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MEMORANDUM

DATE: May 13, 2014

TO: John Burrell, City of Oregon City

FROM: Carl D. Springer, P.E. PTOE, Julie Sosnovske, P.E.

SUBJECT: Traffic Signal Warrant Evaluation for Washington Street/12th Street Intersection P# 14014-000

This memorandum reports the traffic signal warrant and operations analysis conducted by DKS Associates for the intersection of Washington Street/12th Street, in Oregon City, Oregon. The traffic signal warrant analysis evaluates if upgraded traffic controls can be justified.

Background

The Washington Street/12th Street intersection is a two-way stop controlled intersection, with stop control on 12th Street. There is also a flashing signal showing yellow on Washington Street and red on 12th Street. There are vertical curves at the intersection on both Washington Street and 12th Street. Curb extensions were installed on the west side of Washington Street in 2003 in order to move the stop bar on 12th Street closer to the intersection and provide additional sight distance for vehicles on 12th Street.

Summary

Traffic signal warrants were evaluated for both 2014 and 2035 traffic volume conditions. One warrant is met currently (Warrant 7) and additional volume warrants are likely to be met in 2017 (Warrants 1, 2 and 3). Installation of a traffic signal should be considered based on these results. If it is determined that a traffic signal should not be installed immediately, traffic volumes and collision data should continue to be monitored. Based on expected growth trends, it is likely that a traffic signal will meet multiple traffic volume related warrants at this location in the near future.

Table 1: Traffic Signal Warrant Summary (2014 and 2035)

Warrant	Description	2014	Anticipated Year Met	2035
1	Eight-Hour Vehicular Volume	No	2015	Yes
2	Four-Hour Vehicular Volume	No	2017	Yes
3	Peak Hour	No	2017	Yes
4	Pedestrian	No		No
5	School Crossing	No		No



Warrant	Description	2014	Anticipated Year Met	2035
6	Coordinated Signal System	No		No
7	Crash Experience	Yes		Yes
8	Roadway Network	No		No
9	Intersection Near a Grade Crossing	No		No
Total	Number of Warrants Met	1		4

Traffic Signal Warrant Analysis

The Manual on Uniform Traffic Control Devices (MUTCD) includes nine traffic signal warrants that must be evaluated to determine whether a traffic signal is warranted at a given location. While one or more of the warrants must be met in order to install a traffic control signal, an engineering study must indicate that installing a traffic control signal will improve the overall safety and operation of the intersection. The study must present a careful analysis of traffic operations, pedestrian and bicyclist needs, as well as other factors. Engineering judgment must be applied to determine whether a traffic signal is an appropriate solution.

The nine traffic signal warrants were evaluated at the study intersection for both 2014 and 2035 traffic volume conditions, where applicable. 2014 turn movement counts were conducted for the 12th Street/Washington Street intersection on April 14, 2014.¹ 2035 traffic volume data (PM Peak hour intersection turn movements) was obtained from the City of Oregon City Transportation System Plan (TSP), and was assumed to have a similar daily profile as 2014.

Each of the traffic signal warrants were evaluated for both 2014 and 2035 traffic volume conditions. Based on engineering judgment, 25 percent of right turning minor street traffic was removed for warrant analysis. The results of these analyses were summarized in Table 1A discussion related to each signal warrant follows.

Warrant 1 – Eight-Hour Vehicular Volume (Met in Approximately 2015)

This warrant includes two conditions, one of which must be met for each of eight hours:

- *Condition A: Minimum Vehicular Volume*
- *Condition B: Interruption of Continuous Traffic*

If either of these conditions is met with 100 percent of major and minor street volumes, the warrant is considered to be met. If neither condition is met with 100 percent of major and minor street volumes, a combination

¹ Traffic counts conducted from 7:00 AM to 9:00 PM on April 24, 2014 at 12th Street/Washington Street, Oregon City, Oregon.



warrant is possible. The combination warrant requires that both condition A and condition B are met at 80 percent for both major and minor street volumes.

The intersection does not meet Warrant 1 in 2014, but could meet it as soon as 2016 and will meet it in 2035. In 2016, the warrant is met based on Condition B (interruption of continuous traffic) with the minimum required eight hours of the day. In 2035 the warrant is expected to be met based on both Condition A (minimum vehicular volume) and Condition B.

Warrant 2 – Four-Hour Vehicular Volume (Met in Approximately 2017)

The Four-Hour Vehicular Volume signal warrant conditions are intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal. For each of 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) all fall above the applicable curve in Figure 4C-1.

This warrant is not met in 2014, although it is close, meeting the required conditions for three hours of the day (four are required). It could be met as soon as 2017 and will be met in 2035.

Warrant 3 – Peak Hour (Met in Approximately 2017)

The Peak Hour signal warrant is intended for use at a location where traffic conditions are such that for a minimum of one hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street.

This warrant is not met under 2014 traffic volume conditions, although it is very close. It may be met as soon as 2017 and is expected to easily be met under 2035 traffic volume conditions.

Warrant 4 – Pedestrian (2014 – Not Met, 2035 – No Forecasts Available)

The Pedestrian Volume signal warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

There were not enough pedestrians to meet the minimum threshold for this warrant for any hour of the day. Since forecasted pedestrian volumes were not available for 2035, only 2014 volumes were evaluated. Therefore, this warrant is not met.

Warrant 5 – School Crossing (Not Applicable)

The School Crossing signal warrant is intended for application where the fact that schoolchildren cross the major street is the principal reason to consider installing a traffic control signal. For purposes of this warrant, the word “schoolchildren” includes elementary through high school students.

There is not an active elementary, middle or high school in the immediate vicinity of the 12th Street/Washington Street intersection. Therefore, this warrant is not met.

Warrant 6 – Coordinated Signal System (Not Applicable)

Progressive movement in a coordinated signal system sometimes necessitates installing traffic control signals at intersections where they would not otherwise be needed in order to maintain proper platooning of vehicles.

The 12th Street/Washington Street intersection is not located within a coordinated signal system. Therefore, this warrant is not met.

