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## Appendix

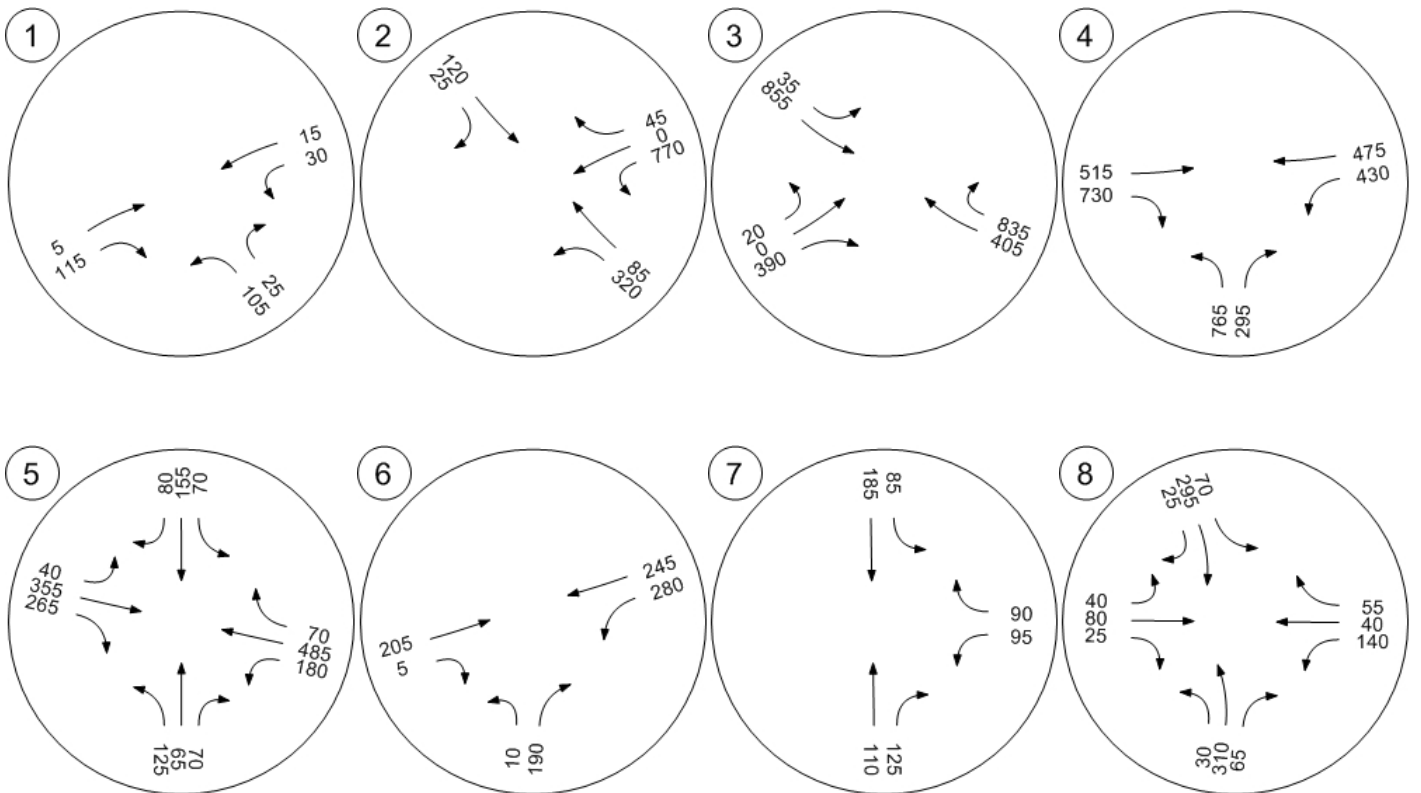
A – 2040 Traffic Volumes

B – 2040 HCM Reports

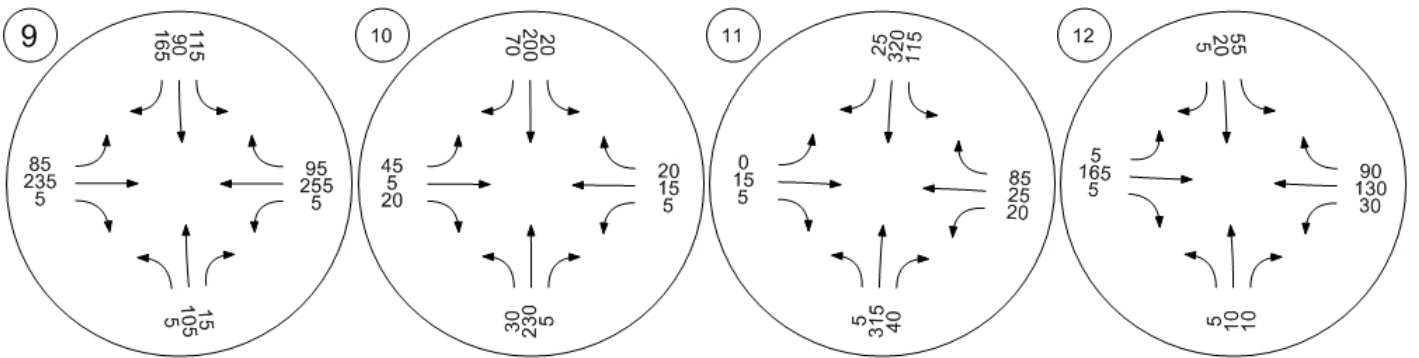
C – 2040 Queuing Reports

Appendix A – 2040 Traffic Volumes

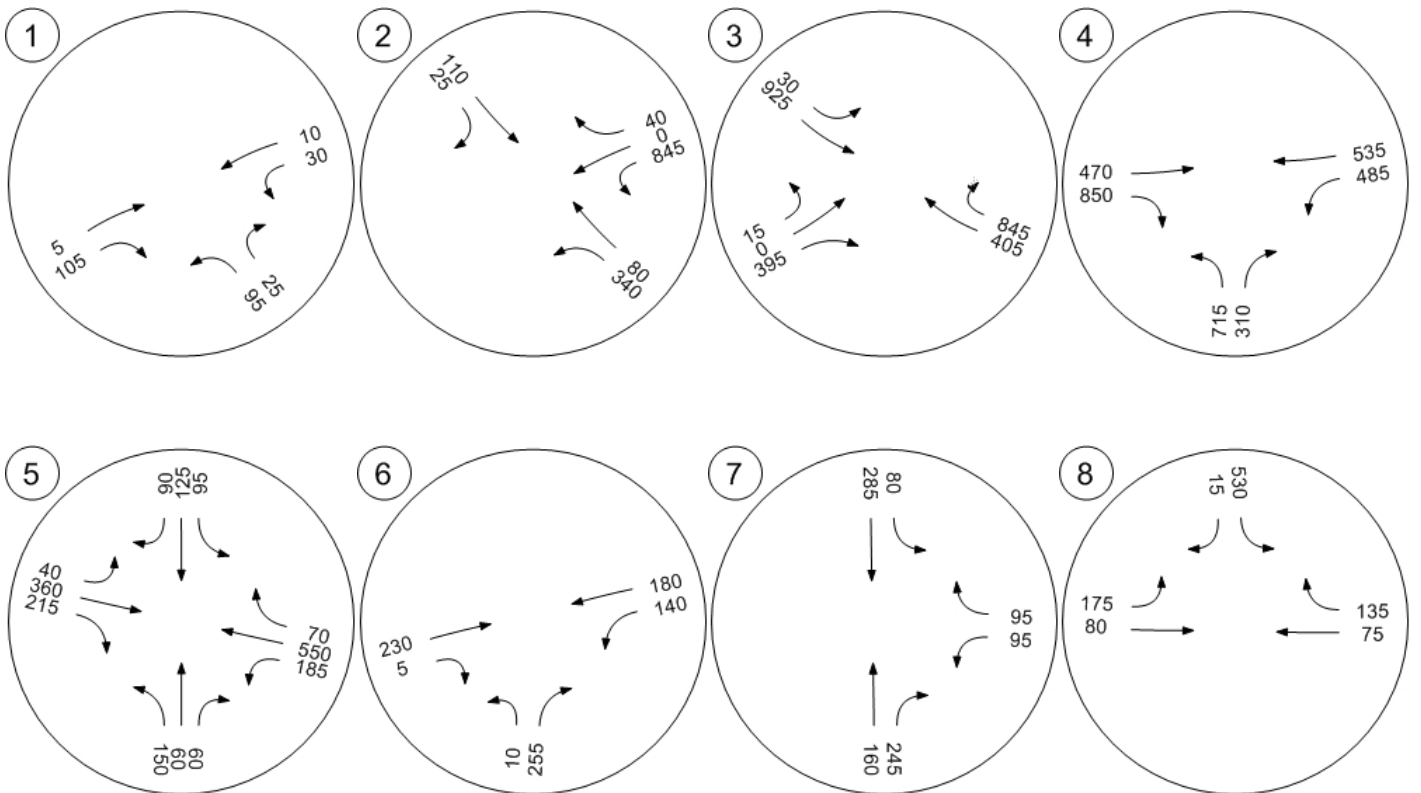
Traffic Volume - Base Volume



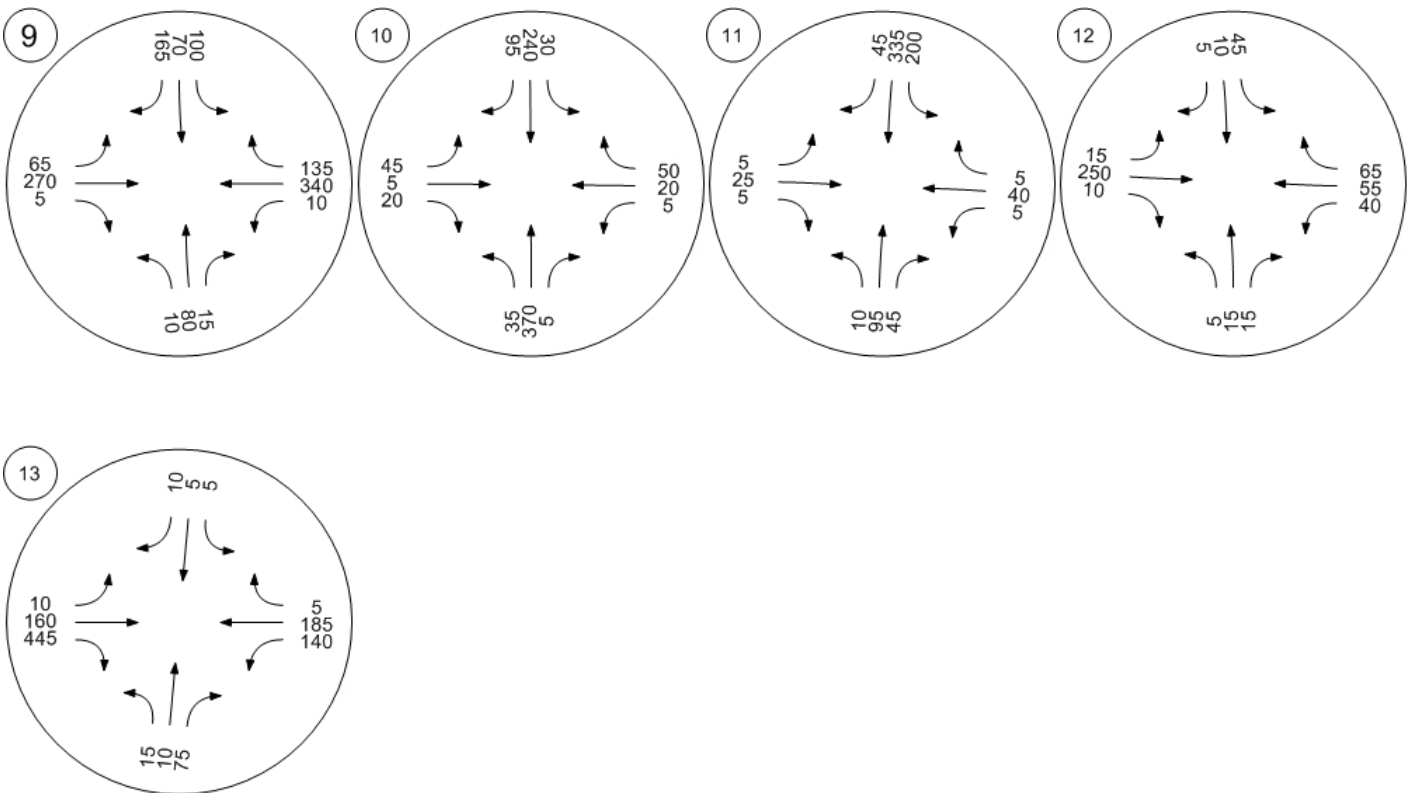
Traffic Volume - Base Volume



Traffic Volume - Base Volume









Traffic Volume - Base Volume



## Appendix B – 2040 HCM Reports

HCM Signalized Intersection Capacity Analysis  
3: Mt Adams Ave & Cascade Ave

2040 Base Scenario  
PM Peak

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	515	730	430	475	765	295
Future Volume (vph)	515	730	430	475	765	295
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
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	1.00	0.97	1.00
Frbp, ped/bikes	1.00	0.98	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1699	1421	1614	1699	3162	1418
Flt Permitted	1.00	1.00	0.11	1.00	0.95	1.00
Satd. Flow (perm)	1699	1421	190	1699	3162	1418
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	572	811	478	528	850	328
RTOR Reduction (vph)	0	0	0	0	0	59
Lane Group Flow (vph)	572	811	478	528	850	269
Confl. Peds. (#/hr)		10	10			10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Turn Type	NA	Free	pm+pt	NA	Prot	pm+ov
Protected Phases	6		5	2	4	5
Permitted Phases		Free	2			4
Actuated Green, G (s)	32.0	90.0	57.0	57.0	25.0	46.0
Effective Green, g (s)	32.0	90.0	57.0	57.0	25.0	46.0
Actuated g/C Ratio	0.36	1.00	0.63	0.63	0.28	0.51
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	604	1421	452	1076	878	787
v/s Ratio Prot	0.34		c0.25	0.31	c0.27	0.08
v/s Ratio Perm		0.57	c0.42			0.11
v/c Ratio	0.95	0.57	1.06	0.49	0.97	0.34
Uniform Delay, d1	28.2	0.0	26.4	8.8	32.1	13.0
