/c ratios under 2046 future background conditions, except for the following movement:
  - **Harris Street and Clarke Road – Eastbound Left.**
    - The eastbound left is projected to have a level of service F during the PM peak hour under future background conditions. However, no mitigation was proposed as the

movements delay (52.1 seconds) only exceed the threshold for becoming critical by 2.1 seconds and the movement has a low v/c ratio of 0.35.

- **Development Trip Generation**: The South West Ingersoll Secondary Plan area is forecast to generate 3,379 trips during the PM peak hour. 703 trips will be generated by residential development, 1,278 trips will be generated by industrial development, and 522 trips will be generated by commercial development.
- **Total Future Conditions:** The following roadway network improvement will be required:
  - Residential collector road between Clarke Road and 450m south of Clarke Road – new road;
  - Union Road west of Culloden Line – upgrade from local to collector;
  - Union Road between Culloden Line and Curry Road – upgrade from local to collector;
  - Curry Road between Union Road and Plank Line – upgrade from local to collector;
  - Wallace Line / Thompson Road between Thomas Road and Ingersoll Street – upgrade from local to collector; and
  - Clarke Road between Plank Line and 725m east of Plank Line – upgrade from rural to urban residential cross section.

  The following intersections are expected to operate at acceptable levels of service and v/c ratios under 2046 total future conditions and do not require any mitigation strategies:
  - **Culloden Road / Line @ Ingersoll Street / Highway 401 WB Ramps;**
  - **Culloden Line @ Highway 401 EB Ramps;**
  - **Wallace Line @ Thomas Road;**
  - **Wallace Line @ Robinson Road;**
  - **Ingersoll Street @ Clarke Road;**
  - **Union Road @ Curry Road;**
  - **Harris Street / County Road 119 @ Highway 401 WB Ramps; and**
  - **Plank Line / Highway 19 @ Highway 401 EB Ramps.**

  The remaining intersections will require intervention to operate at acceptable levels of service and v/c ratios under 2046 total future conditions.
  - **Ingersoll Street & King Street West.**
    - Signals are warranted at this intersection. However, signalization alone does not improve the intersections operations to an acceptable level. It is recommended that the existing northbound shared through/left turn lane should be converted to a designated left turn lane, and the existing right turn lane should become a shared through/right turn lane. With signalization and lane reconfiguration, the intersection of Ingersoll Street and King Street West is expected to operate at an acceptable level (overall LOS B and a v/c ratio of 0.57).
  - **Ingersoll Street & Thomas Street.**
    - Signals are warranted at this intersection. Signalization improves the intersection operations to an acceptable level (overall LOS A and a v/c ratio of 0.44).

- **Ingersoll Street & Thompson Road.**
  - Signals are not warranted at this intersection. To improve operations without signalization it is recommended that the eastbound approach be reconfigured to provide a principal right turn lane and an auxiliary left-turn lane. The eastbound right-turn lane will operate at a LOS C, and the eastbound left turn will continue to operate at a LOS F, however the v/c ratio would be reduced from 1.13 to 0.42.
- **Union Road & Culloden Line.**
  - Signals are warranted at this intersection. However, signalization alone does not improve the intersections operations to an acceptable level. It is recommended that auxiliary left-turn lanes, both northbound and southbound, be constructed on Culloden Line. With signalization and the addition of the auxiliary turning lanes, the intersection of Union Road and Culloden Line is expected to operate at an acceptable level (overall LOS A and a v/c ratio of 0.50).
- **Harris Street & Clarke Road.**
  - Signals are warranted at this intersection. However, signalization alone does not improve the intersections operations to an acceptable level. It is recommended that an auxiliary westbound left-turn lane be constructed on Clarke Road and an auxiliary northbound right-turn lane be constructed on Harris Street. With signalization and the addition of the auxiliary turning lanes, the intersection of Harris Street and Clarke Road is expected to operate at an acceptable level (overall LOS B and a v/c ratio of 0.69).
- **Plank Line & Curry Road.**
  - Signals are warranted at this intersection. However, signalization alone does not improve the intersections operations to an acceptable level. It is recommended that an auxiliary eastbound left-turn lane be constructed on Curry Road and an auxiliary southbound right-turn lane be constructed on Plank Line. With signalization and the addition of the auxiliary turning lanes, the intersection of Harris Street and Clarke Road is expected to operate at an acceptable level (overall LOS B and a v/c ratio of 0.73).

The following rail network improvement will be required:

- Railway spur line off the CP rail line between Curry Road and Highway 401 – new rail spur.

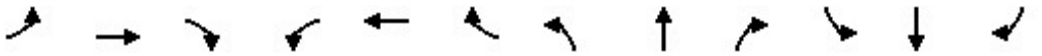
The following railway crossing upgrades will be required:

- Curry Road – upgrade from passive crossing to active crossings with flashing lights and bells;
- King Street West – upgrade from active crossings with lights and bells to active crossings with flashing lights, bells and gates;
- Ingersoll Street – upgrade from active crossings with lights and bells to active crossings with flashing lights, bells and gates;
- Thomas Road (west of Wallace line) – upgrade from passive crossing to active crossings with flashing lights and bells; and

- Thomas Road (east of Wallace line) – upgrade from passive crossing to active crossings with flashing lights and bells.

Appendix A

Operations Reports: Existing Conditions



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	35	120	190	45	70	85	75	165	30	135	215	15
Future Volume (vph)	35	120	190	45	70	85	75	165	30	135	215	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.2	7.2	4.0	7.2	7.2		7.4	7.4		7.4	7.4	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95		0.97	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.92		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1626	1727	1392	1492	2977		2918	1840		1805	1824	
Flt Permitted	0.65	1.00	1.00	0.67	1.00		0.60	1.00		0.63	1.00	
Satd. Flow (perm)	1105	1727	1392	1058	2977		1855	1840		1188	1824	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	130	207	49	76	92	82	179	33	147	234	16
RTOR Reduction (vph)	0	0	0	0	75	0	0	10	0	0	4	0
Lane Group Flow (vph)	38	130	207	49	93	0	82	202	0	147	246	0
Heavy Vehicles (%)	11%	10%	16%	21%	25%	0%	20%	1%	0%	0%	2%	20%
Turn Type	Perm	NA	Free	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		Free	8			2			6		
Actuated Green, G (s)	8.2	8.2	43.6	8.2	8.2		20.8	20.8		20.8	20.8	
Effective Green, g (s)	8.2	8.2	43.6	8.2	8.2		20.8	20.8		20.8	20.8	
Actuated g/C Ratio	0.19	0.19	1.00	0.19	0.19		0.48	0.48		0.48	0.48	
Clearance Time (s)	7.2	7.2		7.2	7.2		7.4	7.4		7.4	7.4	
Vehicle Extension (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
Lane Grp Cap (vph)	207	324	1392	198	559		884	877		566	870	
v/s Ratio Prot		c0.08			0.03			0.11			c0.13	
v/s Ratio Perm	0.03		0.15	0.05			0.04			0.12		
v/c Ratio	0.18	0.40	0.15	0.25	0.17		0.09	0.23		0.26	0.28	
Uniform Delay, d1	14.9	15.5	0.0	15.1	14.8		6.2	6.7		6.8	6.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	1.0	0.2	0.8	0.2		0.1	0.2		1.1	0.8	
Delay (s)	15.4	16.5	0.2	15.8	15.0		6.3	6.9		7.9	7.7	
Level of Service	B	B	A	B	B		A	A		A	A	
Approach Delay (s)		7.4			15.2			6.7			7.8	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.32		
Actuated Cycle Length (s)	43.6	Sum of lost time (s)	14.6
Intersection Capacity Utilization	65.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	145	40	35	120	210	235
Future Volume (vph)	145	40	35	120	210	235
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.1		6.6	6.6	6.6	4.0
Lane Util. Factor	0.97		1.00	0.95	1.00	1.00
Frt	0.97		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3208		1337	3471	1792	1417
Flt Permitted	0.96		0.62	1.00	1.00	1.00
Satd. Flow (perm)	3208		867	3471	1792	1417
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	158	43	38	130	228	255
RTOR Reduction (vph)	31	0	0	0	0	0
Lane Group Flow (vph)	170	0	38	130	228	255
Heavy Vehicles (%)	7%	7%	35%	4%	6%	14%
Turn Type	Prot		Perm	NA	NA	Free
Protected Phases	4			2	6	
Permitted Phases			2			Free
Actuated Green, G (s)	10.2		13.1	13.1	13.1	36.0
Effective Green, g (s)	10.2		13.1	13.1	13.1	36.0
Actuated g/C Ratio	0.28		0.36	0.36	0.36	1.00
Clearance Time (s)	6.1		6.6	6.6	6.6	
Vehicle Extension (s)	3.5		3.5	3.5	3.5	
Lane Grp Cap (vph)	908		315	1263	652	1417
v/s Ratio Prot	0.05			0.04	c0.13	
v/s Ratio Perm			0.04			c0.18
v/c Ratio	0.19		0.12	0.10	0.35	0.18
Uniform Delay, d1	9.8		7.6	7.6	8.3	0.0
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1		0.2	0.0	0.4	0.3
Delay (s)	9.9		7.8	7.6	8.7	0.3
Level of Service	A		A	A	A	A
Approach Delay (s)	9.9			7.7	4.3	
Approach LOS	A			A	A	

Intersection Summary			
HCM 2000 Control Delay	6.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.32		
Actuated Cycle Length (s)	36.0	Sum of lost time (s)	12.7
Intersection Capacity Utilization	43.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	5	0	5	5	5	5
Future Volume (Veh/h)	5	0	5	5	5	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	0	5	5	5	5
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			5		20	5
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			5		20	5
tC, single (s)			4.1		6.9	6.2
tC, 2 stage (s)						
tF (s)			2.2		4.0	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1630		884	1084

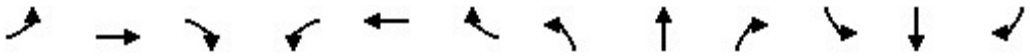
Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	5	10	10
Volume Left	0	5	5
Volume Right	0	0	5
cSH	1700	1630	974
Volume to Capacity	0.00	0.00	0.01
Queue Length 95th (m)	0.0	0.1	0.2
Control Delay (s)	0.0	3.6	8.7
Lane LOS		A	A
Approach Delay (s)	0.0	3.6	8.7
Approach LOS			A

Intersection Summary			
Average Delay	4.9		
Intersection Capacity Utilization	14.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	10	10	5	5	5
Future Volume (Veh/h)	5	10	10	5	5	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	11	11	5	5	5
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	34	8	10			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	34	8	10			
tC, single (s)	6.4	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.3			
p0 queue free %	99	99	99			
cM capacity (veh/h)	977	1046	1553			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	16	16	10
Volume Left	5	11	0
Volume Right	11	0	5
cSH	1023	1553	1700
Volume to Capacity	0.02	0.01	0.01
Queue Length 95th (m)	0.4	0.2	0.0
Control Delay (s)	8.6	5.1	0.0
Lane LOS	A	A	
Approach Delay (s)	8.6	5.1	0.0
Approach LOS	A		

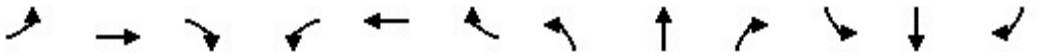
Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	17.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	40	95	20	15	105	135	30	190	35	115	130	25
Future Volume (vph)	40	95	20	15	105	135	30	190	35	115	130	25
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	43	103	22	16	114	147	33	207	38	125	141	27

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	168	277	240	38	125	168
Volume Left (vph)	43	16	33	0	125	0
Volume Right (vph)	22	147	0	38	0	27
Hadj (s)	0.08	-0.30	0.14	-0.70	0.50	0.00
Departure Headway (s)	6.1	5.6	6.5	5.6	6.8	6.3
Degree Utilization, x	0.29	0.43	0.43	0.06	0.24	0.29
Capacity (veh/h)	528	600	516	591	492	532
Control Delay (s)	11.6	12.6	13.1	7.8	10.7	10.7
Approach Delay (s)	11.6	12.6	12.4		10.7	
Approach LOS	B	B	B		B	

Intersection Summary				
Delay	11.8			
Level of Service	B			
Intersection Capacity Utilization	51.1%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	10	25	15	15	40	15	195	20	30	145	15
Future Volume (Veh/h)	15	10	25	15	15	40	15	195	20	30	145	15
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	11	27	16	16	43	16	212	22	33	158	16
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	421	498	87	432	495	117	174			234		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	421	498	87	432	495	117	174			234		
tC, single (s)	7.6	6.5	7.6	8.1	6.6	6.9	5.1			4.3		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.6	3.8	4.1	3.3	2.7			2.3		
p0 queue free %	96	98	97	96	96	95	99			97		
cM capacity (veh/h)	454	458	858	409	445	913	1112			1274		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	54	75	122	128	112	95
Volume Left	16	16	16	0	33	0
Volume Right	27	43	0	22	0	16
cSH	595	614	1112	1700	1274	1700
Volume to Capacity	0.09	0.12	0.01	0.08	0.03	0.06
Queue Length 95th (m)	2.4	3.3	0.4	0.0	0.6	0.0
Control Delay (s)	11.7	11.7	1.2	0.0	2.5	0.0
Lane LOS	B	B	A		A	
Approach Delay (s)	11.7	11.7	0.6		1.3	
Approach LOS	B	B				

Intersection Summary				
Average Delay	3.3			
Intersection Capacity Utilization	26.7%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	5	25	150	10	50	280
Future Volume (Veh/h)	5	25	150	10	50	280
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)	5	25	150	10	50	280
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			348			
pX, platoon unblocked						
vC, conflicting volume	395	80			160	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	395	80			160	
tC, single (s)	6.8	6.9			4.2	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	97			96	
cM capacity (veh/h)	566	971			1402	

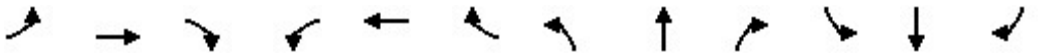
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	30	100	60	143	187
Volume Left	5	0	0	50	0
Volume Right	25	0	10	0	0
cSH	867	1700	1700	1402	1700
Volume to Capacity	0.03	0.06	0.04	0.04	0.11
Queue Length 95th (m)	0.9	0.0	0.0	0.9	0.0
Control Delay (s)	9.3	0.0	0.0	2.9	0.0
Lane LOS	A			A	
Approach Delay (s)	9.3	0.0		1.2	
Approach LOS	A				