Warrant 7 – Crash Experience (Currently Met)

The Crash Experience signal warrant conditions are intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal. A traffic signal should be considered if all of the following criteria are met:

- *Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency; and*
- *Five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a 12-month period; and*
- *For each of any 8 hours of an average day, the vehicles per hour given in both of the 80 percent columns of Warrant 1 Condition A or Condition B*

Each of these conditions is addressed below:

Condition A: Alternatives that have been tested include reconstruction of the intersection in 2003 to improve the approach grades and install curb extensions on the west side of Washington Street to move the stop bar on 12th Street closer to the intersection in order to improve sight distance. Crash data prior to 2003 is not currently available on ODOT's website, however, DKS records indicate eight angle/turning collisions occurred in 1999 and five in 2000. When compared with the total angle/turning collisions in years following the improvements (See Table 2 below for years 2008 – 2012), it appears that collisions of this type have not substantially decreased.

Condition B: Table 2 below summarizes the number of crashes that are either angle or turning collisions, which could potentially be corrected with the installation of a traffic signal. As shown, five or more crashes of these types have been observed at the intersection during four of the previous five years. In 2011, eight angle or turning crashes were related to the eastbound approach, which would most benefit from a traffic signal at this location due to the approach grade.

Table 2: Collisions of Types Susceptible to Correction by Traffic Signal Installation (2008-2012)

<i>Crash Type</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>	<i>2012</i>
Angle	3	8	4	7	6
Turning	0	0	1	3	1
Total Angle/Turning	3	8	5	10	7
Angle/Turning related to eastbound approach	3	4	4	8	4



Condition C: This condition is met for both 2014 and 2035 traffic volume conditions.

Since all three conditions are met in 2014, this warrant is met. In addition, an intersection crash analysis was also conducted and is summarized below.

Intersection Crash Analysis

The intersection crash analysis was performed using the last five years of available data for the years (2008 to 2012).² Over this time period 35 crashes were recorded for this intersection. This translates to an intersection crash rate of 1.55 crashes per million total entering vehicles (TEV). Intersection crash rates greater than 1.0 per million TEV are generally considered indicators that a further investigation in to the cause of the crashes is needed.

Since the crash rate at this location is above 1.0, a more in depth crash analysis was conducted. Most of the crashes occurred during the day under dry conditions, and the cause of these crashes was cited as either “turn” or “angle.” A summary of the crash types reported between 2008 and 2012 is as follows:

- Twenty-three (23) crashes involved drivers traveling eastbound on 12th Street and failing to yield the right of way to the drivers traveling on Washington Street.
- Six (6) crashes involved drivers traveling westbound on 12th Street and failing to yield the right of way to the drivers traveling on Washington Street.
- Two (2) crashes involved drivers traveling northbound on Washington Street turning left onto 12th Street.
- One (1) crash was a rear-end crash.
- One (1) vehicle hit a fixed object.
- The direction could not be determined for two (2) crashes since the intersection is skewed relative to north and more specific (i.e. NW, SE) directions were not provided.

Warrant 8 – Roadway Network (Not Applicable)

Installing a traffic control signal at some intersections might be justified to encourage concentration and organization of traffic flow on a roadway network.

This warrant is not relevant at this location.

Warrant 9 – Intersection Near a Grade Crossing (Not Applicable)

The Intersection Near a Grade Crossing signal warrant is intended for use at a location where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a

² Crash data supplied by the Oregon Department of Transportation for January 2009 through December 2012.



grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic control signal.

This warrant is not relevant at this location.

Traffic Operations

In addition to traffic signal warrants, traffic operations at the study intersection were evaluated for both 2014 and 2035 traffic volume conditions. The results are summarized in Table 3. As shown, the intersection fails for the minor street approach in 2014, although the volume-to-capacity ratio for the minor street (eastbound approach) is still well below 1.0, indicating that relatively few vehicles are affected by this condition. The estimated volume far exceeds the capacity for several turn movements in 2035 resulting in excessive delay and v/c ratios.

Table 3: Intersection Operations at 12th Street/Washington Street without Traffic Signal Controls

<i>Year</i>	<i>Average Delay Per Vehicle</i>	<i>Level of Service for Major Street / Minor Street Approach</i>	<i>Volume to Capacity Ratio of Most Delayed Approach</i>
2014	>60.0	A/F	0.80
2035	>60.0	B/F	>2.0

Conclusion

Based on this analysis, one warrant was determined to be met currently (Warrant 7) and additional volume warrants are likely to be met by 2017 (Warrants 1, 2 and 3). Installation of a traffic signal at 12th Street/Washington Street should be considered based on the results of this analysis. If it is determined that a traffic signal should not be installed immediately, traffic volumes and collision data should continue to be monitored. It is likely that a traffic signal will meet multiple traffic volume related warrants at this location in the near future.

Please contact either of us with any questions regarding this study.



