

CITY OF TORONTO

# GLEN ROAD PEDESTRIAN BRIDGE EA STUDY

## TRAFFIC OPERATIONAL ANALYSIS REPORT

NOVEMBER 9, 2017

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# **GLEN ROAD PEDESTRIAN BRIDGE EA STUDY TRAFFIC OPERATIONAL ANALYSIS REPORT**

**CITY OF TORONTO**

TRAFFIC ANALYSIS REPORT  
PROJECT NO.: 16M-01410-01 (FORMALLY 3216026-000)  
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WSP GROUP LIMITED  
610 CHARTWELL ROAD, SUITE 300  
OAKVILLE, ON, CANADA L6J 4A5

PHONE: +1 905-823-8500  
FAX: +1 905-823-8503

[WWW.WSPGROUP.COM](http://WWW.WSPGROUP.COM)

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# 1 INTRODUCTION

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## 1.1 BACKGROUND

The City of Toronto (hereafter referred to as “the City”) is investigating options to address the declining condition of a Glen Road Pedestrian Bridge spanning Rosedale Valley Road through a Schedule ‘C’ Class Environmental Assessment (Class EA) Study. The Glen Road Pedestrian Bridge is deteriorating and is in need of major improvements. The south end of the bridge continues as a pedestrian tunnel underneath Bloor Street and connects to Glen Road south; the north end of the bridge connects at the intersection of Glen Road and Dale Avenue, located north of the Rosedale Valley. WSP (previously MMM Group) has been retained by the City to carry out the Preliminary Design and Class EA Study.

The Class EA Study assesses the existing conditions and the needs of the pedestrian bridge and tunnel, identify alternatives, and recommend a preferred solution. The preferred alternative solution is to replace the pedestrian bridge in the same location and a widening of the pedestrian tunnel. Design alternatives for the bridge and tunnel were developed and assessed. The preferred design is to replace the pedestrian bridge with an inclined leg steel girder bridge and widening the tunnel to the west.

As part of the EA Study, a detailed traffic operational analysis was conducted to assess the potential impacts during construction stages for the widening of the pedestrian tunnel as that will have direct impact to traffic operation of Bloor Street East and the surrounding area. The construction for the pedestrian tunnel widening would be carried out in two stages. Each construction stage will include the closure of two vehicular lanes on Bloor Street East, by narrowing traffic to one lane in each direction. During each construction stage, the vehicular traffic will be shifted to the north or south, while constructing the south and north portion of the pedestrian tunnel, respectively. It is assumed that the existing dedicated on-street bicycle lanes for cyclists will be maintained during construction stages.

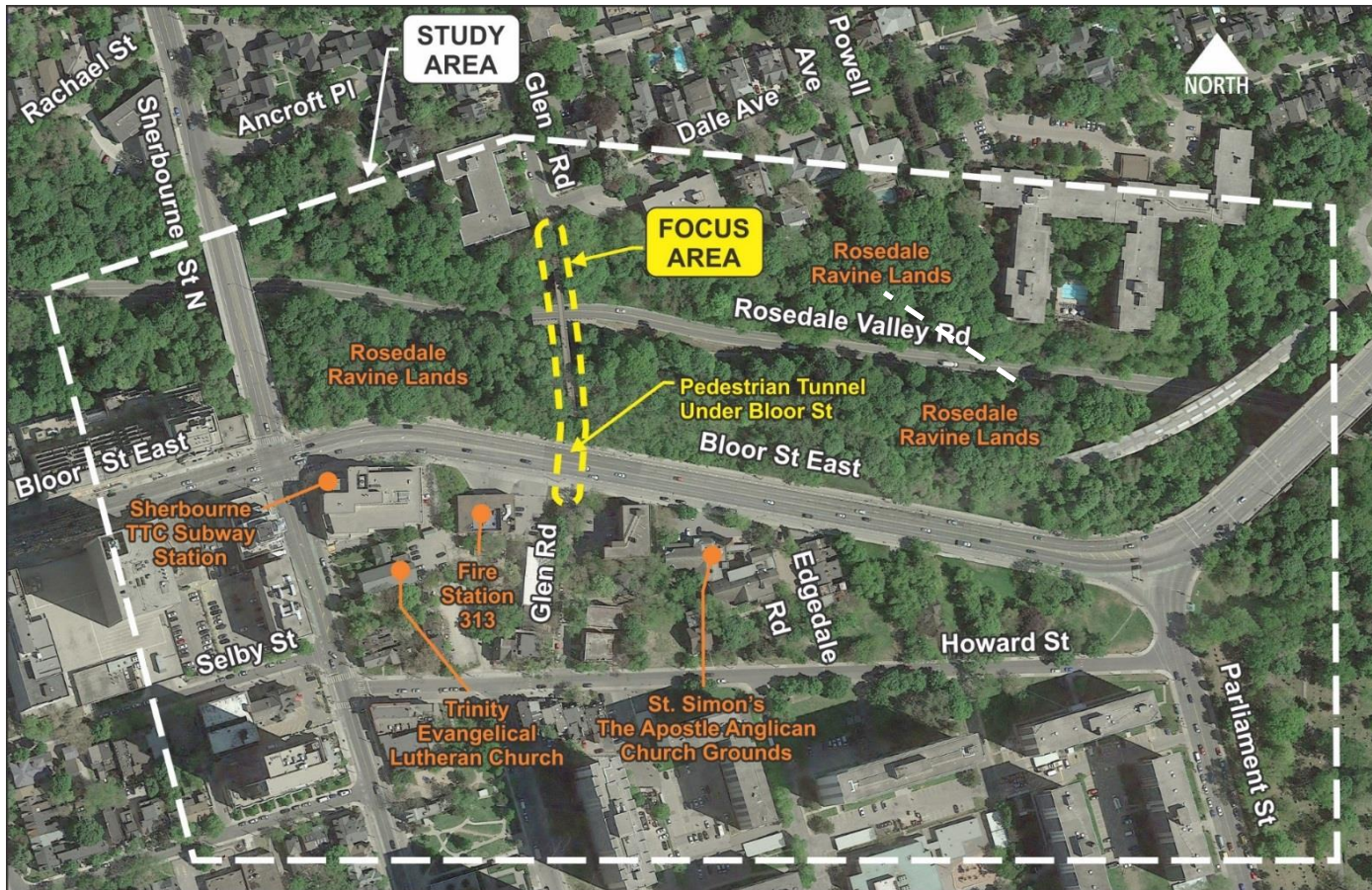
The most recent available traffic data and signal timing plans were provided by the City. The Traffic Operational Analysis was conducted to assess the potential impacts to traffic operations during both the construction stages, and to identify mitigation measures for each stage. The traffic operational analysis was conducted using VISSIM based micro-simulation model and signal timing plans for the construction stages were optimized using Synchro model.

This traffic operational analysis report summarizes the traffic operational analysis results conducted for construction stage alternatives required for the bridge rehabilitation project.

## 1.2 STUDY AREA

Figure 1 presents the extent of the study area for the purpose of micro-simulation modeling and traffic analysis, as well as the location of the pedestrian bridge, and the tunnel underneath Bloor Street East.

**Figure 1: Glen Road Pedestrian Bridge Class EA Study Area**



Glen Road is a north-south local road under the jurisdiction of the City of Toronto, providing access to the residential properties within the study area. Within the study area, a south segment of Glen Road (south of Bloor Street) connects to Howard Street and provide access to the TTC Sherbourne subway station. This segment of Glen Road accommodates all day on-street 'by-permit' parking on the west side between 7:00 am to 11:59 pm; with a 'no exit' sign for vehicular traffic. At the north end of this segment of Glen Road, a pedestrian tunnel underneath Bloor Street provide access to the pedestrian bridge. A pedestrian stairway which connects to the sidewalk on the north side of Bloor Street East is located in the landing area between the north end of the tunnel and the south end of the bridge.

Bloor Street East is a major east-west arterial corridor under the jurisdiction of the City with sidewalks for pedestrians on both sides of the road. It has a posted speed limit of 50 km/h. Within the study area, the segment of Bloor Street operates with two-lane vehicular capacity (i.e. four lanes in total) and a dedicated bike lane in each direction. The bike lanes are indicated by bike and diamond symbol, which are separated by solid white lines. At the Bloor Street East and Parliament Street intersection, it is painted in green to capture drivers' attention and remind them to proceed with caution.

Parliament Street is a north-south minor arterial road under the jurisdiction of the City with a four-lane cross-section, and sidewalks for pedestrians are provided on both sides of the road. There are no dedicated facilities for cyclists along this roadway within the study area. Parliament Street has a posted speed limit of 40 km/h. The northbound left turn movement from Parliament Street onto Bloor Street East is prohibited, and as a result, there are no dedicated left-turn lanes provided on the northbound approach at the Bloor Street intersection. Northbound traffic which are to proceed westbound must make a left-turn onto Howard Street.

Sherbourne Street/Sherbourne Street North is a minor north-south arterial road under the jurisdiction of the City within the study area, with sidewalks for pedestrians on both sides. Within the study area, this corridor includes two-lane cross-section (one lane in each direction) for autos, with a dedicated bike lane in each direction with a raised curb, and a posted speed limit of 40 km/h.

Howard Street (signalized) and Selby Street intersections on Sherbourne Street North and are off-set by approximately 25 m. Howard Street connects between Sherbourne Street and Parliament Street, and Shelby Street connects between Sherbourne Street and Huntley Street.

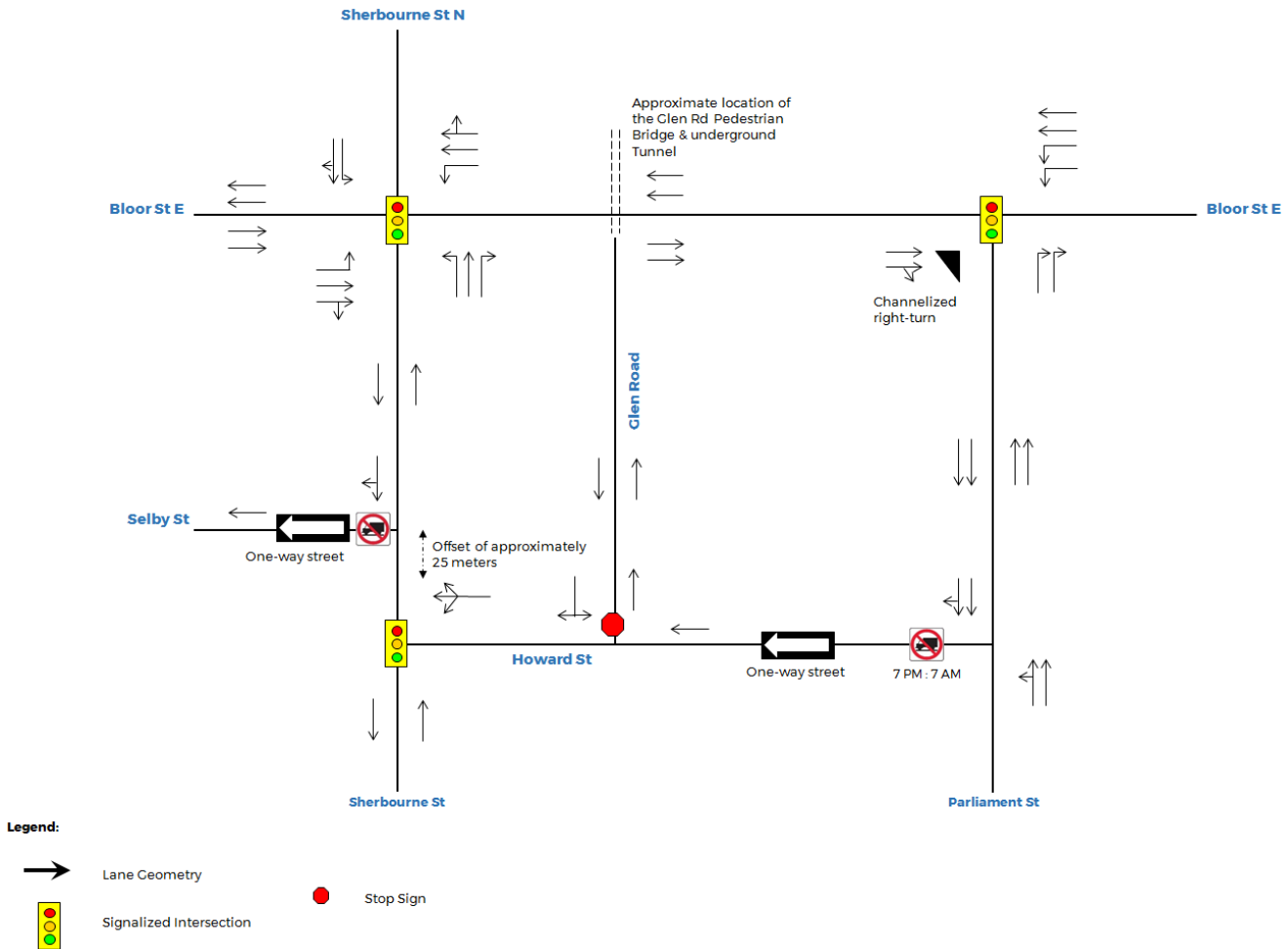
Howard Street is a collector road under the jurisdiction of the City, providing access to various residential apartment buildings. This corridor operates as a one-way street in the westbound direction from Parliament Street to Sherbourne Street with a posted speed limit of 30 km/h. Heavy trucks are restricted to enter this corridor between 7 p.m. and 7 a.m. This corridor provides 'on-street' parking and has several speed bumps for traffic calming. Glen Road intersects with Howard Street as a T-intersection (stop control).