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	27.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	20	65	30	140	275	10
Future Volume (Veh/h)	20	65	30	140	275	10
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)	20	65	30	140	275	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				211		
pX, platoon unblocked						
vC, conflicting volume	410	142	285			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	410	142	285			
tC, single (s)	7.1	7.3	5.1			
tC, 2 stage (s)						
tF (s)	3.6	3.5	2.7			
p0 queue free %	96	92	97			
cM capacity (veh/h)	523	819	989			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	85	30	70	70	183	102
Volume Left	20	30	0	0	0	0
Volume Right	65	0	0	0	0	10
cSH	723	989	1700	1700	1700	1700
Volume to Capacity	0.12	0.03	0.04	0.04	0.11	0.06
Queue Length 95th (m)	3.2	0.8	0.0	0.0	0.0	0.0
Control Delay (s)	10.6	8.8	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	10.6	1.5			0.0	
Approach LOS	B					

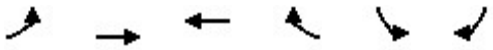
Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	26.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	5	0	5	0	150	5	5	250	0
Future Volume (Veh/h)	0	0	0	5	0	5	0	150	5	5	250	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	0	5	0	5	0	163	5	5	272	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	452	450	272	448	448	166	272			168		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	452	450	272	448	448	166	272			168		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	99	100	99	100			100		
cM capacity (veh/h)	516	506	772	523	507	884	1303			1422		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	10	168	277
Volume Left	0	5	0	5
Volume Right	0	5	5	0
cSH	1700	658	1303	1422
Volume to Capacity	0.00	0.02	0.00	0.00
Queue Length 95th (m)	0.0	0.4	0.0	0.1
Control Delay (s)	0.0	10.6	0.0	0.2
Lane LOS	A	B		A
Approach Delay (s)	0.0	10.6	0.0	0.2
Approach LOS	A	B		

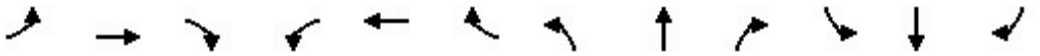
Intersection Summary				
Average Delay	0.3			
Intersection Capacity Utilization	27.2%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	0	0	0	5	5
Future Volume (Veh/h)	5	0	0	0	5	5
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	0	0	0	5	5
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	0				10	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				10	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1636				1012	1091

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	5	0	10
Volume Left	5	0	5
Volume Right	0	0	5
cSH	1636	1700	1050
Volume to Capacity	0.00	0.00	0.01
Queue Length 95th (m)	0.1	0.0	0.2
Control Delay (s)	7.2	0.0	8.5
Lane LOS	A		A
Approach Delay (s)	7.2	0.0	8.5
Approach LOS			A

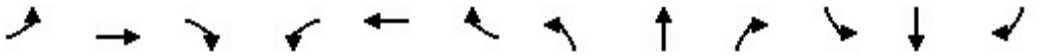
Intersection Summary			
Average Delay		8.0	
Intersection Capacity Utilization		13.3%	ICU Level of Service A
Analysis Period (min)		15	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	70	95	10	50	40	70	320	5	45	240	40
Future Volume (Veh/h)	30	70	95	10	50	40	70	320	5	45	240	40
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	76	103	11	54	43	76	348	5	49	261	43
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	950	886	282	1002	904	350	304			353		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	950	886	282	1002	904	350	304			353		
tC, single (s)	7.1	6.5	6.2	7.1	6.6	6.2	4.2			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.1	3.3	2.3			2.2		
p0 queue free %	81	70	86	92	78	94	94			96		
cM capacity (veh/h)	172	255	759	137	243	697	1234			1217		

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	33	179	108	76	353	49	304
Volume Left	33	0	11	76	0	49	0
Volume Right	0	103	43	0	5	0	43
cSH	172	412	297	1234	1700	1217	1700
Volume to Capacity	0.19	0.43	0.36	0.06	0.21	0.04	0.18
Queue Length 95th (m)	5.5	17.2	12.8	1.6	0.0	1.0	0.0
Control Delay (s)	30.8	20.3	23.9	8.1	0.0	8.1	0.0
Lane LOS	D	C	C	A		A	
Approach Delay (s)	21.9		23.9	1.4		1.1	
Approach LOS	C		C				

Intersection Summary				
Average Delay	7.5			
Intersection Capacity Utilization	44.4%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	5	5	5	5	5	5	525	0	5	560	5
Future Volume (Veh/h)	5	5	5	5	5	5	5	525	0	5	560	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92
Hourly flow rate (vph)	5	5	5	5	5	5	5	525	0	5	609	5
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	1164	1156	612	1164	1159	525	614			525		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1164	1156	612	1164	1159	525	614			525		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	97	99	97	97	99	99			100		
cM capacity (veh/h)	167	196	497	167	196	556	975			1052		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	15	15	530	619
Volume Left	5	5	5	5
Volume Right	5	5	0	5
cSH	229	232	975	1052
Volume to Capacity	0.07	0.06	0.01	0.00
Queue Length 95th (m)	1.7	1.6	0.1	0.1
Control Delay (s)	21.8	21.6	0.1	0.1
Lane LOS	C	C	A	A
Approach Delay (s)	21.8	21.6	0.1	0.1
Approach LOS	C	C		

Intersection Summary				
Average Delay	0.7			
Intersection Capacity Utilization	42.9%	ICU Level of Service	A	
Analysis Period (min)	15			

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.2.1013

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

Filename: 401 at Plank Line.j9
Path: c:\pw working directory\projects 2022\dillon_10hkv\dms88339
Report generation date: 2023-04-10 9:51:42 AM

Summary of junction performance

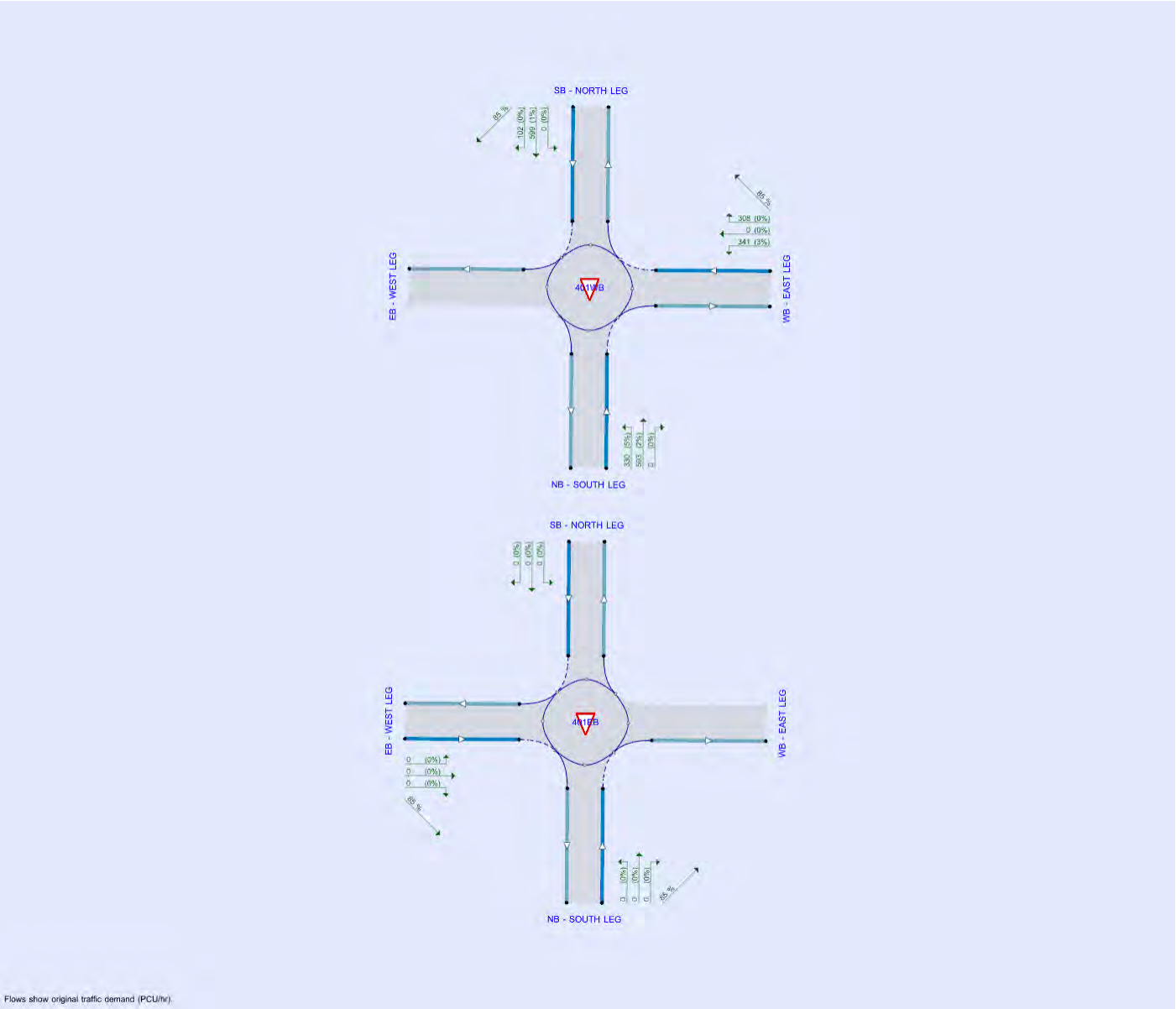
	EB				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
EASTBOUND - EXISTING					
401EB - 401 EB - NB - SOUTH LEG	AEB DEBEX	0.5	3.86	0.32	A
401EB - 401 EB - SB - NORTH LEG		0.6	4.54	0.38	A
401EB - 401 EB - EB - WEST LEG		0.1	4.11	0.11	A

	WB				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
WESTBOUND - EXISTING					
401WB - 401 WB - NB - SOUTH LEG	AWB DWBEX	0.7	4.72	0.39	A
401WB - 401 WB - WB - EAST LEG		0.3	4.64	0.21	A
401WB - 401 WB - SB - NORTH LEG		0.4	4.01	0.27	A

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
DEBEX	EXISTING	EB	PHF	08:00	09:00	15	✓
DWBEX	EXISTING	WB	PHF	08:00	09:00	15	✓

EASTBOUND - EXISTING, EB

Data Errors and Warnings

No errors or warnings

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
AEB	EASTBOUND	✓	✓	DEBEX, DEBFB, DEBTF	100.000	100.000

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
401EB	401 EB	Standard Roundabout		NB, WB, SB, EB	4.16	A

Junction Network Options

Driving side	Lighting
Right	Normal/unknown

Arms

Arms

Junction	Arm	Name	Description
401EB - 401 EB	**NB**	SOUTH LEG	
	WB	EAST LEG	
	SB	NORTH LEG	
	EB	WEST LEG	

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
401EB - 401 EB	**NB - SOUTH LEG**	5.10	5.50	18.4	55.0	46.0	8.0	
	WB - EAST LEG							✓
	SB - NORTH LEG	3.75	5.50	10.6	44.0	46.0	23.0	
	EB - WEST LEG	4.75	4.80	1.0	50.0	46.0	11.0	

Bypass

Junction	Arm	Arm has bypass	Bypass utilisation (%)
401EB - 401 EB	**NB - SOUTH LEG**	✓	85
	WB - EAST LEG		
	SB - NORTH LEG		
	EB - WEST LEG	✓	85

Slope / Intercept / Capacity

Arm Intercept Adjustments

Junction	Arm	Type	Reason	Percentage intercept adjustment (%)
401EB - 401 EB	NB - SOUTH LEG	Percentage		85.00
	WB - EAST LEG			
	SB - NORTH LEG	Percentage		85.00
	EB - WEST LEG	Percentage		85.00

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
401EB - 401 EB	NB - SOUTH LEG	0.683	1561
	WB - EAST LEG		
	SB - NORTH LEG	0.612	1325
	EB - WEST LEG	0.631	1352

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
DEBEX	EXISTING	EB	PHF	08:00	09:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Junction	Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
401EB - 401 EB	NB - SOUTH LEG		PHF	✓	538	100.000
	WB - EAST LEG					
	SB - NORTH LEG		PHF	✓	469	100.000
	EB - WEST LEG		PHF	✓	279	100.000

Peak Hour Factor Data (Traffic)

Junction	Arm	Hourly volume (PCU/hr)	Peak hour factor	Peak time segment
401EB - 401 EB	NB - SOUTH LEG	538	0.92	SecondQuarter
	WB - EAST LEG			
	SB - NORTH LEG	469	0.92	SecondQuarter
	EB - WEST LEG	279	0.92	SecondQuarter

Origin-Destination Data

Demand (PCU/hr)

401EB - 401 EB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	137	401	0
	WB - EAST LEG	Exit-only	Exit-only	Exit-only	Exit-only
	SB - NORTH LEG	359	110	0	0
	EB - WEST LEG	211	0	68	0

Vehicle Mix

Heavy Vehicle Percentages

401EB - 401 EB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	9	4	0
	WB - EAST LEG	Exit-only	Exit-only	Exit-only	Exit-only
	SB - NORTH LEG	3	3	0	0
	EB - WEST LEG	8	0	4	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
401EB - 401 EB	NB - SOUTH LEG	0.32	3.86	0.5	A	538	422
	WB - EAST LEG						
	SB - NORTH LEG	0.38	4.54	0.6	A	469	469
	EB - WEST LEG	0.11	4.11	0.1	A	279	100

WESTBOUND - EXISTING, WB

Data Errors and Warnings

No errors or warnings

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
AWB	WESTBOUND	✓	✓	DWBEX, DWBFB, DWBTF	100.000	100.000

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
401WB	401 WB	Standard Roundabout		NB, WB, SB, EB	4.48	A

Junction Network Options

Driving side	Lighting
Right	Normal/unknown

Arms

Arms

Junction	Arm	Name	Description
401WB - 401 WB	**NB**	SOUTH LEG	
	WB	EAST LEG	
	SB	NORTH LEG	
	EB	WEST LEG	

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
401WB - 401 WB	**NB - SOUTH LEG**	3.75	5.50	8.4	41.0	46.0	22.0	
	WB - EAST LEG	4.75	4.75	0.0	45.0	46.0	11.0	
	SB - NORTH LEG	5.10	5.50	16.4	51.0	46.0	11.0	
	EB - WEST LEG							✓

Bypass

Junction	Arm	Arm has bypass	Bypass utilisation (%)
401WB - 401 WB	**NB - SOUTH LEG**		
	WB - EAST LEG	✓	85
	SB - NORTH LEG	✓	85
	EB - WEST LEG		

Slope / Intercept / Capacity

Arm Intercept Adjustments

Junction	Arm	Type	Reason	Percentage intercept adjustment (%)
401WB - 401 WB	NB - SOUTH LEG	Percentage		85.00
	WB - EAST LEG	Percentage		85.00
	SB - NORTH LEG	Percentage		85.00
	EB - WEST LEG			

