

Upper West Side Secondary Plan

Master Transportation Study

Upper West Side Landowners Group



BURNSIDE

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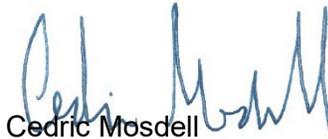
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**November 2023
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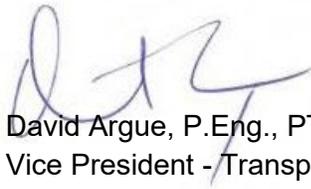
R.J. Burnside & Associates Limited

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Executive Summary

The Upper West Side Landowners Group (“Landowners”) are composed of some landowners in the overall block area bounded by Glancaster Road to the west, Dickenson Road West to the south, Upper James Street to the east, and Twenty Road West to the north. The area within the above confines is referred to as the Block or UWS Secondary Plan. This area is within the Airport Employment Growth District (“AEGD”) Secondary Plan.

The Landowners are proposing to develop the area with a mixture of employment and residential land uses, for which the Landowners are presently proposing a Secondary Plan for the Block to the City of Hamilton (“City”).

The Landowners retained R.J. Burnside & Associates Limited (“Burnside”) to undertake the transportation services for the Secondary Plan as well as coordinate the Integrated Environmental Assessment study (“EA Study”). The Landowners, as the Proponent of the EA Study for the collector and arterial roads within the Block, intends to follow the City’s Integrated Planning Process to fulfill the requirements of the EA Study process and submit the UWS Secondary Plan. The EA Study is a separate study.

This report provides a summary of the existing transportation conditions and forms one of the background reports required for the Secondary Plan and EA Study. The focus of this report is to examine the existing and future transportation systems for all modes of travel (walking, cycling, transit and vehicles) to accommodate the Secondary Plan.

Existing Road Network Operations

Under existing conditions, all area intersections are operating with excess capacity and a level of service of D or better, except for the eastbound left-right movement at the Upper James Street / Talbot Lane intersection during the weekday PM peak hour, which is experiencing high delay.

Background 2031 Traffic Operations

Under background 2031 conditions, all area intersections will operate with excess capacity and a level of service of D or better, with the intersections of Glancaster Road / Twenty Road West and Glancaster Road / Book Road under signalization.

Total 2031 Traffic Operations

Under total 2031 conditions, all area intersections will operate with excess capacity and a level of service of E or better, with the recommended road network improvements as described below for the noted intersections.

At the Upper James Street / Twenty Road West intersection:

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- Twenty Road West should be widened from 2 to 4-lanes from Garth Street to Upper James Street by 2031. It is recommended that the City consider changing this future road network improvement from medium priority to high priority. The specific timing of the Twenty Road West widening should be determined as each phase of the Secondary Plan area is built.
- During the weekday AM peak hour, eastbound and westbound left-turn advanced phases be added.
- During the weekday PM peak hour, an eastbound left-turn advanced phase be added.
- The cycle length increased to 120s during both peak hours.

At the Glancaster Road / Twenty Road West intersection:

- A northbound right-turn lane is recommended to be added.

At the Twenty Road West / Garth Street intersection:

- During the weekday AM peak hour, westbound and southbound left-turn advanced phases be added.
- During the weekday PM peak hour, eastbound, westbound and southbound left-turn advanced phases be added.
- The cycle length increased to 120s during both peak hours.

At the Upper James Street / Dickenson Road intersection:

The following road network improvements are recommended:

- During the weekday AM and PM peak hours, eastbound and northbound left-turn advanced phases be added.
- The cycle length increased to 120s during both peak hours.

At the Upper James Street / Talbot Lane intersection:

- Signalization is recommended.
- Add exclusive northbound and eastbound left-turn lanes.

Total 2041 Traffic Operations

Under total 2041 conditions, all area intersections will operate with excess capacity and a level of service of E or better, with the same recommended road network improvements under total 2031 conditions.

At the Dickenson Road / Collector Road B intersection, signalization is recommended by 2041.

Recommended Road Network

A summary of the 2031 and 2041 recommended road network improvements based on this study's assumptions and the 2023 AEGD TMP are shown in Figure A and Figure B, respectively.

Upper West Side Block Plan Review

Road Phasing

A road phasing implementation plan will be developed as part of future studies for the Secondary Plan area. It is premature to develop this plan at this point as it will depend upon a number of criteria, such as land ownership and infrastructure availability.

Pedestrian Route and Sidewalk Analysis

Pedestrian access in the form of sidewalks would be provided on both sides of all streets within the Block. The sidewalks will also connect to building entrances, schools, and proposed transit stops with connections provided to Twenty Road, Garth Street extension and Collector Road C where future transit service will be provided. To ensure that pedestrians will feel safe and be encouraged to utilize the sidewalk facilities, the designs are based on the City's *Complete Streets Design Guidelines*, dated June 2022 ("Complete Streets Guidelines"), and incorporate the City's design standards.

Two trail systems have been identified on the concept plan along Collector Road C and Twenty Road West to provide connectivity within the Block. The trail along Collector Road C will head northeast to the east of Collector Road B and tie into the path along Twenty Road. Connections from the multi-use paths to the residential areas are recommended.

Cycling Route Analysis

Cycling facilities are proposed on both sides of all proposed collector roads and the Garth Street extension. The proposed multi-use trails along Twenty Road and Collector Road C will provide additional connectivity for cyclists through the Block. The design of the proposed cycling facilities are based on the City's Complete Streets Guidelines.

Transit Assessment

As discussed in Section 3.5, future transit routes are proposed to service the study area. Transit stop locations are recommended at all arterial-collector and collector-collector intersections, as well as midblock between collector roads. Approximately 95% of all residents within the area will be within a 15-minute walk of a transit stop, based on a 400-m radius from each proposed transit stop.

Figure A: 2031 Recommended Road Network

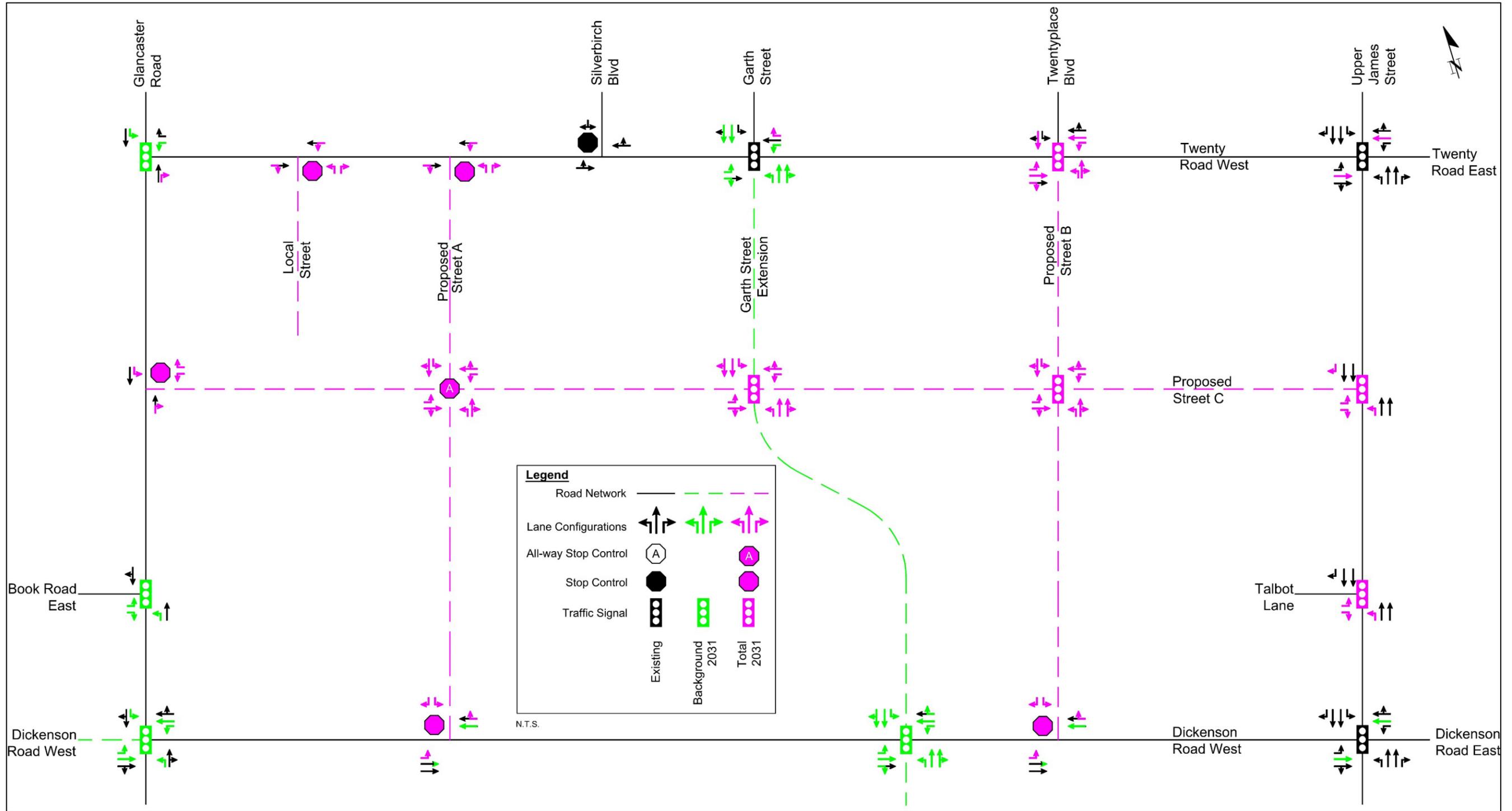
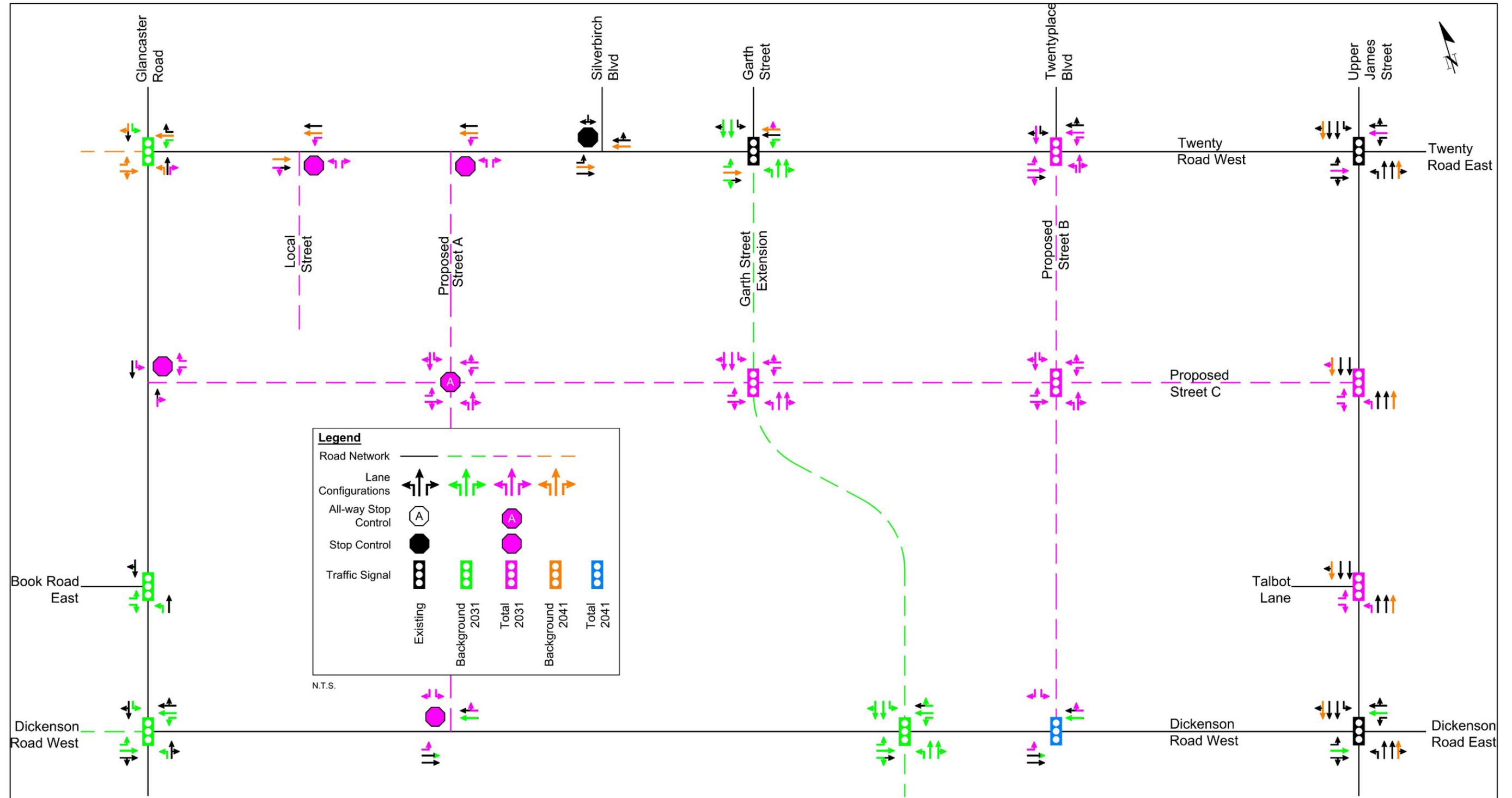


Figure B: 2041 Recommended Road Network



Truck Routes

Upper James Street is part of the existing truck route system according to the Truck Master Plan. It is also recommended that truck routes be added to Dickenson Road and the Garth Street extension to improve the movement of goods.

Traffic Calming

Traffic calming including the type of traffic calming methods and location will be reviewed when subdivision plans are developed and through detailed design process for the collector / arterial road system. Horizontal features will be considered for collector and arterial roads, which is consistent with the City's Transportation Master Plan and the City's Traffic Calming Policy. Gateway features at the entrance point from Twenty Road and Dickenson Road will be investigated and will be done in consultation with the overall Block to develop a cohesive community.

Transit Oriented Development

The Upper West Side Secondary Plan will include suburban corridor areas, as described in the TOD Guidelines. A suburban area includes areas proposed along the A-line BRT along Upper James Street. The long-term goal is to utilize the development around the BRT line to increase transit usage similar to the lower city where transit usage is higher. The planned land uses should be diverse in these TOD areas and uses should be clustered near the transit stations to maximize transit usage.

Typical design elements of suburban corridor areas include the following:

- Medium-density buildings, which is currently being proposed.
- Street-orientated development, which is proposed along the Garth Street extension and collector roads.
- Cycling facilities at transit stations, which will be considered.
- Position pedestrian environment, which is being considered through the proposed cross-sections.
- Locate parking areas for new development at the rear of buildings, which will be considered.
- Development will plan for future intensification along the proposed transit corridors. The site includes high density development along the Garth Street Extension and be serviced by many transit lines, and, as discussed in Section 7.4, will have high level of transit coverage within 400m of proposed transit stations.

Right-of-Way Designations and Cross-sections

The right-of-way cross-sections proposed within the UWS Secondary Plan have been developed in consideration of the City's Complete Streets Guidelines, transportation

needs including pedestrians, cyclists, transit, vehicles, and goods movement. Recommended cross-sections as illustrated by NAK Design are in Section 7.8.

Garth Street would have the same right-of-way, but different allocation with the residential versus employment areas. Bike lanes would be on-street through the residential areas, but within the boulevard through the employment areas. Given driveways and desire to separate cyclists from pedestrians in the higher development urban area along Garth Street, it was desirable to separate the cyclist from pedestrian.

The collector roads will have a variety of cross-sections. All have sidewalks and cycle tracks. Collector roads where four lanes are required will have a 29 m right-of-way. Sections where three lanes are desirable (one lane per direction, plus a centre left turn lane) will have a 26 m right-of-way. Parking would not be accommodated on-street on this road. There is also an option of parking within parking bays on one side with one lane per direction and accommodated in a 26 m right-of-way.

Local streets would have a 20 m right-of-way as per the City's standard cross-section, which provides for sidewalks on both sides. An 18 m right-of-way is proposed on window streets where duplication of facilities is not necessary such as sidewalks.

Daylighting Triangle Designations

Proposed daylighting triangles within the Secondary Plan area will comply with the City's engineering guidelines.

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1.0 Introduction

1.1 Background

The Upper West Side Landowners Group (“Landowners”) are composed of some landowners in the overall area bounded by Glancaster Road to the west, Dickenson Road West (referred to as Dickenson Road in this study) to the south, Upper James Street to the east, and Twenty Road West (referred to as Twenty Road in this study) to the north. The area within the above confines is referred to as the Block or UWS Secondary Plan. This area is within the Airport Employment Growth District (“AEGD”) Secondary Plan. The location of the UWS Secondary Plan is shown in Figure 1.

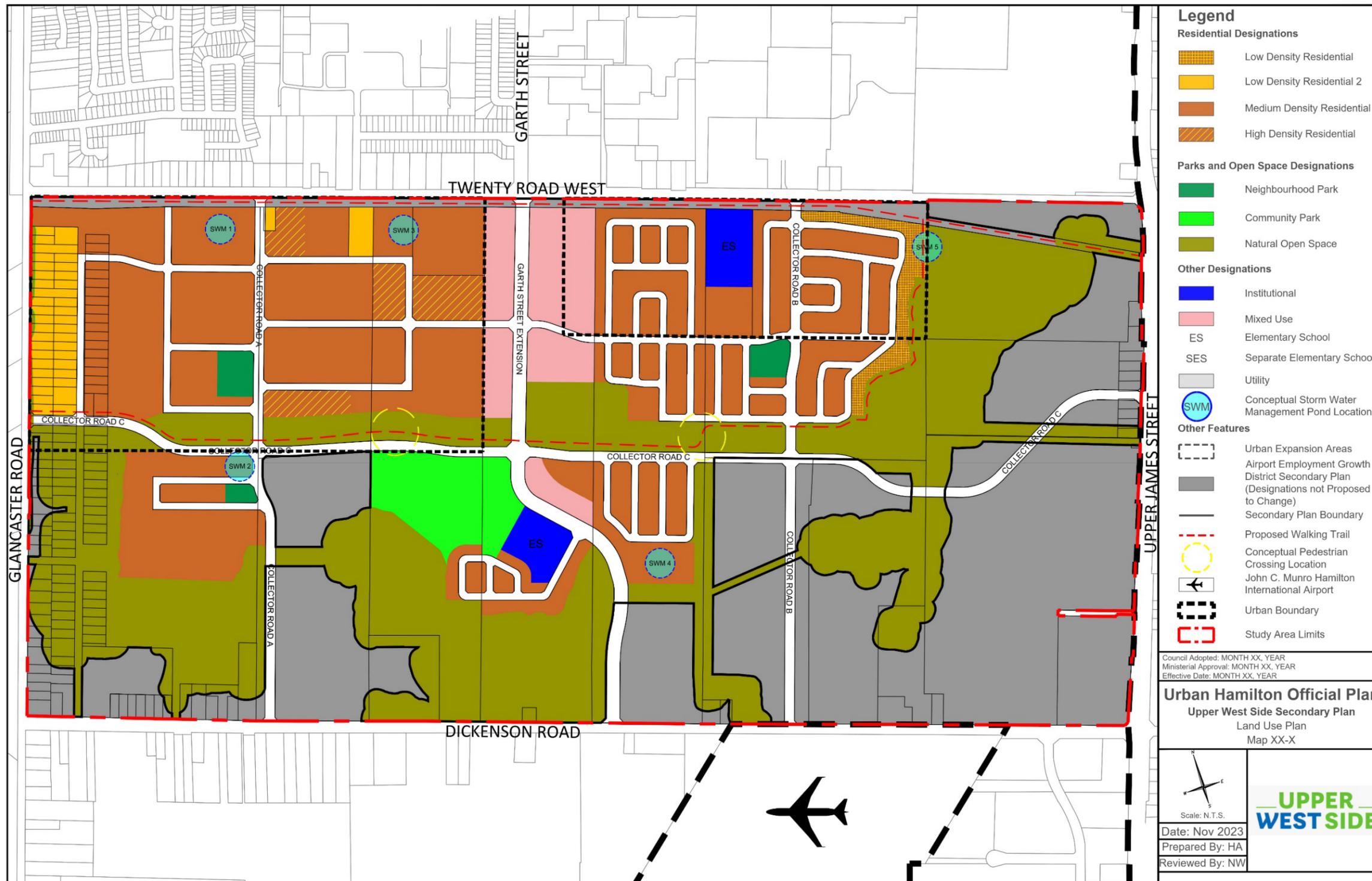
Figure 1: UWS Secondary Plan Location



The Landowners are proposing to develop the Block with a mixture of employment and residential land uses envisioned in the AEGD Secondary Plan, for which the Landowners are presently proposing a Secondary Plan for the Block area to the City of Hamilton (“City”). The proposed Secondary Plan is shown in Figure 2.

The Landowners have retained R.J. Burnside & Associates Limited (“Burnside”) to undertake the Master Transportation Study for the Upper West Side Secondary Plan as well as coordinate the Integrated Environmental Assessment study (“EA Study”). The Landowners, as the Proponent of the EA Study for the collector and arterial roads within the Block, intends to follow the City’s Integrated Planning Process to fulfill the requirements of the EA Study process and submit the UWS Secondary Plan.

Figure 2: Upper West Side Secondary Plan



The existing subject development area is primarily occupied by farmland and single-family homes. To the west is the former Glancaster Golf Club, which closed in 2015. To the east are small businesses, a garden centre and the Hamilton Street Railway Mountain Transit Centre with carpool lots. North of the development area are residential homes. South of the development area is John C. Munro Hamilton International Airport and future employment lands.

This report provides a summary of the existing transportation conditions and forms one of the background reports required for the Secondary Plan and EA Study. The focus of this report is to examine the existing and future transportation systems for all modes of travel (walking, cycling, transit and vehicles) to accommodate the Secondary Plan.

1.2 Intersection Analysis Methodology

Signalized and stop controlled intersection operations were assessed for intersections in the study area using the software program Synchro 11, which employs methodology from the *Highway Capacity Manual (HCM 2000, HCM 2010 and HCM6)*, published by the Transportation Research Board's National Research Council.

Synchro 11 can analyze both signalized and unsignalized intersections in a road corridor or network taking into account the spacing, interaction, queues and operations between intersections.

Signalized intersection analysis considers 2 separate measures of performance:

- The capacity of all intersection movements, which is based on a volume to capacity ratio that measures the degree of capacity utilized.
- The level of service (LOS) for all intersection movements, which is based on the average control delay per vehicle for the various movements through the intersection and overall. Delay is an indicator of how long a vehicle must wait to complete a movement and is represented by a letter between A and F, with F being the longest delay. The link between LOS and delay (in seconds) for signalized intersections is summarized below.

Level of Service	Control Delay per Vehicle(s)
A	≤10
B	> 10 – 20
C	> 20 – 35
D	> 35 – 55
E	> 55 – 80
F	> 80

Stop controlled intersection analysis considers two separate measures of performance:

- The capacity of the intersection's critical movements, which is based on a volume to capacity ratio.

- The level of service for the critical movements, which is based on the average control delay per vehicle for the various critical movements within the intersection. The link between LOS and delay (in seconds) for stop-controlled intersections is summarized below.

Level of Service	Control Delay per Vehicle(s)
A	0 – 10
B	> 10 – 15
C	> 15 – 25
D	> 25 – 35
E	> 35 – 50
F	> 50

1.3 Study Area

The overall study area has been generally defined by Twenty Road to the north, Dickenson Road to the south, Glancaster Road to the east and Upper James Street to the west and it is illustrated in Figure 3.

Figure 3: Study Area



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This study focuses on the following roadways and key intersections that would be impacted by the future development within the Study Area:

- Twenty Road / Glancaster Road
- Twenty Road / Silverbirch Boulevard
- Twenty Road / Garth Street
- Twenty Road / Twentypace Boulevard
- Twenty Road / Upper James Street
- Upper James Street / Talbot Lane
- Upper James Street / Dickenson Road
- Dickenson Road / Glancaster Road
- Glancaster Road / Book Road East

The internal collector and arterial road as well as the new connections to the boundary roads are also assessed.

1.4 Study Approach

These existing conditions study provides preliminary assessment on key transportation infrastructure that services all modes of travel including active transportation (pedestrians and cyclists), transit and vehicles, and a review of all relevant background reports / studies and existing traffic data.

The study also adheres to the City's *Traffic Impact Study Guidelines*, dated July 2009.

A terms of reference, dated July 31, 2023, was submitted to the City and they provided comments in a letter dated October 12, 2023. Generally, we have addressed the comments with the exception that a meeting was not held with City staff and the trip generation approach differed from utilizing the City's model as access was not gained to the City model. The trip generation method utilized is describe in Section 4.1.

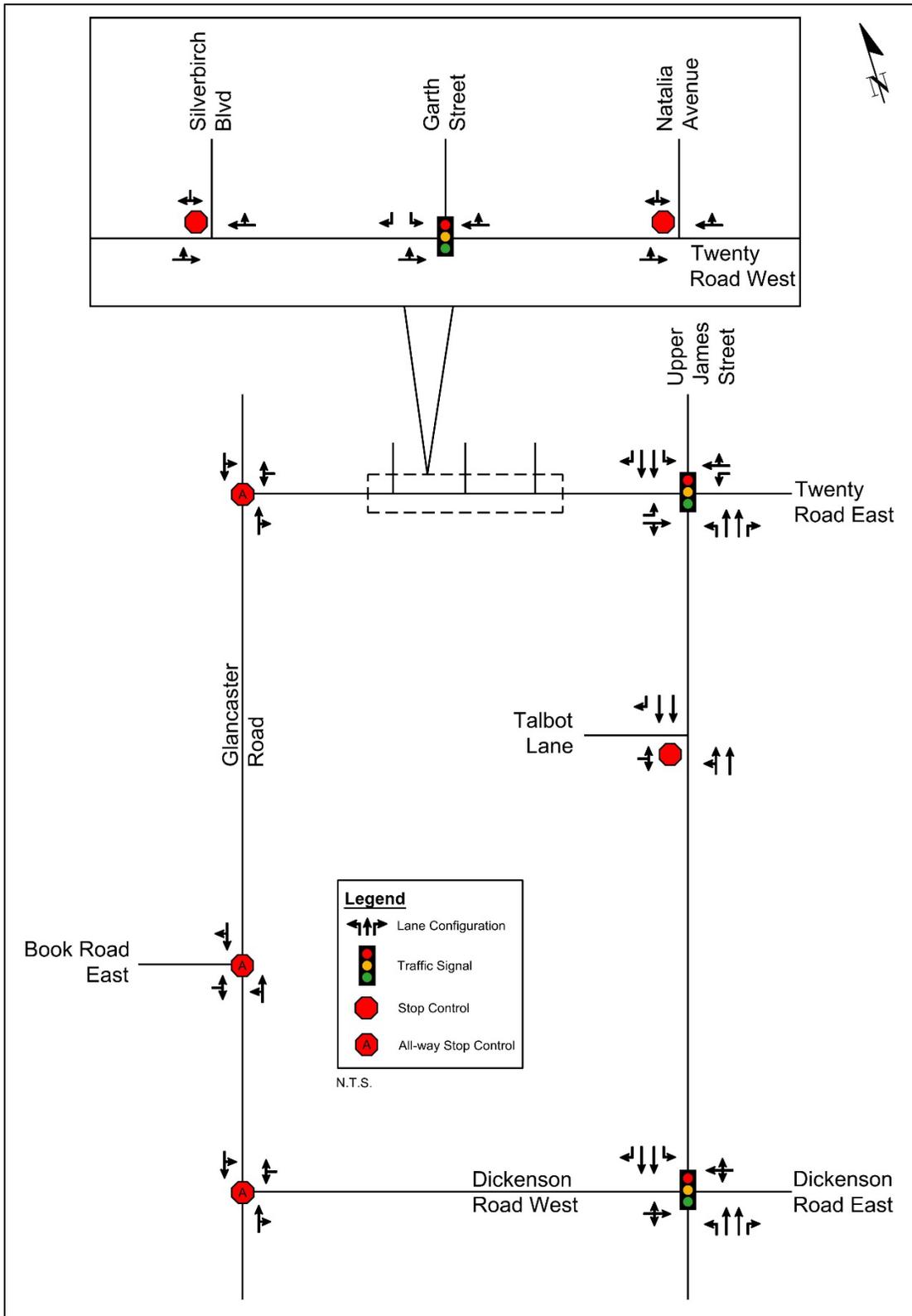
2.0 Existing Conditions

2.1 Existing Road Network

The characteristics of the road network are described below and illustrated in Figure 4 including existing traffic controls within the identified study area. All study roadways are under the jurisdiction of the City unless otherwise specified.

Twenty Road	Twenty Road is an east-west minor arterial road. The roadway consists of a 2-lane rural cross section with a posted speed limit of 50 km/h between 90 m east of Natalia Avenue and Upper James Street, and 60 km/h elsewhere. Stopping is prohibited on the south side of Twenty Road. A sidewalk is provided on the north side and terminates 100 m west of Garth Street and at Twentyplace Boulevard.
Dickenson Road	Dickenson Road is an east-west minor arterial road. The roadway consists of a 2-lane rural cross section with a posted speed limit of 60 km/h.
Glancaster Road	Glancaster Road is a north-south minor arterial road. The roadway consists of a 2-lane rural cross section with a posted speed limit of 60 km/h.
Upper James Street	Upper James Street is a north-south major arterial road. The roadway consists of a 4-lane rural cross section with a posted speed limit of 60 km/h north of Twenty Road and 70 km/h south of Twenty Road.
Garth Street	Garth Street is a north-south minor arterial road north of Rymal Road. Between Rymal Road and Twenty Road, Garth Street is a collector road. Currently, the roadway terminates at Twenty Road West. The roadway consists of a 2-lane urban cross section with a posted speed limit of 50 km/h. Sidewalks and bicycle lanes are provided on both sides of the road.
Book Road East	Book Road East is an east-west collector road. The roadway consists of a 2-lane rural cross section with a posted speed limit of 60 km/h.

Figure 4: Existing Road Network



Silverbirch Boulevard	Silverbirch Boulevard is a north-south local road. The roadway consists of a 2-lane urban cross section with an assumed unposted speed limit of 50 km/h.
Twentyplace Boulevard	Twentyplace Boulevard is a north-south private local road. The roadway consists of a 2-lane urban cross section with an assumed speed limit of 20 km/h, which is the posted speed of Natalia Avenue that also provides access to the same community. Sidewalks are provided on the east side of the road.
Talbot Lane	Talbot Lane is an east-west local road. The roadway consists of a 2-lane rural cross section with an assumed unposted speed limit of 50 km/h.

2.2 Transit Network

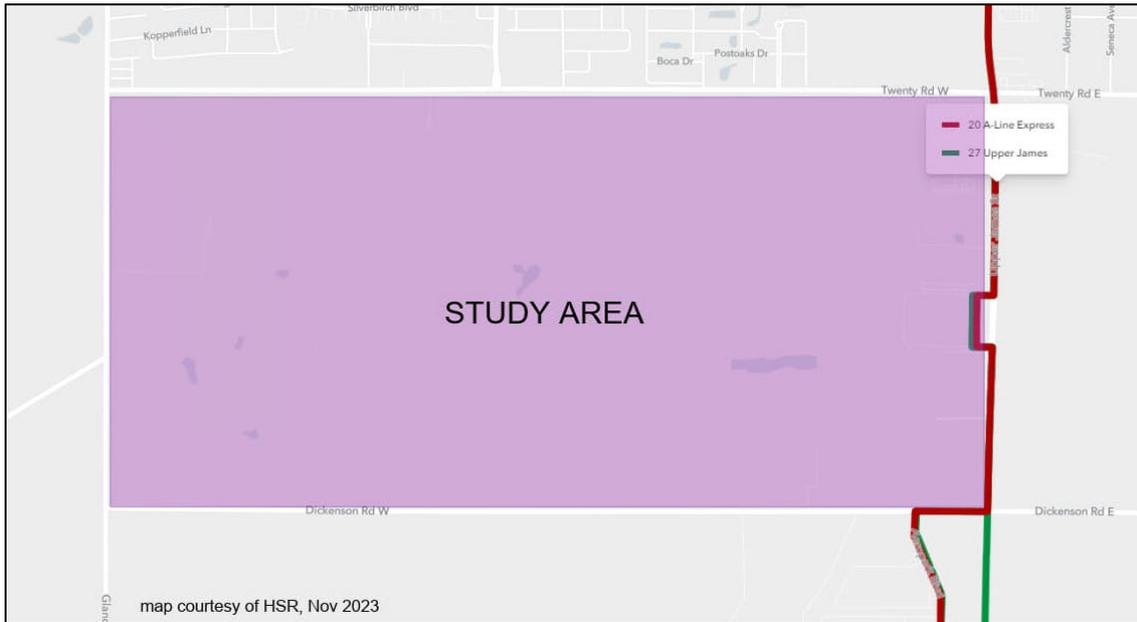
Transit is provided within the vicinity of the site by the Hamilton Street Railway (HSR). The closest transit routes to the site are Route #27 (Upper James) and Route #20 (A Line Express). There is a transit stop located on the west side of Upper James Street, north of Twenty Road and a transit stop located on the east side of Upper James, south of Twenty Road. Route #27 has a service frequency of 15-minutes and Route #20 has a frequency of 10-minutes for the weekday AM and PM peak hours. There is also a carpool parking lot at the Mountain Transit Centre along with transit stops.

Trans-Cab also provides services for areas of the City not served by regular transit. The Trans-Cab will pick up the user at a booked time and connect them to a regular HSR route.

The routes are illustrated in Figure 5.

2.3 Cycling Network

Cycling infrastructure is currently limited within the study area, which consists of bicycle lanes on Garth Street from Twenty Road to Stone Church Road West. Cyclists currently have to share the roadway with motorists on Twenty Road, Dickenson Road, Glancaster Road and Upper James Street.

Figure 5: Existing Transit Route

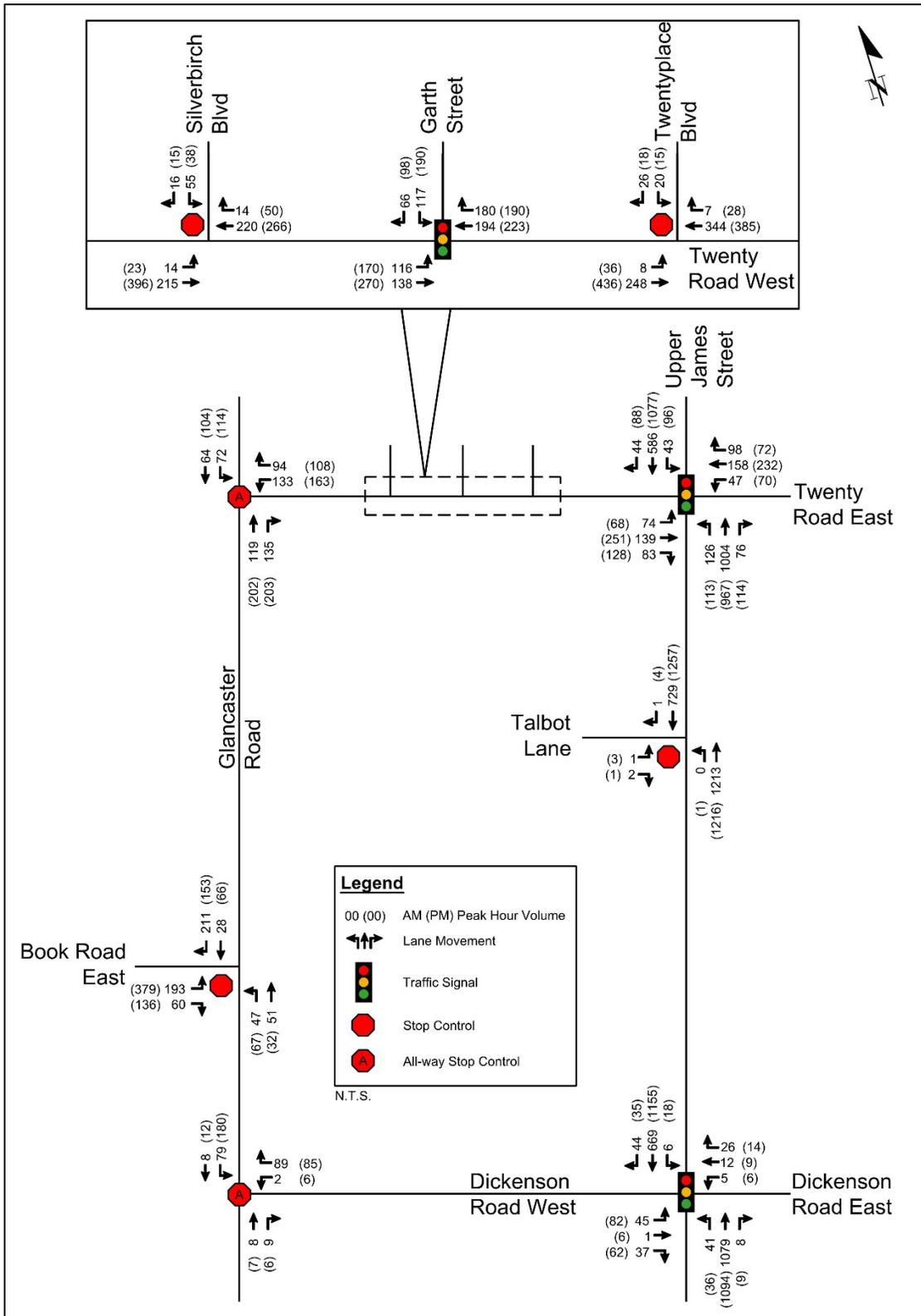
2.4 Pedestrian Network

The sidewalk network is currently limited within the study area. A sidewalk is provided on the north side of Twenty Road from 100 m west of Garth Street to Twentyplace Boulevard. Sidewalks are provided on both sides of Garth Street, which connects to the sidewalks on Twenty Road. Sidewalks are provided on both sides of Natalia Avenue.

2.5 Traffic Volumes

As requested by the City, existing traffic volumes were based on the most recent turning movement counts (TMCs) conducted by Pyramid Traffic Inc. on Wednesday, October 25, 2023, at the study intersections during the weekday AM and PM peak periods. The existing weekday AM and PM peak hour traffic volumes are shown Figure 6. The traffic counts are provided in Appendix A.

Figure 6: Existing Intersection Volumes



3.0 Background Conditions

The horizon years of this study are assumed to be 2031 and 2041, to be consistent with the background studies that were conducted for the AEGD, which are described further below.

3.1 AEGD Background Studies

There have been a number of AEGD studies completed within the study area. A brief synopsis of each is provided in the following sections.

3.1.1 Urban Hamilton Official Plan AEGD Secondary Plan

Within Volume 2, Section B.8 of the *Urban Hamilton Official Plan*, dated October 2019, the AEGD Secondary Plan identified several infrastructure improvements and established a transportation strategy to develop 1,204 hectares of land bounded by Garner Road and Twenty Road West to the north, Upper James Street to the east, and Highway 6 to the south and to the west.

The AEGD is intended to offer a range of employment and employment-related land uses in the context of an eco-industrial park, which provides for prestige industrial, light industrial, airport-related business and institutional development as well as an environmental footprint that is managed through a range of urban design and eco-friendly sustainable design techniques. All of which allows for the development of land uses consistent with the character of surrounding lands. The minimum average employment density in the AEGD is targeted to be 37 employees per hectare, with some areas projected to achieve at least 50 employees per hectare.

The City outlined that a major goal of the AEGD Vision is to attract technologically advanced industries into the AEGD, such as industries with a long-term vision in the carbon neutral and energy sectors. To achieve this goal, numerous attractive aspects of the AEGD must be emphasized including, its excellent working environment, the economic value added from modern transportation connections, the number and sizing of lots, an excellent regional employee pool, and nearby housing choices.

Consistent with these objectives and strategies, the AEGD Transportation Master Plan promotes a strategy of enhancing access to employment lands and maximizing the efficiency of the proposed road network in order to promote pedestrian, cyclist, transit and vehicular connectivity.

3.1.2 AEGD Transportation Master Plan

The AEGD *Transportation Master Plan*, dated June 2011 ("2011 AEGD TMP"), the planned employment growth within the AEGD is projected to reach over 28,000

employees by 2031. To accommodate the development and redevelopment of the lands, several transportation network recommendations were identified that included:

- New and expanded roadways including the expansion of Dickenson Road, Twenty Road and Glancaster Road, as well as the extension of Garth Street
- Additional transportation related infrastructure:
 - Integrated transit facilities
 - Cycling/Pedestrian/Trails networks to provide multi-modal connections throughout the AEGD
- Development of six new transit routes and the extension of two existing transit routes to provide high quality of service to the AEGD area
- Potential Truck Routes based on the need for goods movement
- Recommended Transportation Demand Management measures and guidelines for the AEGD area
- Provisions for new carpool lots and carpool parking spaces

3.1.3 AEGD Transportation Master Plan Update

The AEGD *Transportation Master Plan Implementation Update* (“2016 AEGD TMP”), dated December 2016, updated the 2011 AEGD TMP to reflect changes that were approved by the February 17th, 2015 Ontario Municipal Board approval. The land uses in the AEGD area were revised and employment forecasts were updated to approximately 23,800 employees by 2031. As a result, the recommended transportation network proposed in the 2011 AEGD TMP was reanalyzed; however, only minor revisions were made which included revisions to project timings and the removal of projects that were no longer needed with the revised land use configuration. In addition, the transit network, recreational trail network and truck route network recommended in the 2011 AEGD TMP was maintained in the 2016 AEGD TMP.

3.1.4 AEGD Transportation Master Plan Update (September 2023)

The City undertook a further update to the transportation plan, which was documented in the AEGD *Transportation Master Plan Update* (“2023 AEGD TMP”), dated September 2023, which provided an update to the 2016 AEGD TMP. Following a relatively minor implementation update to the TMP in 2016, the 2023 AEGD TMP underwent a comprehensive review and update. This was due to a number of new policy influences, land use development needs and pattern changes, and Transport Canada concerns related to a future collector road that was in alignment with runway 24-06.

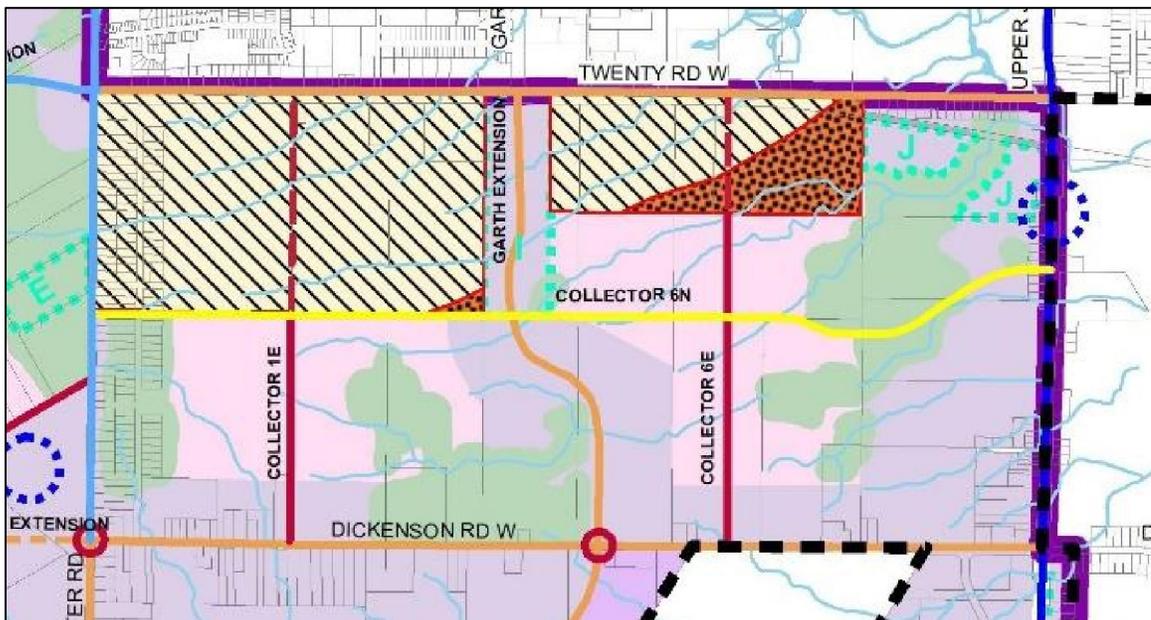
This update re-evaluated the approved transportation network, integrated the approved Complete Street Design Guidelines, reassessed road alignments to address potential impacts to natural and cultural heritage elements, and ensured a sustainable, resilient network that is responsive to climate change, the movement of people and goods, and development industry needs.

The following are some of the network modifications that were recommended:

- Collector 7N removed from network in response to concerns raised by Transport Canada and Hamilton International Airport
- Collector 6N realigned to minimize impacts on HSR Mountain Transit Centre, as well as cultural and natural heritage resources

The equivalent UWS Secondary Plan lands within the 2023 AEGD TMP is shown in Figure 7. It is noted that the overall road network is similar to the proposed road network for the UWS Secondary Plan. It is recognized that there may be some alignment adjustments when detailed designs are developed.

Figure 7: 2023 AEGD TMP UWS Secondary Plan Road Network



3.2 Background Traffic Growth

In the 2023 AEGD TMP, the City's EMME model projected 2051 traffic volumes for the AEGD, including trips for the Secondary Plan. Background corridor traffic, including background development traffic, were determined by removing the Secondary Plan trips from the EMME model forecasts. Background traffic growth was then calculated by comparing the current traffic corridor volumes during the AM peak hour to the AEGD corridor volumes from the EMME model. The inverse was assumed for growth during the weekday PM peak hour as traffic would be in the opposing direction. Where traffic volumes were the same or less than current traffic volumes, a 0.5% growth was assumed. Table 1 summarizes the background growth rates compounded annually that was utilized for the study road network corridors.

Table 1: Background Traffic Growth

Road	Direction	Growth Rate	
		AM Peak Hour	PM Peak Hour
Twenty Road	Eastbound	0.50%	2.50%
	Westbound	2.50%	0.50%
Dickenson Road	Eastbound	7.00%	7.00%
	Westbound		
Glancaster Road	Northbound	2.50%	5.00%
	Southbound	5.00%	2.50%
Garth Street	Northbound	0.50%	4.50%
	Southbound	4.50%	0.50%
Upper James Street	Northbound	0.50%	0.50%
	Southbound		
Book Road	Eastbound	2.00%	2.00%
	Westbound		

3.3 Future Road Network

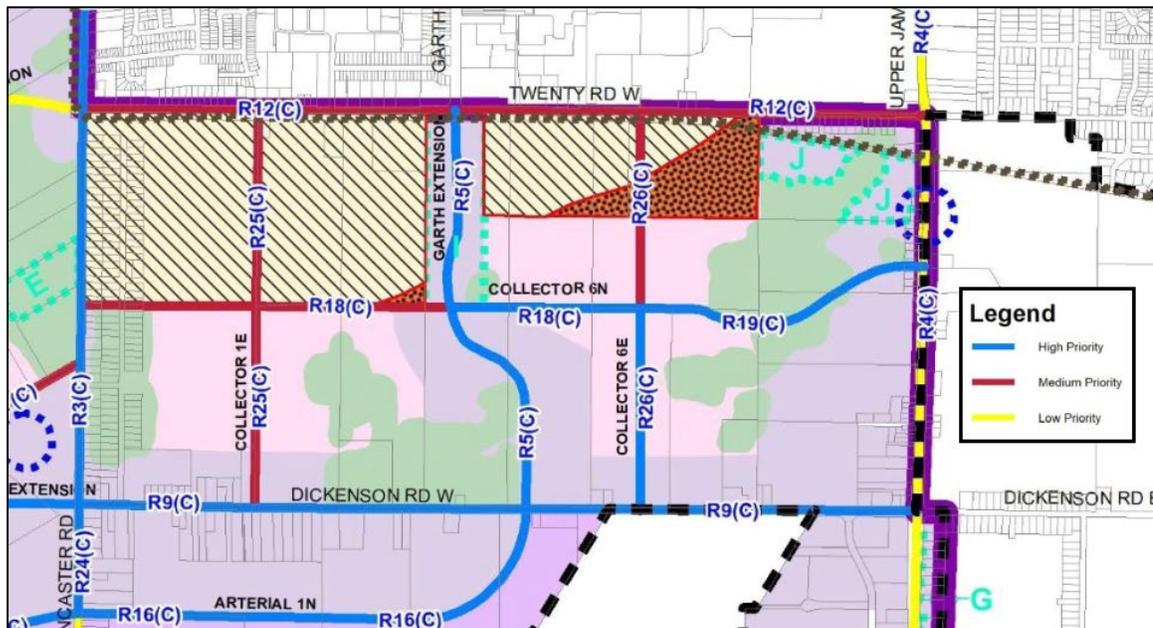
Road projects within the study road network were identified in 2023 AEGD TMP. The timing of implementation has been broken down into three categories: high priority, medium priority, and low priority. High priority is defined as implemented by 2031, medium priority is defined as implemented by 2041, and low priority is defined as implemented beyond 2041, which is intended to be an estimate of the full build-out of the AEGD study area.

The future road network is illustrated in Figure 8 and shows the priority level of each of the road projects.

Garth Street will be extended south creating Garth Street Extension, which will be a north-south arterial road midway between Glancaster Road and Upper James Street. Collector 6N will be an east-west collector road midway between Twenty Road and Dickenson Road. Collector 1E and Collector 6E will be north-south collector roads between Glancaster Road and Garth Street Extension and between Garth Street Extension and Upper James Street, respectively.

The following existing roads were identified to be widened:

- Dickenson Road, from Glancaster Road to Upper James Street, will be widened from a 2-lane rural cross section to a 5-lane urban cross section (high priority).
- Glancaster Road, from Garner Road East to Dickenson Road, will be widened from a 2-lane rural cross section to a 3-lane urban cross section (high priority).
- Twenty Road, from Glancaster Road to Upper James Street, will be widened from a 2-lane rural cross section to a 4-lane urban cross section (medium priority).
- Upper James Street, from Alderlea Avenue to Highway 6 South, will be widened from a 4-lane rural cross section to a 6-lane urban cross section (low priority).

Figure 8: AEGD Road Network Implementation Phasing Map

The following new roads were identified for construction or extension of existing roads:

- Collector 6N, from Glancaster Road to Collector 6E, will have a 4-lane urban cross section (high priority).
- Collector 6N, from Collector 6E to Upper James Street, will have a 5-lane urban cross section (high priority).
- Garth Street Extension, from Twenty Road to Dickenson Road, will have a 5-lane urban cross section (high priority).
- Collector 6E, from Collector 6N to Dickenson Road, will have a 3-lane urban cross section (high priority).
- Dickenson Road Extension, from Smith Road to Glancaster Road, will have a 5-lane urban cross section (high priority).
- Collector 1E, from Twenty Road to Dickenson Road, will have a 3-lane urban cross section (medium priority).
- Collector 6E, from Twenty Road to Collector 6N, will have a 3-lane urban cross section (medium priority).
- Twenty Road Extension, from Collector 2W to Glancaster Road, will have a 2-lane urban cross section (2023 AEGD TMP indicates timing of implementation to be in the medium term, but AEGD Road Network Implementation Phasing Map shows low priority; for the purpose of this study, it is assumed that this extension will occur in the medium term).

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In addition to Garth Street being extended south, it should be noted that Dickenson Road and Twenty Road will be extended to the west and are high priority and low priority, respectively.

The City is currently undertaking a municipal class environmental assessments for Dickenson Road and Glancaster Road.

3.4 Future Active Transportation (AT)

According to the 2023 AEGD TMP, separated bike lanes and sidewalks will be provided on all collector and arterial roads within the study area. The 2023 AEGD TMP AT network is illustrated in Figure 9.

Figure 9: 2023 AEGD Active Transportation Network



The proposed UWS Secondary Plan would be able to accommodate the AT network.

3.5 Future Transit Service

Based on the 2023 AEGD TMP, additional transit routes and transit infrastructure are proposed around the Secondary Plan as follows:

- Future bus rapid transit (“BRT) along Upper James Street with enhanced transit stops at the Mountain Transit Centre, which is less than a 5-minute drive away and offers park and ride services.
- Enhanced transit stop near the intersection of Glancaster Road and Dickenson Road.
- Proposed Route 101, which will provide service along Collector 6N and Collector 6E.
- Proposed Route 102, which will provide service along Twenty Road and Upper James Street.
- Proposed Route 103, which will provide service along the Garth Street extension.

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- Proposed Route 116, which will provide service along Dickenson Road.
- Southerly extension of the existing Route 34, which will provide service along Glancaster Road.
- Southerly extension of the existing Route 35, which will provide service along the Garth Street extension.
- Proposed carpool lots for transit users located south of the Mountain Transit Centre.

The future transit network is shown in Figure 10.

Figure 10: 2023 AEGD Transit Network



The UWS Secondary Plan would be able to accommodate the transit network.

3.6 Background Traffic Volumes

Background traffic volumes consist of the application of growth per annum (up to horizon years 2031 and 2041) to the existing traffic volumes shown in Figure 6. The resulting background 2031 and 2041 traffic volumes are illustrated in Figure 11 and Figure 12, respectively.

Figure 11: Background 2031 Traffic Volumes

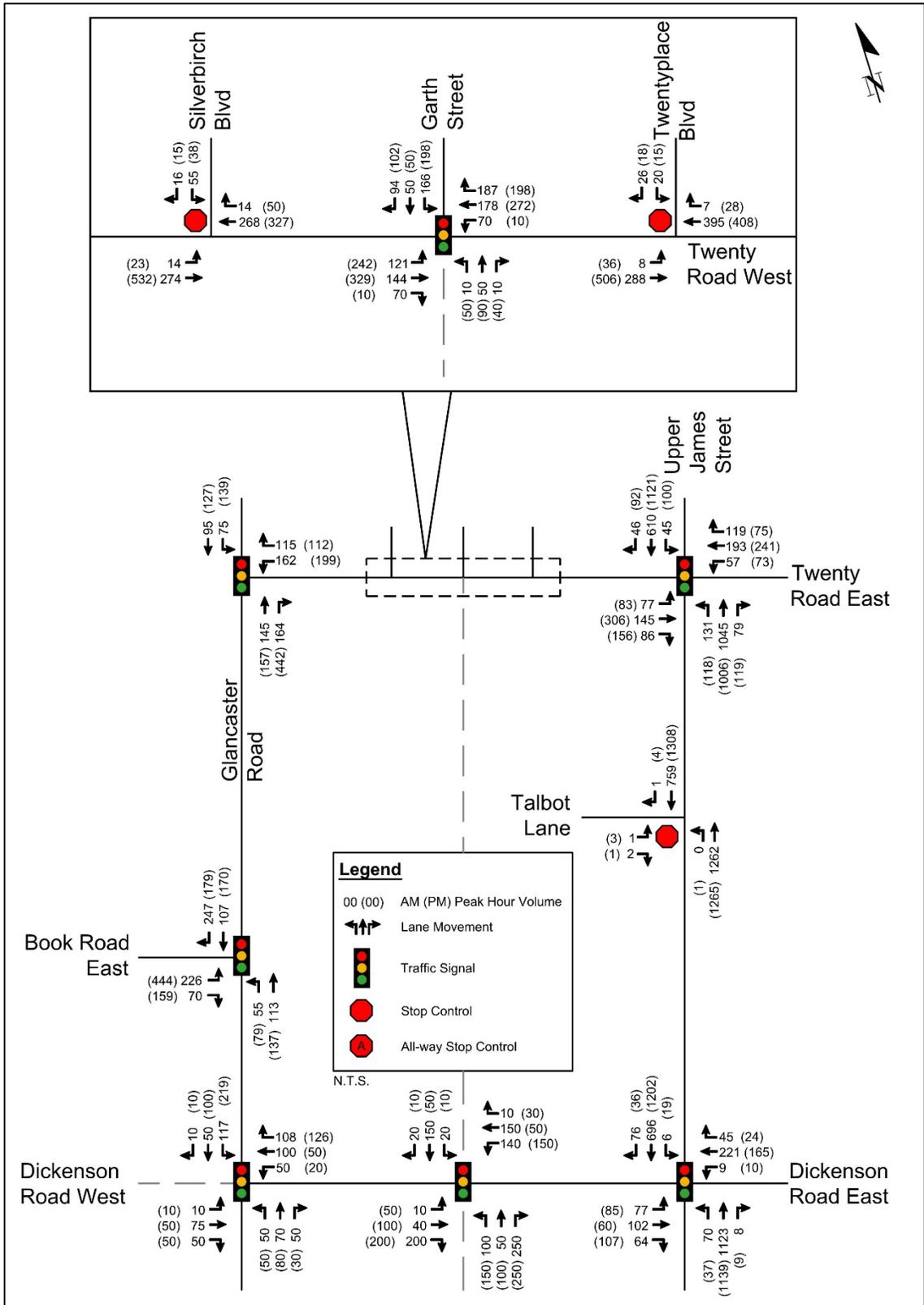
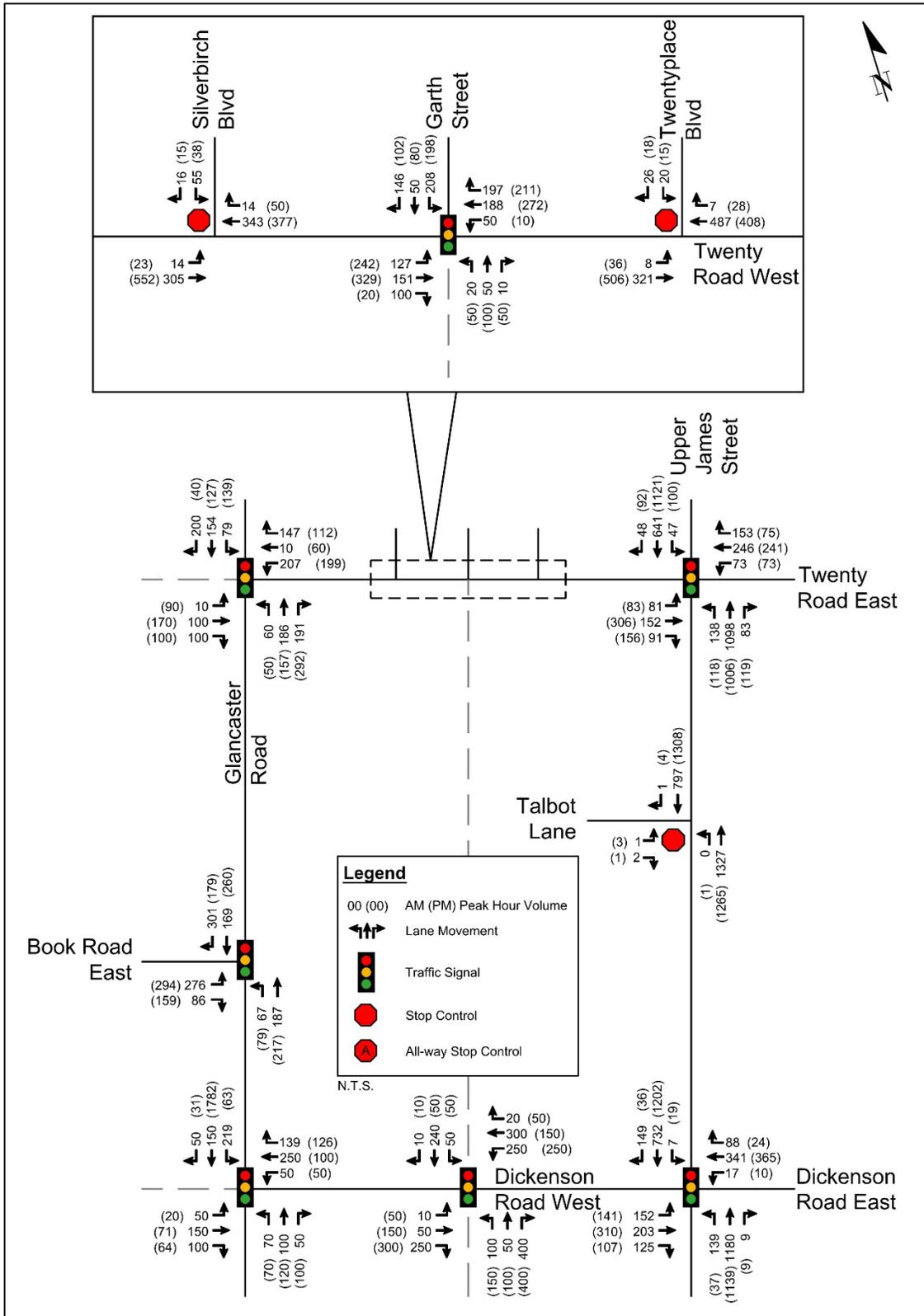


Figure 12: Background 2041 Traffic Volumes



4.0 Proposed Upper West Side Community

The proposed Secondary Plan will consist of low, medium, and high density homes, mixed-use developments, prestige employment, light industrial employment, and two elementary schools.

An internal collector road network is proposed within the UWS Secondary Plan, which is consistent with the 2023 AEGD TMP:

- North-south Collector Road A (referred to as Collector 1E in the 2023 AEGD TMP)
- North-south Collector Road B (referred to as Collector 6E in the 2023 AEGD TMP)
- East-west Collector Road C (referred to as Collector 6N in the 2023 AEGD TMP)

The proposed collector roads will be supported by a network of local roads serving residential, mixed-use, employment and school uses.

The proposed land use zone plan is provided in Figure 13.

The following summarizes the proposed land uses:

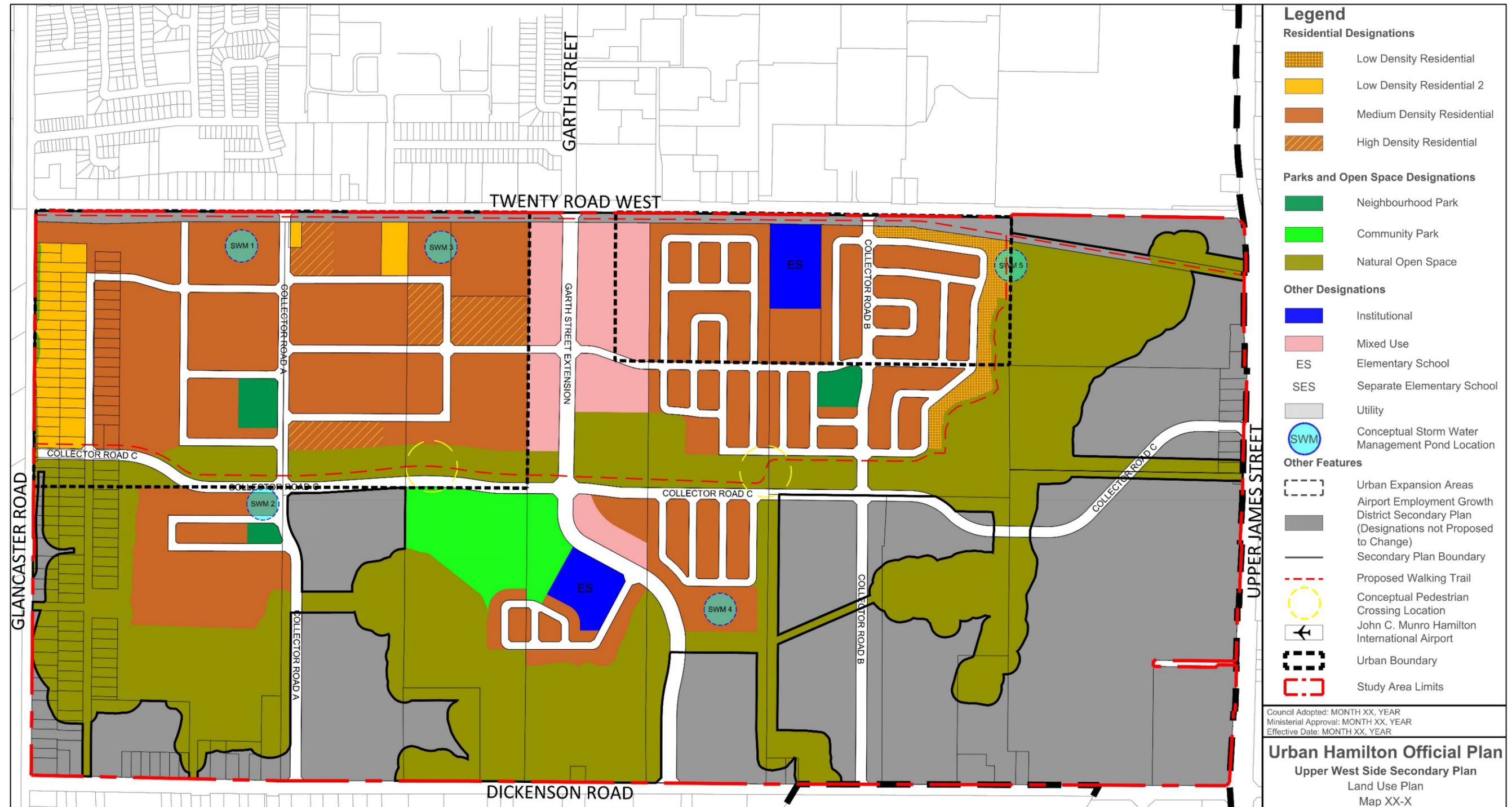
- Single Family Homes – 220 units
- Street/Block Townhomes – 5,393 units
- High-Density Apartments – 1,490 units
- Mixed-Use Mid-Density Apartments – 961 units
- Mixed-use Commercial Area – assumed 413,657 ft² (assumed 30% retail coverage)
- Elementary School – assumed 400 students per school
- Prestige Employment – 1,864 employees
- Light Industrial Employment – 884 employees

4.1 Trip Generation

Trip generation was based upon information contained in the publication *Trip Generation Manual*, 11th Edition, published by ITE (“ITE Trip Generation Manual”) and the following Land Use Codes (“LUC”) were used for the generation of trips:

- LUC 210 (Single-Family Detached Housing) for single family homes.
- LUC 211 (Multifamily Housing Low-Rise) for townhouses and mixed-use mid-density apartments.
- LUC 222 (Multifamily Housing High-Rise) for high-density apartment.
- LUC 822 (Strip Retail Plaza) for the mixed-use commercial components.
- LUC 520 (Elementary School) for the elementary schools.

Figure 13: Upper West Side Secondary Plan



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Trip generation for the prestige employment and light industrial employment were based on the trip generation rates from the 2023 AEGD TMP for prestige business park and light industrial, respectively. These rates are summarized in Table 2.

Table 2: Employment Use Trip Generation

Land Use Type	2023 AEGD TMP Trip Generation Rates (trips/unit)			
	AM Peak		PM Peak	
	In	Out	In	Out
Light Industrial	0.37	0.15	0.13	0.37
Prestige Business Park	0.33	0.04	0.07	0.29

The trip generation difference from the approach in the Terms of Reference provided to the City, which was going to utilize the trip generation from the City's model. However, access to the model was not obtained; therefore, trip rates published in the ITE Trip Generation Manual have been utilized.

It is noted that there is an approved draft plan for an industrial development, the Panattoni-Dickenson Development, which is located at 9236-9322 Dickenson Road. The proposed development will have 4 industrial buildings for a total area of 85,500 m². The development will be built on both sides of Collector Road B, between Dickenson Road and Collector Road C. Future trips for this development were obtained from the *9322 & 9236 Dickenson Road – Transportation Impact Study* letter, dated July 16th, 2023, by JD Engineering ("Panattoni TIS"). Compared to the land use plan for the Block, this development will correspond to 273 employees from the prestige employment use and 381 employees from the light industrial employment use.

The Secondary Plan is designed to encourage many modes of travel other than the single occupant motor vehicle and to take advantage of future bus routes that will service the Secondary Plan, such as the BRT route along Upper James Street. Based on the 2023 AEGD TMP, a 20% modal split (12% transit, 6% walking/cycling, 2% from Transportation Demand Measures) is forecasted for 2051. However, the City's *Transportation Master Plan Review and Update*, dated October 2018 ("City TMP"), forecasts a 27% modal split by 2031. The City TMP also notes the current modal split is 12%. Therefore, an 8% modal split was applied to the UWS Secondary Plan trips to account for the future increase in transit, walking and cycling usage by residents and employees.

There are three types of trips: new trips (all uses), internal capture trips (retail) and pass-by trips (retail). New trips are additional traffic added to the road network. The primary purpose of the trip is to visit the development. For example, a resident would leave their home, travel to work or for shopping and return home. Therefore, the primary trip purpose was to visit the development.

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Internal capture trips are trips that make stops at multiple adjacent facilities within the site or in this case within the UWS Secondary Plan. In this case, internal capture trips would include interaction between the residential and retail, where the retail uses located exclusively along the Garth Street extension are predominantly meant to serve the local residents and employees, not patrons or employees external to the development. A 50% internal capture for retail uses was assumed in the analysis.

For the elementary schools, it was assumed that the catchment areas are predominantly contained within the Secondary Plan area. As a result, some of the auto trips will consist of parents dropping off students on their way to work. Therefore, a 20% internal capture for the elementary schools was assumed in the analysis. This is on the conservative side as a higher internal capture is very feasible.

Pass-by trips are trips associated with commercial uses and are trips that are already using the road network and passing by a commercial site. For example, a person leaves work and happens to see a desired store on their way home or plans to visit the development on their way home along their typical route. They continue their way home after shopping. Pass-by rates for retail uses were reviewed based upon information in the ITE Trip Generation Manual. The ITE Trip Generation Manual does not have pass-by data for Stirp Retail Plaza (LUC 822) but contains data for Shopping Plaza (LUC 821) of an average pass-by of 40% during the PM peak period. Therefore, a pass-by of 25% was assumed in the analysis for a more conservative analysis.

The resulting trip generation for the UWS Secondary Plan is summarized in Table 3.

Table 3: WS Secondary Plan Trips

Land Use	Weekday AM Peak Hour			Weekday PM Peak Hour		
	In	Out	Total	In	Out	Total
Single-Family Homes (LUC 210) – 220 units						
Total Trips	41	124	165	139	82	221
Non-Auto Modal Split (8%)	-3	-10	-13	-11	-7	-18
New Trips	38	114	152	128	75	203
Townhomes and Mixed-use Apartments (LUC 221) – 6,354 units						
Total Trips	621	2082	2703	1513	968	2481
Non-Auto Modal Split (8%)	-49	-166	-215	-119	-77	-196
New Trips	572	1916	2488	1394	891	2285
High-Density Apartments (LUC 222) – 1,262 units						
Total Trips	82	234	316	232	143	375
Non-Auto Modal Split (8%)	-7	-19	-26	-19	-11	-30
New Trips	75	215	290	213	132	345

Table 3: UWS Secondary Plan Trips continued

Land Use	Weekday AM Peak Hour			Weekday PM Peak Hour		
	In	Out	Total	In	Out	Total
Mixed-use Commercial (LUC 822) – 413,657 ft ²						
Total Trips	215	132	347	675	731	1406
Non-Auto Modal Split (8%)	-17	-11	-28	-54	-58	-112
Pass-by Trips (25%)	0	0	0	-83	-83	-166
Internal Capture (50%)	-100	-60	-160	-311	-337	-648
New Trips	98	61	159	227	253	480
Elementary School (LUC 520) – 800 students						
Total Trips	160	136	296	29	35	64
Internal Capture (20%)	-32	-27	-59	-6	-7	-13
New Trips	128	109	237	23	28	51
Prestige Employment – 1,497 employees						
Total Trips	495	60	555	105	435	540
Non-Auto Modal Split (8%)	-39	-4	-43	-9	-35	-44
New Trips	456	56	512	96	400	496
Light Industrial Employment – 465 employees						
Total Trips	172	70	242	60	173	233
Non-Auto Modal Split (8%)	-14	-5	-19	-4	-14	-18
New Trips	158	65	223	56	159	215
Panattoni-Dickenson Development						
New Trips	340	80	420	88	332	420
Total New Trips	2205	2696	4901	2225	2270	4495

4.2 Trip Distribution and Assignment

Trip distribution and assignment were based upon the future road network, and a review of the *2016 Transportation Tomorrow Survey (2016 TTS)* results, published by the University of Toronto Transportation Research Institute. The estimated distribution of site trips is summarized in Table 4.

Table 4: New Site Traffic Distribution

To / From	Via	Residential	Retail
East	Twenty Road	20%	12.5%
	Dickenson Road	10%	12.5%
North	Garth Street	10%	25%
	Glancaster Street	10%	12.5%
	Upper James Street	25%	0%
South	Glancaster Street	5%	12.5%
	Upper James Street	20%	25%

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Site generated trip for horizon year 2031 and 2041 are illustrated in Figure 14 and Figure 15, respectively.

