



Final Report

Banwell Road Corridor Assessment



Prepared for City of Windsor
by IBI Group

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1 Introduction

IBI Group has been retained by the City of Windsor to revisit and update the Banwell Road Environmental Assessment (EA) previously developed to a draft status in 2011. The update includes analysis and recommendations to reflect new traffic data, land use plans and economic development of the area.

This report documents the transportation analysis task and provides traffic growth, operating conditions, and recommended improvements to the road network. Updated recommendations from this report will be reflected in the EA documentation for review and approvals by the public, the City of Windsor, and Ministry of Environment.

1.1 Background

The Banwell Road EA project was started in year 2006 by Giffels Associates Limited (now IBI Group). The traffic analysis for the EA was prepared by Paradigm Transportation Solutions Limited (PTSL), which considered 2006 as the base year and 2027 as the future horizon year.

In November 2011, IBI Group submitted the final draft EA to the City of Windsor. The EA found that increased intensity of development in the area resulted in an increase in travel demands which supported the need to widen Banwell Road to six lanes from Tecumseh Road to Intersection Road. However, due to existing right-of-way constraints north of EC Row Expressway, the EA recommended widening Banwell Road to a four-lane cross-section from Tecumseh Road to EC Row Expressway and protecting for six lanes from the EC Row Expressway to the south City limits (south of the CP Rail crossing) for future grade separation.

Since the previous project initiation at 2006 and draft EA submission in 2011, a number of road network and land use changes have occurred simultaneously. A number of transportation assessments and studies have been conducted in the Windsor area including:

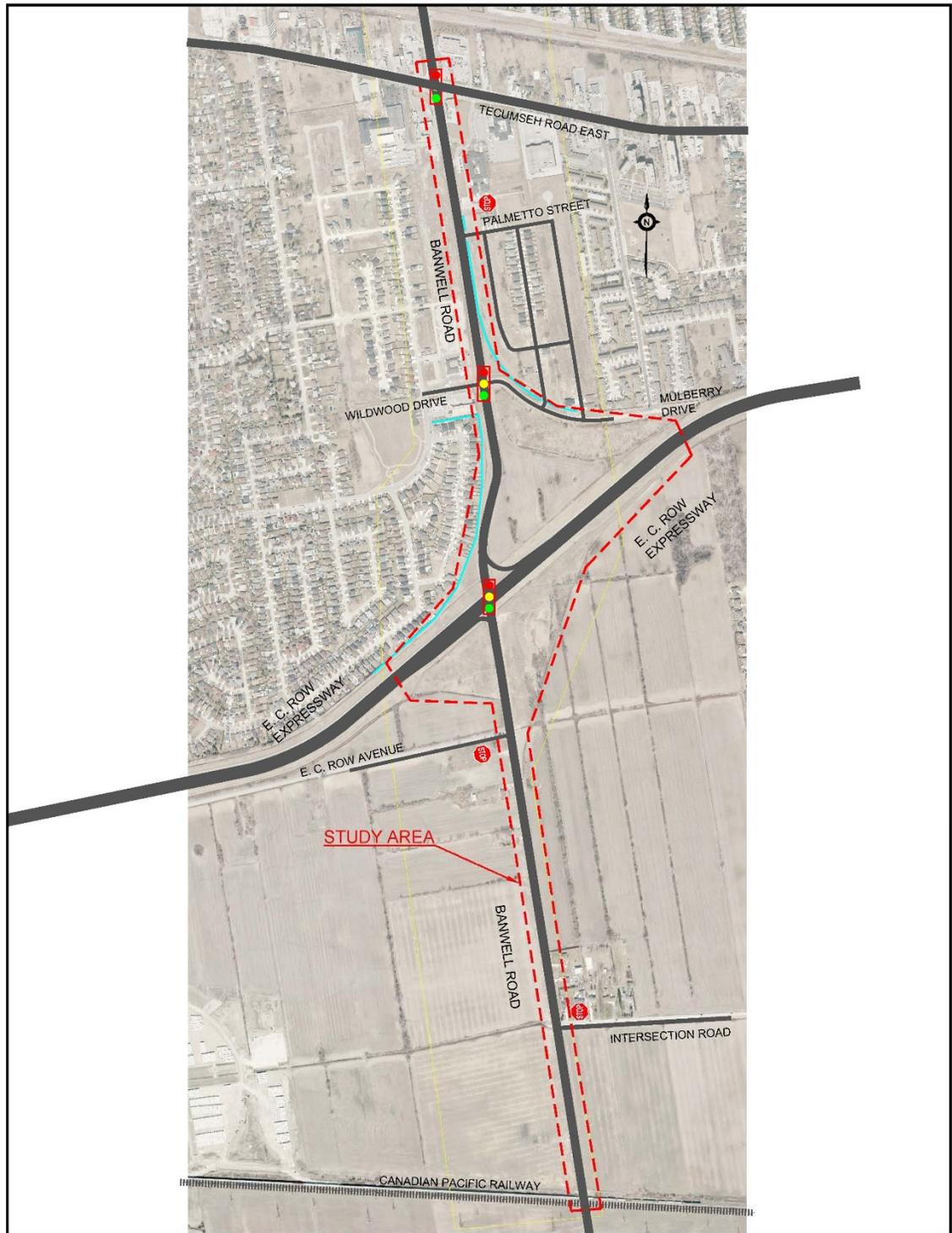
- County Road 22 EA;
- Manning Road EA;
- Lauzon Parkway EA;
- New Detroit River Crossing plans; and
- Updates to the Town of Tecumseh and City of Windsor development plans.

This has initiated a need to determine whether the recommendations of the 2011 traffic study are still valid. This report provides an update to prior analysis by using 2014 as the base year with a future horizon of 2034 along with recommended improvements to mitigate traffic congestion in the future. Additionally, an interim conditions analysis was completed to determine the timings that road network improvements are required.

1.2 Study Area

The study area is bounded on the north by Tecumseh Road East and the City boundary immediately south of the CPR tracks south of Intersection Road to the south. Exhibit 1-1 shows Banwell Road and the intersections within the study area. This corridor is along the boundary between Tecumseh Hamlet and the City of Windsor. Anticipated development plans in both jurisdictions were collected to include an analysis of future traffic conditions.

Exhibit 1-1: Study Area



1.3 Report Structure

This transportation study update is structured as follows:

- Section 2, Prior Studies: presents brief reviews of the recent transportation studies and their findings/recommendations which are relevant to this study.
- Section 3, Existing Conditions: presents traffic operations analysis for intersections within the study area based on the most recent counts available.
- Section 4, Traffic Forecasts: presents future background and development traffic volumes which are based on the City's updated demand model and latest site plans/studies.
- Section 5 Alternatives Development: presents the evaluation of road network alternatives along Banwell Road to determine best network configurations.
- Section 6, 2034 Conditions: presents the analysis of future 2034 conditions for capacity constraints to determine what improvements are required along Banwell Road.
- Section 7: presents the analysis of interim phasing and timing required for the EC Row Expressway interchange with Banwell Road.
- Section 8, Conclusions: presents the summary of study findings and final recommendations.

2 Prior Studies

Tecumseh Hamlet Secondary Plan Transportation Study (Dillon Consulting, 2015)

The titled report is a transportation study completed by Dillon Consulting for the Town of Tecumseh, outlining the potential impact of traffic generated by the continued development of the town. A 20 year horizon (2034) was considered to determine future transportation network needs.

Several proposed network changes to the EC Row Expressway were carried over from previous reports included a full interchange at Banwell Road, a partial interchange at Lesperance Road and a full interchange at Manning Road.

An interim phasing analysis was completed to determine the maximum traffic volumes coming from the Town that would be supportable by an at grade intersection at Banwell Road and EC Row Expressway.

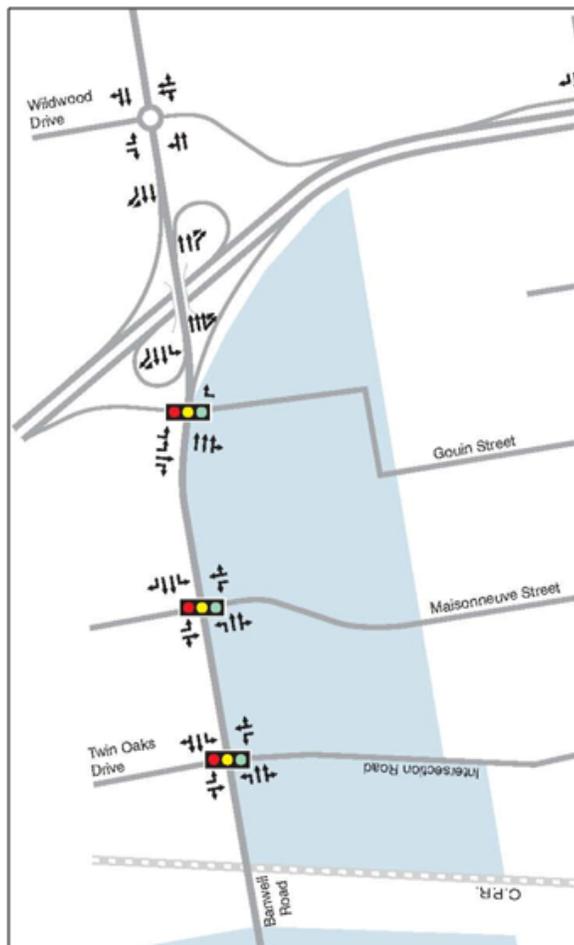
A full build-out of Tecumseh Hamlet is anticipated to accommodate approximately 3,100 residential units, and 413,000 sq. Ft of commercial space. The report indicated that in the 20 year horizon, 2,880 new trips will be added to the network during the a.m. peak hour and 4,450 during the p.m. peak hour.

Along with overall background growth of the region, it was shown there was a left turn volume of around 600vph into Tecumseh Hamlet from Banwell Road. In order to accommodate these volumes using the previously Banwell EA proposed road network, double southbound left turns would be required at the two proposed intersections south of EC Row Expressway. This would cause increased Banwell Road right-of-way and wider collector roads within Tecumseh Hamlet. This is not consistent with what is envisioned for the urban design of the Hamlet.

In order to keep with the intimate scale of the development and the intended design of Tecumseh Hamlet, a third intersection was suggested by adding a 4th leg to the EC Row Expressway W-N/S off-ramp and allowing traffic in and out of Tecumseh Hamlet. This 4th leg would connect to Gouin Street and allow all movements into Tecumseh Hamlet and only right turns out of the Hamlet. The report shows that such a configuration, shown in Exhibit 2-1 would be operationally viable in the 20 year horizon and is recommended.

The interim phasing analysis by Dillon shows that a select portion of the Town can be developed without the need for an interchange; however, full build-out would require an interchange at Banwell Road and EC Row Expressway. Interim analysis shows that the portion that could be developed is approximately 400 low-density/550 medium density units in the north part of the hamlet, or 640 low-density/880 medium density units located in the south part of the Hamlet. This is very small portion of the expected 3,100 residential units expected in the full build-out.

Exhibit 2-1: Proposed Tecumseh Hamlet Intersection Configurations



Lauzon Parkway EA (MRC, 2013)

An EA for Lauzon Parkway to the east of Banwell Road was completed by MRC in 2013. This report provided an update to the Windsor travel demand model with specific emphasis in the areas around Lauzon Parkway. The 2011 and 2031 model outputs are carried forward for analysis to examine existing and future traffic demands.

The Tecumseh Hamlet traffic assessments and Lauzon Parkway EA will serve as the basis of traffic demand projections for this EA update. The Lauzon Parkway EA captures growth west of Banwell Road within the City of Windsor boundaries while the Tecumseh Hamlet traffic assessments looks at developments to the east of Banwell Road within Tecumseh Hamlet.

Traffic Assessment and Review of Tecumseh Hamlet Secondary Plan Memos (Dillon Consulting, 2013)

The traffic assessment memo was completed by Dillon consulting in 2013 and focused on Tecumseh Hamlet which is on the east side of Banwell Road. The memo provides a review of the 2009 Paradigm TIS and proposed new accesses onto Banwell Road. It was found that three access locations south of EC Row Expressway would likely be needed in order to disperse left turn traffic along Banwell Road to different intersections.

The memo showed that a 6 lane Banwell Road ultimately would be needed to accommodate traffic demand south of EC Row Expressway. Interim improvements such as the additional intersections and expansion of other intersections along Banwell Road would be able to delay the need for widening. It was also found that although minor improvements could be made to the intersection of Banwell Road and EC Row Expressway, the planned interchange would be necessary to fully alleviate the traffic congestion. Finally Lesperance Road was found not be effective at providing relieve for Banwell Road due to high demand on Banwell Road as well as existing operational issues along Lesperance Road.

Twin Oaks Drive EA (MMM Group, 2012)

A rail spur is proposed to the west of Banwell Road and the Twin Oaks EA was completed by MMM group in 2012. The report identified and compared several alternatives for the extension of Twin Oaks Drive for feasibility in terms of technical, financial, natural environment, social environment, cultural environment and community planning. This report does not provide significant traffic impact analysis though it should be noted that a future connection between Twin Oaks Drive and Banwell Road is expected along with a future rail spur. This connection was incorporated into the future road network.

Tecumseh Vista Academy Traffic Impact Assessment (Stantec, 2008)

A minor traffic impact assessment was completed in 2008 by Stantec regarding development in the Town of Tecumseh that included a residential, commercial and school site. The mains impacts were to the intersection of County Road 42 and Banwell Road. However, after full build-out of the site, it was found that the future intersection level-of-service (LOS) deteriorated from B to D and B to C in the a.m. and p.m. peaks respectively. The intersection still operates at an acceptable LOS. This development was expected in the assessment to complete full build-out in 2013. Thus, it should be added in future traffic growth projections since existing counts do not capture the development.

3 Existing Conditions

An update of existing conditions analysis was completed in order to account for changes to traffic since 2011 and to develop a base for comparison of future conditions. Network capacities at a macro level were examined using the travel demand model and intersection capacity analysis was completed using Synchro.

3.1 Existing Road Network

Banwell Road between Tecumseh Road East and the City limits south of the CPR track is a Class 2 Arterial Road, with a 30 m right of way between Tecumseh Road and the EC Row Expressway. South of the EC Row Expressway the right of way narrows to 12 m. In addition, a significant parcel of land has been set aside in the area around the Banwell/EC Row Expressway intersection for a future interchange.

Banwell Road operates as a basic 2-lane roadway with narrow gravel shoulders and open ditch drainage between south of the Tecumseh Road East intersection and the City limits. Added turn lanes are provided at the signalized intersections of EC Row Expressway, Wildwood Drive/Mulberry Drive and Tecumseh Road East. Several other minor roads intersect with Banwell Road to provide access to residents and developments in the area. A total of 6 intersections are analyzed within the study area and a summary of their control types is shown in Exhibit 3-1.

Exhibit 3-1: Intersection Control Type

Location	Control Type
Tecumseh Road and Banwell Road	Signalized
Palmetto Road and Banwell Road	Unsignalized
Mulberry Drive and Banwell Road	Signalized
EC Row Expressway and Banwell Road	Signalized
EC Row Avenue and Banwell Road	Unsignalized
Intersection Road and Banwell Road	Unsignalized

Controlled site access to Banwell is currently provided immediately south of Tecumseh Road (commercial/institutional developments) and five residential properties between EC Row Avenue and Intersection Road enjoy direct fronting access. North of Tecumseh Road, Banwell Road widens to a basic 4-lane cross section with a centre median. Currently, no facilities are provided for either pedestrians or an exclusive bike/trails corridor.

The posted speed limit in the study area ranges from 60 km/h from the City limits to the EC Row Expressway and drops to 50 km/h north of the expressway. Within the study limits, Banwell Road is classified as a truck route from EC Row Avenue East to Tecumseh Road East. A single rail track carrying CPR rail traffic exists immediately north of the City limits. This crossing is currently controlled with flashers and a gate system.

EC Row Expressway is an expressway with a posted speed limit of 80 km/h that runs east-west from the City of Windsor to the Town of Lakeshore. In and around the study area, it has two through-lanes each direction and storage/merge lanes at intersections and interchanges. Currently, the intersection of Banwell Road and EC Row Expressway is an at-grade signalized intersection.

3.2 Capacity Analysis

The capacity analysis was based on traffic counts completed in 2012-2014. Count locations and dates are summarized in Exhibit 3-2 below. Traffic counts were scaled using a 1% per annum growth rate to bring older counts up to date as required.

Exhibit 3-2: Intersection Turning Movement Count Summary

Location	Count Date
Tecumseh Road and Banwell Road	2013-06-25
Palmetto Road and Banwell Road	2014-10-06
Mulberry Drive and Banwell Road	2013-06-24
EC Row Expressway and Banwell Road	2013-06-26
EC Row Avenue and Banwell Road	2012-01-17
Intersection Road and Banwell Road	2014-10-08

For analysis, Highway Capacity Manual (HCM) methodology (2000) was used in Synchro 7 to assess intersection and movement operational performance. Refer to Exhibit 3-3 below for the level-of-service (LOS) based on control delay, for signalized and unsignalized intersections and movements.

Exhibit 3-3: Level of Service and Delay Lookup

HCM LOS	Control Delay per Vehicle (s)	
	Signalized	Unsignalized
A	≤10	≤10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

Critical movements are identified by having any one or more of the following criteria, which match Ministry of Transportation, Ontario traffic guidelines:

- Level-of-service E or worse;
- 95th percentile queue exceeding provided storage/link length (marked by # in Synchro); and,
- Volume-to-capacity (v/c) ratio of 0.85 or greater.

Critical movements at all intersections are shown in Exhibit 3-5 and a summary of the issues found are provided below:

- The intersection of Banwell Road and EC Row Expressway is operating at LOS E in the existing conditions. Multiple movements are operating over capacity with a LOS E or F and exceed the storage lengths available.
- The WBL from Mulberry Drive onto Banwell Road has a poor LOS in the a.m. peak hour of F with a v/c ratio of 0.93.

Poor existing operations indicate the need for improvement at the intersection of Banwell Road and EC Row Expressway and at the intersection of Mulberry Drive and Banwell Road.

Exhibit 3-4: Existing 2014 Traffic Volumes

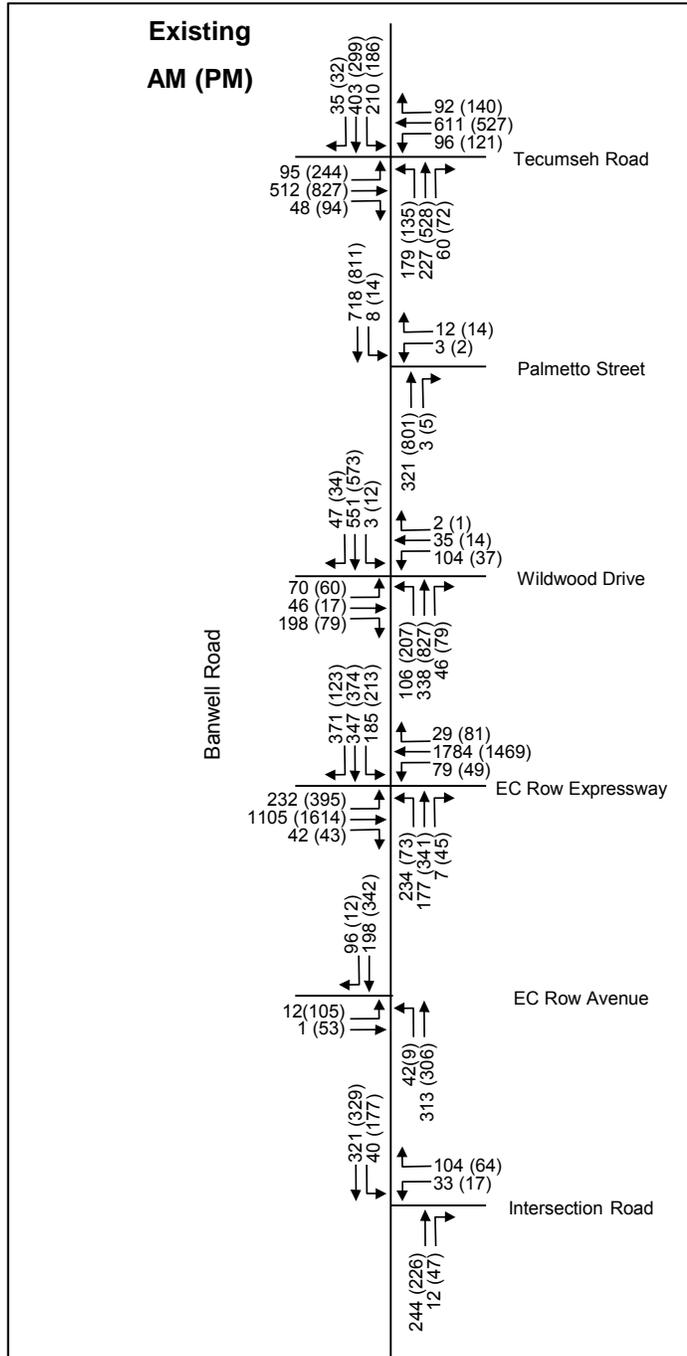


Exhibit 3-5: Existing Conditions

Location	Peak	Overall LOS	Critical				
			Mvmt	LOS	Delay (s)	V/C	95th Queue (m)
Tecumseh Road and Banwell Road	AM PM	C C					
Palmetto Road and Banwell Road	AM PM	n/a n/a					
Mulberry Drive and Banwell Road	AM PM	C B	WBL	F	99	0.93	#43
EC Row Expressway and Banwell Road	AM	E	EBL	F	152	1.16	#104
			WBT	E	70	1.06	#299
			NBL	F	155	1.17	#104
			SBT	E	79	0.94	#141
			SBR	F	83	0.94	#130
	PM	E	EBL	F	142	1.17	#162
			WBT	C	30	0.88	216
			WBL	F	84	1.08	#256
			NBT	E	79	0.95	#156
			SBL	F	148	1.15	#96
SBT	D	50	0.76	#130			
EC Row Avenue and Banwell Road	AM PM	n/a n/a					
Intersection Road and Banwell Road	AM PM	n/a n/a					

sign indicates queue movement exceeds capacity, queue may be longer

3.3 Safety Analysis

The intersection of Banwell Road and EC Row Expressway experienced the 4th highest collision rate from 2009 to 2013. With 1.34 collisions per million entering vehicles, this intersection has the highest number of collisions in the City of Windsor. The average collision rate at signalized intersections in the city is only 0.48 collisions per million entering vehicles.

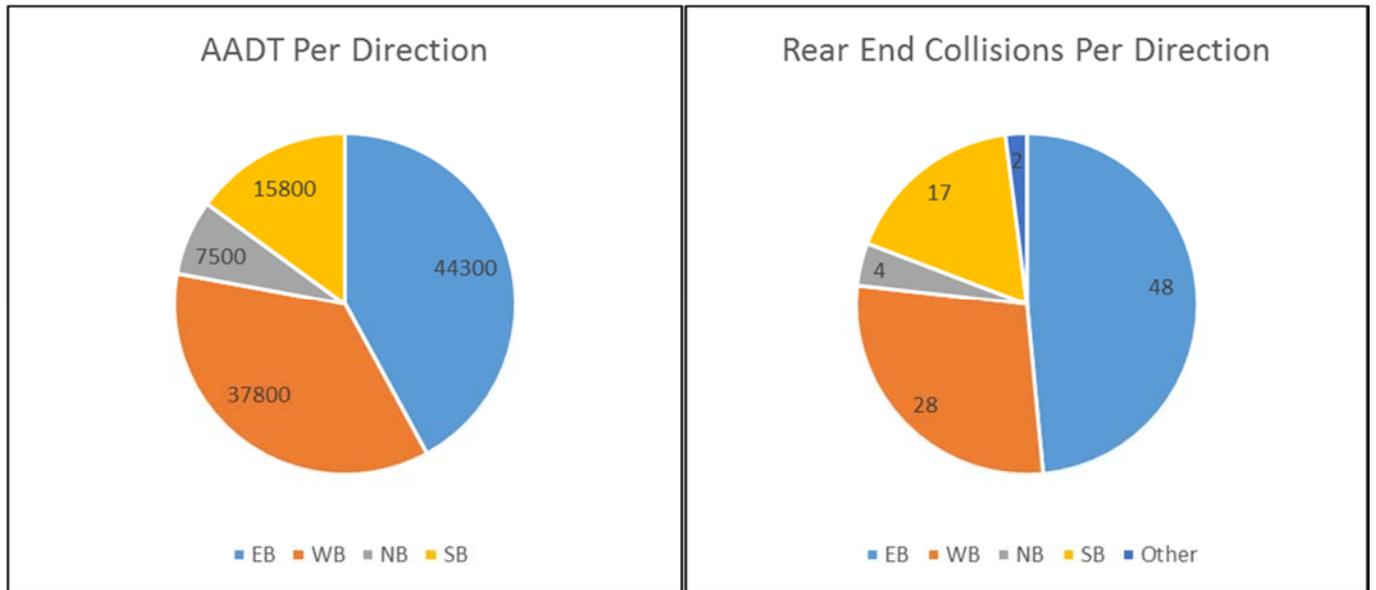
The majority of collisions occur in the daytime (76%), there does not appear to be any significant issues with illumination or visibility in low light conditions.

From 2009 to 2013 there are a total of 125 accidents, of which 99 are rear end collisions. This represents 79% of the collisions. When compared to regional averages, (33% for 2013) this is a significant overrepresentation. There are very low amounts of other collisions, without rear ends there would only be 26 collisions from 2009-2013 which having extremely high volumes of over 96 million vehicles entering the intersection during that time. Of the 125 accidents only 34 (27%) resulted in injuries, this is consistent with the City of Windsor ratio of 929 injuries with 3,798 collisions (24%). As a result, although amount of collisions are high, the number of fatalities is zero and the number of injuries is similar to that of the City-wide average.

The number of rear end collisions does not appear to exhibit a significant bias towards a specific approach direction. All directions shows a reasonably proportional amount of rear end collisions when compared with the number of vehicles travelling in that direction. The eastbound direction seems to be the worst, it represents 42% of the traffic approaching the intersections but is 48% of the rear end collisions. Most of the rear end collisions are likely as a result of congestion causing unexpected slowdowns, long queues and increased driver frustration. The eastbound direction has the poorest level of service which is likely the reason for it having the highest number of rear end collisions.

As a result, in order to reduce the number of rear end collisions, the most effective measure would be to reduce queues and improve LOS. However as shown in the interim analysis, this is very difficult to accommodate at this intersection, only minor improvements can be made.

Exhibit 3-6: Collision Rate Splits



4 Traffic Forecasts

This section provides the 2034 traffic volumes used for analysis of the road network. Future volumes are based on updated traffic counts, background growth provided by the Lauzon EA travel demand model, Town of Tecumseh forecasts, and planned corridor developments.

4.1 Background Growth

The City's travel demand TransCAD model was provided for use in the EA. The model was updated by MRC in 2013 for the Lauzon Parkway EA, with updates reflecting changes to land-use and development plans through 2031, refinements to the road network, and re-calibration and validation of the model. Even with the update, the model is outdated and would require an extensive overhaul to accurately assess traffic conditions along the Banwell Road Corridor.

However, the model scenarios provided for 2011 and 2034 were sufficient for the purpose of evaluating background travel growth and no new model runs were required for this study.

Background growth was developed by extracting traffic forecasts from the City's travel demand model and comparing to prior assumptions. As described previously the Lauzon EA travel demand model was updated by MRC in 2013 and includes updated land-use inputs and networks. Network improvements assumed for 2031 include the following:

- Banwell Road widening to four lanes both north and south of EC Row Expressway;
- Lauzon Parkway widening to six lanes both north and south of EC Row Expressway;
- EC Row Expressway widening to six lanes west of Banwell Road with an interchange at Banwell Road. East of Banwell Road EC Row has an at-grade intersection at Lesperance Road with six lanes (three per direction) continuing east.
- There is a residential community north of Tecumseh Road along Banwell Road that is modelled using multiple centroid connectors directly onto Tecumseh Road rather than Banwell Road. This only affects the distribution of traffic onto the intersection of Banwell Road and Tecumseh Road however the model was only used to determine traffic growth rather than traffic distribution.

Traffic growth rates from the 2013 Lauzon EA, historical traffic counts, and the 2011 Banwell EA were compared to determine an appropriate background growth rate for the current update. Exhibit 4-1 shows the different growth rates of each data set. In order to compare the growth as the timelines are different, the annual compound growth rate is calculated and shown. Two separate growth rates were evaluated for Banwell Road: one north and one south of EC Row Expressway.

The updated demand model from the 2013 Lauzon EA shows the lowest annual growth rate of 0.4% to 2.3%, while the prior study (PTSL 2006) has the highest annual rates at 5.8% to 10.2%. Traffic counts show a relatively high annual growth rate at 3% to 7%. The prior Banwell EA likely used an aggressive growth model dating to the early 2000's when employment and population projections for the region were higher. It appears that the 2013 Lauzon EA model accounted for updated population and employment projections for the region, which have annual growth rates in the range of 1% to 3%.

The model was also assumed to be a coarse representation of the traffic flows in the region, as a such a screenline growth north and south of EC Row Expressway between Walker Street and County Road 19 was completed to assess if localized growth along Banwell Road matched growth in the overall area. It was found that the screenline growth was similar to that along Banwell Road as show in Exhibit 4-1.

Annual growth rates from the 2013 Lauzon EA model (0.4% - 2.3%) are more recent and appropriate for use in background growth, especially when combined with development-specific forecasts as developed in Section 4.3 of this report. However, to remain conservative in light of traffic counts from 2006-2013 showing higher demand than the model, 0.5% annual compound growth is used for Banwell Road north of EC Row Expressway and 2.5% annual compound growth is used for Banwell Road south of EC Row Expressway.

Exhibit 4-1: Growth Rate Comparison

Background Growth	North of EC Row Expressway	South of EC Row Expressway
Demand Model Banwell Road (2011-2031)		
% Growth	9%	57%
Annual Compound Growth Rate	0.4%	2.3%
Demand Model Screenline Road (2011-2031)		
% Growth	9%	17%
Annual Compound Growth Rate	0.4%	1.2%
Traffic Counts (2006-2013)		
% Growth	24%	61%
Annual Compound Growth Rate	3.1%	7.0%
Prior Study (2006-2027)		
% Growth	226%	670%
Annual Compound Growth Rate	5.8%	10.2%

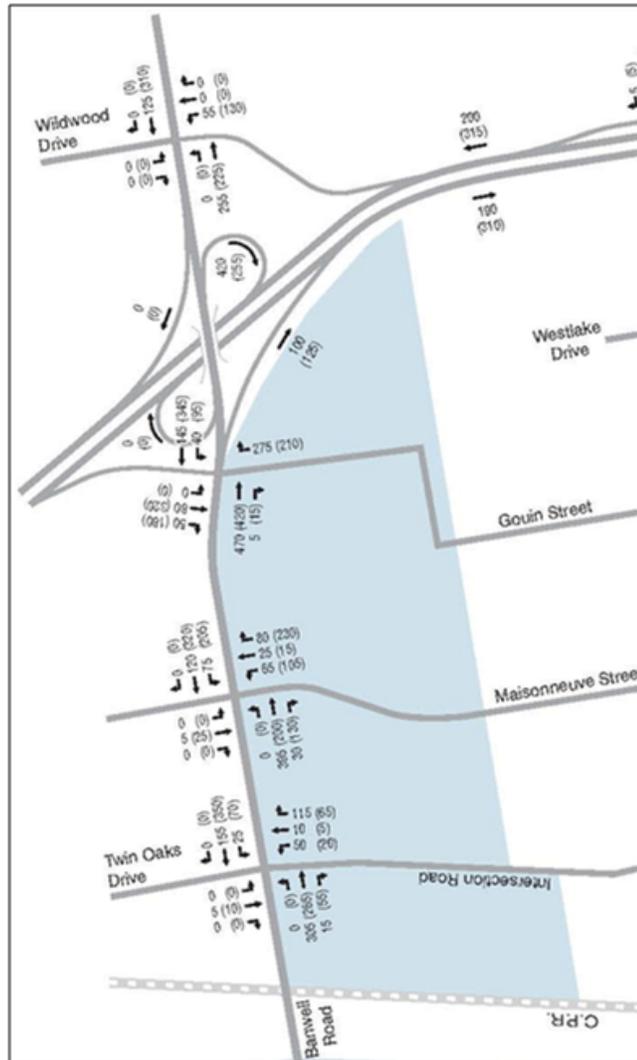
4.2 Development Traffic

Three developments were considered in order to fully represent traffic growth along Banwell Road. The main developments planned along Banwell Road as noted from the prior studies reviewed are, the Tecumseh Hamlet, Pointe East Windsor Limited (formerly known as Fanelli Lands), and Royal Timbers.

Tecumseh Hamlet

The trips generated by the Tecumseh Hamlet were directly adopted from the 2015 Dillon Consulting Transportation Study. These volumes assume the full build-out of the Hamlet (year 2034). The distribution of the volumes is shown in Exhibit 4-2.

Exhibit 4-2: Tecumseh Hamlet Projected Site Traffic



Pointe East Windsor Limited

Trips generated from the future Pointe East Windsor Limited development were based on a retail space of 1.5 million square feet taken from the previous Banwell Road EA and carried forward. This is the anticipated land use and the development yields the following trip generation as shown in Exhibit 4-3.

Exhibit 4-3: Pointe East Windsor Limited Trip Generation

Peak Hour	Units	Total Trips	Enter	Exit
AM	1.5M ft ²	761	464	297
PM		3,904	1,913	1,991

A slight reduction to volumes onto Banwell Road was calculated based on the demand model volumes because the background growth rates based on the model included the Pointe East Developments. To eliminate accounting for the Pointe East Developments twice, the trips already accounted for as part of the background growth was removed from

the trip generation. This was only done for the p.m. peak hour as a demand model for the a.m. peak hour was not available, plus volumes for the a.m. peak hour are much lower and unlikely to cause capacity problems. Site entrance and exit volumes are not affected however volumes distributed through the network are shown in Exhibit 4-4.

It should be noted that the proposed development size is very aggressive and future actual site plans may be significantly different. It was assumed that a development of this size would have a second entrance/exit onto the west side of the development onto Twin Oaks Drive and Lauzon Parkway. Thus 50% of the generated trips were assumed to use the Lauzon Parkway and 50% would use Banwell Road.

To remain conservative due to uncertainty in the long-term growth, no further reductions such as pass-by and internal trips. When the site plan application for the Pointe East Development occurs, a more detailed analysis with more realistic trip generation, distribution and reductions is required. This also may change the requirements of the site accesses onto Banwell Road, but design requirements for this could be based on a weekend scenario.

Exhibit 4-4: Reduced Pointe East Development Volumes

ITE Trip Generation			Reduced		
Total	Enter	Exit	Total	Enter	Exit
761	464	297	761	464	297
3,904	1,913	1,991	3,362	1,606	1,756

Royal Timbers

Trips generated from the proposed Royal Timbers development are shown in Exhibit 4-5 and are based on development information from the previous Banwell Road EA.

Exhibit 4-5: Royal Timbers Trip Generation

Peak Hour	Units	Total Trips	Enter	Exit
AM	10.2	40	24	16
PM		138	68	70

4.3 2034 Total Volume Projections

The previously discussed background growth rates of 0.5% above the EC Row Expressway and 2.5% south of the EC Row Expressway were used to project background volumes. Background traffic volumes distributed onto the new proposed road network is shown in Exhibit 4-8. The developments along Banwell Road including Pointe East Windsor Limited, Tecumseh Hamlet and Royal Timbers were added as additional trips and distributed manually based on existing directional splits as previously shown. The distributions and volumes for the Pointe East Windsor Limited and Royal Timbers developments are shown in Exhibit 4-6 and Exhibit 4-7. The total volumes used for analysis are shown in Exhibit 4-8.

Exhibit 4-6: Added Developments Traffic Distribution

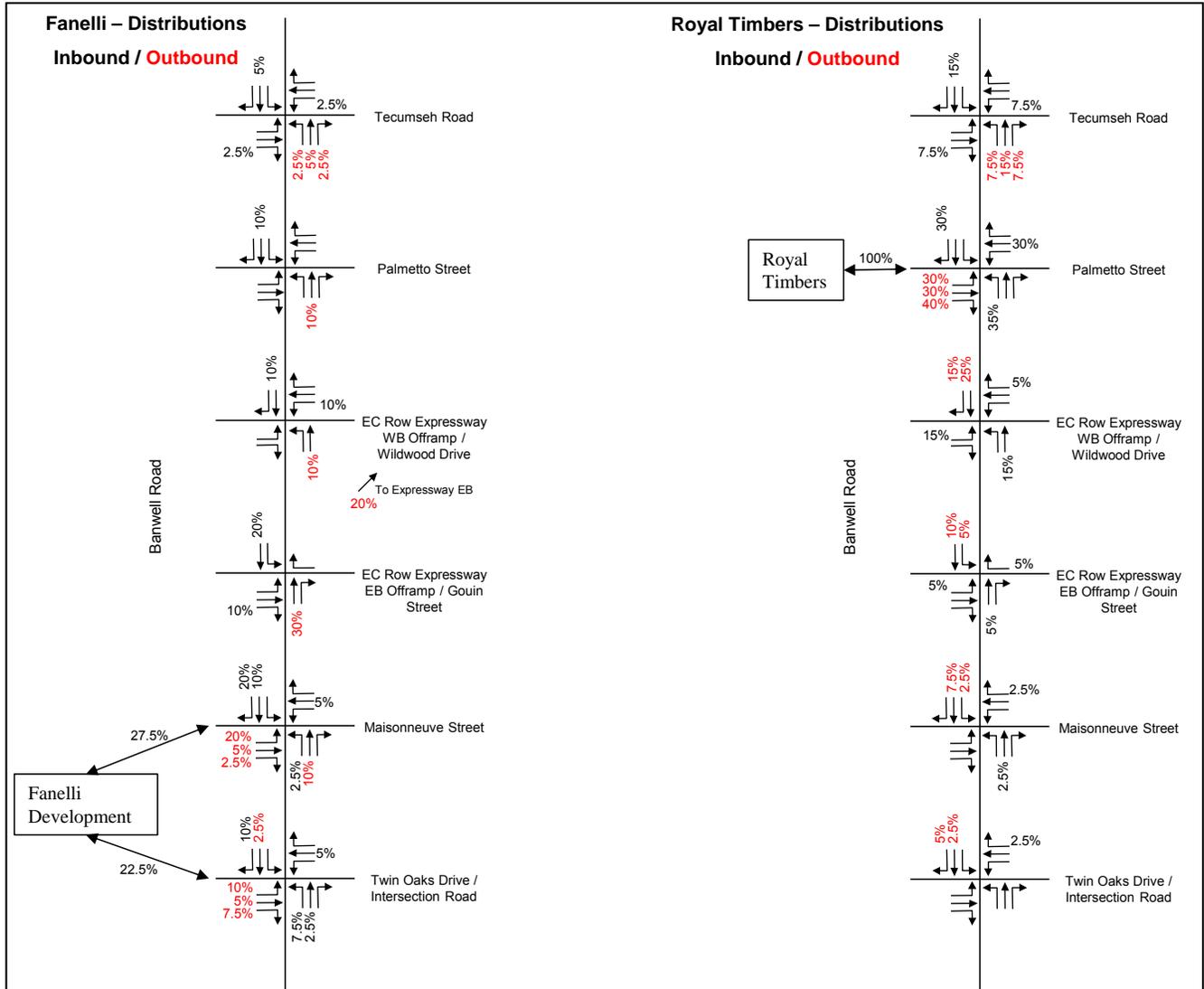


Exhibit 4-7: Added Developments Site Generated Traffic Volumes

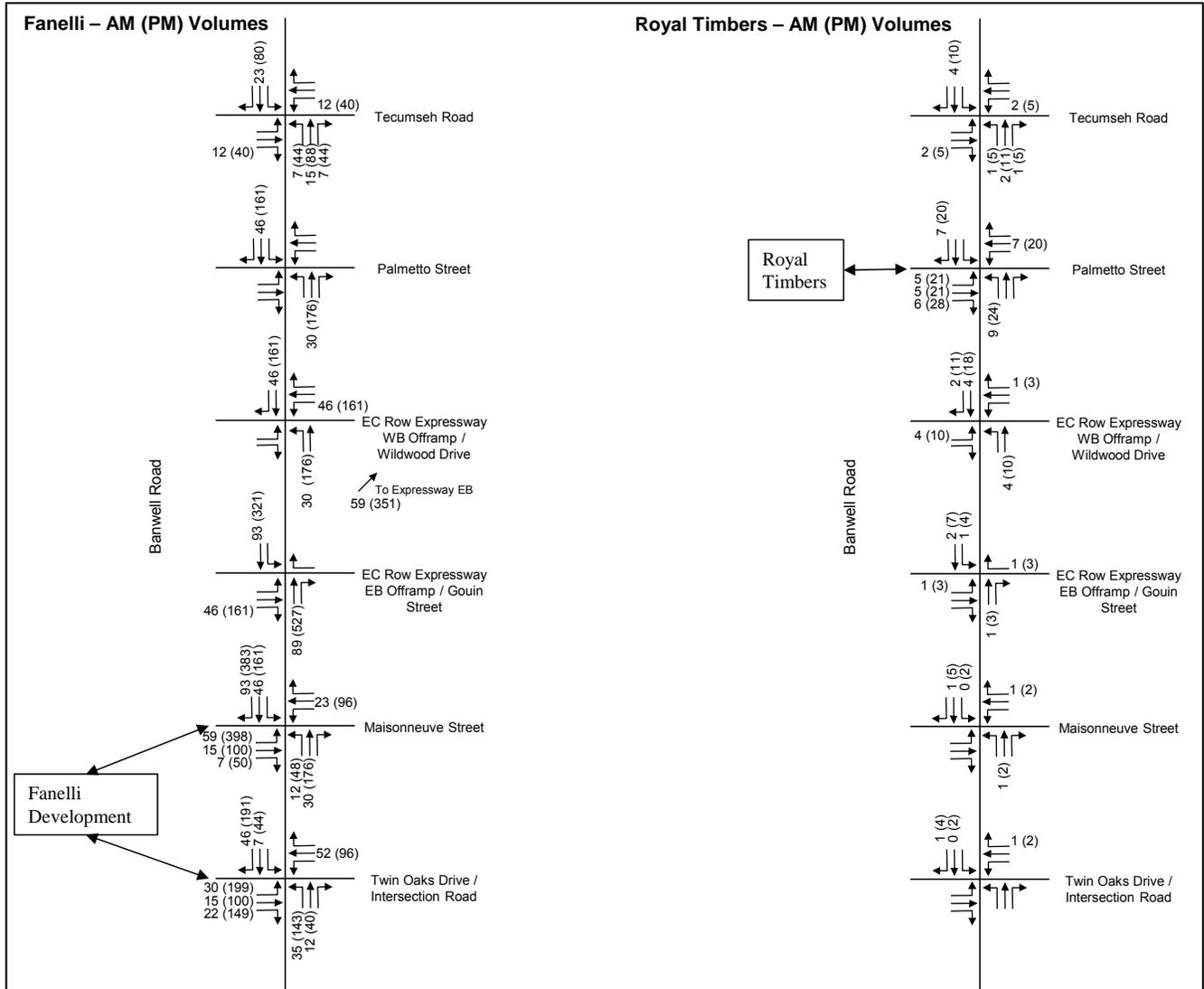
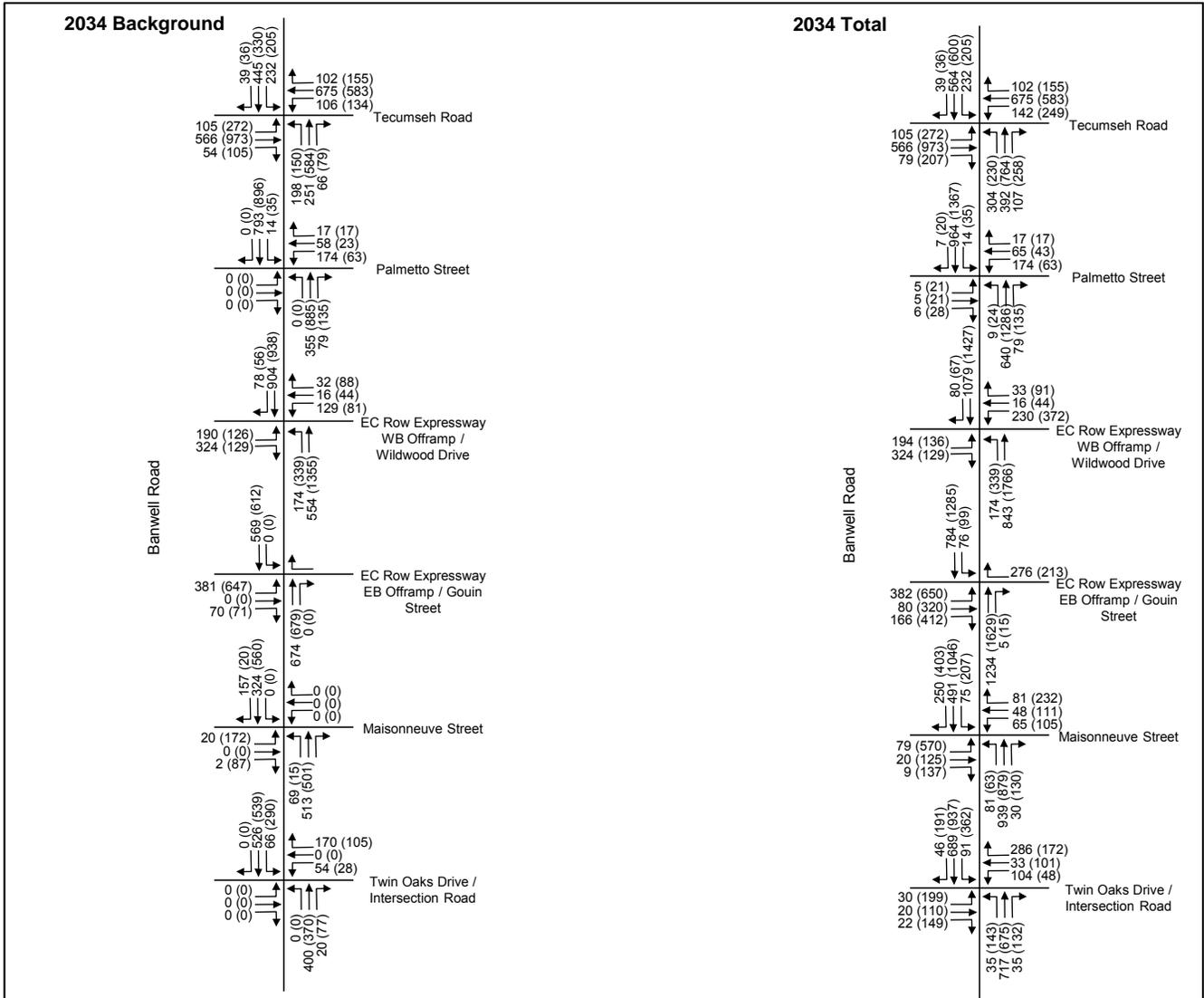


Exhibit 4-8: 2034 Projected Volumes



5 Alternatives Development

5.1 Strategic Alternatives

A review of strategic alternatives is typically included in environmental assessments to ensure that all options are considered including do-nothing, public transportation and active transportation. The following provides a brief review of strategic alternatives.

