



25 Vine Street Gardiner, ME 04345
 (207) 582-5252 FAX (207) 582-1677
 mainetrafficresources.com

SUMMARY MEMORANDUM

TO: Ms. Karen Johnson, AICP
 Charter Realty & Development Corp.
 800 Westchester Avenue, Suite S-632
 Rye Brook, NY 10573

DATE: March 24, 2014

RE: Trip Generation and Traffic Analysis for Proposed Dunkin' Donuts at Westgate Plaza in Portland

The purpose of this memorandum is to summarize trip generation and capacity analysis prepared for a proposed new Dunkin' Donuts to be located in the Westgate Shopping Center in Portland, Maine. The site location is shown on the map in Figure 1. The proposed Dunkin' Donuts' building was previously occupied by a Tim Horton's and has an existing drive-through window. The Tim Horton's was approved by the City of Portland in a Traffic Movement Permit (TMP) in 2008. This traffic permit was issued for 174 AM peak hour trips, based upon the Supplemental AM Analysis for Westgate Plaza Expansion, prepared by Maine Traffic Resources and dated May 7, 2008. That analysis and permit was based upon a 3,000 square foot Tim Horton's. The existing building is actually 2,474 square feet (S. F.) in size based upon the site plan you provided. The proposed project will reoccupy this 2,474 S.F. building as a Dunkin' Donuts shop with drive-through facility.

Trip Generation

The number of trips to be generated by the proposed Dunkin' Donuts addition was estimated using the Institute of Transportation Engineers (ITE) "Trip Generation, 9th Edition" report and Maine's Dunkin' Donuts equations for the AM peak hour. AM peak traffic volumes were obtained from traffic counts performed by Maine Traffic Resources on February 4, 2014, factored to peak summer conditions. The Maine Dunkin' Donuts equations for the proposed 2,474 S.F. facility are shown below:

Square Footage $y = 0.0536(2,474) + 142.75 = 132.61 + 142.75 = 275$ trips

AADT $y = 0.0081X + 139.36$

AADT on Congress Street = 19,160

$y = 0.0081(19,160) + 139.36 = 155.2 + 139.36 = 295$ trips

AM Peak Traffic $y = 0.1061X + 144.49$

$y = 0.1061(1,895) = 201.06 + 144.49 = 346$ trips

Average of Equations = 305 AM peak hour trips

As can be seen in the preceding calculations, the Dunkin' Donuts is projected to generate 305 trips during the AM peak hour. Trip generation for the Dunkin' Donuts on a daily and non-AM basis was estimated using ITE land use code (LUC) 934 – Fast-Food Restaurant with Drive-Through Window. The overall results for the proposed Dunkin' Donuts are summarized below:

**Trip Generation (one-way trip ends)
Proposed Dunkin' Donuts**

<u>Time Period</u>	<u>Trips</u>
Weekday	1,228
AM Peak Hour - Adj. Street	305
AM Peak Hour – Generator	305
PM Peak Hour - Adj. Street	81
PM Peak Hour – Generator	117

Trip generation for the former Tim Horton's shop was taken from the Traffic Movement Permit application and the supplemental AM analysis prepared by Maine Traffic Resources. The results are presented below:

**Trip Generation (one-way trip ends)
Former Tim Horton's**

<u>Time Period</u>	<u>S.F.</u>
Weekday	1,228
AM Peak Hour - Adj. Street	174
AM Peak Hour – Generator	174
PM Peak Hour - Adj. Street	87
PM Peak Hour – Generator	117

A comparison is shown below for projected Dunkin' Donuts volumes versus the permitted volumes for the former Tim Horton's.

New Trip Generation (one-way trip ends)

<u>Time Period</u>	<u>DD</u>	<u>Tim Horton's</u>	<u>New</u>
Weekday	1,228	1,228	0
AM Peak Hour - Adj. Street	305	174	131
AM Peak Hour – Generator	305	174	131
PM Peak Hour - Adj. Street	81	87	-6
PM Peak Hour – Generator	117	117	0

As can be seen in the preceding table, based upon ITE data and Maine's Dunkin Donuts equations, the Dunkin Donuts is projected to generate 131 new one-way trips during the AM peak hour. As a result, the project requires a Traffic Movement Permit modification. Given that there will be no new trips generated during the PM peak hour period, and given the high AM trip generation for Dunkin' Donuts, the AM peak hour is expected to be the only analysis period required by the City or Portland.

Not all of the trips generated by Dunkin Donuts will be new trips. Many of the trips will be pass-by trips, trips that are already on Congress Street or Stevens Avenue. Based upon Maine's Dunkin Donuts study, 70 % of the AM peak hour trips are pass-by trips. This results in the following trip summary for the AM analysis period:

<u>Time Period</u>	<u>Pass-by Trips</u>	<u>Primary Trips</u>	<u>Total Trips</u>
AM Peak Hour – Adj. Street	213	92	305
Entering	107	46	153
Exiting	106	46	152

The Additional Dunkin' Donuts trips were assigned to the Westgate Plaza access drives based upon the recorded traffic patterns. The results are shown in Figure 2.

Traffic Volumes

Updated turning movement/vehicle classification counts were conducted by Maine Traffic Resources at the following access intersections during the weekday AM peak hour period:

<u>Intersection Description</u>	<u>Count Date</u>	<u>Peak Hour</u>
Congress Street, Stevens Avenue and Westgate Plaza	2/4/2014	7:30 – 8:30 AM
Congress Street and Westgate Plaza Right-Turn Drive	2/11/2014	7:30 – 8:30 AM

The turning movement count summaries are attached to this memorandum. The counts were seasonally factored to represent 30th highest hour volumes, the volumes used for design and traffic analysis purposes, using MaineDOT factors, which generally occur in Maine under peak summer volumes in late July and early August. The resulting 2014 summer volumes for the study area are shown in Figure 3.

