

APPENDIX B21

Segment B – AM Existing HCM Results

Intersection

Int Delay, s/veh 0.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↗	↗↗		↘	↘↘
Traffic Vol, veh/h	0	10	1785	0	12	410
Future Vol, veh/h	0	10	1785	0	12	410
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	180	-
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	0	11	1940	0	13	446

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	-	970	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	6.94	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	3.32	-
Pot Cap-1 Maneuver	0	253	-
Stage 1	0	-	-
Stage 2	0	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	-	253	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.9	0	0.5
HCM LOS	C		

Minor Lane/Major Mvmt	NBTWBLn1	SBL	SBT
Capacity (veh/h)	-	253	299
HCM Lane V/C Ratio	-	0.043	0.044
HCM Control Delay (s)	-	19.9	17.6
HCM Lane LOS	-	C	C
HCM 95th %tile Q(veh)	-	0.1	0.1

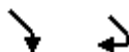
HCM Signalized Intersection Capacity Analysis

2: SW Barbur Blvd (Hwy 99W) & SW Barbur Blvd Frontage Road/SW Miles St & SW 3rd Ave

												
Movement	EBL	EBT	WBL	WBT	NBL2	NBL	NBT	NBR	SBT	SBR	SEL2	SEL
Lane Configurations												
Traffic Volume (vph)	10	7	71	0	4	8	1767	95	409	1	8	0
Future Volume (vph)	10	7	71	0	4	8	1767	95	409	1	8	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0		4.0	4.0		4.0			4.0
Lane Util. Factor		1.00		1.00		1.00	*0.85		0.95			1.00
Frpb, ped/bikes		1.00		1.00		1.00	1.00		1.00			0.88
Flpb, ped/bikes		1.00		1.00		1.00	1.00		1.00			1.00
Frt		1.00		1.00		1.00	0.99		1.00			0.92
Flt Protected		0.97		0.95		0.95	1.00		1.00			0.98
Satd. Flow (prot)		1847		1805		1805	3117		3373			1495
Flt Permitted		0.97		0.95		0.95	1.00		1.00			0.98
Satd. Flow (perm)		1847		1805		1805	3117		3373			1495
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	11	8	78	0	4	9	1942	104	449	1	9	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	19	0	78	0	13	2046	0	450	0	0	24
Confl. Peds. (#/hr)	3		1		9	9				9		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	3%	0%	7%	0%	0%	0%
Turn Type	Split	NA	Split	NA	Prot	Prot	NA		NA		Perm	Prot
Protected Phases	7	7	3	3	5	5	2		6			4
Permitted Phases												
Actuated Green, G (s)		2.4		7.3		1.9	76.9		71.5			3.9
Effective Green, g (s)		3.4		9.3		1.4	78.2		72.8			5.9
Actuated g/C Ratio		0.03		0.08		0.01	0.65		0.61			0.05
Clearance Time (s)		5.0		6.0		3.5	5.3		5.3			6.0
Vehicle Extension (s)		1.0		0.5		0.2	1.0		1.0			1.0
Lane Grp Cap (vph)		52		139		21	2031		2046			73
v/s Ratio Prot		c0.01		c0.04		0.01	c0.66		0.13			
v/s Ratio Perm												0.02
v/c Ratio		0.37		0.56		0.62	1.01		0.22			0.33
Uniform Delay, d1		57.2		53.4		59.0	20.9		10.7			55.1
Progression Factor		1.00		1.00		1.16	0.94		1.00			1.00
Incremental Delay, d2		1.6		3.1		15.0	14.8		0.2			1.0
Delay (s)		58.8		56.4		83.6	34.3		11.0			56.1
Level of Service		E		E		F	C		B			E
Approach Delay (s)		58.8		56.4			34.6		11.0			56.1
Approach LOS		E		E			C		B			E
Intersection Summary												
HCM 2000 Control Delay			31.6			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.93									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			26.0			
Intersection Capacity Utilization			71.2%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: SW Barbur Blvd (Hwy 99W) & SW Barbur Blvd Frontage Road/SW Miles St & SW 3rd Ave 04/21/2020



Movement	SER	SER2
Lane Configurations		
Traffic Volume (vph)	13	1
Future Volume (vph)	13	1
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)		
Lane Util. Factor		
Frpb, ped/bikes		
Flpb, ped/bikes		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Peak-hour factor, PHF	0.91	0.91
Adj. Flow (vph)	14	1
RTOR Reduction (vph)	0	0
Lane Group Flow (vph)	0	0
Confl. Peds. (#/hr)	9	9
Heavy Vehicles (%)	0%	0%
Turn Type		
Protected Phases		
Permitted Phases		
Actuated Green, G (s)		
Effective Green, g (s)		
Actuated g/C Ratio		
Clearance Time (s)		
Vehicle Extension (s)		
Lane Grp Cap (vph)		
v/s Ratio Prot		
v/s Ratio Perm		
v/c Ratio		
Uniform Delay, d1		
Progression Factor		
Incremental Delay, d2		
Delay (s)		
Level of Service		
Approach Delay (s)		
Approach LOS		
Intersection Summary		

HCM Signalized Intersection Capacity Analysis

3: SW Barbur Blvd (Hwy 99W) & SW Terwilliger Blvd

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	142	136	267	215	336	156	1445	311	59	386	48
Future Volume (vph)	93	142	136	267	215	336	156	1445	311	59	386	48
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.96	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.91		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1900	1526	1736	1626		1736	3539	1456	1752	3471	1468
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1900	1526	1736	1626		1736	3539	1456	1752	3471	1468
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	98	149	143	281	226	354	164	1521	327	62	406	51
RTOR Reduction (vph)	0	0	124	0	47	0	0	0	101	0	0	29
Lane Group Flow (vph)	98	149	19	281	533	0	164	1521	226	62	406	22
Confl. Peds. (#/hr)	5		11	11		5	4		6	6		4
Confl. Bikes (#/hr)			5			36			11			7
Heavy Vehicles (%)	2%	0%	2%	4%	3%	3%	4%	2%	7%	3%	4%	6%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pm+ov	Prot	NA	Perm
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases			8						6			2
Actuated Green, G (s)	6.5	15.3	15.3	21.7	30.5		14.4	58.3	80.0	6.5	50.4	50.4
Effective Green, g (s)	6.0	15.8	15.8	21.2	31.0		15.4	59.5	79.0	7.5	51.6	51.6
Actuated g/C Ratio	0.05	0.13	0.13	0.18	0.26		0.13	0.50	0.66	0.06	0.43	0.43
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		5.0	5.2	3.5	5.0	5.2	5.2
Vehicle Extension (s)	0.5	1.0	1.0	0.5	1.0		0.5	0.5	0.5	0.5	0.5	0.5
Lane Grp Cap (vph)	88	250	200	306	420		222	1754	958	109	1492	631
v/s Ratio Prot	0.06	0.08		c0.16	c0.33		c0.09	c0.43	0.04	0.04	0.12	
v/s Ratio Perm			0.01						0.11			0.01
v/c Ratio	1.11	0.60	0.09	0.92	1.27		0.74	0.87	0.24	0.57	0.27	0.03
Uniform Delay, d1	57.0	49.1	45.8	48.5	44.5		50.4	26.8	8.3	54.7	22.1	19.8
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.18	0.78	0.32	1.02	1.07	1.00
Incremental Delay, d2	130.0	2.5	0.1	30.4	139.0		5.2	3.0	0.0	4.0	0.4	0.1
Delay (s)	187.0	51.6	45.9	78.9	183.5		64.5	23.8	2.7	59.7	24.0	19.9
Level of Service	F	D	D	E	F		E	C	A	E	C	B
Approach Delay (s)		83.5			149.4			23.7			27.9	
Approach LOS		F			F			C			C	
Intersection Summary												
HCM 2000 Control Delay			59.1			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.00									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			94.8%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	334	235	13	67	119	203	11	1375	278	55	494	240
Future Volume (vph)	334	235	13	67	119	203	11	1375	278	55	494	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.95		1.00	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1649	1702		1770	1776	1495	1805	3428		1719	3471	1538
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1649	1702		1770	1776	1495	1805	3428		1719	3471	1538
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	344	242	13	69	123	209	11	1418	287	57	509	247
RTOR Reduction (vph)	0	2	0	0	0	125	0	13	0	0	0	48
Lane Group Flow (vph)	296	301	0	69	123	84	11	1692	0	57	509	199
Confl. Peds. (#/hr)			10	10			6					6
Confl. Bikes (#/hr)									13			8
Heavy Vehicles (%)	4%	4%	14%	2%	7%	8%	0%	2%	3%	5%	4%	5%
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	pt+ov
Protected Phases	3	3		4	4		1	6		5	2	2 3
Permitted Phases						4						
Actuated Green, G (s)	22.1	22.1		9.3	9.3	9.3	1.2	65.0		4.8	68.1	95.4
Effective Green, g (s)	22.5	22.5		10.5	10.5	10.5	1.7	66.2		4.8	69.3	96.6
Actuated g/C Ratio	0.19	0.19		0.09	0.09	0.09	0.01	0.55		0.04	0.58	0.80
Clearance Time (s)	4.4	4.4		5.2	5.2	5.2	4.5	5.2		4.0	5.2	
Vehicle Extension (s)	1.0	1.0		1.0	1.0	1.0	1.5	0.5		1.0	0.5	
Lane Grp Cap (vph)	309	319		154	155	130	25	1891		68	2004	1238
v/s Ratio Prot	c0.18	0.18		0.04	c0.07		0.01	c0.49		c0.03	c0.15	0.13
v/s Ratio Perm						0.06						
v/c Ratio	0.96	0.94		0.45	0.79	0.65	0.44	0.89		0.84	0.25	0.16
Uniform Delay, d1	48.3	48.1		52.0	53.7	53.0	58.7	23.8		57.2	12.6	2.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.41	0.44		0.81	0.80	4.32
Incremental Delay, d2	39.3	35.5		0.8	22.3	8.0	1.9	3.2		50.5	0.3	0.0
Delay (s)	87.5	83.6		52.8	76.0	60.9	84.5	13.7		96.9	10.3	11.3
Level of Service	F	F		D	E	E	F	B		F	B	B
Approach Delay (s)		85.6			64.2			14.2			16.7	
Approach LOS		F			E			B			B	
Intersection Summary												
HCM 2000 Control Delay			32.6									
HCM 2000 Volume to Capacity ratio			0.88									
Actuated Cycle Length (s)			120.0									
Intersection Capacity Utilization			86.5%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

9: SW Terwilliger Blvd & I-5 NB Off Ramp

04/21/2020



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	226	157	0	592	512	0
Future Volume (vph)	226	157	0	592	512	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		1863	1863	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		1863	1863	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	248	173	0	651	563	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	248	173	0	651	563	0
Turn Type	Prot	custom		NA	NA	
Protected Phases	4	1		6	2	
Permitted Phases		4				
Actuated Green, G (s)	16.4	26.6		43.3	28.5	
Effective Green, g (s)	17.3	27.8		43.9	29.1	
Actuated g/C Ratio	0.25	0.40		0.63	0.42	
Clearance Time (s)	4.9	4.6		4.6	4.6	
Vehicle Extension (s)	1.0	1.2		1.2	4.0	
Lane Grp Cap (vph)	442	635		1181	783	
v/s Ratio Prot	c0.14	0.04		c0.35	c0.30	
v/s Ratio Perm		0.07				
v/c Ratio	0.56	0.27		0.55	0.72	
Uniform Delay, d1	22.6	13.9		7.1	16.7	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.0	0.1		0.3	3.4	
Delay (s)	23.6	14.0		7.4	20.1	
Level of Service	C	B		A	C	
Approach Delay (s)	19.7			7.4	20.1	
Approach LOS	B			A	C	

Intersection Summary

HCM 2000 Control Delay	14.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	69.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	50.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM 2010 TWSC
10: SW Barbur Blvd (Hwy 99W) & SW 13th Ave

04/21/2020

Intersection

Int Delay, s/veh 1.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↗		↗		↗	↗↘			↗↘	
Traffic Vol, veh/h	0	0	191	0	1	9	210	1640	10	0	497	6
Future Vol, veh/h	0	0	191	0	1	9	210	1640	10	0	497	6
Conflicting Peds, #/hr	4	0	0	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	-	100	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	92	94	94	94	94	94	94	94	92	94	94
Heavy Vehicles, %	0	2	4	2	2	2	2	2	2	2	4	33
Mvmt Flow	0	0	203	0	1	10	223	1745	11	0	529	6

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	-	-	269	-	2733	878	536	0	0	-	-	0
Stage 1	-	-	-	-	2197	-	-	-	-	-	-	-
Stage 2	-	-	-	-	536	-	-	-	-	-	-	-
Critical Hdwy	-	-	6.98	-	6.54	6.94	4.14	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	-	-	3.34	-	4.02	3.32	2.22	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	723	0	20	291	1028	-	-	0	-	-
Stage 1	0	0	-	0	82	-	-	-	-	0	-	-
Stage 2	0	0	-	0	522	-	-	-	-	0	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	-	722	-	16	291	1027	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	16	-	-	-	-	-	-	-
Stage 1	-	-	-	-	64	-	-	-	-	-	-	-
Stage 2	-	-	-	-	521	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	11.9	42.3	1.1	0
HCM LOS	B	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBT	SBR
Capacity (veh/h)	1027	-	-	722	107	-
HCM Lane V/C Ratio	0.218	-	-	0.281	0.099	-
HCM Control Delay (s)	9.5	-	-	11.9	42.3	-
HCM Lane LOS	A	-	-	B	E	-
HCM 95th %tile Q(veh)	0.8	-	-	1.2	0.3	-

HCM Signalized Intersection Capacity Analysis

13: SW Barbur Blvd (Hwy 99W) & SW Capitol Hill Rd/SW 19th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	81	111	193	107	104	77	1666	20	53	626	26
Future Volume (vph)	85	81	111	193	107	104	77	1666	20	53	626	26
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	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.91		1.00	0.93		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1787	1683		1719	1700		1736	3539	1356	1703	3433	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1787	1683		1719	1700		1736	3539	1356	1703	3433	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	93	89	122	212	118	114	85	1831	22	58	688	29
RTOR Reduction (vph)	0	45	0	0	28	0	0	0	10	0	2	0
Lane Group Flow (vph)	93	166	0	212	204	0	85	1831	12	58	715	0
Confl. Peds. (#/hr)	5		13	13		5	8		2	2		8
Confl. Bikes (#/hr)			1			2			12			5
Heavy Vehicles (%)	1%	1%	1%	5%	1%	4%	4%	2%	15%	6%	4%	12%
Turn Type	Prot	NA		Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases									6			
Actuated Green, G (s)	10.7	16.4		19.2	24.9		9.1	62.3	62.3	6.4	59.6	
Effective Green, g (s)	9.7	16.6		18.2	25.1		8.1	63.8	63.8	5.4	61.1	
Actuated g/C Ratio	0.08	0.14		0.15	0.21		0.07	0.53	0.53	0.05	0.51	
Clearance Time (s)	3.0	4.2		3.0	4.2		3.0	5.5	5.5	3.0	5.5	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	0.5	0.5	0.5	0.5	
Lane Grp Cap (vph)	144	232		260	355		117	1881	720	76	1747	
v/s Ratio Prot	0.05	c0.10		c0.12	0.12		c0.05	c0.52		0.03	0.21	
v/s Ratio Perm									0.01			
v/c Ratio	0.65	0.72		0.82	0.57		0.73	0.97	0.02	0.76	0.41	
Uniform Delay, d1	53.5	49.4		49.3	42.6		54.9	27.3	13.3	56.7	18.3	
Progression Factor	1.00	1.00		1.00	1.00		1.17	0.85	1.00	0.91	0.76	
Incremental Delay, d2	7.2	8.5		16.7	1.4		10.8	11.0	0.0	32.5	0.7	
Delay (s)	60.7	57.9		66.0	44.0		75.2	34.0	13.3	84.3	14.6	
Level of Service	E	E		E	D		E	C	B	F	B	
Approach Delay (s)		58.8			54.5			35.6			19.8	
Approach LOS		E			D			D			B	
Intersection Summary												
HCM 2000 Control Delay			36.5			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.90									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			87.2%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 106.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	52	7	27	64	31	14	33	1697	1	1	701	1
Future Vol, veh/h	52	7	27	64	31	14	33	1697	1	1	701	1
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	0	0	0	1
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	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	4	0	0	1	0	6	0	2	0	0	3	0
Mvmt Flow	56	8	29	69	33	15	35	1825	1	1	754	1

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1757	2654	379	2279	2654	913	756	0	0	1826	0	0
Stage 1	758	758	-	1896	1896	-	-	-	-	-	-	-
Stage 2	999	1896	-	383	758	-	-	-	-	-	-	-
Critical Hdwy	7.58	6.5	6.9	7.52	6.5	7.02	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.58	5.5	-	6.52	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.58	5.5	-	6.52	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.54	4	3.3	3.51	4	3.36	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 53	23	625	~ 22	~ 23	268	864	-	-	339	-	-
Stage 1	361	418	-	73	119	-	-	-	-	-	-	-
Stage 2	257	119	-	614	418	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	-	23	624	~ 16	~ 23	268	863	-	-	339	-	-
Mov Cap-2 Maneuver	-	23	-	~ 16	~ 23	-	-	-	-	-	-	-
Stage 1	361	415	-	73	119	-	-	-	-	-	-	-
Stage 2	175	119	-	572	415	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s		\$ 2571	0.2	0
HCM LOS	-	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	863	-	-	- 20	339	-	-
HCM Lane V/C Ratio	0.041	-	-	- 5.86	0.003	-	-
HCM Control Delay (s)	9.3	0	-	- \$ 2571	15.7	0	-
HCM Lane LOS	A	A	-	- F	C	A	-
HCM 95th %tile Q(veh)	0.1	-	-	- 15.1	0	-	-

Notes

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

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	166	0	29	108	8	29	22	2052	2	0	781	0
Future Volume (vph)	166	0	29	108	8	29	22	2052	2	0	781	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.95			0.95	
Frpb, ped/bikes		1.00			1.00	0.98	1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00	1.00	1.00	1.00			1.00	
Frt		0.98			1.00	0.85	1.00	1.00			1.00	
Flt Protected		0.96			0.96	1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1716			1676	1539	1651	3539			3505	
Flt Permitted		0.59			0.74	1.00	0.31	1.00			1.00	
Satd. Flow (perm)		1050			1301	1539	547	3539			3505	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	177	0	31	115	9	31	23	2183	2	0	831	0
RTOR Reduction (vph)	0	18	0	0	0	18	0	0	0	0	0	0
Lane Group Flow (vph)	0	190	0	0	124	13	23	2185	0	0	831	0
Confl. Peds. (#/hr)	5					5	4		5	5		4
Confl. Bikes (#/hr)			2						10			5
Heavy Vehicles (%)	4%	0%	0%	9%	0%	3%	9%	2%	0%	0%	3%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA			NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4		4	2					
Actuated Green, G (s)		23.6			23.6	23.6	86.4	86.4			86.4	
Effective Green, g (s)		24.1			24.1	24.1	87.9	87.9			87.9	
Actuated g/C Ratio		0.20			0.20	0.20	0.73	0.73			0.73	
Clearance Time (s)		4.5			4.5	4.5	5.5	5.5			5.5	
Vehicle Extension (s)		2.0			2.0	2.0	2.0	2.0			2.0	
Lane Grp Cap (vph)		210			261	309	400	2592			2567	
v/s Ratio Prot								c0.62			0.24	
v/s Ratio Perm		c0.18			0.10	0.01	0.04					
v/c Ratio		0.90			0.48	0.04	0.06	0.84			0.32	
Uniform Delay, d1		46.8			42.4	38.6	4.5	11.2			5.6	
Progression Factor		1.00			1.00	1.00	0.97	0.65			1.49	
Incremental Delay, d2		35.9			0.5	0.0	0.2	2.9			0.3	
Delay (s)		82.7			42.9	38.7	4.6	10.2			8.7	
Level of Service		F			D	D	A	B			A	
Approach Delay (s)		82.7			42.0			10.1			8.7	
Approach LOS		F			D			B			A	
Intersection Summary												
HCM 2000 Control Delay		15.7										
HCM 2000 Volume to Capacity ratio		0.85										
Actuated Cycle Length (s)		120.0										
Intersection Capacity Utilization		84.7%										
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

22: SW Barbur Blvd (Hwy 99W) & SW 30th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	70	3	122	6	3	17	26	1722	1	7	832	10
Future Volume (vph)	70	3	122	6	3	17	26	1722	1	7	832	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.98			0.97		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		0.99			1.00		1.00	1.00		1.00	1.00	
Frt		0.92			0.91		1.00	1.00		1.00	1.00	
Flt Protected		0.98			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1635			1662		1515	3539		1805	3461	
Flt Permitted		0.87			0.89		0.28	1.00		0.07	1.00	
Satd. Flow (perm)		1448			1499		451	3539		138	3461	
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)	76	3	133	7	3	18	28	1872	1	8	904	11
RTOR Reduction (vph)	0	49	0	0	15	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	163	0	0	13	0	28	1873	0	8	914	0
Confl. Peds. (#/hr)	24		9	9		24	6		6	6		6
Confl. Bikes (#/hr)									8			1
Heavy Vehicles (%)	3%	0%	1%	0%	0%	0%	19%	2%	0%	0%	4%	9%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		1	6		5	2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.9			16.9		91.5	88.1		85.9	85.2	
Effective Green, g (s)		17.9			17.9		91.9	89.4		85.9	86.5	
Actuated g/C Ratio		0.15			0.15		0.77	0.75		0.72	0.72	
Clearance Time (s)		5.0			5.0		4.2	5.3		4.0	5.3	
Vehicle Extension (s)		2.0			2.0		0.5	0.5		0.5	0.5	
Lane Grp Cap (vph)		215			223		377	2636		108	2494	
v/s Ratio Prot							c0.00	c0.53		0.00	0.26	
v/s Ratio Perm		c0.11			0.01		0.05			0.05		
v/c Ratio		0.76			0.06		0.07	0.71		0.07	0.37	
Uniform Delay, d1		49.0			43.8		5.8	8.3		19.5	6.4	
Progression Factor		1.00			1.00		0.74	0.75		0.38	0.67	
Incremental Delay, d2		12.6			0.0		0.0	1.4		0.1	0.4	
Delay (s)		61.6			43.8		4.3	7.6		7.5	4.6	
Level of Service		E			D		A	A		A	A	
Approach Delay (s)		61.6			43.8			7.5			4.7	
Approach LOS		E			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			10.7			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.71									
Actuated Cycle Length (s)			120.0		Sum of lost time (s)				12.0			
Intersection Capacity Utilization			73.8%		ICU Level of Service				D			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 0.3

Movement EBL EBR NBL NBT SBT SBRLane Configurations 

Traffic Vol, veh/h 11 3 0 1742 944 12

Future Vol, veh/h 11 3 0 1742 944 12

Conflicting Peds, #/hr 0 1 3 0 0 3

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 94 94 94 94 94 94

Heavy Vehicles, % 0 0 0 2 3 0

Mvmt Flow 12 3 0 1853 1004 13

Major/Minor Minor2 Major1 Major2

Conflicting Flow All 1941 513 1020 0 - 0

Stage 1 1014 - - - - -

Stage 2 927 - - - - -

Critical Hdwy 6.8 6.9 4.1 - - -

Critical Hdwy Stg 1 5.8 - - - - -

Critical Hdwy Stg 2 5.8 - - - - -

Follow-up Hdwy 3.5 3.3 2.2 - - -

Pot Cap-1 Maneuver 58 512 688 - - -

Stage 1 316 - - - - -

Stage 2 351 - - - - -

Platoon blocked, % - - -

Mov Cap-1 Maneuver 58 510 686 - - -

Mov Cap-2 Maneuver 58 - - - - -

Stage 1 315 - - - - -

Stage 2 350 - - - - -

Approach EB NB SB

HCM Control Delay, s 67.6 0 0

HCM LOS F

Minor Lane/Major Mvmt NBL NBT EBLn1 SBT SBR

Capacity (veh/h) 686 - 72 - -

HCM Lane V/C Ratio - - 0.207 - -

HCM Control Delay (s) 0 - 67.6 - -

HCM Lane LOS A - F - -

HCM 95th %tile Q(veh) 0 - 0.7 - -

HCM 2010 TWSC

25: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd (Baird St)/SW Taylors Ferry Rd 04/21/2020