Do Nothing - It is not anticipated that this option is feasible as the intersection of EC Row and Banwell Road is already congested to a level that warrants improvements to an interchange. Furthermore, increased traffic volumes driven by developments and background growth will contribute additional traffic to the road network. Overall it has been repeatedly demonstrated based on the previous Banwell Road EA and 2015 Tecumseh Hamlet Study that this alternative would not be adequate in providing future traffic capacity to meet demand.

Road Network Improvements - The main objective is to determine how much additional traffic capacity is required to meet traffic demand in the 20 year horizon. It is important that roads are not overbuilt as the capital and maintenance costs of major infrastructure such as interchanges is very high. Due to the large difference between existing and future volumes and current road capacity, road network improvements are the primary strategic approach to accommodate future travel needs. The prior EA identified a parclo interchange with road widening of Banwell Road as the overall need for the study area. The parclo configuration matches the protection of property in the area and is carried forward for the current EA, as is road widening of Banwell Road.

Public Transportation - Generally this area of Windsor is characterized by low-rise residential along with existing and planned commercial and retail developments. In these types of land-uses the primary travel mode is by private auto, and public transport alternatives without road capacity improvements will not be sufficient to solve the problems identified. However the City's Master Plan has identified policies to increase transit modal share including increased service levels. The Banwell Road EA and preliminary design will therefore identify public transport infrastructure where appropriate, and ensure that bus stops are well-integrated with the surrounding land-use and pedestrian facilities.

Active Transportation - As an arterial road Banwell Road's primary function is to provide road connections between collector roads and to EC Row Expressway. Because travel distances tend to be longer than walking and common cycling distances, active transportation infrastructure is not expected to be a viable alternative to road widening. However active transportation should be incorporated into the design where appropriate, with input from the City.

Road network improvements will be oriented to solve the capacity problems identified; however, the EA and subsequent designs will also consider public transit and active transportation where appropriate; e.g. bike lanes, sidewalk across the interchange, adjacent paths if appropriate, etc.

5.2 Road Network Alternatives

The 2011 draft EA provided a recommended road layout for Banwell Road based on analysis of existing and forecast traffic volumes. Since 2011, the Town of Tecumseh has undertaken a traffic study to determine its preferred road network to accommodate planned growth east of Banwell Road. This section describes the development of the base and alternative road layouts for evaluation in the EA.

Base Scenario

The base scenario consists of the road network from the original environmental assessment with the proposed modifications by the 2015 Dillon Consulting Transportation Study for the Town of Tecumseh. The Dillon Study was reviewed in Section 2 of this report and in provides a solid

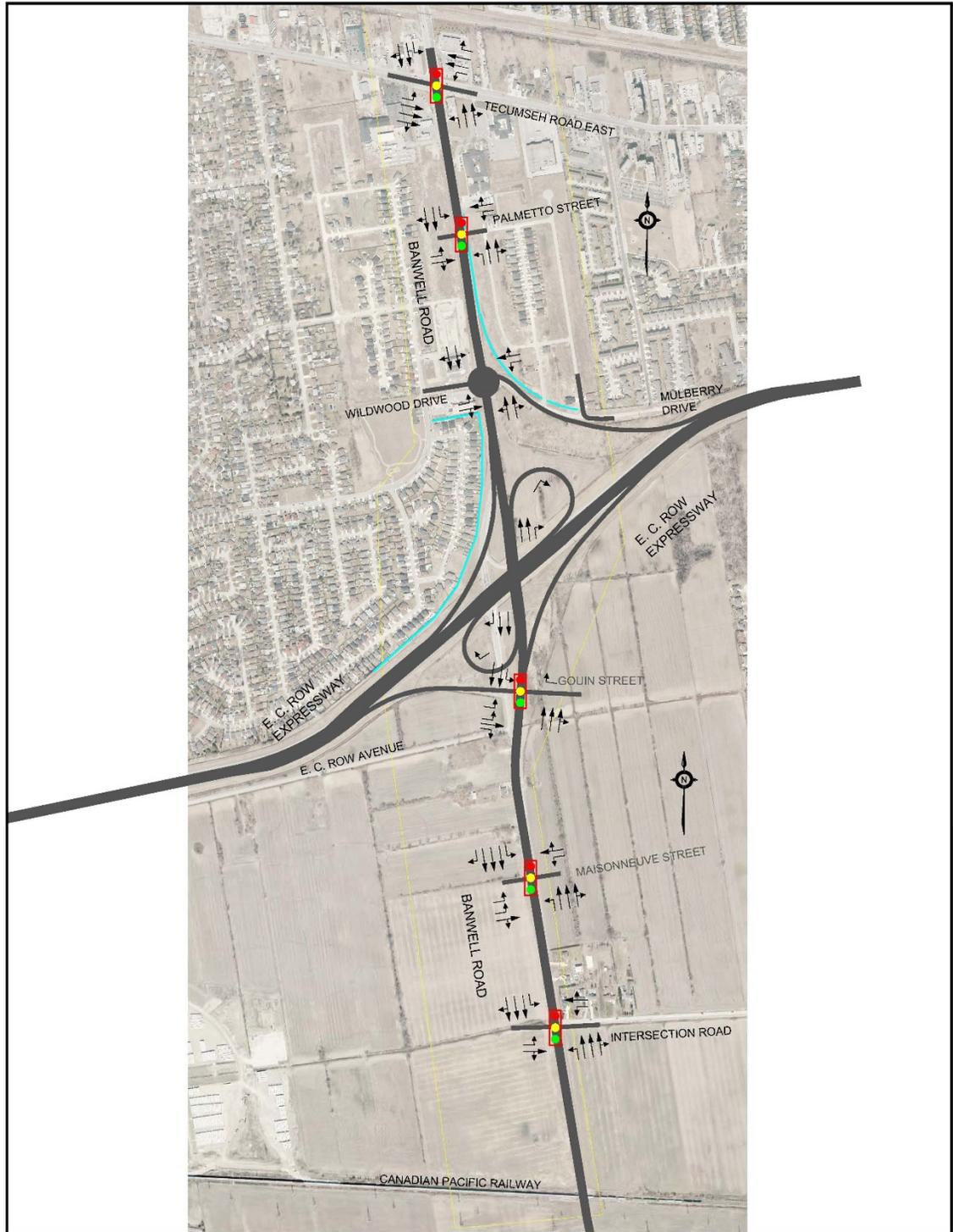
basis for updating the traffic analysis. The base layout lane configurations are shown in Exhibit 5-1 and include the following:

- Banwell Road four lanes north of EC Row Expressway and six lanes south of EC Row Expressway.
 - In the southbound direction the transition from four to six lanes occurs at the eastbound off-ramp. The eastbound right-turn is channelized and becomes the third southbound lane.
 - Northbound the transition occurs at the south to west loop ramp – three lanes are carried through the eastbound off-ramp and the third lane exits onto the loop ramp.
- Two intersections are provided south of EC Row Expressway and north of the CP tracks. The two intersections have single left turn lanes on Banwell Road and dedicated right turn lanes. Turns from the side streets may in future require double-left turns if retail supercenter is implemented as expected.
- North of EC Row Expressway the westbound off-ramp connects directly to a roundabout at Mulberry Drive. Mulberry Drive is disconnected east of Banwell Road so that the westbound off-ramp can connect instead.
- North of Mulberry Drive signalized intersections are provided at Palmetto Street and Tecumseh Road East.

The primary difference between the prior EA road configuration and the Dillon Study is the addition of a fourth leg to the EC Row eastbound off-ramp terminal. The fourth leg was proposed to provide for an inbound and outbound access to development lands south of EC Row and east of Banwell Road. The Dillon Study formed the recommendation based on a preference for the fourth leg over an alternative configuration which would require double-left turns at the two intersections south of EC Row. A third alternative, with three intersections south of EC Row, was also ruled out due to intersection spacing. The base layout lane configurations are shown in Exhibit 5-1.

The analysis of the base configuration is provided in Section 6 of this report which includes a comparison of roundabout vs. signalized intersection operations at the intersection of Mulberry Drive and Banwell Road.

Exhibit 5-1: Base Network Layout North of EC Row Expressway



5.2.1 EC Row Interchange – WB Off-Ramp Alternatives

The City requested a review of alternatives for the EC Row westbound off-ramp and justification of the prior recommended configuration. The prior configuration has two significant drawbacks. The first is the closure Mulberry Drive east of Banwell Road so that the off-ramp can connect to Mulberry Drive instead. This configuration will add travel time and is an inconvenience to adjacent residents.

The second drawback to the base network plan is the creation of a large parcel of land between the westbound off-ramp and the south to west loop ramp (visible in Exhibit 5-1). The land cannot easily be serviced and will essentially become 'locked' as it will likely be undevelopable. Generally it is undesirable to have large inefficient uses of land such as this as neither environmental features or development is possible.

This report provides an update to the 2011 traffic analysis using new traffic forecasts considering the updated demand model and updated development information. Given that both of the above drawbacks are significant, potential alternatives to mitigate the drawbacks were developed as follows:

- Alternative W1 – construct a parclo A4 interchange with a signalized intersection adjacent to the N-W on-ramp. This configuration would result in close spacing between the off-ramp intersection and the Mulberry Drive intersection. The close spacing will result in weaving.
- Alternative W2 – a parclo A4 interchange with a right-out only E-N/S off-ramp. This configuration would be very unusual and will require traffic going south to turn right at the interchange and then perform a u-turn at the proposed roundabout at Mulberry Drive.

The two alternatives are illustrated in Exhibit 5-2 and Exhibit 5-3. Analysis is provided in Section 6 of this report.

Exhibit 5-2: Westbound Off-Ramp Alternative W1

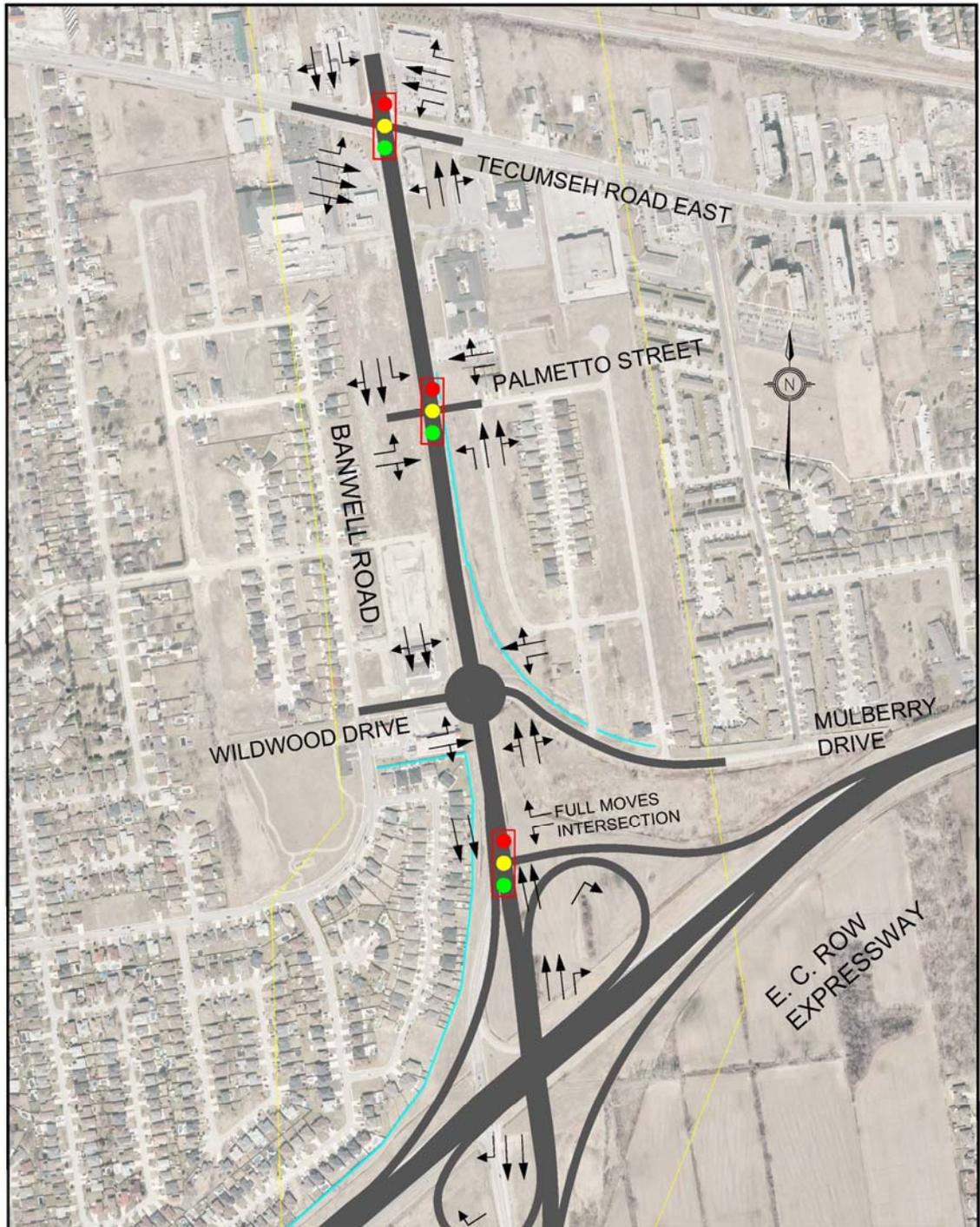
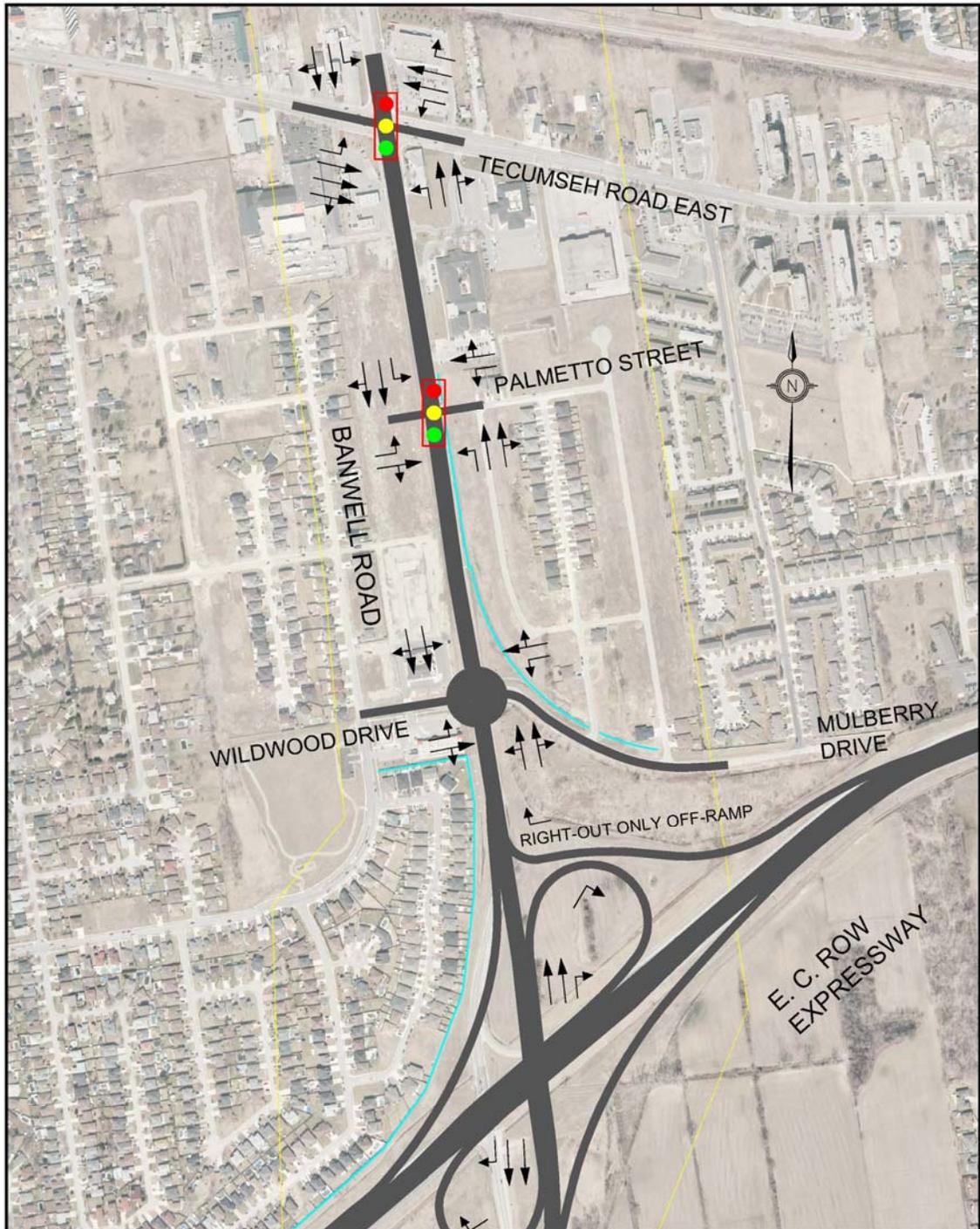


Exhibit 5-3: Westbound Off-Ramp Alternative W2



5.2.2 EC Row Interchange – EB Off-Ramp Alternative

For the eastbound off-ramp, the Town of Tecumseh 2015 traffic study (as described in Section 2 of this report) determined that a fourth leg of the intersection would be desirable. The fourth leg would relieve the requirement for double left turns on Banwell Road, south of EC Row or for three intersections south of EC Row which are both undesirable. The configuration proposed in the Town's Study has no left-out (westbound left turn), as residents could use downstream intersections to travel south.

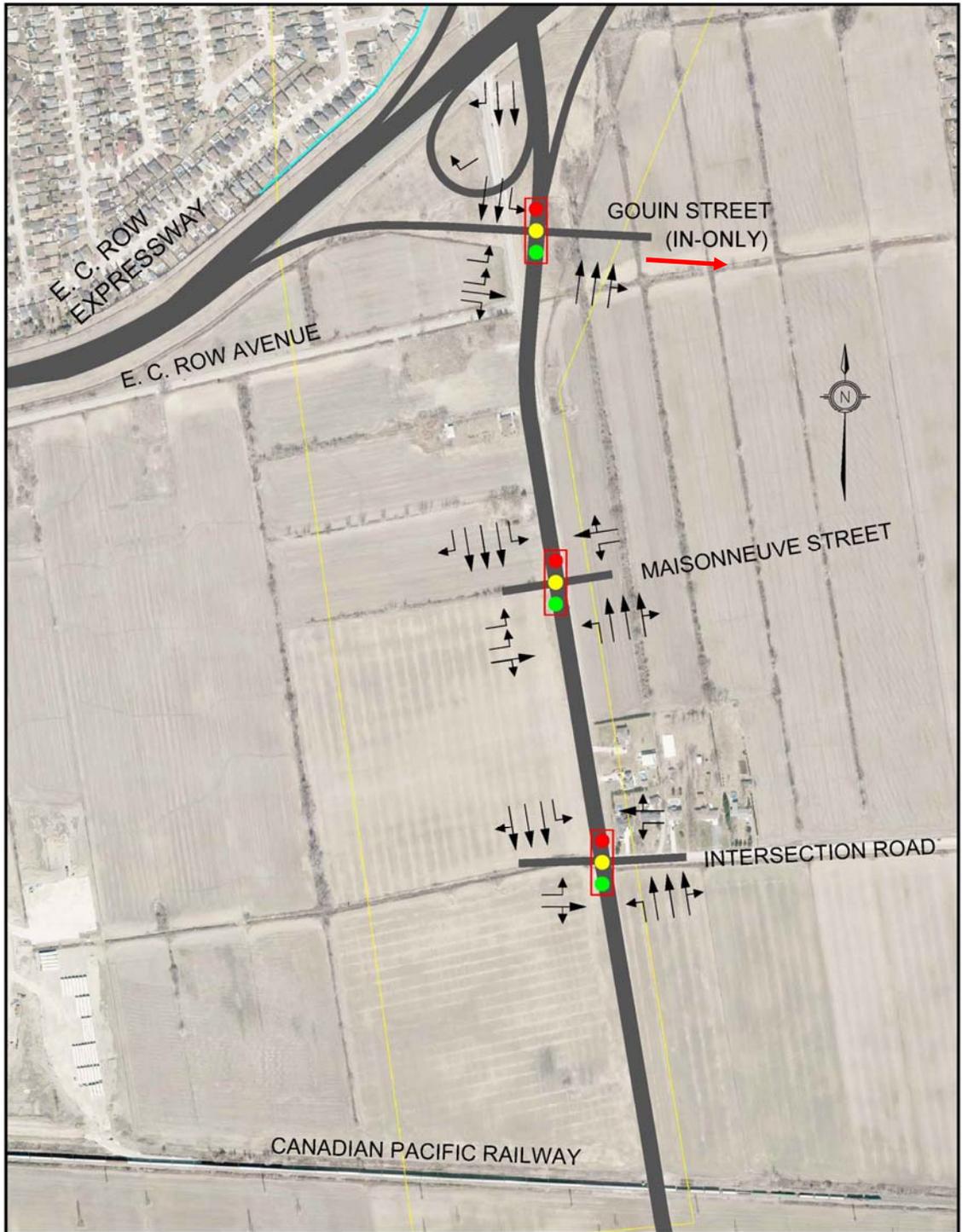
Generally the Town of Tecumseh study findings are valid, however adding a fourth leg to an interchange off-ramp (with traffic permitted to enter Banwell Road northbound) adds a significant penalty to traffic operations. Because the entering movement requires a signal phase or extension of an existing signal phase, most other users of the intersection, including northbound traffic on Banwell Road in both directions, traffic exiting EC Row Expressway eastbound, and traffic entering EC Row expressway eastbound from the south, will experience an increase in delays and travel times.

The allowable movements at the proposed E-N/S/E off-ramp would be a southbound left turn, an eastbound through movement, and a northbound right turn. Proposed N-E on-ramp would need to be consolidated in the intersection. This would penalize traffic entering EC Row expressway as they would need to stop at the signal during the EB phase.

Given the above, under the scope of this traffic study, this alternative was selected for further study to minimize the above drawbacks while maintaining service to Town of Tecumseh development lands. The alternative (termed E1 in this report) would allow only entering traffic to the Town of Tecumseh, and no exiting movement, or a one-way street only. A configuration with one-way entering traffic is in place in other locations in Ontario such as Guelph Line Road and QEW in the Burlington. Traffic operations are maintained as the signal remains a three-phase.

An exhibit of Alternative E1 is shown below; traffic operations are provided in Section 6.

Exhibit 5-4: Alternative E1 Layout



6 2034 Conditions

This section provides a traffic analysis of the base and alternative networks described in Section 5. The purpose is to provide input into the evaluation of alternatives and to provide guidance for updating the preliminary design in terms of lane configuration, turning lane requirements, storage lengths, and geometries.

6.1 Base Network

As stated previously, the Base Network is a combination of the prior recommended layout for Banwell Road with the addition of the fourth leg of the EC Row Expressway EB off-ramp to provide access to and from the Town of Tecumseh development lands adjacent to Banwell Road.

The capacity analysis shows several intersections that are at or near capacity by 2034 in both the a.m. and p.m. peak periods. However none of the movements are over capacity with all v/c ratios below 1.0. Due to the conservative nature of the growth projections and full addition of development traffic, there should be sufficient future capacity in 2034 using the base network with multiple movements nearing capacity.

Exhibit 6-1: AM Peak Period Capacity Analysis Results

Intersection	Intersection LOS	Critical			
		Movement	LOS	V/C	95% Queue (m)
Banwell Road at Tecumseh Road	C	EBT	D	0.57	57
		WBT	D	0.78	95
		WBR	D	0.06	7
Banwell Road at Palmetto Road	B	EBL	D	0.02	4
		EBT	D	0.02	6
		WBL	E	0.73	39
Banwell Road at EC Row EB Offramp/Gouin Street	C	WBT	D	0.23	14
		EBL	D	0.70	59
		EBT	D	0.27	31
Banwell Road at Maisonneuve St	B	WBR	E	0.80	85
		EBL	E	0.40	17
		EBT	D	0.17	13
Banwell Road at Twin Oaks Drive/Intersection Road	C	WBL	D	0.26	23
		WBT	D	0.44	33
		EBL	D	0.26	13
		EBT	D	0.07	12
		WBL	E	0.62	39
		WBT	D	0.35	35

Exhibit 6-2: PM Peak Period Capacity Analysis Results

Intersection	Intersection LOS	Critical			
		Movement	LOS	V/C	95% Queue (m)
Banwell Road at Tecumseh Road	D	EBL	D	0.81	74
		EBT	E	0.94	127
		WBL	E	0.89	88
		WBT	D	0.68	86
		WBR	D	0.10	9
		NBT	D	0.85	110
		SBL	E	0.91	80
		SBT	D	0.57	88
Banwell Road at Palmetto Road	A	EBL	D	0.19	12
		EBT	D	0.17	16
		WBL	E	0.57	28
		WBT	D	0.33	23
Banwell Road at EC Row EB Offramp/Gouin Street	C	EBL	D	0.52	58
		EBT	D	0.74	100
		WBR	E	0.78	72
Banwell Road at Maisonneuve St	D	EBL	E	0.86	91
		WBL	D	0.34	24
		WBT	E	0.86	104
		NBL	D	0.41	25
		NBT	D	0.64	95
		SBL	D	0.73	58
		SBR	D	0.25	24
Banwell Road at Twin Oaks Drive/Intersection Road	C	EBL	D	0.70	50
		WBL	D	0.26	20
		WBT	E	0.78	75
		SBL	D	0.73	100

Wildwood Drive & Banwell Road

A separate analysis is provided for the intersection of Wildwood Drive & Banwell Road. The prior EA recommended a roundabout as it provides the best traffic operations and space is available. For the current update, new traffic forecasts were updated, therefore an analysis is needed to confirm that a roundabout is still operationally preferable. The following table provides the analysis. The signalized intersection analysis was undertaken using Synchro and the roundabout analysis was undertaken using SIDRA. SIDRA is a dedicated roundabout platform with wide use in North America including in New York State. Generally some caution should be applied when comparing level-of-service, delays, and queues between platforms as the internal algorithms are not consistent, however in general terms the overall performance and critical movements identified by both platforms are considered valid.

The analysis indicates that both a signal and a roundabout are feasible alternatives to meet the needs of traffic operations. The roundabout has a lower average delay of 9 seconds on average, in comparison with a signal at 52 seconds on average. Having a signalized intersection at this off-ramp would cause a need for split phasing between the Wildwood Drive approach and the off-ramp approach. This in turn causes significantly higher delay for the mainline traffic on Banwell Road due to the need to accommodate two additional phases. This analysis therefore indicates that the roundabout is an appropriate treatment at the intersection and should be carried forward.

Exhibit 6-3: Traffic Operations 2034 at Mulberry Drive & Banwell Road

Intersection	Control	Peak Hour	LOS	Delay (s)	Critical				
					Movement	LOS	V/C	95% Queue (m)	
Banwell Road at Wildwood Drive/EC Row WB Offramp	Signal	AM	C	32	EBL	E	0.77	78	
					EBR	D	0.20	27	
					WB	D	0.86	46	
					NBL	D	0.75	62	
		PM	E	72	EBL	F	1.19	74	
					EBR	D	0.08	4	
					WB	F	1.35	93	
					NBL	F	1.47	142	
	Roundabout	AM	A	8					
					PM	A	10		

6.2 EC Row Expressway WB Off-Ramp Analysis

As described in Section 5.2, two alternatives were developed to enable Mulberry Drive east of Banwell Road to remain connected to Banwell Road. Alternative W1 was defined as having a signalized intersection adjacent to the east-to-south loop ramp (northbound left loop ramp). Alternative W2 was defined as having a right-out only adjacent to the east-to-south loop ramp, which would require southbound traffic to travel to the roundabout for a u-turn.

The analysis undertaken involved a combination of manual analysis, Synchro, and Sidra. The following provides a summary of the analysis:

Base – intersection performance at the roundabout was provided in Section 6.1.

Alternative W1 – intersection performance at the new signalized intersection was determined via Synchro and analysis results of both the off-ramp and Mulberry Drive intersections are provided in Exhibit 6-4 below. The new intersection operates well with overall LOS A in the a.m.

and B in the p.m. peak hour. Additional concerns with this layout relate to weaving volumes and queue lengths at the intersection and at the adjacent intersection at Mulberry Drive (which may also be a roundabout).

Weaving volumes, from the westbound right at EC Row to the northbound left at Mulberry, were estimated by proportion of traffic counts. The estimated weaving volume was 34vph in the a.m. and 42vph in the p.m. peaks. These volumes are low enough that weaving is not anticipated to be a major concern.

Queue lengths are also a concern with tight intersection spacing. The northbound approach queue at Mulberry Drive could interfere with the off-ramp signal. The maximum queue length, which occurs in the p.m. peak hour as reported in Exhibit 6-4 is 93m, which is short enough that intersection spacing of 150m will again likely operate acceptably. The other queue concern is the southbound through queue at the new intersection which if long could interfere with both the southbound on-ramp to EC Row westbound and/or the intersection at Mulberry Drive. Again the maximum queue length of 34m in the p.m. peak period is short enough that operations are likely to be acceptable.

Exhibit 6-5 shows that a roundabout at the intersection of Mulberry Drive/Wildwood Drive is also feasible from a traffic operations perspective.

Exhibit 6-4: North Ramp Alternative W1 Signalized Capacity Analysis

Intersection	Peak Hour	Overall LOS	Mvmt	Delay (s)	LOS	v/c	95% Queue (m)
Banwell Road and EC Row WB Off-ramp	AM	A	WBL	57	E	0.70	62
			WBR	44	D	0.03	10
			NBT	4	A	0.36	50
			SBT	2	A	0.50	34
	PM	B	WBL	58	E	0.74	70
			WBR	47	D	0.42	39
			NBT	9	A	0.67	145
			SBT	2	A	0.59	12
Banwell Road and Wildwood Drive/Mulberry Drive	AM	C	EBL	56	E	0.64	43
			EBT	47	D	0.30	29
			EBR	48	D	0.37	36
			WBL	40	D	0.55	49
			WBTR	36	D	0.13	20
			NBL	25	C	0.53	36
			NBTR	8	A	0.38	48
			SBL	12	B	0.02	2
	PM	B	SBTR	15	B	0.57	112
			EBL	64	E	0.70	43
			EBT	48	D	0.13	15
			EBR	48	D	0.08	17
			WBL	51	D	0.39	27
			WBTR	48	D	0.11	13
			NBL	51	D	0.83	93
			NBTR	6	A	0.68	88
SBL	16	B	0.17	6			
SBTR	21	C	0.75	160			

Exhibit 6-5: North Ramp Alternative W1 Roundabout Capacity Analysis

Intersection	Peak Hour	Overall LOS	Mvmt	Delay (s)	LOS	v/c	95% Queue (m)
Banwell Road and Wildwood Drive/Mulberry Drive	AM	A	EBL	14	B	0.18	8
			EBT	7	A	0.09	4
			EBR	9	A	0.09	
			WBL	16	B	0.21	9
			WBT	8	A	0.48	27
			WBR	10	A	0.48	
			NBL	14	B	0.50	29
			NBT	6	A	0.51	
			NBR	7	A	0.51	
			SBL	12	B	0.42	25
			SBT	5	A	0.42	
	SBR	6	A	0.42			
	PM	A	EBL	18	B	0.13	42
			EBT	12	B	0.07	45
			EBR	13	B	0.07	
			WBL	16	B	0.23	43
			WBT	7	A	0.23	47
			WBR	9	A	0.23	
			NBL	16	B	0.69	48
			NBT	8	A	0.69	
			NBR	9	A	0.69	
			SBL	13	B	0.81	48
SBT			6	A	0.81		
SBR	7	A	0.81				

Overall the W1 analysis indicates that a new off-ramp intersection is viable from an operational perspective.

Most importantly, this alternative would bring significant benefits to the city by allowing potential developments on the land available between Mulberry Drive and EC Row Expressway in the northwest quadrant of the EC Row Expressway intersection with Banwell Road. Also it would continue to allow current the access to Banwell Road at Mulberry Drive from residential developments to the east of Banwell Road. Therefore it would not have a significant impact on residents' travel patterns in the area.

Despite the advantages indicated, further evaluation based on proposed road geometries is required to determine the feasibility of this suggested alternative.

Alternative W2 – This alternative layout would allow a right-out only for the EC Row westbound off-ramp. With a roundabout at Mulberry Drive, southbound traffic could use travel north to the roundabout and use it for a U-turn. This configuration would be highly unusual in Ontario and would cause driver confusion. However, it helps to address the constraints of intersection spacing, in particular a concern for southbound queues (if a full signal were provided) reaching back to block the southbound on-ramp (north to west ramp) and Mulberry Drive.

Under the W2 configuration two operational concerns arise: 1) the additional weaving volume, as all southbound traffic will weave to the northbound left lane for the U-turn (in addition to NBL volumes), and 2) operations at the roundabout considering the additional volume.

The weaving volume under this alternative increases in the a.m. from 34vph to 218vph due southbound volumes and in the p.m., the weaving volume increases from 42vph to 253vph. In the p.m. peak hour the northbound background volume is 1,766vph, which is approaching the capacity of a four-lane arterial (typically 1,800vph). Under these forecast volumes the weaving would be a concern and there would likely be driver conflicts and safety issues given the short weaving length of 150m. Based on the weaving volumes this alternative is not recommended

6.3 EC Row Expressway EB Off-Ramp Analysis

As stated in Section 5, the base network incorporates the recommendations from the Town of Tecumseh for a fourth leg to the EC Row EB off-ramp terminal. The Town's recommended geometry was carried forward as a base scenario.

Because the base scenario involves a double-left turn for eastbound left, the allowance of the westbound right turn at the intersection requires the use phasing scenario where the westbound right shares a phase with the southbound left.

A comparison of traffic operations between base and Alternative E1 and the possibility of even removing the southbound left turn is provided in Exhibit 6-6. The analysis indicates the following:

- Providing the SBL no WBR (option 2, prior recommendation) adds a small amount of delay to PM background traffic.
- Adding the WBR adds delay to the intersection. Average delay is increased 9.3 seconds in the AM and 4.9 seconds in the PM. Most notably, the NBT background delay rises from 4.1 to 14.9 seconds in the AM, and from 9.6 seconds to 29.3 seconds in the PM.
- Further to the above, the WBR option delays a high amount of background traffic (EBL, EBT, NBT). In total 1,696vph in the a.m. and 2,599vph in the p.m. are delayed. This background traffic is delayed for the benefit of a comparably low number of right turners (276 in the a.m. and 213 in the p.m.). NBT volume that is delayed also includes Town of Tecumseh traffic from upstream intersections.
- The WBR traffic would experience less delay (but longer travel times) if they were assigned to the next intersection.
- WBR operates somewhat poorly at LOS E, though V/C is within range at 0.8.
- Overall intersection operations are C, WBR and SBL are LOS E, and other movements are D or better.

Based on the above, allowing the WB movement adds delay to background traffic and appears unnecessary. Furthermore the removal of a SBL movement has no significant operation benefits.

However the analysis can also be interpreted that the provision of the WBR is acceptable, on the grounds that the intersection operates within acceptable parameters overall. All background movements operate at LOS D or better, and movements to and from the east leg operate at LOS E or better with V/C in acceptable range. Given the acceptable traffic parameters, it would be feasible to proceed with WBR and SBL movements at the intersection.

Exhibit 6-6: South Ramp Alternative Analysis Comparison

Timing	Scenario	Overall LOS	Control Delay	Mvmt	Delay	V/C	LOS
AM	1. Base - With SBL and WBR	C	20.7	NBT	14.8	0.5	B
				WBR	56.6	0.8	E
				SBL	6.6	0.2	A
	2. Alternative E1 - With SBL, No WBR	B	11.5	NBT	4.0	0.4	A
				SBL	10.9	0.4	B
	3. No WBR, No SBL	B	11.6	NBT	4.7	0.4	A
PM	1. Base - With SBL and WBR	C	23.6	NBT	28.0	0.7	C
				WBR	60.7	0.8	E
				SBL	14.4	0.3	B
	2. Alternative E1 - With SBL, No WBR	C	21.5	NBT	9.6	0.5	A
				SBL	60.9	0.8	E
	3. No WBR, No SBL	B	19.0	NBT	14.9	0.6	B

7 Interim Mitigation Options

The only intersection currently overcapacity is the intersection of EC Row Expressway and Banwell Road. Although an interchange is expected in the future, at-grade improvements could potentially help alleviate existing congestion and allow for partial development along the corridor over an intermediate time-period until the interchange is constructed.

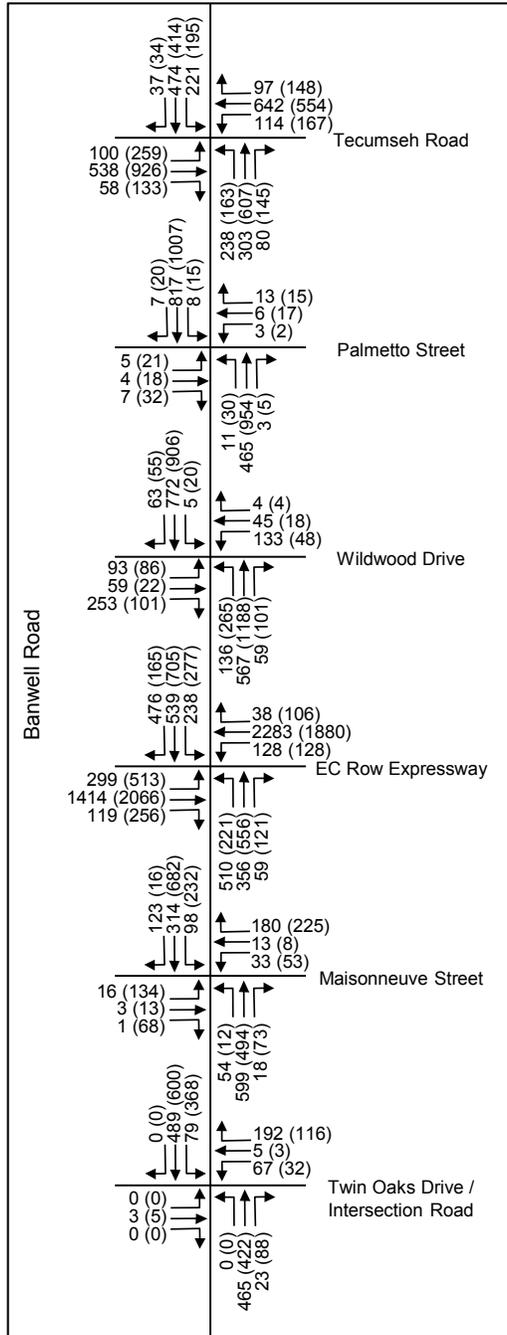
This section determines whether short term mitigation options are sufficient and can allow the City to defer construction of the interchange at Banwell Road and EC Row Expressway.

7.1 Interim Volumes and Forecasts

Three sets of volumes and forecasts were looked at for analysis of interim mitigation options:

- Existing Volumes
- Interim Traffic Forecasts proposed by Dillon Consulting Tecumseh Hamlet Transportation Study (January 2015)
- Updated 2024 forecasts based on recent traffic counts and an assumption that 50% development of the Tecumseh Hamlet and full development of Royal Timbers would be complete.

Exhibit 7-1: 2024 Traffic Volumes Interim



7.2 Banwell Road and EC Row Expressway Mitigation Options

The intersection of Banwell Road and EC Row Expressway currently operates at a LOS of E in both the a.m. and p.m. peak hours. There are several congested movements on both Banwell Road as well as EC Row Expressway. The main challenge is improving operations without incurring too high of a cost that would be redundant or throw-away when the interchange is completed.

The possibility of constructing the ramps for the ultimate configuration but maintaining EC Row at-grade as proposed by Dillon Consulting in a 2013 interim analysis memo was reviewed. A design review found that it would be difficult and costly, mainly due to alignment and construction staging, and a significant amount of work would be throw-away when the interchange was ultimately built.

Alternatively, the Tecumseh Hamlet Transportation Study (Dillon, 2015) provides at-grade intersection improvements that could defer the interchange. The improvement involve an additional eastbound double-left, additional northbound double-left, additional dedicated northbound-right, and extending the southbound right turning lane. A diagram showing the existing and proposed configuration is shown in Exhibit 7-2.

In addition to the Dillon scenario, an alternative improvement was developed for this study involving the following:

- 6-lane EC Row Expressway
- 4-lane Banwell Road
- Double SBL, NBL and EBL
- Dedicated right turn lanes in all directions

This second alternative was developed in an effort to reduce the amount of 'throw-away' cost and infrastructure through construction of road widening (e.g. six lanes) that is compatible with the future interchange (six lanes under Banwell Road including on-ramps). The lane configuration is illustrated in Exhibit 7-3.

For analysis of the above alternatives three sets of volumes were developed:

- Existing conditions (to provide comparison against other options);
- Interim Dillon 2015 forecasts
- New 2024 forecasts.

The results of the analysis shows the following:

- At EC Row Expressway, traffic volumes have grown in the past few years, and some existing volumes are higher than the forecast volumes from the Town's 2015 analysis. For example a.m. peak hour EBL was forecast 195, latest count 232, EBT forecast 965, count 1105, SBL forecast 115, count 185, SBT forecast 135, count 347vph.
- The interim Dillon 2015 configuration, with existing volumes, does improve traffic operations at the intersection. Overall a.m. LOS goes from E to D and we can eliminate most critical movements except the EBL in the p.m. peak hour as seen in Exhibit 7-4.
- However by 2024 the intersection of Banwell Road and EC Row Expressway is failing with most movements LOS F as shown in Exhibit 7-5.
- When Banwell Road is expanded to 4 lanes and EC Row Expressway is expanded to 6 lanes to match the ultimate configuration, operations improve to LOS E and D in the a.m. and p.m. peaks respectively.

Based on the above, interim at-grade improvements appear to offer temporary relief from congestion through 2024, beyond which further improvements are required (i.e. interchange). Given the relatively short life-span of the interim improvements, moving directly to an interchange appears to be preferable.

Exhibit 7-2: Dillon Proposed Interim Layout

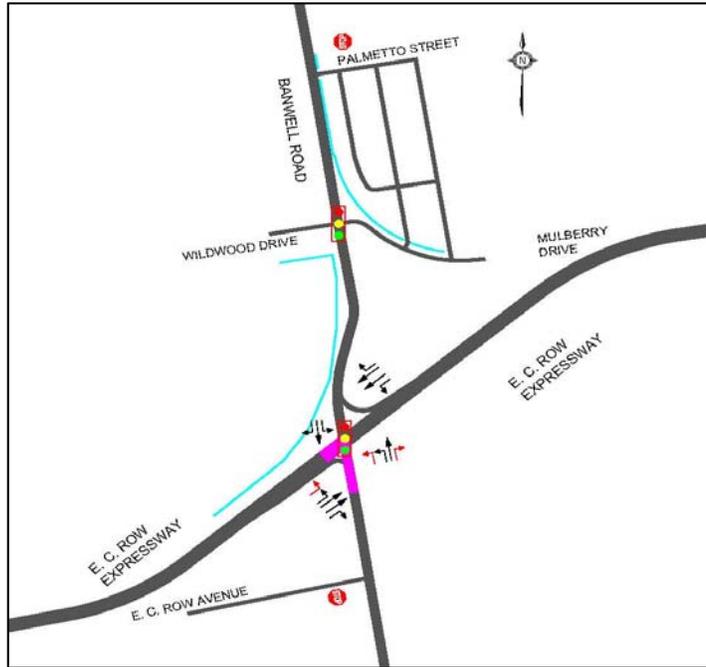
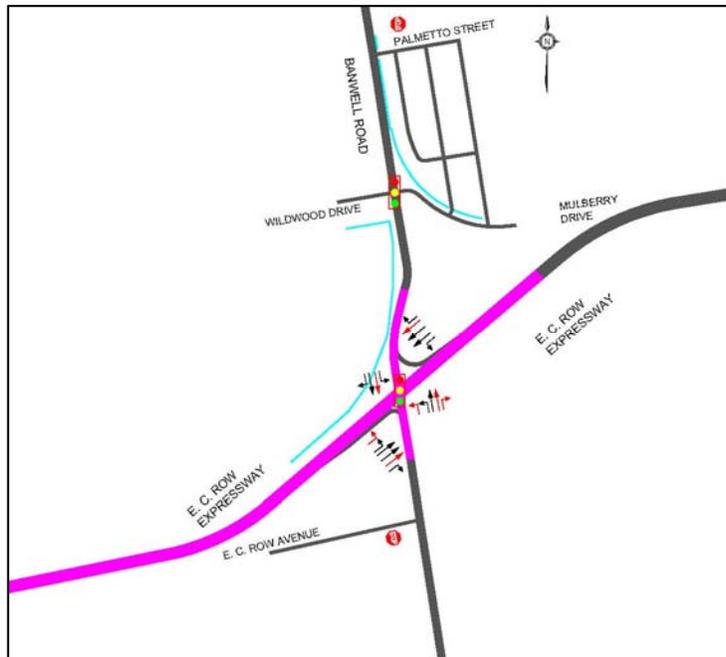


Exhibit 7-3: Interim 6 Lane EC Row and 4 Lane Banwell Configuration



 Proposed improvements

Exhibit 7-4: Existing Volumes Mitigation Measures at Banwell Road and EC Row Expressway

Scenario	Peak	Delay (s)	LOS	Critical		
				Movement	LOS	V/C
Existing Conditions	AM	66	E	EBL	F	1.2
				WBT	E	1.1
				NBL	F	1.2
				NBT	D	0.5
				SBL	D	0.6
				SBT	E	0.9
				SBR	F	0.9
	PM	64	E	EBL	F	1.2
				EBT	C	0.9
				WBT	F	1.1
				NBT	E	1.0
				SBL	F	1.2
				SBT	D	0.8
				Existing Volumes on Dillon Suggested Minor Improvements	AM	40
WBT	D	1.0				
NBL	E	0.9				
NBT	D	0.6				
SBL	D	0.6				
SBT	E	0.8				
SBR	E	0.9				
PM	47	D	EBL		F	1.1
			EBT		D	0.9
			WBT		D	1.0
			NBT		D	0.8
			SBL		E	0.9
			SBT		D	0.7
			Interim Dillon Volumes on Dillon Suggested Minor Improvements		AM	68
WBL	E	0.7				
WBT	F	1.2				
NBL	D	0.7				
NBT	D	0.5				
SBT	D	0.4				
SBR	E	0.9				
PM	42	D		EBL	D	0.8
				EBT	C	0.9
				WBL	E	0.4
				WBT	D	0.9
				NBL	D	0.5
				NBT	E	0.9
				SBL	F	1.2
SBT	D	0.6				
SBR	D	0.2				

Exhibit 7-5: 2024 Forecasted Volumes (50% Tecumseh Hamlet) at Banwell Road and EC Row Expressway

Scenario	Peak	Delay (s)	LOS	Critical		
				Movement	LOS	V/C
2024 Interim Volumes on Dillon Suggested Minor Improvements	AM	124	F	EBL	F	1.1
				WBT	F	1.2
				NBL	F	1.9
				NBT	F	1.2
				SBL	E	0.9
				SBT	F	1.3
				SBR	F	1.1
	PM	143	F	EBL	F	1.3
				EBT	F	1.2
				WBL	F	1.1
				WBT	F	1.2
				NBL	F	0.9
				NBT	F	1.6
				NBR	E	0.9
2024 Interim Volumes on 6 Lane EC Row Expressway and 4 Lane Banwell Road	AM	60	E	EBL	F	1.0
				WBT	E	1.0
				NBL	F	1.0
				SBL	E	0.68
				SBR	F	1.0
	PM	46	D	EBL	E	0.9
				WBT	D	0.9
				NBL	E	0.7
				NBT	E	0.9
				SBL	E	0.8
				SBT	F	1.1
				SBR	E	0.2

7.3 Banwell Road Corridor Intersections Interim Operations

There were several intersections other than the critical junction of Banwell Road and E.C. Row Expressway that were reviewed for interim operations.