Capacity Analyses

Traffic operations are evaluated in terms of level of service (LOS). Level of service is a qualitative measure that describes operations by letter designation. The levels range from A - very little delay to F - extreme delays. Level of service "D" is generally considered acceptable in urban locations while LOS "E" is generally considered the capacity of a facility and the minimum tolerable level. The level of service for signalized intersections is based upon the average control or signal delay per vehicle. These criteria are defined in the following table excerpted from the 2000 "Highway Capacity Manual":

Signalized Intersection Level of Service

<u>LOS</u>	<u>Delay Range</u>
A	<= 10.0 seconds
B	> 10.0 and <= 20.0
C	> 20.0 and <= 35.0
D	> 35.0 and <= 55.0
E	> 55.0 and <= 80.0
F	> 80.0

The level of service for unsignalized intersections is based upon average control delay per vehicle for each minor, opposed movement, as defined in the following table:

Unsignalized Intersection Level of Service

<u>LOS</u>	<u>Delay Range</u>
A	<= 10.0 seconds
B	> 10.0 and <= 15.0
C	> 15.0 and <= 25.0
D	> 25.0 and <= 35.0
E	> 35.0 and <= 50.0
F	> 50.0

The level of service was calculated for the Congress Street access intersections for existing 2014, 2014 with the previous Tim Horton's and projected 2014 volumes with the proposed Dunkin' Donuts using Synchro 7 software for the AM peak hour analysis period. The results are summarized with the LOS followed by the delay in seconds in parentheses in the following table:

<u>Movement</u>	2014 AM Peak Hour Levels of Service		
	<u>Existing</u>	<u>W/ Tim Horton's</u>	<u>Build with DD</u>
Eastbound Congress Street Lefts	D (46.5)	D (46.7)	D (46.7)
Eastbound Congress Streets Throughs/Rights	C (30.9)	D (37.0)	D (39.5)
Eastbound Congress Street Overall	C (31.4)	D (37.3)	D (39.8)

Westbound Congress Street Lefts	D (44.8)	D (42.6)	D (44.2)
Westbound Congress Street Throughs	C (28.9)	C (28.2)	C (27.4)
Westbound Congress Street Rights	A (5.3)	A (6.3)	A (7.0)
Westbound Congress Street Overall	C (25.0)	C (25.0)	C (25.1)
Northbound Westgate Plaza Lefts	D (44.7)	D (45.3)	D (50.6)
Northbound Westgate Plaza Throughs/Rights	D (44.7)	D (41.7)	D (40.2)
Northbound Westgate Plaza Overall	D (44.7)	D (43.7)	D (46.7)
Southbound Stevens Avenue Lefts	D (48.9)	D (48.9)	D (49.9)
Southbound Stevens Avenue Throughs/Rights	B (18.1)	B (18.6)	B (19.1)
Southbound Stevens Avenue Overall	D (43.6)	D (42.8)	D (43.0)
Overall Intersection	C (31.6)	C (33.3)	C (34.4)

As can be seen above, the signalized intersection of Congress Street, Stevens Avenue and Westgate Plaza currently operates at an acceptable LOS "C" overall during the AM analysis period, with all lane movements at LOS "D" or better. The intersection will remain at LOS "C" overall, with all lane movements at LOS "D" or better, with the addition of the Dunkin' Donuts trips. Furthermore, all lane movements are expected to operate at the same LOS as they did previously when the Tim Horton's Restaurant was open. Based upon this, the proposed Dunkin' Donuts will have no significant impact on this access intersection.

The level of service was also calculated for the Westgate Plaza right-turn drive using Synchro 7. The results are summarized for the AM analysis period below:

<u>Movement</u>	2014 AM Peak Hour Levels of Service		
	Intersection of Congress Street and Right-Turn Drive		
	<u>Existing</u>	<u>W/ Tim Horton's</u>	<u>Build with DD</u>
Northbound Westgate Plaza Rights	B (12.4)	B (13.4)	B (14.3)

As can be seen above, the right-turn exit drive operates a high LOS "B" under existing and projected build volumes as well as with the former Tim Horton's trips. There are no capacity concerns on Congress Street at this right-turn only drive and the additional Dunkin' Donuts trips can be accommodated on Congress Street.

On-Site Analysis

Queue observations were made at a similar Dunkin' Donuts facility to determine expected queue lengths at the drive-through window. The store observed is in Brunswick, Maine on Pleasant Street. This Dunkin' Donuts store is very similar to the proposed store since it will be under the same ownership and since it is on the right (AM direction) side of a high volume four-lane road facility. The traffic volumes on Pleasant Street in Brunswick at

the Dunkin' Donuts are actually higher than the Congress Street location in Portland, 28,470 on Pleasant Street versus 19,160 on Congress Street. Given this, the Brunswick Dunkin' Donuts observed would be expected to generate more traffic than the proposed Portland store and queues would be longer than expected.

A Friday and a Monday were selected for the queue observations given data provided by the Dunkin' Donuts owner for the Brunswick drive-through. This data is attached to this memo and shows highest drive-through sales in March occur on Mondays and Fridays. This same sales report shows that August drive-through sales are similar to March so no significant seasonal variation is anticipated based upon the sales reports.

Queue observations were recorded on Friday, March 21st from 7:00 AM to 9:00 AM. The maximum queue recorded was 12 vehicles (one occurrence). There were two occurrences of 11 vehicles. The average queue was 7 vehicles from 7:00 to 8:00 AM while the average queue was 5 vehicles from 8:00 to 9:00 AM. The queue observations were repeated on Monday, March 24th from 7:00 AM to 8:30 AM. The maximum queue on Monday was 9 vehicles with average queues of 5 vehicles. The queue summaries are attached to this memorandum.

Given that the proposed Dunkin' Donuts can currently store approximately 11 vehicles this storage should be adequate to provide for the expected maximum queues, based upon the observations on Pleasant Street in Brunswick.

Given that neither off-site or on-site traffic issues have been identified by this analysis and that the proposed site change is simply a change in tenant, a simple Traffic Movement Permit modification is all that should be required. As always, do not hesitate to contact me if you have any questions or concerns regarding this analysis or the traffic permitting process for the proposed Dunkin' Donuts.



Sincerely,

A handwritten signature in black ink that reads "Diane W. Morabito".