Selby Street is a collector road under the jurisdiction of the City, operates as a 'one-way' corridor in the westbound direction. This corridor provides 'on-street' parking, and access to an underground parking lot and two surface level parking spaces.

The existing roadway geometry and lane configuration of the intersections that were considered for the traffic conditions analysis are presented in **Figure 2**.



**Figure 2: Lane Geometry & Configuration**



**Transit Services:**

Within the study area, the Sherbourne subway station is located on TTC Line 2: Bloor-Danforth line. TTC Route # 300 (Bloor-Danforth Blue Night Bus) operates during the overnight period (1 to 6 a.m.) along Bloor Street serving all local bus stops along the route. TTC Route #65 (Parliament) and Route #94 (Wellesley) operate along Parliament Street seven days a week; TTC Route #75 (Sherbourne) operates along Sherbourne Street North seven days of the week. All the bus routes within the study area are operating with average headway less than 10 minutes during service hours (considering multiple service branches).

## 2 EXISTING TRAFFIC CONDITIONS

### 2.1 EXISTING (2016) TRAFFIC VOLUMES

The turning movement counts (TMC) for the following intersections were provided by the City:

1. Sherbourne Street and Bloor Street (collected on 19<sup>th</sup> Nov, 2015),
2. Howard Street and Sherbourne Street (collected on 8<sup>th</sup> Feb, 2012), and
3. Bloor Street and Parliament Street (collected on 18<sup>th</sup> Apr, 2016).

These counts were categorized by peak hours, peak periods and eight-hour total volumes. The traffic data also contained heavy truck volumes, public transit/bus volumes and total pedestrian volumes for the different categories.

The morning and afternoon peak hour vehicular and pedestrian volumes for Sherbourne Street intersections at Howard Street and Selby Street were retrieved from the “*Transportation Considerations Report for proposed mixed-use development at Bloor Parliament- North St. Jamestown*” (Bloor/Sherbourne TIS, 2013) which was completed in January 2013 for the City. The TMC data received from the City, and from the Bloor/Sherbourne TIS, 2013 report were reviewed and compared, and the most recent available TMCs for each intersection was utilized for the traffic operational analysis. The TMCs were compiled and balanced for each direction, for both the morning and afternoon peak hours.

The existing observed traffic volumes were balanced to ensure consistency in volumes leaving one intersection and that arriving at the adjacent intersection. The existing traffic volumes for the study area intersections are presented in **Figure 3**.

### 2.2 PEDESTRIAN VOLUMES

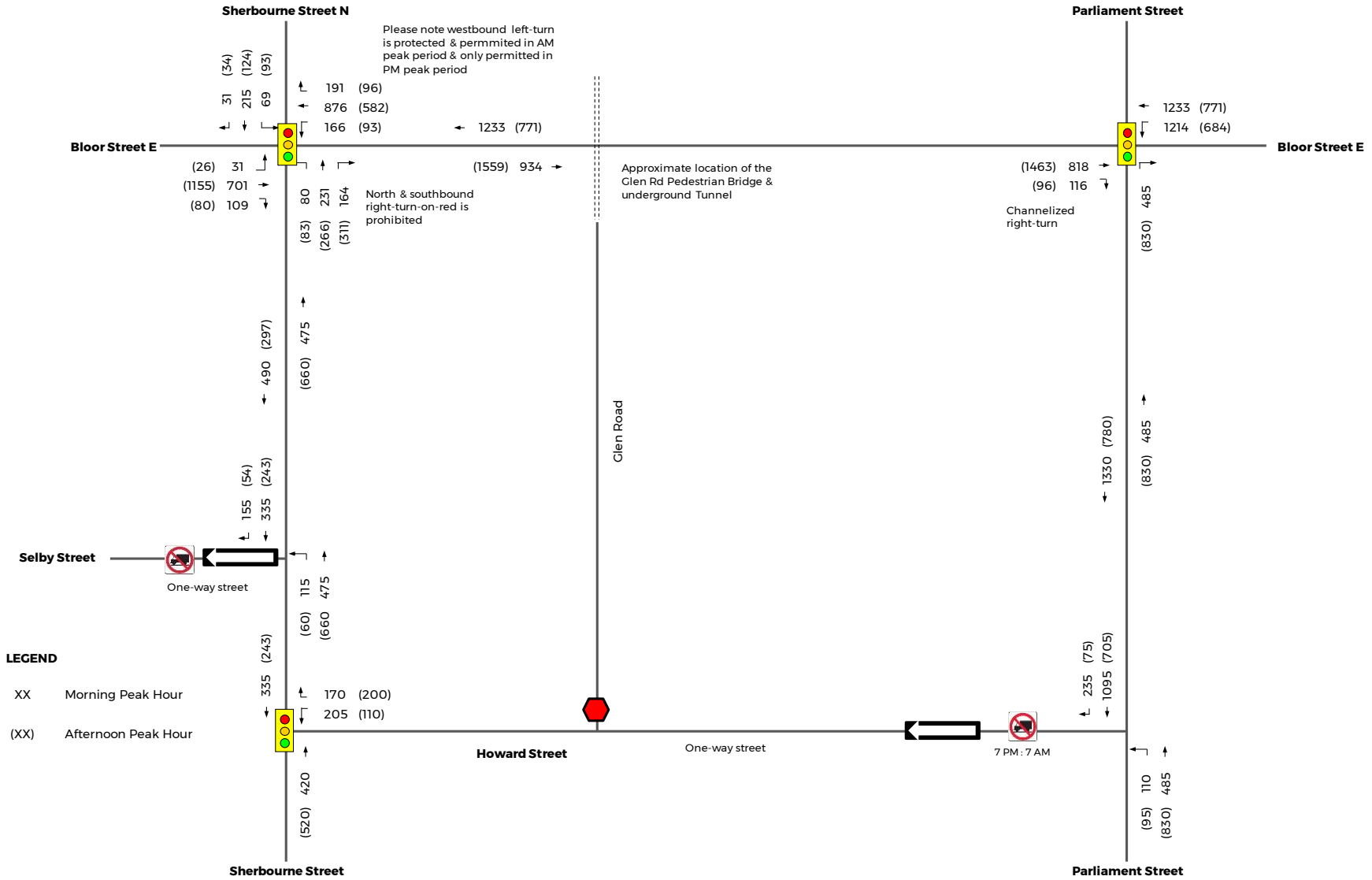
The close proximity of TTC Sherbourne subway station to the intersection of Bloor Street and Sherbourne Street, in addition to the TTC bus Route #75 Sherbourne bus stops in both directions, generates a large volume of pedestrians in the general study area in proximity to the bridge and pedestrian tunnel. As a result, pedestrian traffic was taken into account to assess the intersection operational analysis.

The total number of pedestrians at each leg of the intersections within the study area were derived from the Bloor/Sherbourne TIS Report, January 2013. A directional split of 50/50 was assumed to the total number of pedestrian volume at each leg. **Table 1** summarizes the total number of pedestrians at each leg at each signalized intersection.

**Table 1: Weekday Peak Hour Pedestrian Volume**

Intersection/Leg	Weekday Morning Peak Hour				Weekday Afternoon Peak Hour			
	North Leg	South Leg	East Leg	West Leg	North Leg	South Leg	East Leg	West Leg
Bloor St E & Sherbourne St	115	1,604	144	206	146	1,549	132	220
Sherbourne St & Parliament St	-	21	-	4	-	80	-	27
Sherbourne St & Howard St	19	278	428	217	153	386	563	229

**Figure 3: Existing (2016) Traffic Volumes**



## 2.3 EXISTING (2016) INTERSECTION OPERATIONAL ANALYSIS

The existing (2016) network operating performance is assessed on the basis of capacity utilization, delay and queueing impacts. Capacity utilization is defined as the volume to capacity ratio ( $v/c$ ) for each movement. The vehicular delay, level of service (LOS), and queueing were measured using VISSIM based micro-simulation model, and the  $v/c$  ratio for each movement was measured using Synchro (version 9) software.

A review of the existing (2016) weekday traffic volumes for Bloor Street indicates that volumes are generally higher in the westbound direction during the morning peak hour, and in the eastbound direction during afternoon peak hour. As well, the southbound is the peak direction during the morning peak hour, and the northbound is the peak direction during the afternoon peak hour on Sherbourne Street and Parliament Street.

Capacity is defined as the maximum number of vehicles that can pass over a particular road segment or through a particular intersection within the defined duration. Capacity is combined with a level of service (LOS) to describe the operating characteristics of a road segment or an intersection. LOS is a qualitative measure that describes operational conditions and motorist perceptions within a traffic stream. The Highway Capacity Manual (HCM) defines six levels of service, LOS 'A' through LOS 'F'. LOS 'A' represents the lower average delay and LOS 'F' represents the higher average delays.

The highest possible rating is LOS 'A', under which the average total delay on a movement, approach or intersection is less than 10 seconds per vehicle. When the average delay exceeds 50 seconds at un-signalized intersections, or 80 seconds at signalized intersections, the movement is classified as LOS 'F'. Up to LOS 'D' is generally considered as an acceptable level of service for signalized intersections in urban areas. LOS 'E' is the point at which remedial measures are considered, depending on the nature and extent of the delays. The intersection level of service criteria considered for the traffic operational analysis are presented in **Table 2**.

**Table 2: Intersection Level of Service Criteria**

Level of Service	Intersection Delay Criteria (seconds per vehicle)		Traffic Operation
	Signalized	Stop-Controlled/Roundabout	
A	≤ 10	≤ 10	Acceptable operation
B	> 10.0 and ≤ 20.0	> 10.0 and ≤ 15.0	
C	> 20.0 and ≤ 35.0	> 15.0 and ≤ 25.0	
D	> 35.0 and ≤ 55.0	> 25.0 and ≤ 35.0	
E	> 55.0 and ≤ 80.0	> 35.0 and ≤ 50.0	Marginally Acceptable – occasional queuing
F	> 80.0	> 50.0	Unacceptable – persistent queuing

The intersection level of summary for the weekday morning and afternoon peak hour are presented in **Table 3**. This presents volume/capacity utilization (from *Synchro* model) and delay, LOS and the 95<sup>th</sup> percentile queue length (from *Vissim* model).