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
401WB - 401 WB	NB - SOUTH LEG	0.607	1302
	WB - EAST LEG	0.627	1337
	SB - NORTH LEG	0.675	1544
	EB - WEST LEG		

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
DWBEX	EXISTING	WB	PHF	08:00	09:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Junction	Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
401WB - 401 WB	NB - SOUTH LEG		PHF	✓	469	100.000
	WB - EAST LEG		PHF	✓	338	100.000
	SB - NORTH LEG		PHF	✓	347	100.000
	EB - WEST LEG					

Peak Hour Factor Data (Traffic)

Junction	Arm	Hourly volume (PCU/hr)	Peak hour factor	Peak time segment
401WB - 401 WB	NB - SOUTH LEG	469	0.92	SecondQuarter
	WB - EAST LEG	338	0.92	SecondQuarter
	SB - NORTH LEG	347	0.92	SecondQuarter
	EB - WEST LEG			

Origin-Destination Data

Demand (PCU/hr)

401WB - 401 WB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	0	235	234
	WB - EAST LEG	173	0	165	0
	SB - NORTH LEG	296	0	0	51
	EB - WEST LEG	Exit-only	Exit-only	Exit-only	Exit-only

Vehicle Mix

Heavy Vehicle Percentages

401WB - 401 WB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	0	3	5
	WB - EAST LEG	4	0	1	0
	SB - NORTH LEG	2	0	0	0
	EB - WEST LEG	Exit-only	Exit-only	Exit-only	Exit-only

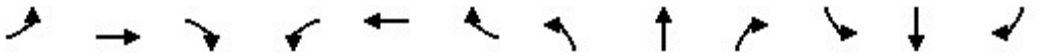
Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
401WB - 401 WB	NB - SOUTH LEG	0.39	4.72	0.7	A	469	469
	WB - EAST LEG	0.21	4.64	0.3	A	338	198
	SB - NORTH LEG	0.27	4.01	0.4	A	347	304
	EB - WEST LEG						

Appendix B

Operations Reports: Future Background Conditions



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	45	150	240	60	90	105	95	205	35	170	270	20
Future Volume (vph)	45	150	240	60	90	105	95	205	35	170	270	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.2	7.2	4.0	7.2	7.2		7.4	7.4		7.4	7.4	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95		0.97	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.92		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1626	1727	1392	1492	2975		2918	1843		1805	1821	
Flt Permitted	0.63	1.00	1.00	0.66	1.00		0.58	1.00		0.61	1.00	
Satd. Flow (perm)	1077	1727	1392	1039	2975		1789	1843		1158	1821	
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)	45	150	240	60	90	105	95	205	35	170	270	20
RTOR Reduction (vph)	0	0	0	0	82	0	0	8	0	0	4	0
Lane Group Flow (vph)	45	150	240	60	113	0	95	232	0	170	286	0
Heavy Vehicles (%)	11%	10%	16%	21%	25%	0%	20%	1%	0%	0%	2%	20%
Turn Type	Perm	NA	Free	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		Free	8			2			6		
Actuated Green, G (s)	11.0	11.0	51.0	11.0	11.0		25.4	25.4		25.4	25.4	
Effective Green, g (s)	11.0	11.0	51.0	11.0	11.0		25.4	25.4		25.4	25.4	
Actuated g/C Ratio	0.22	0.22	1.00	0.22	0.22		0.50	0.50		0.50	0.50	
Clearance Time (s)	7.2	7.2		7.2	7.2		7.4	7.4		7.4	7.4	
Vehicle Extension (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
Lane Grp Cap (vph)	232	372	1392	224	641		890	917		576	906	
v/s Ratio Prot		c0.09			0.04			0.13			c0.16	
v/s Ratio Perm	0.04		0.17	0.06			0.05			0.15		
v/c Ratio	0.19	0.40	0.17	0.27	0.18		0.11	0.25		0.30	0.32	
Uniform Delay, d1	16.4	17.2	0.0	16.6	16.3		6.8	7.4		7.5	7.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	0.8	0.3	0.8	0.2		0.1	0.2		1.3	0.9	
Delay (s)	16.9	18.0	0.3	17.4	16.5		6.8	7.5		8.8	8.5	
Level of Service	B	B	A	B	B		A	A		A	A	
Approach Delay (s)		8.1			16.7			7.3			8.7	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	9.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	51.0	Sum of lost time (s)	14.6
Intersection Capacity Utilization	68.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	185	50	45	150	270	300
Future Volume (vph)	185	50	45	150	270	300
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.1		6.6	6.6	6.6	4.0
Lane Util. Factor	0.97		1.00	0.95	1.00	1.00
Frt	0.97		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3209		1337	3471	1792	1417
Flt Permitted	0.96		0.59	1.00	1.00	1.00
Satd. Flow (perm)	3209		835	3471	1792	1417
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	185	50	45	150	270	300
RTOR Reduction (vph)	31	0	0	0	0	0
Lane Group Flow (vph)	204	0	45	150	270	300
Heavy Vehicles (%)	7%	7%	35%	4%	6%	14%
Turn Type	Prot		Perm	NA	NA	Free
Protected Phases	4			2	6	
Permitted Phases			2			Free
Actuated Green, G (s)	20.0		21.2	21.2	21.2	53.9
Effective Green, g (s)	20.0		21.2	21.2	21.2	53.9
Actuated g/C Ratio	0.37		0.39	0.39	0.39	1.00
Clearance Time (s)	6.1		6.6	6.6	6.6	
Vehicle Extension (s)	3.5		3.5	3.5	3.5	
Lane Grp Cap (vph)	1190		328	1365	704	1417
v/s Ratio Prot	0.06			0.04	c0.15	
v/s Ratio Perm			0.05			c0.21
v/c Ratio	0.17		0.14	0.11	0.38	0.21
Uniform Delay, d1	11.4		10.5	10.4	11.7	0.0
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1		0.2	0.0	0.4	0.3
Delay (s)	11.5		10.7	10.4	12.1	0.3
Level of Service	B		B	B	B	A
Approach Delay (s)	11.5			10.5	5.9	
Approach LOS	B			B	A	

Intersection Summary			
HCM 2000 Control Delay	8.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	53.9	Sum of lost time (s)	12.7
Intersection Capacity Utilization	64.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	5	0	10	10	5	5
Future Volume (Veh/h)	5	0	10	10	5	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	5	0	10	10	5	5
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			5		35	5
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			5		35	5
tC, single (s)			4.1		6.9	6.2
tC, 2 stage (s)						
tF (s)			2.2		4.0	3.3
p0 queue free %			99		99	100
cM capacity (veh/h)			1630		863	1084

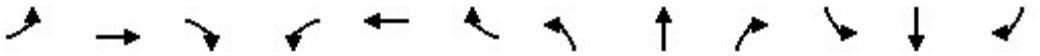
Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	5	20	10
Volume Left	0	10	5
Volume Right	0	0	5
cSH	1700	1630	961
Volume to Capacity	0.00	0.01	0.01
Queue Length 95th (m)	0.0	0.1	0.3
Control Delay (s)	0.0	3.6	8.8
Lane LOS		A	A
Approach Delay (s)	0.0	3.6	8.8
Approach LOS			A

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	17.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	10	10	10	5	5
Future Volume (Veh/h)	5	10	10	10	5	5
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)	5	10	10	10	5	5
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	38	8	10			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	38	8	10			
tC, single (s)	6.4	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.3			
p0 queue free %	99	99	99			
cM capacity (veh/h)	974	1046	1553			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	15	20	10
Volume Left	5	10	0
Volume Right	10	0	5
cSH	1021	1553	1700
Volume to Capacity	0.01	0.01	0.01
Queue Length 95th (m)	0.4	0.2	0.0
Control Delay (s)	8.6	3.7	0.0
Lane LOS	A	A	
Approach Delay (s)	8.6	3.7	0.0
Approach LOS	A		

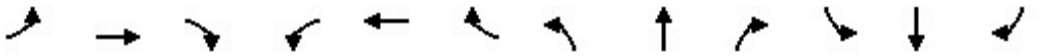
Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	17.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	50	125	25	20	130	170	40	240	45	145	165	35
Future Volume (vph)	50	125	25	20	130	170	40	240	45	145	165	35
Peak Hour 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
Hourly flow rate (vph)	50	125	25	20	130	170	40	240	45	145	165	35

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	200	320	280	45	145	200
Volume Left (vph)	50	20	40	0	145	0
Volume Right (vph)	25	170	0	45	0	35
Hadj (s)	0.08	-0.30	0.14	-0.70	0.50	-0.01
Departure Headway (s)	6.8	6.1	7.1	6.2	7.4	6.9
Degree Utilization, x	0.38	0.54	0.55	0.08	0.30	0.38
Capacity (veh/h)	470	550	478	541	453	488
Control Delay (s)	13.8	16.1	17.1	8.5	12.3	12.9
Approach Delay (s)	13.8	16.1	15.9		12.7	
Approach LOS	B	C	C		B	

Intersection Summary				
Delay	14.7			
Level of Service	B			
Intersection Capacity Utilization	61.6%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	15	30	20	20	50	20	250	25	35	180	15
Future Volume (Veh/h)	20	15	30	20	20	50	20	250	25	35	180	15
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	20	15	30	20	20	50	20	250	25	35	180	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	482	572	98	500	568	138	195			275		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	482	572	98	500	568	138	195			275		
tC, single (s)	7.6	6.5	7.6	8.1	6.6	6.9	5.1			4.3		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.6	3.8	4.1	3.3	2.7			2.3		
p0 queue free %	95	96	96	94	95	94	98			97		
cM capacity (veh/h)	399	413	843	356	401	886	1087			1229		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	65	90	145	150	125	105
Volume Left	20	20	20	0	35	0
Volume Right	30	50	0	25	0	15
cSH	533	554	1087	1700	1229	1700
Volume to Capacity	0.12	0.16	0.02	0.09	0.03	0.06
Queue Length 95th (m)	3.3	4.6	0.4	0.0	0.7	0.0
Control Delay (s)	12.7	12.8	1.3	0.0	2.4	0.0
Lane LOS	B	B	A		A	
Approach Delay (s)	12.7	12.8	0.6		1.3	
Approach LOS	B	B				

Intersection Summary				
Average Delay	3.6			
Intersection Capacity Utilization	31.0%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	10	35	190	15	65	355
Future Volume (Veh/h)	10	35	190	15	65	355
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)	10	35	190	15	65	355
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			348			
pX, platoon unblocked						
vC, conflicting volume	505	102			205	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	505	102			205	
tC, single (s)	6.8	6.9			4.2	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	96			95	
cM capacity (veh/h)	477	939			1349	

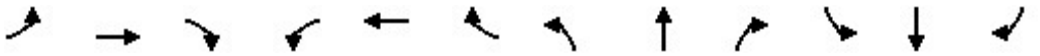
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	45	127	78	183	237
Volume Left	10	0	0	65	0
Volume Right	35	0	15	0	0
cSH	773	1700	1700	1349	1700
Volume to Capacity	0.06	0.07	0.05	0.05	0.14
Queue Length 95th (m)	1.5	0.0	0.0	1.2	0.0
Control Delay (s)	9.9	0.0	0.0	3.0	0.0
Lane LOS	A			A	
Approach Delay (s)	9.9	0.0		1.3	
Approach LOS	A				

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	30.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	25	85	40	180	350	15
Future Volume (Veh/h)	25	85	40	180	350	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)	25	85	40	180	350	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)				211		
pX, platoon unblocked						
vC, conflicting volume	528	182	365			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	528	182	365			
tC, single (s)	7.1	7.3	5.1			
tC, 2 stage (s)						
tF (s)	3.6	3.5	2.7			
p0 queue free %	94	89	96			
cM capacity (veh/h)	432	770	909			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	110	40	90	90	233	132
Volume Left	25	40	0	0	0	0
Volume Right	85	0	0	0	0	15
cSH	654	909	1700	1700	1700	1700
Volume to Capacity	0.17	0.04	0.05	0.05	0.14	0.08
Queue Length 95th (m)	4.8	1.1	0.0	0.0	0.0	0.0
Control Delay (s)	11.6	9.1	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	11.6	1.7			0.0	
Approach LOS	B					

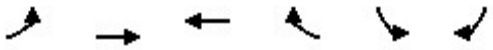
Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	30.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	5	0	5	0	190	5	5	315	0
Future Volume (Veh/h)	0	0	0	5	0	5	0	190	5	5	315	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	0	0	0	5	0	5	0	190	5	5	315	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	520	315	518	518	192	315			195		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	522	520	315	518	518	192	315			195		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	99	100	99	100			100		
cM capacity (veh/h)	464	462	730	470	463	854	1257			1390		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	10	195	320
Volume Left	0	5	0	5
Volume Right	0	5	5	0
cSH	1700	607	1257	1390
Volume to Capacity	0.00	0.02	0.00	0.00
Queue Length 95th (m)	0.0	0.4	0.0	0.1
Control Delay (s)	0.0	11.0	0.0	0.2
Lane LOS	A	B		A
Approach Delay (s)	0.0	11.0	0.0	0.2
Approach LOS	A	B		

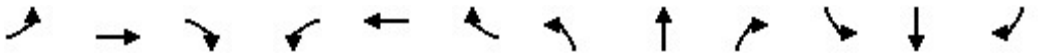
Intersection Summary				
Average Delay	0.3			
Intersection Capacity Utilization	30.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	0	0	0	5	10
Future Volume (Veh/h)	5	0	0	0	5	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	5	0	0	0	5	10
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	0				10	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				10	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	99
cM capacity (veh/h)	1636				1012	1091

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	5	0	15
Volume Left	5	0	5
Volume Right	0	0	10
cSH	1636	1700	1063
Volume to Capacity	0.00	0.00	0.01
Queue Length 95th (m)	0.1	0.0	0.3
Control Delay (s)	7.2	0.0	8.4
Lane LOS	A		A
Approach Delay (s)	7.2	0.0	8.4
Approach LOS			A

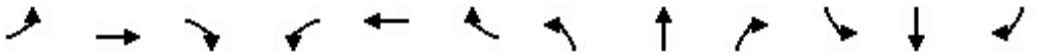
Intersection Summary			
Average Delay	8.1		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	40	90	120	15	65	50	90	410	10	55	305	50
Future Volume (Veh/h)	40	90	120	15	65	50	90	410	10	55	305	50
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	40	90	120	15	65	50	90	410	10	55	305	50
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	1112	1040	330	1175	1060	415	355			420		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1112	1040	330	1175	1060	415	355			420		
tC, single (s)	7.1	6.5	6.2	7.1	6.6	6.2	4.2			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.1	3.3	2.3			2.2		
p0 queue free %	65	55	83	82	66	92	92			95		
cM capacity (veh/h)	115	202	714	84	192	642	1182			1150		