Diane W. Morabito, P.E. PTOE
President

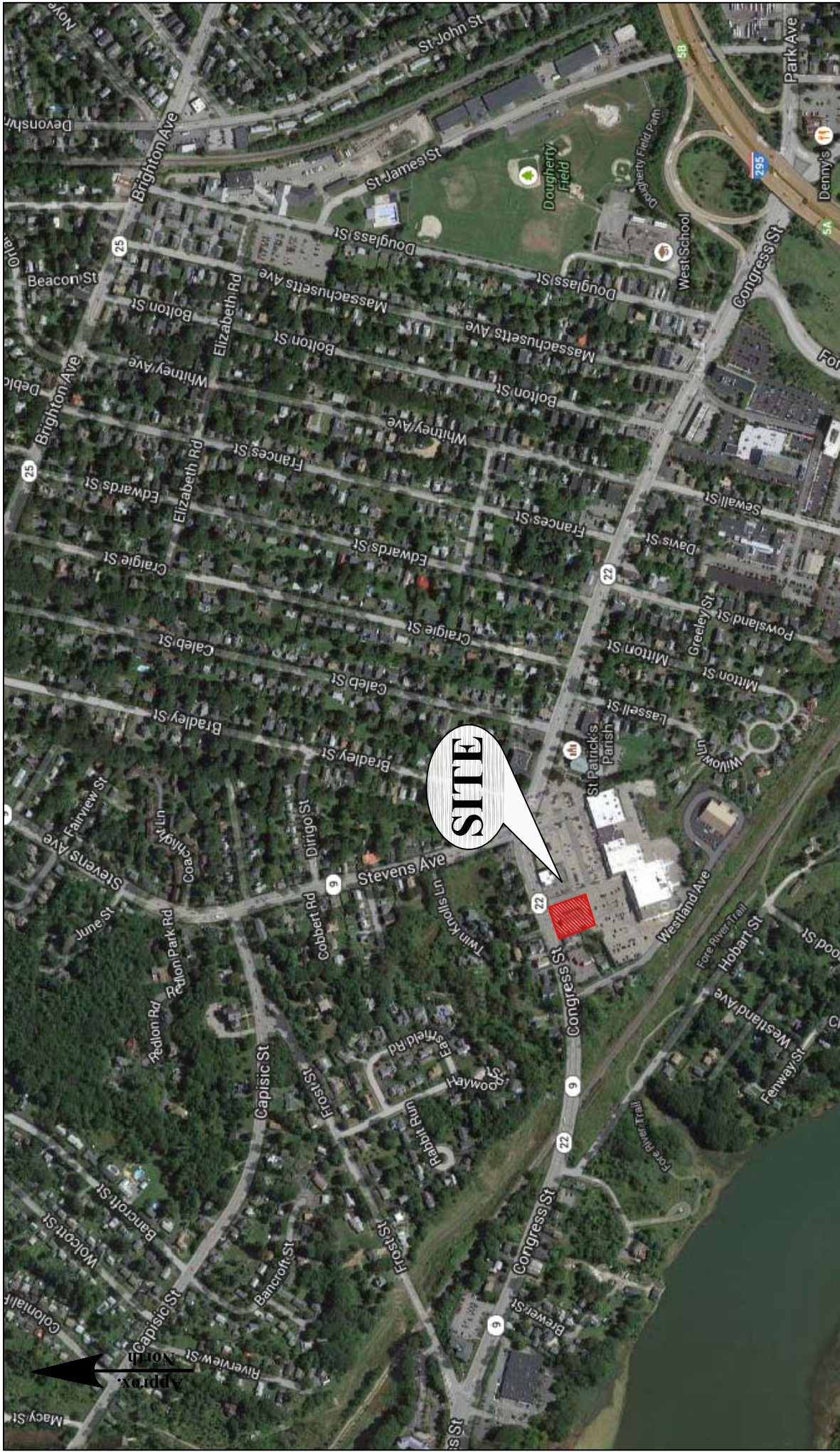


Figure 1

**Site Location Map
Westgate Dunkin' Donuts
Portland, Maine**

**Maine
Traffic
Resources**

25 Vine Street
Gardiner, ME
04345
tel: (207) 582-5252
fax: (207) 582-1677



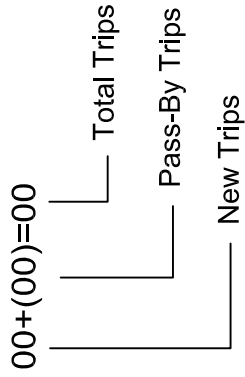
Not To Scale



Figure 2
2014 Existing Peak Hour Volumes
Westgate Dunkin' Donuts
Portland, Maine

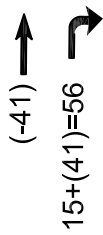


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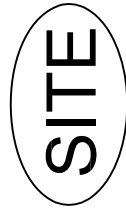


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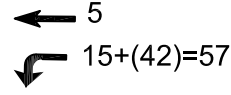
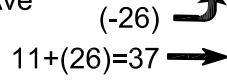
Congress St