Progression Factor	1.07	1.00	1.21	1.00	0.87	1.55
Incremental Delay, d2	21.8	1.4	55.9	1.4	18.3	0.2
Delay (s)	52.0	1.4	87.8	10.2	46.1	20.4
Level of Service	D	A	F	B	D	C
Approach Delay (s)	22.4			47.1	38.9	
Approach LOS	C			D	D	
<b>Intersection Summary</b>						
HCM 2000 Control Delay			34.8		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			1.06			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			89.0%		ICU Level of Service	E
Analysis Period (min)			15			
c Critical Lane Group						





















Intersection												
Int Delay, s/veh	3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	45	5	20	5	15	20	30	230	5	20	200	70
Future Vol, veh/h	45	5	20	5	15	20	30	230	5	20	200	70
Conflicting Peds, #/hr	10	0	10	0	0	0	10	0	0	0	0	10
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	92	93	92	92	92	93	93	92	92	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	48	5	22	5	16	22	32	247	5	22	215	75
Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	650	623	273	635	659	260	300	0	0	253	0	0
Stage 1	306	306	-	315	315	-	-	-	-	-	-	-
Stage 2	344	317	-	320	344	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	382	402	766	391	384	779	1261	-	-	1312	-	-
Stage 1	704	662	-	696	656	-	-	-	-	-	-	-
Stage 2	671	654	-	692	637	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	339	379	753	359	362	773	1250	-	-	1301	-	-
Mov Cap-2 Maneuver	339	379	-	359	362	-	-	-	-	-	-	-
Stage 1	677	643	-	675	636	-	-	-	-	-	-	-
Stage 2	611	634	-	648	619	-	-	-	-	-	-	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	15.9			13			0.9			0.5		
HCM LOS	C			B								
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	1250	-	-	406	492	1301	-	-				
HCM Lane V/C Ratio	0.026	-	-	0.186	0.088	0.017	-	-				
HCM Control Delay (s)	8	0	-	15.9	13	7.8	0	-				
HCM Lane LOS	A	A	-	C	B	A	A	-				
HCM 95th %tile Q(veh)	0.1	-	-	0.7	0.3	0.1	-	-				