Figure 14: Site 2031 Traffic Volumes

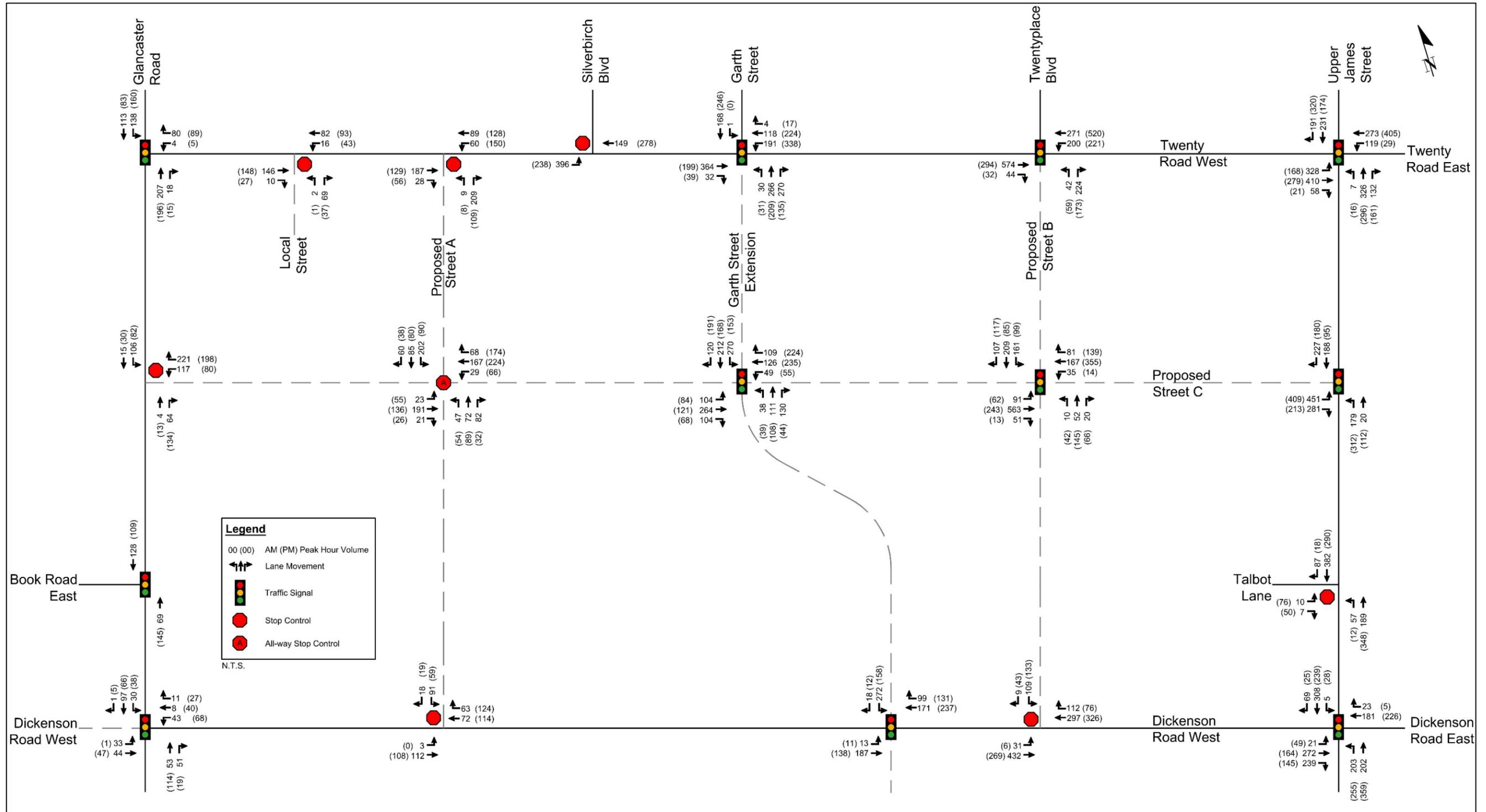
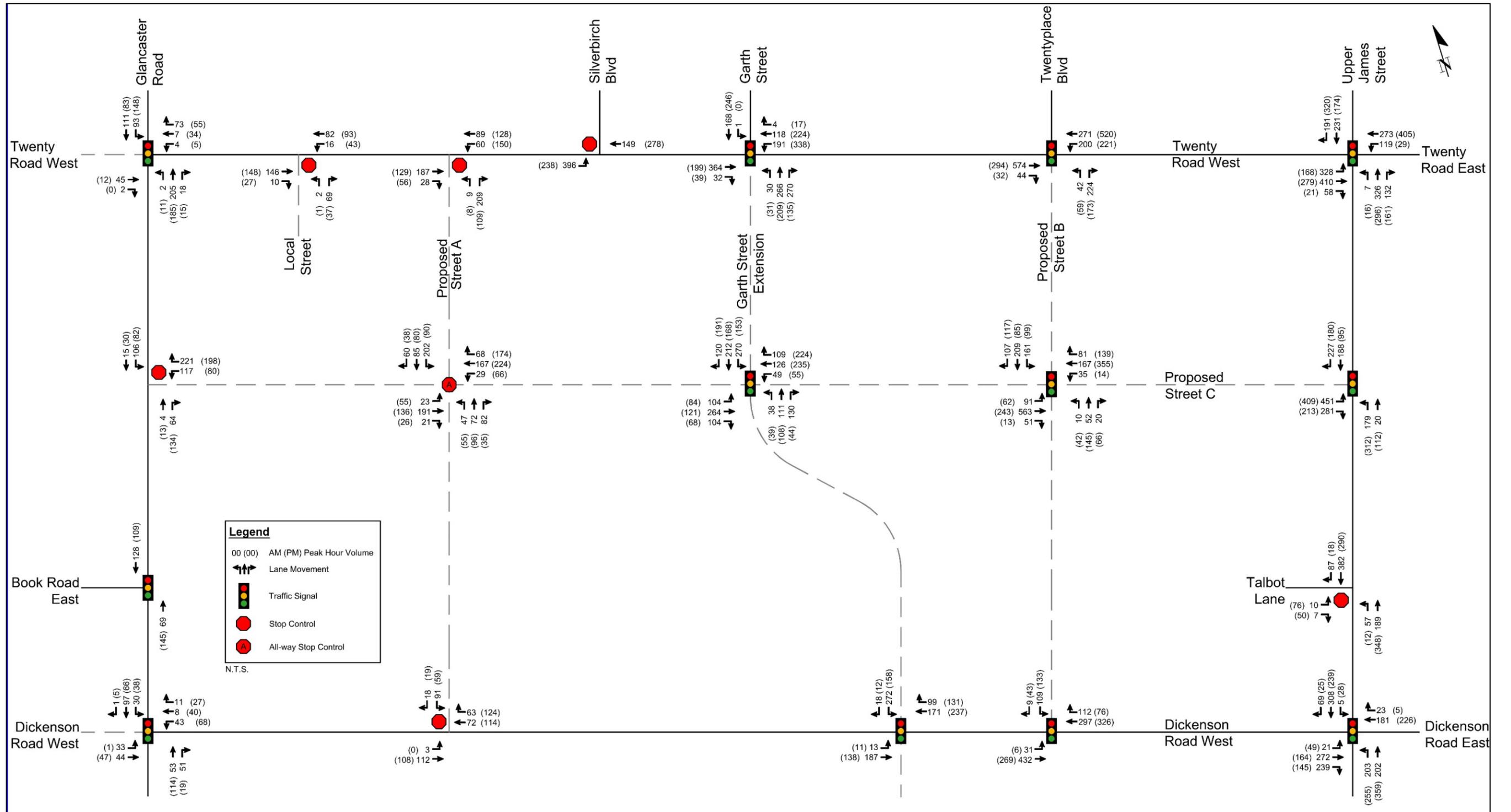


Figure 15: Site 2041 Traffic Volumes



5.0 Total Traffic Conditions

5.1 2031 Total Traffic Volumes

2031 total traffic volumes consist of the 2031 background traffic volumes in Figure 11 plus the 2031 site trips illustrated in Figure 14. The resulting 2031 total traffic volumes are shown in Figure 16.

5.2 2041 Total Traffic Volumes

2041 total traffic volumes consist of the 2041 background traffic volumes in Figure 12 plus the 2041 site trips illustrated in Figure 15. The resulting 2041 total traffic volumes are shown in Figure 17.

Figure 16: Total 2031 Traffic Volumes

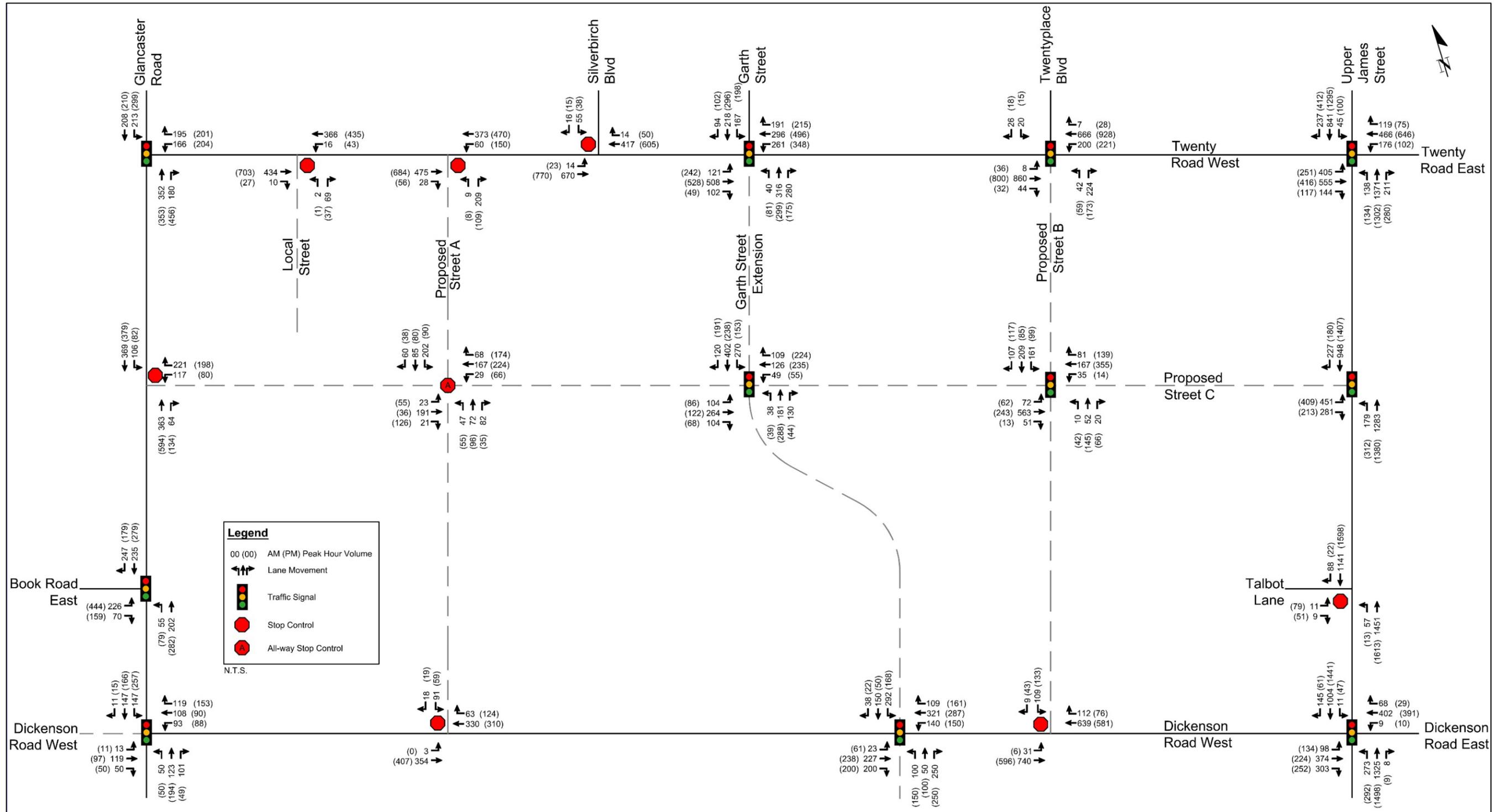
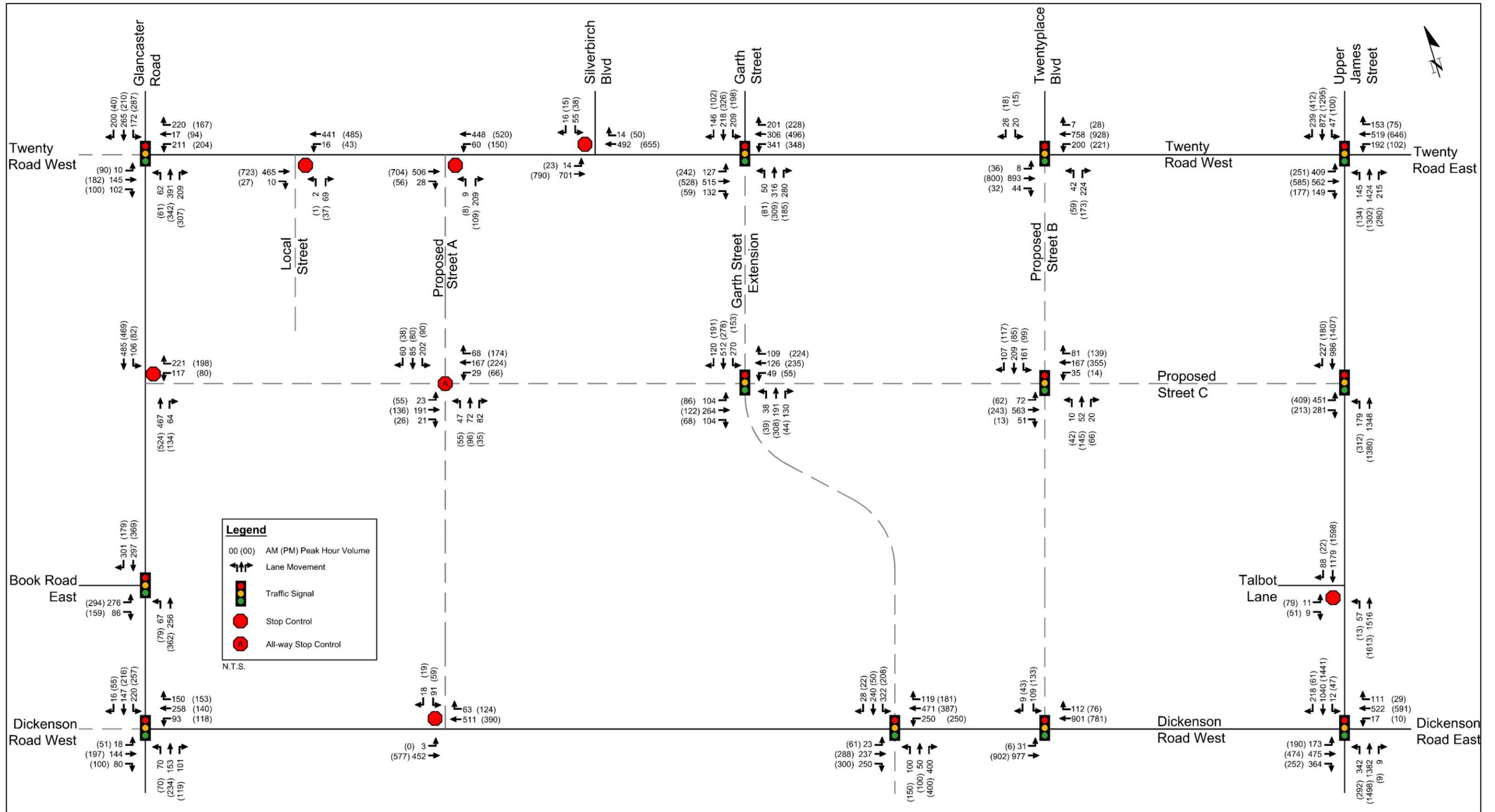


Figure 17: Total 2041 Traffic Volumes



6.0 Traffic Operations Analysis

Traffic operations analyses were conducted for existing and future conditions during the weekday AM and PM peak hours at area intersections. In addition, queueing was reviewed at intersections using Synchro's 95th percentile queue methodology. The results for each intersection are described below with details contained within the memorandum provided in Appendix B.

6.1 Existing Traffic Operations

Under existing conditions, all area intersections are operating with excess capacity and a level of service of D or better, except for the eastbound left-right movement at the Upper James Street / Talbot Lane intersection during the PM peak hour, which is experiencing high delay.

6.2 Background 2031 Traffic Operations

Under background 2031 conditions, all area intersections will operate with excess capacity and a level of service of D or better, with a few exceptions that are described further below.

Glancaster Road / Twenty Road West

During the weekday PM peak hour, the northbound through-right turn movement is projected to be overcapacity with a level of service F. It is recommended that this intersection be signalized. With signalization, all movements are projected to have excess capacity and a level of service D or better.

Glancaster Road / Book Road

During the weekday PM peak hour, the eastbound left-right turn movement is projected to be overcapacity with a level of service F. It is recommended that this intersection be signalized. With signalization, all movements are projected to have excess capacity and a level of service C or better.

6.3 Total 2031 Traffic Operations

Under total 2031 conditions, all area intersections will operate with excess capacity and a level of service of E or better, with the recommended road network improvements as described below for the noted intersections.

Upper James Street / Twenty Road West

The following road network improvements are recommended:

- Twenty Road West should be widened from 2 to 4-lanes from Garth Street to Upper James Street by 2031. It is recommended that the City consider changing this future road network improvement from medium priority to high priority. This assumes that the UWS Secondary Plan is built out by 2031 plus other background growth in the area.
- During the weekday AM peak hour, eastbound and westbound left-turn advanced phases should be added.
- During the weekday PM peak hour, an eastbound left-turn advanced phase should be added.
- The cycle length increased to 120s during both peak hours.

The specific timing of the Twenty Road West widening should be determined as each phase of the Secondary Plan area is built as well as monitoring development in the overall area.

Glancaster Road / Twenty Road West

A northbound right-turn lane is recommended to be added under total 2031 conditions.

Twenty Road West / Garth Street

The following road network improvements are recommended:

- During the weekday AM peak hour, westbound and southbound left-turn advanced phases should be added;
- During the weekday PM peak hour, eastbound, westbound, and southbound left-turn advanced phases should be added;
- The cycle length increased to 120s during both peak hours.

Upper James Street / Dickenson Road

The following road network improvements are recommended:

- During the weekday AM and PM peak hours, eastbound and northbound left-turn advanced phases be added;
- The cycle length increased to 120s during both peak hours.

Upper James Street / Talbot Lane

This intersection is recommended to be signalized, with an exclusive northbound and eastbound left-turn lanes, as the development of the industrial uses are built out.

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For the proposed local / collector road network, the following traffic control is recommended:

- Northbound stop control at Twenty Road / Local Street
- Northbound stop control at Twenty Road / Collector Road A
- Signalization at Twenty Road / Twentyplace Boulevard / Collector Road B
- Signalization at Collector Road B / Collector Road C
- Signalization at Garth Street extension / Collector Road C
- All-way stop control at Collector Road A / Collector Road C
- Eastbound stop control at Glancaster Road / Collector Road C
- Southbound stop control at Dickenson Road / Collector Road A
- Southbound stop control at Dickenson Road / Collector Road B

6.4 Total 2041 Traffic Operations

Under total 2041 conditions, all area intersections will operate with excess capacity and a level of service of E or better, with the same recommended road network improvements under total 2031 conditions.

At the Dickenson Road / Collector Road B intersection, signalization is recommended by 2041.

6.5 Recommended Road Network

A summary of the 2031 and 2041 recommended road network improvements based on this study's assumptions and the 2023 AEGD TMP are shown in Figure 18 and Figure 19, respectively.

Figure 18: 2031 Recommended Road Network

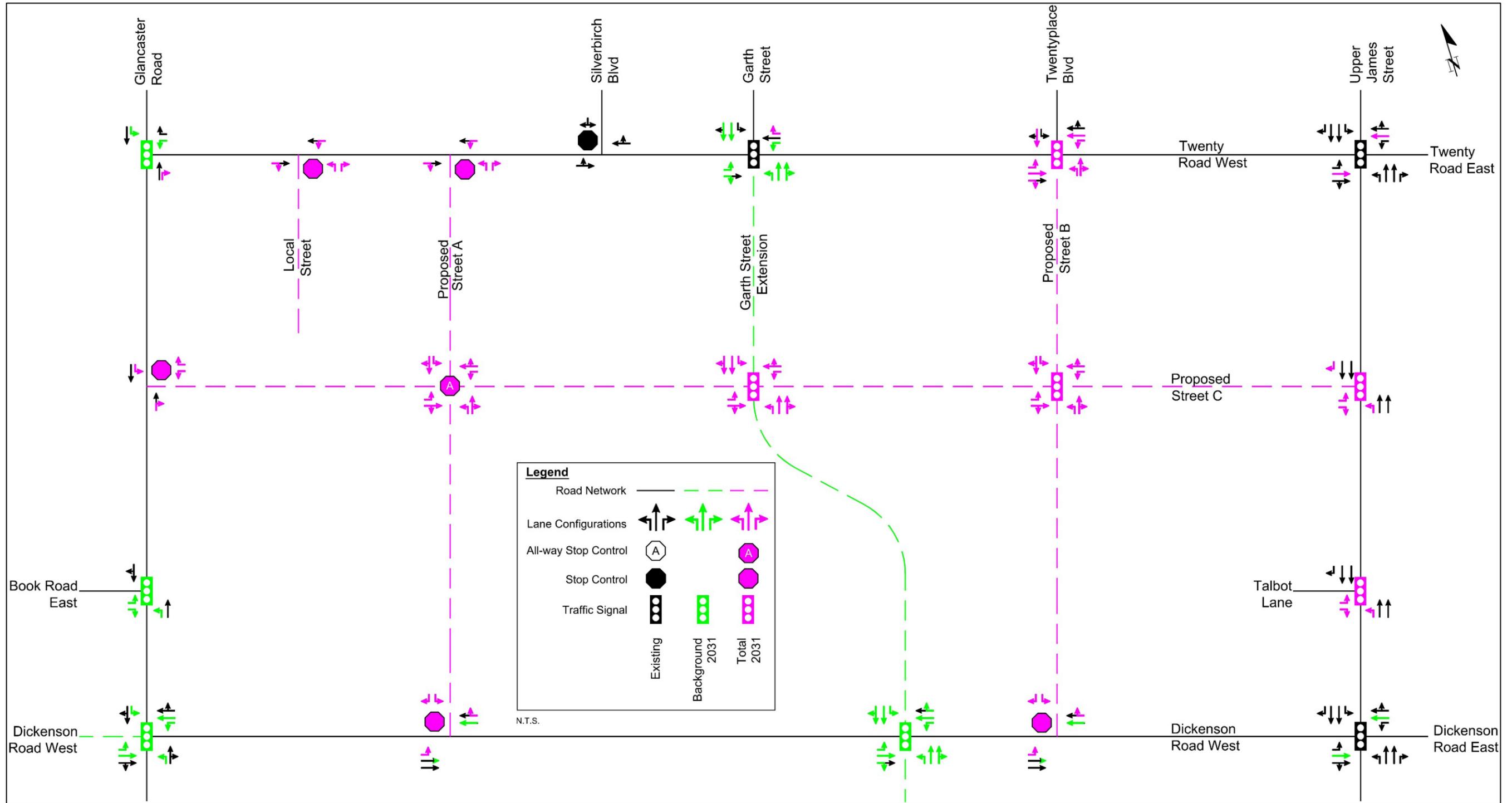
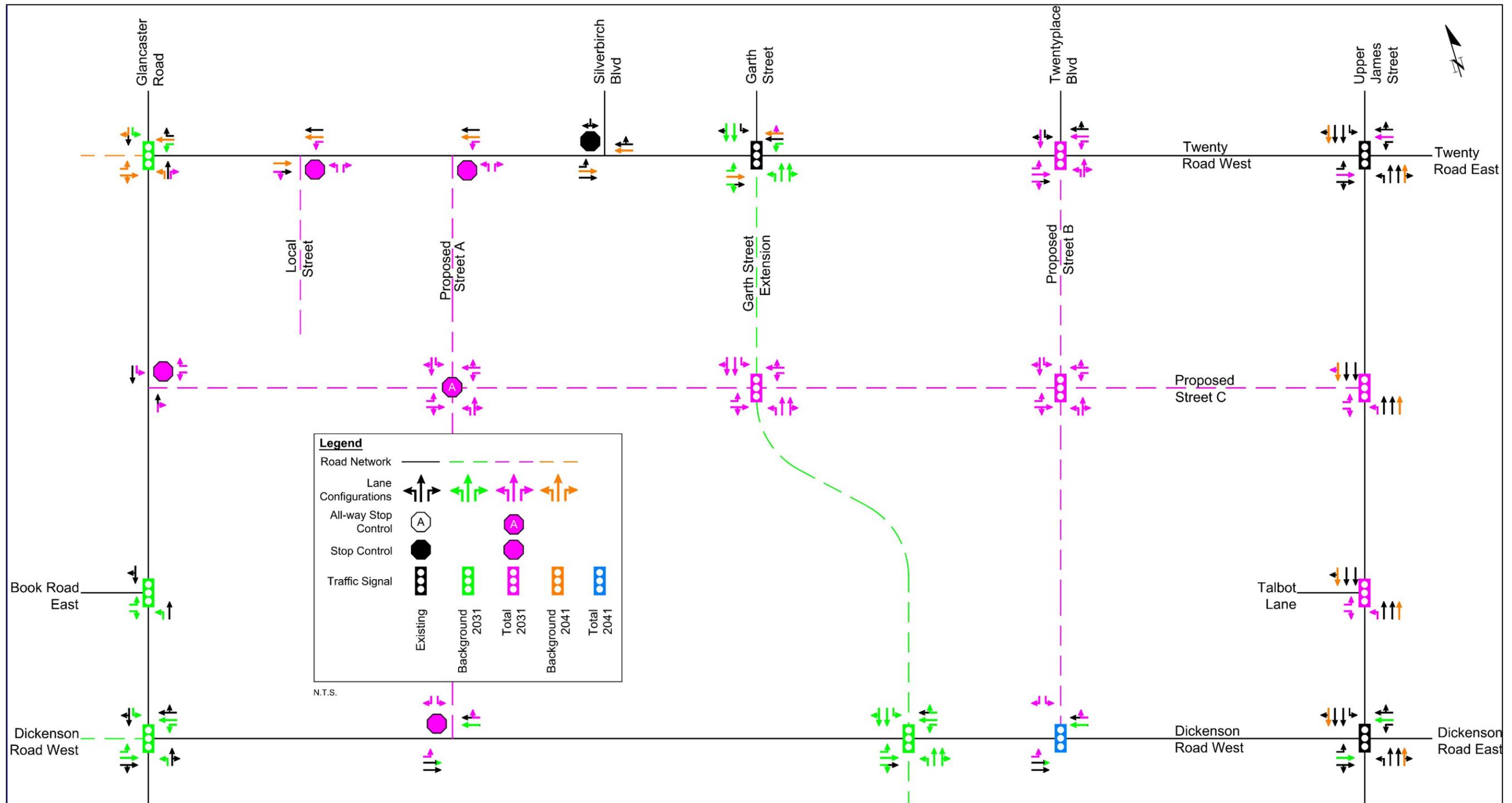


Figure 19: 2041 Recommended Road Network



7.0 Upper West Side Block Plan Review

7.1 Road Phasing

A road phasing implementation plan will be developed as part of future studies for the Secondary Plan area. It is premature to develop this plan at this point as it will depend upon a number of criteria, such as land ownership and infrastructure availability.

7.2 Pedestrian Route and Sidewalk Analysis

Pedestrian access in the form of sidewalks would be provided on both sides of all streets within the Block. The sidewalks will also connect to building entrances, schools, and proposed transit stops with connections provided to Twenty Road, Garth Street extension and Collector Road C where future transit service will be provided. To ensure that pedestrians will feel safe and be encouraged to utilize the sidewalk facilities, the designs are based on the City's *Complete Streets Design Guidelines*, dated June 2022 ("Complete Streets Guidelines"), and incorporate the City's design standards.

Two trail systems have been identified on the concept plan along Collector Road C and Twenty Road West to provide connectivity within the Block. The trail along Collector Road C will head northeast to the east of Collector Road B and tie into the path along Twenty Road. Connections from the multi-use paths to the residential areas are recommended. These trails and other recommended connections are shown in Figure 20.

7.3 Cycling Route Analysis

Cycling facilities are proposed on both sides of all proposed collector roads and the Garth Street extension. The proposed multi-use trails along Twenty Road and Collector Road C will provide additional connectivity for cyclists through the Secondary Plan. The design of the proposed cycling facilities is based on the City's Complete Streets Guidelines. Recommendation cross-sections for all proposed roads are also provided in Section 7.8.

7.4 Transit Assessment

As discussed in Section 3.5, future transit routes are proposed to service the study area. Based on the transit routes, Figure 21 shows recommended transit stop locations, which are mainly at arterial- collector and collector-collector intersections. As shown, approximately 95% of all residents within the Block will be within a 15-minute walk of a transit stop, which are depicted by a 400 m radius.

Figure 20: Proposed Multi-Use Trail and Connections

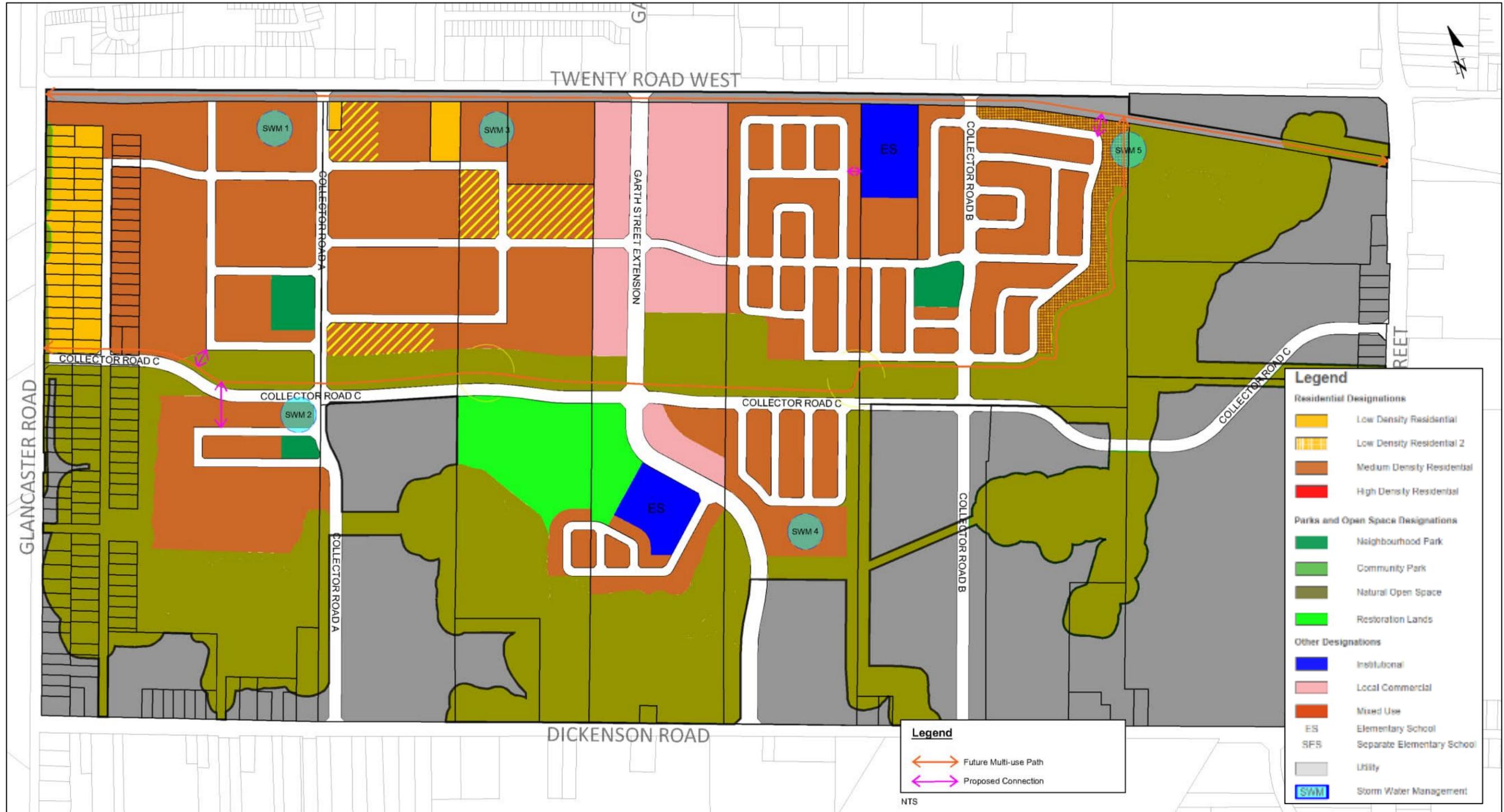
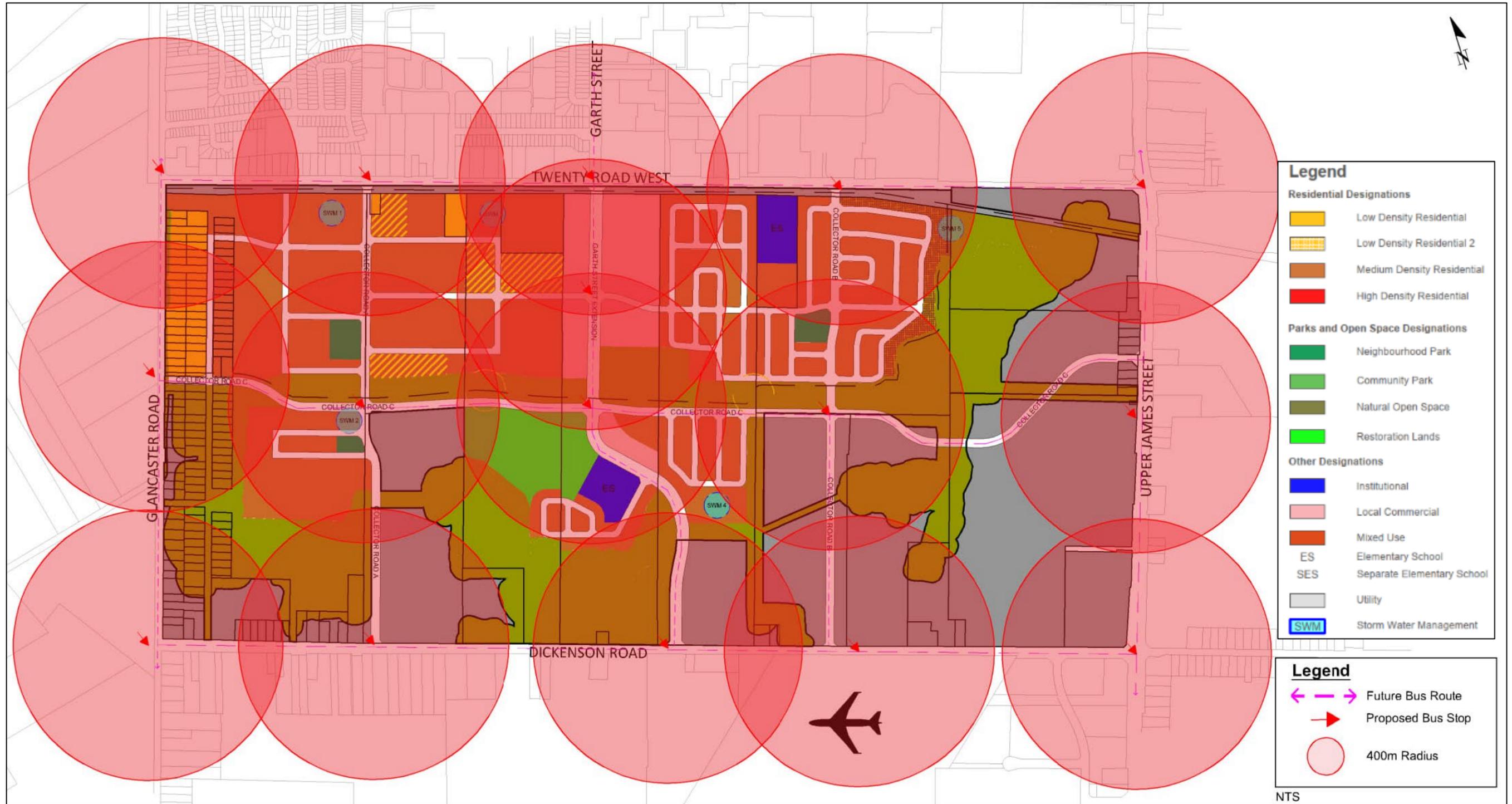


Figure 21: Proposed Transit Stops



7.5 Truck Routes

Upper James Street is part of the existing truck route system, according to the City's *Truck Route Master Plan*, dated April 27, 2022 ("Truck Master Plan"). The Truck Master Plan also recommends that truck routes be added to Dickenson Road and the Garth Street extension to improve the movement of goods. The existing and future truck routes are illustrated in Figure 22.

7.6 Traffic Calming

Traffic calming including the type of traffic calming methods and location will be reviewed when subdivision plans are developed and through detailed design process for the collector / arterial road system. Horizontal features will be considered for collector and arterial roads, which is consistent with the City's Transportation Master Plan and the City's Traffic Calming Policy. Gateway features at the entrance point from Twenty Road and Dickenson Road will be investigated and will be done in consultation with the overall Block to develop a cohesive community.

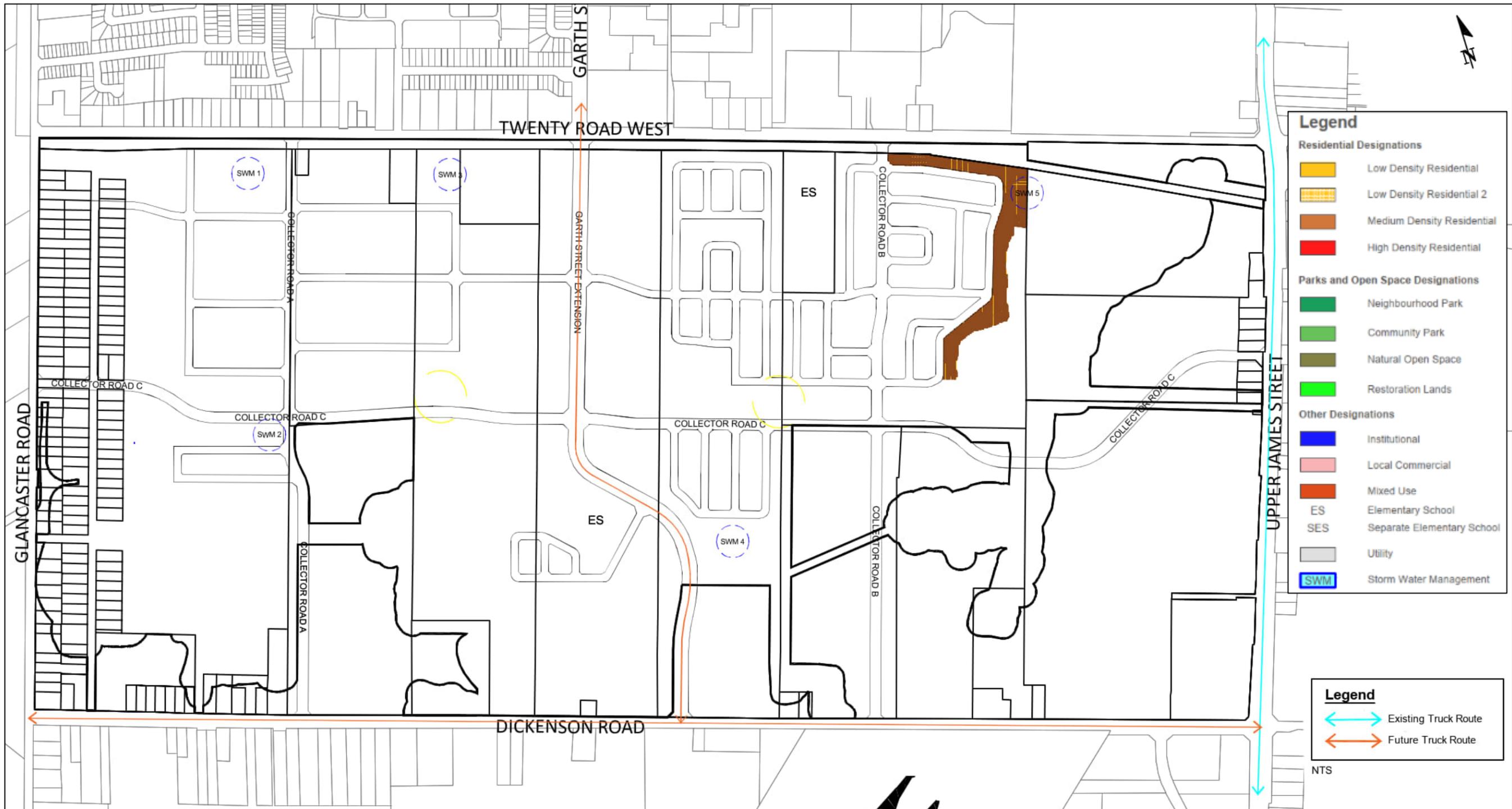
7.7 Transit Oriented Development ("TOD")

According to the City's *Transit Oriented Development Guidelines*, dated August 2010 ("TOD Guidelines"), the following principles are applicable to the City's context, based on research and best practices:

- Promote place making – creating a sense of place;
- Ensure a mix of uses/appropriate land uses;
- Address parking management;
- Focus on urban design;
- Create pedestrian environments;
- Require density and compact urban form;
- Respect market consideration;
- Take a comprehensive approach to planning;
- Plan for transit and promote connections (for all modes); and,
- Promote partnerships and innovative implementation.

The Upper West Side Secondary Plan will include suburban corridor areas, as described in the TOD Guidelines. A suburban area includes areas proposed along the A-line BRT along Upper James Street. The long-term goal is to utilize the development around the BRT line to increase transit usage similar to the lower city where transit usage is higher. The planned land uses should be diverse in these TOD areas and uses should be clustered near the transit stations to maximize transit usage.

Figure 22: Existing and Proposed Truck Routes



Typical design elements of suburban corridor areas include the following:

- Medium-density buildings, which is currently being proposed.
- Street-orientated development, which is proposed along the Garth Street extension and collector roads.
- Cycling facilities at transit stations, which will be considered..
- Position pedestrian environment, which is being considered through the proposed cross-sections.
- Locate parking areas for new development at the rear of buildings, which will be considered.
- Development will plan for future intensification along the proposed transit corridors. The site includes high density development along the Garth Street Extension and be serviced by many transit lines, and, as discussed in Section 7.4, will have high level of transit coverage within 400 m of proposed transit stations.

7.8 Roadway Cross-sections and Right-of-Way (“ROW”) Designations

Based upon the transportation analysis recommended cross sections for the site are summarized in Table 5.

Table 5: Recommend Right-of-Ways

Road	ROW (m)
Garth Street Extension (Mixed-Use Node)	36.576
Garth Street Extension (Employment Area)	36.576
Collector Roads - 4 lanes	29
Collector Roads - 3 lanes	26
Collector Roads - 2 lanes	26
Local Roads	20
Local Roads	18

The right-of-way cross-sections proposed within the UWS Secondary Plan have been developed in consideration of the City’s Complete Streets Guidelines, transportation needs including pedestrians, cyclists, transit, vehicles, and goods movement. The various cross-sections as illustrated by NAK are shown in Figure 23 through Figure 29.

Garth Street would have the same right-of-way, but different allocation with the residential versus employment areas. Bike lanes would be on-street through the residential areas, but within the boulevard through the employment areas. Given driveways and desire to separate cyclists from pedestrian in the higher development urban area along Garth Street, it was desirable to separate the cyclist from pedestrian.

Figure 23: Garth Street Cross-Section North of Collector Road C

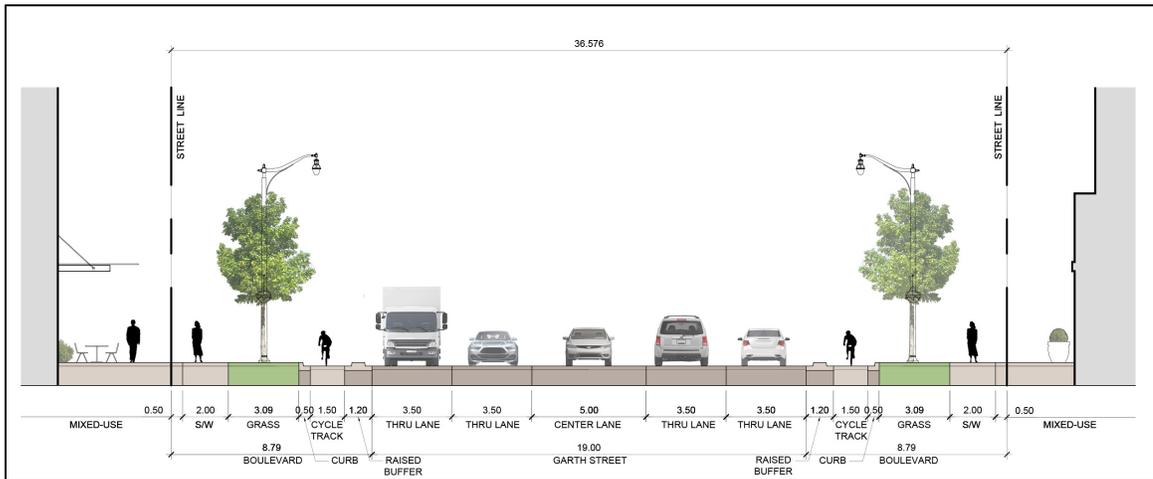
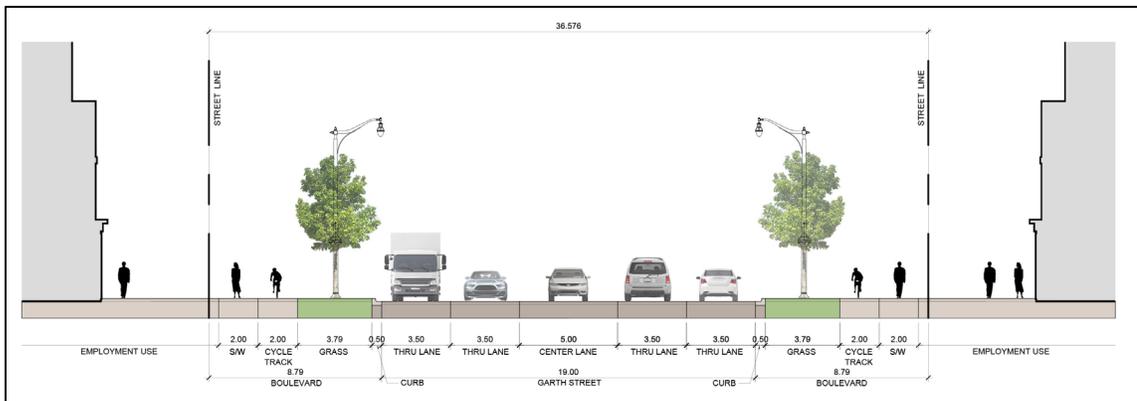


Figure 24: Garth Street Cross-section South of Collector Road C



The collector roads will have a variety of cross-sections. All have sidewalks and cycle tracks. Collector roads where four lanes are required will have a 29 m right-of-way. Sections where three lanes are desirable (one lane per direction, plus a centre left turn lane) will have a 26 m right-of-way. Parking would not be accommodated on-street on this road. There is also an option of parking within parking bays on one side with one lane per direction and accommodated in a 26 m right-of-way.

Local streets would have a 20 m right-of-way as per the City's standard cross-section, which provides for sidewalks on both sides. An 18 m right-of-way is proposed on window streets where duplication of facilities is not necessary such as sidewalks.

Figure 25: Collector Road 4 Lanes (29 m Right-of-way)

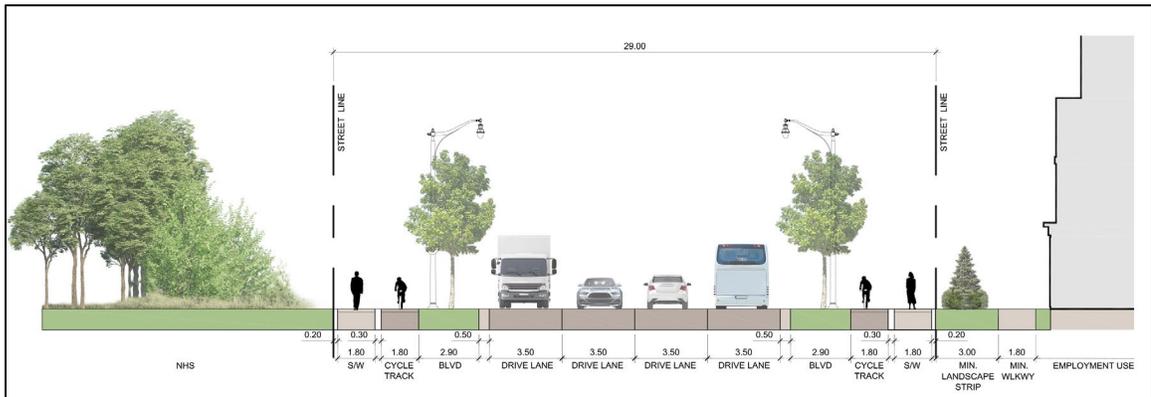


Figure 26: Collector Road with Parking (26 m Right-of-way)

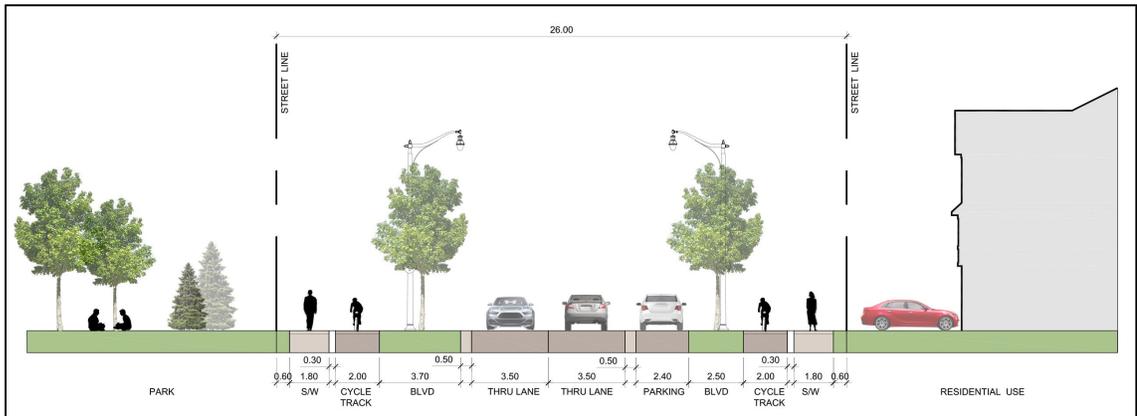


Figure 27: Collector Road No Parking 3 Lane Cross-section (26 m Right-of-way)

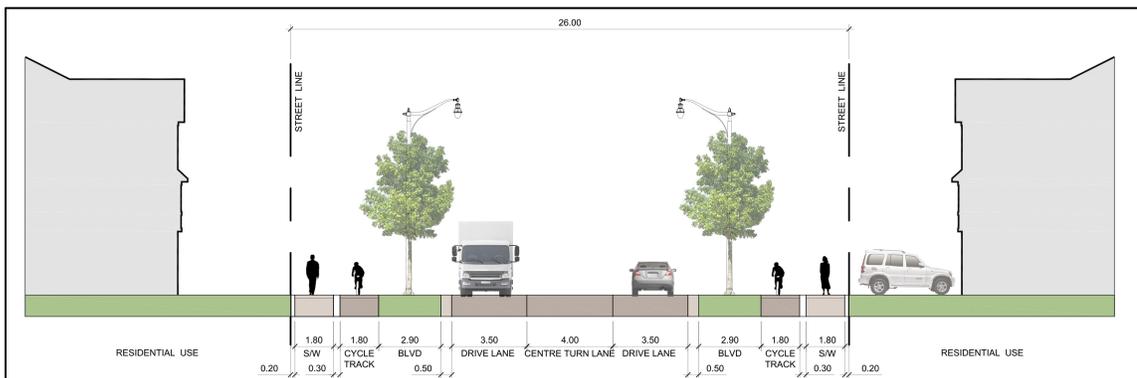


Figure 28: Local Street 20 m Right-of-Way

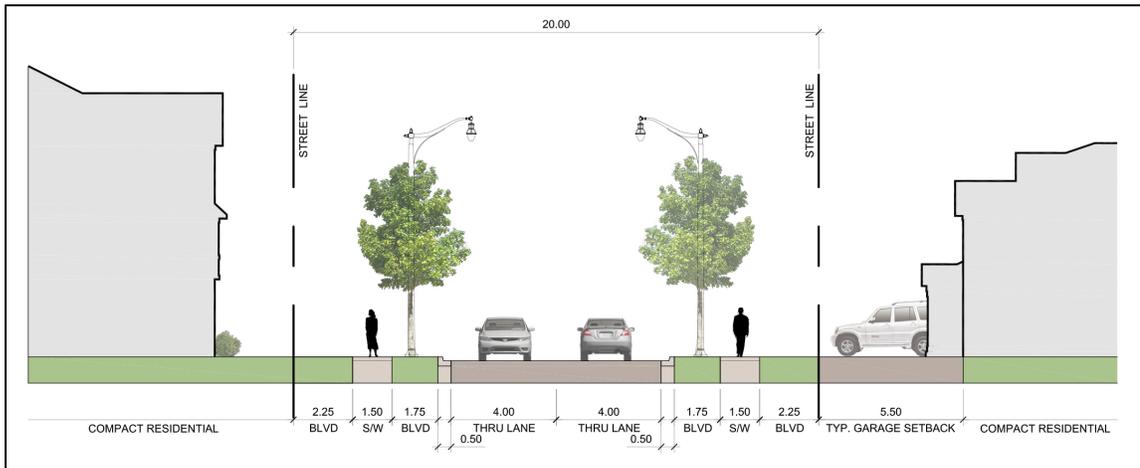
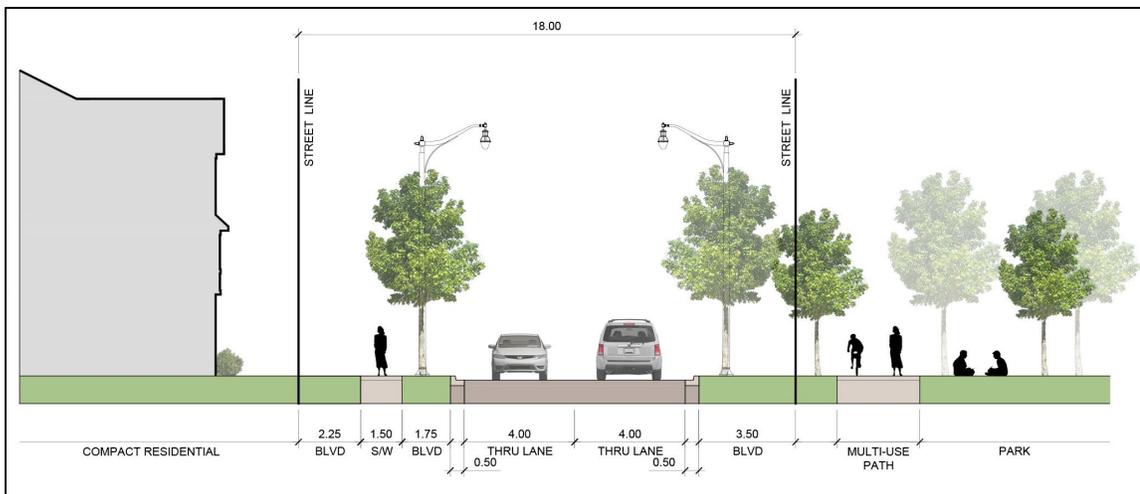


Figure 29: Local Street 18 m Right-of-way



7.9 Daylighting Triangle Designations

In accordance with the City's *Engineering Guidelines for Servicing Land Under Development Applications*, dated December 2012 and *Comprehensive Development Guidelines and Financial Policies Manual*, dated 2019, the daylighting triangles based on road classification are summarized in Table 6.

Master Transportation Study
November 2023

Table 6: Daylighting Triangle Requirements

Road 1	Road 2	Daylighting Triangle
Local	Local	4.5m x 4.5m
Collector	Local	9m x 9m
Collector	Collector	9m x 9m
Arterial	Collector	12m x 12m
Arterial	Arterial (urban)	12m x 12m
On various major road corridors		15m x 15m

8.0 Conclusions

8.1 Traffic Operations

8.1.1 Existing Traffic Operations

Under existing conditions, all area intersections are operating with excess capacity and a level of service of D or better, except for the eastbound left-right movement at the Upper James Street / Talbot Lane intersection during the PM peak hour, which is experiencing high delay.

8.1.2 Background 2031 Traffic Operations

Under background 2031 conditions, all area intersections will operate with excess capacity and a level of service of D or better, with a few exceptions.

At the Glancaster Road / Twenty Road West intersection, during the weekday PM peak hour, the northbound through-right turn movement is projected to be over capacity with a level of service F. It is recommended that this intersection be signalized. With signalization, all movements are projected to have excess capacity and a level of service D or better.

At the Glancaster Road / Book Road intersection, during the weekday PM peak hour, the eastbound left-right turn movement is projected to be overcapacity with a level of service F. It is recommended that this intersection be signalized. With signalization, all movements are projected to have excess capacity and a level of service C or better.

8.1.3 Total 2031 Traffic Operations

Under total 2031 conditions, all area intersections will operate with excess capacity and a level of service of E or better, with the recommended road network improvements as described below for the noted intersections.

Upper James Street / Twenty Road West

The following road network improvements are recommended:

- Twenty Road West should be widened from 2 to 4-lanes from Garth Street to Upper James Street by 2031. It is recommended that the City consider changing this future road network improvement from medium priority to high priority.
- During the weekday AM peak hour, eastbound and westbound left-turn advanced phases be added.
- During the weekday PM peak hour, an eastbound left-turn advanced phase be added.
- The cycle length increased to 120s during both peak hours.

The specific timing of the Twenty Road West widening should be determined as each phase of the Secondary Plan area is built.

Glancaster Road / Twenty Road West

A northbound right-turn lane is recommended to be added.

Twenty Road West / Garth Street

The following road network improvements are recommended:

- During the weekday AM peak hour, westbound and southbound left-turn advanced phases be added.
- During the weekday PM peak hour, eastbound, westbound and southbound left-turn advanced phases be added.
- The cycle length increased to 120s during both peak hours.

Upper James Street / Dickenson Road

The following road network improvements are recommended:

- During the weekday AM and PM peak hours, eastbound and northbound left-turn advanced phases be added.
- The cycle length increased to 120s during both peak hours.

Upper James Street / Talbot Lane

This intersection is recommended to be signalized, with an exclusive northbound and eastbound left-turn lanes, as the development of the industrial uses are built out.

8.1.4 Total 2041 Traffic Operations

Under total 2041 conditions, all area intersections will operate with excess capacity and a level of service of E or better, with the same recommended road network improvements under total 2031 conditions.

At the Dickenson Road / Collector Road B intersection, signalization is recommended by 2041.

8.2 Upper West Side Block Plan Review

8.2.1 Road Phasing

A road phasing implementation plan will be developed as part of future studies for the Secondary Plan area. It is premature to develop this plan at this point as it will depend upon a number of criteria, such as land ownership and infrastructure availability.

8.2.2 Pedestrian Route and Sidewalk Analysis

Pedestrian access in the form of sidewalks would be provided on both sides of all streets within the Block. The sidewalks will also connect to building entrances, schools, and proposed transit stops with connections provided to Twenty Road, Garth Street extension and Collector Road C where future transit service will be provided. To ensure that pedestrians will feel safe and be encouraged to utilize the sidewalk facilities, the designs are based on the City's *Complete Streets Design Guidelines*, dated June 2022 ("Complete Streets Guidelines"), and incorporate the City's design standards.

Two trail systems have been identified on the concept plan along Collector Road C and Twenty Road West to provide connectivity within the Block. The trail along Collector Road C will head northeast to the east of Collector Road B and tie into the path along Twenty Road. Connections from the multi-use paths to the residential areas are recommended.

8.2.3 Cycling Route Analysis

Cycling facilities are proposed on both sides of all proposed collector roads and the Garth Street extension. The proposed multi-use trails along Twenty Road and Collector Road C will provide additional connectivity for cyclists through the Secondary Plan. The design of the proposed cycling facilities are based on the City's Complete Streets Guidelines.

8.2.4 Transit Assessment

As discussed in Section 0, future transit routes are proposed to service the study area. Transit stop locations are recommended at all arterial-collector and collector-collector intersections, as well as midblock between collector roads. Approximately 95% of all residents within the area will be within a 15-minute walk of a transit stop, based on a 400-m radius from each proposed transit stop.

8.2.5 Truck Routes

Upper James Street is part of the existing truck route system according to the Truck Master Plan. It is also recommended that a truck route be added to Dickenson Road and the Garth Street extension to improve the movement of goods.

8.2.6 Traffic Calming

Traffic calming including the type of traffic calming methods and location will be reviewed when subdivision plans are developed and through detailed design process for the collector / arterial road system. Horizontal features will be considered for collector and arterial roads, which is consistent with the City's Transportation Master Plan and the City's Traffic Calming Policy. Gateway features at the entrance point from Twenty Road

and Dickenson Road will be investigated and will be done in consultation with the overall Secondary Plan to develop a cohesive community.

8.2.7 Transit Oriented Development

The Upper West Side Secondary Plan will include suburban corridor areas, as described in the TOD Guidelines. A suburban area includes areas proposed along the A-line BRT along Upper James Street. The long-term goal is to utilize the development around the BRT line to increase transit usage similar to the lower city where transit usage is higher. The planned land uses should be diverse in these TOD areas and uses should be clustered near the transit stations to maximize transit usage.

Typical design elements of suburban corridor areas include the following:

- Medium-density buildings, which is currently being proposed.
- Street-orientated development, which is proposed along the Garth Street extension and collector roads.
- Cycling facilities at transit stations, which will be considered.
- Position pedestrian environment, which is being considered through the proposed cross-sections.
- Locate parking areas for new development at the rear of buildings, which will be considered.
- Development will plan for future intensification along the proposed transit corridors. The site includes high density development along the Garth Street Extension and be serviced by many transit lines, and, as discussed in Section 7.4, will have high level of transit coverage within 400 m of proposed transit stations.

8.2.8 Right-of-Way (“ROW”) Designations

The cross-sections contained in the 2023 AEGD TMP were reviewed. Based on these cross-sections and the above traffic analysis, the following cross-sections ROWs are recommended in Table 7.

Table 7: Recommend Right-of-Ways

Road	ROW (m)
Garth Street Extension (Mixed-Use Node)	36.576
Garth Street Extension (Employment Area)	36.576
Collector Roads - 4 lanes	29
Collector Roads - 3 lanes	26
Collector Roads - 2 lanes	26
Local Roads	20
Local Roads	18

8.2.9 Daylighting Triangle Designations

Proposed daylighting triangles within the Secondary Plan area will comply with the City's engineering guidelines.



Appendix A

Existing Traffic Counts and Signal Timing Plans

Glancaster Rd @ Book Rd

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 7:45:00

To: 8:45:00

Municipality: Hamilton
Site #: 000000006
Intersection: Glancaster Rd & Book Rd E
TFR File #: 6
Count date: 25-Oct-2023

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

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

Major Road: Glancaster Rd runs N/S

North Leg Total: 483

North Entering: 239

North Peds: 0

Peds Cross: ∇

Heavys	4	1	5
Trucks	4	0	4
Cars	203	27	230
Totals	211	28	



Heavys 15

Trucks 1

Cars 228

Totals 244

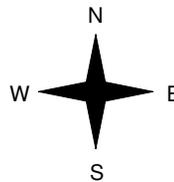
Heavys	5	Trucks	4	Cars	249	Totals	258
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Glancaster Rd



Book Rd E



Heavys	11	Trucks	1	Cars	181	Totals	193
2	2	56	60				
13	3	237					



Glancaster Rd

Peds Cross: ∇

West Peds: 2

West Entering: 253

West Leg Total: 511

Cars	83	46	47	93
Trucks	2	0	0	0
Heavys	3	1	4	5
Totals	88	47	51	



Peds Cross: ∇

South Peds: 1

South Entering: 98

South Leg Total: 186

Comments

Glancaster Rd @ Book Rd

Afternoon Peak Diagram

Specified Period

From: 16:00:00
To: 18:00:00

One Hour Peak

From: 17:00:00
To: 18:00:00

Municipality: Hamilton
Site #: 000000006
Intersection: Glancaster Rd & Book Rd E
TFR File #: 6
Count date: 25-Oct-2023

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

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

Major Road: Glancaster Rd runs N/S

North Leg Total: 630
North Entering: 219
North Peds: 0
Peds Cross: \times

Heavys	1	1	2
Trucks	0	0	0
Cars	152	65	217
Totals	153	66	



Heavys	3
Trucks	3
Cars	405
Totals	411

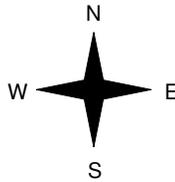
Heavys	2	Trucks	3	Cars	215	Totals	220
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Glancaster Rd



Book Rd E



Heavys	3	Trucks	3	Cars	373	Totals	379
1	1	134	136				
4	4	507					



Glancaster Rd



Peds Cross: \times
West Peds: 0
West Entering: 515
West Leg Total: 735

Cars	199
Trucks	1
Heavys	2
Totals	202



Cars	63	32	95
Trucks	3	0	3
Heavys	1	0	1
Totals	67	32	

Peds Cross: \times
South Peds: 0
South Entering: 99
South Leg Total: 301

Comments

Glancaster Rd @ Dickenson Rd

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 8:00:00

To: 9:00:00

Municipality: Hamilton
Site #: 0000000005
Intersection: Glancaster Rd & Dickenson Rd W
TFR File #: 5
Count date: 25-Oct-2023

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

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

Major Road: Glancaster Rd runs N/S

North Leg Total: 184
 North Entering: 87
 North Peds: 0
 Peds Cross: \times

Heavys	2	1	3
Trucks	0	2	2
Cars	6	76	82
Totals	8	79	

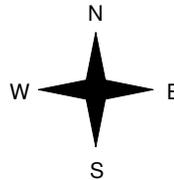


Heavys	4
Trucks	0
Cars	93
Totals	97

East Leg Total: 179
 East Entering: 91
 East Peds: 0
 Peds Cross: \times



Glancaster Rd



	Cars	Trucks	Heavys	Totals
	85	0	4	89
	2	0	0	2
	87	0	4	

Dickenson Rd W



Cars	Trucks	Heavys	Totals
83	2	3	88

Cars	8	Cars	8	7	15
Trucks	0	Trucks	0	0	0
Heavys	2	Heavys	0	2	2
Totals	10	Totals	8	9	



Glancaster Rd

Peds Cross: \times
 South Peds: 0
 South Entering: 17
 South Leg Total: 27

Comments

Glancaster Rd @ Dickenson Rd

Afternoon Peak Diagram

Specified Period

From: 16:00:00

To: 18:00:00

One Hour Peak

From: 17:00:00

To: 18:00:00

Municipality: Hamilton
Site #: 0000000005
Intersection: Glancaster Rd & Dickenson Rd W
TFR File #: 5
Count date: 25-Oct-2023

Weather conditions:

Clear/Dry

Person(s) who counted:

Cam

** Non-Signalized Intersection **

Major Road: Glancaster Rd runs N/S

North Leg Total: 284
 North Entering: 192
 North Peds: 0
 Peds Cross: \times

Heavys	0	3	3
Trucks	0	1	1
Cars	12	176	188
Totals	12	180	

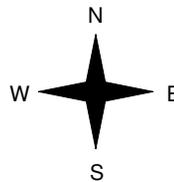


Heavys	1
Trucks	0
Cars	91
Totals	92

East Leg Total: 277
 East Entering: 91
 East Peds: 0
 Peds Cross: \times



Glancaster Rd



	Cars	Trucks	Heavys	Totals
	84	0	1	85
	6	0	0	6
	90	0	1	

Dickenson Rd W



	Cars	Trucks	Heavys	Totals
	182	1	3	186

Cars	18
Trucks	0
Heavys	0
Totals	18



Glancaster Rd

Cars	7	6	13
Trucks	0	0	0
Heavys	0	0	0
Totals	7	6	

Peds Cross: \times
 South Peds: 1
 South Entering: 13
 South Leg Total: 31

Comments

Glancaster Rd @ Twenty Rd

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 8:00:00

To: 9:00:00

Municipality: Hamilton
Site #: 000000007
Intersection: Glancaster Rd & Twenty Rd W
TFR File #: 7
Count date: 25-Oct-2023

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

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

Major Road: Glancaster Rd runs N/S

North Leg Total: 349
 North Entering: 136
 North Peds: 0
 Peds Cross: \times

Heavys	1	0	1
Trucks	0	1	1
Cars	63	71	134
Totals	64	72	

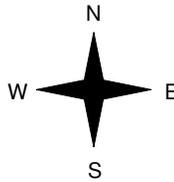


Heavys	13
Trucks	3
Cars	197
Totals	213

East Leg Total: 434
 East Entering: 227
 East Peds: 3
 Peds Cross: \times



Glancaster Rd



	Cars	Trucks	Heavys	Totals
	87	3	4	94
	126	3	4	133
	213	6	8	

Twenty Rd W



	Cars	Trucks	Heavys	Totals
	201	3	3	207

Cars	189
Trucks	3
Heavys	5
Totals	197



Glancaster Rd

Cars	110	130	240
Trucks	0	2	2
Heavys	9	3	12
Totals	119	135	

Peds Cross: \times
 South Peds: 0
 South Entering: 254
 South Leg Total: 451

Comments

Glancaster Rd @ Twenty Rd

Afternoon Peak Diagram

Specified Period

From: 16:00:00

To: 18:00:00

One Hour Peak

From: 16:30:00

To: 17:30:00

Municipality: Hamilton
Site #: 000000007
Intersection: Glancaster Rd & Twenty Rd W
TFR File #: 7
Count date: 25-Oct-2023

Weather conditions:

Clear/Dry

Person(s) who counted:

Cam

** Non-Signalized Intersection **

Major Road: Glancaster Rd runs N/S

North Leg Total: 432
 North Entering: 218
 North Peds: 0
 Peds Cross: \times

Heavys	6	1	7
Trucks	1	3	4
Cars	97	110	207
Totals	104	114	

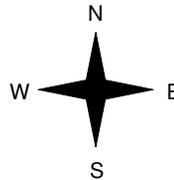


Heavys	2
Trucks	1
Cars	211
Totals	214

East Leg Total: 684
 East Entering: 271
 East Peds: 1
 Peds Cross: \times



Glancaster Rd



	Cars	Trucks	Heavys	Totals
Upward arrow	108	0	0	108
Downward arrow	154	3	6	163
Totals	262	3	6	

Twenty Rd W



	Cars	Trucks	Heavys	Totals
Rightward arrow	405	3	5	413

Cars	251	Cars	103	295	398
Trucks	4	Trucks	1	0	1
Heavys	12	Heavys	2	4	6
Totals	267	Totals	106	299	



Glancaster Rd



Peds Cross: \times
 South Peds: 0
 South Entering: 405
 South Leg Total: 672

Comments

Twenty Rd @ Garth St

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 8:00:00

To: 9:00:00

Municipality: Hamilton
Site #: 000000009
Intersection: Twenty Rd W & Garth St
TFR File #: 9
Count date: 25-Oct-2023

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

**** Signalized Intersection ****

Major Road: Twenty Rd W runs W/E

North Leg Total: 479

North Entering: 183

North Peds: 2

Peds Cross: \times

Heavys	8	3	11
Trucks	0	1	1
Cars	58	113	171
Totals	66	117	



Heavys 5

Trucks 3

Cars 288

Totals 296

East Leg Total: 629

East Entering: 374

East Peds: 0

Peds Cross: \times

Heavys	Trucks	Cars	Totals
12	5	243	260



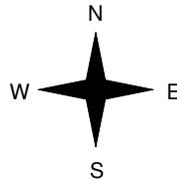
Garth St



Cars	Trucks	Heavys	Totals
175	1	4	180
185	5	4	194
360	6	8	



Twenty Rd W



Twenty Rd W



Heavys	Trucks	Cars	Totals
1	2	113	116
3	1	134	138
4	3	247	



Cars	Trucks	Heavys	Totals
247	2	6	255

Peds Cross: \times

West Peds: 0

West Entering: 254

West Leg Total: 514

Comments

Twenty Rd @ Garth St

Afternoon Peak Diagram

Specified Period

From: 16:00:00

To: 18:00:00

One Hour Peak

From: 16:30:00

To: 17:30:00

Municipality: Hamilton
Site #: 000000009
Intersection: Twenty Rd W & Garth St
TFR File #: 9
Count date: 25-Oct-2023

Weather conditions:

Clear/Dry

Person(s) who counted:

Cam

** Signalized Intersection **

Major Road: Twenty Rd W runs W/E

North Leg Total: 648

North Entering: 288

North Peds: 6

Peds Cross: \times

Heavys	3	2	5
Trucks	2	3	5
Cars	93	185	278
Totals	98	190	



Heavys 5

Trucks 1

Cars 354

Totals 360

East Leg Total: 873

East Entering: 413

East Peds: 0

Peds Cross: \times

Heavys	Trucks	Cars	Totals
7	4	310	321



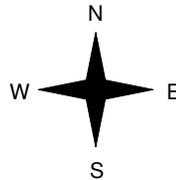
Garth St



Cars	Trucks	Heavys	Totals
187	0	3	190
217	2	4	223
404	2	7	



Twenty Rd W



Heavys	Trucks	Cars	Totals
2	1	167	170
4	2	264	270
6	3	431	



Twenty Rd W



Cars	Trucks	Heavys	Totals
449	5	6	460

Peds Cross: \times

West Peds: 0

West Entering: 440

West Leg Total: 761

Comments

Twenty Rd @ Silverbirch Blvd

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 7:30:00

To: 8:30:00

Municipality: Hamilton
Site #: 000000008
Intersection: Twenty Rd W & Silverbirch Blvd
TFR File #: 8
Count date: 25-Oct-2023

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

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

Major Road: Twenty Rd W runs W/E

North Leg Total: 99

North Entering: 71

North Peds: 0

Peds Cross: \times

Heavys	0	1	1
Trucks	0	0	0
Cars	16	54	70
Totals	16	55	



Heavys 1

Trucks 1

Cars 26

Totals 28

East Leg Total: 504

East Entering: 234

East Peds: 0

Peds Cross: \times

Heavys	Trucks	Cars	Totals
7	2	227	236



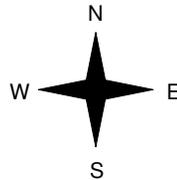
Silverbirch Blvd



Cars	Trucks	Heavys	Totals
13	0	1	14
211	2	7	220
224	2	8	



Twenty Rd W



Heavys	Trucks	Cars	Totals
0	1	13	14
6	4	205	215
6	5	218	



Twenty Rd W



Cars	Trucks	Heavys	Totals
259	4	7	270

Peds Cross: \times

West Peds: 0

West Entering: 229

West Leg Total: 465

Comments

Twenty Rd @ Silverbirch Blvd

Afternoon Peak Diagram

Specified Period

From: 16:00:00

To: 18:00:00

One Hour Peak

From: 16:30:00

To: 17:30:00

Municipality: Hamilton
Site #: 000000008
Intersection: Twenty Rd W & Silverbirch Blvd
TFR File #: 8
Count date: 25-Oct-2023