Westgate Plaza



Stevens Ave



Westgate Plaza

Figure 3

Trip Assignments
Westgate Dunkin' Donuts
Portland, Maine

Maine
Traffic
Resources

25 Vine Street
Gardiner, ME
04345
tel: (207) 582-5252
fax: (207) 582-1677



Not To Scale

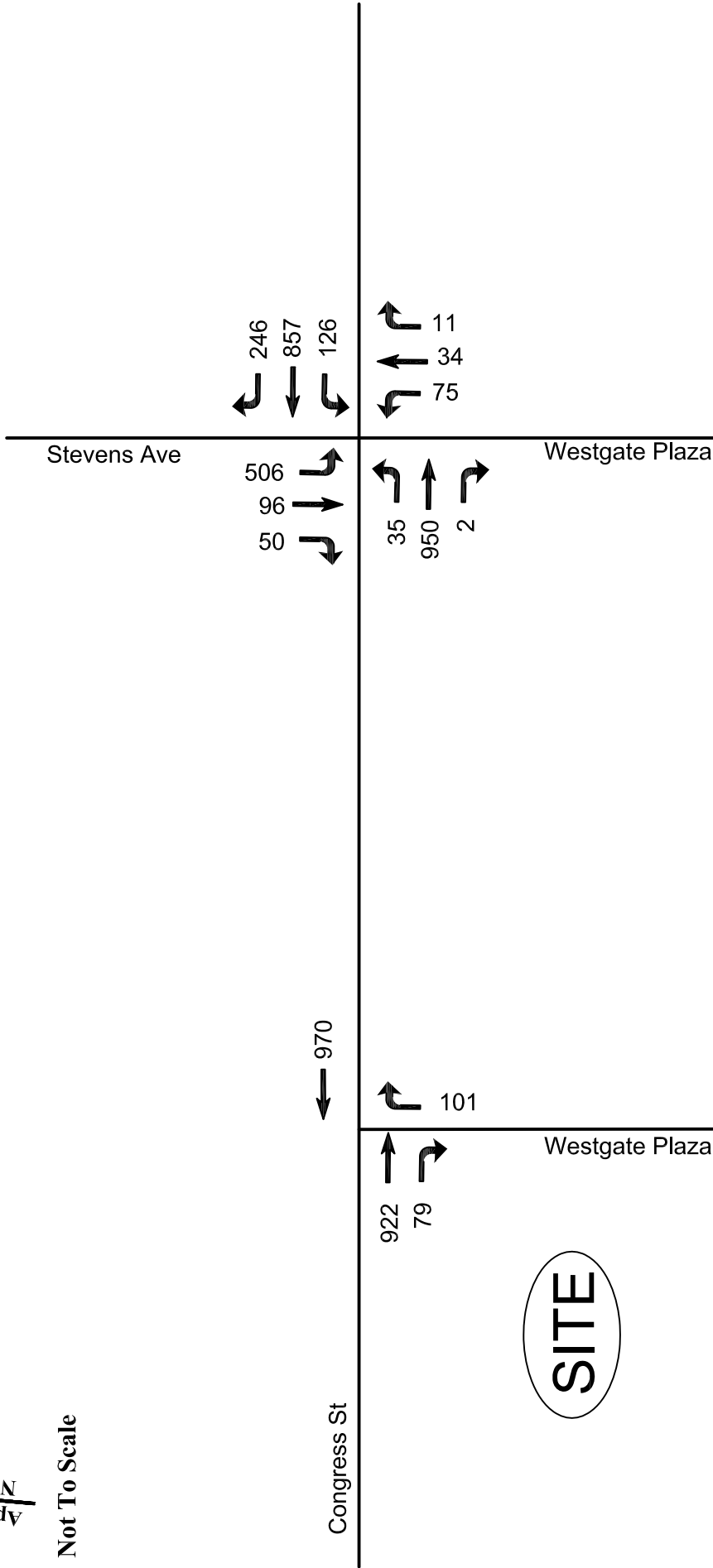


Figure 4

2014 Build Volumes

Westgate Dunkin' Donuts

Portland, Maine

**Maine
Traffic
Resources**

25 Vine Street
Gardiner, ME
04345
tel: (207) 582-5252
fax: (207) 582-1677

Maine Traffic Resources

25 Vine Street

Gardiner, ME 04345

mainetrafficresources.com

Congress St & Westgate Plaza

Town: Portland

Counter: ZG & DWM

Weather: Sunny

File Name : PortlandWestgateCongressStAM

Site Code : 00001234

Start Date : 2/4/2014

Page No : 1

Groups Printed- Passenger Vehicles - Light Trucks - Heavy Trucks

Start Time	Stevens Ave From North					Congress St From East					Westgate Plaza From South					Congress St From West					Int. Total
	Rig ht	Thru	Left	Ped s	App. Total	Rig ht	Thru	Left	Ped s	App. Total	Rig ht	Thru	Left	Ped s	App. Total	Rig ht	Thru	Left	Ped s	App. Total	
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	6	9	70	0	85	36	118	8	1	163	0	4	1	1	6	0	152	1	1	154	408
07:15 AM	9	8	110	5	132	51	148	3	0	202	1	5	1	0	7	0	164	6	0	170	511
07:30 AM	8	14	132	1	155	61	155	13	2	231	0	3	3	0	6	1	204	3	0	208	600
07:45 AM	15	12	146	0	173	59	252	19	0	330	3	9	4	1	17	0	208	7	0	215	735
Total	38	43	458	6	545	207	673	43	3	926	4	21	9	2	36	1	728	17	1	747	2254
08:00 AM	12	13	110	0	135	46	214	10	0	270	2	8	3	1	14	0	199	4	1	204	623
08:15 AM	8	16	105	0	129	46	152	19	2	219	5	7	7	1	20	1	170	11	0	182	550
08:30 AM	9	4	108	0	121	41	180	15	0	236	1	1	6	0	8	0	203	8	0	211	576
08:45 AM	10	23	96	2	131	44	159	15	0	218	2	8	6	1	17	5	167	2	0	174	540
Total	39	56	419	2	516	177	705	59	2	943	10	24	22	3	59	6	739	25	1	771	2289
Grand Total	77	99	877	8	1061	384	1378	102	5	1869	14	45	31	5	95	7	1467	42	2	1518	4543
Apprch %	7.3	9.3	82.7	0.8		20.5	73.7	5.5	0.3		14.7	47.4	32.6	5.3		0.5	96.6	2.8	0.1		
Total %	1.7	2.2	19.3	0.2	23.4	8.5	30.3	2.2	0.1	41.1	0.3	1.0	0.7	0.1	2.1	0.2	32.3	0.9	0.0	33.4	

Start Time	Stevens Ave From North					Congress St From East					Westgate Plaza From South					Congress St From West					Int. Total
	Rig ht	Thru	Left	Ped s	App. Total	Rig ht	Thru	Left	Ped s	App. Total	Rig ht	Thru	Left	Ped s	App. Total	Rig ht	Thru	Left	Ped s	App. Total	
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:30 AM																				
Volume	43	55	493	1	592	212	773	61	4	1050	10	27	17	3	57	2	781	25	1	809	2508
Percent	7.3	9.3	83.3	0.2		20.2	73.6	5.8	0.4		17.5	47.4	29.8	5.3		0.2	96.5	3.1	0.1		
07:45 Volume	15	12	146	0	173	59	252	19	0	330	3	9	4	1	17	0	208	7	0	215	735
Peak Factor																					0.853
High Int.	07:45 AM																				
Volume	15	12	146	0	173	59	252	19	0	330	5	7	7	1	20	0	208	7	0	215	215
Peak Factor																					0.941
	50	59	532		0.855	246	897	66		0.795	11	29	18		0.713	2	906	29			

Congress St, Stevens Ave : $GRP I = \frac{1.02}{0.88} = 1.16$

Westgate Plaza = $\frac{1}{2} GRP I = 1.08$

Maine Traffic Resources
 25 Vine Street
 Gardiner, ME 04345
 mainetrafficresources.com

Congress St & Westgate Plaza
 Town: Portland
 Counter: ZG
 Weather: Clear

File Name : PortlandWestgateRtInRtOut
 Site Code : 00001111
 Start Date : 2/11/2014
 Page No : 1

Groups Printed- Passenger Vehicles - Light Trucks - Heavy Trucks

Start Time	From North					Rte 22 (Congress St) From East					Westgate Plaza From South					Rte 22 (Congress St) From West					Int. Total
	Rig ht	Thr u	Left	Ped s	App. Total	Rig ht	Thr u	Left	Ped s	App. Total	Rig ht	Thr u	Left	Ped s	App. Total	Rig ht	Thr u	Left	Ped s	App. Total	
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	0	0	1	1	0	116	0	0	116	2	0	0	1	3	3	173	0	0	176	296
07:15 AM	0	0	0	1	1	0	168	0	0	168	1	0	0	0	1	2	191	0	0	193	363
07:30 AM	0	0	0	0	0	0	199	0	0	199	1	0	0	0	1	0	198	0	0	198	398
07:45 AM	0	0	0	0	0	0	251	1	0	252	3	0	0	0	3	6	185	0	0	191	446
Total	0	0	0	2	2	0	734	1	0	735	7	0	0	1	8	11	747	0	0	758	1503
08:00 AM	0	0	0	0	0	0	174	0	0	174	5	0	0	0	5	5	228	0	0	233	412
08:15 AM	0	0	0	0	0	0	199	0	0	199	1	0	1	0	2	10	219	0	0	229	430
08:30 AM	0	0	0	0	0	0	159	1	0	160	4	0	0	0	4	3	181	0	0	184	348
08:45 AM	0	0	0	0	0	0	166	0	0	166	1	0	0	0	1	6	160	0	0	166	333
Total	0	0	0	0	0	0	698	1	0	699	11	0	1	0	12	24	788	0	0	812	1523
Grand Total	0	0	0	2	2	0	1432	2	0	1434	18	0	1	1	20	35	1535	0	0	1570	3026
Apprch %	0.0	0.0	0.0	100.0		0.0	99.9	0.1	0.0		90.0	0.0	5.0	5.0		2.2	97.8	0.0	0.0		
Total %	0.0	0.0	0.0	0.1	0.1	0.0	47.3	0.1	0.0	47.4	0.6	0.0	0.0	0.0	0.7	1.2	50.7	0.0	0.0	51.9	