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APPENDIX

2014 PM Peak Hour Traffic Counts

2035 PM Peak Hour Traffic Counts

2014 Hourly Major/Minor Street Traffic Volumes

Signal Warrant Analysis Summaries

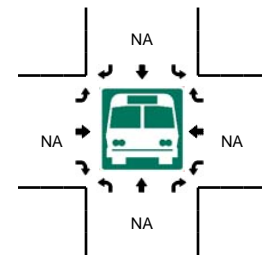
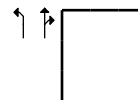
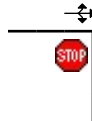
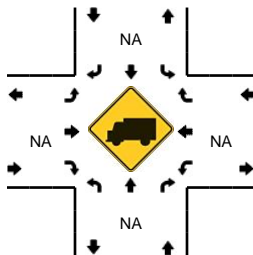
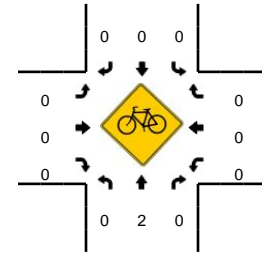
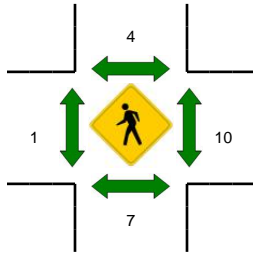
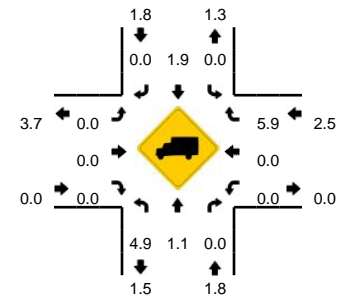
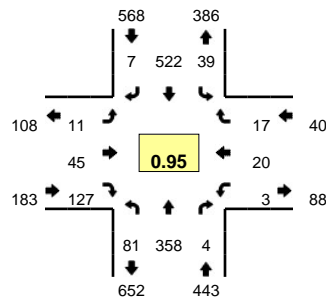
Collision Data