Intersection												
Int Delay, s/veh	8.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	20	0	18	19	0	30	1	1692	4	0	941	9
Future Vol, veh/h	20	0	18	19	0	30	1	1692	4	0	941	9
Conflicting Peds, #/hr	0	0	2	2	0	0	2	0	0	0	0	2
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	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	5	0	0	0	0	0	0	2	20	0	3	0
Mvmt Flow	22	0	19	20	0	32	1	1819	4	0	1012	10

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1931	2844	515	2331	2847	912	1024	0	0	1823	0	0
Stage 1	1019	1019	-	1823	1823	-	-	-	-	-	-	-
Stage 2	912	1825	-	508	1024	-	-	-	-	-	-	-
Critical Hdwy	7.6	6.5	6.9	7.5	6.5	6.9	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.6	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.6	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.55	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	38	17	510	~ 20	17	280	686	-	-	340	-	-
Stage 1	248	317	-	82	130	-	-	-	-	-	-	-
Stage 2	289	129	-	521	315	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	34	17	508	~ 19	17	280	685	-	-	340	-	-
Mov Cap-2 Maneuver	34	17	-	~ 19	17	-	-	-	-	-	-	-
Stage 1	248	316	-	82	130	-	-	-	-	-	-	-
Stage 2	256	129	-	500	314	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	142.4	\$ 345.9	0	0
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	685	-	-	61 44	340	-	-
HCM Lane V/C Ratio	0.002	-	-	0.67 1.197	-	-	-
HCM Control Delay (s)	10.3	0	-	142.4 \$ 345.9	0	-	-
HCM Lane LOS	B	A	-	F F	A	-	-
HCM 95th %tile Q(veh)	0	-	-	2.9 5	0	-	-

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

HCM Signalized Intersection Capacity Analysis

27: SW Barbur Blvd (Hwy 99W) & Transit Center (Signalized)

04/21/2020



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	WT		WT		WT	WT
Traffic Volume (vph)	10	6	1691	23	10	968
Future Volume (vph)	10	6	1691	23	10	968
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	0.97		0.95		1.00	0.95
Frpb, ped/bikes	0.99		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.95		1.00		1.00	1.00
Flt Protected	0.97		1.00		0.95	1.00
Satd. Flow (prot)	3349		3531		1805	3505
Flt Permitted	0.97		1.00		0.95	1.00
Satd. Flow (perm)	3349		3531		1805	3505
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	11	6	1818	25	11	1041
RTOR Reduction (vph)	6	0	0	0	0	0
Lane Group Flow (vph)	11	0	1843	0	11	1041
Confl. Peds. (#/hr)	6	1		6	6	
Confl. Bikes (#/hr)		1		7		
Heavy Vehicles (%)	0%	0%	2%	0%	0%	3%
Turn Type	Prot		NA		Prot	NA
Protected Phases	4		2		1	6
Permitted Phases						
Actuated Green, G (s)	8.4		96.1		1.0	101.3
Effective Green, g (s)	9.4		97.4		1.2	102.6
Actuated g/C Ratio	0.08		0.81		0.01	0.85
Clearance Time (s)	5.0		5.3		4.2	5.3
Vehicle Extension (s)	4.0		1.5		0.5	1.5
Lane Grp Cap (vph)	262		2865		18	2996
v/s Ratio Prot	c0.00		c0.52		0.01	c0.30
v/s Ratio Perm						
v/c Ratio	0.04		0.64		0.61	0.35
Uniform Delay, d1	51.1		4.5		59.2	1.8
Progression Factor	1.00		1.20		1.19	0.28
Incremental Delay, d2	0.1		0.8		34.4	0.3
Delay (s)	51.2		6.2		104.7	0.8
Level of Service	D		A		F	A
Approach Delay (s)	51.2		6.2			1.9
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			4.9		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.59			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			58.1%		ICU Level of Service	B
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

29: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/Barbur Terrace

04/21/2020

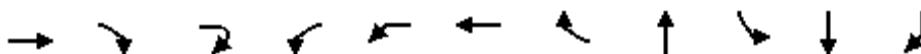


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔					↔	↔		↔	↔	
Traffic Volume (vph)	231	2	7	0	0	0	101	1471	12	8	845	147
Future Volume (vph)	231	2	7	0	0	0	101	1471	12	8	845	147
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0					4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00					1.00	0.95		1.00	*0.79	
Frpb, ped/bikes		1.00					1.00	1.00		1.00	0.99	
Flpb, ped/bikes		0.99					1.00	1.00		1.00	1.00	
Frt		1.00					1.00	1.00		1.00	0.98	
Flt Protected		0.95					0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1745					1687	3509		902	2815	
Flt Permitted		0.95					0.95	1.00		0.08	1.00	
Satd. Flow (perm)		1745					1687	3509		77	2815	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	260	2	8	0	0	0	113	1653	13	9	949	165
RTOR Reduction (vph)	0	1	0	0	0	0	0	0	0	0	9	0
Lane Group Flow (vph)	0	269	0	0	0	0	113	1666	0	9	1105	0
Confl. Peds. (#/hr)	7		1	1		7	11					11
Heavy Vehicles (%)	1%	100%	17%	4%	4%	4%	7%	2%	100%	100%	3%	7%
Turn Type	Perm	NA					Prot	NA		pm+pt	NA	
Protected Phases		4					5	2		1	6	
Permitted Phases	4									6		
Actuated Green, G (s)		21.7					13.1	81.4		72.6	70.2	
Effective Green, g (s)		22.9					13.6	82.7		72.6	71.5	
Actuated g/C Ratio		0.19					0.11	0.69		0.60	0.60	
Clearance Time (s)		5.2					4.5	5.3		4.0	5.3	
Vehicle Extension (s)		3.0					0.5	1.5		0.5	3.0	
Lane Grp Cap (vph)		333					191	2418		63	1677	
v/s Ratio Prot							c0.07	c0.47		0.00	0.39	
v/s Ratio Perm		0.15								0.08		
v/c Ratio		0.81					0.59	0.69		0.14	0.66	
Uniform Delay, d1		46.5					50.6	11.0		27.7	16.1	
Progression Factor		1.00					1.34	1.96		1.65	1.33	
Incremental Delay, d2		13.4					1.4	0.7		0.4	2.0	
Delay (s)		59.9					69.1	22.4		46.0	23.4	
Level of Service		E					E	C		D	C	
Approach Delay (s)		59.9			0.0			25.3			23.6	
Approach LOS		E			A			C			C	
Intersection Summary												
HCM 2000 Control Delay		27.7					HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio		0.73										
Actuated Cycle Length (s)		120.0					Sum of lost time (s)			12.0		
Intersection Capacity Utilization		74.4%					ICU Level of Service			D		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

30: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

04/21/2020



Movement	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBT	SBL	SBT	SBR
Lane Configurations	↑↑					↑↑		↑↑	↖	↑↑	↘
Traffic Volume (vph)	609	35	285	7	98	290	308	1396	1	338	514
Future Volume (vph)	609	35	285	7	98	290	308	1396	1	338	514
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0					4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.95					0.95		0.95	1.00	0.95	1.00
Frpb, ped/bikes	1.00					0.99		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00					1.00		1.00	1.00	1.00	1.00
Frt	0.95					0.93		1.00	1.00	1.00	1.00
Flt Protected	1.00					0.99		1.00	0.95	1.00	1.00
Satd. Flow (prot)	3340					3208		3471	902	3505	1845
Flt Permitted	1.00					0.52		1.00	0.95	1.00	1.00
Satd. Flow (perm)	3340					1687		3471	902	3505	1845
Peak-hour factor, PHF	0.88	0.88	0.88	0.80	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	692	40	324	9	111	330	350	1586	1	384	584
RTOR Reduction (vph)	0	0	0	0	0	111	0	0	0	0	0
Lane Group Flow (vph)	1056	0	0	0	0	689	0	1586	1	384	584
Confl. Peds. (#/hr)							5		1		
Heavy Vehicles (%)	3%	6%	1%	57%	3%	4%	2%	4%	100%	3%	3%
Turn Type	NA			Perm	Perm	NA		NA	Prot	NA	Perm
Protected Phases	4					8		2	1	6	
Permitted Phases				8	8						6
Actuated Green, G (s)	48.6					48.6		53.8	1.4	59.2	59.2
Effective Green, g (s)	50.7					50.7		55.9	1.4	61.3	61.3
Actuated g/C Ratio	0.42					0.42		0.47	0.01	0.51	0.51
Clearance Time (s)	6.1					6.1		6.1	4.0	6.1	6.1
Vehicle Extension (s)	0.2					0.2		0.2	0.5	0.2	0.2
Lane Grp Cap (vph)	1411					712		1616	10	1790	942
v/s Ratio Prot	0.32							c0.46	0.00	0.11	
v/s Ratio Perm						c0.41					c0.32
v/c Ratio	0.75					0.97		0.98	0.10	0.21	0.62
Uniform Delay, d1	29.3					33.9		31.5	58.7	16.1	21.0
Progression Factor	1.00					1.00		1.00	0.93	1.96	1.84
Incremental Delay, d2	1.9					25.5		18.4	1.3	0.2	2.5
Delay (s)	31.2					59.4		49.9	55.9	31.8	41.2
Level of Service	C					E		D	E	C	D
Approach Delay (s)	31.2					59.4		49.9		37.5	
Approach LOS	C					E		D		D	

Intersection Summary

HCM 2000 Control Delay	44.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	98.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Intersection

Int Delay, s/veh 3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↘	↘
Traffic Vol, veh/h	599	0	0	213	89	289
Future Vol, veh/h	599	0	0	213	89	289
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	200	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	77	77	77	77	77	77
Heavy Vehicles, %	1	0	0	0	0	1
Mvmt Flow	778	0	0	277	116	375

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	-	- 1055
Stage 1	-	-	- 778
Stage 2	-	-	- 277
Critical Hdwy	-	-	- 6.4
Critical Hdwy Stg 1	-	-	- 5.4
Critical Hdwy Stg 2	-	-	- 5.4
Follow-up Hdwy	-	-	- 3.5
Pot Cap-1 Maneuver	-	0	0 - 252
Stage 1	-	0	0 - 456
Stage 2	-	0	0 - 774
Platoon blocked, %	-		-
Mov Cap-1 Maneuver	-	-	- 252
Mov Cap-2 Maneuver	-	-	- 252
Stage 1	-	-	- 456
Stage 2	-	-	- 774

Approach	EB	WB	NB
HCM Control Delay, s	0	0	30.8
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	WBT
Capacity (veh/h)	252	-	-	-
HCM Lane V/C Ratio	0.459	-	-	-
HCM Control Delay (s)	30.8	0	-	-
HCM Lane LOS	D	A	-	-
HCM 95th %tile Q(veh)	2.2	-	-	-

Intersection

Intersection Delay, s/veh 42.8

Intersection LOS E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	66	218	200	59	100	40	98	180	12	8	266	15
Future Vol, veh/h	66	218	200	59	100	40	98	180	12	8	266	15
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Heavy Vehicles, %	0	2	1	0	1	0	0	2	0	10	2	0
Mvmt Flow	79	260	238	70	119	48	117	214	14	10	317	18
Number of Lanes	1	1	0	1	1	0	0	2	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	2	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	1	2	2
HCM Control Delay	71.2	15.9	18.8	37.8
HCM LOS	F	C	C	E

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	52%	0%	100%	0%	100%	0%	3%
Vol Thru, %	48%	88%	0%	52%	0%	71%	92%
Vol Right, %	0%	12%	0%	48%	0%	29%	5%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	188	102	66	418	59	140	289
LT Vol	98	0	66	0	59	0	8
Through Vol	90	90	0	218	0	100	266
RT Vol	0	12	0	200	0	40	15
Lane Flow Rate	224	121	79	498	70	167	344
Geometry Grp	7	7	7	7	7	7	6
Degree of Util (X)	0.532	0.279	0.183	1.043	0.177	0.387	0.796
Departure Headway (Hd)	8.86	8.539	8.372	7.544	9.366	8.652	8.623
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	410	424	429	483	386	418	423
Service Time	6.56	6.239	6.122	5.293	7.066	6.352	6.623
HCM Lane V/C Ratio	0.546	0.285	0.184	1.031	0.181	0.4	0.813
HCM Control Delay	21.2	14.5	13	80.4	14.1	16.7	37.8
HCM Lane LOS	C	B	B	F	B	C	E
HCM 95th-tile Q	3	1.1	0.7	15	0.6	1.8	7

HCM Signalized Intersection Capacity Analysis

36: SW Barbur Blvd (Hwy 99W) & SW 53rd Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↕	↗
Traffic Volume (vph)	1	11	1	254	3	48	2	1315	200	0	280	11
Future Volume (vph)	1	11	1	254	3	48	2	1315	200	0	280	11
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
Lane Util. Factor		1.00			1.00			0.95			0.95	1.00
Frpb, ped/bikes		1.00			1.00			1.00			1.00	0.97
Flpb, ped/bikes		1.00			1.00			1.00			1.00	1.00
Frt		0.99			0.98			0.98			1.00	0.85
Flt Protected		1.00			0.96			1.00			1.00	1.00
Satd. Flow (prot)		1719			1737			3301			3282	1571
Flt Permitted		0.98			0.75			0.95			1.00	1.00
Satd. Flow (perm)		1697			1359			3151			3282	1571
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	1	13	1	295	3	56	2	1529	233	0	326	13
RTOR Reduction (vph)	0	1	0	0	9	0	0	15	0	0	0	5
Lane Group Flow (vph)	0	14	0	0	345	0	0	1749	0	0	326	8
Confl. Peds. (#/hr)	3					3	2		1	1		2
Confl. Bikes (#/hr)						2			3			4
Heavy Vehicles (%)	0%	9%	20%	3%	0%	0%	0%	7%	6%	0%	10%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA			NA	Perm
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2					2
Actuated Green, G (s)		20.9			20.9			43.1			43.1	43.1
Effective Green, g (s)		20.9			20.9			44.1			44.1	44.1
Actuated g/C Ratio		0.29			0.29			0.60			0.60	0.60
Clearance Time (s)		4.0			4.0			5.0			5.0	5.0
Vehicle Extension (s)		2.5			2.5			4.8			4.8	4.8
Lane Grp Cap (vph)		485			389			1903			1982	949
v/s Ratio Prot											0.10	
v/s Ratio Perm		0.01			c0.25			c0.55				0.00
v/c Ratio		0.03			0.89			0.92			0.16	0.01
Uniform Delay, d1		18.7			24.9			12.9			6.4	5.7
Progression Factor		1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2		0.0			20.6			7.9			0.1	0.0
Delay (s)		18.8			45.6			20.8			6.4	5.8
Level of Service		B			D			C			A	A
Approach Delay (s)		18.8			45.6			20.8			6.4	
Approach LOS		B			D			C			A	
Intersection Summary												
HCM 2000 Control Delay			22.4									
HCM 2000 Volume to Capacity ratio			0.91									
Actuated Cycle Length (s)			73.0									
Intersection Capacity Utilization			78.8%									
Analysis Period (min)			15									
c Critical Lane Group												

APPENDIX B22

Segment B – PM Existing HCM Results

Intersection						
Int Delay, s/veh	0.1					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↗	↗↗		↘	↗↗
Traffic Vol, veh/h	0	8	1269	0	26	1496
Future Vol, veh/h	0	8	1269	0	26	1496
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	180	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	3	0	0	2
Mvmt Flow	0	9	1379	0	28	1626
Major/Minor	Minor1	Major1		Major2		
Conflicting Flow All	-	690	0	-	1379	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.9	-	-	4.1	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	0	392	-	0	504	-
Stage 1	0	-	-	0	-	-
Stage 2	0	-	-	0	-	-
Platoon blocked, %			-			-
Mov Cap-1 Maneuver	-	392	-	-	504	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Approach	WB	NB		SB		
HCM Control Delay, s	14.4	0		0.2		
HCM LOS	B					
Minor Lane/Major Mvmt	NBTWBLn1		SBL	SBT		
Capacity (veh/h)	-		392	504	-	
HCM Lane V/C Ratio	-		0.022	0.056	-	
HCM Control Delay (s)	-		14.4	12.6	-	
HCM Lane LOS	-		B	B	-	
HCM 95th %tile Q(veh)	-		0.1	0.2	-	

HCM Signalized Intersection Capacity Analysis

2: SW Barbur Blvd (Hwy 99W)/SW Barbur Blvd & SW Barbur Blvd Frontage Road/SW Miles Rd & SW 3rd

	→	↘	↙	←	↖	↑	↗	↓	↘	↙	↘	↙
Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT	SBR	SEL2	SEL	SER
Lane Configurations	↔			↔	↔	↔		↔			↔	
Traffic Volume (vph)	0	7	134	0	18	1267	112	1488	8	2	0	2
Future Volume (vph)	0	7	134	0	18	1267	112	1488	8	2	0	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	4.0		4.0			4.0	
Lane Util. Factor	1.00			1.00	1.00	*0.85		0.95			1.00	
Frpb, ped/bikes	0.94			1.00	1.00	1.00		1.00			0.86	
Flpb, ped/bikes	1.00			1.00	1.00	1.00		1.00			1.00	
Frt	0.86			1.00	1.00	0.99		1.00			0.93	
Flt Protected	1.00			0.95	0.95	1.00		1.00			0.98	
Satd. Flow (prot)	1537			1805	1805	3105		3535			1495	
Flt Permitted	1.00			0.95	0.95	1.00		1.00			0.98	
Satd. Flow (perm)	1537			1805	1805	3105		3535			1495	
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)	0	8	146	0	20	1377	122	1617	9	2	0	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	8	0	0	146	20	1499	0	1626	0	0	4	0
Confl. Peds. (#/hr)		3	3		22				22			22
Heavy Vehicles (%)	0%	0%	0%	0%	0%	3%	0%	2%	0%	0%	0%	0%
Turn Type	NA		Split	NA	Prot	NA		NA		Perm	Prot	
Protected Phases	7		3	3	5	2		6			4	
Permitted Phases										4		
Actuated Green, G (s)	1.0			12.4	2.2	76.1		70.4			1.0	
Effective Green, g (s)	2.0			14.4	1.7	77.4		71.7			3.0	
Actuated g/C Ratio	0.02			0.12	0.01	0.65		0.60			0.02	
Clearance Time (s)	5.0			6.0	3.5	5.3		5.3			6.0	
Vehicle Extension (s)	1.0			0.5	0.2	1.0		1.0			1.0	
Lane Grp Cap (vph)	25			216	25	2002		2112			37	
v/s Ratio Prot	c0.01			c0.08	0.01	c0.48		0.46				
v/s Ratio Perm											0.00	
v/c Ratio	0.32			0.68	0.80	0.75		0.77			0.11	
Uniform Delay, d1	58.3			50.6	59.0	14.6		18.0			57.2	
Progression Factor	1.00			1.00	1.17	0.72		1.00			1.00	
Incremental Delay, d2	2.7			6.4	50.9	1.1		2.8			0.5	
Delay (s)	61.0			57.0	119.9	11.6		20.8			57.7	
Level of Service	E			E	F	B		C			E	
Approach Delay (s)	61.0			57.0		13.0		20.8			57.7	
Approach LOS	E			E		B		C			E	
Intersection Summary												
HCM 2000 Control Delay			19.0			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			26.0			
Intersection Capacity Utilization			68.8%			ICU Level of Service			C			
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

3: SW Barbur Blvd (Hwy 99W) & SW Terwilliger Blvd

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	49	161	231	335	184	382	87	966	450	332	1254	45
Future Volume (vph)	49	161	231	335	184	382	87	966	450	332	1254	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.96	1.00	0.98		1.00	1.00	0.97	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.90		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1881	1517	1787	1646		1770	3539	1551	1787	3539	1515
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1881	1517	1787	1646		1770	3539	1551	1787	3539	1515
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	51	168	241	349	192	398	91	1006	469	346	1306	47
RTOR Reduction (vph)	0	0	185	0	62	0	0	0	0	0	0	24
Lane Group Flow (vph)	51	168	56	349	528	0	91	1006	469	346	1306	23
Confl. Peds. (#/hr)	8		15	15		8	16		7	7		16
Confl. Bikes (#/hr)			4			4			1			1
Heavy Vehicles (%)	2%	1%	2%	1%	2%	2%	2%	2%	1%	1%	2%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pm+ov	Prot	NA	Perm
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases			8						6			2
Actuated Green, G (s)	4.5	12.5	12.5	22.5	30.5		9.1	40.3	62.8	26.5	57.7	57.7
Effective Green, g (s)	4.0	13.0	13.0	22.0	31.0		10.1	41.5	61.8	27.5	58.9	58.9
Actuated g/C Ratio	0.03	0.11	0.11	0.18	0.26		0.08	0.35	0.51	0.23	0.49	0.49
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		5.0	5.2	3.5	5.0	5.2	5.2
Vehicle Extension (s)	0.5	1.0	1.0	0.5	1.0		0.5	0.5	0.5	0.5	0.5	0.5
Lane Grp Cap (vph)	59	203	164	327	425		148	1223	798	409	1737	743
v/s Ratio Prot	0.03	0.09		c0.20	c0.32		0.05	c0.28	0.11	c0.19	0.37	
v/s Ratio Perm			0.04						0.19			0.02
v/c Ratio	0.86	0.83	0.34	1.07	1.24		0.61	0.82	0.59	0.85	0.75	0.03
Uniform Delay, d1	57.7	52.4	49.5	49.0	44.5		53.1	35.9	20.2	44.2	24.7	15.8
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.04	0.93	1.14	1.13	1.14	1.00
Incremental Delay, d2	68.5	22.3	0.4	68.7	127.3		4.3	5.2	0.6	11.4	2.4	0.1
Delay (s)	126.3	74.7	50.0	117.7	171.8		59.4	38.8	23.6	61.6	30.4	15.9
Level of Service	F	E	D	F	F		E	D	C	E	C	B
Approach Delay (s)		67.5			151.7			35.4			36.3	
Approach LOS		E			F			D			D	
Intersection Summary												
HCM 2000 Control Delay			62.3			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			0.98									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			95.9%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	401	83	39	110	103	287	17	815	44	17	1498	305
Future Volume (vph)	401	83	39	110	103	287	17	815	44	17	1498	305
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.95		1.00	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	0.97		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1698	1676		1805	1863	1599	1612	3500		1703	3574	1599
Flt Permitted	0.95	0.97		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1698	1676		1805	1863	1599	1612	3500		1703	3574	1599
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	413	86	40	113	106	296	18	840	45	18	1544	314
RTOR Reduction (vph)	0	5	0	0	0	237	0	2	0	0	0	67
Lane Group Flow (vph)	268	266	0	113	106	59	18	883	0	18	1544	247
Confl. Peds. (#/hr)			5	5			19		1	1		19
Heavy Vehicles (%)	1%	4%	3%	0%	2%	1%	12%	2%	7%	6%	1%	1%
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	pt+ov
Protected Phases	3	3		4	4		1	6		5	2	2 3
Permitted Phases						4						
Actuated Green, G (s)	20.7	20.7		9.9	9.9	9.9	2.7	68.1		2.5	67.4	93.3
Effective Green, g (s)	21.1	21.1		11.1	11.1	11.1	3.2	69.3		2.5	68.6	94.5
Actuated g/C Ratio	0.18	0.18		0.09	0.09	0.09	0.03	0.58		0.02	0.57	0.79
Clearance Time (s)	4.4	4.4		5.2	5.2	5.2	4.5	5.2		4.0	5.2	
Vehicle Extension (s)	1.0	1.0		1.0	1.0	1.0	1.5	0.5		1.0	0.5	
Lane Grp Cap (vph)	298	294		166	172	147	42	2021		35	2043	1259
v/s Ratio Prot	0.16	c0.16		c0.06	0.06		c0.01	0.25		0.01	c0.43	0.15
v/s Ratio Perm						0.04						
v/c Ratio	0.90	0.90		0.68	0.62	0.40	0.43	0.44		0.51	0.76	0.20
Uniform Delay, d1	48.4	48.5		52.7	52.4	51.3	57.5	14.3		58.1	19.4	3.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.55	0.18		1.03	0.68	0.23
Incremental Delay, d2	27.1	28.6		8.8	4.6	0.7	2.2	0.6		3.0	1.5	0.0
Delay (s)	75.5	77.1		61.5	57.0	52.0	91.1	3.2		63.0	14.8	0.8
Level of Service	E	E		E	E	D	F	A		E	B	A
Approach Delay (s)		76.3			55.1			4.9			12.9	
Approach LOS		E			E			A			B	
Intersection Summary												
HCM 2000 Control Delay	25.6			HCM 2000 Level of Service			C					
HCM 2000 Volume to Capacity ratio	0.77											
Actuated Cycle Length (s)	120.0			Sum of lost time (s)			16.0					
Intersection Capacity Utilization	72.9%			ICU Level of Service			C					
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