Start Time	From North					Rte 22 (Congress St) From East					Westgate Plaza From South					Rte 22 (Congress St) From West					Int. Total
	Rig ht	Thr u	Left	Ped s	App. Total	Rig ht	Thr u	Left	Ped s	App. Total	Rig ht	Thr u	Left	Ped s	App. Total	Rig ht	Thr u	Left	Ped s	App. Total	
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:30 AM																				
Volume	0	0	0	0	0	0	823	1	0	824	10	0	1	0	11	21	830	0	0	851	1686
Percent	0.0	0.0	0.0	0.0		0.0	99.9	0.1	0.0		90.9	0.0	9.1	0.0		2.5	97.5	0.0	0.0		
07:45 Volume	0	0	0	0	0	0	251	1	0	252	3	0	0	0	3	6	185	0	0	191	446
Factor	0.945																				
High Int. Volume	6:45:00 AM					07:45 AM					08:00 AM					08:00 AM					
Peak	0	0	0	0	0	0	251	1	0	252	5	0	0	0	5	5	228	0	0	233	
Factor						0.817					0.550					0.913					
						955 1					11 1					23 963					

Congress St : GRP I = $\frac{1.02}{0.88} = 1.16$

Plaza : $\frac{1}{2}$ GRP I = 1.08

Lanes, Volumes, Timings
 Congress St, Stevens Ave & Westgate Plaza

2/12/2014



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	29	906	2	66	897	246	18	29	11	532	59	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	0		25	75		0	250		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	165		25	300		25	25		25	190		25
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	*1.00	1.00	1.00	*1.00	1.00	1.00
Frnt						0.850		0.958			0.931	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3539	0	1752	3505	1568	1805	1820	0	1752	1717	0
Flt Permitted	0.950			0.950			0.679			0.472		
Satd. Flow (perm)	1770	3539	0	1752	3505	1568	1290	1820	0	871	1717	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						82		14			56	
Link Speed (mph)		35			30			30			30	
Link Distance (ft)		342			274			284			532	
Travel Time (s)		6.7			6.2			6.5			12.1	
Peak Hour Factor	0.95	0.95	0.95	0.85	0.85	0.85	0.80	0.80	0.80	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	0%	0%	0%	3%	3%	3%
Adj. Flow (vph)	31	954	2	78	1055	289	22	36	14	591	66	56
Shared Lane Traffic (%)												
Lane Group Flow (vph)	31	956	0	78	1055	289	22	50	0	591	122	0
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(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway 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
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2	1	1	2		1	2	
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0		0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0		0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6		20	6	20	20	6		20	6	
Detector 1 Type	CI+Ex	CI+Ex		CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex		CI+Ex	CI+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	
Detector 1 Queue (s)	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	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot			Prot		pm+ov	Perm			custom		
Protected Phases	5	2		1	6	7		8		7	37	
Permitted Phases						6	8			3		

HCM Signalized Intersection Capacity Analysis

Congress St, Stevens Ave & Westgate Plaza

2/12/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	29	906	2	66	897	246	18	29	11	532	59	50
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	0.95		1.00	0.95	1.00	*1.00	1.00		*1.00	1.00	
Fr't	1.00	1.00		1.00	1.00	0.85	1.00	0.96		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3538		1752	3505	1568	1805	1820		1752	1718	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.68	1.00		0.47	1.00	
Satd. Flow (perm)	1770	3538		1752	3505	1568	1289	1820		871	1718	
Peak-hour factor, PHF	0.95	0.95	0.95	0.85	0.85	0.85	0.80	0.80	0.80	0.90	0.90	0.90
Adj. Flow (vph)	31	954	2	78	1055	289	22	36	14	591	66	56
RTOR Reduction (vph)	0	0	0	0	0	24	0	13	0	0	33	0
Lane Group Flow (vph)	31	956	0	78	1055	265	22	37	0	591	89	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	0%	0%	0%	3%	3%	3%
Turn Type	Prot			Prot		pm+ov	Perm			custom		
Protected Phases	5	2		1	6	7		8		7	3	7
Permitted Phases						6	8			3		
Actuated Green, G (s)	5.0	35.9		8.6	39.5	68.5	6.5	6.5		40.5	40.5	
Effective Green, g (s)	6.0	36.9		9.6	40.5	70.5	7.5	7.5		41.5	41.5	
Actuated g/C Ratio	0.06	0.37		0.10	0.40	0.70	0.08	0.08		0.42	0.42	
Clearance Time (s)	5.0	5.0		5.0	5.0	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		
Lane Grp Cap (vph)	106	1306		168	1420	1168	97	137		626	713	
v/s Ratio Prot	0.02	0.27		c0.04	c0.30	0.07		0.02		c0.28	0.05	
v/s Ratio Perm						0.10	0.02			c0.11		
v/c Ratio	0.29	0.73		0.46	0.74	0.23	0.23	0.27		0.94	0.13	
Uniform Delay, d1	45.0	27.3		42.8	25.3	5.2	43.5	43.7		26.0	18.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.5	3.7		2.0	3.6	0.1	1.2	1.1		23.0	0.1	
Delay (s)	46.5	30.9		44.8	28.9	5.3	44.7	44.7		48.9	18.1	
Level of Service	D	C		D	C	A	D	D		D	B	
Approach Delay (s)		31.4			25.0			44.7			43.6	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	31.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lanes, Volumes, Timings
 Congress St, Stevens Ave & Westgate Plaza