Synchro Output

LOCATION: Washington St -- 12th St
CITY/STATE: Oregon City, OR

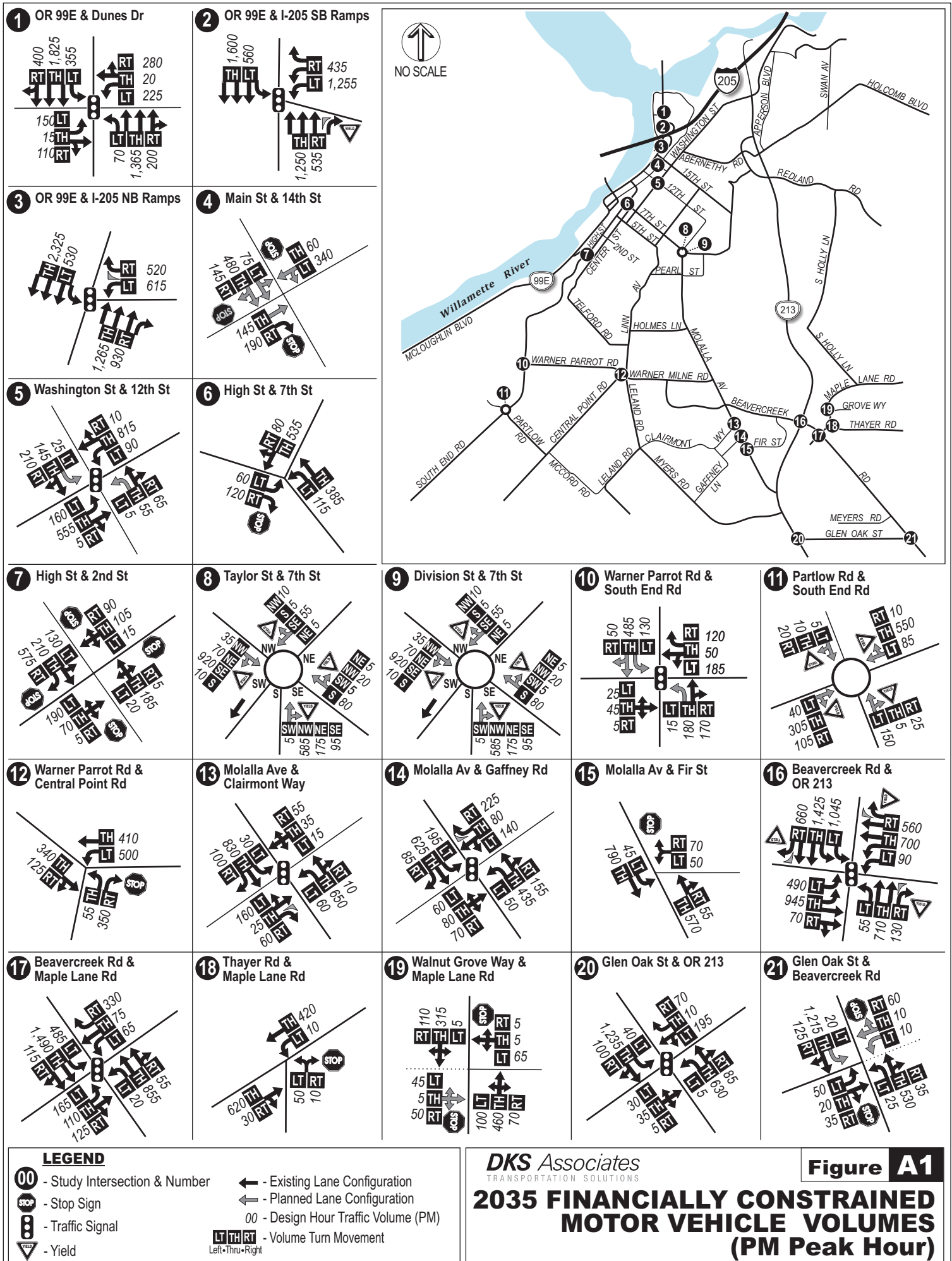
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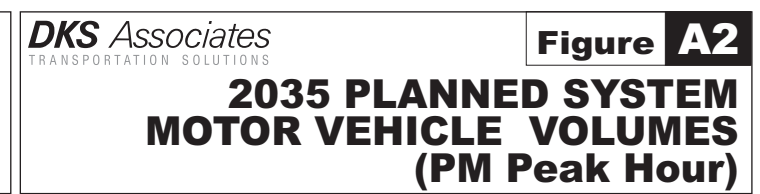
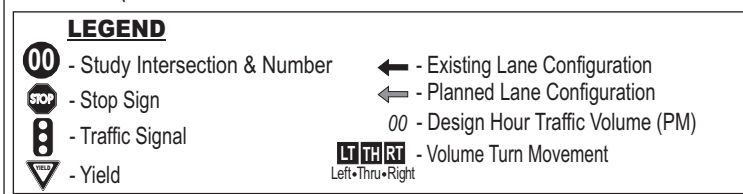
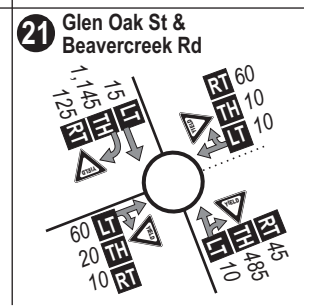
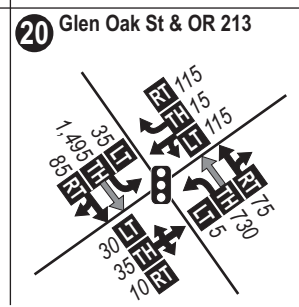
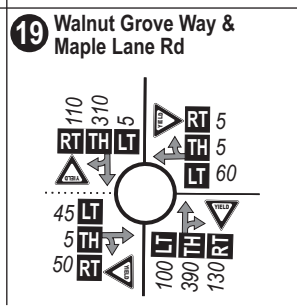
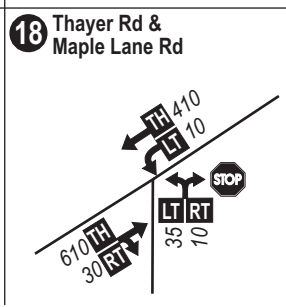
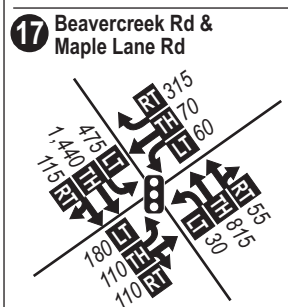
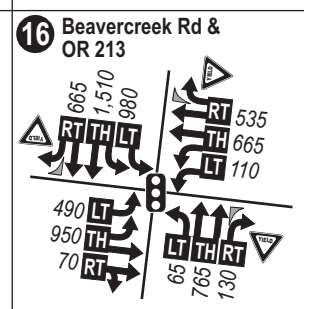
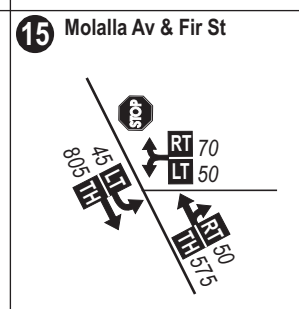
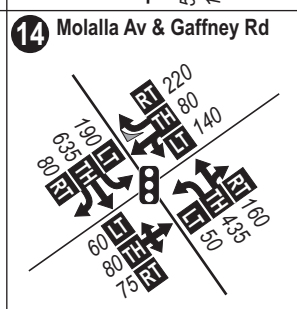
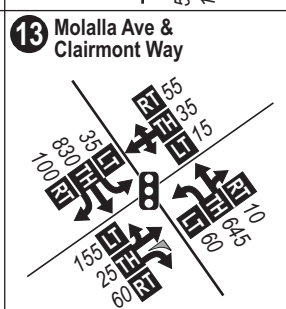
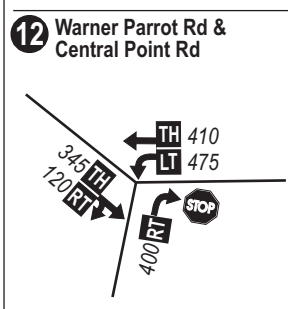
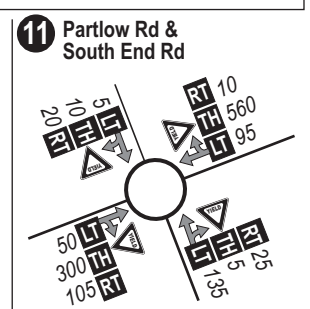
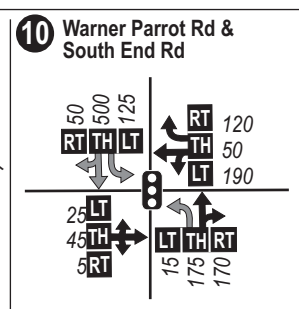
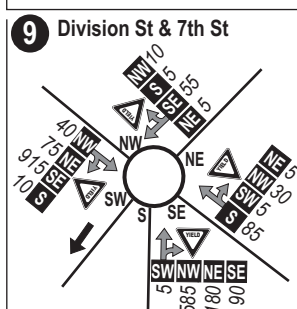
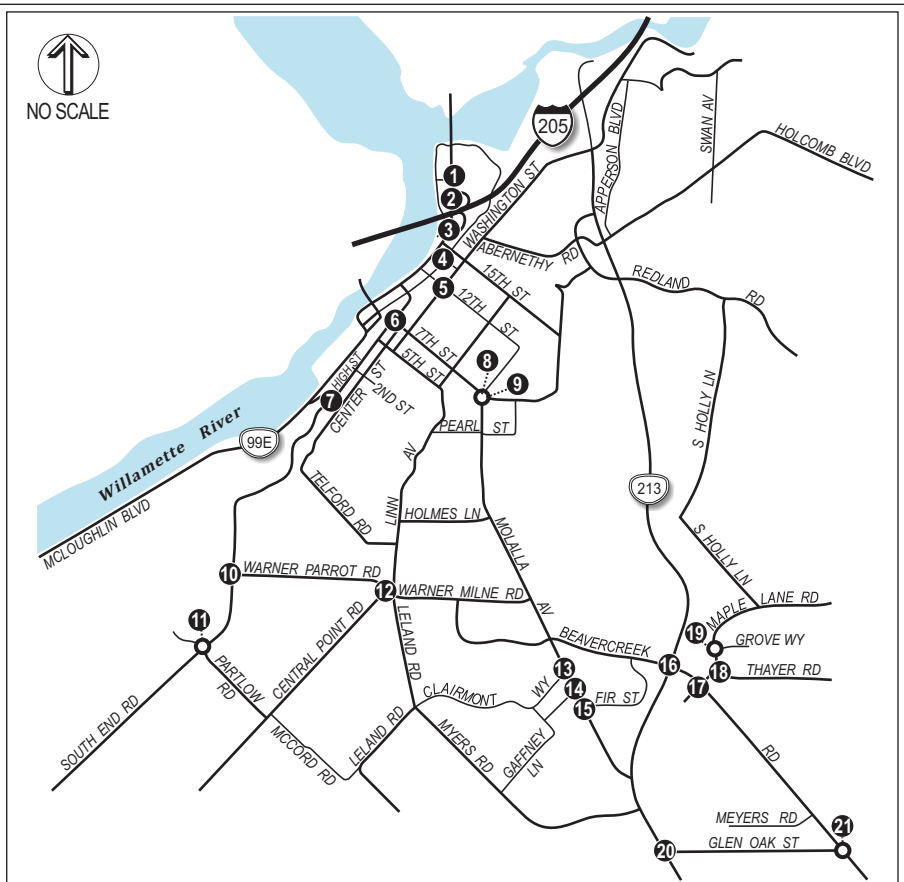
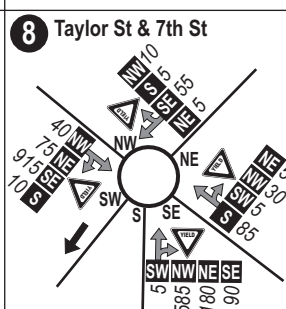
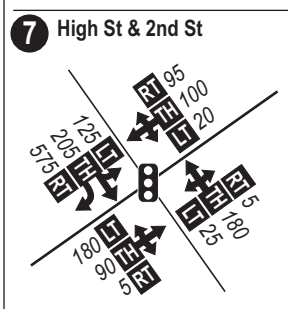
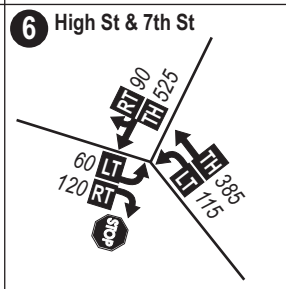
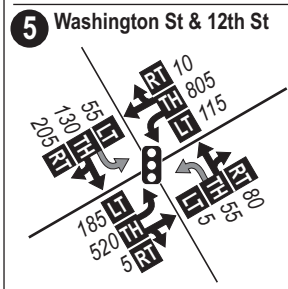
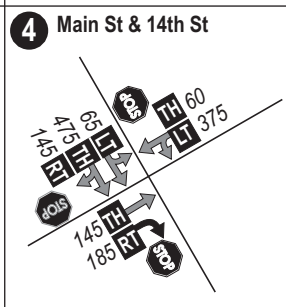
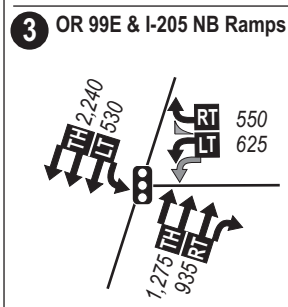
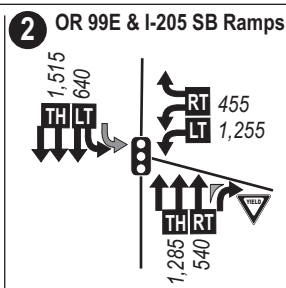
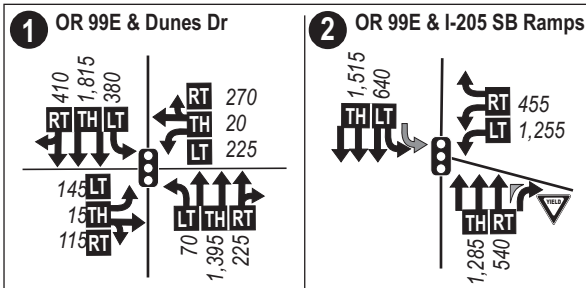
Peak-Hour: 5:00 PM -- 6:00 PM
Peak 15-Min: 5:00 PM -- 5:15 PM