The Synchro model outputs for the Existing Conditions (2016) are provided in **Appendix A**.

**Table 3: Existing (2016) Intersection Level of Service**

Intersection/Movement	Weekday Morning Peak Hour				Weekday Afternoon Peak Hour			
	V/C	Delay	LOS	Queue <sup>1</sup>	V/C	Delay	LOS	Queue <sup>1</sup>
<b>Bloor St E &amp; Sherbourne St (Signalized)</b>		<b>19 s</b>	<b>B</b>			<b>22 s</b>	<b>C</b>	
Eastbound Left	0.21	24 s	C	11 m	0.12	21 s	C	9 m
Eastbound Through/Right	0.74	16/20 s	B/B	64 m	0.90	17/21 s	B/C	97 m
Westbound Left <sup>2</sup>	0.67	20 s	B	32 m	<b>1.33</b>	<b>56 s</b>	<b>E</b>	<b>36 m</b>
Westbound Through/Right	0.69	11/13 s	B/B	71 m	0.49	13/13 s	B/B	49 m
Northbound Left	0.44	38 s	D	26 m	0.28	32 s	C	24 m
Northbound Through	0.53	25 s	C	68 m	0.49	24 s	C	82 m
Northbound Right	0.52	39 s	D	54 m	0.77	46 s	D	124 m
Southbound Left	0.33	34 s	C	24 m	0.38	28 s	C	26 m
Southbound Through/Right	0.61	27/29 s	C/C	59 m	0.33	21/22 s	C/C	40 m
<b>Bloor St E &amp; Parliament St (Signalized)</b>		<b>17 s</b>	<b>B</b>			<b>21 s</b>	<b>C</b>	
Eastbound Through	0.75	23 s	C	83 m	1.06	14 s	B	128 m
Eastbound Right (channelized)	0.25	15 s	B	0 m	0.16	25 s	C	0 m
Westbound Left	0.93	26 s	C	122 m	0.64	4 s	A	66 m
Westbound Through	1.12	2 s	A	84 m	0.56	26 s	C	50 m
Northbound Right	0.48	19 s	B	53 m	0.95	21 s	C	93 m
<b>Sherbourne St &amp; Howard St (Signalized)</b>		<b>18 s</b>	<b>B</b>			<b>17 s</b>	<b>B</b>	
Westbound Left	0.46	54 s	D	70 m	0.25	28 s	C	28 m
Westbound Through/Right	0.33	19/10 s	B/B	28 m	0.42	18/15 s	B/B	31 m
Northbound Left/Through	0.48	24/13 s	C/B	69 m	0.60	24/19 s	C/B	103 m
Southbound Through/Right	0.40	10/6 s	B/A	68 m	0.31	8/5 s	A/A	53 m

Note: 1. Queue length reflects 95th percentile condition.

2. Westbound left-turn is currently operating with protected plus permissive phases during morning peak period, and with a permissive phase only during afternoon peak period.

During both the morning and afternoon weekday peak hours, all three major intersections are operating at an overall level acceptable level of service (LOS) i.e. LOS D or better.

- **Sherbourne Street and Bloor Street East:** the northbound left and right-turn movements are operating at LOS D during weekday morning peak hour. All the individual turning movements at this intersection are also operating with an acceptable LOS, except for the westbound left turn movement, which is operating at LOS E during afternoon peak hour, at over-capacity with v/c ratio of 1.33.

The eastbound through/right movements are operating with a v/c of 0.74 and 0.90 during morning and afternoon peak hour, but despite getting close to capacity, the resulting LOS for these movements are 'C' or better during both peak hours. During afternoon peak hour, the northbound right-turn movement is operating with a v/c ratio of 0.77 and LOS D, and the 95<sup>th</sup> percentile queue of 124 meters. This indicates that the queue for this movement spills back up to the Sherbourne Street and Howard Street intersection, as the distance between the two intersections of Sherbourne Street and Bloor Street East and Sherbourne Street and Howard Street is approximately 125 meters.

These observations are consistent with the fact that at this intersection, the northbound and southbound right-turn-on-red are prohibited, thus adding to the long queuing conditions at the northbound approach. Moreover, westbound left-turn is operating with protected plus permitted phases during morning peak hour, and operates only under a permitted phase during afternoon peak hour.

- **Bloor Street East and Parliament Street:** The eastbound through movement is operating with v/c of 0.75 in the morning peak hour, and at v/c ratio of 1.06 during afternoon peak hour. It also indicates that westbound left-turn movement is operating at v/c ratio of 0.93 during morning peak hour. In the afternoon peak hour, the northbound right-turn movement is operating close to capacity with v/c ratio of 0.95. Despite the higher v/c ratios for various movements at this intersection, the micro-simulation analysis confirms that all the turning movements are operating with an acceptable LOS C and better.
- **Sherbourne Street and Howard Street:** During morning peak hour, the westbound left-turning traffic from Howard Street to Sherbourne Street is operating at LOS 'D/E', with an average delay of 54 seconds. Observing multiple micro-simulation runs reveal that the westbound left-turning vehicles are yielding to a large volume of pedestrians (refer to **Table 1**, in Section 2.2), as a result, this movement is experiencing higher delays. This movement is operating at LOS C with an average vehicular delay of 28 seconds in the afternoon peak hour. All other movements are operating at LOS C and better, with v/c of no more than 0.60.

# 3 CONSTRUCTION STAGES

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## 3.1 CONSTRUCTION STAGING STRATEGY

The widening of the pedestrian tunnel will be constructed in two stages. Each construction staging will include – closure of two vehicular lanes on Bloor Street East, by reducing traffic to one lane in each direction. The construction will require two-lane closure over the length of the pedestrian tunnel. During each construction stage, the vehicular traffic will be shifted to the north or south, while constructing the south and north portion of the pedestrian tunnel, respectively. It is assumed that the existing dedicated on-street bike lanes bicycle will be maintained during construction stages. Description of construction stages are summarized below:

### Stage 1

Stage 1 will consist of working on the south side of the pedestrian tunnel. As a result, the traffic on the eastbound and westbound directions will be shifted to the north side. This will be achieved by merging two travel lanes in each direction into single lane prior to the construction zone with approximately 30 meters of taper length.

### Stage 2

Similarly, Stage 2 will consist of working on the north side of the pedestrian tunnel. As a result, the eastbound and westbound lanes will be shifted to the south side.

The proposed lane closure arrangements for Stage 1 and 2 are presented in **Appendix B**.

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## 3.2 MODELLING PARAMETERS FOR WORK ZONE

In order to accurately capture the behaviour of drivers near work zones, there are few driving behaviour parameters were taken into consideration for the future (2020) conditions analysis during construction stages.

The location of the work zone in the study area is approximately 75 meters east of the intersection of Sherbourne Street and the posted speed on Bloor Street East is 50 km/h; the desired posted speed was not further reduced through the stretch of the work zone. Due to the close proximity of construction zone from the Sherbourne Street and Bloor Street East intersection, a default value for look-ahead distance (for lane-change) of 200 meters per lane was reduced to 100 meters. Since the speed through the corridor of Bloor Street.

Multiple runs of the micro-simulation model were analyzed to assess the potential variation and ensure that impacts are adequately reflected by the analysis (see **Section 4**).

# 4 FUTURE (2020) TRAFFIC CONDITIONS

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## 4.1 FUTURE (2020) TRAFFIC VOLUMES

To account for any traffic growth related to any development outside the study area and to reflect the vehicular volume when the rehabilitation work will be underway in the year 2020, a conservative growth rate of 1% per annum was applied to the existing (2016) volume. During construction of the pedestrian tunnel, some amount of vehicular traffic which typically travel on Bloor Street will likely divert to other adjacent corridors. However, to assess the worst-case condition during the future (2020) peak period, the traffic analysis assumes no traffic diversion.

The future (2020) background traffic data, after the application of the 1% growth per annum is presented in **Figure 4**.

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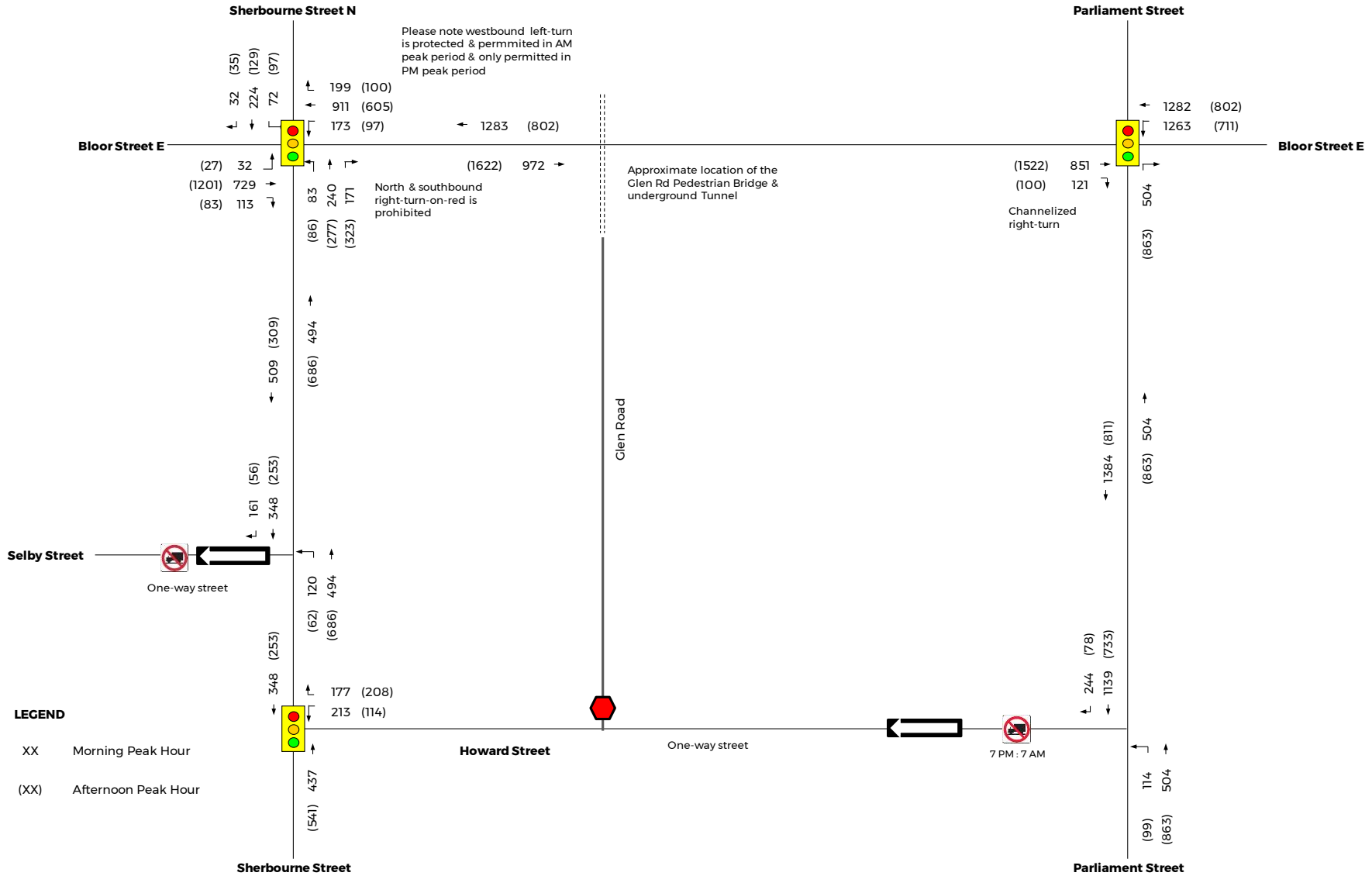
## 4.2 FUTURE (2020) INTERSECTION OPERATIONAL ANALYSIS – BASE CASE

Based on the discussion with the City, the construction for the pedestrian bridge rehabilitation over Bloor Street East is expected to take place by 2020. Therefore, traffic operational analysis for the future (2020) conditions was conducted establishing the base conditions - i.e. without any construction activities/lane reductions.