9: SW Terwilliger Blvd & I-5 NB Off Ramp

04/21/2020



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	330	241	0	571	943	0
Future Volume (vph)	330	241	0	571	943	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1599		1881	1881	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1599		1881	1881	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	347	254	0	601	993	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	347	254	0	601	993	0
Heavy Vehicles (%)	2%	1%	0%	1%	1%	0%
Turn Type	Prot	custom		NA	NA	
Protected Phases	4	1		6	2	
Permitted Phases		4				
Actuated Green, G (s)	20.3	30.5		82.2	67.4	
Effective Green, g (s)	21.2	31.7		82.8	68.0	
Actuated g/C Ratio	0.19	0.28		0.74	0.61	
Clearance Time (s)	4.9	4.6		4.6	4.6	
Vehicle Extension (s)	1.0	1.2		1.2	4.0	
Lane Grp Cap (vph)	335	452		1390	1142	
v/s Ratio Prot	c0.20	c0.05		0.32	c0.53	
v/s Ratio Perm		0.10				
v/c Ratio	1.04	0.56		0.43	0.87	
Uniform Delay, d1	45.4	34.2		5.6	18.3	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	58.7	1.0		0.1	7.5	
Delay (s)	104.1	35.2		5.7	25.8	
Level of Service	F	D		A	C	
Approach Delay (s)	75.0			5.7	25.8	
Approach LOS	E			A	C	

Intersection Summary

HCM 2000 Control Delay	33.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	112.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection

Int Delay, s/veh 4.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	206	213	863	1523	10
Future Vol, veh/h	0	206	213	863	1523	10
Conflicting Peds, #/hr	9	0	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	0	0	2	2	2	0
Mvmt Flow	0	217	224	908	1603	11

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	2524	811	1618
Stage 1	1613	-	-
Stage 2	911	-	-
Critical Hdwy	6.8	6.9	4.14
Critical Hdwy Stg 1	5.8	-	-
Critical Hdwy Stg 2	5.8	-	-
Follow-up Hdwy	3.5	3.3	2.22
Pot Cap-1 Maneuver	23	327	399
Stage 1	152	-	-
Stage 2	357	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	10	326	398
Mov Cap-2 Maneuver	10	-	-
Stage 1	66	-	-
Stage 2	356	-	-

Approach	EB	NB	SB
HCM Control Delay, s	35.5	5	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	398	-	326	-	-
HCM Lane V/C Ratio	0.563	-	0.665	-	-
HCM Control Delay (s)	25.1	-	35.5	-	-
HCM Lane LOS	D	-	E	-	-
HCM 95th %tile Q(veh)	3.4	-	4.5	-	-

HCM Signalized Intersection Capacity Analysis

13: SW Barbur Blvd (Hwy 99W) & SW Capitol Hill Rd/SW 19th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	47	81	102	168	81	57	91	974	13	102	1565	51
Future Volume (vph)	47	81	102	168	81	57	91	974	13	102	1565	51
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	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	0.96		1.00	0.99		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.92		1.00	0.94		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1664		1787	1743		1805	3539	1577	1719	3519	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1664		1787	1743		1805	3539	1577	1719	3519	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	49	84	106	175	84	59	95	1015	14	106	1630	53
RTOR Reduction (vph)	0	38	0	0	19	0	0	0	7	0	1	0
Lane Group Flow (vph)	49	152	0	175	124	0	95	1015	7	106	1682	0
Confl. Peds. (#/hr)	2		40	40		2	10		1	1		10
Confl. Bikes (#/hr)									1			1
Heavy Vehicles (%)	2%	0%	0%	1%	0%	4%	0%	2%	0%	5%	2%	0%
Turn Type	Prot	NA		Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases									6			
Actuated Green, G (s)	6.9	17.4		16.2	26.7		11.3	60.3	60.3	10.4	59.4	
Effective Green, g (s)	5.9	17.6		15.2	26.9		10.3	61.8	61.8	9.4	60.9	
Actuated g/C Ratio	0.05	0.15		0.13	0.22		0.09	0.51	0.51	0.08	0.51	
Clearance Time (s)	3.0	4.2		3.0	4.2		3.0	5.5	5.5	3.0	5.5	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	0.5	0.5	0.5	0.5	
Lane Grp Cap (vph)	87	244		226	390		154	1822	812	134	1785	
v/s Ratio Prot	0.03	c0.09		c0.10	0.07		0.05	0.29		c0.06	c0.48	
v/s Ratio Perm									0.00			
v/c Ratio	0.56	0.62		0.77	0.32		0.62	0.56	0.01	0.79	0.94	
Uniform Delay, d1	55.8	48.1		50.7	38.9		52.9	19.8	14.2	54.3	27.9	
Progression Factor	1.00	1.00		1.00	1.00		1.14	0.59	1.00	1.30	0.47	
Incremental Delay, d2	4.9	3.6		13.9	0.2		4.7	1.1	0.0	20.3	9.4	
Delay (s)	60.7	51.7		64.7	39.0		65.0	12.8	14.2	90.8	22.4	
Level of Service	E	D		E	D		E	B	B	F	C	
Approach Delay (s)		53.5			53.2			17.2			26.5	
Approach LOS		D			D			B			C	
Intersection Summary												
HCM 2000 Control Delay			27.8			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.84									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			88.8%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection												
Int Delay, s/veh	426.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕↕			↕↕	
Traffic Vol, veh/h	25	14	48	113	33	21	26	1032	5	5	1377	6
Future Vol, veh/h	25	14	48	113	33	21	26	1032	5	5	1377	6
Conflicting Peds, #/hr	0	0	1	1	0	0	4	0	5	5	0	4
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	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	4	0	0	0	0	0	0	2	0	0	1	0
Mvmt Flow	27	15	52	122	35	23	28	1110	5	5	1481	6
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2127	2674	749	1933	2675	563	1491	0	0	1120	0	0
Stage 1	1498	1498	-	1174	1174	-	-	-	-	-	-	-
Stage 2	629	1176	-	759	1501	-	-	-	-	-	-	-
Critical Hdwy	7.58	6.5	6.9	7.5	6.5	6.9	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.58	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.58	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.54	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	28	23	359	~ 41	~ 23	475	456	-	-	631	-	-
Stage 1	126	187	-	207	268	-	-	-	-	-	-	-
Stage 2	432	267	-	369	187	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	18	358	~ 9	~ 18	473	454	-	-	628	-	-
Mov Cap-2 Maneuver	-	18	-	~ 9	~ 18	-	-	-	-	-	-	-
Stage 1	105	178	-	173	224	-	-	-	-	-	-	-
Stage 2	290	223	-	276	178	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Control Delay, s			\$ 6895.4		1.3		0.2					
HCM LOS	-		F									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR					
Capacity (veh/h)	454	-	-	- 12	628	-	-					
HCM Lane V/C Ratio	0.062	-	-	- 14.964	0.009	-	-					
HCM Control Delay (s)	13.4	1	-	\$ 6895.4	10.8	0.2	-					
HCM Lane LOS	B	A	-	- F	B	A	-					
HCM 95th %tile Q(veh)	0.2	-	-	- 23.8	0	-	-					
Notes												
~: Volume exceeds capacity		\$: Delay exceeds 300s		+: Computation Not Defined				*: All major volume in platoon				

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	106	0	56	114	18	49	48	1144	0	0	1438	2
Future Volume (vph)	106	0	56	114	18	49	48	1144	0	0	1438	2
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	
Lane Util. Factor		1.00			1.00		1.00	0.95			0.95	
Frpb, ped/bikes		1.00			1.00		0.98	1.00	1.00		1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00	1.00		1.00	
Frt		0.95			1.00		0.85	1.00	1.00		1.00	
Flt Protected		0.97			0.96		1.00	0.95	1.00		1.00	
Satd. Flow (prot)		1740			1806		1589	1805	3574		3539	
Flt Permitted		0.57			0.67		1.00	0.14	1.00		1.00	
Satd. Flow (perm)		1019			1258		1589	258	3574		3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	112	0	59	120	19	52	51	1204	0	0	1514	2
RTOR Reduction (vph)	0	19	0	0	0	43	0	0	0	0	0	0
Lane Group Flow (vph)	0	152	0	0	139	9	51	1204	0	0	1516	0
Confl. Peds. (#/hr)	2					2	1		2	2		1
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	0%	1%	0%	0%	2%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA			NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4		4	2					
Actuated Green, G (s)		19.9			19.9		19.9	90.1	90.1		90.1	
Effective Green, g (s)		20.4			20.4		20.4	91.6	91.6		91.6	
Actuated g/C Ratio		0.17			0.17		0.17	0.76	0.76		0.76	
Clearance Time (s)		4.5			4.5		4.5	5.5	5.5		5.5	
Vehicle Extension (s)		2.0			2.0		2.0	2.0	2.0		2.0	
Lane Grp Cap (vph)		173			213		270	196	2728		2701	
v/s Ratio Prot								0.34			c0.43	
v/s Ratio Perm		c0.15			0.11		0.01	0.20				
v/c Ratio		0.88			0.65		0.03	0.26	0.44		0.56	
Uniform Delay, d1		48.6			46.5		41.6	4.2	5.1		5.9	
Progression Factor		1.00			1.00		1.00	0.39	0.39		2.39	
Incremental Delay, d2		35.0			5.4		0.0	3.1	0.5		0.5	
Delay (s)		83.6			51.9		41.6	4.7	2.5		14.6	
Level of Service		F			D		D	A	A		B	
Approach Delay (s)		83.6			49.1				2.6		14.6	
Approach LOS		F			D				A		B	
Intersection Summary												
HCM 2000 Control Delay			15.6		HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio			0.62									
Actuated Cycle Length (s)			120.0		Sum of lost time (s)				8.0			
Intersection Capacity Utilization			62.5%		ICU Level of Service				B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

22: SW Barbur Blvd (Hwy 99W) & SW 30th Ave

04/21/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↗	↕		↗	↕	
Traffic Volume (vph)	39	0	85	3	0	10	76	960	4	2	1340	40
Future Volume (vph)	39	0	85	3	0	10	76	960	4	2	1340	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.99			0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		0.99			1.00		1.00	1.00		1.00	1.00	
Frt		0.91			0.89		1.00	1.00		1.00	1.00	
Flt Protected		0.98			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1629			1640		1805	3538		1805	3454	
Flt Permitted		0.89			0.95		0.12	1.00		0.24	1.00	
Satd. Flow (perm)		1479			1583		236	3538		451	3454	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	44	0	96	3	0	11	85	1079	4	2	1506	45
RTOR Reduction (vph)	0	65	0	0	12	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	75	0	0	2	0	85	1083	0	2	1549	0
Confl. Peds. (#/hr)	17		7	7		17	6					6
Heavy Vehicles (%)	3%	0%	2%	0%	0%	0%	0%	2%	0%	0%	4%	2%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		1	6		5	2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		13.9			13.9		95.9	91.1		87.5	86.8	
Effective Green, g (s)		14.9			14.9		96.3	92.4		87.5	88.1	
Actuated g/C Ratio		0.12			0.12		0.80	0.77		0.73	0.73	
Clearance Time (s)		5.0			5.0		4.2	5.3		4.0	5.3	
Vehicle Extension (s)		2.0			2.0		0.5	0.5		0.5	0.5	
Lane Grp Cap (vph)		183			196		254	2724		336	2535	
v/s Ratio Prot							c0.01	c0.31		0.00	c0.45	
v/s Ratio Perm		c0.05			0.00		0.25			0.00		
v/c Ratio		0.41			0.01		0.33	0.40		0.01	0.61	
Uniform Delay, d1		48.5			46.1		12.2	4.6		7.1	7.7	
Progression Factor		1.00			1.00		1.87	1.30		0.32	0.51	
Incremental Delay, d2		0.5			0.0		0.3	0.4		0.0	0.9	
Delay (s)		49.0			46.1		23.0	6.3		2.3	4.9	
Level of Service		D			D		C	A		A	A	
Approach Delay (s)		49.0			46.1			7.6			4.9	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		8.3										
HCM 2000 Volume to Capacity ratio		0.58										
Actuated Cycle Length (s)		120.0								12.0		
Intersection Capacity Utilization		67.9%										
Analysis Period (min)		15										
c Critical Lane Group												

Intersection

Int Delay, s/veh 0.4

Movement EBL EBR NBL NBT SBT SBRLane Configurations 

Traffic Vol, veh/h 7 8 4 1050 1401 19

Future Vol, veh/h 7 8 4 1050 1401 19

Conflicting Peds, #/hr 1 0 0 0 0 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 93 93 93 93 93 93

Heavy Vehicles, % 0 0 0 3 2 0

Mvmt Flow 8 9 4 1129 1506 20

Major/Minor Minor2 Major1 Major2

Conflicting Flow All 2090 763 1526 0 - 0

Stage 1 1516 - - - - -

Stage 2 574 - - - - -

Critical Hdwy 6.8 6.9 4.1 - - -

Critical Hdwy Stg 1 5.8 - - - - -

Critical Hdwy Stg 2 5.8 - - - - -

Follow-up Hdwy 3.5 3.3 2.2 - - -

Pot Cap-1 Maneuver 46 351 443 - - -

Stage 1 171 - - - - -

Stage 2 532 - - - - -

Platoon blocked, % - - -

Mov Cap-1 Maneuver 45 351 443 - - -

Mov Cap-2 Maneuver 45 - - - - -

Stage 1 167 - - - - -

Stage 2 532 - - - - -

Approach EB NB SB

HCM Control Delay, s 57.8 0.2 0

HCM LOS F

Minor Lane/Major Mvmt NBL NBT EBLn1 SBT SBR

Capacity (veh/h) 443 - 84 - -

HCM Lane V/C Ratio 0.01 - 0.192 - -

HCM Control Delay (s) 13.2 0.2 57.8 - -

HCM Lane LOS B A F - -

HCM 95th %tile Q(veh) 0 - 0.7 - -

HCM 2010 TWSC

25: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd (Baird St)/SW Taylors Ferry Rd 04/21/2020

Intersection												
Int Delay, s/veh	4.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	18	0	18	17	0	26	6	1011	4	2	1395	15
Future Vol, veh/h	18	0	18	17	0	26	6	1011	4	2	1395	15
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	3	3	0	1
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, %	0	0	0	6	0	0	0	2	50	50	1	0
Mvmt Flow	20	0	20	18	0	28	7	1099	4	2	1516	16
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2093	2649	767	1880	2655	555	1533	0	0	1106	0	0
Stage 1	1529	1529	-	1118	1118	-	-	-	-	-	-	-
Stage 2	564	1120	-	762	1537	-	-	-	-	-	-	-
Critical Hdwy	7.5	6.5	6.9	7.62	6.5	6.9	4.1	-	-	5.1	-	-
Critical Hdwy Stg 1	6.5	5.5	-	6.62	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.5	5.5	-	6.62	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.56	4	3.3	2.2	-	-	2.7	-	-
Pot Cap-1 Maneuver	31	23	349	42	23	480	440	-	-	409	-	-
Stage 1	125	181	-	214	285	-	-	-	-	-	-	-
Stage 2	483	284	-	355	179	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	28	21	349	37	21	479	440	-	-	408	-	-
Mov Cap-2 Maneuver	28	21	-	37	21	-	-	-	-	-	-	-
Stage 1	120	175	-	205	273	-	-	-	-	-	-	-
Stage 2	436	272	-	324	173	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Control Delay, s	181.5		91.9		0.4		0.2					
HCM LOS	F		F									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	440	-	-	52	84	408	-	-				
HCM Lane V/C Ratio	0.015	-	-	0.753	0.556	0.005	-	-				
HCM Control Delay (s)	13.3	0.3	-	181.5	91.9	13.9	0.2	-				
HCM Lane LOS	B	A	-	F	F	B	A	-				
HCM 95th %tile Q(veh)	0	-	-	3.1	2.5	0	-	-				

HCM Signalized Intersection Capacity Analysis

27: SW Barbur Blvd (Hwy 99W) & Transit Center (Signalized)

04/21/2020



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	WT		WT		WT	WT
Traffic Volume (vph)	113	13	1008	12	5	1425
Future Volume (vph)	113	13	1008	12	5	1425
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	0.97		0.95		1.00	0.95
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.98		1.00		1.00	1.00
Flt Protected	0.96		1.00		0.95	1.00
Satd. Flow (prot)	3465		3532		1805	3539
Flt Permitted	0.96		1.00		0.95	1.00
Satd. Flow (perm)	3465		3532		1805	3539
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	122	14	1084	13	5	1532
RTOR Reduction (vph)	10	0	0	0	0	0
Lane Group Flow (vph)	126	0	1097	0	5	1532
Confl. Peds. (#/hr)	8			8	8	
Confl. Bikes (#/hr)		1				
Heavy Vehicles (%)	0%	0%	2%	0%	0%	2%
Turn Type	Prot		NA		Prot	NA
Protected Phases	4		2		1	6
Permitted Phases						
Actuated Green, G (s)	13.6		91.0		0.9	96.1
Effective Green, g (s)	14.6		92.3		1.1	97.4
Actuated g/C Ratio	0.12		0.77		0.01	0.81
Clearance Time (s)	5.0		5.3		4.2	5.3
Vehicle Extension (s)	4.0		1.5		0.5	1.5
Lane Grp Cap (vph)	421		2716		16	2872
v/s Ratio Prot	c0.04		0.31		0.00	c0.43
v/s Ratio Perm						
v/c Ratio	0.30		0.40		0.31	0.53
Uniform Delay, d1	48.0		4.6		59.1	3.8
Progression Factor	1.00		0.56		1.12	0.20
Incremental Delay, d2	0.5		0.4		3.4	0.6
Delay (s)	48.6		3.0		69.6	1.3
Level of Service	D		A		E	A
Approach Delay (s)	48.6		3.0			1.6
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			4.4		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.52			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			49.7%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

29: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/Barbur Terrace

04/21/2020



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕					↕	↕		↕	↕	
Traffic Volume (vph)	178	2	12	0	0	0	212	850	7	11	1270	278
Future Volume (vph)	178	2	12	0	0	0	212	850	7	11	1270	278
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	
Lane Util. Factor		1.00					1.00	0.95		1.00	*0.79	
Frpb, ped/bikes		1.00					1.00	1.00		1.00	0.99	
Flpb, ped/bikes		1.00					1.00	1.00		1.00	1.00	
Frt		0.99					1.00	1.00		1.00	0.97	
Flt Protected		0.96					0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1749					1736	3507		902	2791	
Flt Permitted		0.96					0.95	1.00		0.26	1.00	
Satd. Flow (perm)		1749					1736	3507		247	2791	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	200	2	13	0	0	0	238	955	8	12	1427	312
RTOR Reduction (vph)	0	2	0	0	0	0	0	0	0	0	12	0
Lane Group Flow (vph)	0	213	0	0	0	0	238	963	0	12	1727	0
Confl. Peds. (#/hr)	3		7	7		3	21					21
Heavy Vehicles (%)	1%	100%	8%	0%	0%	0%	4%	2%	100%	100%	4%	1%
Turn Type	Perm	NA					Prot	NA		pm+pt	NA	
Protected Phases		4					5	2		1	6	
Permitted Phases	4									6		
Actuated Green, G (s)		12.8					19.9	85.1		79.9	72.3	
Effective Green, g (s)		14.0					20.4	86.4		79.9	73.6	
Actuated g/C Ratio		0.12					0.17	0.72		0.67	0.61	
Clearance Time (s)		5.2					4.5	5.3		4.0	5.3	
Vehicle Extension (s)		3.0					0.5	1.5		0.5	3.0	
Lane Grp Cap (vph)		204					295	2525		205	1711	
v/s Ratio Prot							c0.14	0.27		0.00	c0.62	
v/s Ratio Perm		0.12								0.04		
v/c Ratio		1.05					0.81	0.38		0.06	1.01	
Uniform Delay, d1		53.0					47.9	6.5		10.6	23.2	
Progression Factor		1.00					0.81	0.69		0.48	0.67	
Incremental Delay, d2		75.4					12.6	0.4		0.0	22.9	
Delay (s)		128.4					51.2	4.8		5.1	38.5	
Level of Service		F					D	A		A	D	
Approach Delay (s)		128.4			0.0			14.0			38.2	
Approach LOS		F			A			B			D	
Intersection Summary												
HCM 2000 Control Delay		35.2					HCM 2000 Level of Service			D		
HCM 2000 Volume to Capacity ratio		0.98										
Actuated Cycle Length (s)		120.0					Sum of lost time (s)			12.0		
Intersection Capacity Utilization		83.5%					ICU Level of Service			E		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

30: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

04/21/2020

	→	↘	↗	↙	↖	←	↗	↑	↘	↙	↓	↘
Movement	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑↑					↑↑		↑↑		↘	↑↑	↘
Traffic Volume (vph)	729	63	131	13	51	470	172	943	3	0	693	582
Future Volume (vph)	729	63	131	13	51	470	172	943	3	0	693	582
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
Lane Util. Factor	0.95					0.95		0.95			0.95	1.00
Frpb, ped/bikes	1.00					0.99		1.00			1.00	0.96
Flpb, ped/bikes	1.00					1.00		1.00			1.00	1.00
Frt	0.97					0.96		1.00			1.00	1.00
Flt Protected	1.00					1.00		1.00			1.00	1.00
Satd. Flow (prot)	3459					3382		3537			3539	1775
Flt Permitted	1.00					0.61		1.00			1.00	1.00
Satd. Flow (perm)	3459					2060		3537			3539	1775
Peak-hour factor, PHF	0.96	0.96	0.92	0.92	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	759	66	142	14	53	490	179	982	3	0	722	606
RTOR Reduction (vph)	0	0	0	0	0	30	0	0	0	0	0	12
Lane Group Flow (vph)	967	0	0	0	0	706	0	985	0	0	722	601
Confl. Peds. (#/hr)							14		18	18		7
Confl. Bikes (#/hr)							2					
Heavy Vehicles (%)	1%	1%	1%	0%	2%	2%	1%	2%	0%	100%	2%	3%
Turn Type	NA			Perm	Perm	NA		NA		Prot	NA	Perm
Protected Phases	4					8		2		1	6	
Permitted Phases				8	8							6
Actuated Green, G (s)	41.7					41.7		66.1			66.1	66.1
Effective Green, g (s)	43.8					43.8		68.2			68.2	68.2
Actuated g/C Ratio	0.36					0.36		0.57			0.57	0.57
Clearance Time (s)	6.1					6.1		6.1			6.1	6.1
Vehicle Extension (s)	0.2					0.2		0.2			0.2	0.2
Lane Grp Cap (vph)	1262					751		2010			2011	1008
v/s Ratio Prot	0.28							0.28			0.20	
v/s Ratio Perm						c0.34						c0.34
v/c Ratio	0.77					0.94		0.49			0.36	0.60
Uniform Delay, d1	33.6					36.8		15.5			14.0	16.9
Progression Factor	1.00					1.00		1.00			0.25	0.32
Incremental Delay, d2	2.6					19.5		0.9			0.1	0.8
Delay (s)	36.1					56.3		16.4			3.7	6.2
Level of Service	D					E		B			A	A
Approach Delay (s)	36.1					56.3		16.4			4.9	
Approach LOS	D					E		B			A	
Intersection Summary												
HCM 2000 Control Delay			24.6			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.76									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			98.0%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

30: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

04/21/2020

Movement	SBR2
Lane Configurations	
Traffic Volume (vph)	7
Future Volume (vph)	7
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	0.96
Adj. Flow (vph)	7
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	7
Confl. Bikes (#/hr)	
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

Intersection

Int Delay, s/veh 48

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↖	↗
Traffic Vol, veh/h	431	0	0	578	278	393
Future Vol, veh/h	431	0	0	578	278	393
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	200	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	1	0	0	0	0	1
Mvmt Flow	479	0	0	642	309	437

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	-	- 1121
Stage 1	-	-	- 479
Stage 2	-	-	- 642
Critical Hdwy	-	-	- 6.4
Critical Hdwy Stg 1	-	-	- 5.4
Critical Hdwy Stg 2	-	-	- 5.4
Follow-up Hdwy	-	-	- 3.5
Pot Cap-1 Maneuver	-	0	- ~ 230
Stage 1	-	0	- 627
Stage 2	-	0	- 528
Platoon blocked, %	-		-
Mov Cap-1 Maneuver	-	-	- ~ 230
Mov Cap-2 Maneuver	-	-	- ~ 230
Stage 1	-	-	- 627
Stage 2	-	-	- 528