15-Min Count Period Beginning At	Washington St (Northbound)				Washington St (Southbound)				12th St (Eastbound)				12th St (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
1:00 PM	21	78	1	0	1	101	2	0	1	5	13	0	2	16	8	0	249	944
1:15 PM	16	75	2	0	7	72	4	0	1	6	18	0	0	7	1	0	209	931
1:30 PM	22	88	0	0	12	84	4	0	0	6	13	0	2	4	2	0	237	959
1:45 PM	13	84	0	0	4	94	5	0	4	5	14	0	0	7	4	0	234	929
2:00 PM	14	78	2	0	9	80	3	0	2	6	20	0	2	12	5	0	233	913
2:15 PM	19	84	3	0	10	101	1	0	5	13	6	0	2	3	5	0	252	956
2:30 PM	26	71	0	0	5	106	6	0	2	11	16	0	2	18	6	0	269	988
2:45 PM	23	78	2	0	9	107	2	0	2	15	12	0	0	9	7	0	266	1020
3:00 PM	18	103	1	0	5	95	2	0	4	9	23	0	3	12	4	0	279	1066
3:15 PM	13	80	2	0	14	115	4	0	3	8	20	0	2	8	6	0	275	1089
3:30 PM	23	114	0	0	5	132	6	0	1	7	27	0	0	6	11	0	332	1152
3:45 PM	17	84	0	0	6	139	4	0	3	7	18	0	2	2	3	0	285	1171
4:00 PM	22	103	1	0	6	114	0	0	2	8	21	0	3	15	11	0	306	1198
4:15 PM	21	88	2	0	7	121	9	0	4	6	19	0	1	11	9	0	298	1221
4:30 PM	22	97	1	0	7	135	3	0	4	3	18	0	0	7	7	0	304	1193
4:45 PM	23	91	0	0	10	97	4	0	2	12	30	0	1	2	8	0	280	1188
5:00 PM	17	107	0	0	5	132	2	0	1	6	42	0	0	5	7	0	324	1206
5:15 PM	20	86	0	0	3	148	0	0	5	8	23	0	1	5	1	0	300	1208
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6:00 PM	17	72	1	0	20	99	1	0	4	22	31	0	0	1	6	0	274	1184
6:15 PM	18	76	0	0	10	90	1	0	1	12	22	0	0	9	8	0	247	1131
6:30 PM	14	73	1	0	2	91	2	0	0	2	19	0	1	3	1	0	209	1029
6:45 PM	14	73	1	0	8	96	2	0	2	11	16	0	0	5	1	0	229	959
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
All Vehicles	68	428	0	0	20	528	8	0	4	24	168	0	0	20	28	0	1296	
Heavy Trucks	8	4	0	0	0	8	0	0	0	0	0	0	0	0	4	0	24	
Pedestrians	8	8	0	0	8	8	0	0	0	0	0	0	0	0	0	0	16	
Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Railroad																		
Stopped Buses																		