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	40	210	130	90	420	55	355
Volume Left	40	0	15	90	0	55	0
Volume Right	0	120	50	0	10	0	50
cSH	115	342	219	1182	1700	1150	1700
Volume to Capacity	0.35	0.61	0.59	0.08	0.25	0.05	0.21
Queue Length 95th (m)	11.1	31.0	26.9	2.0	0.0	1.2	0.0
Control Delay (s)	52.1	30.9	43.0	8.3	0.0	8.3	0.0
Lane LOS	F	D	E	A		A	
Approach Delay (s)	34.3		43.0	1.5		1.1	
Approach LOS	D		E				

Intersection Summary				
Average Delay	11.8			
Intersection Capacity Utilization	55.3%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	5	5	5	5	10	5	670	0	5	710	5
Future Volume (Veh/h)	5	5	5	5	5	10	5	670	0	5	710	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	5	5	5	5	5	10	5	670	0	5	710	5
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	1415	1402	712	1410	1405	670	715			670		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1415	1402	712	1410	1405	670	715			670		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	96	99	96	96	98	99			99		
cM capacity (veh/h)	110	140	436	112	139	460	895			930		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	15	20	675	720
Volume Left	5	5	5	5
Volume Right	5	10	0	5
cSH	161	195	895	930
Volume to Capacity	0.09	0.10	0.01	0.01
Queue Length 95th (m)	2.4	2.7	0.1	0.1
Control Delay (s)	29.6	25.5	0.1	0.1
Lane LOS	D	D	A	A
Approach Delay (s)	29.6	25.5	0.1	0.1
Approach LOS	D	D		

Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	50.9%	ICU Level of Service	A	
Analysis Period (min)	15			

Junctions 9

ARCADY 9 - Roundabout Module

Filename: 401 at Plank Line.j9
Path: c:\pw working directory\projects 2022\dillon_10hkv\dms88339
Report generation date: 2023-04-10 9:51:42 AM

»EASTBOUND - FUTURE BACKGROUND, EB
»WESTBOUND - FUTURE BACKGROUND, WB

Summary of junction performance

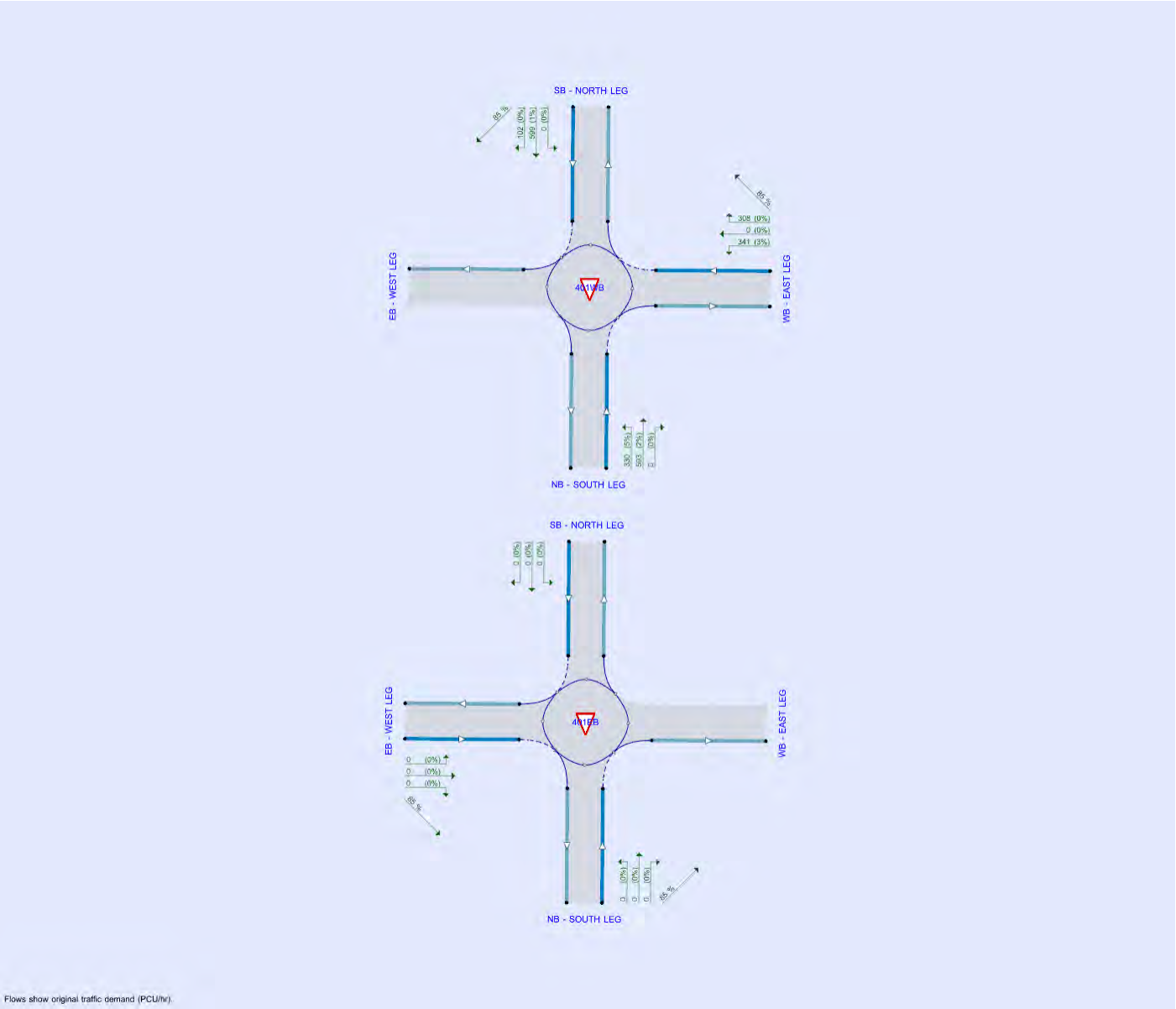
	EB				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
EASTBOUND - FUTURE BACKGROUND					
401EB - 401 EB - NB - SOUTH LEG	AEB DEBFB	0.7	4.61	0.42	A
401EB - 401 EB - SB - NORTH LEG		1.0	5.46	0.49	A
401EB - 401 EB - EB - WEST LEG		0.2	4.70	0.15	A

	WB				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
WESTBOUND - FUTURE BACKGROUND					
401WB - 401 WB - NB - SOUTH LEG	AWB DWBFB	1.0	5.70	0.50	A
401WB - 401 WB - WB - EAST LEG		0.4	5.65	0.29	A
401WB - 401 WB - SB - NORTH LEG		0.6	4.91	0.36	A

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
DEBFB	FUTURE BACKGROUND	EB	PHF	08:00	09:00	15	✓
DWBFB	FUTURE BACKGROUND	WB	PHF	08:00	09:00	15	✓

EASTBOUND - FUTURE BACKGROUND, EB

Data Errors and Warnings

No errors or warnings

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
AEB	EASTBOUND	✓	✓	DEBEX, DEBFB, DEBTF	100.000	100.000

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
401EB	401 EB	Standard Roundabout		NB, WB, SB, EB	4.94	A

Junction Network Options

Driving side	Lighting
Right	Normal/unknown

Arms

Arms

Junction	Arm	Name	Description
401EB - 401 EB	**NB**	SOUTH LEG	
	WB	EAST LEG	
	SB	NORTH LEG	
	EB	WEST LEG	

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
401EB - 401 EB	**NB - SOUTH LEG**	5.10	5.50	18.4	55.0	46.0	8.0	
	WB - EAST LEG							✓
	SB - NORTH LEG	3.75	5.50	10.6	44.0	46.0	23.0	
	EB - WEST LEG	4.75	4.80	1.0	50.0	46.0	11.0	

Bypass

Junction	Arm	Arm has bypass	Bypass utilisation (%)
401EB - 401 EB	**NB - SOUTH LEG**	✓	85
	WB - EAST LEG		
	SB - NORTH LEG		
	EB - WEST LEG	✓	85

Slope / Intercept / Capacity

Arm Intercept Adjustments

Junction	Arm	Type	Reason	Percentage intercept adjustment (%)
401EB - 401 EB	NB - SOUTH LEG	Percentage		85.00
	WB - EAST LEG			
	SB - NORTH LEG	Percentage		85.00
	EB - WEST LEG	Percentage		85.00

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
401EB - 401 EB	NB - SOUTH LEG	0.683	1561
	WB - EAST LEG		
	SB - NORTH LEG	0.612	1325
	EB - WEST LEG	0.631	1352

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
DEBFB	FUTURE BACKGROUND	EB	PHF	08:00	09:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Junction	Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
401EB - 401 EB	NB - SOUTH LEG		PHF	✓	683	100.000
	WB - EAST LEG					
	SB - NORTH LEG		PHF	✓	596	100.000
	EB - WEST LEG		PHF	✓	354	100.000

Peak Hour Factor Data (Traffic)

Junction	Arm	Hourly volume (PCU/hr)	Peak hour factor	Peak time segment
401EB - 401 EB	NB - SOUTH LEG	683	0.92	SecondQuarter
	WB - EAST LEG			
	SB - NORTH LEG	596	0.92	SecondQuarter
	EB - WEST LEG	354	0.92	SecondQuarter

Origin-Destination Data

Demand (PCU/hr)

401EB - 401 EB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	174	509	0
	WB - EAST LEG	Exit-only	Exit-only	Exit-only	Exit-only
	SB - NORTH LEG	456	140	0	0
	EB - WEST LEG	268	0	86	0

Vehicle Mix

Heavy Vehicle Percentages

401EB - 401 EB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	9	4	0
	WB - EAST LEG	Exit-only	Exit-only	Exit-only	Exit-only
	SB - NORTH LEG	3	3	0	0
	EB - WEST LEG	8	0	4	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
401EB - 401 EB	NB - SOUTH LEG	0.42	4.61	0.7	A	683	535
	WB - EAST LEG						
	SB - NORTH LEG	0.49	5.46	1.0	A	596	596
	EB - WEST LEG	0.15	4.70	0.2	A	354	126

WESTBOUND - FUTURE BACKGROUND, WB

Data Errors and Warnings
No errors or warnings

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
AWB	WESTBOUND	✓	✓	DWBEX, DWBFB, DWBTF	100.000	100.000

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
401WB	401 WB	Standard Roundabout		NB, WB, SB, EB	5.45	A

Junction Network Options

Driving side	Lighting
Right	Normal/unknown

Arms

Arms

Junction	Arm	Name	Description
401WB - 401 WB	**NB**	SOUTH LEG	
	WB	EAST LEG	
	SB	NORTH LEG	
	EB	WEST LEG	

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	I' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
401WB - 401 WB	**NB - SOUTH LEG**	3.75	5.50	8.4	41.0	46.0	22.0	
	WB - EAST LEG	4.75	4.75	0.0	45.0	46.0	11.0	
	SB - NORTH LEG	5.10	5.50	16.4	51.0	46.0	11.0	
	EB - WEST LEG							✓

Bypass

Junction	Arm	Arm has bypass	Bypass utilisation (%)
401WB - 401 WB	**NB - SOUTH LEG**		
	WB - EAST LEG	✓	85
	SB - NORTH LEG	✓	85
	EB - WEST LEG		

Slope / Intercept / Capacity

Arm Intercept Adjustments

Junction	Arm	Type	Reason	Percentage intercept adjustment (%)
401WB - 401 WB	NB - SOUTH LEG	Percentage		85.00
	WB - EAST LEG	Percentage		85.00
	SB - NORTH LEG	Percentage		85.00
	EB - WEST LEG			

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
401WB - 401 WB	NB - SOUTH LEG	0.607	1302
	WB - EAST LEG	0.627	1337
	SB - NORTH LEG	0.675	1544
	EB - WEST LEG		

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
DWBFB	FUTURE BACKGROUND	WB	PHF	08:00	09:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Junction	Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
401WB - 401 WB	NB - SOUTH LEG		PHF	✓	595	100.000
	WB - EAST LEG		PHF	✓	430	100.000
	SB - NORTH LEG		PHF	✓	441	100.000
	EB - WEST LEG					

Peak Hour Factor Data (Traffic)

Junction	Arm	Hourly volume (PCU/hr)	Peak hour factor	Peak time segment
401WB - 401 WB	NB - SOUTH LEG	595	0.92	SecondQuarter
	WB - EAST LEG	430	0.92	SecondQuarter
	SB - NORTH LEG	441	0.92	SecondQuarter
	EB - WEST LEG			

Origin-Destination Data

Demand (PCU/hr)

401WB - 401 WB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	0	298	297
	WB - EAST LEG	220	0	210	0
	SB - NORTH LEG	376	0	0	65
	EB - WEST LEG	Exit-only	Exit-only	Exit-only	Exit-only

Vehicle Mix

Heavy Vehicle Percentages

401WB - 401 WB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	0	3	5
	WB - EAST LEG	4	0	1	0
	SB - NORTH LEG	2	0	0	0
	EB - WEST LEG	Exit-only	Exit-only	Exit-only	Exit-only

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
401WB - 401 WB	NB - SOUTH LEG	0.50	5.70	1.0	A	595	595
	WB - EAST LEG	0.29	5.65	0.4	A	430	252
	SB - NORTH LEG	0.36	4.91	0.6	A	441	386
	EB - WEST LEG						

