# TRAFFIC IMPACT STUDY
# IMPERIAL OIL ESSO STATION
# WOODROFFE AVE AND MEDHURST DR
# OTTAWA

# TRAFFIC IMPACT STUDY
# IMPERIAL OIL ESSO STATION
# WOODROFFE AVE AND MEDHURST DR
# OTTAWA

MARCH 2015


READ, VOORHEES & ASSOCIATES
TORONTO, ONTARIO

*Read, Voorhees & Associates Limited, 2 Duncan Mill Road, Toronto, Ontario M3B 1Z4*
*Tel: 416 445-4360 / Fax: 416 445-4809 / readvoorhees@rva.ca*

# TABLE OF CONTENTS

Page

# LIST OF TABLES



# LIST OF FIGURES

# TRAFFIC IMPACT STUDY
# IMPERIAL OIL ESSO STATION
# WOODROFFE AVE AND MEDHURST DR
# OTTAWA

## 1. INTRODUCTION

Imperial Oil Limited is proposing to redevelop the existing service station at the northeast corner of Woodroffe Avenue and Medhurst Drive in the City of Ottawa. The street address is 1545 Woodroffe Avenue. Figure 1 shows the site location.

An application for Site Plan approval is being submitted. Read, Voorhees & Associates Limited has been retained to prepare a traffic impact study (TIS) in support of the Site Plan application.

The hours of analysis are the weekday a.m. and p.m. peak hours. These are the busiest traffic conditions at the site driveways and at the intersections in the area.

The horizon year is a 5 year period to 2020. The site is presently in use, and will be closed during reconstruction.

The study area consists of the site access driveways on the two adjacent streets, Woodroffe Avenue and Medhurst Drive, and the signalized intersection of Woodroffe Avenue and Medhurst Drive. The change in traffic generation at the site will be minor, and no other intersections beyond the noted study area will be affected.

## 2. DEVELOPMENT PROPOSAL

Figure 2 shows the site plan for the redeveloped site.

The site is currently operating as a service station, with ten fuelling positions, an attendant's kiosk, and a car wash on the site. There is also a free standing Tim Horton's outlet on the property, sharing the site access driveways.

The site presently has three access driveways on the adjacent streets, two right-in/right-out driveways on Woodroffe Avenue and one full moves driveway on Medhurst Drive.

The modified station will continue to provide fuel sales at ten fuelling positions in a relocated position, and will have a retail convenience store of 344 $m^2$ (3700 $ft^2$). The convenience store will have the normal 'On The Run' goods and facilities that are available at newer Esso

sites, and there will be a Tim Horton's drive through service, but will also have a Tim Horton's seating area that is not typical.

The existing free standing Tim Horton's outlet will be removed. The current seating capacity at this facility is 70 persons, but there is no drive through window. The area within the convenience store will have seating capacity for 30 persons, approximately half of the current capacity, but will also have the drive through window.

The existing car wash will continue operation in a relocated location on the site.

The redeveloped service station will maintain the same driveway configuration with the same permitted movements. The driveways will be reconstructed in essentially the same locations.

Twenty-five parking spaces, one of which is a handicap parking space, are to be provided. Fourteen of the parking spaces, including the handicap space, are located immediately in front of and adjacent to the convenience store. The other eleven spaces are near the carwash facility, along with two additional spaces provided at the vacuum pumps. There is also a loading area provided adjacent to the convenience store for garbage bins and collection. This area can be used as a loading space for other deliveries as well.

There are existing sidewalks along the Woodroffe Avenue and Medhurst Drive frontages, which will remain in place with reconstruction of the station. A 1.5m pedestrian connection will be provided on the site between the convenience store and the Medhurst Drive sidewalk. Bicycle racks are also provided on site beside the pedestrian path connection.

A bus shelter is located on Woodroffe Avenue on the west edge of the site, and will be maintained in this location.

Right-of-way widening is provided on both adjacent streets. The right-of-way on Woodroffe Avenue will be 22.25m from centreline of pavement, and the right-of-way on Medhurst Drive will be 12m from centreline of pavement.

# 3. EXISTING CONDITIONS

## 3.1 Street System

Woodroffe Avenue is a six lane arterial road with a centre median that provides north-south service to the area. Two of the lanes are exclusive bus lanes. Left turn lanes are provided at main intersections. The posted speed is 60 km/h.

Medhurst Drive is a two lane collector road providing east-west service through the neighbourhood north of Hunt Club Road. It joins into Knoxdale Road which continues the collector road function west of Woodroffe Avenue. There is a separate westbound left turn lane on Medhurst Drive at the Woodroffe Avenue intersection. The posted speed on Medhust Drive is 40 km/h.

The intersection of Woodroffe Avenue and Medhurst Drive is signalized.

No changes to the existing road system are planned for the area, and no new facilities are proposed.

## 3.2 Traffic Volume

Figure 3 shows the existing a.m. and p.m. peak hour traffic volumes at the site driveways and at the Woodroffe Avenue and Medhurst Drive intersection. The volumes are from a count at the signalized intersection carried out by Ottawa in June 2012, and counts at the site driveways carried out by Read Voorhees in December 2014.

## 3.3 Transit Service

Transit service operates along Woodroffe Avenue, which as noted operates with exclusive bus lanes. Transit usage is obviously not a significant factor for the service station use, but bus stops are located at the intersection with Medhurst Drive.

As noted above, the bus stop adjacent of the service station on Woodroffe Avenue will be maintained in its current location.

## 3.4 Pedestrian and Bicycle Facilities

As discussed earlier, there are sidewalks along both Woodroffe Avenue and Medhurst Drive.

Bicycle lanes are provided on Woodroffe Avenue.

## 3.5 Major Trip Generators in Study Area

Woodroffe Avenue is a major arterial road serving the west side of Ottawa. However, there are no major shopping centres or other major trip generators located in the immediate vicinity of the site,

# 4. TRAFFIC FORECASTS

## 4.1 Background Traffic

The Development Application Search Tool was used to identify any applications for new development in the general vicinity of the site. There are no applications within a kilometre of the subject site, and no applications of notable size within several kilometres of the site.

As a conservatively high growth forecast the 2020 horizon year traffic forecast for Woodroffe Avenue has been based on a general 1.5% annual growth rate, which is a total growth factor

of 1.12 over the 2012 volumes. No growth is anticipated on Medhurst Drive which serves a residential area that is essentially built out.

The 2020 background a.m. and p.m. peak hour volumes are shown in Figure 4.

## 4.2 Site Traffic

Read Voorhees has carried out site traffic counts in the Greater Toronto Area (GTA) at various Esso gas stations with Tim Horton's drive through windows, all of which have a good market draw and have been used as representative of a 'design' site. Most of the locations have 12 fuelling positions. The site trip patterns indicate that in the a.m. peak period a substantial number of site trips are also being attracted to the Tim Horton's drive through service, separate from gas purchases. Traffic through the Tim Horton's drive through in the p.m. peak hour is much less than in the a.m. peak hour.

Table 1 shows the a.m. site peak hour volumes counted recently at nine Esso stations with a Tim Horton's drive through service. The surveys indicate an average of 18.0 and 17.0 cars for the total site entry and exit volumes per filling position, and an average of 109 cars passing through the Tim Horton's drive through in the a.m. peak hour. This is equivalent to about 9 trips per filling position.

Traffic counts were also taken in December 2014 in Ottawa at the Innes Road and Belcourt Blvd Esso station that was rebuilt in 2010 with a Tim Horton's drive through added to the site. The results are also shown in Table 1. The volume of traffic in and out of the Ottawa site, and through the Tim Horton's drive through, are similar to the GTA volumes. However, with only 8 fuelling positions the average rates at the Innes Road and Belcourt Blvd station are higher than the rates calculated for the GTA locations with 12 fuelling positions.

Table 1 - A.M. Peak Hour Volumes at Stations with Tim Horton's Drive Through

| Location | Total Site Inbound Traffic | Total Site Outbound Traffic | Volume Passing Through the Drive Through Lane |
|---|---|---|---|
| Kennedy and Ellesmere (10 pos.) | 189 | 183 | 103 |
| Lawrence and Midland | 157 | 148 | 86 |
| Kingston Road and Saunders | 198 | 186 | 132 |
| Markham and Ellesmere | 197 | 201 | 101 |
| Lake Shore and Carlaw | 241 | 227 | 123 |
| Bathurst and Drewry | 244 | 241 | 104 |
| Markham and Sheppard (10 pos.) | 205 | 199 | 109 |
| Speers and Dorval (16 pos.) | 299 | 264 | 81 |
| Jane and Major Mackenzie | 213 | 182 | 138 |
| | | | |
| AVERAGE | 216 | 203 | 109 |
| Rate per fuelling position (12) | 18.0 | 16.9 | 9.1 |
| | | | |
| Innes and Belcourt (8 positions) | 192 | 199 | 119 |
| Rate per fuelling position (8) | 24.0 | 24.9 | 14.9 |

Table 2 shows the p.m. site peak hour volumes counted at five of the nine Esso stations listed in Table 1. The surveys indicate an average of 12.1 and 11.5 cars for the total site entry and exit volumes per filling position, and an average of 36 cars passing through the Tim Horton's drive through in the p.m. peak hour. This is equivalent to about 3 trips per filling position.

The p.m. peak hour results for the Innes and Belcourt station on a per fuelling position basis are about the same as the GTA surveyed stations.

Table 2 - P.M. Peak Hour Volumes at Stations with Tim Horton's Drive Through

| Location | Total Site Inbound Traffic | Total Site Outbound Traffic | Volume Passing Through the Drive Through Lane |
|---|---|---|---|
| Kennedy and Ellesmere | 145 | 160 | 56 |
| Lawrence and Midland | 124 | 128 | 26 |
| Kingston Road and Saunders | 95 | 82 | 27 |
| Markham and Ellesmere | 140 | 124 | 36 |
| Lake Shore and Carlaw | 198 | 173 | 36 |
| | | | |
| AVERAGE | 140 | 133 | 36 |
| Rate per fuelling position (12) | 11.7 | 11.1 | 3.0 |
| | | | |
| Innes and Belcourt (8 positions) | 88 | 92 | 17 |
| Rate per fuelling position (8) | 11.0 | 11.5 | 2.1 |
| | | | |
| | | | |

The total site traffic is less in the p.m. peak hour, largely due to the traffic through a Tim Horton's drive through window being much less than in the a.m. peak hour, a difference of about 6 trips per filling position.

Removal of the Tim Horton's trip generation component gives a resultant fuelling trip rate calculated at about 9.0 trips per filling position in both the a.m. and p.m. peak hours. This applies to the GTA data as well as the Innes Road and Belcourt Blvd data. These rates are higher than the ITE trip rates for service stations presented in the Trip Generation Manual Eighth Edition.

The Tim Horton's trip generation number seems to be less related to number of fuelling positions. A total volume of 110 to 120 trips in the drive through lane seems to be representative of a busy location regardless of the number of filling positions.

Table 3 shows the existing traffic at the existing Woodroffe Avenue and Medhurst Drive station, and traffic forecast for the redeveloped service station. This represents the traffic at the driveways, and includes both the fuel sales traffic and the Tim Horton's drive through traffic.

Table 3 also shows for information purposes the ITE trip rates from the Trip Generation Manual Eighth Edition for land use code 945, Gasoline/Service Station with Convenience

Market. The existing trip rates for the Woodroffe and Medhurst Esso station are substantially higher than the ITE rates, but this is primarily because rather than just a convenience store on site there is a free standing Tim Horton's outlet on the site which generates more traffic independent of the service station.

It is estimated that at this site that the existing fuel sales is in the order of 7 trips per fuelling position, which divides the traffic about equally between fuel sales and the Tim Horton's facility. The number of fuelling positions will remain at 10, and it is anticipated that the fuel sales market will not change to any noticeable extent.