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

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

Major Road: Twenty Rd W runs W/E

North Leg Total: 126
 North Entering: 53
 North Peds: 0
 Peds Cross: \times

Heavys	0	1	1
Trucks	0	1	1
Cars	15	36	51
Totals	15	38	



Heavys	1
Trucks	1
Cars	71
Totals	73

East Leg Total: 750
 East Entering: 316
 East Peds: 0
 Peds Cross: \times

Heavys	Trucks	Cars	Totals
6	3	272	281



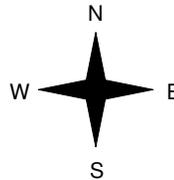
Silverbirch Blvd



Cars	Trucks	Heavys	Totals
48	1	1	50
257	3	6	266
305	4	7	



Twenty Rd W



Heavys	Trucks	Cars	Totals
0	0	23	23
5	3	388	396
5	3	411	



Twenty Rd W



Cars	Trucks	Heavys	Totals
424	4	6	434

Peds Cross: \times
 West Peds: 0
 West Entering: 419
 West Leg Total: 700

Comments

Twenty Rd @ Twentyplace Blvd

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 8:00:00

To: 9:00:00

Municipality: Hamilton
Site #: 000000010
Intersection: Twenty Rd W & Twentyplace Blvd
TFR File #: 10
Count date: 25-Oct-2023

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

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

Major Road: Twenty Rd W runs W/E

North Leg Total: 61

North Entering: 46

North Peds: 2

Peds Cross: \times

Heavys	0	0	0
Trucks	0	0	0
Cars	26	20	46
Totals	26	20	



Heavys 0

Trucks 0

Cars 15

Totals 15

East Leg Total: 619

East Entering: 351

East Peds: 0

Peds Cross: \times

Heavys	Trucks	Cars	Totals
6	6	358	370



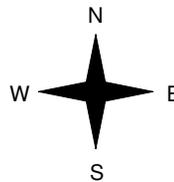
Twentyplace Blvd



Cars	Trucks	Heavys	Totals
7	0	0	7
332	6	6	344
339	6	6	



Twenty Rd W



Heavys	Trucks	Cars	Totals
0	0	8	8
6	2	240	248
6	2	248	



Twenty Rd W



Cars	Trucks	Heavys	Totals
260	2	6	268

Peds Cross: \times

West Peds: 0

West Entering: 256

West Leg Total: 626

Comments

Twenty Rd @ Twentyplace Blvd

Afternoon Peak Diagram

Specified Period

From: 16:00:00

To: 18:00:00

One Hour Peak

From: 16:45:00

To: 17:45:00

Municipality: Hamilton
Site #: 000000010
Intersection: Twenty Rd W & Twentyplace Blvd
TFR File #: 10
Count date: 25-Oct-2023

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

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

Major Road: Twenty Rd W runs W/E

North Leg Total: 97

North Entering: 33

North Peds: 1

Peds Cross: \times

Heavys	0	0	0
Trucks	0	0	0
Cars	18	15	33
Totals	18	15	



Heavys 0

Trucks 1

Cars 63

Totals 64

East Leg Total: 864

East Entering: 413

East Peds: 0

Peds Cross: \times

Heavys	Trucks	Cars	Totals
4	3	396	403



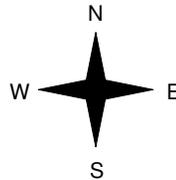
Twentyplace Blvd



Cars	Trucks	Heavys	Totals
28	0	0	28
378	3	4	385
406	3	4	



Twenty Rd W



Heavys	Trucks	Cars	Totals
0	1	35	36
5	4	427	436
5	5	462	



Twenty Rd W



Cars	Trucks	Heavys	Totals
442	4	5	451

Peds Cross: \times

West Peds: 1

West Entering: 472

West Leg Total: 875

Comments

Upper James St @ Dickenson Rd

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 7:15:00

To: 8:15:00

Municipality: Hamilton
Site #: 000000003
Intersection: Upper James St & Dickenson Rd
TFR File #: 3
Count date: 25-Oct-2023

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

**** Signalized Intersection ****

Major Road: Upper James St runs N/S

North Leg Total: 1869
 North Entering: 719
 North Peds: 0
 Peds Cross: \times

Heavys	6	51	0	57
Trucks	0	7	1	8
Cars	38	611	5	654
Totals	44	669	6	



Heavys	49
Trucks	9
Cars	1092
Totals	1150

East Leg Total: 58
 East Entering: 43
 East Peds: 0
 Peds Cross: \times

Heavys	Trucks	Cars	Totals
10	0	87	97

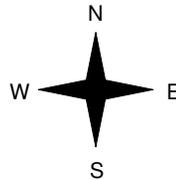


Upper James St

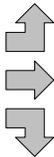
Cars	Trucks	Heavys	Totals
21	0	5	26
11	0	1	12
5	0	0	5
37	0	6	



Dickenson Rd W



Heavys	Trucks	Cars	Totals
15	2	28	45
1	0	0	1
6	1	30	37
22	3	58	



Dickenson Rd E



Cars	Trucks	Heavys	Totals
10	1	4	15

Peds Cross: \times
 West Peds: 0
 West Entering: 83
 West Leg Total: 180

Cars	646	Cars	38	1043	5	1086
Trucks	8	Trucks	0	7	0	7
Heavys	57	Heavys	3	29	3	35
Totals	711	Totals	41	1079	8	



Peds Cross: \times
 South Peds: 1
 South Entering: 1128
 South Leg Total: 1839

Comments

Upper James St @ Dickenson Rd

Afternoon Peak Diagram

Specified Period

From: 16:00:00

To: 18:00:00

One Hour Peak

From: 16:45:00

To: 17:45:00

Municipality: Hamilton
Site #: 000000003
Intersection: Upper James St & Dickenson Rd
TFR File #: 3
Count date: 25-Oct-2023

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

**** Signalized Intersection ****

Major Road: Upper James St runs N/S

North Leg Total: 2398
 North Entering: 1208
 North Peds: 0
 Peds Cross: \times

Heavys	7	18	0	25
Trucks	1	12	0	13
Cars	27	1125	18	1170
Totals	35	1155	18	



Heavys	33
Trucks	9
Cars	1148
Totals	1190

East Leg Total: 62
 East Entering: 29
 East Peds: 0
 Peds Cross: \times

Heavys	Trucks	Cars	Totals
7	1	72	80



Upper James St

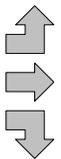
Cars	Trucks	Heavys	Totals
14	0	0	14
9	0	0	9
5	0	1	6
28	0	1	



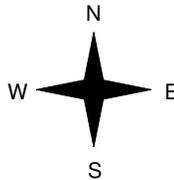
Dickenson Rd E



Heavys	Trucks	Cars	Totals
10	2	70	82
0	0	6	6
1	0	61	62
11	2	137	



Dickenson Rd W



Upper James St



Cars	Trucks	Heavys	Totals
33	0	0	33

Peds Cross: \times
 West Peds: 0
 West Entering: 150
 West Leg Total: 230

Cars	1191	Cars	36	1064	9	1109
Trucks	12	Trucks	0	7	0	7
Heavys	20	Heavys	0	23	0	23
Totals	1223	Totals	36	1094	9	



Peds Cross: \times
 South Peds: 0
 South Entering: 1139
 South Leg Total: 2362

Comments

Upper James St @ Talbot Ln

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 7:15:00

To: 8:15:00

Municipality: Hamilton
Site #: 000000002
Intersection: Upper James St & Talbot Ln
TFR File #: 2
Count date: 25-Oct-2023

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

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

Major Road: Upper James St runs N/S

North Leg Total: 1944
 North Entering: 730
 North Peds: 0
 Peds Cross: ∇

Heavys	1	57	58
Trucks	0	7	7
Cars	0	665	665
Totals	1	729	665

Heavys	54
Trucks	14
Cars	1146
Totals	1214



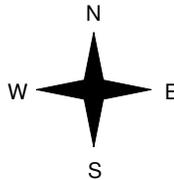
Heavys	Trucks	Cars	Totals
1	0	0	1



Upper James St



Talbot Ln



Heavys	Trucks	Cars	Totals
0	0	1	1
1	0	1	2
1	0	2	



Upper James St

Peds Cross: ∇
 West Peds: 0
 West Entering: 3
 West Leg Total: 4

Cars	666
Trucks	7
Heavys	58
Totals	731



Cars	0	1145	1145
Trucks	0	14	14
Heavys	0	54	54
Totals	0	1213	

Peds Cross: ∇
 South Peds: 0
 South Entering: 1213
 South Leg Total: 1944

Comments

Upper James St @ Talbot Ln

Afternoon Peak Diagram

Specified Period

From: 16:00:00

To: 18:00:00

One Hour Peak

From: 16:45:00

To: 17:45:00

Municipality: Hamilton
Site #: 000000002
Intersection: Upper James St & Talbot Ln
TFR File #: 2
Count date: 25-Oct-2023

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

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

Major Road: Upper James St runs N/S

North Leg Total: 2480
 North Entering: 1261
 North Peds: 0
 Peds Cross: ∇

Heavys	0	25	25
Trucks	0	13	13
Cars	4	1219	1223
Totals	4	1257	



Heavys	31
Trucks	14
Cars	1174
Totals	1219

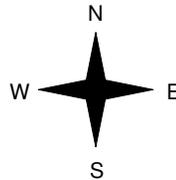
Heavys	Trucks	Cars	Totals
0	0	5	5



Upper James St



Talbot Ln



Heavys	Trucks	Cars	Totals
0	0	3	3
0	0	1	1
0	0	4	



Upper James St

Peds Cross: ∇
 West Peds: 0
 West Entering: 4
 West Leg Total: 9

Cars	1220
Trucks	13
Heavys	25
Totals	1258



Cars	1	1171	1172
Trucks	0	14	14
Heavys	0	31	31
Totals	1	1216	

Peds Cross: ∇
 South Peds: 0
 South Entering: 1217
 South Leg Total: 2475

Comments

Upper James St @ Twenty Rd

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 7:30:00

To: 8:30:00

Municipality: Hamilton
Site #: 000000001
Intersection: Upper James St & Twenty Rd
TFR File #: 1
Count date: 25-Oct-2023

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

**** Signalized Intersection ****

Major Road: Upper James St runs N/S

North Leg Total: 1849
 North Entering: 673
 North Peds: 2
 Peds Cross: \times

Heavys	0	49	1	50
Trucks	0	15	1	16
Cars	44	522	41	607
Totals	44	586	43	



Heavys	64
Trucks	22
Cars	1090
Totals	1176

East Leg Total: 561
 East Entering: 303
 East Peds: 1
 Peds Cross: \times

Heavys	Trucks	Cars	Totals
4	3	321	328

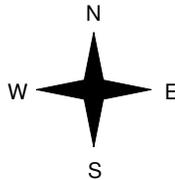


Upper James St

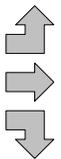
Cars	Trucks	Heavys	Totals
95	0	3	98
154	1	3	158
45	1	1	47
294	2	7	



Twenty Rd W



Heavys	Trucks	Cars	Totals
2	1	71	74
3	1	135	139
0	1	82	83
5	3	288	



Twenty Rd E



Cars	Trucks	Heavys	Totals
245	4	9	258

Peds Cross: \times
 West Peds: 0
 West Entering: 296
 West Leg Total: 624

Cars	649	Cars	123	924	69	1116
Trucks	17	Trucks	2	21	2	25
Heavys	50	Heavys	1	59	5	65
Totals	716	Totals	126	1004	76	



Peds Cross: \times
 South Peds: 1
 South Entering: 1206
 South Leg Total: 1922

Comments

Upper James St @ Twenty Rd

Afternoon Peak Diagram

Specified Period

From: 16:00:00

To: 18:00:00

One Hour Peak

From: 16:45:00

To: 17:45:00

Municipality: Hamilton
Site #: 000000001
Intersection: Upper James St & Twenty Rd
TFR File #: 1
Count date: 25-Oct-2023

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

**** Signalized Intersection ****

Major Road: Upper James St runs N/S

North Leg Total: 2368
 North Entering: 1261
 North Peds: 1
 Peds Cross: \times

Heavys	1	29	2	32
Trucks	1	11	0	12
Cars	86	1037	94	1217
Totals	88	1077	96	



Heavys	36
Trucks	10
Cars	1061
Totals	1107

East Leg Total: 835
 East Entering: 374
 East Peds: 1
 Peds Cross: \times

Heavys	Trucks	Cars	Totals
3	2	428	433

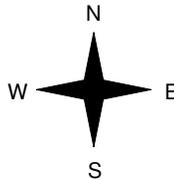


Upper James St

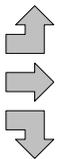
Cars	Trucks	Heavys	Totals
71	0	1	72
231	0	1	232
68	0	2	70
370	0	4	



Twenty Rd W



Heavys	Trucks	Cars	Totals
1	1	66	68
4	3	244	251
0	2	126	128
5	6	436	



Twenty Rd E



Peds Cross: \times
 West Peds: 0
 West Entering: 447
 West Leg Total: 880

Cars	1231	Cars	111	924	112	1147
Trucks	13	Trucks	1	9	1	11
Heavys	31	Heavys	1	34	1	36
Totals	1275	Totals	113	967	114	



Upper James St

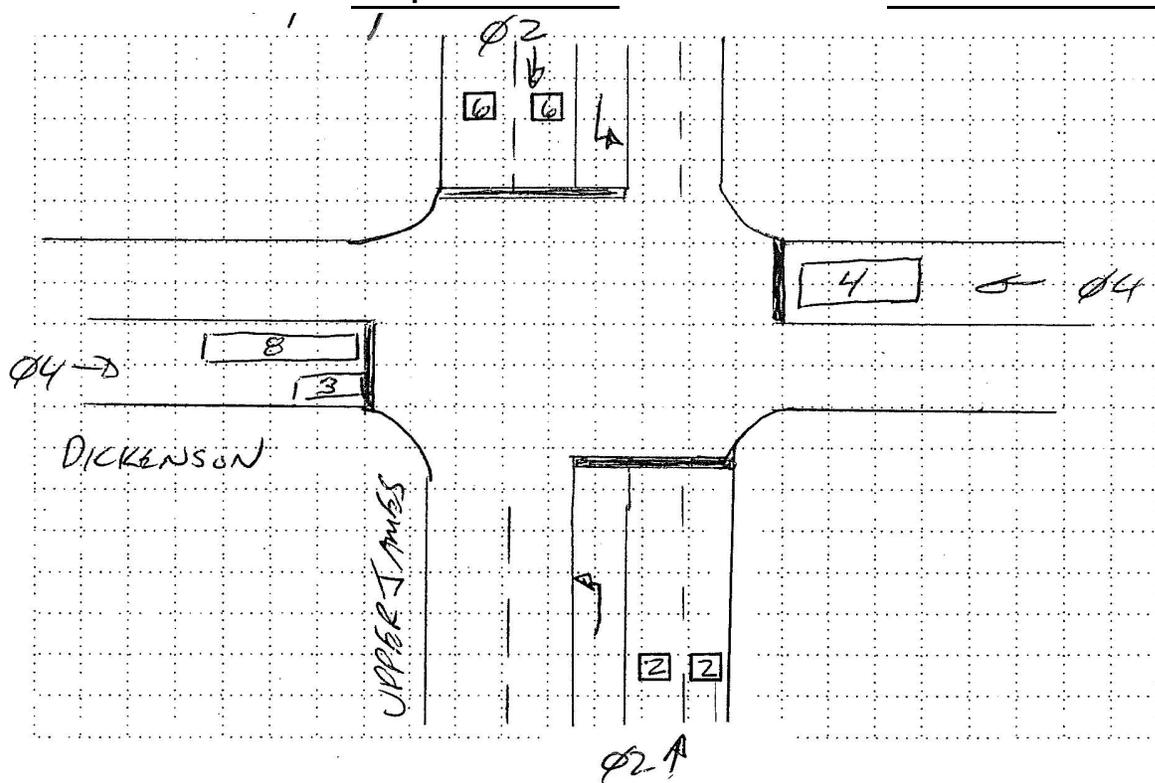


Peds Cross: \times
 South Peds: 1
 South Entering: 1194
 South Leg Total: 2469

Comments

City of Hamilton - Traffic Traffic Signal Controller Timing Data

Intersection ID: <u>535</u>	Page <u>1</u> of <u>15</u>
Intersection: <u>Upper James St at Dickenson Rd</u>	
Cabinet Type: <u>TS1</u>	Timing Revision: <u>22-09-S</u>
Controller Type: <u>Intelight TS2-T2</u>	FW Revision: <u>D4-11312</u>
Prepared |Checked By: <u>MC</u> | <u>BL</u>	Installed By: _____
Prepared Date: <u>27-Sep-22</u>	Install Date: <u>27-Sep-22</u>
Reason for Timing Change: <u>Min Green and Veh Ext time reduction for main st</u>	
Communication: <u>Radio</u>	System: <u>KITS</u>
Operation Type: <u>Semi-Actuated</u>	UPS: <u>None</u>
Pedestrian Detection: <u>Bulldog</u>	RLC: <u>None</u>
Vehicle Detection: <u>Loops</u>	IP Address: <u>10.240.140.23</u>



- φ1:
- φ2: **Upper James - NB/SB**
- φ3:
- φ4: **Dickenson - EB/WB**
- φ5:
- φ6:
- φ7:
- φ8:

Flash Operation: Red/Red

Phase Timings (D-1-1)

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MinGrn		55		10												
VExt		5.7		3.0												
Max 1																
Max 2																
Max 3																
MaxExt																
Yel		4.6		3.7												
RedClr		1.7		2.5												
RedHld																
AdvFls																
BikeMG																
Walk		15		7												
PedClr		12		22												
Walk2																
DWHld																
ElyWik																
DlyWik																
Added																
MaxInt																
MinGap																
RedAft																
TTRed																
CSMin																
CSMax																
Red Rvt																
NegPed																
APDisc																
PmtGrn																
PmtWik																
PmtPC																
RtnGrn																

Phase Options (D-1-2)

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Min Recall																
Max Recall																
Ped Recall		2														
Soft Recall																
Dual Entry																
Red Rest																
Walk Rest		2														
Walk Expand																
Ped Recycle																
Sim PedTerm																
PC Thru Clr																
Guar Passage																
No Sim Gap																
Yel Lock																
Red Lock																
PhsNxt Lock	1	2	3	4	5	6	7	8								
No Trm Call	1	2	3	4	5	6	7	8								
Cond Srv																
Cond Srv Ena																
Cond Resrv																
Reservice																
Veh Omit																
Ped Omit																
Perm Phase		2		4		6		8								
Prot Call																
Prot Call2																
Flsh Entry																
Flsh Exit																
Flsh Exit Yel																

Dickenson @ Upper James D4- Mar 2023.xlsx

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Flsh Exit Red																
Ped Scrambl																
No Min Yel																
No Min Rev																
Max Scram Wik																
Flash Yel																
CNA1																
CNA2																
Free WRst Inh																
Flash FYA																
FYA Omit																
FYA Adapt																
FYA Red Rest																

Phase Startup Options (D-1-3 -1)

Strtup Flash	10
Mode	Yel->Red
Strtup Red	5
Yel	0.0
ExtStr Flash	No
CVM Flash	Yes

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Start Phs				4												
Start Yel																
Start Red				4												
Start NoWik																
Start Next																
No Veh Call																
No Ped Call																
Start YFIs																
Start FYA																

Phase Startup Timings (D-1-3-2)

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Start Walk																
MinGrn																
MaxGrn																

Conflicting Phases (D-1-4)

Conf Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Phase 1																
Phase 2																
Phase 3																
Phase 4																
Phase 5																
Phase 6																
Phase 7																
Phase 8																

Ring Group Assign (D-1-5-1)

Ring 1	1
Ring 2	1
Ring 3	Off
Ring 4	Off

Ring Group 1 (D-1-5-2)

Barriers	.	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.
Ring 1		2		4												
Ring 2																

Set Ring Config (D-1-5-4)

Yes

Ring configuraion changes must be set to become active

Coordination Options (D-3-1)

Sync Time	00:00															
RTC Set	00:00															
Trans Mode	Best 2															
Ped Adjust	None															
Trans Short	15															
Trans Long	25															
Offset Ref	LagFO															
Short Cyc	0															
Dual Entry	Normal															
Olap F/O	Disabled															
Sync Mode	RTC															
Sync Length	0															
Adapt Thresh	0															
Adapt Step	0															
Ext Plan Max	0															
Hardwire No Match	Sched															
Sync Fail	0															
Ovr Omit/Recall	No															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
No Trans Recall																
Trans Ped Call																
Trans Phases																

I/O Interface (D-6-3)

Type	TS1-2B
MMU Disable	No
Det BIU 1	Auto
Det BIU 2	Auto
Det BIU 3	Auto
Det BIU 4	Auto

Set New Cabinet (D-6-4)

Yes

Cabinet changes must be set to become active

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 2

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases		2														
Yellow Lock Phases																
Red Lock Phases																
Extend Phases		2														
XSwitch Phases																
Bike Call Phases																
Call Overlaps																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 2

Delay	0.0
Extend	0.0
Delay 2	0.0
Carryover	0
Queue Lmt	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0
Det Link	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 3

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases				4												
Yellow Lock Phases																
Red Lock Phases																
Extend Phases				4												
XSwitch Phases																
Bike Call Phases																
Call Overlaps																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 3

Delay	10.0
Extend	0.0
Delay 2	0.0
Carryover	0
Queue Lmt	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0
Det Link	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 4

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases				4												
Yellow Lock Phases																
Red Lock Phases																
Extend Phases				4												
XSwitch Phases																
Bike Call Phases																
Call Overlaps																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 4

Delay	5.0
Extend	0.0
Delay 2	0.0
Carryover	0
Queue Lmt	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0
Det Link	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 5

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases																
Yellow Lock Phases																
Red Lock Phases																
Extend Phases																
XSwitch Phases																
Bike Call Phases																
Call Overlaps																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 5

Delay	0.0
Extend	0.0
Delay 2	0.0
Carryover	0
Queue Lmt	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0
Det Link	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 6

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases		2														
Yellow Lock Phases																
Red Lock Phases																
Extend Phases		2														
XSwitch Phases																
Bike Call Phases																
Call Overlaps																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 6

Delay	0.0
Extend	0.0
Delay 2	0.0
Carryover	0
Queue Lmt	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0
Det Link	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 7

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases																
Yellow Lock Phases																
Red Lock Phases																
Extend Phases																
XSwitch Phases																
Bike Call Phases																
Call Overlaps																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 7

Delay	0.0
Extend	0.0
Delay 2	0.0
Carryover	0
Queue Lmt	0.0
Max Pres	60.0
No Act	240
Erratic	0
Fail Time	0
Det Link	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 8

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases				4												
Yellow Lock Phases																
Red Lock Phases																
Extend Phases				4												
XSwitch Phases																
Bike Call Phases																
Call Overlaps																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 8

Delay	5.0
Extend	0.0
Delay 2	0.0
Carryover	0
Queue Lmt	0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0
Det Link	0

Pedestrian Detectors (D-7-3+)

Pedestrian Detector 4

Phases/Overlaps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Peds				4												
Call Olap Peds																
Call Phases																
Locked Call Phs																
Ped Entry																
Olap Ped Entry																
Ped Cascade																
Call Walk2																
No Act	0															
Max Pres	0															
Erratic	0															
Fail Mode	None															

Serial Port 1 (D-A-1)

Serial Port 1	4						
Baud Rate	38400	8N1		RTS On	0	RTS Off	0
Broadcst Pln/Syn	Disabled		Time	0:00			
Serial Rebroad	Dis		Response	None			

Serial Port 2 (D-A-2)

Serial Port 2	0						
Baud Rate	4800	8N1		RTS On	0	RTS Off	0
Broadcst Pln/Syn	Disabled		Time	0:00			

Ethernet Config (D-A-3)

IP Address	10	240	140	23	Port	161
Netmask	255	255	255	0	Mode	Host
Gateway	10	240	140	1		
Broadcast Address	0	0	0	0		
Broadcast Port	0		Time Port	0		
Broadcst Pln/Syn	Disabled		Time	0:00		
Serial Rebroad	Dis		Response	Time/Plan		
Gateway 2	0	0	0	0		
Gateway 3	0	0	0	0		
Gateway 4	0	0	0	0		

General Comm Config (D-A-4)

Database ID#	535		
Cont Address	1	Timeout	0
Peer Address	0	Timeout	0
Remote Calls	Dis		
Remote Preempt	Dis		
Remote Soft Preempt	Dis		
Remote Priority	Dis		
Remote MCE	Dis	MCE Max	0

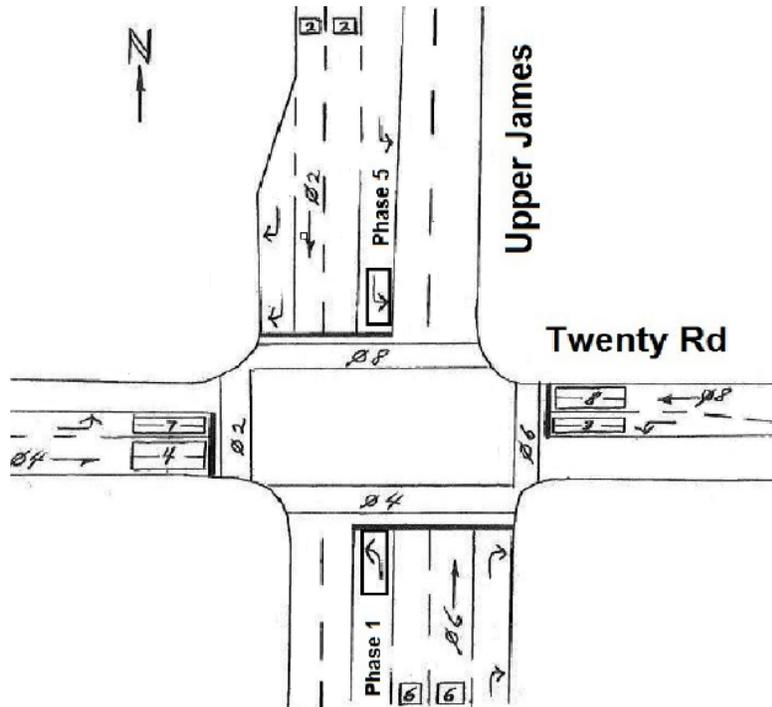
Logging (D-B)

VO Period	0
Power On	Enabled
Ext Start	Enabled
Man Control	Enabled
Cabinet Door	Enabled
MMU Faults	Enabled
BIU Faults	Enabled
Det Faults	Enabled
Coordination	Enabled
Preempt	Enabled
Soft Preempt	Disabled
Zone	Disabled
Speed Traps	Disabled

**City of Hamilton - Traffic
Traffic Signal Controller Timing Data**

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Intersection ID: <u>495</u>	Timing Revision: <u>21-01-D</u>
Intersection: <u>Upper James and Twenty Rd</u>	
Controller Type: <u>Intelight TS2-T2</u>	FW Revision: <u>D4-10032</u>
Prepared |Checked By: <u>MF</u>	Installed By: <u>MF</u>
Prepared Date: <u>22-Oct-21</u>	Install Date: <u>October 22, 2021</u>
Reason for Timing Change: <u>Reversed construction timing</u>	
Communication: <u>Radio</u>	System: <u>KITS</u>
Operation Type: <u>Fully Actuated</u>	UPS: <u>None</u>
Pedestrian Detection: _____	RLC: _____
Vehicle Detection: <u>Loops</u>	IP Address: <u>10.240.140.33</u>



- φ1: Upper James - NBLT
- φ2: Upper James - SB, West Xwalk
- φ3:
- φ4: Twenty - EB, South Xwalk
- φ5: Upper James - SBLT
- φ6: Upper James - NB, East Xwalk
- φ7:
- φ8: Twenty - WB, North Xwalk

Flash Operation: Red/Red

Phase Timings (D-1-1)

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MinGrn	5	45		10	5	45		10								
VExt	1.0	6.5		3.0	1.0	6.5		3.0								
Max 1	10	15		30	10	15		30								
Max 2	10	25		30	10	25		30								
Max 3																
MaxExt																
Yel	3.0	4.2		3.3	3.0	4.2		3.3								
RedClr		1.9		3.5		1.9		3.5								
AdvFls																
BikeMG																
Walk		18		10		18		10								
PedClr		11		18		11		18								
Walk2																
SolDW																
ElyWlk																
DlyWlk																
Added																
MaxInt																
MinGap																
RedAft																
TTRed																
CSMin																
CSMax																
Red Rvt	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0								
NegPed																
APDisc																
PmtGrn																
PmtWlk																
PmtPC																
RtnGrn																

Phase Options (D-1-2)

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Min Rec		2				6										
Max Rec																
Ped Rec		2				6										
Soft Rec																
Dual Ent		2		4		6		8								
Red Rest																
Walk Rest																
Walk Expand		2				6										
Ped Recycle																
SimPedTerm																
PC Thru Clr																
Guar Psg																
No Sim Gap	1			4	5			8								
Yel Lock																
Red Lock																
PhsNxt Lock	1	2	3	4	5	6	7	8								
No Trm Call	1	2	3	4	5	6	7	8								
Cond Srv																
CS Ena																
Cond Resrv																
Reservice																
SecMinRcl																
SecMaxRcl																
Veh Omit																
Ped Omit																
Perm Phase		2		4		6		8								
Prot Call																
Prot Call2																
FlshEntry																
FlshExit																
FlshExit Yel																

Twenty Rd at Upper James - 2021 Oct

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FlshExit Red																
PedScrambl																
No Min Yel																
No Min Rev																
MaxScramWlk																
FlashYel																
FlashFYA																
CNA1																
CNA2																

Phase Startup Options (D-1-3 -1)

Strtup Flash	10
Mode	Yel->Red
Strtup Red	5
Yel	0.0

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Start Phs	1				5											
Start Yel																
Start Red																
Start NoWlk																
Start Next																
Start YFls																
Start FYA																
No Veh Call																
No Ped Call																

Phase Startup Timings (D-1-3-2)

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Start Walk																
MinGrn																
MaxGrn																

Conflicting Phases (D-1-4)

Conf Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Phase 1																
Phase 2																
Phase 3																
Phase 4																
Phase 5																
Phase 6																
Phase 7																
Phase 8																
Phase 9																
Phase 10																
Phase 11																
Phase 12																
Phase 13																
Phase 14																
Phase 15																
Phase 16																

Ring Sequence (D-1-5-1)

Ring 1	1
Ring 2	1
Ring 3	Off
Ring 4	Off

Ringgroup 1 (D-1-5-2)

Barriers	.	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.
Ring 1	1	2	0	4												
Ring 2	5	6	0	8												

Set Ring Config (D-1-5-4)

Yes

Ring configuraion changes must be set to become active

MCE Options (D-1-6)

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MCE Ped Prot		2		4		6		8								
MCE Call	1	2	3	4	5	6	7	8								
MCE Ped Call		2		4		6		8								
MCE Omit																
MCE Ped Omit																
MCE Veh Sync		2		4		6		8								
MCE Ped Sync		2		4		6		8								
MCE Halt DW																
LRV Phases	1	2	3	4	5	6	7	8								
MCE LRVTrmEly																

Custom Sequences (D-1-7)

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Seq 1																
Seq 2																
Seq 3																
Seq 4																
Seq 5																
Seq 6																
Seq 7																
Seq 8																

Unit (D-1-8)

Red Revert	4.0
Ped Protect	No
AdvFls in Flash	No

I/O Interface (D-6-3)

Type	TS2-Type2
MMU Disable	Yes

Set New Cabinet (D-6-4)

Yes

Cabinet changes must be set to become active

MMU Compatibility (D-6-9)

Channels	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MMUIgnore																

TS2 Detector Fail (D-6-A)

Channels	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
BIU 1-No Fail Call																
BIU 2-No Fail Call																

I/O Logic (D-6-7)

Phase	Func1	Idx	Oper	Func2	Idx	Out1	Inx1	Out2	Inx2	Dly	Ext	Trig	Fls
Chan 1	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 2	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 3	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 4	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 5	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 6	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 7	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 8	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 9	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 10	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 11	None	0	Or	None	0	None	0	None	0	0	0	No	No
Chan 12	None	0	Or	None	0	None	0	None	0	0	0	No	No

Twenty Rd at Upper James - 2021 Oct

TOD Patterns (D-5-1)

	Time	DOW							Holidays							Mode	Pattern	Offset	
		S	M	T	W	T	F	S											
Event 1	00:00	S															Sched	1	1
Event 2	00:00																Sched		
Event 3	00:00																Sched		
Event 4	00:00																Sched		
Event 5	00:00																Sched		
Event 6	00:00																Sched		
Event 7	00:00																Sched		
Event 8	00:00																Sched		
Event 9	00:00																Sched		
Event 10	00:00																Sched		
Event 11	00:00																Sched		
Event 12	00:00																Sched		
Event 13	00:00																Sched		
Event 14	00:00																Sched		
Event 15	00:00																Sched		
Event 16	00:00																Sched		
Event 17	00:00																Sched		
Event 18	00:00																Sched		
Event 19	00:00																Sched		
Event 20	00:00																Sched		
Event 21	00:00																Sched		
Event 22	00:00																Sched		
Event 23	00:00																Sched		
Event 24	00:00																Sched		
Event 25	00:00																Sched		
Event 26	00:00																Sched		
Event 27	00:00																Sched		
Event 28	00:00																Sched		
Event 29	00:00																Sched		
Event 30	00:00																Sched		
Event 31	00:00																Sched		
Event 32	00:00																Sched		

Vehicle Detectors (D-7-1-1)

Vehicle Detector 1

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases	1															
Yellow Lock Phases																
Red Lock Phases																
Extend Phases	1															
XSwitch Phases						6										
Bike Call Phases																

Vehicle Detectors (D-7-2-1)

Vehicle Detector 1

Delay	0.0
Extend	0.0
Carryover	0.0
Queue Lmt	0
Delay 2	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 2

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases		2														
Yellow Lock Phases																
Red Lock Phases																
Extend Phases		2														
XSwitch Phases																
Bike Call Phases																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 2

Delay	0.0
Extend	0.0
Carryover	0.0
Queue Lmt	0
Delay 2	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 3

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases								8								
Yellow Lock Phases																
Red Lock Phases																
Extend Phases								8								
XSwitch Phases																
Bike Call Phases																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 3

Delay	0.0
Extend	0.0
Carryover	0.0
Queue Lmt	0
Delay 2	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 4

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases				4												
Yellow Lock Phases																
Red Lock Phases																
Extend Phases				4												
XSwitch Phases																
Bike Call Phases																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 4

Delay	0.0
Extend	0.0
Carryover	0.0
Queue Lmt	0
Delay 2	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 5

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases					5											
Yellow Lock Phases																
Red Lock Phases																
Extend Phases					5											
XSwitch Phases		2														
Bike Call Phases																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 5

Delay	0.0
Extend	0.0
Carryover	0.0
Queue Lmt	0
Delay 2	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 6

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases						6										
Yellow Lock Phases																
Red Lock Phases																
Extend Phases						6										
XSwitch Phases																
Bike Call Phases																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 6

Delay	0.0
Extend	0.0
Carryover	0.0
Queue Lmt	0
Delay 2	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 7

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases				4												
Yellow Lock Phases																
Red Lock Phases																
Extend Phases				4												
XSwitch Phases																
Bike Call Phases																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 7

Delay	0.0
Extend	0.0
Carryover	0.0
Queue Lmt	0
Delay 2	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0

Vehicle Detectors (D-7-1-1+)

Vehicle Detector 8

Mode	No Disconnect															
Added	Dis															
Fail Mode	None															
System	Ena															
Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Phases								8								
Yellow Lock Phases																
Red Lock Phases																
Extend Phases								8								
XSwitch Phases																
Bike Call Phases																

Vehicle Detectors (D-7-2-1+)

Vehicle Detector 8

Delay	0.0
Extend	0.0
Carryover	0.0
Queue Lmt	0
Delay 2	0.0
Max Pres	60
No Act	240
Erratic	0
Fail Time	0

Pedestrian Detectors (D-7-3+)

Pedestrian Detector 2

Phases/Overlaps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Peds																
Call Olap Peds																
Call Phases																
Locked Call Phs																
Ped Entry																
Olap Ped Entry																
Ped Cascade																
Call Walk2																
No Act	0															
Max Pres	0															
Erratic	0															
Fail Mode	None															

Pedestrian Detectors (D-7-3+)

Pedestrian Detector 4

Phases/Overlaps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Peds				4				8								
Call Olap Peds																
Call Phases																
Locked Call Phs																
Ped Entry																
Olap Ped Entry																
Ped Cascade																
Call Walk2																
No Act	0															
Max Pres	0															
Erratic	0															
Fail Mode	None															

Pedestrian Detectors (D-7-3+)

Pedestrian Detector 6

Phases/Overlaps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Peds																
Call Olap Peds																
Call Phases																
Locked Call Phs																
Ped Entry																
Olap Ped Entry																
Ped Cascade																
Call Walk2																
No Act	0															
Max Pres	0															
Erratic	0															
Fail Mode	None															

Pedestrian Detectors (D-7-3+)

Pedestrian Detector 8

Phases/Overlaps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Call Peds				4				8								
Call Olap Peds																
Call Phases																
Locked Call Phs																
Ped Entry																
Olap Ped Entry																
Ped Cascade																
Call Walk2																
No Act	0															
Max Pres	0															
Erratic	0															
Fail Mode	None															

Logging (D-B)

VO Period	0
Power On	Enabled
Ext Start	Enabled
Man Control	Enabled
Cabinet Door	Enabled
MMU Faults	Enabled
BIU Faults	Enabled
Det Faults	Enabled
Coordination	Enabled
Preempt	Enabled
Soft Preempt	Disabled
Zone	Disabled
Speed Traps	Disabled

Serial Port 1 (D-A-1)

Serial Port 1	4						
Baud Rate	38400	8N1		RTS On	0	RTS Off	0
Broadcst Pln/Syn	Disabled		Time	0:00			
Serial Rebroad	Dis		Response	None			

Serial Port 2 (D-A-2)

Serial Port 2	0						
Baud Rate	4800	8N1		RTS On	0	RTS Off	0
Broadcst Pln/Syn	Disabled		Time	0:00			

Ethernet Config (D-A-3)

IP Address	10	240	140	33	Port	161
Netmask	255	255	255	0	Mode	Host
Gateway	10	240	140	1		
Broadcast Address	0	0	0	0		
Broadcast Port	0		Time Port	0		
Broadcst Pln/Syn	Disabled		Time	0:00		
Serial Rebroad	Dis		Response	Time/Plan		
Gateway 2	0	0	0	0		
Gateway 3	0	0	0	0		
Gateway 4	0	0	0	0		

General Comm Config (D-A-4)

Database ID#	495	Timeout	0
Cont Address	1	Timeout	0
Peer Address	0		
Remote Calls	Dis		
Remote Preempt	Dis		
Remote Soft Preempt	Dis		
Remote Priority	Dis		
Remote MCE	Dis	MCE Max	0

Control/Config (D-9)

Pattern Mode	Central															
Man Pattern	0															
Man Offset	0															
Stop Time	Ena															
Aux Switch	StopTm	5														
PWD Timeout	5															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Maint Phs Recall																
Maint Ped Recall																
	Used to place calls															

Data Key Transfer (D-9-NEXT)

4 read USB
5 write to USB

Autp Backup (D-9-NEXT-NEXT)

Auto Backup:	USB
Write Delay:	20

Set Time (D-5-4)

Time	00:00:00
Date	12/31/20
DLS	D4
Zone	Est
GPS Thresh	0

Press **Enter** after setting Time/Date - **ESC** sets time

TOD Functions (D-5-2)

Event 1

Time	06:30						
DOW							
Hol							

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MinRec																
MaxRec																
SoftRec																
PedRec																
OIPedRec																
MinRec																
MaxRec																
SoftRec																
PedRec																
OIPedRec																
PedRcy																
Max 2		2				6										
Max 3																
CondSrv																
PhsOmt																
PedOmt																
OlapOmt																
RedRst																
WalkRst																
AudPdDis																
SpFunc																
FYA Omit																
Pri Plan	0															
Rem PE Time	0															
Alt Det Sel	0															
Dis Det Diag	No															

TOD Functions (D-5-2+)

Event 2

Time	09:30						
DOW							
Hol							

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MinRec																
MaxRec																
SoftRec																
PedRec																
OIPedRec																
MinRec																
MaxRec																
SoftRec																
PedRec																
OIPedRec																
PedRcy																
Max 2																
Max 3																
CondSrv																
PhsOmt																
PedOmt																
OlapOmt																
RedRst																
WalkRst																
AudPdDis																
SpFunc																
FYA Omit																
Pri Plan	0															
Rem PE Time	0															
Alt Det Sel	0															
Dis Det Diag	No															

TOD Functions (D-5-2+)

Event 3

Time	15:30						
DOW							
Hol							

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MinRec																
MaxRec																
SoftRec																
PedRec																
OIPedRec																
MinRec																
MaxRec																
SoftRec																
PedRec																
OIPedRec																
PedRcy																
Max 2		2				6										
Max 3																
CondSrv																
PhsOmt																
PedOmt																
OlapOmt																
RedRst																
WalkRst																
AudPdDis																
SpFunc																
FYA Omit																
Pri Plan	0															
Rem PE Time	0															
Alt Det Sel	0															
Dis Det Diag	No															

TOD Functions (D-5-2+)

Event 4

Time	18:00						
DOW							
Hol							

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MinRec																
MaxRec																
SoftRec																
PedRec																
OIPedRec																
MinRec																
MaxRec																
SoftRec																
PedRec																
OIPedRec																
PedRcy																
Max 2		2				6										
Max 3																
CondSrv																
PhsOmt																
PedOmt																
OlapOmt																
RedRst																
WalkRst																
AudPdDis																
SpFunc																
FYA Omit																
Pri Plan	0															
Rem PE Time	0															
Alt Det Sel	0															
Dis Det Diag	No															

A Connector Outputs (D-6-1-1)

Chan	D	E	F	G	H	J	X	Y
Function	VehRed	VehRed	VehRed	DntWlk	PedClr	Walk	VehRed	VehRed
Index	1	0	2	2	2	2	0	0
Chan	Z	a	b	c	d	e	r	s
Function	VehYel	VehRed	VehYel	VehGrn	PhsChk	PhsOn	VehRed	VehGrn
Index	1	0	2	2	2	2	0	1
Chan	t	u	CC	DD				
Function	VehRed	PhsChk	VehRed	PhsOn				
Index	0	1	0	1				

B Connector Outputs (D-6-1-2)

Chan	A	C	D	E	F	G	H	J
Function	PhsNxt	PhsNxt	VehGrn	VehYel	VehRed	VehRed	PedClr	DntWlk
Index	1	2	3	3	3	4	4	4
Chan	K	Y	Z	a	b	c	d	e
Function	PhsChk	VehRed	VehRed	VehRed	VehGrn	VehYel	Walk	PhsOn
Index	4	0	0	0	4	4	4	4
Chan	f	p	q	r	s	t	u	w
Function	PhsNxt	OlpYel	OlpRed	PhsChk	PhsOn	PhsNxt	OlpRed	OlpGrn
Index	4	9	9	3	3	3	12	12
Chan	AA	BB	CC	DD	EE	FF	GG	HH
Function	VehGrn	OlpYel	OlpRed	OlpRed	OlpYel	OlpGrn	OlpGrn	OlpYel
Index	9	10	10	11	12	11	10	11

C Connector Outputs (D-6-1-3)

Chan	A	B	C	D	E	F	G	H
Function	VehRed	VehRed	DntWlk	VehRed	VehYel	VehRed	VehRed	VehRed
Index	0	0	8	8	7	7	6	5
Chan	J	K	L	M	N	c	d	e
Function	VehYel	VehRed	VehRed	PhsNxt	PhsOn	VehRed	Walk	VehYel
Index	5	0	0	5	5	0	8	8
Chan	f	g	h	i	j	k	w	x
Function	VehGrn	VehGrn	VehYel	VehGrn	VehRed	PhsChk	PedClr	VehGrn
Index	7	6	6	5	0	5	8	8
Chan	y	z	AA	BB	CC	DD	FF	GG
Function	VehRed	DntWlk	PedClr	PhsChk	PhsOn	PhsNxt	PhsChk	PhsOn
Index	0	6	6	6	6	6	8	8
Chan	HH	JJ	KK	LL	MM	NN	PP	
Function	PhsNxt	VehRed	VehRed	Walk	PhsChk	PhsOn	PhsNxt	
Index	8	0	0	6	7	7	7	

A Connector Inputs (D-6-2-1)

Chan	K	L	M	N	P	R	S	T
Function	VehDet	PedDet	VehDet	StopTm	MaxInh	ExtStr	IntAdv	None
Index	2	2	10	5	1	1	1	0
Chan	f	g	h	i	j	k	m	n
Function	VehDet	PedDet	VehDet	Force	MinRec	MCE	CNA	None
Index	1	1	9	1	1	1	1	0
Chan	q	v	w	x	y	z	AA	BB
Function	None	VehDet	OmtRed	RedRst	None	CNA	None	None
Index	0	26	1	1	0	2	0	0
Chan	EE	FF	GG	HH				
Function	VehDet	PedRcy	MaxII	None				

Twenty Rd at Upper James - 2021 Oct

Index	25	1	1	0				
-------	----	---	---	---	--	--	--	--

B Connector Inputs (D-6-2-2)

Chan	B	L	M	N	P	R	S	T
Function	None	VehDet	PedDet	VehDet	PedDet	VehDet	VehDet	VehDet
Index	0	4	4	3	3	19	18	29
Chan	U	V	W	X	g	h	i	j
Function	VehDet	PedRcy	None	None	VehDet	VehDet	VehDet	VehDet
Index	17	2	0	0	20	12	11	27
Chan	k	m	n	v	x	z		
Function	VehDet	VehDet	VehDet	None	VehDet	MaxII		
Index	30	31	32	0	28	2		

C Connector Inputs (D-6-2-3)

Chan	P	R	S	T	U	V	W	X
Function	VehDet	PedDet	VehDet	PedDet	PedDet	VehDet	VehDet	VehDet
Index	5	5	6	6	7	7	8	16
Chan	Y	Z	a	b	m	n	p	q
Function	Force	StopTm	MaxInh	None	VehDet	VehDet	VehDet	VehDet
Index	2	5	2	0	13	21	14	22
Chan	r	s	t	u	v	EE		
Function	VehDet	VehDet	VehDet	RedRst	OmtRed	VehDet		
Index	23	24	8	2	2	15		

City of Hamilton - Traffic Traffic Signal Controller Timing Data

Intersection: Twenty Rd at Garth St

Controller Type: 3000E

Page 1 of 4

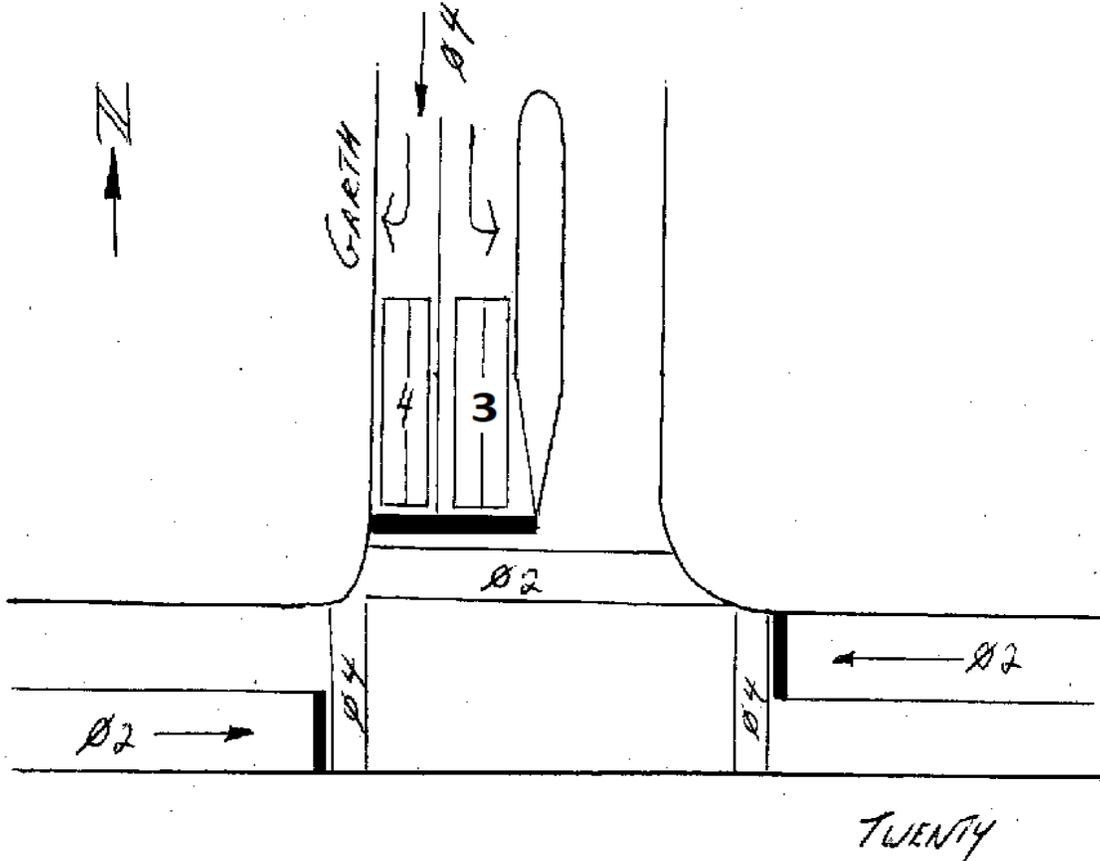
Programmed By: EM

Installed By: EM

Date: Oct 3rd, 2022

Date: Oct. 3rd, 2022

Reason: Adjust ped timing



- phi 1:
- phi 2: TWENTY - E/W, North Xwalk
- phi 3:
- phi 4: GARTH- SB, East/West Xwalks (Loops and pushbuttons)

Free Operation All Times

Flash Operation:

Red: TWENTY RD

Red: GARTH ST

CONTROLLER DATA

SEQUENCE/START-UP (MM-3-1-1)

START-UP PHASES/INTERVAL/SEQUENCE

(X = Enable for start-up phases. Must be compatible if more than one)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
START-UP	Phases		X														
	Interval	0	(0=Red, 1=Yel, 2= Grn, determines color of selected phases above on start-up)														
	Flash	10	(0-255 seconds start-up flash time)														
	Red	0	(0-25.5 secs = length of first red after start-up if start-up in yellow or red)														
	Sequence	2	(2=single ring, 3=dual ring, 4=123/567+48, 5=12/56+3478, 6=1234/56+78, 7=1234/5678, 8=dual quad, 9=12ph)														

PHASE RING ASSIGNMENTS

X = Phase assigned to ring (if used). Phases in different rings but same co-phase group can time together.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RING	Ring 1		X		X												
	Ring 2																
	Ring 3																
	Ring 4																

CO-PHASE GRP 1-4 ASSIGNMENTS

X = phase assigned to co-phase group. All ph's assigned to rings must be assigned to co-phase group.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CO-PHASE	CO PH 1		X														
	CO PH 2				X												
	CO PH 3																
	CO PH 4																

PHASE RECALLS/MODES; MIN, MAX, etc. (MM-3-1-2-1-PGDN, etc.)

USE 1 TO ALL 4 TIMING PLANS

		(X = ENABLE)															
		TP1 PHASE RECALLS															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PHASE RECALLS	MIN RCL																
	MAX RCL																
	PED RCL																
	SOFT REC																
	NON-LOCK				X												
	VEH OMIT																
	PED OMIT																
	WLK REST																
	MAX II																
	RED REST																
	NO SKIP																

PHASE RECALLS/MODES; CNA, INH MAX, PED OPTIONS, etc. (MM-3-1-2-2)

ONLY 1 PLAN PER UNIT

		(X = ENABLE)															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PHASE RECALLS	CNA 1		X														
	CNA 2																
	CNA 3																
	CNA 4																
	WRM		X														
	INH MAX																
	PED RECY		X														
	FL WALK																
	FDW->YEL																
	FDW->RED																
	COND PED																

CONTROLLER DATA

PHASE TIMES (MM-3-1-3-PGDN, etc.)

USE 1 TO ALL 4 TIMING PLANS

		TP1															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PHASE TIMES	Initial		10		10												
	Passage		-		3.0												
	Yellow		3.7		3.3												
	Red		2.7		3.0												
	Walk		12		12												
	Ped Clr		18		8												
	Max 1		-		30												
	Max 2																
	Mx 3 Lim																
	Mx 3 Adh																
	TBR																
	TTR																
	Min Gap																
	Al/Act																
Max In																	

VEHICLE DETECTOR ASSIGNMENTS (MM-3-1-4-1, PGDN etc.)

(X = ASSIGN VEH DETECTOR TO THAT PHASE)

		DET/PH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
VEH DET ASSIGN- MENTS	1																	
	2																	
	3					X												
	4					X												
	5																	
	6																	
	7																	
	8																	

DETECTOR MODES (MM-3-1-4-3)

		DET	1	2	3	4	5	6	7	8
VEH DET MODES	Mode				2	2				
	DET									
	Mode									

DETECTOR TIMES (MM-3-1-4-4)

USE 1 TO ALL 3 DETECTOR TIMING PLANS

		DET	1	2	3	4	5	6	7	8
DET TIMES	Delay				3	5				
	Str/Stp									

PED DETECTOR ASSIGNMENTS (MM-3-1-4-2)

(X = ASSIGN PED DETECTOR TO THAT PHASE)

		DET/PH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PED DET ASSIGN- MENTS	1																	
	2																	
	3																	
	4					X												
	5																	
	6																	
	7																	
	8																	

DAY PLANS (MM-3-3-1-1-32)

	HH:	MM	CIRCUIT PLAN	C	O	S	CKT	ON/OFF
1	00	00					11 (FREE)	ON

WEEK PLANS (MM-3-3-3)

Plan	SUN	MON	TUE	WED	THU	FRI	SAT
1	1	1	1	1	1	1	1
2							
3							
4							
5							

CIRCUIT OVERRIDES (MM-3-3-5)

For each circuit specify TOD (time of day controlled), or manually ON or OFF. Default = TOD

CIRCUIT OVER- RIDES	Circuit	65	66	67	68	69	70	71	72
	Function	LL1	LL2	LL3	LL4	LL5	LL6	LL7	LL8
	State								
	Circuit	73	74	75	76	77	78	79	80
	Function	CN1	CN2	CN3	CN4	WRM	MIN	DIM	CVS
	State	ON				ON			

DAYLIGHT SAVINGS (MM-3-3-7)

DAY LIGHT SAVINGS	Spring		Fall	
	(0-12)	(0-5)	(0-12)	(0-5)
	Month	WOM	Month	WOM
	4	1	10	5

Enter Month and Week of Month for Spring Forward and Fall Back days (typical 4 - 1 and 10 - 5). Unit will adjust at 2AM on Sunday of week specified. Enter zero (or leave blank) if Daylight Savings not used.

SYNC REFERENCE MODE (MM-3-3-8)

Mode:	0	0 = Time dependent, 1 = C/O/S Event
-------	---	-------------------------------------

Time Clock Reset:	00	00	TOD clock reset to by TBC input
Interrupter:	N	N	Y/N; Y = Interrupter pulses provided
Pulses:	0	0-6	= Number of interrupter pulses



BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Operational Analysis Summary

Appendix B



Technical Memorandum

Date: November 20, 2023 **Project No.:** 300035921.4000

Project Name: Upper West Side Secondary Plan Traffic Operations Memo

Client Name: Upper West Side Landowners Group

Submitted To: File

Submitted By: Rebecca Rust

Reviewed By: David Argue, P.Eng., PTOE

An operational analysis was undertaken for the study area intersections for existing conditions, 2031 background conditions, 2031 total conditions, and 2041 total conditions. The detailed Synchro outputs are provided in Attachments 1 through 5 for each of the horizon years and scenarios. Each intersection is summarized in the following sections.

1.0 Glancaster Road / Twenty Road Intersection

Table 1 summarizes the intersection operations for the Glancaster Road / Twenty Road intersection. Under 2031 background operations, it will be necessary to signalize the intersection and left turn lanes added. With the addition of the UWS Secondary Plan, a northbound right-turn lane will be necessary. In 2041, extension of Twenty Road to the west and widening of Twenty Road has been assumed as per the AEGD Secondary Plan.

Table 1: Glancaster Road / Twenty Road Intersection Operation

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		v/c	LOS	95 th Queue	v/c	LOS	95 th Queue
Existing 2023 Operations (AWSC) ¹							
WBLR	500+	0.32	B	-	0.42	B	-
NBTR	500+	0.34	A	-	0.54	B	-
SBTL	150	0.20	A	-	0.34	B	-

Table 1: Glancaster Road / Twenty Road continued

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		v/c	LOS	95 th Queue	v/c	LOS	95 th Queue
Background 2031 Operations (AWSC) ¹							
WBLR	500+	0.47	B	-	0.65	C	-
NBTR	500+	0.49	B	-	1.06	F	-
SBTL	150	0.30	B	-	0.55	C	-
Background 2031 Operations – With Improvements (Signalized)							
Overall	-	0.33	B	-	0.56	B	-
WBL	50	0.66	D	50	0.71	D	59
WBR	100+	0.08	D	13	0.08	C	12
NBTR	100+	0.26	A	26	0.52	A	55
SBL	50	0.12	A	10	0.36	A	24
SBT	150	0.08	A	11	0.11	A	16
Total 2031 Operations (Signalized)							
Overall	-	0.41	B	-	0.57	C	-
WBL	50	0.64	D	47	0.44	C	56
WBR	100+	0.14	C	15	0.14	C	14
NBT	100+	0.30	A	36	0.51	C	85
NBR	50	0.14	A	5	0.48	C	48
SBL	50	0.36	A	28	0.61	B	41
SBT	150	0.18	A	21	0.22	A	30
Total 2041 Operations (Signalized)							
Overall	-	0.58	B	-	0.65	B	-
EBL	50	0.02	A	4	0.19	B	23
EBTR	100+	0.33	B	40	0.40	B	58
WBL	50	0.54	B	47	0.61	B	57
WBT	100+	0.02	A	6	0.14	B	23
WBR	100+	0.15	A	13	0.11	B	13
NBL	50	0.24	A	15	0.12	A	13
NBT	100+	0.55	B	71	0.40	B	58
NBR	50	0.14	A	11	0.20	A	12
SBL	50	0.54	B	40	0.69	B	69
SBTR	150	0.62	B	81	0.30	A	40

Note: 1. HCM 2000 does not report on queues for AWSC intersections

2.0 Twenty Road / Silverbirch Boulevard Intersection

Table 2 summarizes the intersection operations for the Twenty Road / Silverbirch Boulevard intersection. Under 2031 total conditions, widening of Twenty Road has been assumed; otherwise, the intersection will remain with stop control on Silverbirch Boulevard.

Table 2: Twenty Road / Silverbirch Boulevard Intersection Unsignalized Operation

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Existing 2023 Operations							
EBLT	840	0.01	A	1	0.02	A	1
SBLR	100+	0.13	B	4	0.13	B	4
Background 2031 Operations							
EBLT	15	0.01	A	1	0.02	A	1
SBLR	100+	0.15	B	5	0.17	C	5
Total 2031 Operations							
EBL	15	0.01	A	1	0.03	A	1
SBLR	100+	0.17	B	5	0.16	C	5
Total 2041 Operations							
EBL	15	0.01	A	1	0.03	A	1
SBLR	100+	0.14	B	4	0.13	B	4

3.0 Twenty Road / Garth Street Intersection

Table 3 summarizes the intersection operations for the Twenty Road / Garth Street intersection. Under 2031 background conditions, widening of Twenty Road has been assumed with left turn lanes added at the intersection. Under total conditions and during the weekday AM peak hour, westbound and southbound left-turn advanced phases should be added and during the weekday PM peak hour, eastbound, westbound and southbound left-turn advanced phases should be added. The cycle length should be increased to 120s during both peak hours. Additional widening through the intersection is required in 2041.

Table 3: Twenty Road / Garth Street Intersection Signalized Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Existing 2023 Operations							
Overall	-	0.36	B	-	0.54	B	-
EBTL	400	0.31	A	30	0.52	A	67
WBTR	190	0.32	A	34	0.34	A	43
SBL	24	0.53	D	37	0.65	D	52
SBR	220	0.05	C	11	0.07	C	13

**Table 3: Twenty Road / Garth Street Intersection Signalized Operations
 continued**

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Background 2031 Operations							
Overall	-	0.41	B	-	0.57	B	-
EBL	15	0.21	A	18	0.52	B	55
EBTR	400	0.19	A	24	0.31	A	51
WBL	15	0.10	A	11	0.02	A	4
WBTR	190	0.33	A	40	0.44	A	71
NBL	15	0.04	C	6	0.19	C	16
NBTR	100+	0.08	C	8	0.13	C	14
SBL	15	0.66	C	43	0.75	D	56
SBTR	220	0.11	C	11	0.11	C	11
Total 2031 Operations							
Overall	-	0.79	D	-	0.88	D	-
EBL	15	0.27	C	35	0.55	B	36
EBTR	400	0.79	D	198	0.75	C	168
WBL	15	0.75	C	50	0.83	C	70
WBT	190	0.28	B	52	0.58	C	125
WBR	190	0.13	B	10	0.15	B	14
NBL	15	0.22	D	19	0.58	D	36
NBTR	100+	0.86	E	88	0.83	E	76
SBL	15	0.74	D	50	0.85	E	68
SBTR	220	0.27	C	37	0.40	C	53
Total 2041 Operations							
Overall	-	0.84	C	-	0.74	C	-
EBL	15	0.51	C	44	0.59	B	36
EBTR	400	0.58	C	77	0.47	C	65
WBL	15	0.81	C	67	0.69	B	53
WBTR	190	0.26	B	28	0.54	C	75
NBL	15	0.32	D	21	0.53	D	30
NBTR	100+	0.82	D	69	0.73	D	56
SBL	15	0.76	D	55	0.69	C	46
SBTR	220	0.27	C	29	0.37	C	43

4.0 Upper James Street / Twenty Road Intersection

Table 4 summarizes the intersection operations for the Upper James Street / Twenty Road intersection. To accommodate traffic volumes under 2031 conditions, widening of Twenty Road will be necessary. During the weekday AM peak hour, eastbound and westbound left-turn advanced phases should be added. During the weekday PM peak hour, an eastbound left-turn advanced phase be added. The cycle length should be increased to 120 seconds during both the weekday AM and PM peak hours. To accommodate 2041 conditions, Upper James will need to be widened with an additional lane in each direction.

Table 4: Upper James Street / Twenty Road Signalized Intersection Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Existing 2023 Operations							
Overall	-	0.59	B	-	0.64	C	-
EBL	50	0.55	D	27	0.39	C	23
EBTR	680	0.61	D	55	0.82	D	95
WBL	33	0.29	C	18	0.60	D	27
WBTR	215	0.71	D	64	0.64	C	74
NBL	127	0.26	A	17	0.39	B	16
NBT	1050	0.62	B	103	0.58	B	96
NBR	58	0.06	B	8	0.07	B	10
SBL	65	0.12	A	7	0.26	B	14
SBT	560	0.34	B	52	0.58	B	105
SBR	137	0.03	A	3	0.06	B	8
Background 2031 Operations							
Overall	-	0.53	B	-	0.59	B	-
EBL	50	0.56	D	27	0.55	D	29
EBT	680	0.28	C	21	0.53	C	40
EBR	50	0.06	C	12	0.15	C	18
WBL	33	0.31	C	20	0.46	C	25
WBTR	215	0.43	C	29	0.52	C	37
NBL	127	0.25	A	14	0.41	A	15
NBT	1050	0.55	B	84	0.54	B	88
NBR	58	0.05	A	6	0.08	A	8
SBL	65	0.14	A	6	0.31	A	13
SBT	560	0.33	A	44	0.62	B	111
SBR	137	0.03	A	3	0.06	A	8
Total 2031 Operations							
Overall	-	1.04	D	-	1.00	D	-
EBL	50	0.99	E	174	0.98	E	111
EBTR	680	0.59	C	98	0.58	C	96
WBL	33	0.59	D	37	0.75	E	55
WBTR	215	0.93	E	108	0.99	E	137
NBL	127	0.87	E	50	0.93	E	56
NBT	300+	0.98	D	218	0.91	D	200
NBR	58	0.22	C	31	0.32	C	46
SBL	65	0.75	F	33	0.77	E	37
SBT	560	0.80	D	127	0.99	E	220
SBR	137	0.16	C	18	0.30	C	25

Table 4: Upper James Street / Twenty Road Signalized Intersection Operations continued

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2041 Operations							
Overall	-	1.01	D	-	0.84	D	-
EBL	50	0.98	E	148	0.82	D	78
EBT	680	0.52	C	81	0.42	C	67
EBR	50	0.10	C	16	0.16	C	21
WBL	33	0.56	C	42	0.56	D	41
WBTR	215	0.93	E	121	0.87	D	111
NBL	127	0.93	E	52	0.77	D	44
NBTR	300+	0.99	E	185	0.76	C	133
SBL	65	0.38	D	14	0.66	D	31
SBTR	560	0.67	C	97	0.82	C	149

5.0 Glancaster Road / Book Road Intersection

Table 5 summarizes the intersection operations for the Glancaster Road / Book Road intersection. To accommodate traffic volumes under 2031 background conditions, it will be necessary to signalize the intersection as well as construct a northbound and eastbound left turn lane.

Table 5: Glancaster Road / Book Road Intersection Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Existing 2023 Operations (AWSC) ¹							
EBLR	915	0.37	B	-	0.72	C	-
NBTL	460	0.15	A	-	0.17	B	-
SBTR	850	0.31	A	-	0.32	B	-
Background 2031 Operations (AWSC) ¹							
EBLR	915	0.52	B	-	1.13	F	-
NBTL	460	0.34	B	-	0.46	C	-
SBTR	850	0.54	B	-	0.66	C	-
Background 2031 Operations – With Improvements (Signalized)							
Overall	-	0.39	B	-	0.56	B	-
EBL	100	0.68	C	52	0.80	C	87
EBR	915	0.05	C	9	0.12	B	10
NBL	25	0.11	A	9	0.21	B	19
NBT	460	0.13	A	16	0.17	A	26
SBTR	850	0.29	A	25	0.40	B	56

Table 5: Glancaster Road / Book Road Intersection Operations continued

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2031 Operations (Signalized)							
Overall	-	0.49	B	-	0.64	B	-
EBL	100	0.70	C	56	0.81	C	90
EBR	915	0.05	C	10	0.12	B	10
NBL	25	0.13	A	9	0.27	B	20
NBT	460	0.20	A	25	0.35	B	53
SBTR	200+	0.43	A	54	0.53	B	86
Total 2041 Operations (Signalized)							
Overall	-	0.60	B	-	0.54	B	-
EBL	100	0.74	D	68	0.73	C	67
EBR	915	0.06	C	11	0.10	C	13
NBL	50	0.18	A	13	0.18	A	13
NBT	460	0.24	A	34	0.30	A	45
SBTR	200+	0.55	A	87	0.47	A	73

Note: 1. HCM 2000 does not report on queues for AWSC intersections

6.0 Upper James Street / Talbot Lane Intersection

Table 6 summarizes the intersection operations for the Upper James Street / Talbot Lane intersection. To accommodate traffic volumes under 2031 conditions assuming access to the industrial properties in the vicinity of Talbot Lane, it will be necessary to signalize the intersection as well as construct a northbound and eastbound left turn lane. By 2041, Upper James will need to be widened to accommodate projected traffic volumes.

Table 6: Upper James Street / Talbot Lane Intersection Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Existing 2023 Operations (TWSC)							
EBLR	190	0.01	C	1	0.05	F	2
NBTL	290	0	A	0	0	A	0
Background 2031 Operations (TWSC)							
EBL	190	0.01	D	1	0.05	F	2
EBR	190	0	B	1	0	B	1
NBL	290	0	A	0	0	B	0

Table 6: Upper James Street / Talbot Lane continued

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2031 Operations (Signalized)							
Overall	-	0.49	A	-	0.61	A	-
EBL	100+	0.23	D	8	0.50	D	25
EBR	100+	0.01	D	5	0.11	D	12
NBL	50	0.16	A	4	0.08	A	3
NBT	290	0.50	A	40	0.60	A	74
SBT	100+	0.41	A	28	0.62	A	77
SBR	34	0.06	A	2	0.01	A	2
Total 2041 Operations (Signalized)							
Overall	-	0.36	A	-	0.44	A	-
EBL	100+	0.21	D	8	0.49	D	24
EBR	100+	0.01	D	5	0.17	C	13
NBL	50	0.18	A	5	0.08	A	3
NBT	290	0.37	A	23	0.43	A	39
SBTR	100+	0.34	A	19	0.43	A	39

7.0 Glancaster Road / Dickenson Road Intersection

Table 7 summarizes the intersection operations for the Glancaster Road / Dickenson Road intersection. To accommodate traffic volumes under 2031 background conditions, it will be necessary to signalize the intersection as well as construct a left turn lanes on each leg. Widening of Dickenson Road is also assumed.

Table 7: Glancaster Road / Dickenson Road Intersection Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Existing 2023 Operations (AWSC)							
WBLR	2630	0.10	A	-	0.13	A	-
NBTR	600	0.02	A	-	0.02	A	-
SBTL	460	0.12	A	-	0.29	A	-

Table 7: Glancaster Road / Dickenson Road Intersection Operations continued

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Background 2031 Operations (signalized)							
Overall	-	0.25	A	-	0.34	A	-
EBL	50	0.03	A	2	0.04	B	3
EBTR	100+	0.10	A	7	0.10	B	7
WBL	50	0.15	A	5	0.09	B	4
WBTR	2630	0.14	A	9	0.13	B	8
NBL	50	0.15	A	9	0.11	A	8
NBT	600	0.15	A	11	0.12	A	11
NBR	600	0.04	A	4	0.02	A	3
SBL	50	0.35	B	17	0.46	A	29
SBTR	460	0.12	A	9	0.16	A	14
Total 2031 Operations (signalized)							
Overall	-	0.36	A	-	0.48	A	-
EBL	50	0.04	A	3	0.04	A	4
EBTR	100+	0.13	A	7	0.12	A	9
WBL	50	0.33	A	12	0.34	B	17
WBTR	100+	0.15	A	7	0.16	A	10
NBL	50	0.14	A	7	0.11	A	7
NBT	600	0.21	A	12	0.27	A	18
NBR	600	0.07	A	5	0.04	A	4
SBL	50	0.38	A	15	0.59	A	30
SBTR	460	0.27	A	15	0.25	A	17
Total 2041 Operations (signalized)							
Overall	-	0.44	A	-	0.55	B	-
EBL	50	0.07	A	5	0.19	B	14
EBTR	100+	0.17	A	10	0.27	B	22
WBL	50	0.28	A	15	0.44	B	29
WBTR	100+	0.34	A	18	0.22	B	16
NBL	50	0.16	A	8	0.18	A	12
NBT	600	0.22	A	14	0.32	A	31
NBR	600	0.08	A	6	0.09	A	6
SBL	50	0.51	A	24	0.62	B	43
SBTR	460	0.29	A	16	0.37	A	34

8.0 Upper James Street / Dickenson Road Intersection

Table 8 summarizes the intersection operations for the Upper James Street / Dickenson Road intersection. To accommodate traffic volumes under 2031 background conditions, Dickenson Road is assumed to be widened by one lane in each direction. Upper James Street is assumed to be widened for 2041 traffic conditions.

Table 8: Upper James Street / Dickenson Road

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Existing 2023 Operations							
Overall	-	0.44	A	-	0.51	A	-
EBTLR	220	0.46	D	21	0.61	D	39
WBTLR	550	0.13	D	12	0.07	C	10
NBL	40	0.09	A	6	0.14	A	7
NBT	410	0.43	A	52	0.47	A	67
NBR	21	0.01	A	1	0.01	A	1
SBL	68	0.02	A	2	0.07	A	4
SBT	290	0.28	A	29	0.49	A	72
SBR	17	0.04	A	4	0.03	A	4
Background 2031 Operations							
Overall	-	0.49	B	-	0.58	B	-
EBL	15	0.51	D	26	0.67	D	43
EBTR	100+	0.25	C	17	0.23	C	18
WBL	15	0.05	C	6	0.05	C	6
WBTR	550	0.50	C	32	0.28	C	24
NBL	40	0.16	A	10	0.18	A	9
NBT	410	0.48	A	61	0.51	A	82
NBR	21	0	A	0	0.01	A	1
SBL	68	0.03	A	2	0.10	A	5
SBT	290	0.31	A	33	0.55	A	91
SBR	17	0.05	A	6	0.02	A	4
Total 2031 Operations							
Overall	-	0.87	C	-	0.97	D	-
EBL	15	0.52	C	30	0.73	D	41
EBT	100+	0.41	C	51	0.27	C	33
EBR	30	0.40	C	44	0.18	C	20
WBL	15	0.05	D	6	0.06	D	7
WBTR	550	0.74	D	70	0.71	D	65
NBL	40	0.91	D	70	0.99	F	116
NBT	410	0.65	B	136	0.71	B	158
NBR	21	0	A	0	0.01	A	0
SBL	68	0.10	B	6	0.53	D	28
SBT	290	0.63	C	121	0.97	D	240
SBR	17	0.14	B	21	0.04	B	6

Table 8: Upper James Street / Dickenson Road continued

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2041 Operations							
Overall	-	1.02	D	-	1.00	D	-
EBL	15	0.97	F	75	0.94	E	76
EBT	100+	0.80	D	79	0.43	C	64
EBR	30	0.36	C	37	0.23	C	28
WBL	15	0.09	D	10	0.07	D	8
WBTR	550	0.95	E	118	0.92	E	113
NBL	40	0.96	E	130	0.97	E	111
NBTR	410	0.53	B	91	0.55	B	96
SBL	68	0.16	C	8	0.44	D	23
SBTR	290	0.92	D	137	0.78	C	137

9.0 Twenty Road West / Local Street Intersection

Table 9 summarizes the intersection operations for the Twenty Road West / Local Street intersection. To accommodate traffic volumes under 2031 conditions, the local street should have a left and right turn lane. By 2041 traffic conditions, Twenty Road West will need to widen with an additional lane in each direction plus left turn lane.