The intersection operational analysis results for the base case conditions - are presented in **Table 4**, and Synchro model outputs for the Future (2020) Base Case Analysis are provided in **Appendix C**.



**Figure 4: Projected Traffic Volumes for Future (2020) Conditions**



**Table 4: Future (2020) Intersection Level of Service - Base Case**

Intersection/Movement	Weekday Morning Peak Hour				Weekday Afternoon Peak Hour			
	V/C	Delay	LOS	Queue <sup>1</sup>	V/C	Delay	LOS	Queue <sup>1</sup>
<b>Bloor St E &amp; Sherbourne St (Signalized)</b>		<b>19 s</b>	<b>B</b>			<b>23 s</b>	<b>C</b>	
Eastbound Left	0.23	23 s	C	10 m	0.13	22 s	C	8 m
Eastbound Through/Right	0.77	17/21 s	B/C	69 m	0.94	17/20 s	B/B	102 m
Westbound Left <sup>2</sup>	0.71	18 s	B	28 m	<b>1.50</b>	<b>60 s</b>	<b>E</b>	<b>35 m</b>
Westbound Through/Right	0.71	12/14 s	B/B	72 m	0.51	13/15 s	B/B	55 m
Northbound Left	0.47	35 s	D	24 m	0.30	32 s	C	24 m
Northbound Through	0.55	25 s	C	73 m	0.51	25 s	C	95 m
Northbound Right	0.54	41 s	D	58 m	0.80	48 s	D	129 m
Southbound Left	0.36	35 s	C	23 m	0.41	29 s	C	26 m
Southbound Through/Right	0.63	30/29 s	C/C	67 m	0.34	21/21 s	C/C	41 m
<b>Bloor St E &amp; Parliament St (Signalized)</b>		<b>17 s</b>	<b>B</b>			<b>19 s</b>	<b>B</b>	
Eastbound Through	0.79	24 s	C	89 m	1.10	22 s	C	132 m
Eastbound Right (channelized)	0.26	16 s	B	0 m	0.17	16 s	B	0 m
Westbound Left	0.95	26 s	C	150 m	0.66	24 s	C	64 m
Westbound Through	<b>1.17</b>	2 s	A	102 m	0.58	0 s	A	0 m
Northbound Right	0.49	18 s	B	51 m	0.98	25 s	C	90 m
<b>Sherbourne St &amp; Howard St (Signalized)</b>		<b>21 s</b>	<b>C</b>			<b>19 s</b>	<b>B</b>	
Westbound Left	<b>0.47</b>	<b>66 s</b>	<b>E</b>	<b>84 m</b>	0.25	27 s	C	26 m
Westbound Through/Right	0.34	22/12 s	C/B	27 m	0.43	22/17 s	C/B	36 m
Northbound Left/Through	0.50	24/13 s	C/B	69 m	0.62	27/24 s	C/C	122 m
Southbound Through/Right	0.42	10/6 s	B/A	76 m	0.32	9/4 s	A/A	51 m

Note: 1. Queue length reflects 95<sup>th</sup> percentile condition.

2. Westbound left-turn is assumed to operate with protected plus permissive phases during morning peak period, and with a permissive phase only during afternoon peak period.

Similar to the existing conditions, the study area intersections in the future (2020) conditions are expected to operate at an overall level acceptable LOS - i.e. LOS *D* or better. The analysis results demonstrate the following conditions at the study area intersections:

- **Sherbourne Street and Bloor Street East:** with the consideration of 1% growth per annum in traffic volume, the analysis results show that individual turning movements will experience no significant changes in their operating performance and hence, continue to operate at similar LOS and v/c ratios during morning peak hour.

However, during the afternoon peak hour, v/c ratio of the westbound left-turn movement is expected to increase in the future (2020) conditions from 1.33 to 1.50. The delay for this movement is expected to increase to 60 s, from 56 s observed during existing (2016) conditions. All other intersection movements are expected to experience minor changes in their v/c values, 95<sup>th</sup> percentile queue lengths, LOS and delays. Furthermore, the eastbound through/right movement will increase in its v/c ratio from 0.90 to 0.94 with an increase in the queue length from 97 meters to 102 meters. Provision of additional green time for the east-west movements is expected to increase delays for the northbound approach. Hence, revisions in signal timings are not considered.

- **Bloor Street East and Parliament Street:** During morning peak hour, the westbound left and through movement is expected to operate with v/c ratios of 0.95 and 1.17 respectively, and the northbound right and eastbound through movements to operate with v/c ratios of 0.98 and 1.10 respectively in the afternoon peak hour. However, the micro-simulation analysis results confirm that additional traffic volumes with future growth would have minor impacts. All individual turning movements are expected to operate with an acceptable LOS.
- **Sherbourne Street and Howard Street:** During morning peak hour, the delay for the westbound left turn is expected to increase from 54 s to 66 s, resulting LOS will drop *D* to *E*. All other turning movements are expected to operate with an acceptable LOS i.e. LOS *D* or better.

In summary, the traffic operational analysis results for the future (2020) conditions indicate that with the future growth in the traffic volumes, traffic delays for the study area intersections will slightly increase. The critical movements will continue to be the westbound left-turn movement at the Sherbourne Street and Howard Street intersection during the morning peak hour, and westbound left-turn movement and northbound right-turn at the Sherbourne Street and Bloor Street East during afternoon peak hour.

## 4.3 FUTURE (2020) INTERSECTION OPERATIONAL ANALYSIS – CONSTRUCTION STAGES

A summary of the future (2020) weekday morning and afternoon peak hour capacity utilization, delay, LOS and the 95th percentile queue lengths for Construction Stage 1 and 2 are presented in **Table 5** and **Table 6**, respectively. It is noted that there is no change in signal timing plans between Synchro models in Base Case and Construction Stages.

**Table 5: Future (2020) Intersection Level of Service – Construction Stage 1**

Intersection/Movement	Weekday Morning Peak Hour				Weekday Afternoon Peak Hour			
	V/C	Delay	LOS	Queue <sup>1</sup>	V/C	Delay	LOS	Queue <sup>1</sup>
<b>Bloor St E &amp; Sherbourne St (Signalized)</b>		<b>21 s</b>	<b>C</b>			<b>29 s</b>	<b>C</b>	
Eastbound Left	0.23	24 s	C	11 m	0.13	25 s	C	9 m
Eastbound Through/Right	0.77	18/21 s	B/C	69 m	0.94	26/24 s	C/C	125 m
Westbound Left <sup>2</sup>	0.71	22 s	C	28 m	<b>1.50</b>	<b>119 s</b>	<b>F</b>	<b>60 m</b>
Westbound Through/Right	0.71	15/15 s	B/B	69 m	0.51	14/13 s	B/B	52 m
Northbound Left	0.47	36 s	D	25 m	0.30	34 s	C	24 m
Northbound Through	0.55	25 s	C	75 m	0.51	28 s	C	104 m
Northbound Right	0.54	40 s	D	57 m	0.80	54 s	D	130 m
Southbound Left	0.36	35 s	D	23 m	0.41	29 s	C	26 m
Southbound Through/Right	0.63	30/29 s	C/C	67 m	0.34	23/21 s	C/C	41 m
<b>Bloor St E &amp; Parliament St (Signalized)</b>		<b>17 s</b>	<b>B</b>			<b>20 s</b>	<b>C</b>	
Eastbound Through	0.79	24 s	C	86 m	1.10	26 s	C	123 m
Eastbound Right (channelized)	0.26	15 s	B	0 m	0.17	18 s	B	0 m
Westbound Left	0.95	27 s	C	142 m	0.66	24 s	C	65 m
Westbound Through	1.17	2 s	A	92 m	0.58	0 s	A	0 m
Northbound Right	0.49	18 s	B	53 m	0.98	25 s	C	92 m
<b>Sherbourne St &amp; Howard St (Signalized)</b>		<b>21 s</b>	<b>C</b>			<b>23 s</b>	<b>C</b>	
Westbound Left	<b>0.47</b>	<b>66 s</b>	<b>E</b>	<b>84 m</b>	0.25	27 s	C	26 m
Westbound Through/Right	0.34	22/11 s	C/B	26 m	0.43	22/21 s	C/C	40 m
Northbound Left/Through	0.50	24/13 s	C/B	73 m	0.62	35/31 s	D/C	138 m
Southbound Through/Right	0.42	10/6 s	B/A	70 m	0.32	9/5 s	A/A	53 m

Note: 1. Queue length reflects 95<sup>th</sup> percentile queue condition.

2. Westbound left-turn is protected & permissive during morning peak period and permissive during afternoon peak period.

**Table 6: Future (2020) Intersection Level of Service - Construction Stage 2**

Intersection/Movement	Weekday Morning Peak Hour				Weekday Afternoon Peak Hour			
	V/C	Delay	LOS	Queue <sup>1</sup>	V/C	Delay	LOS	Queue <sup>1</sup>
<b>Bloor St E &amp; Sherbourne St (Signalized)</b>		<b>21 s</b>	<b>C</b>			<b>29 s</b>	<b>C</b>	
Eastbound Left	0.23	23 s	C	11 m	0.13	23 s	C	6 m
Eastbound Through/Right	0.77	18/21 s	B/C	70 m	0.94	24/27 s	C/C	124 m
Westbound Left <sup>2</sup>	0.71	22 s	C	29 m	<b>1.50</b>	<b>121 s</b>	<b>F</b>	<b>55 m</b>
Westbound Through/Right	0.71	15/15 s	B/B	66 m	0.51	14/12 s	B/B	52 m
Northbound Left	0.47	36 s	D	25 m	0.30	37 s	D	27 m
Northbound Through	0.55	25 s	C	72 m	0.51	29 s	C	116 m
Northbound Right	0.54	41 s	D	57 m	<b>0.80</b>	<b>59 s</b>	<b>E</b>	<b>131 m</b>
Southbound Left	0.36	36 s	D	23 m	0.41	28 s	C	26 m
Southbound Through/Right	0.63	30/29 s	C/C	67 m	0.34	22/21 s	C/C	41 m
<b>Bloor St E &amp; Parliament St (Signalized)</b>		<b>17 s</b>	<b>B</b>			<b>20 s</b>	<b>B</b>	
Eastbound Through	0.79	24 s	C	87 m	1.10	26 s	C	124 m
Eastbound Right (channelized)	0.26	15 s	B	0 m	0.17	18 s	B	0 m
Westbound Left	0.95	27 s	C	146 m	0.66	24 s	C	65 m
Westbound Through	1.17	2 s	A	100 m	0.58	0 s	A	0 m
Northbound Right	0.49	18 s	B	52 m	0.98	25 s	C	92 m
<b>Sherbourne St &amp; Howard St (Signalized)</b>		<b>20 s</b>	<b>C</b>			<b>28 s</b>	<b>C</b>	
Westbound Left	<b>0.47</b>	<b>66 s</b>	<b>E</b>	<b>84 m</b>	0.25	27 s	C	26 m
Westbound Through/Right	0.34	22/11 s	C/B	27 m	0.43	25/25 s	C/C	44 m
Northbound Left/Through	0.50	24/13 s	C/B	71 m	0.62	44/41 s	D/D	172 m
Southbound Through/Right	0.42	10/6 s	B/A	73 m	0.32	9/5 s	A/A	51 m

Note: 1. Queue length reflects 95<sup>th</sup> percentile queue condition.