## Table 3 - Site Trip Generation

| USE | Fuelling Positions | A.M. Peak Hour | | | | P.M. Peak Hour | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Rate | | Trips | | Rate | | Trips | |
| | | In | Out | In | Out | In | Out | In | Out |
| ITE Trip Rates (LU 945) | | 5.08 | 5.08 | | | 6.69 | 6.69 | | |
| | | | | | | | | | |
| Existing Station (10 fuelling positions) | 10 | 14.9 | 14.3 | 149 | 143 | 14.1 | 13.9 | 141 | 139 |
| Existing Esso Station Fuel sales | | 7.0 | 7.0 | 70 | 70 | 7.0 | 7.0 | 70 | 70 |
| Existing Tim Horton's Traffic | | 7.9 | 7.3 | 79 | 73 | 7.1 | 6.9 | 71 | 69 |
| | | | | | | | | | |
| Future Esso Station Fuel Sales | 10 | 7.0 | 7.0 | 70 | 70 | 7.0 | 7.0 | 70 | 70 |
| Tim Horton's Seating Area Traffic | | | | 53 | 49 | | | 48 | 46 |
| Tim Horton's Drive Through Traffic | | | | 119 | 119 | | | 17 | 17 |
| | | | | | | | | | |
| TOTAL FUTURE SITE TRAFFIC | 10 | | | 242 | 238 | | | 135 | 133 |
| | | | | | | | | | |
| EXISTING SITE TRAFFIC | | | | 149 | 143 | | | 141 | 139 |
| | | | | | | | | | |
| NET NEW SITE TRAFFIC | | | | 93 | 95 | | | - 7 | - 6 |
| | | | | | | | | | |
| NEW PASSBY TRIPS | | 62% | 62% | 58 | 59 | 56% | 56% | 0 | 0 |
| NEW DESTINED TRIPS | | 38% | 38% | 35 | 36 | 44% | 44% | 0 | 0 |
| | | | | | | | | | |

The Tim Horton's seating capacity will decrease by over 50%, but it is anticipated that two-thirds (67%) of the sit down traffic will continue to come to the site, either as sit down customers or drive through customers. The additional Tim Horton's drive through traffic forecast is based on the count from the Innes and Belcourt site, namely 119 trips in the a.m.

peak hour and 17 trips in the p.m. peak hour. The actual number of drive though lane trips will be higher than just the Innes and Belcourt site numbers since the expanded menu should attract more trips that are usually attracted to an Esso drive through.

The net change in site traffic is calculated by subtracting the existing site generated traffic that is already in the traffic pattern at the site from the forecasted total trips. This gives an increase of approximately 90 to 95 trips each way in and out of the site in the a.m. peak hour, and there is essentially no change in the p.m. peak hour.

Much of the new site traffic will be passby traffic, vehicles already on the adjacent roadways, and some will be new traffic attracted to the site. For the site traffic forecast the passby trip percentage is taken from the ITE Trip Generation Handbook, which for land use category 945 is an average of 62% in the a.m. peak hour and 56% in the p.m. peak hour. The remaining traffic constitutes 'new traffic' to the site and includes trips which may already be on the road system in the general area, but will be diverted to Woodroffe Avenue or Medhurst Drive to access the site.

In the a.m. peak hour the passby component is assigned 60% coming in from the south on Woodroffe Avenue, 30% coming in from the west on Medhurst Drive, and 10% coming in from the east on Medhurst Drive. In the p.m. peak hour the existing site traffic is maintained as is.

The destined 'new' traffic attracted to the site is assumed to be distributed the same as existing traffic at the service station. It is recognized that this distribution includes existing passby trips, but it is not possible to distinguish the trip type just from counts that were taken.

Figure 5 shows the peak hour passby site traffic at the driveways, and Figure 6 shows the destined site traffic at the driveways and through the signalized intersection at Woodroffe Avenue and Medhurst Drive.

## 4.3 Total Traffic

Figure 7 shows total future 2020 traffic with the redeveloped service station in place.

# 5. TRAFFIC IMPACT

The study area intersections have been analyzed using the Synchro program. The Synchro output is included in Appendix A to the report, and the electronic files can be provided to the City under separate cover if desired.

## 5.1 Signalized Intersection

Table 4 shows the v/c ratios at the Woodroffe Avenue and Medhurst Drive intersection for current and future conditions.

Table 4 - Signalized Intersection Capacity Analysis

| | Scenario | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Intersection / Condition** | **Existing Traffic** | | | **Future Background Traffic 2020** | | | **Future Total Traffic 2020** | | |
| **A.M. Peak Hour** | Delay (sec) | LOS | HCM v/c | Delay (sec) | LOS | HCM v/c | Delay (sec) | LOS | HCM v/c |
| Woodroffe and Medhurst | **31.1** | **C** | **0.66** | **29.6** | **C** | **0.68** | **33.1** | **C** | **0.72** |
| | | | | | | | | | |
| **P.M. Peak Hour** | | | | | | | | | |
| Woodroffe and Medhurst | **30.7** | **C** | **0.47** | **31.0** | **C** | **0.50** | **31.0** | **C** | **0.50** |
| | | | | | | | | | |

The existing v/c ratios are calculated to be 0.66 in the a.m. peak hour, and 0.47 in the p.m. peak hour. The overall intersection level of service is level C in the a.m. peak hour and level C in the p.m. peak hour. There are no through movements with v/c ratios over 0.85 or turning movements over 1.0 at the intersection in either peak hour.

If background traffic on Woodroffe Avenue increases by 1.5% annually, the overall intersection v/c ratios with the existing signal phasing and timing increase by 0.02 to 0.68 for the a.m. peak hour, and increase by 0.03 to 0.50 for the p.m. peak hour. Level of service remains at level C in the a.m. peak hour, and remains at level C in the p.m. peak hour.

With the small difference in service station traffic that is anticipated in the a.m. peak hour upon reconstruction of the site, the level of service for the a.m. peak hour remains unchanged at level C and the v/c ratio increases by 0.04 to 0.72. There is no change in site traffic for the p.m. peak hour, so conditions will remain unchanged at level C and a v/c ratio of 0.50.

## 5.2 Site Driveway Operation

Table 5 shows the level of service at the site driveways. It is noted that the redeveloped service station will have the same three driveways as now serve the site, and the volumes are expected to remain in the same order of magnitude as existing traffic at the site.

The site driveways on Woodroffe Avenue presently operate with little conflict since only right turns are permitted. The level of service for the outbound right turn at both driveways is level A in the a.m. peak hour and level A in the p.m. peak hour.

Site traffic coming out to Medhurst Drive and making a left turn is delayed more than vehicles making a right turn, but the level of service for the combined movements is level B in both the a.m. and the p.m. peak hours. The eastbound left turn/through lane carrying traffic into the site operates at level of service A in both peak hours.

## Table 5 - Driveway Intersection Level of Service

| Movement | A.M. | | | P.M. | | |
|---|---|---|---|---|---|---|
| | Volume | Delay | LOS | Volume | Delay | LOS |
| **Existing Traffic** | | | | | | |
| Medhurst Drive Driveway | | | | | | |
| SB left/right | 68 | 13.8 | B | 73 | 11.9 | B |
| EB left/thru | 93 + 30 | 6.8 | A | 68 + 165 | 2.7 | A |
| Woodroffe South Driveway | | | | | | |
| WB right | 3 | 9.2 | A | 8 | 9.0 | A |
| Woodroffe North Driveway | | | | | | |
| WB right | 72 | 9.7 | A | 58 | 9.3 | A |
| **2020 Background Traffic** | | | | | | |
| Medhurst Drive Driveway | | | | | | |
| SB left/right | 68 | 13.8 | B | 73 | 11.9 | B |
| EB left/thru | 93 + 30 | 6.8 | A | 68 + 165 | 2.7 | A |
| Woodroffe South Driveway | | | | | | |
| WB right | 3 | 9.4 | A | 8 | 9.1 | A |
| Woodroffe North Driveway | | | | | | |
| WB right | 72 | 9.9 | A | 58 | 9.4 | A |
| **2020 Total Traffic** | | | | | | |
| Medhurst Drive Driveway | | | | | | |
| SB left/right | 108 | 15.2 | C | 73 | 11.9 | B |
| EB left/thru | 117 + 13 | 8.1 | A | 68 + 165 | 2.7 | A |
| Woodroffe South Driveway | | | | | | |
| WB right | 5 | 9.2 | A | 8 | 9.1 | A |
| Woodroffe North Driveway | | | | | | |
| WB right | 125 | 10.1 | B | 58 | 9.4 | A |

With background traffic increases to 2020 there is a minor increase in delay at the driveways on Woodroffe Avenue. The higher through volumes increase delay to driveway traffic slightly, but level of service remains at level A at both driveways in both peak hours.

There is no change on Medhurst Drive for 2020 since no change in traffic is forecast.

With the reconstructed site the volumes are forecast to be almost the same as present volumes, with a small increase in the a.m. peak hour. The level of service at the Woodroffe Avenue south driveway remains at level A in both peak hours, and at the north driveway the level of service changes to level B in the a.m. peak hour and remains at level A in the p.m. peak hour. The a.m. peak hour delay is just over 10 seconds which is the boundary between levels of service A and B.

The level of service at the Medhurst Drive driveway changes to level C in the a.m. peak hour since the average vehicle delay increases to 15.2 seconds which crosses the 15 second boundary between levels B and C. Level of service remains at level B in the p.m. peak hour.

## 5.3 On Site Circulation

The on-site circulation consists primarily of vehicles passing through the pump islands, and to the Tim Horton's drive through lane. The pumps are directly accessible from both streets, and driving aisle space is provided between cars parked at the pumps as well as around the outside of the pumps.

Tanker delivery will occur with entry off Woodroffe Avenue, and exit to Medhurst Drive westbound.

Vehicles will enter the Tim Horton's drive-through on the east side of the site. Vehicles exiting the drive through can proceed to the pumps or to any of the exit driveways.

The stacking capacity for the Tim Horton's drive through is 14 spaces. This is sufficient for the anticipated flow at the drive through window, which peaks in the a.m. peak hour. Drive through volume in the p.m. peak hour is much lower, and requires less stacking length.

Read Voorhees has previously analyzed a number of Esso service station sites with drive through windows in the Toronto area and elsewhere in the province. Every site is unique in terms of the local market and convenience to drivers, but a queue length of 11 cars typically has been found to be adequate for Tim Horton's drive through facilities. The City of Mississauga has also carried out a survey of drive through facilities at service stations, and the study concluded that a 10 space queue covered 95% of the stacking demand.

Queuing surveys in the a.m. peak hours from 7 to 9 a.m. have been carried out in Toronto and adjacent municipalities at a number of Esso stations with Tim Horton's drive through windows. The surveyed sites have been categorized as being on the 'go to work' side of the road, or on the 'home-bound' side.

The surveys measured the number of cars in the drive through window queue every minute for the two hour period of 7 a.m. to 9 a.m. Table 6 shows the 50$^{th}$ percentile queue length over the period between 7 a.m. and 9 a.m., and the 95$^{th}$ percentile queue length for the two hour survey period.

Counts were also taken in December 2014 in Ottawa at the Innes Road and Belcourt Blvd Esso station at the Tim Horton's drive through that was rebuilt in 2010 with a drive through added to the site. Based on the commuter pattern on Innes Road the site is considered to be a 'go to work' site. The results for this survey are also shown in Table 6. The queue lengths at the site, and the volume through the Tim Horton's drive through, are similar to the GTA survey results.

The queuing survey for the Innes Road and Belcourt Blvd Esso station is in Appendix B.

## Table 6 - A.M. Peak Period Queuing at Esso Drive Through Windows

| Site | | Go-to-work Side | | Homebound Side | |
|---|---|---|---|---|---|
| | | Queue of cars | | Queue of cars | |
| | 1 hour peak volume | 50th percentile | 95th percentile | 50th percentile | 95th percentile |
| | | | | | |
| Jane and Finch | | 5.3 | 9 | | |
| Markham and Ellesmere | 101 | | | 7.0 | 9 |
| Markham and Sheppard | 109 | | | 6.8 | 9 |
| Lakeshore and Carlaw | 123 | | | 10.1 | 13 |
| Elgin Mills and Leslie | | 8.5 | 11 | | |
| Lawrence and Midland | 86 | | | 3.0 | 7 |
| Victoria Park and McNicoll | | 8.3 | 11 | | |
| McCowan and Buroak | | 7.1 | 10 | | |
| Bayly and Westney | | 4.7 | 9 | | |
| Kingston and Saunders | 132 | 5.8 | 10 | | |
| Kennedy and Ellesmere | 103 | | | 0.6 | 3 |
| Highway 2 and Sheppard | | 9.4 | 12 | | |
| Thickson and Winchester | | 5.9 | 13 | | |
| | | | | | |
| **AVERAGES** | | **6.9** | **10.6** | **5.5** | **8.2** |
| | | | | | |
| Innes and Belcourt | 119 | 8.0 | 10 | | |
| | | | | | |

The Tim Horton's drive through service is used most heavily in the a.m. peak hour, and especially when a site is directly accessed by a right turn from the heavy direction of traffic. The Woodroffe and Medhurst site has the peak traffic flow in the a.m. peak hour southbound and in the p.m. peak hour northbound, which therefore considers this to be a 'home-bound' site.

The 'go-to-work' defined sites show a higher average queue length, 6.9 versus 5.5 cars, and a higher average 95th percentile queue length at 10.6 versus 8.2 cars.

The maximum queues observed at the surveyed sites occurred for a 1 minute interval. In all locations the maximum queue lengths occurred for only one minute at a time within the survey period. The peaks were quickly absorbed into the drive through flow in the following minute.

The 95th percentile values for the surveyed sites indicate that a design queue length of just under 11 cars will typically cover the 95th percentile queue length. The 50th percentile queue length value is just under 7 cars. As a 'homebound side' site the expectation for Woodroffe and Medhurst is a 95th percentile queue of 8 or 9 cars. At the Innes Road and Belcourt Blvd site 'go to work side' site the 95th percentile value for the Tim Horton's queue was 10 cars. The 50th percentile queue length value was 8 cars.