# HCM Signalized Intersection Capacity Analysis

## 7: Mt Adams Ave & May St.

2040 Base Scenario  
PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	80	25	140	40	55	30	310	65	70	295	25
Future Volume (vph)	40	80	25	140	40	55	30	310	65	70	295	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
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	1.00		1.00	1.00	
Frbp, ped/bikes		0.99			0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			0.99		1.00	1.00		1.00	1.00	
Frt		0.98			0.97		1.00	0.97		1.00	0.99	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1632			1575		1630	1656		1630	1689	
Flt Permitted		0.87			0.68		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1447			1110		1630	1656		1630	1689	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	87	27	152	43	60	33	337	71	76	321	27
RTOR Reduction (vph)	0	9	0	0	13	0	0	6	0	0	2	0
Lane Group Flow (vph)	0	148	0	0	242	0	33	402	0	76	346	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)		23.1			23.1		5.0	46.5		8.4	49.9	
Effective Green, g (s)		23.1			23.1		5.0	46.5		8.4	49.9	
Actuated g/C Ratio		0.26			0.26		0.06	0.52		0.09	0.55	
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)		371			284		90	855		152	936	
v/s Ratio Prot							0.02	c0.24		c0.05	c0.20	
v/s Ratio Perm		0.10			c0.22							
v/c Ratio		0.40			0.85		0.37	0.47		0.50	0.37	
Uniform Delay, d1		27.7			31.8		41.0	13.9		38.8	11.2	
Progression Factor		1.05			1.00		1.00	1.00		0.74	1.67	
Incremental Delay, d2		0.7			20.9		2.5	1.9		2.4	1.0	
Delay (s)		29.6			52.7		43.5	15.7		31.1	19.8	
Level of Service		C			D		D	B		C	B	
Approach Delay (s)		29.6			52.7			17.8			21.8	
Approach LOS		C			D			B			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			27.6				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.58									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			57.6%				ICU Level of Service			B		
Analysis Period (min)			15									

c Critical Lane Group

**Intersection**

Int Delay, s/veh 5.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Vol, veh/h	205	5	280	245	10	190
Future Vol, veh/h	205	5	280	245	10	190
Conflicting Peds, #/hr	0	10	10	0	10	10
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	4	5	5	5	5
Mvmt Flow	228	6	311	272	11	211

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	0	0	243	0
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	-	-	4.15	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	-	-	2.245	-
Pot Cap-1 Maneuver	-	-	1306	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	-	-	1295	-
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4.6	13.6
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	640	-	-	1295	-
HCM Lane V/C Ratio	0.347	-	-	0.24	-
HCM Control Delay (s)	13.6	-	-	8.7	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	1.6	-	-	0.9	-

Intersection												
Int Delay, s/veh	3.9											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↶	↷		↶	↷		↶	↷		↶	↷	
Traffic Vol, veh/h	0	15	5	20	25	85	5	315	40	115	320	25
Future Vol, veh/h	0	15	5	20	25	85	5	315	40	115	320	25
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	200	-	-	200	-	-	200	-	-	200	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	16	5	22	27	92	5	342	43	125	348	27

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1066	1028	381	1017	1020	384	385	0	0	396	0	0
Stage 1	621	621	-	385	385	-	-	-	-	-	-	-
Stage 2	445	407	-	632	635	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	200	234	666	216	237	664	1173	-	-	1163	-	-
Stage 1	475	479	-	638	611	-	-	-	-	-	-	-
Stage 2	592	597	-	468	472	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	139	204	655	181	207	653	1163	-	-	1153	-	-
Mov Cap-2 Maneuver	139	204	-	181	207	-	-	-	-	-	-	-
Stage 1	469	424	-	630	603	-	-	-	-	-	-	-
Stage 2	479	589	-	395	417	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	21	18	0.1	2.1
HCM LOS	C	C		






















Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1163	-	-	-	246	181	438	1153	-	-
HCM Lane V/C Ratio	0.005	-	-	-	0.088	0.12	0.273	0.108	-	-
HCM Control Delay (s)	8.1	-	-	0	21	27.6	16.3	8.5	-	-
HCM Lane LOS	A	-	-	A	C	D	C	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	0.3	0.4	1.1	0.4	-	-

Intersection												
Int Delay, s/veh	3.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	5	165	5	30	130	90	5	10	10	55	20	5
Future Vol, veh/h	5	165	5	30	130	90	5	10	10	55	20	5
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	179	5	33	141	98	5	11	11	60	22	5
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	249	0	0	195	0	0	482	517	202	479	471	210
Stage 1	-	-	-	-	-	-	203	203	-	265	265	-
Stage 2	-	-	-	-	-	-	279	314	-	214	206	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1317	-	-	1378	-	-	495	462	839	497	491	830
Stage 1	-	-	-	-	-	-	799	733	-	740	689	-
Stage 2	-	-	-	-	-	-	728	656	-	788	731	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1306	-	-	1367	-	-	455	440	825	462	467	816
Mov Cap-2 Maneuver	-	-	-	-	-	-	455	440	-	462	467	-
Stage 1	-	-	-	-	-	-	789	724	-	731	664	-
Stage 2	-	-	-	-	-	-	674	632	-	757	722	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.2			0.9			12			14.2		
HCM LOS							B			B		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	545	1306	-	-	1367	-	-	476				
HCM Lane V/C Ratio	0.05	0.004	-	-	0.024	-	-	0.183				
HCM Control Delay (s)	12	7.8	0	-	7.7	0	-	14.2				
HCM Lane LOS	B	A	A	-	A	A	-	B				
HCM 95th %tile Q(veh)	0.2	0	-	-	0.1	-	-	0.7				

Intersection						
Int Delay, s/veh	5.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		T			T
Traffic Vol, veh/h	95	90	110	125	85	185
Future Vol, veh/h	95	90	110	125	85	185
Conflicting Peds, #/hr	10	10	0	10	10	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	103	98	120	136	92	201
Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	594	208	0	0	265	0
Stage 1	198	-	-	-	-	-
Stage 2	396	-	-	-	-	-
Critical Hdwy	7.12	6.22	-	-	4.12	-
Critical Hdwy Stg 1	6.12	-	-	-	-	-
Critical Hdwy Stg 2	6.12	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	417	832	-	-	1299	-
Stage 1	804	-	-	-	-	-
Stage 2	629	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	385	818	-	-	1288	-
Mov Cap-2 Maneuver	385	-	-	-	-	-
Stage 1	804	-	-	-	-	-
Stage 2	574	-	-	-	-	-
Approach	WB		NB		SB	
HCM Control Delay, s	16.3		0		2.5	
HCM LOS	C					
Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT		
Capacity (veh/h)	-	-	519	1288	-	-
HCM Lane V/C Ratio	-	-	0.387	0.072	-	-
HCM Control Delay (s)	-	-	16.3	8	0	-
HCM Lane LOS	-	-	C	A	A	-
HCM 95th %tile Q(veh)	-	-	1.8	0.2	-	-




