Appendix C

Operations Reports: Total Future Conditions – Unmitigated

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	45	230	625	115	250	105	440	285	110	170	345	20
Future Volume (vph)	45	230	625	115	250	105	440	285	110	170	345	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.2	7.2	4.0	7.2	7.2		7.4	7.4		7.4	7.4	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95		0.97	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1626	1776	1524	1626	3244		3367	1821		1805	1847	
Flt Permitted	0.54	1.00	1.00	0.61	1.00		0.54	1.00		0.52	1.00	
Satd. Flow (perm)	923	1776	1524	1051	3244		1927	1821		986	1847	
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)	45	230	625	115	250	105	440	285	110	170	345	20
RTOR Reduction (vph)	0	0	0	0	73	0	0	14	0	0	2	0
Lane Group Flow (vph)	45	230	625	115	282	0	440	381	0	170	363	0
Heavy Vehicles (%)	11%	7%	6%	11%	9%	0%	4%	0%	0%	0%	1%	20%
Turn Type	Perm	NA	Free	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		Free	8			2			6		
Actuated Green, G (s)	14.0	14.0	63.3	14.0	14.0		34.7	34.7		34.7	34.7	
Effective Green, g (s)	14.0	14.0	63.3	14.0	14.0		34.7	34.7		34.7	34.7	
Actuated g/C Ratio	0.22	0.22	1.00	0.22	0.22		0.55	0.55		0.55	0.55	
Clearance Time (s)	7.2	7.2		7.2	7.2		7.4	7.4		7.4	7.4	
Vehicle Extension (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
Lane Grp Cap (vph)	204	392	1524	232	717		1056	998		540	1012	
v/s Ratio Prot		0.13			0.09			0.21			0.20	
v/s Ratio Perm	0.05		c0.41	0.11			0.23			0.17		
v/c Ratio	0.22	0.59	0.41	0.50	0.39		0.42	0.38		0.31	0.36	
Uniform Delay, d1	20.2	22.1	0.0	21.6	21.0		8.4	8.2		7.8	8.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	2.4	0.8	2.0	0.4		0.3	0.3		1.5	1.0	
Delay (s)	20.8	24.5	0.8	23.5	21.4		8.7	8.5		9.3	9.0	
Level of Service	C	C	A	C	C		A	A		A	A	
Approach Delay (s)		7.9			22.0			8.6			9.1	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	63.3	Sum of lost time (s)	14.6
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	280	130	95	555	635	445
Future Volume (vph)	280	130	95	555	635	445
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.1		6.6	6.6	6.6	4.0
Lane Util. Factor	0.97		1.00	0.95	1.00	1.00
Frt	0.95		1.00	1.00	1.00	0.85
Flt Protected	0.97		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3253		1556	3574	1863	1482
Flt Permitted	0.97		0.22	1.00	1.00	1.00
Satd. Flow (perm)	3253		368	3574	1863	1482
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	280	130	95	555	635	445
RTOR Reduction (vph)	84	0	0	0	0	0
Lane Group Flow (vph)	326	0	95	555	635	445
Heavy Vehicles (%)	5%	3%	16%	1%	2%	9%
Turn Type	Prot		Perm	NA	NA	Free
Protected Phases	4			2	6	
Permitted Phases			2			Free
Actuated Green, G (s)	20.1		24.0	24.0	24.0	56.8
Effective Green, g (s)	20.1		24.0	24.0	24.0	56.8
Actuated g/C Ratio	0.35		0.42	0.42	0.42	1.00
Clearance Time (s)	6.1		6.6	6.6	6.6	
Vehicle Extension (s)	3.5		3.5	3.5	3.5	
Lane Grp Cap (vph)	1151		155	1510	787	1482
v/s Ratio Prot	0.10			0.16	c0.34	
v/s Ratio Perm			0.26			c0.30
v/c Ratio	0.28		0.61	0.37	0.81	0.30
Uniform Delay, d1	13.2		12.8	11.2	14.4	0.0
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2		7.3	0.2	6.2	0.5
Delay (s)	13.3		20.1	11.4	20.6	0.5
Level of Service	B		C	B	C	A
Approach Delay (s)	13.3			12.7	12.3	
Approach LOS	B			B	B	

Intersection Summary			
HCM 2000 Control Delay	12.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	56.8	Sum of lost time (s)	12.7
Intersection Capacity Utilization	82.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	5	5	225	10	5	155
Future Volume (Veh/h)	5	5	225	10	5	155
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	5	5	225	10	5	155
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			10		468	8
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			10		468	8
tC, single (s)			4.1		6.6	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.7	3.3
p0 queue free %			86		99	86
cM capacity (veh/h)			1623		447	1081

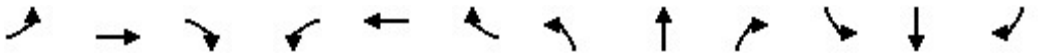
Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	10	235	160
Volume Left	0	225	5
Volume Right	5	0	155
cSH	1700	1623	1035
Volume to Capacity	0.01	0.14	0.15
Queue Length 95th (m)	0.0	3.9	4.4
Control Delay (s)	0.0	7.3	9.1
Lane LOS		A	A
Approach Delay (s)	0.0	7.3	9.1
Approach LOS			A

Intersection Summary			
Average Delay	7.8		
Intersection Capacity Utilization	36.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	10	10	215	280	5
Future Volume (Veh/h)	5	10	10	215	280	5
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)	5	10	10	215	280	5
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	518	282	285			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	518	282	285			
tC, single (s)	6.4	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.3			
p0 queue free %	99	99	99			
cM capacity (veh/h)	517	733	1227			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	15	225	285
Volume Left	5	10	0
Volume Right	10	0	5
cSH	644	1227	1700
Volume to Capacity	0.02	0.01	0.17
Queue Length 95th (m)	0.6	0.2	0.0
Control Delay (s)	10.7	0.4	0.0
Lane LOS	B	A	
Approach Delay (s)	10.7	0.4	0.0
Approach LOS	B		

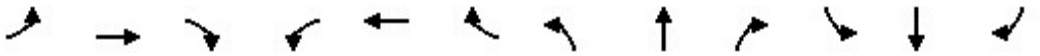
Intersection Summary			
Average Delay		0.5	
Intersection Capacity Utilization		29.4%	ICU Level of Service
Analysis Period (min)		15	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	90	125	140	20	135	170	210	390	45	145	320	95
Future Volume (vph)	90	125	140	20	135	170	210	390	45	145	320	95
Peak Hour 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
Hourly flow rate (vph)	90	125	140	20	135	170	210	390	45	145	320	95

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	355	325	600	45	145	415
Volume Left (vph)	90	20	210	0	145	0
Volume Right (vph)	140	170	0	45	0	95
Hadj (s)	-0.12	-0.29	0.21	-0.70	0.50	-0.11
Departure Headway (s)	8.8	8.8	9.3	8.3	9.5	8.9
Degree Utilization, x	0.87	0.80	1.54	0.10	0.38	1.03
Capacity (veh/h)	394	397	402	425	374	415
Control Delay (s)	48.3	38.8	279.9	11.1	17.1	81.4
Approach Delay (s)	48.3	38.8	261.1		64.8	
Approach LOS	E	E	F		F	

Intersection Summary				
Delay	124.4			
Level of Service	F			
Intersection Capacity Utilization	106.8%	ICU Level of Service	G	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	105	15	95	20	20	50	125	480	25	35	340	125
Future Volume (Veh/h)	105	15	95	20	20	50	125	480	25	35	340	125
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	105	15	95	20	20	50	125	480	25	35	340	125
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	1022	1228	232	1085	1278	252	465			505		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1022	1228	232	1085	1278	252	465			505		
tC, single (s)	7.5	6.5	7.1	8.1	6.6	6.9	4.2			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.4	3.8	4.1	3.3	2.3			2.3		
p0 queue free %	25	90	87	80	85	93	88			97		
cM capacity (veh/h)	141	153	743	98	135	747	1058			1002		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	215	90	365	265	205	295
Volume Left	105	20	125	0	35	0
Volume Right	95	50	0	25	0	125
cSH	221	215	1058	1700	1002	1700
Volume to Capacity	0.97	0.42	0.12	0.16	0.03	0.17
Queue Length 95th (m)	68.9	15.4	3.2	0.0	0.9	0.0
Control Delay (s)	99.7	33.3	3.8	0.0	1.8	0.0
Lane LOS	F	D	A		A	
Approach Delay (s)	99.7	33.3	2.2		0.7	
Approach LOS	F	D				

Intersection Summary				
Average Delay	18.3			
Intersection Capacity Utilization	61.2%	ICU Level of Service	B	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	10	60	505	15	80	565
Future Volume (Veh/h)	10	60	505	15	80	565
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)	10	60	505	15	80	565
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			348			
pX, platoon unblocked						
vC, conflicting volume	955	260			520	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	955	260			520	
tC, single (s)	6.8	6.9			4.2	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	92			92	
cM capacity (veh/h)	240	745			1035	

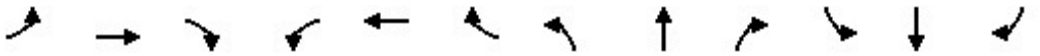
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	70	337	183	268	377
Volume Left	10	0	0	80	0
Volume Right	60	0	15	0	0
cSH	573	1700	1700	1035	1700
Volume to Capacity	0.12	0.20	0.11	0.08	0.22
Queue Length 95th (m)	3.3	0.0	0.0	2.0	0.0
Control Delay (s)	12.2	0.0	0.0	3.1	0.0
Lane LOS	B			A	
Approach Delay (s)	12.2	0.0		1.3	
Approach LOS	B				

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	46.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	45	340	250	475	560	15
Future Volume (Veh/h)	45	340	250	475	560	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)	45	340	250	475	560	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)				211		
pX, platoon unblocked						
vC, conflicting volume	1305	288	575			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1305	288	575			
tC, single (s)	7.0	7.0	4.3			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.3			
p0 queue free %	58	51	74			
cM capacity (veh/h)	106	697	954			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	385	250	238	238	373	202
Volume Left	45	250	0	0	0	0
Volume Right	340	0	0	0	0	15
cSH	423	954	1700	1700	1700	1700
Volume to Capacity	0.91	0.26	0.14	0.14	0.22	0.12
Queue Length 95th (m)	79.1	8.4	0.0	0.0	0.0	0.0
Control Delay (s)	55.9	10.1	0.0	0.0	0.0	0.0
Lane LOS	F	B				
Approach Delay (s)	55.9	3.5			0.0	
Approach LOS	F					

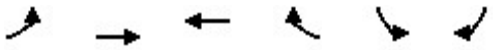
Intersection Summary			
Average Delay	14.3		
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	15	40	75	15	180	40	390	75	190	490	85
Future Volume (Veh/h)	85	15	40	75	15	180	40	390	75	190	490	85
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	92	16	43	82	16	196	43	424	82	207	533	92
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	1748	1585	579	1595	1590	465	625			506		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1748	1585	579	1595	1590	465	625			506		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	81	92	0	81	67	96			81		
cM capacity (veh/h)	32	84	519	57	84	602	966			1069		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	151	294	549	832
Volume Left	92	82	43	207
Volume Right	43	196	82	92
cSH	49	149	966	1069
Volume to Capacity	3.11	1.97	0.04	0.19
Queue Length 95th (m)	Err	183.1	1.1	5.7
Control Delay (s)	Err	508.9	1.2	4.4
Lane LOS	F	F	A	A
Approach Delay (s)	Err	508.9	1.2	4.4
Approach LOS	F	F		

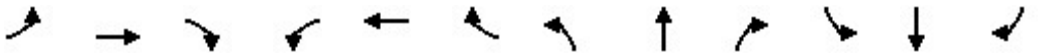
Intersection Summary				
Average Delay	911.2			
Intersection Capacity Utilization	95.1%	ICU Level of Service	F	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	125	80	65	0	5	160
Future Volume (Veh/h)	125	80	65	0	5	160
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	87	71	0	5	174
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	71				430	71
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	71				430	71
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	91				99	83
cM capacity (veh/h)	1542				534	997

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	223	71	179
Volume Left	136	0	5
Volume Right	0	0	174
cSH	1542	1700	974
Volume to Capacity	0.09	0.04	0.18
Queue Length 95th (m)	2.3	0.0	5.4
Control Delay (s)	4.9	0.0	9.5
Lane LOS	A		A
Approach Delay (s)	4.9	0.0	9.5
Approach LOS			A

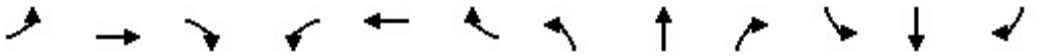
Intersection Summary			
Average Delay	5.9		
Intersection Capacity Utilization	34.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	40	120	120	190	80	100	105	495	300	145	390	50
Future Volume (Veh/h)	40	120	120	190	80	100	105	495	300	145	390	50
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	40	120	120	190	80	100	105	495	300	145	390	50
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	1550	1710	415	1715	1585	645	440			795		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1550	1710	415	1715	1585	645	440			795		
tC, single (s)	7.1	6.5	6.2	7.1	6.6	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.1	3.3	2.2			2.2		
p0 queue free %	0	0	81	0	0	79	90			83		
cM capacity (veh/h)	0	68	640	0	79	476	1104			835		

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	40	240	370	105	795	145	440
Volume Left	40	0	190	105	0	145	0
Volume Right	0	120	100	0	300	0	50
cSH	0	123	0	1104	1700	835	1700
Volume to Capacity	Err	1.96	Err	0.10	0.47	0.17	0.26
Queue Length 95th (m)	Err	154.6	Err	2.5	0.0	5.0	0.0
Control Delay (s)	Err	518.1	Err	8.6	0.0	10.2	0.0
Lane LOS	F	F	F	A		B	
Approach Delay (s)	Err		Err	1.0		2.5	
Approach LOS	F		F				

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	100.2%	ICU Level of Service	G	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	240	10	105	5	10	10	80	815	0	5	790	245
Future Volume (Veh/h)	240	10	105	5	10	10	80	815	0	5	790	245
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	261	11	114	5	11	11	87	886	0	5	859	266
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	2078	2062	992	2182	2195	886	1125			886		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2078	2062	992	2182	2195	886	1125			886		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	77	62	67	72	97	86			99		
cM capacity (veh/h)	27	47	301	15	39	346	628			773		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	386	27	973	1130
Volume Left	261	5	87	5
Volume Right	114	11	0	266
cSH	37	42	628	773
Volume to Capacity	10.30	0.64	0.14	0.01
Queue Length 95th (m)	Err	19.0	3.8	0.2
Control Delay (s)	Err	185.7	4.1	0.2
Lane LOS	F	F	A	A
Approach Delay (s)	Err	185.7	4.1	0.2
Approach LOS	F	F		

Intersection Summary				
Average Delay	1537.7			
Intersection Capacity Utilization	135.2%	ICU Level of Service	H	
Analysis Period (min)	15			

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.2.1013

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

Filename: 401 at Plank Line.j9
Path: c:\pw working directory\projects 2022\dillon_10hkv\dms88339
Report generation date: 2023-04-10 9:51:42 AM