Table 9: Twenty Road West / Local Street Intersection Unsignalized Intersection Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2031 Operations							
WBLT	100+	0.02	A	1	0.06	A	2
NBL	15	0.01	C	1	0.01	D	1
NBR	100+	0.13	B	4	0.10	C	3
Total 2041 Operations							
WBL	15	0.02	A	1	0.06	A	2
NBL	15	0.00	B	1	0.00	B	1
NBR	100+	0.10	B	3	0.07	B	2

10.0 Collector Road A & Twenty Road West Intersection

Table 10 summarizes the intersection operations for the Twenty Road West / Collector Road A intersection. To accommodate traffic volumes under 2031 conditions, the Collector Road A should have a left and right turn lane. By 2041 traffic conditions, Twenty Road West will need to widen with an additional lane in each direction, plus a left turn lane.

Table 10: Collector Road A / Twenty Road West Intersection Unsignalized Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2031 Operations							
WBLT	100+	0.06	A	2	0.20	A	6
NBL	15	0.04	C	1	0.10	E	3
NBR	100+	0.41	C	16	0.30	C	10
Total 2041 Operations							
WBL	15	0.07	A	2	0.20	B	6
NBL	15	0.02	B	1	0.03	C	1
NBR	100+	0.30	B	10	0.19	B	6

11.0 Twenty Road West / Twentyplace Boulevard / Collector Road B Intersection

Table 11 summarizes the intersection operations for the Twenty Road West / Twentyplace Boulevard / Collector Road B intersection. To accommodate traffic volumes under 2031 conditions, the Twenty Road will need to be widened to provide an additional lane in each direction, left turn lanes, and signalization of the intersection.

Table 11: Twenty Road / Twentyplace Boulevard / Collector Road B Intersection Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Existing 2023 Operations (Southbound Stop Controlled)							
EBTL	430	0.01	A	1	0.03	A	1
SBLR	110	0.10	B	3	0.09	B	3
Background 2031 Operations (Southbound Stop Controlled)							
EBTL	430	0.01	A	1	0.04	A	1
SBLR	110	0.10	B	3	0.10	C	3
Total 2031 Operations (Signalized)							
Overall	-	0.52	B	-	0.49	B	-
EBL	15	0.03	B	4	0.22	B	11
EBTR	430	0.78	C	94	0.76	C	83
WBL	30	0.61	B	31	0.65	B	35
WBTR	220	0.37	A	35	0.54	B	56
NBL	15	0.10	B	15	0.14	B	18
NBTR	100+	0.17	B	4	0.12	B	0
SBL	110	0.08	B	9	0.04	B	7
SBTR	110	0.02	B	0	0.01	B	0

Table 11: Twenty Road / Twentypace Boulevard / Collector Road B Intersection Operations continued

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2041 Operations (Signalized)							
Overall	-	0.52	B	-	0.45	B	-
EBL	15	0.04	B	4	0.22	B	11
EBTR	430	0.78	C	92	0.74	C	72
WBL	30	0.62	B	31	0.61	B	29
WBT	220	0.43	A	41	0.54	B	54
NBL	15	0.11	B	15	0.12	B	16
NBR	100+	0.15	B	17	0.11	B	14
SBL	110	0.04	B	9	0.03	B	6
SBTR	110	0.02	B	0	0.01	B	0

12.0 Glancaster Road / Collector Road C Intersection

Table 12 summarizes the intersection operations for the Glancaster Road / Collector Road C intersection. To accommodate traffic volumes under 2031 conditions, a southbound left turn lane needs to be added as well, Collection Road C should have a left turn lane and right turn lane. Delays will be expected for westbound left turn movements in the future and potential signalization of the intersection may need to be considered.

Table 12: Glancaster Road / Collector Road C Intersection Unsignalized Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2031 Operations							
WBL	15	0.57	E	25	0.55	F	22
WBR	100+	0.38	B	14	0.50	C	21
SBL	15	0.11	A	3	0.11	B	3
Total 2041 Operations							
WBL	15	0.77	F	38	0.52	E	20
WBR	100+	0.42	C	16	0.41	C	15
SBL	15	0.12	A	3	0.10	A	3

13.0 Upper James Street / Collector Road C

Table 13 summarizes the intersection operations for the Upper James Street / Collector Road C intersection. To accommodate traffic volumes under 2031 conditions, the intersection will need

to be signalized with a northbound left turn lane and southbound left turn lane provided on Upper James Street. 2041 conditions will require Upper James to be widened.

Table 13: Upper James Street / Collector Road C Intersection Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2031 Operations							
Overall	-	0.68	B	-	0.95	C	-
EBL	200+	0.83	D	112	0.91	E	144
EBR	200+	0.19	C	19	0.14	D	19
NBL	15	0.53	B	31	0.93	E	116
NBT	300+	0.59	B	133	0.61	B	115
SBT	300+	0.54	B	125	0.87	C	204
SBR	30	0.23	B	38	0.20	B	32
Total 2041 Operations							
Overall	-	0.72	C	-	0.91	C	-
EBL	200+	0.86	D	133	0.89	E	146
EBR	200+	0.19	C	17	0.15	C	18
NBL	15	0.63	B	43	0.89	E	106
NBT	300+	0.47	B	93	0.45	B	75
SBTR	300+	0.56	C	113	0.76	C	152

14.0 Dickenson Road West / Collector Road A Intersection

Table 14 summarizes the intersection operations for the Dickenson Road West / Collector Road A intersection. To accommodate traffic volumes under 2031 conditions, Dickenson Road is assumed to be widened and the intersection will function with Collector Road A under stop control. The intersection will continue to function under 2041 traffic conditions.

Table 14: Dickenson Road West / Collector Road A Intersection Unsignalized Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2031 Operations							
EBL	15	0	A	1	0	A	0
SBL	30	0.23	C	7	0.15	C	5
SBR	100+	0.03	A	1	0.03	A	1
Total 2041 Operations							
EBL	15	0	A	1	0	A	0
SBL	30	0.33	C	11	0.20	C	6
SBR	100+	0.03	B	1	0.03	B	1

15.0 Garth Street Extension / Dickenson Road West Intersection

Table 15 summarizes the intersection operations for the Dickenson Road West / Garth Street Extension intersection. To accommodate traffic volumes under 2031 conditions, Dickenson Road is assumed to be widened and the intersection signalized. The intersection will continue to function under 2041 traffic conditions.

Table 15: Garth Street Extension / Dickenson Road West Intersection Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Background 2031 Operations							
Overall	-	0.32	A	-	0.40	B	-
EBL	50	0.03	A	2	0.17	B	16
EBTR	100+	0.11	A	5	0.21	B	17
WBL	50	0.38	A	14	0.33	A	25
WBTR	100+	0.13	A	6	0.05	A	6
NBL	50	0.27	A	11	0.45	B	33
NBTR	100+	0.14	A	6	0.21	B	15
SBL	50	0.06	A	4	0.03	A	3
SBTR	100+	0.14	A	7	0.04	A	5
Total 2031 Operations							
Overall	-	0.58	B	-	0.48	A	-
EBL	50	0.08	B	8	0.19	A	11
EBTR	100+	0.27	B	24	0.26	A	17
WBL	50	0.47	B	35	0.46	A	25
WBTR	100+	0.35	B	36	0.30	A	20
NBL	50	0.21	A	18	0.33	A	24
NBTR	100+	0.13	A	9	0.18	A	11
SBL	50	0.66	B	60	0.48	A	29
SBTR	100+	0.11	A	12	0.05	A	5
Total 2041 Operations							
Overall	-	0.88	C	-	0.81	B	-
EBL	50	0.10	B	9	0.19	B	15
EBTR	100+	0.27	B	28	0.29	B	27
WBL	50	0.87	D	95	0.81	C	89
WBTR	100+	0.42	B	57	0.33	B	41
NBL	50	0.21	B	23	0.32	B	37
NBTR	100+	0.18	B	11	0.23	B	17
SBL	50	0.88	D	114	0.79	C	77
SBTR	100+	0.17	B	23	0.05	B	8

16.0 Dickenson Road West / Collector Road B Intersection

Table 16 summarizes the intersection operations for the Dickenson Road West / Collector Road B intersection. To accommodate traffic volumes under 2031 conditions, Dickenson Road is

assumed to be widened. By 2041 traffic conditions, traffic signals will be required at the intersection.

Table 16: Dickenson Road West / Collector Road B Intersection Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2031 Operations (Unsignalized)							
EBL	15	0.04	A	1	0.01	A	1
SBL	15	0.72	F	34	0.62	E	28
SBR	100+	0.02	B	1	0.07	B	2
Total 2041 Operations (Signalized)							
Overall	-	0.44	B	-	0.42	B	-
EBL	15	0.28	B	9	0.06	B	3
EBT	100+	0.73	B	70	0.74	B	67
WBTR	100+	0.76	B	73	0.70	B	62
SBL	15	0.15	B	19	0.17	A	21
SBR	100+	0.01	A	3	0.03	A	5

17.0 Garth Street Extension / Collector Road C Intersection

Table 17 summarizes the intersection operations for the Garth Street Extension / Collector Road C intersection. To accommodate traffic volumes under 2031 conditions, traffic signals will need to be provided at the intersection. Garth Street Extension will need to be a five-lane cross-section. Collector Road C will need to be a three-lane cross-section.

Table 17: Garth Street Extension / Collector Road C Intersection Signalized Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2031 Operations							
Overall	-	0.56	B	-	0.49	B	-
EBL	15	0.47	C	29	0.79	D	33
EBTR	100+	0.77	C	80	0.31	B	30
WBL	15	0.43	C	17	0.17	B	13
WBTR	100+	0.45	C	44	0.79	C	81
NBL	15	0.08	A	9	0.09	A	10
NBTR	100+	0.14	A	17	0.19	A	25
SBL	15	0.47	B	54	0.31	B	31
SBTR	100+	0.26	A	33	0.20	A	21

Table 17: Garth Street Extension / Collector Road C Intersection Signalized Operations continued

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2041 Operations							
Overall	-	0.58	B	-	0.49	B	-
EBL	15	0.44	C	28	0.77	D	32
EBTR	100+	0.80	D	88	0.31	B	30
WBL	15	0.46	C	18	0.17	B	13
WBTR	100+	0.44	C	45	0.79	C	81
NBL	15	0.10	A	9	0.09	A	10
NBTR	100+	0.14	A	16	0.19	A	26
SBL	15	0.47	B	55	0.31	B	31
SBTR	100+	0.32	A	43	0.23	A	23

18.0 Collector Road B / Collector Road C Intersection

Table 18 summarizes the intersection operations for the Collector Road B / Collector Road C intersection. Collector Road C should have a four-lane cross-section east of Collector Road B and three lane cross-section to the west. A three-lane cross-section will be required on Collector Road B. The intersection will need to be signalized.

Table 18: Collector Road B & Collector Road C Intersection Signalized Operations

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2031 Operations							
Overall	-	0.56	B	-	0.48	B	-
EBL	15	0.27	B	19	0.54	B	19
EBTR	200+	0.81	C	99	0.38	B	35
WBL	200+	0.30	B	11	0.04	B	4
WBTR	200+	0.36	B	37	0.79	C	79
NBL	50	0.02	A	4	0.08	A	10
NBTR	200+	0.08	A	14	0.25	A	32
SBL	50	0.27	B	33	0.19	A	19
SBTR	200+	0.37	B	56	0.21	A	25

Table 18: Collector Road B & Collector Road C Intersection Signalized Operations continued

Intersection & Movement	Existing Storage Length/ Link Distance	Weekday AM Peak Hour			Weekday PM Peak Hour		
		LOS	v/c	95 th Queue	LOS	v/c	95 th Queue
Total 2041 Operations							
Overall	-	0.62	B	-	0.48	B	-
EBL	15	0.18	B	14	0.47	B	16
EBTR	200+	0.84	C	113	0.41	B	38
WBL	200+	0.33	B	11	0.04	B	4
WBTR	200+	0.32	B	33	0.79	C	79
NBL	50	0.03	B	5	0.08	A	10
NBTR	200+	0.08	B	15	0.25	A	32
SBL	50	0.29	B	37	0.19	A	19
SBTR	200+	0.41	B	64	0.21	A	25

Appendix 1
Existing Conditions

HCM Unsignalized Intersection Capacity Analysis
1: Glanaster Road & Twenty Road West

Existing AM Peak Hour

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	T	T	T	T	T	T
Sign Control	Stop		Stop			Stop
Traffic Volume (vph)	133	94	119	135	72	64
Future Volume (vph)	133	94	119	135	72	64
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	141	100	127	144	77	68
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total (vph)	241	271	145			
Volume Left (vph)	141	0	77			
Volume Right (vph)	100	144	0			
Hadj (s)	-0.03	-0.22	0.13			
Departure Headway (s)	4.9	4.5	5.0			
Degree Utilization, x	0.32	0.34	0.20			
Capacity (veh/h)	692	761	676			
Control Delay (s)	10.2	9.8	9.2			
Approach Delay (s)	10.2	9.8	9.2			
Approach LOS	B	A	A			
Intersection Summary						
Delay		9.8				
Level of Service		A				
Intersection Capacity Utilization		45.2%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
2: Twenty Road West & Silverbirch Blvd

Existing AM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		T	T		T	
Traffic Volume (veh/h)	14	215	220	14	55	16
Future Volume (Veh/h)	14	215	220	14	55	16
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	14	222	227	14	57	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	241				484	234
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	241				484	234
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	99				89	98
cM capacity (veh/h)	1297				536	810
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	236	241	73			
Volume Left	14	0	57			
Volume Right	0	14	16			
cSH	1297	1700	579			
Volume to Capacity	0.01	0.14	0.13			
Queue Length 95th (m)	0.2	0.0	3.3			
Control Delay (s)	0.6	0.0	12.1			
Lane LOS	A		B			
Approach Delay (s)	0.6	0.0	12.1			
Approach LOS			B			
Intersection Summary						
Average Delay		1.8				
Intersection Capacity Utilization		33.5%		ICU Level of Service		A
Analysis Period (min)		15				

Timings
3: Twenty Road West & Garth Street

Existing AM Peak Hour

	EBL	EBT	WBT	SBL	SBR
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Configurations		↕	↕	↕	↕
Traffic Volume (vph)	116	138	194	117	66
Future Volume (vph)	116	138	194	117	66
Lane Group Flow (vph)	0	282	416	130	73
Turn Type	Perm	NA	NA	Perm	Perm
Protected Phases		2	2		
Permitted Phases	2			4	4
Detector Phase	2	2	2	4	4
Switch Phase					
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	36.4	36.4	36.4	26.3	26.3
Total Split (s)	66.4	66.4	66.4	36.3	36.3
Total Split (%)	64.7%	64.7%	64.7%	35.3%	35.3%
Yellow Time (s)	3.7	3.7	3.7	3.3	3.3
All-Red Time (s)	2.7	2.7	2.7	3.0	3.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0
Total Lost Time (s)		6.4	6.4	6.3	6.3
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	Max	Max	Max	None	None
v/c Ratio		0.31	0.33	0.53	0.28
Control Delay		6.0	4.8	42.4	11.0
Queue Delay		0.0	0.0	0.0	0.0
Total Delay		6.0	4.8	42.4	11.0
Queue Length 50th (m)		13.9	16.2	19.8	0.0
Queue Length 95th (m)		29.1	33.5	36.3	11.0
Internal Link Dist (m)		397.1	654.5	148.8	
Turn Bay Length (m)			24.0	24.0	
Base Capacity (vph)		914	1245	607	547
Starvation Cap Reductn		0	0	0	0
Spillback Cap Reductn		0	0	0	0
Storage Cap Reductn		0	0	0	0
Reduced v/c Ratio		0.31	0.33	0.21	0.13

Intersection Summary

Cycle Length: 102.7
Actuated Cycle Length: 87.8
Natural Cycle: 65
Control Type: Semi Act-Uncoord

Splits and Phases: 3: Twenty Road West & Garth Street



HCM Signalized Intersection Capacity Analysis
3: Twenty Road West & Garth Street

Existing AM Peak Hour

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	↕
Traffic Volume (vph)	116	138	194	180	117	66
Future Volume (vph)	116	138	194	180	117	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.4	6.4		6.3	6.3
Lane Util. Factor		1.00	1.00		1.00	1.00
Frbp, ped/bikes		1.00	0.99		1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	0.94		1.00	0.85
Flt Protected		0.98	1.00		0.95	1.00
Satd. Flow (prot)		1822	1708		1772	1458
Flt Permitted		0.69	1.00		0.95	1.00
Satd. Flow (perm)		1278	1708		1772	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	129	153	216	200	130	73
RTOR Reduction (vph)	0	0	22	0	0	63
Lane Group Flow (vph)	0	282	394	0	130	10
Confl. Peds. (#/hr)	2			2		
Heavy Vehicles (%)	3%	3%	5%	3%	3%	12%
Turn Type	Perm	NA	NA		Perm	Perm
Protected Phases		2	2			
Permitted Phases	2				4	4
Actuated Green, G (s)		62.9	62.9		12.2	12.2
Effective Green, g (s)		62.9	62.9		12.2	12.2
Actuated g/C Ratio		0.72	0.72		0.14	0.14
Clearance Time (s)		6.4	6.4		6.3	6.3
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		915	1223		246	202
v/s Ratio Prot			c0.23			
v/s Ratio Perm		0.22			c0.07	0.01
v/c Ratio		0.31	0.32		0.53	0.05
Uniform Delay, d1		4.5	4.6		35.1	32.8
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.9	0.7		2.0	0.1
Delay (s)		5.4	5.3		37.2	32.9
Level of Service		A	A		D	C
Approach Delay (s)		5.4	5.3		35.6	
Approach LOS		A	A		D	

Intersection Summary

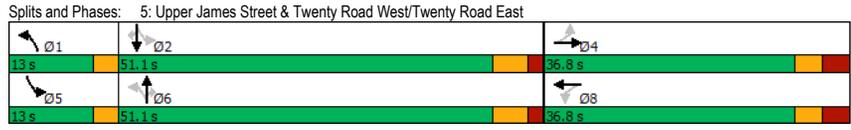
HCM 2000 Control Delay	12.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	87.8	Sum of lost time (s)	12.7
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Timings Existing AM Peak Hour
5: Upper James Street & Twenty Road West/Twenty Road East

	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	74	139	47	158	126	1004	76	43	586	44
Future Volume (vph)	74	139	47	158	126	1004	76	43	586	44
Lane Group Flow (vph)	79	236	50	272	134	1068	81	46	623	47
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4		8		6		5	2	
Permitted Phases	4		8		6		6	2		2
Detector Phase	4	4	8	8	1	6	6	5	2	2
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	45.0	45.0	5.0	45.0	45.0
Minimum Split (s)	34.8	34.8	34.8	34.8	8.0	51.1	51.1	8.0	51.1	51.1
Total Split (s)	36.8	36.8	36.8	36.8	13.0	51.1	51.1	13.0	51.1	51.1
Total Split (%)	36.5%	36.5%	36.5%	36.5%	12.9%	50.6%	50.6%	12.9%	50.6%	50.6%
Yellow Time (s)	3.3	3.3	3.3	3.3	3.0	4.2	4.2	3.0	4.2	4.2
All-Red Time (s)	3.5	3.5	3.5	3.5	0.0	1.9	1.9	0.0	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.8	6.8	6.8	6.8	3.0	6.1	6.1	3.0	6.1	6.1
Lead/Lag					Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.55	0.63	0.29	0.73	0.24	0.62	0.10	0.12	0.34	0.05
Control Delay	46.3	35.8	33.9	41.2	7.0	18.6	3.9	6.3	12.7	1.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.3	35.8	33.9	41.2	7.0	18.6	3.9	6.3	12.7	1.6
Queue Length 50th (m)	12.2	32.2	7.3	38.6	6.5	64.8	0.1	2.1	28.2	0.0
Queue Length 95th (m)	26.1	54.4	17.1	63.5	16.5	102.9	7.6	7.0	51.5	2.9
Internal Link Dist (m)		925.4		263.2		1046.5			203.7	
Turn Bay Length (m)	50.0		33.0		127.0		58.0	65.0		137.0
Base Capacity (vph)	247	618	297	613	628	1719	785	380	1816	935
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.38	0.17	0.44	0.21	0.62	0.10	0.12	0.34	0.05

Intersection Summary
 Cycle Length: 100.9
 Actuated Cycle Length: 88.8
 Natural Cycle: 95
 Control Type: Actuated-Uncoordinated



HCM Signalized Intersection Capacity Analysis Existing AM Peak Hour
5: Upper James Street & Twenty Road West/Twenty Road East

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	74	139	83	47	158	98	126	1004	76	43	586	44
Future Volume (vph)	74	139	83	47	158	98	126	1004	76	43	586	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.8	6.8		6.8	6.8		3.0	6.1	6.1	3.0	6.1	6.1
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00	0.98	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.94		1.00	0.94		1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1753	1765		1754	1749		1789	3380	1466	1738	3288	1633
Fit Permitted	0.40	1.00		0.48	1.00		0.42	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	729	1765		877	1749		783	3380	1466	321	3288	1633
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	79	148	88	50	168	104	134	1068	81	46	623	47
RTOR Reduction (vph)	0	24	0	0	25	0	0	0	39	0	0	21
Lane Group Flow (vph)	79	212	0	50	247	0	134	1068	42	46	623	26
Confl. Peds. (#/hr)	2		1	1		2			1	1		
Heavy Vehicles (%)	4%	3%	1%	4%	3%	3%	2%	8%	9%	5%	11%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		1	6		5	2	
Permitted Phases	4				8		6		6	2		2
Actuated Green, G (s)	17.6	17.6		17.6	17.6		51.3	45.2	45.2	58.2	49.1	49.1
Effective Green, g (s)	17.6	17.6		17.6	17.6		51.3	45.2	45.2	58.2	49.1	49.1
Actuated g/C Ratio	0.20	0.20		0.20	0.20		0.58	0.51	0.51	0.66	0.55	0.55
Clearance Time (s)	6.8	6.8		6.8	6.8		3.0	6.1	6.1	3.0	6.1	6.1
Vehicle Extension (s)	3.0	3.0		3.0	3.0		1.0	6.5	6.5	1.0	6.5	6.5
Lane Grp Cap (vph)	144	350		174	347		522	1722	747	370	1820	903
v/s Ratio Prot		0.12			c0.14		c0.02	c0.32		0.01	c0.19	
v/s Ratio Perm	0.11			0.06			0.13		0.03	0.07		0.02
v/c Ratio	0.55	0.61		0.29	0.71		0.26	0.62	0.06	0.12	0.34	0.03
Uniform Delay, d1	32.0	32.4		30.2	33.2		8.5	15.6	11.0	7.1	10.9	9.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.2	3.0		0.9	6.8		0.1	1.7	0.1	0.7	0.5	0.1
Delay (s)	36.2	35.3		31.1	39.9		8.6	17.3	11.1	7.8	11.4	9.0
Level of Service	D	D		C	D		A	B	B	A	B	A
Approach Delay (s)		35.6			38.6			16.0			11.0	
Approach LOS		D			D			B			B	

Intersection Summary
 HCM 2000 Control Delay 19.7 HCM 2000 Level of Service B
 HCM 2000 Volume to Capacity ratio 0.59
 Actuated Cycle Length (s) 88.7 Sum of lost time (s) 15.9
 Intersection Capacity Utilization 87.5% ICU Level of Service E
 Analysis Period (min) 15
 c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Glancaster Road & Book Road East

Existing AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement						
Lane Configurations	T	T		T	T	
Sign Control	Stop			Stop	Stop	
Traffic Volume (vph)	193	60	47	51	28	211
Future Volume (vph)	193	60	47	51	28	211
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	208	65	51	55	30	227
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total (vph)	273	106	257			
Volume Left (vph)	208	51	0			
Volume Right (vph)	65	0	227			
Hadj (s)	0.12	0.18	-0.46			
Departure Headway (s)	4.9	5.1	4.3			
Degree Utilization, x	0.37	0.15	0.31			
Capacity (veh/h)	699	659	787			
Control Delay (s)	10.7	9.0	9.2			
Approach Delay (s)	10.7	9.0	9.2			
Approach LOS	B	A	A			
Intersection Summary						
Delay		9.8				
Level of Service		A				
Intersection Capacity Utilization		44.4%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
7: Upper James Street & Talbot Lane

Existing AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement						
Lane Configurations	T	T		T	T	T
Traffic Volume (veh/h)	1	2	0	1213	729	1
Future Volume (Veh/h)	1	2	0	1213	729	1
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	1	2	0	1264	759	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)				304		
pX, platoon unblocked	0.88					
vC, conflicting volume	1391	380	760			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1167	380	760			
tC, single (s)	6.8	7.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.8	2.2			
p0 queue free %	99	100	100			
cM capacity (veh/h)	167	500	861			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	3	421	843	380	380	1
Volume Left	1	0	0	0	0	0
Volume Right	2	0	0	0	0	1
cSH	300	861	1700	1700	1700	1700
Volume to Capacity	0.01	0.00	0.50	0.22	0.22	0.00
Queue Length 95th (m)	0.2	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	17.1	0.0	0.0	0.0	0.0	0.0
Lane LOS	C					
Approach Delay (s)	17.1	0.0		0.0		
Approach LOS	C					
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			43.5%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
8: Glancaster Road & Dickenson Road West

Existing AM Peak Hour

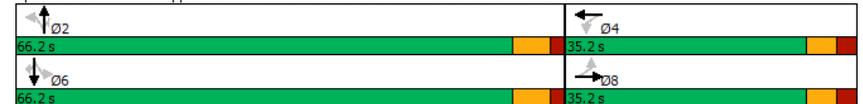
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↕	↕	↔	↕
Sign Control	Stop		Stop			Stop
Traffic Volume (vph)	2	89	8	9	79	8
Future Volume (vph)	2	89	8	9	79	8
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	2	100	9	10	89	9
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total (vph)	102	19	98			
Volume Left (vph)	2	0	89			
Volume Right (vph)	100	10	0			
Hadj (s)	-0.52	-0.12	0.28			
Departure Headway (s)	3.6	4.1	4.4			
Degree Utilization, x	0.10	0.02	0.12			
Capacity (veh/h)	954	845	797			
Control Delay (s)	7.1	7.2	8.0			
Approach Delay (s)	7.1	7.2	8.0			
Approach LOS	A	A	A			
Intersection Summary						
Delay			7.5			
Level of Service			A			
Intersection Capacity Utilization			23.7%		ICU Level of Service	A
Analysis Period (min)			15			

Timings
9: Upper James Street & Dickenson Road West/Dickenson Road East

Existing AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↕	↕	↕	↕	↕	↕	↕
Traffic Volume (vph)	45	1	5	12	41	1079	8	6	669	44
Future Volume (vph)	45	1	5	12	41	1079	8	6	669	44
Lane Group Flow (vph)	0	88	0	46	44	1148	9	6	712	47
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA	Perm
Protected Phases		8		4		2		2	6	
Permitted Phases	8		4		2		2	6		6
Detector Phase	8	8	4	4	2	2	2	6	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	55.0	55.0	55.0	55.0	55.0	55.0
Minimum Split (s)	35.2	35.2	35.2	35.2	66.2	66.2	66.2	66.2	66.2	66.2
Total Split (s)	35.2	35.2	35.2	35.2	66.2	66.2	66.2	66.2	66.2	66.2
Total Split (%)	34.7%	34.7%	34.7%	34.7%	65.3%	65.3%	65.3%	65.3%	65.3%	65.3%
Yellow Time (s)	3.7	3.7	3.7	3.7	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	2.5	2.5	2.5	2.5	1.7	1.7	1.7	1.7	1.7	1.7
Lost Time Adjust (s)		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		6.2		6.2	6.3	6.3	6.3	6.3	6.3	6.3
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	Max	Max	Max	Max	Max	Max
v/c Ratio		0.49		0.21	0.08	0.42	0.01	0.02	0.27	0.04
Control Delay		30.6		19.9	4.4	5.0	0.0	4.2	4.2	2.0
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		30.6		19.9	4.4	5.0	0.0	4.2	4.2	2.0
Queue Length 50th (m)		7.2		2.6	1.7	31.2	0.0	0.2	16.5	0.4
Queue Length 95th (m)		20.7		11.5	5.4	51.4	0.2	1.4	28.5	3.4
Internal Link Dist (m)		2863.6		232.1		174.3			280.1	
Turn Bay Length (m)				40.0		21.0		68.0		17.0
Base Capacity (vph)		406		529	530	2750	925	293	2598	1119
Starvation Cap Reductn		0		0	0	0	0	0	0	0
Spillback Cap Reductn		0		0	0	0	0	0	0	0
Storage Cap Reductn		0		0	0	0	0	0	0	0
Reduced v/c Ratio		0.22		0.09	0.08	0.42	0.01	0.02	0.27	0.04
Intersection Summary										
Cycle Length: 101.4										
Actuated Cycle Length: 84.6										
Natural Cycle: 105										
Control Type: Semi Act-Uncoord										

Splits and Phases: 9: Upper James Street & Dickenson Road West/Dickenson Road East



HCM Signalized Intersection Capacity Analysis

Existing AM Peak Hour

9: Upper James Street & Dickenson Road West/Dickenson Road East



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	45	1	37	5	12	26	41	1079	8	6	669	44
Future Volume (vph)	45	1	37	5	12	26	41	1079	8	6	669	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.2			6.2		6.3	6.3	6.3	6.3	6.3	6.3
Lane Util. Factor		1.00			1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frb, ped/bikes		0.99			1.00		1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes		1.00			1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.94			0.92		1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected		0.97			0.99		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1342			1541		1706	3544	1183	1560	3349	1432
Fit Permitted		0.80			0.96		0.38	1.00	1.00	0.23	1.00	1.00
Satd. Flow (perm)		1109			1488		684	3544	1183	377	3349	1432
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	48	1	39	5	13	28	44	1148	9	6	712	47
RTOR Reduction (vph)	0	35	0	0	25	0	0	0	2	0	0	9
Lane Group Flow (vph)	0	53	0	0	21	0	44	1148	7	6	712	38
Confl. Peds. (#/hr)			1	1								
Heavy Vehicles (%)	38%	100%	19%	0%	8%	19%	7%	3%	38%	17%	9%	14%
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		8			4			2		6		6
Permitted Phases	8			4			2		6			6
Actuated Green, G (s)		9.0			9.0		64.3	64.3	64.3	64.3	64.3	64.3
Effective Green, g (s)		9.0			9.0		64.3	64.3	64.3	64.3	64.3	64.3
Actuated g/C Ratio		0.10			0.10		0.75	0.75	0.75	0.75	0.75	0.75
Clearance Time (s)		6.2			6.2		6.3	6.3	6.3	6.3	6.3	6.3
Vehicle Extension (s)		3.0			3.0		5.7	5.7	5.7	5.7	5.7	5.7
Lane Grp Cap (vph)		116			156		512	2655	886	282	2509	1073
v/s Ratio Prot							c0.32				0.21	
v/s Ratio Perm		c0.05			0.01		0.06		0.01	0.02		0.03
v/c Ratio		0.46			0.13		0.09	0.43	0.01	0.02	0.28	0.04
Uniform Delay, d1		36.1			34.9		2.9	4.0	2.7	2.7	3.4	2.8
Progression Factor		1.00			1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		2.8			0.4		0.3	0.5	0.0	0.1	0.3	0.1
Delay (s)		39.0			35.3		3.2	4.5	2.7	2.9	3.7	2.8
Level of Service		D			D		A	A	A	A	A	A
Approach Delay (s)		39.0			35.3			4.4			3.6	
Approach LOS		D			D			A			A	

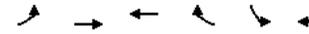
Intersection Summary	
HCM 2000 Control Delay	6.3 HCM 2000 Level of Service A
HCM 2000 Volume to Capacity ratio	0.44
Actuated Cycle Length (s)	85.8 Sum of lost time (s) 12.5
Intersection Capacity Utilization	116.2% ICU Level of Service H
Analysis Period (min)	15

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

Existing AM Peak Hour

12: Twenty Road West & Twentyplace Blvd



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	↔
Traffic Volume (veh/h)	8	248	344	7	20	26
Future Volume (Veh/h)	8	248	344	7	20	26
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	9	279	387	8	22	29
Pedestrians					2	
Lane Width (m)					3.7	
Walking Speed (m/s)					1.1	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume		397			690	393
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		397			690	393
tC, single (s)		4.1			6.4	6.2
tC, 2 stage (s)						
tF (s)		2.2			3.5	3.3
p0 queue free %		99			95	96
cM capacity (veh/h)		1170			410	659

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	288	395	51
Volume Left	9	0	22
Volume Right	0	8	29
cSH	1170	1700	522
Volume to Capacity	0.01	0.23	0.10
Queue Length 95th (m)	0.2	0.0	2.5
Control Delay (s)	0.3	0.0	12.6
Lane LOS	A		B
Approach Delay (s)	0.3	0.0	12.6
Approach LOS			B

Intersection Summary	
Average Delay	1.0
Intersection Capacity Utilization	29.5% ICU Level of Service A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
1: Glancaster Road & Twenty Road West

Existing PM Peak Hour

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	T	T	T	T	T	T
Sign Control	Stop		Stop			Stop
Traffic Volume (vph)	163	108	106	299	114	104
Future Volume (vph)	163	108	106	299	114	104
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	168	111	109	308	118	107
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total (vph)	279	417	225			
Volume Left (vph)	168	0	118			
Volume Right (vph)	111	308	0			
Hadj (s)	-0.06	-0.42	0.20			
Departure Headway (s)	5.4	4.6	5.5			
Degree Utilization, x	0.42	0.54	0.34			
Capacity (veh/h)	617	737	622			
Control Delay (s)	12.3	12.9	11.3			
Approach Delay (s)	12.3	12.9	11.3			
Approach LOS	B	B	B			
Intersection Summary						
Delay		12.3				
Level of Service		B				
Intersection Capacity Utilization		61.5%		ICU Level of Service	B	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
2: Twenty Road West & Silverbirch Blvd

Existing PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		T	T		T	T
Traffic Volume (veh/h)	23	396	266	50	38	15
Future Volume (Veh/h)	23	396	266	50	38	15
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	24	412	277	52	40	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	329				763	303
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	329				763	303
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				89	98
cM capacity (veh/h)	1242				361	741
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	436	329	56			
Volume Left	24	0	40			
Volume Right	0	52	16			
cSH	1242	1700	423			
Volume to Capacity	0.02	0.19	0.13			
Queue Length 95th (m)	0.4	0.0	3.4			
Control Delay (s)	0.6	0.0	14.8			
Lane LOS	A		B			
Approach Delay (s)	0.6	0.0	14.8			
Approach LOS			B			
Intersection Summary						
Average Delay		1.3				
Intersection Capacity Utilization		49.6%		ICU Level of Service	A	
Analysis Period (min)		15				

Timings
3: Twenty Road West & Garth Street

Existing PM Peak Hour

	EBL	EBT	WBT	SBL	SBR
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Configurations		↑	↑	↑	↑
Traffic Volume (vph)	170	270	223	190	98
Future Volume (vph)	170	270	223	190	98
Lane Group Flow (vph)	0	453	426	196	101
Turn Type	Perm	NA	NA	Perm	Perm
Protected Phases		2	2		
Permitted Phases	2			4	4
Detector Phase	2	2	2	4	4
Switch Phase					
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	36.4	36.4	36.4	26.3	26.3
Total Split (s)	66.4	66.4	66.4	36.3	36.3
Total Split (%)	64.7%	64.7%	64.7%	35.3%	35.3%
Yellow Time (s)	3.7	3.7	3.7	3.3	3.3
All-Red Time (s)	2.7	2.7	2.7	3.0	3.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0
Total Lost Time (s)		6.4	6.4	6.3	6.3
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	Max	Max	Max	None	None
v/c Ratio		0.52	0.35	0.65	0.29
Control Delay		10.1	6.1	44.7	8.9
Queue Delay		0.0	0.0	0.0	0.0
Total Delay		10.1	6.1	44.7	8.9
Queue Length 50th (m)		31.9	20.2	31.1	0.0
Queue Length 95th (m)		66.5	42.4	51.9	12.4
Internal Link Dist (m)		397.1	654.5	148.8	
Turn Bay Length (m)			24.0	24.0	
Base Capacity (vph)		878	1212	602	595
Starvation Cap Reductn		0	0	0	0
Spillback Cap Reductn		0	0	0	0
Storage Cap Reductn		0	0	0	0
Reduced v/c Ratio		0.52	0.35	0.33	0.17

Intersection Summary

Cycle Length: 102.7
Actuated Cycle Length: 88.4
Natural Cycle: 65
Control Type: Semi Act-Uncoord

Splits and Phases: 3: Twenty Road West & Garth Street



HCM Signalized Intersection Capacity Analysis
3: Twenty Road West & Garth Street

Existing PM Peak Hour

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↑	↑
Traffic Volume (vph)	170	270	223	190	190	98
Future Volume (vph)	170	270	223	190	190	98
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.4	6.4		6.3	6.3
Lane Util. Factor		1.00	1.00		1.00	1.00
Frbp, ped/bikes		1.00	0.99		1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	0.94		1.00	0.85
Fit Protected		0.98	1.00		0.95	1.00
Satd. Flow (prot)		1844	1734		1772	1555
Fit Permitted		0.68	1.00		0.95	1.00
Satd. Flow (perm)		1280	1734		1772	1555
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	175	278	230	196	196	101
RTOR Reduction (vph)	0	0	23	0	0	84
Lane Group Flow (vph)	0	453	403	0	196	17
Confl. Peds. (#/hr)	6			6		
Heavy Vehicles (%)	2%	2%	3%	2%	3%	5%
Turn Type	Perm	NA	NA		Perm	Perm
Protected Phases		2	2			
Permitted Phases	2				4	4
Actuated Green, G (s)		60.7	60.7		15.0	15.0
Effective Green, g (s)		60.7	60.7		15.0	15.0
Actuated g/C Ratio		0.69	0.69		0.17	0.17
Clearance Time (s)		6.4	6.4		6.3	6.3
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		878	1190		300	263
v/s Ratio Prot			0.23			
v/s Ratio Perm		c0.35			c0.11	0.01
v/c Ratio		0.52	0.34		0.65	0.07
Uniform Delay, d1		6.7	5.7		34.3	30.8
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		2.2	0.8		5.0	0.1
Delay (s)		8.9	6.4		39.3	30.9
Level of Service		A	A		D	C
Approach Delay (s)		8.9	6.4		36.5	
Approach LOS		A	A		D	

Intersection Summary

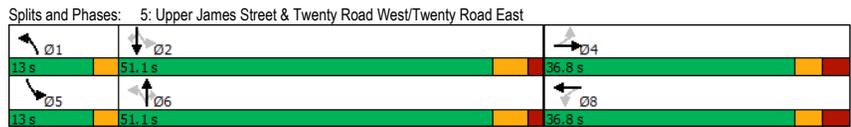
HCM 2000 Control Delay	15.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	88.4	Sum of lost time (s)	12.7
Intersection Capacity Utilization	75.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Timings Existing PM Peak Hour
5: Upper James Street & Twenty Road West/Twenty Road East

	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	68	251	70	232	113	967	114	96	1077	88
Future Volume (vph)	68	251	70	232	113	967	114	96	1077	88
Lane Group Flow (vph)	69	383	71	307	114	977	115	97	1088	89
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4		8		1		6		2
Permitted Phases	4		8		6		6	2		2
Detector Phase	4	4	8	8	1	6	6	5	2	2
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	45.0	45.0	5.0	45.0	45.0
Minimum Split (s)	34.8	34.8	34.8	34.8	8.0	51.1	51.1	8.0	51.1	51.1
Total Split (s)	36.8	36.8	36.8	36.8	13.0	51.1	51.1	13.0	51.1	51.1
Total Split (%)	36.5%	36.5%	36.5%	36.5%	12.9%	50.6%	50.6%	12.9%	50.6%	50.6%
Yellow Time (s)	3.3	3.3	3.3	3.3	3.0	4.2	4.2	3.0	4.2	4.2
All-Red Time (s)	3.5	3.5	3.5	3.5	0.0	1.9	1.9	0.0	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.8	6.8	6.8	6.8	3.0	6.1	6.1	3.0	6.1	6.1
Lead/Lag					Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.39	0.83	0.60	0.65	0.38	0.58	0.14	0.25	0.58	0.10
Control Delay	35.9	47.2	53.1	36.8	11.3	20.7	3.7	9.1	18.4	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.9	47.2	53.1	36.8	11.3	20.7	3.7	9.1	18.4	3.7
Queue Length 50th (m)	10.5	62.0	11.4	47.6	7.3	66.6	0.0	6.1	69.1	0.0
Queue Length 95th (m)	23.0	94.9	26.9	74.0	15.8	95.6	9.2	13.9	104.4	8.0
Internal Link Dist (m)		925.4		263.2		1046.5			203.7	
Turn Bay Length (m)	50.0		33.0		127.0		58.0	65.0		137.0
Base Capacity (vph)	227	578	150	595	376	1671	805	382	1886	870
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.66	0.47	0.52	0.30	0.58	0.14	0.25	0.58	0.10

Intersection Summary
 Cycle Length: 100.9
 Actuated Cycle Length: 94.9
 Natural Cycle: 95
 Control Type: Actuated-Uncoordinated



HCM Signalized Intersection Capacity Analysis Existing PM Peak Hour
 5: Upper James Street & Twenty Road West/Twenty Road East

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	68	251	128	70	232	72	113	967	114	96	1077	88
Future Volume (vph)	68	251	128	70	232	72	113	967	114	96	1077	88
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.8	6.8		6.8	6.8		3.0	6.1	6.1	3.0	6.1	6.1
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.95		1.00	0.96		1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1771	1769		1771	1842		1789	3510	1566	1789	3650	1601
Fit Permitted	0.38	1.00		0.25	1.00		0.20	1.00	1.00	0.19	1.00	1.00
Satd. Flow (perm)	716	1769		475	1842		369	3510	1566	360	3650	1601
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	69	254	129	71	234	73	114	977	115	97	1088	89
RTOR Reduction (vph)	0	20	0	0	12	0	0	0	60	0	0	43
Lane Group Flow (vph)	69	364	0	71	295	0	114	977	55	97	1088	46
Confl. Peds. (#/hr)	1		1	1		1		1	1		1	1
Heavy Vehicles (%)	3%	3%	2%	3%	0%	1%	2%	4%	2%	2%	0%	2%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		1	6		5	2	
Permitted Phases	4			8			6	2		2		2
Actuated Green, G (s)	23.7	23.7		23.7	23.7		51.4	45.2	45.2	58.2	49.0	49.0
Effective Green, g (s)	23.7	23.7		23.7	23.7		51.4	45.2	45.2	58.2	49.0	49.0
Actuated g/C Ratio	0.25	0.25		0.25	0.25		0.54	0.48	0.48	0.61	0.52	0.52
Clearance Time (s)	6.8	6.8		6.8	6.8		3.0	6.1	6.1	3.0	6.1	6.1
Vehicle Extension (s)	3.0	3.0		3.0	3.0		1.0	6.5	6.5	1.0	6.5	6.5
Lane Grp Cap (vph)	179	442		118	460		292	1673	746	371	1886	827
v/s Ratio Prot		c0.21			0.16		c0.03	0.28		c0.03	c0.30	
v/s Ratio Perm	0.10			0.15			0.19		0.04	0.13		0.03
v/c Ratio	0.39	0.82		0.60	0.64		0.39	0.58	0.07	0.26	0.58	0.06
Uniform Delay, d1	29.5	33.6		31.4	31.8		11.5	18.0	13.4	9.3	15.8	11.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.4	11.7		8.4	3.0		0.3	1.5	0.2	1.7	1.3	0.1
Delay (s)	30.9	45.3		39.7	34.8		11.8	19.5	13.6	11.0	17.1	11.5
Level of Service	C	D		D	C		B	B	B	B	B	B
Approach Delay (s)		43.1			35.7			18.2			16.2	
Approach LOS		D			D			B			B	

Intersection Summary
 HCM 2000 Control Delay 22.8 HCM 2000 Level of Service C
 HCM 2000 Volume to Capacity ratio 0.64
 Actuated Cycle Length (s) 94.8 Sum of lost time (s) 15.9
 Intersection Capacity Utilization 93.0% ICU Level of Service F
 Analysis Period (min) 15
 c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Glancaster Road & Book Road East

Existing PM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement						
Lane Configurations	T	T		T	T	
Sign Control	Stop			Stop	Stop	
Traffic Volume (vph)	379	136	67	32	66	153
Future Volume (vph)	379	136	67	32	66	153
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	395	142	70	33	69	159
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total (vph)	537	103	228			
Volume Left (vph)	395	70	0			
Volume Right (vph)	142	0	159			
Hadj (s)	0.02	0.21	-0.40			
Departure Headway (s)	4.8	5.9	5.1			
Degree Utilization, x	0.72	0.17	0.32			
Capacity (veh/h)	726	544	648			
Control Delay (s)	19.2	10.1	10.5			
Approach Delay (s)	19.2	10.1	10.5			
Approach LOS	C	B	B			
Intersection Summary						
Delay		15.8				
Level of Service		C				
Intersection Capacity Utilization		57.6%		ICU Level of Service	B	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
7: Upper James Street & Talbot Lane

Existing PM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement						
Lane Configurations	T	T		T	T	T
Traffic Volume (veh/h)	3	1	1	1216	1257	4
Future Volume (Veh/h)	3	1	1	1216	1257	4
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	3	1	1	1308	1352	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)				304		
pX, platoon unblocked	0.85					
vC, conflicting volume	2008	676	1356			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1831	676	1356			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	100	100			
cM capacity (veh/h)	59	401	514			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	4	437	872	676	676	4
Volume Left	3	1	0	0	0	0
Volume Right	1	0	0	0	0	4
cSH	75	514	1700	1700	1700	1700
Volume to Capacity	0.05	0.00	0.51	0.40	0.40	0.00
Queue Length 95th (m)	1.3	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	55.9	0.1	0.0	0.0	0.0	0.0
Lane LOS	F	A				
Approach Delay (s)	55.9	0.0		0.0		
Approach LOS	F					
Intersection Summary						
Average Delay		0.1				
Intersection Capacity Utilization		44.7%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
8: Glancaster Road & Dickenson Road West

Existing PM Peak Hour

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔		↔		↕	
Sign Control	Stop		Stop		Stop	
Traffic Volume (vph)	6	85	7	6	180	12
Future Volume (vph)	6	85	7	6	180	12
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Hourly flow rate (vph)	8	106	9	8	225	15
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total (vph)	114	17	240			
Volume Left (vph)	8	0	225			
Volume Right (vph)	106	8	0			
Hadj (s)	-0.53	-0.28	0.22			
Departure Headway (s)	4.0	4.1	4.4			
Degree Utilization, x	0.13	0.02	0.29			
Capacity (veh/h)	845	830	793			
Control Delay (s)	7.5	7.2	9.2			
Approach Delay (s)	7.5	7.2	9.2			
Approach LOS	A	A	A			
Intersection Summary						
Delay	8.6					
Level of Service	A					
Intersection Capacity Utilization	29.5%		ICU Level of Service		A	
Analysis Period (min)	15					

Timings

9: Upper James Street & Dickenson Road West/Dickenson Road East

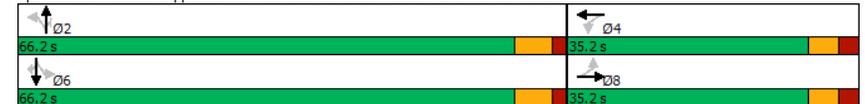
Existing PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↔		↔		↕		↕		↕		
Traffic Volume (vph)	82	6	6	9	36	1094	9	18	1155	35	
Future Volume (vph)	82	6	6	9	36	1094	9	18	1155	35	
Lane Group Flow (vph)	0	159	0	31	38	1164	10	19	1229	37	
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	
Protected Phases	8		4		2		2		6		
Permitted Phases	8		4		2		2		6		
Detector Phase	8	8	4	4	2	2	2	6	6	6	
Switch Phase											
Minimum Initial (s)	10.0	10.0	10.0	10.0	55.0	55.0	55.0	55.0	55.0	55.0	
Minimum Split (s)	35.2	35.2	35.2	35.2	66.2	66.2	66.2	66.2	66.2	66.2	
Total Split (s)	35.2	35.2	35.2	35.2	66.2	66.2	66.2	66.2	66.2	66.2	
Total Split (%)	34.7%	34.7%	34.7%	34.7%	65.3%	65.3%	65.3%	65.3%	65.3%	65.3%	
Yellow Time (s)	3.7	3.7	3.7	3.7	4.6	4.6	4.6	4.6	4.6	4.6	
All-Red Time (s)	2.5	2.5	2.5	2.5	1.7	1.7	1.7	1.7	1.7	1.7	
Lost Time Adjust (s)	0.0		0.0		0.0		0.0		0.0		
Total Lost Time (s)	6.2		6.2		6.3		6.3		6.3		
Lead/Lag											
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	Max	Max	Max	Max	Max	Max	
v/c Ratio		0.66		0.12	0.14	0.47	0.01	0.07	0.49	0.04	
Control Delay		39.9		20.6	7.1	7.1	0.1	6.1	7.4	2.3	
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay		39.9		20.6	7.1	7.1	0.1	6.1	7.4	2.3	
Queue Length 50th (m)		19.2		2.3	1.8	37.9	0.0	0.8	41.1	0.2	
Queue Length 95th (m)		38.3		9.3	6.8	66.2	0.3	3.8	71.6	3.3	
Internal Link Dist (m)		2863.6		232.1		174.3		280.1			
Turn Bay Length (m)				40.0		21.0		68.0		17.0	
Base Capacity (vph)		463		542	265	2490	1157	290	2490	943	
Starvation Cap Reductn		0		0	0	0	0	0	0	0	
Spillback Cap Reductn		0		0	0	0	0	0	0	0	
Storage Cap Reductn		0		0	0	0	0	0	0	0	
Reduced v/c Ratio		0.34		0.06	0.14	0.47	0.01	0.07	0.49	0.04	

Intersection Summary

Cycle Length: 101.4
Actuated Cycle Length: 89.4
Natural Cycle: 105
Control Type: Semi Act-Uncoord

Splits and Phases: 9: Upper James Street & Dickenson Road West/Dickenson Road East



HCM Signalized Intersection Capacity Analysis

Existing PM Peak Hour

9: Upper James Street & Dickenson Road West/Dickenson Road East



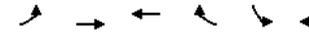
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	82	6	62	6	9	14	36	1094	9	18	1155	35
Future Volume (vph)	82	6	62	6	9	14	36	1094	9	18	1155	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.2			6.2		6.3	6.3	6.3	6.3	6.3	6.3
Lane Util. Factor		1.00			1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frt		0.94			0.93		1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected		0.97			0.99		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1619			1722		1825	3544	1633	1825	3544	1328
Fit Permitted		0.81			0.94		0.20	1.00	1.00	0.21	1.00	1.00
Satd. Flow (perm)		1351			1635		378	3544	1633	413	3544	1328
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	87	6	66	6	10	15	38	1164	10	19	1229	37
RTOR Reduction (vph)	0	30	0	0	13	0	0	0	3	0	0	10
Lane Group Flow (vph)	0	129	0	0	18	0	38	1164	7	19	1229	27
Heavy Vehicles (%)	15%	0%	2%	17%	0%	0%	0%	3%	0%	0%	3%	23%
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		8			4			2		6		6
Permitted Phases	8			4			2		2	6		6
Actuated Green, G (s)		14.0			14.0		62.8	62.8	62.8	62.8		62.8
Effective Green, g (s)		14.0			14.0		62.8	62.8	62.8	62.8		62.8
Actuated g/C Ratio		0.16			0.16		0.70	0.70	0.70	0.70		0.70
Clearance Time (s)		6.2			6.2		6.3	6.3	6.3	6.3		6.3
Vehicle Extension (s)		3.0			3.0		5.7	5.7	5.7	5.7		5.7
Lane Grp Cap (vph)		211			256		265	2492	1148	290	2492	933
v/s Ratio Prot								0.33				0.35
v/s Ratio Perm		0.10			0.01		0.10		0.00	0.05		0.02
v/c Ratio		0.61			0.07		0.14	0.47	0.01	0.07		0.49
Uniform Delay, d1		35.1			32.1		4.4	5.9	3.9	4.1		6.0
Progression Factor		1.00			1.00		1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2		5.2			0.1		1.1	0.6	0.0	0.4		0.7
Delay (s)		40.3			32.2		5.5	6.5	4.0	4.6		6.7
Level of Service		D			C		A	A	A	A		A
Approach Delay (s)		40.3			32.2			6.4				6.6
Approach LOS		D			C			A				A

Intersection Summary			
HCM 2000 Control Delay	8.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	89.3	Sum of lost time (s)	12.5
Intersection Capacity Utilization	116.0%	ICU Level of Service	H
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis

Existing PM Peak Hour

12: Twenty Road West & Twentyplace Blvd



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	↔
Traffic Volume (veh/h)	36	436	385	28	15	18
Future Volume (Veh/h)	36	436	385	28	15	18
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	38	454	401	29	16	19
Pedestrians		1			1	
Lane Width (m)		3.7			3.7	
Walking Speed (m/s)		1.1			1.1	
Percent Blockage		0			0	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	431				946	418
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	431				946	418
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				94	97
cM capacity (veh/h)	1122				282	638

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	492	430	35
Volume Left	38	0	16
Volume Right	0	29	19
cSH	1122	1700	405
Volume to Capacity	0.03	0.25	0.09
Queue Length 95th (m)	0.8	0.0	2.1
Control Delay (s)	1.0	0.0	14.7
Lane LOS	A		B
Approach Delay (s)	1.0	0.0	14.7
Approach LOS			B

Intersection Summary			
Average Delay		1.1	
Intersection Capacity Utilization		60.6%	ICU Level of Service
Analysis Period (min)		15	

Appendix 2

2031 Background Conditions

HCM Unsignalized Intersection Capacity Analysis
1: Glancaster Road & Twenty Road West

Background 2031 AM Peak Hour

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	T	T	T	T	T	T
Sign Control	Stop		Stop			Stop
Traffic Volume (vph)	162	115	145	164	75	95
Future Volume (vph)	162	115	145	164	75	95
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	191	135	171	193	88	112
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total (vph)	326	364	200			
Volume Left (vph)	191	0	88			
Volume Right (vph)	135	193	0			
Hadj (s)	-0.12	-0.26	0.12			
Departure Headway (s)	5.2	4.9	5.4			
Degree Utilization, x	0.47	0.49	0.30			
Capacity (veh/h)	648	697	619			
Control Delay (s)	12.8	12.5	10.8			
Approach Delay (s)	12.8	12.5	10.8			
Approach LOS	B	B	B			
Intersection Summary						
Delay		12.2				
Level of Service		B				
Intersection Capacity Utilization		52.8%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
2: Twenty Road West & Silverbirch Blvd

Background 2031 AM Peak Hour

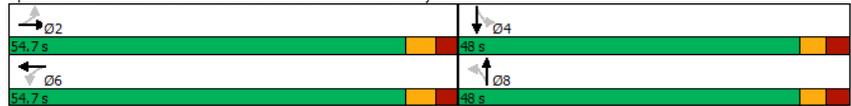
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		T	T		T	
Traffic Volume (veh/h)	14	274	268	14	55	16
Future Volume (Veh/h)	14	274	268	14	55	16
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	15	291	285	15	59	17
Pedestrians						
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	300				614	292
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	300				614	292
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				87	98
cM capacity (veh/h)	1273				453	742
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	306	300	76			
Volume Left	15	0	59			
Volume Right	0	15	17			
cSH	1273	1700	497			
Volume to Capacity	0.01	0.18	0.15			
Queue Length 95th (m)	0.3	0.0	4.1			
Control Delay (s)	0.5	0.0	13.6			
Lane LOS	A		B			
Approach Delay (s)	0.5	0.0	13.6			
Approach LOS			B			
Intersection Summary						
Average Delay		1.7				
Intersection Capacity Utilization		36.5%		ICU Level of Service	A	
Analysis Period (min)		15				

Timings Background 2031 AM Peak Hour
3: Garth Street Extension/Garth Street & Twenty Road West

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	121	144	70	178	10	50	166	50
Future Volume (vph)	121	144	70	178	10	50	166	50
Lane Group Flow (vph)	127	226	74	384	11	64	175	152
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		8		4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	4	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	5.0	10.0	10.0
Minimum Split (s)	36.4	36.4	36.4	36.4	24.5	24.5	26.3	26.3
Total Split (s)	54.7	54.7	54.7	54.7	48.0	48.0	48.0	48.0
Total Split (%)	53.3%	53.3%	53.3%	53.3%	46.7%	46.7%	46.7%	46.7%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.3	3.3	3.3	3.3
All-Red Time (s)	2.7	2.7	2.7	2.7	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.4	6.4	6.4	6.4	6.3	6.3	6.3	6.3
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	None	None	None	None
v/c Ratio	0.21	0.20	0.10	0.35	0.04	0.09	0.66	0.21
Control Delay	8.0	6.2	7.0	7.0	24.0	21.0	40.3	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.0	6.2	7.0	7.0	24.0	21.0	40.3	10.8
Queue Length 50th (m)	6.8	10.0	3.7	17.7	1.3	3.3	23.4	3.3
Queue Length 95th (m)	17.8	23.5	10.4	40.0	5.1	7.9	42.4	10.1
Internal Link Dist (m)		397.1		655.9		1388.7		148.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	603	1138	750	1105	688	1948	727	1821
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.21	0.20	0.10	0.35	0.02	0.03	0.24	0.08

Intersection Summary
 Cycle Length: 102.7
 Actuated Cycle Length: 76.5
 Natural Cycle: 65
 Control Type: Semi Act-Uncoord

Splits and Phases: 3: Garth Street Extension/Garth Street & Twenty Road West



HCM Signalized Intersection Capacity Analysis Background 2031 AM Peak Hour
3: Garth Street Extension/Garth Street & Twenty Road West

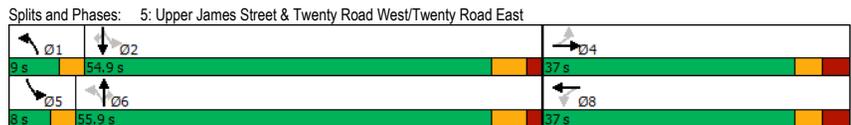
	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	121	144	70	70	178	187	10	50	10	166	50	94
Future Volume (vph)	121	144	70	70	178	187	10	50	10	166	50	94
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4		6.4	6.4		6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.95		1.00	0.92		1.00	0.97		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1738	1779		1825	1705		1825	3556		1772	3251	
Flt Permitted	0.52	1.00		0.62	1.00		0.66	1.00		0.71	1.00	
Satd. Flow (perm)	953	1779		1186	1705		1260	3556		1330	3251	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	127	152	74	74	187	197	11	53	11	175	53	99
RTOR Reduction (vph)	0	12	0	0	26	0	0	9	0	0	79	0
Lane Group Flow (vph)	127	214	0	74	358	0	11	55	0	175	73	0
Heavy Vehicles (%)	5%	4%	0%	0%	3%	5%	0%	0%	0%	3%	0%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2				6			8			4	
Actuated Green, G (s)	48.4	48.4		48.4	48.4		15.3	15.3		15.3	15.3	
Effective Green, g (s)	48.4	48.4		48.4	48.4		15.3	15.3		15.3	15.3	
Actuated g/C Ratio	0.63	0.63		0.63	0.63		0.20	0.20		0.20	0.20	
Clearance Time (s)	6.4	6.4		6.4	6.4		6.3	6.3		6.3	6.3	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	603	1127		751	1080		252	712		266	651	
v/s Ratio Prot		0.12			0.21			0.02			0.02	
v/s Ratio Perm	0.13			0.06			0.01			0.13		
v/c Ratio	0.21	0.19		0.10	0.33		0.04	0.08		0.66	0.11	
Uniform Delay, d1	5.9	5.8		5.5	6.5		24.6	24.8		28.1	25.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.8	0.4		0.3	0.8		0.1	0.0		5.8	0.1	
Delay (s)	6.7	6.2		5.7	7.3		24.7	24.9		33.9	25.1	
Level of Service	A	A		A	A		C	C		C	C	
Approach Delay (s)		6.4			7.1			24.8			29.8	
Approach LOS		A			A			C			C	

Intersection Summary
 HCM 2000 Control Delay: 14.1
 HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.41
 Actuated Cycle Length (s): 76.4
 Sum of lost time (s): 12.7
 Intersection Capacity Utilization: 60.9%
 ICU Level of Service: B
 Analysis Period (min): 15
 Critical Lane Group

Timings Background 2031 AM Peak Hour
5: Upper James Street & Twenty Road West/Twenty Road East

	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	77	145	57	193	131	1045	79	45	610	46
Future Volume (vph)	77	145	57	193	131	1045	79	45	610	46
Lane Group Flow (vph)	83	248	61	336	141	1124	85	48	656	49
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4		8		6		5		2
Permitted Phases	4		8		6		6	2		2
Detector Phase	4	4	8	8	1	6	6	5	2	2
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	45.0	45.0	5.0	45.0	45.0
Minimum Split (s)	34.8	34.8	34.8	34.8	8.0	51.1	51.1	8.0	51.1	51.1
Total Split (s)	37.0	37.0	37.0	37.0	9.0	55.9	55.9	8.0	54.9	54.9
Total Split (%)	36.7%	36.7%	36.7%	36.7%	8.9%	55.4%	55.4%	7.9%	54.4%	54.4%
Yellow Time (s)	3.3	3.3	3.3	3.3	3.0	4.2	4.2	3.0	4.2	4.2
All-Red Time (s)	3.5	3.5	3.5	3.5	0.0	1.9	1.9	0.0	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.8	6.8	6.8	6.8	3.0	6.1	6.1	3.0	6.1	6.1
Lead/Lag					Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.63	0.57	0.29	0.78	0.27	0.60	0.09	0.16	0.37	0.05
Control Delay	53.1	32.5	32.3	42.8	8.2	17.0	3.3	8.2	14.1	1.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.1	32.5	32.3	42.8	8.2	17.0	3.3	8.2	14.1	1.7
Queue Length 50th (m)	13.3	34.2	8.9	50.9	8.0	66.3	0.0	2.6	33.4	0.0
Queue Length 95th (m)	29.2	56.6	19.6	79.5	19.1	105.5	7.3	7.9	55.5	3.2
Internal Link Dist (m)		924.0		263.2		1046.5		203.7		
Turn Bay Length (m)	50.0		33.0		127.0		58.0	65.0		137.0
Base Capacity (vph)	189	609	300	606	523	1868	924	298	1778	909
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.41	0.20	0.55	0.27	0.60	0.09	0.16	0.37	0.05

Intersection Summary
 Cycle Length: 100.9
 Actuated Cycle Length: 92.2
 Natural Cycle: 95
 Control Type: Actuated-Uncoordinated



HCM Signalized Intersection Capacity Analysis Background 2031 AM Peak Hour
 5: Upper James Street & Twenty Road West/Twenty Road East

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	77	145	86	57	193	119	131	1045	79	45	610	46
Future Volume (vph)	77	145	86	57	193	119	131	1045	79	45	610	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.8	6.8		6.8	6.8		3.0	6.1	6.1	3.0	6.1	6.1
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.94		1.00	0.94		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	1792		1825	1778		1825	3444	1633	1825	3318	1633
Flt Permitted	0.31	1.00		0.48	1.00		0.37	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	576	1792		914	1778		702	3444	1633	350	3318	1633
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	83	156	92	61	208	128	141	1124	85	48	656	49
RTOR Reduction (vph)	0	23	0	0	24	0	0	0	39	0	0	23
Lane Group Flow (vph)	83	225	0	61	312	0	141	1124	46	48	656	26
Heavy Vehicles (%)	3%	2%	0%	0%	3%	0%	0%	6%	0%	0%	10%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		1	6		5		2
Permitted Phases	4			8			6		6	2		2
Actuated Green, G (s)	21.2	21.2		21.2	21.2		55.6	50.0	50.0	54.4	49.4	49.4
Effective Green, g (s)	21.2	21.2		21.2	21.2		55.6	50.0	50.0	54.4	49.4	49.4
Actuated g/C Ratio	0.23	0.23		0.23	0.23		0.60	0.54	0.54	0.59	0.54	0.54
Clearance Time (s)	6.8	6.8		6.8	6.8		3.0	6.1	6.1	3.0	6.1	6.1
Vehicle Extension (s)	3.0	3.0		3.0	3.0		1.0	6.5	6.5	1.0	6.5	6.5
Lane Grp Cap (vph)	132	412		210	409		492	1869	886	286	1779	875
v/s Ratio Prot		0.13			c0.18		c0.02	c0.33		0.01	0.20	
v/s Ratio Perm	0.14			0.07			0.16		0.03	0.09		0.02
v/c Ratio	0.63	0.55		0.29	0.76		0.29	0.60	0.05	0.17	0.37	0.03
Uniform Delay, d1	31.9	31.2		29.2	33.1		8.0	14.3	9.9	9.1	12.3	10.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.0	1.5		0.8	8.2		0.1	1.4	0.1	1.3	0.6	0.1
Delay (s)	40.9	32.7		30.0	41.3		8.1	15.7	10.0	10.4	12.9	10.1
Level of Service	D	C		C	D		A	B	B	B	B	B
Approach Delay (s)		34.8			39.6			14.6			12.6	
Approach LOS		C			D			B			B	

Intersection Summary
 HCM 2000 Control Delay: 19.9
 HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.63
 Actuated Cycle Length (s): 92.1
 Sum of lost time (s): 15.9
 Intersection Capacity Utilization: 90.3%
 ICU Level of Service: E
 Analysis Period (min): 15
 Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Glancaster Road & Book Road East

Background 2031 AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔			↑	↔	
Sign Control	Stop			Stop	Stop	
Traffic Volume (vph)	226	70	55	133	107	247
Future Volume (vph)	226	70	55	133	107	247
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	257	80	62	151	122	281
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total (vph)	337	213	403			
Volume Left (vph)	257	62	0			
Volume Right (vph)	80	0	281			
Hadj (s)	0.08	0.20	-0.42			
Departure Headway (s)	5.5	5.7	4.8			
Degree Utilization, x	0.52	0.34	0.54			
Capacity (veh/h)	612	585	710			
Control Delay (s)	14.4	11.5	13.4			
Approach Delay (s)	14.4	11.5	13.4			
Approach LOS	B	B	B			
Intersection Summary						
Delay	13.3					
Level of Service	B					
Intersection Capacity Utilization	57.6%		ICU Level of Service	B		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
7: Upper James Street & Talbot Lane

Background 2031 AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR		
Lane Configurations	↔	↔	↔	↑↑	↑↑	↔		
Traffic Volume (veh/h)	1	2	0	1262	759	1		
Future Volume (Veh/h)	1	2	0	1262	759	1		
Sign Control	Stop			Free	Free			
Grade	0%			0%	0%			
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95		
Hourly flow rate (vph)	1	2	0	1328	799	1		
Pedestrians								
Lane Width (m)								
Walking Speed (m/s)								
Percent Blockage								
Right turn flare (veh)								
Median type			None	None				
Median storage (veh)								
Upstream signal (m)	304							
pX, platoon unblocked	0.84							
vC, conflicting volume	1463	400	800					
vC1, stage 1 conf vol								
vC2, stage 2 conf vol								
vCu, unblocked vol	1180	400	800					
tC, single (s)	6.8	6.9	4.1					
tC, 2 stage (s)								
tF (s)	3.5	3.3	2.2					
p0 queue free %	99	100	100					
cM capacity (veh/h)	157	606	832					
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	1	2	0	664	664	400	400	1
Volume Left	1	0	0	0	0	0	0	0
Volume Right	0	2	0	0	0	0	0	1
cSH	157	606	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.01	0.00	0.00	0.39	0.39	0.23	0.23	0.00
Queue Length 95th (m)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	28.1	11.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	D	B						
Approach Delay (s)	16.7	0.0		0.0				
Approach LOS	C							
Intersection Summary								
Average Delay	0.0							
Intersection Capacity Utilization	44.9%		ICU Level of Service	A				
Analysis Period (min)	15							

Timings
8: Glancaster Road & Dickenson Road West

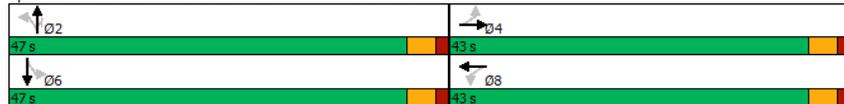
Background 2031 AM Peak Hour

	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↔	↕	↔	↕	↔	↕	↔	↔	↕
Traffic Volume (vph)	10	75	50	100	50	70	50	117	50
Future Volume (vph)	10	75	50	100	50	70	50	117	50
Lane Group Flow (vph)	12	149	60	248	60	83	60	139	72
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA
Protected Phases		4		8		2		2	6
Permitted Phases	4		8		2		2	6	
Detector Phase	4	4	8	8	2	2	2	6	6
Switch Phase									
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	43.0	43.0	43.0	43.0	47.0	47.0	47.0	47.0	47.0
Total Split (%)	47.8%	47.8%	47.8%	47.8%	52.2%	52.2%	52.2%	52.2%	52.2%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Min	Min	Min	Min	Min
v/c Ratio	0.03	0.11	0.16	0.18	0.09	0.09	0.07	0.22	0.08
Control Delay	6.7	4.7	8.0	4.0	7.0	6.8	2.7	8.1	6.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.7	4.7	8.0	4.0	7.0	6.8	2.7	8.1	6.0
Queue Length 50th (m)	0.3	1.3	1.8	1.7	1.7	2.4	0.0	4.2	1.7
Queue Length 95th (m)	1.7	3.6	5.2	4.7	4.7	5.8	2.7	9.3	4.8
Internal Link Dist (m)		150.3		1543.1		112.9			456.5
Turn Bay Length (m)	50.0		50.0		50.0		50.0		
Base Capacity (vph)	1149	3431	1011	3365	1364	1921	1633	1351	1873
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.04	0.06	0.07	0.04	0.04	0.04	0.10	0.04

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 27
Natural Cycle: 45
Control Type: Semi Act-Uncoord

Splits and Phases: 8: Glancaster Road & Dickenson Road West



HCM Signalized Intersection Capacity Analysis
8: Glancaster Road & Dickenson Road West

Background 2031 AM Peak Hour

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↕	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	10	75	50	50	100	108	50	70	50	117	50	10
Future Volume (vph)	10	75	50	50	100	108	50	70	50	117	50	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.94		1.00	0.92		1.00	1.00	0.85	1.00	0.97	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1825	3430		1460	3365		1825	1921	1633	1825	1873	
Fit Permitted	0.60	1.00		0.66	1.00		0.71	1.00	1.00	0.70	1.00	
Satd. Flow (perm)	1149	3430		1011	3365		1364	1921	1633	1351	1873	
Peak-hour factor, PHF	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Adj. Flow (vph)	12	89	60	60	119	129	60	83	60	139	60	12
RTOR Reduction (vph)	0	44	0	0	95	0	0	35	0	7	0	0
Lane Group Flow (vph)	12	105	0	60	153	0	60	83	25	139	65	0
Heavy Vehicles (%)	0%	0%	0%	25%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2		6		
Permitted Phases	4			8			2		6			
Actuated Green, G (s)	7.4	7.4		7.4	7.4		11.6	11.6	11.6	11.6		
Effective Green, g (s)	7.4	7.4		7.4	7.4		11.6	11.6	11.6	11.6		
Actuated g/C Ratio	0.26	0.26		0.26	0.26		0.41	0.41	0.41	0.41		
Clearance Time (s)	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		
Lane Grp Cap (vph)	303	906		267	889		565	795	676	559	775	
v/s Ratio Prot		0.03			0.05			0.04			0.03	
v/s Ratio Perm	0.01			c0.06			0.04		0.02	c0.10		
v/c Ratio	0.04	0.12		0.22	0.17		0.11	0.10	0.04	0.25	0.08	
Uniform Delay, d1	7.7	7.8		8.1	7.9		5.0	5.0	4.9	5.4	5.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.1		0.4	0.1		0.1	0.1	0.0	0.2	0.0	
Delay (s)	7.7	7.9		8.5	8.0		5.1	5.1	4.9	5.6	5.0	
Level of Service	A	A		A	A		A	A	A	A	A	
Approach Delay (s)		7.9			8.1			5.0			5.4	
Approach LOS		A			A			A			A	

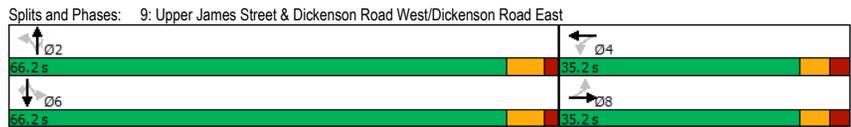
Intersection Summary

HCM 2000 Control Delay: 6.7, HCM 2000 Level of Service: A
 HCM 2000 Volume to Capacity ratio: 0.24
 Actuated Cycle Length (s): 28.0, Sum of lost time (s): 9.0
 Intersection Capacity Utilization: 41.1%, ICU Level of Service: A
 Analysis Period (min): 15
 c Critical Lane Group

Timings Background 2031 AM Peak Hour
9: Upper James Street & Dickenson Road West/Dickenson Road East

	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	77	102	9	221	70	1123	8	6	696	76
Future Volume (vph)	77	102	9	221	70	1123	8	6	696	76
Lane Group Flow (vph)	81	174	9	280	74	1182	8	6	733	80
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA	Perm
Protected Phases		8		4		2		2	6	
Permitted Phases	8		4		2		2	6		6
Detector Phase	8	8	4	4	2	2	2	6	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	55.0	55.0	55.0	55.0	55.0	55.0
Minimum Split (s)	35.2	35.2	35.2	35.2	66.2	66.2	66.2	61.3	61.3	61.3
Total Split (s)	35.2	35.2	35.2	35.2	66.2	66.2	66.2	66.2	66.2	66.2
Total Split (%)	34.7%	34.7%	34.7%	34.7%	65.3%	65.3%	65.3%	65.3%	65.3%	65.3%
Yellow Time (s)	3.7	3.7	3.7	3.7	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	2.5	2.5	2.5	2.5	1.7	1.7	1.7	1.7	1.7	1.7
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	Max	Max	Max	Max	Max	Max
v/c Ratio	0.51	0.33	0.05	0.52	0.16	0.48	0.01	0.03	0.31	0.07
Control Delay	45.1	21.4	31.0	34.1	5.8	6.6	0.0	5.0	5.3	2.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.1	21.4	31.0	34.1	5.8	6.6	0.0	5.0	5.3	2.1
Queue Length 50th (m)	12.3	8.1	1.3	20.4	3.2	35.7	0.0	0.2	18.6	0.8
Queue Length 95th (m)	25.9	16.9	5.2	32.0	9.7	60.7	0.0	1.6	33.0	5.2
Internal Link Dist (m)		1296.5		232.1		174.3			280.1	
Turn Bay Length (m)	15.0		15.0		40.0		21.0	68.0		17.0
Base Capacity (vph)	372	1144	421	1232	452	2455	1163	226	2388	1170
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.15	0.02	0.23	0.16	0.48	0.01	0.03	0.31	0.07