2. Westbound left-turn is protected & permissive during morning peak period and permissive during afternoon peak period.

Based on the summaries of future (2020) traffic conditions with work zone during Construction Stage 1 and 2, as presented in **Table 5** and **Table 6**, the following characteristics at the study area signalized intersections were observed for weekday morning and afternoon peak hour:

- **Sherbourne Street and Bloor Street East:** With the lane reduction due to the work zone, an overall intersection delay is expected to increase from 19 seconds to 21 seconds, and the LOS will drop from *B* to *C* in the morning peak hour. An overall average intersection delay in the afternoon peak hour will increase from 23 seconds to 29 seconds, operating at LOS *C*.

The traffic operational analysis results confirm that individual turning movements are expected to operate at an acceptable level of service during morning peak hour. However, during afternoon peak hour, LOS of the westbound left-turn movement is expected to get worse from LOS *E* to LOS *F*, and delay for this movement is expected to increase from 60 seconds to 119 seconds (two minutes). Similarly, LOS for the northbound right-turn movement is expected to drop from LOS *D* to *E* during stage 2, with an average delay of 59 seconds and the 95<sup>th</sup> queue length of 131 meters. All other intersection movements will experience a slight increase in their LOS and delays. Based on the micro-simulation results, the 95<sup>th</sup> percentile queue is expected to increase for the eastbound through movement from 102 meters to 125 meters, along with westbound left-turn movement, which will experience an increase in its queue length from 35 meters to 60 meters.

- **Bloor Street East and Parliament Street:** The construction activities on Bloor Street East would have not significant impacts on the traffic operations at this intersection. All the individual turning movements are expected to operate with an acceptable level of service.
- **Sherbourne Street and Howard Street:** The northbound through movement at Sherbourne Street and Howard Street intersection is expected to experience additional delays as a result of the northbound right-turn queues at Sherbourne Street and Bloor Street intersection extending back up to Howard Street intersection.

In addition to the intersection operational analysis, the impacts on the travel time for the eastbound and westbound traffic on Bloor Street East were also assessed using micro-simulation analysis, for both the morning and afternoon peak hours. A comparison of travel times (between west of Sherbourne Street and east of Parliament Street) - i.e. with and without Construction Stages, for the morning and afternoon peak hours are presented in **Table 7** and **Table 8**, respectively.

**Table 7: Impact on Travel Time - Future (2020) Weekday Morning Peak Hour**

Construction Stage	Stage 1				Stage 2			
Simulation Run	Eastbound Travel Time (s)		Westbound Travel Time (s)		Eastbound Travel Time (s)		Westbound Travel Time (s)	
	Without Work Zone	With Work Zone	Without Work Zone	With Work Zone	Without Work Zone	With Work Zone	Without Work Zone	With Work Zone
1	109	110	72	75	109	110	72	76
2	108	108	72	76	108	108	72	74
3	106	107	73	78	106	106	73	78
4	107	107	73	76	107	107	73	78
5	109	109	72	74	109	109	72	74
6	105	105	72	75	105	106	72	75
7	106	106	73	77	106	106	73	76
8	109	109	73	78	109	109	73	77
9	107	107	72	75	107	107	72	75
10	107	107	71	76	107	108	71	75
Average Travel Time (s)	107	107	72	76	107	107	72	76
Increase in Travel Time (s)	No change		4		No change		4	

As presented in **Table 7** the average travel time for the westbound directions during morning peak hour is projected to increase by about 4 seconds for the proposed construction stages. There are negligible changes in the eastbound direction.

**Table 8: Impact on Travel Time - Future (2020) Weekday Afternoon Peak Hour**

Construction Stage	Stage 1				Stage 2			
Simulation Run	Eastbound Travel Time (s)		Westbound Travel Time (s)		Eastbound Travel Time (s)		Westbound Travel Time (s)	
	Without Work Zone	With Work Zone	Without Work Zone	With Work Zone	Without Work Zone	With Work Zone	Without Work Zone	With Work Zone
1	104	127	71	81	104	120	71	72
2	103	114	72	73	103	112	72	72
3	104	120	73	74	104	114	73	73
4	105	116	72	72	105	115	72	72
5	103	116	72	72	103	116	72	72
6	109	122	71	72	109	119	71	71
7	105	118	72	73	105	115	72	73
8	104	120	73	73	104	116	73	73
9	104	112	73	73	104	114	73	73
10	102	111	71	72	102	110	71	72
Average Travel Time (s)	104	118	72	74	104	115	72	72
Increase in Travel Time (s)	14		2		11		No change	

As shown in **Table 8**, during afternoon peak hour, the average travel time for the eastbound direction is expected to increase up to about 14 seconds, and for the westbound direction by about 2 seconds with the proposed construction activities.



## 4.4 FUTURE (2020) INTERSECTION OPERATIONAL ANALYSIS – CONSTRUCTION STAGES AND OPTIMIZED SIGNAL TIMINGS

Based on the comparison between the analysis results of the future (2020) background traffic condition and the future (2020) traffic condition with work zones, the presence of the construction work zone for the widening of the pedestrian tunnel, may not significantly impact the traffic operations for the Bloor Street/Parliament Street intersection, and Sherbourne Street/Howard Street intersection. However, queue length for the westbound left-turn movement at the intersection of Bloor Street East/Sherbourne Street could potentially extend back to the work zone and delay for this movement could go up to two minutes for travelers.

In order to provide an acceptable level of service for the westbound left-turn movement at the Bloor Street East/Sherbourne Street intersection, this movement is proposed to operate with protected plus permitted phases during afternoon peak hour. With this improvement, an average delay for this movement could reduce from 120 seconds to 28 seconds; and the 95<sup>th</sup> percentile queue length is expected to reduce from 60 m to 24 m (presented in **Table 9**). However, the operational delays for the eastbound movements are expected to increase (at LOS 'E' with 60 seconds delay) with a reduction in green time.

**Table 9: Future (2020) Operating Performance-with Protected & Permitted Phases for WBL at Bloor Street East and Sherbourne Street Intersection (Afternoon Peak Hour)**

Intersection/Movement	With Protected & Permitted Phases for WBL-Stage 1 Afternoon Peak Hour				With Protected & Permitted Phases for WBL-Stage 2 Afternoon Peak Hour			
	V/C	Delay	LOS	Queue <sup>1</sup>	V/C	Delay	LOS	Queue <sup>1</sup>
<b>Bloor St E &amp; Sherbourne St (Signalized)</b>		43 s	D			41 s	D	
Eastbound Left	0.13	56 s	E	7 m	0.13	43 s	D	8 m
Eastbound Through/Right	1.09	61/61 s	E/E	246 m	1.09	52/61 s	D/E	238 m
Westbound Left	0.65	28 s	C	24 m	0.65	28 s	C	24 m
Westbound Through/Right	0.50	13/12 s	B/B	51 m	0.50	13/12 s	B/B	51 m
Northbound Left	0.31	39 s	D	28 m	0.31	42 s	D	28 m
Northbound Through	0.52	31 s	C	122 m	0.52	36 s	D	128 m
Northbound Right	0.82	62 s	E	131 m	0.82	73 s	E	132 m
Southbound Left	0.42	32 s	C	28 m	0.42	31 s	C	28 m
Southbound Through/Right	0.35	24/25 s	C/C	47 m	0.35	24/25 s	C/C	49 m

Note: 1. Queue length reflects 95<sup>th</sup> percentile queue condition.

To further improve the overall level of service for the Bloor Street East and Sherbourne Street intersection, an additional Sensitivity Analysis was conducted which consider the following improvements to the signal timings:

- Protected and permitted phases for the westbound left-turn movement, and
- Permitted plus overlap phases for the northbound right-turn movement

The provision of protected & permitted westbound left-turn during the afternoon peak hour could utilize the existing loop detector which is in place for this approach. For the permitted plus over phases for the northbound right turn movement could require revisions in signal heads. The guidelines for minimum interval times from the Ontario Traffic Manual book 12 (OTM book 12) were followed for signal control timing modifications. The total cycle length during afternoon peak period is assumed to remain at 88 seconds. The intersection operational analysis results with the suggested traffic signal modifications are summarized in **Table 10** for Construction Stage 1 and 2. The Synchro model outputs for Future (2020) Conditions during Construction Stages with optimized signal timing plans are provided in **Appendix D**.

**Table 10: Future (2020) Intersection Level of Service with Optimized Signal Timing Plans**

Intersection/Movement	<u>Without Signal Control Timing Modification</u>				<u>With Signal Control Timing Modification</u>			
	Afternoon Peak Hour				Afternoon Peak Hour			
	V/C	Delay	LOS	Queue <sup>1</sup>	V/C	Delay	LOS	Queue <sup>1</sup>
<b>Construction Stage 1</b>								
<b>Bloor St E &amp; Sherbourne St (Signalized)</b>		<b>29 s</b>	<b>C</b>			<b>27 s</b>	<b>C</b>	
Eastbound Left	0.13	25 s	C	9 m	0.12	26 s	C	7 m
Eastbound Through/Right	0.94	26/24 s	C/C	125 m	1.03	30/29 s	C/C	147 m
Westbound Left	1.50	<b>119 s</b>	<b>F</b>	60 m	0.62	24 s	C	23 m
Westbound Through/Right	0.51	14/13 s	B/B	52 m	0.46	11/10 s	B/B	45 m
Northbound Left	0.30	34 s	C	24 m	0.36	37 s	D	28 m
Northbound Through	0.51	28 s	C	104 m	0.60	30 s	C	105 m
Northbound Right	0.80	54 s	D	130 m	0.73	44 s	D	130 m
Southbound Left	0.41	29 s	C	26 m	0.52	38 s	D	32 m
Southbound Through/Right	0.34	23/21 s	C/C	41 m	0.40	27/25 s	C/C	45 m
<b>Construction Stage 2</b>								
<b>Bloor St E &amp; Sherbourne St (Signalized)</b>		<b>29 s</b>	<b>C</b>			<b>26 s</b>	<b>C</b>	
Eastbound Left	0.13	23 s	C	6 m	0.12	23 s	C	8 m
Eastbound Through/Right	0.94	24/27 s	C/C	124 m	1.03	27/33 s	C/C	134 m
Westbound Left	1.50	121 s	F	55 m	0.62	24 s	C	23 m
Westbound Through/Right	0.51	14/12 s	B/B	52 m	0.46	11/10 s	B/A	45 m
Northbound Left	0.30	37 s	D	27 m	0.36	36 s	D	26 m
Northbound Through	0.51	29 s	C	116 m	0.60	30 s	C	104 m
Northbound Right	0.80	59 s	E	131 m	0.73	45 s	D	127 m
Southbound Left	0.41	28 s	C	26 m	0.52	36 s	D	31 m
Southbound Through/Right	0.34	22/21 s	C/C	41 m	0.40	27/27 s	C/C	44 m

Note: 1. Queue length reflects 95<sup>th</sup> percentile queue condition.

As summarized in **Table 10**, the optimized signal control timing for the Sherbourne Street and Bloor Street East intersection could reduce the potential delays during construction stage during afternoon peak hour. With the optimized signal timing plans, all the individual turning movements are expected to operate with an acceptable level of service.

# 5 STUDY FINDINGS

The following summarizes the key findings in regards to the existing (2016) traffic conditions, and future (2020) traffic conditions with proposed construction stages for rehabilitation of Glenn Road pedestrian tunnel.