Approach	EB	WB	NB
HCM Control Delay, s	0	0	222
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	WBT
Capacity (veh/h)	230	-	-	-
HCM Lane V/C Ratio	1.343	-	-	-
HCM Control Delay (s)	222	0	-	-
HCM Lane LOS	F	A	-	-
HCM 95th %tile Q(veh)	16.8	-	-	-

Notes

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

Intersection	
Intersection Delay, s/veh	64.2
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	50	142	209	50	319	19	227	228	22	20	241	32
Future Vol, veh/h	50	142	209	50	319	19	227	228	22	20	241	32
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	2	1	0	1	0	0	2	0	10	2	0
Mvmt Flow	54	154	227	54	347	21	247	248	24	22	262	35
Number of Lanes	1	1	0	1	1	0	0	2	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	2	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	1	2	2
HCM Control Delay	62	63.8	68.8	60.4
HCM LOS	F	F	F	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	67%	0%	100%	0%	100%	0%	7%
Vol Thru, %	33%	84%	0%	40%	0%	94%	82%
Vol Right, %	0%	16%	0%	60%	0%	6%	11%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	341	136	50	351	50	338	293
LT Vol	227	0	50	0	50	0	20
Through Vol	114	114	0	142	0	319	241
RT Vol	0	22	0	209	0	19	32
Lane Flow Rate	371	148	54	382	54	367	318
Geometry Grp	7	7	7	7	7	7	6
Degree of Util (X)	1.034	0.394	0.151	0.966	0.151	0.969	0.903
Departure Headway (Hd)	10.038	9.606	10.306	9.375	10.301	9.75	10.466
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	367	380	350	389	351	375	350
Service Time	7.673	7.241	8.006	7.075	8.001	7.45	8.466
HCM Lane V/C Ratio	1.011	0.389	0.154	0.982	0.154	0.979	0.909
HCM Control Delay	88.9	18.3	14.8	68.7	14.8	71.1	60.4
HCM Lane LOS	F	C	B	F	B	F	F
HCM 95th-tile Q	12.6	1.8	0.5	11	0.5	10.9	8.9

HCM Signalized Intersection Capacity Analysis

36: SW Barbur Blvd (Hwy 99W) & SW 53rd Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	↔
Traffic Volume (vph)	4	32	6	177	1	22	8	1069	271	4	449	30
Future Volume (vph)	4	32	6	177	1	22	8	1069	271	4	449	30
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
Lane Util. Factor		1.00			1.00			0.95			0.95	1.00
Frpb, ped/bikes		1.00			1.00			1.00			1.00	0.97
Flpb, ped/bikes		1.00			1.00			1.00			1.00	1.00
Frt		0.98			0.99			0.97			1.00	0.85
Flt Protected		1.00			0.96			1.00			1.00	1.00
Satd. Flow (prot)		1812			1752			3398			3471	1525
Flt Permitted		0.98			0.72			0.95			0.95	1.00
Satd. Flow (perm)		1776			1310			3237			3282	1525
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)	4	36	7	197	1	24	9	1188	301	4	499	33
RTOR Reduction (vph)	0	5	0	0	6	0	0	26	0	0	0	11
Lane Group Flow (vph)	0	42	0	0	216	0	0	1472	0	0	503	22
Confl. Peds. (#/hr)	1					1	3					3
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	3%	0%	2%	0%	4%	0%	3%	1%	0%	4%	3%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		2
Actuated Green, G (s)		16.4			16.4			48.6			48.6	48.6
Effective Green, g (s)		16.4			16.4			49.6			49.6	49.6
Actuated g/C Ratio		0.22			0.22			0.67			0.67	0.67
Clearance Time (s)		4.0			4.0			5.0			5.0	5.0
Vehicle Extension (s)		2.5			2.5			4.8			4.8	4.8
Lane Grp Cap (vph)		393			290			2169			2199	1022
v/s Ratio Prot												
v/s Ratio Perm		0.02			0.16			0.45			0.15	0.01
v/c Ratio		0.11			0.74			0.68			0.23	0.02
Uniform Delay, d1		23.0			26.8			7.4			4.8	4.1
Progression Factor		1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2		0.1			9.4			1.1			0.1	0.0
Delay (s)		23.0			36.3			8.5			4.9	4.1
Level of Service		C			D			A			A	A
Approach Delay (s)		23.0			36.3			8.5			4.8	
Approach LOS		C			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			10.6									
HCM 2000 Volume to Capacity ratio			0.69									
Actuated Cycle Length (s)			74.0									
Intersection Capacity Utilization			68.6%									
Analysis Period (min)			15									
c Critical Lane Group												

APPENDIX B23

Segment B – Vissim Report

MEMORANDUM

DATE: June 21, 2019

TO: Randy Johnson, PE, PTOE, DKS Associates

FROM: Charles Allen PE, PTOE, Parametrix

SUBJECT: Terwilliger Interchange (Study Area Segment B) Auxiliary Right-turn Lane and Ramp Clearance Preemption VISSIM Modeling Results Report

CC:

PROJECT NUMBER: 274-8018-001

PROJECT NAME: Southwest Corridor Light Rail EIS

INTRODUCTION

As part of the Southwest Corridor Light Rail Extension EIS, Parametrix conducted mitigation evaluation of an auxiliary lane concept from the I-5 southbound off-ramp at Bertha Boulevard to Terwilliger Boulevard. This analysis utilized the 2045 PM Build VISSIM model developed during the DEIS plus the model refinements added for a subsequent rail delay analysis. Additionally, analysis explores the effects of the queue clearance preemption phase for the I-5 southbound off-ramp. This memorandum documents key model setup parameters and assumptions as well as preliminary traffic analysis results.

MODEL SETUP

Parametrix utilized the 2045 PM Build VISSIM model which was built during the DEIS plus the model refinements added for a subsequent rail delay analysis. Table 1 summarizes the key assumptions for transit operations added to the DEIS 2045 Build model for the rail delay analysis and carried forward to the current analysis.

The model was then configured to evaluate four scenarios. The four scenarios represent conditions with and without the auxiliary right-turn lane from the I-5 southbound off-ramp at Bertha Boulevard. Additionally, each auxiliary right-turn lane scenario was modeled with and without the I-5 southbound off-ramp queue clearance preemption at Bertha Boulevard. Table 2 summarizes the four modeling scenarios. Details regarding the setup and calibration of the existing conditions model and the DEIS 2045 Build model can be found in the Terwilliger Interchange (Study Area Segment B) VISSIM Modeling Calibration Report and the Terwilliger Interchange (Study Area Segment B) Build & No Build VISSIM Modeling Results Report.

Scenarios with an auxiliary right-turn lane provide a continuous northbound lane on Barbur Boulevard from the southbound I-5 off-ramp terminus to the Terwilliger Boulevard intersection. This auxiliary lane is similar to the existing auxiliary lane with a few exceptions. First, right-turns from the southbound off-ramp into the auxiliary lane are signal controlled rather than free-flow. Vehicles are permitted to make a right-turn on red but must yield to any crossing pedestrians or cyclists. Second, the bike lane crosses the auxiliary lane and runs shoulder side rather than between the auxiliary lane and the outside general purpose lane. Lastly, northbound bicyclists on Barbur Boulevard at Terwilliger Boulevard (and pedestrians on the south crosswalk) receive a special protected phase to cross the turning path of vehicles turning right from the auxiliary lane onto Terwilliger Boulevard. Figure 1 illustrates the auxiliary lane concept.

Figure 1. Auxiliary Lane Concept

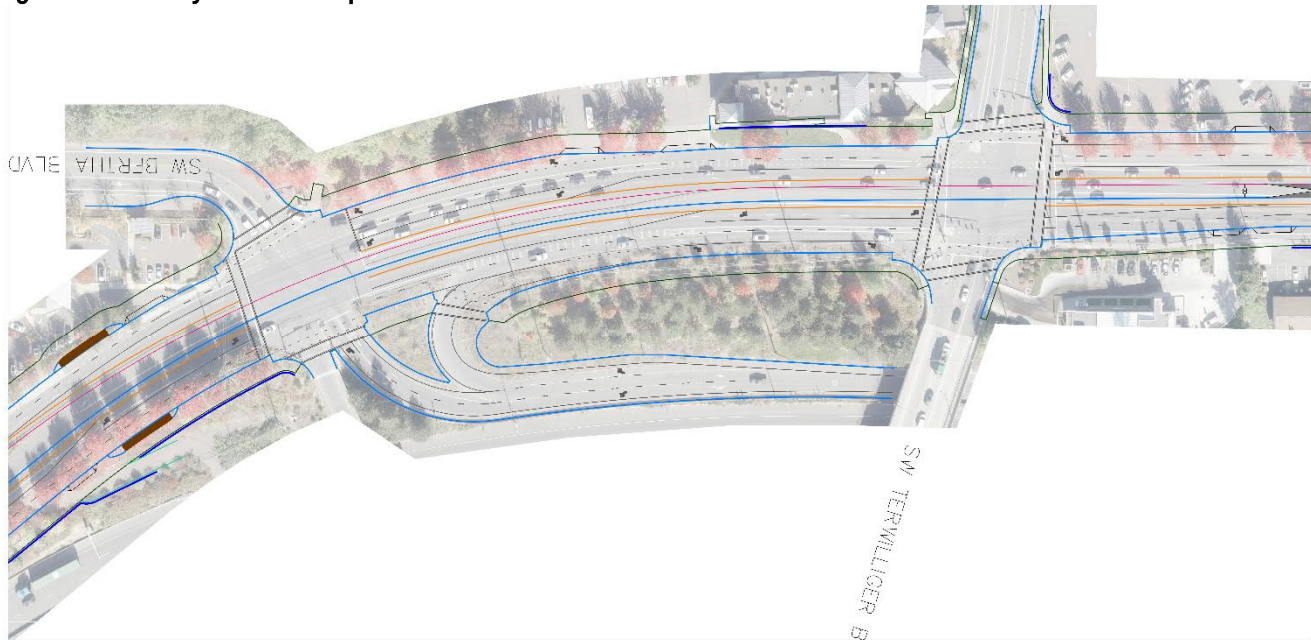


Table 1. Key Rail Delay Analysis Assumptions

Assumption	Value/Treatment	
Light Rail Operation		
Adjusted station dwell time distribution	• Min: 13 sec • 10th %ile: 19.8 sec • 25th %ile: 21.6 sec • 50th %ile: 24.1 sec • 75th %ile: 27.6 sec • 90th %ile: 32 sec • Max: 80 sec	
LRT arrival time variability	NB • Min: 0 sec • 8th %ile: 30 sec • 22nd %ile: 45 sec • 50th %ile: 90 sec • 73rd %ile: 120 sec • 90th %ile: 210 sec • Max: 360 sec	SB • Min: 0 sec • 9th %ile: 60 sec • 30th %ile: 120 sec • 55th %ile: 180 sec • 79th %ile: 240 sec • 92nd %ile: 300 sec • Max: 390 sec
LRT preemption call maximum	• Preemption call time set to terminate after 40 seconds	

Parameters provided by LTK

Table 2. Modeling Scenario Summary

		Queue Clearance Preemption	
		Off	On
Auxiliary Right-turn Lane	Without Turn Lane	Scenario 1	Scenario 2
	With Turn Lane	Scenario 3	Scenario 4

RESULTS

As with 2045 No Build model analysis, all modeled scenarios exhibit significant congestion. The majority of the congestion stems from capacity constraints at the Terwilliger Boulevard/Barbur Boulevard intersection. The congestion leads to significant queues on eastbound and westbound Barbur Boulevard approaches and the northbound Terwilliger approach. These queues perpetuate past the extents of the model and prevent the model from serving the full demand volumes. Because the models do not serve the full traffic demand, caution is required in interpreting detailed results. Most likely, the model outputs understate the actual queuing and delay. For example, many queue lengths on Barbur Boulevard are maxed out by the limits of the link length – often the distance to the next upstream intersection. In actuality, the queues often extend through the upstream intersection.

Without the auxiliary right turn lane (Scenario 1 and 2), the I-5 southbound off-ramp experiences severe congestion and the Bertha Boulevard/Barbur Boulevard intersection exhibits LOS E (See Table 3). The queue clearance preemption in Scenario 2 helps to reduce I-5 southbound off-ramp queues by nearly 50 percent. However, overall simulation-measured intersection delay remains at LOS E.

When the auxiliary right-turn lane is added (Scenario 3 and 4), the overall intersection delay improves by about 5-15 seconds compared to without the auxiliary right-turn lane. Additionally, the 95th percentile queue lengths for the I-5 southbound off-ramp are also reduced with the auxiliary right-turn lane. Both scenarios exhibit shorter queue lengths than scenarios that do not provide the auxiliary right-turn lane (Scenario 1 and 2) even when the queue clearance preemption is turned on. Table 3 also provides 2050 No Build results for reference, showing that scenarios with the auxiliary right-turn lane are able to achieve I-5 southbound off-ramp queue lengths similar to the 2050 No Build conditions.

Tables 4 through 11 present more detailed model outputs for both the Bertha Boulevard/Barbur Boulevard and Terwilliger Boulevard/Barbur Boulevard intersections. It should be noted that the high GEH values reported for all scenarios are a result of the capacity constraints being unable to serve the full traffic demand.

Table 3. Modeling Scenario Results Summary

Auxiliary Right-turn Lane	Queue Clearance Preemption	Scenario	Bertha Blvd & Barbur Blvd		I-5 SB Off Ramp
			Peak Hour Delay (sec/veh)	LOS	95 th %ile Queue Length (ft)
Without Auxiliary Right-turn Lane	Off	Scenario 1	79	E	1,175
	On	Scenario 2	76	E	625
With Auxiliary Right-turn Lane	Off	Scenario 3	63	E	175
	On	Scenario 4	72	E	175
No Build			54	D	200

Table 4. Scenario 1 (Without Auxiliary Lane & Without Queue Dump) Delay and Volume Results

Int	Name	Movement	Avg Peak Hr Delay (sec)	Peak Hour Output Vol	VISSIM Input Vol	Diff	GEH
B3	Terwilliger Blvd & Barbur Blvd	EBL	109	94	110	-16	1.5
		EBR	18	345	405	-60	3.1
		EBT	46	1,124	1,335	-211	6.0
		NBL	142	251	355	-104	6.0
		NBR	56	335	490	-155	7.7
		NBT	64	172	255	-83	5.7
		SBL	102	43	45	-2	0.2
		SBR	49	202	205	-3	0.2
		SBT	89	241	250	-9	0.6
		WBL	98	325	355	-30	1.6
		WBR	8	76	85	-9	1.0
		WBT	39	1,344	1,475	-131	3.5
		Total	68	4,551	5,365	-814	11.6
B4	Bertha Blvd & Barbur Blvd	EBL	120	70	90	-20	2.2
		EBR	58	150	195	-45	3.4
		EBT	60	972	1,225	-253	7.6
		NBL	97	92	95	-3	0.3
		NBR	158	201	215	-14	1.0
		NBT	119	112	115	-3	0.3
		SBL	83	392	410	-18	0.9
		SBR	69	43	45	-2	0.3
		SBT	88	124	130	-6	0.5
		WBL	67	23	25	-2	0.4
		WBR	7	403	455	-52	2.5
		WBT	17	1,369	1,555	-186	4.9
		Total	79	3,952	4,555	-603	9.2

Table 5. Scenario 1 (Without Auxiliary Lane & Without Queue Dump) Queue Report

Intersection	Movement	PM Peak Hour Queues (ft)		
		Avg of Max	St Dev	95th Percentile (rounded to nearest 25 ft)
B3 Terwilliger Blvd & Barbur Blvd	Barbur Blvd EB	580	112	775
	Barbur Blvd WB	816	203	1,150
	Terwilliger Blvd NB	613	131	825
	Terwilliger Blvd SB	379	249	800
B4 Bertha Blvd & Barbur Blvd	Barbur Blvd EB	874	93	1,025
	Barbur Blvd WB	374	238	775
	Bertha Blvd SB	415	615	1,425
	I-5 SB off Ramp	516	402	1,175

Table 6. Scenario 2 (Without Auxiliary Lane & With Queue Dump) Delay and Volume Results

Int	Name	Movement	Avg Peak Hr	Peak Hour	VISSIM		
			Delay (sec)	Output Vol	Input Vol	Diff	GEH
B3	Terwilliger Blvd & Barbur Blvd	EBL	108	95	110	-15	1.5
		EBR	17	345	405	-60	3.1
		EBT	45	1,121	1,335	-214	6.1
		NBL	143	252	355	-103	5.9
		NBR	56	335	490	-155	7.6
		NBT	65	173	255	-82	5.6
		SBL	100	43	45	-2	0.2
		SBR	51	201	205	-4	0.3
		SBT	89	241	250	-9	0.6
		WBL	98	320	355	-35	1.9
		WBR	8	75	85	-10	1.1
		WBT	41	1,315	1,475	-160	4.3
		Total	68	4,517	5,365	-848	12.1
B4	Bertha Blvd & Barbur Blvd	EBL	134	69	90	-21	2.3
		EBR	57	149	195	-46	3.5
		EBT	61	960	1,225	-265	8.0
		NBL	89	94	95	-1	0.1
		NBR	124	208	215	-7	0.4
		NBT	102	116	115	1	0.1
		SBL	80	393	410	-17	0.9
		SBR	80	43	45	-2	0.3
		SBT	85	124	130	-6	0.5
		WBL	68	23	25	-2	0.5
		WBR	7	395	455	-60	2.9
		WBT	19	1,344	1,555	-211	5.5
		Total	76	3,919	4,555	-636	9.8

Table 7. Scenario 2 (Without Auxiliary Lane & With Queue Dump) Queue Report

Intersection	Movement	PM Peak Hour Queues (ft)		
		Avg of Max	St Dev	95th Percentile (rounded to nearest 25 ft)
B3 Terwilliger Blvd & Barbur Blvd	Barbur Blvd EB	571	123	775
	Barbur Blvd WB	840	193	1,150
	Terwilliger Blvd NB	613	128	825
	Terwilliger Blvd SB	375	250	775
B4 Bertha Blvd & Barbur Blvd	Barbur Blvd EB	872	97	1,025
	Barbur Blvd WB	395	241	800
	Bertha Blvd SB	470	653	1,550
	I-5 SB off Ramp	311	190	625

Table 8. Scenario 3 (With Auxiliary Lane & Without Queue Dump) Delay and Volume Results

Int	Name	Movement	Avg Peak Hr	Peak Hour	VISSIM		
			Delay (sec)	Output Vol	Input Vol	Diff	GEH
B3	Terwilliger Blvd & Barbur Blvd	EBL	140	95	110	-15	1.5
		EBR	83	347	405	-58	3.0
		EBT	58	1,126	1,335	-209	6.0
		NBL	196	227	355	-128	7.5
		NBR	54	307	490	-183	9.2
		NBT	65	157	255	-98	6.8
		SBL	95	43	45	-2	0.3
		SBR	48	201	205	-4	0.3
		SBT	96	240	250	-10	0.6
		WBL	141	301	355	-54	3.0
		WBR	7	73	85	-12	1.3
		WBT	32	1,281	1,475	-194	5.2
		Total	84	4,398	5,365	-967	13.8
B4	Bertha Blvd & Barbur Blvd	EBL	111	70	90	-20	2.3
		EBR	58	150	195	-45	3.4
		EBT	66	967	1,225	-258	7.8
		NBL	101	94	95	-1	0.1
		NBR	13	212	215	-3	0.2
		NBT	115	115	115	0	0.0
		SBL	66	88	410	-322	20.4
		SBR	64	44	45	-1	0.1
		SBT	77	126	130	-4	0.3
		WBL	67	22	25	-3	0.7
		WBR	5	382	455	-73	3.6
		WBT	16	1,304	1,555	-251	6.6
		Total	63	3,576	4,555	-979	15.4

Table 9. Scenario 3 (With Auxiliary Lane & Without Queue Dump) Queue Report

Intersection	Movement	PM Peak Hour Queues (ft)		
		Avg of Max	St Dev	95th Percentile (rounded to nearest 25 ft)
B3 Terwilliger Blvd & Barbur Blvd	Barbur Blvd EB	558	83	700
	Barbur Blvd WB	649	288	1,125
	Terwilliger Blvd NB	508	211	850
	Terwilliger Blvd SB	442	272	900
B4 Bertha Blvd & Barbur Blvd	Barbur Blvd EB	873	100	1,025
	Barbur Blvd WB	325	274	775
	Bertha Blvd SB	405	717	1,575
	I-5 SB off Ramp	95	41	175

Table 10. Scenario 4 (With Auxiliary Lane & With Queue Dump) Delay and Volume Results

Int	Name	Movement	Peak 15 min Delay (sec)	Peak Hour Output Vol	VISSIM Input Vol	Diff	% Diff	GEH
B3	Terwilliger Blvd & Barbur Blvd	EBL	144	95	110	-15	-16%	1.5
		EBR	85	347	405	-58	-17%	3.0
		EBT	57	1,125	1,335	-210	-19%	6.0
		NBL	173	227	355	-128	-57%	7.5
		NBR	53	307	490	-183	-60%	9.2
		NBT	62	157	255	-98	-62%	6.8
		SBL	89	43	45	-2	-4%	0.2
		SBR	53	201	205	-4	-2%	0.3
		SBT	116	240	250	-10	-4%	0.6
		WBL	128	301	355	-54	-18%	3.0
		WBR	6	73	85	-12	-16%	1.3
		WBT	31	1,281	1,475	-194	-15%	5.2
		Total	83	4,398	5,365	-967	-22%	13.8
B4	Bertha Blvd & Barbur Blvd	EBL	126	70	90	-20	-29%	2.3
		EBR	59	150	195	-45	-30%	3.4
		EBT	65	967	1,225	-258	-27%	7.8
		NBL	111	94	95	-1	-1%	0.1
		NBR	11	212	215	-3	-1%	0.2
		NBT	151	115	115	0	0%	0.0
		SBL	83	88	410	-322	-367%	20.4
		SBR	72	44	45	-1	-2%	0.1
		SBT	85	126	130	-4	-3%	0.3
		WBL	84	22	25	-3	-15%	0.7
		WBR	5	382	455	-73	-19%	3.5
		WBT	17	1,304	1,555	-251	-19%	6.7
		Total	72	3,575	4,555	-980	-27%	15.4

Table 11. Scenario 4 (With Auxiliary Lane & With Queue Dump) Queue Report

Intersection	Movement	PM Peak Hour Queues (ft)		
		Avg of Max	St Dev	95th Percentile (rounded to nearest 25 ft)
B3 Terwilliger Blvd & Barbur Blvd	Barbur Blvd EB	558	83	700
	Barbur Blvd WB	650	288	1,125
	Terwilliger Blvd NB	508	211	850
	Terwilliger Blvd SB	442	272	900
B4 Bertha Blvd & Barbur Blvd	Barbur Blvd EB	873	100	1,025
	Barbur Blvd WB	325	274	775
	Bertha Blvd SB	406	717	1,575
	I-5 SB off Ramp	95	41	175

PREEMPTION

I-5 Southbound Queue Clearance Preemption

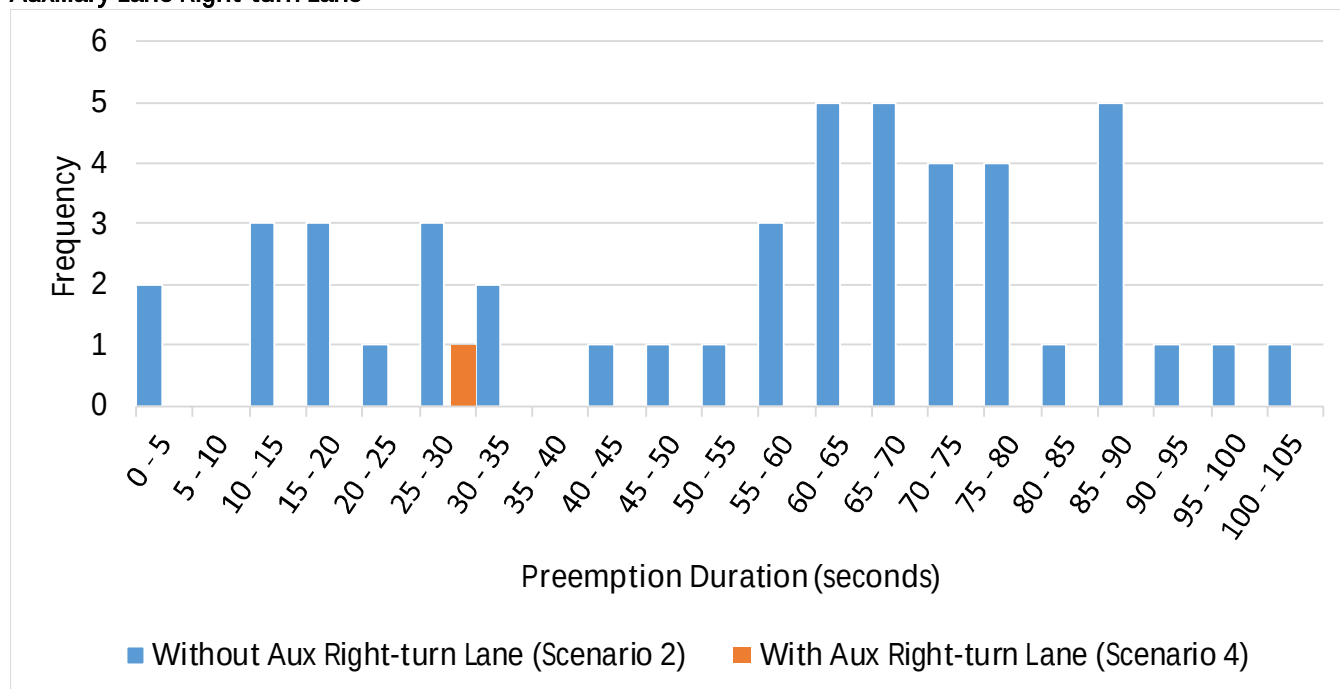
Table 12 and Figure 2 summarize the metrics for the I-5 ramp clearance preemption. Analysis indicates the southbound I-5 off-ramp queue detector triggers the ramp clearance preemption in the model approximately once per peak hour per each simulation run for the scenario without the auxiliary lane (Scenario 2). With the auxiliary lane present (Scenario 4), the model triggered the clearance preemption only once over the course of 50 simulation runs.