Intersection Summary
 Cycle Length: 101.4
 Actuated Cycle Length: 84.9
 Natural Cycle: 105
 Control Type: Semi Act-Uncoord



HCM Signalized Intersection Capacity Analysis Background 2031 AM Peak Hour
9: Upper James Street & Dickenson Road West/Dickenson Road East

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	77	102	64	9	221	45	70	1123	8	6	696	76
Future Volume (vph)	77	102	64	9	221	45	70	1123	8	6	696	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.2	6.2		6.2	6.2		6.3	6.3	6.3	6.3	6.3	6.3
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.94		1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	3219		1825	3558		1644	3476	1633	1437	3380	1633
Fit Permitted	0.57	1.00		0.64	1.00		0.37	1.00	1.00	0.21	1.00	1.00
Satd. Flow (perm)	1090	3219		1233	3558		641	3476	1633	320	3380	1633
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	81	107	67	9	233	47	74	1182	8	6	733	80
RTOR Reduction (vph)	0	57	0	0	20	0	0	2	0	0	17	0
Lane Group Flow (vph)	81	117	0	9	260	0	74	1182	6	6	733	63
Heavy Vehicles (%)	0%	3%	13%	0%	0%	0%	11%	5%	0%	27%	8%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		8			4			2		6		6
Permitted Phases	8			4			2		6		6	
Actuated Green, G (s)	12.4	12.4		12.4	12.4		60.0	60.0	60.0	60.0	60.0	60.0
Effective Green, g (s)	12.4	12.4		12.4	12.4		60.0	60.0	60.0	60.0	60.0	60.0
Actuated g/C Ratio	0.15	0.15		0.15	0.15		0.71	0.71	0.71	0.71	0.71	0.71
Clearance Time (s)	6.2	6.2		6.2	6.2		6.3	6.3	6.3	6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0		3.0	3.0		5.7	5.7	5.7	5.7	5.7	5.7
Lane Grp Cap (vph)	159	470		180	519		453	2456	1154	226	2388	1154
v/s Ratio Prot		0.04			0.07			c0.34				0.22
v/s Ratio Perm	c0.07			0.01			0.12		0.00	0.02		0.04
v/c Ratio	0.51	0.25		0.05	0.50		0.16	0.48	0.00	0.03	0.31	0.05
Uniform Delay, d1	33.4	32.1		31.2	33.4		4.1	5.5	3.7	3.7	4.7	3.8
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.6	0.3		0.1	0.8		0.8	0.7	0.0	0.2	0.3	0.1
Delay (s)	36.0	32.4		31.3	34.2		4.9	6.2	3.7	3.9	5.0	3.9
Level of Service	D	C		C	C		A	A	A	A	A	A
Approach Delay (s)		33.5			34.1			6.1			4.9	
Approach LOS		C			C			A			A	

Intersection Summary

HCM 2000 Control Delay	11.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	84.9	Sum of lost time (s)	12.5
Intersection Capacity Utilization	115.7%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
12: Twenty Road West & Twentyplace Boulevard

Background 2031 AM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑↓		↓	
Traffic Volume (veh/h)	8	288	395	7	20	26
Future Volume (Veh/h)	8	288	395	7	20	26
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)	9	313	429	8	22	28
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	437				764	433
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	437				764	433
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				94	96
cM capacity (veh/h)	1123				369	623
Direction_Lane #	EB 1	WB 1	SB 1			
Volume Total	322	437	50			
Volume Left	9	0	22			
Volume Right	0	8	28			
cSH	1123	1700	478			
Volume to Capacity	0.01	0.26	0.10			
Queue Length 95th (m)	0.2	0.0	2.6			
Control Delay (s)	0.3	0.0	13.4			
Lane LOS	A		B			
Approach Delay (s)	0.3	0.0	13.4			
Approach LOS			B			
Intersection Summary						
Average Delay		1.0				
Intersection Capacity Utilization		31.6%		ICU Level of Service	A	
Analysis Period (min)		15				

Timings
16: Garth Street Extension & Dickenson Road West

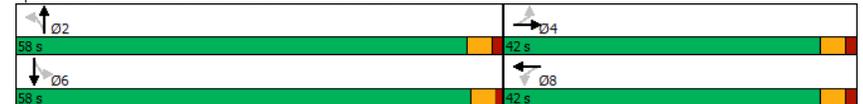
Background 2031 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↑	↑↓	↑	↑↓	↑	↑↓	↑	↑↓
Traffic Volume (vph)	10	40	140	150	100	50	20	150
Future Volume (vph)	10	40	140	150	100	50	20	150
Lane Group Flow (vph)	11	260	152	174	109	326	22	185
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	42.0	42.0	42.0	42.0	58.0	58.0	58.0	58.0
Total Split (%)	42.0%	42.0%	42.0%	42.0%	58.0%	58.0%	58.0%	58.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.03	0.21	0.39	0.14	0.26	0.26	0.06	0.14
Control Delay	6.7	2.5	10.8	6.7	9.4	2.6	7.1	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.7	2.5	10.8	6.7	9.4	2.6	7.1	6.2
Queue Length 50th (m)	0.3	0.6	4.9	2.5	3.3	0.7	0.6	2.3
Queue Length 95th (m)	1.9	4.4	13.8	6.2	10.5	5.3	3.1	6.4
Internal Link Dist (m)		1543.1		1296.5		105.4		1388.7
Turn Bay Length (m)	50.0		50.0		50.0		50.0	
Base Capacity (vph)	1209	3131	1113	3546	1196	3131	1045	3514
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.08	0.14	0.05	0.09	0.10	0.02	0.05

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 30.1
Natural Cycle: 45
Control Type: Actuated-Uncoordinated

Splits and Phases: 16: Garth Street Extension & Dickenson Road West



HCM Signalized Intersection Capacity Analysis
 16: Garth Street Extension & Dickenson Road West

Background 2031 AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕		↔	↕		↔	↕		↔	↕	
Traffic Volume (vph)	10	40	200	140	150	10	100	50	250	20	150	20
Future Volume (vph)	10	40	200	140	150	10	100	50	250	20	150	20
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		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.87		1.00	0.99		1.00	0.87		1.00	0.98	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3131		1789	3545		1789	3131		1789	3515	
Fit Permitted	0.64	1.00		0.59	1.00		0.64	1.00		0.55	1.00	
Satd. Flow (perm)	1209	3131		1113	3545		1196	3131		1045	3515	
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)	11	43	217	152	163	11	109	54	272	22	163	22
RTOR Reduction (vph)	0	140	0	0	5	0	0	178	0	0	14	0
Lane Group Flow (vph)	11	120	0	152	169	0	109	148	0	22	171	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)	10.7	10.7		10.7	10.7		10.4	10.4		10.9	10.9	
Effective Green, g (s)	10.7	10.7		10.7	10.7		10.4	10.4		10.9	10.9	
Actuated g/C Ratio	0.36	0.36		0.36	0.36		0.35	0.35		0.36	0.36	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	429	1113		395	1260		413	1081		378	1272	
v/s Ratio Prot		0.04			0.05			0.05			0.05	
v/s Ratio Perm	0.01			0.14			0.09			0.02		
v/c Ratio	0.03	0.11		0.38	0.13		0.26	0.14		0.06	0.13	
Uniform Delay, d1	6.3	6.5		7.2	6.6		7.1	6.8		6.3	6.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.0	0.0		0.6	0.0		0.3	0.1		0.1	0.0	
Delay (s)	6.3	6.5		7.9	6.6		7.4	6.8		6.3	6.5	
Level of Service	A	A		A	A		A	A		A	A	
Approach Delay (s)		6.5			7.2			7.0			6.5	
Approach LOS		A			A			A			A	
Intersection Summary												
HCM 2000 Control Delay			6.9									
HCM 2000 Volume to Capacity ratio			0.32									
Actuated Cycle Length (s)			30.1									
Intersection Capacity Utilization			44.9%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis
1: Glancaster Road & Twenty Road West

Background 2031 PM Peak Hour

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	T		T			T
Sign Control	Stop		Stop			Stop
Traffic Volume (vph)	199	112	157	442	139	127
Future Volume (vph)	199	112	157	442	139	127
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	234	132	185	520	164	149
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total (vph)	366	705	313			
Volume Left (vph)	234	0	164			
Volume Right (vph)	132	520	0			
Hadj (s)	-0.08	-0.37	0.13			
Departure Headway (s)	6.4	5.4	6.3			
Degree Utilization, x	0.65	1.06	0.55			
Capacity (veh/h)	555	674	547			
Control Delay (s)	20.3	75.3	16.8			
Approach Delay (s)	20.3	75.3	16.8			
Approach LOS	C	F	C			
Intersection Summary						
Delay		47.5				
Level of Service		E				
Intersection Capacity Utilization		77.7%		ICU Level of Service	D	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
2: Twenty Road West & Silverbirch Blvd

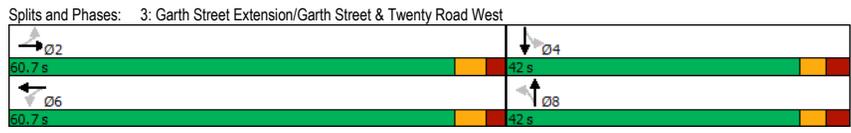
Background 2031 PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		T	T		T	
Traffic Volume (veh/h)	23	532	327	50	38	15
Future Volume (Veh/h)	23	532	327	50	38	15
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	24	566	348	53	40	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	401				988	374
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	401				988	374
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				85	98
cM capacity (veh/h)	1169				270	667
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	590	401	56			
Volume Left	24	0	40			
Volume Right	0	53	16			
cSH	1169	1700	326			
Volume to Capacity	0.02	0.24	0.17			
Queue Length 95th (m)	0.5	0.0	4.6			
Control Delay (s)	0.6	0.0	18.3			
Lane LOS	A		C			
Approach Delay (s)	0.6	0.0	18.3			
Approach LOS			C			
Intersection Summary						
Average Delay		1.3				
Intersection Capacity Utilization		56.7%		ICU Level of Service	B	
Analysis Period (min)		15				

Timings Background 2031 PM Peak Hour
3: Garth Street Extension/Garth Street & Twenty Road West

	↖	→	↘	←	↙	↑	↗	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	242	329	10	272	50	90	198	50
Future Volume (vph)	242	329	10	272	50	90	198	50
Lane Group Flow (vph)	255	357	11	494	53	137	208	160
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		8		4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	4	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	5.0	10.0	10.0
Minimum Split (s)	36.4	36.4	36.4	36.4	24.5	24.5	26.3	26.3
Total Split (s)	60.7	60.7	60.7	60.7	42.0	42.0	42.0	42.0
Total Split (%)	59.1%	59.1%	59.1%	59.1%	40.9%	40.9%	40.9%	40.9%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.3	3.3	3.3	3.3
All-Red Time (s)	2.7	2.7	2.7	2.7	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.4	6.4	6.4	6.4	6.3	6.3	6.3	6.3
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	None	None	None	None
v/c Ratio	0.52	0.31	0.02	0.45	0.19	0.17	0.75	0.20
Control Delay	15.3	9.4	8.3	9.9	27.8	18.4	47.7	10.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.3	9.4	8.3	9.9	27.8	18.4	47.7	10.4
Queue Length 50th (m)	20.9	24.4	0.6	33.1	7.1	6.6	32.2	3.6
Queue Length 95th (m)	54.1	50.8	3.2	70.7	16.0	13.4	55.1	10.7
Internal Link Dist (m)		397.1		655.9		1388.7		148.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	495	1155	641	1107	516	1461	511	1400
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.52	0.31	0.02	0.45	0.10	0.09	0.41	0.11

Intersection Summary
 Cycle Length: 102.7
 Actuated Cycle Length: 86.9
 Natural Cycle: 65
 Control Type: Semi Act-Uncoord



HCM Signalized Intersection Capacity Analysis Background 2031 PM Peak Hour
3: Garth Street Extension/Garth Street & Twenty Road West

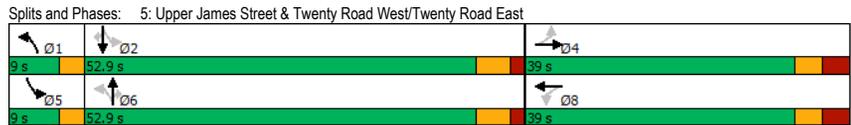
	↖	→	↘	←	↙	↑	↗	↓	↖	↗	↖	↗	↖	↗
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗	↖	↗	
Traffic Volume (vph)	242	329	10	10	272	198	50	90	40	198	50	102		
Future Volume (vph)	242	329	10	10	272	198	50	90	40	198	50	102		
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900		
Total Lost time (s)	6.4	6.4		6.4	6.4		6.3	6.3		6.3	6.3			
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95			
Frt	1.00	1.00		1.00	0.94		1.00	0.95		1.00	0.90			
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00			
Satd. Flow (prot)	1738	1841		1825	1733		1825	3482		1772	3241			
Fit Permitted	0.43	1.00		0.53	1.00		0.65	1.00		0.67	1.00			
Satd. Flow (perm)	789	1841		1021	1733		1250	3482		1241	3241			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	255	346	11	11	286	208	53	95	42	208	53	107		
RTOR Reduction (vph)	0	1	0	0	20	0	0	33	0	0	83	0		
Lane Group Flow (vph)	255	356	0	11	474	0	53	104	0	208	77	0		
Heavy Vehicles (%)	5%	4%	0%	0%	3%	5%	0%	0%	0%	3%	0%	2%		
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA			
Protected Phases		2			6			8			4			
Permitted Phases	2				6			8			4			
Actuated Green, G (s)	54.6	54.6		54.6	54.6		19.6	19.6		19.6	19.6			
Effective Green, g (s)	54.6	54.6		54.6	54.6		19.6	19.6		19.6	19.6			
Actuated g/C Ratio	0.63	0.63		0.63	0.63		0.23	0.23		0.23	0.23			
Clearance Time (s)	6.4	6.4		6.4	6.4		6.3	6.3		6.3	6.3			
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0			
Lane Grp Cap (vph)	495	1156		641	1088		281	785		279	730			
v/s Ratio Prot		0.19			0.27			0.03			0.02			
v/s Ratio Perm	c0.32			0.01			0.04			c0.17				
v/c Ratio	0.52	0.31		0.02	0.44		0.19	0.13		0.75	0.11			
Uniform Delay, d1	8.9	7.4		6.1	8.3		27.2	26.9		31.3	26.7			
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00			
Incremental Delay, d2	3.8	0.7		0.0	1.3		0.3	0.1		10.3	0.1			
Delay (s)	12.7	8.1		6.1	9.5		27.5	26.9		41.7	26.8			
Level of Service	B	A		A	A		C	C		D	C			
Approach Delay (s)		10.0			9.5			27.1			35.2			
Approach LOS		B			A			C			D			

Intersection Summary
 HCM 2000 Control Delay: 17.3 HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.57
 Actuated Cycle Length (s): 86.9 Sum of lost time (s): 12.7
 Intersection Capacity Utilization: 76.1% ICU Level of Service: D
 Analysis Period (min): 15
 c Critical Lane Group

Timings Background 2031 PM Peak Hour
5: Upper James Street & Twenty Road West/Twenty Road East

	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	83	306	73	241	118	1006	119	100	1121	92
Future Volume (vph)	83	306	73	241	118	1006	119	100	1121	92
Lane Group Flow (vph)	89	497	78	340	127	1082	128	108	1205	99
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4		8		6		5		2
Permitted Phases	4		8		6		6	2		2
Detector Phase	4	4	8	8	1	6	6	5	2	2
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	45.0	45.0	5.0	45.0	45.0
Minimum Split (s)	34.8	34.8	34.8	34.8	8.0	51.1	51.1	8.0	51.1	51.1
Total Split (s)	39.0	39.0	39.0	39.0	9.0	52.9	52.9	9.0	52.9	52.9
Total Split (%)	38.7%	38.7%	38.7%	38.7%	8.9%	52.4%	52.4%	8.9%	52.4%	52.4%
Yellow Time (s)	3.3	3.3	3.3	3.3	3.0	4.2	4.2	3.0	4.2	4.2
All-Red Time (s)	3.5	3.5	3.5	3.5	0.0	1.9	1.9	0.0	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.8	6.8	6.8	6.8	3.0	6.1	6.1	3.0	6.1	6.1
Lead/Lag					Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.42	0.90	0.86	0.62	0.55	0.66	0.15	0.39	0.75	0.12
Control Delay	34.4	51.7	98.5	33.5	18.4	22.4	3.3	13.4	25.1	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.4	51.7	98.5	33.5	18.4	22.4	3.3	13.4	25.1	3.6
Queue Length 50th (m)	13.5	85.4	13.8	52.6	10.4	84.3	0.0	8.7	101.1	0.0
Queue Length 95th (m)	28.2	#138.9	#40.9	80.6	18.4	107.0	9.3	16.0	128.0	8.3
Internal Link Dist (m)		924.0		263.2		1046.5		203.7		
Turn Bay Length (m)	50.0		33.0		127.0		58.0	65.0		137.0
Base Capacity (vph)	233	610	100	606	237	1648	848	274	1598	838
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	0.81	0.78	0.56	0.54	0.66	0.15	0.39	0.75	0.12

Intersection Summary
 Cycle Length: 100.9
 Actuated Cycle Length: 98
 Natural Cycle: 95
 Control Type: Actuated-Uncoordinated
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis Background 2031 PM Peak Hour
5: Upper James Street & Twenty Road West/Twenty Road East

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	83	306	156	73	241	75	118	1006	119	100	1121	92
Future Volume (vph)	83	306	156	73	241	75	118	1006	119	100	1121	92
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.8	6.8		6.8	6.8		3.0	6.1	6.1	3.0	6.1	6.1
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.95		1.00	0.96		1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	1800		1825	1811		1825	3444	1633	1825	3318	1633
Fit Permitted	0.38	1.00		0.16	1.00		0.13	1.00	1.00	0.16	1.00	1.00
Satd. Flow (perm)	709	1800		307	1811		246	3444	1633	316	3318	1633
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	89	329	168	78	259	81	127	1082	128	108	1205	99
RTOR Reduction (vph)	0	19	0	0	11	0	0	67	0	0	51	
Lane Group Flow (vph)	89	478	0	78	329	0	127	1082	61	108	1205	48
Heavy Vehicles (%)	3%	2%	0%	0%	3%	0%	0%	6%	0%	0%	10%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		1	6		5		2
Permitted Phases	4			8			6		6	2		2
Actuated Green, G (s)	29.1	29.1		29.1	29.1		52.6	46.9	46.9	53.2	47.2	47.2
Effective Green, g (s)	29.1	29.1		29.1	29.1		52.6	46.9	46.9	53.2	47.2	47.2
Actuated g/C Ratio	0.30	0.30		0.30	0.30		0.54	0.48	0.48	0.54	0.48	0.48
Clearance Time (s)	6.8	6.8		6.8	6.8		3.0	6.1	6.1	3.0	6.1	6.1
Vehicle Extension (s)	3.0	3.0		3.0	3.0		1.0	6.5	6.5	1.0	6.5	6.5
Lane Grp Cap (vph)	210	535		91	538		224	1649	782	264	1599	787
v/s Ratio Prot		c0.27			0.18		c0.03	0.31		0.03	c0.36	
v/s Ratio Perm	0.13			0.25			0.27		0.04	0.20		0.03
v/c Ratio	0.42	0.89		0.86	0.61		0.57	0.66	0.08	0.41	0.75	0.06
Uniform Delay, d1	27.7	32.9		32.4	29.5		14.5	19.4	13.8	12.9	20.6	13.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.4	17.1		50.5	2.1		2.0	2.1	0.2	4.6	3.3	0.1
Delay (s)	29.0	50.1		83.0	31.6		16.4	21.4	14.0	17.5	24.0	13.7
Level of Service	C	D		F	C		B	C	B	B	C	B
Approach Delay (s)		46.9			41.2			20.2			22.7	
Approach LOS		D			D			C			C	

Intersection Summary
 HCM 2000 Control Delay 27.7 HCM 2000 Level of Service C
 HCM 2000 Volume to Capacity ratio 0.79
 Actuated Cycle Length (s) 97.9 Sum of lost time (s) 15.9
 Intersection Capacity Utilization 97.7% ICU Level of Service F
 Analysis Period (min) 15
 c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Glancaster Road & Book Road East

Background 2031 PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔		↔	↑	↓	↔
Sign Control	Stop			Stop	Stop	
Traffic Volume (vph)	444	159	79	137	170	179
Future Volume (vph)	444	159	79	137	170	179
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	505	181	90	156	193	203
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total (vph)	686	246	396			
Volume Left (vph)	505	90	0			
Volume Right (vph)	181	0	203			
Hadj (s)	0.06	0.21	-0.31			
Departure Headway (s)	5.9	6.8	6.0			
Degree Utilization, x	1.13	0.46	0.66			
Capacity (veh/h)	602	520	588			
Control Delay (s)	100.4	15.5	20.1			
Approach Delay (s)	100.4	15.5	20.1			
Approach LOS	F	C	C			
Intersection Summary						
Delay	60.7					
Level of Service	F					
Intersection Capacity Utilization	75.8%		ICU Level of Service	D		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
7: Upper James Street & Talbot Lane

Background 2031 PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR		
Lane Configurations	↔	↔	↔	↑	↓	↔		
Traffic Volume (veh/h)	3	1	1	1265	1308	4		
Future Volume (Veh/h)	3	1	1	1265	1308	4		
Sign Control	Stop			Free	Free			
Grade	0%			0%	0%			
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95		
Hourly flow rate (vph)	3	1	1	1332	1377	4		
Pedestrians								
Lane Width (m)								
Walking Speed (m/s)								
Percent Blockage								
Right turn flare (veh)								
Median type			None	None				
Median storage (veh)								
Upstream signal (m)	304							
pX, platoon unblocked	0.83							
vC, conflicting volume	2045	688	1381					
vC1, stage 1 conf vol								
vC2, stage 2 conf vol								
vCu, unblocked vol	1847	688	1381					
tC, single (s)	6.8	6.9	4.1					
tC, 2 stage (s)								
tF (s)	3.5	3.3	2.2					
p0 queue free %	95	100	100					
cM capacity (veh/h)	56	393	503					
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	3	1	1	666	666	688	688	4
Volume Left	3	0	1	0	0	0	0	0
Volume Right	0	1	0	0	0	0	0	4
cSH	56	393	503	1700	1700	1700	1700	1700
Volume to Capacity	0.05	0.00	0.00	0.39	0.39	0.41	0.41	0.00
Queue Length 95th (m)	1.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	73.0	14.2	12.2	0.0	0.0	0.0	0.0	0.0
Lane LOS	F	B	B					
Approach Delay (s)	58.3	0.0		0.0				
Approach LOS	F							
Intersection Summary								
Average Delay	0.1							
Intersection Capacity Utilization	46.2%		ICU Level of Service	A				
Analysis Period (min)	15							

Timings
8: Glancaster Road & Dickenson Road West

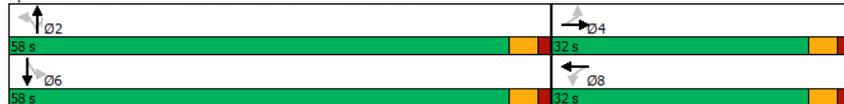
Background 2031 PM Peak Hour

	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↔	↕	↔	↕	↔	↕	↔	↕	↔
Traffic Volume (vph)	10	50	20	50	50	80	30	219	100
Future Volume (vph)	10	50	20	50	50	80	30	219	100
Lane Group Flow (vph)	12	120	24	210	60	95	36	261	131
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA
Protected Phases		4		8		2		2	6
Permitted Phases	4		8		2		2	6	
Detector Phase	4	4	8	8	2	2	2	6	6
Switch Phase									
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	32.0	32.0	32.0	32.0	58.0	58.0	58.0	58.0	58.0
Total Split (%)	35.6%	35.6%	35.6%	35.6%	64.4%	64.4%	64.4%	64.4%	64.4%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Min	Min	Min	Min	Min
v/c Ratio	0.03	0.10	0.07	0.17	0.09	0.10	0.04	0.38	0.14
Control Delay	8.3	5.1	8.8	3.7	6.4	6.3	2.8	9.0	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.3	5.1	8.8	3.7	6.4	6.3	2.8	9.0	6.2
Queue Length 50th (m)	0.4	0.9	0.7	0.9	1.7	2.7	0.0	9.0	3.6
Queue Length 95th (m)	2.2	4.0	3.6	4.7	4.7	6.4	2.1	17.5	7.9
Internal Link Dist (m)		150.3		1543.1		112.9			456.5
Turn Bay Length (m)	50.0		50.0		50.0		50.0		50.0
Base Capacity (vph)	1085	3082	947	2985	1293	1921	1633	1335	1894
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.04	0.03	0.07	0.05	0.05	0.02	0.20	0.07

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 29.6
Natural Cycle: 45
Control Type: Semi Act-Uncoord

Splits and Phases: 8: Glancaster Road & Dickenson Road West



HCM Signalized Intersection Capacity Analysis
8: Glancaster Road & Dickenson Road West

Background 2031 PM Peak Hour

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↕	↔	↔
Traffic Volume (vph)	10	50	50	20	50	126	50	80	30	219	100	10
Future Volume (vph)	10	50	50	20	50	126	50	80	30	219	100	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.93		1.00	0.89		1.00	1.00	0.85	1.00	0.99	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1825	3376		1460	3259		1825	1921	1633	1825	1895	
Fit Permitted	0.62	1.00		0.68	1.00		0.67	1.00	1.00	0.70	1.00	
Satd. Flow (perm)	1191	3376		1039	3259		1293	1921	1633	1336	1895	
Peak-hour factor, PHF	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Adj. Flow (vph)	12	60	60	24	60	150	60	95	36	261	119	12
RTOR Reduction (vph)	0	45	0	0	112	0	0	0	20	0	5	0
Lane Group Flow (vph)	12	75	0	24	98	0	60	95	16	261	126	0
Heavy Vehicles (%)	0%	0%	0%	25%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2		6		
Permitted Phases	4			8			2		6			
Actuated Green, G (s)	7.7	7.7		7.7	7.7		13.9	13.9	13.9	13.9	13.9	
Effective Green, g (s)	7.7	7.7		7.7	7.7		13.9	13.9	13.9	13.9	13.9	
Actuated g/C Ratio	0.25	0.25		0.25	0.25		0.45	0.45	0.45	0.45	0.45	
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)	299	849		261	820		587	872	741	606	860	
v/s Ratio Prot		0.02			c0.03			0.05			0.07	
v/s Ratio Perm	0.01			0.02			0.05		0.01		c0.20	
v/c Ratio	0.04	0.09		0.09	0.12		0.10	0.11	0.02	0.43	0.15	
Uniform Delay, d1	8.7	8.8		8.8	8.8		4.8	4.8	4.6	5.7	4.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.0		0.2	0.1		0.1	0.1	0.0	0.5	0.1	
Delay (s)	8.7	8.8		8.9	8.9		4.9	4.8	4.6	6.2	5.0	
Level of Service	A	A		A	A		A	A	A	A	A	
Approach Delay (s)		8.8			8.9			4.8			5.8	
Approach LOS		A			A			A			A	

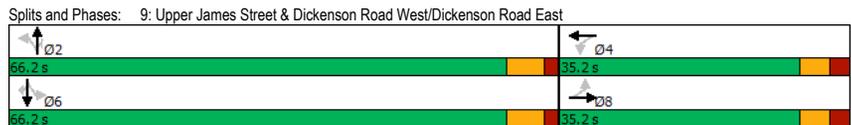
Intersection Summary

HCM 2000 Control Delay: 6.8
HCM 2000 Level of Service: A
HCM 2000 Volume to Capacity ratio: 0.32
Actuated Cycle Length (s): 30.6
Sum of lost time (s): 9.0
Intersection Capacity Utilization: 40.0%
ICU Level of Service: A
Analysis Period (min): 15
c Critical Lane Group

Timings Background 2031 PM Peak Hour
9: Upper James Street & Dickenson Road West/Dickenson Road East

	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↕	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	141	60	10	165	37	1139	9	19	1202	36
Future Volume (vph)	141	60	10	165	37	1139	9	19	1202	36
Lane Group Flow (vph)	148	176	11	199	39	1199	9	20	1265	38
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	8		4		2		6		6	
Permitted Phases	8		4		2		2	6		6
Detector Phase	8	8	4	4	2	2	2	6	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	55.0	55.0	55.0	55.0	55.0	55.0
Minimum Split (s)	35.2	35.2	35.2	35.2	66.2	66.2	66.2	61.3	61.3	61.3
Total Split (s)	35.2	35.2	35.2	35.2	66.2	66.2	66.2	66.2	66.2	66.2
Total Split (%)	34.7%	34.7%	34.7%	34.7%	65.3%	65.3%	65.3%	65.3%	65.3%	65.3%
Yellow Time (s)	3.7	3.7	3.7	3.7	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	2.5	2.5	2.5	2.5	1.7	1.7	1.7	1.7	1.7	1.7
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	Max	Max	Max	Max	Max	Max
v/c Ratio	0.67	0.29	0.05	0.30	0.18	0.51	0.01	0.10	0.55	0.03
Control Delay	48.6	20.5	28.9	29.2	9.6	8.9	0.0	8.1	9.4	2.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	48.6	20.5	28.9	29.2	9.6	8.9	0.0	8.1	9.4	2.8
Queue Length 50th (m)	23.7	8.7	1.6	14.2	2.1	45.6	0.0	1.0	50.3	0.2
Queue Length 95th (m)	42.7	17.1	5.8	23.2	8.6	81.6	0.1	4.9	90.3	3.9
Internal Link Dist (m)	1296.5		232.1		174.3		280.1			
Turn Bay Length (m)	15.0		15.0		40.0		21.0	68.0		17.0
Base Capacity (vph)	393	1027	402	1180	211	2346	1113	203	2281	1113
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	0.17	0.03	0.17	0.18	0.51	0.01	0.10	0.55	0.03

Intersection Summary
 Cycle Length: 101.4
 Actuated Cycle Length: 89
 Natural Cycle: 105
 Control Type: Semi Act-Uncoord



HCM Signalized Intersection Capacity Analysis Background 2031 PM Peak Hour
9: Upper James Street & Dickenson Road West/Dickenson Road East

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	141	60	107	10	165	24	37	1139	9	19	1202	36
Future Volume (vph)	141	60	107	10	165	24	37	1139	9	19	1202	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.2	6.2		6.2	6.2		6.3	6.3	6.3	6.3	6.3	6.3
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00
Fr't	1.00	0.90		1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	3015		1825	3581		1644	3476	1633	1437	3380	1633
Fit Permitted	0.63	1.00		0.64	1.00		0.18	1.00	1.00	0.20	1.00	1.00
Satd. Flow (perm)	1204	3015		1231	3581		313	3476	1633	300	3380	1633
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	148	63	113	11	174	25	39	1199	9	20	1265	38
RTOR Reduction (vph)	0	51	0	0	13	0	0	0	3	0	0	11
Lane Group Flow (vph)	148	125	0	11	186	0	39	1199	6	20	1265	27
Heavy Vehicles (%)	0%	3%	13%	0%	0%	0%	11%	5%	0%	27%	8%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	8			4			2		6		6	
Permitted Phases	8			4			2		6		6	
Actuated Green, G (s)	16.4	16.4		16.4	16.4		60.1	60.1	60.1	60.1	60.1	60.1
Effective Green, g (s)	16.4	16.4		16.4	16.4		60.1	60.1	60.1	60.1	60.1	60.1
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.68	0.68	0.68	0.68	0.68	0.68
Clearance Time (s)	6.2	6.2		6.2	6.2		6.3	6.3	6.3	6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0		3.0	3.0		5.7	5.7	5.7	5.7	5.7	5.7
Lane Grp Cap (vph)	221	555		226	659		211	2347	1102	202	2282	1102
v/s Ratio Prot		0.04			0.05			0.34			c0.37	
v/s Ratio Perm	c0.12			0.01			0.12		0.00	0.07		0.02
v/c Ratio	0.67	0.23		0.05	0.28		0.18	0.51	0.01	0.10	0.55	0.02
Uniform Delay, d1	33.8	30.9		29.9	31.2		5.4	7.2	4.7	5.0	7.5	4.8
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.5	0.2		0.1	0.2		1.9	0.8	0.0	1.0	1.0	0.0
Delay (s)	41.3	31.1		30.0	31.5		7.3	8.0	4.7	6.0	8.5	4.8
Level of Service	D	C		C	C		A	A	A	A	A	A
Approach Delay (s)	35.7			31.4			7.9		8.3			
Approach LOS	D			C			A		A			

Intersection Summary
 HCM 2000 Control Delay: 12.6
 HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.58
 Actuated Cycle Length (s): 89.0
 Sum of lost time (s): 12.5
 Intersection Capacity Utilization: 115.7%
 ICU Level of Service: H
 Analysis Period (min): 15
 c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
12: Twenty Road West & Twentyplace Boulevard

Background 2031 PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑↓		↓	
Traffic Volume (veh/h)	36	506	408	28	15	18
Future Volume (Veh/h)	36	506	408	28	15	18
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)	39	550	443	30	16	20
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	473			1086	458	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	473			1086	458	
tC, single (s)	4.1			6.4	6.2	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	96			93	97	
cM capacity (veh/h)	1089			231	603	
Direction_Lane #	EB 1	WB 1	SB 1			
Volume Total	589	473	36			
Volume Left	39	0	16			
Volume Right	0	30	20			
cSH	1089	1700	351			
Volume to Capacity	0.04	0.28	0.10			
Queue Length 95th (m)	0.8	0.0	2.6			
Control Delay (s)	1.0	0.0	16.4			
Lane LOS	A		C			
Approach Delay (s)	1.0	0.0	16.4			
Approach LOS			C			
Intersection Summary						
Average Delay		1.1				
Intersection Capacity Utilization		65.1%		ICU Level of Service	C	
Analysis Period (min)		15				

Timings
16: Garth Street Extension & Dickenson Road West

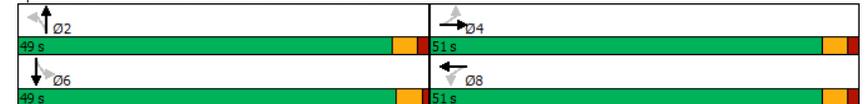
Background 2031 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↓	↑↓	↓	↑↓	↓	↑↓	↓	↑↓
Traffic Volume (vph)	50	100	150	50	150	100	10	50
Future Volume (vph)	50	100	150	50	150	100	10	50
Lane Group Flow (vph)	54	326	163	87	163	381	11	65
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	51.0	51.0	51.0	51.0	49.0	49.0	49.0	49.0
Total Split (%)	51.0%	51.0%	51.0%	51.0%	49.0%	49.0%	49.0%	49.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.11	0.25	0.43	0.07	0.35	0.29	0.03	0.05
Control Delay	7.7	3.4	12.1	5.1	10.8	3.4	7.6	6.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.7	3.4	12.1	5.1	10.8	3.4	7.6	6.4
Queue Length 50th (m)	1.6	1.6	5.3	0.7	5.2	1.6	0.3	0.7
Queue Length 95th (m)	6.6	7.3	18.1	3.7	17.7	8.3	2.4	3.5
Internal Link Dist (m)		1543.1		1296.5		105.4		1388.7
Turn Bay Length (m)	50.0		50.0		50.0		50.0	
Base Capacity (vph)	1315	3221	1045	3375	1341	3196	991	3489
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.10	0.16	0.03	0.12	0.12	0.01	0.02

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 32
Natural Cycle: 45
Control Type: Actuated-Uncoordinated

Splits and Phases: 16: Garth Street Extension & Dickenson Road West



HCM Signalized Intersection Capacity Analysis
 16: Garth Street Extension & Dickenson Road West

Background 2031 PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	50	100	200	150	50	30	150	100	250	10	50	10
Future Volume (vph)	50	100	200	150	50	30	150	100	250	10	50	10
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		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.90		1.00	0.94		1.00	0.89		1.00	0.97	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3221		1789	3375		1789	3195		1789	3488	
Fit Permitted	0.70	1.00		0.55	1.00		0.71	1.00		0.53	1.00	
Satd. Flow (perm)	1314	3221		1045	3375		1342	3195		991	3488	
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)	54	109	217	163	54	33	163	109	272	11	54	11
RTOR Reduction (vph)	0	137	0	0	21	0	0	177	0	0	7	0
Lane Group Flow (vph)	54	189	0	163	66	0	163	204	0	11	58	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)	11.7	11.7		11.7	11.7		11.2	11.2		11.7	11.7	
Effective Green, g (s)	11.7	11.7		11.7	11.7		11.2	11.2		11.7	11.7	
Actuated g/C Ratio	0.37	0.37		0.37	0.37		0.35	0.35		0.37	0.37	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	481	1181		383	1237		471	1121		363	1279	
v/s Ratio Prot		0.06			0.02			0.06			0.02	
v/s Ratio Perm	0.04			0.16			0.12			0.01		
v/c Ratio	0.11	0.16		0.43	0.05		0.35	0.18		0.03	0.05	
Uniform Delay, d1	6.7	6.8		7.6	6.5		7.6	7.2		6.5	6.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.1		0.8	0.0		0.4	0.1		0.0	0.0	
Delay (s)	6.8	6.9		8.3	6.5		8.1	7.3		6.5	6.5	
Level of Service	A	A		A	A		A	A		A	A	
Approach Delay (s)		6.8			7.7			7.5			6.5	
Approach LOS		A			A			A			A	
Intersection Summary												
HCM 2000 Control Delay			7.3									A
HCM 2000 Volume to Capacity ratio			0.39									
Actuated Cycle Length (s)			31.9									9.0
Intersection Capacity Utilization			43.8%									A
Analysis Period (min)			15									

c Critical Lane Group

Appendix 3

2031 Background Conditions with Improvements

Timings
6: Glancaster Road & Book Road East

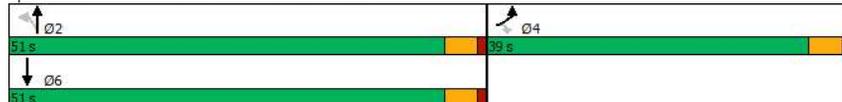
Background 2031 AM Peak Hour
With Improvements

	↖	↗	↙	↘	↕
Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Configurations	↖	↗	↙	↘	↕
Traffic Volume (vph)	226	70	55	133	107
Future Volume (vph)	226	70	55	133	107
Lane Group Flow (vph)	257	80	63	151	403
Turn Type	Prot	Perm	Perm	NA	NA
Protected Phases	4			2	6
Permitted Phases		4	2		
Detector Phase	4	4	2	2	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	30.0	30.0	30.0
Minimum Split (s)	22.5	22.5	34.5	34.5	34.5
Total Split (s)	39.0	39.0	51.0	51.0	51.0
Total Split (%)	43.3%	43.3%	56.7%	56.7%	56.7%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	Max	Max	Max
v/c Ratio	0.68	0.20	0.11	0.13	0.33
Control Delay	35.2	7.0	6.2	5.8	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	35.2	7.0	6.2	5.8	4.0
Queue Length 50th (m)	31.5	0.0	2.7	6.4	9.4
Queue Length 95th (m)	51.5	8.6	8.3	15.6	24.4
Internal Link Dist (m)	171.0			456.5	855.9
Turn Bay Length (m)	15.0		15.0		
Base Capacity (vph)	835	789	598	1152	1213
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.31	0.10	0.11	0.13	0.33

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 72.6
Natural Cycle: 60
Control Type: Semi Act-Uncoord

Splits and Phases: 6: Glancaster Road & Book Road East



HCM Signalized Intersection Capacity Analysis
6: Glancaster Road & Book Road East

Background 2031 AM Peak Hour
With Improvements

	↖	↗	↙	↘	↕	↖
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↙	↘	↕	↖
Traffic Volume (vph)	226	70	55	133	107	247
Future Volume (vph)	226	70	55	133	107	247
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Fr _t	1.00	0.85	1.00	1.00	0.91	
Fit Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1755	1570	1738	1746	1740	
Fit Permitted	0.95	1.00	0.50	1.00	1.00	
Satd. Flow (perm)	1755	1570	908	1746	1740	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	257	80	62	151	122	281
RTOR Reduction (vph)	0	63	0	0	65	0
Lane Group Flow (vph)	257	17	63	151	338	0
Heavy Vehicles (%)	4%	4%	5%	10%	0%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	15.7	15.7	47.9	47.9	47.9	
Effective Green, g (s)	15.7	15.7	47.9	47.9	47.9	
Actuated g/C Ratio	0.22	0.22	0.66	0.66	0.66	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	379	339	599	1151	1148	
v/s Ratio Prot	c0.15			0.09	c0.19	
v/s Ratio Perm		0.01	0.07			
v/c Ratio	0.68	0.05	0.11	0.13	0.29	
Uniform Delay, d1	26.1	22.5	4.5	4.6	5.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	4.8	0.1	0.4	0.2	0.7	
Delay (s)	30.9	22.6	4.9	4.8	5.9	
Level of Service	C	C	A	A	A	
Approach Delay (s)	28.9			4.8	5.9	
Approach LOS	C			A	A	

Intersection Summary

HCM 2000 Control Delay: 13.8
HCM 2000 Volume to Capacity ratio: 0.39
Actuated Cycle Length (s): 72.6
Intersection Capacity Utilization: 65.7%
Analysis Period (min): 15
c Critical Lane Group

HCM 2000 Level of Service: B
Sum of lost time (s): 9.0
ICU Level of Service: C

Timings
1: Glancaster Road & Twenty Road West

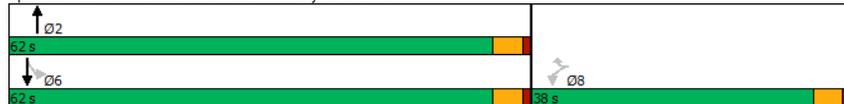
Background 2031 AM Peak Hour
With Improvements

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Configurations	↖	↗	↕	↙	↘
Traffic Volume (vph)	162	115	145	75	95
Future Volume (vph)	162	115	145	75	95
Lane Group Flow (vph)	191	135	364	88	112
Turn Type	Perm	Perm	NA	Perm	NA
Protected Phases			2		6
Permitted Phases	8	8		6	
Detector Phase	8	8	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	30.0	30.0	30.0
Minimum Split (s)	22.5	22.5	34.5	34.5	34.5
Total Split (s)	38.0	38.0	62.0	62.0	62.0
Total Split (%)	38.0%	38.0%	62.0%	62.0%	62.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	Max	Max	Max
v/c Ratio	0.63	0.35	0.29	0.12	0.08
Control Delay	40.6	8.1	3.9	4.7	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	40.6	8.1	3.9	4.7	4.2
Queue Length 50th (m)	27.3	0.0	11.1	3.4	4.2
Queue Length 95th (m)	43.8	11.5	23.3	8.8	9.9
Internal Link Dist (m)	827.6		855.9		262.6
Turn Bay Length (m)	15.0			15.0	
Base Capacity (vph)	741	749	1267	737	1344
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.26	0.18	0.29	0.12	0.08

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 81.7
Natural Cycle: 60
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Glancaster Road & Twenty Road West



HCM Signalized Intersection Capacity Analysis
1: Glancaster Road & Twenty Road West

Background 2031 AM Peak Hour
With Improvements

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↕	↖	↙	↘
Traffic Volume (vph)	162	115	145	164	75	95
Future Volume (vph)	162	115	145	164	75	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.93		1.00	1.00
Fit Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1807	1633	1722		1825	1865
Fit Permitted	0.95	1.00	1.00		0.53	1.00
Satd. Flow (perm)	1807	1633	1722		1023	1865
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	191	135	171	193	88	112
RTOR Reduction (vph)	0	112	27	0	0	0
Lane Group Flow (vph)	191	23	337	0	88	112
Heavy Vehicles (%)	1%	0%	2%	5%	0%	3%
Turn Type	Perm	Perm	NA		Perm	NA
Protected Phases			2			6
Permitted Phases	8	8			6	
Actuated Green, G (s)	13.8	13.8	58.9		58.9	58.9
Effective Green, g (s)	13.8	13.8	58.9		58.9	58.9
Actuated g/C Ratio	0.17	0.17	0.72		0.72	0.72
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	305	275	1241		737	1344
v/s Ratio Prot			c0.20			0.06
v/s Ratio Perm	c0.11	0.01			0.09	
v/c Ratio	0.63	0.08	0.27		0.12	0.08
Uniform Delay, d1	31.6	28.6	4.0		3.5	3.4
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	4.0	0.1	0.5		0.3	0.1
Delay (s)	35.5	28.7	4.5		3.8	3.5
Level of Service	D	C	A		A	A
Approach Delay (s)	32.7		4.5			3.6
Approach LOS	C		A			A

Intersection Summary

HCM 2000 Control Delay: 14.6, HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.34
 Actuated Cycle Length (s): 81.7, Sum of lost time (s): 9.0
 Intersection Capacity Utilization: 70.2%, ICU Level of Service: C
 Analysis Period (min): 15
 c Critical Lane Group

Timings
6: Glancaster Road & Book Road East

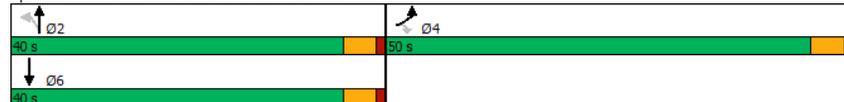
Background 2031 PM Peak Hour
With Improvements

	↖	↗	↙	↘	↕
Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Configurations	↖	↗	↙	↘	↕
Traffic Volume (vph)	444	159	79	137	170
Future Volume (vph)	444	159	79	137	170
Lane Group Flow (vph)	505	181	90	156	396
Turn Type	Prot	Perm	Perm	NA	NA
Protected Phases	4			2	6
Permitted Phases		4	2		
Detector Phase	4	4	2	2	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	30.0	30.0	30.0
Minimum Split (s)	22.5	22.5	34.5	34.5	34.5
Total Split (s)	50.0	50.0	40.0	40.0	40.0
Total Split (%)	55.6%	55.6%	44.4%	44.4%	44.4%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	Max	Max	Max
v/c Ratio	0.80	0.27	0.21	0.17	0.42
Control Delay	30.6	3.5	13.6	11.7	11.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	30.6	3.5	13.6	11.7	11.7
Queue Length 50th (m)	57.6	0.0	5.9	9.9	23.2
Queue Length 95th (m)	86.2	9.4	18.1	25.4	55.3
Internal Link Dist (m)	171.0			456.5	855.9
Turn Bay Length (m)	15.0		15.0		
Base Capacity (vph)	1152	1092	424	894	949
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.44	0.17	0.21	0.17	0.42

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 70
Natural Cycle: 60
Control Type: Semi Act-Uncoord

Splits and Phases: 6: Glancaster Road & Book Road East



HCM Signalized Intersection Capacity Analysis
6: Glancaster Road & Book Road East

Background 2031 PM Peak Hour
With Improvements

	↖	↗	↙	↘	↕	↖
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↙	↘	↕	↖
Traffic Volume (vph)	444	159	79	137	170	179
Future Volume (vph)	444	159	79	137	170	179
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Fr _t	1.00	0.85	1.00	1.00	0.93	
Fit Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1755	1570	1738	1746	1788	
Fit Permitted	0.95	1.00	0.45	1.00	1.00	
Satd. Flow (perm)	1755	1570	829	1746	1788	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	505	181	90	156	193	203
RTOR Reduction (vph)	0	116	0	0	34	0
Lane Group Flow (vph)	505	65	90	156	362	0
Heavy Vehicles (%)	4%	4%	5%	10%	0%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	25.1	25.1	35.9	35.9	35.9	
Effective Green, g (s)	25.1	25.1	35.9	35.9	35.9	
Actuated g/C Ratio	0.36	0.36	0.51	0.51	0.51	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	629	562	425	895	916	
v/s Ratio Prot	c0.29			0.09	c0.20	
v/s Ratio Perm		0.04	0.11			
v/c Ratio	0.80	0.12	0.21	0.17	0.40	
Uniform Delay, d1	20.2	15.0	9.3	9.1	10.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	7.3	0.1	1.1	0.4	1.3	
Delay (s)	27.5	15.1	10.5	9.5	11.7	
Level of Service	C	B	B	A	B	
Approach Delay (s)	24.3			9.9	11.7	
Approach LOS	C			A	B	

Intersection Summary

HCM 2000 Control Delay: 17.9, HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.56
 Actuated Cycle Length (s): 70.0, Sum of lost time (s): 9.0
 Intersection Capacity Utilization: 85.8%, ICU Level of Service: E
 Analysis Period (min): 15
 c Critical Lane Group

Timings
1: Glancaster Road & Twenty Road West

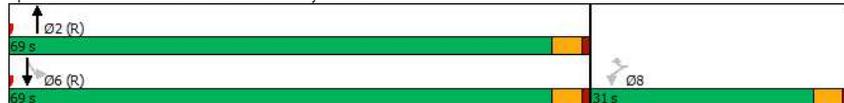
Background 2031 PM Peak Hour
With Improvements

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Configurations	↖	↗	↑	↙	↘
Traffic Volume (vph)	199	112	157	139	127
Future Volume (vph)	199	112	157	139	127
Lane Group Flow (vph)	234	132	705	164	149
Turn Type	Perm	Perm	NA	Perm	NA
Protected Phases			2		6
Permitted Phases	8	8		6	
Detector Phase	8	8	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	30.0	30.0	30.0
Minimum Split (s)	22.5	22.5	34.5	34.5	34.5
Total Split (s)	31.0	31.0	69.0	69.0	69.0
Total Split (%)	31.0%	31.0%	69.0%	69.0%	69.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	C-Max	C-Max	C-Max
v/c Ratio	0.72	0.33	0.55	0.36	0.11
Control Delay	50.3	7.9	5.7	8.7	4.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	50.3	7.9	5.7	8.7	4.9
Queue Length 50th (m)	43.0	0.0	26.4	10.0	7.2
Queue Length 95th (m)	58.6	11.7	54.7	23.8	15.2
Internal Link Dist (m)	827.6		855.9		262.6
Turn Bay Length (m)	15.0			15.0	
Base Capacity (vph)	478	529	1285	456	1358
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.49	0.25	0.55	0.36	0.11

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated

Splits and Phases: 1: Glancaster Road & Twenty Road West



HCM Signalized Intersection Capacity Analysis
1: Glancaster Road & Twenty Road West

Background 2031 PM Peak Hour
With Improvements

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↑	↘	↙	↘
Traffic Volume (vph)	199	112	157	442	139	127
Future Volume (vph)	199	112	157	442	139	127
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.90		1.00	1.00
Fit Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1807	1633	1660		1825	1865
Fit Permitted	0.95	1.00	1.00		0.33	1.00
Satd. Flow (perm)	1807	1633	1660		626	1865
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	234	132	185	520	164	149
RTOR Reduction (vph)	0	108	78	0	0	0
Lane Group Flow (vph)	234	24	627	0	164	149
Heavy Vehicles (%)	1%	0%	2%	5%	0%	3%
Turn Type	Perm	Perm	NA		Perm	NA
Protected Phases			2			6
Permitted Phases	8	8			6	
Actuated Green, G (s)	18.2	18.2	72.8		72.8	72.8
Effective Green, g (s)	18.2	18.2	72.8		72.8	72.8
Actuated g/C Ratio	0.18	0.18	0.73		0.73	0.73
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	328	297	1208		455	1357
v/s Ratio Prot			c0.38			0.08
v/s Ratio Perm	c0.13	0.01			0.26	
v/c Ratio	0.71	0.08	0.52		0.36	0.11
Uniform Delay, d1	38.4	34.0	5.9		5.0	4.0
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	7.2	0.1	1.6		2.2	0.2
Delay (s)	45.6	34.1	7.5		7.2	4.2
Level of Service	D	C	A		A	A
Approach Delay (s)	41.5		7.5			5.8
Approach LOS	D		A			A

Intersection Summary

HCM 2000 Control Delay	16.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	82.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Appendix 4

2031 Total Conditions

Timings
1: Glancaster Road & Twenty Road West

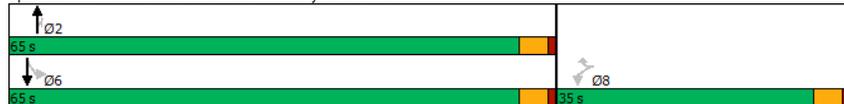
Total 2031 AM Peak Hour

	↖	↗	↑	↘	↙	↓
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↑	↘	↙	↓
Traffic Volume (vph)	166	195	352	180	213	208
Future Volume (vph)	166	195	352	180	213	208
Lane Group Flow (vph)	195	229	414	212	251	245
Turn Type	Perm	Perm	NA	Perm	Perm	NA
Protected Phases			2			6
Permitted Phases	8	8		2	6	
Detector Phase	8	8	2	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	35.0	35.0	65.0	65.0	65.0	65.0
Total Split (%)	35.0%	35.0%	65.0%	65.0%	65.0%	65.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Max	Max	Max	Max
v/c Ratio	0.64	0.49	0.30	0.18	0.36	0.18
Control Delay	42.2	8.2	5.3	1.1	6.8	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.2	8.2	5.3	1.1	6.8	4.6
Queue Length 50th (m)	29.3	0.0	19.3	0.0	12.4	10.3
Queue Length 95th (m)	46.3	14.3	35.9	5.0	27.2	20.6
Internal Link Dist (m)	282.7		557.6		262.6	
Turn Bay Length (m)	50.0		30.0	50.0		
Base Capacity (vph)	657	740	1361	1182	693	1348
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.31	0.30	0.18	0.36	0.18

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 83.9
Natural Cycle: 55
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Glancaster Road & Twenty Road West



HCM Signalized Intersection Capacity Analysis
1: Glancaster Road & Twenty Road West

Total 2031 AM Peak Hour

	↖	↗	↑	↘	↙	↓
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↑	↘	↙	↓
Traffic Volume (vph)	166	195	352	180	213	208
Future Volume (vph)	166	195	352	180	213	208
Ideal Flow (vphpl)	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	1.00	0.85	1.00	0.85	1.00	1.00
Fit Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1807	1633	1883	1555	1825	1865
Fit Permitted	0.95	1.00	1.00	1.00	0.50	1.00
Satd. Flow (perm)	1807	1633	1883	1555	959	1865
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	195	229	414	212	251	245
RTOR Reduction (vph)	0	190	0	59	0	0
Lane Group Flow (vph)	195	39	414	153	251	245
Heavy Vehicles (%)	1%	0%	2%	5%	0%	3%
Turn Type	Perm	Perm	NA	Perm	Perm	NA
Protected Phases			2			6
Permitted Phases	8	8		2	6	
Actuated Green, G (s)	14.2	14.2	60.7	60.7	60.7	60.7
Effective Green, g (s)	14.2	14.2	60.7	60.7	60.7	60.7
Actuated g/C Ratio	0.17	0.17	0.72	0.72	0.72	0.72
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)	305	276	1362	1125	693	1349
v/s Ratio Prot			0.22			0.13
v/s Ratio Perm	c0.11	0.02		0.10	c0.26	
v/c Ratio	0.64	0.14	0.30	0.14	0.36	0.18
Uniform Delay, d1	32.5	29.7	4.1	3.6	4.3	3.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.4	0.2	0.6	0.3	1.5	0.3
Delay (s)	36.8	29.9	4.7	3.8	5.8	4.0
Level of Service	D	C	A	A	A	A
Approach Delay (s)	33.1		4.4		4.9	
Approach LOS	C		A		A	

Intersection Summary

HCM 2000 Control Delay: 12.4
HCM 2000 Volume to Capacity ratio: 0.41
Actuated Cycle Length (s): 83.9
Intersection Capacity Utilization: 50.8%
Analysis Period (min): 15
c Critical Lane Group

HCM 2000 Level of Service: B
Sum of lost time (s): 9.0
ICU Level of Service: A

HCM Unsignalized Intersection Capacity Analysis
2: Twenty Road West & Silverbirch Blvd

Total 2031 AM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	14	651	417	14	55	16
Future Volume (Veh/h)	14	651	417	14	55	16
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	15	693	444	15	59	17
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	459				1174	452
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	459				1174	452
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				72	97
cM capacity (veh/h)	1113				211	604
Direction_Lane #	EB 1	WB 1	SB 1			
Volume Total	708	459	76			
Volume Left	15	0	59			
Volume Right	0	15	17			
cSH	1113	1700	247			
Volume to Capacity	0.01	0.27	0.31			
Queue Length 95th (m)	0.3	0.0	9.6			
Control Delay (s)	0.4	0.0	25.9			
Lane LOS	A		D			
Approach Delay (s)	0.4	0.0	25.9			
Approach LOS			D			
Intersection Summary						
Average Delay		1.8				
Intersection Capacity Utilization		56.2%		ICU Level of Service		B
Analysis Period (min)		15				

Timings
3: Garth Street Extension/Garth Street & Twenty Road West

Total 2031 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↕	↕	↕	↕	↕	↕	↕	↕	↕
Traffic Volume (vph)	121	489	261	296	191	40	316	167	218
Future Volume (vph)	121	489	261	296	191	40	316	167	218
Lane Group Flow (vph)	127	622	275	312	201	42	628	176	328
Turn Type	Perm	NA	pm+pt	NA	Perm	Perm	NA	pm+pt	NA
Protected Phases		2	1	6			8	7	4
Permitted Phases	2		6		6	8		4	
Detector Phase	2	2	1	6	6	8	8	7	4
Switch Phase									
Minimum Initial (s)	10.0	10.0	5.0	10.0	10.0	5.0	5.0	5.0	10.0
Minimum Split (s)	36.4	36.4	9.5	36.4	36.4	24.5	24.5	9.5	26.3
Total Split (s)	55.9	55.9	19.8	75.7	75.7	29.3	29.3	15.0	44.3
Total Split (%)	46.6%	46.6%	16.5%	63.1%	63.1%	24.4%	24.4%	12.5%	36.9%
Yellow Time (s)	3.7	3.7	3.0	3.7	3.7	3.3	3.3	3.0	3.3
All-Red Time (s)	2.7	2.7	0.0	2.7	2.7	3.0	3.0	0.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.4	6.4	3.0	6.4	6.4	6.3	6.3	3.0	6.3
Lead/Lag	Lag	Lag	Lead			Lag	Lag	Lead	
Lead-Lag Optimize?	Yes	Yes	Yes			Yes	Yes	Yes	
Recall Mode	Max	Max	None	Max	Max	None	None	None	None
v/c Ratio	0.27	0.76	0.69	0.28	0.20	0.23	0.86	0.71	0.30
Control Delay	23.9	35.0	20.5	13.0	2.1	44.7	47.2	45.8	26.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.9	35.0	20.5	13.0	2.1	44.7	47.2	45.8	26.2
Queue Length 50th (m)	18.6	119.1	27.8	34.8	0.0	8.4	55.9	30.0	24.6
Queue Length 95th (m)	35.0	#180.1	43.4	51.9	9.6	18.9	77.4	#51.2	36.5
Internal Link Dist (m)		397.1		655.9			650.8		148.8
Turn Bay Length (m)	15.0		15.0			15.0		15.0	
Base Capacity (vph)	471	822	439	1103	1001	208	799	253	1163
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.76	0.63	0.28	0.20	0.20	0.79	0.70	0.28
Intersection Summary									
Cycle Length: 120									
Actuated Cycle Length: 117.3									
Natural Cycle: 90									
Control Type: Semi Act-Uncoord									
# 95th percentile volume exceeds capacity, queue may be longer.									
Queue shown is maximum after two cycles.									
Plots and Phases: 3: Garth Street Extension/Garth Street & Twenty Road West									
↕ 01	↕ 02	↕ 04							
19.8 s	55.9 s	44.3 s							
↕ 06	↕ 07	↕ 08							
75.7 s	15 s	29.3 s							

HCM Signalized Intersection Capacity Analysis
3: Garth Street Extension/Garth Street & Twenty Road West

Total 2031 AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	121	489	102	261	296	191	40	316	280	167	218	94
Future Volume (vph)	121	489	102	261	296	191	40	316	280	167	218	94
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4	3.0	6.4	6.4	6.3	6.3	3.0	6.3	3.0	6.3	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.95	1.00	0.95	
Frt	1.00	0.97	1.00	1.00	0.85	1.00	0.93	1.00	0.95	1.00	0.95	
Flt Protected	0.95	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00	0.95	1.00	
Satd. Flow (prot)	1738	1812	1825	1865	1555	1825	3393	1772	3464			
Flt Permitted	0.57	1.00	0.19	1.00	1.00	0.55	1.00	0.17	1.00			
Satd. Flow (perm)	1044	1812	373	1865	1555	1064	3393	317	3464			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Adj. Flow (vph)	127	515	107	275	312	201	42	333	295	176	229	99
RTOR Reduction (vph)	0	6	0	0	0	82	0	137	0	0	41	0
Lane Group Flow (vph)	127	616	0	275	312	119	42	491	0	176	287	0
Heavy Vehicles (%)	5%	4%	0%	0%	3%	5%	0%	0%	0%	3%	0%	2%
Turn Type	Perm	NA	pm+pt	NA	Perm	Perm	NA	pm+pt	NA			
Protected Phases	2		1	6		8		7		4		
Permitted Phases	2		6		6	8		4				
Actuated Green, G (s)	52.9	52.9	69.4	69.4	69.4	20.5	20.5	35.2	35.2			
Effective Green, g (s)	52.9	52.9	69.4	69.4	69.4	20.5	20.5	35.2	35.2			
Actuated g/C Ratio	0.45	0.45	0.59	0.59	0.59	0.17	0.17	0.30	0.30			
Clearance Time (s)	6.4	6.4	3.0	6.4	6.4	6.3	6.3	3.0	6.3			
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)	470	817	387	1103	920	185	592	240	1039			
v/s Ratio Prot	c0.34		c0.08	0.17		c0.14		c0.07	0.08			
v/s Ratio Perm	0.12		0.34		0.08	0.04		0.15				
v/c Ratio	0.27	0.75	0.71	0.28	0.13	0.23	0.83	0.73	0.28			
Uniform Delay, d1	20.1	26.8	17.5	11.7	10.6	41.6	46.7	33.6	31.3			
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Incremental Delay, d2	1.4	6.4	6.0	0.6	0.3	0.6	9.4	11.0	0.1			
Delay (s)	21.5	33.2	23.6	12.4	10.9	42.2	56.1	44.5	31.5			
Level of Service	C	C	C	B	B	D	E	D	C			
Approach Delay (s)		31.2		15.9		55.2		36.0				
Approach LOS		C		B		E		D				

Intersection Summary			
HCM 2000 Control Delay	33.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	117.3	Sum of lost time (s)	18.7
Intersection Capacity Utilization	90.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

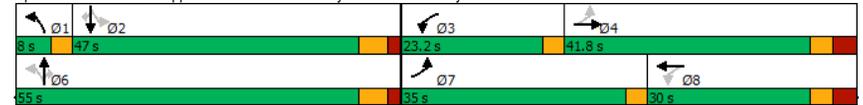
Timings
5: Upper James Street & Twenty Road West/Twenty Road East

Total 2031 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	405	555	176	466	138	1371	211	45	841	237
Future Volume (vph)	405	555	176	466	138	1371	211	45	841	237
Lane Group Flow (vph)	435	752	189	629	148	1474	227	48	904	255
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	7	4	3	8	1	6				
Permitted Phases	4		8		6		6	2		2
Detector Phase	7	4	3	8	1	6	6	2	2	2
Switch Phase										
Minimum Initial (s)	5.0	10.0	5.0	10.0	5.0	45.0	45.0	45.0	45.0	45.0
Minimum Split (s)	9.5	34.8	9.5	34.8	8.0	51.1	51.1	51.1	51.1	51.1
Total Split (s)	35.0	41.8	23.2	30.0	8.0	55.0	55.0	47.0	47.0	47.0
Total Split (%)	29.2%	34.8%	19.3%	25.0%	6.7%	45.8%	45.8%	39.2%	39.2%	39.2%
Yellow Time (s)	3.0	3.3	3.0	3.3	3.0	4.2	4.2	4.2	4.2	4.2
All-Red Time (s)	0.0	3.5	0.0	3.5	0.0	1.9	1.9	1.9	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.8	3.0	6.8	3.0	6.1	6.1	6.1	6.1	6.1
Lead/Lag	Lead	Lag	Lead	Lag	Lead		Lag	Lag	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	
Recall Mode	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.86	0.64	0.54	0.91	0.77	1.01	0.30	0.73	0.77	0.34
Control Delay	45.3	34.6	24.4	63.2	49.6	59.5	11.3	92.7	39.0	4.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.3	34.6	24.4	63.2	49.6	59.5	11.3	92.7	39.0	4.7
Queue Length 50th (m)	75.3	72.7	23.2	73.8	20.8	~196.5	14.3	9.9	99.8	0.0
Queue Length 95th (m)	#122.8	97.7	36.7	#107.9	#47.0	#241.4	32.2	#33.0	126.2	17.1
Internal Link Dist (m)		924.0		263.2		419.6		203.7		
Turn Bay Length (m)	50.0		33.0		127.0		58.0	65.0		137.0
Base Capacity (vph)	556	1202	480	714	193	1463	767	66	1179	744
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.63	0.39	0.88	0.77	1.01	0.30	0.73	0.77	0.34

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	115.4
Natural Cycle:	115
Control Type:	Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 5: Upper James Street & Twenty Road West/Twenty Road East



HCM Signalized Intersection Capacity Analysis

Total 2031 AM Peak Hour

5: Upper James Street & Twenty Road West/Twenty Road East

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	405	555	144	176	466	119	138	1371	211	45	841	237
Future Volume (vph)	405	555	144	176	466	119	138	1371	211	45	841	237
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.8		3.0	6.8		3.0	6.1	6.1	6.1	6.1	6.1
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	3482		1825	3456		1825	3444	1633	1825	3318	1633
Fit Permitted	0.16	1.00		0.37	1.00		0.15	1.00	1.00	0.10	1.00	1.00
Satd. Flow (perm)	293	3482		704	3456		281	3444	1633	187	3318	1633
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	435	597	155	189	501	128	148	1474	227	48	904	255
RTOR Reduction (vph)	0	18	0	0	19	0	0	0	74	0	0	164
Lane Group Flow (vph)	435	734	0	189	610	0	148	1474	153	48	904	91
Heavy Vehicles (%)	3%	2%	0%	0%	3%	0%	0%	0%	6%	0%	10%	0%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8		1	6		2		2
Permitted Phases	4			8			6		6	2		2
Actuated Green, G (s)	53.5	38.3		34.7	22.5		49.1	49.1	49.1	41.1	41.1	41.1
Effective Green, g (s)	53.5	38.3		34.7	22.5		49.1	49.1	49.1	41.1	41.1	41.1
Actuated g/C Ratio	0.46	0.33		0.30	0.19		0.43	0.43	0.43	0.36	0.36	0.36
Clearance Time (s)	3.0	6.8		3.0	6.8		3.0	6.1	6.1	6.1	6.1	6.1
Vehicle Extension (s)	3.0	3.0		3.0	3.0		1.0	6.5	6.5	6.5	6.5	6.5
Lane Grp Cap (vph)	494	1154		329	673		186	1464	694	66	1180	581
v/s Ratio Prot	c0.21	0.21		0.06	0.18		0.03	c0.43			0.27	
v/s Ratio Perm	c0.19			0.11			0.30		0.09	0.26		0.06
v/c Ratio	0.88	0.64		0.57	0.91		0.80	1.01	0.22	0.73	0.77	0.16
Uniform Delay, d1	30.3	32.7		31.5	45.5		26.7	33.2	21.1	32.3	32.9	25.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	16.6	1.2		2.4	15.9		19.3	25.2	0.7	51.3	4.8	0.6
Delay (s)	46.9	33.9		33.9	61.4		46.0	58.4	21.8	83.6	37.7	25.9
Level of Service	D	C		C	E		D	E	C	F	D	C
Approach Delay (s)		38.6			55.0			52.9			37.1	
Approach LOS		D			E			D			D	

Intersection Summary			
HCM 2000 Control Delay	46.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	115.5	Sum of lost time (s)	18.9
Intersection Capacity Utilization	133.7%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Timings

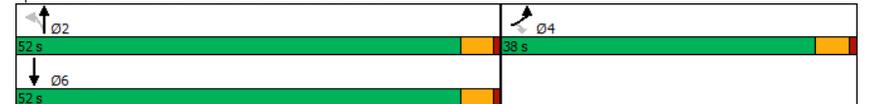
Total 2031 AM Peak Hour

6: Glanccaster Road & Book Road East

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Configurations	↔	↔	↔	↕	↕
Traffic Volume (vph)	226	70	55	202	235
Future Volume (vph)	226	70	55	202	235
Lane Group Flow (vph)	257	80	63	230	548
Turn Type	Prot	Perm	Perm	NA	NA
Protected Phases	4			2	6
Permitted Phases		4	2		
Detector Phase	4	4	2	2	6
Switch Phase					
Minimum Initial (s)	30.0	30.0	30.0	30.0	30.0
Minimum Split (s)	34.5	34.5	34.5	34.5	34.5
Total Split (s)	38.0	38.0	52.0	52.0	52.0
Total Split (%)	42.2%	42.2%	57.8%	57.8%	57.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	Max	Max	Max
v/c Ratio	0.43	0.14	0.18	0.24	0.53
Control Delay	24.7	5.4	11.5	10.9	12.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	24.7	5.4	11.5	10.9	12.4
Queue Length 50th (m)	32.1	0.0	4.9	18.5	44.6
Queue Length 95th (m)	51.1	8.3	11.3	29.8	68.1
Internal Link Dist (m)	171.0			456.5	274.4
Turn Bay Length (m)	100.0		50.0		
Base Capacity (vph)	669	649	346	969	1033
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.38	0.12	0.18	0.24	0.53

Intersection Summary				
Cycle Length: 90				
Actuated Cycle Length: 87.8				
Natural Cycle: 70				
Control Type: Semi Act-Uncoord				

Splits and Phases: 6: Glanccaster Road & Book Road East



HCM Signalized Intersection Capacity Analysis
6: Glanaster Road & Book Road East

Total 2031 AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↖	↖	↗	↗
Traffic Volume (vph)	226	70	55	202	235	247
Future Volume (vph)	226	70	55	202	235	247
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.93	
Fit Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1755	1570	1738	1746	1788	
Fit Permitted	0.95	1.00	0.34	1.00	1.00	
Satd. Flow (perm)	1755	1570	624	1746	1788	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	257	80	62	230	267	281
RTOR Reduction (vph)	0	53	0	0	40	0
Lane Group Flow (vph)	257	27	63	230	508	0
Heavy Vehicles (%)	4%	4%	5%	10%	0%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	30.0	30.0	48.8	48.8	48.8	
Effective Green, g (s)	30.0	30.0	48.8	48.8	48.8	
Actuated g/C Ratio	0.34	0.34	0.56	0.56	0.56	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	599	536	346	970	993	
v/s Ratio Prot	c0.15			0.13	c0.28	
v/s Ratio Perm		0.02	0.10			
v/c Ratio	0.43	0.05	0.18	0.24	0.51	
Uniform Delay, d1	22.3	19.4	9.6	10.0	12.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.5	0.0	1.2	0.6	1.9	
Delay (s)	22.8	19.4	10.8	10.6	14.0	
Level of Service	C	B	B	B	B	
Approach Delay (s)	22.0			10.6	14.0	
Approach LOS	C			B	B	

Intersection Summary			
HCM 2000 Control Delay	15.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	87.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

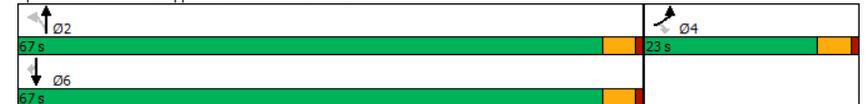
Timings
7: Upper James Street & Talbot Lane

Total 2031 AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↖	↖	↗	↗
Traffic Volume (vph)	11	9	57	1451	1141	88
Future Volume (vph)	11	9	57	1451	1141	88
Lane Group Flow (vph)	12	9	60	1527	1201	93
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	23.0	23.0	67.0	67.0	67.0	67.0
Total Split (%)	25.6%	25.6%	74.4%	74.4%	74.4%	74.4%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Max	Max	Max	Max
v/c Ratio	0.09	0.07	0.15	0.47	0.38	0.06
Control Delay	41.3	23.7	2.0	1.7	1.5	0.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.3	23.7	2.0	1.7	1.5	0.4
Queue Length 50th (m)	1.8	0.0	0.0	0.0	0.0	0.0
Queue Length 95th (m)	7.3	4.7	3.8	39.7	27.8	1.8
Internal Link Dist (m)	158.6			280.1	602.9	
Turn Bay Length (m)			50.0			34.0
Base Capacity (vph)	391	357	410	3269	3120	1527
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.03	0.15	0.47	0.38	0.06

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 86.6	
Natural Cycle: 60	
Control Type: Semi Act-Uncoord	

Splits and Phases: 7: Upper James Street & Talbot Lane



HCM Signalized Intersection Capacity Analysis
7: Upper James Street & Talbot Lane