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## 5.1 EXISTING (2016) CONDITIONS

- The traffic analysis for the existing conditions confirms that all the study area intersections are operating with an acceptable level of service – i.e. LOS *D* or better, during morning peak hours. The westbound left-turn movement at the Sherbourne Street and Howard Street intersection is the critical movement, which is currently operating at LOS *D/E* with an average delay of 54 seconds per vehicle.
  - During afternoon peak hour, the westbound left-turn movement at the Sherbourne Street and Bloor Street East intersection is operating at LOS *E* with a delay of 56 seconds, and northbound right-turn movement, which is operating at LOS *D*. The 95<sup>th</sup> percentile queue length for the northbound right turn is approximately 124 meters, extends back to Sherbourne Street and Howard Street intersection.
  - All other signalized intersection movements are operating at LOS *C* and better during both weekday morning and afternoon peak hour.
- 

## 5.2 FUTURE (2020) TRAFFIC CONDITIONS – BASE CASE

- The traffic operational analysis results for the future (2020) conditions show that with the future growth in the traffic volumes, delays for the study area intersections will slightly increase.
  - During morning peak hour, the average delay for the westbound left-turn movement at the Sherbourne Street and Howard Street intersection is expected to increase from 54 s to 66 s, resulting LOS will drop *D* to *E*.
  - During afternoon peak hour, the westbound left-turn movement at the Sherbourne Street and Bloor Street East is expected to operate with an unacceptable LOS *E* with an average delay of 60 s, and v/c ratio of 1.50.
- 

## 5.3 FUTURE (2020) TRAFFIC CONDITIONS – CONSTRUCTION STAGES

- The rehabilitation of the pedestrian tunnel will be conducted in two stages. Each construction staging will include – closure of two vehicular lanes on Bloor Street East, by reducing traffic to one lane in each direction. The construction will require two-lane closure over the length of the pedestrian tunnel. During construction, the vehicular traffic will be shifted to the north or south, while constructing the south and north portion of the pedestrian tunnel, respectively. It is assumed that the existing on-street dedicated bike lanes bicycle will be maintained during construction stages.
- Under both the construction stages, the overall delay for the Sherbourne Street and Bloor Street East intersection is expected to increase from 19 seconds to 21 seconds during morning peak hour, and from 23 seconds to 29 seconds during afternoon peak hour. The Bloor Street and Parliament Street intersection is not expected to experience any significant impacts with the lane closures on Bloor Street East.
- Without any modifications to the signal timings, the delays for the westbound left-turn movement at the Sherbourne Street and Bloor Street East intersection is expected to increase to 119 seconds (LOS *F*), compared to 60 seconds (LOS *E*) without lane closures on Bloor Street East. Similarly, LOS for the northbound right-turn movement

is expected to drop from LOS *D* to *E* during stage 2, with a delay of 59 seconds and the 95<sup>th</sup> queue length of 131 meters. All other intersection movements will experience a slight increase in their LOS and delays.

- The northbound through movement at Sherbourne Street and Howard Street intersection is expected to experience additional delays as a result of the northbound right-turn queues at Sherbourne Street and Bloor Street intersection extending back up to Howard Street intersection.
- During the morning peak hour, the average travel time for the westbound direction is projected to increase by about 4 seconds for the proposed construction stages (**Table 7**); during the afternoon peak hour, the average travel time is expected to increase up to about 14 seconds for the eastbound direction, and by about 2 seconds for the westbound direction (**Table 8**).

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## 5.4 FUTURE (2020) TRAFFIC CONDITIONS - CONSTRUCTION STAGES AND OPTIMIZED SIGNAL TIMING PLANS

To improve the traffic operations for the Bloor Street East and Sherbourne Street intersection during afternoon peak hour, an additional sensitivity analysis was conducted with the following modifications to the signal timings:

- Protected and permitted phases for the westbound left-turn movement, and
- Permitted plus overlap phases for the northbound right-turn movement

The total cycle length during afternoon peak period is assumed to remain at 88 seconds. The analysis results with this changes in the signal timings, the potential delays for the westbound left turn movement and the northbound right turn movements are expected to improve. A comparison of the intersection level of service with and without traffic signal timing modifications for the afternoon peak hour conditions are summarized in **Table 10** for Construction Stage 1 and 2. The analysis results confirm that with the optimized signal timings, all the individual turning movements at the Bloor Street East and Sherbourne Street intersection are expected to operate with an acceptable LOS (i.e. LOS *D* or better).

# APPENDIX

# A

SYNCHRO RESULTS -  
EXISTING (2016) CONDITIONS





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↙	↕	↙	↕	↙	↕	↗	↙	↕
Traffic Volume (vph)	31	701	166	876	80	231	164	69	215
Future Volume (vph)	31	701	166	876	80	231	164	69	215
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	Perm	NA
Protected Phases		2	1	6		8			4
Permitted Phases	2		6		8		8	4	
Detector Phase	2	2	1	6	8	8	8	4	4
Switch Phase									
Minimum Initial (s)	27.0	27.0	6.0	27.0	25.0	25.0	25.0	25.0	25.0
Minimum Split (s)	33.0	33.0	10.0	33.0	31.0	31.0	31.0	31.0	31.0
Total Split (s)	45.0	45.0	11.0	56.0	32.0	32.0	32.0	32.0	32.0
Total Split (%)	51.1%	51.1%	12.5%	63.6%	36.4%	36.4%	36.4%	36.4%	36.4%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lag	Lead						
Lead-Lag Optimize?									
Recall Mode	Max	Max	None	Max	Max	Max	Max	Max	Max
Act Effect Green (s)	39.1	39.1	52.0	50.0	26.0	26.0	26.0	26.0	26.0
Actuated g/C Ratio	0.44	0.44	0.59	0.57	0.30	0.30	0.30	0.30	0.30
v/c Ratio	0.21	0.74	0.67	0.69	0.44	0.53	0.52	0.33	0.61
Control Delay	19.3	24.2	21.9	15.4	33.7	30.7	32.3	29.4	33.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.3	24.2	21.9	15.4	33.7	30.7	32.3	29.4	33.5
LOS	B	C	C	B	C	C	C	C	C
Approach Delay		24.0		16.3		31.7			32.6
Approach LOS		C		B		C			C

Intersection Summary

Cycle Length: 88  
 Actuated Cycle Length: 88  
 Natural Cycle: 75  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 0.74  
 Intersection Signal Delay: 22.9  
 Intersection Capacity Utilization 119.0%  
 Analysis Period (min) 15  
 Intersection LOS: C  
 ICU Level of Service H

Splits and Phases: 3: Bloor St E & Sherbourne St N





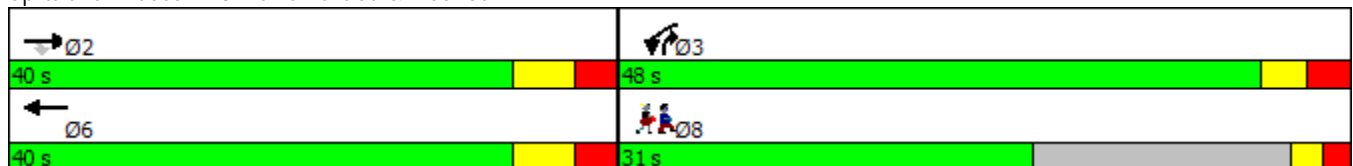


Lane Group	EBT	EBR	WBL	WBT	NBR	Ø8
Lane Configurations	↑↑	↑	↙↘	↑↑	↙↘	
Traffic Volume (vph)	818	116	1214	1233	485	
Future Volume (vph)	818	116	1214	1233	485	
Turn Type	NA	Perm	Prot	NA	Over	
Protected Phases	2		3	6	3	8
Permitted Phases		2				
Detector Phase	2	2	3	6	3	
Switch Phase						
Minimum Initial (s)	6.0	6.0	7.0	6.0	7.0	7.0
Minimum Split (s)	31.0	31.0	33.0	13.0	33.0	31.0
Total Split (s)	40.0	40.0	48.0	40.0	48.0	31.0
Total Split (%)	45.5%	45.5%	54.5%	45.5%	54.5%	35%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	2.0
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.0	7.0	6.0	7.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	Min	Min	None	Min	None	Ped
Act Effct Green (s)	33.0	33.0	40.7	33.0	40.7	
Actuated g/C Ratio	0.38	0.38	0.47	0.38	0.47	
v/c Ratio	0.75	0.25	0.93	1.12	0.48	
Control Delay	28.3	16.4	34.5	91.9	17.5	
Queue Delay	0.0	0.0	0.0	0.0	14.2	
Total Delay	28.3	16.4	34.5	91.9	31.7	
LOS	C	B	C	F	C	
Approach Delay	26.8			63.4		
Approach LOS	C			E		

**Intersection Summary**

Cycle Length: 88  
 Actuated Cycle Length: 86.7  
 Natural Cycle: 90  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 1.12  
 Intersection Signal Delay: 50.6  
 Intersection LOS: D  
 Intersection Capacity Utilization 74.4%  
 ICU Level of Service D  
 Analysis Period (min) 15

Splits and Phases: 8: Parliament St & Bloor St E



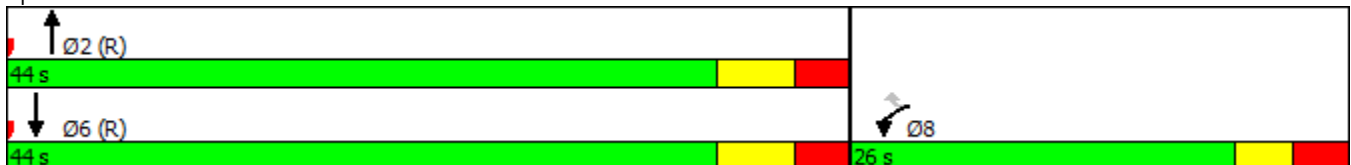


Lane Group	WBL	WBR	NBT	SBT
Lane Configurations	↘	↗	↑	↑
Traffic Volume (vph)	205	170	420	335
Future Volume (vph)	205	170	420	335
Turn Type	Prot	Perm	NA	NA
Protected Phases	8		2	6
Permitted Phases		8		
Detector Phase	8	8	2	6
Switch Phase				
Minimum Initial (s)	19.0	19.0	16.0	16.0
Minimum Split (s)	25.0	25.0	23.0	23.0
Total Split (s)	26.0	26.0	44.0	44.0
Total Split (%)	37.1%	37.1%	62.9%	62.9%
Yellow Time (s)	3.0	3.0	4.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	7.0	7.0
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	C-Max	C-Max
Act Effect Green (s)	19.0	19.0	38.0	38.0
Actuated g/C Ratio	0.27	0.27	0.54	0.54
v/c Ratio	0.46	0.33	0.48	0.40
Control Delay	24.8	5.4	12.1	11.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	24.8	5.4	12.1	11.0
LOS	C	A	B	B
Approach Delay	16.0		12.1	11.0
Approach LOS	B		B	B

**Intersection Summary**

Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 47 (67%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 50  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.48  
 Intersection Signal Delay: 13.1  
 Intersection Capacity Utilization 48.8%  
 Analysis Period (min) 15  
 Intersection LOS: B  
 ICU Level of Service A

Splits and Phases: 10: Sherbourne St & Howard St





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↗	↖	↗
Traffic Volume (vph)	26	1155	93	582	83	266	311	93	124
Future Volume (vph)	26	1155	93	582	83	266	311	93	124
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA
Protected Phases		2		6		8			4
Permitted Phases	2		6		8		8	4	
Detector Phase	2	2	6	6	8	8	8	4	4
Switch Phase									
Minimum Initial (s)	27.0	27.0	27.0	27.0	25.0	25.0	25.0	25.0	25.0
Minimum Split (s)	33.0	33.0	33.0	33.0	31.0	31.0	31.0	31.0	31.0
Total Split (s)	50.0	50.0	50.0	50.0	38.0	38.0	38.0	38.0	38.0
Total Split (%)	56.8%	56.8%	56.8%	56.8%	43.2%	43.2%	43.2%	43.2%	43.2%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)	44.0	44.0	44.0	44.0	32.0	32.0	32.0	32.0	32.0
Actuated g/C Ratio	0.50	0.50	0.50	0.50	0.36	0.36	0.36	0.36	0.36
v/c Ratio	0.12	0.90	1.33	0.49	0.28	0.49	0.77	0.38	0.33
Control Delay	13.4	30.0	241.0	15.4	22.9	25.1	38.3	25.9	22.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.4	30.0	241.0	15.4	22.9	25.1	38.3	25.9	22.5
LOS	B	C	F	B	C	C	D	C	C
Approach Delay		29.6		42.6		31.1			23.7
Approach LOS		C		D		C			C