When the queue clearance preemption is triggered during Scenario 2, the duration of the clearance preemption is highly variable. The average duration is nearly one minute with the maximum duration reaching 105 seconds. The one instance queue clearance preemption is triggered during Scenario 4, the duration was about 30 seconds.

Table 12. I-5 Southbound Off-ramp Queue Clearance Preemption With and Without Auxiliary Right-turn Lane

Preemption Frequency	Without Aux lane (Scenario 2)	With Aux Lane (Scenario 4)
Total Runs	50	50
Total Peak Hour Preemptions	47	1
Preemptions per Run	0.9	0.0
Preemption Duration (sec)	Without Aux lane (Scenario 2)	With Aux Lane (Scenario 4)
Average Duration	56.0	29.8
Max Duration	104.6	29.8
Standard Deviation	27.7	--

Figure 2. Histogram of I-5 Southbound Off-ramp Queue Clearance Preemption Duration With and Without Auxiliary Lane Right-turn Lane



Effect on Light Rail Operations

Scenarios with I-5 southbound off-ramp queue clearance preemption assumed priority for the ramp clearance preemption over the light rail preemption. Thus, ramp queue clearance can potentially result in delay for the light rail vehicles should the light rail vehicles arrive during queue clearance preemption.

For scenarios with the queue clearance preemption (Scenario 2 and 4), disruption to light rail vehicles happened infrequently or not at all in the model. For Scenario 2, the queue clearance preemptions triggered about once per peak hour per simulation run. This interfered with about 17 of the 900 simulated light rail trains (approximately two percent). The average delay to light rail trains because of queue clearance preemption was 67 seconds for northbound trains and 34 seconds for southbound trains with an average delay of about 53 seconds for all affected trains. For Scenario 4, the one instance of queue clearance preemption did not affect a light rail train.

KEY FINDINGS

Scenarios with the auxiliary lane significantly reduce queues for the I-5 southbound off ramp. Additionally, with the auxiliary lane present, the southbound off-ramp queue clearance preemption is rarely activated – only once during 50 peak hour simulation runs.

Presence of the auxiliary lane also reduces delay for light rail trains caused by the off-ramp queue clearance preemption. Approximately two percent of simulated trains were affected by off-ramp queue clearance without the auxiliary lane. The average delay to these light rail trains was 67 seconds for northbound trains and 34 seconds for southbound trains with an average delay of about 53 seconds for all affected trains. With the auxiliary lane, the percentage of trains affected reduces to nearly zero percent as no light rail train delay was measured.

It is recommended that a northbound auxiliary lane from the I-5 southbound off ramp to Terwilliger Boulevard be incorporated into final designs for the Southwest Corridor project to mitigate queue impacts to the off ramp.

APPENDIX B24

Segment B – AM No Build HCM Results

Intersection

Int Delay, s/veh 0.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	15	1900	0	15	525
Future Vol, veh/h	0	15	1900	0	15	525
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	180	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	15	1900	0	15	525

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	-	950	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	6.94	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	3.32	-
Pot Cap-1 Maneuver	0	261	0
Stage 1	0	-	0
Stage 2	0	-	0
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	-	261	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.6	0	0.5
HCM LOS	C		

Minor Lane/Major Mvmt	NBTWBLn1	SBL	SBT
Capacity (veh/h)	-	261	310
HCM Lane V/C Ratio	-	0.057	0.048
HCM Control Delay (s)	-	19.6	17.2
HCM Lane LOS	-	C	C
HCM 95th %tile Q(veh)	-	0.2	0.2

HCM Signalized Intersection Capacity Analysis

2: SW Barbur Blvd (Hwy 99W) & SW Barbur Blvd Frontage Road/SW Miles St & SW 3rd Ave

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT	SBR	SEL2	SEL
Lane Configurations		↰			↰	↰	↰		↰			↰
Traffic Volume (vph)	10	0	5	125	0	15	1880	130	520	5	10	0
Future Volume (vph)	10	0	5	125	0	15	1880	130	520	5	10	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0		4.0			4.0
Lane Util. Factor		1.00			1.00	1.00	*0.85		0.95			1.00
Frpb, ped/bikes		0.97			1.00	1.00	1.00		1.00			0.95
Flpb, ped/bikes		1.00			1.00	1.00	1.00		1.00			1.00
Frt		0.95			1.00	1.00	0.99		1.00			0.93
Flt Protected		0.97			0.95	0.95	1.00		1.00			0.98
Satd. Flow (prot)		1709			1805	1805	3111		3369			1633
Flt Permitted		0.97			0.95	0.95	1.00		1.00			0.98
Satd. Flow (perm)		1709			1805	1805	3111		3369			1633
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	10	0	5	125	0	15	1880	130	520	5	10	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	15	0	0	125	15	2010	0	525	0	0	20
Confl. Peds. (#/hr)	5		5	5		10				10		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	3%	0%	7%	0%	0%	0%
Turn Type	Split	NA		Split	NA	Prot	NA		NA		Perm	Prot
Protected Phases	7	7		3	3	5	2		6			4
Permitted Phases											4	
Actuated Green, G (s)		1.6			4.0	2.3	83.3		77.5			1.6
Effective Green, g (s)		2.6			6.0	1.8	84.6		78.8			3.6
Actuated g/C Ratio		0.02			0.05	0.02	0.70		0.66			0.03
Clearance Time (s)		5.0			6.0	3.5	5.3		5.3			6.0
Vehicle Extension (s)		1.0			0.5	0.2	1.0		1.0			1.0
Lane Grp Cap (vph)		37			90	27	2193		2212			48
v/s Ratio Prot		c0.01			c0.07	0.01	c0.65		0.16			
v/s Ratio Perm												0.01
v/c Ratio		0.41			1.39	0.56	0.92		0.24			0.42
Uniform Delay, d1		57.9			57.0	58.7	14.8		8.4			57.2
Progression Factor		1.00			1.00	0.64	0.71		1.00			1.00
Incremental Delay, d2		2.6			229.5	1.3	0.8		0.3			2.1
Delay (s)		60.6			286.5	38.7	11.3		8.6			59.3
Level of Service		E			F	D	B		A			E
Approach Delay (s)		60.6			286.5		11.5		8.6			59.3
Approach LOS		E			F		B		A			E
Intersection Summary												
HCM 2000 Control Delay			24.2				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.94									
Actuated Cycle Length (s)			120.0				Sum of lost time (s)		26.0			
Intersection Capacity Utilization			78.9%				ICU Level of Service		D			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: SW Barbur Blvd (Hwy 99W) & SW Barbur Blvd Frontage Road/SW Miles St & SW 3rd Ave 04/21/2020



Movement	SER
Lane Configurations	
Traffic Volume (vph)	10
Future Volume (vph)	10
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	10
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	10
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

3: SW Barbur Blvd (Hwy 99W) & SW Terwilliger Blvd

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	160	140	270	225	400	160	1520	325	95	500	65
Future Volume (vph)	105	160	140	270	225	400	160	1520	325	95	500	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.96	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.90		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1900	1517	1736	1616		1736	3539	1451	1752	3471	1463
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1900	1517	1736	1616		1736	3539	1451	1752	3471	1463
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	105	160	140	270	225	400	160	1520	325	95	500	65
RTOR Reduction (vph)	0	0	121	0	53	0	0	0	0	0	0	42
Lane Group Flow (vph)	105	160	19	270	572	0	160	1520	325	95	500	23
Confl. Peds. (#/hr)	10		15	15		10	5		10	10		5
Confl. Bikes (#/hr)			5			36			11			7
Heavy Vehicles (%)	2%	0%	2%	4%	3%	3%	4%	2%	7%	3%	4%	6%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pm+ov	Prot	NA	Perm
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases			8						6			2
Actuated Green, G (s)	8.1	16.2	16.2	30.4	38.5		13.6	49.2	79.6	6.0	41.6	41.6
Effective Green, g (s)	7.6	16.7	16.7	29.9	39.0		14.6	50.4	78.6	7.0	42.8	42.8
Actuated g/C Ratio	0.06	0.14	0.14	0.25	0.32		0.12	0.42	0.65	0.06	0.36	0.36
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		5.0	5.2	3.5	5.0	5.2	5.2
Vehicle Extension (s)	0.5	1.0	1.0	0.5	1.0		0.5	0.5	0.5	0.5	0.5	0.5
Lane Grp Cap (vph)	112	264	211	432	525		211	1486	998	102	1237	521
v/s Ratio Prot	c0.06	0.08		0.16	c0.35		0.09	c0.43	0.08	c0.05	0.14	
v/s Ratio Perm			0.01						0.14			0.02
v/c Ratio	0.94	0.61	0.09	0.62	1.09		0.76	1.02	0.33	0.93	0.40	0.04
Uniform Delay, d1	56.0	48.6	45.0	40.1	40.5		51.0	34.8	9.1	56.3	29.0	25.2
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.01	0.64	0.45	0.96	0.91	1.00
Incremental Delay, d2	64.2	2.7	0.1	2.0	65.6		5.4	20.8	0.0	63.2	0.9	0.1
Delay (s)	120.2	51.2	45.1	42.1	106.1		57.0	43.2	4.1	117.4	27.3	25.4
Level of Service	F	D	D	D	F		E	D	A	F	C	C
Approach Delay (s)		67.0			86.8			38.0			40.1	
Approach LOS		E			F			D			D	
Intersection Summary												
HCM 2000 Control Delay			52.3			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			1.03									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			103.5%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	360	270	20	70	120	205	15	1440	315	55	590	265
Future Volume (vph)	360	270	20	70	120	205	15	1440	315	55	590	265
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.95		1.00	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1649	1696		1770	1776	1495	1805	3420		1719	3471	1538
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1649	1696		1770	1776	1495	1805	3420		1719	3471	1538
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	360	270	20	70	120	205	15	1440	315	55	590	265
RTOR Reduction (vph)	0	2	0	0	0	136	0	16	0	0	0	60
Lane Group Flow (vph)	320	328	0	70	120	69	15	1739	0	55	590	205
Confl. Peds. (#/hr)			15	15			10					10
Confl. Bikes (#/hr)									13			8
Heavy Vehicles (%)	4%	4%	14%	2%	7%	8%	0%	2%	3%	5%	4%	5%
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	pt+ov
Protected Phases	3	3		4	4		1	6		5	2	2 3
Permitted Phases						4						
Actuated Green, G (s)	24.1	24.1		8.5	8.5	8.5	1.9	61.9		6.7	66.2	90.3
Effective Green, g (s)	24.5	24.5		9.7	9.7	9.7	2.4	63.1		6.7	67.4	92.7
Actuated g/C Ratio	0.20	0.20		0.08	0.08	0.08	0.02	0.53		0.06	0.56	0.77
Clearance Time (s)	4.4	4.4		5.2	5.2	5.2	4.5	5.2		4.0	5.2	
Vehicle Extension (s)	1.0	1.0		1.0	1.0	1.0	1.5	0.5		1.0	0.5	
Lane Grp Cap (vph)	336	346		143	143	120	36	1798		95	1949	1188
v/s Ratio Prot	c0.19	0.19		0.04	c0.07		0.01	c0.51		c0.03	0.17	0.13
v/s Ratio Perm						0.05						
v/c Ratio	0.95	0.95		0.49	0.84	0.57	0.42	0.97		0.58	0.30	0.17
Uniform Delay, d1	47.2	47.1		52.8	54.4	53.2	58.1	27.4		55.3	13.9	3.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.36	0.36		0.78	0.69	3.16
Incremental Delay, d2	36.2	34.5		1.0	31.7	4.1	1.5	9.4		4.8	0.4	0.0
Delay (s)	83.4	81.7		53.7	86.1	57.2	80.5	19.2		48.0	10.0	11.3
Level of Service	F	F		D	F	E	F	B		D	B	B
Approach Delay (s)		82.5			65.4			19.7			12.7	
Approach LOS		F			E			B			B	
Intersection Summary												
HCM 2000 Control Delay			33.8			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.93									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			91.2%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

9: SW Terwilliger Blvd & I-5 NB Off Ramp

04/21/2020



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	290	165	0	605	580	0
Future Volume (vph)	290	165	0	605	580	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		1863	1863	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		1863	1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	290	165	0	605	580	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	290	165	0	605	580	0
Turn Type	Prot	custom		NA	NA	
Protected Phases	4	1		6	2	
Permitted Phases		4				
Actuated Green, G (s)	16.8	27.3		47.1	32.0	
Effective Green, g (s)	17.7	28.5		47.7	32.6	
Actuated g/C Ratio	0.24	0.39		0.65	0.44	
Clearance Time (s)	4.9	4.6		4.6	4.6	
Vehicle Extension (s)	1.0	1.2		1.2	4.0	
Lane Grp Cap (vph)	426	614		1210	827	
v/s Ratio Prot	c0.16	0.04		c0.32	c0.31	
v/s Ratio Perm		0.06				
v/c Ratio	0.68	0.27		0.50	0.70	
Uniform Delay, d1	25.3	15.3		6.7	16.5	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.6	0.1		0.1	2.9	
Delay (s)	28.8	15.4		6.8	19.4	
Level of Service	C	B		A	B	
Approach Delay (s)	24.0			6.8	19.4	
Approach LOS	C			A	B	

Intersection Summary

HCM 2000 Control Delay	16.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	73.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection

Int Delay, s/veh 1.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	245	225	1745	590	10
Future Vol, veh/h	0	245	225	1745	590	10
Conflicting Peds, #/hr	5	0	5	0	0	5
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	4	2	2	4	33
Mvmt Flow	0	245	225	1745	590	10

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	1928	305	605
Stage 1	600	-	-
Stage 2	1328	-	-
Critical Hdwy	6.8	6.98	4.14
Critical Hdwy Stg 1	5.8	-	-
Critical Hdwy Stg 2	5.8	-	-
Follow-up Hdwy	3.5	3.34	2.22
Pot Cap-1 Maneuver	60	685	969
Stage 1	516	-	-
Stage 2	216	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	46	682	965
Mov Cap-2 Maneuver	46	-	-
Stage 1	394	-	-
Stage 2	215	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.2	1.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	965	-	682	-	-
HCM Lane V/C Ratio	0.233	-	0.359	-	-
HCM Control Delay (s)	9.9	-	13.2	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0.9	-	1.6	-	-

HCM Signalized Intersection Capacity Analysis

13: SW Barbur Blvd (Hwy 99W) & SW Capitol Hill Rd/SW 19th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	85	115	195	110	135	80	1730	30	80	760	40
Future Volume (vph)	115	85	115	195	110	135	80	1730	30	80	760	40
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	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.98		1.00	1.00	0.96	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.91		1.00	0.92		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1787	1681		1719	1671		1736	3539	1345	1703	3423	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1787	1681		1719	1671		1736	3539	1345	1703	3423	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	115	85	115	195	110	135	80	1730	30	80	760	40
RTOR Reduction (vph)	0	43	0	0	39	0	0	0	13	0	3	0
Lane Group Flow (vph)	115	157	0	195	206	0	80	1730	17	80	797	0
Confl. Peds. (#/hr)	10		15	15		10	10		5	5		10
Confl. Bikes (#/hr)			1			2			12			5
Heavy Vehicles (%)	1%	1%	1%	5%	1%	4%	4%	2%	15%	6%	4%	12%
Turn Type	Prot	NA		Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases									6			
Actuated Green, G (s)	9.0	15.6		15.0	21.6		8.5	66.2	66.2	7.5	65.2	
Effective Green, g (s)	8.0	15.8		14.0	21.8		7.5	67.7	67.7	6.5	66.7	
Actuated g/C Ratio	0.07	0.13		0.12	0.18		0.06	0.56	0.56	0.05	0.56	
Clearance Time (s)	3.0	4.2		3.0	4.2		3.0	5.5	5.5	3.0	5.5	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	0.5	0.5	0.5	0.5	
Lane Grp Cap (vph)	119	221		200	303		108	1996	758	92	1902	
v/s Ratio Prot	0.06	0.09		c0.11	c0.12		0.05	c0.49		c0.05	0.23	
v/s Ratio Perm									0.01			
v/c Ratio	0.97	0.71		0.97	0.68		0.74	0.87	0.02	0.87	0.42	
Uniform Delay, d1	55.9	49.9		52.8	45.8		55.3	22.3	11.5	56.3	15.4	
Progression Factor	1.00	1.00		1.00	1.00		1.23	0.64	1.00	0.84	0.67	
Incremental Delay, d2	70.9	8.7		55.8	4.7		12.4	3.1	0.0	51.3	0.7	
Delay (s)	126.8	58.6		108.6	50.5		80.3	17.3	11.6	98.5	11.0	
Level of Service	F	E		F	D		F	B	B	F	B	
Approach Delay (s)		83.5			76.3			20.0			18.9	
Approach LOS		F			E			B			B	
Intersection Summary												
HCM 2000 Control Delay			32.6			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.87									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			90.8%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 3.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	55	10	35	65	40	15	50	1770	5	5	805	5
Future Vol, veh/h	55	10	35	65	40	15	50	1770	5	5	805	5
Conflicting Peds, #/hr	0	0	0	0	0	0	5	0	0	0	0	5
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	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	4	0	0	1	0	6	0	2	0	0	3	0
Mvmt Flow	55	10	35	65	40	15	50	1770	5	5	805	5

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1828	2698	410	2291	2698	888	815	0	0	1775	0	0
Stage 1	823	823	-	1873	1873	-	-	-	-	-	-	-
Stage 2	1005	1875	-	418	825	-	-	-	-	-	-	-
Critical Hdwy	7.58	6.5	6.9	7.52	6.5	7.02	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.58	5.5	-	6.52	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.58	5.5	-	6.52	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.54	4	3.3	3.51	4	3.36	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 47	22	596	~ 21	~ 22	279	821	-	-	355	-	-
Stage 1	330	391	-	75	122	-	-	-	-	-	-	-
Stage 2	255	122	-	586	390	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	-	0	594	-	0	279	818	-	-	355	-	-
Mov Cap-2 Maneuver	-	0	-	-	0	-	-	-	-	-	-	-
Stage 1	330	379	-	75	0	-	-	-	-	-	-	-
Stage 2	-	0	-	523	378	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			4.7	0.3
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	818	-	-	-	355	-	-
HCM Lane V/C Ratio	0.061	-	-	-	0.014	-	-
HCM Control Delay (s)	9.7	4.6	-	-	15.3	0.2	-
HCM Lane LOS	A	A	-	-	C	A	-
HCM 95th %tile Q(veh)	0.2	-	-	-	0	-	-

Notes

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

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	170	5	30	110	15	30	30	2195	5	0	865	0
Future Volume (vph)	170	5	30	110	15	30	30	2195	5	0	865	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.95			0.95	
Frpb, ped/bikes		1.00			1.00	0.97	1.00	1.00			1.00	
Flpb, ped/bikes		0.99			1.00	1.00	1.00	1.00			1.00	
Frt		0.98			1.00	0.85	1.00	1.00			1.00	
Flt Protected		0.96			0.96	1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1712			1686	1529	1650	3538			3505	
Flt Permitted		0.59			0.73	1.00	0.30	1.00			1.00	
Satd. Flow (perm)		1060			1292	1529	523	3538			3505	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	170	5	30	110	15	30	30	2195	5	0	865	0
RTOR Reduction (vph)	0	6	0	0	0	18	0	0	0	0	0	0
Lane Group Flow (vph)	0	199	0	0	125	12	30	2200	0	0	865	0
Confl. Peds. (#/hr)	10					10	5		10	10		5
Confl. Bikes (#/hr)			2						10			5
Heavy Vehicles (%)	4%	0%	0%	9%	0%	3%	9%	2%	0%	0%	3%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA			NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4		4	2					
Actuated Green, G (s)		24.4			24.4	24.4	85.6	85.6			85.6	
Effective Green, g (s)		24.9			24.9	24.9	87.1	87.1			87.1	
Actuated g/C Ratio		0.21			0.21	0.21	0.73	0.73			0.73	
Clearance Time (s)		4.5			4.5	4.5	5.5	5.5			5.5	
Vehicle Extension (s)		2.0			2.0	2.0	2.0	2.0			2.0	
Lane Grp Cap (vph)		219			268	317	379	2567			2544	
v/s Ratio Prot								c0.62			0.25	
v/s Ratio Perm		c0.19			0.10	0.01	0.06					
v/c Ratio		0.91			0.47	0.04	0.08	0.86			0.34	
Uniform Delay, d1		46.5			41.7	38.0	4.8	11.9			6.0	
Progression Factor		1.00			1.00	1.00	0.23	0.21			1.27	
Incremental Delay, d2		36.7			0.5	0.0	0.3	3.1			0.3	
Delay (s)		83.2			42.2	38.0	1.4	5.7			7.9	
Level of Service		F			D	D	A	A			A	
Approach Delay (s)		83.2			41.4			5.6			7.9	
Approach LOS		F			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		12.4										
HCM 2000 Volume to Capacity ratio		0.87										
Actuated Cycle Length (s)		120.0										
Intersection Capacity Utilization		91.7%										
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

22: SW Barbur Blvd (Hwy 99W) & SW 30th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↔		↔	↔	
Traffic Volume (vph)	100	5	180	10	5	20	40	1840	5	10	905	15
Future Volume (vph)	100	5	180	10	5	20	40	1840	5	10	905	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.98			0.97		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		0.99			1.00		1.00	1.00		1.00	1.00	
Frt		0.91			0.92		1.00	1.00		1.00	1.00	
Flt Protected		0.98			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1630			1674		1515	3537		1805	3457	
Flt Permitted		0.88			0.87		0.25	1.00		0.07	1.00	
Satd. Flow (perm)		1456			1484		406	3537		140	3457	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	100	5	180	10	5	20	40	1840	5	10	905	15
RTOR Reduction (vph)	0	55	0	0	16	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	230	0	0	19	0	40	1845	0	10	919	0
Confl. Peds. (#/hr)	30		10	10		30	10		10	10		10
Confl. Bikes (#/hr)									8			1
Heavy Vehicles (%)	3%	0%	1%	0%	0%	0%	19%	2%	0%	0%	4%	9%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		1	6		5	2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		22.7			22.7		82.4	82.4		80.5	79.9	
Effective Green, g (s)		23.7			23.7		82.6	83.7		80.5	81.2	
Actuated g/C Ratio		0.20			0.20		0.69	0.70		0.67	0.68	
Clearance Time (s)		5.0			5.0		4.2	5.3		4.0	5.3	
Vehicle Extension (s)		2.0			2.0		0.5	0.5		0.5	0.5	
Lane Grp Cap (vph)		287			293		308	2467		102	2339	
v/s Ratio Prot							0.00	c0.52		0.00	c0.27	
v/s Ratio Perm		c0.16			0.01		0.09			0.06		
v/c Ratio		0.80			0.06		0.13	0.75		0.10	0.39	
Uniform Delay, d1		45.9			39.1		6.9	11.5		21.9	8.5	
Progression Factor		1.00			1.00		0.31	0.38		0.56	0.49	
Incremental Delay, d2		14.1			0.0		0.1	1.8		0.1	0.5	
Delay (s)		60.0			39.2		2.2	6.1		12.5	4.7	
Level of Service		E			D		A	A		B	A	
Approach Delay (s)		60.0			39.2			6.0			4.8	
Approach LOS		E			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			10.9									HCM 2000 Level of Service B
HCM 2000 Volume to Capacity ratio			0.77									
Actuated Cycle Length (s)			120.0							12.0		
Intersection Capacity Utilization			81.9%									ICU Level of Service D
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 0.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	20	5	0	1870	1065	20
Future Vol, veh/h	20	5	0	1870	1065	20
Conflicting Peds, #/hr	0	5	5	0	0	5
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	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	2	3	0
Mvmt Flow	20	5	0	1870	1065	20