The main findings are as follows:

- Most intersections along the corridor are able to operate with good levels of service with Banwell Road being widened to 4 lanes as shown in Exhibit 7-6 and Exhibit 7-7.
- Intersection signalization and minor improvements are driven primarily by development traffic.

Exhibit 7-6: Interim 2024 4-lane AM Peak Period Analysis Results

Intersection	Intersection LOS	Critical			
		Movement	LOS	V/C	95% Queue (m)
Banwell Road at Tecumseh Road	C	EBT	D	0.49	25
		WBT	D	0.76	87
		WBR	D	0.06	12
Banwell Road at Palmetto Road	A	EBL	E	0.08	5
		EBT	E	0.07	7
		WBL	E	0.05	4
		WBT	E	0.11	9
Banwell Road at Wildwood Drive/Mulberry Drive	C	EBL	D	0.48	34
		EBT	E	0.69	58
		WBL	D	0.58	36
Banwell Road at EC Row Avenue/Maisonneuve St	B	EBL	E	0.21	6
		EBT	D	0.01	4
		WBL	D	0.31	17
		WBT	D	0.22	24
Banwell Road at Twin Oaks Drive/Intersection Road	B	EBT	D	0.02	4
		WBL	E	0.51	29
		WBT	D	0.15	22

Exhibit 7-7: Interim 2024 4-lane PM Peak Period Analysis Results

Intersection	Intersection LOS	Critical			
		Movement	LOS	V/C	95% Queue (m)
Banwell Road at Tecumseh Road	C	EBT	D	0.77	97
		WBL	D	0.66	42
		WBT	D	0.67	82
		WBR	D	0.09	15
Banwell Road at Palmetto Road	A	EBL	D	0.34	11
		EBT	D	0.09	12
		WBL	E	0.03	3
		WBT	E	0.26	14
Banwell Road at Wildwood Drive/Mulberry Drive	B	EBL	E	0.58	35
		EBT	D	0.19	22
		WBL	D	0.46	22
		WBT	D	0.10	11
Banwell Road at EC Row Avenue/Maisonneuve St	C	EBL	D	0.46	25
		EBT	D	0.08	14
		WBL	E	0.47	24
		WBT	D	0.20	25
Banwell Road at Twin Oaks Drive/Intersection Road	A				

7.4 Cost Estimates of Short-Term Mitigation Measures

No formal cost estimates were developed, however order-of-magnitude costs estimates for the two options are provided below:

- Interim Dillon (2015) proposed layouts – \$1.5M, all throwaway with 5 years of potential usage.

- Six lanes EC Row and 4 lanes Banwell Road at-grade – \$6M, 3M is throwaway with 10 years of potential usage.

The above figures are based on MTO unit rates for road widening excluding property acquisition and utility relocations, if necessary.

7.5 Summary of Short-Term Mitigation Measures

The analysis shows that minor improvements (e.g. Town of Tecumseh, 2015) can provide a short-term benefit to traffic operations on the corridor. However the minor improvements are not sufficient by 2024, where the analysis shows that the intersection of Banwell Road and EC Row Expressway will again become congested.

More extensive at-grade improvements including six-laning of EC Row and four-laning of Banwell Road could improve level of service in 2024 from F to E. LOS E can be considered a threshold for acceptable traffic operations; MTO may find it past the threshold while other municipalities such as Toronto are more accepting of congestion. Therefore, even the more extensive at-grade option indicates that it will reach traffic thresholds at or near 2024.

A 2024 lifespan would not normally be considered acceptable for capital projects and therefore the recommendation would be to proceed with an interchange as soon as possible. However, given the high cost of the interchange, and as of writing (2016) lack of funding availability even through the 2024 time-frame, the City and Town may wish to pursue these at-grade improvements separately from the current study, as they could relieve the most severely congested movements through 2024.

8 Conclusions

IBI Group has been retained to update and complete the Banwell Road Class Environmental Assessment (EA), which was brought to draft status in 2011. This report provides an update to the traffic study, which provides input to the recommended road configuration to be developed in further detail under preliminary design.

Analysis of existing (2014) conditions found that several intersections in the corridor operate with poor level-of-service, in particular the intersection of EC Row Expressway and Banwell Road. With several movements operate at level-of-service 'F' indicating long delay normally considered unacceptable, there is a need for road capacity improvements in the short term.

Long Term (2034) Analysis

Updated traffic forecasts account for background regional growth and local developments including the build-out of the Town of Tecumseh, large-format retail on the Pointe East property west of Banwell Road, and the Royal Timbers completion north of EC Row Expressway. Updated traffic forecasts are lower than the prior EA due to new background growth projections more in line with development trends in the region, however substantial traffic growth is still forecasted clearly indicating a need for Banwell Road widening and an interchange at EC Row Expressway.

Future road network alternatives were developed based on the prior EA and the *Tecumseh Hamlet Secondary Plan Transportation Study (Dillon Consulting, 2015)*. Analysis of alternatives resulted in the following recommended road layout for 2034:

- North of EC Row Expressway, Banwell Road should be widened to four lanes with signalized intersections at Tecumseh Road East and Palmetto Street. At Banwell

Road and Mulberry Drive/ Wildwood Drive, a roundabout provides superior traffic operations compared to a signal.

- Analysis of the EC Row westbound off-ramp indicates acceptable operations if it connects directly to Banwell Road adjacent to the N-W on-ramp. This would create a new signalized intersection.
- Banwell Road will require a modified parclo A4 interchange. The recommended configuration is to provide a fourth leg to the eastbound off-ramp (south ramp intersection) for a one-way only movement to the east, into the Town of Tecumseh development lands.
- South of EC Row expressway Banwell Road requires widening to six lanes with two signalized intersections between EC Row Expressway and the Canadian Pacific railway.

Analysis of alternatives for the EC Row westbound off-ramp indicated acceptable operations if it connects directly to Banwell Road adjacent to the south to west loop ramp. This is a deviation from the prior EA which recommended the off-ramp connect to Wildwood Drive and disconnection of Mulberry Drive. The disconnection would create a large parcel of undevelopable land and would inconvenience local residents. The change in recommendation is mainly driven by updated traffic forecasts and analysis which indicate acceptable operations despite the close intersection spacing.

Due to the update, Mulberry Drive can remain connected to Banwell Road and the City can develop the parcel of land previously landlocked. However, further review of ramp location and geometries is suggested to be undertaken during preliminary design.

At the proposed W-N/S off-ramp, the Tecumseh Transportation Study recommended a fourth leg to provide two-direction travel to and from the adjacent development lands. The exiting westbound movement would be restricted to a westbound right turn.

Analysis of the intersection indicated that providing the exiting movement (westbound right) results in additional delay to background traffic. The delay is caused by a requirement for a signal phase for the movement by extending the southbound left phase, which involves taking green time away from northbound through (3 lanes) and eastbound approach (3 lanes) to provide capacity for a single right-turn lane. The analysis indicated that traffic operations can be better managed by requiring exiting traffic to use the next intersection south. The recommended configuration can be found at modern interchanges elsewhere in Ontario and operates well. Although not ideal, it would be acceptable from an operations perspective to allow for the westbound right turn as no excessive delays or failing movements are caused.

The recommended road layout for 2034 is shown in Exhibit 5-2 on page 27 and Exhibit 5-4 on page 30 for areas north and south of the EC Row Expressway respectively.

Interim Conditions Analysis

An interim analysis was undertaken to identify potential phasing opportunities. Due to the high cost of the recommended ultimate roadway with a new interchange and significant road widening, objectives of the analysis were to identify opportunities to limit road widening and defer the interchange.

The interim analysis indicates that some minor improvements (e.g. additional turning lanes) can be made in order to improve existing conditions and accommodate some growth in the short-term (potentially 5 years). Alternatively, a more extensive at-grade widening of EC Row to six lanes and Banwell Road to four lanes would provide acceptable traffic operations to around 2024. This type of improvement would likely entail at least \$6M in capital cost of which approximately half would be throw-away (not compatible with the future interchange).

An eight or ten-year lifespan would not normally be considered acceptable for capital projects and therefore the recommendation would be to proceed with an interchange as soon as possible. However, given the high cost of the interchange, and as of writing (2016) lack of funding availability even through the 2024 time-frame, the City and Town may wish to pursue the at-grade improvements separately from the current study, as they could relieve the most severely congested movements through 2024.

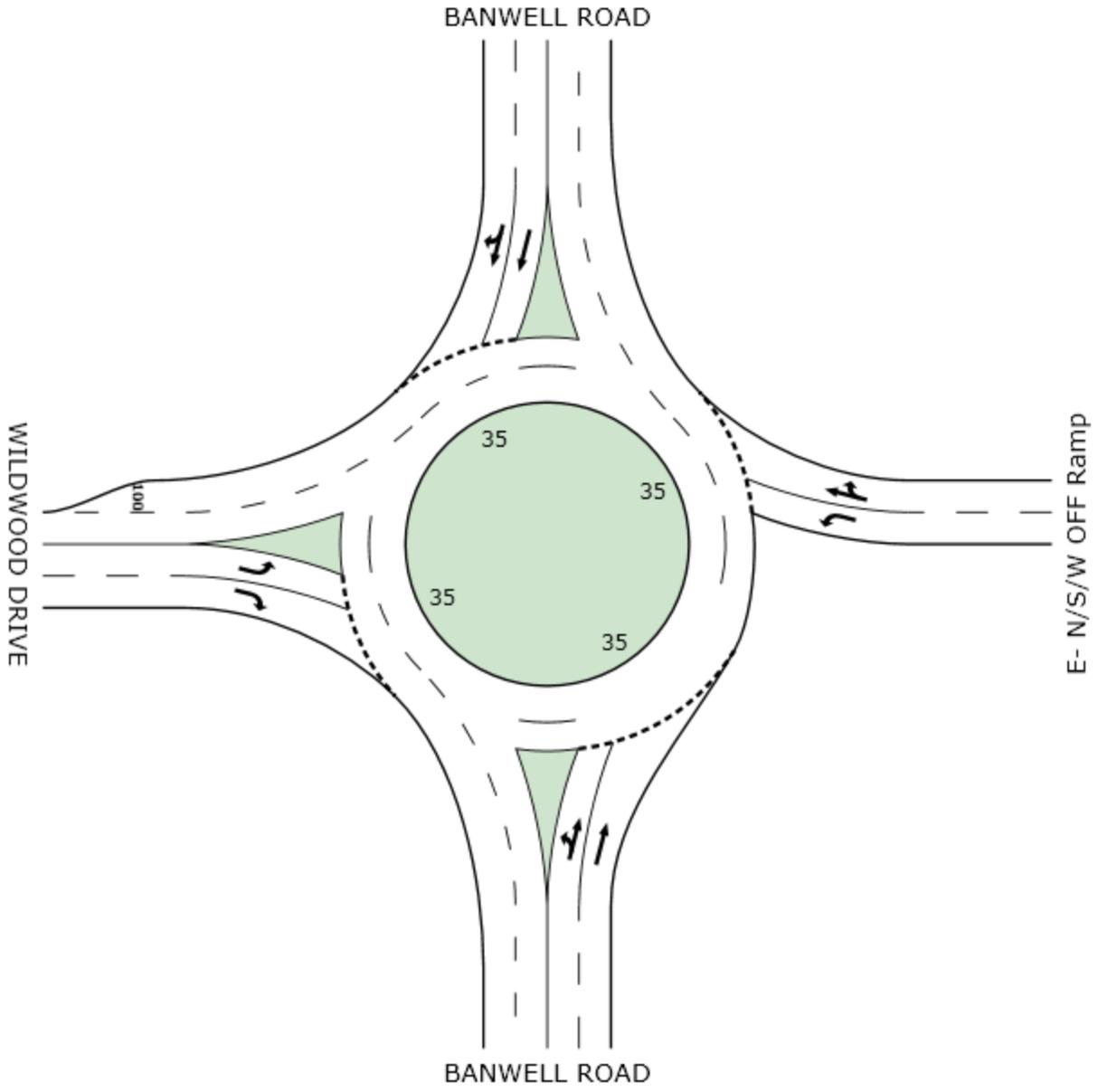
Appendix A – Response to Comments

Comment / City of Windsor May 23, 2015	Response IBI Group August 04, 2015
According to Exhibits 4-8 and 4-9, no traffic has been assigned between the Fanelli retail development and the westbound Expressway (i.e. westbound in from Tecumseh or westbound out to central Windsor).	Analysis will be updated to consider trips assigned under the movements indicated, also see response below.
Based on the discussion in Section 4, no pass-by adjustment was made for the Fanelli retail trips, so weekday PM operations may be better than forecast, particularly from the interchange to Tecumseh.	Trips to/from the Fanelli retail development were reduced 50% to account for access to Lauzon Parkway via Twin Oaks (to/from west), and internal trip reduction. Report will be updated to clarify. Further reduction of through trips along Banwell Road to account for pass-by may be reviewed at development site plan application. Small discussion added to the report.
The spacing between the proposed westbound Expressway off-ramp and Wildwood/Mulberry is very short (150 m) – shorter than the recommended minimum between signalized intersections (recommended: 215 m to allow drivers to recognize each device) and too short to provide a standard taper with the queue lengths they're forecasting.	Agreed that the spacing is very short. Based on discussions from the June 02 Meeting, it is felt that despite close spacing the benefits of the new ramp intersection outweighs the cons. In general, the operations appears workable from a traffic perspective. Alignment will be reviewed in detail under preliminary design and may result in a need to re-visit the spacing and recommended layout.
Saturday traffic in the vicinity of the Fanelli lands is going to be significant (~5,000 peak hour trips) and may warrant Saturday analysis for a few intersections, since this may be the controlling case for some aspects of the design (e.g. required storage length for turning lanes into and out of the Fanelli lands).	This study intends to provide a conservative analysis of weekday peak periods. Analysis of a Saturday peak would be completed when the development is actually built and the associated TIS
The network diagram (e.g. Exhibit 3-2) doesn't show Banwell Road north of Tecumseh. Hopefully this isn't how the network was actually modelled.	Local roads are represented in the model by centroid connectors. No adjustment to the model was undertaken for this study as the model is used primarily for background traffic.
Synchro worksheets weren't provided, so I wasn't able to confirm that the signal timings and analysis settings are correct. They may be fine, but we frequently find errors in Synchro analyses we receive; these errors can have a significant effect on analysis results.	Signal timings for future analysis was based on 120s cycle length and re-optimized, these will be submitted with the updated draft report.
Exhibit 5-2: Title of exhibit needs to reflect that this is for alternative W1 as noted on the previous page.	Fixed
Exhibit 5-3: Likewise for this table, title needs to reflect that this is for alternative W2.	Fixed
Page 28: I'm confused with the directions noted in the third paragraph, first sentence. Need to confirm they have the southbound and northbound directions correct.	Fixed
Exhibit 6-1: I can only assume that there are no northbound or southbound movement capacity issues as none of these movements are included in this table.	Yes only critical movements are shown based on previously described criteria.
Section 6.3: Same comment as above. Can the southbound left-turn movement be eliminated? I think this would help with the operation of the traffic signal.	The southbound left-turn does delay background traffic (northbound through traffic). Removal will likely require additional SBL green time at next intersection. Report will be updated to assess removal of movement.
Page 46: In the second paragraph it notes that "further review of ramp location and... during preliminary design." I think it needs to happen now as part of the EA to ensure that this is going to work. What if it doesn't and we already have an approved EA?	Is included as part of the overall EA, however outside of scope of traffic report.

Comment / Dillon Consulting May 28, 2015	Response IBI Group August 07, 2015
<p>Aggressively high traffic projections, in particular related to the likelihood of a power centre on the Fanelli Lands and the appropriateness of the traffic projections related to that site;</p>	<p>The analysis considers the Fanelli Lands using its current land use designation. We agree that this is an aggressive projection however given the current lack of development plans we believe it is a conservative approach.</p> <p>Existing traffic counts will be included as an appendix to the report. IBI group agrees with the sentiment that school traffic may not be included subject to seasonal variation, however 3 of the six counts occurred at the end of June in 2013 which may be outside of the school year. As a result to remain conservative, and due to the low volumes south of E.C. Row Expressway, no reductions were completed.</p>
<p>Whether a six-lane cross section is required on Banwell Road south of E.C. Row Expressway</p>	<p>A big reason for this is as a result of the Fanelli Development. As shown within the interim analysis results and recommendations, IBI believes that Banwell Road should be expanded to 4-lanes south of E.C. Row Expressway with protection for 6 should the Fanelli Lands and Tecumseh Hamlet developments occur.</p>
<p>The recommendation for the Gouin Street extension to be designated for one-way travel within the block east of the E.C. Row eastbound off-ramp</p>	<p>IBI agrees that this may reduce the connectivity within the Hamlet. The report has been updated to show that a two way Gouin Street extension could work at the cost of some delay to the other users of the Gouin Street/Banwell Road intersections. The report notes that both scenarios are acceptable from a traffic operations perspective given that the WBR shares a signal phase with the SBL. IBI disagrees with the assumption that the EBL and WBR could be on the same signal phase as this would cause issues with conflicting movements and weaving. The City of Windsor has also stated that such operations would not be acceptable.</p>
<p>More information required on the assumptions related to the interim conditions analyses at the Banwell Road and E.C. Row Expressway intersection, and the lack of guidance on interim measures should funding for a full interchange not be available within a reasonable timeframe</p>	<p>More details regarding the interim conditions analysis has been added to the report.</p>

Comment / Dillon Consulting July 21, 2015	Response IBI Group August 07, 2015
<p>Growth rates used in the report are quite aggressive and interim conditions assume a 50% buildout of Tecumseh Hamlet which is inconsistent with a 10 year timeline.</p>	<p>- The Fanelli Development has been removed from The interim analysis.</p>
	<p>- The Royal Timbers area is already partially existing and thus should be considered developed within 10 years.</p>
	<p>- Part of The reason for interim conditions being so poor is both; updated counts being higher than those in Dillon Consultings report and a 50% built out of Tecumseh Hamlet. This is to show that should development levels reach this, or if Fanelli was developed, the associated volumes would not be supportable by Banwell Road in its current configuration.</p>
	<p>- The existing counts have been included within the report and Dillon Consulting should look to update their supportable development levels as needed. IBI would be in agreeance with the Dillon Consulting numbers in terms of numbers of units that can be developed should they reflect the newer updated traffic counts provided by the City.</p>

Appendix B – Sidra Outputs



MOVEMENT SUMMARY

Site: 2034 - AM

E - N/S/W OFF RAMP
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: BANWELL ROAD											
NBL	L	174	5.0	0.389	12.2	LOS B	3.1	22.5	0.44	0.78	46.3
NBT	T	843	5.0	0.390	4.8	LOS A	3.2	23.2	0.43	0.43	50.4
Approach		1017	5.0	0.389	6.0	LOS B	3.2	23.2	0.44	0.49	49.6
East: E- N/S/W OFF Ramp											
WBL	L	184	5.0	0.207	14.3	LOS B	1.3	9.4	0.69	0.87	43.9
WBT	T	16	5.0	0.083	8.1	LOS A	0.4	3.2	0.67	0.74	48.2
WBR	R	33	5.0	0.083	9.5	LOS A	0.4	3.2	0.67	0.80	48.0
Approach		233	5.0	0.207	13.2	LOS B	1.3	9.4	0.69	0.85	44.6
North: BANWELL ROAD											
SBT	T	1079	5.0	0.497	5.8	LOS A	4.0	29.1	0.59	0.53	49.3
SBL	R	80	5.0	0.497	6.9	LOS A	4.0	29.1	0.58	0.61	49.2
Approach		1159	5.0	0.497	5.9	LOS A	4.0	29.1	0.59	0.54	49.3
West: WILDWOOD DRIVE											
EBL	L	194	5.0	0.315	15.7	LOS B	1.9	13.9	0.75	0.93	43.2
EBR	R	324	5.0	0.388	8.9	LOS A	2.8	20.1	0.78	0.80	47.2
Approach		518	5.0	0.388	11.4	LOS B	2.8	20.1	0.77	0.85	45.5
All Vehicles		2927	5.0	0.497	7.5	LOS A	4.0	29.1	0.57	0.60	48.3

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).

Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).

Approach LOS values are based on the worst delay for any vehicle movement.

Roundabout LOS Method: Same as Signalised Intersections.

Roundabout Capacity Model: SIDRA Standard.

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Project: J:\37628_Banwell_EA\5.9 Drawings\59civil\Roundabout - SIDRA\BANWELL ROAD - E-N_S OFF

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SIDRA
INTERSECTION

MOVEMENT SUMMARY

Site: 2034 - PM

E - N/S/W OFF RAMP
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: BANWELL ROAD												
NBL	L	339	5.0	0.752	12.5	LOS B	10.4	76.2	0.66	0.71	46.1	
NBT	T	1766	5.0	0.752	5.0	LOS A	10.6	77.6	0.63	0.47	48.8	
Approach		2105	5.0	0.752	6.2	LOS B	10.6	77.6	0.64	0.50	48.3	
East: E- N/S/W OFF Ramp												
WBL	L	211	5.0	0.446	22.8	LOS C	3.9	28.1	0.97	1.06	38.3	
WBT	T	44	5.0	0.440	19.4	LOS B	3.1	22.8	0.91	1.01	38.8	
WBR	R	91	5.0	0.442	20.7	LOS C	3.1	22.8	0.91	1.03	38.6	
Approach		346	5.0	0.446	21.8	LOS C	3.9	28.1	0.94	1.05	38.4	
North: BANWELL ROAD												
SBT	T	1427	5.0	0.748	10.8	LOS B	10.4	76.1	0.87	1.01	46.4	
SBL	R	67	5.0	0.744	11.6	LOS B	10.4	76.1	0.87	1.01	46.6	
Approach		1494	5.0	0.748	10.9	LOS B	10.4	76.1	0.87	1.01	46.4	
West: WILDWOOD DRIVE												
EBL	L	136	5.0	0.231	15.7	LOS B	1.7	12.4	0.87	0.96	43.2	
EBR	R	129	5.0	0.311	11.6	LOS B	2.0	14.8	0.85	0.93	45.6	
Approach		265	5.0	0.311	13.7	LOS B	2.0	14.8	0.86	0.94	44.3	
All Vehicles		4210	5.0	0.752	9.6	LOS A	10.6	77.6	0.76	0.76	46.3	

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).

Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (HCM).

Approach LOS values are based on the worst delay for any vehicle movement.

Roundabout LOS Method: Same as Signalised Intersections.

Roundabout Capacity Model: SIDRA Standard.

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SIDRA INTERSECTION 5.0.5.1510

Project: J:\37628_Banwell_EA\5.9 Drawings\59civil\Roundabout - SIDRA\BANWELL ROAD - E-N_S OFF

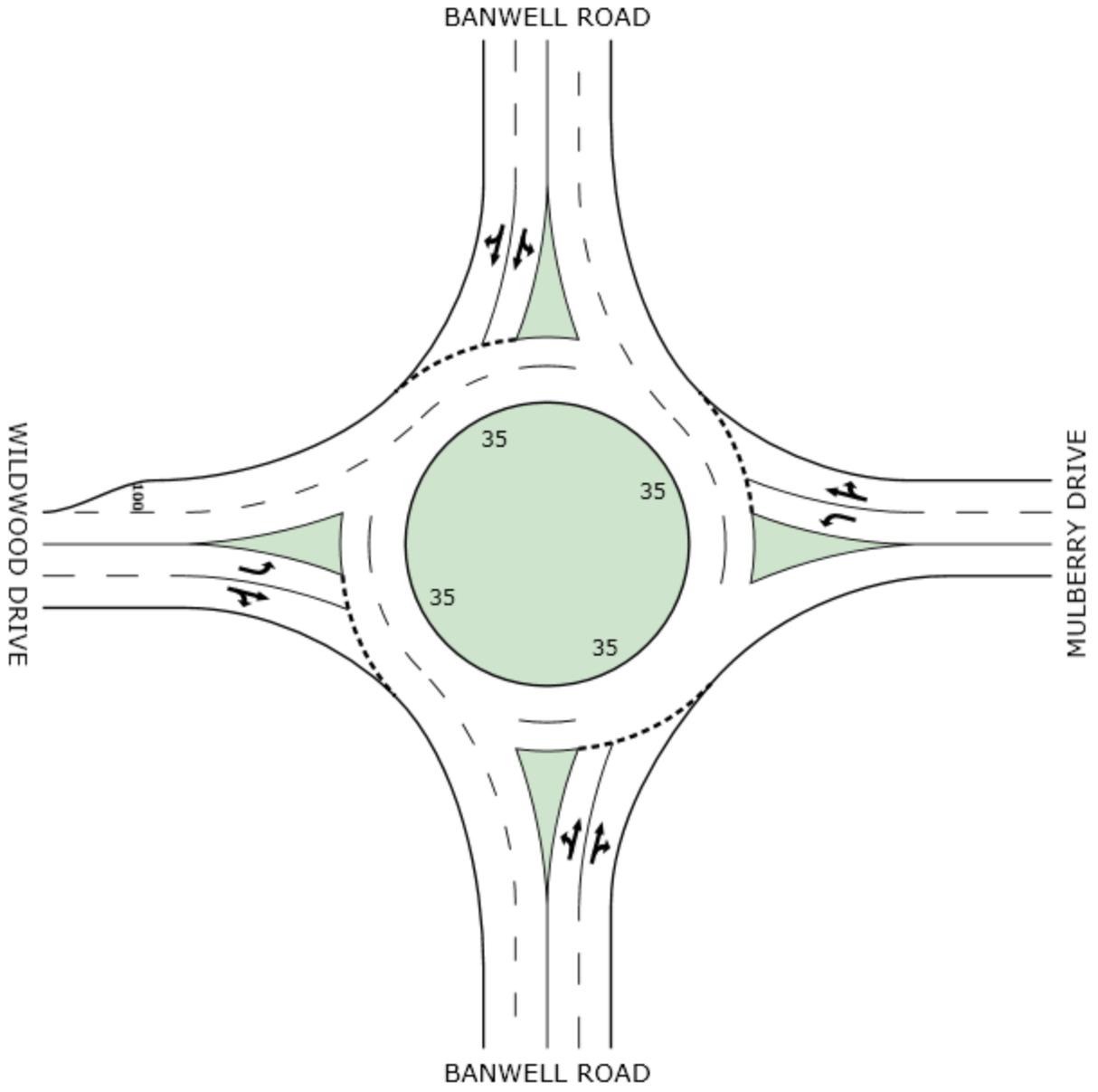
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INTERSECTION



MOVEMENT SUMMARY

Site: 2034 - AM

MULBERRY DRIVE
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: BANWELL ROAD												
NBL	L	174	5.0	0.420	12.2	LOS B	3.3	24.2	0.46	0.79	46.4	
NBT	T	843	5.0	0.420	4.7	LOS A	3.4	24.9	0.45	0.43	50.2	
NBR	R	76	5.0	0.420	6.0	LOS A	3.4	24.9	0.44	0.53	49.9	
Approach		1093	5.0	0.421	6.0	LOS B	3.4	24.9	0.45	0.50	49.5	
East: MULBERRY DRIVE												
WBL	L	170	5.0	0.183	13.8	LOS B	1.1	7.9	0.65	0.84	44.0	
WBT	T	58	5.0	0.094	7.4	LOS A	0.5	3.5	0.64	0.68	48.9	
WBR	R	3	5.0	0.094	8.8	LOS A	0.5	3.5	0.64	0.79	48.9	
Approach		231	5.0	0.183	12.1	LOS B	1.1	7.9	0.65	0.80	45.1	
North: BANWELL ROAD												
SBL	L	5	5.0	0.500	13.5	LOS B	4.0	29.0	0.61	0.93	46.3	
SBT	T	1079	5.0	0.506	5.9	LOS A	4.0	29.0	0.60	0.55	49.3	
SBR	R	80	5.0	0.506	7.0	LOS A	4.0	29.0	0.59	0.61	49.1	
Approach		1164	5.0	0.506	6.0	LOS B	4.0	29.0	0.60	0.55	49.2	
West: WILDWOOD DRIVE												
EBL	L	118	5.0	0.208	15.6	LOS B	1.2	8.5	0.72	0.91	43.2	
EBT	T	76	5.0	0.478	8.2	LOS A	3.7	27.3	0.80	0.80	46.9	
EBR	R	324	5.0	0.479	9.5	LOS A	3.7	27.3	0.80	0.89	47.2	
Approach		518	5.0	0.478	10.7	LOS B	3.7	27.3	0.78	0.88	46.1	
All Vehicles		3006	5.0	0.506	7.3	LOS A	4.0	29.0	0.58	0.61	48.4	

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).

Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).

Approach LOS values are based on the worst delay for any vehicle movement.

Roundabout LOS Method: Same as Signalised Intersections.

Roundabout Capacity Model: SIDRA Standard.

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SIDRA INTERSECTION 5.0.5.1510

Project: J:\37628_Banwell_EA\5.0 Design (Work) Phase\Roundabout - SIDRA\BANWELL ROAD - MULBERRY

DRIVE.sip

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SIDRA
INTERSECTION

MOVEMENT SUMMARY

Site: 2034 - PM

MULBERRY DRIVE
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: BANWELL ROAD												
NBL	L	339	5.0	0.811	13.3	LOS B	12.9	94.3	0.77	0.72	46.1	
NBT	T	1766	5.0	0.811	5.5	LOS A	12.9	94.3	0.74	0.52	47.9	
NBR	R	129	5.0	0.811	6.6	LOS A	12.6	91.9	0.72	0.56	48.4	
Approach		2234	5.0	0.811	6.8	LOS B	12.9	94.3	0.74	0.55	47.6	
East: MULBERRY DRIVE												
WBL	L	61	5.0	0.127	17.7	LOS B	0.9	6.9	0.91	0.95	41.7	
WBT	T	23	5.0	0.074	12.1	LOS B	0.5	3.4	0.86	0.91	45.1	
WBR	R	2	5.0	0.074	13.3	LOS B	0.5	3.4	0.86	0.93	44.9	
Approach		86	5.0	0.127	16.1	LOS B	0.9	6.9	0.90	0.94	42.6	
North: BANWELL ROAD												
SBL	L	20	5.0	0.690	15.8	LOS B	8.4	61.2	0.80	0.98	44.7	
SBT	T	1427	5.0	0.689	8.0	LOS A	8.6	62.9	0.79	0.80	47.8	
SBR	R	67	5.0	0.691	9.0	LOS A	8.6	62.9	0.78	0.83	48.1	
Approach		1514	5.0	0.689	8.1	LOS B	8.6	62.9	0.79	0.81	47.8	
West: WILDWOOD DRIVE												
EBL	L	108	5.0	0.225	15.8	LOS B	1.4	9.9	0.80	0.94	43.1	
EBT	T	28	5.0	0.233	7.3	LOS A	1.6	11.8	0.82	0.69	46.8	
EBR	R	129	5.0	0.234	8.7	LOS A	1.6	11.8	0.82	0.76	47.1	
Approach		265	5.0	0.233	11.5	LOS B	1.6	11.8	0.81	0.82	45.3	
All Vehicles		4099	5.0	0.811	7.8	LOS A	12.9	94.3	0.77	0.67	47.4	

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).

Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).

Approach LOS values are based on the worst delay for any vehicle movement.

Roundabout LOS Method: Same as Signalised Intersections.

Roundabout Capacity Model: SIDRA Standard.

Appendix C – Existing Conditions Synchro Outputs

Timings

1: Banwell Road & Tecumseh Road

8/4/2015

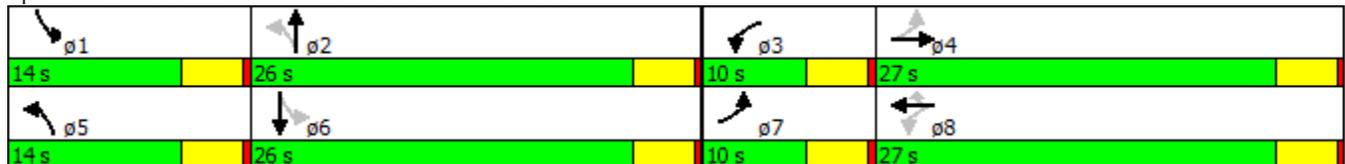


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	95	512	96	611	92	179	227	210	403
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0	5.0
Minimum Split (s)	8.0	20.0	9.0	20.0	20.0	8.0	20.0	8.0	20.0
Total Split (s)	10.0	27.0	10.0	27.0	27.0	14.0	26.0	14.0	26.0
Total Split (%)	13.0%	35.1%	13.0%	35.1%	35.1%	18.2%	33.8%	18.2%	33.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	23.0	18.5	23.0	18.5	18.5	31.4	22.5	31.9	22.7
Actuated g/C Ratio	0.33	0.26	0.33	0.26	0.26	0.45	0.32	0.46	0.32
v/c Ratio	0.38	0.43	0.32	0.68	0.19	0.39	0.26	0.39	0.40
Control Delay	18.3	21.8	16.7	27.4	3.2	14.1	17.7	13.8	21.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.3	21.8	16.7	27.4	3.2	14.1	17.7	13.8	21.0
LOS	B	C	B	C	A	B	B	B	C
Approach Delay		21.3		23.3			16.3		18.7
Approach LOS		C		C			B		B

Intersection Summary

Cycle Length: 77	
Actuated Cycle Length: 69.9	
Natural Cycle: 60	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.68	
Intersection Signal Delay: 20.4	Intersection LOS: C
Intersection Capacity Utilization 57.7%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1: Banwell Road & Tecumseh Road



Queues

1: Banwell Road & Tecumseh Road

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	100	590	101	643	97	188	302	221	461
v/c Ratio	0.38	0.43	0.32	0.68	0.19	0.39	0.26	0.39	0.40
Control Delay	18.3	21.8	16.7	27.4	3.2	14.1	17.7	13.8	21.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.3	21.8	16.7	27.4	3.2	14.1	17.7	13.8	21.0
Queue Length 50th (m)	8.5	23.7	8.6	41.8	0.0	14.1	14.2	17.0	26.1
Queue Length 95th (m)	17.2	33.0	17.4	58.1	6.2	27.5	24.8	32.1	41.1
Internal Link Dist (m)		438.6		520.2			80.5		113.8
Turn Bay Length (m)	80.0		75.0		70.0	50.0		80.0	
Base Capacity (vph)	261	1720	315	1204	623	514	1144	596	1157
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	0.34	0.32	0.53	0.16	0.37	0.26	0.37	0.40

Intersection Summary

HCM Signalized Intersection Capacity Analysis

1: Banwell Road & Tecumseh Road

8/4/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	95	512	48	96	611	92	179	227	60	210	403	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	5075		1789	3579	1601	1789	3467		1789	3535	
Flt Permitted	0.23	1.00		0.35	1.00	1.00	0.42	1.00		0.55	1.00	
Satd. Flow (perm)	433	5075		656	3579	1601	784	3467		1029	3535	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	100	539	51	101	643	97	188	239	63	221	424	37
RTOR Reduction (vph)	0	15	0	0	0	72	0	29	0	0	8	0
Lane Group Flow (vph)	100	575	0	101	643	25	188	273	0	221	453	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	23.0	18.5		23.0	18.5	18.5	31.4	22.5		31.8	22.7	
Effective Green, g (s)	23.0	18.5		23.0	18.5	18.5	31.4	22.5		31.8	22.7	
Actuated g/C Ratio	0.33	0.26		0.33	0.26	0.26	0.44	0.32		0.45	0.32	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	227	1329		285	937	419	475	1104		561	1136	
v/s Ratio Prot	c0.03	0.11		0.02	c0.18		0.05	0.08		c0.05	c0.13	
v/s Ratio Perm	0.12			0.09		0.02	0.13			0.13		
v/c Ratio	0.44	0.43		0.35	0.69	0.06	0.40	0.25		0.39	0.40	
Uniform Delay, d1	17.5	21.7		17.1	23.4	19.5	12.3	17.8		12.2	18.6	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.4	0.2		0.8	2.1	0.1	0.5	0.5		0.5	1.0	
Delay (s)	18.9	21.9		17.8	25.5	19.6	12.8	18.3		12.6	19.7	
Level of Service	B	C		B	C	B	B	B		B	B	
Approach Delay (s)		21.5			23.9			16.2			17.4	
Approach LOS		C			C			B			B	

Intersection Summary

HCM 2000 Control Delay	20.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	70.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	57.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis

2: Banwell Road & Palmetto Road

8/4/2015



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	3	12	321	3	8	718
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	3	13	338	3	8	756
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)			373			376
pX, platoon unblocked	0.83					
vC, conflicting volume	1112	339			341	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1032	339			341	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	98			99	
cM capacity (veh/h)	212	703			1218	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	16	341	764
Volume Left	3	0	8
Volume Right	13	3	0
cSH	481	1700	1218
Volume to Capacity	0.03	0.20	0.01
Queue Length 95th (m)	0.8	0.0	0.2
Control Delay (s)	12.7	0.0	0.2
Lane LOS	B		A
Approach Delay (s)	12.7	0.0	0.2
Approach LOS	B		

Intersection Summary			
Average Delay		0.3	
Intersection Capacity Utilization		54.2%	ICU Level of Service
Analysis Period (min)		15	A

Timings

3: Banwell Road & Mulberry Road

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↑	↗	↖	↗
Volume (vph)	70	46	104	35	106	338	46	3	551
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	Perm	NA
Protected Phases		4		8	5	2			6
Permitted Phases	4		8		2		2	6	
Detector Phase	4	4	8	8	5	2	2	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	21.0	21.0	21.0	21.0	8.0	21.0	21.0	21.0	21.0
Total Split (s)	32.0	32.0	32.0	32.0	11.0	68.0	68.0	57.0	57.0
Total Split (%)	32.0%	32.0%	32.0%	32.0%	11.0%	68.0%	68.0%	57.0%	57.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.5	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	0.5	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0	5.0
Lead/Lag					Lead			Lag	Lag
Lead-Lag Optimize?					Yes			Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max	Max
Act Effct Green (s)	16.8	16.8	16.8	16.8	64.6	63.6	63.6	55.1	55.1
Actuated g/C Ratio	0.19	0.19	0.19	0.19	0.71	0.70	0.70	0.61	0.61
v/c Ratio	0.29	0.54	0.92	0.11	0.23	0.27	0.04	0.00	0.55
Control Delay	33.4	11.9	101.2	28.5	6.3	6.5	2.1	10.7	15.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.4	11.9	101.2	28.5	6.3	6.5	2.1	10.7	15.0
LOS	C	B	F	C	A	A	A	B	B
Approach Delay		16.8		82.0		6.1			15.0
Approach LOS		B		F		A			B

Intersection Summary

Cycle Length: 100	
Actuated Cycle Length: 90.5	
Natural Cycle: 60	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.92	
Intersection Signal Delay: 18.6	Intersection LOS: B
Intersection Capacity Utilization 73.9%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 3: Banwell Road & Mulberry Road



Queues

3: Banwell Road & Mulberry Road

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	74	256	109	39	112	356	48	3	629
v/c Ratio	0.29	0.54	0.92	0.11	0.23	0.27	0.04	0.00	0.55
Control Delay	33.4	11.9	101.2	28.5	6.3	6.5	2.1	10.7	15.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.4	11.9	101.2	28.5	6.3	6.5	2.1	10.7	15.0
Queue Length 50th (m)	11.1	7.0	18.6	5.4	5.0	19.3	0.0	0.2	63.2
Queue Length 95th (m)	22.6	26.8	#42.6	13.2	13.8	43.1	3.8	1.6	120.6
Internal Link Dist (m)		123.0		405.6		513.6			349.0
Turn Bay Length (m)	30.0		30.0		80.0		45.0	90.0	
Base Capacity (vph)	413	641	190	561	490	1323	1139	628	1135
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.18	0.40	0.57	0.07	0.23	0.27	0.04	0.00	0.55

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

3: Banwell Road & Mulberry Road

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	70	46	198	104	35	2	106	338	46	3	551	47
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		4.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.88		1.00	0.99		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1789	1654		1789	1869		1789	1883	1601	1789	1861	
Flt Permitted	0.73	1.00		0.34	1.00		0.29	1.00	1.00	0.55	1.00	
Satd. Flow (perm)	1378	1654		636	1869		552	1883	1601	1032	1861	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	74	48	208	109	37	2	112	356	48	3	580	49
RTOR Reduction (vph)	0	170	0	0	2	0	0	0	14	0	2	0
Lane Group Flow (vph)	74	86	0	109	37	0	112	356	34	3	627	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA	Perm	Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	16.8	16.8		16.8	16.8		64.5	64.5	64.5	55.1	55.1	
Effective Green, g (s)	16.8	16.8		16.8	16.8		64.5	64.5	64.5	55.1	55.1	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.71	0.71	0.71	0.60	0.60	
Clearance Time (s)	5.0	5.0		5.0	5.0		4.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	253	304		117	343		463	1330	1131	622	1123	
v/s Ratio Prot		0.05			0.02		0.01	c0.19			c0.34	
v/s Ratio Perm	0.05			c0.17			0.16		0.02	0.00		
v/c Ratio	0.29	0.28		0.93	0.11		0.24	0.27	0.03	0.00	0.56	
Uniform Delay, d1	32.1	32.1		36.7	31.0		6.4	4.9	4.0	7.2	10.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.6	0.5		61.8	0.1		0.3	0.5	0.0	0.0	2.0	
Delay (s)	32.8	32.6		98.5	31.2		6.6	5.3	4.1	7.2	12.8	
Level of Service	C	C		F	C		A	A	A	A	B	
Approach Delay (s)		32.6			80.8			5.5			12.8	
Approach LOS		C			F			A			B	

Intersection Summary

HCM 2000 Control Delay	20.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	91.3	Sum of lost time (s)	14.0
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Timings

4: Banwell Road & EC Row Expressway

8/4/2015

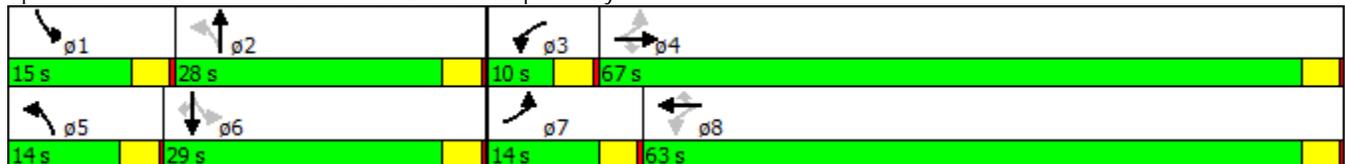


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	232	1105	42	79	1784	29	234	177	185	347	371
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2	1	6	
Permitted Phases	4		4	8		8	2		6		6
Detector Phase	7	4	4	3	8	8	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	8.0	20.0	20.0
Total Split (s)	14.0	67.0	67.0	10.0	63.0	63.0	14.0	28.0	15.0	29.0	29.0
Total Split (%)	11.7%	55.8%	55.8%	8.3%	52.5%	52.5%	11.7%	23.3%	12.5%	24.2%	24.2%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	None	Max	Max
Act Effct Green (s)	73.0	65.0	65.0	65.0	59.0	59.0	34.2	24.2	35.8	25.0	25.0
Actuated g/C Ratio	0.61	0.54	0.54	0.54	0.49	0.49	0.28	0.20	0.30	0.21	0.21
v/c Ratio	1.16	0.60	0.05	0.34	1.07	0.04	1.17	0.51	0.60	0.93	0.95
Control Delay	140.3	20.8	0.6	14.1	72.5	0.1	145.6	48.0	39.8	78.2	68.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	140.3	20.8	0.6	14.1	72.5	0.1	145.6	48.0	39.8	78.2	68.0
LOS	F	C	A	B	E	A	F	D	D	E	E
Approach Delay		40.3			69.0			102.7		66.1	
Approach LOS		D			E			F		E	

Intersection Summary

Cycle Length: 120	
Actuated Cycle Length: 120	
Natural Cycle: 110	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 1.17	
Intersection Signal Delay: 62.9	Intersection LOS: E
Intersection Capacity Utilization 106.7%	ICU Level of Service G
Analysis Period (min) 15	

Splits and Phases: 4: Banwell Road & EX ROW Expressway



Queues

4: Banwell Road & EC Row Expressway

8/4/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	244	1163	44	83	1878	31	246	193	195	365	391
v/c Ratio	1.16	0.60	0.05	0.34	1.07	0.04	1.17	0.51	0.60	0.93	0.95
Control Delay	140.3	20.8	0.6	14.1	72.5	0.1	145.6	48.0	39.8	78.2	68.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	140.3	20.8	0.6	14.1	72.5	0.1	145.6	48.0	39.8	78.2	68.0
Queue Length 50th (m)	~52.2	97.7	0.0	7.5	~257.4	0.0	~53.0	40.6	34.7	85.1	70.4
Queue Length 95th (m)	#103.5	119.0	1.3	14.1	#299.4	0.0	#104.1	63.9	54.7	#140.6	#130.1
Internal Link Dist (m)		349.1			515.1			303.7		513.6	
Turn Bay Length (m)	300.0		110.0	140.0		100.0	50.0		110.0		20.0
Base Capacity (vph)	211	1938	904	241	1759	828	211	378	329	392	413
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.16	0.60	0.05	0.34	1.07	0.04	1.17	0.51	0.59	0.93	0.95