Summary of junction performance

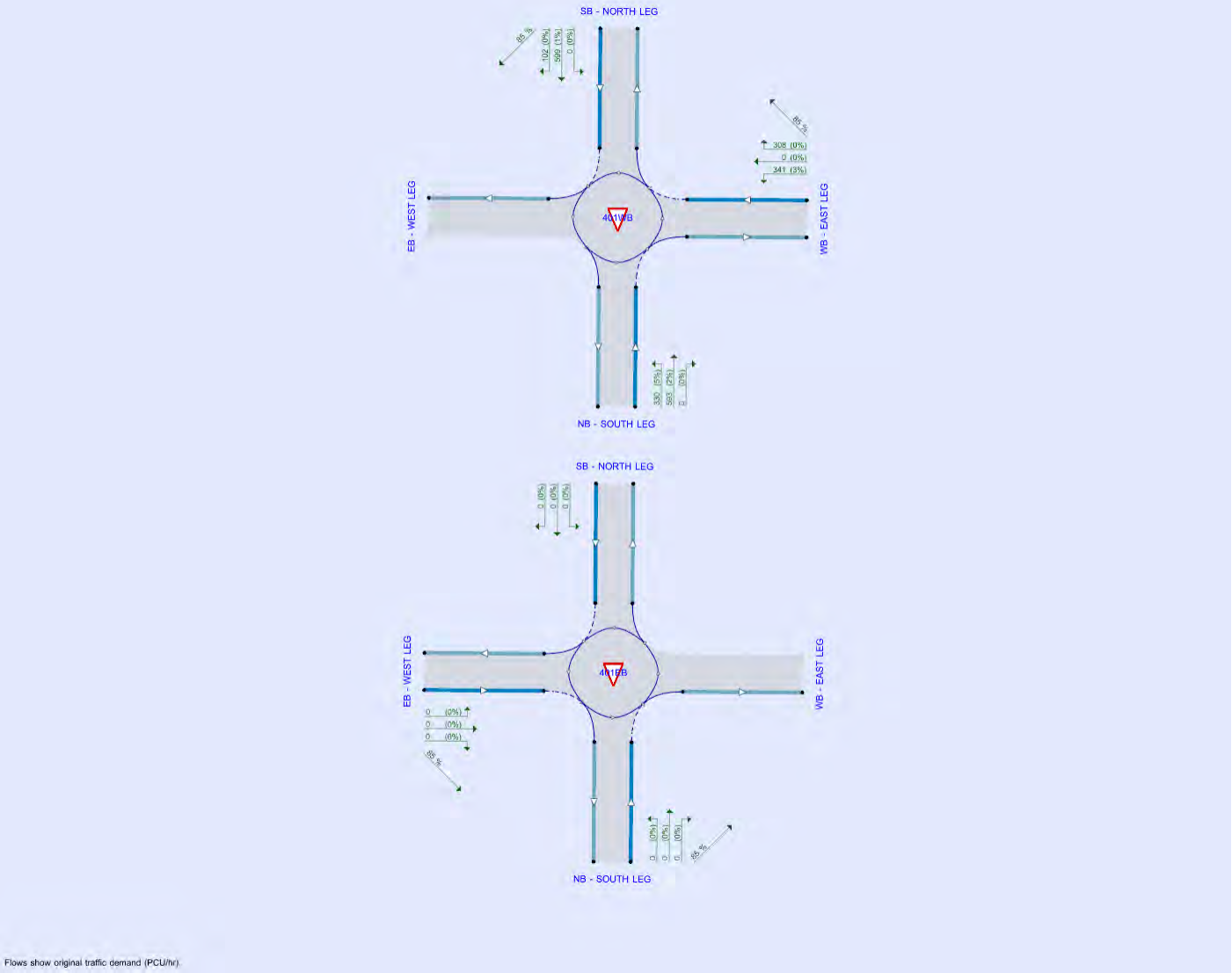
	EB				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
	EASTBOUND - TOTAL FUTURE				
401EB - 401 EB - NB - SOUTH LEG	AEB DEBTF	2.1	8.80	0.68	A
401EB - 401 EB - SB - NORTH LEG		3.2	11.67	0.77	B
401EB - 401 EB - EB - WEST LEG		0.4	7.47	0.30	A

	WB				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
	WESTBOUND - TOTAL FUTURE				
401WB - 401 WB - NB - SOUTH LEG	AWB DWBTF	3.3	12.01	0.77	B
401WB - 401 WB - WB - EAST LEG		1.4	12.52	0.59	B
401WB - 401 WB - SB - NORTH LEG		1.7	9.28	0.63	A

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
DEBTF	TOTAL FUTURE	EB	PHF	08:00	09:00	15	✓
DWBTF	TOTAL FUTURE	WB	PHF	08:00	09:00	15	✓

EASTBOUND - TOTAL FUTURE, EB

Data Errors and Warnings

No errors or warnings

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
AEB	EASTBOUND	✓	✓	DEBEX, DEBFB, DEBTF	100.000	100.000

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
401EB	401 EB	Standard Roundabout		NB, WB, SB, EB	9.65	A

Junction Network Options

Driving side	Lighting
Right	Normal/unknown

Arms

Arms

Junction	Arm	Name	Description
401EB - 401 EB	**NB**	SOUTH LEG	
	WB	EAST LEG	
	SB	NORTH LEG	
	EB	WEST LEG	

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
401EB - 401 EB	**NB - SOUTH LEG**	5.10	5.50	18.4	55.0	46.0	8.0	
	WB - EAST LEG							✓
	SB - NORTH LEG	3.75	5.50	10.6	44.0	46.0	23.0	
	EB - WEST LEG	4.75	4.80	1.0	50.0	46.0	11.0	

Bypass

Junction	Arm	Arm has bypass	Bypass utilisation (%)
401EB - 401 EB	**NB - SOUTH LEG**	✓	85
	WB - EAST LEG		
	SB - NORTH LEG		
	EB - WEST LEG	✓	85

Slope / Intercept / Capacity

Arm Intercept Adjustments

Junction	Arm	Type	Reason	Percentage intercept adjustment (%)
401EB - 401 EB	NB - SOUTH LEG	Percentage		85.00
	WB - EAST LEG			
	SB - NORTH LEG	Percentage		85.00
	EB - WEST LEG	Percentage		85.00

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
401EB - 401 EB	NB - SOUTH LEG	0.683	1561
	WB - EAST LEG		
	SB - NORTH LEG	0.612	1325
	EB - WEST LEG	0.631	1352

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
DEBTF	TOTAL FUTURE	EB	PHF	08:00	09:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Junction	Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
401EB - 401 EB	NB - SOUTH LEG		PHF	✓	1067	100.000
	WB - EAST LEG					
	SB - NORTH LEG		PHF	✓	939	100.000
	EB - WEST LEG		PHF	✓	450	100.000

Peak Hour Factor Data (Traffic)

Junction	Arm	Hourly volume (PCU/hr)	Peak hour factor	Peak time segment
401EB - 401 EB	NB - SOUTH LEG	1067	0.92	SecondQuarter
	WB - EAST LEG			
	SB - NORTH LEG	939	0.92	SecondQuarter
	EB - WEST LEG	450	0.92	SecondQuarter

Origin-Destination Data

Demand (PCU/hr)

401EB - 401 EB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	293	774	0
	WB - EAST LEG	Exit-only	Exit-only	Exit-only	Exit-only
	SB - NORTH LEG	741	198	0	0
	EB - WEST LEG	301	0	149	0

Vehicle Mix

Heavy Vehicle Percentages

401EB - 401 EB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	6	3	0
	WB - EAST LEG	Exit-only	Exit-only	Exit-only	Exit-only
	SB - NORTH LEG	2	2	0	0
	EB - WEST LEG	7	0	3	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
401EB - 401 EB	NB - SOUTH LEG	0.68	8.80	2.1	A	1067	818
	WB - EAST LEG						
	SB - NORTH LEG	0.77	11.67	3.2	B	939	939
	EB - WEST LEG	0.30	7.47	0.4	A	450	194

WESTBOUND - TOTAL FUTURE, WB

Data Errors and Warnings

No errors or warnings

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
AWB	WESTBOUND	✓	✓	DWBEX, DWBFB, DWBTF	100.000	100.000

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
401WB	401 WB	Standard Roundabout		NB, WB, SB, EB	11.31	B

Junction Network Options

Driving side	Lighting
Right	Normal/unknown

Arms

Arms

Junction	Arm	Name	Description
401WB - 401 WB	**NB**	SOUTH LEG	
	WB	EAST LEG	
	SB	NORTH LEG	
	EB	WEST LEG	

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
401WB - 401 WB	**NB - SOUTH LEG**	3.75	5.50	8.4	41.0	46.0	22.0	
	WB - EAST LEG	4.75	4.75	0.0	45.0	46.0	11.0	
	SB - NORTH LEG	5.10	5.50	16.4	51.0	46.0	11.0	
	EB - WEST LEG							✓

Bypass

Junction	Arm	Arm has bypass	Bypass utilisation (%)
401WB - 401 WB	**NB - SOUTH LEG**		
	WB - EAST LEG	✓	85
	SB - NORTH LEG	✓	85
	EB - WEST LEG		

Slope / Intercept / Capacity

Arm Intercept Adjustments

Junction	Arm	Type	Reason	Percentage intercept adjustment (%)
401WB - 401 WB	NB - SOUTH LEG	Percentage		85.00
	WB - EAST LEG	Percentage		85.00
	SB - NORTH LEG	Percentage		85.00
	EB - WEST LEG			

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
401WB - 401 WB	NB - SOUTH LEG	0.607	1302
	WB - EAST LEG	0.627	1337
	SB - NORTH LEG	0.675	1544
	EB - WEST LEG		

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
DWBTF	TOTAL FUTURE	WB	PHF	08:00	09:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Junction	Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
401WB - 401 WB	NB - SOUTH LEG		PHF	✓	923	100.000
	WB - EAST LEG		PHF	✓	649	100.000
	SB - NORTH LEG		PHF	✓	701	100.000
	EB - WEST LEG					

Peak Hour Factor Data (Traffic)

Junction	Arm	Hourly volume (PCU/hr)	Peak hour factor	Peak time segment
401WB - 401 WB	NB - SOUTH LEG	923	0.92	SecondQuarter
	WB - EAST LEG	649	0.92	SecondQuarter
	SB - NORTH LEG	701	0.92	SecondQuarter
	EB - WEST LEG			

Origin-Destination Data

Demand (PCU/hr)

401WB - 401 WB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	0	593	330
	WB - EAST LEG	341	0	308	0
	SB - NORTH LEG	599	0	0	102
	EB - WEST LEG	Exit-only	Exit-only	Exit-only	Exit-only

Vehicle Mix

Heavy Vehicle Percentages

401WB - 401 WB

		To			
		NB - SOUTH LEG	WB - EAST LEG	SB - NORTH LEG	EB - WEST LEG
From	NB - SOUTH LEG	0	0	2	5
	WB - EAST LEG	3	0	0	0
	SB - NORTH LEG	1	0	0	0
	EB - WEST LEG	Exit-only	Exit-only	Exit-only	Exit-only

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
401WB - 401 WB	NB - SOUTH LEG	0.77	12.01	3.3	B	923	923
	WB - EAST LEG	0.59	12.52	1.4	B	649	387
	SB - NORTH LEG	0.63	9.28	1.7	A	701	614
	EB - WEST LEG						

Appendix D

OTM Signal Warrants

Traffic Signal Warrant Analysis

MTO Method (Ontario Traffic Manual, Book 12)
2046 Future Total

Main street direction	North/South	**Major Street**	Ingersoll Street
Main street cross-section	2+ lanes	**Minor Street**	Thomas Road
Roadway environment	Free flow		
"T" intersection?	No		

	Major Street						Minor Street				
	Ingersoll Street						Thomas Road				
	Northbound			Southbound			Eastbound			Westbound	
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through
PM Peak	125	480	25	35	340	125	105	15	95	20	20
Average Hourly Volume	63	240	13	18	170	63	53	8	48	10	10

Justification 7 - OTM Book 12

Warrant 1 - Minimum Vehicular Volume

		1		2+		Average Hourly Volume	
1A	**Approach Lanes**					718	
	Flow Conditions	Free	Restricted	Free	Restricted		
	All Approaches	480	720	**600**	900	% Satisfied	120%

		1		2+		Average Hourly Volume	
1B	**Approach Lanes**					153	
	Flow Conditions	Free	Restricted	Free	Restricted		
	All Approaches	120	170	**120**	170	% Satisfied	127%

Warrant 2 - Delay to Cross Traffic

		1		2+		Average Hourly Volume	
2A	**Approach Lanes**					565	
	Flow Conditions	Free	Restricted	Free	Restricted		
	All Approaches	480	720	**600**	900	% Satisfied	94%

		1		2+		Average Hourly Volume	
2B	**Approach Lanes**					80	
	Flow Conditions	Free	Restricted	Free	Restricted		
	All Approaches	50	75	**120**	170	% Satisfied	67%

Result	Signal Warranted

Traffic Signal Warrant Analysis

MTO Method (Ontario Traffic Manual, Book 12)
2046 Future Total

Main street direction	North/South	**Major Street**	Plank Line
Main street cross-section	1 lane	**Minor Street**	Curry Road
Roadway environment	Free flow		
"T" intersection?	No		

	Major Street						Minor Street				
	Plank Line						Curry Road				
	Northbound			Southbound			Eastbound			Westbound	
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through
PM Peak	80	815	0	5	790	245	240	10	105	5	10
Average Hourly Volume	40	408	0	3	395	123	120	5	53	3	5

Justification 7 - OTM Book 12

Warrant 1 - Minimum Vehicular Volume

1A	**Approach Lanes**	1		2+		**Average Hourly Volume**
	Flow Conditions	Free	Restricted	Free	Restricted	1158
	All Approaches	**480**	720	600	900	% Satisfied: 241%

1B	**Approach Lanes**	1		2+		**Average Hourly Volume**
	Flow Conditions	Free	Restricted	Free	Restricted	190
	All Approaches	**120**	170	120	170	% Satisfied: 158%

Warrant 2 - Delay to Cross Traffic

2A	**Approach Lanes**	1		2+		**Average Hourly Volume**
	Flow Conditions	Free	Restricted	Free	Restricted	968
	All Approaches	**480**	720	600	900	% Satisfied: 202%

2B	**Approach Lanes**	1		2+		**Average Hourly Volume**
	Flow Conditions	Free	Restricted	Free	Restricted	133
	All Approaches	**50**	75	120	170	% Satisfied: 265%

Result	Signal Warranted

Traffic Signal Warrant Analysis

MTO Method (Ontario Traffic Manual, Book 12)
2046 Future Total

Main street direction	North/South	**Major Street**	Ingersoll Street
Main street cross-section	1 lane	**Minor Street**	Thompson Road
Roadway environment	Free flow		
"T" intersection?	Yes		

	Major Street						Minor Street					
	Ingersoll Street						Thompson Road					
	Northbound			Southbound			Eastbound			Westbound		
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
PM Peak	250	475			560	15	45		340			
Average Hourly Volume	125	238	0	0	280	8	23	0	170	0	0	0