Intersection Summary

Cycle Length: 88  
 Actuated Cycle Length: 88  
 Natural Cycle: 80  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 1.33  
 Intersection Signal Delay: 32.8  
 Intersection Capacity Utilization 123.4%  
 Analysis Period (min) 15  
 Intersection LOS: C  
 ICU Level of Service H

Splits and Phases: 3: Bloor St E & Sherbourne St N



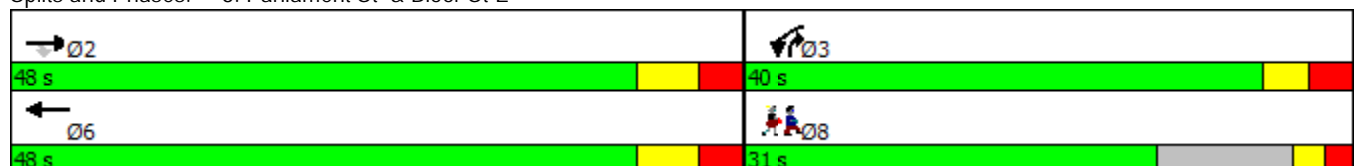


Lane Group	EBT	EBR	WBL	WBT	NBR	Ø8
Lane Configurations	↑↑	↑	↙↘	↑↑	↙↘	
Traffic Volume (vph)	1463	96	684	771	830	
Future Volume (vph)	1463	96	684	771	830	
Turn Type	NA	Perm	Prot	NA	Over	
Protected Phases	2		3	6	3	8
Permitted Phases		2				
Detector Phase	2	2	3	6	3	
Switch Phase						
Minimum Initial (s)	6.0	6.0	7.0	6.0	7.0	7.0
Minimum Split (s)	31.0	31.0	33.0	13.0	33.0	31.0
Total Split (s)	48.0	48.0	40.0	48.0	40.0	31.0
Total Split (%)	54.5%	54.5%	45.5%	54.5%	45.5%	35%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	2.0
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.0	7.0	6.0	7.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	Min	Min	None	Min	None	Ped
Act Effect Green (s)	41.0	41.0	33.6	41.0	33.6	
Actuated g/C Ratio	0.47	0.47	0.38	0.47	0.38	
v/c Ratio	1.06	0.16	0.64	0.56	0.95	
Control Delay	64.4	10.2	25.1	18.6	46.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	64.4	10.2	25.1	18.6	46.4	
LOS	E	B	C	B	D	
Approach Delay	61.1			21.7		
Approach LOS	E			C		

**Intersection Summary**

Cycle Length: 88  
 Actuated Cycle Length: 87.6  
 Natural Cycle: 90  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 1.06  
 Intersection Signal Delay: 43.0  
 Intersection LOS: D  
 Intersection Capacity Utilization 88.0%  
 ICU Level of Service E  
 Analysis Period (min) 15

Splits and Phases: 8: Parliament St & Bloor St E



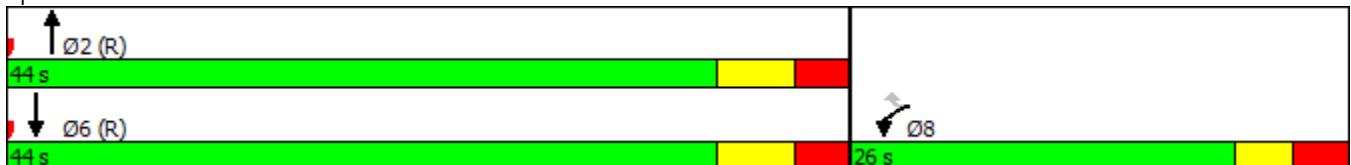


Lane Group	WBL	WBR	NBT	SBT
Lane Configurations	↖	↗	↑	↑
Traffic Volume (vph)	110	200	520	243
Future Volume (vph)	110	200	520	243
Turn Type	Prot	Perm	NA	NA
Protected Phases	8		2	6
Permitted Phases		8		
Detector Phase	8	8	2	6
Switch Phase				
Minimum Initial (s)	19.0	19.0	16.0	16.0
Minimum Split (s)	25.0	25.0	23.0	23.0
Total Split (s)	26.0	26.0	44.0	44.0
Total Split (%)	37.1%	37.1%	62.9%	62.9%
Yellow Time (s)	3.0	3.0	4.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	7.0	7.0
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	C-Max	C-Max
Act Effect Green (s)	19.0	19.0	38.0	38.0
Actuated g/C Ratio	0.27	0.27	0.54	0.54
v/c Ratio	0.25	0.42	0.60	0.31
Control Delay	21.6	6.1	14.1	10.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	21.6	6.1	14.1	10.0
LOS	C	A	B	B
Approach Delay	11.6		14.1	10.0
Approach LOS	B		B	B

**Intersection Summary**

Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 9 (13%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 60  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.60  
 Intersection Signal Delay: 12.5  
 Intersection Capacity Utilization 57.7%  
 Analysis Period (min) 15  
 Intersection LOS: B  
 ICU Level of Service B

Splits and Phases: 10: Sherbourne St & Howard St

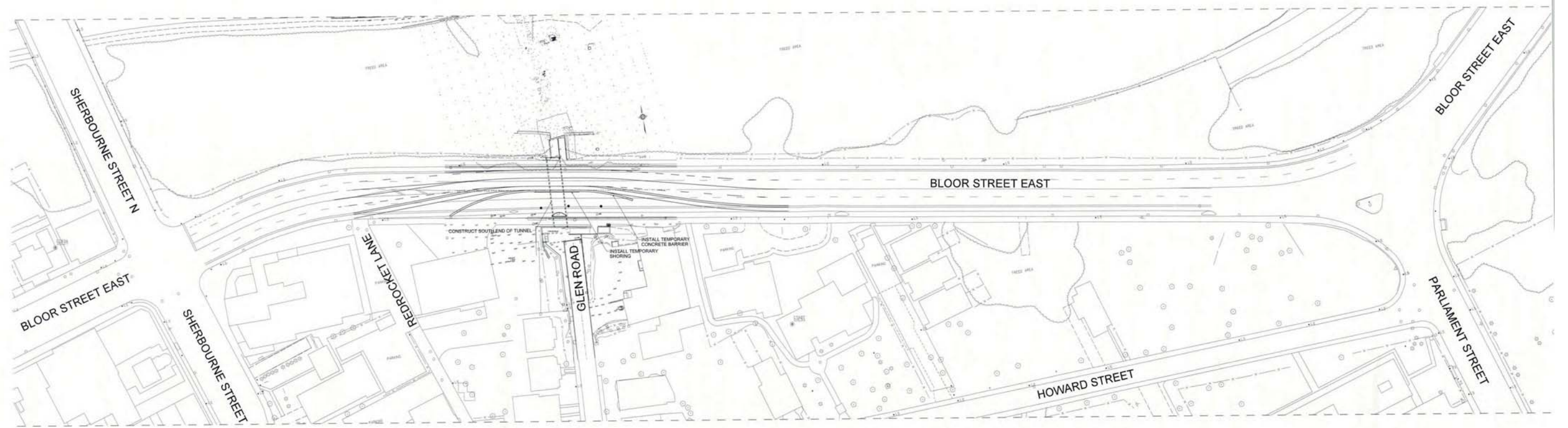


# APPENDIX

## B

### PROPOSED LANE CLOSURE ARRANGEMENT FOR CONSTRUCTION STAGES





STAGE 1





STAGE 2

# APPENDIX

C

SYNCHRO RESULTS -  
FUTURE (2020) BASE CASE  
CONDITIONS



3: Bloor St E & Sherbourne St N

2020 Base Case AM



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↙	↕	↙	↕	↙	↕	↗	↙	↕
Traffic Volume (vph)	31	701	166	876	80	231	164	69	215
Future Volume (vph)	31	701	166	876	80	231	164	69	215
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	Perm	NA
Protected Phases		2	1	6		8			4
Permitted Phases	2		6		8		8	4	
Detector Phase	2	2	1	6	8	8	8	4	4
Switch Phase									
Minimum Initial (s)	27.0	27.0	6.0	27.0	25.0	25.0	25.0	25.0	25.0
Minimum Split (s)	33.0	33.0	10.0	33.0	31.0	31.0	31.0	31.0	31.0
Total Split (s)	45.0	45.0	11.0	56.0	32.0	32.0	32.0	32.0	32.0
Total Split (%)	51.1%	51.1%	12.5%	63.6%	36.4%	36.4%	36.4%	36.4%	36.4%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lag	Lead						
Lead-Lag Optimize?									
Recall Mode	Max	Max	None	Max	Max	Max	Max	Max	Max
Act Effect Green (s)	39.0	39.0	52.0	50.0	26.0	26.0	26.0	26.0	26.0
Actuated g/C Ratio	0.44	0.44	0.59	0.57	0.30	0.30	0.30	0.30	0.30
v/c Ratio	0.23	0.77	0.71	0.71	0.47	0.55	0.54	0.36	0.63
Control Delay	20.3	25.4	25.5	16.1	35.1	31.2	33.0	30.2	34.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.3	25.4	25.5	16.1	35.1	31.2	33.0	30.2	34.3
LOS	C	C	C	B	D	C	C	C	C
Approach Delay		25.2		17.4		32.5			33.4
Approach LOS		C		B		C			C

Intersection Summary

Cycle Length: 88  
 Actuated Cycle Length: 88  
 Natural Cycle: 75  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 0.77  
 Intersection Signal Delay: 24.0  
 Intersection LOS: C  
 Intersection Capacity Utilization 120.3%  
 ICU Level of Service H  
 Analysis Period (min) 15

Splits and Phases: 3: Bloor St E & Sherbourne St N



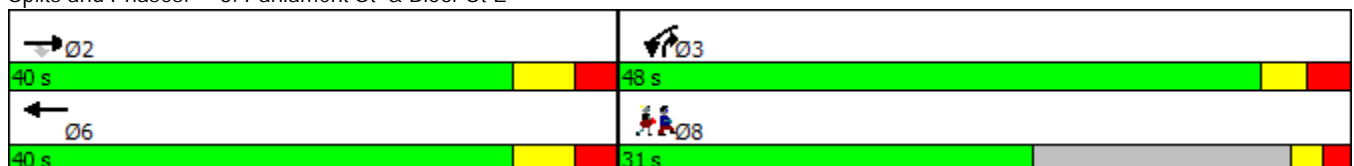


Lane Group	EBT	EBR	WBL	WBT	NBR	Ø8
Lane Configurations	↑↑	↑	↙↘	↑↑	↙↘	
Traffic Volume (vph)	818	116	1214	1233	485	
Future Volume (vph)	818	116	1214	1233	485	
Turn Type	NA	Perm	Prot	NA	Over	
Protected Phases	2		3	6	3	8
Permitted Phases		2				
Detector Phase	2	2	3	6	3	
Switch Phase						
Minimum Initial (s)	6.0	6.0	7.0	6.0	7.0	7.0
Minimum Split (s)	31.0	31.0	33.0	13.0	33.0	31.0
Total Split (s)	40.0	40.0	48.0	40.0	48.0	31.0
Total Split (%)	45.5%	45.5%	54.5%	45.5%	54.5%	35%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	2.0
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.0	7.0	6.0	7.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	Min	Min	None	Min	None	Ped
Act Effect Green (s)	33.0	33.0	41.5	33.0	41.5	
Actuated g/C Ratio	0.38	0.38	0.47	0.38	0.47	
v/c Ratio	0.79	0.26	0.95	1.17	0.49	
Control Delay	30.0	17.4	38.4	114.4	17.6	
Queue Delay	0.0	0.0	0.0	0.0	24.5	
Total Delay	30.0	17.4	38.4	114.4	42.2	
LOS	C	B	D	F	D	
Approach Delay	28.4			76.7		
Approach LOS	C			E		