Total 2031 AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↖	↕	↕	↗
Traffic Volume (vph)	11	9	57	1451	1141	88
Future Volume (vph)	11	9	57	1451	1141	88
Ideal Flow (vphpl)	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	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Fit Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1825	1633	1825	3510	3349	1633
Fit Permitted	0.95	1.00	0.23	1.00	1.00	1.00
Satd. Flow (perm)	1825	1633	440	3510	3349	1633
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	12	9	60	1527	1201	93
RTOR Reduction (vph)	0	9	0	0	0	12
Lane Group Flow (vph)	12	0	60	1527	1201	81
Heavy Vehicles (%)	0%	0%	0%	4%	9%	0%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	2.6	2.6	77.8	77.8	77.8	77.8
Effective Green, g (s)	2.6	2.6	77.8	77.8	77.8	77.8
Actuated g/C Ratio	0.03	0.03	0.87	0.87	0.87	0.87
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)	53	47	382	3054	2914	1421
v/s Ratio Prot	c0.01			c0.44	0.36	
v/s Ratio Perm		0.00	0.14			0.05
v/c Ratio	0.23	0.01	0.16	0.50	0.41	0.06
Uniform Delay, d1	42.4	42.1	0.9	1.3	1.2	0.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.2	0.0	0.9	0.6	0.4	0.1
Delay (s)	44.6	42.2	1.7	1.9	1.6	0.9
Level of Service	D	D	A	A	A	A
Approach Delay (s)	43.6			1.9	1.6	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	2.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	89.4	Sum of lost time (s)	9.0
Intersection Capacity Utilization	51.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

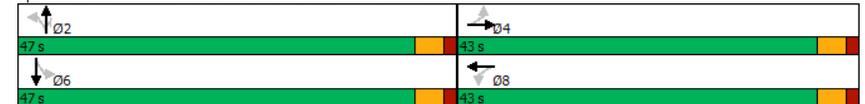
Timings
8: Glanccaster Road & Dickenson Road West

Total 2031 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗	↗
Traffic Volume (vph)	13	119	93	108	50	123	101	147	147
Future Volume (vph)	13	119	93	108	50	123	101	147	147
Lane Group Flow (vph)	15	202	111	271	60	146	120	175	188
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA
Protected Phases		4		8		2		2	6
Permitted Phases	4		8		2		2	6	
Detector Phase	4	4	8	8	2	2	2	6	6
Switch Phase									
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	43.0	43.0	43.0	43.0	47.0	47.0	47.0	47.0	47.0
Total Split (%)	47.8%	47.8%	47.8%	47.8%	52.2%	52.2%	52.2%	52.2%	52.2%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Min	Min	Min	Min	Min
v/c Ratio	0.04	0.16	0.33	0.22	0.14	0.21	0.18	0.38	0.27
Control Delay	7.7	5.8	11.3	4.4	7.8	7.9	2.8	10.4	8.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.7	5.8	11.3	4.4	7.8	7.9	2.8	10.4	8.2
Queue Length 50th (m)	0.4	2.1	3.5	1.9	1.7	4.3	0.0	5.6	5.6
Queue Length 95th (m)	2.6	6.5	11.7	6.7	6.2	11.6	4.8	15.0	14.2
Internal Link Dist (m)		150.3		619.9		112.9			456.5
Turn Bay Length (m)	50.0		50.0		50.0		50.0		50.0
Base Capacity (vph)	1124	3486	961	3362	1228	1921	1633	1276	1902
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.06	0.12	0.08	0.05	0.08	0.07	0.14	0.10

Intersection Summary	
Cycle Length:	90
Actuated Cycle Length:	31
Natural Cycle:	45
Control Type:	Semi Act-Uncoord

Splits and Phases: 8: Glanccaster Road & Dickenson Road West



HCM Signalized Intersection Capacity Analysis
8: Glanaster Road & Dickenson Road West

Total 2031 AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	13	119	50	93	108	119	50	123	101	147	147	11
Future Volume (vph)	13	119	50	93	108	119	50	123	101	147	147	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.96	1.00	0.92	1.00	1.00	1.00	0.85	1.00	0.99	1.00	1.00
Fit Protected	0.95	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	3487	1460	3363	1825	1921	1633	1825	1901	1825	1901	1901
Fit Permitted	0.58	1.00	0.62	1.00	0.64	1.00	1.00	0.66	1.00	0.66	1.00	1.00
Satd. Flow (perm)	1124	3487	960	3363	1228	1921	1633	1276	1901	1276	1901	1901
Peak-hour factor, PHF	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Adj. Flow (vph)	15	142	60	111	129	142	60	146	120	175	175	13
RTOR Reduction (vph)	0	39	0	0	93	0	0	0	77	0	4	0
Lane Group Flow (vph)	15	163	0	111	178	0	60	146	43	175	184	0
Heavy Vehicles (%)	0%	0%	0%	25%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA	NA
Protected Phases		4			8			2		6		
Permitted Phases	4		8			2		2		6		
Actuated Green, G (s)	10.8	10.8	10.8	10.8	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
Effective Green, g (s)	10.8	10.8	10.8	10.8	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
Actuated g/C Ratio	0.35	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	391	1214		334	1171		443	694	589	461	686	
v/s Ratio Prot		0.05			0.05			0.08				0.10
v/s Ratio Perm	0.01			c0.12			0.05		0.03		c0.14	
v/c Ratio	0.04	0.13		0.33	0.15		0.14	0.21	0.07	0.38	0.27	
Uniform Delay, d1	6.7	6.9		7.4	7.0		6.6	6.8	6.5	7.3	7.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.1		0.6	0.1		0.1	0.2	0.1	0.5	0.2	
Delay (s)	6.7	7.0		8.0	7.0		6.8	7.0	6.5	7.9	7.2	
Level of Service	A	A		A	A		A	A	A	A	A	
Approach Delay (s)		6.9			7.3			6.8			7.5	
Approach LOS		A			A			A			A	

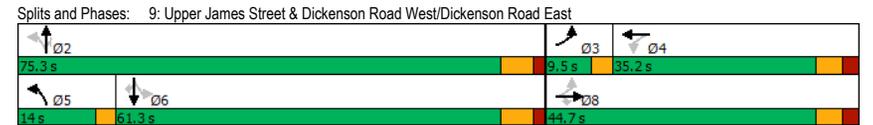
Intersection Summary		
HCM 2000 Control Delay	7.2	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.36	
Actuated Cycle Length (s)	31.0	Sum of lost time (s)
Intersection Capacity Utilization	48.4%	ICU Level of Service
Analysis Period (min)	15	
c Critical Lane Group		

Timings
9: Upper James Street & Dickenson Road West/Dickenson Road East

Total 2031 AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	98	374	303	9	402	273	1325	8	11	1004	145
Future Volume (vph)	98	374	303	9	402	273	1325	8	11	1004	145
Lane Group Flow (vph)	103	394	319	9	495	287	1395	8	12	1057	153
Turn Type	pm+pt	NA	Perm	Perm	NA	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8			4	5	2			6	
Permitted Phases	8		8	4		2		2	6		6
Detector Phase	3	8	8	4	4	5	2	2	6	6	6
Switch Phase											
Minimum Initial (s)	5.0	10.0	10.0	10.0	10.0	5.0	55.0	55.0	55.0	55.0	55.0
Minimum Split (s)	9.5	35.2	35.2	35.2	35.2	9.5	66.2	66.2	61.3	61.3	61.3
Total Split (s)	9.5	44.7	44.7	35.2	35.2	14.0	75.3	75.3	61.3	61.3	61.3
Total Split (%)	7.9%	37.3%	37.3%	29.3%	29.3%	11.7%	62.8%	62.8%	51.1%	51.1%	51.1%
Yellow Time (s)	3.0	3.7	3.7	3.7	3.7	3.0	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	0.0	2.5	2.5	2.5	2.5	0.0	1.7	1.7	1.7	1.7	1.7
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.2	6.2	6.2	6.2	3.0	6.3	6.3	6.3	6.3	6.3
Lead/Lag	Lead			Lag	Lag	Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes			Yes	Yes	Yes			Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.49	0.41	0.58	0.05	0.74	0.89	0.65	0.01	0.10	0.63	0.18
Control Delay	37.3	34.8	15.2	37.2	49.0	42.8	15.9	0.0	19.5	23.5	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.3	34.8	15.2	37.2	49.0	42.8	15.9	0.0	19.5	23.5	8.5
Queue Length 50th (m)	16.7	37.2	16.4	1.6	52.5	24.0	93.2	0.0	1.3	85.4	7.6
Queue Length 95th (m)	29.7	50.8	43.8	5.9	70.0	#69.8	135.1	0.0	5.7	120.2	20.5
Internal Link Dist (m)		868.4			232.1		174.3			280.1	
Turn Bay Length (m)	15.0		30.0	15.0		40.0		21.0	68.0		17.0
Base Capacity (vph)	209	1225	645	259	940	323	2153	1032	120	1669	849
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.32	0.49	0.03	0.53	0.89	0.65	0.01	0.10	0.63	0.18

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	111.5
Natural Cycle:	120
Control Type:	Semi Act-Uncoord
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	



HCM Signalized Intersection Capacity Analysis Total 2031 AM Peak Hour
 9: Upper James Street & Dickenson Road West/Dickenson Road East

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	98	374	303	9	402	68	273	1325	8	11	1004	145
Future Volume (vph)	98	374	303	9	402	68	273	1325	8	11	1004	145
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.2	6.2	6.2	6.2		3.0	6.3	6.3	6.3	6.3	6.3
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	3544	1445	1825	3570		1644	3476	1633	1437	3380	1633
Fit Permitted	0.23	1.00	1.00	0.52	1.00		0.17	1.00	1.00	0.16	1.00	1.00
Satd. Flow (perm)	432	3544	1445	998	3570		292	3476	1633	245	3380	1633
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	103	394	319	9	423	72	287	1395	8	12	1057	153
RTOR Reduction (vph)	0	0	163	0	12	0	0	0	3	0	0	42
Lane Group Flow (vph)	103	394	156	9	483	0	287	1395	5	12	1057	111
Heavy Vehicles (%)	0%	3%	13%	0%	0%	0%	11%	5%	0%	27%	8%	0%
Turn Type	pm+pt	NA	Perm	Perm	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8			4		5	2			6	
Permitted Phases	8		8	4			2		2	6		6
Actuated Green, G (s)	29.9	29.9	29.9	20.4	20.4		69.1	69.1	69.1	55.1	55.1	55.1
Effective Green, g (s)	29.9	29.9	29.9	20.4	20.4		69.1	69.1	69.1	55.1	55.1	55.1
Actuated g/C Ratio	0.27	0.27	0.27	0.18	0.18		0.62	0.62	0.62	0.49	0.49	0.49
Clearance Time (s)	3.0	6.2	6.2	6.2	6.2		3.0	6.3	6.3	6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	5.7	5.7	5.7	5.7	5.7
Lane Grp Cap (vph)	197	950	387	182	653		314	2154	1012	121	1670	806
v/s Ratio Prot	c0.03	0.11			c0.14		c0.09	0.40			0.31	
v/s Ratio Perm	0.11		0.11	0.01			c0.48	0.00	0.05		0.07	
v/c Ratio	0.52	0.41	0.40	0.05	0.74		0.91	0.65	0.00	0.10	0.63	0.14
Uniform Delay, d1	32.4	33.6	33.5	37.6	43.0		15.3	13.5	8.1	15.0	20.8	15.3
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.5	0.3	0.7	0.1	4.4		29.6	1.5	0.0	1.6	1.8	0.4
Delay (s)	34.9	33.9	34.2	37.7	47.4		44.9	15.0	8.1	16.6	22.6	15.7
Level of Service	C	C	C	D	D		D	B	A	B	C	B
Approach Delay (s)		34.1			47.2			20.0			21.7	
Approach LOS		C			D			C			C	
Intersection Summary												
HCM 2000 Control Delay	26.5			HCM 2000 Level of Service				C				
HCM 2000 Volume to Capacity ratio	0.87											
Actuated Cycle Length (s)	111.5				Sum of lost time (s)				18.5			
Intersection Capacity Utilization	131.2%			ICU Level of Service				H				
Analysis Period (min)	15											
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis Total 2031 AM Peak Hour
 10: Local Street & Twenty Road West

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (veh/h)	432	10	16	366	2	69
Future Volume (Veh/h)	432	10	16	366	2	69
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)	470	11	17	398	2	75
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)	307					
pX, platoon unblocked						
vC, conflicting volume			481		908	476
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			481		908	476
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		99	87
cM capacity (veh/h)			1082		301	589
Direction, Lane #	EB 1	WB 1	NB 1	NB 2		
Volume Total	481	415	2	75		
Volume Left	0	17	2	0		
Volume Right	11	0	0	75		
cSH	1700	1082	301	589		
Volume to Capacity	0.28	0.02	0.01	0.13		
Queue Length 95th (m)	0.0	0.4	0.2	3.3		
Control Delay (s)	0.0	0.5	17.0	12.0		
Lane LOS		A	C	B		
Approach Delay (s)	0.0	0.5	12.1			
Approach LOS			B			
Intersection Summary						
Average Delay	1.2					
Intersection Capacity Utilization	42.3%			ICU Level of Service		A
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
11: Collector Road A & Twenty Road West

Total 2031 AM Peak Hour

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	473	28	60	373	9	192
Future Volume (Veh/h)	473	28	60	373	9	192
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)	514	30	65	405	10	209
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			544	1064	529	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			544	1064	529	
tC, single (s)			4.1	6.4	6.2	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			94	96	62	
cM capacity (veh/h)			1025	231	550	
Direction_Lane #	EB 1	WB 1	NB 1	NB 2		
Volume Total	544	470	10	209		
Volume Left	0	65	10	0		
Volume Right	30	0	0	209		
cSH	1700	1025	231	550		
Volume to Capacity	0.32	0.06	0.04	0.38		
Queue Length 95th (m)	0.0	1.5	1.0	13.4		
Control Delay (s)	0.0	1.8	21.3	15.5		
Lane LOS	A		C		C	
Approach Delay (s)	0.0		1.8	15.8		
Approach LOS			C			
Intersection Summary						
Average Delay			3.5			
Intersection Capacity Utilization			62.9%		ICU Level of Service B	
Analysis Period (min)			15			

Timings

12: Collector Road B/Twentyplace Boulevard & Twenty Road West

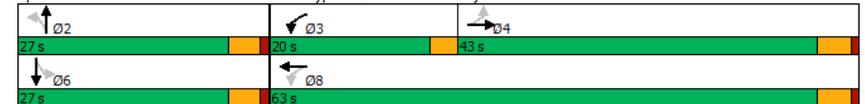
Total 2031 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔		↔		↔		↔	
Traffic Volume (vph)	8	860	200	666	42	0	20	0
Future Volume (vph)	8	860	200	666	42	0	20	0
Lane Group Flow (vph)	9	983	217	732	46	243	22	28
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases	4		3		8		2	
Permitted Phases	4		8		2		6	
Detector Phase	4		3		8		2	
Switch Phase	4		3		8		2	
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	9.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	43.0	43.0	20.0	63.0	27.0	27.0	27.0	27.0
Total Split (%)	47.8%	47.8%	22.2%	70.0%	30.0%	30.0%	30.0%	30.0%
Yellow Time (s)	3.5	3.5	3.0	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	3.0	4.5	4.5	4.5	4.5	4.5
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.04	0.77	0.60	0.38	0.10	0.31	0.07	0.04
Control Delay	14.8	24.0	16.3	9.4	20.6	1.1	20.9	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.8	24.0	16.3	9.4	20.6	1.1	20.9	0.1
Queue Length 50th (m)	0.7	57.0	12.5	26.0	4.1	0.0	1.9	0.0
Queue Length 95th (m)	3.5	83.2	28.6	35.1	13.5	0.0	8.2	0.0
Internal Link Dist (m)			655.9	924.0	640.3		89.8	
Turn Bay Length (m)	15.0		15.0		15.0			
Base Capacity (vph)	392	1982	525	3023	453	774	326	693
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.50	0.41	0.24	0.10	0.31	0.07	0.04

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 70
Natural Cycle: 60
Control Type: Semi Act-Uncoord

Splits and Phases: 12: Collector Road B/Twentyplace Boulevard & Twenty Road West



HCM Signalized Intersection Capacity Analysis

Total 2031 AM Peak Hour

12: Collector Road B/Twentyplace Boulevard & Twenty Road West

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔		↔	↔		↔	↔		↔	↔	
Traffic Volume (vph)	8	860	44	200	666	7	42	0	224	20	0	26
Future Volume (vph)	8	860	44	200	666	7	42	0	224	20	0	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		3.0	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.85		1.00	0.85	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3552		1789	3573		1789	1601		1789	1601	
Fit Permitted	0.37	1.00		0.14	1.00		0.74	1.00		0.53	1.00	
Satd. Flow (perm)	704	3552		266	3573		1392	1601		1002	1601	
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)	9	935	48	217	724	8	46	0	243	22	0	28
RTOR Reduction (vph)	0	4	0	0	1	0	0	164	0	0	19	0
Lane Group Flow (vph)	9	979	0	217	731	0	46	79	0	22	9	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8		2	2		6	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	25.3	25.3		38.1	38.1		22.8	22.8		22.8	22.8	
Effective Green, g (s)	25.3	25.3		38.1	38.1		22.8	22.8		22.8	22.8	
Actuated g/C Ratio	0.36	0.36		0.55	0.55		0.33	0.33		0.33	0.33	
Clearance Time (s)	4.5	4.5		3.0	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	
Lane Grp Cap (vph)	254	1285		358	1947		454	522		326	522	
v/s Ratio Prot		c0.28		c0.08	0.20			c0.05			0.01	
v/s Ratio Perm	0.01			0.24			0.03			0.02		
v/c Ratio	0.04	0.76		0.61	0.38		0.10	0.15		0.07	0.02	
Uniform Delay, d1	14.4	19.6		11.2	9.1		16.4	16.7		16.2	16.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	2.7		2.9	0.1		0.4	0.6		0.4	0.1	
Delay (s)	14.5	22.4		14.1	9.2		16.9	17.3		16.6	16.0	
Level of Service	B	C		B	A		B	B		B	B	
Approach Delay (s)		22.3			10.3			17.2			16.3	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	69.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	63.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

Total 2031 AM Peak Hour

13: Glanaster Road & Collector Road C

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (veh/h)	117	219	363	64	106	369
Future Volume (Veh/h)	117	219	363	64	106	369
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)	127	238	395	70	115	401
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)			298			
pX, platoon unblocked	0.98	0.98			0.98	
vC, conflicting volume	1061	430			465	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1054	413			448	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	42	62			89	
cM capacity (veh/h)	220	629			1094	
Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2	
Volume Total	127	238	465	115	401	
Volume Left	127	0	0	115	0	
Volume Right	0	238	70	0	0	
cSH	220	629	1700	1094	1700	
Volume to Capacity	0.58	0.38	0.27	0.11	0.24	
Queue Length 95th (m)	24.3	13.4	0.0	2.7	0.0	
Control Delay (s)	41.4	14.2	0.0	8.7	0.0	
Lane LOS	E	B		A		
Approach Delay (s)	23.6		0.0	1.9		
Approach LOS	C					

Intersection Summary			
Average Delay	7.2		
Intersection Capacity Utilization	45.3%	ICU Level of Service	A
Analysis Period (min)	15		

Timings
14: Upper James Street & Collector Road C

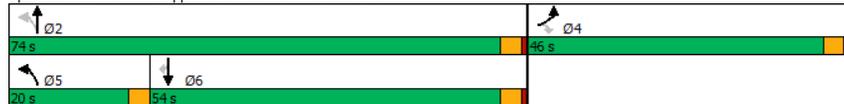
Total 2031 AM Peak Hour

	↖	↗	↙	↘	↑	↓
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↙	↘	↑	↓
Traffic Volume (vph)	451	281	179	1283	948	227
Future Volume (vph)	451	281	179	1283	948	227
Lane Group Flow (vph)	490	305	195	1395	1030	247
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	5.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	9.5	22.5	22.5	22.5
Total Split (s)	46.0	46.0	20.0	74.0	54.0	54.0
Total Split (%)	38.3%	38.3%	16.7%	61.7%	45.0%	45.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	0.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	3.0	4.0	4.0	4.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Recall Mode	None	None	None	Max	Max	Max
v/c Ratio	0.89	0.43	0.57	0.63	0.58	0.29
Control Delay	56.4	5.1	16.5	15.9	23.7	11.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.4	5.1	16.5	15.9	23.7	11.3
Queue Length 50th (m)	102.7	0.0	17.2	97.2	83.5	15.7
Queue Length 95th (m)	144.2	18.2	31.3	135.0	126.2	38.6
Internal Link Dist (m)	946.4		602.9	419.6		
Turn Bay Length (m)			15.0		30.0	
Base Capacity (vph)	666	787	420	2222	1771	850
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.74	0.39	0.46	0.63	0.58	0.29

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 113.1
Natural Cycle: 55
Control Type: Semi Act-Uncoord

Splits and Phases: 14: Upper James Street & Collector Road C



HCM Signalized Intersection Capacity Analysis
14: Upper James Street & Collector Road C

Total 2031 AM Peak Hour

	↖	↗	↙	↘	↑	↓
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↙	↘	↑	↓
Traffic Volume (vph)	451	281	179	1283	948	227
Future Volume (vph)	451	281	179	1283	948	227
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	3.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Fit Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1789	1601	1789	3579	3579	1601
Fit Permitted	0.95	1.00	0.17	1.00	1.00	1.00
Satd. Flow (perm)	1789	1601	314	3579	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	490	305	195	1395	1030	247
RTOR Reduction (vph)	0	211	0	0	0	59
Lane Group Flow (vph)	490	94	195	1395	1030	188
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	34.9	34.9	70.3	70.3	56.0	56.0
Effective Green, g (s)	34.9	34.9	70.3	70.3	56.0	56.0
Actuated g/C Ratio	0.31	0.31	0.62	0.62	0.49	0.49
Clearance Time (s)	4.0	4.0	3.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	551	493	342	2222	1770	792
v/s Ratio Prot	c0.27		0.06	c0.39	0.29	
v/s Ratio Perm		0.06	0.30			0.12
v/c Ratio	0.89	0.19	0.57	0.63	0.58	0.24
Uniform Delay, d1	37.3	28.8	13.1	13.3	20.3	16.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	16.0	0.2	2.3	1.4	1.4	0.7
Delay (s)	53.3	29.0	15.3	14.7	21.7	17.1
Level of Service	D	C	B	B	C	B
Approach Delay (s)	44.0			14.8	20.8	
Approach LOS	D			B	C	

Intersection Summary

HCM 2000 Control Delay: 23.2, HCM 2000 Level of Service: C
 HCM 2000 Volume to Capacity ratio: 0.74
 Actuated Cycle Length (s): 113.2, Sum of lost time (s): 11.0
 Intersection Capacity Utilization: 71.1%, ICU Level of Service: C
 Analysis Period (min): 15

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
15: Dickenson Road West & Collector Road A

Total 2031 AM Peak Hour

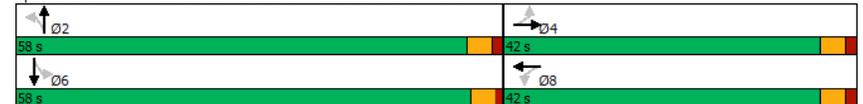
Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations	↘	↕	↕	↕	↘	↘	
Traffic Volume (veh/h)	3	354	330	63	91	18	
Future Volume (Veh/h)	3	354	330	63	91	18	
Sign Control		Free	Free		Stop		
Grade		0%	0%		0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	3	385	359	68	99	20	
Pedestrians							
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	427				592	214	
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	427				592	214	
tC, single (s)	4.1				6.8	6.9	
tC, 2 stage (s)							
tF (s)	2.2				3.5	3.3	
p0 queue free %	100				77	97	
cM capacity (veh/h)	1129				437	792	
Direction_Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	3	192	192	239	188	99	20
Volume Left	3	0	0	0	0	99	0
Volume Right	0	0	0	0	68	0	20
cSH	1129	1700	1700	1700	1700	437	792
Volume to Capacity	0.00	0.11	0.11	0.14	0.11	0.23	0.03
Queue Length 95th (m)	0.1	0.0	0.0	0.0	0.0	6.6	0.6
Control Delay (s)	8.2	0.0	0.0	0.0	0.0	15.6	9.7
Lane LOS	A					C	A
Approach Delay (s)	0.1			0.0		14.6	
Approach LOS						B	
Intersection Summary							
Average Delay		1.9					
Intersection Capacity Utilization		22.8%		ICU Level of Service	A		
Analysis Period (min)		15					

Timings
16: Garth Street Extension & Dickenson Road West

Total 2031 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↘	↕	↕	↕	↕	↕	↕	↕
Traffic Volume (vph)	23	227	140	321	100	50	292	150
Future Volume (vph)	23	227	140	321	100	50	292	150
Lane Group Flow (vph)	25	464	152	467	109	326	317	204
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	42.0	42.0	42.0	42.0	58.0	58.0	58.0	58.0
Total Split (%)	42.0%	42.0%	42.0%	42.0%	58.0%	58.0%	58.0%	58.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.08	0.36	0.48	0.38	0.21	0.21	0.67	0.13
Control Delay	14.6	7.9	21.1	12.6	10.3	2.7	19.5	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.6	7.9	21.1	12.6	10.3	2.7	19.5	6.8
Queue Length 50th (m)	1.2	6.5	8.6	11.5	4.5	1.0	16.4	3.2
Queue Length 95th (m)	7.5	23.8	34.8	35.4	17.7	8.1	59.1	11.6
Internal Link Dist (m)		899.2		404.1		105.4		811.8
Turn Bay Length (m)	50.0		50.0		50.0		50.0	
Base Capacity (vph)	714	2705	718	2764	1080	2900	963	3204
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.17	0.21	0.17	0.10	0.11	0.33	0.06
Intersection Summary								
Cycle Length: 100								
Actuated Cycle Length: 49								
Natural Cycle: 50								
Control Type: Actuated-Uncoordinated								

Splits and Phases: 16: Garth Street Extension & Dickenson Road West



HCM Signalized Intersection Capacity Analysis
16: Garth Street Extension & Dickenson Road West

Total 2031 AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕		↔	↕		↔	↕		↔	↕	
Traffic Volume (vph)	23	227	200	140	321	109	100	50	250	292	150	38
Future Volume (vph)	23	227	200	140	321	109	100	50	250	292	150	38
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		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.93		1.00	0.96		1.00	0.87		1.00	0.97	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3328		1789	3443		1789	3131		1789	3471	
Fit Permitted	0.47	1.00		0.48	1.00		0.62	1.00		0.55	1.00	
Satd. Flow (perm)	893	3328		898	3443		1175	3131		1045	3471	
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)	25	247	217	152	349	118	109	54	272	317	163	41
RTOR Reduction (vph)	0	139	0	0	34	0	0	149	0	0	22	0
Lane Group Flow (vph)	25	325	0	152	433	0	109	177	0	317	182	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)	17.2	17.2		17.2	17.2		21.6	21.6		22.1	22.1	
Effective Green, g (s)	17.2	17.2		17.2	17.2		21.6	21.6		22.1	22.1	
Actuated g/C Ratio	0.36	0.36		0.36	0.36		0.45	0.45		0.46	0.46	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	321	1197		323	1238		530	1414		483	1604	
v/s Ratio Prot		0.10			0.13			0.06			0.05	
v/s Ratio Perm	0.03			c0.17			0.09			c0.30		
v/c Ratio	0.08	0.27		0.47	0.35		0.21	0.13		0.66	0.11	
Uniform Delay, d1	10.1	10.9		11.8	11.2		7.9	7.6		9.9	7.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.1		1.1	0.2		0.2	0.0		3.2	0.0	
Delay (s)	10.2	11.0		12.9	11.4		8.1	7.7		13.1	7.3	
Level of Service	B	B		B	B		A	A		B	A	
Approach Delay (s)		10.9			11.7			7.8			10.9	
Approach LOS		B			B			A			B	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	47.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
17: Dickenson Road West & Collector Road B

Total 2031 AM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕	↕	↕	↔	↔
Traffic Volume (veh/h)	31	740	639	112	109	9
Future Volume (Veh/h)	31	740	639	112	109	9
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)	34	804	695	122	118	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	817			1226	408	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	817			1226	408	
tC, single (s)	4.1			6.8	6.9	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	96			28	98	
cM capacity (veh/h)	807			164	592	

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	34	402	402	463	354	118	10
Volume Left	34	0	0	0	0	118	0
Volume Right	0	0	0	0	122	0	10
cSH	807	1700	1700	1700	1700	164	592
Volume to Capacity	0.04	0.24	0.24	0.27	0.21	0.72	0.02
Queue Length 95th (m)	1.0	0.0	0.0	0.0	0.0	33.3	0.4
Control Delay (s)	9.7	0.0	0.0	0.0	0.0	69.4	11.2
Lane LOS	A					F	B
Approach Delay (s)	0.4			0.0		64.9	
Approach LOS						F	

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	38.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
18: Collector Road A & Collector Road C

Total 2031 AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔		↔	↔		↔	↔		↔	↔	↔	↔
Sign Control	Stop			Stop			Stop			Stop		
Traffic Volume (vph)	23	191	21	29	167	68	45	55	101	202	85	60
Future Volume (vph)	23	191	21	29	167	68	45	55	101	202	85	60
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)	25	208	23	32	182	74	49	60	110	220	92	65
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2				
Volume Total (vph)	25	231	32	256	49	170	220	157				
Volume Left (vph)	25	0	32	0	49	0	220	0				
Volume Right (vph)	0	23	0	74	0	110	0	65				
Hadj (s)	0.53	-0.04	0.53	-0.17	0.53	-0.42	0.53	-0.26				
Departure Headway (s)	7.2	6.6	7.2	6.5	7.3	6.3	7.0	6.2				
Degree Utilization, x	0.05	0.43	0.06	0.46	0.10	0.30	0.43	0.27				
Capacity (veh/h)	467	513	471	529	461	529	488	545				
Control Delay (s)	9.4	13.3	9.5	13.7	9.9	10.8	14.0	10.4				
Approach Delay (s)	12.9		13.2		10.6		12.5					
Approach LOS	B		B		B		B					
Intersection Summary												
Delay	12.4											
Level of Service	B											
Intersection Capacity Utilization	49.9%			ICU Level of Service			A					
Analysis Period (min)	15											

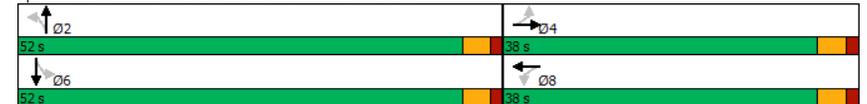
Timings
19: Garth Street Extension & Collector Road C

Total 2031 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔		↔		↔		↔	
Traffic Volume (vph)	101	286	49	126	38	181	270	402
Future Volume (vph)	101	286	49	126	38	181	270	402
Lane Group Flow (vph)	110	424	53	255	41	338	293	567
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	4		8		2		6	
Permitted Phases	4		8		2		6	
Detector Phase	4		8		2		6	
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	38.0	38.0	38.0	38.0	52.0	52.0	52.0	52.0
Total Split (%)	42.2%	42.2%	42.2%	42.2%	57.8%	57.8%	57.8%	57.8%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.43	0.80	0.45	0.47	0.09	0.16	0.47	0.27
Control Delay	28.2	36.2	35.5	20.5	9.4	5.1	13.8	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.2	36.2	35.5	20.5	9.4	5.1	13.8	8.0
Queue Length 50th (m)	13.4	55.5	6.5	24.2	2.3	5.9	22.1	16.6
Queue Length 95th (m)	27.0	85.7	17.2	43.2	8.5	15.1	55.5	33.8
Internal Link Dist (m)	644.3		697.4		811.8		650.8	
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	376	778	175	773	477	2068	619	2100
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.54	0.30	0.33	0.09	0.16	0.47	0.27

Intersection Summary								
Cycle Length:	90							
Actuated Cycle Length:	79.7							
Natural Cycle:	45							
Control Type:	Semi Act-Uncoord							

Splits and Phases: 19: Garth Street Extension & Collector Road C



HCM Signalized Intersection Capacity Analysis
19: Garth Street Extension & Collector Road C

Total 2031 AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔		↔	↔		↔	↔		↔	↔	
Traffic Volume (vph)	101	286	104	49	126	109	38	181	130	270	402	120
Future Volume (vph)	101	286	104	49	126	109	38	181	130	270	402	120
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	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.96		1.00	0.93		1.00	0.94		1.00	0.97	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1808		1789	1753		1789	3355		1789	3455	
Fit Permitted	0.47	1.00		0.22	1.00		0.42	1.00		0.55	1.00	
Satd. Flow (perm)	890	1808		417	1753		795	3355		1033	3455	
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)	110	311	113	53	137	118	41	197	141	293	437	130
RTOR Reduction (vph)	0	16	0	0	39	0	0	56	0	0	26	0
Lane Group Flow (vph)	110	408	0	53	216	0	41	282	0	293	541	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)	22.8	22.8		22.8	22.8		47.8	47.8		47.8	47.8	
Effective Green, g (s)	22.8	22.8		22.8	22.8		47.8	47.8		47.8	47.8	
Actuated g/C Ratio	0.29	0.29		0.29	0.29		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	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	254	517		119	502		477	2014		620	2074	
v/s Ratio Prot		c0.23			0.12			0.08			0.16	
v/s Ratio Perm	0.12			0.13			0.05			c0.28		
v/c Ratio	0.43	0.79		0.45	0.43		0.09	0.14		0.47	0.26	
Uniform Delay, d1	23.1	26.2		23.2	23.1		6.7	6.9		8.9	7.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.2	7.8		2.6	0.6		0.4	0.1		2.6	0.3	
Delay (s)	24.3	34.0		25.9	23.7		7.1	7.1		11.4	7.8	
Level of Service	C	C		C	C		A	A		B	A	
Approach Delay (s)		32.0			24.1			7.1			9.1	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	16.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	79.6	Sum of lost time (s)	9.0
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

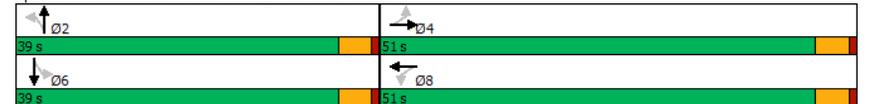
Timings
20: Collector Road B & Collector Road C

Total 2031 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	72	563	35	167	10	52	161	209
Future Volume (vph)	72	563	35	167	10	52	161	209
Lane Group Flow (vph)	78	667	38	270	11	79	175	343
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	51.0	51.0	51.0	51.0	39.0	39.0	39.0	39.0
Total Split (%)	56.7%	56.7%	56.7%	56.7%	43.3%	43.3%	43.3%	43.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.19	0.85	0.36	0.35	0.03	0.09	0.29	0.41
Control Delay	14.0	30.6	24.9	13.2	15.6	11.8	17.0	16.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.0	30.6	24.9	13.2	15.6	11.8	17.0	16.1
Queue Length 50th (m)	6.7	81.4	3.6	20.9	0.8	4.4	14.8	27.7
Queue Length 95th (m)	14.3	120.7	11.5	35.7	4.5	14.9	37.4	63.7
Internal Link Dist (m)		697.4		946.4		692.1		640.3
Turn Bay Length (m)	15.0				50.0		50.0	
Base Capacity (vph)	622	1158	156	1127	411	843	613	841
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.58	0.24	0.24	0.03	0.09	0.29	0.41

Intersection Summary	
Cycle Length:	90
Actuated Cycle Length:	75.9
Natural Cycle:	60
Control Type:	Semi Act-Uncoord

Splits and Phases: 20: Collector Road B & Collector Road C



HCM Signalized Intersection Capacity Analysis

Total 2031 AM Peak Hour

20: Collector Road B & Collector Road C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔		↔	↔		↔	↔		↔	↔	
Traffic Volume (vph)	72	563	51	35	167	81	10	52	20	161	209	107
Future Volume (vph)	72	563	51	35	167	81	10	52	20	161	209	107
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	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.95		1.00	0.96		1.00	0.95	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1860		1789	1791		1789	1805		1789	1788	
Fit Permitted	0.53	1.00		0.13	1.00		0.47	1.00		0.71	1.00	
Satd. Flow (perm)	1002	1860		253	1791		892	1805		1329	1788	
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)	78	612	55	38	182	88	11	57	22	175	227	116
RTOR Reduction (vph)	0	4	0	0	23	0	0	12	0	0	18	0
Lane Group Flow (vph)	78	663	0	38	247	0	11	67	0	175	325	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)	31.8	31.8		31.8	31.8		35.0	35.0		35.0	35.0	
Effective Green, g (s)	31.8	31.8		31.8	31.8		35.0	35.0		35.0	35.0	
Actuated g/C Ratio	0.42	0.42		0.42	0.42		0.46	0.46		0.46	0.46	
Clearance Time (s)	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	
Lane Grp Cap (vph)	420	780		106	751		411	833		613	825	
v/s Ratio Prot		c0.36			0.14			0.04			c0.18	
v/s Ratio Perm	0.08			0.15			0.01			0.13		
v/c Ratio	0.19	0.85		0.36	0.33		0.03	0.08		0.29	0.39	
Uniform Delay, d1	13.8	19.8		15.0	14.8		11.1	11.4		12.6	13.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	8.6		2.1	0.3		0.1	0.2		1.2	1.4	
Delay (s)	14.1	28.5		17.1	15.1		11.2	11.6		13.8	14.8	
Level of Service	B	C		B	B		B	B		B	B	
Approach Delay (s)		27.0			15.3			11.6			14.5	
Approach LOS		C			B			B			B	
Intersection Summary												
HCM 2000 Control Delay			20.1			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			75.8			Sum of lost time (s)			9.0			
Intersection Capacity Utilization			65.7%			ICU Level of Service				C		
Analysis Period (min)			15									

c Critical Lane Group

Timings
1: Glancaster Road & Twenty Road West

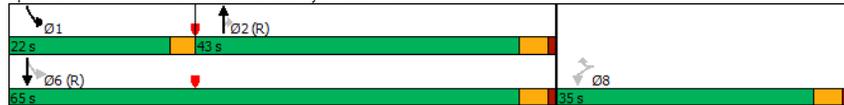
Total 2031 PM Peak Hour

	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↑	↘	↙	↓
Traffic Volume (vph)	204	201	353	456	299	210
Future Volume (vph)	204	201	353	456	299	210
Lane Group Flow (vph)	240	236	415	536	352	247
Turn Type	Perm	Perm	NA	Perm	pm+pt	NA
Protected Phases			2		1	6
Permitted Phases	8	8		2	6	
Detector Phase	8	8	2	2	1	6
Switch Phase						
Minimum Initial (s)	30.0	30.0	30.0	30.0	5.0	30.0
Minimum Split (s)	34.5	34.5	34.5	34.5	9.5	34.5
Total Split (s)	35.0	35.0	43.0	43.0	22.0	65.0
Total Split (%)	35.0%	35.0%	43.0%	43.0%	22.0%	65.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.0	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	0.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	3.0	4.5
Lead/Lag			Lag	Lag	Lead	
Lead-Lag Optimize?			Yes	Yes	Yes	
Recall Mode	None	None	C-Max	C-Max	None	C-Max
v/c Ratio	0.44	0.36	0.51	0.60	0.60	0.22
Control Delay	31.4	5.2	24.1	9.9	13.4	9.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.4	5.2	24.1	9.9	13.4	9.4
Queue Length 50th (m)	37.4	0.0	56.6	19.2	29.0	19.8
Queue Length 95th (m)	55.3	13.5	84.9	47.5	40.4	29.2
Internal Link Dist (m)	282.7		557.6		262.6	
Turn Bay Length (m)	50.0		30.0	50.0		
Base Capacity (vph)	551	662	817	886	637	1137
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.36	0.51	0.60	0.55	0.22

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 80
 Control Type: Actuated-Coordinated

Splits and Phases: 1: Glancaster Road & Twenty Road West



HCM Signalized Intersection Capacity Analysis
1: Glancaster Road & Twenty Road West

Total 2031 PM Peak Hour

	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↑	↘	↙	↓
Traffic Volume (vph)	204	201	353	456	299	210
Future Volume (vph)	204	201	353	456	299	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	3.0	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Fit Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1807	1633	1883	1555	1825	1865
Fit Permitted	0.95	1.00	1.00	1.00	0.35	1.00
Satd. Flow (perm)	1807	1633	1883	1555	665	1865
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	240	236	415	536	352	247
RTOR Reduction (vph)	0	165	0	212	0	0
Lane Group Flow (vph)	240	71	415	324	352	247
Heavy Vehicles (%)	1%	0%	2%	5%	0%	3%
Turn Type	Perm	Perm	NA	Perm	pm+pt	NA
Protected Phases			2		1	6
Permitted Phases	8	8		2	6	
Actuated Green, G (s)	30.0	30.0	43.4	43.4	61.0	61.0
Effective Green, g (s)	30.0	30.0	43.4	43.4	61.0	61.0
Actuated g/C Ratio	0.30	0.30	0.43	0.43	0.61	0.61
Clearance Time (s)	4.5	4.5	4.5	4.5	3.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	542	489	817	674	575	1137
v/s Ratio Prot			0.22		c0.09	0.13
v/s Ratio Perm	c0.13	0.04		0.21	c0.28	
v/c Ratio	0.44	0.14	0.51	0.48	0.61	0.22
Uniform Delay, d1	28.3	25.6	20.5	20.2	11.3	8.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.1	2.3	2.5	1.9	0.4
Delay (s)	28.8	25.7	22.8	22.7	13.2	9.2
Level of Service	C	C	C	C	B	A
Approach Delay (s)	27.3		22.7			11.6
Approach LOS	C		C			B

Intersection Summary

HCM 2000 Control Delay	20.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
2: Twenty Road West & Silverbirch Blvd

Total 2031 PM Peak Hour

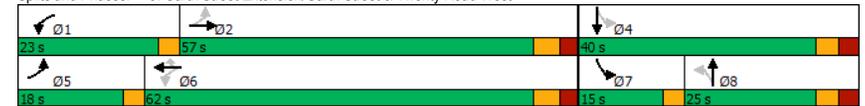
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	23	762	605	50	38	15
Future Volume (Veh/h)	23	762	605	50	38	15
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	24	811	644	53	40	16
Pedestrians						
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	697				1530	670
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	697				1530	670
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				68	96
cM capacity (veh/h)	909				127	453
Direction_Lane #	EB 1	WB 1	SB 1			
Volume Total	835	697	56			
Volume Left	24	0	40			
Volume Right	0	53	16			
cSH	909	1700	160			
Volume to Capacity	0.03	0.41	0.35			
Queue Length 95th (m)	0.6	0.0	11.1			
Control Delay (s)	0.7	0.0	39.2			
Lane LOS	A		E			
Approach Delay (s)	0.7	0.0	39.2			
Approach LOS			E			
Intersection Summary						
Average Delay		1.8				
Intersection Capacity Utilization		68.7%		ICU Level of Service	C	
Analysis Period (min)		15				

Timings
3: Garth Street Extension/Garth Street & Twenty Road West

Total 2031 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↕	↕	↕	↕	↕	↕	↕	↕	↕
Traffic Volume (vph)	242	520	348	496	215	81	299	198	296
Future Volume (vph)	242	520	348	496	215	81	299	198	296
Lane Group Flow (vph)	255	599	366	522	226	85	499	208	419
Turn Type	pm+pt	NA	pm+pt	NA	Perm	Perm	NA	pm+pt	NA
Protected Phases	5	2	1	6			8	7	4
Permitted Phases	2		6		6	8		4	
Detector Phase	5	2	1	6	6	8	8	7	4
Switch Phase									
Minimum Initial (s)	5.0	10.0	5.0	10.0	10.0	5.0	5.0	5.0	10.0
Minimum Split (s)	9.5	36.4	9.5	36.4	36.4	24.5	24.5	9.5	26.3
Total Split (s)	18.0	57.0	23.0	62.0	62.0	25.0	25.0	15.0	40.0
Total Split (%)	15.0%	47.5%	19.2%	51.7%	51.7%	20.8%	20.8%	12.5%	33.3%
Yellow Time (s)	3.0	3.7	3.0	3.7	3.7	3.3	3.3	3.0	3.3
All-Red Time (s)	0.0	2.7	0.0	2.7	2.7	3.0	3.0	0.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.4	3.0	6.4	6.4	6.3	6.3	3.0	6.3
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	Max	None	Max	Max	None	None	None	None
v/c Ratio	0.53	0.74	0.80	0.59	0.26	0.58	0.85	0.81	0.42
Control Delay	13.7	34.2	26.3	26.0	3.2	63.6	54.6	57.5	32.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.7	34.2	26.3	26.0	3.2	63.6	54.6	57.5	32.6
Queue Length 50th (m)	23.3	113.7	35.7	86.2	0.0	18.3	49.7	37.3	37.2
Queue Length 95th (m)	35.4	164.5	65.9	124.5	13.1	36.0	#74.8	#67.8	52.9
Internal Link Dist (m)		397.1		655.9			650.8		148.8
Turn Bay Length (m)	15.0		15.0			15.0		15.0	
Base Capacity (vph)	517	813	499	892	861	156	623	257	1038
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.74	0.73	0.59	0.26	0.54	0.80	0.81	0.40
Intersection Summary									
Cycle Length: 120									
Actuated Cycle Length: 116.6									
Natural Cycle: 90									
Control Type: Semi Act-Uncoord									
# 95th percentile volume exceeds capacity, queue may be longer.									
Queue shown is maximum after two cycles.									

Split and Phases: 3: Garth Street Extension/Garth Street & Twenty Road West



HCM Signalized Intersection Capacity Analysis
3: Garth Street Extension/Garth Street & Twenty Road West

Total 2031 PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔		↔	↔		↔	↔		↔	↔		↔
Traffic Volume (vph)	242	520	49	348	496	215	81	299	175	198	296	102
Future Volume (vph)	242	520	49	348	496	215	81	299	175	198	296	102
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.4		3.0	6.4	6.4	6.3	6.3		3.0	6.3	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	0.95	0.95		1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.94		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1738	1829		1825	1865	1555	1825	3448		1772	3492	
Flt Permitted	0.34	1.00		0.21	1.00	1.00	0.51	1.00		0.20	1.00	
Satd. Flow (perm)	622	1829		396	1865	1555	974	3448		364	3492	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	255	547	52	366	522	226	85	315	184	208	312	107
RTOR Reduction (vph)	0	3	0	0	0	118	0	71	0	0	28	0
Lane Group Flow (vph)	255	596	0	366	522	108	85	428	0	208	391	0
Heavy Vehicles (%)	5%	4%	0%	0%	3%	5%	0%	0%	0%	3%	0%	2%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA		pm+pt	NA	
Protected Phases	5	2		1	6		8			7	4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	64.3	51.7		71.4	55.8	55.8	17.5	17.5		32.5	32.5	
Effective Green, g (s)	64.3	51.7		71.4	55.8	55.8	17.5	17.5		32.5	32.5	
Actuated g/C Ratio	0.55	0.44		0.61	0.48	0.48	0.15	0.15		0.28	0.28	
Clearance Time (s)	3.0	6.4		3.0	6.4	6.4	6.3	6.3		3.0	6.3	
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)	463	810		447	892	744	146	517		246	973	
v/s Ratio Prot	0.06	0.33		c0.12	0.28			0.12		c0.09	0.11	
v/s Ratio Perm	0.24			c0.38		0.07	0.09			c0.15		
v/c Ratio	0.55	0.74		0.82	0.59	0.15	0.58	0.83		0.85	0.40	
Uniform Delay, d1	15.0	26.8		17.3	22.0	17.0	46.1	48.1		35.3	34.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.4	5.9		11.1	2.8	0.4	5.8	10.6		22.5	0.3	
Delay (s)	16.4	32.7		28.5	24.8	17.4	51.9	58.6		57.9	34.4	
Level of Service	B	C		C	C	B	D	E		E	C	
Approach Delay (s)		27.8			24.5			57.7			42.2	
Approach LOS		C			C			E			D	

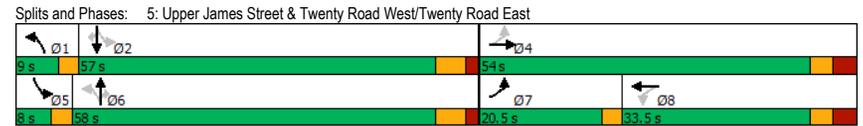
Intersection Summary			
HCM 2000 Control Delay	35.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	116.6	Sum of lost time (s)	18.7
Intersection Capacity Utilization	91.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Timings
5: Upper James Street & Twenty Road West/Twenty Road East

Total 2031 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔		↔		↔		↔		↔	
Traffic Volume (vph)	251	585	102	646	134	1302	280	100	1295	412
Future Volume (vph)	251	585	102	646	134	1302	280	100	1295	412
Lane Group Flow (vph)	270	819	110	776	144	1400	301	108	1392	443
Turn Type	pm+pt	NA	Perm	NA	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		8	1	6		5	2	
Permitted Phases	4		8		6		6	2		2
Detector Phase	7	4	8	8	1	6	6	5	2	2
Switch Phase										
Minimum Initial (s)	5.0	10.0	10.0	10.0	5.0	45.0	45.0	5.0	45.0	45.0
Minimum Split (s)	9.5	34.8	34.8	34.8	8.0	51.1	51.1	8.0	51.1	51.1
Total Split (s)	20.5	54.0	33.5	33.5	9.0	58.0	58.0	8.0	57.0	57.0
Total Split (%)	17.1%	45.0%	27.9%	27.9%	7.5%	48.3%	48.3%	6.7%	47.5%	47.5%
Yellow Time (s)	3.0	3.3	3.3	3.3	3.0	4.2	4.2	3.0	4.2	4.2
All-Red Time (s)	0.0	3.5	3.5	3.5	0.0	1.9	1.9	0.0	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.8	6.8	6.8	3.0	6.1	6.1	3.0	6.1	6.1
Lead/Lag	Lead		Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.84	0.59	0.75	0.98	0.90	0.94	0.38	0.74	0.99	0.48
Control Delay	50.5	29.5	74.6	74.2	71.7	45.2	13.6	47.5	55.1	4.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.5	29.5	74.6	74.2	71.7	45.2	13.6	47.5	55.1	4.9
Queue Length 50th (m)	43.9	75.5	24.3	95.4	17.0	162.7	24.2	12.4	168.2	4.6
Queue Length 95th (m)	#86.3	95.4	#54.2	#136.5	#55.6	#211.0	45.7	#36.8	#219.5	25.0
Internal Link Dist (m)		924.0		263.2		419.6		203.7		
Turn Bay Length (m)	50.0		33.0		127.0		58.0	65.0		137.0
Base Capacity (vph)	328	1393	147	789	160	1495	786	145	1412	930
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.59	0.75	0.98	0.90	0.94	0.38	0.74	0.99	0.48

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	119.5
Natural Cycle:	105
Control Type:	Actuated-Uncoordinated
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	



HCM Signalized Intersection Capacity Analysis

Total 2031 PM Peak Hour

5: Upper James Street & Twenty Road West/Twenty Road East

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	251	585	177	102	646	75	134	1302	280	100	1295	412
Future Volume (vph)	251	585	177	102	646	75	134	1302	280	100	1295	412
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.8		6.8	6.8		3.0	6.1	6.1	3.0	6.1	6.1
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	3470		1825	3499		1825	3444	1633	1825	3318	1633
Fit Permitted	0.13	1.00		0.34	1.00		0.08	1.00	1.00	0.08	1.00	1.00
Satd. Flow (perm)	251	3470		659	3499		148	3444	1633	151	3318	1633
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	270	629	190	110	695	81	144	1400	301	108	1392	443
RTOR Reduction (vph)	0	24	0	0	8	0	0	0	77	0	0	235
Lane Group Flow (vph)	270	795	0	110	768	0	144	1400	224	108	1392	208
Heavy Vehicles (%)	3%	2%	0%	0%	3%	0%	0%	6%	0%	0%	10%	0%
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		8	8		1	6	5	2	2	2
Permitted Phases	4			8			6		2			2
Actuated Green, G (s)	46.7	46.7		26.7	26.7		57.9	51.9	51.9	55.9	50.9	50.9
Effective Green, g (s)	46.7	46.7		26.7	26.7		57.9	51.9	51.9	55.9	50.9	50.9
Actuated g/C Ratio	0.39	0.39		0.22	0.22		0.48	0.43	0.43	0.47	0.43	0.43
Clearance Time (s)	3.0	6.8		6.8	6.8		3.0	6.1	6.1	3.0	6.1	6.1
Vehicle Extension (s)	3.0	3.0		3.0	3.0		1.0	6.5	6.5	1.0	6.5	6.5
Lane Grp Cap (vph)	314	1356		147	781		155	1495	709	140	1413	695
v/s Ratio Prot	c0.12	0.23		c0.22			c0.05	0.41		0.03	c0.42	
v/s Ratio Perm	0.21			0.17			0.40		0.14	0.33		0.13
v/c Ratio	0.86	0.59		0.75	0.98		0.93	0.94	0.32	0.77	0.99	0.30
Uniform Delay, d1	30.6	28.8		43.3	46.2		26.3	32.2	22.2	25.8	33.9	22.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	20.2	0.7		18.6	28.0		50.4	12.4	1.2	32.9	20.7	1.1
Delay (s)	50.9	29.4		61.9	74.1		76.7	44.6	23.3	58.7	54.6	23.7
Level of Service	D	C		E	E		E	D	C	E	D	C
Approach Delay (s)		34.7			72.6			43.6			47.8	
Approach LOS		C			E			D			D	

Intersection Summary			
HCM 2000 Control Delay	47.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	119.5	Sum of lost time (s)	18.9
Intersection Capacity Utilization	96.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Timings

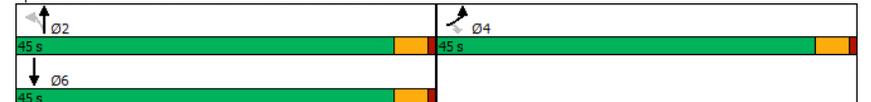
Total 2031 PM Peak Hour

6: Glanccaster Road & Book Road East

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Configurations	↔	↔	↔	↔	↔
Traffic Volume (vph)	444	159	79	282	279
Future Volume (vph)	444	159	79	282	279
Lane Group Flow (vph)	505	181	90	320	520
Turn Type	Prot	Perm	Perm	NA	NA
Protected Phases	4			2	6
Permitted Phases		4	2		
Detector Phase	4	4	2	2	6
Switch Phase					
Minimum Initial (s)	30.0	30.0	30.0	30.0	30.0
Minimum Split (s)	34.5	34.5	34.5	34.5	34.5
Total Split (s)	45.0	45.0	45.0	45.0	45.0
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	Max	Max	Max
v/c Ratio	0.73	0.25	0.30	0.37	0.56
Control Delay	28.2	3.4	16.9	15.0	16.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	28.2	3.4	16.9	15.0	16.6
Queue Length 50th (m)	65.1	0.0	7.4	27.3	45.4
Queue Length 95th (m)	95.0	9.9	20.8	54.3	87.9
Internal Link Dist (m)	171.0			456.5	274.4
Turn Bay Length (m)	100.0		50.0		
Base Capacity (vph)	870	869	298	865	924
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.58	0.21	0.30	0.37	0.56

Intersection Summary				
Cycle Length: 90				
Actuated Cycle Length: 81.9				
Natural Cycle: 70				
Control Type: Semi Act-Uncoord				

Splits and Phases: 6: Glanccaster Road & Book Road East



HCM Signalized Intersection Capacity Analysis
6: Glanaster Road & Book Road East

Total 2031 PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↖	↖	↗	↗
Traffic Volume (vph)	444	159	79	282	279	179
Future Volume (vph)	444	159	79	282	279	179
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.95	
Fit Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1755	1570	1738	1746	1820	
Fit Permitted	0.95	1.00	0.33	1.00	1.00	
Satd. Flow (perm)	1755	1570	602	1746	1820	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	505	181	90	320	317	203
RTOR Reduction (vph)	0	110	0	0	24	0
Lane Group Flow (vph)	505	71	90	320	496	0
Heavy Vehicles (%)	4%	4%	5%	10%	0%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	32.3	32.3	40.6	40.6	40.6	
Effective Green, g (s)	32.3	32.3	40.6	40.6	40.6	
Actuated g/C Ratio	0.39	0.39	0.50	0.50	0.50	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	692	619	298	865	902	
v/s Ratio Prot	c0.29			0.18	c0.27	
v/s Ratio Perm		0.05	0.15			
v/c Ratio	0.73	0.12	0.30	0.37	0.55	
Uniform Delay, d1	21.1	15.7	12.2	12.8	14.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.9	0.1	2.6	1.2	2.4	
Delay (s)	25.0	15.8	14.8	14.0	16.7	
Level of Service	C	B	B	B	B	
Approach Delay (s)	22.5			14.2	16.7	
Approach LOS	C			B	B	

Intersection Summary			
HCM 2000 Control Delay	18.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	81.9	Sum of lost time (s)	9.0
Intersection Capacity Utilization	86.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

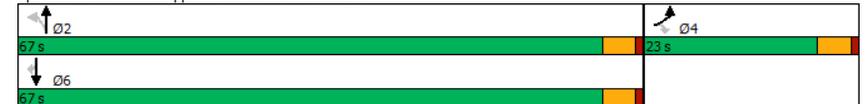
Timings
7: Upper James Street & Talbot Lane

Total 2031 PM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↖	↖	↗	↗
Traffic Volume (vph)	79	51	13	1613	1598	22
Future Volume (vph)	79	51	13	1613	1598	22
Lane Group Flow (vph)	83	54	14	1698	1682	23
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	23.0	23.0	67.0	67.0	67.0	67.0
Total Split (%)	25.6%	25.6%	74.4%	74.4%	74.4%	74.4%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Max	Max	Max	Max
v/c Ratio	0.43	0.25	0.07	0.59	0.61	0.02
Control Delay	41.7	17.1	3.6	4.7	5.1	1.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.7	17.1	3.6	4.7	5.1	1.4
Queue Length 50th (m)	13.2	1.8	0.4	45.0	46.2	0.2
Queue Length 95th (m)	24.8	11.3	2.1	73.3	76.3	1.6
Internal Link Dist (m)	158.6			280.1	602.9	
Turn Bay Length (m)			50.0			34.0
Base Capacity (vph)	393	384	188	2892	2759	1349
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.21	0.14	0.07	0.59	0.61	0.02

Intersection Summary	
Cycle Length:	90
Actuated Cycle Length:	86.1
Natural Cycle:	60
Control Type:	Semi Act-Uncoord

Splits and Phases: 7: Upper James Street & Talbot Lane



HCM Signalized Intersection Capacity Analysis
7: Upper James Street & Talbot Lane

Total 2031 PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕↕	↕↕	↔
Traffic Volume (vph)	79	51	13	1613	1598	22
Future Volume (vph)	79	51	13	1613	1598	22
Ideal Flow (vphpl)	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	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Fit Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1825	1633	1825	3510	3349	1633
Fit Permitted	0.95	1.00	0.12	1.00	1.00	1.00
Satd. Flow (perm)	1825	1633	229	3510	3349	1633
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	83	54	14	1698	1682	23
RTOR Reduction (vph)	0	38	0	0	0	4
Lane Group Flow (vph)	83	16	14	1698	1682	19
Heavy Vehicles (%)	0%	0%	0%	4%	9%	0%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	8.0	8.0	70.0	70.0	70.0	70.0
Effective Green, g (s)	8.0	8.0	70.0	70.0	70.0	70.0
Actuated g/C Ratio	0.09	0.09	0.80	0.80	0.80	0.80
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)	167	150	184	2824	2694	1313
v/s Ratio Prot	c0.05			0.48	c0.50	
v/s Ratio Perm		0.01	0.06			0.01
v/c Ratio	0.50	0.11	0.08	0.60	0.62	0.01
Uniform Delay, d1	37.6	36.2	1.8	3.2	3.3	1.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.3	0.3	0.8	1.0	1.1	0.0
Delay (s)	39.9	36.5	2.6	4.2	4.4	1.7
Level of Service	D	D	A	A	A	A
Approach Delay (s)	38.6			4.2	4.4	
Approach LOS	D			A	A	
Intersection Summary						
HCM 2000 Control Delay	5.6		HCM 2000 Level of Service		A	
HCM 2000 Volume to Capacity ratio	0.61					
Actuated Cycle Length (s)	87.0		Sum of lost time (s)		9.0	
Intersection Capacity Utilization	56.5%		ICU Level of Service		B	
Analysis Period (min)	15					
c Critical Lane Group						

Timings
8: Glanccaster Road & Dickenson Road West

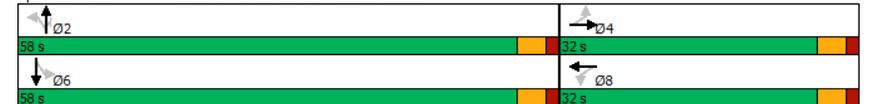
Total 2031 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↔	↕↕	↔	↕↕	↔	↕↕	↔	↔	↔
Traffic Volume (vph)	11	97	88	90	50	194	49	257	166
Future Volume (vph)	11	97	88	90	50	194	49	257	166
Lane Group Flow (vph)	13	175	105	289	60	231	58	306	216
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA
Protected Phases		4		8		2		2	6
Permitted Phases	4		8		2		2	6	
Detector Phase	4	4	8	8	2	2	2	6	6
Switch Phase									
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	32.0	32.0	32.0	32.0	58.0	58.0	58.0	58.0	58.0
Total Split (%)	35.6%	35.6%	35.6%	35.6%	64.4%	64.4%	64.4%	64.4%	64.4%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Min	Min	Min	Min	Min
v/c Ratio	0.04	0.16	0.34	0.25	0.12	0.28	0.08	0.60	0.26
Control Delay	12.0	8.3	15.8	5.6	6.5	7.4	2.4	13.3	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.0	8.3	15.8	5.6	6.5	7.4	2.4	13.3	7.0
Queue Length 50th (m)	0.5	2.4	4.5	2.2	1.8	7.2	0.0	11.3	6.4
Queue Length 95th (m)	3.5	8.7	16.9	9.4	6.2	18.0	3.2	29.5	16.4
Internal Link Dist (m)		150.3		619.9		112.9			456.5
Turn Bay Length (m)	50.0		50.0		50.0		50.0		50.0
Base Capacity (vph)	857	2700	764	2606	1197	1921	1633	1181	1896
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.06	0.14	0.11	0.05	0.12	0.04	0.26	0.11

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 37.1
Natural Cycle: 50
Control Type: Semi Act-Uncoord

Splits and Phases: 8: Glanccaster Road & Dickenson Road West



HCM Signalized Intersection Capacity Analysis
8: Glanaster Road & Dickenson Road West

Total 2031 PM Peak Hour

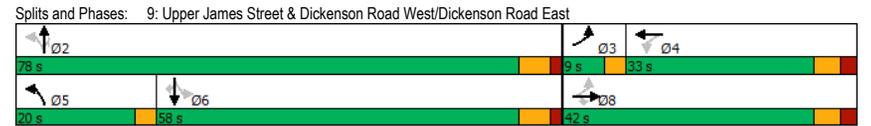
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	11	97	50	88	90	153	50	194	49	257	166	15
Future Volume (vph)	11	97	50	88	90	153	50	194	49	257	166	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
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	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.95		1.00	0.91		1.00	1.00	0.85	1.00	0.99	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1825	3462		1460	3305		1825	1921	1633	1825	1897	
Fit Permitted	0.57	1.00		0.64	1.00		0.62	1.00	1.00	0.61	1.00	
Satd. Flow (perm)	1104	3462		986	3305		1197	1921	1633	1181	1897	
Peak-hour factor, PHF	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Adj. Flow (vph)	13	115	60	105	107	182	60	231	58	306	198	18
RTOR Reduction (vph)	0	41	0	0	125	0	0	0	32	0	5	0
Lane Group Flow (vph)	13	134	0	105	164	0	60	231	26	306	211	0
Heavy Vehicles (%)	0%	0%	0%	25%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2		6		
Permitted Phases	4			8			2		6			
Actuated Green, G (s)	11.5	11.5		11.5	11.5		16.2	16.2	16.2	16.2	16.2	
Effective Green, g (s)	11.5	11.5		11.5	11.5		16.2	16.2	16.2	16.2	16.2	
Actuated g/C Ratio	0.31	0.31		0.31	0.31		0.44	0.44	0.44	0.44	0.44	
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)	345	1084		308	1035		528	847	720	521	837	
v/s Ratio Prot		0.04			0.05			0.12			0.11	
v/s Ratio Perm	0.01			c0.11			0.05		0.02	c0.26		
v/c Ratio	0.04	0.12		0.34	0.16		0.11	0.27	0.04	0.59	0.25	
Uniform Delay, d1	8.8	9.0		9.7	9.1		6.0	6.5	5.8	7.7	6.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.1		0.7	0.1		0.1	0.2	0.0	1.7	0.2	
Delay (s)	8.8	9.1		10.4	9.2		6.1	6.7	5.8	9.4	6.6	
Level of Service	A	A		B	A		A	A	A	A	A	
Approach Delay (s)		9.0			9.5			6.4			8.3	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	36.7	Sum of lost time (s)	9.0
Intersection Capacity Utilization	56.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Timings
9: Upper James Street & Dickenson Road West/Dickenson Road East

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	134	224	252	10	391	292	1498	9	47	1441	61
Future Volume (vph)	134	224	252	10	391	292	1498	9	47	1441	61
Lane Group Flow (vph)	141	236	265	11	443	307	1577	9	49	1517	64
Turn Type	pm+pt	NA	Perm	Perm	NA	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8			4	5	2			6	
Permitted Phases	8		8	4		2		2	6		6
Detector Phase	3	8	8	4	4	5	2	2	6	6	6
Switch Phase											
Minimum Initial (s)	5.0	10.0	10.0	10.0	10.0	5.0	55.0	55.0	55.0	55.0	55.0
Minimum Split (s)	9.5	35.2	35.2	35.2	35.2	9.5	66.2	66.2	61.3	61.3	61.3
Total Split (s)	9.0	42.0	42.0	33.0	33.0	20.0	78.0	78.0	58.0	58.0	58.0
Total Split (%)	7.5%	35.0%	35.0%	27.5%	27.5%	16.7%	65.0%	65.0%	48.3%	48.3%	48.3%
Yellow Time (s)	3.0	3.7	3.7	3.7	3.7	3.0	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	0.0	2.5	2.5	2.5	2.5	0.0	1.7	1.7	1.7	1.7	1.7
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.2	6.2	6.2	6.2	3.0	6.3	6.3	6.3	6.3	6.3
Lead/Lag	Lead			Lag	Lag	Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes			Yes	Yes	Yes			Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio	0.68	0.27	0.47	0.06	0.72	0.98	0.71	0.01	0.53	0.97	0.08
Control Delay	49.8	34.4	6.9	38.8	50.4	78.5	16.3	0.0	48.0	48.1	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.8	34.4	6.9	38.8	50.4	78.5	16.3	0.0	48.0	48.1	2.6
Queue Length 50th (m)	24.2	22.0	0.0	2.1	48.2	51.8	109.5	0.0	7.4	165.4	0.0
Queue Length 95th (m)	#40.9	32.4	19.3	7.0	65.0	#115.8	157.6	0.0	#27.8	#239.8	5.1
Internal Link Dist (m)		868.4			232.1		174.3			280.1	
Turn Bay Length (m)	15.0		30.0	15.0		40.0		21.0	68.0		17.0
Base Capacity (vph)	208	1130	641	277	867	314	2220	1063	93	1557	797
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.21	0.41	0.04	0.51	0.98	0.71	0.01	0.53	0.97	0.08

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	112.4
Natural Cycle:	140
Control Type:	Semi Act-Uncoord
#	95th percentile volume exceeds capacity, queue may be longer.
	Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis Total 2031 PM Peak Hour
 9: Upper James Street & Dickenson Road West/Dickenson Road East

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	
Traffic Volume (vph)	134	224	252	10	391	29	292	1498	9	47	1441	61	
Future Volume (vph)	134	224	252	10	391	29	292	1498	9	47	1441	61	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	3.0	6.2	6.2	6.2	6.2		3.0	6.3	6.3	6.3	6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	
Fit Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	3544	1445	1825	3612		1644	3476	1633	1437	3380	1633	
Fit Permitted	0.26	1.00	1.00	0.60	1.00		0.07	1.00	1.00	0.13	1.00	1.00	
Satd. Flow (perm)	492	3544	1445	1162	3612		126	3476	1633	203	3380	1633	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Adj. Flow (vph)	141	236	265	11	412	31	307	1577	9	49	1517	64	
RTOR Reduction (vph)	0	0	199	0	5	0	0	0	3	0	0	35	
Lane Group Flow (vph)	141	236	66	11	438	0	307	1577	6	49	1517	29	
Heavy Vehicles (%)	0%	3%	13%	0%	0%	0%	11%	5%	0%	27%	8%	0%	
Turn Type	pm+pt	NA	Perm	Perm	NA	pm+pt	NA	Perm	Perm	NA	NA	Perm	
Protected Phases	3	8			4		5	2			6		
Permitted Phases	8		8	4			2		2	6		6	
Actuated Green, G (s)	28.1	28.1	28.1	19.1	19.1		71.8	71.8	71.8	51.8	51.8	51.8	
Effective Green, g (s)	28.1	28.1	28.1	19.1	19.1		71.8	71.8	71.8	51.8	51.8	51.8	
Actuated g/C Ratio	0.25	0.25	0.25	0.17	0.17		0.64	0.64	0.64	0.46	0.46	0.46	
Clearance Time (s)	3.0	6.2	6.2	6.2	6.2		3.0	6.3	6.3	6.3	6.3	6.3	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	5.7	5.7	5.7	5.7	5.7	
Lane Grp Cap (vph)	194	886	361	197	613		310	2220	1043	93	1557	752	
v/s Ratio Prot	c0.04	0.07			0.12		c0.15	0.45			0.45		
v/s Ratio Perm	c0.14		0.05	0.01			c0.48	0.00	0.24			0.02	
v/c Ratio	0.73	0.27	0.18	0.06	0.71		0.99	0.71	0.01	0.53	0.97	0.04	
Uniform Delay, d1	36.3	33.9	33.1	39.1	44.1		36.8	13.4	7.4	21.6	29.6	16.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	12.7	0.2	0.2	0.1	4.0		48.3	2.0	0.0	19.7	17.5	0.1	
Delay (s)	49.0	34.0	33.4	39.2	48.0		85.1	15.4	7.4	41.3	47.1	16.7	
Level of Service	D	C	C	D	D		F	B	A	D	D	B	
Approach Delay (s)		37.1			47.8			26.7			45.7		
Approach LOS		D			D			C			D		
Intersection Summary													
HCM 2000 Control Delay	36.9			HCM 2000 Level of Service				D					
HCM 2000 Volume to Capacity ratio	0.97												
Actuated Cycle Length (s)	112.4				Sum of lost time (s)				18.5				
Intersection Capacity Utilization	129.8%			ICU Level of Service				H					
Analysis Period (min)	15												
c Critical Lane Group													

HCM Unsignalized Intersection Capacity Analysis Total 2031 PM Peak Hour
 10: Local Street & Twenty Road West

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (veh/h)	702	27	43	435	1	37
Future Volume (Veh/h)	702	27	43	435	1	37
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)	763	29	47	473	1	40
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)	307					
pX, platoon unblocked						
vC, conflicting volume			792		1344	778
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			792		1344	778
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			94		99	90
cM capacity (veh/h)			829		158	397
Direction, Lane #	EB 1	WB 1	NB 1	NB 2		
Volume Total	792	520	1	40		
Volume Left	0	47	1	0		
Volume Right	29	0	0	40		
cSH	1700	829	158	397		
Volume to Capacity	0.47	0.06	0.01	0.10		
Queue Length 95th (m)	0.0	1.4	0.1	2.5		
Control Delay (s)	0.0	1.6	28.0	15.1		
Lane LOS		A	D	C		
Approach Delay (s)	0.0	1.6	15.4			
Approach LOS			C			
Intersection Summary						
Average Delay	1.1					
Intersection Capacity Utilization	68.6%		ICU Level of Service		C	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
11: Collector Road A & Twenty Road West

Total 2031 PM Peak Hour

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	683	56	150	470	8	102
Future Volume (Veh/h)	683	56	150	470	8	102
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)	742	61	163	511	9	111
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			803	1610	772	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			803	1610	772	
tC, single (s)			4.1	6.4	6.2	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			80	90	72	
cM capacity (veh/h)			821	92	399	
Direction, Lane #	EB 1	WB 1	NB 1	NB 2		
Volume Total	803	674	9	111		
Volume Left	0	163	9	0		
Volume Right	61	0	0	111		
cSH	1700	821	92	399		
Volume to Capacity	0.47	0.20	0.10	0.28		
Queue Length 95th (m)	0.0	5.6	2.4	8.5		
Control Delay (s)	0.0	4.8	48.2	17.5		
Lane LOS	A		E	C		
Approach Delay (s)	0.0	4.8	19.8			
Approach LOS	C					
Intersection Summary						
Average Delay			3.5			
Intersection Capacity Utilization			85.7%	ICU Level of Service	E	
Analysis Period (min)			15			

Timings

12: Collector Road B/Twentyplace Boulevard & Twenty Road West

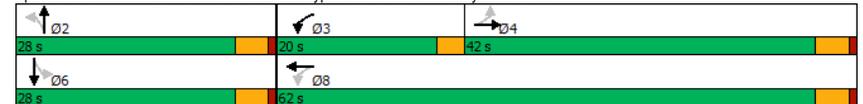
Total 2031 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔		↔		↔		↔	
Traffic Volume (vph)	36	800	221	928	59	0	15	0
Future Volume (vph)	36	800	221	928	59	0	15	0
Lane Group Flow (vph)	39	905	240	1039	64	188	16	20
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases	4		3		8		2	
Permitted Phases	4		8		2		6	
Detector Phase	4		4		3		8	
Switch Phase	4		3		8		2	
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	9.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	42.0	42.0	20.0	62.0	28.0	28.0	28.0	28.0
Total Split (%)	46.7%	46.7%	22.2%	68.9%	31.1%	31.1%	31.1%	31.1%
Yellow Time (s)	3.5	3.5	3.0	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	3.0	4.5	4.5	4.5	4.5	4.5
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.22	0.76	0.63	0.55	0.13	0.23	0.04	0.03
Control Delay	20.2	25.0	17.8	11.7	20.0	0.7	19.7	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.2	25.0	17.8	11.7	20.0	0.7	19.7	0.1
Queue Length 50th (m)	3.5	53.4	14.7	42.8	5.6	0.0	1.4	0.0
Queue Length 95th (m)	10.9	77.7	32.8	56.3	17.0	0.0	6.3	0.0
Internal Link Dist (m)			655.9	924.0			640.3	89.8
Turn Bay Length (m)	15.0		15.0		15.0			
Base Capacity (vph)	283	1939	527	2977	477	801	395	635
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.47	0.46	0.35	0.13	0.23	0.04	0.03