HCM Signalized Intersection Capacity Analysis  
15: Rand Rd & Cascade Ave

2040 Base Scenario  
PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	355	265	180	485	70	125	65	70	70	155	80
Future Volume (vph)	40	355	265	180	485	70	125	65	70	70	155	80
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
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	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	0.97		1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		0.98	1.00		0.98	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.92		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1626	1716	1383	1609	1656		1605	1538		1595	1598	
Flt Permitted	0.31	1.00	1.00	0.37	1.00		0.45	1.00		0.62	1.00	
Satd. Flow (perm)	532	1716	1383	631	1656		760	1538		1040	1598	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	44	394	294	200	539	78	139	72	78	78	172	89
RTOR Reduction (vph)	0	0	158	0	6	0	0	43	0	0	21	0
Lane Group Flow (vph)	44	394	136	200	611	0	139	107	0	78	240	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			4				8
Permitted Phases	6		6	2			4			8		
Actuated Green, G (s)	44.7	41.7	41.7	55.0	48.0		27.0	27.0		27.0	27.0	
Effective Green, g (s)	44.7	41.7	41.7	55.0	48.0		27.0	27.0		27.0	27.0	
Actuated g/C Ratio	0.50	0.46	0.46	0.61	0.53		0.30	0.30		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	
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)	300	795	640	486	883		228	461		312	479	
v/s Ratio Prot	0.00	0.23		c0.04	c0.37			0.07				0.15
v/s Ratio Perm	0.07		0.10	0.21			c0.18			0.08		
v/c Ratio	0.15	0.50	0.21	0.41	0.69		0.61	0.23		0.25	0.50	
Uniform Delay, d1	12.5	16.8	14.4	9.1	15.5		27.0	23.7		23.8	26.0	
Progression Factor	0.59	0.92	2.84	1.00	1.00		1.03	1.05		1.00	1.00	
Incremental Delay, d2	0.1	1.4	0.5	0.6	4.4		11.6	1.2		0.4	0.8	
Delay (s)	7.5	16.8	41.3	9.7	20.0		39.3	26.1		24.3	26.8	
Level of Service	A	B	D	A	B		D	C		C	C	
Approach Delay (s)		26.1			17.5			32.4			26.2	
Approach LOS		C			B			C			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			23.7				HCM 2000 Level of Service				C	
HCM 2000 Volume to Capacity ratio			0.66									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			72.0%				ICU Level of Service			C		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
 18: I-84 EB Ramp & Cascade Ave

2040 Base Scenario  
 PM Peak



















												
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		 										
Traffic Volume (vph)	35	855	0	0	405	835	20	0	390	0	0	0
Future Volume (vph)	35	855	0	0	405	835	20	0	390	0	0	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Lane Util. Factor	1.00	0.95			1.00	1.00		1.00	1.00			
Frbp, ped/bikes	1.00	1.00			1.00	0.95		1.00	0.97			
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.98	1.00			
Frt	1.00	1.00			1.00	0.85		1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (prot)	1630	3260			1699	1370		1602	1411			
Flt Permitted	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (perm)	1630	3260			1699	1370		1602	1411			
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	39	950	0	0	450	928	22	0	433	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	426	0	0	137	0	0	0
Lane Group Flow (vph)	39	950	0	0	450	502	0	22	296	0	0	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	3%	3%	3%
Turn Type	Prot	NA			NA	Perm	Perm	NA	Perm			
Protected Phases	1	6			2			4				
Permitted Phases						2	4		4			
Actuated Green, G (s)	5.3	56.0			46.7	46.7		26.0	26.0			
Effective Green, g (s)	5.3	56.0			46.7	46.7		26.0	26.0			
Actuated g/C Ratio	0.06	0.62			0.52	0.52		0.29	0.29			
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)	95	2028			881	710		462	407			
v/s Ratio Prot	0.02	c0.29			0.26							
v/s Ratio Perm						c0.37		0.01	c0.21			
v/c Ratio	0.41	0.47			0.51	0.71		0.05	0.73			
Uniform Delay, d1	40.8	9.1			14.2	16.4		23.1	28.8			
Progression Factor	1.17	0.59			1.23	7.49		1.00	1.00			
Incremental Delay, d2	2.1	0.6			1.3	3.5		0.0	6.4			
Delay (s)	49.7	5.9			18.7	126.7		23.1	35.2			
Level of Service	D	A			B	F		C	D			
Approach Delay (s)		7.7			91.4			34.6			0.0	
Approach LOS		A			F			C			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			52.9				HCM 2000 Level of Service		D			
HCM 2000 Volume to Capacity ratio			0.71									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)		12.0			
Intersection Capacity Utilization			114.1%				ICU Level of Service		H			
Analysis Period (min)			15									
c Critical Lane Group												



Intersection												
Int Delay, s/veh	73.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	85	235	5	5	255	95	5	105	15	115	90	165
Future Vol, veh/h	85	235	5	5	255	95	5	105	15	115	90	165
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	20	20	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	3	3	3	2	2	2	8	8	8	2	2	2
Mvmt Flow	91	253	5	5	274	102	5	113	16	124	97	177
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	386	0	0	268	0	0	931	845	285	869	797	345
Stage 1	-	-	-	-	-	-	448	448	-	346	346	-
Stage 2	-	-	-	-	-	-	483	397	-	523	451	-
Critical Hdwy	4.13	-	-	4.12	-	-	7.18	6.58	6.28	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.18	5.58	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.18	5.58	-	6.12	5.52	-
Follow-up Hdwy	2.227	-	-	2.218	-	-	3.572	4.072	3.372	3.518	4.018	3.318
Pot Cap-1 Maneuver	1167	-	-	1296	-	-	241	293	740	272	319	698
Stage 1	-	-	-	-	-	-	579	563	-	670	635	-
Stage 2	-	-	-	-	-	-	554	593	-	537	571	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1157	-	-	1274	-	-	120	260	722	160	283	686
Mov Cap-2 Maneuver	-	-	-	-	-	-	120	260	-	160	283	-
Stage 1	-	-	-	-	-	-	521	507	-	603	627	-
Stage 2	-	-	-	-	-	-	343	585	-	364	514	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	2.2			0.1			31.2			222.2		
HCM LOS							D			F		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	268	1157	-	-	1274	-	-	290				
HCM Lane V/C Ratio	0.502	0.079	-	-	0.004	-	-	1.372				
HCM Control Delay (s)	31.2	8.4	0	-	7.8	0	-	222.2				
HCM Lane LOS	D	A	A	-	A	A	-	F				
HCM 95th %tile Q(veh)	2.6	0.3	-	-	0	-	-	20.7				