It is possible that the drive through queue at Woodroffe and Medhurst will be longer than the 'normal' queue that would be expected at an Esso station because of the additional menu item availability at the Woodroffe and Medhurst site that will be provided because of the increased seating capacity. The difference could increase the queue length to the 11 cars used for a 'go to work side' site.

At the Woodroffe and Medhurst site an 11 car queue reaches to the bend in the two car ordering lane. There is still storage for 3 additional cars to join the queue for a total of 14 stacking spaces, and this will be clear of pedestrians on the sidewalk linking to Medhurst Drive or traffic within the site going past the drive through lane entry point. A further 2 or 3 cars for a total of 16 to 17 could stack on site without affecting operation at the Medhurst driveway.

A queue of 14 to 17 cars is not expected to occur at this site as shown by the site surveys, including the survey at Innes Road and Belcourt Blvd. Nevertheless, such storage length is available within the site with the layout proposed should it be required, ensuring that there is no risk of the drive through queue affecting the adjacent public road system.

With respect to on-site parking, based on experience at similar sites elsewhere, the twenty-five parking spaces will be adequate to meet the demand anticipated for the uses planned on this site.

# 6. CONCLUSIONS

Imperial Oil is proposing to redevelop the existing service station in the north-east corner at Woodroffe Avenue and Medhurst Drive. The station will continue to have ten fuelling positions. The existing carwash will be relocated within the site, and the existing free standing Tim Horton's outlet will be removed, and will be replaced by a smaller seating area and a drive through window facility in the Esso convenience store.

Site access will consist of the same driveway configuration as is now on the site, two right-in/right-out driveways on Woodroffe Avenue, and one full moves driveway on Medhurst Drive.

Surveys at other existing Esso service stations has been used as a basis for forecasting site traffic, including the Esso station in Ottawa at Innes Road and Belcourt Blvd. Since the Tim Horton's outlet on the site will include a seating area, which is not the case for most other Esso stations, the trip generation forecast has taken that condition into account. The forecast indicates a minor traffic increase in site traffic in the a.m. peak hour and no change in the p.m. peak hour. A large proportion of site traffic at service stations is passby traffic, or vehicles already on the road system. Therefore only about half of any site traffic increase will be new traffic added to the adjacent road system.

The additional volume of new traffic through the signalized intersection at Woodroffe Avenue and Medhurst Drive is negligible and has minor impact on the intersection operation. The

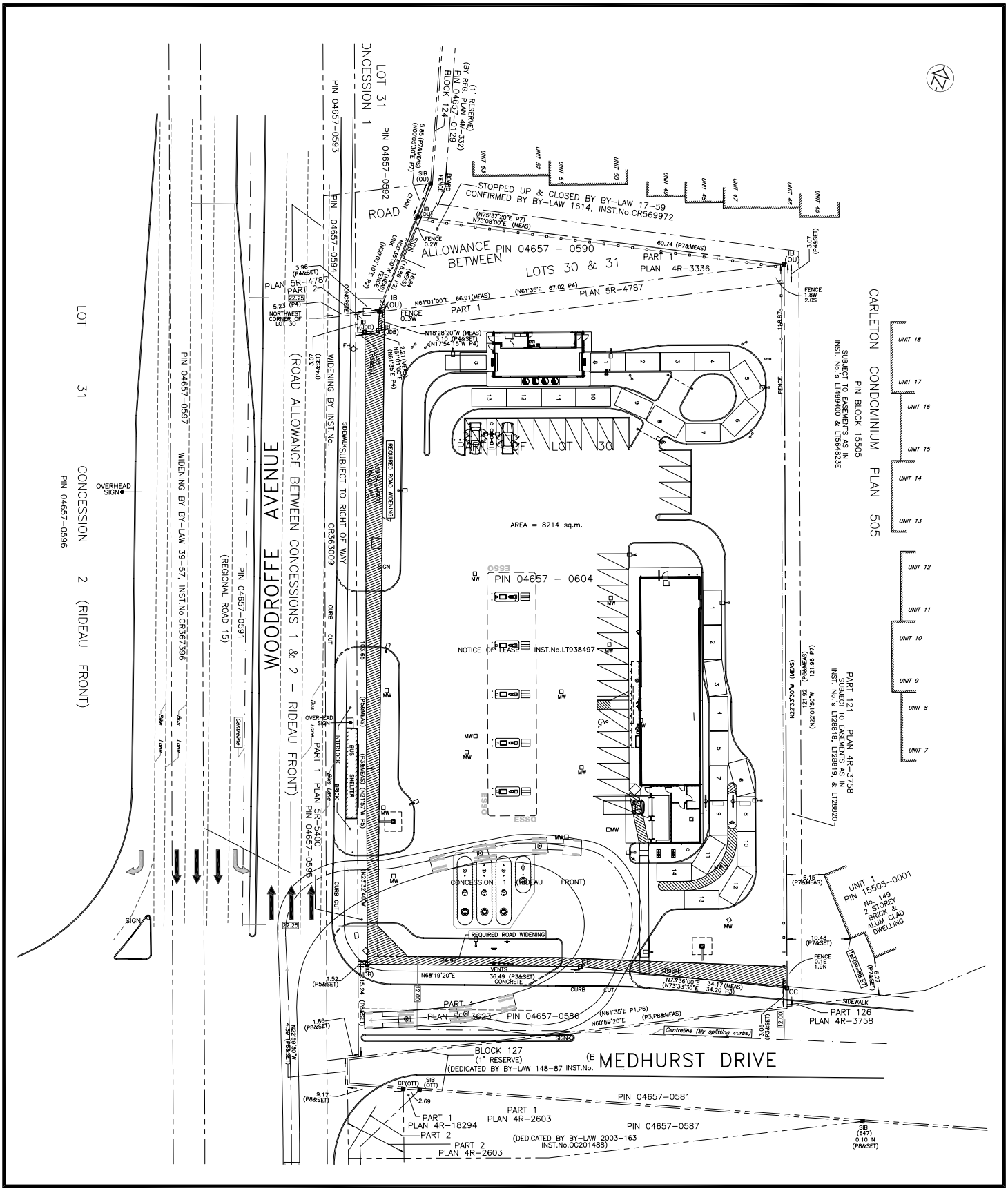
existing intersection operates at a good level of service in both peak hours. There will be no change in the level of service at the intersection with the site redeveloped in either the a.m. peak hour or the p.m. peak hour.

The two driveways on Woodroffe Avenue will continue to operate at good level of service, as will the driveway on Medhurst Drive.

The on-site circulation will operate efficiently, with no impact on traffic on the adjacent streets from internal queuing at the Tim Horton's drive through. Surveys at other Esso service stations with the same facilities, including the drive through lane at the Innes Road and Belcourt Blvd Esso station, indicate that a queue length of 11 cars will meet the peak queuing requirements for a Tim Horton's drive through facility. The site plan has a drive through queue storage length of 14 cars which can accommodate the traffic that is expected in the drive through lane, ensuring that there is no risk of the drive through queue affecting the adjacent public road system.