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 69.8
Natural Cycle: 55
Control Type: Semi Act-Uncoord

Splits and Phases: 12: Collector Road B/Twentyplace Boulevard & Twenty Road West



HCM Signalized Intersection Capacity Analysis

Total 2031 PM Peak Hour

12: Collector Road B/Twentyplace Boulevard & Twenty Road West

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔		↔	↔		↔	↔		↔	↔	
Traffic Volume (vph)	36	800	32	221	928	28	59	0	173	15	0	18
Future Volume (vph)	36	800	32	221	928	28	59	0	173	15	0	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		3.0	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.85		1.00	0.85	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3558		1789	3563		1789	1601		1789	1601	
Fit Permitted	0.28	1.00		0.15	1.00		0.74	1.00		0.62	1.00	
Satd. Flow (perm)	519	3558		284	3563		1402	1601		1161	1601	
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)	39	870	35	240	1009	30	64	0	188	16	0	20
RTOR Reduction (vph)	0	3	0	0	3	0	0	124	0	0	13	0
Lane Group Flow (vph)	39	902	0	240	1036	0	64	64	0	16	7	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8		2	2		6	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	23.5	23.5		36.9	36.9		23.8	23.8		23.8	23.8	
Effective Green, g (s)	23.5	23.5		36.9	36.9		23.8	23.8		23.8	23.8	
Actuated g/C Ratio	0.34	0.34		0.53	0.53		0.34	0.34		0.34	0.34	
Clearance Time (s)	4.5	4.5		3.0	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	
Lane Grp Cap (vph)	174	1199		374	1886		478	546		396	546	
v/s Ratio Prot		c0.25		c0.10	0.29			0.04			0.00	
v/s Ratio Perm	0.08			0.24			c0.05			0.01		
v/c Ratio	0.22	0.75		0.64	0.55		0.13	0.12		0.04	0.01	
Uniform Delay, d1	16.6	20.5		11.5	10.9		15.8	15.7		15.3	15.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.7	2.7		3.7	0.3		0.6	0.4		0.2	0.0	
Delay (s)	17.2	23.2		15.2	11.2		16.4	16.2		15.5	15.2	
Level of Service	B	C		B	B		B	B		B	B	
Approach Delay (s)		23.0			12.0			16.2			15.4	
Approach LOS		C			B			B			B	
Intersection Summary												
HCM 2000 Control Delay		16.6			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.48										
Actuated Cycle Length (s)		69.7			Sum of lost time (s)			12.0				
Intersection Capacity Utilization		58.7%			ICU Level of Service			B				
Analysis Period (min)		15										

HCM Unsignalized Intersection Capacity Analysis

Total 2031 PM Peak Hour

13: Glancaster Road & Collector Road C

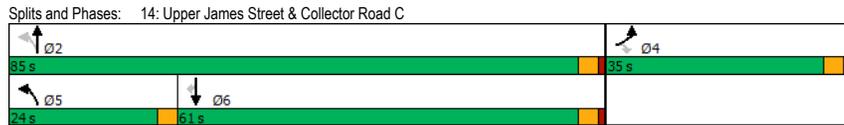
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (veh/h)	80	197	594	134	82	379
Future Volume (Veh/h)	80	197	594	134	82	379
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	87	214	646	146	89	412
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)			298			
pX, platoon unblocked	0.92	0.92			0.92	
vC, conflicting volume	1309	719			792	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1293	652			731	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	41	50			89	
cM capacity (veh/h)	147	431			804	
Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2	
Volume Total	87	214	792	89	412	
Volume Left	87	0	0	89	0	
Volume Right	0	214	146	0	0	
cSH	147	431	1700	804	1700	
Volume to Capacity	0.59	0.50	0.47	0.11	0.24	
Queue Length 95th (m)	23.4	20.5	0.0	2.8	0.0	
Control Delay (s)	59.8	21.3	0.0	10.0	0.0	
Lane LOS	F	C			B	
Approach Delay (s)	32.4		0.0	1.8		
Approach LOS	D					
Intersection Summary						
Average Delay			6.7			
Intersection Capacity Utilization			58.4%		ICU Level of Service	B
Analysis Period (min)			15			

Timings
14: Upper James Street & Collector Road C

Total 2031 PM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↑↑	↑↑	↔
Traffic Volume (vph)	409	213	312	1380	1407	180
Future Volume (vph)	409	213	312	1380	1407	180
Lane Group Flow (vph)	445	232	339	1500	1529	196
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	5.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	9.5	22.5	22.5	22.5
Total Split (s)	35.0	35.0	24.0	85.0	61.0	61.0
Total Split (%)	29.2%	29.2%	20.0%	70.8%	50.8%	50.8%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	0.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	3.0	4.0	4.0	4.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Recall Mode	None	None	None	Max	Max	Max
v/c Ratio	0.97	0.40	0.93	0.62	0.88	0.24
Control Delay	79.1	6.6	67.1	12.3	35.8	12.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.1	6.6	67.1	12.3	35.8	12.6
Queue Length 50th (m)	103.8	0.0	62.4	94.7	169.1	16.6
Queue Length 95th (m)	#167.1	18.7	#115.5	114.1	203.4	31.4
Internal Link Dist (m)	946.4		602.9	419.6		
Turn Bay Length (m)			15.0		30.0	
Base Capacity (vph)	463	586	376	2419	1728	808
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.40	0.90	0.62	0.88	0.24

Intersection Summary
 Cycle Length: 120
 Actuated Cycle Length: 119.8
 Natural Cycle: 80
 Control Type: Semi Act-Uncoord
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis
14: Upper James Street & Collector Road C

Total 2031 PM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement	↔	↔	↔	↑↑	↑↑	↔
Lane Configurations	↔	↔	↔	↑↑	↑↑	↔
Traffic Volume (vph)	409	213	312	1380	1407	180
Future Volume (vph)	409	213	312	1380	1407	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	3.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Fit Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1789	1601	1789	3579	3579	1601
Fit Permitted	0.95	1.00	0.07	1.00	1.00	1.00
Satd. Flow (perm)	1789	1601	124	3579	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	445	232	339	1500	1529	196
RTOR Reduction (vph)	0	172	0	0	0	36
Lane Group Flow (vph)	445	60	339	1500	1529	160
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	30.8	30.8	81.0	81.0	57.9	57.9
Effective Green, g (s)	30.8	30.8	81.0	81.0	57.9	57.9
Actuated g/C Ratio	0.26	0.26	0.68	0.68	0.48	0.48
Clearance Time (s)	4.0	4.0	3.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	459	411	363	2419	1729	773
v/s Ratio Prot	c0.25		c0.16	0.42	0.43	
v/s Ratio Perm		0.04	c0.48			0.10
v/c Ratio	0.97	0.15	0.93	0.62	0.88	0.21
Uniform Delay, d1	44.0	34.3	39.0	10.8	27.9	17.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	33.7	0.2	30.6	1.2	7.0	0.6
Delay (s)	77.8	34.5	69.7	12.0	34.9	18.4
Level of Service	E	C	E	B	C	B
Approach Delay (s)	62.9		22.7	33.1		
Approach LOS	E		C	C		

Intersection Summary
 HCM 2000 Control Delay: 33.3
 HCM 2000 Volume to Capacity ratio: 0.96
 Actuated Cycle Length (s): 119.8
 Intersection Capacity Utilization: 88.8%
 Analysis Period (min): 15
 HCM 2000 Level of Service: C
 Sum of lost time (s): 11.0
 ICU Level of Service: E
 c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
15: Dickenson Road West & Collector Road A

Total 2031 PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations	↔	↕↕	↕↕		↔	↕↕	
Traffic Volume (veh/h)	0	407	310	124	59	19	
Future Volume (Veh/h)	0	407	310	124	59	19	
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)	0	442	337	135	64	21	
Pedestrians							
Lane Width (m)							
Walking Speed (m/s)							
Percent Blockage							
Right turn flare (veh)							
Median type		None	None				
Median storage (veh)							
Upstream signal (m)							
pX, platoon unblocked							
vC, conflicting volume	472				626	236	
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	472				626	236	
tC, single (s)	4.1				6.8	6.9	
tC, 2 stage (s)							
tF (s)	2.2				3.5	3.3	
p0 queue free %	100				85	97	
cM capacity (veh/h)	1086				417	766	
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	0	221	221	225	247	64	21
Volume Left	0	0	0	0	0	64	0
Volume Right	0	0	0	0	135	0	21
cSH	1700	1700	1700	1700	1700	417	766
Volume to Capacity	0.00	0.13	0.13	0.13	0.15	0.15	0.03
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	4.1	0.6
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	15.2	9.8
Lane LOS						C	A
Approach Delay (s)	0.0			0.0		13.9	
Approach LOS						B	
Intersection Summary							
Average Delay			1.2				
Intersection Capacity Utilization			22.5%			ICU Level of Service	A
Analysis Period (min)			15				

Timings
16: Garth Street Extension & Dickenson Road West

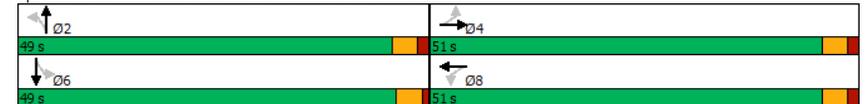
Total 2031 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↕↕	↔	↕↕	↔	↕↕	↔	↕↕
Traffic Volume (vph)	61	238	150	287	150	100	168	50
Future Volume (vph)	61	238	150	287	150	100	168	50
Lane Group Flow (vph)	66	476	163	487	163	381	183	78
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	51.0	51.0	51.0	51.0	49.0	49.0	49.0	49.0
Total Split (%)	51.0%	51.0%	51.0%	51.0%	49.0%	49.0%	49.0%	49.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.19	0.34	0.47	0.35	0.34	0.28	0.49	0.06
Control Delay	10.4	5.4	15.0	6.9	12.2	3.8	15.4	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.4	5.4	15.0	6.9	12.2	3.8	15.4	6.9
Queue Length 50th (m)	2.3	4.7	6.4	6.4	6.3	2.0	7.4	0.9
Queue Length 95th (m)	10.6	16.2	25.0	19.7	23.1	10.5	28.5	4.8
Internal Link Dist (m)		899.2		404.1		105.4		811.8
Turn Bay Length (m)	50.0		50.0		50.0		50.0	
Base Capacity (vph)	857	3202	865	3247	1260	3051	944	3252
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.08	0.15	0.19	0.15	0.13	0.12	0.19	0.02

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 38.9
Natural Cycle: 45
Control Type: Actuated-Uncoordinated

Splits and Phases: 16: Garth Street Extension & Dickenson Road West



HCM Signalized Intersection Capacity Analysis
16: Garth Street Extension & Dickenson Road West

Total 2031 PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	61	238	200	150	287	161	150	100	250	168	50	22
Future Volume (vph)	61	238	200	150	287	161	150	100	250	168	50	22
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		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.93		1.00	0.95		1.00	0.89		1.00	0.95	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3334		1789	3386		1789	3195		1789	3413	
Fit Permitted	0.47	1.00		0.48	1.00		0.70	1.00		0.53	1.00	
Satd. Flow (perm)	894	3334		903	3386		1325	3195		991	3413	
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)	66	259	217	163	312	175	163	109	272	183	54	24
RTOR Reduction (vph)	0	132	0	0	88	0	0	170	0	0	15	0
Lane Group Flow (vph)	66	344	0	163	399	0	163	211	0	183	63	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)	15.0	15.0		15.0	15.0		14.3	14.3		14.8	14.8	
Effective Green, g (s)	15.0	15.0		15.0	15.0		14.3	14.3		14.8	14.8	
Actuated g/C Ratio	0.39	0.39		0.39	0.39		0.37	0.37		0.39	0.39	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	350	1305		353	1326		494	1192		382	1318	
v/s Ratio Prot		0.10			0.12			0.07			0.02	
v/s Ratio Perm	0.07			c0.18			0.12			c0.18		
v/c Ratio	0.19	0.26		0.46	0.30		0.33	0.18		0.48	0.05	
Uniform Delay, d1	7.7	7.9		8.7	8.0		8.6	8.1		8.8	7.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.1		1.0	0.1		0.4	0.1		0.9	0.0	
Delay (s)	7.9	8.0		9.6	8.2		9.0	8.1		9.8	7.4	
Level of Service	A	A		A	A		A	A		A	A	
Approach Delay (s)		8.0			8.5			8.4			9.1	
Approach LOS		A			A			A			A	
Intersection Summary												
HCM 2000 Control Delay		8.4			HCM 2000 Level of Service			A				
HCM 2000 Volume to Capacity ratio		0.48										
Actuated Cycle Length (s)		38.3			Sum of lost time (s)			9.0				
Intersection Capacity Utilization		56.1%			ICU Level of Service			B				
Analysis Period (min)		15										

HCM Unsignalized Intersection Capacity Analysis
17: Dickenson Road West & Collector Road B

Total 2031 PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations	↔	↕	↕	↕	↔	↔	
Traffic Volume (veh/h)	6	596	581	76	133	43	
Future Volume (Veh/h)	6	596	581	76	133	43	
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)	7	648	632	83	145	47	
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	715				1012	358	
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	715				1012	358	
tC, single (s)	4.1				6.8	6.9	
tC, 2 stage (s)							
tF (s)	2.2				3.5	3.3	
p0 queue free %	99				38	93	
cM capacity (veh/h)	881				234	639	
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	7	324	324	421	294	145	47
Volume Left	7	0	0	0	0	145	0
Volume Right	0	0	0	0	83	0	47
cSH	881	1700	1700	1700	1700	234	639
Volume to Capacity	0.01	0.19	0.19	0.25	0.17	0.62	0.07
Queue Length 95th (m)	0.2	0.0	0.0	0.0	0.0	28.0	1.8
Control Delay (s)	9.1	0.0	0.0	0.0	0.0	42.6	11.1
Lane LOS	A					E	B
Approach Delay (s)	0.1			0.0		34.9	
Approach LOS						D	
Intersection Summary							
Average Delay			4.3				
Intersection Capacity Utilization			32.5%		ICU Level of Service		A
Analysis Period (min)			15				

HCM Unsignalized Intersection Capacity Analysis
18: Collector Road A & Collector Road C

Total 2031 PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔		↔	↔		↔	↔		↔	↔		↔
Sign Control	Stop			Stop			Stop			Stop		
Traffic Volume (vph)	55	136	26	66	224	174	54	89	32	90	80	38
Future Volume (vph)	55	136	26	66	224	174	54	89	32	90	80	38
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)	60	148	28	72	243	189	59	97	35	98	87	41
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2				
Volume Total (vph)	60	176	72	432	59	132	98	128				
Volume Left (vph)	60	0	72	0	59	0	98	0				
Volume Right (vph)	0	28	0	189	0	35	0	41				
Hadj (s)	0.53	-0.08	0.53	-0.27	0.53	-0.15	0.53	-0.19				
Departure Headway (s)	7.0	6.4	6.7	5.9	7.4	6.8	7.4	6.6				
Degree Utilization, x	0.12	0.31	0.13	0.71	0.12	0.25	0.20	0.24				
Capacity (veh/h)	479	529	516	591	450	494	454	503				
Control Delay (s)	9.8	11.2	9.5	20.6	10.3	10.8	11.0	10.5				
Approach Delay (s)	10.8		19.0		10.6		10.7					
Approach LOS	B		C		B		B					
Intersection Summary												
Delay	14.3											
Level of Service	B											
Intersection Capacity Utilization	50.7%			ICU Level of Service			A					
Analysis Period (min)	15											

Timings
19: Garth Street Extension & Collector Road C

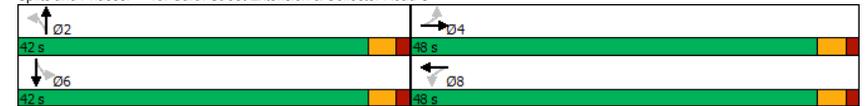
Total 2031 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔		↔		↔		↔	
Traffic Volume (vph)	84	121	55	235	39	288	153	238
Future Volume (vph)	84	121	55	235	39	288	153	238
Lane Group Flow (vph)	91	206	60	498	42	361	166	467
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	4		8		2		6	
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	48.0	48.0	48.0	48.0	42.0	42.0	42.0	42.0
Total Split (%)	53.3%	53.3%	53.3%	53.3%	46.7%	46.7%	46.7%	46.7%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.77	0.34	0.17	0.81	0.09	0.19	0.30	0.24
Control Delay	61.8	14.8	16.9	28.9	10.6	9.0	12.5	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.8	14.8	16.9	28.9	10.6	9.0	12.5	5.7
Queue Length 50th (m)	10.4	15.4	5.4	49.4	2.3	10.4	10.5	7.8
Queue Length 95th (m)	#32.0	29.3	12.7	80.9	9.1	23.5	30.0	20.2
Internal Link Dist (m)	644.3		697.4		811.8		650.8	
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	230	1143	697	1131	490	1923	550	1915
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.18	0.09	0.44	0.09	0.19	0.30	0.24

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 69.4
 Natural Cycle: 45
 Control Type: Semi Act-Uncoord
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 19: Garth Street Extension & Collector Road C



HCM Signalized Intersection Capacity Analysis
19: Garth Street Extension & Collector Road C

Total 2031 PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔		↔	↔		↔	↔		↔	↔	
Traffic Volume (vph)	84	121	68	55	235	224	39	288	44	153	238	191
Future Volume (vph)	84	121	68	55	235	224	39	288	44	153	238	191
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	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.95		1.00	0.93		1.00	0.98		1.00	0.93	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1782		1789	1746		1789	3507		1789	3339	
Fit Permitted	0.19	1.00		0.59	1.00		0.48	1.00		0.54	1.00	
Satd. Flow (perm)	365	1782		1102	1746		900	3507		1010	3339	
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)	91	132	74	60	255	243	42	313	48	166	259	208
RTOR Reduction (vph)	0	29	0	0	50	0	0	10	0	0	94	0
Lane Group Flow (vph)	91	177	0	60	448	0	42	351	0	166	373	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)	22.5	22.5		22.5	22.5		37.9	37.9		37.9	37.9	
Effective Green, g (s)	22.5	22.5		22.5	22.5		37.9	37.9		37.9	37.9	
Actuated g/C Ratio	0.32	0.32		0.32	0.32		0.55	0.55		0.55	0.55	
Clearance Time (s)	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	
Lane Grp Cap (vph)	118	577		357	566		491	1915		551	1823	
v/s Ratio Prot		0.10			c0.26			0.10			0.11	
v/s Ratio Perm	0.25			0.05			0.05			c0.16		
v/c Ratio	0.77	0.31		0.17	0.79		0.09	0.18		0.30	0.20	
Uniform Delay, d1	21.1	17.6		16.8	21.3		7.5	7.9		8.6	8.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	26.2	0.3		0.2	7.4		0.3	0.2		1.4	0.3	
Delay (s)	47.3	17.9		17.0	28.8		7.8	8.2		10.0	8.3	
Level of Service	D	B		B	C		A	A		A	A	
Approach Delay (s)		26.9			27.5			8.1			8.7	
Approach LOS		C			C			A			A	

Intersection Summary				
HCM 2000 Control Delay		17.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.48		
Actuated Cycle Length (s)		69.4	Sum of lost time (s)	9.0
Intersection Capacity Utilization	70.4%		ICU Level of Service	C
Analysis Period (min)		15		

c Critical Lane Group

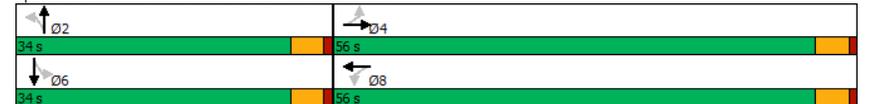
Timings
20: Collector Road B & Collector Road C

Total 2031 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	62	243	14	355	42	145	99	85
Future Volume (vph)	62	243	14	355	42	145	99	85
Lane Group Flow (vph)	67	278	15	537	46	230	108	219
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	56.0	56.0	56.0	56.0	34.0	34.0	34.0	34.0
Total Split (%)	62.2%	62.2%	62.2%	62.2%	37.8%	37.8%	37.8%	37.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.47	0.41	0.04	0.80	0.08	0.26	0.19	0.25
Control Delay	26.1	15.7	11.7	25.4	11.1	10.5	12.1	7.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.1	15.7	11.7	25.4	11.1	10.5	12.1	7.9
Queue Length 50th (m)	5.6	22.0	1.0	48.2	2.5	11.9	6.2	7.8
Queue Length 95th (m)	16.0	37.3	3.9	78.6	9.4	31.8	18.9	24.4
Internal Link Dist (m)		697.4		946.4		692.1		640.3
Turn Bay Length (m)	15.0				50.0		50.0	
Base Capacity (vph)	339	1596	836	1546	572	891	565	883
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.17	0.02	0.35	0.08	0.26	0.19	0.25

Intersection Summary	
Cycle Length:	90
Actuated Cycle Length:	60.9
Natural Cycle:	50
Control Type:	Semi Act-Uncoord

Splits and Phases: 20: Collector Road B & Collector Road C



HCM Signalized Intersection Capacity Analysis

Total 2031 PM Peak Hour

20: Collector Road B & Collector Road C



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔		↔	↔		↔	↔		↔	↔	
Traffic Volume (vph)	62	243	13	14	355	139	42	145	66	99	85	117
Future Volume (vph)	62	243	13	14	355	139	42	145	66	99	85	117
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	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.96		1.00	0.95		1.00	0.91	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1869		1789	1804		1789	1795		1789	1720	
Fit Permitted	0.21	1.00		0.52	1.00		0.62	1.00		0.61	1.00	
Satd. Flow (perm)	397	1869		979	1804		1170	1795		1157	1720	
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)	67	264	14	15	386	151	46	158	72	108	92	127
RTOR Reduction (vph)	0	3	0	0	24	0	0	14	0	0	42	0
Lane Group Flow (vph)	67	275	0	15	513	0	46	216	0	108	177	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)	22.0	22.0		22.0	22.0		29.8	29.8		29.8	29.8	
Effective Green, g (s)	22.0	22.0		22.0	22.0		29.8	29.8		29.8	29.8	
Actuated g/C Ratio	0.36	0.36		0.36	0.36		0.49	0.49		0.49	0.49	
Clearance Time (s)	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	
Lane Grp Cap (vph)	143	676		354	652		573	879		567	843	
v/s Ratio Prot		0.15			c0.28			c0.12			0.10	
v/s Ratio Perm	0.17			0.02			0.04			0.09		
v/c Ratio	0.47	0.41		0.04	0.79		0.08	0.25		0.19	0.21	
Uniform Delay, d1	14.9	14.5		12.6	17.3		8.2	9.0		8.7	8.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.4	0.4		0.0	6.3		0.3	0.7		0.7	0.6	
Delay (s)	17.3	14.9		12.6	23.6		8.5	9.7		9.5	9.4	
Level of Service	B	B		B	C		A	A		A	A	
Approach Delay (s)		15.4			23.3			9.5			9.4	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	15.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	60.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

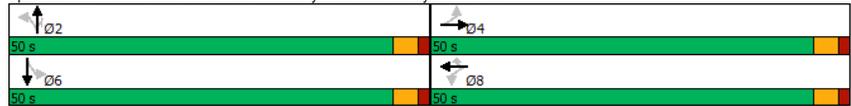
Appendix 5

2041 Total Conditions

Timings Total 2041 AM Peak Hour
 1: Glanccaster Road & Twenty Extension/Twenty Road West

	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↖	↖	↖	↖	↖
Traffic Volume (vph)	10	145	211	17	220	62	391	207	172	265
Future Volume (vph)	10	145	211	17	220	62	391	207	172	265
Lane Group Flow (vph)	11	263	224	18	234	66	416	220	183	495
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA
Protected Phases		4		8			2		6	6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	4	4	8	8	8	2	2	2	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	Min	Min	Min	Min	Min
v/c Ratio	0.02	0.37	0.56	0.02	0.32	0.25	0.57	0.29	0.56	0.65
Control Delay	12.2	11.9	20.0	12.1	3.6	13.9	15.5	3.1	20.1	15.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.2	11.9	20.0	12.1	3.6	13.9	15.5	3.1	20.1	15.8
Queue Length 50th (m)	0.5	11.0	12.7	0.8	0.0	3.1	22.6	0.0	9.9	24.8
Queue Length 95th (m)	3.8	39.2	46.6	5.3	12.1	14.7	70.6	10.9	39.1	80.3
Internal Link Dist (m)		118.9		282.7			557.6			262.6
Turn Bay Length (m)	50.0		50.0		50.0		50.0		50.0	
Base Capacity (vph)	1242	1568	917	1666	1354	564	1542	1368	691	1546
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.17	0.24	0.01	0.17	0.12	0.27	0.16	0.26	0.32
Intersection Summary										
Cycle Length: 100										
Actuated Cycle Length: 50.3										
Natural Cycle: 50										
Control Type: Actuated-Uncoordinated										

Splits and Phases: 1: Glanccaster Road & Twenty Extension/Twenty Road West



HCM Signalized Intersection Capacity Analysis Total 2041 AM Peak Hour
 1: Glanccaster Road & Twenty Extension/Twenty Road West

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (vph)	10	145	102	211	17	220	62	391	207	172	265	200
Future Volume (vph)	10	145	102	211	17	220	62	391	207	172	265	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frbp, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.94		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	1.00
Fit Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	1802		1738	1921	1526	1825	1779	1548	1805	1777	1777
Fit Permitted	0.75	1.00		0.58	1.00	1.00	0.34	1.00	1.00	0.42	1.00	1.00
Satd. Flow (perm)	1433	1802		1058	1921	1526	651	1779	1548	797	1777	1777
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	11	154	109	224	18	234	66	416	220	183	282	213
RTOR Reduction (vph)	0	29	0	0	0	142	0	0	127	0	29	0
Lane Group Flow (vph)	11	234	0	224	18	92	66	416	93	183	466	0
Confl. Peds. (#/hr)									3	3		
Heavy Vehicles (%)	0%	0%	0%	5%	0%	7%	0%	8%	4%	1%	2%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	NA
Protected Phases		4			8			2		6		6
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	19.2	19.2		19.2	19.2	19.2	20.8	20.8	20.8	20.8	20.8	20.8
Effective Green, g (s)	19.2	19.2		19.2	19.2	19.2	20.8	20.8	20.8	20.8	20.8	20.8
Actuated g/C Ratio	0.39	0.39		0.39	0.39	0.39	0.42	0.42	0.42	0.42	0.42	0.42
Clearance Time (s)	4.5	4.5		4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	561	706		414	752	597	276	755	657	338	754	
v/s Ratio Prot		0.13			0.01			0.23				c0.26
v/s Ratio Perm	0.01			c0.21		0.06	0.10		0.06	0.23		
v/c Ratio	0.02	0.33		0.54	0.02	0.15	0.24	0.55	0.14	0.54	0.62	
Uniform Delay, d1	9.1	10.4		11.5	9.1	9.6	9.0	10.6	8.6	10.5	11.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.3		1.4	0.0	0.1	0.5	0.9	0.1	1.8	1.5	
Delay (s)	9.1	10.7		12.9	9.2	9.8	9.5	11.5	8.7	12.3	12.5	
Level of Service	A	B		B	A	A	A	B	A	B	B	
Approach Delay (s)		10.6			11.2		10.4				12.5	
Approach LOS		B			B		B				B	
Intersection Summary												
HCM 2000 Control Delay	11.3		HCM 2000 Level of Service		B							
HCM 2000 Volume to Capacity ratio	0.58											
Actuated Cycle Length (s)	49.0		Sum of lost time (s)		9.0							
Intersection Capacity Utilization	75.0%		ICU Level of Service		D							
Analysis Period (min)	15											

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
2: Twenty Road West & Silverbirch Blvd

Total 2041 AM Peak Hour

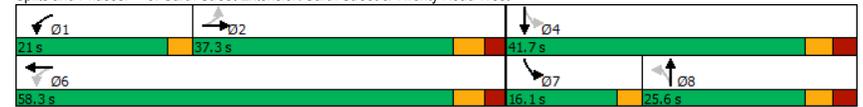
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕	↕	↔	↕	↔
Traffic Volume (veh/h)	14	682	492	14	55	16
Future Volume (Veh/h)	14	682	492	14	55	16
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	14	703	507	14	57	16
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLTL	TWLTL			
Median storage (veh)		2	2			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	521				894	260
vC1, stage 1 conf vol					514	
vC2, stage 2 conf vol					380	
vCu, unblocked vol	521				894	260
tC, single (s)	4.2				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.3				3.5	3.3
p0 queue free %	99				88	98
cM capacity (veh/h)	1007				481	744
Direction_Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	14	352	352	338	183	73
Volume Left	14	0	0	0	0	57
Volume Right	0	0	0	0	14	16
cSH	1007	1700	1700	1700	1700	522
Volume to Capacity	0.01	0.21	0.21	0.20	0.11	0.14
Queue Length 95th (m)	0.3	0.0	0.0	0.0	0.0	3.7
Control Delay (s)	8.6	0.0	0.0	0.0	0.0	13.0
Lane LOS	A					B
Approach Delay (s)	0.2			0.0		13.0
Approach LOS						B
Intersection Summary						
Average Delay		0.8				
Intersection Capacity Utilization		29.5%		ICU Level of Service	A	
Analysis Period (min)		15				

Timings
3: Garth Street Extension/Garth Street & Twenty Road West

Total 2041 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↕	↕	↕	↔	↕	↕	↕
Traffic Volume (vph)	127	496	341	306	50	316	209	218
Future Volume (vph)	127	496	341	306	50	316	209	218
Lane Group Flow (vph)	141	698	379	563	56	662	232	404
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+pt	NA
Protected Phases		2	1	6		8	7	4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	1	6	8	8	7	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	5.0	10.0	5.0	5.0	5.0	10.0
Minimum Split (s)	36.4	36.4	9.5	36.4	24.5	24.5	9.5	26.3
Total Split (s)	37.3	37.3	21.0	58.3	25.6	25.6	16.1	41.7
Total Split (%)	37.3%	37.3%	21.0%	58.3%	25.6%	25.6%	16.1%	41.7%
Yellow Time (s)	3.7	3.7	3.0	3.7	3.3	3.3	3.0	3.3
All-Red Time (s)	2.7	2.7	0.0	2.7	3.0	3.0	0.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.4	6.4	3.0	6.4	6.3	6.3	3.0	6.3
Lead/Lag	Lag	Lag	Lead		Lag	Lag	Lead	
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes	
Recall Mode	Max	Max	None	Max	None	None	None	None
v/c Ratio	0.51	0.59	0.78	0.31	0.32	0.86	0.73	0.33
Control Delay	35.8	28.9	25.3	8.2	40.3	39.3	36.8	14.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.8	28.9	25.3	8.2	40.3	39.3	36.8	14.6
Queue Length 50th (m)	22.7	57.9	39.1	17.7	9.4	46.2	31.2	17.0
Queue Length 95th (m)	43.1	77.0	#66.6	27.6	21.0	#68.2	#54.1	28.3
Internal Link Dist (m)		397.1		655.9		650.8		148.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	276	1185	514	1842	194	828	323	1287
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.51	0.59	0.74	0.31	0.29	0.80	0.72	0.31
Intersection Summary								
Cycle Length: 100								
Actuated Cycle Length: 98								
Natural Cycle: 80								
Control Type: Semi Act-Uncoord								
# 95th percentile volume exceeds capacity, queue may be longer.								
Queue shown is maximum after two cycles.								

Plots and Phases: 3: Garth Street Extension/Garth Street & Twenty Road West



HCM Signalized Intersection Capacity Analysis

Total 2041 AM Peak Hour

3: Garth Street Extension/Garth Street & Twenty Road West

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	127	496	132	341	306	201	50	316	280	209	218	146
Future Volume (vph)	127	496	132	341	306	201	50	316	280	209	218	146
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4		3.0	6.4		6.3	6.3		3.0	6.3	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.94		1.00	0.93		1.00	0.94	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3453		1825	3276		1825	3393		1772	3273	
Fit Permitted	0.44	1.00		0.24	1.00		0.51	1.00		0.19	1.00	
Satd. Flow (perm)	821	3453		469	3276		988	3393		362	3273	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	141	551	147	379	340	223	56	351	311	232	242	162
RTOR Reduction (vph)	0	23	0	0	105	0	0	162	0	0	107	0
Lane Group Flow (vph)	141	675	0	379	458	0	56	500	0	232	297	0
Confl. Peds. (#/hr)	2					2						
Heavy Vehicles (%)	3%	3%	0%	0%	5%	3%	0%	0%	0%	3%	0%	12%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		pm+pt	NA	
Protected Phases		2		1	6			8		7	4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	33.0	33.0		52.0	52.0		17.6	17.6		33.3	33.3	
Effective Green, g (s)	33.0	33.0		52.0	52.0		17.6	17.6		33.3	33.3	
Actuated g/C Ratio	0.34	0.34		0.53	0.53		0.18	0.18		0.34	0.34	
Clearance Time (s)	6.4	6.4		3.0	6.4		6.3	6.3		3.0	6.3	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	276	1162		470	1738		177	609		305	1112	
v/s Ratio Prot		0.20		c0.13	0.14			0.15		c0.10	0.09	
v/s Ratio Perm	0.17			c0.30			0.06			c0.16		
v/c Ratio	0.51	0.58		0.81	0.26		0.32	0.82		0.76	0.27	
Uniform Delay, d1	26.0	26.8		15.5	12.6		35.0	38.7		26.1	23.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.6	2.1		9.8	0.4		1.0	8.7		10.7	0.1	
Delay (s)	32.6	28.9		25.2	12.9		36.0	47.4		36.7	23.6	
Level of Service	C	C		C	B		D	D		D	C	
Approach Delay (s)		29.5			17.9			46.5			28.4	
Approach LOS		C			B			D			C	

Intersection Summary			
HCM 2000 Control Delay	29.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	98.0	Sum of lost time (s)	18.7
Intersection Capacity Utilization	83.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Timings

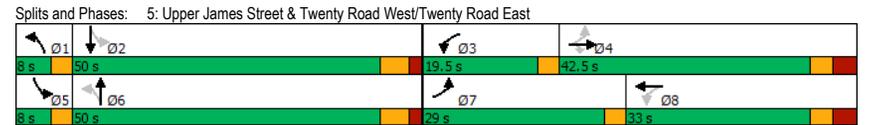
Total 2041 AM Peak Hour

5: Upper James Street & Twenty Road West/Twenty Road East

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↕	↔	↔	↕	↔	↕	↔	↕
Traffic Volume (vph)	409	562	149	192	519	145	1424	47	872
Future Volume (vph)	409	562	149	192	519	145	1424	47	872
Lane Group Flow (vph)	435	598	159	204	715	154	1744	50	1182
Turn Type	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA	pm+pt	NA
Protected Phases	7	4		3	8	1	6	5	2
Permitted Phases	4		4	8		6		2	
Detector Phase	7	4	4	3	8	1	6	5	2
Switch Phase									
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	5.0	45.0	5.0	45.0
Minimum Split (s)	9.5	34.8	34.8	9.5	34.8	8.0	51.1	8.0	51.1
Total Split (s)	29.0	42.5	42.5	19.5	33.0	8.0	50.0	8.0	50.0
Total Split (%)	24.2%	35.4%	35.4%	16.3%	27.5%	6.7%	41.7%	6.7%	41.7%
Yellow Time (s)	3.0	3.3	3.3	3.0	3.3	3.0	4.2	3.0	4.2
All-Red Time (s)	0.0	3.5	3.5	0.0	3.5	0.0	1.9	0.0	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.8	6.8	3.0	6.8	3.0	6.1	3.0	6.1
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.97	0.52	0.26	0.52	0.94	0.89	0.99	0.36	0.67
Control Delay	67.9	35.5	5.9	24.1	64.9	70.2	57.6	25.8	32.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	67.9	35.5	5.9	24.1	64.9	70.2	57.6	25.8	32.4
Queue Length 50th (m)	84.0	60.2	0.0	26.8	84.4	21.0	147.0	6.4	80.6
Queue Length 95th (m)	#148.0	80.8	15.2	42.0	#120.2	#51.8	#184.1	13.6	96.8
Internal Link Dist (m)		924.0			263.2		419.6		203.7
Turn Bay Length (m)	50.0		50.0	33.0		127.0		65.0	
Base Capacity (vph)	449	1146	623	437	768	173	1755	137	1753
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.97	0.52	0.26	0.47	0.93	0.89	0.99	0.36	0.67

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 119.8
Natural Cycle: 125
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis

Total 2041 AM Peak Hour

5: Upper James Street & Twenty Road West/Twenty Road East

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	409	562	149	192	519	153	145	1424	215	47	872	239
Future Volume (vph)	409	562	149	192	519	153	145	1424	215	47	872	239
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.8	6.8	3.0	6.8		3.0	6.1		3.0	6.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	0.98		1.00	0.97	
Fit Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1755	3544	1595	1754	3411		1789	4746		1738	4672	
Fit Permitted	0.14	1.00	1.00	0.43	1.00		0.13	1.00		0.09	1.00	
Satd. Flow (perm)	254	3544	1595	787	3411		252	4746		167	4672	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	435	598	159	204	552	163	154	1515	229	50	928	254
RTOR Reduction (vph)	0	0	108	0	23	0	0	16	0	0	41	0
Lane Group Flow (vph)	435	598	51	204	692	0	154	1728	0	50	1141	0
Confl. Peds. (#/hr)	2		1	1		2			1	1		
Heavy Vehicles (%)	4%	3%	1%	4%	3%	3%	2%	8%	9%	5%	11%	0%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		1	6		5	2	
Permitted Phases	4		4	8			6			2		
Actuated Green, G (s)	55.1	38.8	38.8	39.4	26.1		48.9	43.9		48.9	43.9	
Effective Green, g (s)	55.1	38.8	38.8	39.4	26.1		48.9	43.9		48.9	43.9	
Actuated g/C Ratio	0.46	0.32	0.32	0.33	0.22		0.41	0.37		0.41	0.37	
Clearance Time (s)	3.0	6.8	6.8	3.0	6.8		3.0	6.1		3.0	6.1	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		1.0	6.5		1.0	6.5	
Lane Grp Cap (vph)	442	1146	516	365	742		166	1737		133	1710	
v/s Ratio Prot	c0.21	0.17		0.06	0.20		c0.04	c0.36		0.02	0.24	
v/s Ratio Perm	c0.24		0.03	0.12			0.34			0.14		
v/c Ratio	0.98	0.52	0.10	0.56	0.93		0.93	0.99		0.38	0.67	
Uniform Delay, d1	35.1	33.0	28.3	30.6	46.0		29.9	37.9		27.3	31.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	38.4	0.4	0.1	1.9	18.6		48.1	20.3		7.9	2.1	
Delay (s)	73.5	33.4	28.4	32.4	64.6		78.0	58.2		35.2	34.0	
Level of Service	E	C	C	C	E		E	E		D	C	
Approach Delay (s)		47.4			57.5			59.8			34.0	
Approach LOS		D			E			E			C	

Intersection Summary			
HCM 2000 Control Delay	50.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	119.9	Sum of lost time (s)	18.9
Intersection Capacity Utilization	105.2%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Timings

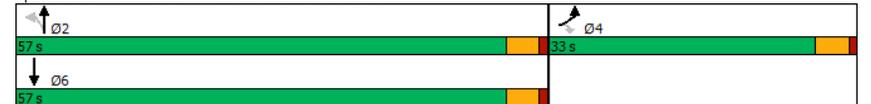
Total 2041 AM Peak Hour

6: Glanccaster Road & Book Road East

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Configurations	↔	↔	↔	↔	↔
Traffic Volume (vph)	276	86	67	256	297
Future Volume (vph)	276	86	67	256	297
Lane Group Flow (vph)	297	92	72	275	643
Turn Type	Prot	Perm	Perm	NA	NA
Protected Phases	4			2	6
Permitted Phases		4	2		
Detector Phase	4	4	2	2	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5
Total Split (s)	33.0	33.0	57.0	57.0	57.0
Total Split (%)	36.7%	36.7%	63.3%	63.3%	63.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	Max	Max	Max
v/c Ratio	0.74	0.22	0.18	0.24	0.56
Control Delay	40.2	6.8	8.3	7.2	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	40.2	6.8	8.3	7.2	9.5
Queue Length 50th (m)	42.1	0.0	3.8	15.0	38.4
Queue Length 95th (m)	67.1	10.2	12.1	33.4	86.2
Internal Link Dist (m)	171.0			456.5	274.4
Turn Bay Length (m)	100.0		50.0		
Base Capacity (vph)	606	584	410	1165	1148
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.49	0.16	0.18	0.24	0.56

Intersection Summary	
Cycle Length:	90
Actuated Cycle Length:	81.2
Natural Cycle:	60
Control Type:	Semi Act-Uncoord

Splits and Phases: 6: Glanccaster Road & Book Road East



HCM Signalized Intersection Capacity Analysis
6: Glanaster Road & Book Road East

Total 2041 AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Volume (vph)	276	86	67	256	297	301
Future Volume (vph)	276	86	67	256	297	301
Ideal Flow (vphpl)	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
Frb, ped/bikes	1.00	0.98	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.93	
Fit Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1722	1492	1787	1779	1700	
Fit Permitted	0.95	1.00	0.33	1.00	1.00	
Satd. Flow (perm)	1722	1492	627	1779	1700	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	297	92	72	275	319	324
RTOR Reduction (vph)	0	70	0	0	34	0
Lane Group Flow (vph)	297	22	72	275	609	0
Confl. Peds. (#/hr)		1	2			2
Heavy Vehicles (%)	6%	7%	2%	8%	4%	4%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	19.0	19.0	53.2	53.2	53.2	
Effective Green, g (s)	19.0	19.0	53.2	53.2	53.2	
Actuated g/C Ratio	0.23	0.23	0.66	0.66	0.66	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	402	349	410	1165	1113	
v/s Ratio Prot	c0.17			0.15	c0.36	
v/s Ratio Perm		0.01	0.11			
v/c Ratio	0.74	0.06	0.18	0.24	0.55	
Uniform Delay, d1	28.8	24.2	5.5	5.7	7.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	7.0	0.1	0.9	0.5	1.9	
Delay (s)	35.8	24.2	6.4	6.2	9.5	
Level of Service	D	C	A	A	A	
Approach Delay (s)	33.0			6.2	9.5	
Approach LOS	C			A	A	

Intersection Summary			
HCM 2000 Control Delay	15.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	81.2	Sum of lost time (s)	9.0
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

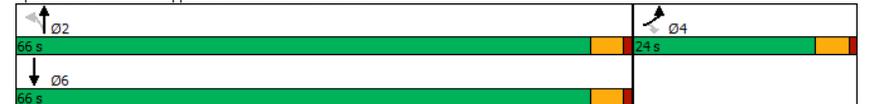
Timings
7: Upper James Street & Talbot Lane

Total 2041 AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Volume (vph)	11	9	57	1516	1179
Future Volume (vph)	11	9	57	1516	1179
Lane Group Flow (vph)	11	9	59	1579	1320
Turn Type	Prot	Perm	Perm	NA	NA
Protected Phases	4			2	6
Permitted Phases		4	2		
Detector Phase	4	4	2	2	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5
Total Split (s)	24.0	24.0	66.0	66.0	66.0
Total Split (%)	26.7%	26.7%	73.3%	73.3%	73.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	Max	Max	Max
v/c Ratio	0.08	0.10	0.17	0.34	0.31
Control Delay	40.5	24.8	2.4	1.2	1.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	40.5	24.8	2.4	1.2	1.1
Queue Length 50th (m)	1.6	0.0	0.0	0.0	0.0
Queue Length 95th (m)	7.1	4.7	4.1	22.8	18.2
Internal Link Dist (m)	158.6			280.1	602.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	417	256	351	4606	4192
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.04	0.17	0.34	0.31

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 85.6	
Natural Cycle: 55	
Control Type: Semi Act-Uncoord	

Splits and Phases: 7: Upper James Street & Talbot Lane



HCM Signalized Intersection Capacity Analysis
7: Upper James Street & Talbot Lane

Total 2041 AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↖	↖↗	↖↗	↖
Traffic Volume (vph)	11	9	57	1516	1179	88
Future Volume (vph)	11	9	57	1516	1179	88
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	
Frt	1.00	0.85	1.00	1.00	0.99	
Fit Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	1089	1825	4948	4499	
Fit Permitted	0.95	1.00	0.20	1.00	1.00	
Satd. Flow (perm)	1825	1089	377	4948	4499	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	11	9	59	1579	1228	92
RTOR Reduction (vph)	0	9	0	0	4	0
Lane Group Flow (vph)	11	0	59	1579	1316	0
Heavy Vehicles (%)	0%	50%	0%	6%	9%	100%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	2.6	2.6	76.8	76.8	76.8	
Effective Green, g (s)	2.6	2.6	76.8	76.8	76.8	
Actuated g/C Ratio	0.03	0.03	0.87	0.87	0.87	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	53	32	327	4298	3908	
v/s Ratio Prot	c0.01		c0.32	0.29		
v/s Ratio Perm		0.00	0.16			
v/c Ratio	0.21	0.01	0.18	0.37	0.34	
Uniform Delay, d1	41.9	41.6	0.9	1.1	1.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.9	0.1	1.2	0.2	0.2	
Delay (s)	43.8	41.8	2.1	1.4	1.3	
Level of Service	D	D	A	A	A	
Approach Delay (s)	42.9			1.4	1.3	
Approach LOS	D			A	A	
Intersection Summary						
HCM 2000 Control Delay			1.6	HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio			0.36			
Actuated Cycle Length (s)			88.4	Sum of lost time (s)	9.0	
Intersection Capacity Utilization			44.3%	ICU Level of Service	A	
Analysis Period (min)			15			
c Critical Lane Group						

Timings
8: Glanccaster Road & Dickenson Road West

Total 2041 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↖	↖	↖	↖
Traffic Volume (vph)	18	144	93	258	70	153	101	220	147
Future Volume (vph)	18	144	93	258	70	153	101	220	147
Lane Group Flow (vph)	20	252	104	459	79	172	113	247	183
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA
Protected Phases		4		8		2		2	6
Permitted Phases	4		8		2		2	6	
Detector Phase	4	4	8	8	2	2	2	6	6
Switch Phase									
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	37.0	37.0	37.0	37.0	63.0	63.0	63.0	63.0	63.0
Total Split (%)	37.0%	37.0%	37.0%	37.0%	63.0%	63.0%	63.0%	63.0%	63.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Min	Min	Min	Min	Min
v/c Ratio	0.07	0.21	0.28	0.39	0.16	0.22	0.19	0.52	0.30
Control Delay	10.1	6.7	12.1	8.0	7.2	7.3	2.6	11.9	7.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.1	6.7	12.1	8.0	7.2	7.3	2.6	11.9	7.8
Queue Length 50th (m)	0.6	2.8	3.6	6.2	2.3	5.2	0.0	8.6	5.4
Queue Length 95th (m)	4.2	10.0	14.2	17.8	7.9	14.0	5.1	23.8	15.2
Internal Link Dist (m)		150.3		619.9		112.9			456.5
Turn Bay Length (m)	50.0		50.0		50.0		50.0		
Base Capacity (vph)	881	3251	1076	3202	1233	1921	1338	1199	1544
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.08	0.10	0.14	0.06	0.09	0.08	0.21	0.12
Intersection Summary									
Cycle Length: 100									
Actuated Cycle Length: 33.3									
Natural Cycle: 45									
Control Type: Actuated-Uncoordinated									
Splits and Phases: 8: Glanccaster Road & Dickenson Road West									

HCM Signalized Intersection Capacity Analysis
8: Glanaster Road & Dickenson Road West

Total 2041 AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	18	144	80	93	258	150	70	153	101	220	147	16
Future Volume (vph)	18	144	80	93	258	150	70	153	101	220	147	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.95	1.00	0.94	1.00	1.00	0.85	1.00	0.99	1.00	0.99	1.00
Fit Protected	0.95	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	3455	1825	3398	1825	1921	1338	1755	1545	1825	3455	1825
Fit Permitted	0.49	1.00	0.60	1.00	0.64	1.00	1.00	0.65	1.00	0.49	1.00	1.00
Satd. Flow (perm)	937	3455	1144	3398	1233	1921	1338	1198	1545	937	3455	1144
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	20	162	90	104	290	169	79	172	113	247	165	18
RTOR Reduction (vph)	0	61	0	0	83	0	0	68	0	5	0	0
Lane Group Flow (vph)	20	191	0	104	376	0	79	172	45	247	178	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	4%	0%	0%	22%	4%	25%	0%
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	Perm	NA	NA	NA
Protected Phases	4	8	8	8	2	2	6	6	6	6	6	6
Permitted Phases	4	8	8	8	2	2	6	6	6	6	6	6
Actuated Green, G (s)	10.8	10.8	10.8	10.8	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Effective Green, g (s)	10.8	10.8	10.8	10.8	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Actuated g/C Ratio	0.33	0.33	0.33	0.33	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	305	1127	373	1108	495	771	537	481	620	305	1127	373
v/s Ratio Prot	0.06	0.06	0.06	0.06	0.09	0.09	0.09	0.09	0.09	0.06	0.06	0.06
v/s Ratio Perm	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
v/c Ratio	0.07	0.17	0.28	0.34	0.16	0.22	0.08	0.51	0.29	0.07	0.17	0.28
Uniform Delay, d1	7.7	8.0	8.3	8.4	6.3	6.5	6.1	7.5	6.7	7.7	8.0	8.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.1	0.4	0.2	0.2	0.1	0.1	0.9	0.3	0.1	0.1	0.4
Delay (s)	7.8	8.0	8.7	8.6	6.5	6.7	6.2	8.4	6.9	7.8	8.0	8.7
Level of Service	A	A	A	A	A	A	A	A	A	A	A	A
Approach Delay (s)	8.0	8.0	8.6	8.6	6.5	6.5	6.5	8.4	7.8	8.0	8.0	8.6
Approach LOS	A	A	A	A	A	A	A	A	A	A	A	A

Intersection Summary			
HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	33.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

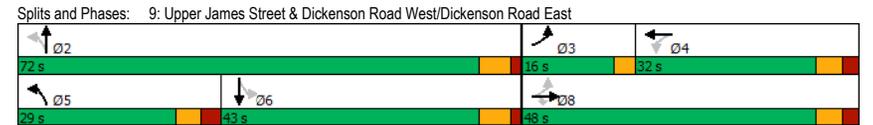
Timings

Total 2041 AM Peak Hour

9: Upper James Street & Dickenson Road West/Dickenson Road East

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	173	475	364	17	522	342	1382	12	1040
Future Volume (vph)	173	475	364	17	522	342	1382	12	1040
Lane Group Flow (vph)	184	505	387	18	673	364	1480	13	1338
Turn Type	pm+pt	NA	Perm	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases	3	8	8	4	4	5	2	6	6
Permitted Phases	8	8	8	4	4	5	2	6	6
Detector Phase	3	8	8	4	4	5	2	6	6
Switch Phase									
Minimum Initial (s)	5.0	10.0	10.0	10.0	10.0	5.0	55.0	55.0	55.0
Minimum Split (s)	9.5	35.2	35.2	35.2	35.2	11.5	66.2	61.3	61.3
Total Split (s)	16.0	48.0	48.0	32.0	32.0	29.0	72.0	43.0	43.0
Total Split (%)	13.3%	40.0%	40.0%	26.7%	26.7%	24.2%	60.0%	35.8%	35.8%
Yellow Time (s)	3.0	3.7	3.7	3.7	3.7	3.5	4.6	4.6	4.6
All-Red Time (s)	0.0	2.5	2.5	2.5	2.5	3.0	1.7	1.7	1.7
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.2	6.2	6.2	6.2	6.5	6.3	6.3	6.3
Lead/Lag	Lead			Lag	Lag	Lead		Lag	Lag
Lead-Lag Optimize?	Yes			Yes	Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.94	0.80	0.56	0.09	0.95	0.97	0.53	0.16	0.92
Control Delay	82.2	46.1	8.9	39.5	69.2	72.9	18.2	36.2	50.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	82.2	46.1	8.9	39.5	69.2	72.9	18.2	36.2	50.1
Queue Length 50th (m)	31.2	56.0	8.9	3.4	80.7	70.4	78.0	2.2	108.7
Queue Length 95th (m)	#74.5	#78.4	36.5	9.9	#117.3	#129.2	90.9	7.9	#136.9
Internal Link Dist (m)		868.4			232.1		174.3		280.1
Turn Bay Length (m)	15.0		30.0	15.0		40.0		68.0	
Base Capacity (vph)	195	636	687	192	711	379	2781	83	1456
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.94	0.79	0.56	0.09	0.95	0.96	0.53	0.16	0.92

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	119.9
Natural Cycle:	140
Control Type:	Semi Act-Uncoord
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	



HCM Signalized Intersection Capacity Analysis

Total 2041 AM Peak Hour

9: Upper James Street & Dickenson Road West/Dickenson Road East



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔↔	↔	↔	↔↔		↔	↔↔		↔	↔↔	
Traffic Volume (vph)	173	475	364	17	522	111	342	1382	9	12	1040	218
Future Volume (vph)	173	475	364	17	522	111	342	1382	9	12	1040	218
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.2	6.2	6.2	6.2		6.5	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00		1.00	0.97	
Fit Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1323	1825	1354	1824	3233		1706	5075		1560	4649	
Fit Permitted	0.14	1.00	1.00	0.47	1.00		0.09	1.00		0.17	1.00	
Satd. Flow (perm)	194	1825	1354	895	3233		166	5075		272	4649	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	184	505	387	18	555	118	364	1470	10	13	1106	232
RTOR Reduction (vph)	0	0	216	0	15	0	0	0	0	0	27	0
Lane Group Flow (vph)	184	505	171	18	658	0	364	1480	0	13	1311	0
Confl. Peds. (#/hr)			1	1								
Heavy Vehicles (%)	38%	100%	19%	0%	8%	19%	7%	3%	38%	17%	9%	14%
Turn Type	pm+pt	NA	Perm	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA	
Protected Phases	3	8			4		5	2			6	
Permitted Phases	8		8	4			2			6		
Actuated Green, G (s)	41.7	41.7	41.7	25.7	25.7		65.7	65.7		36.8	36.8	
Effective Green, g (s)	41.7	41.7	41.7	25.7	25.7		65.7	65.7		36.8	36.8	
Actuated g/C Ratio	0.35	0.35	0.35	0.21	0.21		0.55	0.55		0.31	0.31	
Clearance Time (s)	3.0	6.2	6.2	6.2	6.2		6.5	6.3		6.3	6.3	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	5.7		5.7	5.7	
Lane Grp Cap (vph)	189	634	470	191	692		378	2780		83	1426	
v/s Ratio Prot	c0.11	0.28			0.20		c0.18	0.29			0.28	
v/s Ratio Perm	c0.23		0.13	0.02			c0.35			0.05		
v/c Ratio	0.97	0.80	0.36	0.09	0.95		0.96	0.53		0.16	0.92	
Uniform Delay, d1	31.9	35.3	29.2	37.8	46.5		36.6	17.3		30.3	40.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	57.4	6.9	0.5	0.2	22.8		36.4	0.7		4.0	11.0	
Delay (s)	89.3	42.2	29.7	38.0	69.3		73.0	18.0		34.2	51.1	
Level of Service	F	D	C	D	E		E	B		C	D	
Approach Delay (s)		45.7			68.5			28.9			51.0	
Approach LOS		D			E			C			D	

Intersection Summary			
HCM 2000 Control Delay	44.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	119.9	Sum of lost time (s)	22.0
Intersection Capacity Utilization	138.2%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

Total 2041 AM Peak Hour

10: Local Street & Twenty Road West



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔↔		↔	↔↔	↔	↔
Traffic Volume (veh/h)	463	10	16	441	2	69
Future Volume (Veh/h)	463	10	16	441	2	69
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)	503	11	17	479	2	75
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL		TWLTL			
Median storage (veh)	2			2		
Upstream signal (m)	307					
pX, platoon unblocked						
vC, conflicting volume			514		782	257
vC1, stage 1 conf vol					508	
vC2, stage 2 conf vol					274	
vCu, unblocked vol			514		782	257
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			98		100	90
cM capacity (veh/h)			1048		512	742

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	335	179	17	240	240	2	75
Volume Left	0	0	17	0	0	2	0
Volume Right	0	11	0	0	0	0	75
cSH	1700	1700	1048	1700	1700	512	742
Volume to Capacity	0.20	0.11	0.02	0.14	0.14	0.00	0.10
Queue Length 95th (m)	0.0	0.0	0.4	0.0	0.0	0.1	2.6
Control Delay (s)	0.0	0.0	8.5	0.0	0.0	12.1	10.4
Lane LOS			A			B	B
Approach Delay (s)	0.0		0.3			10.4	
Approach LOS						B	

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	24.1%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
11: Collector Road A & Twenty Road West

Total 2041 AM Peak Hour

Movement	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Configurations	↔↔		↔	↔↔	↔	↔	
Traffic Volume (veh/h)	504	28	60	448	9	192	
Future Volume (Veh/h)	504	28	60	448	9	192	
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)	548	30	65	487	10	209	
Pedestrians							
Lane Width (m)							
Walking Speed (m/s)							
Percent Blockage							
Right turn flare (veh)							
Median type	TWLTL			TWLTL			
Median storage (veh)	2			2			
Upstream signal (m)							
pX, platoon unblocked							
vC, conflicting volume			578		936	289	
vC1, stage 1 conf vol					563		
vC2, stage 2 conf vol					374		
vCU, unblocked vol			578		936	289	
tC, single (s)			4.1		6.8	6.9	
tC, 2 stage (s)					5.8		
tF (s)			2.2		3.5	3.3	
p0 queue free %			93		98	70	
cM capacity (veh/h)			992		451	708	
Direction_Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	365	213	65	244	244	10	209
Volume Left	0	0	65	0	0	10	0
Volume Right	0	30	0	0	0	0	209
cSH	1700	1700	992	1700	1700	451	708
Volume to Capacity	0.21	0.13	0.07	0.14	0.14	0.02	0.30
Queue Length 95th (m)	0.0	0.0	1.6	0.0	0.0	0.5	9.4
Control Delay (s)	0.0	0.0	8.9	0.0	0.0	13.2	12.2
Lane LOS			A			B	B
Approach Delay (s)	0.0		1.0			12.2	
Approach LOS						B	
Intersection Summary							
Average Delay			2.4				
Intersection Capacity Utilization			33.4%			ICU Level of Service	A
Analysis Period (min)			15				

Timings

12: Collector Road B/Twentyplace Boulevard & Twenty Road West

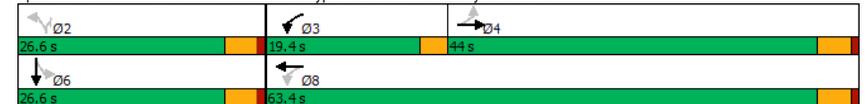
Total 2041 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBR	SBL	SBT
Lane Configurations	↔	↔↔	↔	↔↔	↔	↔	↔	↔
Traffic Volume (vph)	8	893	200	758	42	224	20	0
Future Volume (vph)	8	893	200	758	42	224	20	0
Lane Group Flow (vph)	9	1052	225	860	47	252	22	29
Turn Type	Perm	NA	pm+pt	NA	Perm	Perm	Perm	NA
Protected Phases		4	3	8				6
Permitted Phases	4		8		2	2	6	
Detector Phase	4	4	3	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	9.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	44.0	44.0	19.4	63.4	26.6	26.6	26.6	26.6
Total Split (%)	48.9%	48.9%	21.6%	70.4%	29.6%	29.6%	29.6%	29.6%
Yellow Time (s)	3.5	3.5	3.0	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	3.0	4.5	4.5	4.5	4.5	4.5
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.04	0.78	0.61	0.43	0.11	0.37	0.04	0.05
Control Delay	14.4	24.2	17.4	9.4	22.5	5.4	22.0	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.4	24.2	17.4	9.4	22.5	5.4	22.0	0.1
Queue Length 50th (m)	0.7	62.3	12.8	31.6	4.4	0.0	2.0	0.0
Queue Length 95th (m)	3.5	91.1	31.0	41.0	14.5	16.6	8.3	0.0
Internal Link Dist (m)		655.9		924.0				89.8
Turn Bay Length (m)	15.0		15.0		15.0			
Base Capacity (vph)	350	1961	510	2933	440	681	567	643
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.54	0.44	0.29	0.11	0.37	0.04	0.05

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 72.3
Natural Cycle: 60
Control Type: Semi Act-Uncoord

Splits and Phases: 12: Collector Road B/Twentyplace Boulevard & Twenty Road West



HCM Signalized Intersection Capacity Analysis

Total 2041 AM Peak Hour

12: Collector Road B/Twentyplace Boulevard & Twenty Road West

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	8	893	44	200	758	7	42	0	224	20	0	26
Future Volume (vph)	8	893	44	200	758	7	42	0	224	20	0	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		3.0	4.5		4.5		4.5	4.5	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00		1.00	1.00	1.00	
Frb, ped/bikes	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00		0.85	1.00	0.85	
Fit Protected	0.95	1.00		0.95	1.00		0.95		1.00	0.95	1.00	
Satd. Flow (prot)	1823	3524		1825	3539		1825		1633	1825	1633	
Fit Permitted	0.33	1.00		0.13	1.00		0.74		1.00	0.95	1.00	
Satd. Flow (perm)	632	3524		251	3539		1418		1633	1825	1633	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	9	1003	49	225	852	8	47	0	252	22	0	29
RTOR Reduction (vph)	0	4	0	0	1	0	0	0	173	0	20	0
Lane Group Flow (vph)	9	1048	0	225	859	0	47	0	79	22	9	0
Confl. Peds. (#/hr)	2					2						
Heavy Vehicles (%)	0%	3%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		pm+pt	NA		Perm		Perm	Perm	NA	
Protected Phases		4		3	8						6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	27.6	27.6		40.7	40.7		22.5		22.5	22.5	22.5	
Effective Green, g (s)	27.6	27.6		40.7	40.7		22.5		22.5	22.5	22.5	
Actuated g/C Ratio	0.38	0.38		0.56	0.56		0.31		0.31	0.31	0.31	
Clearance Time (s)	4.5	4.5		3.0	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	
Lane Grp Cap (vph)	241	1347		361	1994		441		508	568	508	
v/s Ratio Prot		c0.30		c0.09	0.24						0.01	
v/s Ratio Perm	0.01			0.26			0.03		c0.05	0.01		
v/c Ratio	0.04	0.78		0.62	0.43		0.11		0.15	0.04	0.02	
Uniform Delay, d1	14.0	19.6		11.5	9.1		17.7		18.0	17.3	17.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.1	2.9		3.3	0.2		0.5		0.6	0.1	0.1	
Delay (s)	14.0	22.5		14.8	9.2		18.2		18.6	17.4	17.3	
Level of Service	B	C		B	A		B		B	B	B	
Approach Delay (s)		22.4			10.4			18.5			17.3	
Approach LOS		C			B			B			B	
Intersection Summary												
HCM 2000 Control Delay		16.6										B
HCM 2000 Volume to Capacity ratio		0.52										
Actuated Cycle Length (s)		72.2			Sum of lost time (s)				12.0			
Intersection Capacity Utilization		56.6%										B
Analysis Period (min)		15										

HCM Unsignalized Intersection Capacity Analysis

Total 2041 AM Peak Hour

13: Glanaster Road & Collector Road C

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (veh/h)	117	219	467	64	106	485
Future Volume (Veh/h)	117	219	467	64	106	485
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)	127	238	508	70	115	527
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)			298			
pX, platoon unblocked						
vC, conflicting volume	1265	508			578	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1265	508			578	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	23	58			88	
cM capacity (veh/h)	165	565			996	
Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	127	238	531	47	115	527
Volume Left	127	0	0	0	115	0
Volume Right	0	238	23	47	0	0
cSH	165	565	1700	1700	996	1700
Volume to Capacity	0.77	0.42	0.31	0.03	0.12	0.31
Queue Length 95th (m)	37.3	15.8	0.0	0.0	3.0	0.0
Control Delay (s)	75.9	15.9	0.0	0.0	9.1	0.0
Lane LOS	F	C			A	
Approach Delay (s)	36.8		0.0		1.6	
Approach LOS	E					
Intersection Summary						
Average Delay			9.1			
Intersection Capacity Utilization			48.2%		ICU Level of Service	A
Analysis Period (min)			15			

Timings
14: Upper James Street & Collector Road C

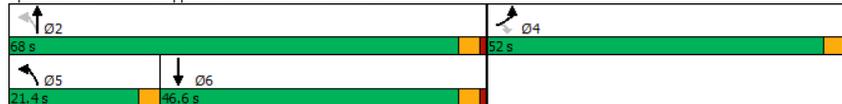
Total 2041 AM Peak Hour

	↖	↗	↙	↘	↕	↕
Lane Group	EBL	EBR	NBL	NBT	SBT	
Lane Configurations	↖	↗	↙	↘	↕	↕
Traffic Volume (vph)	451	281	179	1348	986	
Future Volume (vph)	451	281	179	1348	986	
Lane Group Flow (vph)	490	305	195	1465	1319	
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Detector Phase	4	4	5	2	6	
Switch Phase						
Minimum Initial (s)	10.0	10.0	5.0	10.0	10.0	
Minimum Split (s)	22.5	22.5	9.5	22.5	22.5	
Total Split (s)	52.0	52.0	21.4	68.0	46.6	
Total Split (%)	43.3%	43.3%	17.8%	56.7%	38.8%	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	
All-Red Time (s)	1.0	1.0	0.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	4.0	3.0	4.0	4.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	None	Max	Max	
v/c Ratio	0.86	0.42	0.62	0.47	0.56	
Control Delay	48.9	4.6	22.1	13.4	23.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	48.9	4.6	22.1	13.4	23.2	
Queue Length 50th (m)	94.1	0.0	16.0	56.3	66.4	
Queue Length 95th (m)	132.1	16.6	42.6	92.1	112.1	
Internal Link Dist (m)	946.4		602.9	419.6		
Turn Bay Length (m)			15.0			
Base Capacity (vph)	811	892	412	3109	2350	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.60	0.34	0.47	0.47	0.56	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 106.6
 Natural Cycle: 55
 Control Type: Semi Act-Uncoord

Splits and Phases: 14: Upper James Street & Collector Road C



HCM Signalized Intersection Capacity Analysis
 14: Upper James Street & Collector Road C

Total 2041 AM Peak Hour

	↖	↗	↙	↘	↕	↕
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↙	↘	↕	↕
Traffic Volume (vph)	451	281	179	1348	986	227
Future Volume (vph)	451	281	179	1348	986	227
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	3.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	
Fr _t	1.00	0.85	1.00	1.00	0.97	
Fit Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	5142	4997	
Fit Permitted	0.95	1.00	0.12	1.00	1.00	
Satd. Flow (perm)	1789	1601	230	5142	4997	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	490	305	195	1465	1072	247
RTOR Reduction (vph)	0	207	0	0	26	0
Lane Group Flow (vph)	490	98	195	1465	1293	0
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	34.1	34.1	64.4	64.4	49.6	
Effective Green, g (s)	34.1	34.1	64.4	64.4	49.6	
Actuated g/C Ratio	0.32	0.32	0.60	0.60	0.47	
Clearance Time (s)	4.0	4.0	3.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	572	512	311	3109	2327	
v/s Ratio Prot	c0.27		c0.07	0.28	0.26	
v/s Ratio Perm		0.06	c0.31			
v/c Ratio	0.86	0.19	0.63	0.47	0.56	
Uniform Delay, d1	33.9	26.2	13.3	11.6	20.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	12.0	0.2	3.9	0.5	1.0	
Delay (s)	46.0	26.4	17.2	12.2	21.5	
Level of Service	D	C	B	B	C	
Approach Delay (s)	38.4		12.7	21.5		
Approach LOS	D		B	C		

Intersection Summary

HCM 2000 Control Delay: 21.2, HCM 2000 Level of Service: C
 HCM 2000 Volume to Capacity ratio: 0.72
 Actuated Cycle Length (s): 106.5, Sum of lost time (s): 11.0
 Intersection Capacity Utilization: 69.0%, ICU Level of Service: C
 Analysis Period (min): 15

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
15: Dickenson Road West & Collector Road A

Total 2041 AM Peak Hour

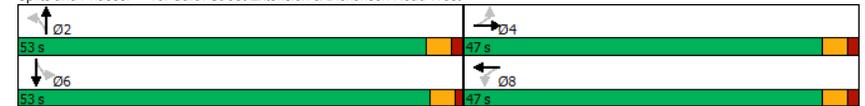
Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations	↔	↕↕	↕↕		↔	↕↕	
Traffic Volume (veh/h)	3	452	511	63	91	18	
Future Volume (Veh/h)	3	452	511	63	91	18	
Sign Control		Free	Free		Stop		
Grade		0%	0%		0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	3	491	555	68	99	20	
Pedestrians							
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	623				840	312	
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	623				840	312	
tC, single (s)	4.1				6.8	6.9	
tC, 2 stage (s)							
tF (s)	2.2				3.5	3.3	
p0 queue free %	100				67	97	
cM capacity (veh/h)	954				303	684	
Direction_Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	3	246	246	370	253	99	20
Volume Left	3	0	0	0	0	99	0
Volume Right	0	0	0	0	68	0	20
cSH	954	1700	1700	1700	1700	303	684
Volume to Capacity	0.00	0.14	0.14	0.22	0.15	0.33	0.03
Queue Length 95th (m)	0.1	0.0	0.0	0.0	0.0	10.5	0.7
Control Delay (s)	8.8	0.0	0.0	0.0	0.0	22.6	10.4
Lane LOS	A					C	B
Approach Delay (s)	0.1			0.0		20.5	
Approach LOS						C	
Intersection Summary							
Average Delay	2.0						
Intersection Capacity Utilization	27.8%		ICU Level of Service		A		
Analysis Period (min)	15						

Timings
16: Garth Street Extension & Dickenson Road West

Total 2041 AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↕↕	↔	↕↕	↔	↕↕	↔	↕↕
Traffic Volume (vph)	23	237	250	471	100	50	322	240
Future Volume (vph)	23	237	250	471	100	50	322	240
Lane Group Flow (vph)	25	530	272	641	109	489	350	291
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	47.0	47.0	47.0	47.0	53.0	53.0	53.0	53.0
Total Split (%)	47.0%	47.0%	47.0%	47.0%	53.0%	53.0%	53.0%	53.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.10	0.34	0.87	0.43	0.22	0.29	0.89	0.17
Control Delay	18.4	9.1	54.1	18.6	16.1	2.8	48.3	13.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.4	9.1	54.1	18.6	16.1	2.8	48.3	13.0
Queue Length 50th (m)	2.8	16.0	46.5	42.0	11.7	2.7	57.7	14.8
Queue Length 95th (m)	8.2	27.2	#94.7	56.4	22.3	10.8	#113.3	22.2
Internal Link Dist (m)		899.2		404.1		105.4		811.8
Turn Bay Length (m)	50.0		50.0		50.0		50.0	
Base Capacity (vph)	321	1841	386	1816	635	2011	494	2111
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.08	0.29	0.70	0.35	0.17	0.24	0.71	0.14
Intersection Summary								
Cycle Length: 100								
Actuated Cycle Length: 87.2								
Natural Cycle: 50								
Control Type: Actuated-Uncoordinated								
# 95th percentile volume exceeds capacity, queue may be longer.								
Queue shown is maximum after two cycles.								