Justification 7 - OTM Book 12

Warrant 1 - Minimum Vehicular Volume

1A	**Approach Lanes**	1		2+	
	Flow Conditions	Free	Restricted	Free	Restricted
	All Approaches	**480**	720	600	900

Average Hourly Volume	
843	
% Satisfied	176%

1B	**Approach Lanes**	1		2+	
	Flow Conditions	Free	Restricted	Free	Restricted
	All Approaches	**180**	255	180	255

Average Hourly Volume	
193	
% Satisfied	107%

Warrant 2 - Delay to Cross Traffic

2A	**Approach Lanes**	1		2+	
	Flow Conditions	Free	Restricted	Free	Restricted
	All Approaches	**480**	720	600	900

Average Hourly Volume	
650	
% Satisfied	135%

2B	**Approach Lanes**	1		2+	
	Flow Conditions	Free	Restricted	Free	Restricted
	All Approaches	**50**	75	120	170

Average Hourly Volume	
23	
% Satisfied	45%

Result	Signal Not Warranted

Traffic Signal Warrant Analysis

MTO Method (Ontario Traffic Manual, Book 12)
2046 Future Total

Main street direction	North/South	**Major Street**	Culloden Line
Main street cross-section	1 lane	**Minor Street**	Union Road
Roadway environment	Free flow		
"T" intersection?	No		

	Major Street						Minor Street					
	Culloden Line						Union Road					
	Northbound			Southbound			Eastbound			Westbound		
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
PM Peak	40	390	75	190	490	85	85	15	40	75	15	180
Average Hourly Volume	20	195	38	95	245	43	43	8	20	38	8	90

Justification 7 - OTM Book 12

Warrant 1 - Minimum Vehicular Volume

1A	**Approach Lanes**	1		2+	
	Flow Conditions	Free	Restricted	Free	Restricted
	All Approaches	**480**	720	600	900

Average Hourly Volume	
840	
% Satisfied	175%

1B	**Approach Lanes**	1		2+	
	Flow Conditions	Free	Restricted	Free	Restricted
	All Approaches	**120**	170	120	170

Average Hourly Volume	
205	
% Satisfied	171%

Warrant 2 - Delay to Cross Traffic

2A	**Approach Lanes**	1		2+	
	Flow Conditions	Free	Restricted	Free	Restricted
	All Approaches	**480**	720	600	900

Average Hourly Volume	
635	
% Satisfied	132%

2B	**Approach Lanes**	1		2+	
	Flow Conditions	Free	Restricted	Free	Restricted
	All Approaches	**50**	75	120	170

Average Hourly Volume	
95	
% Satisfied	190%

Result	Signal Warranted

Traffic Signal Warrant Analysis

MTO Method (Ontario Traffic Manual, Book 12)
2046 Future Total

Main street direction	North/South	**Major Street**	Harris Street
Main street cross-section	2+ lanes	**Minor Street**	Clarke Road
Roadway environment	Free flow		
"T" intersection?	No		

	Major Street						Minor Street				
	Harris Street						Clarke Road				
	Northbound			Southbound			Eastbound			Westbound	
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through
PM Peak	105	495	300	145	390	50	40	120	120	190	80
Average Hourly Volume	53	248	150	73	195	25	20	60	60	95	40

Justification 7 - OTM Book 12

Warrant 1 - Minimum Vehicular Volume

1A	**Approach Lanes**	1		2+		**Average Hourly Volume**	
	Flow Conditions	Free	Restricted	Free	Restricted	1068	
	All Approaches	480	720	**600**	900	% Satisfied	178%

1B	**Approach Lanes**	1		2+		**Average Hourly Volume**	
	Flow Conditions	Free	Restricted	Free	Restricted	325	
	All Approaches	120	170	**120**	170	% Satisfied	271%

Warrant 2 - Delay to Cross Traffic

2A	**Approach Lanes**	1		2+		**Average Hourly Volume**	
	Flow Conditions	Free	Restricted	Free	Restricted	743	
	All Approaches	480	720	**600**	900	% Satisfied	124%

2B	**Approach Lanes**	1		2+		**Average Hourly Volume**	
	Flow Conditions	Free	Restricted	Free	Restricted	215	
	All Approaches	50	75	**120**	170	% Satisfied	179%

Result	Signal Warranted

Traffic Signal Warrant Analysis

MTO Method (Ontario Traffic Manual, Book 12)
2046 Future Total

Main street direction	North/South	**Major Street**	Ingersoll Street
Main street cross-section	2+ lanes	**Minor Street**	King St W
Roadway environment	Free flow		
"T" intersection?	No		

	Major Street						Minor Street					
	Ingersoll Street						King St W					
	Northbound			Southbound			Eastbound			Westbound		
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
PM Peak	210	390	45	145	320	95	90	125	140	20	135	170
Average Hourly Volume	105	195	23	73	160	48	45	63	70	10	68	85

Justification 7 - OTM Book 12

Warrant 1 - Minimum Vehicular Volume

		1		2+		Average Hourly Volume	
1A	**Approach Lanes**					943	
	Flow Conditions	Free	Restricted	Free	Restricted	% Satisfied	157%
	All Approaches	480	720	**600**	900		

		1		2+		Average Hourly Volume	
1B	**Approach Lanes**					340	
	Flow Conditions	Free	Restricted	Free	Restricted	% Satisfied	283%
	All Approaches	120	170	**120**	170		

Warrant 2 - Delay to Cross Traffic

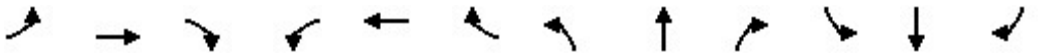
		1		2+		Average Hourly Volume	
2A	**Approach Lanes**					603	
	Flow Conditions	Free	Restricted	Free	Restricted	% Satisfied	100%
	All Approaches	480	720	**600**	900		

		1		2+		Average Hourly Volume	
2B	**Approach Lanes**					185	
	Flow Conditions	Free	Restricted	Free	Restricted	% Satisfied	370%
	All Approaches	50	75	**50**	75		

Result	Signal Warranted

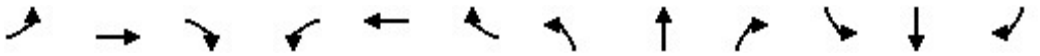
Appendix E

Operations Reports: Total Future Conditions – Mitigated (Signalization)



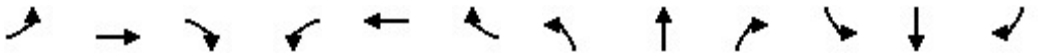
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	90	125	140	20	135	170	210	390	45	145	320	95
Future Volume (vph)	90	125	140	20	135	170	210	390	45	145	320	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5	4.5	4.5	4.5	
Lane Util. Factor		1.00			1.00			1.00	1.00	1.00	1.00	
Frt		0.95			0.93			1.00	0.85	1.00	0.97	
Flt Protected		0.99			1.00			0.98	1.00	0.95	1.00	
Satd. Flow (prot)		1713			1753			1825	1615	1805	1780	
Flt Permitted		0.72			0.97			0.67	1.00	0.34	1.00	
Satd. Flow (perm)		1256			1705			1251	1615	639	1780	
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)	90	125	140	20	135	170	210	390	45	145	320	95
RTOR Reduction (vph)	0	36	0	0	61	0	0	0	19	0	16	0
Lane Group Flow (vph)	0	319	0	0	264	0	0	600	26	145	399	0
Heavy Vehicles (%)	1%	3%	6%	0%	1%	0%	1%	3%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)		17.6			17.6			38.0	38.0	38.0	38.0	
Effective Green, g (s)		17.6			17.6			38.0	38.0	38.0	38.0	
Actuated g/C Ratio		0.27			0.27			0.59	0.59	0.59	0.59	
Clearance Time (s)		4.5			4.5			4.5	4.5	4.5	4.5	
Vehicle Extension (s)		3.0			3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		342			464			735	950	375	1047	
v/s Ratio Prot											0.22	
v/s Ratio Perm		c0.25			0.15			c0.48	0.02	0.23		
v/c Ratio		0.93			0.57			0.82	0.03	0.39	0.38	
Uniform Delay, d1		22.9			20.2			10.5	5.6	7.1	7.1	
Progression Factor		1.00			1.00			1.00	1.00	1.00	1.00	
Incremental Delay, d2		31.5			1.6			9.7	0.1	3.0	1.1	
Delay (s)		54.4			21.8			20.3	5.6	10.1	8.1	
Level of Service		D			C			C	A	B	A	
Approach Delay (s)		54.4			21.8			19.3			8.6	
Approach LOS		D			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	23.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	64.6	Sum of lost time (s)	9.0
Intersection Capacity Utilization	108.5%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			



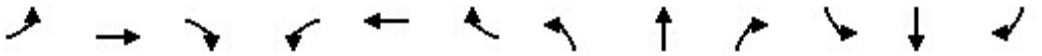
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	15	95	20	20	50	125	480	25	35	340	125
Future Volume (vph)	105	15	95	20	20	50	125	480	25	35	340	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frt		0.94			0.93			0.99			0.96	
Flt Protected		0.98			0.99			0.99			1.00	
Satd. Flow (prot)		1656			1587			3430			3283	
Flt Permitted		0.80			0.92			0.78			0.90	
Satd. Flow (perm)		1356			1468			2704			2953	
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)	105	15	95	20	20	50	125	480	25	35	340	125
RTOR Reduction (vph)	0	74	0	0	39	0	0	5	0	0	55	0
Lane Group Flow (vph)	0	141	0	0	51	0	0	625	0	0	445	0
Heavy Vehicles (%)	1%	0%	11%	31%	7%	2%	7%	2%	17%	10%	7%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		8.8			8.8			21.2			21.2	
Effective Green, g (s)		8.8			8.8			21.2			21.2	
Actuated g/C Ratio		0.23			0.23			0.54			0.54	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		305			331			1469			1605	
v/s Ratio Prot												
v/s Ratio Perm		c0.10			0.03			c0.23			0.15	
v/c Ratio		0.46			0.15			0.43			0.28	
Uniform Delay, d1		13.1			12.1			5.3			4.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.1			0.2			0.9			0.4	
Delay (s)		14.2			12.3			6.2			5.2	
Level of Service		B			B			A			A	
Approach Delay (s)		14.2			12.3			6.2			5.2	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	39.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	62.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			



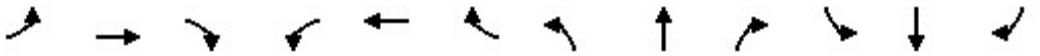
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	15	40	75	15	180	40	390	75	190	490	85
Future Volume (vph)	85	15	40	75	15	180	40	390	75	190	490	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.96			0.91			0.98			0.98	
Flt Protected		0.97			0.99			1.00			0.99	
Satd. Flow (prot)		1773			1705			1772			1802	
Flt Permitted		0.51			0.87			0.92			0.77	
Satd. Flow (perm)		924			1500			1629			1412	
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)	85	15	40	75	15	180	40	390	75	190	490	85
RTOR Reduction (vph)	0	19	0	0	95	0	0	7	0	0	5	0
Lane Group Flow (vph)	0	121	0	0	175	0	0	498	0	0	760	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	6%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		13.9			13.9			53.6			53.6	
Effective Green, g (s)		13.9			13.9			53.6			53.6	
Actuated g/C Ratio		0.18			0.18			0.70			0.70	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		167			272			1141			989	
v/s Ratio Prot												
v/s Ratio Perm		c0.13			0.12			0.31			c0.54	
v/c Ratio		0.73			0.64			0.44			0.77	
Uniform Delay, d1		29.5			29.0			4.9			7.4	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		14.5			5.1			1.2			5.7	
Delay (s)		44.0			34.1			6.2			13.1	
Level of Service		D			C			A			B	
Approach Delay (s)		44.0			34.1			6.2			13.1	
Approach LOS		D			C			A			B	

Intersection Summary			
HCM 2000 Control Delay	17.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	76.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	96.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	120	120	190	80	100	105	495	300	145	390	50
Future Volume (vph)	40	120	120	190	80	100	105	495	300	145	390	50
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	
Lane Util. Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.93			0.96		1.00	0.94		1.00	0.98	
Flt Protected	0.95	1.00			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1732			1762		1719	1781		1805	1835	
Flt Permitted	0.53	1.00			0.60		0.51	1.00		0.09	1.00	
Satd. Flow (perm)	978	1732			1077		918	1781		164	1835	
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)	40	120	120	190	80	100	105	495	300	145	390	50
RTOR Reduction (vph)	0	34	0	0	15	0	0	24	0	0	5	0
Lane Group Flow (vph)	40	206	0	0	355	0	105	771	0	145	435	0
Heavy Vehicles (%)	3%	2%	1%	0%	6%	0%	5%	1%	0%	0%	1%	8%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		pm+pt	NA	
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	29.0	29.0			29.0		41.8	41.8		52.0	52.0	
Effective Green, g (s)	29.0	29.0			29.0		41.8	41.8		52.0	52.0	
Actuated g/C Ratio	0.32	0.32			0.32		0.46	0.46		0.58	0.58	
Clearance Time (s)	4.5	4.5			4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	315	558			347		426	827		198	1060	
v/s Ratio Prot		0.12						c0.43		c0.05	0.24	
v/s Ratio Perm	0.04				c0.33		0.11			0.38		
v/c Ratio	0.13	0.37			1.02		0.25	0.93		0.73	0.41	
Uniform Delay, d1	21.6	23.5			30.5		14.6	22.8		18.3	10.5	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.4			54.4		1.4	18.6		13.1	1.2	
Delay (s)	21.7	23.9			84.9		16.0	41.4		31.4	11.7	
Level of Service	C	C			F		B	D		C	B	
Approach Delay (s)		23.6			84.9			38.4			16.6	
Approach LOS		C			F			D			B	

Intersection Summary			
HCM 2000 Control Delay	38.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	101.9%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