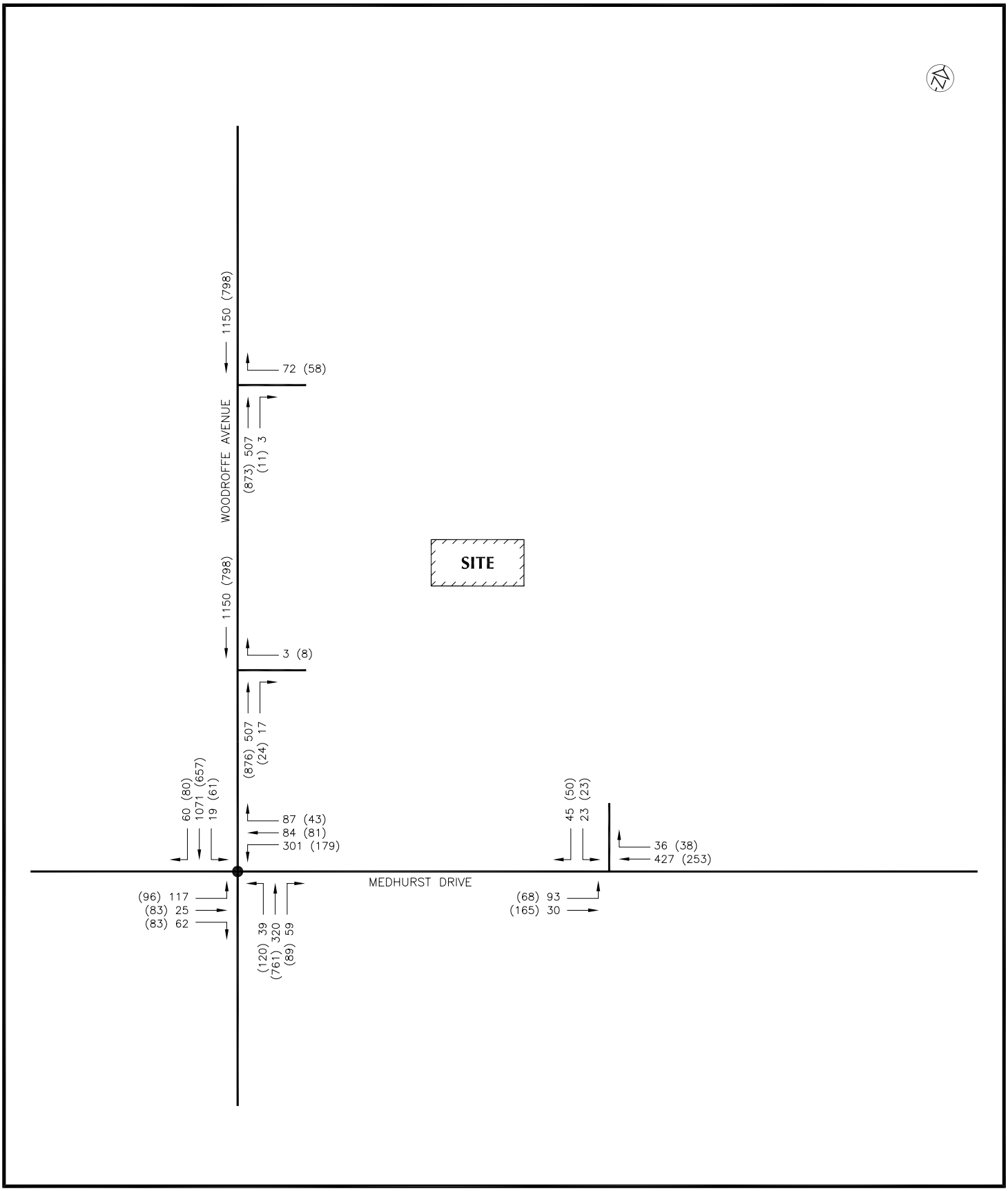

## LOCATION PLAN

**FIGURE 1**




# SITE PLAN

## FIGURE 2




LEGEND

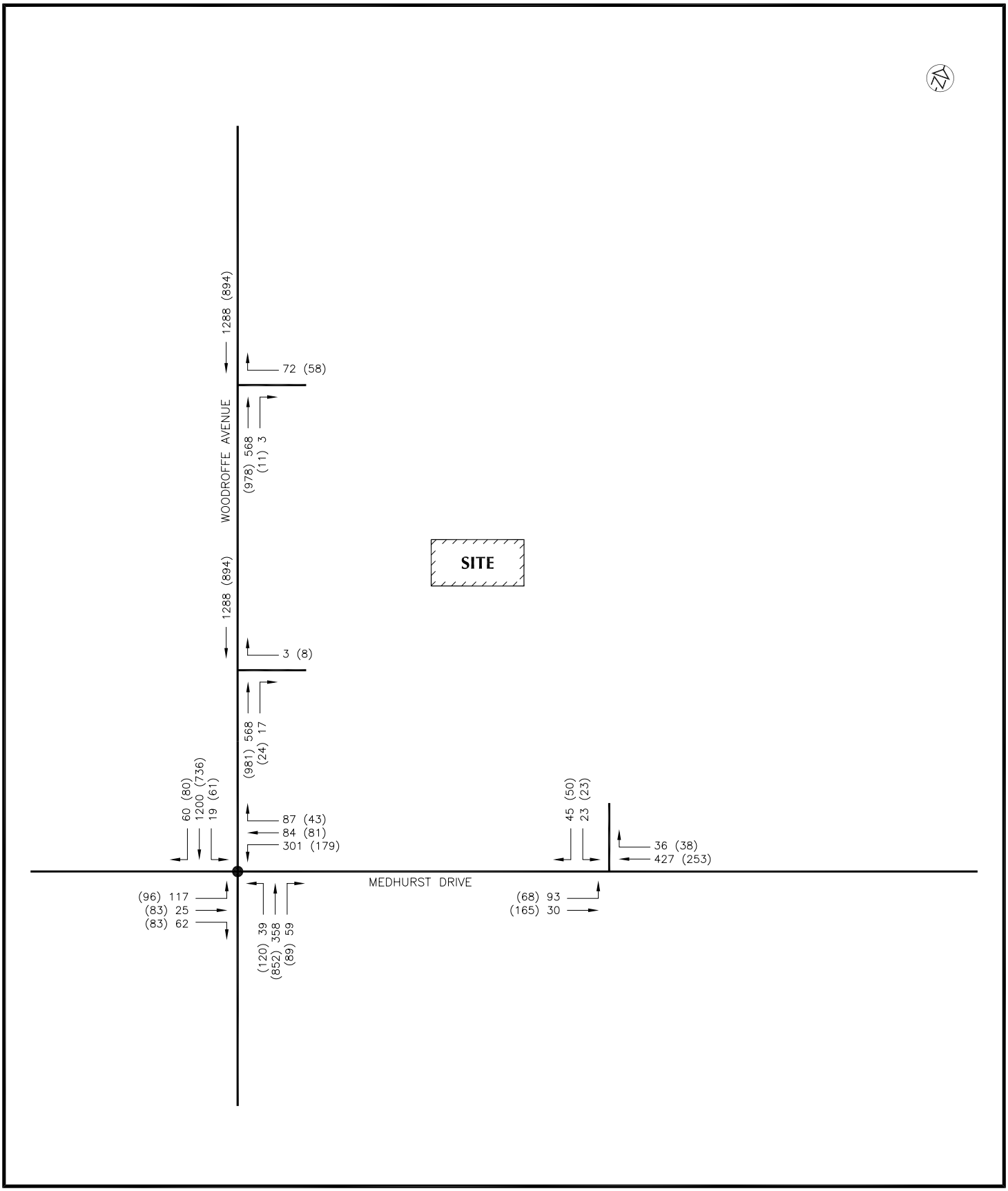
48 A.M. PEAK HOUR VOLUME

(11) P.M. PEAK HOUR VOLUME

● SIGNALIZED INTERSECTION

# EXISTING TRAFFIC

## FIGURE 3




LEGEND

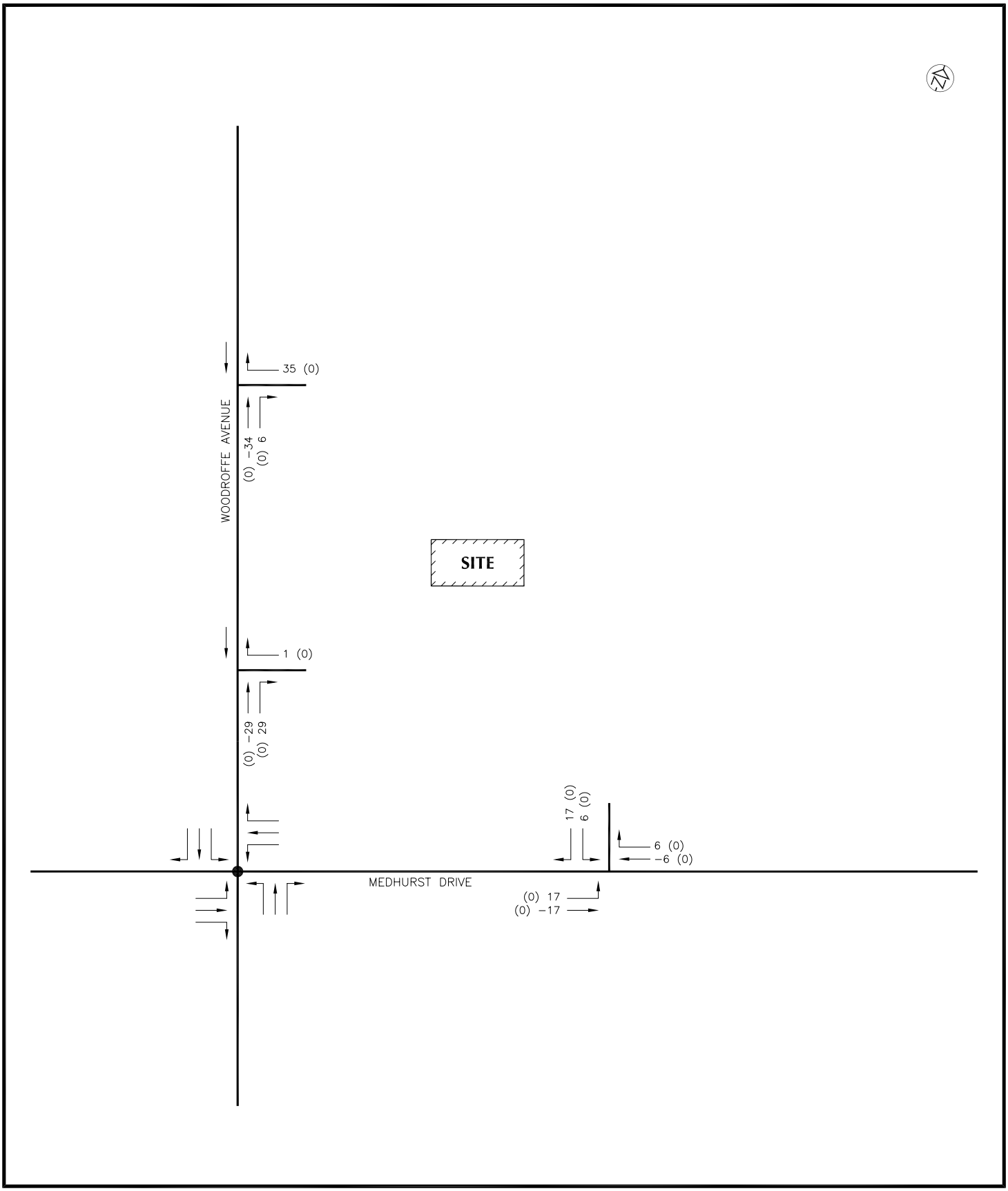
48 A.M. PEAK HOUR VOLUME

(11) P.M. PEAK HOUR VOLUME

● SIGNALIZED INTERSECTION

# 2020 BACKGROUND TRAFFIC

## FIGURE 4




LEGEND

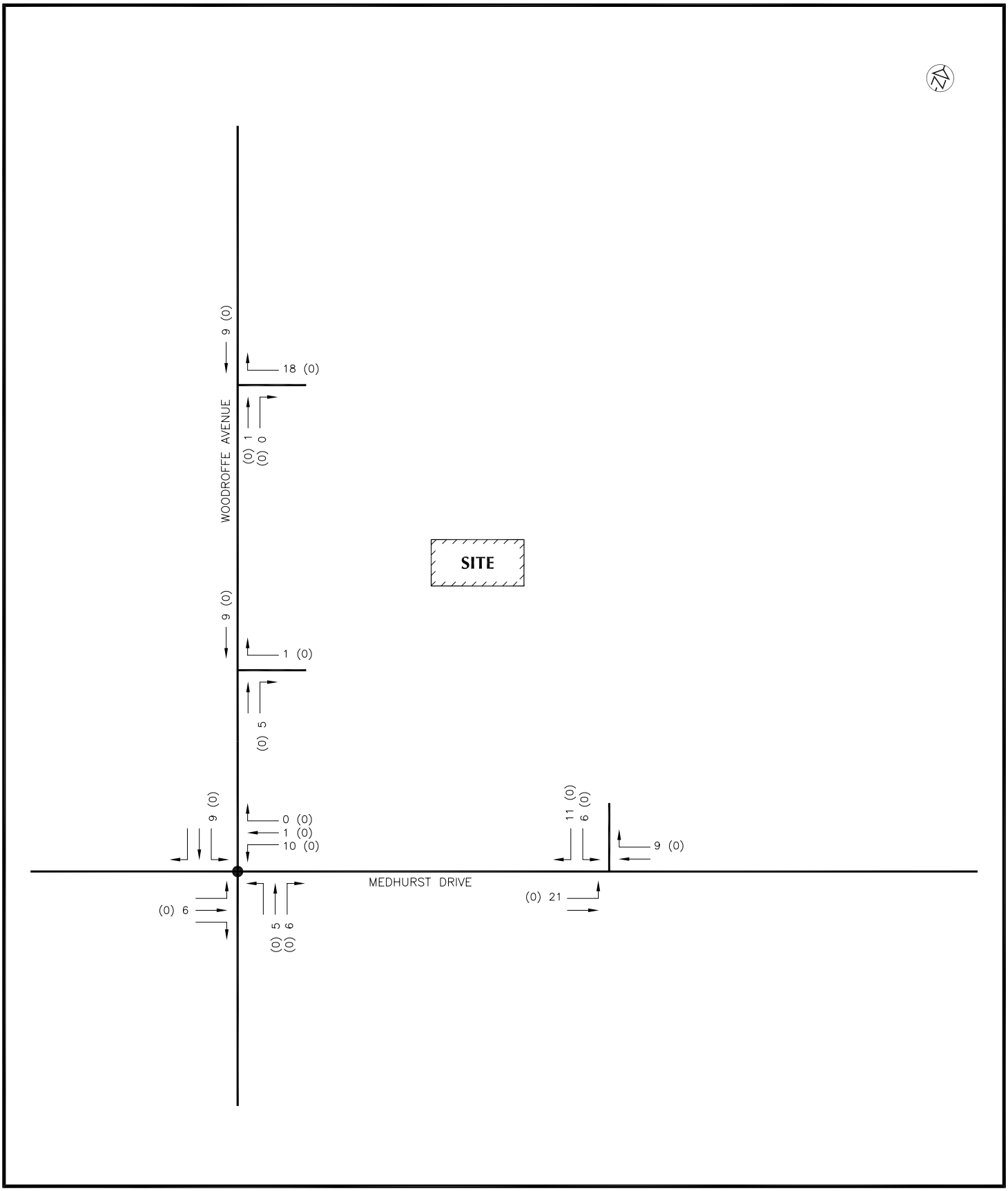
48 A.M. PEAK HOUR VOLUME

(11) P.M. PEAK HOUR VOLUME

● SIGNALIZED INTERSECTION

# NEW PASSBY SITE TRAFFIC

## FIGURE 5




LEGEND

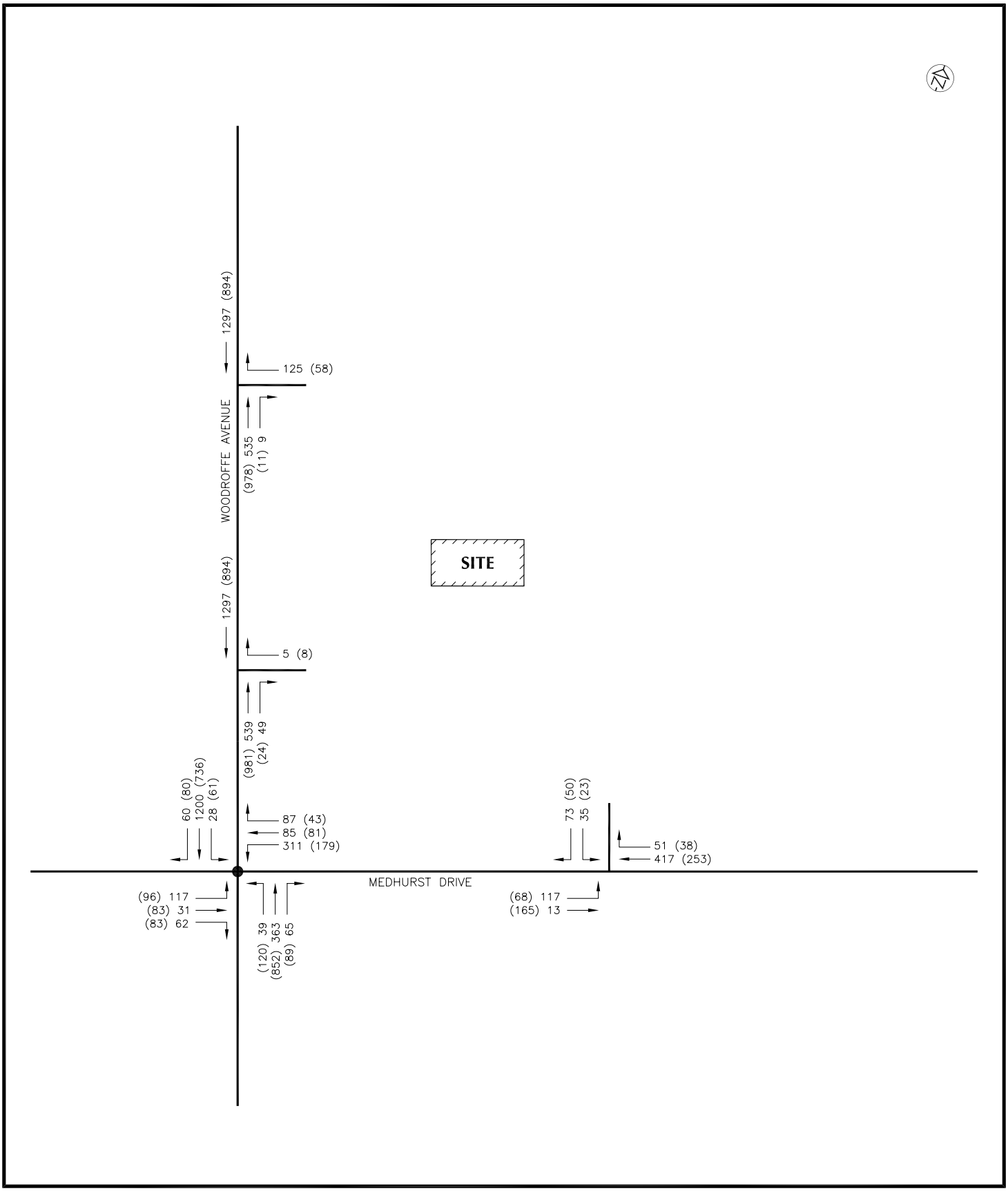
48 A.M. PEAK HOUR VOLUME

(11) P.M. PEAK HOUR VOLUME

● SIGNALIZED INTERSECTION

# NEW DESTINED SITE TRAFFIC

## FIGURE 6




LEGEND

48 A.M. PEAK HOUR VOLUME

(11) P.M. PEAK HOUR VOLUME

● SIGNALIZED INTERSECTION

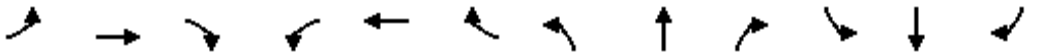
# 2020 TOTAL TRAFFIC

## FIGURE 7

# APPENDIX A

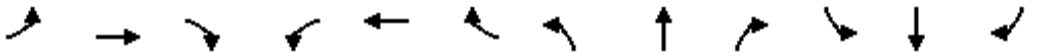
## SYNCHRO OUTPUT

# SIGNALIZED INTERSECTIONS



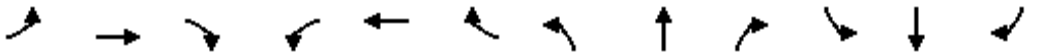
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 117 | 25 | 62 | 300 | 84 | 86 | 39 | 320 | 59 | 19 | 1071 | 60 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 |
| Frpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | | 1.00 | 1.00 | 0.98 | 1.00 | 1.00 | 0.97 |
| Flpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 1.00 | 0.85 | 1.00 | 0.92 | | 1.00 | 1.00 | 0.85 | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 3541 | 1921 | 1633 | 1825 | 1752 | | 1825 | 3650 | 1564 | 1822 | 3650 | 1591 |
| Flt Permitted | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.14 | 1.00 | 1.00 | 0.53 | 1.00 | 1.00 |
| Satd. Flow (perm) | 3541 | 1921 | 1633 | 1825 | 1752 | | 269 | 3650 | 1564 | 1019 | 3650 | 1591 |
| 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) | 127 | 27 | 67 | 326 | 91 | 93 | 42 | 348 | 64 | 21 | 1164 | 65 |
| RTOR Reduction (vph) | 0 | 0 | 43 | 0 | 31 | 0 | 0 | 0 | 32 | 0 | 0 | 32 |
| Lane Group Flow (vph) | 127 | 27 | 24 | 326 | 153 | 0 | 42 | 348 | 32 | 21 | 1164 | 33 |
| Confl. Peds. (#/hr) | 3 | | | | | 3 | 2 | | 1 | 1 | | 2 |
| Heavy Vehicles (%) | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 2% | 0% | 0% | 0% |
| Turn Type | Prot | | Perm | Prot | | | Perm | | Perm | Perm | | Perm |
| Protected Phases | 7 | 4 | | 3 | 8 | | | 2 | | | 6 | |
| Permitted Phases | | | 4 | | | | 2 | | 2 | 6 | | 6 |
| Actuated Green, G (s) | 28.6 | 6.9 | 6.9 | 38.2 | 16.5 | | 64.9 | 64.9 | 64.9 | 64.9 | 64.9 | 64.9 |
| Effective Green, g (s) | 28.6 | 6.9 | 6.9 | 38.2 | 16.5 | | 64.9 | 64.9 | 64.9 | 64.9 | 64.9 | 64.9 |
| Actuated g/C Ratio | 0.22 | 0.05 | 0.05 | 0.29 | 0.13 | | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Clearance Time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| 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) | 779 | 102 | 87 | 536 | 222 | | 134 | 1822 | 781 | 509 | 1822 | 794 |
| v/s Ratio Prot | 0.04 | 0.01 | | c0.18 | c0.09 | | | 0.10 | | | c0.32 | |
| v/s Ratio Perm | | | 0.01 | | | | 0.16 | | 0.02 | 0.02 | | 0.02 |
| v/c Ratio | 0.16 | 0.26 | 0.28 | 0.61 | 0.69 | | 0.31 | 0.19 | 0.04 | 0.04 | 0.64 | 0.04 |
| Uniform Delay, d1 | 41.0 | 59.1 | 59.2 | 39.5 | 54.3 | | 19.3 | 18.0 | 16.6 | 16.6 | 23.9 | 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 | 0.1 | 1.4 | 1.8 | 2.0 | 8.5 | | 6.0 | 0.2 | 0.1 | 0.2 | 1.7 | 0.1 |
| Delay (s) | 41.1 | 60.5 | 60.9 | 41.4 | 62.8 | | 25.3 | 18.3 | 16.7 | 16.8 | 25.7 | 16.7 |
| Level of Service | D | E | E | D | E | | C | B | B | B | C | B |
| Approach Delay (s) | | 49.5 | | | 49.1 | | | 18.7 | | | 25.0 | |
| Approach LOS | | D | | | D | | | B | | | C | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 31.1 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.66 | | |
| Actuated Cycle Length (s) | 130.0 | Sum of lost time (s) | 20.0 |
| Intersection Capacity Utilization | 69.0% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |



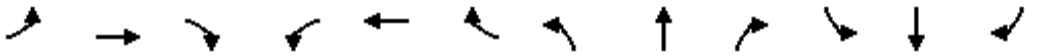
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 96 | 83 | 83 | 179 | 81 | 43 | 120 | 761 | 89 | 61 | 657 | 80 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 |
| Frpb, ped/bikes | 1.00 | 1.00 | 0.99 | 1.00 | 0.99 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.93 |
| Flpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 1.00 | 0.85 | 1.00 | 0.95 | | 1.00 | 1.00 | 0.85 | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 3541 | 1921 | 1611 | 1825 | 1791 | | 1800 | 3650 | 1617 | 1825 | 3650 | 1514 |
| Flt Permitted | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.30 | 1.00 | 1.00 | 0.25 | 1.00 | 1.00 |
| Satd. Flow (perm) | 3541 | 1921 | 1611 | 1825 | 1791 | | 565 | 3650 | 1617 | 484 | 3650 | 1514 |
| 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) | 104 | 90 | 90 | 195 | 88 | 47 | 130 | 827 | 97 | 66 | 714 | 87 |
| RTOR Reduction (vph) | 0 | 0 | 82 | 0 | 17 | 0 | 0 | 0 | 52 | 0 | 0 | 47 |