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	2015	553	1090
Stage 1	1080	-	-
Stage 2	935	-	-
Critical Hdwy	6.8	6.9	4.1
Critical Hdwy Stg 1	5.8	-	-
Critical Hdwy Stg 2	5.8	-	-
Follow-up Hdwy	3.5	3.3	2.2
Pot Cap-1 Maneuver	52	482	648
Stage 1	292	-	-
Stage 2	347	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	52	478	645
Mov Cap-2 Maneuver	52	-	-
Stage 1	291	-	-
Stage 2	346	-	-

Approach	EB	NB	SB
HCM Control Delay, s	95.6	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	645	-	63	-	-
HCM Lane V/C Ratio	-	-	0.397	-	-
HCM Control Delay (s)	0	-	95.6	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	0	-	1.5	-	-

HCM 2010 TWSC

25: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd (Baird St)/SW Taylors Ferry Rd 04/21/2020

Intersection												
Int Delay, s/veh	17.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	25	0	30	30	0	40	5	1805	10	0	1060	15
Future Vol, veh/h	25	0	30	30	0	40	5	1805	10	0	1060	15
Conflicting Peds, #/hr	0	0	5	5	0	0	5	0	0	0	0	5
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	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	5	0	0	0	0	0	0	2	20	0	3	0
Mvmt Flow	25	0	30	30	0	40	5	1805	10	0	1060	15

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1986	2898	548	2355	2900	908	1080	0	0	1815	0	0
Stage 1	1073	1073	-	1820	1820	-	-	-	-	-	-	-
Stage 2	913	1825	-	535	1080	-	-	-	-	-	-	-
Critical Hdwy	7.6	6.5	6.9	7.5	6.5	6.9	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.6	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.6	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.55	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	35	16	485	~ 19	16	282	653	-	-	343	-	-
Stage 1	230	299	-	82	130	-	-	-	-	-	-	-
Stage 2	288	129	-	502	297	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	30	16	481	~ 18	16	282	650	-	-	343	-	-
Mov Cap-2 Maneuver	30	16	-	~ 18	16	-	-	-	-	-	-	-
Stage 1	229	298	-	82	130	-	-	-	-	-	-	-
Stage 2	247	129	-	469	296	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	198.2	\$ 602.6	0	0
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	650	-	-	61 39	343	-	-
HCM Lane V/C Ratio	0.008	-	-	0.902 1.795	-	-	-
HCM Control Delay (s)	10.6	0	-	198.2 \$ 602.6	0	-	-
HCM Lane LOS	B	A	-	F F	A	-	-
HCM 95th %tile Q(veh)	0	-	-	4.2 7.4	0	-	-

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

HCM Signalized Intersection Capacity Analysis

27: SW Barbur Blvd (Hwy 99W) & Transit Center (Signalized)

04/21/2020



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	WT		WT		WT	WT
Traffic Volume (vph)	15	10	1810	25	15	1105
Future Volume (vph)	15	10	1810	25	15	1105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	0.97		0.95		1.00	0.95
Frpb, ped/bikes	0.99		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.94		1.00		1.00	1.00
Flt Protected	0.97		1.00		0.95	1.00
Satd. Flow (prot)	3317		3530		1805	3505
Flt Permitted	0.97		1.00		0.95	1.00
Satd. Flow (perm)	3317		3530		1805	3505
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	10	1810	25	15	1105
RTOR Reduction (vph)	9	0	0	0	0	0
Lane Group Flow (vph)	16	0	1835	0	15	1105
Confl. Peds. (#/hr)	10	5		10	10	
Confl. Bikes (#/hr)		1		7		
Heavy Vehicles (%)	0%	0%	2%	0%	0%	3%
Turn Type	Prot		NA		Prot	NA
Protected Phases	4		2		1	6
Permitted Phases						
Actuated Green, G (s)	8.5		95.3		1.7	101.2
Effective Green, g (s)	9.5		96.6		1.9	102.5
Actuated g/C Ratio	0.08		0.80		0.02	0.85
Clearance Time (s)	5.0		5.3		4.2	5.3
Vehicle Extension (s)	4.0		1.5		0.5	1.5
Lane Grp Cap (vph)	262		2841		28	2993
v/s Ratio Prot	c0.00		c0.52		0.01	c0.32
v/s Ratio Perm						
v/c Ratio	0.06		0.65		0.54	0.37
Uniform Delay, d1	51.1		4.8		58.6	1.9
Progression Factor	1.00		0.35		1.09	0.59
Incremental Delay, d2	0.1		0.9		8.9	0.3
Delay (s)	51.3		2.6		72.6	1.4
Level of Service	D		A		E	A
Approach Delay (s)	51.3		2.6			2.4
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			2.9		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.59			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			63.9%		ICU Level of Service	B
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

29: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/Barbur Terrace

04/21/2020



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗				↖	↗		↖	↗	
Traffic Volume (vph)	265	5	110	0	0	0	105	1550	15	10	965	170
Future Volume (vph)	265	5	110	0	0	0	105	1550	15	10	965	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	5.2				4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00				1.00	0.95		1.00	*0.79	
Frpb, ped/bikes		1.00	0.98				1.00	1.00		1.00	0.99	
Flpb, ped/bikes		0.98	1.00				1.00	1.00		1.00	1.00	
Frt		1.00	0.85				1.00	1.00		1.00	0.98	
Flt Protected		0.95	1.00				0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1732	1352				1687	3502		902	2811	
Flt Permitted		0.95	1.00				0.95	1.00		0.10	1.00	
Satd. Flow (perm)		1732	1352				1687	3502		91	2811	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	265	5	110	0	0	0	105	1550	15	10	965	170
RTOR Reduction (vph)	0	0	89	0	0	0	0	0	0	0	8	0
Lane Group Flow (vph)	0	270	21	0	0	0	105	1565	0	10	1127	0
Confl. Peds. (#/hr)	10		5	5		10	15					15
Heavy Vehicles (%)	1%	100%	17%	4%	4%	4%	7%	2%	100%	100%	3%	7%
Turn Type	Perm	NA	Perm				Prot	NA		pm+pt	NA	
Protected Phases		4					5	2		1	6	
Permitted Phases	4		4							6		
Actuated Green, G (s)		23.4	23.4				13.7	81.1		68.9	67.9	
Effective Green, g (s)		24.6	23.4				14.2	82.4		68.9	69.2	
Actuated g/C Ratio		0.21	0.19				0.12	0.69		0.57	0.58	
Clearance Time (s)		5.2	5.2				4.5	5.3		4.0	5.3	
Vehicle Extension (s)		3.0	3.0				0.5	1.5		0.5	3.0	
Lane Grp Cap (vph)		355	263				199	2404		59	1621	
v/s Ratio Prot							c0.06	c0.45		0.00	c0.40	
v/s Ratio Perm		0.16	0.02							0.10		
v/c Ratio		0.76	0.08				0.53	0.65		0.17	0.70	
Uniform Delay, d1		44.9	39.5				49.7	10.7		27.7	17.9	
Progression Factor		1.00	1.00				0.82	0.46		0.38	0.78	
Incremental Delay, d2		9.3	0.1				0.8	1.0		0.5	2.4	
Delay (s)		54.2	39.6				41.8	5.9		11.0	16.3	
Level of Service		D	D				D	A		B	B	
Approach Delay (s)		50.0			0.0			8.2			16.3	
Approach LOS		D			A			A			B	
Intersection Summary												
HCM 2000 Control Delay			16.0				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.71									
Actuated Cycle Length (s)			120.0				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			78.3%				ICU Level of Service			D		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

30: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

04/21/2020



Movement	EBT	EBR	EBR2	WBT	WBR	NBT	SBL	SBT	SBR	SBR2
Lane Configurations	↑↑			↑↑		↑↑	↵	↑↑	↵	
Traffic Volume (vph)	735	45	285	515	370	1425	0	410	660	5
Future Volume (vph)	735	45	285	515	370	1425	0	410	660	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0		4.0		4.0	4.0	
Lane Util. Factor	0.95			0.95		0.95		0.95	1.00	
Frpb, ped/bikes	1.00			0.99		1.00		1.00	1.00	
Flpb, ped/bikes	1.00			1.00		1.00		1.00	1.00	
Frt	0.95			0.94		1.00		1.00	1.00	
Flt Protected	1.00			1.00		1.00		1.00	1.00	
Satd. Flow (prot)	3355			3250		3471		3505	1845	
Flt Permitted	1.00			1.00		1.00		1.00	1.00	
Satd. Flow (perm)	3355			3250		3471		3505	1845	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	735	45	285	515	370	1425	0	410	660	5
RTOR Reduction (vph)	0	0	0	91	0	0	0	0	12	0
Lane Group Flow (vph)	1065	0	0	794	0	1425	0	410	653	0
Confl. Peds. (#/hr)					10		5			
Heavy Vehicles (%)	3%	6%	1%	4%	2%	4%	100%	3%	3%	0%
Turn Type	NA			NA		NA	Prot	NA	Perm	
Protected Phases	4			8		2	1	6		
Permitted Phases									6	
Actuated Green, G (s)	39.7			39.7		68.1		68.1	68.1	
Effective Green, g (s)	41.8			41.8		70.2		70.2	70.2	
Actuated g/C Ratio	0.35			0.35		0.59		0.59	0.59	
Clearance Time (s)	6.1			6.1		6.1		6.1	6.1	
Vehicle Extension (s)	0.2			0.2		0.2		0.2	0.2	
Lane Grp Cap (vph)	1168			1132		2030		2050	1079	
v/s Ratio Prot	c0.32			0.24		c0.41		0.12		
v/s Ratio Perm									0.35	
v/c Ratio	0.91			0.70		0.70		0.20	0.61	
Uniform Delay, d1	37.3			33.7		17.5		11.7	16.0	
Progression Factor	1.00			1.00		1.00		0.15	0.14	
Incremental Delay, d2	10.5			1.6		2.1		0.2	2.0	
Delay (s)	47.9			35.4		19.6		1.9	4.1	
Level of Service	D			D		B		A	A	
Approach Delay (s)	47.9			35.4		19.6		3.3		
Approach LOS	D			D		B		A		
Intersection Summary										
HCM 2000 Control Delay			25.6			HCM 2000 Level of Service			C	
HCM 2000 Volume to Capacity ratio			0.81							
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			12.0	
Intersection Capacity Utilization			78.7%			ICU Level of Service			D	
Analysis Period (min)			15							
c Critical Lane Group										

Intersection

Int Delay, s/veh 1.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↘	↘
Traffic Vol, veh/h	615	0	0	270	90	290
Future Vol, veh/h	615	0	0	270	90	290
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	200	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	0	0	0	0	1
Mvmt Flow	615	0	0	270	90	290

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	-	- 885
Stage 1	-	-	- 615
Stage 2	-	-	- 270
Critical Hdwy	-	-	- 6.4
Critical Hdwy Stg 1	-	-	- 5.4
Critical Hdwy Stg 2	-	-	- 5.4
Follow-up Hdwy	-	-	- 3.5
Pot Cap-1 Maneuver	-	0	0 - 318
Stage 1	-	0	0 - 543
Stage 2	-	0	0 - 780
Platoon blocked, %	-		-
Mov Cap-1 Maneuver	-	-	- 318
Mov Cap-2 Maneuver	-	-	- 318
Stage 1	-	-	- 543
Stage 2	-	-	- 780

Approach	EB	WB	NB
HCM Control Delay, s	0	0	20.7
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	WBT
Capacity (veh/h)	318	-	-	-
HCM Lane V/C Ratio	0.283	-	-	-
HCM Control Delay (s)	20.7	0	-	-
HCM Lane LOS	C	A	-	-
HCM 95th %tile Q(veh)	1.1	-	-	-

Intersection

Intersection Delay, s/veh 52.4

Intersection LOS F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	70	230	200	65	110	50	135	265	120	15	395	25
Future Vol, veh/h	70	230	200	65	110	50	135	265	120	15	395	25
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	0	2	1	0	1	0	0	2	0	10	2	0
Mvmt Flow	70	230	200	65	110	50	135	265	120	15	395	25
Number of Lanes	1	1	0	1	1	0	0	2	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	2	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	1	2	2
HCM Control Delay	59.1	17.7	25.4	95.1
HCM LOS	F	C	D	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	50%	0%	100%	0%	100%	0%	3%
Vol Thru, %	50%	52%	0%	53%	0%	69%	91%
Vol Right, %	0%	48%	0%	47%	0%	31%	6%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	268	253	70	430	65	160	435
LT Vol	135	0	70	0	65	0	15
Through Vol	133	133	0	230	0	110	395
RT Vol	0	120	0	200	0	50	25
Lane Flow Rate	268	252	70	430	65	160	435
Geometry Grp	7	7	7	7	7	7	6
Degree of Util (X)	0.658	0.582	0.172	0.973	0.177	0.406	1.07
Departure Headway (Hd)	9.206	8.631	9.319	8.492	10.306	9.565	8.853
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	396	422	387	430	350	379	409
Service Time	6.906	6.331	7.019	6.192	8.006	7.265	6.916
HCM Lane V/C Ratio	0.677	0.597	0.181	1	0.186	0.422	1.064
HCM Control Delay	27.9	22.7	13.9	66.4	15.2	18.7	95.1
HCM Lane LOS	D	C	B	F	C	C	F
HCM 95th-tile Q	4.5	3.6	0.6	11.7	0.6	1.9	14.6

HCM Signalized Intersection Capacity Analysis

36: SW Barbur Blvd (Hwy 99W) & SW 53rd Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	15	5	255	5	50	5	1380	250	0	380	15
Future Volume (vph)	5	15	5	255	5	50	5	1380	250	0	380	15
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
Lane Util. Factor		1.00			1.00			0.95			0.95	1.00
Frpb, ped/bikes		1.00			1.00			0.99			1.00	0.97
Flpb, ped/bikes		1.00			1.00			1.00			1.00	1.00
Frt		0.97			0.98			0.98			1.00	0.85
Flt Protected		0.99			0.96			1.00			1.00	1.00
Satd. Flow (prot)		1672			1737			3284			3282	1560
Flt Permitted		0.94			0.75			0.95			1.00	1.00
Satd. Flow (perm)		1588			1350			3134			3282	1560
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	15	5	255	5	50	5	1380	250	0	380	15
RTOR Reduction (vph)	0	4	0	0	10	0	0	18	0	0	0	6
Lane Group Flow (vph)	0	21	0	0	300	0	0	1617	0	0	380	9
Confl. Peds. (#/hr)	5					5	5		5	5		5
Confl. Bikes (#/hr)						2			3			4
Heavy Vehicles (%)	0%	9%	20%	3%	0%	0%	0%	7%	6%	0%	10%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA			NA	Perm
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2					2
Actuated Green, G (s)		19.1			19.1			43.2			43.2	43.2
Effective Green, g (s)		19.1			19.1			44.2			44.2	44.2
Actuated g/C Ratio		0.27			0.27			0.62			0.62	0.62
Clearance Time (s)		4.0			4.0			5.0			5.0	5.0
Vehicle Extension (s)		2.5			2.5			4.8			4.8	4.8
Lane Grp Cap (vph)		425			361			1942			2034	967
v/s Ratio Prot											0.12	
v/s Ratio Perm		0.01			c0.22			c0.52				0.01
v/c Ratio		0.05			0.83			0.83			0.19	0.01
Uniform Delay, d1		19.4			24.6			10.6			5.8	5.2
Progression Factor		1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2		0.0			14.8			3.6			0.1	0.0
Delay (s)		19.4			39.4			14.2			5.9	5.2
Level of Service		B			D			B			A	A
Approach Delay (s)		19.4			39.4			14.2			5.9	
Approach LOS		B			D			B			A	
Intersection Summary												
HCM 2000 Control Delay			16.2			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.83									
Actuated Cycle Length (s)			71.3			Sum of lost time (s)				8.0		
Intersection Capacity Utilization			83.1%			ICU Level of Service				E		
Analysis Period (min)			15									
c Critical Lane Group												

APPENDIX B25

Segment B – PM No-Build HCM

Intersection

Int Delay, s/veh 0.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↗	↗↗		↘	↗↗
Traffic Vol, veh/h	0	20	1425	0	35	1615
Future Vol, veh/h	0	20	1425	0	35	1615
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	180	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	3	0	0	2
Mvmt Flow	0	20	1425	0	35	1615

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	-	713	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	6.9	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	3.3	-
Pot Cap-1 Maneuver	0	379	0
Stage 1	0	-	0
Stage 2	0	-	0
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	-	379	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15	0	0.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBTWBLn1	SBL	SBT
Capacity (veh/h)	-	379	484
HCM Lane V/C Ratio	-	0.053	0.072
HCM Control Delay (s)	-	15	13
HCM Lane LOS	-	C	B
HCM 95th %tile Q(veh)	-	0.2	0.2

HCM Signalized Intersection Capacity Analysis

2: SW Barbur Blvd (Hwy 99W)/SW Barbur Blvd & SW Barbur Blvd Frontage Road/SW Miles Rd & SW 3rd

	→	↘	↙	←	↖	↗	↑	↘	↓	↙	↖	↗
Movement	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBT	SBR	SEL2	SEL
Lane Configurations	↔			↔		↔	↔		↔			↔
Traffic Volume (vph)	0	5	180	0	5	20	1420	135	1610	5	5	0
Future Volume (vph)	0	5	180	0	5	20	1420	135	1610	5	5	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0		4.0	4.0		4.0			4.0
Lane Util. Factor	1.00			1.00		1.00	0.95		0.95			1.00
Frpb, ped/bikes	0.89			1.00		1.00	1.00		1.00			0.84
Flpb, ped/bikes	1.00			1.00		1.00	1.00		1.00			1.00
Frt	0.86			1.00		1.00	0.99		1.00			0.93
Flt Protected	1.00			0.95		0.95	1.00		1.00			0.98
Satd. Flow (prot)	1463			1801		1805	3468		3536			1450
Flt Permitted	1.00			0.95		0.95	1.00		1.00			0.98
Satd. Flow (perm)	1463			1801		1805	3468		3536			1450
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	5	180	0	5	20	1420	135	1610	5	5	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	5	0	0	185	0	20	1555	0	1615	0	0	10
Confl. Peds. (#/hr)		5	5		10	30				30		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	3%	0%	2%	0%	0%	0%
Turn Type	NA		Split	NA		Prot	NA		NA		Perm	Prot
Protected Phases	7		3	3		5	2		6			4
Permitted Phases											4	
Actuated Green, G (s)	0.8			8.0		2.9	80.9		74.5			0.8
Effective Green, g (s)	1.8			10.0		2.4	82.2		75.8			2.8
Actuated g/C Ratio	0.02			0.08		0.02	0.69		0.63			0.02
Clearance Time (s)	5.0			6.0		3.5	5.3		5.3			6.0
Vehicle Extension (s)	1.0			0.5		0.2	1.0		1.0			1.0
Lane Grp Cap (vph)	21			150		36	2375		2233			33
v/s Ratio Prot	c0.00			c0.10		0.01	c0.45		c0.46			
v/s Ratio Perm												0.01
v/c Ratio	0.24			1.23		0.56	0.65		0.72			0.30
Uniform Delay, d1	58.4			55.0		58.3	10.8		15.0			57.6
Progression Factor	1.00			1.00		1.08	0.79		1.00			1.00
Incremental Delay, d2	2.1			149.5		1.0	0.1		2.1			1.9
Delay (s)	60.6			204.5		63.6	8.7		17.1			59.5
Level of Service	E			F		E	A		B			E
Approach Delay (s)	60.6			204.5			9.4		17.1			59.5
Approach LOS	E			F			A		B			E
Intersection Summary												
HCM 2000 Control Delay			23.9			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.75									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			26.0			
Intersection Capacity Utilization			75.0%			ICU Level of Service			D			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: SW Barbur Blvd (Hwy 99W)/SW Barbur Blvd & SW Barbur Blvd Frontage Road/SW Miles St & SW 3rd

Movement	SER
Lane Configurations	
Traffic Volume (vph)	5
Future Volume (vph)	5
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	5
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	30
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

3: SW Barbur Blvd (Hwy 99W) & SW Terwilliger Blvd

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	165	235	365	210	450	90	1070	450	365	1380	55
Future Volume (vph)	55	165	235	365	210	450	90	1070	450	365	1380	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.98		1.00	1.00	0.97	1.00	1.00	0.93
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.90		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1881	1508	1787	1641		1770	3539	1552	1787	3539	1499
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1881	1508	1787	1641		1770	3539	1552	1787	3539	1499
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	55	165	235	365	210	450	90	1070	450	365	1380	55
RTOR Reduction (vph)	0	0	159	0	64	0	0	0	0	0	0	32
Lane Group Flow (vph)	55	165	76	365	596	0	90	1070	450	365	1380	23
Confl. Peds. (#/hr)	10		20	20		10	20		10	10		20
Confl. Bikes (#/hr)			4			4			1			1
Heavy Vehicles (%)	2%	1%	2%	1%	2%	2%	2%	2%	1%	1%	2%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pm+ov	Prot	NA	Perm
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases			8						6			2
Actuated Green, G (s)	4.2	16.4	16.4	30.6	42.8		6.0	32.6	63.2	22.2	48.8	48.8
Effective Green, g (s)	3.7	16.9	16.9	30.1	43.3		7.0	33.8	62.2	23.2	50.0	50.0
Actuated g/C Ratio	0.03	0.14	0.14	0.25	0.36		0.06	0.28	0.52	0.19	0.42	0.42
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		5.0	5.2	3.5	5.0	5.2	5.2
Vehicle Extension (s)	0.5	1.0	1.0	0.5	1.0		0.5	0.5	0.5	0.5	0.5	0.5
Lane Grp Cap (vph)	54	264	212	448	592		103	996	804	345	1474	624
v/s Ratio Prot	0.03	0.09		c0.20	c0.36		0.05	c0.30	0.14	c0.20	0.39	
v/s Ratio Perm			0.05						0.15			0.02
v/c Ratio	1.02	0.62	0.36	0.81	1.01		0.87	1.07	0.56	1.06	0.94	0.04
Uniform Delay, d1	58.1	48.6	46.6	42.3	38.4		56.1	43.1	19.6	48.4	33.5	20.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		0.90	0.89	0.78	0.91	1.10	1.00
Incremental Delay, d2	127.8	3.3	0.4	10.3	38.7		41.1	47.5	0.4	57.5	9.7	0.1
Delay (s)	186.0	51.9	47.0	52.7	77.1		91.5	85.7	15.6	101.7	46.5	20.8
Level of Service	F	D	D	D	E		F	F	B	F	D	C
Approach Delay (s)		65.6			68.4			66.4			56.9	
Approach LOS		E			E			E			E	
Intersection Summary												
HCM 2000 Control Delay			63.2			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.05									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			105.9%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	415	95	45	120	115	290	25	905	55	20	1615	345
Future Volume (vph)	415	95	45	120	115	290	25	905	55	20	1615	345
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.95		1.00	1.00	1.00	1.00	0.95		1.00	*0.98	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	0.98		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1698	1672		1805	1863	1599	1612	3494		1703	3687	1599
Flt Permitted	0.95	0.98		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1698	1672		1805	1863	1599	1612	3494		1703	3687	1599
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	415	95	45	120	115	290	25	905	55	20	1615	345
RTOR Reduction (vph)	0	6	0	0	0	108	0	3	0	0	0	98
Lane Group Flow (vph)	278	271	0	120	115	182	25	957	0	20	1615	247
Confl. Peds. (#/hr)			10	10			25		5	5		25
Heavy Vehicles (%)	1%	4%	3%	0%	2%	1%	12%	2%	7%	6%	1%	1%
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	pt+ov
Protected Phases	3	3		4	4		1	6		5	2	2 3
Permitted Phases						4						
Actuated Green, G (s)	21.6	21.6		14.5	14.5	14.5	2.7	63.1		2.0	61.9	83.5
Effective Green, g (s)	22.0	22.0		15.7	15.7	15.7	3.2	64.3		2.0	63.1	85.9
Actuated g/C Ratio	0.18	0.18		0.13	0.13	0.13	0.03	0.54		0.02	0.53	0.72
Clearance Time (s)	4.4	4.4		5.2	5.2	5.2	4.5	5.2		4.0	5.2	
Vehicle Extension (s)	1.0	1.0		1.0	1.0	1.0	1.5	0.5		1.0	0.5	
Lane Grp Cap (vph)	311	306		236	243	209	42	1872		28	1938	1144
v/s Ratio Prot	c0.16	0.16		0.07	0.06		c0.02	0.27		0.01	c0.44	0.15
v/s Ratio Perm						c0.11						
v/c Ratio	0.89	0.89		0.51	0.47	0.87	0.60	0.51		0.71	0.83	0.22
Uniform Delay, d1	47.9	47.8		48.6	48.3	51.2	57.8	17.8		58.7	24.0	5.7
Progression Factor	1.00	1.00		1.00	1.00	1.00	0.78	0.29		0.76	0.28	0.47
Incremental Delay, d2	25.5	24.4		0.6	0.5	29.6	11.9	0.8		29.2	2.2	0.0
Delay (s)	73.4	72.2		49.2	48.9	80.8	56.7	5.9		73.6	8.9	2.7
Level of Service	E	E		D	D	F	E	A		E	A	A
Approach Delay (s)		72.8			66.6			7.2			8.5	
Approach LOS		E			E			A			A	
Intersection Summary												
HCM 2000 Control Delay			24.5			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.84									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)				16.0		
Intersection Capacity Utilization			78.0%			ICU Level of Service				D		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