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row Expressway

8/4/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (vph)	232	1105	42	79	1784	29	234	177	7	185	347	371
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	1873		1789	1883	1601
Flt Permitted	0.06	1.00	1.00	0.16	1.00	1.00	0.17	1.00		0.42	1.00	1.00
Satd. Flow (perm)	118	3579	1601	309	3579	1601	311	1873		796	1883	1601
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	244	1163	44	83	1878	31	246	186	7	195	365	391
RTOR Reduction (vph)	0	0	20	0	0	16	0	1	0	0	0	80
Lane Group Flow (vph)	244	1163	24	83	1878	15	246	192	0	195	365	311
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2			6		6
Actuated Green, G (s)	73.8	65.0	65.0	64.6	59.8	59.8	34.2	24.2		35.8	25.0	25.0
Effective Green, g (s)	73.8	65.0	65.0	64.6	59.8	59.8	34.2	24.2		35.8	25.0	25.0
Actuated g/C Ratio	0.61	0.54	0.54	0.53	0.50	0.50	0.28	0.20		0.30	0.21	0.21
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
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)	210	1925	861	224	1771	792	210	375		324	389	331
v/s Ratio Prot	c0.10	0.32		0.01	0.52		c0.10	0.10		0.05	0.19	
v/s Ratio Perm	c0.61		0.01	0.18		0.01	c0.23			0.12		0.19
v/c Ratio	1.16	0.60	0.03	0.37	1.06	0.02	1.17	0.51		0.60	0.94	0.94
Uniform Delay, d1	39.4	19.1	13.1	15.6	30.5	15.6	39.1	43.0		33.9	47.1	47.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	112.6	0.5	0.0	1.0	39.5	0.0	116.1	4.9		3.1	32.4	36.2
Delay (s)	152.0	19.6	13.1	16.7	70.0	15.6	155.2	48.0		37.0	79.6	83.3
Level of Service	F	B	B	B	E	B	F	D		D	E	F
Approach Delay (s)		41.7			66.9			108.1			72.4	
Approach LOS		D			E			F			E	

Intersection Summary

HCM 2000 Control Delay	64.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.18		
Actuated Cycle Length (s)	120.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	106.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis

5: Banwell Road & EC ROW Avenue

8/4/2015



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	12	1	42	313	198	96
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	13	1	44	329	208	101
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					328	
pX, platoon unblocked	0.89	0.89	0.89			
vC, conflicting volume	677	259	309			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	580	113	169			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	100	96			
cM capacity (veh/h)	411	841	1260			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	14	374	309			
Volume Left	13	44	0			
Volume Right	1	0	101			
cSH	428	1260	1700			
Volume to Capacity	0.03	0.04	0.18			
Queue Length 95th (m)	0.8	0.8	0.0			
Control Delay (s)	13.7	1.2	0.0			
Lane LOS	B	A				
Approach Delay (s)	13.7	1.2	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			0.9			
Intersection Capacity Utilization			48.4%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

6: Banwell Road & Intersection Road

8/4/2015



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	33	104	244	12	40	321
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	35	109	257	13	42	338
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	685	263			269	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	685	263			269	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	91	86			97	
cM capacity (veh/h)	400	775			1294	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	144	269	380
Volume Left	35	0	42
Volume Right	109	13	0
cSH	633	1700	1294
Volume to Capacity	0.23	0.16	0.03
Queue Length 95th (m)	6.6	0.0	0.8
Control Delay (s)	12.4	0.0	1.2
Lane LOS	B		A
Approach Delay (s)	12.4	0.0	1.2
Approach LOS	B		

Intersection Summary			
Average Delay		2.8	
Intersection Capacity Utilization		50.9%	ICU Level of Service A
Analysis Period (min)		15	

Timings

1: Banwell Road & Tecumseh Road

8/5/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↙	↑↑↓	↙	↑↑	↗	↙	↑↓	↙	↑↑
Volume (vph)	244	872	121	527	140	135	528	186	299
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0	5.0
Minimum Split (s)	8.0	20.0	9.0	20.0	20.0	8.0	20.0	8.0	20.0
Total Split (s)	10.0	29.0	10.0	29.0	29.0	10.0	30.2	16.0	36.2
Total Split (%)	11.7%	34.0%	11.7%	34.0%	34.0%	11.7%	35.4%	18.8%	42.5%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	28.9	22.9	28.9	22.9	22.9	34.1	28.1	41.4	32.2
Actuated g/C Ratio	0.35	0.28	0.35	0.28	0.28	0.41	0.34	0.50	0.39
v/c Ratio	0.91	0.72	0.58	0.56	0.26	0.30	0.53	0.49	0.25
Control Delay	58.9	29.9	27.9	28.2	4.3	14.2	24.3	16.4	17.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	58.9	29.9	27.9	28.2	4.3	14.2	24.3	16.4	17.5
LOS	E	C	C	C	A	B	C	B	B
Approach Delay		35.7		23.9			22.4		17.1
Approach LOS		D		C			C		B

Intersection Summary

Cycle Length: 85.2

Actuated Cycle Length: 83.1

Natural Cycle: 60

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.91

Intersection Signal Delay: 26.9

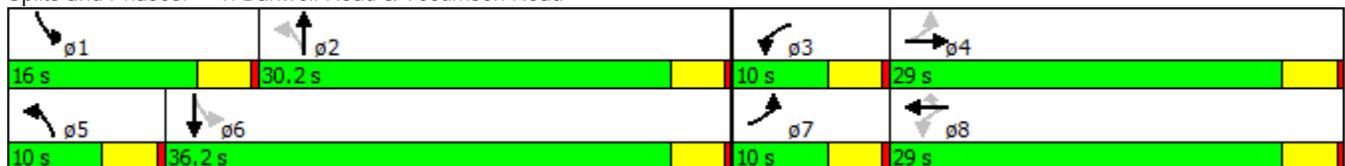
Intersection LOS: C

Intersection Capacity Utilization 68.6%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 1: Banwell Road & Tecumseh Road



Queues

1: Banwell Road & Tecumseh Road

8/5/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	257	1017	127	555	147	142	632	196	349
v/c Ratio	0.91	0.72	0.58	0.56	0.26	0.30	0.53	0.49	0.25
Control Delay	58.9	29.9	27.9	28.2	4.3	14.2	24.3	16.4	17.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	58.9	29.9	27.9	28.2	4.3	14.2	24.3	16.4	17.5
Queue Length 50th (m)	28.0	52.0	12.8	39.5	0.0	12.0	42.7	17.2	19.2
Queue Length 95th (m)	#65.1	66.1	#23.8	54.8	10.0	21.9	60.5	29.4	28.9
Internal Link Dist (m)		438.6		520.2			80.5		113.8
Turn Bay Length (m)	80.0		75.0		70.0	50.0		80.0	
Base Capacity (vph)	282	1540	219	1077	598	474	1201	431	1376
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.91	0.66	0.58	0.52	0.25	0.30	0.53	0.45	0.25

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Banwell Road & Tecumseh Road

8/5/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↕↕↕		↖	↕↕	↗	↖	↕↕		↖	↕↕	
Volume (vph)	244	872	94	121	527	140	135	528	72	186	299	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	5067		1789	3579	1601	1789	3514		1789	3526	
Flt Permitted	0.30	1.00		0.17	1.00	1.00	0.54	1.00		0.25	1.00	
Satd. Flow (perm)	557	5067		329	3579	1601	1022	3514		475	3526	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	257	918	99	127	555	147	142	556	76	196	315	34
RTOR Reduction (vph)	0	16	0	0	0	106	0	12	0	0	9	0
Lane Group Flow (vph)	257	1001	0	127	555	41	142	620	0	196	340	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	28.9	22.9		28.9	22.9	22.9	34.1	28.1		42.2	32.2	
Effective Green, g (s)	28.9	22.9		28.9	22.9	22.9	34.1	28.1		42.2	32.2	
Actuated g/C Ratio	0.35	0.28		0.35	0.28	0.28	0.41	0.34		0.51	0.39	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	282	1396		219	986	441	474	1188		400	1366	
v/s Ratio Prot	c0.07	0.20		0.04	0.16		0.02	0.18		c0.06	0.10	
v/s Ratio Perm	c0.25			0.16		0.03	0.10			c0.19		
v/c Ratio	0.91	0.72		0.58	0.56	0.09	0.30	0.52		0.49	0.25	
Uniform Delay, d1	24.2	27.2		20.0	25.8	22.4	15.7	22.1		12.6	17.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	31.4	1.8		3.7	0.7	0.1	0.4	1.6		0.9	0.4	
Delay (s)	55.6	29.0		23.7	26.5	22.5	16.0	23.7		13.5	17.7	
Level of Service	E	C		C	C	C	B	C		B	B	
Approach Delay (s)		34.3			25.4			22.3			16.2	
Approach LOS		C			C			C			B	

Intersection Summary

HCM 2000 Control Delay	26.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	83.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis

2: Banwell Road & Palmetto Road

8/5/2015



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	2	14	801	5	14	811
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	2	15	843	5	15	854
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)			373			376
pX, platoon unblocked	0.85	0.80			0.80	
vC, conflicting volume	1729	846			848	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1510	682			686	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	96			98	
cM capacity (veh/h)	110	360			726	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	17	848	868
Volume Left	2	0	15
Volume Right	15	5	0
cSH	280	1700	726
Volume to Capacity	0.06	0.50	0.02
Queue Length 95th (m)	1.4	0.0	0.5
Control Delay (s)	18.7	0.0	0.6
Lane LOS	C		A
Approach Delay (s)	18.7	0.0	0.6
Approach LOS	C		

Intersection Summary			
Average Delay		0.5	
Intersection Capacity Utilization		63.9%	ICU Level of Service
Analysis Period (min)		15	B

Timings

3: Banwell Road & Mulberry Road

8/5/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↗	↖	↗
Volume (vph)	60	17	37	14	207	827	79	12	573
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	Perm	NA
Protected Phases		4		8	5	2			6
Permitted Phases	4		8		2		2	6	
Detector Phase	4	4	8	8	5	2	2	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	21.0	21.0	21.0	21.0	8.0	21.0	21.0	21.0	21.0
Total Split (s)	22.0	22.0	22.0	22.0	18.0	84.0	84.0	66.0	66.0
Total Split (%)	20.8%	20.8%	20.8%	20.8%	17.0%	79.2%	79.2%	62.3%	62.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.5	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	0.5	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0	5.0
Lead/Lag					Lead			Lag	Lag
Lead-Lag Optimize?					Yes			Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max	Max
Act Effect Green (s)	9.8	9.8	9.8	9.8	81.1	80.1	80.1	67.8	67.8
Actuated g/C Ratio	0.10	0.10	0.10	0.10	0.81	0.80	0.80	0.68	0.68
v/c Ratio	0.46	0.43	0.32	0.09	0.37	0.58	0.06	0.03	0.50
Control Delay	52.7	18.7	48.0	39.0	4.1	5.9	0.7	6.9	10.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.7	18.7	48.0	39.0	4.1	5.9	0.7	6.9	10.2
LOS	D	B	D	D	A	A	A	A	B
Approach Delay		31.7		45.4		5.2			10.1
Approach LOS		C		D		A			B

Intersection Summary

Cycle Length: 106	
Actuated Cycle Length: 99.9	
Natural Cycle: 60	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.58	
Intersection Signal Delay: 10.0	Intersection LOS: A
Intersection Capacity Utilization 69.4%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 3: Banwell Road & Mulberry Road



Queues

3: Banwell Road & Mulberry Road

8/5/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	63	101	39	16	218	871	83	13	639
v/c Ratio	0.46	0.43	0.32	0.09	0.37	0.58	0.06	0.03	0.50
Control Delay	52.7	18.7	48.0	39.0	4.1	5.9	0.7	6.9	10.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.7	18.7	48.0	39.0	4.1	5.9	0.7	6.9	10.2
Queue Length 50th (m)	11.6	3.2	7.1	2.7	6.7	47.0	0.0	0.7	52.2
Queue Length 95th (m)	24.3	17.9	17.0	8.8	14.4	89.4	2.9	3.2	95.4
Internal Link Dist (m)		123.0		405.6		513.6			349.0
Turn Bay Length (m)	30.0		30.0		80.0		45.0	90.0	
Base Capacity (vph)	239	349	213	318	660	1510	1300	426	1269
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.29	0.18	0.05	0.33	0.58	0.06	0.03	0.50

Intersection Summary

HCM Signalized Intersection Capacity Analysis

3: Banwell Road & Mulberry Road

8/5/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	60	17	79	37	14	1	207	827	79	12	573	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		4.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.88		1.00	0.99		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1789	1651		1789	1866		1789	1883	1601	1789	1868	
Flt Permitted	0.75	1.00		0.67	1.00		0.32	1.00	1.00	0.33	1.00	
Satd. Flow (perm)	1407	1651		1255	1866		611	1883	1601	628	1868	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	63	18	83	39	15	1	218	871	83	13	603	36
RTOR Reduction (vph)	0	75	0	0	1	0	0	0	16	0	2	0
Lane Group Flow (vph)	63	26	0	39	15	0	218	871	67	13	637	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA	Perm	Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	9.8	9.8		9.8	9.8		80.1	80.1	80.1	67.8	67.8	
Effective Green, g (s)	9.8	9.8		9.8	9.8		80.1	80.1	80.1	67.8	67.8	
Actuated g/C Ratio	0.10	0.10		0.10	0.10		0.80	0.80	0.80	0.68	0.68	
Clearance Time (s)	5.0	5.0		5.0	5.0		4.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	138	161		123	183		587	1509	1283	426	1267	
v/s Ratio Prot		0.02			0.01		0.03	c0.46			0.34	
v/s Ratio Perm	c0.04			0.03			0.27		0.04	0.02		
v/c Ratio	0.46	0.16		0.32	0.08		0.37	0.58	0.05	0.03	0.50	
Uniform Delay, d1	42.5	41.3		41.9	41.0		4.1	3.7	2.0	5.3	7.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.4	0.5		1.5	0.2		0.4	1.6	0.1	0.1	1.4	
Delay (s)	44.9	41.8		43.4	41.2		4.5	5.3	2.1	5.4	9.3	
Level of Service	D	D		D	D		A	A	A	A	A	
Approach Delay (s)		43.0			42.8			4.9			9.2	
Approach LOS		D			D			A			A	

Intersection Summary

HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	99.9	Sum of lost time (s)	14.0
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Timings

4: Banwell Road & EC Row Expressway

8/5/2015

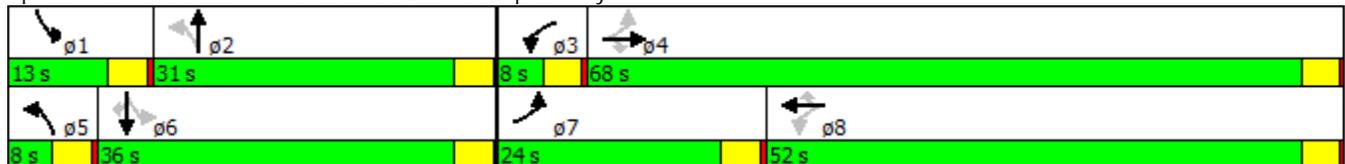


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	395	1614	43	49	1469	81	73	341	213	374	123
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2	1	6	
Permitted Phases	4		4	8		8	2		6		6
Detector Phase	7	4	4	3	8	8	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	8.0	20.0	20.0
Total Split (s)	24.0	68.0	68.0	8.0	52.0	52.0	8.0	31.0	13.0	36.0	36.0
Total Split (%)	20.0%	56.7%	56.7%	6.7%	43.3%	43.3%	6.7%	25.8%	10.8%	30.0%	30.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	None	Max	Max
Act Effct Green (s)	72.0	65.6	65.6	52.0	48.0	48.0	31.0	27.0	40.0	33.6	33.6
Actuated g/C Ratio	0.60	0.55	0.55	0.43	0.40	0.40	0.26	0.22	0.33	0.28	0.28
v/c Ratio	1.16	0.87	0.05	0.43	1.08	0.12	0.47	0.97	1.15	0.75	0.24
Control Delay	130.6	30.0	0.1	24.4	83.7	0.3	40.4	82.3	142.0	50.1	8.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	130.6	30.0	0.1	24.4	83.7	0.3	40.4	82.3	142.0	50.1	8.7
LOS	F	C	A	C	F	A	D	F	F	D	A
Approach Delay		48.8			77.7			75.6		70.5	
Approach LOS		D			E			E		E	

Intersection Summary

Cycle Length: 120	
Actuated Cycle Length: 120	
Natural Cycle: 100	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 1.16	
Intersection Signal Delay: 64.1	Intersection LOS: E
Intersection Capacity Utilization 108.3%	ICU Level of Service G
Analysis Period (min) 15	

Splits and Phases: 4: Banwell Road & EC Row Expressway



Queues

4: Banwell Road & EC Row Expressway

8/5/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	416	1699	45	52	1546	85	77	406	224	394	129
v/c Ratio	1.16	0.87	0.05	0.43	1.08	0.12	0.47	0.97	1.15	0.75	0.24
Control Delay	130.6	30.0	0.1	24.4	83.7	0.3	40.4	82.3	142.0	50.1	8.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	130.6	30.0	0.1	24.4	83.7	0.3	40.4	82.3	142.0	50.1	8.7
Queue Length 50th (m)	~100.4	179.7	0.0	4.8	~214.1	0.0	12.6	94.3	-46.3	86.2	1.9
Queue Length 95th (m)	#162.2	216.0	0.0	9.9	#256.4	0.0	23.7	#156.2	#96.0	#129.8	16.5
Internal Link Dist (m)		349.1			515.1			303.7		513.6	
Turn Bay Length (m)	300.0		110.0	140.0		100.0	50.0		110.0		20.0
Base Capacity (vph)	360	1956	928	121	1431	733	163	420	195	527	533
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.16	0.87	0.05	0.43	1.08	0.12	0.47	0.97	1.15	0.75	0.24

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row Expressway

8/5/2015

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 			 			 			 		
Volume (vph)	395	1614	43	49	1469	81	73	341	45	213	374	123	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00		1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	1851		1789	1883	1601	
Flt Permitted	0.08	1.00	1.00	0.08	1.00	1.00	0.25	1.00		0.13	1.00	1.00	
Satd. Flow (perm)	143	3579	1601	154	3579	1601	464	1851		237	1883	1601	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Adj. Flow (vph)	416	1699	45	52	1546	85	77	359	47	224	394	129	
RTOR Reduction (vph)	0	0	21	0	0	51	0	4	0	0	0	85	
Lane Group Flow (vph)	416	1699	24	52	1546	34	77	402	0	224	394	44	
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm	
Protected Phases	7	4		3	8		5	2		1	6		
Permitted Phases	4		4	8		8	2			6		6	
Actuated Green, G (s)	72.8	65.6	65.6	52.0	48.8	48.8	31.0	27.8		40.8	33.6	33.6	
Effective Green, g (s)	72.8	65.6	65.6	52.0	48.8	48.8	31.0	27.8		40.8	33.6	33.6	
Actuated g/C Ratio	0.60	0.54	0.54	0.43	0.40	0.40	0.25	0.23		0.34	0.28	0.28	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	
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)	356	1930	863	108	1436	642	153	423		194	520	442	
v/s Ratio Prot	c0.19	0.47		0.01	0.43		0.01	0.22		c0.09	0.21		
v/s Ratio Perm	c0.51		0.02	0.19		0.02	0.11			c0.30		0.03	
v/c Ratio	1.17	0.88	0.03	0.48	1.08	0.05	0.50	0.95		1.15	0.76	0.10	
Uniform Delay, d1	40.2	24.6	13.1	25.9	36.4	22.3	38.9	46.2		35.3	40.3	32.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	
Incremental Delay, d2	101.9	5.1	0.0	3.4	47.3	0.0	2.6	33.0		112.5	9.9	0.4	
Delay (s)	142.1	29.6	13.1	29.3	83.7	22.3	41.5	79.2		147.8	50.2	33.2	
Level of Service	F	C	B	C	F	C	D	E		F	D	C	
Approach Delay (s)		50.9			78.9			73.2			76.5		
Approach LOS		D			E			E			E		
Intersection Summary													
HCM 2000 Control Delay			66.1									HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio			1.22										
Actuated Cycle Length (s)			121.6									Sum of lost time (s)	16.0
Intersection Capacity Utilization			108.3%									ICU Level of Service	G
Analysis Period (min)			15										
c	Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

5: Banwell Road & EC Row Avenue

8/5/2015



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	105	53	9	306	342	12
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	111	56	9	322	360	13
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					328	
pX, platoon unblocked	0.85	0.85	0.85			
vC, conflicting volume	707	366	373			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	563	160	168			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	73	93	99			
cM capacity (veh/h)	409	749	1193			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	166	332	373			
Volume Left	111	9	0			
Volume Right	56	0	13			
cSH	482	1193	1700			
Volume to Capacity	0.34	0.01	0.22			
Queue Length 95th (m)	11.5	0.2	0.0			
Control Delay (s)	16.3	0.3	0.0			
Lane LOS	C	A				
Approach Delay (s)	16.3	0.3	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			3.2			
Intersection Capacity Utilization			39.1%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

6: Banwell Road & Intersection Road

8/5/2015



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	17	64	226	47	177	329
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	18	67	238	49	186	346
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	982	263			287	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	982	263			287	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	92	91			85	
cM capacity (veh/h)	236	776			1275	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	85	287	533
Volume Left	18	0	186
Volume Right	67	49	0
cSH	524	1700	1275
Volume to Capacity	0.16	0.17	0.15
Queue Length 95th (m)	4.4	0.0	3.9
Control Delay (s)	13.2	0.0	3.9
Lane LOS	B		A
Approach Delay (s)	13.2	0.0	3.9
Approach LOS	B		

Intersection Summary			
Average Delay		3.5	
Intersection Capacity Utilization		56.7%	ICU Level of Service
Analysis Period (min)		15	B

Appendix D – Future 2034 Conditions Synchro Outputs

Timings

1: Banwell Road & Tecumseh Road

9/10/2015

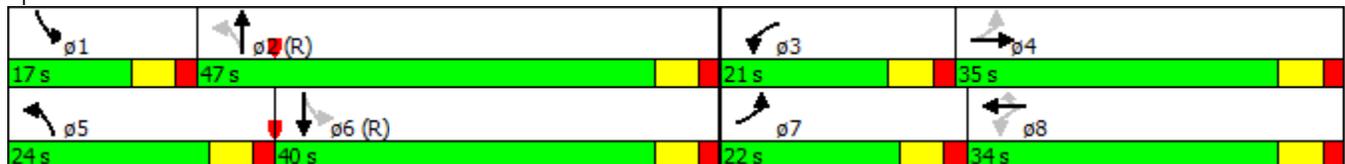


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↖	↕↕↕	↖	↕↕	↖	↖	↕↕	↖	↕↕
Volume (vph)	272	973	249	583	155	230	764	205	600
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	10.0	22.0	22.0	10.0	22.0	10.0	22.0
Total Split (s)	22.0	35.0	21.0	34.0	34.0	24.0	47.0	17.0	40.0
Total Split (%)	18.3%	29.2%	17.5%	28.3%	28.3%	20.0%	39.2%	14.2%	33.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	C-Max	None	C-Max
Act Effct Green (s)	44.7	29.3	43.3	28.6	28.6	55.2	41.0	48.6	37.6
Actuated g/C Ratio	0.37	0.24	0.36	0.24	0.24	0.46	0.34	0.40	0.31
v/c Ratio	0.81	0.94	0.89	0.68	0.29	0.62	0.85	0.91	0.57
Control Delay	44.5	58.5	62.1	46.6	3.8	30.5	40.6	70.5	37.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.5	58.5	62.1	46.6	3.8	30.5	40.6	70.5	37.2
LOS	D	E	E	D	A	C	D	E	D
Approach Delay		55.8		43.8			38.7		45.3
Approach LOS		E		D			D		D

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.94
 Intersection Signal Delay: 46.5
 Intersection LOS: D
 Intersection Capacity Utilization 97.9%
 ICU Level of Service F
 Analysis Period (min) 15

Splits and Phases: 1: Banwell Road & Tecumseh Road



Queues

1: Banwell Road & Tecumseh Road

9/10/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	272	1180	249	583	155	230	1022	205	636
v/c Ratio	0.81	0.94	0.89	0.68	0.29	0.62	0.85	0.91	0.57
Control Delay	44.5	58.5	62.1	46.6	3.8	30.5	40.6	70.5	37.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.5	58.5	62.1	46.6	3.8	30.5	40.6	70.5	37.2
Queue Length 50th (m)	43.3	98.1	42.1	66.5	0.0	30.5	84.3	32.5	65.3
Queue Length 95th (m)	#74.3	#127.3	#87.5	86.3	9.2	62.8	109.6	#79.8	87.7
Internal Link Dist (m)		438.6		520.2			80.5		113.8
Turn Bay Length (m)	80.0		75.0		70.0	50.0		80.0	
Base Capacity (vph)	345	1251	286	853	527	424	1204	226	1115
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.94	0.87	0.68	0.29	0.54	0.85	0.91	0.57

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Banwell Road & Tecumseh Road

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↕↕↕		↖	↕↕	↗	↖	↕↕		↖	↕↕	
Volume (vph)	272	973	207	249	583	155	230	764	258	205	600	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.97		1.00	1.00	0.85	1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	5006		1789	3579	1601	1789	3443		1789	3548	
Flt Permitted	0.23	1.00		0.14	1.00	1.00	0.25	1.00		0.11	1.00	
Satd. Flow (perm)	439	5006		263	3579	1601	467	3443		200	3548	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	272	973	207	249	583	155	230	764	258	205	600	36
RTOR Reduction (vph)	0	27	0	0	0	118	0	28	0	0	3	0
Lane Group Flow (vph)	272	1153	0	249	583	37	230	994	0	205	633	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	44.7	29.3		43.3	28.6	28.6	55.4	41.0		48.6	37.6	
Effective Green, g (s)	44.7	29.3		43.3	28.6	28.6	55.4	41.0		48.6	37.6	
Actuated g/C Ratio	0.37	0.24		0.36	0.24	0.24	0.46	0.34		0.41	0.31	
Clearance Time (s)	6.0	6.0		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	
Lane Grp Cap (vph)	336	1222		281	852	381	374	1176		226	1111	
v/s Ratio Prot	0.10	c0.23		c0.11	0.16		0.07	c0.29		c0.08	0.18	
v/s Ratio Perm	0.20			0.21		0.02	0.21			c0.28		
v/c Ratio	0.81	0.94		0.89	0.68	0.10	0.61	0.85		0.91	0.57	
Uniform Delay, d1	29.0	44.5		31.0	41.6	35.6	21.5	36.6		28.4	34.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.27	0.95		1.00	1.00	
Incremental Delay, d2	13.4	14.2		26.5	2.3	0.1	2.7	6.8		35.4	2.1	
Delay (s)	42.4	58.8		57.6	43.9	35.7	30.0	41.6		63.8	36.6	
Level of Service	D	E		E	D	D	C	D		E	D	
Approach Delay (s)		55.7			46.1			39.5			43.2	
Approach LOS		E			D			D			D	

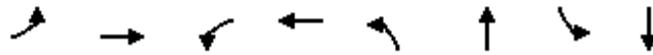
Intersection Summary

HCM 2000 Control Delay	46.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	97.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Timings

2: Banwell Road & Palmetto Road

9/10/2015

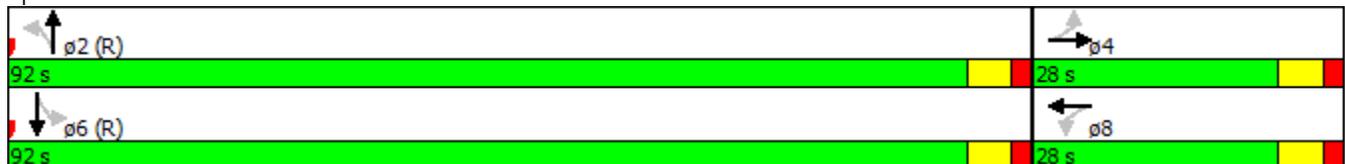


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	21	21	63	43	24	1286	35	1367
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	28.0	28.0	28.0	28.0	92.0	92.0	92.0	92.0
Total Split (%)	23.3%	23.3%	23.3%	23.3%	76.7%	76.7%	76.7%	76.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	10.8	10.8	10.9	10.9	100.7	100.7	100.7	100.7
Actuated g/C Ratio	0.09	0.09	0.09	0.09	0.84	0.84	0.84	0.84
v/c Ratio	0.17	0.27	0.51	0.34	0.09	0.48	0.13	0.46
Control Delay	51.7	29.9	65.3	43.7	3.8	4.2	4.2	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.7	29.9	65.3	43.7	3.8	4.2	4.2	3.8
LOS	D	C	E	D	A	A	A	A
Approach Delay		36.5		54.7		4.2		3.8
Approach LOS		D		D		A		A

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.51
 Intersection Signal Delay: 6.8
 Intersection Capacity Utilization 60.0%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service B

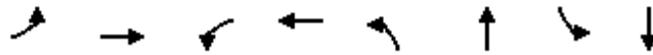
Splits and Phases: 2: Banwell Road & Palmetto Road



Queues

2: Banwell Road & Palmetto Road

9/10/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	21	49	63	60	24	1421	35	1387
v/c Ratio	0.17	0.27	0.51	0.34	0.09	0.48	0.13	0.46
Control Delay	51.7	29.9	65.3	43.7	3.8	4.2	4.2	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.7	29.9	65.3	43.7	3.8	4.2	4.2	3.8
Queue Length 50th (m)	4.7	4.6	14.4	10.1	0.9	43.7	1.5	42.7
Queue Length 95th (m)	12.1	15.8	27.8	22.5	3.4	68.2	m3.3	m49.3
Internal Link Dist (m)		370.5		214.8		349.0		247.8
Turn Bay Length (m)					120.0		120.0	
Base Capacity (vph)	247	338	250	342	279	2964	268	2997
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.14	0.25	0.18	0.09	0.48	0.13	0.46

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

2: Banwell Road & Palmetto Road

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	21	28	63	43	17	24	1286	135	35	1367	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.91		1.00	0.96		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1722		1789	1803		1789	3528		1789	3571	
Flt Permitted	0.72	1.00		0.73	1.00		0.18	1.00		0.17	1.00	
Satd. Flow (perm)	1352	1722		1366	1803		333	3528		320	3571	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	21	21	28	63	43	17	24	1286	135	35	1367	20
RTOR Reduction (vph)	0	26	0	0	14	0	0	4	0	0	1	0
Lane Group Flow (vph)	21	23	0	63	46	0	24	1417	0	35	1386	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	9.7	9.7		9.7	9.7		98.3	98.3		98.3	98.3	
Effective Green, g (s)	9.7	9.7		9.7	9.7		98.3	98.3		98.3	98.3	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.82	0.82		0.82	0.82	
Clearance Time (s)	6.0	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	
Lane Grp Cap (vph)	109	139		110	145		272	2890		262	2925	
v/s Ratio Prot		0.01			0.03			c0.40			0.39	
v/s Ratio Perm	0.02			c0.05			0.07			0.11		
v/c Ratio	0.19	0.17		0.57	0.32		0.09	0.49		0.13	0.47	
Uniform Delay, d1	51.5	51.4		53.2	52.0		2.1	3.3		2.2	3.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.01	0.94	
Incremental Delay, d2	0.9	0.6		7.0	1.3		0.6	0.6		0.9	0.5	
Delay (s)	52.4	52.0		60.2	53.3		2.8	3.9		3.1	3.5	
Level of Service	D	D		E	D		A	A		A	A	
Approach Delay (s)		52.1			56.8			3.9			3.5	
Approach LOS		D			E			A			A	

Intersection Summary

HCM 2000 Control Delay	6.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Timings

3: Banwell Road & Wildwood Drive/EC Row WB Offramp

9/10/2015

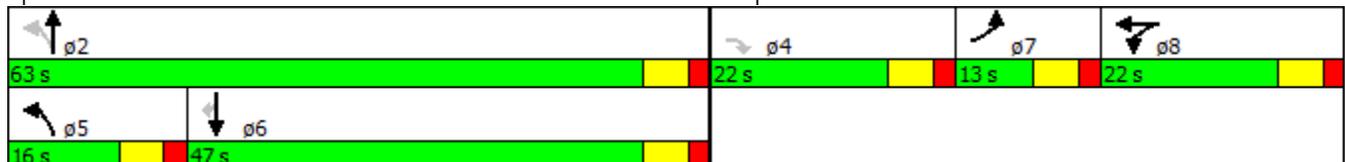


Lane Group	EBL	EBR	WBT	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↔	↖	↑↑	↑↑	↗
Volume (vph)	136	129	44	339	1766	1427	67
Turn Type	Prot	Perm	NA	pm+pt	NA	NA	Perm
Protected Phases	7		8	5	2	6	
Permitted Phases		4		2			6
Detector Phase	7	4	8	5	2	6	6
Switch Phase							
Minimum Initial (s)	4.0	1.0	4.0	1.0	4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	22.0	7.0	22.0	22.0	22.0
Total Split (s)	13.0	22.0	22.0	16.0	63.0	47.0	47.0
Total Split (%)	10.8%	18.3%	18.3%	13.3%	52.5%	39.2%	39.2%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lead		Lag	Lag
Lead-Lag Optimize?	Yes		Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	Max	Max	Max
Act Effect Green (s)	7.0	5.8	16.0	57.0	57.0	41.0	41.0
Actuated g/C Ratio	0.06	0.05	0.15	0.52	0.52	0.37	0.37
v/c Ratio	1.19	0.49	1.35dl	1.47	0.95	1.07	0.09
Control Delay	190.8	7.9	86.9	256.5	37.7	78.8	0.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	190.8	7.9	86.9	256.5	37.7	78.8	0.3
LOS	F	A	F	F	D	E	A
Approach Delay			86.9		73.0	75.2	
Approach LOS			F		E	E	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 109.8
 Natural Cycle: 145
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 1.47
 Intersection Signal Delay: 77.1
 Intersection LOS: E
 Intersection Capacity Utilization 104.7%
 ICU Level of Service G
 Analysis Period (min) 15
 dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 3: Banwell Road & Wildwood Drive/EC Row WB Offramp



Queues

3: Banwell Road & Wildwood Drive/EC Row WB Offramp

9/10/2015



Lane Group	EBL	EBR	WBT	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	136	129	507	339	1766	1427	67
v/c Ratio	1.19	0.49	1.35dl	1.47	0.95	1.07	0.09
Control Delay	190.8	7.9	86.9	256.5	37.7	78.8	0.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	190.8	7.9	86.9	256.5	37.7	78.8	0.3
Queue Length 50th (m)	~35.1	0.0	~56.0	~84.4	180.2	~177.5	0.0
Queue Length 95th (m)	#74.2	4.4	#92.6	#142.3	#243.0	#223.3	0.0
Internal Link Dist (m)			532.6		261.8	349.0	
Turn Bay Length (m)	30.0			80.0			
Base Capacity (vph)	114	396	505	231	1859	1337	717
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.19	0.33	1.00	1.47	0.95	1.07	0.09

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
- dl Defacto Left Lane. Recode with 1 though lane as a left lane.

HCM Signalized Intersection Capacity Analysis

3: Banwell Road & Wildwood Drive/EC Row WB Offramp

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖		↗		↔		↖	↗			↗	↖
Volume (vph)	136	0	129	372	44	91	339	1766	0	0	1427	67
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0		6.0		6.0	6.0			6.0	6.0
Lane Util. Factor	1.00		1.00		0.95		1.00	0.95			0.95	1.00
Frt	1.00		0.85		0.97		1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00		0.96		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1789		1601		3359		1789	3579			3579	1601
Flt Permitted	0.95		1.00		0.96		0.09	1.00			1.00	1.00
Satd. Flow (perm)	1789		1601		3359		160	3579			3579	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	136	0	129	372	44	91	339	1766	0	0	1427	67
RTOR Reduction (vph)	0	0	122	0	15	0	0	0	0	0	0	42
Lane Group Flow (vph)	136	0	7	0	492	0	339	1766	0	0	1427	25
Turn Type	Prot		Perm	Split	NA		pm+pt	NA			NA	Perm
Protected Phases	7			8	8		5	2			6	
Permitted Phases			4				2					6
Actuated Green, G (s)	7.0		5.8		16.0		57.0	57.0			41.0	41.0
Effective Green, g (s)	7.0		5.8		16.0		57.0	57.0			41.0	41.0
Actuated g/C Ratio	0.06		0.05		0.15		0.52	0.52			0.37	0.37
Clearance Time (s)	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
Lane Grp Cap (vph)	114		84		489		231	1857			1336	597
v/s Ratio Prot	c0.08				c0.15		c0.13	0.49			0.40	
v/s Ratio Perm			c0.00				c0.63					0.02
v/c Ratio	1.19		0.08		1.35dl		1.47	0.95			1.07	0.04
Uniform Delay, d1	51.4		49.5		46.9		32.1	25.1			34.4	21.9
Progression Factor	1.00		1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	145.2		0.4		42.0		232.5	12.1			45.0	0.1
Delay (s)	196.6		49.9		88.9		264.6	37.2			79.4	22.0
Level of Service	F		D		F		F	D			E	C
Approach Delay (s)		125.2			88.9			73.8			76.9	
Approach LOS		F			F			E			E	

Intersection Summary

HCM 2000 Control Delay	79.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.30		
Actuated Cycle Length (s)	109.8	Sum of lost time (s)	30.0
Intersection Capacity Utilization	104.7%	ICU Level of Service	G
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

Timings

4: Banwell Road & EC Row EB Offramp/Gouin Street

9/10/2015

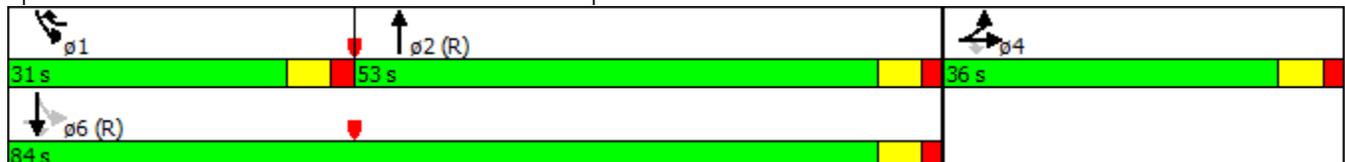


Lane Group	EBL	EBT	EBR	WBR	NBT	SBL	SBT
Lane Configurations							
Volume (vph)	412	320	572	213	1629	99	1285
Turn Type	Split	NA	custom	Over	NA	pm+pt	NA
Protected Phases	4	4		1	2	1	6
Permitted Phases			4 6			6	
Detector Phase	4	4	4 6	1	2	1	6
Switch Phase							
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0
Minimum Split (s)	22.0	22.0		10.0	22.0	10.0	22.0
Total Split (s)	36.0	36.0		31.0	53.0	31.0	84.0
Total Split (%)	30.0%	30.0%		25.8%	44.2%	25.8%	70.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0
Lead/Lag				Lead	Lag	Lead	
Lead-Lag Optimize?				Yes	Yes	Yes	
Recall Mode	None	None		None	C-Max	None	C-Min
Act Effect Green (s)	27.5	27.5	120.0	20.2	54.3	80.5	80.5
Actuated g/C Ratio	0.23	0.23	1.00	0.17	0.45	0.67	0.67
v/c Ratio	0.52	0.74	0.36	0.78	0.71	0.27	0.54
Control Delay	42.5	53.7	0.6	66.5	29.6	12.6	11.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.5	53.7	0.6	66.5	29.6	12.6	11.6
LOS	D	D	A	E	C	B	B
Approach Delay		26.9			29.6		11.7
Approach LOS		C			C		B

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 65
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.78
 Intersection Signal Delay: 25.1
 Intersection LOS: C
 Intersection Capacity Utilization 81.0%
 ICU Level of Service D
 Analysis Period (min) 15

Splits and Phases: 4: Banwell Road & EC Row EB Offramp/Gouin Street



Queues

4: Banwell Road & EC Row EB Offramp/Gouin Street

9/10/2015



Lane Group	EBL	EBT	EBR	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	412	320	572	213	1644	99	1288
v/c Ratio	0.52	0.74	0.36	0.78	0.71	0.27	0.54
Control Delay	42.5	53.7	0.6	66.5	29.6	12.6	11.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.5	53.7	0.6	66.5	29.6	12.6	11.6
Queue Length 50th (m)	42.7	68.4	0.0	48.2	93.5	8.0	80.5
Queue Length 95th (m)	57.9	99.7	0.0	72.0	94.4	20.0	97.7
Internal Link Dist (m)		204.2			84.3		81.0
Turn Bay Length (m)						80.0	
Base Capacity (vph)	867	470	1592	339	2323	430	2399
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.48	0.68	0.36	0.63	0.71	0.23	0.54

Intersection Summary

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row EB Offramp/Gouin Street

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↑	↖			↖		↖↗↘		↖	↖↗	
Volume (vph)	412	320	572	0	0	213	0	1629	15	99	1285	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	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		0.91		1.00	0.95	
Frt	1.00	1.00	0.85			0.86		1.00		1.00	1.00	
Flt Protected	0.95	1.00	1.00			1.00		1.00		0.95	1.00	
Satd. Flow (prot)	3471	1883	1601			1629		5135		1789	3577	
Flt Permitted	0.95	1.00	1.00			1.00		1.00		0.07	1.00	
Satd. Flow (perm)	3471	1883	1601			1629		5135		125	3577	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	412	320	572	0	0	213	0	1629	15	99	1285	3
RTOR Reduction (vph)	0	0	0	0	0	0	0	1	0	0	0	0
Lane Group Flow (vph)	412	320	572	0	0	213	0	1643	0	99	1288	0
Turn Type	Split	NA	custom			Over		NA		pm+pt	NA	
Protected Phases	4	4				1		2		1	6	
Permitted Phases			4 6							6		
Actuated Green, G (s)	27.5	27.5	120.0			20.2		54.3		80.5	80.5	
Effective Green, g (s)	27.5	27.5	120.0			20.2		54.3		80.5	80.5	
Actuated g/C Ratio	0.23	0.23	1.00			0.17		0.45		0.67	0.67	
Clearance Time (s)	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	
Lane Grp Cap (vph)	795	431	1601			274		2323		363	2399	
v/s Ratio Prot	0.12	c0.17				c0.13		c0.32		0.05	0.36	
v/s Ratio Perm			0.36							0.14		
v/c Ratio	0.52	0.74	0.36			0.78		0.71		0.27	0.54	
Uniform Delay, d1	40.5	43.0	0.0			47.7		26.5		14.0	10.2	
Progression Factor	1.00	1.00	1.00			1.00		1.01		1.00	1.00	
Incremental Delay, d2	0.6	6.8	0.1			13.0		1.3		0.4	0.9	
Delay (s)	41.0	49.7	0.1			60.7		28.0		14.4	11.0	
Level of Service	D	D	A			E		C		B	B	
Approach Delay (s)		25.2			60.7			28.0			11.3	
Approach LOS		C			E			C			B	

Intersection Summary

HCM 2000 Control Delay	23.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Timings

5: Banwell Road & Maisonneuve St

9/10/2015

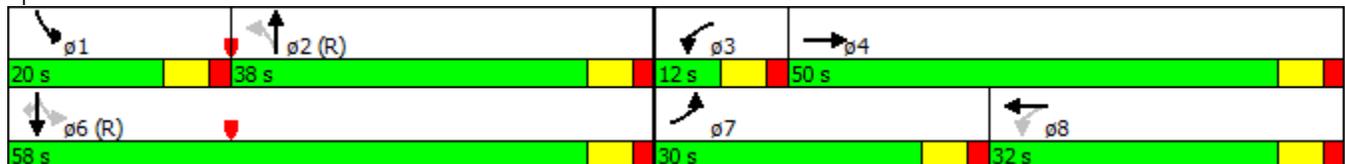


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations	↖↖	↗	↖	↗	↖	↑↑↑	↖	↑↑↑	↗
Volume (vph)	570	125	105	111	63	879	207	1046	403
Turn Type	Prot	NA	pm+pt	NA	Perm	NA	pm+pt	NA	Perm
Protected Phases	7	4	3	8		2	1	6	
Permitted Phases			8		2		6		6
Detector Phase	7	4	3	8	2	2	1	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	10.0	22.0	22.0	22.0	10.0	22.0	22.0
Total Split (s)	30.0	50.0	12.0	32.0	38.0	38.0	20.0	58.0	58.0
Total Split (%)	25.0%	41.7%	10.0%	26.7%	31.7%	31.7%	16.7%	48.3%	48.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	22.9	39.9	29.0	23.0	37.2	37.2	56.1	56.1	56.1
Actuated g/C Ratio	0.19	0.33	0.24	0.19	0.31	0.31	0.47	0.47	0.47
v/c Ratio	0.86	0.43	0.35	0.88	0.41	0.64	0.73	0.43	0.42
Control Delay	61.1	26.1	25.9	59.7	54.3	41.1	47.7	17.9	2.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.1	26.1	25.9	59.7	54.3	41.1	47.7	17.9	2.1
LOS	E	C	C	E	D	D	D	B	A
Approach Delay		50.0		51.8		41.8		17.7	
Approach LOS		D		D		D		B	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 75
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.88
 Intersection Signal Delay: 34.7
 Intersection LOS: C
 Intersection Capacity Utilization 87.7%
 ICU Level of Service E
 Analysis Period (min) 15

Splits and Phases: 5: Banwell Road & Maisonneuve St



Queues

5: Banwell Road & Maisonneuve St

9/10/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	570	262	105	343	63	1009	207	1046	403
v/c Ratio	0.86	0.43	0.35	0.88	0.41	0.64	0.73	0.43	0.42
Control Delay	61.1	26.1	25.9	59.7	54.3	41.1	47.7	17.9	2.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.1	26.1	25.9	59.7	54.3	41.1	47.7	17.9	2.1
Queue Length 50th (m)	66.8	36.1	13.8	60.5	7.9	44.1	28.2	38.9	0.0
Queue Length 95th (m)	#90.9	58.2	24.1	#104.1	m25.3	94.5	#56.3	45.4	9.0
Internal Link Dist (m)		533.0		108.9		442.9		249.5	
Turn Bay Length (m)			120.0		120.0		120.0		120.0
Base Capacity (vph)	694	669	304	429	152	1580	300	2405	963
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.39	0.35	0.80	0.41	0.64	0.69	0.43	0.42

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

5: Banwell Road & Maisonneuve St

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↔		↔	↔		↔	↑↑↑↔		↔	↑↑↑	↔
Volume (vph)	570	125	137	105	111	232	63	879	130	207	1046	403
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		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	0.91		1.00	0.91	1.00
Frt	1.00	0.92		1.00	0.90		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3471	1736		1789	1692		1789	5042		1789	5142	1601
Flt Permitted	0.95	1.00		0.60	1.00		0.26	1.00		0.14	1.00	1.00
Satd. Flow (perm)	3471	1736		1125	1692		493	5042		258	5142	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	570	125	137	105	111	232	63	879	130	207	1046	403
RTOR Reduction (vph)	0	35	0	0	65	0	0	15	0	0	0	215
Lane Group Flow (vph)	570	227	0	105	278	0	63	994	0	207	1046	188
Turn Type	Prot	NA		pm+pt	NA		Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8		2	2		1	6	6
Permitted Phases				8			2			6		6
Actuated Green, G (s)	22.9	39.9		29.0	23.0		37.2	37.2		56.1	56.1	56.1
Effective Green, g (s)	22.9	39.9		29.0	23.0		37.2	37.2		56.1	56.1	56.1
Actuated g/C Ratio	0.19	0.33		0.24	0.19		0.31	0.31		0.47	0.47	0.47
Clearance Time (s)	6.0	6.0		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
Lane Grp Cap (vph)	662	577		305	324		152	1563		285	2403	748
v/s Ratio Prot	c0.16	0.13		0.02	c0.16			0.20		c0.08	0.20	
v/s Ratio Perm				0.07			0.13			c0.26		0.12
v/c Ratio	0.86	0.39		0.34	0.86		0.41	0.64		0.73	0.44	0.25
Uniform Delay, d1	47.0	30.8		36.7	46.9		32.8	35.6		22.4	21.4	19.3
Progression Factor	1.00	1.00		1.00	1.00		1.24	1.09		1.56	0.78	0.42
Incremental Delay, d2	11.1	0.4		0.7	19.6		6.9	1.7		8.0	0.5	0.7
Delay (s)	58.1	31.2		37.3	66.6		47.5	40.3		43.0	17.2	8.8
Level of Service	E	C		D	E		D	D		D	B	A
Approach Delay (s)		49.6			59.7			40.8			18.4	
Approach LOS		D			E			D			B	