HCM Signalized Intersection Capacity Analysis  
 23: Cascade Ave & I-84 WB Ramp

2040 Base Scenario  
 PM Peak

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR	
Lane Configurations													
Traffic Volume (vph)	0	0	0	770	0	45	0	120	25	320	85	0	
Future Volume (vph)	0	0	0	770	0	45	0	120	25	320	85	0	
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	
Total Lost time (s)				4.0	4.0	4.0		4.0		4.0	4.0		
Lane Util. Factor				0.95	0.95	1.00		0.95		1.00	1.00		
Frbp, ped/bikes				1.00	1.00	0.97		0.99		1.00	1.00		
Flpb, ped/bikes				0.98	0.98	1.00		1.00		1.00	1.00		
Frt				1.00	1.00	0.85		0.97		1.00	1.00		
Flt Protected				0.95	0.95	1.00		1.00		0.95	1.00		
Satd. Flow (prot)				1522	1522	1412		3157		1576	1667		
Flt Permitted				0.95	0.95	1.00		1.00		0.41	1.00		
Satd. Flow (perm)				1522	1522	1412		3157		686	1667		
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
Adj. Flow (vph)	0	0	0	856	0	50	0	133	28	356	94	0	
RTOR Reduction (vph)	0	0	0	0	0	32	0	23	0	0	0	0	
Lane Group Flow (vph)	0	0	0	428	428	18	0	138	0	356	94	0	
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10	
Confl. Bikes (#/hr)			5			5			5			5	
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	5%	5%	5%	
Turn Type				Perm	NA	Perm		NA		pm+pt	NA		
Protected Phases					8			7 6		5	2		
Permitted Phases				8		8				2			
Actuated Green, G (s)				32.0	32.0	32.0		17.3		39.7	39.7		
Effective Green, g (s)				32.0	32.0	32.0		17.3		39.7	39.7		
Actuated g/C Ratio				0.36	0.36	0.36		0.19		0.44	0.44		
Clearance Time (s)				4.0	4.0	4.0				4.0	4.0		
Vehicle Extension (s)				3.0	3.0	3.0				3.0	3.0		
Lane Grp Cap (vph)				541	541	502		606		586	735		
v/s Ratio Prot								c0.04		c0.19	0.06		
v/s Ratio Perm				c0.28	0.28	0.01				c0.07			
v/c Ratio				0.79	0.79	0.04		0.23		0.61	0.13		
Uniform Delay, d1				26.0	26.0	18.9		30.7		18.3	14.9		
Progression Factor				1.00	1.00	1.00		0.74		0.65	0.56		
Incremental Delay, d2				7.8	7.8	0.0		0.2		4.2	0.3		
Delay (s)				33.8	33.8	19.0		23.0		16.0	8.6		
Level of Service				C	C	B		C		B	A		
Approach Delay (s)		0.0			32.9			23.0			14.5		
Approach LOS		A			C			C			B		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			26.4	HCM 2000 Level of Service						C			
HCM 2000 Volume to Capacity ratio			0.69										
Actuated Cycle Length (s)			90.0	Sum of lost time (s)					16.0				
Intersection Capacity Utilization			63.7%	ICU Level of Service					B				
Analysis Period (min)			15										
c Critical Lane Group													

HCM Signalized Intersection Capacity Analysis  
26: Cascade Ave & Westcliff Dr

2040 Base Scenario  
PM Peak

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations	↑	↗		↖	↖	↗
Traffic Volume (vph)	5	115	30	15	105	25
Future Volume (vph)	5	115	30	15	105	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00
Frbp, ped/bikes	1.00	0.99		1.00	1.00	0.95
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		0.97	0.95	1.00
Satd. Flow (prot)	1716	1445		1513	1630	1383
Flt Permitted	1.00	1.00		0.80	0.95	1.00
Satd. Flow (perm)	1716	1445		1247	1630	1383
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	6	128	33	17	117	28
RTOR Reduction (vph)	0	109	0	0	0	16
Lane Group Flow (vph)	6	19	0	50	117	12
Confl. Peds. (#/hr)					10	10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	2%	2%	12%	12%	2%	2%
Turn Type	NA	custom	Perm	NA	Prot	Perm
Protected Phases	7	6		7	2 8	
Permitted Phases		7	7			2
Actuated Green, G (s)	6.3	13.3		6.3	75.7	39.7
Effective Green, g (s)	6.3	13.3		6.3	75.7	39.7
Actuated g/C Ratio	0.07	0.15		0.07	0.84	0.44
Clearance Time (s)	4.0	4.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	120	277		87	1371	610
v/s Ratio Prot	0.00	0.01			c0.07	
v/s Ratio Perm		0.01		c0.04		0.01
v/c Ratio	0.05	0.07		0.57	0.09	0.02
Uniform Delay, d1	39.1	33.0		40.6	1.2	14.2
Progression Factor	1.00	1.00		1.00	0.76	0.17
Incremental Delay, d2	0.2	0.1		8.9	0.0	0.1
Delay (s)	39.2	33.1		49.4	1.0	2.4
Level of Service	D	C		D	A	A
Approach Delay (s)	33.4			49.4	1.2	
Approach LOS	C			D	A	
<b>Intersection Summary</b>						
HCM 2000 Control Delay			21.7		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.14			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	16.0
Intersection Capacity Utilization			29.3%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis  
3: Mt Adams Ave & Cascade Ave

2040 Strong Scenario Alternative  
PM Peak Hour

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↘	↑	↖	↗
Traffic Volume (vph)	470	850	485	535	715	310
Future Volume (vph)	470	850	485	535	715	310
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
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	1.00	0.97	1.00
Frbp, ped/bikes	1.00	0.98	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1699	1421	1614	1699	3162	1422
Flt Permitted	1.00	1.00	0.15	1.00	0.95	1.00
Satd. Flow (perm)	1699	1421	249	1699	3162	1422
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	522	944	539	594	794	344
RTOR Reduction (vph)	0	0	0	0	0	65
Lane Group Flow (vph)	522	944	539	594	794	279
Confl. Peds. (#/hr)		10	10			10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Turn Type	NA	Free	pm+pt	NA	Prot	pm+ov
Protected Phases	6		5	2	4	5
Permitted Phases		Free	2			4
Actuated Green, G (s)	31.0	90.0	59.0	59.0	23.0	47.0
Effective Green, g (s)	31.0	90.0	59.0	59.0	23.0	47.0
Actuated g/C Ratio	0.34	1.00	0.66	0.66	0.26	0.52
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	585	1421	527	1113	808	805
v/s Ratio Prot	0.31		c0.27	0.35	c0.25	0.09
v/s Ratio Perm		0.66	c0.40			0.10
v/c Ratio	0.89	0.66	1.02	0.53	0.98	0.35
Uniform Delay, d1	27.9	0.0	24.1	8.2	33.3	12.5
Progression Factor	1.04	1.00	1.28	1.03	0.81	0.36
Incremental Delay, d2	13.2	2.0	42.0	1.6	16.8	0.1
Delay (s)	42.2	2.0	72.8	10.1	43.7	4.7
Level of Service	D	A	E	B	D	A
Approach Delay (s)	16.3			39.9	31.9	
Approach LOS	B			D	C	
<b>Intersection Summary</b>						
HCM 2000 Control Delay			28.2		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			1.05			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			88.2%		ICU Level of Service	E
Analysis Period (min)			15			
c Critical Lane Group						

**Intersection**

Int Delay, s/veh 3.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	45	5	20	5	20	50	35	370	5	30	240	95
Future Vol, veh/h	45	5	20	5	20	50	35	370	5	30	240	95
Conflicting Peds, #/hr	10	0	10	0	0	0	10	0	0	0	0	10
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	92	93	92	92	92	93	93	92	92	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	48	5	22	5	22	54	38	398	5	33	258	102

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	908	863	329	874	911	411	370	0	0	403	0	0
Stage 1	384	384	-	476	476	-	-	-	-	-	-	-
Stage 2	524	479	-	398	435	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	256	292	712	270	274	641	1189	-	-	1156	-	-
Stage 1	639	611	-	570	557	-	-	-	-	-	-	-
Stage 2	537	555	-	628	580	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	202	267	700	240	251	636	1179	-	-	1146	-	-
Mov Cap-2 Maneuver	202	267	-	240	251	-	-	-	-	-	-	-
Stage 1	607	583	-	546	534	-	-	-	-	-	-	-
Stage 2	448	532	-	576	554	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	24.5	15.7	0.7	0.7
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1179	-	-	259	419	1146	-
HCM Lane V/C Ratio	0.032	-	-	0.291	0.195	0.028	-
HCM Control Delay (s)	8.2	0	-	24.5	15.7	8.2	0
HCM Lane LOS	A	A	-	C	C	A	A
HCM 95th %tile Q(veh)	0.1	-	-	1.2	0.7	0.1	-

**Intersection**

Int Delay, s/veh 5.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Vol, veh/h	230	5	140	180	10	255
Future Vol, veh/h	230	5	140	180	10	255
Conflicting Peds, #/hr	0	10	10	0	10	10
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	4	5	5	5	5
Mvmt Flow	256	6	156	200	11	283

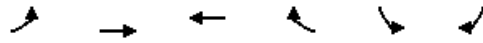
Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	0	0	271	0
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	-	-	4.15	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	-	-	2.245	-
Pot Cap-1 Maneuver	-	-	1275	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	-	-	1264	-
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.6	13.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	702	-	-	1264	-
HCM Lane V/C Ratio	0.419	-	-	0.123	-
HCM Control Delay (s)	13.8	-	-	8.2	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	2.1	-	-	0.4	-