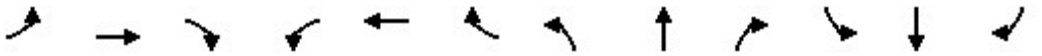


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	240	10	105	5	10	10	80	815	0	5	790	245
Future Volume (vph)	240	10	105	5	10	10	80	815	0	5	790	245
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.96			0.95			1.00			0.97	
Flt Protected		0.97			0.99			1.00			1.00	
Satd. Flow (prot)		1764			1780			1809			1785	
Flt Permitted		0.78			0.95			0.84			1.00	
Satd. Flow (perm)		1426			1713			1520			1780	
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)	240	10	105	5	10	10	80	815	0	5	790	245
RTOR Reduction (vph)	0	17	0	0	8	0	0	0	0	0	12	0
Lane Group Flow (vph)	0	338	0	0	17	0	0	895	0	0	1028	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		18.5			18.5			62.5			62.5	
Effective Green, g (s)		18.5			18.5			62.5			62.5	
Actuated g/C Ratio		0.21			0.21			0.69			0.69	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		293			352			1055			1236	
v/s Ratio Prot												
v/s Ratio Perm		c0.24			0.01			c0.59			0.58	
v/c Ratio		1.15			0.05			0.85			0.83	
Uniform Delay, d1		35.8			28.7			10.2			9.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		101.2			0.1			8.5			6.6	
Delay (s)		136.9			28.7			18.7			16.6	
Level of Service		F			C			B			B	
Approach Delay (s)		136.9			28.7			18.7			16.6	
Approach LOS		F			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	36.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	136.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

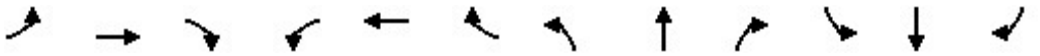
Appendix F

Operations Reports: Total Future Conditions – Mitigated (Signalization + Lane Modifications)



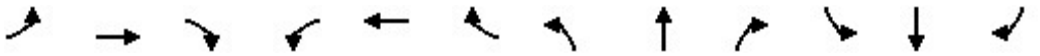
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	90	125	140	20	135	170	210	390	45	145	320	95
Future Volume (vph)	90	125	140	20	135	170	210	390	45	145	320	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.95			0.93		1.00	0.98		1.00	0.97	
Flt Protected		0.99			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1713			1753		1787	1822		1805	1780	
Flt Permitted		0.81			0.97		0.46	1.00		0.45	1.00	
Satd. Flow (perm)		1414			1705		873	1822		847	1780	
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)	90	125	140	20	135	170	210	390	45	145	320	95
RTOR Reduction (vph)	0	51	0	0	87	0	0	8	0	0	20	0
Lane Group Flow (vph)	0	304	0	0	238	0	210	427	0	145	395	0
Heavy Vehicles (%)	1%	3%	6%	0%	1%	0%	1%	3%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		14.0			14.0		22.6	22.6		22.6	22.6	
Effective Green, g (s)		14.0			14.0		22.6	22.6		22.6	22.6	
Actuated g/C Ratio		0.31			0.31		0.50	0.50		0.50	0.50	
Clearance Time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		434			523		432	903		419	882	
v/s Ratio Prot								0.23			0.22	
v/s Ratio Perm		c0.21			0.14		c0.24			0.17		
v/c Ratio		0.70			0.46		0.49	0.47		0.35	0.45	
Uniform Delay, d1		13.9			12.7		7.6	7.6		7.0	7.5	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		4.9			0.6		3.9	1.8		2.3	1.6	
Delay (s)		18.8			13.4		11.5	9.4		9.3	9.1	
Level of Service		B			B		B	A		A	A	
Approach Delay (s)		18.8			13.4			10.1			9.1	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	12.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	45.6	Sum of lost time (s)	9.0
Intersection Capacity Utilization	88.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



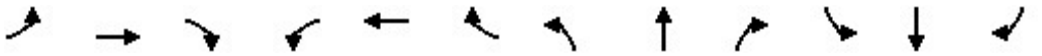
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	15	40	75	15	180	40	390	75	190	490	85
Future Volume (vph)	85	15	40	75	15	180	40	390	75	190	490	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.91		1.00	0.98		1.00	0.98	
Flt Protected		0.97			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1773			1705		1805	1765		1805	1797	
Flt Permitted		0.62			0.89		0.37	1.00		0.45	1.00	
Satd. Flow (perm)		1133			1531		708	1765		862	1797	
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)	85	15	40	75	15	180	40	390	75	190	490	85
RTOR Reduction (vph)	0	30	0	0	140	0	0	11	0	0	9	0
Lane Group Flow (vph)	0	110	0	0	130	0	40	454	0	190	566	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	6%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		11.2			11.2		29.7	29.7		29.7	29.7	
Effective Green, g (s)		11.2			11.2		29.7	29.7		29.7	29.7	
Actuated g/C Ratio		0.22			0.22		0.60	0.60		0.60	0.60	
Clearance Time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		254			343		421	1050		513	1069	
v/s Ratio Prot								0.26			c0.31	
v/s Ratio Perm		c0.10			0.09		0.06			0.22		
v/c Ratio		0.43			0.38		0.10	0.43		0.37	0.53	
Uniform Delay, d1		16.6			16.4		4.3	5.5		5.2	6.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.2			0.7		0.4	1.3		2.0	1.9	
Delay (s)		17.8			17.1		4.8	6.8		7.3	7.8	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		17.8			17.1			6.6			7.7	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	9.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	49.9	Sum of lost time (s)	9.0
Intersection Capacity Utilization	66.9%	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
Lane Configurations												
Traffic Volume (vph)	40	120	120	190	80	100	105	495	300	145	390	50
Future Volume (vph)	40	120	120	190	80	100	105	495	300	145	390	50
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	
Lane Util. Factor	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	0.92		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1752	1732		1805	1696		1719	1881	1615	1805	1835	
Flt Permitted	0.64	1.00		0.32	1.00		0.51	1.00	1.00	0.24	1.00	
Satd. Flow (perm)	1188	1732		609	1696		918	1881	1615	451	1835	
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)	40	120	120	190	80	100	105	495	300	145	390	50
RTOR Reduction (vph)	0	56	0	0	65	0	0	0	184	0	6	0
Lane Group Flow (vph)	40	184	0	190	115	0	105	495	116	145	434	0
Heavy Vehicles (%)	3%	2%	1%	0%	6%	0%	5%	1%	0%	0%	1%	8%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	pm+pt	NA	
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	12.7	12.7		22.7	22.7		25.5	25.5	25.5	34.0	34.0	
Effective Green, g (s)	12.7	12.7		22.7	22.7		25.5	25.5	25.5	34.0	34.0	
Actuated g/C Ratio	0.19	0.19		0.35	0.35		0.39	0.39	0.39	0.52	0.52	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	229	334		310	585		356	730	626	315	949	
v/s Ratio Prot		0.11		c0.05	0.07			c0.26		0.03	c0.24	
v/s Ratio Perm	0.03			c0.16			0.11		0.07	0.21		
v/c Ratio	0.17	0.55		0.61	0.20		0.29	0.68	0.19	0.46	0.46	
Uniform Delay, d1	22.1	23.9		16.3	15.1		13.9	16.7	13.3	10.4	10.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	2.0		3.6	0.2		2.1	5.0	0.7	1.1	1.6	
Delay (s)	22.5	25.9		19.9	15.3		16.0	21.7	13.9	11.5	11.6	
Level of Service	C	C		B	B		B	C	B	B	B	
Approach Delay (s)		25.4			17.6			18.4			11.6	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	65.7	Sum of lost time (s)	18.0
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	240	10	105	5	10	10	80	815	0	5	790	245
Future Volume (vph)	240	10	105	5	10	10	80	815	0	5	790	245
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
Lane Util. Factor	1.00	1.00			1.00		1.00	1.00			1.00	1.00
Frt	1.00	0.86			0.95		1.00	1.00			1.00	0.85
Flt Protected	0.95	1.00			0.99		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1805	1640			1780		1805	1810			1827	1615
Flt Permitted	0.74	1.00			0.95		0.22	1.00			1.00	1.00
Satd. Flow (perm)	1408	1640			1712		421	1810			1820	1615
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)	240	10	105	5	10	10	80	815	0	5	790	245
RTOR Reduction (vph)	0	79	0	0	8	0	0	0	0	0	0	97
Lane Group Flow (vph)	240	36	0	0	17	0	80	815	0	0	795	148
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	14.5	14.5			14.5		35.8	35.8			35.8	35.8
Effective Green, g (s)	14.5	14.5			14.5		35.8	35.8			35.8	35.8
Actuated g/C Ratio	0.24	0.24			0.24		0.60	0.60			0.60	0.60
Clearance Time (s)	4.5	4.5			4.5		4.5	4.5			4.5	4.5
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	344	401			418		254	1092			1098	974
v/s Ratio Prot		0.02						c0.45				
v/s Ratio Perm	c0.17				0.01		0.19				0.44	0.09
v/c Ratio	0.70	0.09			0.04		0.31	0.75			0.72	0.15
Uniform Delay, d1	20.4	17.3			17.1		5.7	8.5			8.3	5.1
Progression Factor	1.00	1.00			1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	6.1	0.1			0.0		3.2	4.7			4.2	0.3
Delay (s)	26.5	17.4			17.1		9.0	13.1			12.4	5.5
Level of Service	C	B			B		A	B			B	A
Approach Delay (s)		23.5			17.1			12.8			10.8	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	13.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	59.3	Sum of lost time (s)	9.0
Intersection Capacity Utilization	93.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Appendix G

Operations Reports: Total Future Conditions – Mitigated (Lane Modifications)

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	45	340	250	475	560	15
Future Volume (Veh/h)	45	340	250	475	560	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)	45	340	250	475	560	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)				211		
pX, platoon unblocked						
vC, conflicting volume	1305	288	575			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1305	288	575			
tC, single (s)	7.0	7.0	4.3			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.3			
p0 queue free %	58	51	74			
cM capacity (veh/h)	106	697	954			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	45	340	250	238	238	373	202
Volume Left	45	0	250	0	0	0	0
Volume Right	0	340	0	0	0	0	15
cSH	106	697	954	1700	1700	1700	1700
Volume to Capacity	0.42	0.49	0.26	0.14	0.14	0.22	0.12
Queue Length 95th (m)	14.3	21.5	8.4	0.0	0.0	0.0	0.0
Control Delay (s)	61.7	15.0	10.1	0.0	0.0	0.0	0.0
Lane LOS	F	B	B				
Approach Delay (s)	20.4		3.5			0.0	
Approach LOS	C						

Intersection Summary			
Average Delay	6.2		
Intersection Capacity Utilization	43.7%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix H

Capital Cost Estimates

South-West Ingersoll Secondary Plan - Estimate of Capital Costs - Transportation

	Location	Proposed Infrastructure	Assumptions	Cost Estimate (incl. 30% contingency)
New Roads	South of Clarke Road	New residential collector road (450 m)	Urban cross section. Paved. 2 x 3.3 m travel lanes, 1 x 2.4 m parking lane, 2 x 2.2 m on road bike lanes (1.8 m lane + 0.4 m buffer) or 2 x 2.0 cycle tracks (behind the curb), 2 x 1.8 m sidewalk	$ 846,000.00
	West Residential	New residential local roads (1000 m)	Urban cross section. Paved. 2 x 3.5 m travel lanes, 2 x 1.8 m sidewalk	$ 846,000.00
	West Industrial	New industrial / commercial local roads (350 m)	Urban cross section. Paved. 2 x 3.5 m travel lanes, 2 x 1.8 m sidewalk	$ 296,000.00
	South Industrial / Commercial	New industrial / commercial local roads (3500 m)	Urban cross section. Paved. 2 x 3.5 m travel lanes, 2 x 1.8 m sidewalk	$ 2,960,000.00
	East Residential	New residential local roads (2500 m)	Urban cross section. Paved. 2 x 3.5 m travel lanes, 2 x 1.8 m sidewalk	$ 2,114,000.00
			New Roads Sub-total	**$ 7,062,000.00**
Road Upgrades	Union Road west of Culloden	Upgrade from local to collector (775 m)	Rural cross section. Paved. 2 x 3.5 m travel lanes, 2 x 2.0 m paved shoulder	$ 852,000.00
	Union Road between Culloden & Curry	Upgrade from local to collector (700 m)	Rural cross section. Paved. 2 x 3.5 m travel lanes, 2 x 2.0 m paved shoulder	$ 770,000.00
	Curry Road between Union and Plank	Upgrade from local to collector (2460 m)	Rural cross section. Paved. 2 x 3.5 m travel lanes, 2 x 2.0 m paved shoulder	$ 2,703,000.00
	Wallace Line (& Thompson Road)	Upgrade from local to collector (3400 m)	Rural cross section. Paved. 2 x 3.5 m travel lanes, 2 x 2.0 m paved shoulder	$ 3,736,000.00
	Clarke Road east of Plank Line	Upgrade from rural to urban residential cross section (725 km)	Urban cross section. Paved. 2 x 3.5 m travel lanes, 2 x 2.2 m on road bike lanes (1.8 m lane + 0.4 m buffer), 2 x 1.8 m sidewalk	$ 1,112,000.00
			Road Upgrades Sub-total	**$ 9,173,000.00**
Intersection Upgrades	Ingersoll Street & King Street West	Signalization		$ 437,000.00
	Ingersoll Street & Thomas Street	Signalization		$ 437,000.00
	Ingersoll Street & Thompson Road	Add EB auxiliary left-turn lane	Storage = 30 m, Taper = 30 m	$ 12,000.00
	Union Road & Culloden Line	Signalization Add NB auxiliary left-turn lane Add SB auxiliary left-turn lane	 Storage = 75 m, Taper = 105 m (from Plank line & Sweaburg Rd) Storage = 75 m, Taper = 105 m (from Plank line & Sweaburg Rd)	$ 502,000.00
	Harris Street & Clarke Road	Signalization Add WB auxiliary left-turn lane Add NB auxiliary right-turn lane	 Storage = 30 m, Taper = 30 m Storage = 45 m, Taper = 75 m (from Plank line & Sweaburg Rd)	$ 470,000.00
	Plank Line & Curry Road	Signalization Add EB auxiliary left-turn lane Add SB auxiliary right-turn lane	 Storage = 30 m, Taper = 30 m Storage = 45 m, Taper = 75 m (from Plank line & Sweaburg Rd)	$ 470,000.00
			Intersection Upgrades Sub-total	**$ 2,328,000.00**
New Rail lines	North of Curry	New rail spur (750 m)		$ 6,435,000.00
			New Rail Lines Sub-total	**$ 6,435,000.00**
Railway Crossing Upgrades	Curry Road	Active Crossing (flashing lights and bells)		$ 163,000.00
	King Street West	Active Crossing (flashing lights bells and gate)		$ 195,000.00
	Ingersoll Street	Active Crossing (flashing lights bells and gate)		$ 195,000.00
	Thomas Road west of Wallace Line	Active Crossing (flashing lights and bells)		$ 163,000.00
	Thomas Road east of Wallace Line	Active Crossing (flashing lights and bells)		$ 163,000.00
			Railway Crossing Upgrades Sub-total	**$ 879,000.00**
			OVERALL TOTAL	**$ 25,877,000.00**