3/11/2014



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	33	932	2	100	874	246	51	31	11	517	80	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	0		25	75		0	250		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	165		25	300		25	25		25	190		25
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	*1.00	1.00	1.00	*1.00	1.00	1.00
Fr _t						0.850		0.960			0.942	
Fl _t Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3539	0	1752	3505	1568	1805	1824	0	1752	1738	0
Fl _t Permitted	0.950			0.950			0.665			0.520		
Satd. Flow (perm)	1770	3539	0	1752	3505	1568	1264	1824	0	959	1738	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						84		14			44	
Link Speed (mph)		35			30			30			30	
Link Distance (ft)		342			274			284			532	
Travel Time (s)		6.7			6.2			6.5			12.1	
Peak Hour Factor	0.95	0.95	0.95	0.85	0.85	0.85	0.80	0.80	0.80	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	0%	0%	0%	3%	3%	3%
Adj. Flow (vph)	35	981	2	118	1028	289	64	39	14	574	89	56
Shared Lane Traffic (%)												
Lane Group Flow (vph)	35	983	0	118	1028	289	64	53	0	574	145	0
Enter Blocked Intersection	No	No	No	No	Yes	Yes	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway 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
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2	1	1	2		1	2	
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0		0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0		0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6		20	6	20	20	6		20	6	
Detector 1 Type	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	
Detector 1 Queue (s)	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	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
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	Prot			Prot		pm+ov	Perm			custom		
Protected Phases	5	2		1	6	7		8		7	3	7
Permitted Phases						6	8				3	

Lanes, Volumes, Timings
 Congress St, Stevens Ave & Westgate Plaza

3/11/2014

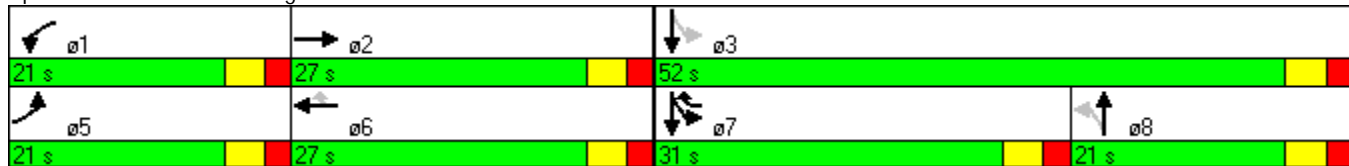


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	5	2		1	6	7	8	8		7	3	7
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0		
Minimum Split (s)	21.0	21.0		21.0	21.0	25.0	21.0	21.0		25.0		
Total Split (s)	21.0	27.0	0.0	21.0	27.0	31.0	21.0	21.0	0.0	31.0	83.0	0.0
Total Split (%)	21.0%	27.0%	0.0%	21.0%	27.0%	31.0%	21.0%	21.0%	0.0%	31.0%	83.0%	0.0%
Maximum Green (s)	16.0	22.0		16.0	22.0	26.0	16.0	16.0		26.0		
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0		
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0		
Lost Time Adjust (s)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lag	Lag		Lead		
Lead-Lag Optimize?		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		
Recall Mode	None	C-Max		None	C-Max	None	None	None		None		
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)	8.5	34.8		13.0	43.6	75.4	11.4	11.4		40.3	40.3	
Actuated g/C Ratio	0.08	0.35		0.13	0.44	0.75	0.11	0.11		0.40	0.40	
v/c Ratio	0.23	0.80		0.52	0.67	0.24	0.44	0.24		0.96	0.20	
Control Delay	45.8	38.2		48.1	28.8	5.1	50.0	33.0		54.3	12.4	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	45.8	38.2		48.1	28.8	5.1	50.0	33.0		54.3	12.4	
LOS	D	D		D	C	A	D	C		D	B	
Approach Delay		38.5			25.6			42.3			45.9	
Approach LOS		D			C			D			D	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.96
 Intersection Signal Delay: 34.6
 Intersection LOS: C
 Intersection Capacity Utilization 76.7%
 ICU Level of Service D
 Analysis Period (min) 15
 * User Entered Value

Splits and Phases: 1: Congress Street & Stevens Avenue



HCM Signalized Intersection Capacity Analysis

Congress St, Stevens Ave & Westgate Plaza

3/11/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↕↗		↖	↕↗	↖	↖	↗		↖	↗	
Volume (vph)	33	932	2	100	874	246	51	31	11	517	80	50
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	0.95		1.00	0.95	1.00	*1.00	1.00		*1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.96		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3538		1752	3505	1568	1805	1825		1752	1738	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.66	1.00		0.52	1.00	
Satd. Flow (perm)	1770	3538		1752	3505	1568	1263	1825		960	1738	
Peak-hour factor, PHF	0.95	0.95	0.95	0.85	0.85	0.85	0.80	0.80	0.80	0.90	0.90	0.90
Adj. Flow (vph)	35	981	2	118	1028	289	64	39	14	574	89	56
RTOR Reduction (vph)	0	0	0	0	0	27	0	13	0	0	26	0
Lane Group Flow (vph)	35	983	0	118	1028	262	64	40	0	574	119	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	0%	0%	0%	3%	3%	3%
Turn Type	Prot			Prot		pm+ov	Perm			custom		
Protected Phases	5	2		1	6	7		8		7	3	7
Permitted Phases						6	8			3		
Actuated Green, G (s)	5.1	32.7		12.0	39.6	65.6	9.3	9.3		40.3	40.3	
Effective Green, g (s)	6.1	33.7		13.0	40.6	67.6	10.3	10.3		41.3	41.3	
Actuated g/C Ratio	0.06	0.34		0.13	0.41	0.68	0.10	0.10		0.41	0.41	
Clearance Time (s)	5.0	5.0		5.0	5.0	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		
Lane Grp Cap (vph)	108	1192		228	1423	1123	130	188		610	718	
v/s Ratio Prot	0.02	c0.28		c0.07	c0.29	0.06		0.02		c0.25	0.07	
v/s Ratio Perm						0.10	0.05			c0.13		
v/c Ratio	0.32	0.82		0.52	0.72	0.23	0.49	0.22		0.94	0.17	
Uniform Delay, d1	45.0	30.4		40.6	25.0	6.2	42.4	41.1		26.0	18.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.7	6.6		2.0	3.2	0.1	2.9	0.6		22.9	0.1	
Delay (s)	46.7	37.0		42.6	28.2	6.3	45.3	41.7		48.9	18.6	
Level of Service	D	D		D	C	A	D	D		D	B	
Approach Delay (s)		37.3			25.0			43.7			42.8	
Approach LOS		D			C			D			D	

Intersection Summary

HCM Average Control Delay	33.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lanes, Volumes, Timings
 Congress St, Stevens Ave, & Westgate Plaza