HCM Signalized Intersection Capacity Analysis  
 10: May St. & Mt. Adams Ave

2040 Strong Scenario Alternative  
 PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	↕
Traffic Volume (vph)	175	80	75	135	530	15
Future Volume (vph)	175	80	75	135	530	15
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00
Frbp, ped/bikes		1.00	0.97		1.00	0.95
Flpb, ped/bikes		0.99	1.00		1.00	1.00
Frt		1.00	0.91		1.00	0.85
Flt Protected		0.97	1.00		0.95	1.00
Satd. Flow (prot)		1639	1514		1630	1384
Flt Permitted		0.55	1.00		0.95	1.00
Satd. Flow (perm)		934	1514		1630	1384
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	87	82	147	576	16
RTOR Reduction (vph)	0	0	82	0	0	7
Lane Group Flow (vph)	0	277	147	0	576	9
Confl. Peds. (#/hr)	10			10	10	10
Confl. Bikes (#/hr)				5		5
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)		29.3	29.3		52.7	52.7
Effective Green, g (s)		29.3	29.3		52.7	52.7
Actuated g/C Ratio		0.33	0.33		0.59	0.59
Clearance Time (s)		4.0	4.0		4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		304	492		954	810
v/s Ratio Prot			0.10		c0.35	
v/s Ratio Perm		c0.30				0.01
v/c Ratio		0.91	0.30		0.60	0.01
Uniform Delay, d1		29.1	22.7		12.0	7.8
Progression Factor		0.99	1.00		1.57	1.98
Incremental Delay, d2		29.8	0.3		0.3	0.0
Delay (s)		58.5	23.0		19.1	15.4
Level of Service		E	C		B	B
Approach Delay (s)		58.5	23.0		19.0	
Approach LOS		E	C		B	

Intersection Summary

HCM 2000 Control Delay	29.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	70.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Intersection												
Int Delay, s/veh	5.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	5	25	5	5	40	5	10	95	45	200	335	45
Future Vol, veh/h	5	25	5	5	40	5	10	95	45	200	335	45
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	27	5	5	43	5	11	103	49	217	364	49

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1017	1017	409	1009	1017	148	423	0	0	162	0	0
Stage 1	833	833	-	159	159	-	-	-	-	-	-	-
Stage 2	184	184	-	850	858	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	216	238	642	219	238	899	1136	-	-	1417	-	-
Stage 1	363	384	-	843	766	-	-	-	-	-	-	-
Stage 2	818	747	-	355	374	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	146	185	631	159	185	884	1127	-	-	1405	-	-
Mov Cap-2 Maneuver	146	185	-	159	185	-	-	-	-	-	-	-
Stage 1	356	304	-	827	751	-	-	-	-	-	-	-
Stage 2	751	733	-	254	296	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	27.6	30.1	0.5	2.8
HCM LOS	D	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1127	-	-	197	197	1405	-	-
HCM Lane V/C Ratio	0.01	-	-	0.193	0.276	0.155	-	-
HCM Control Delay (s)	8.2	0	-	27.6	30.1	8	0	-
HCM Lane LOS	A	A	-	D	D	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.7	1.1	0.5	-	-



Intersection												
Int Delay, s/veh	3.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	15	250	10	40	55	65	5	15	15	45	10	5
Future Vol, veh/h	15	250	10	40	55	65	5	15	15	45	10	5
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	16	272	11	43	60	71	5	16	16	49	11	5
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	140	0	0	293	0	0	520	547	297	528	517	115
Stage 1	-	-	-	-	-	-	320	320	-	192	192	-
Stage 2	-	-	-	-	-	-	200	227	-	336	325	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1443	-	-	1269	-	-	467	445	742	461	462	937
Stage 1	-	-	-	-	-	-	692	652	-	810	742	-
Stage 2	-	-	-	-	-	-	802	716	-	678	649	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1431	-	-	1258	-	-	431	416	730	414	432	921
Mov Cap-2 Maneuver	-	-	-	-	-	-	431	416	-	414	432	-
Stage 1	-	-	-	-	-	-	677	638	-	793	709	-
Stage 2	-	-	-	-	-	-	750	684	-	632	635	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.4			2			12.6			14.7		
HCM LOS							B			B		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	513	1431	-	-	1258	-	-	437				
HCM Lane V/C Ratio	0.074	0.011	-	-	0.035	-	-	0.149				
HCM Control Delay (s)	12.6	7.5	0	-	8	0	-	14.7				
HCM Lane LOS	B	A	A	-	A	A	-	B				
HCM 95th %tile Q(veh)	0.2	0	-	-	0.1	-	-	0.5				

**Intersection**

Int Delay, s/veh 4.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		P			A
Traffic Vol, veh/h	95	95	160	245	80	285
Future Vol, veh/h	95	95	160	245	80	285
Conflicting Peds, #/hr	10	10	0	10	10	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	103	103	174	266	87	310






















Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	811	327	0
Stage 1	317	-	-
Stage 2	494	-	-
Critical Hdwy	6.42	6.22	4.12
Critical Hdwy Stg 1	5.42	-	-
Critical Hdwy Stg 2	5.42	-	-
Follow-up Hdwy	3.518	3.318	2.218
Pot Cap-1 Maneuver	349	714	1110
Stage 1	738	-	-
Stage 2	613	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	311	702	1101
Mov Cap-2 Maneuver	311	-	-
Stage 1	732	-	-
Stage 2	550	-	-

Approach	WB	NB	SB
HCM Control Delay, s	20.8	0	1.9
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	431	1101
HCM Lane V/C Ratio	-	-	0.479	0.079
HCM Control Delay (s)	-	-	20.8	8.6
HCM Lane LOS	-	-	C	A
HCM 95th %tile Q(veh)	-	-	2.5	0.3




















HCM Signalized Intersection Capacity Analysis  
15: Rand Rd & Cascade Ave

2040 Strong Scenario Alternative  
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	360	215	185	550	70	150	60	60	95	125	90
Future Volume (vph)	40	360	215	185	550	70	150	60	60	95	125	90
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
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	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	0.97		1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		0.98	1.00		0.98	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1628	1716	1383	1609	1661		1603	1544		1593	1572	
Flt Permitted	0.26	1.00	1.00	0.37	1.00		0.47	1.00		0.64	1.00	
Satd. Flow (perm)	446	1716	1383	634	1661		800	1544		1076	1572	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	44	400	239	206	611	78	167	67	67	106	139	100
RTOR Reduction (vph)	0	0	126	0	5	0	0	40	0	0	28	0
Lane Group Flow (vph)	44	400	113	206	684	0	167	94	0	106	211	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			4				8
Permitted Phases	6		6	2			4			8		
Actuated Green, G (s)	45.7	42.7	42.7	56.0	49.0		26.0	26.0		26.0	26.0	
Effective Green, g (s)	45.7	42.7	42.7	56.0	49.0		26.0	26.0		26.0	26.0	
Actuated g/C Ratio	0.51	0.47	0.47	0.62	0.54		0.29	0.29		0.29	0.29	
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)	265	814	656	495	904		231	446		310	454	
v/s Ratio Prot	0.01	0.23		c0.04	c0.41			0.06				0.13
v/s Ratio Perm	0.08		0.08	0.22			c0.21			0.10		
v/c Ratio	0.17	0.49	0.17	0.42	0.76		0.72	0.21		0.34	0.46	
Uniform Delay, d1	12.6	16.2	13.5	8.7	15.9		28.8	24.2		25.2	26.3	
Progression Factor	0.54	0.85	2.24	1.00	1.00		0.98	0.98		1.00	1.00	
Incremental Delay, d2	0.2	1.5	0.4	0.6	5.9		17.8	1.1		0.7	0.8	
Delay (s)	7.0	15.2	30.7	9.3	21.8		45.9	24.7		25.9	27.0	
Level of Service	A	B	C	A	C		D	C		C	C	
Approach Delay (s)		20.1			18.9			36.5			26.7	
Approach LOS		C			B			D			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			22.8				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			76.2%				ICU Level of Service			D		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
 18: I-84 EB Ramp & Cascade Ave