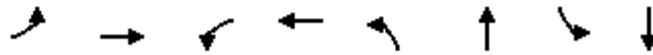
Intersection Summary

HCM 2000 Control Delay	35.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	87.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Timings

6: Banwell Road & Twin Oaks Drive/Intersection Road

9/10/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↶	↷	↶	↷	↶	↑↑↑	↶	↑↑↑
Volume (vph)	199	110	48	101	143	675	362	937
Turn Type	pm+pt	NA	Perm	NA	pm+pt	NA	pm+pt	NA
Protected Phases	7	4		8	5	2	1	6
Permitted Phases	4		8		2		6	
Detector Phase	7	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	22.0	22.0	10.0	22.0	10.0	22.0
Total Split (s)	21.0	52.0	31.0	31.0	21.0	32.0	36.0	47.0
Total Split (%)	17.5%	43.3%	25.8%	25.8%	17.5%	26.7%	30.0%	39.2%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	C-Max	None	C-Max
Act Effect Green (s)	40.0	40.0	19.7	19.7	49.3	39.0	68.0	51.6
Actuated g/C Ratio	0.33	0.33	0.16	0.16	0.41	0.32	0.57	0.43
v/c Ratio	0.70	0.42	0.26	0.82	0.49	0.49	0.73	0.52
Control Delay	42.1	23.8	45.4	55.8	22.2	34.7	44.7	25.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.1	23.8	45.4	55.8	22.2	34.7	44.7	25.8
LOS	D	C	D	E	C	C	D	C
Approach Delay		31.8		54.2		32.8		30.4
Approach LOS		C		D		C		C

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 70
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.82
 Intersection Signal Delay: 33.7
 Intersection LOS: C
 Intersection Capacity Utilization 82.9%
 ICU Level of Service E
 Analysis Period (min) 15

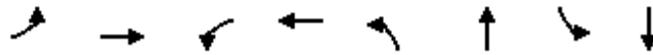
Splits and Phases: 6: Banwell Road & Twin Oaks Drive/Intersection Road



Queues

6: Banwell Road & Twin Oaks Drive/Intersection Road

9/10/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	199	259	48	273	143	807	362	1128
v/c Ratio	0.70	0.42	0.26	0.82	0.49	0.49	0.73	0.52
Control Delay	42.1	23.8	45.4	55.8	22.2	34.7	44.7	25.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.1	23.8	45.4	55.8	22.2	34.7	44.7	25.8
Queue Length 50th (m)	34.3	33.9	9.9	48.0	15.6	54.7	67.2	55.4
Queue Length 95th (m)	50.3	53.2	20.4	75.1	28.4	77.7	99.9	68.1
Internal Link Dist (m)		461.7		590.5		67.6		442.9
Turn Bay Length (m)	120.0		120.0		120.0		120.0	
Base Capacity (vph)	293	700	235	406	363	1649	575	2177
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.37	0.20	0.67	0.39	0.49	0.63	0.52

Intersection Summary

HCM Signalized Intersection Capacity Analysis

6: Banwell Road & Twin Oaks Drive/Intersection Road

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	199	110	149	48	101	172	143	675	132	362	937	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.91		1.00	0.91	
Frt	1.00	0.91		1.00	0.91		1.00	0.98		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1721		1789	1705		1789	5016		1789	5011	
Flt Permitted	0.18	1.00		0.60	1.00		0.23	1.00		0.22	1.00	
Satd. Flow (perm)	337	1721		1128	1705		431	5016		407	5011	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	199	110	149	48	101	172	143	675	132	362	937	191
RTOR Reduction (vph)	0	44	0	0	54	0	0	21	0	0	22	0
Lane Group Flow (vph)	199	215	0	48	219	0	143	786	0	362	1106	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	40.1	40.1		19.7	19.7		49.3	38.9		67.9	51.5	
Effective Green, g (s)	40.1	40.1		19.7	19.7		49.3	38.9		67.9	51.5	
Actuated g/C Ratio	0.33	0.33		0.16	0.16		0.41	0.32		0.57	0.43	
Clearance Time (s)	6.0	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	
Lane Grp Cap (vph)	286	575		185	279		294	1626		495	2150	
v/s Ratio Prot	c0.08	0.12			0.13		0.04	0.16		c0.14	0.22	
v/s Ratio Perm	c0.15			0.04			0.16			c0.27		
v/c Ratio	0.70	0.37		0.26	0.78		0.49	0.48		0.73	0.51	
Uniform Delay, d1	31.6	30.4		43.8	48.1		22.7	32.5		16.7	25.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		2.12	0.97	
Incremental Delay, d2	7.2	0.4		0.7	13.4		1.3	1.0		5.2	0.8	
Delay (s)	38.7	30.8		44.5	61.5		23.9	33.5		40.6	25.2	
Level of Service	D	C		D	E		C	C		D	C	
Approach Delay (s)		34.3			59.0			32.1			29.0	
Approach LOS		C			E			C			C	

Intersection Summary

HCM 2000 Control Delay	33.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	82.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Timings

1: Banwell Road & Tecumseh Road

9/10/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↖	↕↕↕	↖	↕↕	↖	↖	↕↕	↖	↕↕
Volume (vph)	105	566	142	675	102	304	392	232	564
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	22.0	8.0	22.0	22.0	8.0	22.0	8.0	22.0
Total Split (s)	13.0	39.0	13.0	39.0	39.0	31.0	49.0	19.0	37.0
Total Split (%)	10.8%	32.5%	10.8%	32.5%	32.5%	25.8%	40.8%	15.8%	30.8%
Yellow Time (s)	3.5	4.0	3.5	4.0	4.0	3.5	4.0	3.5	4.0
All-Red Time (s)	0.5	2.0	0.5	2.0	2.0	0.5	2.0	0.5	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	C-Max	None	C-Max
Act Effct Green (s)	39.3	28.6	39.7	28.9	28.9	67.4	49.7	60.7	45.9
Actuated g/C Ratio	0.33	0.24	0.33	0.24	0.24	0.56	0.41	0.51	0.38
v/c Ratio	0.50	0.53	0.53	0.78	0.21	0.62	0.34	0.44	0.44
Control Delay	33.2	39.6	33.2	49.4	3.3	27.2	22.4	16.9	30.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.2	39.6	33.2	49.4	3.3	27.2	22.4	16.9	30.4
LOS	C	D	C	D	A	C	C	B	C
Approach Delay		38.7		41.8			24.2		26.7
Approach LOS		D		D			C		C

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.78
 Intersection Signal Delay: 33.0
 Intersection LOS: C
 Intersection Capacity Utilization 74.8%
 ICU Level of Service D
 Analysis Period (min) 15

Splits and Phases: 1: Banwell Road & Tecumseh Road



Queues

1: Banwell Road & Tecumseh Road

9/10/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	105	645	142	675	102	304	499	232	603
v/c Ratio	0.50	0.53	0.53	0.78	0.21	0.62	0.34	0.44	0.44
Control Delay	33.2	39.6	33.2	49.4	3.3	27.2	22.4	16.9	30.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.2	39.6	33.2	49.4	3.3	27.2	22.4	16.9	30.4
Queue Length 50th (m)	16.4	46.7	22.7	78.2	0.0	35.1	33.3	26.0	54.7
Queue Length 95th (m)	27.4	56.7	35.7	95.4	6.7	73.3	43.5	43.1	82.1
Internal Link Dist (m)		438.6		520.2			80.5		113.8
Turn Bay Length (m)	80.0		75.0		70.0	50.0		80.0	
Base Capacity (vph)	217	1403	272	984	538	602	1454	560	1359
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.48	0.46	0.52	0.69	0.19	0.50	0.34	0.41	0.44

Intersection Summary

HCM Signalized Intersection Capacity Analysis

1: Banwell Road & Tecumseh Road

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗↖↗		↖	↗↖↗	↖	↖	↗↖↗		↖	↗↖↗	
Volume (vph)	105	566	79	142	675	102	304	392	107	232	564	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	5047		1789	3579	1601	1789	3463		1789	3544	
Flt Permitted	0.17	1.00		0.28	1.00	1.00	0.31	1.00		0.45	1.00	
Satd. Flow (perm)	325	5047		536	3579	1601	579	3463		841	3544	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	105	566	79	142	675	102	304	392	107	232	564	39
RTOR Reduction (vph)	0	16	0	0	0	77	0	19	0	0	4	0
Lane Group Flow (vph)	105	629	0	142	675	25	304	480	0	232	599	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	37.2	28.6		37.8	28.9	28.9	66.3	49.7		58.7	45.9	
Effective Green, g (s)	37.2	28.6		37.8	28.9	28.9	66.3	49.7		58.7	45.9	
Actuated g/C Ratio	0.31	0.24		0.31	0.24	0.24	0.55	0.41		0.49	0.38	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	205	1202		261	861	385	487	1434		512	1355	
v/s Ratio Prot	0.04	0.12		c0.04	c0.19		c0.09	0.14		0.05	0.17	
v/s Ratio Perm	0.12			0.13		0.02	c0.26			0.17		
v/c Ratio	0.51	0.52		0.54	0.78	0.06	0.62	0.33		0.45	0.44	
Uniform Delay, d1	31.6	39.8		30.9	42.6	35.1	15.7	23.9		18.0	27.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.50	0.92		1.00	1.00	
Incremental Delay, d2	2.2	0.4		2.3	4.7	0.1	2.5	0.6		0.6	1.0	
Delay (s)	33.8	40.2		33.2	47.3	35.2	26.0	22.5		18.7	28.6	
Level of Service	C	D		C	D	D	C	C		B	C	
Approach Delay (s)		39.3			43.8			23.8			25.8	
Approach LOS		D			D			C			C	

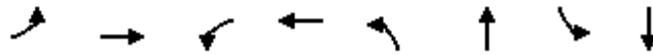
Intersection Summary

HCM 2000 Control Delay	33.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Timings

2: Banwell Road & Palmetto Road

9/10/2015

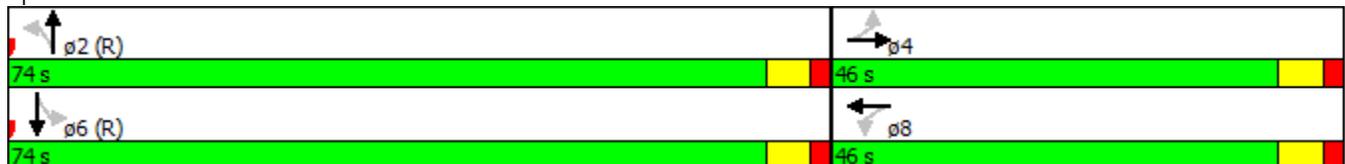


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↕	↖	↕
Volume (vph)	5	5	174	65	9	640	14	964
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	46.0	46.0	46.0	46.0	74.0	74.0	74.0	74.0
Total Split (%)	38.3%	38.3%	38.3%	38.3%	61.7%	61.7%	61.7%	61.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	20.3	20.3	20.3	20.3	87.7	87.7	87.7	87.7
Actuated g/C Ratio	0.17	0.17	0.17	0.17	0.73	0.73	0.73	0.73
v/c Ratio	0.02	0.04	0.73	0.26	0.02	0.28	0.03	0.37
Control Delay	37.6	27.0	64.1	36.9	6.3	6.2	4.4	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.6	27.0	64.1	36.9	6.3	6.2	4.4	4.3
LOS	D	C	E	D	A	A	A	A
Approach Delay		30.3		55.4		6.2		4.3
Approach LOS		C		E		A		A

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 45
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.73
 Intersection Signal Delay: 11.8
 Intersection LOS: B
 Intersection Capacity Utilization 53.2%
 ICU Level of Service A
 Analysis Period (min) 15

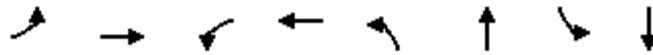
Splits and Phases: 2: Banwell Road & Palmetto Road



Queues

2: Banwell Road & Palmetto Road

9/10/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	5	11	174	82	9	719	14	971
v/c Ratio	0.02	0.04	0.73	0.26	0.02	0.28	0.03	0.37
Control Delay	37.6	27.0	64.1	36.9	6.3	6.2	4.4	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.6	27.0	64.1	36.9	6.3	6.2	4.4	4.3
Queue Length 50th (m)	1.0	1.0	39.3	14.4	0.5	25.5	0.6	22.1
Queue Length 95th (m)	4.3	5.7	58.8	26.7	2.5	42.5	m1.7	32.5
Internal Link Dist (m)		370.5		214.8		349.0		247.8
Turn Bay Length (m)					120.0		120.0	
Base Capacity (vph)	442	580	471	616	374	2579	505	2614
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.02	0.37	0.13	0.02	0.28	0.03	0.37

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

2: Banwell Road & Palmetto Road

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↕		↖	↗	
Volume (vph)	5	5	6	174	65	17	9	640	79	14	964	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.92		1.00	0.97		1.00	0.98		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1729		1789	1825		1789	3520		1789	3575	
Flt Permitted	0.70	1.00		0.75	1.00		0.27	1.00		0.37	1.00	
Satd. Flow (perm)	1325	1729		1413	1825		512	3520		691	3575	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	5	6	174	65	17	9	640	79	14	964	7
RTOR Reduction (vph)	0	5	0	0	10	0	0	5	0	0	0	0
Lane Group Flow (vph)	5	6	0	174	72	0	9	714	0	14	971	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	20.3	20.3		20.3	20.3		87.7	87.7		87.7	87.7	
Effective Green, g (s)	20.3	20.3		20.3	20.3		87.7	87.7		87.7	87.7	
Actuated g/C Ratio	0.17	0.17		0.17	0.17		0.73	0.73		0.73	0.73	
Clearance Time (s)	6.0	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	
Lane Grp Cap (vph)	224	292		239	308		374	2572		505	2612	
v/s Ratio Prot		0.00			0.04			0.20			c0.27	
v/s Ratio Perm	0.00			c0.12			0.02			0.02		
v/c Ratio	0.02	0.02		0.73	0.23		0.02	0.28		0.03	0.37	
Uniform Delay, d1	41.6	41.6		47.2	43.1		4.4	5.5		4.4	6.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.71	0.60	
Incremental Delay, d2	0.0	0.0		10.5	0.4		0.1	0.3		0.1	0.4	
Delay (s)	41.6	41.6		57.8	43.5		4.5	5.7		3.2	4.0	
Level of Service	D	D		E	D		A	A		A	A	
Approach Delay (s)		41.6			53.2			5.7			3.9	
Approach LOS		D			D			A			A	

Intersection Summary

HCM 2000 Control Delay	11.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	53.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Timings

3: Banwell Road & Wildwood Drive/EC Row WB Offramp

9/10/2015

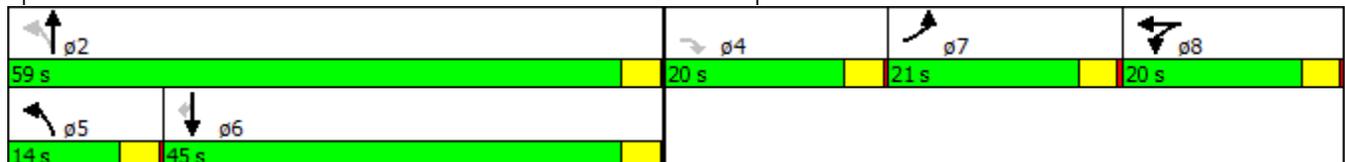


Lane Group	EBL	EBR	WBT	NBL	NBT	SBT	SBR
Lane Configurations							
Volume (vph)	194	324	16	174	843	1079	80
Turn Type	Prot	Perm	NA	pm+pt	NA	NA	Perm
Protected Phases	7		8	5	2	6	
Permitted Phases		4		2			6
Detector Phase	7	4	8	5	2	6	6
Switch Phase							
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	20.0
Total Split (s)	21.0	20.0	20.0	14.0	59.0	45.0	45.0
Total Split (%)	17.5%	16.7%	16.7%	11.7%	49.2%	37.5%	37.5%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag	Lead		Lag	Lag
Lead-Lag Optimize?	Yes		Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	Max	Max	Max
Act Effct Green (s)	15.3	8.3	13.4	55.3	55.3	41.5	41.5
Actuated g/C Ratio	0.14	0.08	0.12	0.51	0.51	0.38	0.38
v/c Ratio	0.77	0.77	1.00dl	0.75	0.46	0.79	0.12
Control Delay	66.2	18.3	52.2	43.0	19.2	36.0	2.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.2	18.3	52.2	43.0	19.2	36.0	2.0
LOS	E	B	D	D	B	D	A
Approach Delay			52.2		23.3	33.6	
Approach LOS			D		C	C	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 108.4
 Natural Cycle: 90
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.79
 Intersection Signal Delay: 32.3
 Intersection LOS: C
 Intersection Capacity Utilization 72.6%
 ICU Level of Service C
 Analysis Period (min) 15
 dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 3: Banwell Road & Wildwood Drive/EC Row WB Offramp



Queues

3: Banwell Road & Wildwood Drive/EC Row WB Offramp

9/10/2015



Lane Group	EBL	EBR	WBT	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	194	324	279	174	843	1079	80
v/c Ratio	0.77	0.77	1.00dl	0.75	0.46	0.79	0.12
Control Delay	66.2	18.3	52.2	43.0	19.2	36.0	2.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.2	18.3	52.2	43.0	19.2	36.0	2.0
Queue Length 50th (m)	38.7	0.0	28.4	19.7	56.7	103.5	0.0
Queue Length 95th (m)	#78.5	26.5	46.1	#62.3	90.3	#156.5	4.2
Internal Link Dist (m)			532.6		261.8	349.0	
Turn Bay Length (m)	30.0			80.0			
Base Capacity (vph)	282	513	509	235	1825	1369	685
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.63	0.55	0.74	0.46	0.79	0.12

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

HCM Signalized Intersection Capacity Analysis

3: Banwell Road & Wildwood Drive/EC Row WB Offramp

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	194	0	324	230	16	33	174	843	0	0	1079	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0		4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		1.00		0.95		1.00	0.95			0.95	1.00
Frt	1.00		0.85		0.98		1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00		0.96		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1789		1601		3376		1789	3579			3579	1601
Flt Permitted	0.95		1.00		0.96		0.09	1.00			1.00	1.00
Satd. Flow (perm)	1789		1601		3376		166	3579			3579	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	194	0	324	230	16	33	174	843	0	0	1079	80
RTOR Reduction (vph)	0	0	299	0	9	0	0	0	0	0	0	49
Lane Group Flow (vph)	194	0	25	0	270	0	174	843	0	0	1079	31
Turn Type	Prot		Perm	Split	NA		pm+pt	NA			NA	Perm
Protected Phases	7			8	8		5	2			6	
Permitted Phases			4				2					6
Actuated Green, G (s)	15.3		8.3		13.4		55.3	55.3			41.5	41.5
Effective Green, g (s)	15.3		8.3		13.4		55.3	55.3			41.5	41.5
Actuated g/C Ratio	0.14		0.08		0.12		0.51	0.51			0.38	0.38
Clearance Time (s)	4.0		4.0		4.0		4.0	4.0			4.0	4.0
Vehicle Extension (s)	3.0		3.0		3.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	252		122		417		231	1827			1371	613
v/s Ratio Prot	c0.11				c0.08		c0.07	0.24			0.30	
v/s Ratio Perm			c0.02				c0.32					0.02
v/c Ratio	0.77		0.20		1.00dl		0.75	0.46			0.79	0.05
Uniform Delay, d1	44.8		46.9		45.2		22.2	17.0			29.5	21.0
Progression Factor	1.00		1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	13.2		0.8		3.5		13.0	0.8			4.6	0.2
Delay (s)	58.0		47.7		48.7		35.2	17.8			34.1	21.2
Level of Service	E		D		D		D	B			C	C
Approach Delay (s)		51.6			48.7			20.8			33.2	
Approach LOS		D			D			C			C	

Intersection Summary

HCM 2000 Control Delay	33.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	108.3	Sum of lost time (s)	20.0
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

Timings

4: Banwell Road & EC Row EB Offramp/Gouin Street

9/10/2015

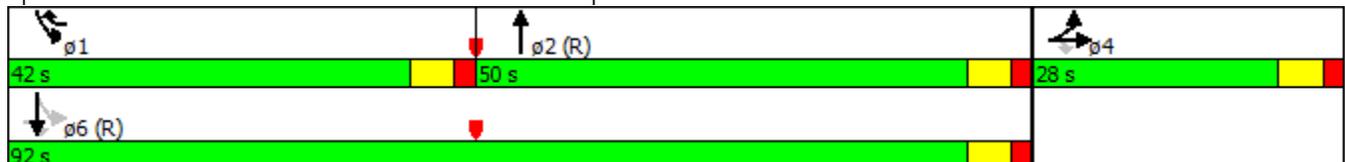


Lane Group	EBL	EBT	EBR	WBR	NBT	SBL	SBT
Lane Configurations							
Volume (vph)	382	80	166	276	1234	76	784
Turn Type	Split	NA	custom	Over	NA	pm+pt	NA
Protected Phases	4	4		1	2	1	6
Permitted Phases			4 6			6	
Detector Phase	4	4	4 6	1	2	1	6
Switch Phase							
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0
Minimum Split (s)	22.0	22.0		10.0	22.0	10.0	22.0
Total Split (s)	28.0	28.0		42.0	50.0	42.0	92.0
Total Split (%)	23.3%	23.3%		35.0%	41.7%	35.0%	76.7%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0
Lead/Lag				Lead	Lag	Lead	
Lead-Lag Optimize?				Yes	Yes	Yes	
Recall Mode	None	None		None	C-Max	None	C-Max
Act Effct Green (s)	18.9	18.9	120.0	25.6	57.5	89.1	89.1
Actuated g/C Ratio	0.16	0.16	1.00	0.21	0.48	0.74	0.74
v/c Ratio	0.70	0.27	0.10	0.80	0.50	0.15	0.30
Control Delay	54.8	45.9	0.1	60.8	15.9	5.3	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.8	45.9	0.1	60.8	15.9	5.3	5.7
LOS	D	D	A	E	B	A	A
Approach Delay		39.2			15.9		5.6
Approach LOS		D			B		A

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.80
 Intersection Signal Delay: 22.0
 Intersection LOS: C
 Intersection Capacity Utilization 66.9%
 ICU Level of Service C
 Analysis Period (min) 15

Splits and Phases: 4: Banwell Road & EC Row EB Offramp/Gouin Street



Queues

4: Banwell Road & EC Row EB Offramp/Gouin Street

9/10/2015



Lane Group	EBL	EBT	EBR	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	382	80	166	276	1239	76	784
v/c Ratio	0.70	0.27	0.10	0.80	0.50	0.15	0.30
Control Delay	54.8	45.9	0.1	60.8	15.9	5.3	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.8	45.9	0.1	60.8	15.9	5.3	5.7
Queue Length 50th (m)	44.2	16.7	0.0	62.0	40.5	4.3	28.2
Queue Length 95th (m)	58.7	30.5	0.0	84.7	47.6	9.0	39.2
Internal Link Dist (m)		204.2			84.3		81.0
Turn Bay Length (m)							
Base Capacity (vph)	636	345	1588	488	2461	655	2657
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.60	0.23	0.10	0.57	0.50	0.12	0.30

Intersection Summary

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row EB Offramp/Gouin Street

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↑	↖			↖		↖↗↘		↖	↖↗	
Volume (vph)	382	80	166	0	0	276	0	1234	5	76	784	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	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		0.91		1.00	0.95	
Frt	1.00	1.00	0.85			0.86		1.00		1.00	1.00	
Flt Protected	0.95	1.00	1.00			1.00		1.00		0.95	1.00	
Satd. Flow (prot)	3471	1883	1601			1629		5139		1789	3579	
Flt Permitted	0.95	1.00	1.00			1.00		1.00		0.14	1.00	
Satd. Flow (perm)	3471	1883	1601			1629		5139		269	3579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	382	80	166	0	0	276	0	1234	5	76	784	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	1	0	0	0	0
Lane Group Flow (vph)	382	80	166	0	0	276	0	1238	0	76	784	0
Turn Type	Split	NA	custom			Over		NA		pm+pt	NA	
Protected Phases	4	4				1		2		1	6	
Permitted Phases			4 6							6		
Actuated Green, G (s)	18.9	18.9	120.0			25.6		57.5		89.1	89.1	
Effective Green, g (s)	18.9	18.9	120.0			25.6		57.5		89.1	89.1	
Actuated g/C Ratio	0.16	0.16	1.00			0.21		0.48		0.74	0.74	
Clearance Time (s)	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	
Lane Grp Cap (vph)	546	296	1601			347		2462		523	2657	
v/s Ratio Prot	c0.11	0.04				c0.17		c0.24		0.03	0.22	
v/s Ratio Perm			0.10							0.08		
v/c Ratio	0.70	0.27	0.10			0.80		0.50		0.15	0.30	
Uniform Delay, d1	47.9	44.5	0.0			44.7		21.4		6.4	5.1	
Progression Factor	1.00	1.00	1.00			1.00		0.66		1.00	1.00	
Incremental Delay, d2	3.9	0.5	0.0			11.9		0.7		0.1	0.3	
Delay (s)	51.8	45.0	0.0			56.6		14.8		6.6	5.4	
Level of Service	D	D	A			E		B		A	A	
Approach Delay (s)		37.2			56.6			14.8			5.5	
Approach LOS		D			E			B			A	

Intersection Summary

HCM 2000 Control Delay	20.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	66.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Timings

5: Banwell Road & Maisonneuve St

9/10/2015

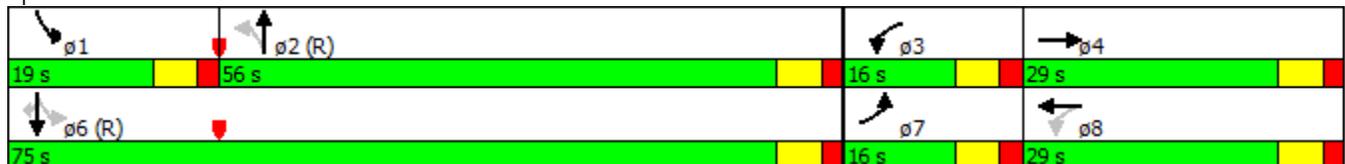


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations	↖↖	↗	↖	↗	↖	↑↑↑	↖	↑↑↑	↗
Volume (vph)	79	20	65	48	81	939	75	491	250
Turn Type	Prot	NA	pm+pt	NA	Perm	NA	pm+pt	NA	Perm
Protected Phases	7	4	3	8		2	1	6	
Permitted Phases			8		2		6		6
Detector Phase	7	4	3	8	2	2	1	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	10.0	22.0	22.0	22.0	10.0	22.0	22.0
Total Split (s)	16.0	29.0	16.0	29.0	56.0	56.0	19.0	75.0	75.0
Total Split (%)	13.3%	24.2%	13.3%	24.2%	46.7%	46.7%	15.8%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	8.1	9.6	18.9	10.4	75.1	75.1	86.0	86.0	86.0
Actuated g/C Ratio	0.07	0.08	0.16	0.09	0.63	0.63	0.72	0.72	0.72
v/c Ratio	0.34	0.19	0.28	0.63	0.15	0.30	0.19	0.13	0.21
Control Delay	57.0	40.2	40.9	41.0	9.5	8.3	5.8	4.4	0.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.0	40.2	40.9	41.0	9.5	8.3	5.8	4.4	0.6
LOS	E	D	D	D	A	A	A	A	A
Approach Delay		52.5		41.0		8.4		3.4	
Approach LOS		D		D		A		A	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 65
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.63
 Intersection Signal Delay: 11.6
 Intersection LOS: B
 Intersection Capacity Utilization 53.8%
 ICU Level of Service A
 Analysis Period (min) 15

Splits and Phases: 5: Banwell Road & Maisonneuve St



Queues

5: Banwell Road & Maisonneuve St

9/10/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	79	29	65	129	81	969	75	491	250
v/c Ratio	0.34	0.19	0.28	0.63	0.15	0.30	0.19	0.13	0.21
Control Delay	57.0	40.2	40.9	41.0	9.5	8.3	5.8	4.4	0.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.0	40.2	40.9	41.0	9.5	8.3	5.8	4.4	0.6
Queue Length 50th (m)	9.3	4.5	12.8	15.0	5.1	23.0	3.1	7.4	0.0
Queue Length 95th (m)	16.8	13.1	23.1	33.3	11.6	32.9	6.1	10.1	2.6
Internal Link Dist (m)		533.0		108.9		442.9		249.5	
Turn Bay Length (m)			120.0		120.0		120.0		120.0
Base Capacity (vph)	289	351	247	377	545	3203	468	3683	1217
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.08	0.26	0.34	0.15	0.30	0.16	0.13	0.21

Intersection Summary

HCM Signalized Intersection Capacity Analysis

5: Banwell Road & Maisonneuve St

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	79	20	9	65	48	81	81	939	30	75	491	250
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		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	0.91		1.00	0.91	1.00
Frt	1.00	0.95		1.00	0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3471	1796		1789	1706		1789	5118		1789	5142	1601
Flt Permitted	0.95	1.00		0.54	1.00		0.46	1.00		0.24	1.00	1.00
Satd. Flow (perm)	3471	1796		1016	1706		872	5118		452	5142	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	79	20	9	65	48	81	81	939	30	75	491	250
RTOR Reduction (vph)	0	8	0	0	57	0	0	2	0	0	0	76
Lane Group Flow (vph)	79	21	0	65	72	0	81	967	0	75	491	174
Turn Type	Prot	NA		pm+pt	NA		Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8		2	2		1	6	6
Permitted Phases				8			2			6		6
Actuated Green, G (s)	6.9	8.4		21.5	11.5		71.5	71.5		83.6	83.6	83.6
Effective Green, g (s)	6.9	8.4		21.5	11.5		71.5	71.5		83.6	83.6	83.6
Actuated g/C Ratio	0.06	0.07		0.18	0.10		0.60	0.60		0.70	0.70	0.70
Clearance Time (s)	6.0	6.0		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
Lane Grp Cap (vph)	199	125		246	163		519	3049		382	3582	1115
v/s Ratio Prot	c0.02	0.01		0.02	c0.04			c0.19		0.01	0.10	
v/s Ratio Perm				0.03			0.09			0.13		c0.11
v/c Ratio	0.40	0.17		0.26	0.44		0.16	0.32		0.20	0.14	0.16
Uniform Delay, d1	54.5	52.5		42.0	51.2		10.8	12.1		6.5	6.1	6.2
Progression Factor	1.00	1.00		1.00	1.00		0.67	0.65		0.70	0.69	0.22
Incremental Delay, d2	1.3	0.6		0.6	1.9		0.6	0.3		0.2	0.1	0.3
Delay (s)	55.8	53.1		42.6	53.1		7.9	8.1		4.8	4.3	1.6
Level of Service	E	D		D	D		A	A		A	A	A
Approach Delay (s)		55.1			49.6			8.1			3.5	
Approach LOS		E			D			A			A	

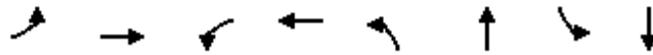
Intersection Summary

HCM 2000 Control Delay	12.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	53.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Timings

6: Banwell Road & Twin Oaks Drive/Intersection Road

9/10/2015

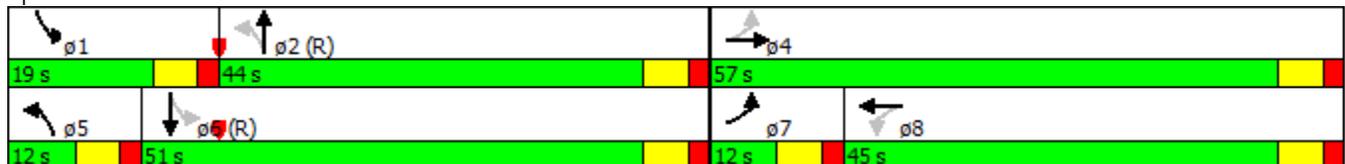


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↶	↷	↶	↷	↶	↑↑↑	↶	↑↑↑
Volume (vph)	30	20	104	33	35	717	91	689
Turn Type	pm+pt	NA	Perm	NA	pm+pt	NA	pm+pt	NA
Protected Phases	7	4		8	5	2	1	6
Permitted Phases	4		8		2		6	
Detector Phase	7	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	22.0	22.0	10.0	22.0	10.0	22.0
Total Split (s)	12.0	57.0	45.0	45.0	12.0	44.0	19.0	51.0
Total Split (%)	10.0%	47.5%	37.5%	37.5%	10.0%	36.7%	15.8%	42.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	C-Max	None	C-Max
Act Effct Green (s)	22.0	22.0	14.8	14.8	78.7	72.4	83.4	78.3
Actuated g/C Ratio	0.18	0.18	0.12	0.12	0.66	0.60	0.70	0.65
v/c Ratio	0.22	0.12	0.61	0.71	0.07	0.24	0.18	0.22
Control Delay	39.0	20.7	64.1	17.4	8.0	12.9	7.3	9.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.0	20.7	64.1	17.4	8.0	12.9	7.3	9.6
LOS	D	C	E	B	A	B	A	A
Approach Delay		28.3		28.9		12.7		9.4
Approach LOS		C		C		B		A

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 65
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.71
 Intersection Signal Delay: 15.2
 Intersection LOS: B
 Intersection Capacity Utilization 59.6%
 ICU Level of Service B
 Analysis Period (min) 15

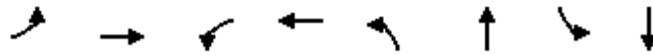
Splits and Phases: 6: Banwell Road & Twin Oaks Drive/Intersection Road



Queues

6: Banwell Road & Twin Oaks Drive/Intersection Road

9/10/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	30	42	104	319	35	752	91	735
v/c Ratio	0.22	0.12	0.61	0.71	0.07	0.24	0.18	0.22
Control Delay	39.0	20.7	64.1	17.4	8.0	12.9	7.3	9.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.0	20.7	64.1	17.4	8.0	12.9	7.3	9.6
Queue Length 50th (m)	5.6	3.7	23.6	7.7	2.5	31.1	6.1	27.2
Queue Length 95th (m)	12.6	12.0	39.3	34.7	6.9	46.5	12.7	34.5
Internal Link Dist (m)		461.7		590.5		67.6		442.9
Turn Bay Length (m)	120.0		120.0		120.0		120.0	
Base Capacity (vph)	138	750	446	721	506	3083	562	3327
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.06	0.23	0.44	0.07	0.24	0.16	0.22

Intersection Summary

HCM Signalized Intersection Capacity Analysis

6: Banwell Road & Twin Oaks Drive/Intersection Road

9/10/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↶	↷		↶	↷		↶	↑↑↑		↶	↑↑↑	
Volume (vph)	30	20	22	104	33	286	35	717	35	91	689	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.91		1.00	0.91	
Frt	1.00	0.92		1.00	0.87		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1735		1789	1630		1789	5106		1789	5094	
Flt Permitted	0.19	1.00		0.73	1.00		0.36	1.00		0.32	1.00	
Satd. Flow (perm)	362	1735		1374	1630		680	5106		608	5094	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	30	20	22	104	33	286	35	717	35	91	689	46
RTOR Reduction (vph)	0	18	0	0	248	0	0	3	0	0	4	0
Lane Group Flow (vph)	30	24	0	104	71	0	35	750	0	91	731	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	24.4	24.4		14.8	14.8		74.1	70.0		81.1	73.5	
Effective Green, g (s)	24.4	24.4		14.8	14.8		74.1	70.0		81.1	73.5	
Actuated g/C Ratio	0.20	0.20		0.12	0.12		0.62	0.58		0.68	0.61	
Clearance Time (s)	6.0	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	
Lane Grp Cap (vph)	116	352		169	201		457	2978		485	3120	
v/s Ratio Prot	c0.01	0.01			0.04		0.00	c0.15		c0.01	c0.14	
v/s Ratio Perm	0.04			c0.08			0.04			0.11		
v/c Ratio	0.26	0.07		0.62	0.35		0.08	0.25		0.19	0.23	
Uniform Delay, d1	39.9	38.6		49.9	48.2		9.0	12.2		6.8	10.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.91	0.87	
Incremental Delay, d2	1.2	0.1		6.5	1.1		0.1	0.2		0.2	0.2	
Delay (s)	41.1	38.7		56.4	49.3		9.0	12.4		6.4	9.4	
Level of Service	D	D		E	D		A	B		A	A	
Approach Delay (s)		39.7			51.0			12.3			9.0	
Approach LOS		D			D			B			A	

Intersection Summary

HCM 2000 Control Delay	19.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.31		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	59.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Timings

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015

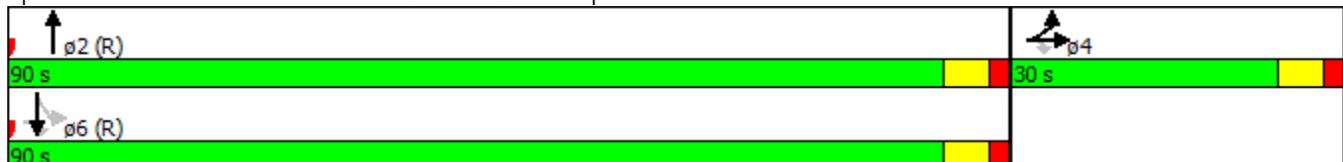


Lane Group	EBL	EBT	EBR	NBT	SBL	SBT
Lane Configurations						
Volume (vph)	650	320	412	1842	99	1285
Turn Type	Split	NA	custom	NA	Perm	NA
Protected Phases	4	4		2		6
Permitted Phases			4 6		6	
Detector Phase	4	4	4 6	2	6	6
Switch Phase						
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	22.0	22.0		22.0	22.0	22.0
Total Split (s)	30.0	30.0		90.0	90.0	90.0
Total Split (%)	25.0%	25.0%		75.0%	75.0%	75.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None		C-Max	C-Max	C-Max
Act Effect Green (s)	24.0	24.0	120.0	84.0	84.0	84.0
Actuated g/C Ratio	0.20	0.20	1.00	0.70	0.70	0.70
v/c Ratio	0.94	0.85	0.26	0.52	0.83	0.51
Control Delay	69.3	67.8	0.4	9.7	66.5	9.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	69.3	67.8	0.4	9.7	66.5	9.3
LOS	E	E	A	A	E	A
Approach Delay		48.4		9.7		13.4
Approach LOS		D		A		B

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 104 (87%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.94
 Intersection Signal Delay: 22.4
 Intersection Capacity Utilization 75.0%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service D

Splits and Phases: 4: Banwell Road & EC Row EB Offramp/Gouin Street



Queues

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015



Lane Group	EBL	EBT	EBR	NBT	SBL	SBT
Lane Group Flow (vph)	650	320	412	1857	99	1285
v/c Ratio	0.94	0.85	0.26	0.52	0.83	0.51
Control Delay	69.3	67.8	0.4	9.7	66.5	9.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	69.3	67.8	0.4	9.7	66.5	9.3
Queue Length 50th (m)	78.3	73.3	0.0	58.4	15.0	66.8
Queue Length 95th (m)	#112.3	#119.9	0.0	67.4	#25.8	81.1
Internal Link Dist (m)		204.2		84.3		81.0
Turn Bay Length (m)					80.0	
Base Capacity (vph)	694	376	1601	3596	119	2505
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.94	0.85	0.26	0.52	0.83	0.51

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↑	↖					↑↑↑		↖	↑↑	
Volume (vph)	650	320	412	0	0	0	0	1842	15	99	1285	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0					6.0		6.0	6.0	
Lane Util. Factor	0.97	1.00	1.00					0.91		1.00	0.95	
Frt	1.00	1.00	0.85					1.00		1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00		0.95	1.00	
Satd. Flow (prot)	3471	1883	1601					5136		1789	3579	
Flt Permitted	0.95	1.00	1.00					1.00		0.09	1.00	
Satd. Flow (perm)	3471	1883	1601					5136		169	3579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	650	320	412	0	0	0	0	1842	15	99	1285	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	1	0	0	0	0
Lane Group Flow (vph)	650	320	412	0	0	0	0	1856	0	99	1285	0
Turn Type	Split	NA	custom					NA		Perm	NA	
Protected Phases	4	4						2			6	
Permitted Phases			4 6							6		
Actuated Green, G (s)	24.0	24.0	120.0					84.0		84.0	84.0	
Effective Green, g (s)	24.0	24.0	120.0					84.0		84.0	84.0	
Actuated g/C Ratio	0.20	0.20	1.00					0.70		0.70	0.70	
Clearance Time (s)	6.0	6.0						6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0						3.0		3.0	3.0	
Lane Grp Cap (vph)	694	376	1601					3595		118	2505	
v/s Ratio Prot	c0.19	0.17						0.36			0.36	
v/s Ratio Perm			0.26							c0.59		
v/c Ratio	0.94	0.85	0.26					0.52		0.84	0.51	
Uniform Delay, d1	47.3	46.3	0.0					8.5		13.1	8.4	
Progression Factor	1.00	1.00	1.00					1.09		1.00	1.00	
Incremental Delay, d2	20.0	16.7	0.1					0.4		47.9	0.8	
Delay (s)	67.3	62.9	0.1					9.6		60.9	9.2	
Level of Service	E	E	A					A		E	A	
Approach Delay (s)		46.2			0.0			9.6			12.9	
Approach LOS		D			A			A			B	

Intersection Summary

HCM 2000 Control Delay	21.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	75.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Timings

5: Banwell Road & Maisonneuve St

8/4/2015

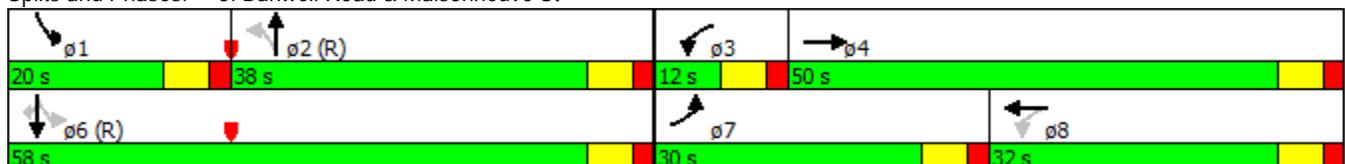


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations	↖↖	↗	↖	↗	↖	↑↑↑	↖	↑↑↑	↗
Volume (vph)	570	125	105	111	63	879	207	1046	403
Turn Type	Prot	NA	pm+pt	NA	Perm	NA	pm+pt	NA	Perm
Protected Phases	7	4	3	8		2	1	6	
Permitted Phases			8		2		6		6
Detector Phase	7	4	3	8	2	2	1	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	10.0	22.0	22.0	22.0	10.0	22.0	22.0
Total Split (s)	30.0	50.0	12.0	32.0	38.0	38.0	20.0	58.0	58.0
Total Split (%)	25.0%	41.7%	10.0%	26.7%	31.7%	31.7%	16.7%	48.3%	48.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	22.9	39.9	29.0	23.0	37.2	37.2	56.1	56.1	56.1
Actuated g/C Ratio	0.19	0.33	0.24	0.19	0.31	0.31	0.47	0.47	0.47
v/c Ratio	0.86	0.43	0.35	0.88	0.41	0.64	0.73	0.43	0.42
Control Delay	61.1	26.1	25.9	59.7	54.3	41.1	50.5	21.5	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.1	26.1	25.9	59.7	54.3	41.1	50.5	21.5	3.3
LOS	E	C	C	E	D	D	D	C	A
Approach Delay		50.0		51.8		41.8		20.7	
Approach LOS		D		D		D		C	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 75
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.88
 Intersection Signal Delay: 35.9
 Intersection LOS: D
 Intersection Capacity Utilization 87.7%
 ICU Level of Service E
 Analysis Period (min) 15

Splits and Phases: 5: Banwell Road & Maisonneuve St



Queues

5: Banwell Road & Maisonneuve St

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	570	262	105	343	63	1009	207	1046	403
v/c Ratio	0.86	0.43	0.35	0.88	0.41	0.64	0.73	0.43	0.42
Control Delay	61.1	26.1	25.9	59.7	54.3	41.1	50.5	21.5	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.1	26.1	25.9	59.7	54.3	41.1	50.5	21.5	3.3
Queue Length 50th (m)	66.8	36.1	13.8	60.5	7.9	44.1	36.2	50.6	0.1
Queue Length 95th (m)	#90.9	58.2	24.1	#104.1	m25.3	94.5	#64.1	60.7	17.3
Internal Link Dist (m)		533.0		108.9		442.9		249.5	
Turn Bay Length (m)			120.0		120.0		120.0		120.0
Base Capacity (vph)	694	669	304	429	152	1580	300	2405	963
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.39	0.35	0.80	0.41	0.64	0.69	0.43	0.42

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

5: Banwell Road & Maisonneuve St

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↗		↖↗	↗		↖↗	↑↑↑↗		↖	↑↑↑	↗
Volume (vph)	570	125	137	105	111	232	63	879	130	207	1046	403
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		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	0.91		1.00	0.91	1.00
Frt	1.00	0.92		1.00	0.90		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3471	1736		1789	1692		1789	5042		1789	5142	1601
Flt Permitted	0.95	1.00		0.60	1.00		0.26	1.00		0.14	1.00	1.00
Satd. Flow (perm)	3471	1736		1125	1692		493	5042		258	5142	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	570	125	137	105	111	232	63	879	130	207	1046	403
RTOR Reduction (vph)	0	35	0	0	65	0	0	15	0	0	0	215
Lane Group Flow (vph)	570	227	0	105	278	0	63	994	0	207	1046	188
Turn Type	Prot	NA		pm+pt	NA		Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8		2	2		1	6	
Permitted Phases				8			2			6		6
Actuated Green, G (s)	22.9	39.9		29.0	23.0		37.2	37.2		56.1	56.1	56.1
Effective Green, g (s)	22.9	39.9		29.0	23.0		37.2	37.2		56.1	56.1	56.1
Actuated g/C Ratio	0.19	0.33		0.24	0.19		0.31	0.31		0.47	0.47	0.47
Clearance Time (s)	6.0	6.0		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
Lane Grp Cap (vph)	662	577		305	324		152	1563		285	2403	748
v/s Ratio Prot	c0.16	0.13		0.02	c0.16			0.20		c0.08	0.20	
v/s Ratio Perm				0.07			0.13			c0.26		0.12
v/c Ratio	0.86	0.39		0.34	0.86		0.41	0.64		0.73	0.44	0.25
Uniform Delay, d1	47.0	30.8		36.7	46.9		32.8	35.6		22.4	21.4	19.3
Progression Factor	1.00	1.00		1.00	1.00		1.24	1.09		1.69	0.95	1.01
Incremental Delay, d2	11.1	0.4		0.7	19.6		6.9	1.7		8.1	0.5	0.7
Delay (s)	58.1	31.2		37.3	66.6		47.5	40.3		45.9	20.7	20.3
Level of Service	E	C		D	E		D	D		D	C	C
Approach Delay (s)		49.6			59.7			40.8			23.8	
Approach LOS		D			E			D			C	