**Intersection Summary**

Cycle Length: 88  
 Actuated Cycle Length: 87.5  
 Natural Cycle: 100  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 1.17  
 Intersection Signal Delay: 60.7  
 Intersection Capacity Utilization 77.0%  
 Analysis Period (min) 15  
 Intersection LOS: E  
 ICU Level of Service D

Splits and Phases: 8: Parliament St & Bloor St E





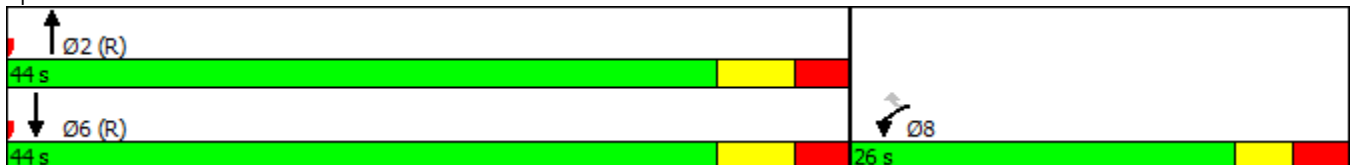
Lane Group	WBL	WBR	NBT	SBT
Lane Configurations	↘	↗	↑	↑
Traffic Volume (vph)	205	170	420	335
Future Volume (vph)	205	170	420	335
Turn Type	Prot	Perm	NA	NA
Protected Phases	8		2	6
Permitted Phases		8		
Detector Phase	8	8	2	6
Switch Phase				
Minimum Initial (s)	19.0	19.0	16.0	16.0
Minimum Split (s)	25.0	25.0	23.0	23.0
Total Split (s)	26.0	26.0	44.0	44.0
Total Split (%)	37.1%	37.1%	62.9%	62.9%
Yellow Time (s)	3.0	3.0	4.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	7.0	7.0
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	C-Max	C-Max
Act Effect Green (s)	19.1	19.1	37.9	37.9
Actuated g/C Ratio	0.27	0.27	0.54	0.54
v/c Ratio	0.47	0.34	0.50	0.42
Control Delay	25.1	5.4	12.5	11.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	25.1	5.4	12.5	11.3
LOS	C	A	B	B
Approach Delay	16.1		12.5	11.3
Approach LOS	B		B	B

**Intersection Summary**

Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 47 (67%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 50  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.50  
 Intersection Signal Delay: 13.4  
 Intersection Capacity Utilization 49.7%  
 Analysis Period (min) 15

Intersection LOS: B  
 ICU Level of Service A

Splits and Phases: 10: Sherbourne St & Howard St



3: Bloor St E & Sherbourne St N

2020 Base Case PM



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↖	↕	↖	↕	↖	↕	↗	↖	↗
Traffic Volume (vph)	26	1155	93	582	83	266	311	93	124
Future Volume (vph)	26	1155	93	582	83	266	311	93	124
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA
Protected Phases		2		6		8			4
Permitted Phases	2		6		8		8	4	
Detector Phase	2	2	6	6	8	8	8	4	4
Switch Phase									
Minimum Initial (s)	27.0	27.0	27.0	27.0	25.0	25.0	25.0	25.0	25.0
Minimum Split (s)	33.0	33.0	33.0	33.0	31.0	31.0	31.0	31.0	31.0
Total Split (s)	50.0	50.0	50.0	50.0	38.0	38.0	38.0	38.0	38.0
Total Split (%)	56.8%	56.8%	56.8%	56.8%	43.2%	43.2%	43.2%	43.2%	43.2%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)	44.0	44.0	44.0	44.0	32.0	32.0	32.0	32.0	32.0
Actuated g/C Ratio	0.50	0.50	0.50	0.50	0.36	0.36	0.36	0.36	0.36
v/c Ratio	0.13	0.94	1.50	0.51	0.30	0.51	0.80	0.41	0.34
Control Delay	13.7	34.2	311.0	15.7	23.2	25.6	40.8	26.8	22.6
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	311.0	15.7	23.2	25.6	40.8	26.8	22.6
LOS	B	C	F	B	C	C	D	C	C
Approach Delay		33.8		51.2		32.5			24.2
Approach LOS		C		D		C			C

Intersection Summary

Cycle Length: 88  
 Actuated Cycle Length: 88  
 Natural Cycle: 90  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 1.50  
 Intersection Signal Delay: 37.2  
 Intersection LOS: D  
 Intersection Capacity Utilization 124.9%  
 ICU Level of Service H  
 Analysis Period (min) 15

Splits and Phases: 3: Bloor St E & Sherbourne St N



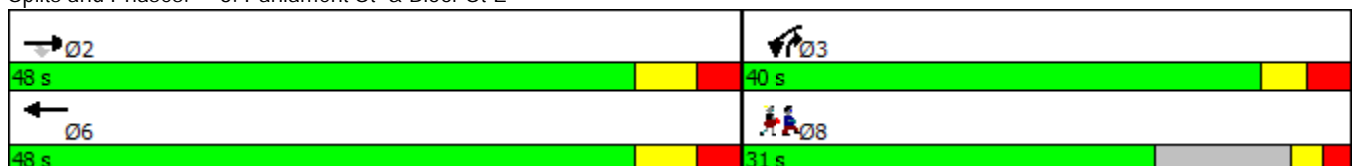


Lane Group	EBT	EBR	WBL	WBT	NBR	Ø8
Lane Configurations	↑↑	↑	↙↘	↑↑	↙↘	
Traffic Volume (vph)	1463	96	684	771	830	
Future Volume (vph)	1463	96	684	771	830	
Turn Type	NA	Perm	Prot	NA	Over	
Protected Phases	2		3	6	3	8
Permitted Phases		2				
Detector Phase	2	2	3	6	3	
Switch Phase						
Minimum Initial (s)	6.0	6.0	7.0	6.0	7.0	7.0
Minimum Split (s)	31.0	31.0	33.0	13.0	33.0	31.0
Total Split (s)	48.0	48.0	40.0	48.0	40.0	31.0
Total Split (%)	54.5%	54.5%	45.5%	54.5%	45.5%	35%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	2.0
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.0	7.0	6.0	7.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	Min	Min	None	Min	None	Ped
Act Effect Green (s)	41.0	41.0	34.0	41.0	34.0	
Actuated g/C Ratio	0.47	0.47	0.39	0.47	0.39	
v/c Ratio	1.10	0.17	0.66	0.58	0.98	
Control Delay	82.1	10.3	25.6	19.2	52.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	82.1	10.3	25.6	19.2	52.4	
LOS	F	B	C	B	D	
Approach Delay	77.6			22.2		
Approach LOS	E			C		

**Intersection Summary**

Cycle Length: 88  
 Actuated Cycle Length: 88  
 Natural Cycle: 100  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 1.10  
 Intersection Signal Delay: 51.2  
 Intersection LOS: D  
 Intersection Capacity Utilization 91.1%  
 ICU Level of Service F  
 Analysis Period (min) 15

Splits and Phases: 8: Parliament St & Bloor St E





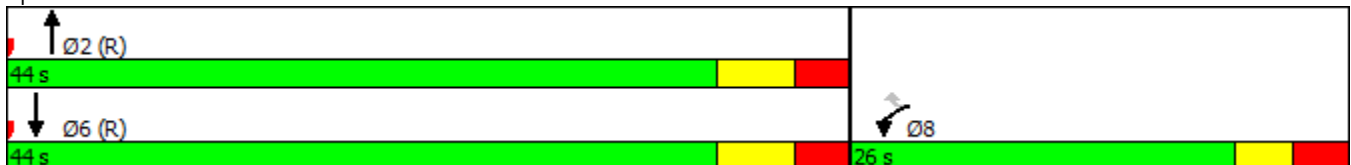


Lane Group	WBL	WBR	NBT	SBT
Lane Configurations	↖	↗	↑	↑
Traffic Volume (vph)	110	200	520	243
Future Volume (vph)	110	200	520	243
Turn Type	Prot	Perm	NA	NA
Protected Phases	8		2	6
Permitted Phases		8		
Detector Phase	8	8	2	6
Switch Phase				
Minimum Initial (s)	19.0	19.0	16.0	16.0
Minimum Split (s)	25.0	25.0	23.0	23.0
Total Split (s)	26.0	26.0	44.0	44.0
Total Split (%)	37.1%	37.1%	62.9%	62.9%
Yellow Time (s)	3.0	3.0	4.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	7.0	7.0
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	C-Max	C-Max
Act Effect Green (s)	19.0	19.0	38.0	38.0
Actuated g/C Ratio	0.27	0.27	0.54	0.54
v/c Ratio	0.25	0.43	0.62	0.32
Control Delay	21.7	6.1	14.7	10.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	21.7	6.1	14.7	10.2
LOS	C	A	B	B
Approach Delay	11.6		14.7	10.2
Approach LOS	B		B	B

**Intersection Summary**

Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 9 (13%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 60  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.62  
 Intersection Signal Delay: 12.8  
 Intersection LOS: B  
 Intersection Capacity Utilization 59.3%  
 ICU Level of Service B  
 Analysis Period (min) 15

Splits and Phases: 10: Sherbourne St & Howard St



# APPENDIX

**D**

SYNCHRO RESULTS -  
FUTURE (2020) CONDITIONS -  
CONSTRUCTION STAGES AND  
OPTIMIZED SIGNAL TIMINGS



3: Bloor St E & Sherbourne St N

2020 Stage 1&2 With Timing Modification - PM



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↙	↕	↙	↕	↙	↕	↗	↙	↕
Traffic Volume (vph)	26	1155	93	582	83	266	311	93	124
Future Volume (vph)	26	1155	93	582	83	266	311	93	124
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases		2	1	6		8	1		4
Permitted Phases	2		6		8		8	4	
Detector Phase	2	2	1	6	8	8	1	4	4
Switch Phase									
Minimum Initial (s)	27.0	27.0	5.0	27.0	25.0	25.0	5.0	25.0	25.0
Minimum Split (s)	33.0	33.0	9.0	33.0	31.0	31.0	9.0	31.0	31.0
Total Split (s)	46.0	46.0	9.0	55.0	33.0	33.0	9.0	33.0	33.0
Total Split (%)	52.3%	52.3%	10.2%	62.5%	37.5%	37.5%	10.2%	37.5%	37.5%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.0	6.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lag	Lag	Lead				Lead		
Lead-Lag Optimize?									
Recall Mode	Max	Max	None	Max	Max	Max	None	Max	Max
Act Effect Green (s)	40.0	40.0	51.0	49.0	27.0	27.0	34.0	27.0	27.0
Actuated g/C Ratio	0.45	0.45	0.58	0.56	0.31	0.31	0.39	0.31	0.31
v/c Ratio	0.12	1.03	0.62	0.46	0.36	0.60	0.73	0.52	0.40
Control Delay	15.6	57.9	27.9	12.2	28.6	32.0	31.1	36.3	27.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.6	57.9	27.9	12.2	28.6	32.0	31.1	36.3	27.5
LOS	B	E	C	B	C	C	C	D	C
Approach Delay		57.1		14.1		31.2			30.8
Approach LOS		E		B		C			C

Intersection Summary

Cycle Length: 88  
 Actuated Cycle Length: 88  
 Natural Cycle: 90  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 1.03  
 Intersection Signal Delay: 37.7  
 Intersection LOS: D  
 Intersection Capacity Utilization 107.3%  
 ICU Level of Service G  
 Analysis Period (min) 15

Splits and Phases: 3: Bloor St E & Sherbourne St N