2/12/2014



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	35	950	2	126	857	246	75	34	11	506	96	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	0		25	75		0	250		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	165		25	300		25	25		25	190		25
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	*1.00	1.00	1.00	*1.00	1.00	1.00
Frnt						0.850		0.962			0.948	
Fit Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3539	0	1752	3505	1568	1805	1828	0	1752	1749	0
Fit Permitted	0.950			0.950			0.654			0.539		
Satd. Flow (perm)	1770	3539	0	1752	3505	1568	1243	1828	0	994	1749	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						85		14			35	
Link Speed (mph)		35			30			30			30	
Link Distance (ft)		342			274			284			532	
Travel Time (s)		6.7			6.2			6.5			12.1	
Peak Hour Factor	0.95	0.95	0.95	0.85	0.85	0.85	0.80	0.80	0.80	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	0%	0%	0%	3%	3%	3%
Adj. Flow (vph)	37	1000	2	148	1008	289	94	42	14	562	107	56
Shared Lane Traffic (%)												
Lane Group Flow (vph)	37	1002	0	148	1008	289	94	56	0	562	163	0
Enter Blocked Intersection	No	No	No	No	Yes	Yes	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway 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
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2	1	1	2		1	2	
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0		0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0		0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6		20	6	20	20	6		20	6	
Detector 1 Type	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	
Detector 1 Queue (s)	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	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
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	Prot			Prot		pm+ov	Perm			custom		
Protected Phases	5	2		1	6	7		8		7	37	
Permitted Phases						6	8			3		

Lanes, Volumes, Timings
 Congress St, Stevens Ave, & Westgate Plaza

2/12/2014

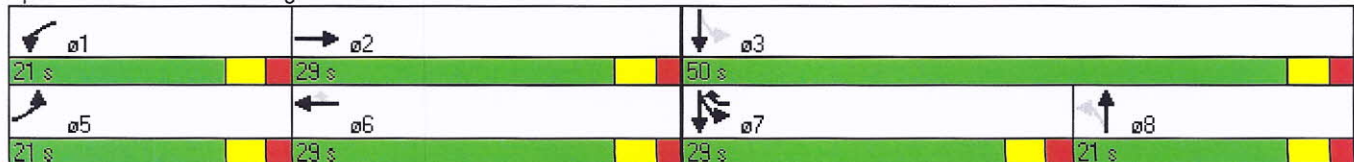


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	5	2		1	6	7	8	8		7	3	7
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0		
Minimum Split (s)	21.0	21.0		21.0	21.0	25.0	21.0	21.0		25.0		
Total Split (s)	21.0	29.0	0.0	21.0	29.0	29.0	21.0	21.0	0.0	29.0	79.0	0.0
Total Split (%)	21.0%	29.0%	0.0%	21.0%	29.0%	29.0%	21.0%	21.0%	0.0%	29.0%	79.0%	0.0%
Maximum Green (s)	16.0	24.0		16.0	24.0	24.0	16.0	16.0		24.0		
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0		
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0		
Lost Time Adjust (s)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lag	Lag		Lead		
Lead-Lag Optimize?		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		
Recall Mode	None	C-Max		None	C-Max	None	None	None		None		
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)	8.6	34.0		14.1	43.9	73.7	13.3	13.3		39.9	39.9	
Actuated g/C Ratio	0.09	0.34		0.14	0.44	0.74	0.13	0.13		0.40	0.40	
v/c Ratio	0.24	0.83		0.60	0.65	0.25	0.57	0.22		0.96	0.23	
Control Delay	45.9	40.6		50.2	28.3	5.6	53.6	31.6		55.4	14.7	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	45.9	40.6		50.2	28.3	5.6	53.6	31.6		55.4	14.7	
LOS	D	D		D	C	A	D	C		E	B	
Approach Delay		40.8			26.0			45.4			46.2	
Approach LOS		D			C			D			D	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.96
 Intersection Signal Delay: 35.8
 Intersection LOS: D
 Intersection Capacity Utilization 78.0%
 ICU Level of Service D
 Analysis Period (min) 15
 * User Entered Value

Splits and Phases: 1: Congress Street & Stevens Avenue



HCM Signalized Intersection Capacity Analysis

Congress St, Stevens Ave, & Westgate Plaza

2/12/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	35	950	2	126	857	246	75	34	11	506	96	50
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	0.95		1.00	0.95	1.00	*1.00	1.00		*1.00	1.00	
Fr't	1.00	1.00		1.00	1.00	0.85	1.00	0.96		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3538		1752	3505	1568	1805	1829		1752	1750	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.65	1.00		0.54	1.00	
Satd. Flow (perm)	1770	3538		1752	3505	1568	1242	1829		995	1750	
Peak-hour factor, PHF	0.95	0.95	0.95	0.85	0.85	0.85	0.80	0.80	0.80	0.90	0.90	0.90
Adj. Flow (vph)	37	1000	2	148	1008	289	94	42	14	562	107	56
RTOR Reduction (vph)	0	0	0	0	0	29	0	12	0	0	21	0
Lane Group Flow (vph)	37	1002	0	148	1008	260	94	44	0	562	142	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	0%	0%	0%	3%	3%	3%
Turn Type	Prot			Prot		pm+ov	Perm			custom		
Protected Phases	5	2		1	6	7		8		7	3	7
Permitted Phases						6	8			3		
Actuated Green, G (s)	5.2	32.0		13.1	39.9	63.9	10.9	10.9		39.9	39.9	
Effective Green, g (s)	6.2	33.0		14.1	40.9	65.9	11.9	11.9		40.9	40.9	
Actuated g/C Ratio	0.06	0.33		0.14	0.41	0.66	0.12	0.12		0.41	0.41	
Clearance Time (s)	5.0	5.0		5.0	5.0	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		
Lane Grp Cap (vph)	110	1168		247	1434	1096	148	218		596	716	
v/s Ratio Prot	0.02	c0.28		c0.08	0.29	0.06		0.02		c0.24	0.08	
v/s Ratio Perm						0.11	0.08			c0.15		
v/c Ratio	0.34	0.86		0.60	0.70	0.24	0.64	0.20		0.94	0.20	
Uniform Delay, d1	44.9	31.3		40.3	24.5	6.9	42.0	39.8		26.3	19.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.8	8.2		3.9	2.9	0.1	8.6	0.5		23.5	0.1	
Delay (s)	46.7	39.5		44.2	27.4	7.0	50.6	40.2		49.9	19.1	
Level of Service	D	D		D	C	A	D	D		D	B	
Approach Delay (s)		39.8			25.1			46.7			43.0	
Approach LOS		D			C			D			D	

Intersection Summary

HCM Average Control Delay	34.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