Splits and Phases: 16: Garth Street Extension & Dickenson Road West



HCM Signalized Intersection Capacity Analysis
16: Garth Street Extension & Dickenson Road West

Total 2041 AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	23	237	250	250	471	119	100	50	400	322	240	28
Future Volume (vph)	23	237	250	250	471	119	100	50	400	322	240	28
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		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.92		1.00	0.97		1.00	0.87		1.00	0.98	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3303		1789	3471		1789	3101		1789	3523	
Fit Permitted	0.33	1.00		0.40	1.00		0.57	1.00		0.44	1.00	
Satd. Flow (perm)	620	3303		747	3471		1076	3101		826	3523	
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)	25	258	272	272	512	129	109	54	435	350	261	30
RTOR Reduction (vph)	0	157	0	0	23	0	0	228	0	0	9	0
Lane Group Flow (vph)	25	373	0	272	618	0	109	261	0	350	282	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)	36.5	36.5		36.5	36.5		41.2	41.2		41.7	41.7	
Effective Green, g (s)	36.5	36.5		36.5	36.5		41.2	41.2		41.7	41.7	
Actuated g/C Ratio	0.42	0.42		0.42	0.42		0.48	0.48		0.48	0.48	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	261	1390		314	1461		511	1473		397	1694	
v/s Ratio Prot		0.11			0.18			0.08			0.08	
v/s Ratio Perm	0.04			c0.36			0.10			c0.42		
v/c Ratio	0.10	0.27		0.87	0.42		0.21	0.18		0.88	0.17	
Uniform Delay, d1	15.1	16.4		22.9	17.7		13.3	13.0		20.3	12.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.1		21.3	0.2		0.2	0.1		19.9	0.0	
Delay (s)	15.3	16.5		44.2	17.9		13.5	13.1		40.1	12.7	
Level of Service	B	B		D	B		B	B		D	B	
Approach Delay (s)		16.4			25.7			13.2			27.7	
Approach LOS		B			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	21.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	86.7	Sum of lost time (s)	9.0
Intersection Capacity Utilization	75.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

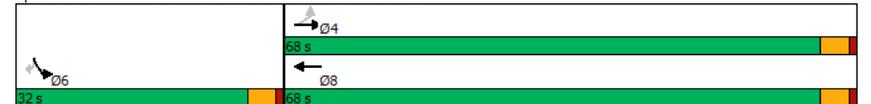
Timings
17: Dickenson Road West & Collector Road B

Total 2041 AM Peak Hour

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Configurations	↔	↕	↕	↔	↔
Traffic Volume (vph)	31	977	901	109	9
Future Volume (vph)	31	977	901	109	9
Lane Group Flow (vph)	34	1062	1101	118	10
Turn Type	Perm	NA	NA	Prot	Perm
Protected Phases		4	8	6	
Permitted Phases	4				6
Detector Phase	4	4	8	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5
Total Split (s)	68.0	68.0	68.0	32.0	32.0
Total Split (%)	68.0%	68.0%	68.0%	32.0%	32.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	None	Max	Max
v/c Ratio	0.28	0.73	0.76	0.15	0.01
Control Delay	18.7	18.7	19.2	12.3	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	18.7	18.7	19.2	12.3	7.0
Queue Length 50th (m)	2.5	51.2	52.8	7.4	0.0
Queue Length 95th (m)	8.7	69.6	72.1	19.0	2.5
Internal Link Dist (m)		404.1	868.4	692.1	
Turn Bay Length (m)	15.0			15.0	
Base Capacity (vph)	293	3507	3448	801	722
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.12	0.30	0.32	0.15	0.01

Intersection Summary	
Cycle Length:	100
Actuated Cycle Length:	61.8
Natural Cycle:	45
Control Type:	Semi Act-Uncoord

Splits and Phases: 17: Dickenson Road West & Collector Road B



HCM Signalized Intersection Capacity Analysis
17: Dickenson Road West & Collector Road B

Total 2041 AM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕	↕		↕	↕
Traffic Volume (vph)	31	977	901	112	109	9
Future Volume (vph)	31	977	901	112	109	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Fit	1.00	1.00	0.98		1.00	0.85
Fit Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	3579	3519		1789	1601
Fit Permitted	0.16	1.00	1.00		0.95	1.00
Satd. Flow (perm)	300	3579	3519		1789	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	34	1062	979	122	118	10
RTOR Reduction (vph)	0	0	15	0	0	6
Lane Group Flow (vph)	34	1062	1086	0	118	4
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		4	8		6	
Permitted Phases		4				6
Actuated Green, G (s)	25.1	25.1	25.1		27.7	27.7
Effective Green, g (s)	25.1	25.1	25.1		27.7	27.7
Actuated g/C Ratio	0.41	0.41	0.41		0.45	0.45
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	121	1453	1429		801	717
v/s Ratio Prot		0.30	c0.31		c0.07	
w/s Ratio Perm	0.11					0.00
v/c Ratio	0.28	0.73	0.76		0.15	0.01
Uniform Delay, d1	12.3	15.5	15.8		10.1	9.4
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.3	1.9	2.4		0.4	0.0
Delay (s)	13.6	17.4	18.1		10.5	9.5
Level of Service	B	B	B		B	A
Approach Delay (s)		17.3	18.1		10.4	
Approach LOS		B	B		B	
Intersection Summary						
HCM 2000 Control Delay			17.3		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.44			
Actuated Cycle Length (s)			61.8		Sum of lost time (s)	9.0
Intersection Capacity Utilization			42.0%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
18: Collector Road A & Collector Road C

Total 2041 AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↕	↔	↕	↕	↔	↕	↕	↔	↕	↕
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	23	191	21	29	167	68	45	55	101	202	85	60
Future Volume (vph)	23	191	21	29	167	68	45	55	101	202	85	60
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)	25	208	23	32	182	74	49	60	110	220	92	65
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2				
Volume Total (vph)	25	231	32	256	49	170	220	157				
Volume Left (vph)	25	0	32	0	49	0	220	0				
Volume Right (vph)	0	23	0	74	0	110	0	65				
Hadj (s)	0.53	-0.04	0.53	-0.17	0.53	-0.42	0.53	-0.26				
Departure Headway (s)	7.2	6.6	7.2	6.5	7.3	6.3	7.0	6.2				
Degree Utilization, x	0.05	0.43	0.06	0.46	0.10	0.30	0.43	0.27				
Capacity (veh/h)	467	513	471	529	461	529	488	545				
Control Delay (s)	9.4	13.3	9.5	13.7	9.9	10.8	14.0	10.4				
Approach Delay (s)	12.9		13.2		10.6		12.5					
Approach LOS	B		B		B		B					
Intersection Summary												
Delay					12.4							
Level of Service					B							
Intersection Capacity Utilization			49.9%		ICU Level of Service					A		
Analysis Period (min)			15									

Timings
19: Garth Street Extension & Collector Road C

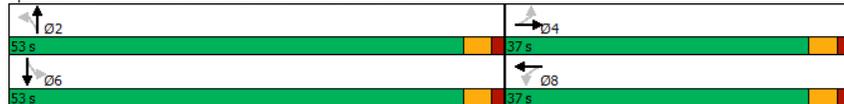
Total 2041 AM Peak Hour

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	101	286	49	126	38	191	270	512
Future Volume (vph)	101	286	49	126	38	191	270	512
Lane Group Flow (vph)	110	424	53	255	41	349	293	687
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	37.0	37.0	37.0	37.0	53.0	53.0	53.0	53.0
Total Split (%)	41.1%	41.1%	41.1%	41.1%	58.9%	58.9%	58.9%	58.9%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.44	0.80	0.46	0.48	0.10	0.17	0.47	0.32
Control Delay	29.1	37.4	37.7	21.2	9.4	5.1	13.7	8.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.1	37.4	37.7	21.2	9.4	5.1	13.7	8.6
Queue Length 50th (m)	13.7	56.6	6.6	24.8	2.4	6.3	22.4	22.4
Queue Length 95th (m)	27.6	87.3	17.7	44.3	8.5	15.3	54.4	42.3
Internal Link Dist (m)		644.3		697.4		811.8		650.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	357	746	163	742	412	2087	617	2122
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.57	0.33	0.34	0.10	0.17	0.47	0.32

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 80.7
Natural Cycle: 50
Control Type: Semi Act-Uncoord

Splits and Phases: 19: Garth Street Extension & Collector Road C



HCM Signalized Intersection Capacity Analysis
19: Garth Street Extension & Collector Road C

Total 2041 AM Peak Hour

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	101	286	104	49	126	109	38	191	130	270	512	120
Future Volume (vph)	101	286	104	49	126	109	38	191	130	270	512	120
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	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.96		1.00	0.93		1.00	0.94		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1808		1789	1753		1789	3362		1789	3477	
Flt Permitted	0.47	1.00		0.21	1.00		0.36	1.00		0.54	1.00	
Satd. Flow (perm)	882	1808		404	1753		683	3362		1022	3477	
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)	110	311	113	53	137	118	41	208	141	293	557	130
RTOR Reduction (vph)	0	16	0	0	39	0	0	56	0	0	19	0
Lane Group Flow (vph)	110	408	0	53	216	0	41	293	0	293	668	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Actuated Green, G (s)	22.8	22.8		22.8	22.8		48.8	48.8		48.8	48.8	
Effective Green, g (s)	22.8	22.8		22.8	22.8		48.8	48.8		48.8	48.8	
Actuated g/C Ratio	0.28	0.28		0.28	0.28		0.61	0.61		0.61	0.61	
Clearance Time (s)	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	
Lane Grp Cap (vph)	249	511		114	495		413	2035		618	2105	
v/s Ratio Prot		c0.23			0.12			0.09			0.19	
v/s Ratio Perm	0.12			0.13			0.06			c0.29		
v/c Ratio	0.44	0.80		0.46	0.44		0.10	0.14		0.47	0.32	
Uniform Delay, d1	23.7	26.8		23.9	23.6		6.7	6.9		8.8	7.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.3	8.5		3.0	0.6		0.5	0.1		2.6	0.4	
Delay (s)	24.9	35.2		26.8	24.3		7.2	7.0		11.4	8.2	
Level of Service	C	D		C	C		A	A		B	A	
Approach Delay (s)		33.1			24.7			7.0			9.1	
Approach LOS		C			C			A			A	

Intersection Summary

HCM 2000 Control Delay: 16.7, HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.58
 Actuated Cycle Length (s): 80.6, Sum of lost time (s): 9.0
 Intersection Capacity Utilization: 71.0%, ICU Level of Service: C
 Analysis Period (min): 15

c Critical Lane Group

Timings Total 2041 AM Peak Hour

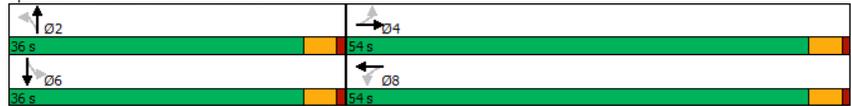
20: Collector Road B & Collector Road C

	↖	→	↘	←	↙	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↘	↖	↘	↖	↘	↖	↘
Traffic Volume (vph)	72	563	35	167	10	52	161	209
Future Volume (vph)	72	563	35	167	10	52	161	209
Lane Group Flow (vph)	78	667	38	270	11	79	175	343
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	54.0	54.0	54.0	54.0	36.0	36.0	36.0	36.0
Total Split (%)	60.0%	60.0%	60.0%	60.0%	40.0%	40.0%	40.0%	40.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.18	0.84	0.33	0.34	0.03	0.10	0.29	0.42
Control Delay	12.9	28.2	21.3	12.0	15.6	11.8	17.0	16.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.9	28.2	21.3	12.0	15.6	11.8	17.0	16.2
Queue Length 50th (m)	6.2	74.7	3.2	19.0	0.8	4.1	14.1	26.6
Queue Length 95th (m)	13.3	112.2	10.4	33.0	4.4	14.9	36.8	63.2
Internal Link Dist (m)		697.4		946.4		692.1		640.3
Turn Bay Length (m)	15.0				50.0		50.0	
Base Capacity (vph)	715	1311	192	1272	398	819	595	817
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.51	0.20	0.21	0.03	0.10	0.29	0.42

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 71.5
 Natural Cycle: 60
 Control Type: Semi Act-Uncoord

Splits and Phases: 20: Collector Road B & Collector Road C



HCM Signalized Intersection Capacity Analysis

Total 2041 AM Peak Hour

20: Collector Road B & Collector Road C

	↖	→	↘	←	↙	↑	↘	↓	↙	↘		
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↘		↖	↘		↖	↘		↖	↘	
Traffic Volume (vph)	72	563	51	35	167	81	10	52	20	161	209	107
Future Volume (vph)	72	563	51	35	167	81	10	52	20	161	209	107
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	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.95		1.00	0.96		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1860		1789	1791		1789	1805		1789	1788	
Flt Permitted	0.54	1.00		0.14	1.00		0.47	1.00		0.71	1.00	
Satd. Flow (perm)	1016	1860		273	1791		890	1805		1329	1788	
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)	78	612	55	38	182	88	11	57	22	175	227	116
RTOR Reduction (vph)	0	5	0	0	25	0	0	12	0	0	17	0
Lane Group Flow (vph)	78	662	0	38	245	0	11	67	0	175	326	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)	30.3	30.3		30.3	30.3		32.0	32.0		32.0	32.0	
Effective Green, g (s)	30.3	30.3		30.3	30.3		32.0	32.0		32.0	32.0	
Actuated g/C Ratio	0.42	0.42		0.42	0.42		0.45	0.45		0.45	0.45	
Clearance Time (s)	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	
Lane Grp Cap (vph)	431	790		116	761		399	810		596	802	
v/s Ratio Prot		c0.36			0.14		0.14	0.04			c0.18	
v/s Ratio Perm	0.08			0.14			0.01			0.13		
v/c Ratio	0.18	0.84		0.33	0.32		0.03	0.08		0.29	0.41	
Uniform Delay, d1	12.8	18.3		13.7	13.7		11.0	11.2		12.5	13.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	7.8		1.7	0.2		0.1	0.2		1.3	1.5	
Delay (s)	13.0	26.1		15.3	13.9		11.1	11.4		13.7	14.8	
Level of Service	B	C		B	B		B	B		B	B	
Approach Delay (s)		24.7			14.1			11.4			14.4	
Approach LOS		C			B			B			B	

Intersection Summary

HCM 2000 Control Delay: 18.8
 HCM 2000 Volume to Capacity ratio: 0.62
 Actuated Cycle Length (s): 71.3
 Intersection Capacity Utilization: 65.7%
 Analysis Period (min): 15
 HCM 2000 Level of Service: B
 Sum of lost time (s): 9.0
 ICU Level of Service: C

c Critical Lane Group

Timings Total 2041 PM Peak Hour
 1: Glancaster Road & Twenty Extension/Twenty Road West

	↖	→	↘	←	↙	↑	↗	↘	↓	
Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↗	↖	↗	↖	↗	↖
Traffic Volume (vph)	90	182	204	94	167	61	342	306	287	210
Future Volume (vph)	90	182	204	94	167	61	342	306	287	210
Lane Group Flow (vph)	93	291	210	97	172	63	353	315	296	257
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA
Protected Phases		4		8			2			6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	4	4	8	8	8	2	2	2	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	43.0	43.0	43.0	43.0	43.0	57.0	57.0	57.0	57.0	57.0
Total Split (%)	43.0%	43.0%	43.0%	43.0%	43.0%	57.0%	57.0%	57.0%	57.0%	57.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	Min	Min	Min	Min	Min
v/c Ratio	0.19	0.43	0.63	0.14	0.25	0.12	0.41	0.35	0.71	0.31
Control Delay	17.3	17.0	28.4	16.3	4.4	10.9	12.7	2.7	24.5	11.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.3	17.0	28.4	16.3	4.4	10.9	12.7	2.7	24.5	11.2
Queue Length 50th (m)	6.1	18.3	16.5	6.2	0.0	3.2	20.8	0.0	21.0	13.4
Queue Length 95th (m)	22.7	57.2	56.6	22.6	12.4	12.5	57.3	12.0	68.4	39.8
Internal Link Dist (m)		118.9		282.7			557.6			262.6
Turn Bay Length (m)	50.0		50.0			50.0		50.0		50.0
Base Capacity (vph)	952	1308	664	1372	1215	953	1573	1395	764	1496
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.22	0.32	0.07	0.14	0.07	0.22	0.23	0.39	0.17

Intersection Summary
 Cycle Length: 100
 Actuated Cycle Length: 59.5
 Natural Cycle: 50
 Control Type: Actuated-Uncoordinated



HCM Signalized Intersection Capacity Analysis Total 2041 PM Peak Hour
 1: Glancaster Road & Twenty Extension/Twenty Road West

	↖	→	↘	←	↙	↑	↗	↘	↓	↖		
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	90	182	100	204	94	167	61	342	306	287	210	40
Future Volume (vph)	90	182	100	204	94	167	61	342	306	287	210	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	
Frlp, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
Fit Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1825	1819		1722	1921	1633	1825	1865	1596	1754	1771	
Fit Permitted	0.69	1.00		0.51	1.00	1.00	0.59	1.00	1.00	0.49	1.00	
Satd. Flow (perm)	1334	1819		930	1921	1633	1129	1865	1596	907	1771	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	93	188	103	210	97	172	63	353	315	296	216	41
RTOR Reduction (vph)	0	20	0	0	0	108	0	0	166	0	7	0
Lane Group Flow (vph)	93	271	0	210	97	64	63	353	149	296	250	0
Confl. Peds. (#/hr)								1		1		
Heavy Vehicles (%)	0%	0%	0%	6%	0%	0%	0%	3%	1%	4%	7%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2		6		
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	21.4	21.4		21.4	21.4	21.4	27.4	27.4	27.4	27.4	27.4	
Effective Green, g (s)	21.4	21.4		21.4	21.4	21.4	27.4	27.4	27.4	27.4	27.4	
Actuated g/C Ratio	0.37	0.37		0.37	0.37	0.37	0.47	0.47	0.47	0.47	0.47	
Clearance Time (s)	4.5	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	3.0	
Lane Grp Cap (vph)	493	673		344	711	604	535	884	756	429	839	
v/s Ratio Prot		0.15			0.05			0.19			0.14	
v/s Ratio Perm	0.07			c0.23		0.04	0.06		0.09	c0.33		
v/c Ratio	0.19	0.40		0.61	0.14	0.11	0.12	0.40	0.20	0.69	0.30	
Uniform Delay, d1	12.3	13.5		14.8	12.1	11.9	8.5	9.9	8.8	11.9	9.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	0.4		3.2	0.1	0.1	0.1	0.3	0.1	4.6	0.2	
Delay (s)	12.5	13.9		18.0	12.2	12.0	8.6	10.2	8.9	16.5	9.5	
Level of Service	B	B		B	B	B	A	B	A	B	A	
Approach Delay (s)		13.5			14.7			9.5			13.2	
Approach LOS		B			B			A			B	

Intersection Summary
 HCM 2000 Control Delay: 12.3 HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.65
 Actuated Cycle Length (s): 57.8 Sum of lost time (s): 9.0
 Intersection Capacity Utilization: 75.9% ICU Level of Service: D
 Analysis Period (min): 15

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
2: Twenty Road West & Silverbirch Blvd

Total 2041 PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕↕	↕↕		↕↕	
Traffic Volume (veh/h)	23	782	655	50	38	15
Future Volume (Veh/h)	23	782	655	50	38	15
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	24	815	682	52	40	16
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLTL	TWLTL			
Median storage (veh)		2	2			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	734				1164	367
vC1, stage 1 conf vol					708	
vC2, stage 2 conf vol					456	
vCu, unblocked vol	734				1164	367
tC, single (s)	4.1				6.9	6.9
tC, 2 stage (s)					5.9	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				89	97
cM capacity (veh/h)	880				378	636
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	24	408	408	455	279	56
Volume Left	24	0	0	0	0	40
Volume Right	0	0	0	0	52	16
cSH	880	1700	1700	1700	1700	428
Volume to Capacity	0.03	0.24	0.24	0.27	0.16	0.13
Queue Length 95th (m)	0.6	0.0	0.0	0.0	0.0	3.4
Control Delay (s)	9.2	0.0	0.0	0.0	0.0	14.7
Lane LOS	A					B
Approach Delay (s)	0.3			0.0		14.7
Approach LOS						B
Intersection Summary						
Average Delay		0.6				
Intersection Capacity Utilization		31.6%		ICU Level of Service	A	
Analysis Period (min)		15				

Timings
3: Garth Street Extension/Garth Street & Twenty Road West

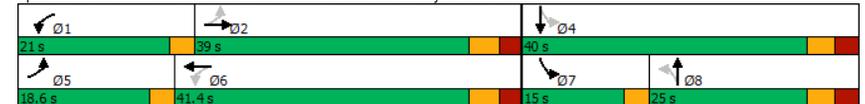
Total 2041 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↕↕	↔	↕↕	↔	↕↕	↔	↕↕
Traffic Volume (vph)	242	520	348	496	81	309	198	326
Future Volume (vph)	242	520	348	496	81	309	198	326
Lane Group Flow (vph)	249	597	359	746	84	510	204	441
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	pm+pt	NA
Protected Phases	5	2	1	6		8	7	4
Permitted Phases	2		6		8		4	
Detector Phase	5	2	1	6	8	8	7	4
Switch Phase								
Minimum Initial (s)	5.0	10.0	5.0	10.0	5.0	5.0	5.0	10.0
Minimum Split (s)	9.5	36.4	9.5	36.4	24.5	24.5	9.5	26.3
Total Split (s)	18.6	39.0	21.0	41.4	25.0	25.0	15.0	40.0
Total Split (%)	18.6%	39.0%	21.0%	41.4%	25.0%	25.0%	15.0%	40.0%
Yellow Time (s)	3.0	3.7	3.0	3.7	3.3	3.3	3.0	3.3
All-Red Time (s)	0.0	2.7	0.0	2.7	3.0	3.0	0.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.4	3.0	6.4	6.3	6.3	3.0	6.3
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	Max	None	Max	None	None	None	
v/c Ratio	0.57	0.48	0.66	0.56	0.53	0.76	0.66	0.38
Control Delay	16.0	25.7	17.5	22.9	49.3	37.5	33.1	23.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.0	25.7	17.5	22.9	49.3	37.5	33.1	23.1
Queue Length 50th (m)	21.3	44.2	32.9	50.0	14.2	37.1	26.5	28.7
Queue Length 95th (m)	35.9	64.1	52.5	74.1	29.9	56.0	45.4	43.0
Internal Link Dist (m)		397.1		655.9		650.8		148.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	508	1253	587	1335	191	780	320	1288
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.48	0.61	0.56	0.44	0.65	0.64	0.34

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 93.5
Natural Cycle: 80
Control Type: Semi Act-Uncoord

Splits and Phases: 3: Garth Street Extension/Garth Street & Twenty Road West



HCM Signalized Intersection Capacity Analysis
3: Garth Street Extension/Garth Street & Twenty Road West

Total 2041 PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	242	520	59	348	496	228	81	309	185	198	326	102
Future Volume (vph)	242	520	59	348	496	228	81	309	185	198	326	102
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.4		3.0	6.4		6.3	6.3		3.0	6.3	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frb, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.95		1.00	0.94		1.00	0.96	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1788	3531		1825	3368		1825	3445		1772	3478	
Fit Permitted	0.29	1.00		0.32	1.00		0.50	1.00		0.22	1.00	
Satd. Flow (perm)	546	3531		610	3368		953	3445		401	3478	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	249	536	61	359	511	235	84	319	191	204	336	105
RTOR Reduction (vph)	0	8	0	0	51	0	0	92	0	0	31	0
Lane Group Flow (vph)	249	589	0	359	695	0	84	418	0	204	410	0
Confl. Peds. (#/hr)	6			6			6			6		
Heavy Vehicles (%)	2%	2%	0%	0%	3%	2%	0%	0%	0%	3%	0%	5%
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		pm+pt	NA	
Protected Phases	5	2		1	6		8			7	4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	45.0	33.0		50.4	35.7		15.6	15.6		30.1	30.1	
Effective Green, g (s)	45.0	33.0		50.4	35.7		15.6	15.6		30.1	30.1	
Actuated g/C Ratio	0.48	0.35		0.54	0.38		0.17	0.17		0.32	0.32	
Clearance Time (s)	3.0	6.4		3.0	6.4		6.3	6.3		3.0	6.3	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	422	1246		519	1285		159	574		297	1119	
v/s Ratio Prot	0.08	0.17		c0.11	0.21		0.12			c0.08	0.12	
v/s Ratio Perm	0.21			c0.26			0.09			c0.14		
v/c Ratio	0.59	0.47		0.69	0.54		0.53	0.73		0.69	0.37	
Uniform Delay, d1	15.0	23.5		13.2	22.5		35.6	36.9		25.0	24.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.2	1.3		4.0	1.6		3.1	4.6		6.5	0.2	
Delay (s)	17.2	24.8		17.1	24.2		38.7	41.6		31.5	24.6	
Level of Service	B	C		B	C		D	D		C	C	
Approach Delay (s)		22.6			21.9			41.2			26.8	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	26.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	93.5	Sum of lost time (s)	18.7
Intersection Capacity Utilization	81.1%	ICU Level of Service	D
Analysis Period (min)	15		

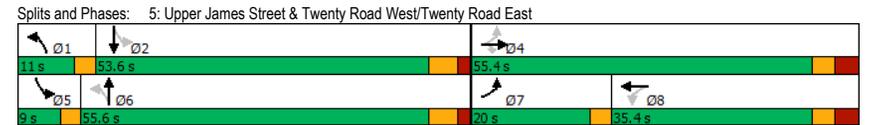
c Critical Lane Group

Timings
5: Upper James Street & Twenty Road West/Twenty Road East

Total 2041 PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↕	↔	↔	↕	↔	↕	↔	↕
Traffic Volume (vph)	251	585	177	102	646	134	1302	100	1295
Future Volume (vph)	251	585	177	102	646	134	1302	100	1295
Lane Group Flow (vph)	254	591	179	103	729	135	1598	101	1724
Turn Type	pm+pt	NA	Perm	Perm	NA	pm+pt	NA	pm+pt	NA
Protected Phases	7	4			8	1	6	5	2
Permitted Phases	4		4	8		6		2	
Detector Phase	7	4	4	8	8	1	6	5	2
Switch Phase									
Minimum Initial (s)	5.0	10.0	10.0	10.0	10.0	5.0	45.0	5.0	45.0
Minimum Split (s)	9.5	34.8	34.8	34.8	34.8	8.0	51.1	8.0	51.1
Total Split (s)	20.0	55.4	55.4	35.4	35.4	11.0	55.6	9.0	53.6
Total Split (%)	16.7%	46.2%	46.2%	29.5%	29.5%	9.2%	46.3%	7.5%	44.7%
Yellow Time (s)	3.0	3.3	3.3	3.3	3.3	3.0	4.2	3.0	4.2
All-Red Time (s)	0.0	3.5	3.5	3.5	3.5	0.0	1.9	0.0	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.8	6.8	6.8	6.8	3.0	6.1	3.0	6.1
Lead/Lag	Lead			Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes			Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.80	0.42	0.25	0.56	0.87	0.75	0.77	0.64	0.82
Control Delay	46.2	26.9	8.0	53.3	55.8	45.7	31.7	36.2	34.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.2	26.9	8.0	53.3	55.8	45.7	31.7	36.2	34.1
Queue Length 50th (m)	39.2	51.5	6.6	21.3	85.6	16.1	114.3	11.8	128.1
Queue Length 95th (m)	#78.0	66.6	20.8	40.4	#111.0	#43.4	133.0	#30.2	148.3
Internal Link Dist (m)		924.0			263.2		419.6		203.7
Turn Bay Length (m)	50.0		50.0	33.0		127.0		65.0	
Base Capacity (vph)	324	1459	729	193	875	189	2088	158	2099
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.41	0.25	0.53	0.83	0.71	0.77	0.64	0.82

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	118.1
Natural Cycle:	105
Control Type:	Actuated-Uncoordinated
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	



HCM Signalized Intersection Capacity Analysis

Total 2041 PM Peak Hour

5: Upper James Street & Twenty Road West/Twenty Road East

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔		↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	251	585	177	102	646	75	134	1302	280	100	1295	412
Future Volume (vph)	251	585	177	102	646	75	134	1302	280	100	1295	412
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.8	6.8	6.8	6.8		3.0	6.1		3.0	6.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.97		1.00	0.96	
Fit Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1772	3544	1580	1771	3584		1789	4914		1789	5031	
Fit Permitted	0.13	1.00	1.00	0.43	1.00		0.08	1.00		0.08	1.00	
Satd. Flow (perm)	246	3544	1580	799	3584		152	4914		156	5031	
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	254	591	179	103	653	76	135	1315	283	101	1308	416
RTOR Reduction (vph)	0	0	80	0	8	0	0	28	0	0	47	0
Lane Group Flow (vph)	254	591	99	103	721	0	135	1570	0	101	1677	0
Confl. Peds. (#/hr)	1		1	1		1			1	1		
Heavy Vehicles (%)	3%	3%	2%	3%	0%	1%	2%	4%	2%	2%	0%	2%
Turn Type	pm+pt	NA	Perm	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4			8		1	6		5	2	
Permitted Phases	4		4	8			6			2		
Actuated Green, G (s)	46.7	46.7	46.7	27.3	27.3		57.0	49.6		54.2	48.2	
Effective Green, g (s)	46.7	46.7	46.7	27.3	27.3		57.0	49.6		54.2	48.2	
Actuated g/C Ratio	0.40	0.40	0.40	0.23	0.23		0.48	0.42		0.46	0.41	
Clearance Time (s)	3.0	6.8	6.8	6.8	6.8		3.0	6.1		3.0	6.1	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		1.0	6.5		1.0	6.5	
Lane Grp Cap (vph)	308	1400	624	184	827		175	2062		154	2051	
v/s Ratio Prot	c0.11	0.17			0.20		c0.05	0.32		0.03	c0.33	
v/s Ratio Perm	c0.21		0.06	0.13			0.32			0.27		
v/c Ratio	0.82	0.42	0.16	0.56	0.87		0.77	0.76		0.66	0.82	
Uniform Delay, d1	28.6	26.0	23.1	40.1	43.8		23.7	29.3		22.3	31.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	16.2	0.2	0.1	3.7	10.0		17.2	2.7		19.8	3.8	
Delay (s)	44.8	26.2	23.2	43.8	53.8		41.0	32.0		42.1	34.9	
Level of Service	D	C	C	D	D		D	C		D	C	
Approach Delay (s)		30.3			52.6			32.7			35.3	
Approach LOS		C			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	36.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	118.2	Sum of lost time (s)	18.9
Intersection Capacity Utilization	96.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Timings

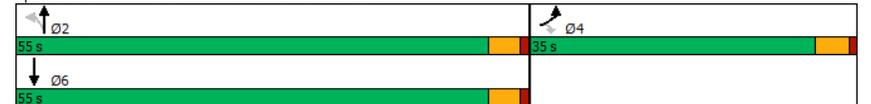
Total 2041 PM Peak Hour

6: Glanccaster Road & Book Road East

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Configurations	↔	↔	↔	↔	↔
Traffic Volume (vph)	294	159	79	362	369
Future Volume (vph)	294	159	79	362	369
Lane Group Flow (vph)	306	166	82	377	570
Turn Type	Prot	Perm	Perm	NA	NA
Protected Phases	4			2	6
Permitted Phases		4	2		
Detector Phase	4	4	2	2	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5
Total Split (s)	35.0	35.0	55.0	55.0	55.0
Total Split (%)	38.9%	38.9%	61.1%	61.1%	61.1%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	Max	Max	Max
v/c Ratio	0.73	0.33	0.18	0.30	0.48
Control Delay	38.1	5.9	8.1	7.6	8.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	38.1	5.9	8.1	7.6	8.9
Queue Length 50th (m)	41.7	0.0	4.2	21.0	33.6
Queue Length 95th (m)	66.7	13.0	13.0	44.7	72.4
Internal Link Dist (m)	171.0			456.5	274.4
Turn Bay Length (m)	100.0		50.0		
Base Capacity (vph)	701	735	444	1247	1188
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.44	0.23	0.18	0.30	0.48

Intersection Summary				
Cycle Length:	90			
Actuated Cycle Length:	78.1			
Natural Cycle:	50			
Control Type:	Semi Act-Uncoord			

Splits and Phases: 6: Glanccaster Road & Book Road East



HCM Signalized Intersection Capacity Analysis
6: Glancaster Road & Book Road East

Total 2041 PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Volume (vph)	294	159	79	362	369	179
Future Volume (vph)	294	159	79	362	369	179
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.96	
Fit Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1617	1722	1921	1806	
Fit Permitted	0.95	1.00	0.38	1.00	1.00	
Satd. Flow (perm)	1789	1617	685	1921	1806	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	306	166	82	377	384	186
RTOR Reduction (vph)	0	127	0	0	15	0
Lane Group Flow (vph)	306	39	82	377	555	0
Heavy Vehicles (%)	2%	1%	6%	0%	2%	1%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	18.3	18.3	50.7	50.7	50.7	
Effective Green, g (s)	18.3	18.3	50.7	50.7	50.7	
Actuated g/C Ratio	0.23	0.23	0.65	0.65	0.65	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	419	379	445	1248	1173	
v/s Ratio Prot	c0.17			0.20	c0.31	
v/s Ratio Perm		0.02	0.12			
v/c Ratio	0.73	0.10	0.18	0.30	0.47	
Uniform Delay, d1	27.6	23.4	5.4	5.9	6.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	6.4	0.1	0.9	0.6	1.4	
Delay (s)	34.0	23.5	6.3	6.6	8.3	
Level of Service	C	C	A	A	A	
Approach Delay (s)	30.3			6.5	8.3	
Approach LOS	C			A	A	

Intersection Summary			
HCM 2000 Control Delay	14.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	78.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	62.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

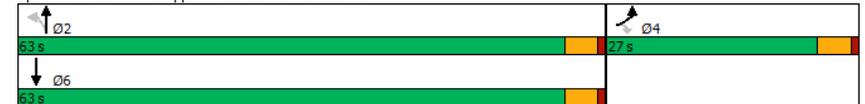
Timings
7: Upper James Street & Talbot Lane

Total 2041 PM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Volume (vph)	79	51	13	1613	1598
Future Volume (vph)	79	51	13	1613	1598
Lane Group Flow (vph)	85	55	14	1734	1742
Turn Type	Prot	Perm	Perm	NA	NA
Protected Phases	4			2	6
Permitted Phases		4	2		
Detector Phase	4	4	2	2	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5
Total Split (s)	27.0	27.0	63.0	63.0	63.0
Total Split (%)	30.0%	30.0%	70.0%	70.0%	70.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	Max	Max	Max
v/c Ratio	0.42	0.26	0.08	0.42	0.42
Control Delay	39.2	20.5	3.8	3.3	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	39.2	20.5	3.8	3.3	3.3
Queue Length 50th (m)	12.7	3.5	0.4	25.0	24.9
Queue Length 95th (m)	24.0	12.7	2.1	38.2	38.2
Internal Link Dist (m)	158.6			280.1	602.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	503	472	182	4115	4149
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.17	0.12	0.08	0.42	0.42

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 81.8	
Natural Cycle: 50	
Control Type: Semi Act-Uncoord	

Splits and Phases: 7: Upper James Street & Talbot Lane



HCM Signalized Intersection Capacity Analysis
7: Upper James Street & Talbot Lane

Total 2041 PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↑↑↑	↑↑↑	↔
Traffic Volume (vph)	79	51	13	1613	1598	22
Future Volume (vph)	79	51	13	1613	1598	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	
Frt	1.00	0.85	1.00	1.00	1.00	
Fit Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	1633	1825	5043	5083	
Fit Permitted	0.95	1.00	0.12	1.00	1.00	
Satd. Flow (perm)	1825	1633	223	5043	5083	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	85	55	14	1734	1718	24
RTOR Reduction (vph)	0	28	0	0	1	0
Lane Group Flow (vph)	85	27	14	1734	1741	0
Heavy Vehicles (%)	0%	0%	0%	4%	3%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	7.9	7.9	65.8	65.8	65.8	
Effective Green, g (s)	7.9	7.9	65.8	65.8	65.8	
Actuated g/C Ratio	0.10	0.10	0.80	0.80	0.80	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	174	155	177	4012	4044	
v/s Ratio Prot	c0.05		c0.34	0.34		
v/s Ratio Perm		0.02	0.06			
v/c Ratio	0.49	0.17	0.08	0.43	0.43	
Uniform Delay, d1	35.5	34.4	1.8	2.6	2.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.2	0.5	0.9	0.3	0.3	
Delay (s)	37.6	34.9	2.7	3.0	3.0	
Level of Service	D	C	A	A	A	
Approach Delay (s)	36.6			3.0	3.0	
Approach LOS	D			A	A	
Intersection Summary						
HCM 2000 Control Delay			4.3	HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio			0.44			
Actuated Cycle Length (s)			82.7	Sum of lost time (s)		9.0
Intersection Capacity Utilization			43.2%	ICU Level of Service		A
Analysis Period (min)			15			
c Critical Lane Group						

Timings
8: Glanccaster Road & Dickenson Road West

Total 2041 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	51	197	118	140	70	234	119	257	216
Future Volume (vph)	51	197	118	140	70	234	119	257	216
Lane Group Flow (vph)	64	371	148	366	88	293	149	321	339
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA
Protected Phases		4		8		2		2	6
Permitted Phases	4		8		2		2	6	
Detector Phase	4	4	8	8	2	2	2	6	6
Switch Phase									
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	38.0	38.0	38.0	38.0	62.0	62.0	62.0	62.0	62.0
Total Split (%)	38.0%	38.0%	38.0%	38.0%	62.0%	62.0%	62.0%	62.0%	62.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Min	Min	Min	Min	Min
v/c Ratio	0.20	0.32	0.46	0.31	0.19	0.33	0.18	0.63	0.38
Control Delay	16.7	11.3	21.3	7.9	8.7	9.0	2.3	16.2	9.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.7	11.3	21.3	7.9	8.7	9.0	2.3	16.2	9.0
Queue Length 50th (m)	3.4	7.7	8.6	4.8	3.3	11.6	0.0	15.4	12.8
Queue Length 95th (m)	13.6	21.4	28.5	15.2	11.5	30.6	5.2	42.6	33.7
Internal Link Dist (m)		150.3		619.9		112.9			456.5
Turn Bay Length (m)	50.0		50.0		50.0		50.0		
Base Capacity (vph)	779	2635	774	2589	958	1815	1551	1023	1760
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.08	0.14	0.19	0.14	0.09	0.16	0.10	0.31	0.19
Intersection Summary									
Cycle Length: 100									
Actuated Cycle Length: 47.9									
Natural Cycle: 55									
Control Type: Actuated-Uncoordinated									
Splits and Phases: 8: Glanccaster Road & Dickenson Road West									

HCM Signalized Intersection Capacity Analysis
8: Glanaster Road & Dickenson Road West

Total 2041 PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	51	197	100	118	140	153	70	234	119	257	216	55
Future Volume (vph)	51	197	100	118	140	153	70	234	119	257	216	55
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	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frbp, ped/bikes	1.00	0.99		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.95		1.00	0.92		1.00	1.00	0.85	1.00	0.97	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1825	3441		1824	3347		1825	1921	1633	1789	1862	
Fit Permitted	0.53	1.00		0.53	1.00		0.53	1.00	1.00	0.57	1.00	
Satd. Flow (perm)	1025	3441		1019	3347		1015	1921	1633	1083	1862	
Peak-hour factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adj. Flow (vph)	64	246	125	148	175	191	88	292	149	321	270	69
RTOR Reduction (vph)	0	65	0	0	128	0	0	0	78	0	11	0
Lane Group Flow (vph)	64	306	0	148	238	0	88	293	71	321	328	0
Confl. Peds. (#/hr)			1	1								
Heavy Vehicles (%)	0%	0%	0%	0%	0%	1%	0%	0%	0%	2%	0%	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)	15.3	15.3		15.3	15.3		22.4	22.4	22.4	22.4	22.4	
Effective Green, g (s)	15.3	15.3		15.3	15.3		22.4	22.4	22.4	22.4	22.4	
Actuated g/C Ratio	0.33	0.33		0.33	0.33		0.48	0.48	0.48	0.48	0.48	
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)	335	1127		333	1096		486	921	783	519	893	
v/s Ratio Prot		0.09			0.07			0.15			0.18	
v/s Ratio Perm	0.06			c0.15			0.09		0.04	c0.30		
v/c Ratio	0.19	0.27		0.44	0.22		0.18	0.32	0.09	0.62	0.37	
Uniform Delay, d1	11.3	11.6		12.4	11.4		6.9	7.5	6.6	9.0	7.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	0.1		0.9	0.1		0.2	0.2	0.1	2.2	0.3	
Delay (s)	11.5	11.7		13.3	11.5		7.1	7.7	6.7	11.2	7.9	
Level of Service	B	B		B	B		A	A	A	B	A	
Approach Delay (s)		11.7			12.0			7.3			9.5	
Approach LOS		B			B			A			A	

Intersection Summary		
HCM 2000 Control Delay	10.0	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.55	B
Actuated Cycle Length (s)	46.7	Sum of lost time (s)
Intersection Capacity Utilization	58.8%	ICU Level of Service
Analysis Period (min)	15	B

c Critical Lane Group

Timings

9: Upper James Street & Dickenson Road West/Dickenson Road East

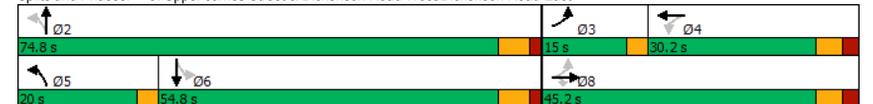
Total 2041 PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↕	↔	↔	↕	↔	↕	↔	↕
Traffic Volume (vph)	190	474	252	10	591	292	1498	47	1441
Future Volume (vph)	190	474	252	10	591	292	1498	47	1441
Lane Group Flow (vph)	202	504	268	11	660	311	1604	50	1598
Turn Type	pm+pt	NA	Perm	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases	3	8			4	5	2		6
Permitted Phases	8		8	4		2		6	
Detector Phase	3	8	8	4	4	5	2	6	6
Switch Phase									
Minimum Initial (s)	5.0	10.0	10.0	10.0	10.0	5.0	55.0	55.0	55.0
Minimum Split (s)	9.5	35.2	35.2	35.2	35.2	9.5	66.2	61.3	61.3
Total Split (s)	15.0	45.2	45.2	30.2	30.2	20.0	74.8	54.8	54.8
Total Split (%)	12.5%	37.7%	37.7%	25.2%	25.2%	16.7%	62.3%	45.7%	45.7%
Yellow Time (s)	3.0	3.7	3.7	3.7	3.7	3.0	4.6	4.6	4.6
All-Red Time (s)	0.0	2.5	2.5	2.5	2.5	0.0	1.7	1.7	1.7
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.2	6.2	6.2	6.2	3.0	6.3	6.3	6.3
Lead/Lag	Lead			Lag	Lag	Lead		Lag	Lag
Lead-Lag Optimize?	Yes			Yes	Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.91	0.43	0.40	0.07	0.92	0.95	0.55	0.44	0.78
Control Delay	73.8	33.2	8.5	40.6	65.9	71.6	16.9	41.5	34.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	73.8	33.2	8.5	40.6	65.9	71.6	16.9	41.5	34.2
Queue Length 50th (m)	35.1	48.6	7.5	2.1	80.2	55.9	82.3	8.4	118.2
Queue Length 95th (m)	#75.8	64.0	27.8	7.4	#112.8	#110.6	95.3	22.6	137.0
Internal Link Dist (m)		868.4			232.1		174.3		280.1
Turn Bay Length (m)	15.0		30.0	15.0		40.0		68.0	
Base Capacity (vph)	221	1190	672	154	731	328	2914	113	2043
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.91	0.42	0.40	0.07	0.90	0.95	0.55	0.44	0.78

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 119.6
Natural Cycle: 130
Control Type: Semi Act-Uncoord
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Split and Phases: 9: Upper James Street & Dickenson Road West/Dickenson Road East



HCM Signalized Intersection Capacity Analysis

Total 2041 PM Peak Hour

9: Upper James Street & Dickenson Road West/Dickenson Road East

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔↔	↔	↔	↔↔	↔	↔	↔↔	↔	↔	↔↔	↔
Traffic Volume (vph)	190	474	252	10	591	29	292	1498	9	47	1441	61
Future Volume (vph)	190	474	252	10	591	29	292	1498	9	47	1441	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.2	6.2	6.2	6.2		3.0	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.91		1.00	0.91	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00		1.00	0.99	
Fit Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1587	3650	1601	1560	3624		1825	5088		1825	5021	
Fit Permitted	0.15	1.00	1.00	0.47	1.00		0.08	1.00		0.15	1.00	
Satd. Flow (perm)	251	3650	1601	767	3624		149	5088		279	5021	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	202	504	268	11	629	31	311	1594	10	50	1533	65
RTOR Reduction (vph)	0	0	150	0	3	0	0	0	0	0	4	0
Lane Group Flow (vph)	202	504	118	11	657	0	311	1604	0	50	1594	0
Heavy Vehicles (%)	15%	0%	2%	17%	0%	0%	0%	3%	0%	0%	3%	23%
Turn Type	pm+pt	NA	Perm	Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	3	8			4		5	2			6	
Permitted Phases	8		8	4			2			6		
Actuated Green, G (s)	38.6	38.6	38.6	23.6	23.6		68.5	68.5		48.6	48.6	
Effective Green, g (s)	38.6	38.6	38.6	23.6	23.6		68.5	68.5		48.6	48.6	
Actuated g/C Ratio	0.32	0.32	0.32	0.20	0.20		0.57	0.57		0.41	0.41	
Clearance Time (s)	3.0	6.2	6.2	6.2	6.2		3.0	6.3		6.3	6.3	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	5.7		5.7	5.7	
Lane Grp Cap (vph)	215	1178	516	151	715		322	2914		113	2040	
v/s Ratio Prot	c0.09	0.14			0.18		c0.14	0.32			0.32	
v/s Ratio Perm	c0.21		0.07	0.01			c0.42			0.18		
v/c Ratio	0.94	0.43	0.23	0.07	0.92		0.97	0.55		0.44	0.78	
Uniform Delay, d1	33.5	31.8	29.6	39.1	47.1		36.6	15.9		25.7	30.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	44.1	0.3	0.2	0.2	16.7		40.6	0.8		12.1	3.1	
Delay (s)	77.6	32.1	29.8	39.3	63.8		77.2	16.7		37.8	33.9	
Level of Service	E	C	C	D	E		E	B		D	C	
Approach Delay (s)		40.9			63.4			26.5			34.1	
Approach LOS		D			E			C			C	
Intersection Summary												
HCM 2000 Control Delay		36.3										D
HCM 2000 Volume to Capacity ratio		1.00										
Actuated Cycle Length (s)		119.6			Sum of lost time (s)			18.5				
Intersection Capacity Utilization		138.5%			ICU Level of Service			H				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

Total 2041 PM Peak Hour

10: Local Street & Twenty Road West

Movement	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Configurations	↔↔		↔	↔↔	↔	↔	
Traffic Volume (veh/h)	722	27	43	485	1	37	
Future Volume (Veh/h)	722	27	43	485	1	37	
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)	785	29	47	527	1	40	
Pedestrians							
Lane Width (m)							
Walking Speed (m/s)							
Percent Blockage							
Right turn flare (veh)							
Median type	TWLTL			TWLTL			
Median storage (veh)	2			2			
Upstream signal (m)	307						
pX, platoon unblocked							
vC, conflicting volume			814		1157	407	
vC1, stage 1 conf vol					800		
vC2, stage 2 conf vol					358		
vCu, unblocked vol			814		1157	407	
tC, single (s)			4.1		6.8	6.9	
tC, 2 stage (s)					5.8		
tF (s)			2.2		3.5	3.3	
p0 queue free %			94		100	93	
cM capacity (veh/h)			809		363	593	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	523	291	47	264	264	1	40
Volume Left	0	0	47	0	0	1	0
Volume Right	0	29	0	0	0	0	40
cSH	1700	1700	809	1700	1700	363	593
Volume to Capacity	0.31	0.17	0.06	0.15	0.15	0.00	0.07
Queue Length 95th (m)	0.0	0.0	1.4	0.0	0.0	0.1	1.6
Control Delay (s)	0.0	0.0	9.7	0.0	0.0	14.9	11.5
Lane LOS			A			B	B
Approach Delay (s)	0.0		0.8			11.6	
Approach LOS						B	
Intersection Summary							
Average Delay			0.7				
Intersection Capacity Utilization			37.5%		ICU Level of Service		A
Analysis Period (min)			15				

HCM Unsignalized Intersection Capacity Analysis
11: Collector Road A & Twenty Road West

Total 2041 PM Peak Hour

Movement	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Configurations	↔↔		↔	↔↔	↔	↔	
Traffic Volume (veh/h)	703	56	150	520	8	102	
Future Volume (Veh/h)	703	56	150	520	8	102	
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)	764	61	163	565	9	111	
Pedestrians							
Lane Width (m)							
Walking Speed (m/s)							
Percent Blockage							
Right turn flare (veh)							
Median type	TWLTL		TWLTL				
Median storage (veh)	2		2				
Upstream signal (m)							
pX, platoon unblocked							
vC, conflicting volume			825	1403	412		
vC1, stage 1 conf vol				794			
vC2, stage 2 conf vol				608			
vCu, unblocked vol			825	1403	412		
tC, single (s)			4.1	6.8	6.9		
tC, 2 stage (s)				5.8			
tF (s)			2.2	3.5	3.3		
p0 queue free %			80	97	81		
cM capacity (veh/h)			801	297	589		
Direction_Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	509	316	163	282	282	9	111
Volume Left	0	0	163	0	0	9	0
Volume Right	0	61	0	0	0	0	111
cSH	1700	1700	801	1700	1700	297	589
Volume to Capacity	0.30	0.19	0.20	0.17	0.17	0.03	0.19
Queue Length 95th (m)	0.0	0.0	5.8	0.0	0.0	0.7	5.2
Control Delay (s)	0.0	0.0	10.6	0.0	0.0	17.5	12.5
Lane LOS			B			C	B
Approach Delay (s)	0.0		2.4			12.9	
Approach LOS			B			B	
Intersection Summary							
Average Delay			2.0				
Intersection Capacity Utilization			42.9%			ICU Level of Service	A
Analysis Period (min)			15				

Timings

12: Collector Road B/Twentyplace Boulevard & Twenty Road West

Total 2041 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBR	SBL	SBT
Lane Configurations	↔	↔↔	↔	↔↔	↔	↔	↔	↔
Traffic Volume (vph)	36	800	221	928	59	173	15	0
Future Volume (vph)	36	800	221	928	59	173	15	0
Lane Group Flow (vph)	38	866	230	996	61	180	16	19
Turn Type	Perm	NA	pm+pt	NA	Perm	Perm	Perm	NA
Protected Phases		4	3	8				6
Permitted Phases	4		8		2	2	6	
Detector Phase	4	4	3	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	9.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	42.0	42.0	20.0	62.0	28.0	28.0	28.0	28.0
Total Split (%)	46.7%	46.7%	22.2%	68.9%	31.1%	31.1%	31.1%	31.1%
Yellow Time (s)	3.5	3.5	3.0	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	3.0	4.5	4.5	4.5	4.5	4.5
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.22	0.74	0.60	0.54	0.12	0.26	0.03	0.03
Control Delay	19.9	24.5	15.9	11.8	18.8	4.7	18.3	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.9	24.5	15.9	11.8	18.8	4.7	18.3	0.1
Queue Length 50th (m)	3.4	49.8	13.9	40.4	5.1	0.0	1.3	0.0
Queue Length 95th (m)	10.4	71.8	28.6	53.7	15.4	13.1	5.9	0.0
Internal Link Dist (m)		655.9		924.0				89.8
Turn Bay Length (m)	15.0		15.0		15.0			
Base Capacity (vph)	299	1985	548	3044	498	687	637	658
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.44	0.42	0.33	0.12	0.26	0.03	0.03

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 68.1
Natural Cycle: 60
Control Type: Semi Act-Uncoord

Splits and Phases: 12: Collector Road B/Twentyplace Boulevard & Twenty Road West



HCM Signalized Intersection Capacity Analysis

Total 2041 PM Peak Hour

12: Collector Road B/Twentyplace Boulevard & Twenty Road West

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	36	800	32	221	928	28	59	0	173	15	0	18
Future Volume (vph)	36	800	32	221	928	28	59	0	173	15	0	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		3.0	4.5		4.5		4.5	4.5	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00		1.00	1.00	1.00	
Frb, ped/bikes	1.00	1.00		1.00	1.00		1.00		1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00		0.85	1.00	0.85	
Fit Protected	0.95	1.00		0.95	1.00		0.95		1.00	0.95	1.00	
Satd. Flow (prot)	1771	3561		1825	3563		1823		1633	1825	1612	
Fit Permitted	0.29	1.00		0.16	1.00		0.75		1.00	0.95	1.00	
Satd. Flow (perm)	536	3561		304	3563		1430		1633	1825	1612	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	38	833	33	230	967	29	61	0	180	16	0	19
RTOR Reduction (vph)	0	3	0	0	3	0	0	0	117	0	12	0
Lane Group Flow (vph)	38	863	0	230	993	0	61	0	63	16	7	0
Conf. Peds. (#/hr)	1					1	1					1
Heavy Vehicles (%)	3%	2%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		pm+pt	NA		Perm		Perm	Perm	NA	
Protected Phases		4		3	8						6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	22.3	22.3		35.2	35.2		23.8		23.8	23.8	23.8	
Effective Green, g (s)	22.3	22.3		35.2	35.2		23.8		23.8	23.8	23.8	
Actuated g/C Ratio	0.33	0.33		0.52	0.52		0.35		0.35	0.35	0.35	
Clearance Time (s)	4.5	4.5		3.0	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	
Lane Grp Cap (vph)	175	1167		378	1844		500		571	638	564	
v/s Ratio Prot		c0.24		c0.09	0.28						0.00	
v/s Ratio Perm	0.07			0.23			c0.04		0.04	0.01		
v/c Ratio	0.22	0.74		0.61	0.54		0.12		0.11	0.03	0.01	
Uniform Delay, d1	16.5	20.3		11.2	11.0		15.0		14.9	14.5	14.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.6	2.5		2.8	0.3		0.5		0.4	0.1	0.0	
Delay (s)	17.2	22.8		14.0	11.3		15.5		15.3	14.6	14.5	
Level of Service	B	C		B	B		B		B	B	B	
Approach Delay (s)		22.5			11.8			15.4			14.5	
Approach LOS		C			B			B			B	

Intersection Summary		
HCM 2000 Control Delay	16.2	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.45	
Actuated Cycle Length (s)	68.0	Sum of lost time (s)
Intersection Capacity Utilization	61.2%	ICU Level of Service
Analysis Period (min)	15	

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

Total 2041 PM Peak Hour

13: Glancaster Road & Collector Road C

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (veh/h)	80	197	524	134	82	469
Future Volume (Veh/h)	80	197	524	134	82	469
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)	87	214	570	146	89	510
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)			298			
pX, platoon unblocked	0.98	0.98			0.98	
vC, conflicting volume	1258	570			716	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1253	549			699	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	48	59			90	
cM capacity (veh/h)	167	524			878	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	87	214	619	97	89	510
Volume Left	87	0	0	0	89	0
Volume Right	0	214	49	97	0	0
cSH	167	524	1700	1700	878	1700
Volume to Capacity	0.52	0.41	0.36	0.06	0.10	0.30
Queue Length 95th (m)	19.7	15.0	0.0	0.0	2.6	0.0
Control Delay (s)	47.8	16.5	0.0	0.0	9.6	0.0
Lane LOS	E	C			A	
Approach Delay (s)	25.6		0.0		1.4	
Approach LOS	D					

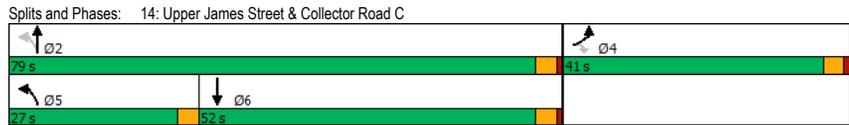
Intersection Summary		
Average Delay	5.3	
Intersection Capacity Utilization	49.3%	ICU Level of Service
Analysis Period (min)	15	

Timings
14: Upper James Street & Collector Road C

Total 2041 PM Peak Hour

	EBL	EBR	NBL	NBT	SBT
Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Configurations	↔	↔	↔	↑↑↑	↑↑↑
Traffic Volume (vph)	409	213	312	1380	1407
Future Volume (vph)	409	213	312	1380	1407
Lane Group Flow (vphpl)	445	232	339	1500	1725
Turn Type	Prot	Perm	pm+pt	NA	NA
Protected Phases	4		5	2	6
Permitted Phases		4	2		
Detector Phase	4	4	5	2	6
Switch Phase					
Minimum Initial (s)	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	22.5	22.5	9.5	22.5	22.5
Total Split (s)	41.0	41.0	27.0	79.0	52.0
Total Split (%)	34.2%	34.2%	22.5%	65.8%	43.3%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	0.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	3.0	4.0	4.0
Lead/Lag			Lead		Lag
Lead-Lag Optimize?			Yes		Yes
Recall Mode	None	None	None	Max	Max
v/c Ratio	0.89	0.38	0.89	0.45	0.76
Control Delay	61.1	5.8	56.3	10.9	30.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	61.1	5.8	56.3	10.9	30.5
Queue Length 50th (m)	96.3	0.0	59.2	60.1	126.0
Queue Length 95th (m)	#145.2	17.3	#106.0	74.3	151.9
Internal Link Dist (m)	946.4		602.9	419.6	
Turn Bay Length (m)			15.0		
Base Capacity (vph)	575	672	435	3350	2277
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.77	0.35	0.78	0.45	0.76

Intersection Summary
 Cycle Length: 120
 Actuated Cycle Length: 115.3
 Natural Cycle: 65
 Control Type: Semi Act-Uncoord
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis
14: Upper James Street & Collector Road C

Total 2041 PM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↑↑↑	↑↑↑	
Traffic Volume (vph)	409	213	312	1380	1407	180
Future Volume (vph)	409	213	312	1380	1407	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	3.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	
Fr _t	1.00	0.85	1.00	1.00	0.98	
Fit Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	5142	5054	
Fit Permitted	0.95	1.00	0.07	1.00	1.00	
Satd. Flow (perm)	1789	1601	138	5142	5054	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	445	232	339	1500	1529	196
RTOR Reduction (vph)	0	167	0	0	12	0
Lane Group Flow (vph)	445	65	339	1500	1713	0
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	32.2	32.2	75.2	75.2	51.7	
Effective Green, g (s)	32.2	32.2	75.2	75.2	51.7	
Actuated g/C Ratio	0.28	0.28	0.65	0.65	0.45	
Clearance Time (s)	4.0	4.0	3.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	499	446	383	3350	2264	
v/s Ratio Prot	c0.25		c0.16	0.29	0.34	
v/s Ratio Perm		0.04	c0.42			
v/c Ratio	0.89	0.15	0.89	0.45	0.76	
Uniform Delay, d1	39.9	31.3	34.6	9.9	26.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	17.9	0.2	20.8	0.4	2.4	
Delay (s)	57.8	31.4	55.4	10.3	29.0	
Level of Service	E	C	E	B	C	
Approach Delay (s)	48.8		18.6	29.0		
Approach LOS	D		B	C		

Intersection Summary
 HCM 2000 Control Delay: 27.7
 HCM 2000 Level of Service: C
 HCM 2000 Volume to Capacity ratio: 0.91
 Actuated Cycle Length (s): 115.4
 Sum of lost time (s): 11.0
 Intersection Capacity Utilization: 81.1%
 ICU Level of Service: D
 Analysis Period (min): 15
 c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
15: Dickenson Road West & Collector Road A

Total 2041 PM Peak Hour

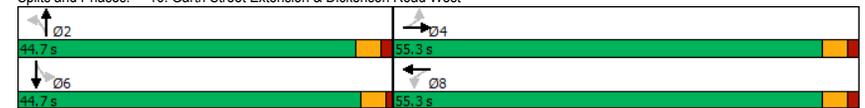
Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations	↔	↕	↕	↔	↔	↕	
Traffic Volume (veh/h)	0	577	390	124	59	19	
Future Volume (Veh/h)	0	577	390	124	59	19	
Sign Control		Free	Free		Stop		
Grade		0%	0%		0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	0	627	424	135	64	21	
Pedestrians							
Lane Width (m)							
Walking Speed (m/s)							
Percent Blockage							
Right turn flare (veh)							
Median type		None	None				
Median storage (veh)							
Upstream signal (m)							
pX, platoon unblocked							
vC, conflicting volume	559				805	280	
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	559				805	280	
tC, single (s)	4.1				6.8	6.9	
tC, 2 stage (s)							
tF (s)	2.2				3.5	3.3	
p0 queue free %	100				80	97	
cM capacity (veh/h)	1008				320	718	
Direction_Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	0	314	314	283	276	64	21
Volume Left	0	0	0	0	0	64	0
Volume Right	0	0	0	0	135	0	21
cSH	1700	1700	1700	1700	1700	320	718
Volume to Capacity	0.00	0.18	0.18	0.17	0.16	0.20	0.03
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	5.6	0.7
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	19.0	10.2
Lane LOS						C	B
Approach Delay (s)	0.0			0.0		16.8	
Approach LOS						C	
Intersection Summary							
Average Delay			1.1				
Intersection Capacity Utilization			25.9%		ICU Level of Service		A
Analysis Period (min)			15				

Timings
16: Garth Street Extension & Dickenson Road West

Total 2041 PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↕	↔	↕	↔	↕	↔	↕
Traffic Volume (vph)	61	288	250	387	150	100	208	50
Future Volume (vph)	61	288	250	387	150	100	208	50
Lane Group Flow (vph)	66	639	272	618	163	544	226	78
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	55.3	55.3	55.3	55.3	44.7	44.7	44.7	44.7
Total Split (%)	55.3%	55.3%	55.3%	55.3%	44.7%	44.7%	44.7%	44.7%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.19	0.36	0.83	0.36	0.32	0.37	0.80	0.06
Control Delay	14.6	6.7	42.0	11.1	21.2	5.0	46.4	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.6	6.7	42.0	11.1	21.2	5.0	46.4	12.9
Queue Length 50th (m)	5.8	14.5	36.3	25.0	18.5	5.8	32.2	2.8
Queue Length 95th (m)	14.7	27.0	#88.9	40.3	36.8	17.0	#76.8	7.6
Internal Link Dist (m)		899.2		404.1		105.4		811.8
Turn Bay Length (m)	50.0		50.0		50.0		50.0	
Base Capacity (vph)	478	2356	463	2359	771	2013	425	2010
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.27	0.59	0.26	0.21	0.27	0.53	0.04
Intersection Summary								
Cycle Length: 100								
Actuated Cycle Length: 77.9								
Natural Cycle: 55								
Control Type: Actuated-Uncoordinated								
# 95th percentile volume exceeds capacity, queue may be longer.								
Queue shown is maximum after two cycles.								

Splits and Phases: 16: Garth Street Extension & Dickenson Road West



HCM Signalized Intersection Capacity Analysis
16: Garth Street Extension & Dickenson Road West

Total 2041 PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	61	288	300	250	387	181	150	100	400	208	50	22
Future Volume (vph)	61	288	300	250	387	181	150	100	400	208	50	22
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		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.92		1.00	0.95		1.00	0.88		1.00	0.95	
Fit Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3305		1789	3407		1789	3149		1789	3413	
Fit Permitted	0.37	1.00		0.36	1.00		0.70	1.00		0.38	1.00	
Satd. Flow (perm)	701	3305		680	3407		1325	3149		725	3413	
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)	66	313	326	272	421	197	163	109	435	226	54	24
RTOR Reduction (vph)	0	166	0	0	57	0	0	265	0	0	14	0
Lane Group Flow (vph)	66	473	0	272	561	0	163	279	0	226	64	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)	37.8	37.8		37.8	37.8		30.0	30.0		30.5	30.5	
Effective Green, g (s)	37.8	37.8		37.8	37.8		30.0	30.0		30.5	30.5	
Actuated g/C Ratio	0.49	0.49		0.49	0.49		0.39	0.39		0.40	0.40	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	345	1626		334	1676		517	1230		287	1355	
v/s Ratio Prot		0.14			0.16			0.09			0.02	
v/s Ratio Perm	0.09			c0.40			0.12			c0.31		
v/c Ratio	0.19	0.29		0.81	0.33		0.32	0.23		0.79	0.05	
Uniform Delay, d1	10.9	11.6		16.5	11.9		16.3	15.6		20.3	14.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.1		14.1	0.1		0.4	0.1		13.3	0.0	
Delay (s)	11.2	11.7		30.6	12.0		16.6	15.7		33.6	14.2	
Level of Service	B	B		C	B		B	B		C	B	
Approach Delay (s)		11.6			17.7			15.9			28.6	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	16.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	76.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

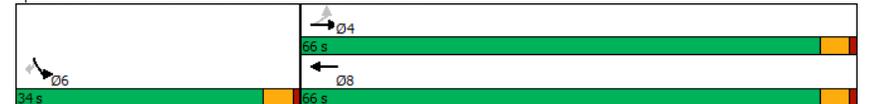
Timings
17: Dickenson Road West & Collector Road B

Total 2041 PM Peak Hour

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Configurations	↔	↕	↕	↔	↔
Traffic Volume (vph)	6	902	781	133	43
Future Volume (vph)	6	902	781	133	43
Lane Group Flow (vph)	7	980	932	145	47
Turn Type	Perm	NA	NA	Prot	Perm
Protected Phases		4	8	6	
Permitted Phases	4				6
Detector Phase	4	4	8	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5
Total Split (s)	66.0	66.0	66.0	34.0	34.0
Total Split (%)	66.0%	66.0%	66.0%	34.0%	34.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None	None	Max	Max
v/c Ratio	0.06	0.74	0.71	0.17	0.06
Control Delay	13.0	20.4	19.2	10.8	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	13.0	20.4	19.2	10.8	4.0
Queue Length 50th (m)	0.5	48.8	44.6	8.7	0.0
Queue Length 95th (m)	2.7	66.6	61.7	21.0	5.0
Internal Link Dist (m)		404.1	868.4	692.1	
Turn Bay Length (m)	15.0		15.0		
Base Capacity (vph)	322	3485	3440	863	797
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.02	0.28	0.27	0.17	0.06

Intersection Summary	
Cycle Length:	100
Actuated Cycle Length:	61.4
Natural Cycle:	45
Control Type:	Semi Act-Uncoord

Splits and Phases: 17: Dickenson Road West & Collector Road B



HCM Signalized Intersection Capacity Analysis
17: Dickenson Road West & Collector Road B

Total 2041 PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕	↕		↕	↕
Traffic Volume (vph)	6	902	781	76	133	43
Future Volume (vph)	6	902	781	76	133	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Fit	1.00	1.00	0.99		1.00	0.85
Fit Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	3579	3531		1789	1601
Fit Permitted	0.18	1.00	1.00		0.95	1.00
Satd. Flow (perm)	332	3579	3531		1789	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	980	849	83	145	47
RTOR Reduction (vph)	0	0	12	0	0	24
Lane Group Flow (vph)	7	980	920	0	145	23
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		4	8		6	
Permitted Phases		4				6
Actuated Green, G (s)	22.7	22.7	22.7		29.6	29.6
Effective Green, g (s)	22.7	22.7	22.7		29.6	29.6
Actuated g/C Ratio	0.37	0.37	0.37		0.48	0.48
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	122	1325	1307		863	773
v/s Ratio Prot		c0.27	0.26		c0.08	
v/s Ratio Perm	0.02					0.01
v/c Ratio	0.06	0.74	0.70		0.17	0.03
Uniform Delay, d1	12.4	16.7	16.4		8.9	8.3
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.2	2.2	1.7		0.4	0.1
Delay (s)	12.6	18.9	18.2		9.3	8.4
Level of Service	B	B	B		A	A
Approach Delay (s)		18.9	18.2		9.1	
Approach LOS		B	B		A	

Intersection Summary			
HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	61.3	Sum of lost time (s)	9.0
Intersection Capacity Utilization	39.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
18: Collector Road A & Collector Road C

Total 2041 PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	55	136	26	66	224	174	54	89	32	90	80	38
Future Volume (vph)	55	136	26	66	224	174	54	89	32	90	80	38
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)	60	148	28	72	243	189	59	97	35	98	87	41
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2				
Volume Total (vph)	60	176	72	432	59	132	98	128				
Volume Left (vph)	60	0	72	0	59	0	98	0				
Volume Right (vph)	0	28	0	189	0	35	0	41				
Hadj (s)	0.53	-0.08	0.53	-0.27	0.53	-0.15	0.53	-0.19				
Departure Headway (s)	7.0	6.4	6.7	5.9	7.4	6.8	7.4	6.6				
Degree Utilization, x	0.12	0.31	0.13	0.71	0.12	0.25	0.20	0.24				
Capacity (veh/h)	479	529	516	591	450	494	454	503				
Control Delay (s)	9.8	11.2	9.5	20.6	10.3	10.8	11.0	10.5				
Approach Delay (s)	10.8		19.0		10.6		10.7					
Approach LOS	B		C		B		B					

Intersection Summary			
Delay	14.3		
Level of Service	B		
Intersection Capacity Utilization	50.7%	ICU Level of Service	A
Analysis Period (min)	15		

Timings
19: Garth Street Extension & Collector Road C

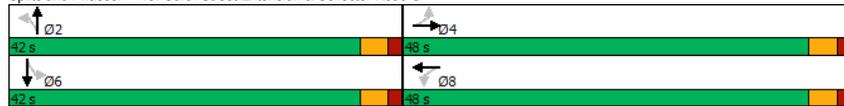
Total 2041 PM Peak Hour

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	84	121	55	235	39	308	153	278
Future Volume (vph)	84	121	55	235	39	308	153	278
Lane Group Flow (vph)	91	206	60	498	42	383	166	510
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	48.0	48.0	48.0	48.0	42.0	42.0	42.0	42.0
Total Split (%)	53.3%	53.3%	53.3%	53.3%	46.7%	46.7%	46.7%	46.7%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.77	0.34	0.17	0.81	0.09	0.20	0.31	0.26
Control Delay	61.8	14.8	16.9	28.9	10.7	9.2	12.7	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.8	14.8	16.9	28.9	10.7	9.2	12.7	6.1
Queue Length 50th (m)	10.4	15.4	5.4	49.4	2.3	11.2	10.6	9.2
Queue Length 95th (m)	#32.0	29.3	12.7	80.9	9.1	25.1	30.3	22.8
Internal Link Dist (m)		644.3		697.4		811.8		650.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	230	1143	697	1131	464	1924	539	1927
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.18	0.09	0.44	0.09	0.20	0.31	0.26

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 69.4
Natural Cycle: 45
Control Type: Semi Act-Uncoord
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 19: Garth Street Extension & Collector Road C



HCM Signalized Intersection Capacity Analysis
19: Garth Street Extension & Collector Road C

Total 2041 PM Peak Hour

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (vph)	84	121	68	55	235	224	39	308	44	153	278	191
Future Volume (vph)	84	121	68	55	235	224	39	308	44	153	278	191
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	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.95		1.00	0.93		1.00	0.98		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1782		1789	1746		1789	3511		1789	3360	
Flt Permitted	0.19	1.00		0.59	1.00		0.45	1.00		0.52	1.00	
Satd. Flow (perm)	365	1782		1102	1746		851	3511		989	3360	
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)	91	132	74	60	255	243	42	335	48	166	302	208
RTOR Reduction (vph)	0	29	0	0	50	0	0	10	0	0	94	0
Lane Group Flow (vph)	91	177	0	60	448	0	42	373	0	166	416	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Actuated Green, G (s)	22.5	22.5		22.5	22.5		37.9	37.9		37.9	37.9	
Effective Green, g (s)	22.5	22.5		22.5	22.5		37.9	37.9		37.9	37.9	
Actuated g/C Ratio	0.32	0.32		0.32	0.32		0.55	0.55		0.55	0.55	
Clearance Time (s)	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	
Lane Grp Cap (vph)	118	577		357	566		464	1917		540	1834	
v/s Ratio Prot		0.10			c0.26			0.11			0.12	
v/s Ratio Perm	0.25			0.05			0.05			c0.17		
v/c Ratio	0.77	0.31		0.17	0.79		0.09	0.19		0.31	0.23	
Uniform Delay, d1	21.1	17.6		16.8	21.3		7.5	8.0		8.6	8.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	26.2	0.3		0.2	7.4		0.4	0.2		1.5	0.3	
Delay (s)	47.3	17.9		17.0	28.8		7.9	8.2		10.1	8.4	
Level of Service	D	B		B	C		A	A		B	A	
Approach Delay (s)		26.9			27.5			8.2			8.8	
Approach LOS		C			C			A			A	

Intersection Summary

HCM 2000 Control Delay	16.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	69.4	Sum of lost time (s)	9.0
Intersection Capacity Utilization	71.5%	ICU Level of Service	C
Analysis Period (min)	15		

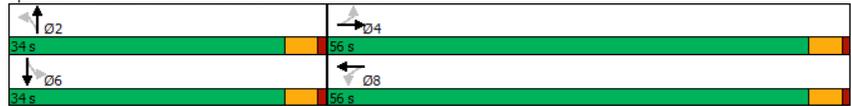
c Critical Lane Group

Timings Total 2041 PM Peak Hour
 20: Collector Road B & Collector Road C

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	62	243	14	355	42	145	99	85
Future Volume (vph)	62	243	14	355	42	145	99	85
Lane Group Flow (vph)	67	278	15	537	46	230	108	219
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	4		8		2		6	
Permitted Phases	4		8		2		6	
Detector Phase	4		8		2		6	
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	56.0	56.0	56.0	56.0	34.0	34.0	34.0	34.0
Total Split (%)	62.2%	62.2%	62.2%	62.2%	37.8%	37.8%	37.8%	37.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio	0.47	0.41	0.04	0.80	0.08	0.26	0.19	0.25
Control Delay	26.1	15.7	11.7	25.4	11.1	10.5	12.1	7.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.1	15.7	11.7	25.4	11.1	10.5	12.1	7.9
Queue Length 50th (m)	5.6	22.0	1.0	48.2	2.5	11.9	6.2	7.8
Queue Length 95th (m)	16.0	37.3	3.9	78.6	9.4	31.8	18.9	24.4
Internal Link Dist (m)	697.4		946.4		692.1		640.3	
Turn Bay Length (m)	15.0		50.0		50.0			
Base Capacity (vph)	339	1596	836	1546	572	891	565	883
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.17	0.02	0.35	0.08	0.26	0.19	0.25

Intersection Summary
 Cycle Length: 90
 Actuated Cycle Length: 60.9
 Natural Cycle: 50
 Control Type: Semi Act-Uncoord

Splits and Phases: 20: Collector Road B & Collector Road C



HCM Signalized Intersection Capacity Analysis Total 2041 PM Peak Hour
 20: Collector Road B & Collector Road C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔		↔	↔		↔	↔		↔	↔	
Traffic Volume (vph)	62	243	13	14	355	139	42	145	66	99	85	117
Future Volume (vph)	62	243	13	14	355	139	42	145	66	99	85	117
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	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.96		1.00	0.95		1.00	0.91	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1869		1789	1804		1789	1795		1789	1720	
Flt Permitted	0.21	1.00		0.52	1.00		0.62	1.00		0.61	1.00	
Satd. Flow (perm)	397	1869		979	1804		1170	1795		1157	1720	
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)	67	264	14	15	386	151	46	158	72	108	92	127
RTOR Reduction (vph)	0	3	0	0	24	0	0	14	0	0	42	0
Lane Group Flow (vph)	67	275	0	15	513	0	46	216	0	108	177	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	4			8			2			6		
Actuated Green, G (s)	22.0	22.0		22.0	22.0		29.8	29.8		29.8	29.8	
Effective Green, g (s)	22.0	22.0		22.0	22.0		29.8	29.8		29.8	29.8	
Actuated g/C Ratio	0.36	0.36		0.36	0.36		0.49	0.49		0.49	0.49	
Clearance Time (s)	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	
Lane Grp Cap (vph)	143	676		354	652		573	879		567	843	
v/s Ratio Prot	0.15			c0.28			c0.12			0.10		
v/s Ratio Perm	0.17			0.02			0.04			0.09		
v/c Ratio	0.47	0.41		0.04	0.79		0.08	0.25		0.19	0.21	
Uniform Delay, d1	14.9	14.5		12.6	17.3		8.2	9.0		8.7	8.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.4	0.4		0.0	6.3		0.3	0.7		0.7	0.6	
Delay (s)	17.3	14.9		12.6	23.6		8.5	9.7		9.5	9.4	
Level of Service	B	B		B	C		A	A		A	A	
Approach Delay (s)	15.4			23.3			9.5			9.4		
Approach LOS	B			C			A			A		

Intersection Summary
 HCM 2000 Control Delay: 15.9
 HCM 2000 Volume to Capacity ratio: 0.48
 Actuated Cycle Length (s): 60.8
 Intersection Capacity Utilization: 63.4%
 Analysis Period (min): 15
 HCM 2000 Level of Service: B
 Sum of lost time (s): 9.0
 ICU Level of Service: B

c Critical Lane Group