Intersection Summary

HCM 2000 Control Delay	37.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	87.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Timings

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015



Lane Group	EBL	EBT	EBR	NBT	SBL	SBT
Lane Configurations						
Volume (vph)	382	80	166	1510	76	781
Turn Type	Split	NA	custom	NA	Perm	NA
Protected Phases	4	4		2		6
Permitted Phases			4 6		6	
Detector Phase	4	4	4 6	2	6	6
Switch Phase						
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	22.0	22.0		22.0	22.0	22.0
Total Split (s)	29.0	29.0		91.0	91.0	91.0
Total Split (%)	24.2%	24.2%		75.8%	75.8%	75.8%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None		C-Max	C-Max	C-Max
Act Effect Green (s)	19.1	19.1	120.0	88.9	88.9	88.9
Actuated g/C Ratio	0.16	0.16	1.00	0.74	0.74	0.74
v/c Ratio	0.69	0.27	0.10	0.40	0.38	0.29
Control Delay	54.2	45.5	0.1	4.2	12.9	5.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.2	45.5	0.1	4.2	12.9	5.8
LOS	D	D	A	A	B	A
Approach Delay		38.8		4.2		6.4
Approach LOS		D		A		A

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 102 (85%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.69
 Intersection Signal Delay: 12.1
 Intersection LOS: B
 Intersection Capacity Utilization 56.9%
 ICU Level of Service B
 Analysis Period (min) 15

Splits and Phases: 4: Banwell Road & EC Row EB Offramp/Gouin Street



Queues

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015



Lane Group	EBL	EBT	EBR	NBT	SBL	SBT
Lane Group Flow (vph)	382	80	166	1515	76	781
v/c Ratio	0.69	0.27	0.10	0.40	0.38	0.29
Control Delay	54.2	45.5	0.1	4.2	12.9	5.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.2	45.5	0.1	4.2	12.9	5.8
Queue Length 50th (m)	44.2	16.7	0.0	26.4	5.6	28.1
Queue Length 95th (m)	58.1	30.2	0.0	31.2	17.6	40.4
Internal Link Dist (m)		204.2		84.3		81.0
Turn Bay Length (m)						
Base Capacity (vph)	665	360	1580	3809	202	2651
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.22	0.11	0.40	0.38	0.29

Intersection Summary

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	382	80	166	0	0	0	0	1510	5	76	781	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0					6.0		6.0	6.0	
Lane Util. Factor	0.97	1.00	1.00					0.91		1.00	0.95	
Frt	1.00	1.00	0.85					1.00		1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00		0.95	1.00	
Satd. Flow (prot)	3471	1883	1601					5139		1789	3579	
Flt Permitted	0.95	1.00	1.00					1.00		0.15	1.00	
Satd. Flow (perm)	3471	1883	1601					5139		274	3579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	382	80	166	0	0	0	0	1510	5	76	781	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	382	80	166	0	0	0	0	1515	0	76	781	0
Turn Type	Split	NA	custom					NA		Perm	NA	
Protected Phases	4	4						2			6	
Permitted Phases			4 6							6		
Actuated Green, G (s)	19.1	19.1	120.0					88.9		88.9	88.9	
Effective Green, g (s)	19.1	19.1	120.0					88.9		88.9	88.9	
Actuated g/C Ratio	0.16	0.16	1.00					0.74		0.74	0.74	
Clearance Time (s)	6.0	6.0						6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0						3.0		3.0	3.0	
Lane Grp Cap (vph)	552	299	1601					3807		202	2651	
v/s Ratio Prot	c0.11	0.04						c0.29			0.22	
v/s Ratio Perm			0.10							0.28		
v/c Ratio	0.69	0.27	0.10					0.40		0.38	0.29	
Uniform Delay, d1	47.7	44.3	0.0					5.7		5.6	5.2	
Progression Factor	1.00	1.00	1.00					0.65		1.00	1.00	
Incremental Delay, d2	3.7	0.5	0.0					0.3		5.3	0.3	
Delay (s)	51.4	44.8	0.0					4.0		10.9	5.4	
Level of Service	D	D	A					A		B	A	
Approach Delay (s)		37.0			0.0			4.0			5.9	
Approach LOS		D			A			A			A	

Intersection Summary

HCM 2000 Control Delay	11.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	56.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Timings

5: Banwell Road & Maisonneuve St

8/4/2015

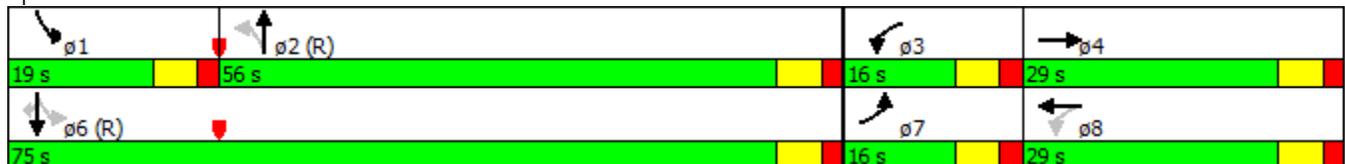


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations	↖↖	↗	↖	↗	↖	↖↖↗	↖	↖↖↖	↗
Volume (vph)	79	20	65	48	81	939	75	491	250
Turn Type	Prot	NA	pm+pt	NA	Perm	NA	pm+pt	NA	Perm
Protected Phases	7	4	3	8		2	1	6	
Permitted Phases			8		2		6		6
Detector Phase	7	4	3	8	2	2	1	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	10.0	22.0	22.0	22.0	10.0	22.0	22.0
Total Split (s)	16.0	29.0	16.0	29.0	56.0	56.0	19.0	75.0	75.0
Total Split (%)	13.3%	24.2%	13.3%	24.2%	46.7%	46.7%	15.8%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	8.1	9.6	18.9	10.4	75.1	75.1	86.0	86.0	86.0
Actuated g/C Ratio	0.07	0.08	0.16	0.09	0.63	0.63	0.72	0.72	0.72
v/c Ratio	0.34	0.19	0.28	0.63	0.15	0.30	0.19	0.13	0.21
Control Delay	57.0	40.2	40.9	41.0	9.5	8.3	7.8	6.3	1.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.0	40.2	40.9	41.0	9.5	8.3	7.8	6.3	1.3
LOS	E	D	D	D	A	A	A	A	A
Approach Delay		52.5		41.0		8.4		4.9	
Approach LOS		D		D		A		A	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 65
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.63
 Intersection Signal Delay: 12.2
 Intersection LOS: B
 Intersection Capacity Utilization 53.8%
 ICU Level of Service A
 Analysis Period (min) 15

Splits and Phases: 5: Banwell Road & Maisonneuve St



Queues

5: Banwell Road & Maisonneuve St

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	79	29	65	129	81	969	75	491	250
v/c Ratio	0.34	0.19	0.28	0.63	0.15	0.30	0.19	0.13	0.21
Control Delay	57.0	40.2	40.9	41.0	9.5	8.3	7.8	6.3	1.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.0	40.2	40.9	41.0	9.5	8.3	7.8	6.3	1.3
Queue Length 50th (m)	9.3	4.5	12.8	15.0	5.1	23.0	5.0	12.7	0.0
Queue Length 95th (m)	16.8	13.1	23.1	33.3	11.6	32.9	11.7	19.4	7.9
Internal Link Dist (m)		533.0		108.9		442.9		249.5	
Turn Bay Length (m)			120.0		120.0		120.0		120.0
Base Capacity (vph)	289	351	247	377	545	3203	468	3683	1217
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.08	0.26	0.34	0.15	0.30	0.16	0.13	0.21

Intersection Summary

HCM Signalized Intersection Capacity Analysis

5: Banwell Road & Maisonneuve St

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	79	20	9	65	48	81	81	939	30	75	491	250
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		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	0.91		1.00	0.91	1.00
Frt	1.00	0.95		1.00	0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3471	1796		1789	1706		1789	5118		1789	5142	1601
Flt Permitted	0.95	1.00		0.54	1.00		0.46	1.00		0.24	1.00	1.00
Satd. Flow (perm)	3471	1796		1016	1706		872	5118		452	5142	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	79	20	9	65	48	81	81	939	30	75	491	250
RTOR Reduction (vph)	0	8	0	0	57	0	0	2	0	0	0	76
Lane Group Flow (vph)	79	21	0	65	72	0	81	967	0	75	491	174
Turn Type	Prot	NA		pm+pt	NA		Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8		2	2		1	6	
Permitted Phases				8			2			6		6
Actuated Green, G (s)	6.9	8.4		21.5	11.5		71.5	71.5		83.6	83.6	83.6
Effective Green, g (s)	6.9	8.4		21.5	11.5		71.5	71.5		83.6	83.6	83.6
Actuated g/C Ratio	0.06	0.07		0.18	0.10		0.60	0.60		0.70	0.70	0.70
Clearance Time (s)	6.0	6.0		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
Lane Grp Cap (vph)	199	125		246	163		519	3049		382	3582	1115
v/s Ratio Prot	c0.02	0.01		0.02	c0.04			c0.19		0.01	0.10	
v/s Ratio Perm				0.03			0.09			0.13		c0.11
v/c Ratio	0.40	0.17		0.26	0.44		0.16	0.32		0.20	0.14	0.16
Uniform Delay, d1	54.5	52.5		42.0	51.2		10.8	12.1		6.5	6.1	6.2
Progression Factor	1.00	1.00		1.00	1.00		0.67	0.65		1.00	0.99	0.96
Incremental Delay, d2	1.3	0.6		0.6	1.9		0.6	0.3		0.2	0.1	0.3
Delay (s)	55.8	53.1		42.6	53.1		7.9	8.1		6.7	6.1	6.2
Level of Service	E	D		D	D		A	A		A	A	A
Approach Delay (s)		55.1			49.6			8.1			6.2	
Approach LOS		E			D			A			A	

Intersection Summary

HCM 2000 Control Delay	13.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	53.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Timings

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015

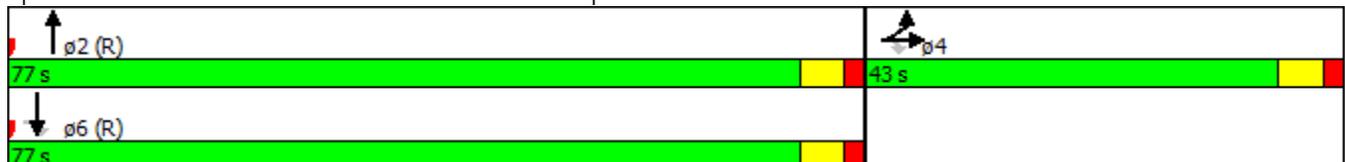


Lane Group	EBL	EBT	EBR	NBT	SBT
Lane Configurations	↖↗	↑	↖	↑↑↑	↑↑
Volume (vph)	650	320	412	1842	1384
Turn Type	Split	NA	custom	NA	NA
Protected Phases	4	4		2	6
Permitted Phases			4 6		
Detector Phase	4	4	4 6	2	6
Switch Phase					
Minimum Initial (s)	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0		22.0	22.0
Total Split (s)	43.0	43.0		77.0	77.0
Total Split (%)	35.8%	35.8%		64.2%	64.2%
Yellow Time (s)	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None		C-Max	C-Max
Act Effect Green (s)	33.0	33.0	120.0	75.0	75.0
Actuated g/C Ratio	0.28	0.28	1.00	0.62	0.62
v/c Ratio	0.68	0.62	0.26	0.58	0.62
Control Delay	42.4	43.1	0.4	15.6	15.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	42.4	43.1	0.4	15.6	15.9
LOS	D	D	A	B	B
Approach Delay		30.0		15.6	15.9
Approach LOS		C		B	B

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 104 (87%), Referenced to phase 2:NBT and 6:SBT, Start of Green
 Natural Cycle: 55
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.68
 Intersection Signal Delay: 20.0
 Intersection LOS: C
 Intersection Capacity Utilization 73.8%
 ICU Level of Service D
 Analysis Period (min) 15

Splits and Phases: 4: Banwell Road & EC Row EB Offramp/Gouin Street



Queues

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015



Lane Group	EBL	EBT	EBR	NBT	SBT
Lane Group Flow (vph)	650	320	412	1857	1384
v/c Ratio	0.68	0.62	0.26	0.58	0.62
Control Delay	42.4	43.1	0.4	15.6	15.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	42.4	43.1	0.4	15.6	15.9
Queue Length 50th (m)	68.9	64.5	0.0	81.1	102.4
Queue Length 95th (m)	85.9	91.4	0.0	89.5	130.3
Internal Link Dist (m)		204.2		84.3	81.0
Turn Bay Length (m)					
Base Capacity (vph)	1070	580	1591	3212	2237
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.61	0.55	0.26	0.58	0.62

Intersection Summary

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↑	↖					↑↑↑			↑↑	
Volume (vph)	650	320	412	0	0	0	0	1842	15	0	1384	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0					6.0			6.0	
Lane Util. Factor	0.97	1.00	1.00					0.91			0.95	
Frt	1.00	1.00	0.85					1.00			1.00	
Flt Protected	0.95	1.00	1.00					1.00			1.00	
Satd. Flow (prot)	3471	1883	1601					5136			3579	
Flt Permitted	0.95	1.00	1.00					1.00			1.00	
Satd. Flow (perm)	3471	1883	1601					5136			3579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	650	320	412	0	0	0	0	1842	15	0	1384	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	1	0	0	0	0
Lane Group Flow (vph)	650	320	412	0	0	0	0	1856	0	0	1384	0
Turn Type	Split	NA	custom					NA			NA	
Protected Phases	4	4						2			6	
Permitted Phases			4 6									
Actuated Green, G (s)	33.0	33.0	120.0					75.0			75.0	
Effective Green, g (s)	33.0	33.0	120.0					75.0			75.0	
Actuated g/C Ratio	0.28	0.28	1.00					0.62			0.62	
Clearance Time (s)	6.0	6.0						6.0			6.0	
Vehicle Extension (s)	3.0	3.0						3.0			3.0	
Lane Grp Cap (vph)	954	517	1601					3210			2236	
v/s Ratio Prot	c0.19	0.17						0.36			c0.39	
v/s Ratio Perm			0.26									
v/c Ratio	0.68	0.62	0.26					0.58			0.62	
Uniform Delay, d1	38.8	38.0	0.0					13.2			13.8	
Progression Factor	1.00	1.00	1.00					1.09			1.00	
Incremental Delay, d2	2.0	2.2	0.1					0.6			1.3	
Delay (s)	40.8	40.2	0.1					14.9			15.1	
Level of Service	D	D	A					B			B	
Approach Delay (s)		28.5			0.0			14.9			15.1	
Approach LOS		C			A			B			B	

Intersection Summary		
HCM 2000 Control Delay	19.0	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.64	B
Actuated Cycle Length (s)	120.0	Sum of lost time (s)
Intersection Capacity Utilization	73.8%	12.0
Analysis Period (min)	15	ICU Level of Service
c Critical Lane Group		D

Timings

5: Banwell Road & Maisonneuve St

8/4/2015

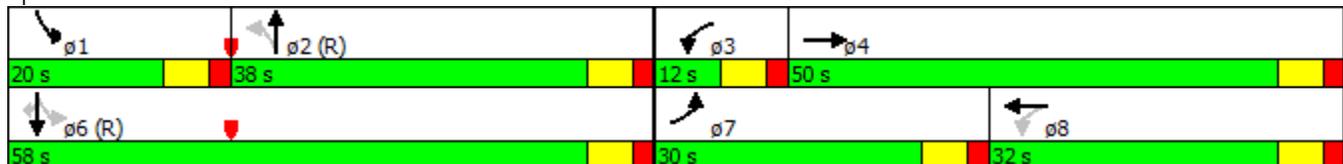


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations	↖↖	↗	↖	↗	↖	↑↑↑	↖	↑↑↑	↗
Volume (vph)	570	125	105	111	63	879	207	1046	403
Turn Type	Prot	NA	pm+pt	NA	Perm	NA	pm+pt	NA	Perm
Protected Phases	7	4	3	8		2	1	6	
Permitted Phases			8		2		6		6
Detector Phase	7	4	3	8	2	2	1	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	10.0	22.0	22.0	22.0	10.0	22.0	22.0
Total Split (s)	30.0	50.0	12.0	32.0	38.0	38.0	20.0	58.0	58.0
Total Split (%)	25.0%	41.7%	10.0%	26.7%	31.7%	31.7%	16.7%	48.3%	48.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	22.9	39.9	29.0	23.0	37.2	37.2	56.1	56.1	56.1
Actuated g/C Ratio	0.19	0.33	0.24	0.19	0.31	0.31	0.47	0.47	0.47
v/c Ratio	0.86	0.43	0.35	0.88	0.41	0.64	0.73	0.43	0.42
Control Delay	61.1	26.1	25.9	59.7	54.3	41.1	52.6	23.2	5.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.1	26.1	25.9	59.7	54.3	41.1	52.6	23.2	5.9
LOS	E	C	C	E	D	D	D	C	A
Approach Delay		50.0		51.8		41.8		22.6	
Approach LOS		D		D		D		C	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 75
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.88
 Intersection Signal Delay: 36.7
 Intersection LOS: D
 Intersection Capacity Utilization 87.7%
 ICU Level of Service E
 Analysis Period (min) 15

Splits and Phases: 5: Banwell Road & Maisonneuve St



Queues

5: Banwell Road & Maisonneuve St

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	570	262	105	343	63	1009	207	1046	403
v/c Ratio	0.86	0.43	0.35	0.88	0.41	0.64	0.73	0.43	0.42
Control Delay	61.1	26.1	25.9	59.7	54.3	41.1	52.6	23.2	5.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.1	26.1	25.9	59.7	54.3	41.1	52.6	23.2	5.9
Queue Length 50th (m)	66.8	36.1	13.8	60.5	7.9	44.1	35.4	44.2	2.3
Queue Length 95th (m)	#90.9	58.2	24.1	#104.1	m25.3	94.5	#64.3	63.5	29.3
Internal Link Dist (m)		533.0		108.9		442.9		249.5	
Turn Bay Length (m)			120.0		120.0		120.0		120.0
Base Capacity (vph)	694	669	304	429	152	1580	300	2405	963
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.39	0.35	0.80	0.41	0.64	0.69	0.43	0.42

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

5: Banwell Road & Maisonneuve St

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↔		↔	↔		↔	↑↑↑↔		↔	↑↑↑	↔
Volume (vph)	570	125	137	105	111	232	63	879	130	207	1046	403
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		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	0.91		1.00	0.91	1.00
Frt	1.00	0.92		1.00	0.90		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3471	1736		1789	1692		1789	5042		1789	5142	1601
Flt Permitted	0.95	1.00		0.60	1.00		0.26	1.00		0.14	1.00	1.00
Satd. Flow (perm)	3471	1736		1125	1692		493	5042		258	5142	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	570	125	137	105	111	232	63	879	130	207	1046	403
RTOR Reduction (vph)	0	35	0	0	65	0	0	15	0	0	0	215
Lane Group Flow (vph)	570	227	0	105	278	0	63	994	0	207	1046	188
Turn Type	Prot	NA		pm+pt	NA		Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8		2	2		1	6	
Permitted Phases				8			2			6		6
Actuated Green, G (s)	22.9	39.9		29.0	23.0		37.2	37.2		56.1	56.1	56.1
Effective Green, g (s)	22.9	39.9		29.0	23.0		37.2	37.2		56.1	56.1	56.1
Actuated g/C Ratio	0.19	0.33		0.24	0.19		0.31	0.31		0.47	0.47	0.47
Clearance Time (s)	6.0	6.0		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
Lane Grp Cap (vph)	662	577		305	324		152	1563		285	2403	748
v/s Ratio Prot	c0.16	0.13		0.02	c0.16			0.20		c0.08	0.20	
v/s Ratio Perm				0.07			0.13			c0.26		0.12
v/c Ratio	0.86	0.39		0.34	0.86		0.41	0.64		0.73	0.44	0.25
Uniform Delay, d1	47.0	30.8		36.7	46.9		32.8	35.6		22.4	21.4	19.3
Progression Factor	1.00	1.00		1.00	1.00		1.24	1.09		1.82	1.02	2.25
Incremental Delay, d2	11.1	0.4		0.7	19.6		6.9	1.7		7.7	0.5	0.7
Delay (s)	58.1	31.2		37.3	66.6		47.5	40.3		48.4	22.3	44.0
Level of Service	E	C		D	E		D	D		D	C	D
Approach Delay (s)		49.6			59.7			40.8			30.9	
Approach LOS		D			E			D			C	

Intersection Summary

HCM 2000 Control Delay	40.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	87.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Timings

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015



Lane Group	EBL	EBT	EBR	NBT	SBT
Lane Configurations					
Volume (vph)	382	80	166	1510	860
Turn Type	Split	NA	custom	NA	NA
Protected Phases	4	4		2	6
Permitted Phases			4 6		
Detector Phase	4	4	4 6	2	6
Switch Phase					
Minimum Initial (s)	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0		22.0	22.0
Total Split (s)	40.0	40.0		80.0	80.0
Total Split (%)	33.3%	33.3%		66.7%	66.7%
Yellow Time (s)	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None		C-Max	C-Max
Act Effect Green (s)	19.9	19.9	120.0	88.1	88.1
Actuated g/C Ratio	0.17	0.17	1.00	0.73	0.73
v/c Ratio	0.66	0.26	0.10	0.40	0.33
Control Delay	52.2	44.1	0.1	5.0	6.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	52.2	44.1	0.1	5.0	6.4
LOS	D	D	A	A	A
Approach Delay		37.4		5.0	6.4
Approach LOS		D		A	A

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 102 (85%), Referenced to phase 2:NBT and 6:SBT, Start of Green
 Natural Cycle: 45
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.66
 Intersection Signal Delay: 12.2
 Intersection Capacity Utilization 50.2%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service A

Splits and Phases: 4: Banwell Road & EC Row EB Offramp/Gouin Street



Queues

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015



Lane Group	EBL	EBT	EBR	NBT	SBT
Lane Group Flow (vph)	382	80	166	1515	860
v/c Ratio	0.66	0.26	0.10	0.40	0.33
Control Delay	52.2	44.1	0.1	5.0	6.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	52.2	44.1	0.1	5.0	6.4
Queue Length 50th (m)	44.2	16.7	0.0	30.6	31.9
Queue Length 95th (m)	55.8	29.0	0.0	37.6	51.2
Internal Link Dist (m)		204.2		84.3	81.0
Turn Bay Length (m)					
Base Capacity (vph)	983	533	1601	3775	2627
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.39	0.15	0.10	0.40	0.33

Intersection Summary

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row EB Offramp/Gouin Street

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↑	↖					↑↑↑			↑↑	
Volume (vph)	382	80	166	0	0	0	0	1510	5	0	860	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0					6.0			6.0	
Lane Util. Factor	0.97	1.00	1.00					0.91			0.95	
Frt	1.00	1.00	0.85					1.00			1.00	
Flt Protected	0.95	1.00	1.00					1.00			1.00	
Satd. Flow (prot)	3471	1883	1601					5139			3579	
Flt Permitted	0.95	1.00	1.00					1.00			1.00	
Satd. Flow (perm)	3471	1883	1601					5139			3579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	382	80	166	0	0	0	0	1510	5	0	860	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	382	80	166	0	0	0	0	1515	0	0	860	0
Turn Type	Split	NA	custom					NA			NA	
Protected Phases	4	4						2			6	
Permitted Phases			4 6									
Actuated Green, G (s)	19.9	19.9	120.0					88.1			88.1	
Effective Green, g (s)	19.9	19.9	120.0					88.1			88.1	
Actuated g/C Ratio	0.17	0.17	1.00					0.73			0.73	
Clearance Time (s)	6.0	6.0						6.0			6.0	
Vehicle Extension (s)	3.0	3.0						3.0			3.0	
Lane Grp Cap (vph)	575	312	1601					3772			2627	
v/s Ratio Prot	c0.11	0.04						c0.29			0.24	
v/s Ratio Perm			0.10									
v/c Ratio	0.66	0.26	0.10					0.40			0.33	
Uniform Delay, d1	46.9	43.6	0.0					6.0			5.6	
Progression Factor	1.00	1.00	1.00					0.73			1.00	
Incremental Delay, d2	2.9	0.4	0.0					0.3			0.3	
Delay (s)	49.8	44.0	0.0					4.7			5.9	
Level of Service	D	D	A					A			A	
Approach Delay (s)		35.9			0.0			4.7			5.9	
Approach LOS		D			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	11.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	50.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Timings

5: Banwell Road & Maisonneuve St

8/4/2015

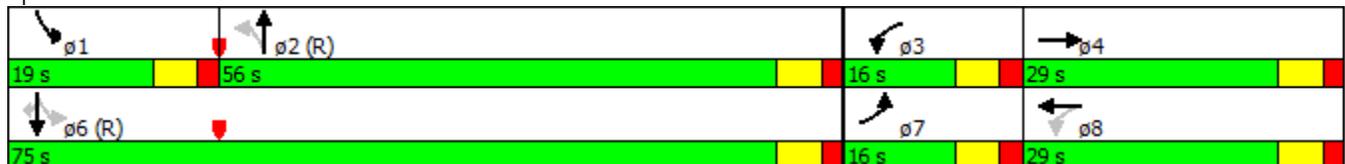


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations	↖↖	↗	↖	↗	↖	↑↑↑	↖	↑↑↑	↗
Volume (vph)	79	20	65	48	81	939	75	491	250
Turn Type	Prot	NA	pm+pt	NA	Perm	NA	pm+pt	NA	Perm
Protected Phases	7	4	3	8		2	1	6	
Permitted Phases			8		2		6		6
Detector Phase	7	4	3	8	2	2	1	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	10.0	22.0	22.0	22.0	10.0	22.0	22.0
Total Split (s)	16.0	29.0	16.0	29.0	56.0	56.0	19.0	75.0	75.0
Total Split (%)	13.3%	24.2%	13.3%	24.2%	46.7%	46.7%	15.8%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	8.1	9.6	18.9	10.4	75.1	75.1	86.0	86.0	86.0
Actuated g/C Ratio	0.07	0.08	0.16	0.09	0.63	0.63	0.72	0.72	0.72
v/c Ratio	0.34	0.19	0.28	0.63	0.15	0.30	0.19	0.13	0.21
Control Delay	57.0	40.2	40.9	41.0	9.5	8.3	7.2	5.8	1.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.0	40.2	40.9	41.0	9.5	8.3	7.2	5.8	1.0
LOS	E	D	D	D	A	A	A	A	A
Approach Delay		52.5		41.0		8.4		4.4	
Approach LOS		D		D		A		A	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 65
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.63
 Intersection Signal Delay: 12.0
 Intersection LOS: B
 Intersection Capacity Utilization 53.8%
 ICU Level of Service A
 Analysis Period (min) 15

Splits and Phases: 5: Banwell Road & Maisonneuve St



Queues

5: Banwell Road & Maisonneuve St

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	79	29	65	129	81	969	75	491	250
v/c Ratio	0.34	0.19	0.28	0.63	0.15	0.30	0.19	0.13	0.21
Control Delay	57.0	40.2	40.9	41.0	9.5	8.3	7.2	5.8	1.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.0	40.2	40.9	41.0	9.5	8.3	7.2	5.8	1.0
Queue Length 50th (m)	9.3	4.5	12.8	15.0	5.1	23.0	4.6	11.2	0.0
Queue Length 95th (m)	16.8	13.1	23.1	33.3	11.6	32.9	9.0	14.9	5.3
Internal Link Dist (m)		533.0		108.9		442.9		249.5	
Turn Bay Length (m)			120.0		120.0		120.0		120.0
Base Capacity (vph)	289	351	247	377	545	3203	468	3683	1217
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.08	0.26	0.34	0.15	0.30	0.16	0.13	0.21

Intersection Summary

HCM Signalized Intersection Capacity Analysis

5: Banwell Road & Maisonneuve St

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↖		↖	↖		↖	↑↑↑		↖	↑↑↑	↖
Volume (vph)	79	20	9	65	48	81	81	939	30	75	491	250
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		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	0.91		1.00	0.91	1.00
Frt	1.00	0.95		1.00	0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3471	1796		1789	1706		1789	5118		1789	5142	1601
Flt Permitted	0.95	1.00		0.54	1.00		0.46	1.00		0.24	1.00	1.00
Satd. Flow (perm)	3471	1796		1016	1706		872	5118		452	5142	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	79	20	9	65	48	81	81	939	30	75	491	250
RTOR Reduction (vph)	0	8	0	0	57	0	0	2	0	0	0	76
Lane Group Flow (vph)	79	21	0	65	72	0	81	967	0	75	491	174
Turn Type	Prot	NA		pm+pt	NA		Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8		2	2		1	6	6
Permitted Phases				8			2			6		6
Actuated Green, G (s)	6.9	8.4		21.5	11.5		71.5	71.5		83.6	83.6	83.6
Effective Green, g (s)	6.9	8.4		21.5	11.5		71.5	71.5		83.6	83.6	83.6
Actuated g/C Ratio	0.06	0.07		0.18	0.10		0.60	0.60		0.70	0.70	0.70
Clearance Time (s)	6.0	6.0		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
Lane Grp Cap (vph)	199	125		246	163		519	3049		382	3582	1115
v/s Ratio Prot	c0.02	0.01		0.02	c0.04			c0.19		0.01	0.10	
v/s Ratio Perm				0.03			0.09			0.13		c0.11
v/c Ratio	0.40	0.17		0.26	0.44		0.16	0.32		0.20	0.14	0.16
Uniform Delay, d1	54.5	52.5		42.0	51.2		10.8	12.1		6.5	6.1	6.2
Progression Factor	1.00	1.00		1.00	1.00		0.67	0.65		0.92	0.90	0.63
Incremental Delay, d2	1.3	0.6		0.6	1.9		0.6	0.3		0.2	0.1	0.3
Delay (s)	55.8	53.1		42.6	53.1		7.9	8.1		6.2	5.6	4.2
Level of Service	E	D		D	D		A	A		A	A	A
Approach Delay (s)		55.1			49.6			8.1			5.2	
Approach LOS		E			D			A			A	

Intersection Summary

HCM 2000 Control Delay	13.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	53.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Appendix E – Interim Conditions Synchro Outputs

Timings

1: Banwell Road & Tecumseh Road

8/4/2015

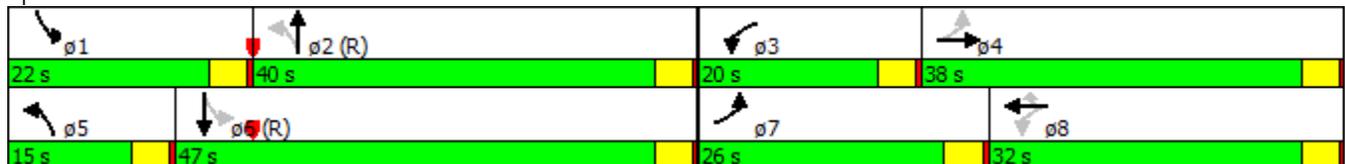


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↖	↕↕↕	↖	↕↕	↖	↖	↕↕	↖	↕↕
Volume (vph)	259	926	167	554	148	163	607	195	414
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0	5.0
Minimum Split (s)	8.0	20.0	9.0	20.0	20.0	8.0	20.0	8.0	20.0
Total Split (s)	26.0	38.0	20.0	32.0	32.0	15.0	40.0	22.0	47.0
Total Split (%)	21.7%	31.7%	16.7%	26.7%	26.7%	12.5%	33.3%	18.3%	39.2%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	C-Max	None	C-Max
Act Effct Green (s)	48.8	32.3	40.4	27.7	27.7	56.3	46.2	61.2	49.0
Actuated g/C Ratio	0.41	0.27	0.34	0.23	0.23	0.47	0.38	0.51	0.41
v/c Ratio	0.73	0.77	0.67	0.67	0.30	0.34	0.56	0.55	0.31
Control Delay	36.7	43.7	38.5	46.3	6.8	9.5	20.0	22.4	25.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.7	43.7	38.5	46.3	6.8	9.5	20.0	22.4	25.6
LOS	D	D	D	D	A	A	B	C	C
Approach Delay		42.3		38.1			18.1		24.6
Approach LOS		D		D			B		C

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 31 (26%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.77
 Intersection Signal Delay: 32.4
 Intersection LOS: C
 Intersection Capacity Utilization 75.6%
 ICU Level of Service D
 Analysis Period (min) 15

Splits and Phases: 1: Banwell Road & Tecumseh Road



Queues

1: Banwell Road & Tecumseh Road

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	259	1059	167	554	148	163	752	195	448
v/c Ratio	0.73	0.77	0.67	0.67	0.30	0.34	0.56	0.55	0.31
Control Delay	36.7	43.7	38.5	46.3	6.8	9.5	20.0	22.4	25.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.7	43.7	38.5	46.3	6.8	9.5	20.0	22.4	25.6
Queue Length 50th (m)	40.7	81.4	24.8	61.8	0.0	10.4	75.1	24.2	37.7
Queue Length 95th (m)	57.9	97.3	42.4	81.5	14.7	13.0	114.0	40.8	53.3
Internal Link Dist (m)		438.6		520.2			80.5		113.8
Turn Bay Length (m)	80.0		75.0		70.0	50.0		80.0	
Base Capacity (vph)	410	1460	301	859	502	491	1353	423	1448
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.63	0.73	0.55	0.64	0.29	0.33	0.56	0.46	0.31

Intersection Summary

HCM Signalized Intersection Capacity Analysis

1: Banwell Road & Tecumseh Road

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↑↑↑		↖	↑↑	↗	↖	↑↑		↖	↑↑	
Volume (vph)	259	926	133	167	554	148	163	607	145	195	414	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	5045		1789	3579	1601	1789	3475		1789	3538	
Flt Permitted	0.20	1.00		0.14	1.00	1.00	0.45	1.00		0.22	1.00	
Satd. Flow (perm)	368	5045		271	3579	1601	848	3475		415	3538	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	259	926	133	167	554	148	163	607	145	195	414	34
RTOR Reduction (vph)	0	16	0	0	0	114	0	15	0	0	5	0
Lane Group Flow (vph)	259	1043	0	167	554	34	163	737	0	195	443	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	49.0	32.3		40.5	27.8	27.8	56.3	46.2		61.7	48.9	
Effective Green, g (s)	49.0	32.3		40.5	27.8	27.8	56.3	46.2		61.7	48.9	
Actuated g/C Ratio	0.41	0.27		0.34	0.23	0.23	0.47	0.39		0.51	0.41	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	353	1357		252	829	370	477	1337		359	1441	
v/s Ratio Prot	c0.10	c0.21		0.07	0.15		0.03	0.21		c0.06	0.13	
v/s Ratio Perm	0.19			0.15		0.02	0.13			c0.22		
v/c Ratio	0.73	0.77		0.66	0.67	0.09	0.34	0.55		0.54	0.31	
Uniform Delay, d1	26.5	40.4		30.4	41.9	36.2	18.7	28.8		18.1	24.1	
Progression Factor	1.00	1.00		1.00	1.00	1.00	0.46	0.62		1.00	1.00	
Incremental Delay, d2	7.7	2.7		6.4	2.1	0.1	0.4	1.6		1.7	0.6	
Delay (s)	34.2	43.1		36.8	44.0	36.3	9.0	19.3		19.8	24.6	
Level of Service	C	D		D	D	D	A	B		B	C	
Approach Delay (s)		41.3			41.3			17.5			23.2	
Approach LOS		D			D			B			C	

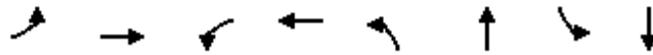
Intersection Summary

HCM 2000 Control Delay	32.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	75.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

2: Banwell Road & Palmetto Road

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	21	50	2	32	30	959	15	1027
v/c Ratio	0.32	0.17	0.02	0.28	0.09	0.36	0.04	0.39
Control Delay	51.6	18.8	52.5	40.2	11.7	10.2	11.9	9.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.6	18.8	52.5	40.2	11.7	10.2	11.9	9.8
Queue Length 50th (m)	4.5	3.7	0.5	3.9	2.8	59.3	0.7	28.7
Queue Length 95th (m)	10.7	12.3	3.1	13.8	9.3	81.4	m4.7	97.8
Internal Link Dist (m)		314.9		214.8		349.0		247.8
Turn Bay Length (m)							120.0	
Base Capacity (vph)	129	533	238	246	341	2651	371	2646
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.09	0.01	0.13	0.09	0.36	0.04	0.39

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

2: Banwell Road & Palmetto Road

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↕		↖	↗	
Volume (vph)	21	18	32	2	17	15	30	954	5	15	1007	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.90		1.00	0.93		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1703		1789	1751		1789	3576		1789	3568	
Flt Permitted	0.23	1.00		0.95	1.00		0.24	1.00		0.27	1.00	
Satd. Flow (perm)	431	1703		1789	1751		460	3576		501	3568	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	21	18	32	2	17	15	30	954	5	15	1007	20
RTOR Reduction (vph)	0	27	0	0	14	0	0	0	0	0	1	0
Lane Group Flow (vph)	21	23	0	2	18	0	30	959	0	15	1026	0
Turn Type	Perm	NA		Split	NA		Perm	NA		Perm	NA	
Protected Phases		4		8	8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)	17.5	17.5		4.7	4.7		85.8	85.8		85.8	85.8	
Effective Green, g (s)	17.5	17.5		4.7	4.7		85.8	85.8		85.8	85.8	
Actuated g/C Ratio	0.15	0.15		0.04	0.04		0.71	0.71		0.71	0.71	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	62	248		70	68		328	2556		358	2551	
v/s Ratio Prot		0.01		0.00	c0.01			0.27			c0.29	
v/s Ratio Perm	c0.05						0.07			0.03		
v/c Ratio	0.34	0.09		0.03	0.26		0.09	0.38		0.04	0.40	
Uniform Delay, d1	46.1	44.4		55.5	56.0		5.2	6.7		5.0	6.8	
Progression Factor	1.00	1.00		1.00	1.00		1.06	1.07		1.10	0.99	
Incremental Delay, d2	3.2	0.2		0.2	2.0		0.5	0.4		0.2	0.5	
Delay (s)	49.3	44.5		55.6	58.0		6.0	7.5		5.8	7.3	
Level of Service	D	D		E	E		A	A		A	A	
Approach Delay (s)		45.9			57.8			7.5			7.2	
Approach LOS		D			E			A			A	

Intersection Summary

HCM 2000 Control Delay	9.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	43.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Timings

3: Banwell Road & Wildwood Drive/Mulberry Road

8/4/2015

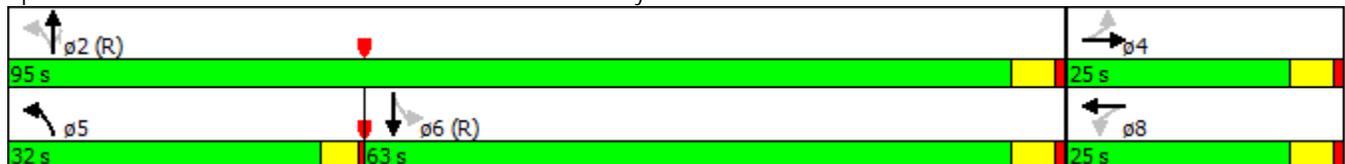


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↑↑	↗	↖	↑↑
Volume (vph)	86	22	48	18	265	1188	101	20	906
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	Perm	NA
Protected Phases		4		8	5	2			6
Permitted Phases	4		8		2		2	6	
Detector Phase	4	4	8	8	5	2	2	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	21.0	21.0	21.0	21.0	8.0	21.0	21.0	21.0	21.0
Total Split (s)	25.0	25.0	25.0	25.0	32.0	95.0	95.0	63.0	63.0
Total Split (%)	20.8%	20.8%	20.8%	20.8%	26.7%	79.2%	79.2%	52.5%	52.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.5	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	0.5	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0	5.0
Lead/Lag					Lead			Lag	Lag
Lead-Lag Optimize?					Yes			Yes	Yes
Recall Mode	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	12.7	12.7	12.7	12.7	98.3	97.3	97.3	83.5	83.5
Actuated g/C Ratio	0.11	0.11	0.11	0.11	0.82	0.81	0.81	0.70	0.70
v/c Ratio	0.59	0.47	0.46	0.11	0.53	0.41	0.08	0.06	0.39
Control Delay	66.0	19.2	63.4	41.2	15.3	8.6	3.7	4.0	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.0	19.2	63.4	41.2	15.3	8.6	3.7	4.0	3.6
LOS	E	B	E	D	B	A	A	A	A
Approach Delay		38.5		56.4		9.4			3.6
Approach LOS		D		E		A			A

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 17 (14%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.59
 Intersection Signal Delay: 10.7
 Intersection LOS: B
 Intersection Capacity Utilization 68.0%
 ICU Level of Service C
 Analysis Period (min) 15

Splits and Phases: 3: Banwell Road & Wildwood Drive/Mulberry Road



Queues

3: Banwell Road & Wildwood Drive/Mulberry Road

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	86	123	48	22	265	1188	101	20	961
v/c Ratio	0.59	0.47	0.46	0.11	0.53	0.41	0.08	0.06	0.39
Control Delay	66.0	19.2	63.4	41.2	15.3	8.6	3.7	4.0	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.0	19.2	63.4	41.2	15.3	8.6	3.7	4.0	3.6
Queue Length 50th (m)	19.6	4.8	10.8	3.9	28.9	60.4	3.4	0.3	7.3
Queue Length 95th (m)	34.8	21.6	22.3	11.3	m44.4	m74.8	m6.2	m1.3	14.4
Internal Link Dist (m)		123.0		405.6		513.6			349.0
Turn Bay Length (m)	30.0		30.0		80.0		45.0	90.0	
Base Capacity (vph)	233	359	164	308	697	2903	1317	311	2470
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.34	0.29	0.07	0.38	0.41	0.08	0.06	0.39

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

3: Banwell Road & Wildwood Drive/Mulberry Road

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	86	22	101	48	18	4	265	1188	101	20	906	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		4.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.88		1.00	0.97		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1789	1651		1789	1832		1789	3579	1601	1789	3548	
Flt Permitted	0.74	1.00		0.52	1.00		0.25	1.00	1.00	0.24	1.00	
Satd. Flow (perm)	1399	1651		988	1832		476	3579	1601	447	3548	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	86	22	101	48	18	4	265	1188	101	20	906	55
RTOR Reduction (vph)	0	90	0	0	4	0	0	0	19	0	2	0
Lane Group Flow (vph)	86	33	0	48	18	0	265	1188	82	20	959	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA	Perm	Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	12.7	12.7		12.7	12.7		97.3	97.3	97.3	83.5	83.5	
Effective Green, g (s)	12.7	12.7		12.7	12.7		97.3	97.3	97.3	83.5	83.5	
Actuated g/C Ratio	0.11	0.11		0.11	0.11		0.81	0.81	0.81	0.70	0.70	
Clearance Time (s)	5.0	5.0		5.0	5.0		4.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	148	174		104	193		493	2901	1298	311	2468	
v/s Ratio Prot		0.02			0.01		c0.04	0.33			0.27	
v/s Ratio Perm	c0.06			0.05			c0.39		0.05	0.04		
v/c Ratio	0.58	0.19		0.46	0.10		0.54	0.41	0.06	0.06	0.39	
Uniform Delay, d1	51.1	48.9		50.4	48.5		3.9	3.2	2.3	5.8	7.6	
Progression Factor	1.00	1.00		1.00	1.00		4.52	2.31	5.63	0.45	0.38	
Incremental Delay, d2	5.7	0.5		3.2	0.2		0.9	0.3	0.1	0.4	0.4	
Delay (s)	56.8	49.5		53.7	48.7		18.6	7.8	12.8	3.0	3.3	
Level of Service	E	D		D	D		B	A	B	A	A	
Approach Delay (s)		52.5			52.1			9.9			3.3	
Approach LOS		D			D			A			A	

Intersection Summary

HCM 2000 Control Delay	11.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	68.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Timings

4: Banwell Road & EC Row Expressway

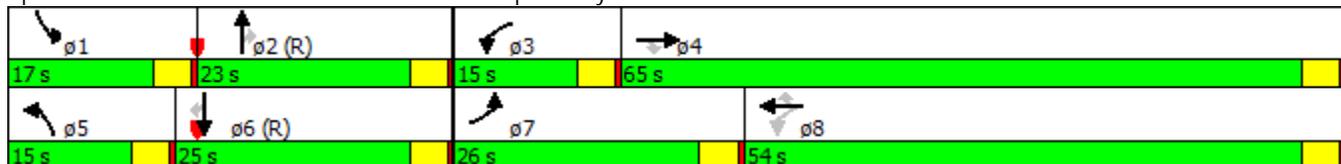
8/4/2015

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	513	2066	256	128	1880	106	221	556	121	277	705	165
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8		8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	26.0	65.0	65.0	15.0	54.0	54.0	15.0	23.0	23.0	17.0	25.0	25.0
Total Split (%)	21.7%	54.2%	54.2%	12.5%	45.0%	45.0%	12.5%	19.2%	19.2%	14.2%	20.8%	20.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	20.9	61.5	61.5	59.2	49.9	49.9	10.7	20.6	20.6	12.6	22.5	22.5
Actuated g/C Ratio	0.17	0.51	0.51	0.49	0.42	0.42	0.09	0.17	0.17	0.10	0.19	0.19
v/c Ratio	0.85	0.78	0.27	0.64	0.88	0.14	0.72	0.91	0.32	0.76	1.05	0.42
Control Delay	61.8	26.5	2.6	36.9	38.2	3.5	61.8	69.1	12.4	72.5	98.3	26.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.8	26.5	2.6	36.9	38.2	3.5	61.8	69.1	12.4	72.5	98.3	26.0
LOS	E	C	A	D	D	A	E	E	B	E	F	C
Approach Delay		30.7			36.4			59.7			81.7	
Approach LOS		C			D			E			F	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 18 (15%), Referenced to phase 2:NBT and 6:SBT, Start of Green
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.05
 Intersection Signal Delay: 44.5
 Intersection LOS: D
 Intersection Capacity Utilization 90.1%
 ICU Level of Service E
 Analysis Period (min) 15