| Lane Group Flow (vph) | 104 | 90 | 8 | 195 | 118 | 0 | 130 | 827 | 45 | 66 | 714 | 40 |
| Confl. Peds. (#/hr) | 18 | | 1 | 1 | | 18 | 19 | | | | | 19 |
| Heavy Vehicles (%) | 0% | 0% | 0% | 0% | 0% | 1% | 1% | 0% | 1% | 0% | 0% | 0% |
| Turn Type | Prot | | Perm | Prot | | | pm+pt | | Perm | pm+pt | | Perm |
| Protected Phases | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Permitted Phases | | | 4 | | | | 2 | | 2 | 6 | | 6 |
| Actuated Green, G (s) | 23.1 | 11.4 | 11.4 | 25.5 | 13.8 | | 67.7 | 60.6 | 60.6 | 66.5 | 60.0 | 60.0 |
| Effective Green, g (s) | 23.1 | 11.4 | 11.4 | 25.5 | 13.8 | | 67.7 | 60.6 | 60.6 | 66.5 | 60.0 | 60.0 |
| Actuated g/C Ratio | 0.18 | 0.09 | 0.09 | 0.20 | 0.11 | | 0.52 | 0.47 | 0.47 | 0.51 | 0.46 | 0.46 |
| Clearance Time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| 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) | 629 | 168 | 141 | 358 | 190 | | 362 | 1701 | 754 | 315 | 1685 | 699 |
| v/s Ratio Prot | 0.03 | 0.05 | | c0.11 | c0.07 | | c0.02 | c0.23 | | 0.01 | 0.20 | |
| v/s Ratio Perm | | | 0.00 | | | | 0.17 | | 0.03 | 0.10 | | 0.03 |
| v/c Ratio | 0.17 | 0.54 | 0.06 | 0.54 | 0.62 | | 0.36 | 0.49 | 0.06 | 0.21 | 0.42 | 0.06 |
| Uniform Delay, d1 | 45.3 | 56.8 | 54.4 | 47.0 | 55.6 | | 16.9 | 24.0 | 19.1 | 17.1 | 23.4 | 19.4 |
| Progression Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 0.1 | 3.3 | 0.2 | 1.7 | 6.2 | | 0.6 | 1.0 | 0.2 | 0.3 | 0.8 | 0.2 |
| Delay (s) | 45.4 | 60.0 | 54.5 | 48.7 | 61.8 | | 17.5 | 25.0 | 19.2 | 17.5 | 24.2 | 19.5 |
| Level of Service | D | E | D | D | E | | B | C | B | B | C | B |
| Approach Delay (s) | | 52.9 | | | 54.1 | | | 23.5 | | | 23.2 | |
| Approach LOS | | D | | | D | | | C | | | C | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 30.7 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.47 | | |
| Actuated Cycle Length (s) | 130.0 | Sum of lost time (s) | 13.0 |
| Intersection Capacity Utilization | 65.5% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |



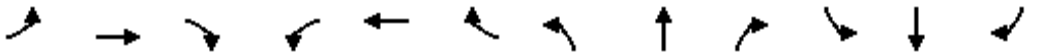
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 117 | 25 | 62 | 301 | 84 | 87 | 39 | 358 | 59 | 19 | 1200 | 60 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.0 | 6.0 | 6.0 | 5.0 | 6.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 |
| Frpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | | 1.00 | 1.00 | 0.98 | 1.00 | 1.00 | 0.97 |
| Flpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 1.00 | 0.85 | 1.00 | 0.92 | | 1.00 | 1.00 | 0.85 | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 3541 | 1921 | 1633 | 1825 | 1750 | | 1825 | 3650 | 1564 | 1822 | 3650 | 1591 |
| Flt Permitted | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.12 | 1.00 | 1.00 | 0.51 | 1.00 | 1.00 |
| Satd. Flow (perm) | 3541 | 1921 | 1633 | 1825 | 1750 | | 225 | 3650 | 1564 | 976 | 3650 | 1591 |
| 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) | 127 | 27 | 67 | 327 | 91 | 95 | 42 | 389 | 64 | 21 | 1304 | 65 |
| RTOR Reduction (vph) | 0 | 0 | 36 | 0 | 32 | 0 | 0 | 0 | 30 | 0 | 0 | 26 |
| Lane Group Flow (vph) | 127 | 27 | 31 | 327 | 154 | 0 | 42 | 389 | 34 | 21 | 1304 | 39 |
| Confl. Peds. (#/hr) | 3 | | | | | 3 | 2 | | 1 | 1 | | 2 |
| Heavy Vehicles (%) | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 2% | 0% | 0% | 0% |
| Turn Type | Prot | | Perm | Prot | | | Perm | | Perm | Perm | | Perm |
| Protected Phases | 7 | 4 | | 3 | 8 | | | 2 | | | 6 | |
| Permitted Phases | | | 4 | | | | 2 | | 2 | 6 | | 6 |
| Actuated Green, G (s) | 26.7 | 7.2 | 7.2 | 36.1 | 16.6 | | 69.7 | 69.7 | 69.7 | 69.7 | 69.7 | 69.7 |
| Effective Green, g (s) | 26.7 | 7.2 | 7.2 | 36.1 | 16.6 | | 69.7 | 69.7 | 69.7 | 69.7 | 69.7 | 69.7 |
| Actuated g/C Ratio | 0.21 | 0.06 | 0.06 | 0.28 | 0.13 | | 0.54 | 0.54 | 0.54 | 0.54 | 0.54 | 0.54 |
| Clearance Time (s) | 5.0 | 6.0 | 6.0 | 5.0 | 6.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| 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) | 727 | 106 | 90 | 507 | 223 | | 121 | 1957 | 839 | 523 | 1957 | 853 |
| v/s Ratio Prot | 0.04 | 0.01 | | c0.18 | c0.09 | | | 0.11 | | | c0.36 | |
| v/s Ratio Perm | | | 0.02 | | | | 0.19 | | 0.02 | 0.02 | | 0.02 |
| v/c Ratio | 0.17 | 0.25 | 0.35 | 0.64 | 0.69 | | 0.35 | 0.20 | 0.04 | 0.04 | 0.67 | 0.05 |
| Uniform Delay, d1 | 42.6 | 58.8 | 59.1 | 41.3 | 54.2 | | 17.2 | 15.7 | 14.3 | 14.3 | 21.8 | 14.3 |
| Progression Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 0.1 | 1.3 | 2.3 | 2.8 | 8.6 | | 7.7 | 0.2 | 0.1 | 0.1 | 1.8 | 0.1 |
| Delay (s) | 42.7 | 60.1 | 61.4 | 44.1 | 62.8 | | 24.9 | 15.9 | 14.4 | 14.4 | 23.6 | 14.4 |
| Level of Service | D | E | E | D | E | | C | B | B | B | C | B |
| Approach Delay (s) | | 50.5 | | | 50.9 | | | 16.5 | | | 23.0 | |
| Approach LOS | | D | | | D | | | B | | | C | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 29.6 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.68 | | |
| Actuated Cycle Length (s) | 130.0 | Sum of lost time (s) | 17.0 |
| Intersection Capacity Utilization | 67.9% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |



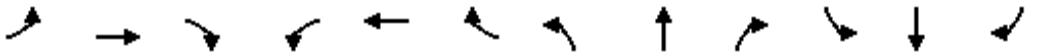
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 96 | 83 | 83 | 179 | 81 | 43 | 120 | 852 | 89 | 61 | 736 | 80 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 |
| Frpb, ped/bikes | 1.00 | 1.00 | 0.99 | 1.00 | 0.99 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.93 |
| Flpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 1.00 | 0.85 | 1.00 | 0.95 | | 1.00 | 1.00 | 0.85 | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 3541 | 1921 | 1611 | 1825 | 1791 | | 1802 | 3650 | 1617 | 1825 | 3650 | 1514 |
| Flt Permitted | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.26 | 1.00 | 1.00 | 0.21 | 1.00 | 1.00 |
| Satd. Flow (perm) | 3541 | 1921 | 1611 | 1825 | 1791 | | 488 | 3650 | 1617 | 403 | 3650 | 1514 |
| 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) | 104 | 90 | 90 | 195 | 88 | 47 | 130 | 926 | 97 | 66 | 800 | 87 |
| RTOR Reduction (vph) | 0 | 0 | 82 | 0 | 17 | 0 | 0 | 0 | 52 | 0 | 0 | 47 |
| Lane Group Flow (vph) | 104 | 90 | 8 | 195 | 118 | 0 | 130 | 926 | 45 | 66 | 800 | 40 |
| Confl. Peds. (#/hr) | 18 | | 1 | 1 | | 18 | 19 | | | | | 19 |
| Heavy Vehicles (%) | 0% | 0% | 0% | 0% | 0% | 1% | 1% | 0% | 1% | 0% | 0% | 0% |
| Turn Type | Prot | | Perm | Prot | | | pm+pt | | Perm | pm+pt | | Perm |
| Protected Phases | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Permitted Phases | | | 4 | | | | 2 | | 2 | 6 | | 6 |
| Actuated Green, G (s) | 23.1 | 11.4 | 11.4 | 25.5 | 13.8 | | 67.7 | 60.6 | 60.6 | 66.5 | 60.0 | 60.0 |
| Effective Green, g (s) | 23.1 | 11.4 | 11.4 | 25.5 | 13.8 | | 67.7 | 60.6 | 60.6 | 66.5 | 60.0 | 60.0 |
| Actuated g/C Ratio | 0.18 | 0.09 | 0.09 | 0.20 | 0.11 | | 0.52 | 0.47 | 0.47 | 0.51 | 0.46 | 0.46 |
| Clearance Time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| 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) | 629 | 168 | 141 | 358 | 190 | | 326 | 1701 | 754 | 277 | 1685 | 699 |
| v/s Ratio Prot | 0.03 | 0.05 | | c0.11 | c0.07 | | c0.02 | c0.25 | | 0.01 | 0.22 | |
| v/s Ratio Perm | | | 0.00 | | | | 0.19 | | 0.03 | 0.11 | | 0.03 |
| v/c Ratio | 0.17 | 0.54 | 0.06 | 0.54 | 0.62 | | 0.40 | 0.54 | 0.06 | 0.24 | 0.47 | 0.06 |
| Uniform Delay, d1 | 45.3 | 56.8 | 54.4 | 47.0 | 55.6 | | 17.3 | 24.8 | 19.1 | 17.7 | 24.1 | 19.4 |
| Progression Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 0.1 | 3.3 | 0.2 | 1.7 | 6.2 | | 0.8 | 1.3 | 0.2 | 0.4 | 1.0 | 0.2 |
| Delay (s) | 45.4 | 60.0 | 54.5 | 48.7 | 61.8 | | 18.1 | 26.1 | 19.2 | 18.1 | 25.1 | 19.5 |
| Level of Service | D | E | D | D | E | | B | C | B | B | C | B |
| Approach Delay (s) | | 52.9 | | | 54.1 | | | 24.6 | | | 24.1 | |
| Approach LOS | | D | | | D | | | C | | | C | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 31.0 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.50 | | |
| Actuated Cycle Length (s) | 130.0 | Sum of lost time (s) | 13.0 |
| Intersection Capacity Utilization | 66.6% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 117 | 31 | 62 | 311 | 85 | 87 | 39 | 363 | 65 | 28 | 1200 | 60 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 |
| Frpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | | 1.00 | 1.00 | 0.98 | 1.00 | 1.00 | 0.97 |
| Flpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 1.00 | 0.85 | 1.00 | 0.92 | | 1.00 | 1.00 | 0.85 | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 3541 | 1921 | 1633 | 1825 | 1751 | | 1825 | 3650 | 1564 | 1822 | 3650 | 1591 |
| Flt Permitted | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.09 | 1.00 | 1.00 | 0.50 | 1.00 | 1.00 |
| Satd. Flow (perm) | 3541 | 1921 | 1633 | 1825 | 1751 | | 177 | 3650 | 1564 | 951 | 3650 | 1591 |
| 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) | 127 | 34 | 67 | 338 | 92 | 95 | 42 | 395 | 71 | 30 | 1304 | 65 |
| RTOR Reduction (vph) | 0 | 0 | 30 | 0 | 31 | 0 | 0 | 0 | 37 | 0 | 0 | 29 |
| Lane Group Flow (vph) | 127 | 34 | 37 | 338 | 156 | 0 | 42 | 395 | 34 | 30 | 1304 | 36 |
| Confl. Peds. (#/hr) | 3 | | | | | 3 | 2 | | 1 | 1 | | 2 |
| Heavy Vehicles (%) | 0% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 2% | 0% | 0% | 0% |
| Turn Type | Prot | | Perm | Prot | | | Perm | | Perm | Perm | | Perm |
| Protected Phases | 7 | 4 | | 3 | 8 | | | 2 | | | 6 | |
| Permitted Phases | | | 4 | | | | 2 | | 2 | 6 | | 6 |
| Actuated Green, G (s) | 30.5 | 7.5 | 7.5 | 39.7 | 16.7 | | 62.8 | 62.8 | 62.8 | 62.8 | 62.8 | 62.8 |
| Effective Green, g (s) | 30.5 | 7.5 | 7.5 | 39.7 | 16.7 | | 62.8 | 62.8 | 62.8 | 62.8 | 62.8 | 62.8 |
| Actuated g/C Ratio | 0.23 | 0.06 | 0.06 | 0.31 | 0.13 | | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 |
| Clearance Time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| 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) | 831 | 111 | 94 | 557 | 225 | | 86 | 1763 | 756 | 459 | 1763 | 769 |
| v/s Ratio Prot | 0.04 | 0.02 | | c0.19 | c0.09 | | | 0.11 | | | c0.36 | |
| v/s Ratio Perm | | | 0.02 | | | | 0.24 | | 0.02 | 0.03 | | 0.02 |
| v/c Ratio | 0.15 | 0.31 | 0.39 | 0.61 | 0.69 | | 0.49 | 0.22 | 0.05 | 0.07 | 0.74 | 0.05 |
| Uniform Delay, d1 | 39.5 | 58.8 | 59.1 | 38.5 | 54.2 | | 22.7 | 19.5 | 17.8 | 17.9 | 27.0 | 17.8 |
| Progression Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 0.1 | 1.6 | 2.7 | 1.9 | 8.8 | | 18.5 | 0.3 | 0.1 | 0.3 | 2.8 | 0.1 |
| Delay (s) | 39.6 | 60.3 | 61.7 | 40.4 | 63.0 | | 41.2 | 19.8 | 17.9 | 18.2 | 29.9 | 17.9 |
| Level of Service | D | E | E | D | E | | D | B | B | B | C | B |
| Approach Delay (s) | | 49.2 | | | 48.4 | | | 21.3 | | | 29.1 | |
| Approach LOS | | D | | | D | | | C | | | C | |

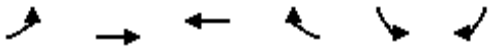
| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 33.1 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.72 | | |
| Actuated Cycle Length (s) | 130.0 | Sum of lost time (s) | 20.0 |
| Intersection Capacity Utilization | 70.9% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 96 | 83 | 83 | 179 | 81 | 43 | 120 | 852 | 89 | 61 | 736 | 80 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 |
| Frpb, ped/bikes | 1.00 | 1.00 | 0.99 | 1.00 | 0.99 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.93 |
| Flpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 1.00 | 0.85 | 1.00 | 0.95 | | 1.00 | 1.00 | 0.85 | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 3541 | 1921 | 1611 | 1825 | 1791 | | 1802 | 3650 | 1617 | 1825 | 3650 | 1514 |
| Flt Permitted | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | | 0.26 | 1.00 | 1.00 | 0.21 | 1.00 | 1.00 |
| Satd. Flow (perm) | 3541 | 1921 | 1611 | 1825 | 1791 | | 488 | 3650 | 1617 | 403 | 3650 | 1514 |
| 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) | 104 | 90 | 90 | 195 | 88 | 47 | 130 | 926 | 97 | 66 | 800 | 87 |
| RTOR Reduction (vph) | 0 | 0 | 82 | 0 | 17 | 0 | 0 | 0 | 52 | 0 | 0 | 47 |
| Lane Group Flow (vph) | 104 | 90 | 8 | 195 | 118 | 0 | 130 | 926 | 45 | 66 | 800 | 40 |
| Confl. Peds. (#/hr) | 18 | | 1 | 1 | | 18 | 19 | | | | | 19 |
| Heavy Vehicles (%) | 0% | 0% | 0% | 0% | 0% | 1% | 1% | 0% | 1% | 0% | 0% | 0% |
| Turn Type | Prot | | Perm | Prot | | | pm+pt | | Perm | pm+pt | | Perm |
| Protected Phases | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Permitted Phases | | | 4 | | | | 2 | | 2 | 6 | | 6 |
| Actuated Green, G (s) | 23.1 | 11.4 | 11.4 | 25.5 | 13.8 | | 67.7 | 60.6 | 60.6 | 66.5 | 60.0 | 60.0 |
| Effective Green, g (s) | 23.1 | 11.4 | 11.4 | 25.5 | 13.8 | | 67.7 | 60.6 | 60.6 | 66.5 | 60.0 | 60.0 |
| Actuated g/C Ratio | 0.18 | 0.09 | 0.09 | 0.20 | 0.11 | | 0.52 | 0.47 | 0.47 | 0.51 | 0.46 | 0.46 |
| Clearance Time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| 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) | 629 | 168 | 141 | 358 | 190 | | 326 | 1701 | 754 | 277 | 1685 | 699 |
| v/s Ratio Prot | 0.03 | 0.05 | | c0.11 | c0.07 | | c0.02 | c0.25 | | 0.01 | 0.22 | |
| v/s Ratio Perm | | | 0.00 | | | | 0.19 | | 0.03 | 0.11 | | 0.03 |
| v/c Ratio | 0.17 | 0.54 | 0.06 | 0.54 | 0.62 | | 0.40 | 0.54 | 0.06 | 0.24 | 0.47 | 0.06 |
| Uniform Delay, d1 | 45.3 | 56.8 | 54.4 | 47.0 | 55.6 | | 17.3 | 24.8 | 19.1 | 17.7 | 24.1 | 19.4 |
| Progression Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 0.1 | 3.3 | 0.2 | 1.7 | 6.2 | | 0.8 | 1.3 | 0.2 | 0.4 | 1.0 | 0.2 |
| Delay (s) | 45.4 | 60.0 | 54.5 | 48.7 | 61.8 | | 18.1 | 26.1 | 19.2 | 18.1 | 25.1 | 19.5 |
| Level of Service | D | E | D | D | E | | B | C | B | B | C | B |
| Approach Delay (s) | | 52.9 | | | 54.1 | | | 24.6 | | | 24.1 | |
| Approach LOS | | D | | | D | | | C | | | C | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 31.0 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.50 | | |
| Actuated Cycle Length (s) | 130.0 | Sum of lost time (s) | 13.0 |
| Intersection Capacity Utilization | 66.6% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