Comments:





ALL-VEHICLE VOLUMES		2014 Hourly Volumes					2035				
Time Period	Hourly Total	Major	Min-WB	Min-EB	EB RTs	EB-25% RTs	Major	WB	EB	EB RTs	EB-25% RTs
7:00 AM	940	828	41	71	55	57	1339	144	147	114	119
8:00 AM	906	761	49	96	44	85	1231	172	199	92	176
9:00 AM	778	653	67	58	29	51	1056	235	120	60	105
10:00 AM	768	675	33	60	39	50	1092	116	125	81	104
11:00 AM	872	738	44	90	54	77	1194	154	187	112	159
12:00 PM	913	788	42	83	51	70	1274	147	172	106	146
1:00 PM	929	790	53	86	58	72	1278	186	179	121	148
2:00 PM	1020	839	71	110	54	97	1357	249	228	112	200
3:00 PM	1171	982	59	130	88	108	1588	207	270	183	224
4:00 PM	1188	984	75	129	88	107	1591	263	268	183	222
5:00 PM	1234	1011	40	183	127	151	1635	140	380	264	314
6:00 PM	959	782	35	142	88	120	1265	123	295	183	249
7:00 PM	659	528	73	58	42	48	854	256	120	87	99
8:00 PM	534	411	53	70	39	60	665	186	145	81	125

2014	Meets Warrant 1?	No																						
	Eight-Hour Vehicular Volume																							
	Hourly Volumes				Warrant 1 - Condition A								Warrant 1 - Condition B								Both A & B			
Hour	Hourly Totals	Major	Min-WB	Min-EB	Major	Min-WB	Min-EB	Maj/WB	Maj/EB	Maj/WB	Maj/EB	Major	Min-WB	Min-EB	Maj/WB	Maj/EB	Maj/WB	Maj/EB	WB	EB				
								100%	100%	80%	80%				100%	100%	80%	80%	A&B 80%	A&B 80%				
7:00 AM	940	828	41	57	100%	No	No	No	No	No	No	100%	No	No	No	No	No	No	No	No				
8:00 AM	906	761	49	85	100%	No	No	No	No	No	No	100%	No	100%	No	Yes	No	Yes	No	No				
9:00 AM	1606	653	67	51	100%	No	No	No	No	No	No	80%	80%	No	No	No	Yes	No	No	No				
10:00 AM	768	675	33	50	100%	No	No	No	No	No	No	80%	No	No	No	No	No	No	No	No				
11:00 AM	872	738	44	77	100%	No	No	No	No	No	No	80%	No	100%	No	No	No	Yes	No	No				
12:00 PM	913	788	42	70	100%	No	No	No	No	No	No	100%	No	80%	No	No	No	Yes	No	No				
1:00 PM	929	790	53	72	100%	No	No	No	No	No	No	100%	No	80%	No	No	No	Yes	No	No				
2:00 PM	1020	839	71	97	100%	No	No	No	No	No	No	100%	80%	100%	No	Yes	Yes	Yes	No	No				
3:00 PM	1171	982	59	108	100%	No	No	No	No	No	No	100%	No	100%	No	Yes	No	Yes	No	No				
4:00 PM	1188	984	75	107	100%	No	No	No	No	No	No	100%	100%	100%	Yes	Yes	Yes	Yes	No	No				
5:00 PM	1234	1011	40	151	100%	No	100%	No	Yes	No	Yes	100%	No	100%	No	Yes	No	Yes	No	Yes				
6:00 PM	959	782	35	120	100%	No	80%	No	No	No	Yes	100%	No	100%	No	Yes	No	Yes	No	Yes				
7:00 PM	659	528	73	48	100%	No	No	No	No	No	No	No	80%	No	No	No	No	No	No	No				
8:00 PM	534	411	53	60	80%	No	No	No	No	No	No	No	No	80%	No	No	No	No	No	No				
					Hours 100% Met =			0	1						1	6				2				
					Warrant Met			No	No						No	No				No				

2035	Meets Warrant 1?	Yes																				
	Eight-Hour Vehicular Volume																					
	Hourly Volumes				Warrant 1 - Condition A								Warrant 1 - Condition B						Both A & B			
Hour	Hourly Totals	Major	Min-WB	Min-EB	Major	Min-WB	Min-EB	Maj/WB	Maj/EB	Maj/WB	Maj/EB	Major	Min-WB	Min-EB	Maj/WB	Maj/EB	Maj/WB	Maj/EB	WB	EB		
								100%	100%	80%	80%				100%	100%	80%	80%	A&B 80%	A&B 80%		
7:00 AM		1339	144	119	100%	80%	No	No	No	Yes	No	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	No		
8:00 AM		1231	172	176	100%	100%	100%	Yes	Yes	Yes	Yes	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	Yes		
9:00 AM		1056	235	105	100%	100%	No	Yes	No	Yes	No	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	No		
10:00 AM		1092	116	104	100%	No	No	No	No	No	No	100%	100%	100%	Yes	Yes	Yes	Yes	No	No		
11:00 AM		1194	154	159	100%	100%	100%	Yes	Yes	Yes	Yes	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	Yes		
12:00 PM		1274	147	146	100%	80%	80%	No	No	Yes	Yes	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	Yes		
1:00 PM		1278	186	148	100%	100%	80%	Yes	No	Yes	Yes	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	Yes		
2:00 PM		1357	249	200	100%	100%	100%	Yes	Yes	Yes	Yes	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	Yes		
3:00 PM		1588	207	224	100%	100%	100%	Yes	Yes	Yes	Yes	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	Yes		
4:00 PM		1591	263	222	100%	100%	100%	Yes	Yes	Yes	Yes	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	Yes		
5:00 PM		1635	140	314	100%	80%	100%	No	Yes	Yes	Yes	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	Yes		
6:00 PM		1265	123	249	100%	80%	100%	No	Yes	Yes	Yes	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	Yes		
7:00 PM		854	256	99	100%	100%	No	Yes	No	Yes	No	100%	100%	100%	Yes	Yes	Yes	Yes	Yes	No		
8:00 PM		665	186	125	100%	100%	80%	Yes	No	Yes	Yes	80%	100%	100%	No	No	Yes	Yes	Yes	Yes		
					Hours 100% Met =			9	7						13	13				23		
					Warrant Met			Yes	Yes						Yes	Yes				Yes		