9: SW Terwilliger Blvd & I-5 NB Off Ramp

04/21/2020



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	380	245	0	645	980	0
Future Volume (vph)	380	245	0	645	980	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1599		1881	1881	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1599		1881	1881	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	380	245	0	645	980	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	380	245	0	645	980	0
Heavy Vehicles (%)	2%	1%	0%	1%	1%	0%
Turn Type	Prot	custom		NA	NA	
Protected Phases	4	1		6	2	
Permitted Phases		4				
Actuated Green, G (s)	29.5	39.8		85.4	70.5	
Effective Green, g (s)	30.4	41.0		86.0	71.1	
Actuated g/C Ratio	0.24	0.33		0.69	0.57	
Clearance Time (s)	4.9	4.6		4.6	4.6	
Vehicle Extension (s)	1.0	1.2		1.2	4.0	
Lane Grp Cap (vph)	432	527		1300	1075	
v/s Ratio Prot	c0.21	0.04		c0.34	c0.52	
v/s Ratio Perm		0.11				
v/c Ratio	0.88	0.46		0.50	0.91	
Uniform Delay, d1	45.2	33.0		9.0	23.8	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	17.6	0.2		0.1	11.7	
Delay (s)	62.8	33.3		9.1	35.5	
Level of Service	E	C		A	D	
Approach Delay (s)	51.2			9.1	35.5	
Approach LOS	D			A	D	

Intersection Summary

HCM 2000 Control Delay	32.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	124.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection

Int Delay, s/veh 5.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	240	250	970	1620	15
Future Vol, veh/h	0	240	250	970	1620	15
Conflicting Peds, #/hr	15	0	5	0	0	5
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	2	2	2	0
Mvmt Flow	0	240	250	970	1620	15

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	-	823	1640
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	6.9	4.14
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	3.3	2.22
Pot Cap-1 Maneuver	0	321	391
Stage 1	0	-	-
Stage 2	0	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	-	320	389
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	43.4	6	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	389	-	320	-	-
HCM Lane V/C Ratio	0.643	-	0.75	-	-
HCM Control Delay (s)	29.5	-	43.4	-	-
HCM Lane LOS	D	-	E	-	-
HCM 95th %tile Q(veh)	4.3	-	5.7	-	-

HCM Signalized Intersection Capacity Analysis

13: SW Barbur Blvd (Hwy 99W) & SW Capitol Hill Rd/SW 19th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	70	95	105	170	95	75	95	1085	15	120	1640	70
Future Volume (vph)	70	95	105	170	95	75	95	1085	15	120	1640	70
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	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	0.95		1.00	0.99		1.00	1.00	0.96	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.92		1.00	0.93		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1662		1787	1729		1805	3539	1558	1719	3511	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1662		1787	1729		1805	3539	1558	1719	3511	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	70	95	105	170	95	75	95	1085	15	120	1640	70
RTOR Reduction (vph)	0	34	0	0	24	0	0	0	7	0	2	0
Lane Group Flow (vph)	70	166	0	170	147	0	95	1085	8	120	1708	0
Confl. Peds. (#/hr)	5		50	50		5	15		5	5		15
Confl. Bikes (#/hr)									1			1
Heavy Vehicles (%)	2%	0%	0%	1%	0%	4%	0%	2%	0%	5%	2%	0%
Turn Type	Prot	NA		Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases									6			
Actuated Green, G (s)	6.9	18.6		14.1	25.8		8.0	60.4	60.4	11.2	63.6	
Effective Green, g (s)	5.9	18.8		13.1	26.0		7.0	61.9	61.9	10.2	65.1	
Actuated g/C Ratio	0.05	0.16		0.11	0.22		0.06	0.52	0.52	0.08	0.54	
Clearance Time (s)	3.0	4.2		3.0	4.2		3.0	5.5	5.5	3.0	5.5	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	0.5	0.5	0.5	0.5	
Lane Grp Cap (vph)	87	260		195	374		105	1825	803	146	1904	
v/s Ratio Prot	c0.04	c0.10		c0.10	0.08		c0.05	0.31		0.07	c0.49	
v/s Ratio Perm									0.00			
v/c Ratio	0.80	0.64		0.87	0.39		0.90	0.59	0.01	0.82	0.90	
Uniform Delay, d1	56.5	47.4		52.6	40.2		56.2	20.3	14.1	54.0	24.5	
Progression Factor	1.00	1.00		1.00	1.00		0.98	0.91	1.00	1.27	0.28	
Incremental Delay, d2	38.1	3.8		31.2	0.2		54.2	1.3	0.0	21.9	5.3	
Delay (s)	94.5	51.2		83.8	40.5		109.2	19.8	14.2	90.5	12.3	
Level of Service	F	D		F	D		F	B	B	F	B	
Approach Delay (s)		62.4			62.2			26.9			17.4	
Approach LOS		E			E			C			B	
Intersection Summary												
HCM 2000 Control Delay			28.0			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.85									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			92.4%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 576.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	40	15	55	115	45	30	35	1125	5	5	1435	10
Future Vol, veh/h	40	15	55	115	45	30	35	1125	5	5	1435	10
Conflicting Peds, #/hr	0	0	5	5	0	0	5	0	10	10	0	5
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	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	4	0	0	0	0	0	0	2	0	0	1	0
Mvmt Flow	40	15	55	115	45	30	35	1125	5	5	1435	10

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2110	2665	733	1948	2668	575	1450	0	0	1140	0	0
Stage 1	1455	1455	-	1208	1208	-	-	-	-	-	-	-
Stage 2	655	1210	-	740	1460	-	-	-	-	-	-	-
Critical Hdwy	7.58	6.5	6.9	7.5	6.5	6.9	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.58	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.58	5.5	-	6.5	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.54	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 28	23	368	~ 40	~ 23	466	473	-	-	620	-	-
Stage 1	134	197	-	197	258	-	-	-	-	-	-	-
Stage 2	417	258	-	379	196	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	-	17	365	~ 7	~ 17	462	471	-	-	615	-	-
Mov Cap-2 Maneuver	-	17	-	~ 7	~ 17	-	-	-	-	-	-	-
Stage 1	107	188	-	156	205	-	-	-	-	-	-	-
Stage 2	243	205	-	283	187	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s		\$ 8828.7	1.6	0.2
HCM LOS	-	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	471	-	-	- 10	615	-	-
HCM Lane V/C Ratio	0.074	-	-	- 19	0.008	-	-
HCM Control Delay (s)	13.3	1.2	-	\$ 8828.7	10.9	0.2	-
HCM Lane LOS	B	A	-	F	B	A	-
HCM 95th %tile Q(veh)	0.2	-	-	- 25.3	0	-	-

Notes

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

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔	↔	↔			↔	
Traffic Volume (vph)	115	0	60	115	25	55	60	1235	0	0	1500	2
Future Volume (vph)	115	0	60	115	25	55	60	1235	0	0	1500	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.95			0.95	
Frpb, ped/bikes		1.00			1.00	0.98	1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00	1.00	1.00	1.00			1.00	
Frt		0.95			1.00	0.85	1.00	1.00			1.00	
Flt Protected		0.97			0.96	1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1737			1810	1583	1803	3574			3538	
Flt Permitted		0.57			0.68	1.00	0.14	1.00			1.00	
Satd. Flow (perm)		1022			1278	1583	261	3574			3538	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	115	0	60	115	25	55	60	1235	0	0	1500	2
RTOR Reduction (vph)	0	19	0	0	0	45	0	0	0	0	0	0
Lane Group Flow (vph)	0	156	0	0	140	10	60	1235	0	0	1502	0
Confl. Peds. (#/hr)	5					5	5		5	5		5
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	0%	1%	0%	0%	2%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA			NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4		4	2					
Actuated Green, G (s)		20.5			20.5	20.5	89.5	89.5			89.5	
Effective Green, g (s)		21.0			21.0	21.0	91.0	91.0			91.0	
Actuated g/C Ratio		0.18			0.18	0.18	0.76	0.76			0.76	
Clearance Time (s)		4.5			4.5	4.5	5.5	5.5			5.5	
Vehicle Extension (s)		2.0			2.0	2.0	2.0	2.0			2.0	
Lane Grp Cap (vph)		178			223	277	197	2710			2682	
v/s Ratio Prot								0.35			c0.42	
v/s Ratio Perm		c0.15			0.11	0.01	0.23					
v/c Ratio		0.88			0.63	0.03	0.30	0.46			0.56	
Uniform Delay, d1		48.2			45.9	41.1	4.6	5.4			6.1	
Progression Factor		1.00			1.00	1.00	1.03	1.13			0.16	
Incremental Delay, d2		34.1			3.9	0.0	3.8	0.5			0.5	
Delay (s)		82.3			49.8	41.1	8.5	6.6			1.5	
Level of Service		F			D	D	A	A			A	
Approach Delay (s)		82.3			47.4			6.7			1.5	
Approach LOS		F			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		10.9										
HCM 2000 Volume to Capacity ratio		0.62										
Actuated Cycle Length (s)		120.0										
Intersection Capacity Utilization		73.2%										
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

22: SW Barbur Blvd (Hwy 99W) & SW 30th Ave

04/21/2020



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↗	↗		↗	↗	
Traffic Volume (vph)	50	0	135	5	0	10	120	985	5	5	1380	55
Future Volume (vph)	50	0	135	5	0	10	120	985	5	5	1380	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.98			0.97		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		0.99			1.00		1.00	1.00		1.00	1.00	
Frt		0.90			0.91		1.00	1.00		1.00	0.99	
Flt Protected		0.99			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1610			1652		1805	3537		1805	3447	
Flt Permitted		0.91			0.92		0.13	1.00		0.29	1.00	
Satd. Flow (perm)		1485			1540		238	3537		550	3447	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	50	0	135	5	0	10	120	985	5	5	1380	55
RTOR Reduction (vph)	0	90	0	0	13	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	95	0	0	2	0	120	990	0	5	1433	0
Confl. Peds. (#/hr)	20		10	10		20	10					10
Heavy Vehicles (%)	3%	0%	2%	0%	0%	0%	0%	2%	0%	0%	4%	2%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		1	6		5	2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		17.6			17.6		87.5	87.5		82.7	82.1	
Effective Green, g (s)		18.6			18.6		87.7	88.8		82.7	83.4	
Actuated g/C Ratio		0.16			0.16		0.73	0.74		0.69	0.70	
Clearance Time (s)		5.0			5.0		4.2	5.3		4.0	5.3	
Vehicle Extension (s)		2.0			2.0		0.5	0.5		0.5	0.5	
Lane Grp Cap (vph)		230			238		252	2617		385	2395	
v/s Ratio Prot							c0.02	0.28		0.00	c0.42	
v/s Ratio Perm		c0.06			0.00		0.32			0.01		
v/c Ratio		0.41			0.01		0.48	0.38		0.01	0.60	
Uniform Delay, d1		45.8			42.9		9.1	5.6		5.9	9.6	
Progression Factor		1.00			1.00		1.03	0.34		0.36	0.35	
Incremental Delay, d2		0.4			0.0		0.5	0.4		0.0	0.9	
Delay (s)		46.2			42.9		9.9	2.3		2.1	4.2	
Level of Service		D			D		A	A		A	A	
Approach Delay (s)		46.2			42.9			3.1			4.2	
Approach LOS		D			D			A			A	

Intersection Summary

HCM 2000 Control Delay	6.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Intersection

Int Delay, s/veh 0.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	10	10	1125	1475	30
Future Vol, veh/h	10	10	10	1125	1475	30
Conflicting Peds, #/hr	5	0	0	0	0	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	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	3	2	0
Mvmt Flow	10	10	10	1125	1475	30

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	2078	753	1505	0	-	0
Stage 1	1490	-	-	-	-	-
Stage 2	588	-	-	-	-	-
Critical Hdwy	6.8	6.9	4.1	-	-	-
Critical Hdwy Stg 1	5.8	-	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	47	357	451	-	-	-
Stage 1	177	-	-	-	-	-
Stage 2	524	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	44	357	451	-	-	-
Mov Cap-2 Maneuver	44	-	-	-	-	-
Stage 1	167	-	-	-	-	-
Stage 2	524	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	66.4	0.5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	451	-	78	-	-
HCM Lane V/C Ratio	0.022	-	0.256	-	-
HCM Control Delay (s)	13.2	0.4	66.4	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0.1	-	0.9	-	-

HCM 2010 TWSC

25: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd (Baird St)/SW Taylors Ferry Rd 04/21/2020

Intersection												
Int Delay, s/veh	6.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	20	0	30	25	0	30	15	1085	10	5	1455	25
Future Vol, veh/h	20	0	30	25	0	30	15	1085	10	5	1455	25
Conflicting Peds, #/hr	0	0	0	0	0	0	5	0	5	5	0	5
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	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	6	0	0	0	2	50	50	1	0
Mvmt Flow	20	0	30	25	0	30	15	1085	10	5	1455	25
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2056	2613	745	1863	2620	553	1485	0	0	1100	0	0
Stage 1	1483	1483	-	1125	1125	-	-	-	-	-	-	-
Stage 2	573	1130	-	738	1495	-	-	-	-	-	-	-
Critical Hdwy	7.5	6.5	6.9	7.62	6.5	6.9	4.1	-	-	5.1	-	-
Critical Hdwy Stg 1	6.5	5.5	-	6.62	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.5	5.5	-	6.62	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.56	4	3.3	2.2	-	-	2.7	-	-
Pot Cap-1 Maneuver	33	25	361	43	24	482	459	-	-	412	-	-
Stage 1	133	191	-	212	283	-	-	-	-	-	-	-
Stage 2	477	281	-	367	188	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	27	21	359	35	20	480	457	-	-	410	-	-
Mov Cap-2 Maneuver	27	21	-	35	20	-	-	-	-	-	-	-
Stage 1	121	177	-	193	258	-	-	-	-	-	-	-
Stage 2	410	256	-	313	174	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Control Delay, s	176.5		147.3		0.7		0.5					
HCM LOS	F		F									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR					
Capacity (veh/h)	457	-	-	61	71	410	-	-				
HCM Lane V/C Ratio	0.033	-	-	0.82	0.775	0.012	-	-				
HCM Control Delay (s)	13.1	0.5	-	176.5	147.3	13.9	0.5	-				
HCM Lane LOS	B	A	-	F	F	B	A	-				
HCM 95th %tile Q(veh)	0.1	-	-	3.7	3.6	0	-	-				

HCM Signalized Intersection Capacity Analysis

27: SW Barbur Blvd (Hwy 99W) & Transit Center (Signalized)

04/21/2020



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	WT		WT		WT	WT
Traffic Volume (vph)	115	15	1095	15	5	1505
Future Volume (vph)	115	15	1095	15	5	1505
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	0.97		0.95		1.00	0.95
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.98		1.00		1.00	1.00
Flt Protected	0.96		1.00		0.95	1.00
Satd. Flow (prot)	3460		3531		1805	3539
Flt Permitted	0.96		1.00		0.95	1.00
Satd. Flow (perm)	3460		3531		1805	3539
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	115	15	1095	15	5	1505
RTOR Reduction (vph)	10	0	0	0	0	0
Lane Group Flow (vph)	120	0	1110	0	5	1505
Confl. Peds. (#/hr)	10			10	10	
Confl. Bikes (#/hr)		1				
Heavy Vehicles (%)	0%	0%	2%	0%	0%	2%
Turn Type	Prot		NA		Prot	NA
Protected Phases	4		2		1	6
Permitted Phases						
Actuated Green, G (s)	13.5		91.2		0.8	96.2
Effective Green, g (s)	14.5		92.5		1.0	97.5
Actuated g/C Ratio	0.12		0.77		0.01	0.81
Clearance Time (s)	5.0		5.3		4.2	5.3
Vehicle Extension (s)	4.0		1.5		0.5	1.5
Lane Grp Cap (vph)	418		2721		15	2875
v/s Ratio Prot	c0.03		0.31		0.00	c0.43
v/s Ratio Perm						
v/c Ratio	0.29		0.41		0.33	0.52
Uniform Delay, d1	48.0		4.6		59.2	3.7
Progression Factor	1.00		0.52		1.03	0.63
Incremental Delay, d2	0.5		0.4		4.0	0.6
Delay (s)	48.6		2.8		64.8	2.9
Level of Service	D		A		E	A
Approach Delay (s)	48.6		2.8			3.1
Approach LOS	D		A			A

Intersection Summary

HCM 2000 Control Delay	5.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis

29: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/Barbur Terrace

04/21/2020



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗				↖	↗		↖	↗	
Traffic Volume (vph)	235	5	105	0	0	0	220	885	10	10	1335	295
Future Volume (vph)	235	5	105	0	0	0	220	885	10	10	1335	295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.5				4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00				1.00	0.95		1.00	*0.79	
Frpb, ped/bikes		1.00	0.98				1.00	1.00		1.00	0.99	
Flpb, ped/bikes		0.99	1.00				1.00	1.00		1.00	1.00	
Frt		1.00	0.85				1.00	1.00		1.00	0.97	
Flt Protected		0.95	1.00				0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1743	1471				1736	3496		902	2786	
Flt Permitted		0.95	1.00				0.05	1.00		0.28	1.00	
Satd. Flow (perm)		1743	1471				97	3496		268	2786	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	235	5	105	0	0	0	220	885	10	10	1335	295
RTOR Reduction (vph)	0	0	36	0	0	0	0	1	0	0	12	0
Lane Group Flow (vph)	0	240	69	0	0	0	220	894	0	10	1618	0
Confl. Peds. (#/hr)	5		10	10		5	25					25
Heavy Vehicles (%)	1%	100%	8%	0%	0%	0%	4%	2%	100%	100%	4%	1%
Turn Type	Perm	NA	pm+ov				pm+pt	NA		pm+pt	NA	
Protected Phases		4	5				5	2		1	6	
Permitted Phases	4		4				2			6		
Actuated Green, G (s)		19.7	34.7				90.6	85.0		71.1	70.3	
Effective Green, g (s)		20.9	34.7				91.1	86.3		71.1	71.6	
Actuated g/C Ratio		0.17	0.29				0.76	0.72		0.59	0.60	
Clearance Time (s)		5.2	4.5				4.5	5.3		4.0	5.3	
Vehicle Extension (s)		3.0	0.5				0.5	1.5		0.5	3.0	
Lane Grp Cap (vph)		303	480				285	2514		163	1662	
v/s Ratio Prot			0.02				c0.10	0.26		0.00	c0.58	
v/s Ratio Perm		0.14	0.03				0.49			0.04		
v/c Ratio		0.79	0.14				0.77	0.36		0.06	0.97	
Uniform Delay, d1		47.5	31.6				42.3	6.4		13.9	23.3	
Progression Factor		1.00	1.00				0.81	0.52		0.37	0.47	
Incremental Delay, d2		13.2	0.1				9.9	0.3		0.1	15.4	
Delay (s)		60.7	31.7				44.3	3.6		5.1	26.4	
Level of Service		E	C				D	A		A	C	
Approach Delay (s)		51.9			0.0			11.6			26.3	
Approach LOS		D			A			B			C	

Intersection Summary

HCM 2000 Control Delay	23.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

30: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

04/21/2020



Movement	EBT	EBR	EBR2	WBT	WBR	NBT	NBR	SBL	SBT	SBR	SBR2
Lane Configurations	↑↑			↑↑		↑↑		↵	↑↑	↵	
Traffic Volume (vph)	855	90	165	755	215	945	5	0	715	715	10
Future Volume (vph)	855	90	165	755	215	945	5	0	715	715	10
Ideal Flow (vphpl)	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	
Lane Util. Factor	0.95			0.95		0.95			0.95	1.00	
Frpb, 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	0.97			0.97		1.00			1.00	1.00	
Flt Protected	1.00			1.00		1.00			1.00	1.00	
Satd. Flow (prot)	3451			3404		3536			3539	1755	
Flt Permitted	1.00			1.00		1.00			1.00	1.00	
Satd. Flow (perm)	3451			3404		3536			3539	1755	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	855	90	165	755	215	945	5	0	715	715	10
RTOR Reduction (vph)	0	0	0	23	0	0	0	0	0	12	0
Lane Group Flow (vph)	1110	0	0	947	0	950	0	0	715	713	0
Confl. Peds. (#/hr)					20		25	25		10	10
Confl. Bikes (#/hr)					2						
Heavy Vehicles (%)	1%	1%	1%	2%	1%	2%	0%	100%	2%	3%	0%
Turn Type	NA			NA		NA		Prot	NA	Perm	
Protected Phases	4			8		2		1	6		
Permitted Phases										6	
Actuated Green, G (s)	41.7			41.7		66.1			66.1	66.1	
Effective Green, g (s)	43.8			43.8		68.2			68.2	68.2	
Actuated g/C Ratio	0.36			0.36		0.57			0.57	0.57	
Clearance Time (s)	6.1			6.1		6.1			6.1	6.1	
Vehicle Extension (s)	0.2			0.2		0.2			0.2	0.2	
Lane Grp Cap (vph)	1259			1242		2009			2011	997	
v/s Ratio Prot	c0.32			0.28		0.27			0.20		
v/s Ratio Perm										c0.41	
v/c Ratio	0.88			0.76		0.47			0.36	0.72	
Uniform Delay, d1	35.7			33.5		15.3			14.0	18.8	
Progression Factor	1.00			1.00		1.00			0.20	0.20	
Incremental Delay, d2	7.3			2.5		0.8			0.2	2.0	
Delay (s)	43.0			36.1		16.1			3.0	5.7	
Level of Service	D			D		B			A	A	
Approach Delay (s)	43.0			36.1		16.1			4.3		
Approach LOS	D			D		B			A		

Intersection Summary

HCM 2000 Control Delay	23.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	84.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Intersection

Int Delay, s/veh 39.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↖	↖
Traffic Vol, veh/h	505	0	0	655	280	460
Future Vol, veh/h	505	0	0	655	280	460
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	200	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	0	0	0	0	1
Mvmt Flow	505	0	0	655	280	460

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	-	- 1160
Stage 1	-	-	- 505
Stage 2	-	-	- 655
Critical Hdwy	-	-	- 6.4
Critical Hdwy Stg 1	-	-	- 5.4
Critical Hdwy Stg 2	-	-	- 5.4
Follow-up Hdwy	-	-	- 3.5
Pot Cap-1 Maneuver	-	0	0 - ~ 218
Stage 1	-	0	0 - 610
Stage 2	-	0	0 - 521
Platoon blocked, %	-		-
Mov Cap-1 Maneuver	-	-	- ~ 218
Mov Cap-2 Maneuver	-	-	- ~ 218
Stage 1	-	-	- 610
Stage 2	-	-	- 521

Approach	EB	WB	NB
HCM Control Delay, s	0	0	202.3
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	WBT
Capacity (veh/h)	218	-	-	-
HCM Lane V/C Ratio	1.284	-	-	-
HCM Control Delay (s)	202.3	0	-	-
HCM Lane LOS	F	A	-	-
HCM 95th %tile Q(veh)	14.8	-	-	-