2040 Strong Scenario Alternative  
 PM Peak Hour

												
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		 										
Traffic Volume (vph)	30	925	0	0	405	845	15	0	395	0	0	0
Future Volume (vph)	30	925	0	0	405	845	15	0	395	0	0	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Lane Util. Factor	1.00	0.95			1.00	1.00		1.00	1.00			
Frbp, ped/bikes	1.00	1.00			1.00	0.95		1.00	0.97			
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.98	1.00			
Frt	1.00	1.00			1.00	0.85		1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (prot)	1630	3260			1699	1371		1602	1411			
Flt Permitted	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (perm)	1630	3260			1699	1371		1602	1411			
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	33	1028	0	0	450	939	17	0	439	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	441	0	0	76	0	0	0
Lane Group Flow (vph)	33	1028	0	0	450	498	0	17	363	0	0	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	3%	3%	3%
Turn Type	Prot	NA			NA	Perm	Perm	NA	Perm			
Protected Phases	1	6			2			4				
Permitted Phases						2	4		4			
Actuated Green, G (s)	3.8	55.2			47.4	47.4		26.8	26.8			
Effective Green, g (s)	3.8	55.2			47.4	47.4		26.8	26.8			
Actuated g/C Ratio	0.04	0.61			0.53	0.53		0.30	0.30			
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)	68	1999			894	722		477	420			
v/s Ratio Prot	0.02	c0.32			0.26							
v/s Ratio Perm						c0.36		0.01	c0.26			
v/c Ratio	0.49	0.51			0.50	0.69		0.04	0.86			
Uniform Delay, d1	42.1	9.8			13.7	15.8		22.4	29.9			
Progression Factor	1.05	0.72			1.09	7.76		1.00	1.00			
Incremental Delay, d2	3.7	0.7			1.2	3.2		0.0	16.7			
Delay (s)	47.9	7.7			16.1	126.1		22.5	46.6			
Level of Service	D	A			B	F		C	D			
Approach Delay (s)		9.0			90.4			45.7			0.0	
Approach LOS		A			F			D			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			53.7				HCM 2000 Level of Service		D			
HCM 2000 Volume to Capacity ratio			0.75									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)		12.0			
Intersection Capacity Utilization			117.0%				ICU Level of Service		H			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection												
Int Delay, s/veh	63											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	65	270	5	10	340	135	10	80	15	100	70	165
Future Vol, veh/h	65	270	5	10	340	135	10	80	15	100	70	165
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	20	20	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	3	3	3	2	2	2	8	8	8	2	2	2
Mvmt Flow	70	290	5	11	366	145	11	86	16	108	75	177



















Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	521	0	0	306	0	0	1039	985	323	974	915	458
Stage 1	-	-	-	-	-	-	443	443	-	470	470	-
Stage 2	-	-	-	-	-	-	596	542	-	504	445	-
Critical Hdwy	4.13	-	-	4.12	-	-	7.18	6.58	6.28	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.18	5.58	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.18	5.58	-	6.12	5.52	-
Follow-up Hdwy	2.227	-	-	2.218	-	-	3.572	4.072	3.372	3.518	4.018	3.318
Pot Cap-1 Maneuver	1040	-	-	1255	-	-	203	242	704	231	273	603
Stage 1	-	-	-	-	-	-	582	566	-	574	560	-
Stage 2	-	-	-	-	-	-	480	510	-	550	575	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1031	-	-	1234	-	-	99	216	686	142	244	593
Mov Cap-2 Maneuver	-	-	-	-	-	-	99	216	-	142	244	-
Stage 1	-	-	-	-	-	-	530	516	-	523	548	-
Stage 2	-	-	-	-	-	-	284	499	-	404	524	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.7	0.2	39.5	223.5
HCM LOS			E	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	213	1031	-	-	1234	-	-	264
HCM Lane V/C Ratio	0.53	0.068	-	-	0.009	-	-	1.364
HCM Control Delay (s)	39.5	8.7	0	-	7.9	0	-	223.5
HCM Lane LOS	E	A	A	-	A	A	-	F
HCM 95th %tile Q(veh)	2.8	0.2	-	-	0	-	-	19.1

HCM Signalized Intersection Capacity Analysis  
23: Cascade Ave & I-84 WB Ramp

2040 Strong Scenario Alternative  
PM Peak Hour

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR	
Lane Configurations													
Traffic Volume (vph)	0	0	0	845	0	40	0	110	25	340	80	0	
Future Volume (vph)	0	0	0	845	0	40	0	110	25	340	80	0	
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	
Total Lost time (s)				4.0	4.0	4.0		4.0		4.0	4.0		
Lane Util. Factor				0.95	0.95	1.00		0.95		1.00	1.00		
Frbp, ped/bikes				1.00	1.00	0.97		0.99		1.00	1.00		
Flpb, ped/bikes				0.98	0.98	1.00		1.00		1.00	1.00		
Frt				1.00	1.00	0.85		0.97		1.00	1.00		
Flt Protected				0.95	0.95	1.00		1.00		0.95	1.00		
Satd. Flow (prot)				1522	1522	1413		3149		1576	1667		
Flt Permitted				0.95	0.95	1.00		1.00		0.41	1.00		
Satd. Flow (perm)				1522	1522	1413		3149		682	1667		
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
Adj. Flow (vph)	0	0	0	939	0	44	0	122	28	378	89	0	
RTOR Reduction (vph)	0	0	0	0	0	26	0	23	0	0	0	0	
Lane Group Flow (vph)	0	0	0	469	470	18	0	127	0	378	89	0	
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10	
Confl. Bikes (#/hr)			5			5			5			5	
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	5%	5%	5%	
Turn Type				Perm	NA	Perm		NA		pm+pt	NA		
Protected Phases					8			7 6		5	2		
Permitted Phases				8		8				2			
Actuated Green, G (s)				35.9	35.9	35.9		16.8		36.0	36.0		
Effective Green, g (s)				35.9	35.9	35.9		16.8		36.0	36.0		
Actuated g/C Ratio				0.40	0.40	0.40		0.19		0.40	0.40		
Clearance Time (s)				4.0	4.0	4.0				4.0	4.0		
Vehicle Extension (s)				3.0	3.0	3.0				3.0	3.0		
Lane Grp Cap (vph)				607	607	563		587		524	666		
v/s Ratio Prot								c0.04		c0.20	0.05		
v/s Ratio Perm				0.31	0.31	0.01				c0.09			
v/c Ratio				0.77	0.77	0.03		0.22		0.72	0.13		
Uniform Delay, d1				23.5	23.5	16.5		31.0		21.4	17.1		
Progression Factor				1.00	1.00	1.00		0.72		0.75	0.58		
Incremental Delay, d2				6.1	6.1	0.0		0.2		7.6	0.4		
Delay (s)				29.6	29.6	16.5		22.6		23.8	10.3		
Level of Service				C	C	B		C		C	B		
Approach Delay (s)		0.0			29.0			22.6			21.2		
Approach LOS		A			C			C			C		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			26.1	HCM 2000 Level of Service						C			
HCM 2000 Volume to Capacity ratio			0.74										
Actuated Cycle Length (s)			90.0	Sum of lost time (s)					16.0				
Intersection Capacity Utilization			66.9%	ICU Level of Service					C				
Analysis Period (min)			15										
c Critical Lane Group													