# UNSIGNALIZED INTERSECTIONS



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 93 | 30 | 427 | 36 | 23 | 45 |
| 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) | 101 | 33 | 464 | 39 | 25 | 49 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | 66 | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 503 | | | | 718 | 484 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 503 | | | | 718 | 484 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 90 | | | | 93 | 92 |
| cM capacity (veh/h) | 1061 | | | | 358 | 583 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 134 | 503 | 74 |
| Volume Left | 101 | 0 | 25 |
| Volume Right | 0 | 39 | 49 |
| cSH | 1061 | 1700 | 481 |
| Volume to Capacity | 0.10 | 0.30 | 0.15 |
| Queue Length 95th (m) | 2.4 | 0.0 | 4.1 |
| Control Delay (s) | 6.8 | 0.0 | 13.8 |
| Lane LOS | A | | B |
| Approach Delay (s) | 6.8 | 0.0 | 13.8 |
| Approach LOS | | | B |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 2.7 | | |
| Intersection Capacity Utilization | 45.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 3 | 507 | 17 | 0 | 1150 |
| 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) | 0 | 3 | 551 | 18 | 0 | 1250 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 30 | | | |
| pX, platoon unblocked | 0.95 | 0.95 | | | 0.95 | |
| vC, conflicting volume | 1176 | 276 | | | 570 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1078 | 129 | | | 439 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 100 | | | 100 | |
| cM capacity (veh/h) | 203 | 851 | | | 1060 | |

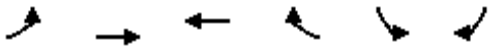
| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 3 | 276 | 276 | 18 | 625 | 625 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 3 | 0 | 0 | 18 | 0 | 0 |
| cSH | 851 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.00 | 0.16 | 0.16 | 0.01 | 0.37 | 0.37 |
| Queue Length 95th (m) | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.2 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.0 | | |
| Intersection Capacity Utilization | 35.1% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 72 | 507 | 3 | 0 | 1150 |
| 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) | 0 | 78 | 551 | 3 | 0 | 1250 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 80 | | | |
| pX, platoon unblocked | 0.95 | 0.95 | | | 0.95 | |
| vC, conflicting volume | 1176 | 276 | | | 554 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1085 | 139 | | | 432 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 91 | | | 100 | |
| cM capacity (veh/h) | 201 | 841 | | | 1070 | |

| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 78 | 276 | 276 | 3 | 625 | 625 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 78 | 0 | 0 | 3 | 0 | 0 |
| cSH | 841 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.09 | 0.16 | 0.16 | 0.00 | 0.37 | 0.37 |
| Queue Length 95th (m) | 2.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.7 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

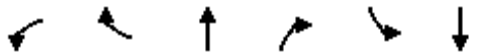
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.4 | | |
| Intersection Capacity Utilization | 35.1% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 68 | 165 | 253 | 38 | 23 | 50 |
| 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) | 74 | 179 | 275 | 41 | 25 | 54 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | 66 | | | | |
| pX, platoon unblocked | | | | | 0.97 | |
| vC, conflicting volume | 316 | | | | 623 | 296 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 316 | | | | 597 | 296 |
| 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 | | | | 94 | 93 |
| cM capacity (veh/h) | 1244 | | | | 426 | 744 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 253 | 316 | 79 |
| Volume Left | 74 | 0 | 25 |
| Volume Right | 0 | 41 | 54 |
| cSH | 1244 | 1700 | 602 |
| Volume to Capacity | 0.06 | 0.19 | 0.13 |
| Queue Length 95th (m) | 1.4 | 0.0 | 3.4 |
| Control Delay (s) | 2.7 | 0.0 | 11.9 |
| Lane LOS | A | | B |
| Approach Delay (s) | 2.7 | 0.0 | 11.9 |
| Approach LOS | | | B |

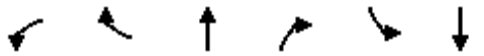
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 2.5 | | |
| Intersection Capacity Utilization | 42.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 8 | 876 | 24 | 0 | 798 |
| 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) | 0 | 9 | 952 | 26 | 0 | 867 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 30 | | | |
| pX, platoon unblocked | 0.84 | 0.84 | | | 0.84 | |
| vC, conflicting volume | 1386 | 476 | | | 978 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1087 | 8 | | | 603 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 99 | | | 100 | |
| cM capacity (veh/h) | 178 | 904 | | | 819 | |

| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 9 | 476 | 476 | 26 | 434 | 434 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 9 | 0 | 0 | 26 | 0 | 0 |
| cSH | 904 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.01 | 0.28 | 0.28 | 0.02 | 0.26 | 0.26 |
| Queue Length 95th (m) | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.0 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

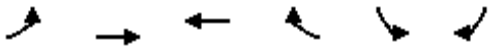
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.0 | | |
| Intersection Capacity Utilization | 34.2% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 58 | 873 | 11 | 0 | 798 |
| 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) | 0 | 63 | 949 | 12 | 0 | 867 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 80 | | | |
| pX, platoon unblocked | 0.84 | 0.84 | | | 0.84 | |
| vC, conflicting volume | 1383 | 474 | | | 961 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1084 | 8 | | | 585 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 93 | | | 100 | |
| cM capacity (veh/h) | 179 | 904 | | | 832 | |

| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 63 | 474 | 474 | 12 | 434 | 434 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 63 | 0 | 0 | 12 | 0 | 0 |
| cSH | 904 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.07 | 0.28 | 0.28 | 0.01 | 0.26 | 0.26 |
| Queue Length 95th (m) | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.3 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.3 | | |
| Intersection Capacity Utilization | 34.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 93 | 30 | 427 | 36 | 23 | 45 |
| 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) | 101 | 33 | 464 | 39 | 25 | 49 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | 66 | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 503 | | | | 718 | 484 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 503 | | | | 718 | 484 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 90 | | | | 93 | 92 |
| cM capacity (veh/h) | 1061 | | | | 358 | 583 |

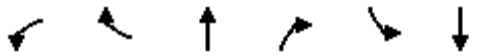
| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 134 | 503 | 74 |
| Volume Left | 101 | 0 | 25 |
| Volume Right | 0 | 39 | 49 |
| cSH | 1061 | 1700 | 481 |
| Volume to Capacity | 0.10 | 0.30 | 0.15 |
| Queue Length 95th (m) | 2.4 | 0.0 | 4.1 |
| Control Delay (s) | 6.8 | 0.0 | 13.8 |
| Lane LOS | A | | B |
| Approach Delay (s) | 6.8 | 0.0 | 13.8 |
| Approach LOS | | | B |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 2.7 | | |
| Intersection Capacity Utilization | 45.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 3 | 568 | 17 | 0 | 1288 |
| 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) | 0 | 3 | 617 | 18 | 0 | 1400 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 30 | | | |
| pX, platoon unblocked | 0.95 | 0.95 | | | 0.95 | |
| vC, conflicting volume | 1317 | 309 | | | 636 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1222 | 156 | | | 501 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 100 | | | 100 | |
| cM capacity (veh/h) | 163 | 816 | | | 1002 | |

| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 3 | 309 | 309 | 18 | 700 | 700 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 3 | 0 | 0 | 18 | 0 | 0 |
| cSH | 816 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.00 | 0.18 | 0.18 | 0.01 | 0.41 | 0.41 |
| Queue Length 95th (m) | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.4 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

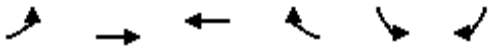
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.0 | | |
| Intersection Capacity Utilization | 38.9% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 72 | 568 | 3 | 0 | 1288 |
| 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) | 0 | 78 | 617 | 3 | 0 | 1400 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 80 | | | |
| pX, platoon unblocked | 0.95 | 0.95 | | | 0.95 | |
| vC, conflicting volume | 1317 | 309 | | | 621 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1227 | 165 | | | 493 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 90 | | | 100 | |
| cM capacity (veh/h) | 162 | 808 | | | 1012 | |

| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 78 | 309 | 309 | 3 | 700 | 700 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 78 | 0 | 0 | 3 | 0 | 0 |
| cSH | 808 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.10 | 0.18 | 0.18 | 0.00 | 0.41 | 0.41 |
| Queue Length 95th (m) | 2.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.9 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

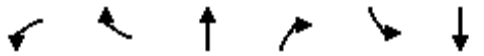
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.4 | | |
| Intersection Capacity Utilization | 38.9% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 68 | 165 | 253 | 38 | 23 | 50 |
| 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) | 74 | 179 | 275 | 41 | 25 | 54 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | 66 | | | | |
| pX, platoon unblocked | | | | | 0.97 | |
| vC, conflicting volume | 316 | | | | 623 | 296 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 316 | | | | 597 | 296 |
| 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 | | | | 94 | 93 |
| cM capacity (veh/h) | 1244 | | | | 426 | 744 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 253 | 316 | 79 |
| Volume Left | 74 | 0 | 25 |
| Volume Right | 0 | 41 | 54 |
| cSH | 1244 | 1700 | 602 |
| Volume to Capacity | 0.06 | 0.19 | 0.13 |
| Queue Length 95th (m) | 1.4 | 0.0 | 3.4 |
| Control Delay (s) | 2.7 | 0.0 | 11.9 |
| Lane LOS | A | | B |
| Approach Delay (s) | 2.7 | 0.0 | 11.9 |
| Approach LOS | | | B |

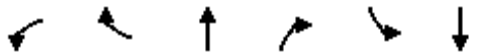
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 2.5 | | |
| Intersection Capacity Utilization | 42.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 8 | 981 | 24 | 0 | 894 |
| 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) | 0 | 9 | 1066 | 26 | 0 | 972 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 30 | | | |
| pX, platoon unblocked | 0.82 | 0.82 | | | 0.82 | |
| vC, conflicting volume | 1552 | 533 | | | 1092 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1230 | 0 | | | 668 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 99 | | | 100 | |
| cM capacity (veh/h) | 139 | 887 | | | 751 | |

| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 9 | 533 | 533 | 26 | 486 | 486 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 9 | 0 | 0 | 26 | 0 | 0 |
| cSH | 887 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.01 | 0.31 | 0.31 | 0.02 | 0.29 | 0.29 |
| Queue Length 95th (m) | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.1 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

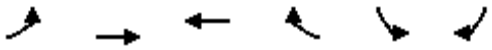
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.0 | | |
| Intersection Capacity Utilization | 37.1% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 58 | 978 | 11 | 0 | 894 |
| 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) | 0 | 63 | 1063 | 12 | 0 | 972 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 80 | | | |
| pX, platoon unblocked | 0.82 | 0.82 | | | 0.82 | |
| vC, conflicting volume | 1549 | 532 | | | 1075 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1226 | 0 | | | 647 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 93 | | | 100 | |
| cM capacity (veh/h) | 140 | 887 | | | 765 | |

| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 63 | 532 | 532 | 12 | 486 | 486 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 63 | 0 | 0 | 12 | 0 | 0 |
| cSH | 887 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.07 | 0.31 | 0.31 | 0.01 | 0.29 | 0.29 |
| Queue Length 95th (m) | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.4 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

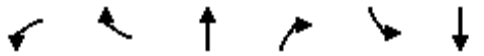
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.3 | | |
| Intersection Capacity Utilization | 37.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 117 | 13 | 417 | 51 | 35 | 73 |
| 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) | 127 | 14 | 453 | 55 | 38 | 79 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | 66 | | | | |
| pX, platoon unblocked | | | | | 0.99 | |
| vC, conflicting volume | 509 | | | | 749 | 481 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 509 | | | | 744 | 481 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 88 | | | | 89 | 86 |
| cM capacity (veh/h) | 1056 | | | | 334 | 585 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 141 | 509 | 117 |
| Volume Left | 127 | 0 | 38 |
| Volume Right | 0 | 55 | 79 |
| cSH | 1056 | 1700 | 470 |
| Volume to Capacity | 0.12 | 0.30 | 0.25 |
| Queue Length 95th (m) | 3.1 | 0.0 | 7.4 |
| Control Delay (s) | 8.1 | 0.0 | 15.2 |
| Lane LOS | A | | C |
| Approach Delay (s) | 8.1 | 0.0 | 15.2 |
| Approach LOS | | | C |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 3.8 | | |
| Intersection Capacity Utilization | 48.6% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 5 | 539 | 49 | 0 | 1297 |
| 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) | 0 | 5 | 586 | 53 | 0 | 1410 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 30 | | | |
| pX, platoon unblocked | 0.94 | 0.94 | | | 0.94 | |
| vC, conflicting volume | 1291 | 293 | | | 639 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1182 | 121 | | | 489 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 99 | | | 100 | |
| cM capacity (veh/h) | 172 | 854 | | | 1007 | |