Congress St & Right Turn Drive

2/12/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Volume (veh/h)	963	23	0	955	0	11
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.85	0.85	0.75	0.75
Hourly flow rate (vph)	1014	24	0	1124	0	15
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				342		
pX, platoon unblocked					0.75	
vC, conflicting volume			1038		1588	519
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1038		1106	519
tC, single (s)			4.2		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	97
cM capacity (veh/h)			660		154	504

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	676	362	562	562	15
Volume Left	0	0	0	0	0
Volume Right	0	24	0	0	15
cSH	1700	1700	1700	1700	504
Volume to Capacity	0.40	0.21	0.33	0.33	0.03
Queue Length 95th (ft)	0	0	0	0	2
Control Delay (s)	0.0	0.0	0.0	0.0	12.4
Lane LOS					B
Approach Delay (s)	0.0		0.0		12.4
Approach LOS					B

Intersection Summary					
Average Delay			0.1		
Intersection Capacity Utilization			37.4%	ICU Level of Service	A
Analysis Period (min)			15		

HCM Unsignalized Intersection Capacity Analysis

Congress St & Right Turn Drive

3/11/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Volume (veh/h)	940	55	0	964	0	63
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.85	0.85	0.90	0.90
Hourly flow rate (vph)	989	58	0	1134	0	70
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				342		
pX, platoon unblocked					0.75	
vC, conflicting volume			1047		1585	524
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1047		1119	524
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	86
cM capacity (veh/h)			660		152	501
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	660	388	567	567	70	
Volume Left	0	0	0	0	0	
Volume Right	0	58	0	0	70	
cSH	1700	1700	1700	1700	501	
Volume to Capacity	0.39	0.23	0.33	0.33	0.14	
Queue Length 95th (ft)	0	0	0	0	12	
Control Delay (s)	0.0	0.0	0.0	0.0	13.4	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		13.4	
Approach LOS					B	
Intersection Summary						
Average Delay			0.4			
Intersection Capacity Utilization			38.3%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

Congress St & Right-Turn Drive

2/12/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Volume (veh/h)	922	79	0	970	0	101
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.85	0.85	0.90	0.90
Hourly flow rate (vph)	971	83	0	1141	0	112
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				342		
pX, platoon unblocked					0.76	
vC, conflicting volume			1054		1583	527
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1054		1137	527
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	77
cM capacity (veh/h)			656		150	498

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	647	407	571	571	112
Volume Left	0	0	0	0	0
Volume Right	0	83	0	0	112
cSH	1700	1700	1700	1700	498
Volume to Capacity	0.38	0.24	0.34	0.34	0.23
Queue Length 95th (ft)	0	0	0	0	21
Control Delay (s)	0.0	0.0	0.0	0.0	14.3
Lane LOS					B
Approach Delay (s)	0.0		0.0		14.3
Approach LOS					B

Intersection Summary					
Average Delay			0.7		
Intersection Capacity Utilization			40.9%	ICU Level of Service	A
Analysis Period (min)			15		

**Queue Length Study for Westgate Dunkin' Donuts
 Observed at Brunswick Dunkin' Donuts
 3/21/2014**

Time	# In Queue	Time	# In Queue	Time	# In Queue
6:55	6	8:00	4	8:31	4
7:00	7	8:01	7	8:32	5
7:05	9	8:02	8	8:33	4
7:10	8	8:03	5	8:34	6
7:12	6	8:04	8	8:35	4
7:13	7	8:05	7	8:36	5
7:14	8	8:06	8	8:37	6
7:15	7	8:07	5	8:38	6
7:16	8	8:08	2	8:39	4
7:17	7	8:09	0	8:40	3
7:18	8	8:10	2	8:41	1
7:19	8	8:11	1	8:42	2
7:20	7	8:12	0	8:43	6
7:21	9	8:13	2	8:44	5
7:22	7	8:14	0	8:45	4
7:23	6	8:15	1	8:46	6
7:24	5	8:16	0	8:47	3
7:25	4	8:17	3	8:48	3
7:26	5	8:18	5	8:49	2
7:27	7	8:19	5	8:50	3
7:28	9	8:20	4	8:51	2
7:29	7	8:21	3	8:52	3
7:30	6	8:22	2	8:53	2
7:31	7	8:23	3	8:54	3
7:32	6	8:24	6	8:55	5
7:33	5	8:25	3	8:56	4
7:34	6	8:26	4	8:57	6
7:35	6	8:27	5	8:58	5
7:36	5	8:28	2	8:59	7
7:37	5	8:29	2	9:00	5
7:38	6	8:30	3		
7:39	9				
7:40	8				
7:41	9			Maximum Queue Length	12 vehicles
7:42	11				
7:43	10			Average Queue 7:00 - 8:00	7.24 vehicles
7:44	9				
7:45	8			Average Queue 7:00 - 9:00	5.39 vehicles
7:46	8				
7:47	9				
7:48	9				
7:49	12				
7:50	10				
7:51	11				
7:52	8				
7:53	5				
7:54	5				
7:55	6				
7:56	7				
7:57	5				
7:58	4				
7:59	5				

**Queue Length Study for Westgate Dunkin' Donuts
 Observed at Brunswick Dunkin' Donuts
 3/24/2014**

Time	# In Queue	Time	# In Queue
7:00	2	8:00	3
7:01	3	8:01	2
7:02	4	8:02	2
7:03	1	8:03	4
7:04	2	8:04	5
7:05	3	8:05	6
7:06	2	8:06	5
7:07	4	8:07	8
7:08	5	8:08	7
7:09	4	8:09	6
7:10	4	8:10	9
7:11	3	8:11	8
7:12	5	8:12	6
7:13	4	8:13	7
7:14	6	8:14	6
7:15	5	8:15	8
7:16	6	8:16	7
7:17	6	8:17	7
7:18	7	8:18	7
7:19	7	8:19	6
7:20	6	8:20	5
7:21	6	8:21	4
7:22	9	8:22	3
7:23	8	8:23	1
7:24	8	8:24	4
7:25	7	8:25	6
7:26	6	8:26	5
7:27	4	8:27	2
7:28	4	8:28	4
7:29	4	8:29	3
7:30	4	8:30	1
7:31	3		
7:32	5		
7:33	7	Maximum Queue Length	9 vehicles
7:34	7		
7:35	8	Average Queue 7:00 - 8:00	5.03
7:36	6		
7:37	8	Average Queue 7:00 - 8:30	5.04
7:38	8		
7:39	7		
7:40	7		
7:41	9		
7:42	7		
7:43	5		
7:44	4		
7:45	2		
7:46	5		
7:47	5		
7:48	2		
7:49	8		
7:50	6		
7:51	6		
7:52	5		
7:53	4		
7:54	5		
7:55	4		
7:56	3		
7:57	3		
7:58	4		
7:59	0		