Figure 4C-3. Warrant 3, Peak Hour

The graph illustrates the relationship between the volume on the major street and the volume on the minor street for Warrant 3 during the peak hour. The Y-axis represents the volume on the minor street (Higher-Volume Approach) in VPH, ranging from 100 to 600. The X-axis represents the total volume on the major street (both approaches) in VPH, ranging from 400 to 1800. Four lines represent different lane configurations:

- 2 OR MORE LANES & 2 OR MORE LANES:** The highest line, starting at approximately (450, 520) and ending at (1800, 150).
- 2 OR MORE LANES & 1 LANE:** The second line from the top, starting at approximately (450, 450) and ending at (1800, 100).
- 1 LANE & 1 LANE:** The third line from the top, starting at approximately (450, 380) and ending at (1800, 100).
- 100*:** A horizontal line at the bottom, representing the 100 VPH threshold for the 1-lane/1-lane configuration.

A blue line with dots shows a sample path starting at (1000, 150) and ending at (1650, 330).

***Note:** 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

2014	Warrant 4 Met?		No					
	Pedestrian							
	PEDESTRIAN VOLUMES							
	Time Period	North	South	East	West	Total	Hourly	Meets Minimum (107)?
	7:00 AM	1	0	0	0	1		
	7:15 AM	2	0	0	0	2		
	7:30 AM	0	0	0	1	1		
	7:45 AM	1	1	0	0	2	6	No
	8:00 AM	2	3	2	0	7	12	No
	8:15 AM	4	2	2	0	8	18	No
	8:30 AM	1	0	2	0	3	20	No
	8:45 AM	4	1	1	0	6	24	No
	9:00 AM	4	0	2	0	6	23	No
	9:15 AM	4	1	0	0	5	20	No
	9:30 AM	2	0	3	0	5	22	No
	9:45 AM	1	0	0	0	1	17	No
	10:00 AM	1	0	1	0	2	13	No
	10:15 AM	0	2	0	0	2	10	No
	10:30 AM	2	1	2	1	6	11	No
	10:45 AM	1	0	1	0	2	12	No
	11:00 AM	0	1	0	0	1	11	No
	11:15 AM	2	0	0	0	2	11	No
	11:30 AM	3	2	0	0	5	10	No
	11:45 AM	9	1	1	2	13	21	No
	12:00 PM	3	0	0	0	3	23	No
	12:15 PM	0	0	1	1	2	23	No
	12:30 PM	1	0	1	0	2	20	No
	12:45 PM	1	0	0	0	1	8	No
	1:00 PM	2	0	1	0	3	8	No
	1:15 PM	6	1	1	1	9	15	No
	1:30 PM	3	1	0	0	4	17	No
	1:45 PM	6	0	0	1	7	23	No
	2:00 PM	8	0	0	0	8	28	No
	2:15 PM	0	1	0	0	1	20	No
	2:30 PM	4	0	0	0	4	20	No
	2:45 PM	6	0	0	0	6	19	No
	3:00 PM	2	1	0	0	3	14	No
	3:15 PM	2	0	1	0	3	16	No
	3:30 PM	6	0	2	3	11	23	No
	3:45 PM	1	1	0	4	6	23	No
	4:00 PM	1	1	1	1	4	24	No
	4:15 PM	5	1	0	0	6	27	No
	4:30 PM	0	0	0	2	2	18	No
	4:45 PM	2	5	1	0	8	20	No
	5:00 PM	2	2	0	0	4	20	No
	5:15 PM	1	3	0	1	5	19	No
	5:30 PM	1	1	7	0	9	26	No
	5:45 PM	0	1	3	0	4	22	No
	6:00 PM	0	0	2	0	2	20	No
	6:15 PM	0	2	2	0	4	19	No
	6:30 PM	0	0	1	0	1	11	No
	6:45 PM	0	0	0	2	2	9	No
	Meets Minimum Pedestrian Threshold (107 pph)?							0
	Meets Warrant?							No

2014	Meets Warrant 7?		Yes			
	Crash Experience					
	A.					
	Alternatives have failed					
	to reduce crash frequency	Meets?	Yes			
	B.	Type	2010	2011	2012	3-year
	>=5 crashes in 12 months	Angle	4	7	6	17
	Correctable by Signal	Turning	1	3	1	5
		Rear End	0	1	0	1
		Fixed Object	1	0	0	1
		Total (Angle/Turning)	5	10	7	22
		Meets?	Yes			
	C.					
	Meets 8-hour Warrant 1 -A		No			
	or 8-hour Warrant 1 - B		Yes			
		Meets?	Yes			