Splits and Phases: 4: Banwell Road & EC Row Expressway



Queues

4: Banwell Road & EC Row Expressway

8/4/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	513	2066	256	128	1880	106	221	556	121	277	705	165
v/c Ratio	0.85	0.78	0.27	0.64	0.88	0.14	0.72	0.91	0.32	0.76	1.05	0.42
Control Delay	61.8	26.5	2.6	36.9	38.2	3.5	61.8	69.1	12.4	72.5	98.3	26.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.8	26.5	2.6	36.9	38.2	3.5	61.8	69.1	12.4	72.5	98.3	26.0
Queue Length 50th (m)	60.2	137.8	0.0	12.9	146.7	0.0	26.9	70.4	2.4	35.7	-96.0	7.5
Queue Length 95th (m)	#80.7	161.1	12.5	32.9	167.9	8.6	#40.4	#106.6	18.5	#51.1	#135.6	37.5
Internal Link Dist (m)		349.1			515.1			303.7				513.6
Turn Bay Length (m)	300.0		110.0	140.0		100.0	50.0			110.0		20.0
Base Capacity (vph)	636	2652	949	226	2151	738	318	613	374	376	670	395
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.81	0.78	0.27	0.57	0.87	0.14	0.69	0.91	0.32	0.74	1.05	0.42

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row Expressway

8/4/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	513	2066	256	128	1880	106	221	556	121	277	705	165
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3471	5142	1601	1789	5142	1601	3471	3579	1601	3471	3579	1601
Flt Permitted	0.95	1.00	1.00	0.08	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3471	5142	1601	151	5142	1601	3471	3579	1601	3471	3579	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	513	2066	256	128	1880	106	221	556	121	277	705	165
RTOR Reduction (vph)	0	0	125	0	0	62	0	0	100	0	0	96
Lane Group Flow (vph)	513	2066	131	128	1880	44	221	556	21	277	705	69
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8		8			2			6
Actuated Green, G (s)	20.9	61.5	61.5	59.2	49.9	49.9	10.7	20.6	20.6	12.6	22.5	22.5
Effective Green, g (s)	20.9	61.5	61.5	59.2	49.9	49.9	10.7	20.6	20.6	12.6	22.5	22.5
Actuated g/C Ratio	0.17	0.51	0.51	0.49	0.42	0.42	0.09	0.17	0.17	0.10	0.19	0.19
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
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	3.0
Lane Grp Cap (vph)	604	2635	820	201	2138	665	309	614	274	364	671	300
v/s Ratio Prot	c0.15	0.40		0.05	c0.37		0.06	0.16		c0.08	c0.20	
v/s Ratio Perm			0.08	0.26		0.03			0.01			0.04
v/c Ratio	0.85	0.78	0.16	0.64	0.88	0.07	0.72	0.91	0.08	0.76	1.05	0.23
Uniform Delay, d1	48.0	23.8	15.5	21.5	32.3	21.1	53.2	48.7	41.7	52.2	48.8	41.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.01	1.27	1.13	1.07	1.55
Incremental Delay, d2	10.8	1.6	0.1	6.5	4.5	0.0	7.4	18.9	0.5	8.7	48.0	1.7
Delay (s)	58.8	25.4	15.6	28.0	36.8	21.1	56.1	68.2	53.5	67.7	100.1	65.9
Level of Service	E	C	B	C	D	C	E	E	D	E	F	E
Approach Delay (s)		30.6			35.4			63.2			87.4	
Approach LOS		C			D			E			F	

Intersection Summary			
HCM 2000 Control Delay	45.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	90.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Timings

5: Banwell Road & EC Row Avenue/Maisonneuve St

8/4/2015

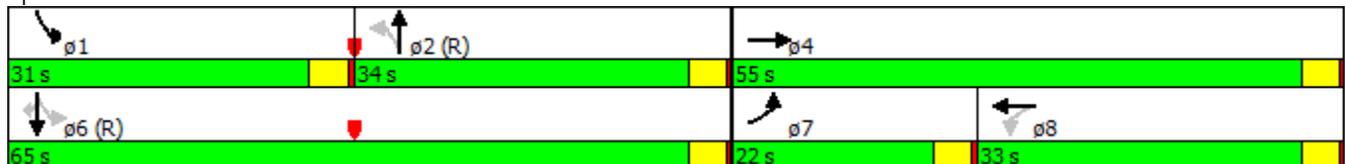


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations	↖↖	↗	↖	↗	↖	↗↗	↖	↕↕	↗
Volume (vph)	134	13	53	8	12	494	232	682	16
Turn Type	Prot	NA	Perm	NA	Perm	NA	pm+pt	NA	Perm
Protected Phases	7	4		8		2	1	6	
Permitted Phases			8		2		6		6
Detector Phase	7	4	8	8	2	2	1	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	22.0	55.0	33.0	33.0	34.0	34.0	31.0	65.0	65.0
Total Split (%)	18.3%	45.8%	27.5%	27.5%	28.3%	28.3%	25.8%	54.2%	54.2%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag	Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes		Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	10.0	24.3	10.3	10.3	73.1	73.1	87.7	87.7	87.7
Actuated g/C Ratio	0.08	0.20	0.09	0.09	0.61	0.61	0.73	0.73	0.73
v/c Ratio	0.47	0.21	0.47	0.68	0.03	0.26	0.37	0.26	0.01
Control Delay	57.4	12.4	64.4	17.9	12.8	12.2	19.7	20.1	8.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.4	12.4	64.4	17.9	12.8	12.2	19.7	20.1	8.6
LOS	E	B	E	B	B	B	B	C	A
Approach Delay		40.4		26.5		12.2		19.8	
Approach LOS		D		C		B		B	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 70
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.68
 Intersection Signal Delay: 20.8
 Intersection LOS: C
 Intersection Capacity Utilization 60.3%
 ICU Level of Service B
 Analysis Period (min) 15

Splits and Phases: 5: Banwell Road & EC Row Avenue/Maisonneuve St



Queues

5: Banwell Road & EC Row Avenue/Maisonneuve St

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	134	81	53	233	12	567	232	682	16
v/c Ratio	0.47	0.21	0.47	0.68	0.03	0.26	0.37	0.26	0.01
Control Delay	57.4	12.4	64.4	17.9	12.8	12.2	19.7	20.1	8.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.4	12.4	64.4	17.9	12.8	12.2	19.7	20.1	8.6
Queue Length 50th (m)	15.7	2.5	12.1	1.8	1.0	29.6	45.9	72.1	0.6
Queue Length 95th (m)	25.1	14.2	24.2	25.1	4.6	50.5	m53.7	m80.0	m1.6
Internal Link Dist (m)		627.5		541.0		716.4		303.7	
Turn Bay Length (m)			120.0		120.0		120.0		120.0
Base Capacity (vph)	520	738	320	559	449	2144	770	2617	1182
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.11	0.17	0.42	0.03	0.26	0.30	0.26	0.01

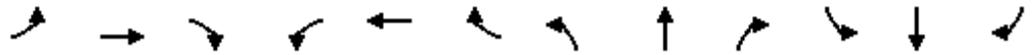
Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

5: Banwell Road & EC Row Avenue/Maisonneuve St

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	134	13	68	53	8	225	12	494	73	232	682	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.87		1.00	0.86		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3471	1646		1789	1611		1789	3509		1789	3579	1601
Flt Permitted	0.95	1.00		0.70	1.00		0.39	1.00		0.39	1.00	1.00
Satd. Flow (perm)	3471	1646		1327	1611		739	3509		727	3579	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	134	13	68	53	8	225	12	494	73	232	682	16
RTOR Reduction (vph)	0	54	0	0	206	0	0	5	0	0	0	4
Lane Group Flow (vph)	134	27	0	53	27	0	12	562	0	232	682	12
Turn Type	Prot	NA		Perm	NA		Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4			8			2		1	6	
Permitted Phases				8			2			6		6
Actuated Green, G (s)	10.0	24.3		10.3	10.3		73.1	73.1		87.7	87.7	87.7
Effective Green, g (s)	10.0	24.3		10.3	10.3		73.1	73.1		87.7	87.7	87.7
Actuated g/C Ratio	0.08	0.20		0.09	0.09		0.61	0.61		0.73	0.73	0.73
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	289	333		113	138		450	2137		625	2615	1170
v/s Ratio Prot	c0.04	0.02			0.02			0.16		c0.03	0.19	
v/s Ratio Perm				c0.04			0.02			c0.24		0.01
v/c Ratio	0.46	0.08		0.47	0.20		0.03	0.26		0.37	0.26	0.01
Uniform Delay, d1	52.4	38.8		52.2	51.0		9.3	10.9		5.5	5.4	4.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		3.24	3.37	1.00
Incremental Delay, d2	1.2	0.1		3.1	0.7		0.1	0.3		0.2	0.1	0.0
Delay (s)	53.6	38.9		55.3	51.7		9.4	11.2		18.0	18.2	4.4
Level of Service	D	D		E	D		A	B		B	B	A
Approach Delay (s)		48.1			52.4			11.2			17.9	
Approach LOS		D			D			B			B	

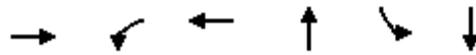
Intersection Summary

HCM 2000 Control Delay	24.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Timings

6: Banwell Road & Twin Oaks Drive/Intersection Road

8/4/2015

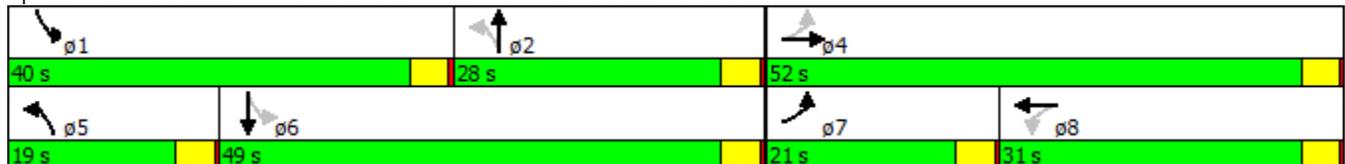


Lane Group	EBT	WBL	WBT	NBT	SBL	SBT	ø5	ø7
Lane Configurations	↻	↻	↻	↻	↻	↻		
Volume (vph)	5	32	3	422	368	600		
Turn Type	NA	Perm	NA	NA	pm+pt	NA		
Protected Phases	4		8	2	1	6	5	7
Permitted Phases		8			6			
Detector Phase	4	8	8	2	1	6		
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	8.0	20.0	8.0	8.0
Total Split (s)	52.0	31.0	31.0	28.0	40.0	49.0	19.0	21.0
Total Split (%)	43.3%	25.8%	25.8%	23.3%	33.3%	40.8%	16%	18%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		
Lead/Lag		Lag	Lag	Lag	Lead	Lag	Lead	Lead
Lead-Lag Optimize?		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	Min	None	Min	None	None
Act Effect Green (s)	7.3	7.3	7.3	13.9	29.3	30.6		
Actuated g/C Ratio	0.17	0.17	0.17	0.33	0.70	0.73		
v/c Ratio	0.02	0.13	0.32	0.44	0.49	0.23		
Control Delay	19.0	20.2	8.2	13.1	5.6	3.1		
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		
Total Delay	19.0	20.2	8.2	13.1	5.6	3.1		
LOS	B	C	A	B	A	A		
Approach Delay	19.0		10.7	13.1		4.0		
Approach LOS	B		B	B		A		

Intersection Summary

Cycle Length: 120	
Actuated Cycle Length: 42	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.49	
Intersection Signal Delay: 7.5	Intersection LOS: A
Intersection Capacity Utilization 53.3%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 6: Banwell Road & Twin Oaks Drive/Intersection Road



Queues

6: Banwell Road & Twin Oaks Drive/Intersection Road

8/4/2015

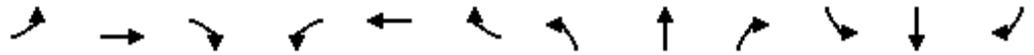


Lane Group	EBT	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	5	32	119	510	368	600
v/c Ratio	0.02	0.13	0.32	0.44	0.49	0.23
Control Delay	19.0	20.2	8.2	13.1	5.6	3.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.0	20.2	8.2	13.1	5.6	3.1
Queue Length 50th (m)	0.4	2.0	0.2	14.4	8.7	7.0
Queue Length 95th (m)	2.9	9.3	11.6	31.3	19.4	13.5
Internal Link Dist (m)	357.8		590.5	67.6		716.4
Turn Bay Length (m)		120.0			120.0	
Base Capacity (vph)	1816	963	1128	2172	1510	3375
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.00	0.03	0.11	0.23	0.24	0.18

Intersection Summary

HCM Signalized Intersection Capacity Analysis
 6: Banwell Road & Twin Oaks Drive/Intersection Road

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↕		↖	↕	
Volume (vph)	0	5	0	32	3	116	0	422	88	368	600	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00			0.95		1.00	0.95	
Frt		1.00		1.00	0.85			0.97		1.00	1.00	
Flt Protected		1.00		0.95	1.00			1.00		0.95	1.00	
Satd. Flow (prot)		1883		1789	1608			3486		1789	3579	
Flt Permitted		1.00		0.75	1.00			1.00		0.34	1.00	
Satd. Flow (perm)		1883		1421	1608			3486		636	3579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	5	0	32	3	116	0	422	88	368	600	0
RTOR Reduction (vph)	0	0	0	0	101	0	0	12	0	0	0	0
Lane Group Flow (vph)	0	5	0	32	18	0	0	498	0	368	600	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		5.4		5.4	5.4			14.3		29.3	29.3	
Effective Green, g (s)		5.4		5.4	5.4			14.3		29.3	29.3	
Actuated g/C Ratio		0.13		0.13	0.13			0.33		0.69	0.69	
Clearance Time (s)		4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)		3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		238		179	203			1167		733	2455	
v/s Ratio Prot		0.00			0.01			0.14		c0.13	0.17	
v/s Ratio Perm				c0.02						c0.21		
v/c Ratio		0.02		0.18	0.09			0.43		0.50	0.24	
Uniform Delay, d1		16.3		16.7	16.5			11.0		3.1	2.5	
Progression Factor		1.00		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2		0.0		0.5	0.2			0.3		0.5	0.1	
Delay (s)		16.4		17.1	16.7			11.3		3.7	2.6	
Level of Service		B		B	B			B		A	A	
Approach Delay (s)		16.4			16.8			11.3			3.0	
Approach LOS		B			B			B			A	

Intersection Summary		
HCM 2000 Control Delay	6.9	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.57	A
Actuated Cycle Length (s)	42.7	Sum of lost time (s)
Intersection Capacity Utilization	53.3%	16.0
Analysis Period (min)	15	ICU Level of Service
c Critical Lane Group		A

Timings

1: Banwell Road & Tecumseh Road

8/4/2015

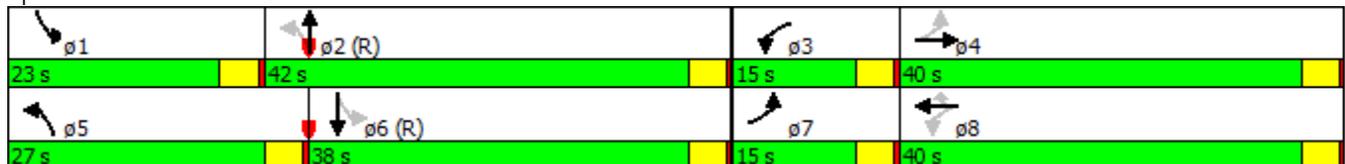


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↖	↕↕↕	↖	↕↕	↖	↖	↕↕	↖	↕↕
Volume (vph)	100	538	114	642	97	238	303	221	474
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0	5.0
Minimum Split (s)	8.0	20.0	9.0	20.0	20.0	8.0	20.0	8.0	20.0
Total Split (s)	15.0	40.0	15.0	40.0	40.0	27.0	42.0	23.0	38.0
Total Split (%)	12.5%	33.3%	12.5%	33.3%	33.3%	22.5%	35.0%	19.2%	31.7%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	C-Max	None	C-Max
Act Effct Green (s)	38.0	28.2	38.5	28.5	28.5	66.4	52.8	65.1	52.1
Actuated g/C Ratio	0.32	0.24	0.32	0.24	0.24	0.55	0.44	0.54	0.43
v/c Ratio	0.46	0.50	0.41	0.76	0.21	0.45	0.25	0.37	0.33
Control Delay	32.1	39.4	30.0	48.2	7.4	15.2	16.0	15.4	24.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.1	39.4	30.0	48.2	7.4	15.2	16.0	15.4	24.9
LOS	C	D	C	D	A	B	B	B	C
Approach Delay		38.4		41.1			15.7		22.0
Approach LOS		D		D			B		C

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 27 (23%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.76
 Intersection Signal Delay: 30.2
 Intersection LOS: C
 Intersection Capacity Utilization 64.1%
 ICU Level of Service C
 Analysis Period (min) 15

Splits and Phases: 1: Banwell Road & Tecumseh Road



Queues

1: Banwell Road & Tecumseh Road

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	100	596	114	642	97	238	383	221	511
v/c Ratio	0.46	0.50	0.41	0.76	0.21	0.45	0.25	0.37	0.33
Control Delay	32.1	39.4	30.0	48.2	7.4	15.2	16.0	15.4	24.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.1	39.4	30.0	48.2	7.4	15.2	16.0	15.4	24.9
Queue Length 50th (m)	15.9	43.5	18.3	74.3	0.0	21.6	17.7	24.0	40.7
Queue Length 95th (m)	25.4	50.9	28.4	87.4	12.2	30.3	32.6	43.1	65.6
Internal Link Dist (m)		438.6		520.2			80.5		113.8
Turn Bay Length (m)	80.0		75.0		70.0	50.0		80.0	
Base Capacity (vph)	236	1530	291	1073	548	628	1542	662	1540
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.39	0.39	0.60	0.18	0.38	0.25	0.33	0.33

Intersection Summary

HCM Signalized Intersection Capacity Analysis

1: Banwell Road & Tecumseh Road

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↕↕↕		↖	↕↕	↗	↖	↕↕		↖	↕↕	
Volume (vph)	100	538	58	114	642	97	238	303	80	221	474	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	5067		1789	3579	1601	1789	3466		1789	3540	
Flt Permitted	0.16	1.00		0.29	1.00	1.00	0.39	1.00		0.49	1.00	
Satd. Flow (perm)	309	5067		537	3579	1601	733	3466		915	3540	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	100	538	58	114	642	97	238	303	80	221	474	37
RTOR Reduction (vph)	0	12	0	0	0	74	0	16	0	0	4	0
Lane Group Flow (vph)	100	584	0	114	642	23	238	367	0	221	507	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	37.9	28.2		38.5	28.5	28.5	66.4	52.8		65.2	52.2	
Effective Green, g (s)	37.9	28.2		38.5	28.5	28.5	66.4	52.8		65.2	52.2	
Actuated g/C Ratio	0.32	0.23		0.32	0.24	0.24	0.55	0.44		0.54	0.44	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	217	1190		276	850	380	525	1525		591	1539	
v/s Ratio Prot	c0.04	0.12		0.03	c0.18		c0.05	0.11		0.04	0.14	
v/s Ratio Perm	0.11			0.10		0.01	c0.20			0.16		
v/c Ratio	0.46	0.49		0.41	0.76	0.06	0.45	0.24		0.37	0.33	
Uniform Delay, d1	31.1	39.7		30.0	42.5	35.4	14.2	21.0		14.4	22.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	0.91	0.73		1.00	1.00	
Incremental Delay, d2	1.5	0.3		1.0	3.9	0.1	0.6	0.4		0.4	0.6	
Delay (s)	32.7	40.0		31.0	46.4	35.5	13.5	15.6		14.8	22.9	
Level of Service	C	D		C	D	D	B	B		B	C	
Approach Delay (s)		39.0			43.1			14.8			20.5	
Approach LOS		D			D			B			C	

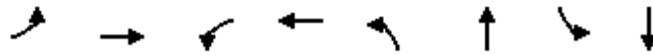
Intersection Summary

HCM 2000 Control Delay	30.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Timings

2: Banwell Road & Palmetto Road

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↕	↖	↕
Volume (vph)	5	4	3	6	11	465	8	817
Turn Type	Perm	NA	Split	NA	Perm	NA	Perm	NA
Protected Phases		4	8	8		2		6
Permitted Phases	4				2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	27.0	27.0	23.0	23.0	70.0	70.0	70.0	70.0
Total Split (%)	22.5%	22.5%	19.2%	19.2%	58.3%	58.3%	58.3%	58.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	8.1	8.1	6.3	6.3	105.0	105.0	105.0	105.0
Actuated g/C Ratio	0.07	0.07	0.05	0.05	0.88	0.88	0.88	0.88
v/c Ratio	0.04	0.09	0.03	0.19	0.02	0.15	0.01	0.26
Control Delay	50.6	34.9	53.7	35.2	2.6	1.7	3.0	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.6	34.9	53.7	35.2	2.6	1.7	3.0	2.4
LOS	D	C	D	D	A	A	A	A
Approach Delay		39.8		37.7		1.7		2.4
Approach LOS		D		D		A		A

Intersection Summary

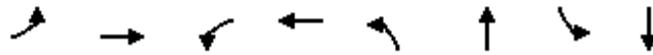
Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.26
 Intersection Signal Delay: 3.1
 Intersection LOS: A
 Intersection Capacity Utilization 33.6%
 ICU Level of Service A
 Analysis Period (min) 15

Splits and Phases: 2: Banwell Road & Palmetto Road

Queues

2: Banwell Road & Palmetto Road

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	5	11	3	19	11	468	8	824
v/c Ratio	0.04	0.09	0.03	0.19	0.02	0.15	0.01	0.26
Control Delay	50.6	34.9	53.7	35.2	2.6	1.7	3.0	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.6	34.9	53.7	35.2	2.6	1.7	3.0	2.4
Queue Length 50th (m)	1.2	0.9	0.7	1.4	0.2	4.0	0.1	7.1
Queue Length 95th (m)	5.0	6.5	3.8	8.9	1.2	10.0	m1.3	31.4
Internal Link Dist (m)		314.9		214.8		349.0		247.8
Turn Bay Length (m)							120.0	
Base Capacity (vph)	320	332	283	278	547	3128	796	3128
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.03	0.01	0.07	0.02	0.15	0.01	0.26

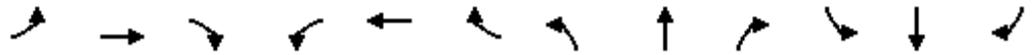
Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

2: Banwell Road & Palmetto Road

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↕		↖	↕	
Volume (vph)	5	4	7	3	6	13	11	465	3	8	817	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.90		1.00	0.90		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1704		1789	1690		1789	3575		1789	3574	
Flt Permitted	0.89	1.00		0.95	1.00		0.33	1.00		0.48	1.00	
Satd. Flow (perm)	1674	1704		1789	1690		626	3575		911	3574	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	4	7	3	6	13	11	465	3	8	817	7
RTOR Reduction (vph)	0	7	0	0	13	0	0	0	0	0	0	0
Lane Group Flow (vph)	5	4	0	3	6	0	11	468	0	8	824	0
Turn Type	Perm	NA		Split	NA		Perm	NA		Perm	NA	
Protected Phases		4		8	8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)	4.5	4.5		4.1	4.1		99.4	99.4		99.4	99.4	
Effective Green, g (s)	4.5	4.5		4.1	4.1		99.4	99.4		99.4	99.4	
Actuated g/C Ratio	0.04	0.04		0.03	0.03		0.83	0.83		0.83	0.83	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	62	63		61	57		518	2961		754	2960	
v/s Ratio Prot		0.00		0.00	c0.00			0.13			c0.23	
v/s Ratio Perm	c0.00						0.02			0.01		
v/c Ratio	0.08	0.07		0.05	0.11		0.02	0.16		0.01	0.28	
Uniform Delay, d1	55.8	55.7		56.1	56.2		1.8	2.0		1.8	2.3	
Progression Factor	1.00	1.00		1.00	1.00		0.70	0.63		0.83	0.78	
Incremental Delay, d2	0.6	0.5		0.3	0.9		0.1	0.1		0.0	0.2	
Delay (s)	56.3	56.2		56.4	57.1		1.3	1.4		1.5	2.0	
Level of Service	E	E		E	E		A	A		A	A	
Approach Delay (s)		56.2			57.0			1.4			2.0	
Approach LOS		E			E			A			A	

Intersection Summary

HCM 2000 Control Delay	3.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.26		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	33.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Timings

3: Banwell Road & Wildwood Drive/Mulberry Road

8/4/2015

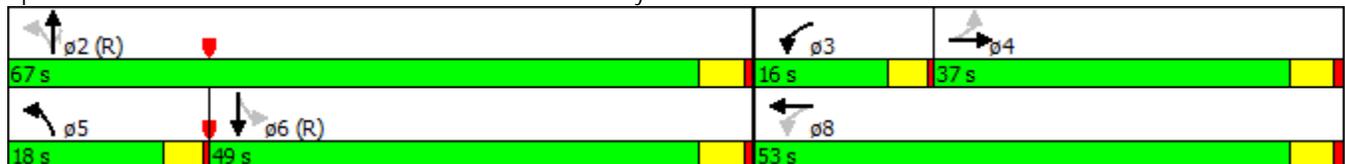


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↑↑	↗	↖	↑↑
Volume (vph)	93	59	133	45	136	567	59	5	772
Turn Type	Perm	NA	pm+pt	NA	pm+pt	NA	Perm	Perm	NA
Protected Phases		4	3	8	5	2			6
Permitted Phases	4		8		2		2	6	
Detector Phase	4	4	3	8	5	2	2	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	21.0	21.0	8.0	21.0	8.0	21.0	21.0	21.0	21.0
Total Split (s)	37.0	37.0	16.0	53.0	18.0	67.0	67.0	49.0	49.0
Total Split (%)	30.8%	30.8%	13.3%	44.2%	15.0%	55.8%	55.8%	40.8%	40.8%
Yellow Time (s)	4.0	4.0	3.5	4.0	3.5	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	0.5	1.0	0.5	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	5.0	4.0	5.0	5.0	5.0	5.0
Lead/Lag	Lag	Lag	Lead		Lead			Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes			Yes	Yes
Recall Mode	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	17.0	17.0	33.1	32.1	78.9	77.9	77.9	64.7	64.7
Actuated g/C Ratio	0.14	0.14	0.28	0.27	0.66	0.65	0.65	0.54	0.54
v/c Ratio	0.48	0.81	0.58	0.10	0.33	0.24	0.06	0.01	0.44
Control Delay	53.6	37.4	42.1	27.8	11.4	10.2	3.1	29.6	26.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.6	37.4	42.1	27.8	11.4	10.2	3.1	29.6	26.7
LOS	D	D	D	C	B	B	A	C	C
Approach Delay		41.1		38.2		9.9			26.7
Approach LOS		D		D		A			C

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 17 (14%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.81
 Intersection Signal Delay: 24.5
 Intersection LOS: C
 Intersection Capacity Utilization 71.9%
 ICU Level of Service C
 Analysis Period (min) 15

Splits and Phases: 3: Banwell Road & Wildwood Drive/Mulberry Road



Queues

3: Banwell Road & Wildwood Drive/Mulberry Road

8/4/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	93	312	133	49	136	567	59	5	835
v/c Ratio	0.48	0.81	0.58	0.10	0.33	0.24	0.06	0.01	0.44
Control Delay	53.6	37.4	42.1	27.8	11.4	10.2	3.1	29.6	26.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.6	37.4	42.1	27.8	11.4	10.2	3.1	29.6	26.7
Queue Length 50th (m)	20.5	32.0	24.4	8.0	11.1	27.3	0.0	0.6	64.6
Queue Length 95th (m)	33.7	58.4	35.7	15.3	24.1	45.9	5.8	m3.4	123.2
Internal Link Dist (m)		123.0		405.6		513.6			349.0
Turn Bay Length (m)	30.0		30.0		80.0		45.0	90.0	
Base Capacity (vph)	364	569	241	746	468	2323	1059	445	1912
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.55	0.55	0.07	0.29	0.24	0.06	0.01	0.44

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

3: Banwell Road & Wildwood Drive/Mulberry Road

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↑↑	↗	↖	↗	
Volume (vph)	93	59	253	133	45	4	136	567	59	5	772	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		4.0	5.0		4.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.88		1.00	0.99		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1789	1654		1789	1860		1789	3579	1601	1789	3538	
Flt Permitted	0.73	1.00		0.19	1.00		0.25	1.00	1.00	0.44	1.00	
Satd. Flow (perm)	1366	1654		359	1860		480	3579	1601	827	3538	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	93	59	253	133	45	4	136	567	59	5	772	63
RTOR Reduction (vph)	0	150	0	0	3	0	0	0	21	0	4	0
Lane Group Flow (vph)	93	162	0	133	46	0	136	567	38	5	831	0
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA	Perm	Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	17.0	17.0		32.1	32.1		77.9	77.9	77.9	64.7	64.7	
Effective Green, g (s)	17.0	17.0		32.1	32.1		77.9	77.9	77.9	64.7	64.7	
Actuated g/C Ratio	0.14	0.14		0.27	0.27		0.65	0.65	0.65	0.54	0.54	
Clearance Time (s)	5.0	5.0		4.0	5.0		4.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	193	234		228	497		411	2323	1039	445	1907	
v/s Ratio Prot		c0.10		c0.05	0.02		c0.03	0.16			c0.23	
v/s Ratio Perm	0.07			0.10			0.19		0.02	0.01		
v/c Ratio	0.48	0.69		0.58	0.09		0.33	0.24	0.04	0.01	0.44	
Uniform Delay, d1	47.4	49.0		36.1	33.0		9.5	8.8	7.6	12.8	16.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.60	1.40	
Incremental Delay, d2	1.9	8.5		3.8	0.1		0.5	0.3	0.1	0.0	0.7	
Delay (s)	49.3	57.5		39.8	33.1		10.0	9.0	7.6	20.6	24.1	
Level of Service	D	E		D	C		A	A	A	C	C	
Approach Delay (s)		55.6			38.0			9.1			24.1	
Approach LOS		E			D			A			C	

Intersection Summary

HCM 2000 Control Delay	25.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Timings

4: Banwell Road & EC Row Expressway

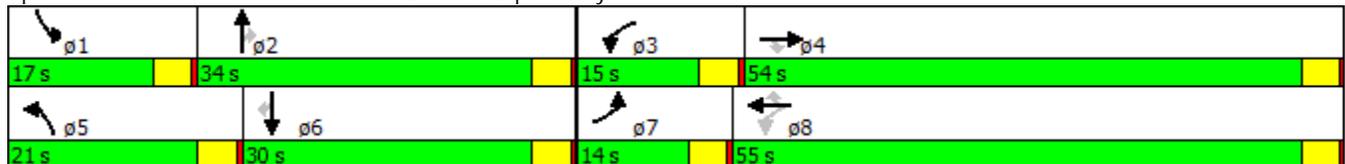
8/4/2015

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	299	1414	119	128	2283	38	510	356	59	238	539	476
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8		8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	14.0	54.0	54.0	15.0	55.0	55.0	21.0	34.0	34.0	17.0	30.0	30.0
Total Split (%)	11.7%	45.0%	45.0%	12.5%	45.8%	45.8%	17.5%	28.3%	28.3%	14.2%	25.0%	25.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max	Max
Act Effect Green (s)	10.0	51.6	51.6	60.4	51.0	51.0	17.0	30.8	30.8	12.2	26.0	26.0
Actuated g/C Ratio	0.08	0.43	0.43	0.50	0.42	0.42	0.14	0.26	0.26	0.10	0.22	0.22
v/c Ratio	1.03	0.64	0.16	0.59	1.04	0.05	1.04	0.39	0.12	0.68	0.70	1.02
Control Delay	115.7	28.8	4.3	27.4	66.3	0.1	101.0	38.5	4.2	62.1	48.8	80.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	115.7	28.8	4.3	27.4	66.3	0.1	101.0	38.5	4.2	62.1	48.8	80.0
LOS	F	C	A	C	E	A	F	D	A	E	D	E
Approach Delay		41.4			63.3			70.8			63.2	
Approach LOS		D			E			E			E	

Intersection Summary

Cycle Length: 120	
Actuated Cycle Length: 120	
Natural Cycle: 100	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 1.04	
Intersection Signal Delay: 58.1	Intersection LOS: E
Intersection Capacity Utilization 98.1%	ICU Level of Service F
Analysis Period (min) 15	

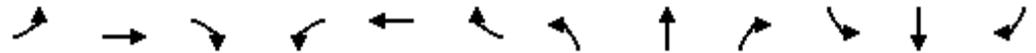
Splits and Phases: 4: Banwell Road & EC Row Expressway



Queues

4: Banwell Road & EC Row Expressway

8/4/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	299	1414	119	128	2283	38	510	356	59	238	539	476
v/c Ratio	1.03	0.64	0.16	0.59	1.04	0.05	1.04	0.39	0.12	0.68	0.70	1.02
Control Delay	115.7	28.8	4.3	27.4	66.3	0.1	101.0	38.5	4.2	62.1	48.8	80.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	115.7	28.8	4.3	27.4	66.3	0.1	101.0	38.5	4.2	62.1	48.8	80.0
Queue Length 50th (m)	-39.0	94.5	0.0	14.3	-213.6	0.0	-66.7	36.8	0.0	28.0	62.1	-89.4
Queue Length 95th (m)	#67.0	112.7	10.8	28.6	#242.3	0.4	#100.0	50.8	6.0	41.2	81.0	#154.2
Internal Link Dist (m)		349.1			515.1			303.7			513.6	
Turn Bay Length (m)	300.0		110.0	140.0		100.0	50.0			110.0		20.0
Base Capacity (vph)	289	2209	755	241	2185	727	491	919	472	376	775	465
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.03	0.64	0.16	0.53	1.04	0.05	1.04	0.39	0.13	0.63	0.70	1.02

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row Expressway

8/4/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			  		 	 		 	 	
Volume (vph)	299	1414	119	128	2283	38	510	356	59	238	539	476
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3471	5142	1601	1789	5142	1601	3471	3579	1601	3471	3579	1601
Flt Permitted	0.95	1.00	1.00	0.10	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3471	5142	1601	183	5142	1601	3471	3579	1601	3471	3579	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	299	1414	119	128	2283	38	510	356	59	238	539	476
RTOR Reduction (vph)	0	0	68	0	0	22	0	0	44	0	0	118
Lane Group Flow (vph)	299	1414	51	128	2283	16	510	356	15	238	539	358
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8		8			2			6
Actuated Green, G (s)	10.0	51.6	51.6	60.4	51.0	51.0	17.0	30.8	30.8	12.2	26.0	26.0
Effective Green, g (s)	10.0	51.6	51.6	60.4	51.0	51.0	17.0	30.8	30.8	12.2	26.0	26.0
Actuated g/C Ratio	0.08	0.43	0.43	0.50	0.42	0.42	0.14	0.26	0.26	0.10	0.22	0.22
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
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	3.0
Lane Grp Cap (vph)	289	2211	688	217	2185	680	491	918	410	352	775	346
v/s Ratio Prot	c0.09	0.28		0.05	c0.44		c0.15	0.10		0.07	0.15	
v/s Ratio Perm			0.03	0.25		0.01			0.01			c0.22
v/c Ratio	1.03	0.64	0.07	0.59	1.04	0.02	1.04	0.39	0.04	0.68	0.70	1.03
Uniform Delay, d1	55.0	26.9	20.1	19.5	34.5	20.0	51.5	36.8	33.5	52.0	43.3	47.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	62.2	0.6	0.0	4.1	32.2	0.0	51.0	1.2	0.2	5.1	5.1	57.4
Delay (s)	117.2	27.5	20.2	23.6	66.7	20.1	102.5	38.1	33.6	57.1	48.5	104.4
Level of Service	F	C	C	C	E	C	F	D	C	E	D	F
Approach Delay (s)		41.7			63.7			73.3			71.3	
Approach LOS		D			E			E			E	

Intersection Summary

HCM 2000 Control Delay	60.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	98.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Timings

5: Banwell Road & EC Row Avenue/Maisonneuve St

8/4/2015

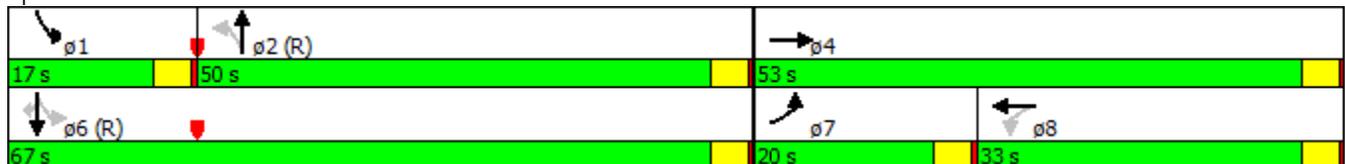


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations	↖↖	↗	↖	↗	↖	↗	↖↗	↖↗	↖
Volume (vph)	16	3	33	13	54	599	98	314	123
Turn Type	Prot	NA	Perm	NA	Perm	NA	pm+pt	NA	Perm
Protected Phases	7	4		8		2	1	6	
Permitted Phases			8		2		6		6
Detector Phase	7	4	8	8	2	2	1	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	20.0	53.0	33.0	33.0	50.0	50.0	17.0	67.0	67.0
Total Split (%)	16.7%	44.2%	27.5%	27.5%	41.7%	41.7%	14.2%	55.8%	55.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag	Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes		Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	6.1	13.2	9.0	9.0	87.8	87.8	98.8	98.8	98.8
Actuated g/C Ratio	0.05	0.11	0.08	0.08	0.73	0.73	0.82	0.82	0.82
v/c Ratio	0.09	0.02	0.31	0.67	0.07	0.24	0.15	0.11	0.09
Control Delay	55.2	36.8	58.7	21.2	6.7	6.2	3.6	2.9	0.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.2	36.8	58.7	21.2	6.7	6.2	3.6	2.9	0.9
LOS	E	D	E	C	A	A	A	A	A
Approach Delay		51.5		26.7		6.2		2.6	
Approach LOS		D		C		A		A	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 70
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.67
 Intersection Signal Delay: 8.7
 Intersection LOS: A
 Intersection Capacity Utilization 44.4%
 ICU Level of Service A
 Analysis Period (min) 15

Splits and Phases: 5: Banwell Road & EC Row Avenue/Maisonneuve St



Queues

5: Banwell Road & EC Row Avenue/Maisonneuve St

8/4/2015



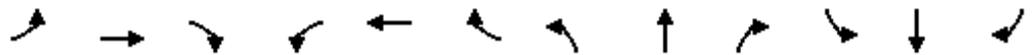
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	16	4	33	193	54	617	98	314	123
v/c Ratio	0.09	0.02	0.31	0.67	0.07	0.24	0.15	0.11	0.09
Control Delay	55.2	36.8	58.7	21.2	6.7	6.2	3.6	2.9	0.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.2	36.8	58.7	21.2	6.7	6.2	3.6	2.9	0.9
Queue Length 50th (m)	1.9	0.7	7.6	2.9	1.4	9.0	2.2	3.8	0.0
Queue Length 95th (m)	5.5	3.6	17.1	24.2	12.1	50.1	10.8	14.8	4.8
Internal Link Dist (m)		627.5		541.0		716.4		303.7	
Turn Bay Length (m)			120.0		120.0		120.0		120.0
Base Capacity (vph)	462	740	343	528	773	2609	707	2945	1339
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.01	0.10	0.37	0.07	0.24	0.14	0.11	0.09

Intersection Summary

HCM Signalized Intersection Capacity Analysis

5: Banwell Road & EC Row Avenue/Maisonneuve St

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	16	3	1	33	13	180	54	599	18	98	314	123
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.96		1.00	0.86		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3471	1813		1789	1620		1789	3563		1789	3579	1601
Flt Permitted	0.95	1.00		0.76	1.00		0.56	1.00		0.38	1.00	1.00
Satd. Flow (perm)	3471	1813		1422	1620		1057	3563		720	3579	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	16	3	1	33	13	180	54	599	18	98	314	123
RTOR Reduction (vph)	0	1	0	0	167	0	0	1	0	0	0	24
Lane Group Flow (vph)	16	3	0	33	27	0	54	616	0	98	314	99
Turn Type	Prot	NA		Perm	NA		Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4			8			2		1	6	
Permitted Phases				8			2			6		6
Actuated Green, G (s)	2.7	15.7		9.0	9.0		85.4	85.4		96.3	96.3	96.3
Effective Green, g (s)	2.7	15.7		9.0	9.0		85.4	85.4		96.3	96.3	96.3
Actuated g/C Ratio	0.02	0.13		0.08	0.08		0.71	0.71		0.80	0.80	0.80
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	78	237		106	121		752	2535		639	2872	1284
v/s Ratio Prot	c0.00	0.00			0.02			c0.17		c0.01	0.09	
v/s Ratio Perm				c0.02			0.05			0.11		0.06
v/c Ratio	0.21	0.01		0.31	0.22		0.07	0.24		0.15	0.11	0.08
Uniform Delay, d1	57.6	45.4		52.6	52.2		5.3	6.0		2.8	2.6	2.5
Progression Factor	1.00	1.00		1.00	1.00		0.95	0.94		1.00	1.00	1.00
Incremental Delay, d2	1.3	0.0		1.7	0.9		0.2	0.2		0.1	0.1	0.1
Delay (s)	58.9	45.4		54.2	53.1		5.2	5.9		2.9	2.6	2.6
Level of Service	E	D		D	D		A	A		A	A	A
Approach Delay (s)		56.2			53.3			5.8			2.7	
Approach LOS		E			D			A			A	

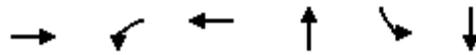
Intersection Summary

HCM 2000 Control Delay	12.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.24		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	44.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Timings

6: Banwell Road & Twin Oaks Drive/Intersection Road

8/4/2015

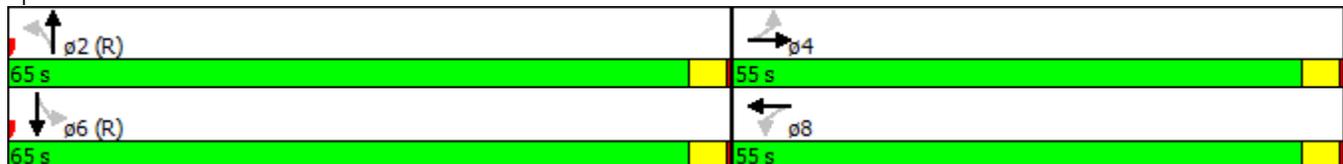


Lane Group	EBT	WBL	WBT	NBT	SBL	SBT
Lane Configurations	↑	↵	↑	↑↑	↵	↑↑
Volume (vph)	3	67	5	465	79	489
Turn Type	NA	Perm	NA	NA	Perm	NA
Protected Phases	4		8	2		6
Permitted Phases		8			6	
Detector Phase	4	8	8	2	6	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	55.0	55.0	55.0	65.0	65.0	65.0
Total Split (%)	45.8%	45.8%	45.8%	54.2%	54.2%	54.2%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	None	C-Min	C-Min	C-Min
Act Effect Green (s)	11.1	11.1	11.1	100.9	100.9	100.9
Actuated g/C Ratio	0.09	0.09	0.09	0.84	0.84	0.84
v/c Ratio	0.02	0.51	0.61	0.16	0.11	0.16
Control Delay	46.7	64.4	16.0	2.1	2.3	2.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.7	64.4	16.0	2.1	2.3	2.0
LOS	D	E	B	A	A	A
Approach Delay	46.7		28.3	2.1		2.0
Approach LOS	D		C	A		A

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 40
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.61
 Intersection Signal Delay: 7.4
 Intersection Capacity Utilization 40.1%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service A

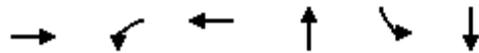
Splits and Phases: 6: Banwell Road & Twin Oaks Drive/Intersection Road



Queues

6: Banwell Road & Twin Oaks Drive/Intersection Road

8/4/2015



Lane Group	EBT	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	3	67	197	488	79	489
v/c Ratio	0.02	0.51	0.61	0.16	0.11	0.16
Control Delay	46.7	64.4	16.0	2.1	2.3	2.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.7	64.4	16.0	2.1	2.3	2.0
Queue Length 50th (m)	0.7	15.3	1.1	8.1	2.3	7.7
Queue Length 95th (m)	3.6	28.8	22.1	14.7	6.1	14.0
Internal Link Dist (m)	357.8		590.5	67.6		716.4
Turn Bay Length (m)		120.0			120.0	
Base Capacity (vph)	800	605	793	2988	750	3009
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.00	0.11	0.25	0.16	0.11	0.16

Intersection Summary

HCM Signalized Intersection Capacity Analysis

6: Banwell Road & Twin Oaks Drive/Intersection Road

8/4/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↕		↖	↕	
Volume (vph)	0	3	0	67	5	192	0	465	23	79	489	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00			0.95		1.00	0.95	
Frt		1.00		1.00	0.85			0.99		1.00	1.00	
Flt Protected		1.00		0.95	1.00			1.00		0.95	1.00	
Satd. Flow (prot)		1883		1789	1608			3553		1789	3579	
Flt Permitted		1.00		0.76	1.00			1.00		0.47	1.00	
Satd. Flow (perm)		1883		1424	1608			3553		893	3579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	3	0	67	5	192	0	465	23	79	489	0
RTOR Reduction (vph)	0	0	0	0	174	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	3	0	67	23	0	0	487	0	79	489	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		11.1		11.1	11.1			100.9		100.9	100.9	
Effective Green, g (s)		11.1		11.1	11.1			100.9		100.9	100.9	
Actuated g/C Ratio		0.09		0.09	0.09			0.84		0.84	0.84	
Clearance Time (s)		4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)		3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		174		131	148			2987		750	3009	
v/s Ratio Prot		0.00			0.01			c0.14			0.14	
v/s Ratio Perm				c0.05						0.09		
v/c Ratio		0.02		0.51	0.15			0.16		0.11	0.16	
Uniform Delay, d1		49.5		51.9	50.1			1.8		1.7	1.8	
Progression Factor		1.00		1.00	1.00			1.00		0.94	0.94	
Incremental Delay, d2		0.0		3.3	0.5			0.1		0.3	0.1	
Delay (s)		49.5		55.2	50.6			1.9		1.8	1.8	
Level of Service		D		E	D			A		A	A	
Approach Delay (s)		49.5			51.8			1.9			1.8	
Approach LOS		D			D			A			A	

Intersection Summary

HCM 2000 Control Delay	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.20		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	40.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

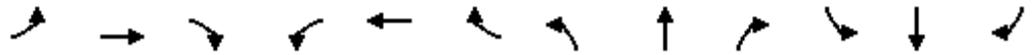
Lanes, Volumes, Timings
 4: Banwell Road & EC Row Expressway