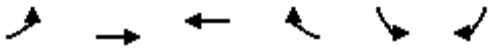
| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 5 | 293 | 293 | 53 | 705 | 705 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 5 | 0 | 0 | 53 | 0 | 0 |
| cSH | 854 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.01 | 0.17 | 0.17 | 0.03 | 0.41 | 0.41 |
| Queue Length 95th (m) | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.2 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

| Intersection Summary | | | | |
|---|---|---|---|---|
| Average Delay | 0.0 | | | |
| Intersection Capacity Utilization | 39.2% | ICU Level of Service | | A |
| Analysis Period (min) | 15 | | | |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 125 | 535 | 9 | 0 | 1297 |
| 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) | 0 | 136 | 582 | 10 | 0 | 1410 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 80 | | | |
| pX, platoon unblocked | 0.94 | 0.94 | | | 0.94 | |
| vC, conflicting volume | 1286 | 291 | | | 591 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1187 | 133 | | | 451 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 84 | | | 100 | |
| cM capacity (veh/h) | 171 | 843 | | | 1045 | |

| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 136 | 291 | 291 | 10 | 705 | 705 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 136 | 0 | 0 | 10 | 0 | 0 |
| cSH | 843 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.16 | 0.17 | 0.17 | 0.01 | 0.41 | 0.41 |
| Queue Length 95th (m) | 4.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 10.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | B | | | | | |
| Approach Delay (s) | 10.1 | 0.0 | | | 0.0 | |
| Approach LOS | B | | | | | |

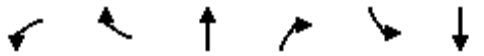
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.6 | | |
| Intersection Capacity Utilization | 39.2% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 68 | 165 | 253 | 38 | 23 | 50 |
| 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) | 74 | 179 | 275 | 41 | 25 | 54 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | 66 | | | | |
| pX, platoon unblocked | | | | | 0.97 | |
| vC, conflicting volume | 316 | | | | 623 | 296 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 316 | | | | 597 | 296 |
| 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 | | | | 94 | 93 |
| cM capacity (veh/h) | 1244 | | | | 426 | 744 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 253 | 316 | 79 |
| Volume Left | 74 | 0 | 25 |
| Volume Right | 0 | 41 | 54 |
| cSH | 1244 | 1700 | 602 |
| Volume to Capacity | 0.06 | 0.19 | 0.13 |
| Queue Length 95th (m) | 1.4 | 0.0 | 3.4 |
| Control Delay (s) | 2.7 | 0.0 | 11.9 |
| Lane LOS | A | | B |
| Approach Delay (s) | 2.7 | 0.0 | 11.9 |
| Approach LOS | | | B |

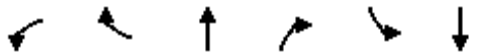
| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 2.5 | | |
| Intersection Capacity Utilization | 42.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 8 | 981 | 24 | 0 | 894 |
| 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) | 0 | 9 | 1066 | 26 | 0 | 972 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 30 | | | |
| pX, platoon unblocked | 0.82 | 0.82 | | | 0.82 | |
| vC, conflicting volume | 1552 | 533 | | | 1092 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1230 | 0 | | | 668 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 99 | | | 100 | |
| cM capacity (veh/h) | 139 | 887 | | | 751 | |

| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 9 | 533 | 533 | 26 | 486 | 486 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 9 | 0 | 0 | 26 | 0 | 0 |
| cSH | 887 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.01 | 0.31 | 0.31 | 0.02 | 0.29 | 0.29 |
| Queue Length 95th (m) | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.1 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.0 | | |
| Intersection Capacity Utilization | 37.1% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |



| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (veh/h) | 0 | 58 | 978 | 11 | 0 | 894 |
| 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) | 0 | 63 | 1063 | 12 | 0 | 972 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | None | | | None |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 80 | | | |
| pX, platoon unblocked | 0.82 | 0.82 | | | 0.82 | |
| vC, conflicting volume | 1549 | 532 | | | 1075 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1226 | 0 | | | 647 | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | |
| p0 queue free % | 100 | 93 | | | 100 | |
| cM capacity (veh/h) | 140 | 887 | | | 765 | |

| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|
| Volume Total | 63 | 532 | 532 | 12 | 486 | 486 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 63 | 0 | 0 | 12 | 0 | 0 |
| cSH | 887 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.07 | 0.31 | 0.31 | 0.01 | 0.29 | 0.29 |
| Queue Length 95th (m) | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 9.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 9.4 | 0.0 | | | 0.0 | |
| Approach LOS | A | | | | | |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.3 | | |
| Intersection Capacity Utilization | 37.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

# APPENDIX B

# QUEUE SURVEYS

**Location:** *ESSO at Innes Rd & Belcourt Blvd, Ottawa* *Queue length at Tim Horton's*

**Date:** December 18, 2014

| Start time | Queue |
|---|---|
| 7:00 | 1 |
| 7:01 | 1 |
| 7:02 | 2 |
| 7:03 | 4 |
| 7:04 | 2 |
| 7:05 | 6 |
| 7:06 | 4 |
| 7:07 | 7 |
| 7:08 | 6 |
| 7:09 | 5 |
| 7:10 | 7 |
| 7:11 | 5 |
| 7:12 | 2 |
| 7:13 | 1 |
| 7:14 | 3 |
| 7:15 | 5 |
| 7:16 | 4 |
| 7:17 | 5 |
| 7:18 | 5 |
| 7:19 | 6 |
| 7:20 | 4 |
| 7:21 | 2 |
| 7:22 | 3 |
| 7:23 | 3 |
| 7:24 | 2 |
| 7:25 | 6 |
| 7:26 | 9 |
| 7:27 | 5 |
| 7:28 | 5 |
| 7:29 | 4 |
| 7:30 | 2 |
| 7:31 | 3 |
| 7:32 | 5 |
| 7:33 | 6 |
| 7:34 | 8 |
| 7:35 | 8 |
| 7:36 | 6 |
| 7:37 | 8 |
| 7:38 | 8 |
| 7:39 | 8 |

| Start time | Queue |
|---|---|
| 7:40 | 8 |
| 7:41 | 7 |
| 7:42 | 8 |
| 7:43 | 8 |
| 7:44 | 7 |
| 7:45 | 9 |
| 7:46 | 1 |
| 7:47 | 9 |
| 7:48 | 10 |
| 7:49 | 8 |
| 7:50 | 10 |
| 7:51 | 10 |
| 7:52 | 8 |
| 7:53 | 9 |
| 7:54 | 8 |
| 7:55 | 8 |
| 7:56 | 7 |
| 7:57 | 10 |
| 7:58 | 9 |
| 7:59 | 10 |
| 8:00 | 10 |
| 8:01 | 10 |
| 8:02 | 10 |
| 8:03 | 9 |
| 8:04 | 8 |
| 8:05 | 9 |
| 8:06 | 9 |
| 8:07 | 7 |
| 8:08 | 6 |
| 8:09 | 8 |
| 8:10 | 9 |
| 8:11 | 8 |
| 8:12 | 8 |
| 8:13 | 6 |
| 8:14 | 5 |
| 8:15 | 4 |
| 8:16 | 4 |
| 8:17 | 5 |
| 8:18 | 6 |
| 8:19 | 4 |

| Start time | Queue |
|---|---|
| 8:20 | 1 |
| 8:21 | 6 |
| 8:22 | 6 |
| 8:23 | 10 |
| 8:24 | 11 |
| 8:25 | 10 |
| 8:26 | 8 |
| 8:27 | 10 |
| 8:28 | 7 |
| 8:29 | 7 |
| 8:30 | 6 |
| 8:31 | 7 |
| 8:32 | 5 |
| 8:33 | 8 |
| 8:34 | 7 |
| 8:35 | 9 |
| 8:36 | 8 |
| 8:37 | 7 |
| 8:38 | 10 |
| 8:39 | 9 |
| 8:40 | 11 |
| 8:41 | 10 |
| 8:42 | 10 |
| 8:43 | 10 |
| 8:44 | 8 |
| 8:45 | 10 |
| 8:46 | 9 |
| 8:47 | 9 |
| 8:48 | 10 |
| 8:49 | 10 |
| 8:50 | 8 |
| 8:51 | 10 |
| 8:52 | 8 |
| 8:53 | 7 |
| 8:54 | 6 |
| 8:55 | 5 |
| 8:56 | 5 |
| 8:57 | 3 |
| 8:58 | 1 |
| 8:59 | 0 |

| Start time | Queue |
|---|---|
| 9:00 | 1 |
| 9:01 | 0 |
| 9:02 | 1 |
| 9:03 | 1 |
| 9:04 | 0 |
| 9:05 | 2 |
| 9:06 | 2 |
| 9:07 | 4 |
| 9:08 | 5 |
| 9:09 | 6 |
| 9:10 | 5 |
| 9:11 | 3 |
| 9:12 | 3 |
| 9:13 | 4 |
| 9:14 | 3 |
| 9:15 | 4 |
| 9:16 | 3 |
| 9:17 | 2 |
| 9:18 | 2 |
| 9:19 | 0 |
| 9:20 | 0 |
| 9:21 | 1 |
| 9:22 | 2 |
| 9:23 | 1 |
| 9:24 | 1 |
| 9:25 | 0 |
| 9:26 | 2 |
| 9:27 | 2 |
| 9:28 | 2 |
| 9:29 | 1 |
| 9:30 | 2 |

**Location:** *ESSO at Innes Rd & Belcourt Blvd, Ottawa* *Queue length at Tim Horton's*

**Date:** December 18, 2014

| Start time | Queue |
|---|---|
| 16:00 | 2 |
| 16:01 | |
| 16:02 | 1 |
| 16:03 | 1 |
| 16:04 | |
| 16:05 | |
| 16:06 | |
| 16:07 | 1 |
| 16:08 | |
| 16:09 | |
| 16:10 | |
| 16:11 | |
| 16:12 | |
| 16:13 | |
| 16:14 | |
| 16:15 | |
| 16:16 | 2 |
| 16:17 | |
| 16:18 | |
| 16:19 | |
| 16:20 | |
| 16:21 | |
| 16:22 | |
| 16:23 | |
| 16:24 | |
| 16:25 | |
| 16:26 | |
| 16:27 | |
| 16:28 | |
| 16:29 | |
| 16:30 | |
| 16:31 | |
| 16:32 | 1 |
| 16:33 | |
| 16:34 | |
| 16:35 | |
| 16:36 | 1 |
| 16:37 | |
| 16:38 | |
| 16:39 | |

| Start time | Queue |
|---|---|
| 16:40 | |
| 16:41 | |
| 16:42 | |
| 16:43 | |
| 16:44 | 1 |
| 16:45 | |
| 16:46 | 1 |
| 16:47 | |
| 16:48 | 1 |
| 16:49 | |
| 16:50 | |
| 16:51 | 1 |
| 16:52 | |
| 16:53 | |
| 16:54 | |
| 16:55 | |
| 16:56 | |
| 16:57 | 1 |
| 16:58 | |
| 16:59 | |
| 17:00 | |
| 17:01 | |
| 17:02 | |
| 17:03 | 1 |
| 17:04 | |
| 17:05 | |
| 17:06 | |
| 17:07 | |
| 17:08 | |
| 17:09 | |
| 17:10 | |
| 17:11 | |
| 17:12 | |
| 17:13 | |
| 17:14 | |
| 17:15 | |
| 17:16 | |
| 17:17 | 1 |
| 17:18 | 2 |
| 17:19 | |

| Start time | Queue |
|---|---|
| 17:20 | 1 |
| 17:21 | 2 |
| 17:22 | |
| 17:23 | |
| 17:24 | 1 |
| 17:25 | |
| 17:26 | |
| 17:27 | |
| 17:28 | |
| 17:29 | |
| 17:30 | 2 |
| 17:31 | |
| 17:32 | 1 |
| 17:33 | |
| 17:34 | |
| 17:35 | |
| 17:36 | |
| 17:37 | |
| 17:38 | 1 |
| 17:39 | |
| 17:40 | |
| 17:41 | |
| 17:42 | 1 |
| 17:43 | |
| 17:44 | |
| 17:45 | |
| 17:46 | |
| 17:47 | |
| 17:48 | 1 |
| 17:49 | |
| 17:50 | 2 |
| 17:51 | |
| 17:52 | |
| 17:53 | |
| 17:54 | |
| 17:55 | 1 |
| 17:56 | |
| 17:57 | |
| 17:58 | |
| 17:59 | |