YEAR_NO	COLLISION TYPE	FATAL CRASHES	NON-FATAL CRASHES	PROP DAMAGE ONLY	CRASHES TOTAL	PEOPLE KILLED	PEOPLE INJURED	TRUCKS	DRY SURF	WET SURF	DAY	DARK	INTERSECTION	INTERSECTION RELATED	OFFROAD
2011	ANGLE	0	2	5	7	0	2	0	6	0	6	1	7	0	0
2011	REAR-END	0	0	1	1	0	0	1	1	0	1	0	1	0	0
2011	TURNING MOVEMENTS	0	2	1	3	0	2	0	3	0	3	0	3	0	0
2011	YEAR 2011 TOTAL	0	4	7	11	0	4	1	10	0	10	1	11	0	0
2010	ANGLE	0	2	2	4	0	4	0	2	2	4	0	4	0	0
2010	FIXED / OTHER OBJECT	0	0	1	1	0	0	0	0	1	1	0	1	0	1
2010	TURNING MOVEMENTS	0	0	1	1	0	0	0	1	0	1	0	1	0	0
2010	YEAR 2010 TOTAL	0	2	4	6	0	4	0	3	3	6	0	6	0	1
2009	ANGLE	0	2	6	8	0	4	0	8	0	5	3	8	0	0
2009	YEAR 2009 TOTAL	0	2	6	8	0	4	0	8	0	5	3	8	0	0
2008	ANGLE	0	1	2	3	0	2	0	2	1	3	0	3	0	0
2008	YEAR 2008 TOTAL	0	1	2	3	0	2	0	2	1	3	0	3	0	0
9999	FINAL TOTAL	0	9	19	28	0	14	1	23	4	24	4	28	0	1

HCM 2010 TWSC
3: Washington Street & 12th Street

5/7/2014

Intersection												
Intersection Delay, s/veh	11.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	11	45	127	3	20	17	81	358	4	39	522	7
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	5	-	-	5	-	-	-10	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	3	3	3	2	2	2	2	2	2
Mvmt Flow	12	47	134	3	21	18	85	377	4	41	549	7
Major/Minor	Minor2		Minor1			Major1			Major2			
Conflicting Flow All	1204	1187	553	1275	1188	379	557	0	0	381	0	0
Stage 1	635	635	-	549	549	-	-	-	-	-	-	-
Stage 2	569	552	-	726	639	-	-	-	-	-	-	-
Follow-up Headway	3.518	4.018	3.318	3.527	4.027	3.327	2.218	-	-	2.218	-	-
Pot Capacity-1 Maneuver	115	135	493	100	135	632	1014	-	-	1177	-	-
Stage 1	391	396	-	445	442	-	-	-	-	-	-	-
Stage 2	433	442	-	339	393	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	88	119	493	46	119	632	1014	-	-	1177	-	-
Mov Capacity-2 Maneuver	88	119	-	46	119	-	-	-	-	-	-	-
Stage 1	358	382	-	408	405	-	-	-	-	-	-	-
Stage 2	365	405	-	209	379	-	-	-	-	-	-	-
Approach	EB		WB			NB			SB			
HCM Control Delay, s	60.9		36.9			1.6			0.6			
HCM LOS	F		E									
Minor Lane / Major Mvmt	NBL		NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR			
Capacity (veh/h)	1014		-	-	241	154	1177	-	-			
HCM Lane V/C Ratio	0.084		-	-	0.799	0.273	0.035	-	-			
HCM Control Delay (s)	8.876		-	-	60.9	36.9	8.169	-	-			
HCM Lane LOS	A				F	E	A					
HCM 95th %tile Q(veh)	0.275		-	-	5.998	1.05	0.108	-	-			
Notes												
~ : Volume Exceeds Capacity; \$: Delay Exceeds 300 Seconds; Error : Computation Not Defined												

HCM 2010 TWSC
3: Washington Street & 12th Street

5/8/2014

Intersection									
Int Delay, s/veh	1.4								

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR
Vol, veh/h	55	130	205	5	55	80	185	520	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-
Grade, %	-	5	-	-	5	-	-	-10	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	3	3	3	2	2	2
Mvmt Flow	58	137	216	5	58	84	195	547	5

Major/Minor	Minor2		Minor1			Major1			
Conflicting Flow All	2106	2037	853	2210	2039	550	858	0	0
Stage 1	1095	1095	-	939	939	-	-	-	-
Stage 2	1011	942	-	1271	1100	-	-	-	-
Critical Hdwy	8.12	7.52	6.72	8.13	7.53	6.73	4.12	-	-
Critical Hdwy Stg 1	7.12	6.52	-	7.13	6.53	-	-	-	-
Critical Hdwy Stg 2	7.12	6.52	-	7.13	6.53	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.527	4.027	3.327	2.218	-	-
Pot Cap-1 Maneuver	~ 21	~ 32	319	17	~ 32	494	783	-	-
Stage 1	191	214	-	243	263	-	-	-	-
Stage 2	218	263	-	144	211	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	~ 21	319	-	~ 21	494	783	-	-
Mov Cap-2 Maneuver	-	~ 21	-	-	~ 21	-	-	-	-
Stage 1	143	189	-	182	198	-	-	-	-
Stage 2	96	198	-	11	186	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s			2.9
HCM LOS	-	-	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	783	-	-	-	-	1017	-	-
HCM Lane V/C Ratio	0.249	-	-	-	-	0.119	-	-
HCM Control Delay (s)	11.1	-	-	-	-	9	-	-
HCM Lane LOS	B	-	-	-	-	A	-	-
HCM 95th %tile Q(veh)	1	-	-	-	-	0.4	-	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection			
Int Delay, s/veh			
Movement	SBL	SBT	SBR
Vol, veh/h	115	805	10
Conflicting Peds, #/hr	0	0	0
Sign Control	Free	Free	Free
RT Channelized	-	-	None
Storage Length	0	-	-
Veh in Median Storage, #	-	0	-
Grade, %	-	0	-
Peak Hour Factor	95	95	95
Heavy Vehicles, %	2	2	2
Mvmt Flow	121	847	11
Major/Minor	Major2		
Conflicting Flow All	553	0	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	4.12	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	2.218	-	-
Pot Cap-1 Maneuver	1017	-	-
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	1017	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-
Approach	SB		
HCM Control Delay, s	1.1		
HCM LOS			
Minor Lane/Major Mvmt			