6/12/2015

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 	 	 	 	 	 		 	 		
Volume (vph)	513	2066	577	128	1880	106	221	732	472	277	866	165
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	300.0		110.0	140.0		100.0	50.0		0.0	110.0		20.0
Storage Lanes	2		1	1		1	2		1	1		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Fr _t			0.850			0.850			0.850			0.850
Fl _t Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Fl _t Permitted	0.068			0.073			0.133			0.118		
Satd. Flow (perm)	248	3579	1601	137	3579	1601	486	1883	1601	222	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			135			155			155			118
Link Speed (k/h)		80			80			60				60
Link Distance (m)		373.1			539.1			327.7				537.6
Travel Time (s)		16.8			24.3			19.7				32.3
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	513	2066	577	128	1880	106	221	732	472	277	866	165
Shared Lane Traffic (%)												
Lane Group Flow (vph)	513	2066	577	128	1880	106	221	732	472	277	866	165
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			7.4				7.4
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7				28.7
Detector 2 Size(m)		1.8			1.8			1.8				1.8
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6

Lanes, Volumes, Timings
 4: Banwell Road & EC Row Expressway

6/12/2015

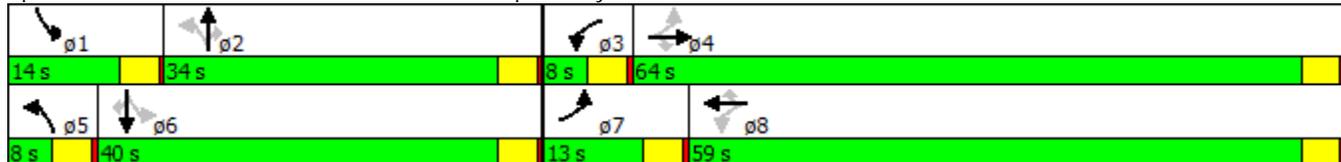


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	13.0	64.0	64.0	8.0	59.0	59.0	8.0	34.0	34.0	14.0	40.0	40.0
Total Split (%)	10.8%	53.3%	53.3%	6.7%	49.2%	49.2%	6.7%	28.3%	28.3%	11.7%	33.3%	33.3%
Maximum Green (s)	9.0	60.0	60.0	4.0	55.0	55.0	4.0	30.0	30.0	10.0	36.0	36.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max	Max
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effect Green (s)	68.0	60.0	60.0	59.0	55.0	55.0	34.0	30.0	30.0	44.0	36.0	36.0
Actuated g/C Ratio	0.57	0.50	0.50	0.49	0.46	0.46	0.28	0.25	0.25	0.37	0.30	0.30
v/c Ratio	1.34	1.15	0.66	1.05	1.15	0.13	0.93	1.56	0.91	1.31	1.54	0.29
Control Delay	197.9	106.0	21.2	118.3	105.0	1.1	76.1	293.5	53.1	198.0	281.2	12.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	197.9	106.0	21.2	118.3	105.0	1.1	76.1	293.5	53.1	198.0	281.2	12.0
LOS	F	F	C	F	F	A	E	F	D	F	F	B
Approach Delay		105.4			100.6			180.1			229.6	
Approach LOS		F			F			F			F	

Intersection Summary

Area Type:	Other
Cycle Length:	120
Actuated Cycle Length:	120
Natural Cycle:	140
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	1.56
Intersection Signal Delay:	137.7
Intersection LOS:	F
Intersection Capacity Utilization:	133.8%
ICU Level of Service:	H
Analysis Period (min):	15

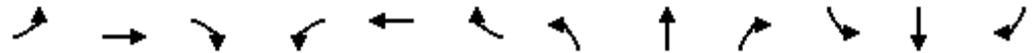
Splits and Phases: 4: Banwell Road & EC Row Expressway



Queues

4: Banwell Road & EC Row Expressway

6/12/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	513	2066	577	128	1880	106	221	732	472	277	866	165
v/c Ratio	1.34	1.15	0.66	1.05	1.15	0.13	0.93	1.56	0.91	1.31	1.54	0.29
Control Delay	197.9	106.0	21.2	118.3	105.0	1.1	76.1	293.5	53.1	198.0	281.2	12.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	197.9	106.0	21.2	118.3	105.0	1.1	76.1	293.5	53.1	198.0	281.2	12.0
Queue Length 50th (m)	-65.9	-302.0	76.2	-14.8	-273.3	0.0	17.9	-243.3	76.9	-68.4	-285.9	8.0
Queue Length 95th (m)	#99.8	#343.8	116.1	#44.2	#315.6	3.0	#37.8	#314.9	#139.2	#121.7	#360.4	24.7
Internal Link Dist (m)		349.1			515.1			303.7				513.6
Turn Bay Length (m)	300.0		110.0	140.0		100.0	50.0			110.0		20.0
Base Capacity (vph)	382	1789	868	122	1640	817	237	470	516	211	564	562
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.34	1.15	0.66	1.05	1.15	0.13	0.93	1.56	0.91	1.31	1.54	0.29

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row Expressway

6/12/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 		 				 	
Volume (vph)	513	2066	577	128	1880	106	221	732	472	277	866	165
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Flt Permitted	0.07	1.00	1.00	0.07	1.00	1.00	0.13	1.00	1.00	0.12	1.00	1.00
Satd. Flow (perm)	248	3579	1601	137	3579	1601	487	1883	1601	222	1883	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	513	2066	577	128	1880	106	221	732	472	277	866	165
RTOR Reduction (vph)	0	0	68	0	0	57	0	0	116	0	0	83
Lane Group Flow (vph)	513	2066	510	128	1880	49	221	732	356	277	866	82
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	68.0	60.0	60.0	59.0	55.0	55.0	34.0	30.0	30.0	44.0	36.0	36.0
Effective Green, g (s)	68.0	60.0	60.0	59.0	55.0	55.0	34.0	30.0	30.0	44.0	36.0	36.0
Actuated g/C Ratio	0.57	0.50	0.50	0.49	0.46	0.46	0.28	0.25	0.25	0.37	0.30	0.30
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
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	3.0
Lane Grp Cap (vph)	382	1789	800	122	1640	733	237	470	400	211	564	480
v/s Ratio Prot	c0.10	0.58		0.03	0.53		0.03	0.39		c0.11	c0.46	
v/s Ratio Perm	c0.66		0.32	0.48		0.03	0.23		0.22	0.37		0.05
v/c Ratio	1.34	1.15	0.64	1.05	1.15	0.07	0.93	1.56	0.89	1.31	1.54	0.17
Uniform Delay, d1	36.8	30.0	22.0	31.1	32.5	18.2	42.2	45.0	43.4	31.8	42.0	31.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	171.0	76.5	1.7	95.3	73.6	0.0	40.1	261.1	24.3	170.3	249.8	0.8
Delay (s)	207.8	106.5	23.7	126.4	106.1	18.2	82.3	306.1	67.7	202.2	291.8	31.8
Level of Service	F	F	C	F	F	B	F	F	E	F	F	C
Approach Delay (s)		107.8			102.9			192.4			240.0	
Approach LOS		F			F			F			F	

Intersection Summary

HCM 2000 Control Delay	143.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.47		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	133.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

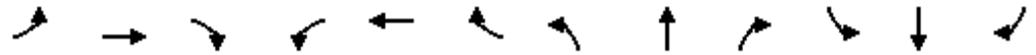
Lanes, Volumes, Timings
 4: Banwell Road & EC ROW Expressway

6/12/2015

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	299	1414	212	128	2283	38	510	386	118	238	585	476
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	300.0		110.0	140.0		100.0	50.0		0.0	110.0		20.0
Storage Lanes	2		1	1		1	2		1	1		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Fr _t			0.850			0.850			0.850			0.850
Fl _t Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Fl _t Permitted	0.062			0.087			0.200			0.167		
Satd. Flow (perm)	227	3579	1601	164	3579	1601	731	1883	1601	315	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			212			118			118			82
Link Speed (k/h)		80			80			60				60
Link Distance (m)		373.1			539.1			327.7				537.6
Travel Time (s)		16.8			24.3			19.7				32.3
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	299	1414	212	128	2283	38	510	386	118	238	585	476
Shared Lane Traffic (%)												
Lane Group Flow (vph)	299	1414	212	128	2283	38	510	386	118	238	585	476
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			7.4				7.4
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7				28.7
Detector 2 Size(m)		1.8			1.8			1.8				1.8
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6

Lanes, Volumes, Timings
 4: Banwell Road & EC ROW Expressway

6/12/2015

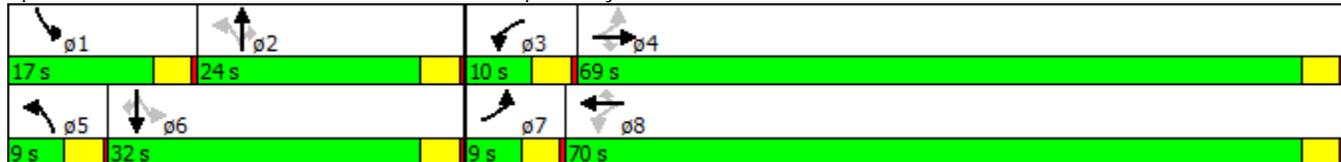


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	9.0	69.0	69.0	10.0	70.0	70.0	9.0	24.0	24.0	17.0	32.0	32.0
Total Split (%)	7.5%	57.5%	57.5%	8.3%	58.3%	58.3%	7.5%	20.0%	20.0%	14.2%	26.7%	26.7%
Maximum Green (s)	5.0	65.0	65.0	6.0	66.0	66.0	5.0	20.0	20.0	13.0	28.0	28.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max	Max
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effect Green (s)	70.0	65.0	65.0	72.0	66.0	66.0	25.0	20.0	20.0	37.0	28.0	28.0
Actuated g/C Ratio	0.58	0.54	0.54	0.60	0.55	0.55	0.21	0.17	0.17	0.31	0.23	0.23
v/c Ratio	1.12	0.73	0.22	0.72	1.16	0.04	1.92	1.23	0.32	0.93	1.33	1.09
Control Delay	114.3	23.7	2.3	35.5	105.3	0.1	451.4	171.7	10.2	76.4	201.7	106.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	114.3	23.7	2.3	35.5	105.3	0.1	451.4	171.7	10.2	76.4	201.7	106.4
LOS	F	C	A	D	F	A	F	F	B	E	F	F
Approach Delay		35.4			100.0			293.6			143.8	
Approach LOS		D			F			F			F	

Intersection Summary

Area Type:	Other
Cycle Length:	120
Actuated Cycle Length:	120
Natural Cycle:	120
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	1.92
Intersection Signal Delay:	119.3
Intersection LOS:	F
Intersection Capacity Utilization:	130.3%
ICU Level of Service:	H
Analysis Period (min):	15

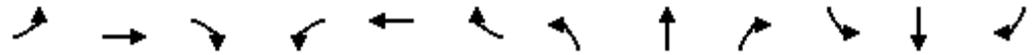
Splits and Phases: 4: Banwell Road & EC ROW Expressway



Queues

4: Banwell Road & EC ROW Expressway

6/12/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	299	1414	212	128	2283	38	510	386	118	238	585	476
v/c Ratio	1.12	0.73	0.22	0.72	1.16	0.04	1.92	1.23	0.32	0.93	1.33	1.09
Control Delay	114.3	23.7	2.3	35.5	105.3	0.1	451.4	171.7	10.2	76.4	201.7	106.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	114.3	23.7	2.3	35.5	105.3	0.1	451.4	171.7	10.2	76.4	201.7	106.4
Queue Length 50th (m)	~25.8	127.3	0.0	11.3	~334.9	0.0	~78.8	~112.3	0.0	44.6	~179.0	~110.7
Queue Length 95th (m)	#54.3	153.6	10.7	#26.1	#376.2	0.0	#111.7	#171.5	15.8	#87.9	#246.6	#175.5
Internal Link Dist (m)		349.1			515.1			303.7			513.6	
Turn Bay Length (m)	300.0		110.0	140.0		100.0	50.0			110.0		20.0
Base Capacity (vph)	267	1938	964	179	1968	933	266	313	365	256	439	436
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.12	0.73	0.22	0.72	1.16	0.04	1.92	1.23	0.32	0.93	1.33	1.09

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC ROW Expressway

6/12/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 		 				 	
Volume (vph)	299	1414	212	128	2283	38	510	386	118	238	585	476
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Flt Permitted	0.06	1.00	1.00	0.09	1.00	1.00	0.20	1.00	1.00	0.17	1.00	1.00
Satd. Flow (perm)	225	3579	1601	163	3579	1601	731	1883	1601	314	1883	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	299	1414	212	128	2283	38	510	386	118	238	585	476
RTOR Reduction (vph)	0	0	97	0	0	17	0	0	98	0	0	63
Lane Group Flow (vph)	299	1414	115	128	2283	21	510	386	20	238	585	413
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	70.0	65.0	65.0	72.0	66.0	66.0	25.0	20.0	20.0	37.0	28.0	28.0
Effective Green, g (s)	70.0	65.0	65.0	72.0	66.0	66.0	25.0	20.0	20.0	37.0	28.0	28.0
Actuated g/C Ratio	0.58	0.54	0.54	0.60	0.55	0.55	0.21	0.17	0.17	0.31	0.23	0.23
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
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	3.0
Lane Grp Cap (vph)	266	1938	867	179	1968	880	266	313	266	256	439	373
v/s Ratio Prot	c0.05	0.40		0.04	c0.64		c0.08	0.20		0.10	c0.31	
v/s Ratio Perm	0.61		0.07	0.39		0.01	c0.32		0.01	0.19		0.26
v/c Ratio	1.12	0.73	0.13	0.72	1.16	0.02	1.92	1.23	0.07	0.93	1.33	1.11
Uniform Delay, d1	32.5	20.8	13.6	18.7	27.0	12.3	46.9	50.0	42.2	35.0	46.0	46.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	92.7	1.4	0.1	12.7	78.1	0.0	426.5	129.6	0.5	37.2	164.6	78.9
Delay (s)	125.3	22.2	13.6	31.4	105.1	12.3	473.3	179.6	42.7	72.3	210.6	124.9
Level of Service	F	C	B	C	F	B	F	F	D	E	F	F
Approach Delay (s)		37.3			99.8			311.4			153.8	
Approach LOS		D			F			F			F	

Intersection Summary

HCM 2000 Control Delay	124.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.32		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	130.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

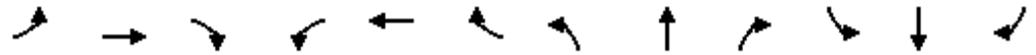
Lanes, Volumes, Timings
 4: Banwell Road & EC Row Expressway

6/12/2015

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 		 				 	
Volume (vph)	395	1614	43	49	1469	81	73	341	45	213	374	123
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	300.0		110.0	140.0		100.0	50.0		0.0	110.0		20.0
Storage Lanes	2		1	1		1	2		1	1		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Fr _t			0.850			0.850			0.850			0.850
Fl _t Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Fl _t Permitted	0.068			0.073			0.314			0.194		
Satd. Flow (perm)	248	3579	1601	137	3579	1601	1147	1883	1601	365	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			118			155			155			118
Link Speed (k/h)		80			80			60				60
Link Distance (m)		373.1			539.1			327.7				537.6
Travel Time (s)		16.8			24.3			19.7				32.3
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	416	1699	45	52	1546	85	77	359	47	224	394	129
Shared Lane Traffic (%)												
Lane Group Flow (vph)	416	1699	45	52	1546	85	77	359	47	224	394	129
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			7.4				7.4
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7				28.7
Detector 2 Size(m)		1.8			1.8			1.8				1.8
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6

Lanes, Volumes, Timings
 4: Banwell Road & EC Row Expressway

6/12/2015

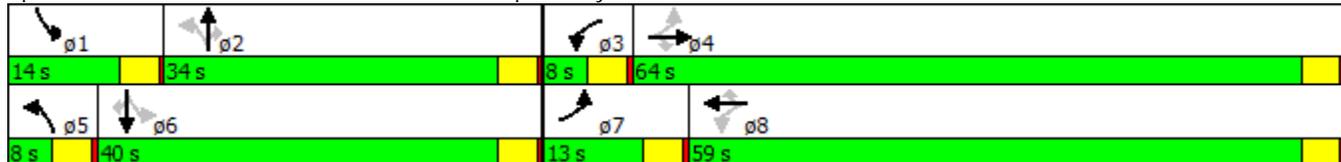


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	13.0	64.0	64.0	8.0	59.0	59.0	8.0	34.0	34.0	14.0	40.0	40.0
Total Split (%)	10.8%	53.3%	53.3%	6.7%	49.2%	49.2%	6.7%	28.3%	28.3%	11.7%	33.3%	33.3%
Maximum Green (s)	9.0	60.0	60.0	4.0	55.0	55.0	4.0	30.0	30.0	10.0	36.0	36.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max	Max
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effct Green (s)	67.2	60.8	60.8	58.2	54.2	54.2	34.0	30.0	30.0	44.0	37.6	37.6
Actuated g/C Ratio	0.56	0.51	0.51	0.49	0.45	0.45	0.29	0.25	0.25	0.37	0.32	0.32
v/c Ratio	1.09	0.93	0.05	0.43	0.95	0.10	0.19	0.76	0.09	0.88	0.66	0.22
Control Delay	99.6	38.1	0.1	23.2	44.9	0.3	26.2	53.1	0.4	63.8	42.6	7.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	99.6	38.1	0.1	23.2	44.9	0.3	26.2	53.1	0.4	63.8	42.6	7.9
LOS	F	D	A	C	D	A	C	D	A	E	D	A
Approach Delay		49.1			41.9			43.7			43.0	
Approach LOS		D			D			D			D	

Intersection Summary

Area Type:	Other
Cycle Length:	120
Actuated Cycle Length:	119.2
Natural Cycle:	90
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	1.09
Intersection Signal Delay:	45.3
Intersection LOS:	D
Intersection Capacity Utilization:	95.0%
ICU Level of Service:	F
Analysis Period (min):	15

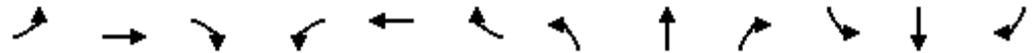
Splits and Phases: 4: Banwell Road & EC Row Expressway



Queues

4: Banwell Road & EC Row Expressway

6/12/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	416	1699	45	52	1546	85	77	359	47	224	394	129
v/c Ratio	1.09	0.93	0.05	0.43	0.95	0.10	0.19	0.76	0.09	0.88	0.66	0.22
Control Delay	99.6	38.1	0.1	23.2	44.9	0.3	26.2	53.1	0.4	63.8	42.6	7.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	99.6	38.1	0.1	23.2	44.9	0.3	26.2	53.1	0.4	63.8	42.6	7.9
Queue Length 50th (m)	-41.0	194.1	0.0	5.2	178.5	0.0	6.0	78.7	0.0	37.9	82.1	1.8
Queue Length 95th (m)	#72.8	#249.7	0.0	10.8	#229.4	0.0	11.1	#115.4	0.0	#70.1	117.1	15.7
Internal Link Dist (m)		349.1			515.1			303.7				513.6
Turn Bay Length (m)	300.0		110.0	140.0		100.0	50.0			110.0		20.0
Base Capacity (vph)	383	1826	874	122	1651	822	405	473	518	254	594	586
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.09	0.93	0.05	0.43	0.94	0.10	0.19	0.76	0.09	0.88	0.66	0.22

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC Row Expressway

6/12/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 		 				 	
Volume (vph)	395	1614	43	49	1469	81	73	341	45	213	374	123
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Flt Permitted	0.07	1.00	1.00	0.07	1.00	1.00	0.31	1.00	1.00	0.19	1.00	1.00
Satd. Flow (perm)	247	3579	1601	137	3579	1601	1147	1883	1601	365	1883	1601
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	416	1699	45	52	1546	85	77	359	47	224	394	129
RTOR Reduction (vph)	0	0	22	0	0	46	0	0	35	0	0	81
Lane Group Flow (vph)	416	1699	23	52	1546	39	77	359	12	224	394	48
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	68.1	60.9	60.9	58.3	55.1	55.1	34.0	30.8	30.8	44.8	37.6	37.6
Effective Green, g (s)	68.1	60.9	60.9	58.3	55.1	55.1	34.0	30.8	30.8	44.8	37.6	37.6
Actuated g/C Ratio	0.56	0.50	0.50	0.48	0.46	0.46	0.28	0.25	0.25	0.37	0.31	0.31
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
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	3.0
Lane Grp Cap (vph)	379	1802	806	109	1631	729	384	479	407	253	585	497
v/s Ratio Prot	c0.08	0.47		0.01	0.43		0.01	0.19		c0.07	0.21	
v/s Ratio Perm	c0.54		0.01	0.22		0.02	0.05		0.01	c0.25		0.03
v/c Ratio	1.10	0.94	0.03	0.48	0.95	0.05	0.20	0.75	0.03	0.89	0.67	0.10
Uniform Delay, d1	36.9	28.4	15.1	27.2	31.5	18.4	32.6	41.5	33.8	31.5	36.3	29.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	75.1	10.6	0.0	3.3	12.0	0.0	0.3	10.3	0.1	28.6	6.1	0.4
Delay (s)	112.0	38.9	15.1	30.5	43.5	18.4	32.9	51.8	34.0	60.1	42.4	30.0
Level of Service	F	D	B	C	D	B	C	D	C	E	D	C
Approach Delay (s)		52.5			41.9			47.0			45.6	
Approach LOS		D			D			D			D	

Intersection Summary

HCM 2000 Control Delay	47.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	120.9	Sum of lost time (s)	16.0
Intersection Capacity Utilization	95.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

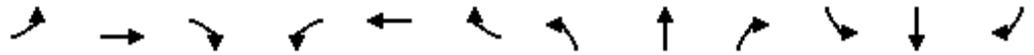
Lanes, Volumes, Timings
 4: Banwell Road & EC ROW Expressway

6/12/2015

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	232	1105	42	79	1784	29	234	177	7	185	347	371
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	300.0		110.0	140.0		100.0	50.0		0.0	110.0		20.0
Storage Lanes	2		1	1		1	2		1	1		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Fr _t			0.850			0.850			0.850			0.850
Fl _t Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Fl _t Permitted	0.060			0.157			0.226			0.342		
Satd. Flow (perm)	219	3579	1601	296	3579	1601	826	1883	1601	644	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			118			118			118			83
Link Speed (k/h)		80			80			60				60
Link Distance (m)		373.1			539.1			327.7				537.6
Travel Time (s)		16.8			24.3			19.7				32.3
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	244	1163	44	83	1878	31	246	186	7	195	365	391
Shared Lane Traffic (%)												
Lane Group Flow (vph)	244	1163	44	83	1878	31	246	186	7	195	365	391
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			7.4				7.4
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7				28.7
Detector 2 Size(m)		1.8			1.8			1.8				1.8
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6

Lanes, Volumes, Timings
 4: Banwell Road & EC ROW Expressway

6/12/2015

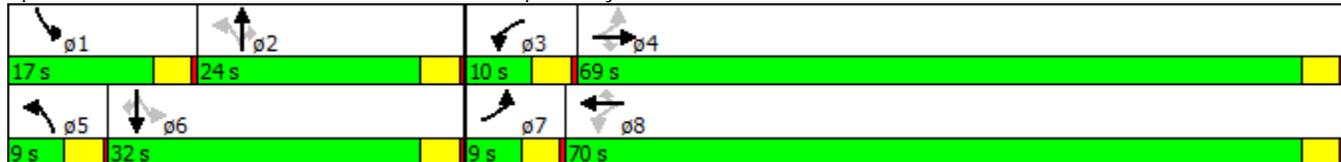


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	9.0	69.0	69.0	10.0	70.0	70.0	9.0	24.0	24.0	17.0	32.0	32.0
Total Split (%)	7.5%	57.5%	57.5%	8.3%	58.3%	58.3%	7.5%	20.0%	20.0%	14.2%	26.7%	26.7%
Maximum Green (s)	5.0	65.0	65.0	6.0	66.0	66.0	5.0	20.0	20.0	13.0	28.0	28.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max	Max
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effct Green (s)	70.4	66.4	66.4	71.4	65.4	65.4	25.6	20.6	20.6	37.0	28.0	28.0
Actuated g/C Ratio	0.59	0.56	0.56	0.60	0.55	0.55	0.21	0.17	0.17	0.31	0.23	0.23
v/c Ratio	0.92	0.58	0.05	0.33	0.96	0.03	0.85	0.57	0.02	0.61	0.83	0.89
Control Delay	59.4	19.3	0.1	12.5	38.8	0.1	62.7	53.7	0.1	41.4	60.4	58.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.4	19.3	0.1	12.5	38.8	0.1	62.7	53.7	0.1	41.4	60.4	58.4
LOS	E	B	A	B	D	A	E	D	A	D	E	E
Approach Delay		25.5			37.1			57.9			55.7	
Approach LOS		C			D			E			E	

Intersection Summary

Area Type:	Other
Cycle Length:	120
Actuated Cycle Length:	119.4
Natural Cycle:	90
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	0.96
Intersection Signal Delay:	39.2
Intersection LOS:	D
Intersection Capacity Utilization:	94.2%
ICU Level of Service:	F
Analysis Period (min):	15

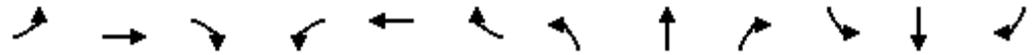
Splits and Phases: 4: Banwell Road & EC ROW Expressway



Queues

4: Banwell Road & EC ROW Expressway

6/12/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	244	1163	44	83	1878	31	246	186	7	195	365	391
v/c Ratio	0.92	0.58	0.05	0.33	0.96	0.03	0.85	0.57	0.02	0.61	0.83	0.89
Control Delay	59.4	19.3	0.1	12.5	38.8	0.1	62.7	53.7	0.1	41.4	60.4	58.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.4	19.3	0.1	12.5	38.8	0.1	62.7	53.7	0.1	41.4	60.4	58.4
Queue Length 50th (m)	14.4	93.8	0.0	7.2	211.0	0.0	22.2	41.0	0.0	35.6	82.3	72.7
Queue Length 95th (m)	#39.2	114.3	0.0	13.4	#272.5	0.0	#34.4	64.8	0.0	56.1	#129.0	#128.3
Internal Link Dist (m)		349.1			515.1			303.7			513.6	
Turn Bay Length (m)	300.0		110.0	140.0		100.0	50.0			110.0		20.0
Base Capacity (vph)	265	1990	943	252	1979	937	288	324	374	324	441	439
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.92	0.58	0.05	0.33	0.95	0.03	0.85	0.57	0.02	0.60	0.83	0.89

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

4: Banwell Road & EC ROW Expressway

6/12/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 		 				 	
Volume (vph)	232	1105	42	79	1784	29	234	177	7	185	347	371
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Flt Permitted	0.06	1.00	1.00	0.16	1.00	1.00	0.23	1.00	1.00	0.34	1.00	1.00
Satd. Flow (perm)	220	3579	1601	296	3579	1601	824	1883	1601	643	1883	1601
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	244	1163	44	83	1878	31	246	186	7	195	365	391
RTOR Reduction (vph)	0	0	20	0	0	14	0	0	6	0	0	64
Lane Group Flow (vph)	244	1163	24	83	1878	17	246	186	1	195	365	327
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	71.4	66.4	66.4	71.0	66.2	66.2	25.6	20.6	20.6	37.0	28.0	28.0
Effective Green, g (s)	71.4	66.4	66.4	71.0	66.2	66.2	25.6	20.6	20.6	37.0	28.0	28.0
Actuated g/C Ratio	0.59	0.55	0.55	0.59	0.55	0.55	0.21	0.17	0.17	0.31	0.23	0.23
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
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	3.0
Lane Grp Cap (vph)	265	1977	884	234	1971	881	285	322	274	316	438	372
v/s Ratio Prot	c0.04	0.32		0.01	c0.52		c0.04	0.10		0.06	0.19	
v/s Ratio Perm	0.51		0.02	0.20		0.01	0.15		0.00	0.13		c0.20
v/c Ratio	0.92	0.59	0.03	0.35	0.95	0.02	0.86	0.58	0.00	0.62	0.83	0.88
Uniform Delay, d1	30.7	17.8	12.2	13.4	25.5	12.3	44.3	45.8	41.3	33.0	43.9	44.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	34.8	0.5	0.0	0.9	11.1	0.0	22.6	7.4	0.0	3.6	16.8	24.4
Delay (s)	65.6	18.3	12.2	14.3	36.7	12.3	66.9	53.2	41.3	36.5	60.7	68.9
Level of Service	E	B	B	B	D	B	E	D	D	D	E	E
Approach Delay (s)		26.1			35.3			60.7			59.1	
Approach LOS		C			D			E			E	
Intersection Summary												
HCM 2000 Control Delay			39.5				HCM 2000 Level of Service			D		
HCM 2000 Volume to Capacity ratio			0.93									
Actuated Cycle Length (s)			120.2				Sum of lost time (s)		16.0			
Intersection Capacity Utilization			94.2%				ICU Level of Service		F			
Analysis Period (min)			15									
c	Critical Lane Group											

Lanes, Volumes, Timings
120: CR 22 & Banwell Rd.

AM Peak Hour
Interim Background Traffic Volumes and Intersection Modifications

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 		 				 	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (m)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turning Speed (k/h)	24		20	24		40	24		14	24		14
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Fr _t			0.850			0.850			0.850			0.850
Fl _t Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3506	3444	1617	1825	3476	1617	3506	1902	1633	1807	1865	1541
Fl _t Permitted	0.950			0.950			0.950			0.428		
Satd. Flow (perm)	3506	3444	1617	1825	3476	1617	3506	1902	1633	814	1865	1541
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			83			20			31			306
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Link Speed (k/h)		50			50			70			70	
Link Distance (m)		330.3			1360.2			1043.4			741.1	
Travel Time (s)		23.8			97.9			53.7			38.1	
Volume (vph)	195	965	80	115	1725	55	225	175	30	115	135	505
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	1%	6%	1%	0%	5%	1%	1%	1%	0%	1%	3%	6%
Adj. Flow (vph)	203	1005	83	120	1797	57	234	182	31	120	141	526
Lane Group Flow (vph)	203	1005	83	120	1797	57	234	182	31	120	141	526
Turn Type	Prot		Perm	Prot		Free	Prot		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			Free			8	4		4
Detector Phases	5	2	2	1	6		3	8	8	7	4	4
Minimum Initial (s)	9.0	15.0	15.0	9.0	15.0		9.0	12.0	12.0	7.0	12.0	12.0
Minimum Split (s)	13.0	21.0	21.0	13.0	21.0		13.0	17.0	17.0	11.0	17.0	17.0
Total Split (s)	29.0	51.0	51.0	14.0	51.0	0.0	14.0	25.0	25.0	14.0	25.0	25.0
Total Split (%)	24.4%	42.9%	42.9%	11.8%	42.9%	0.0%	11.8%	21.0%	21.0%	11.8%	21.0%	21.0%
Maximum Green (s)	25.0	45.0	45.0	10.0	45.0		10.0	20.0	20.0	10.0	20.0	20.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0		1.0	1.0	1.0	1.0	1.0	1.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.5	4.0	4.0	3.5	4.0		3.5	4.0	4.0	3.5	4.0	4.0
Recall Mode	None	Min	Min	None	Min		Min	Min	Min	Min	None	None
Act Effct Green (s)	11.9	49.1	49.1	9.8	47.0	105.9	9.9	21.6	21.6	30.4	21.0	21.0
Actuated g/C Ratio	0.11	0.46	0.46	0.09	0.44	1.00	0.09	0.20	0.20	0.29	0.20	0.20
v/c Ratio	0.51	0.63	0.10	0.71	1.16	0.04	0.71	0.47	0.09	0.37	0.38	0.95
Control Delay	49.0	23.6	3.8	70.5	110.5	0.0	59.7	42.5	13.2	29.8	40.9	47.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.0	23.6	3.8	70.5	110.5	0.0	59.7	42.5	13.2	29.8	40.9	47.3
LOS	D	C	A	E	F	A	E	D	B	C	D	D
Approach Delay		26.3			104.9			49.5			43.5	
Approach LOS		C			F			D			D	
90th %ile Green (s)	15.2	50.2	50.2	10.0	45.0		10.0	20.0	20.0	10.0	20.0	20.0
90th %ile Term Code	Gap	Hold	Hold	Max	Max		Max	Max	Max	Max	Max	Max

Lanes, Volumes, Timings
120: CR 22 & Banwell Rd.

AM Peak Hour
Interim Background Traffic Volumes and Intersection Modifications

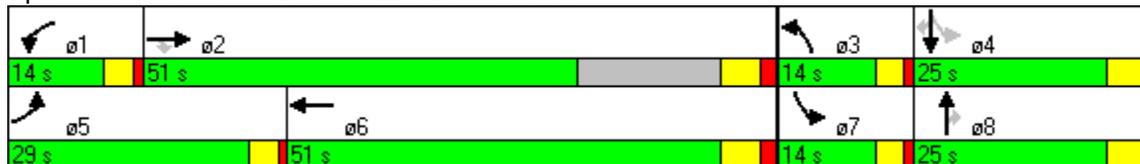


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
70th %ile Green (s)	13.2	48.2	48.2	10.0	45.0		10.0	20.0	20.0	10.0	20.0	20.0
70th %ile Term Code	Gap	Hold	Hold	Max	Max		Max	Hold	Hold	Max	Max	Max
50th %ile Green (s)	11.9	46.9	46.9	10.0	45.0		10.0	20.0	20.0	10.0	20.0	20.0
50th %ile Term Code	Gap	Hold	Hold	Max	Max		Max	Hold	Hold	Max	Max	Max
30th %ile Green (s)	10.5	45.5	45.5	10.0	45.0		10.0	20.6	20.6	9.4	20.0	20.0
30th %ile Term Code	Gap	Hold	Hold	Max	Max		Max	Hold	Hold	Gap	Max	Max
10th %ile Green (s)	9.0	45.0	45.0	9.0	45.0		9.7	22.3	22.3	7.4	20.0	20.0
10th %ile Term Code	Min	Hold	Hold	Min	Max		Gap	Hold	Hold	Gap	Max	Max
Queue Length 50th (m)	20.3	79.4	0.0	24.1	~229.3	0.0	24.2	33.1	0.0	17.4	25.1	49.2
Queue Length 95th (m)	31.4	99.5	7.7	#51.5	#283.6	0.0	#40.5	55.7	7.9	32.2	44.5	#119.0
Internal Link Dist (m)		306.3			1336.2			1019.4			717.1	
Turn Bay Length (m)												
Base Capacity (vph)	737	1798	884	172	1543	1617	331	388	358	330	370	551
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.56	0.09	0.70	1.16	0.04	0.71	0.47	0.09	0.36	0.38	0.95

Intersection Summary

Area Type: Other
 Cycle Length: 119
 Actuated Cycle Length: 105.9
 Natural Cycle: 130
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.16
 Intersection Signal Delay: 66.1 Intersection LOS: E
 Intersection Capacity Utilization 96.5% ICU Level of Service F
 Analysis Period (min) 15
 90th %ile Actuated Cycle: 109.2
 70th %ile Actuated Cycle: 107.2
 50th %ile Actuated Cycle: 105.9
 30th %ile Actuated Cycle: 104.5
 10th %ile Actuated Cycle: 102.7
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 120: CR 22 & Banwell Rd.



HCM Signalized Intersection Capacity Analysis

AM Peak Hour

120: CR 22 & Banwell Rd.

Interim Background Traffic Volumes and Intersection Modifications

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 		 				 	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3506	3444	1617	1825	3476	1617	3506	1902	1633	1807	1865	1541
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.49	1.00	1.00
Satd. Flow (perm)	3506	3444	1617	1825	3476	1617	3506	1902	1633	939	1865	1541
Volume (vph)	195	965	80	115	1725	55	225	175	30	115	135	505
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	203	1005	83	120	1797	57	234	182	31	120	141	526
RTOR Reduction (vph)	0	0	44	0	0	0	0	0	25	0	0	245
Lane Group Flow (vph)	203	1005	39	120	1797	57	234	182	6	120	141	281
Heavy Vehicles (%)	1%	6%	1%	0%	5%	1%	1%	1%	0%	1%	3%	6%
Turn Type	Prot		Perm	Prot		Free	Prot		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			Free			8	4		4
Actuated Green, G (s)	11.9	47.1	47.1	9.8	45.0	105.8	9.9	20.6	20.6	29.3	20.0	20.0
Effective Green, g (s)	11.9	49.1	49.1	9.8	47.0	105.8	9.9	21.6	21.6	30.3	21.0	21.0
Actuated g/C Ratio	0.11	0.46	0.46	0.09	0.44	1.00	0.09	0.20	0.20	0.29	0.20	0.20
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.5	4.0	4.0	3.5	4.0		3.5	4.0	4.0	3.5	4.0	4.0
Lane Grp Cap (vph)	394	1598	750	169	1544	1617	328	388	333	345	370	306
v/s Ratio Prot	0.06	0.29		c0.07	c0.52		c0.07	0.10		0.03	0.08	
v/s Ratio Perm			0.02			c0.04			0.00	0.07		c0.18
v/c Ratio	0.52	0.63	0.05	0.71	1.16	0.04	0.71	0.47	0.02	0.35	0.38	0.92
Uniform Delay, d1	44.2	21.5	15.6	46.6	29.4	0.0	46.6	37.1	33.6	29.0	36.8	41.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.3	0.9	0.0	13.6	81.3	0.0	7.4	1.2	0.0	0.7	0.9	31.1
Delay (s)	45.6	22.3	15.6	60.2	110.7	0.0	54.0	38.3	33.7	29.7	37.7	72.6
Level of Service	D	C	B	E	F	A	D	D	C	C	D	E
Approach Delay (s)		25.6			104.4			46.2			59.8	
Approach LOS		C			F			D			E	
Intersection Summary												
HCM Average Control Delay			68.2			HCM Level of Service				E		
HCM Volume to Capacity ratio			0.98									
Actuated Cycle Length (s)			105.8			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			96.5%			ICU Level of Service			F			
Analysis Period (min)			15									

c Critical Lane Group

Lanes, Volumes, Timings
120: CR 22 & Banwell Rd.

PM Peak Hour
Interim Background Traffic Volumes and Intersection Modifications

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 		 					
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		15.0
Storage Lanes	2		1	1		1	2		1	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (m)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turning Speed (k/h)	24		20	24		40	24		14	24		14
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Fr _t			0.850			0.850			0.850			0.850
Fl _t Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3506	3444	1617	1825	3476	1617	3506	1902	1633	1807	1865	1541
Fl _t Permitted	0.950			0.950			0.950			0.190		
Satd. Flow (perm)	3506	3444	1617	1825	3476	1617	3506	1902	1633	361	1865	1541
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			214			121			89			260
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Link Speed (k/h)		50			50			70			70	
Link Distance (m)		330.3			1360.2			1043.4			741.1	
Travel Time (s)		23.8			97.9			53.7			38.1	
Volume (vph)	505	1730	280	20	1175	225	120	280	85	255	205	250
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	1%	6%	1%	0%	5%	1%	1%	1%	0%	1%	3%	6%
Adj. Flow (vph)	526	1802	292	21	1224	234	125	292	89	266	214	260
Lane Group Flow (vph)	526	1802	292	21	1224	234	125	292	89	266	214	260
Turn Type	Prot		Perm	Prot		Free	Prot		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			Free			8	4		4
Detector Phases	5	2	2	1	6		3	8	8	7	4	4
Minimum Initial (s)	9.0	15.0	15.0	9.0	15.0		7.0	12.0	12.0	7.0	12.0	12.0
Minimum Split (s)	13.0	21.0	21.0	13.0	21.0		11.0	17.0	17.0	11.0	17.0	17.0
Total Split (s)	29.0	51.0	51.0	14.0	51.0	0.0	14.0	25.0	25.0	14.0	25.0	25.0
Total Split (%)	24.4%	42.9%	42.9%	11.8%	42.9%	0.0%	11.8%	21.0%	21.0%	11.8%	21.0%	21.0%
Maximum Green (s)	25.0	45.0	45.0	10.0	45.0		10.0	20.0	20.0	10.0	20.0	20.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0		1.0	1.0	1.0	1.0	1.0	1.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.5	4.0	4.0	3.5	4.0		3.5	4.0	4.0	3.5	4.0	4.0
Recall Mode	None	Min	Min	None	Min		Min	Min	Min	Min	None	None
Act Effct Green (s)	21.5	65.5	65.5	9.1	45.0	112.8	9.1	20.1	20.1	31.1	21.1	21.1
Actuated g/C Ratio	0.19	0.58	0.58	0.08	0.40	1.00	0.08	0.18	0.18	0.28	0.19	0.19
v/c Ratio	0.79	0.90	0.28	0.15	0.88	0.14	0.44	0.86	0.24	1.16	0.61	0.52
Control Delay	53.0	29.5	4.7	55.4	40.9	0.2	56.0	70.4	10.6	144.1	52.4	9.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.0	29.5	4.7	55.4	40.9	0.2	56.0	70.4	10.6	144.1	52.4	9.3
LOS	D	C	A	E	D	A	E	E	B	F	D	A
Approach Delay		31.5			34.6			56.4			70.2	
Approach LOS		C			C			E			E	

Lanes, Volumes, Timings
120: CR 22 & Banwell Rd.

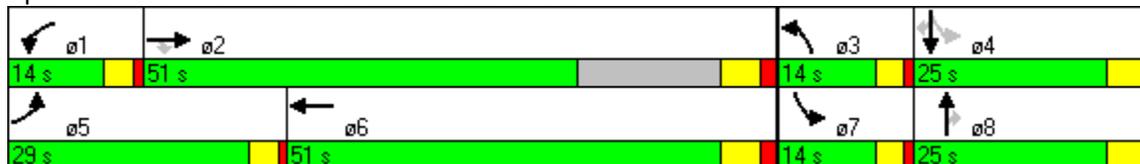
PM Peak Hour
Interim Background Traffic Volumes and Intersection Modifications

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
90th %ile Green (s)	25.0	60.7	60.7	9.3	45.0		10.0	20.0	20.0	10.0	20.0	20.0
90th %ile Term Code	Max	Hold	Hold	Gap	Max		Max	Max	Max	Max	Max	Max
70th %ile Green (s)	25.0	61.0	61.0	9.0	45.0		10.0	20.0	20.0	10.0	20.0	20.0
70th %ile Term Code	Max	Hold	Hold	Min	Max		Max	Max	Max	Max	Max	Max
50th %ile Green (s)	23.0	72.0	72.0	0.0	45.0		10.0	20.0	20.0	10.0	20.0	20.0
50th %ile Term Code	Gap	Hold	Hold	Skip	Max		Max	Max	Max	Max	Hold	Hold
30th %ile Green (s)	20.5	69.5	69.5	0.0	45.0		8.9	20.0	20.0	10.0	21.1	21.1
30th %ile Term Code	Gap	Hold	Hold	Skip	Max		Gap	Max	Max	Max	Hold	Hold
10th %ile Green (s)	15.0	54.0	54.0	0.0	35.0		7.0	15.7	15.7	10.0	18.7	18.7
10th %ile Term Code	Gap	Hold	Hold	Skip	Gap		Min	Gap	Gap	Max	Hold	Hold
Queue Length 50th (m)	58.4	153.2	6.3	4.5	132.6	0.0	14.0	64.7	0.0	~57.9	45.3	0.0
Queue Length 95th (m)	77.0	#267.3	22.7	12.5	#170.0	0.0	23.8	#112.3	13.6	#112.6	71.6	22.2
Internal Link Dist (m)		306.3			1336.2			1019.4			717.1	
Turn Bay Length (m)												15.0
Base Capacity (vph)	757	2017	1036	151	1426	1617	310	353	375	229	352	502
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.89	0.28	0.14	0.86	0.14	0.40	0.83	0.24	1.16	0.61	0.52

Intersection Summary

Area Type: Other
 Cycle Length: 119
 Actuated Cycle Length: 112.8
 Natural Cycle: 120
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.16
 Intersection Signal Delay: 40.1 Intersection LOS: D
 Intersection Capacity Utilization 97.5% ICU Level of Service F
 Analysis Period (min) 15
 90th %ile Actuated Cycle: 119
 70th %ile Actuated Cycle: 119
 50th %ile Actuated Cycle: 117
 30th %ile Actuated Cycle: 114.5
 10th %ile Actuated Cycle: 94.7
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 120: CR 22 & Banwell Rd.



HCM Signalized Intersection Capacity Analysis

PM Peak Hour

120: CR 22 & Banwell Rd.

Interim Background Traffic Volumes and Intersection Modifications

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 		 				 	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3506	3444	1617	1825	3476	1617	3506	1902	1633	1807	1865	1541
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.19	1.00	1.00
Satd. Flow (perm)	3506	3444	1617	1825	3476	1617	3506	1902	1633	361	1865	1541
Volume (vph)	505	1730	280	20	1175	225	120	280	85	255	205	250
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	526	1802	292	21	1224	234	125	292	89	266	214	260
RTOR Reduction (vph)	0	0	92	0	0	0	0	0	73	0	0	212
Lane Group Flow (vph)	526	1802	200	21	1224	234	125	292	16	266	214	48
Heavy Vehicles (%)	1%	6%	1%	0%	5%	1%	1%	1%	0%	1%	3%	6%
Turn Type	Prot		Perm	Prot		Free	Prot		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			Free			8	4		4
Actuated Green, G (s)	21.5	63.5	63.5	3.5	45.5	115.2	9.1	19.1	19.1	30.2	20.1	20.1
Effective Green, g (s)	21.5	65.5	65.5	3.5	47.5	115.2	9.1	20.1	20.1	31.2	21.1	21.1
Actuated g/C Ratio	0.19	0.57	0.57	0.03	0.41	1.00	0.08	0.17	0.17	0.27	0.18	0.18
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.5	4.0	4.0	3.5	4.0		3.5	4.0	4.0	3.5	4.0	4.0
Lane Grp Cap (vph)	654	1958	919	55	1433	1617	277	332	285	225	342	282
v/s Ratio Prot	c0.15	c0.52		0.01	0.35		0.04	0.15		c0.10	0.11	
v/s Ratio Perm			0.12			c0.14			0.01	c0.22		0.03
v/c Ratio	0.80	0.92	0.22	0.38	0.85	0.14	0.45	0.88	0.05	1.18	0.63	0.17
Uniform Delay, d1	44.8	22.5	12.2	54.8	30.7	0.0	50.7	46.4	39.6	38.4	43.4	39.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.3	7.8	0.2	5.2	5.4	0.2	1.4	22.8	0.1	118.1	4.0	0.4
Delay (s)	52.1	30.2	12.4	59.9	36.1	0.2	52.0	69.2	39.7	156.4	47.4	40.0
Level of Service	D	C	B	E	D	A	D	E	D	F	D	D
Approach Delay (s)		32.7			30.7			59.8			84.0	
Approach LOS		C			C			E			F	
Intersection Summary												
HCM Average Control Delay			41.8			HCM Level of Service			D			
HCM Volume to Capacity ratio			0.98									
Actuated Cycle Length (s)			115.2	Sum of lost time (s)			12.0					
Intersection Capacity Utilization			97.5%	ICU Level of Service			F					
Analysis Period (min)			15									

c Critical Lane Group