HCM Signalized Intersection Capacity Analysis  
26: Cascade Ave & Westcliff Dr

2040 Strong Scenario Alternative  
PM Peak Hour

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations	↑	↗		↖	↖	↗
Traffic Volume (vph)	5	105	30	10	95	25
Future Volume (vph)	5	105	30	10	95	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00
Frbp, ped/bikes	1.00	0.99		1.00	1.00	0.95
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		0.96	0.95	1.00
Satd. Flow (prot)	1716	1445		1506	1630	1382
Flt Permitted	1.00	1.00		0.78	0.95	1.00
Satd. Flow (perm)	1716	1445		1213	1630	1382
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	6	117	33	11	106	28
RTOR Reduction (vph)	0	100	0	0	0	17
Lane Group Flow (vph)	6	17	0	44	106	11
Confl. Peds. (#/hr)					10	10
Confl. Bikes (#/hr)		5				5
Heavy Vehicles (%)	2%	2%	12%	12%	2%	2%
Turn Type	NA	custom	Perm	NA	Prot	Perm
Protected Phases	7	6		7	2 8	
Permitted Phases		7	7			2
Actuated Green, G (s)	6.1	12.8		6.1	75.9	36.0
Effective Green, g (s)	6.1	12.8		6.1	75.9	36.0
Actuated g/C Ratio	0.07	0.14		0.07	0.84	0.40
Clearance Time (s)	4.0	4.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	116	269		82	1374	552
v/s Ratio Prot	0.00	0.00			c0.07	
v/s Ratio Perm		0.01		c0.04		0.01
v/c Ratio	0.05	0.06		0.54	0.08	0.02
Uniform Delay, d1	39.2	33.4		40.6	1.2	16.3
Progression Factor	1.00	1.00		1.00	0.76	0.17
Incremental Delay, d2	0.2	0.1		6.6	0.0	0.1
Delay (s)	39.4	33.5		47.2	0.9	2.9
Level of Service	D	C		D	A	A
Approach Delay (s)	33.8			47.2	1.3	
Approach LOS	C			D	A	
<b>Intersection Summary</b>						
HCM 2000 Control Delay			21.3		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.12			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	16.0
Intersection Capacity Utilization			29.0%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

Intersection												
Int Delay, s/veh	3.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	10	160	445	140	185	5	15	10	75	5	5	10
Future Vol, veh/h	10	160	445	140	185	5	15	10	75	5	5	10
Conflicting Peds, #/hr	10	0	10	10	0	10	10	0	10	10	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	11	174	484	152	201	5	16	11	82	5	5	11

















Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	217	0	0	668	0	0	974	969	436	1012	1207	224
Stage 1	-	-	-	-	-	-	448	448	-	518	518	-
Stage 2	-	-	-	-	-	-	526	521	-	494	689	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1353	-	-	922	-	-	231	254	620	218	183	815
Stage 1	-	-	-	-	-	-	590	573	-	541	533	-
Stage 2	-	-	-	-	-	-	535	532	-	557	446	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1342	-	-	914	-	-	184	200	610	151	144	801
Mov Cap-2 Maneuver	-	-	-	-	-	-	184	200	-	151	144	-
Stage 1	-	-	-	-	-	-	577	560	-	529	429	-
Stage 2	-	-	-	-	-	-	420	428	-	463	436	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	4.1	17.6	20.8
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	393	1342	-	-	914	-	-	249
HCM Lane V/C Ratio	0.277	0.008	-	-	0.166	-	-	0.087
HCM Control Delay (s)	17.6	7.7	0	-	9.7	0	-	20.8
HCM Lane LOS	C	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	1.1	0	-	-	0.6	-	-	0.3



HCM Signalized Intersection Capacity Analysis 2040 Strong Scenario Alternative - Mitigated  
 19: 27th St/Rand Rd & May St. PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	65	270	5	10	340	135	10	80	15	100	70	165
Future Volume (vph)	65	270	5	10	340	135	10	80	15	100	70	165
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frbp, ped/bikes		1.00			0.99			0.99			0.98	
Flpb, ped/bikes		1.00			1.00			1.00			0.99	
Frt		1.00			0.96			0.98			0.93	
Flt Protected		0.99			1.00			1.00			0.99	
Satd. Flow (prot)		1676			1629			1566			1527	
Flt Permitted		0.85			0.99			0.96			0.88	
Satd. Flow (perm)		1435			1618			1507			1364	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	70	290	5	11	366	145	11	86	16	108	75	177
RTOR Reduction (vph)	0	0	0	0	11	0	0	9	0	0	53	0
Lane Group Flow (vph)	0	365	0	0	511	0	0	104	0	0	307	0
Confl. Peds. (#/hr)	10		10	10		10	10		20	20		10
Confl. Bikes (#/hr)			5			5			5			5
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	8%	8%	8%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		38.4			38.4			19.8			19.8	
Effective Green, g (s)		38.4			38.4			19.8			19.8	
Actuated g/C Ratio		0.58			0.58			0.30			0.30	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		832			938			450			407	
v/s Ratio Prot												
v/s Ratio Perm		0.25			c0.32			0.07			c0.22	
v/c Ratio		0.44			0.54			0.23			0.75	
Uniform Delay, d1		7.8			8.5			17.5			21.0	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.7			2.3			0.3			7.7	
Delay (s)		9.5			10.8			17.7			28.7	
Level of Service		A			B			B			C	
Approach Delay (s)		9.5			10.8			17.7			28.7	
Approach LOS		A			B			B			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			15.8				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			66.2				Sum of lost time (s)			8.0		
Intersection Capacity Utilization			87.1%				ICU Level of Service			E		
Analysis Period (min)			15									
c Critical Lane Group												

## Appendix C – 2040 Queuing Reports

**Intersection: 18: I-84 EB Ramp & Cascade Ave**

Movement	SE	SE	SE	NW	NW	NE	NE
Directions Served	L	T	T	T	R	LT	R
Maximum Queue (ft)	164	248	253	317	528	327	322
Average Queue (ft)	90	77	82	149	224	56	174
95th Queue (ft)	165	211	216	283	440	311	308
Link Distance (ft)		299	299	749	749	4472	
Upstream Blk Time (%)		0	0		0		
Queuing Penalty (veh)		2	1		0		
Storage Bay Dist (ft)	150						300
Storage Blk Time (%)	2	3				0	5
Queuing Penalty (veh)	10	1				0	1

**Intersection: 23: Cascade Ave & I-84 WB Ramp**

Movement	WB	WB	WB	SE	SE	NW	NW
Directions Served	L	LT	R	T	TR	L	T
Maximum Queue (ft)	275	567	209	88	101	305	160
Average Queue (ft)	196	235	30	32	40	193	61
95th Queue (ft)	293	428	120	68	84	301	124
Link Distance (ft)		6682		99	99	299	299
Upstream Blk Time (%)				0	0	1	
Queuing Penalty (veh)				0	0	3	
Storage Bay Dist (ft)	250		250				
Storage Blk Time (%)	2	4	0				
Queuing Penalty (veh)	8	18	0				

**Zone Summary**

Zone wide Queuing Penalty: 46

**Intersection: 18: I-84 EB Ramp & Cascade Ave**

Movement	SE	SE	SE	NW	NW	NE	NE
Directions Served	L	T	T	T	R	LT	R
Maximum Queue (ft)	168	248	252	234	412	238	318
Average Queue (ft)	96	59	68	73	121	21	178
95th Queue (ft)	163	185	202	176	295	123	291
Link Distance (ft)		299	299	749	749	4472	
Upstream Blk Time (%)		0	0				
Queuing Penalty (veh)		1	1				
Storage Bay Dist (ft)	150						300
Storage Blk Time (%)	3	1					2
Queuing Penalty (veh)	11	0					0

**Intersection: 23: Cascade Ave & I-84 WB Ramp**

Movement	WB	WB	WB	SE	SE	NW	NW
Directions Served	L	LT	R	T	TR	L	T
Maximum Queue (ft)	275	803	274	82	101	310	116
Average Queue (ft)	216	304	41	29	42	191	45
95th Queue (ft)	317	629	168	65	85	298	100
Link Distance (ft)		6682		99	99	299	299
Upstream Blk Time (%)				0	0	1	
Queuing Penalty (veh)				0	0	2	
Storage Bay Dist (ft)	250		250				
Storage Blk Time (%)	3	8	0				
Queuing Penalty (veh)	14	36	1				

**Zone Summary**

Zone wide Queuing Penalty: 67