Notes

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

HCM 2010 AWSC
32: SW Capitol Hwy & SW Taylors Ferry Rd

04/21/2020

Intersection

Intersection Delay, s/veh 101.6
Intersection LOS F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	70	170	240	55	320	25	285	355	125	35	330	50
Future Vol, veh/h	70	170	240	55	320	25	285	355	125	35	330	50
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	0	2	1	0	1	0	0	2	0	10	2	0
Mvmt Flow	70	170	240	55	320	25	285	355	125	35	330	50
Number of Lanes	1	1	0	1	1	0	0	2	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	2	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	1	2	2
HCM Control Delay	81.7	57.2	119.7	134.2
HCM LOS	F	F	F	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	62%	0%	100%	0%	100%	0%	8%
Vol Thru, %	38%	59%	0%	41%	0%	93%	80%
Vol Right, %	0%	41%	0%	59%	0%	7%	12%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	463	303	70	410	55	345	415
LT Vol	285	0	70	0	55	0	35
Through Vol	178	178	0	170	0	320	330
RT Vol	0	125	0	240	0	25	50
Lane Flow Rate	462	302	70	410	55	345	415
Geometry Grp	7	7	7	7	7	7	6
Degree of Util (X)	1.267	0.781	0.196	1.049	0.155	0.921	1.165
Departure Headway (Hd)	10.562	9.968	10.825	9.897	11.079	10.512	10.639
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	347	366	334	369	326	348	344
Service Time	8.262	7.668	8.525	7.597	8.779	8.212	8.639
HCM Lane V/C Ratio	1.331	0.825	0.21	1.111	0.169	0.991	1.206
HCM Control Delay	171.5	40.4	16.1	92.9	15.8	63.8	134.2
HCM Lane LOS	F	E	C	F	C	F	F
HCM 95th-tile Q	19.6	6.5	0.7	13.1	0.5	9.3	16.1

HCM Signalized Intersection Capacity Analysis

36: SW Barbur Blvd (Hwy 99W) & SW 53rd Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	35	10	205	5	25	10	1190	330	5	495	35
Future Volume (vph)	5	35	10	205	5	25	10	1190	330	5	495	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			4.0			4.0	4.0
Lane Util. Factor		1.00			1.00			0.95			0.95	1.00
Frpb, ped/bikes		1.00			1.00			1.00			1.00	0.97
Flpb, ped/bikes		1.00			1.00			1.00			1.00	1.00
Frt		0.97			0.99			0.97			1.00	0.85
Flt Protected		1.00			0.96			1.00			1.00	1.00
Satd. Flow (prot)		1801			1753			3390			3471	1519
Flt Permitted		0.97			0.72			0.95			0.94	1.00
Satd. Flow (perm)		1756			1313			3228			3267	1519
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	35	10	205	5	25	10	1190	330	5	495	35
RTOR Reduction (vph)	0	8	0	0	6	0	0	29	0	0	0	12
Lane Group Flow (vph)	0	42	0	0	229	0	0	1501	0	0	500	23
Confl. Peds. (#/hr)	5					5	5					5
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	3%	0%	2%	0%	4%	0%	3%	1%	0%	4%	3%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		2
Actuated Green, G (s)		16.0			16.0			42.5			42.5	42.5
Effective Green, g (s)		16.0			16.0			43.5			43.5	43.5
Actuated g/C Ratio		0.24			0.24			0.64			0.64	0.64
Clearance Time (s)		4.0			4.0			5.0			5.0	5.0
Vehicle Extension (s)		2.5			2.5			4.8			4.8	4.8
Lane Grp Cap (vph)		416			311			2080			2105	978
v/s Ratio Prot												
v/s Ratio Perm		0.02			0.17			0.47			0.15	0.01
v/c Ratio		0.10			0.74			0.72			0.24	0.02
Uniform Delay, d1		20.1			23.8			8.0			5.0	4.3
Progression Factor		1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2		0.1			8.3			1.5			0.1	0.0
Delay (s)		20.2			32.1			9.5			5.2	4.3
Level of Service		C			C			A			A	A
Approach Delay (s)		20.2			32.1			9.5			5.1	
Approach LOS		C			C			A			A	
Intersection Summary												
HCM 2000 Control Delay			11.0			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			67.5			Sum of lost time (s)				8.0		
Intersection Capacity Utilization			77.2%			ICU Level of Service				D		
Analysis Period (min)			15									
c Critical Lane Group												

APPENDIX B26

Segment B – 2045 No-Build HCM SimTraffic

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd

06/08/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	385	285	20	70	135	205	20	1465	315	60	590	340
Future Volume (vph)	385	285	20	70	135	205	20	1465	315	60	590	340
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.95		1.00	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1649	1697		1770	1776	1495	1805	3421		1719	3471	1538
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1649	1697		1770	1776	1495	1805	3421		1719	3471	1538
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	385	285	20	70	135	205	20	1465	315	60	590	340
RTOR Reduction (vph)	0	2	0	0	0	135	0	16	0	0	0	73
Lane Group Flow (vph)	339	349	0	70	135	70	20	1765	0	60	590	267
Confl. Peds. (#/hr)			15	15			10					10
Confl. Bikes (#/hr)									13			8
Heavy Vehicles (%)	4%	4%	14%	2%	7%	8%	0%	2%	3%	5%	4%	5%
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	pt+ov
Protected Phases	3	3		4	4		1	6		5	2	2 3
Permitted Phases						4						
Actuated Green, G (s)	25.4	25.4		9.3	9.3	9.3	2.0	58.8		7.7	64.0	89.4
Effective Green, g (s)	25.8	25.8		10.5	10.5	10.5	2.5	60.0		7.7	65.2	91.8
Actuated g/C Ratio	0.22	0.22		0.09	0.09	0.09	0.02	0.50		0.06	0.54	0.76
Clearance Time (s)	4.4	4.4		5.2	5.2	5.2	4.5	5.2		4.0	5.2	
Vehicle Extension (s)	1.0	1.0		1.0	1.0	1.0	1.5	0.5		1.0	0.5	
Lane Grp Cap (vph)	354	364		154	155	130	37	1710		110	1885	1176
v/s Ratio Prot	0.21	c0.21		0.04	c0.08		0.01	c0.52		c0.03	0.17	0.17
v/s Ratio Perm						0.05						
v/c Ratio	0.96	0.96		0.45	0.87	0.54	0.54	1.03		0.55	0.31	0.23
Uniform Delay, d1	46.6	46.6		52.0	54.1	52.4	58.2	30.0		54.5	15.1	4.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	36.1	36.0		0.8	36.8	2.1	8.4	30.4		2.9	0.4	0.0
Delay (s)	82.7	82.6		52.8	90.8	54.6	66.5	60.4		57.4	15.5	4.0
Level of Service	F	F		D	F	D	E	E		E	B	A
Approach Delay (s)		82.6			66.2			60.5			14.1	
Approach LOS		F			E			E			B	
Intersection Summary												
HCM 2000 Control Delay			53.2									
HCM 2000 Volume to Capacity ratio			0.96									
Actuated Cycle Length (s)			120.0									
Intersection Capacity Utilization			92.5%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

9: SW Terwilliger Blvd & I-5 NB Off Ramp

06/08/2020



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	355	190	0	605	605	0
Future Volume (vph)	355	190	0	605	605	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		1863	1863	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		1863	1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	355	190	0	605	605	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	355	190	0	605	605	0
Turn Type	Prot	custom		NA	NA	
Protected Phases	4	1		6	2	
Permitted Phases		4				
Actuated Green, G (s)	21.6	32.2		51.6	36.4	
Effective Green, g (s)	22.5	33.4		52.2	37.0	
Actuated g/C Ratio	0.27	0.40		0.63	0.45	
Clearance Time (s)	4.9	4.6		4.6	4.6	
Vehicle Extension (s)	1.0	1.2		1.2	4.0	
Lane Grp Cap (vph)	481	639		1175	833	
v/s Ratio Prot	c0.20	0.04		c0.32	c0.32	
v/s Ratio Perm		0.08				
v/c Ratio	0.74	0.30		0.51	0.73	
Uniform Delay, d1	27.4	16.7		8.3	18.7	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.1	0.1		0.2	3.4	
Delay (s)	32.5	16.8		8.5	22.1	
Level of Service	C	B		A	C	
Approach Delay (s)	27.0			8.5	22.1	
Approach LOS	C			A	C	

Intersection Summary

HCM 2000 Control Delay	18.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	82.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	58.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

06/08/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	170	5	30	110	15	30	30	2195	5	0	900	0
Future Volume (vph)	170	5	30	110	15	30	30	2195	5	0	900	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.95			0.95	
Frpb, ped/bikes		1.00			1.00	0.97	1.00	1.00			1.00	
Flpb, ped/bikes		0.99			1.00	1.00	1.00	1.00			1.00	
Frt		0.98			1.00	0.85	1.00	1.00			1.00	
Flt Protected		0.96			0.96	1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1712			1686	1529	1651	3538			3505	
Flt Permitted		0.59			0.73	1.00	0.29	1.00			1.00	
Satd. Flow (perm)		1060			1292	1529	501	3538			3505	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	170	5	30	110	15	30	30	2195	5	0	900	0
RTOR Reduction (vph)	0	6	0	0	0	18	0	0	0	0	0	0
Lane Group Flow (vph)	0	199	0	0	125	12	30	2200	0	0	900	0
Confl. Peds. (#/hr)	10					10	5		10	10		5
Confl. Bikes (#/hr)			2						10			5
Heavy Vehicles (%)	4%	0%	0%	9%	0%	3%	9%	2%	0%	0%	3%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA			NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4		4	2					
Actuated Green, G (s)		24.4			24.4	24.4	85.6	85.6			85.6	
Effective Green, g (s)		24.9			24.9	24.9	87.1	87.1			87.1	
Actuated g/C Ratio		0.21			0.21	0.21	0.73	0.73			0.73	
Clearance Time (s)		4.5			4.5	4.5	5.5	5.5			5.5	
Vehicle Extension (s)		2.0			2.0	2.0	2.0	2.0			2.0	
Lane Grp Cap (vph)		219			268	317	363	2567			2544	
v/s Ratio Prot								c0.62			0.26	
v/s Ratio Perm		c0.19			0.10	0.01	0.06					
v/c Ratio		0.91			0.47	0.04	0.08	0.86			0.35	
Uniform Delay, d1		46.5			41.7	38.0	4.8	11.9			6.1	
Progression Factor		1.00			1.00	1.00	1.00	1.00			1.00	
Incremental Delay, d2		36.7			0.5	0.0	0.4	4.0			0.4	
Delay (s)		83.2			42.2	38.0	5.2	15.9			6.5	
Level of Service		F			D	D	A	B			A	
Approach Delay (s)		83.2			41.4			15.7			6.5	
Approach LOS		F			D			B			A	
Intersection Summary												
HCM 2000 Control Delay		18.5										
HCM 2000 Volume to Capacity ratio		0.87										
Actuated Cycle Length (s)		120.0										
Intersection Capacity Utilization		91.7%										
Analysis Period (min)		15										
c Critical Lane Group												

Intersection						
Int Delay, s/veh	2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↘	↘
Traffic Vol, veh/h	665	0	0	335	90	315
Future Vol, veh/h	665	0	0	335	90	315
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	200	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	0	0	0	0	1
Mvmt Flow	665	0	0	335	90	315
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	-	-	-	1000	-
Stage 1	-	-	-	-	665	-
Stage 2	-	-	-	-	335	-
Critical Hdwy	-	-	-	-	6.4	-
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	-	-	3.5	-
Pot Cap-1 Maneuver	-	0	0	-	272	0
Stage 1	-	0	0	-	515	0
Stage 2	-	0	0	-	729	0
Platoon blocked, %	-			-		
Mov Cap-1 Maneuver	-	-	-	-	272	-
Mov Cap-2 Maneuver	-	-	-	-	272	-
Stage 1	-	-	-	-	515	-
Stage 2	-	-	-	-	729	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0		24.6	
HCM LOS					C	
Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	WBT		
Capacity (veh/h)	272		-	-	-	
HCM Lane V/C Ratio	0.331		-	-	-	
HCM Control Delay (s)	24.6		0	-	-	
HCM Lane LOS	C		A	-	-	
HCM 95th %tile Q(veh)	1.4		-	-	-	

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd

04/22/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	445	105	45	120	115	290	35	955	55	20	1645	425
Future Volume (vph)	445	105	45	120	115	290	35	955	55	20	1645	425
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.95		1.00	1.00	1.00	1.00	0.95		1.00	*0.98	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	0.98		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1698	1675		1805	1863	1599	1612	3496		1703	3687	1599
Flt Permitted	0.95	0.98		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1698	1675		1805	1863	1599	1612	3496		1703	3687	1599
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	445	105	45	120	115	290	35	955	55	20	1645	425
RTOR Reduction (vph)	0	6	0	0	0	99	0	3	0	0	0	102
Lane Group Flow (vph)	298	291	0	120	115	191	35	1007	0	20	1645	323
Confl. Peds. (#/hr)			10	10			25		5	5		25
Heavy Vehicles (%)	1%	4%	3%	0%	2%	1%	12%	2%	7%	6%	1%	1%
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	pt+ov
Protected Phases	3	3		4	4		1	6		5	2	2 3
Permitted Phases						4						
Actuated Green, G (s)	22.7	22.7		14.7	14.7	14.7	4.3	61.8		2.0	59.0	81.7
Effective Green, g (s)	23.1	23.1		15.9	15.9	15.9	4.8	63.0		2.0	60.2	84.1
Actuated g/C Ratio	0.19	0.19		0.13	0.13	0.13	0.04	0.52		0.02	0.50	0.70
Clearance Time (s)	4.4	4.4		5.2	5.2	5.2	4.5	5.2		4.0	5.2	
Vehicle Extension (s)	1.0	1.0		1.0	1.0	1.0	1.5	0.5		1.0	0.5	
Lane Grp Cap (vph)	326	322		239	246	211	64	1835		28	1849	1120
v/s Ratio Prot	c0.18	0.17		0.07	0.06		c0.02	0.29		0.01	c0.45	0.20
v/s Ratio Perm						c0.12						
v/c Ratio	0.91	0.90		0.50	0.47	0.91	0.55	0.55		0.71	0.89	0.29
Uniform Delay, d1	47.5	47.4		48.4	48.1	51.3	56.5	19.0		58.7	26.9	6.7
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		0.76	0.29	0.56
Incremental Delay, d2	28.4	26.8		0.6	0.5	36.2	5.0	1.2		26.2	3.2	0.0
Delay (s)	75.9	74.2		49.0	48.6	87.6	61.6	20.2		71.1	11.0	3.8
Level of Service	E	E		D	D	F	E	C		E	B	A
Approach Delay (s)		75.0			70.2			21.6			10.1	
Approach LOS		E			E			C			B	
Intersection Summary												
HCM 2000 Control Delay			29.4			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.88									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)				16.0		
Intersection Capacity Utilization			79.6%			ICU Level of Service				D		
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

9: SW Terwilliger Blvd & I-5 NB Off Ramp

04/22/2020



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	405	245	0	700	1015	0
Future Volume (vph)	405	245	0	700	1015	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1599		1881	1881	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1599		1881	1881	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	405	245	0	700	1015	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	405	245	0	700	1015	0
Heavy Vehicles (%)	2%	1%	0%	1%	1%	0%
Turn Type	Prot	custom		NA	NA	
Protected Phases	4	1		6	2	
Permitted Phases		4				
Actuated Green, G (s)	31.4	41.5		89.6	74.9	
Effective Green, g (s)	32.3	42.7		90.2	75.5	
Actuated g/C Ratio	0.25	0.33		0.69	0.58	
Clearance Time (s)	4.9	4.6		4.6	4.6	
Vehicle Extension (s)	1.0	1.2		1.2	4.0	
Lane Grp Cap (vph)	438	523		1300	1088	
v/s Ratio Prot	c0.23	0.04		c0.37	c0.54	
v/s Ratio Perm		0.11				
v/c Ratio	0.92	0.47		0.54	0.93	
Uniform Delay, d1	47.9	34.9		9.9	25.2	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	24.9	0.2		0.2	14.1	
Delay (s)	72.8	35.1		10.1	39.3	
Level of Service	E	D		B	D	
Approach Delay (s)	58.6			10.1	39.3	
Approach LOS	E			B	D	

Intersection Summary

HCM 2000 Control Delay	36.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	130.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/22/2020



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔	↔	↔			↔	
Traffic Volume (vph)	115	0	60	120	25	60	60	1320	0	0	1530	0
Future Volume (vph)	115	0	60	120	25	60	60	1320	0	0	1530	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.95			0.95	
Frpb, ped/bikes		1.00			1.00	0.98	1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00	1.00	1.00	1.00			1.00	
Frt		0.95			1.00	0.85	1.00	1.00			1.00	
Flt Protected		0.97			0.96	1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1737			1810	1583	1803	3574			3539	
Flt Permitted		0.56			0.68	1.00	0.13	1.00			1.00	
Satd. Flow (perm)		1002			1274	1583	250	3574			3539	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	115	0	60	120	25	60	60	1320	0	0	1530	0
RTOR Reduction (vph)	0	19	0	0	0	49	0	0	0	0	0	0
Lane Group Flow (vph)	0	156	0	0	145	11	60	1320	0	0	1530	0
Confl. Peds. (#/hr)	5					5	5		5	5		5
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	0%	1%	0%	0%	2%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA			NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4		4	2					
Actuated Green, G (s)		20.7			20.7	20.7	89.3	89.3			89.3	
Effective Green, g (s)		21.2			21.2	21.2	90.8	90.8			90.8	
Actuated g/C Ratio		0.18			0.18	0.18	0.76	0.76			0.76	
Clearance Time (s)		4.5			4.5	4.5	5.5	5.5			5.5	
Vehicle Extension (s)		2.0			2.0	2.0	2.0	2.0			2.0	
Lane Grp Cap (vph)		177			225	279	189	2704			2677	
v/s Ratio Prot								0.37			c0.43	
v/s Ratio Perm		c0.16			0.11	0.01	0.24					
v/c Ratio		0.88			0.64	0.04	0.32	0.49			0.57	
Uniform Delay, d1		48.2			45.9	40.9	4.7	5.6			6.3	
Progression Factor		1.00			1.00	1.00	1.00	1.00			1.00	
Incremental Delay, d2		35.6			4.7	0.0	4.4	0.6			0.9	
Delay (s)		83.8			50.6	41.0	9.0	6.3			7.2	
Level of Service		F			D	D	A	A			A	
Approach Delay (s)		83.8			47.8			6.4			7.2	
Approach LOS		F			D			A			A	

Intersection Summary

HCM 2000 Control Delay	13.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection

Int Delay, s/veh 89.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↖	↗
Traffic Vol, veh/h	655	0	0	770	300	490
Future Vol, veh/h	655	0	0	770	300	490
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	200	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	0	0	0	0	1
Mvmt Flow	655	0	0	770	300	490

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	-	- 1425
Stage 1	-	-	- 655
Stage 2	-	-	- 770
Critical Hdwy	-	-	- 6.4
Critical Hdwy Stg 1	-	-	- 5.4
Critical Hdwy Stg 2	-	-	- 5.4
Follow-up Hdwy	-	-	- 3.5
Pot Cap-1 Maneuver	-	0	- ~ 151
Stage 1	-	0	- 521
Stage 2	-	0	- 460
Platoon blocked, %	-		-
Mov Cap-1 Maneuver	-	-	- ~ 151
Mov Cap-2 Maneuver	-	-	- ~ 151
Stage 1	-	-	- 521
Stage 2	-	-	- 460

Approach	EB	WB	NB
HCM Control Delay, s	0	0	\$ 516.6
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	WBT
Capacity (veh/h)	151	-	-	-
HCM Lane V/C Ratio	1.987	-	-	-
HCM Control Delay (s)	\$ 516.6	0	-	-
HCM Lane LOS	F	A	-	-
HCM 95th %tile Q(veh)	23.4	-	-	-

Notes

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

Queuing and Blocking Report
2045 Ramp Queuing No Build

03/20/2020

Intersection: 31: 4th Ave & I-405 WB Off Ramp & Lincoln St

Movement	EB	EB	WB	NB	NB	NW	NW
Directions Served	L	T	TR	LT	T	R	>
Maximum Queue (ft)	90	125	286	310	285	115	181
Average Queue (ft)	31	51	149	217	148	46	91
95th Queue (ft)	71	102	263	326	267	95	160
Link Distance (ft)		257	354	290	290	957	957
Upstream Blk Time (%)		0	1	4	1		
Queuing Penalty (veh)		0	0	0	0		
Storage Bay Dist (ft)	100						
Storage Blk Time (%)	0	1					
Queuing Penalty (veh)	0	0					

Intersection: 112: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

Movement	EB	WB	WB	NB	NB	NB	B18	B18	B19	B19	B20	B20
Directions Served	LTR	LT	R	L	T	TR	T	T	T	T	T	T
Maximum Queue (ft)	238	215	111	152	232	231	141	135	66	57	51	41
Average Queue (ft)	104	108	33	68	168	164	22	18	6	6	5	5
95th Queue (ft)	192	183	69	143	260	254	96	85	60	52	59	59
Link Distance (ft)	405	651			153	153	89	89	100	100	819	819
Upstream Blk Time (%)				1	12	9	4	1	2	1		
Queuing Penalty (veh)				0	0	0	0	0	0	0		
Storage Bay Dist (ft)			200	100								
Storage Blk Time (%)		1		12	14							
Queuing Penalty (veh)		0		80	8							

Intersection: 112: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

Movement	SB	SB	B2	B2
Directions Served	T	TR	T	T
Maximum Queue (ft)	227	215	318	240
Average Queue (ft)	190	151	90	38
95th Queue (ft)	252	235	234	153
Link Distance (ft)	132	132	382	382
Upstream Blk Time (%)	15	9	0	0
Queuing Penalty (veh)	0	0	0	0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 119: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/Barbur Terrace

Movement	EB	EB	NB	NB	NB	SB	SB	SB
Directions Served	LT	R	L	T	TR	L	T	TR
Maximum Queue (ft)	113	82	166	221	220	62	427	457
Average Queue (ft)	71	38	144	156	81	6	254	416
95th Queue (ft)	118	85	194	269	210	35	491	437
Link Distance (ft)	81			169	169		393	393
Upstream Blk Time (%)	27	2	14	31	1		4	74
Queuing Penalty (veh)	94	0	0	187	5		0	0
Storage Bay Dist (ft)		100	250			100		
Storage Blk Time (%)	27	2	14	31		0	16	
Queuing Penalty (veh)	27	4	70	75		0	2	

Intersection: 120: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

Movement	EB	EB	WB	WB	NB	NB	B33	B33	B34	B34	B35	B35
Directions Served	T	TR>	T	TR	T	TR	T	T	T	T	T	T
Maximum Queue (ft)	223	285	523	531	429	443	170	153	109	104	203	203
Average Queue (ft)	190	243	495	496	250	238	39	14	57	57	94	93
95th Queue (ft)	295	373	513	518	429	429	231	116	438	441	774	775
Link Distance (ft)	209	209	477	477	391	391	378	378	970	970	2014	2014
Upstream Blk Time (%)	20	53	90	89	11	4	6	0	5	5	4	4
Queuing Penalty (veh)	134	348	0	0	0	0	0	0	0	0	0	0
Storage Bay Dist (ft)												
Storage Blk Time (%)												
Queuing Penalty (veh)												

Intersection: 120: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

Movement	SB	SB	SB
Directions Served	T	T	R>
Maximum Queue (ft)	165	256	176
Average Queue (ft)	32	195	157
95th Queue (ft)	104	315	239
Link Distance (ft)	176	176	
Upstream Blk Time (%)	0	38	32
Queuing Penalty (veh)	1	285	0
Storage Bay Dist (ft)			350
Storage Blk Time (%)	1	38	32
Queuing Penalty (veh)	0	297	113

Queuing and Blocking Report
2045 Ramp Queueing No Build

03/20/2020

Intersection: 122: I-5 SB Off Ramp & SW Taylors Ferry Rd

Movement	EB	NB	NB
Directions Served	T	L	R
Maximum Queue (ft)	1092	225	2392
Average Queue (ft)	1061	199	2321
95th Queue (ft)	1082	315	2581
Link Distance (ft)	1042		2338
Upstream Blk Time (%)	99		90
Queuing Penalty (veh)	0		0
Storage Bay Dist (ft)		200	
Storage Blk Time (%)		6	83
Queuing Penalty (veh)		32	250

Intersection: 123: SW Capitol Hwy & SW Taylors Ferry Rd

Movement	EB	EB	EB	WB	WB	NB	NB	SB	B54
Directions Served	L	T	R	L	TR	LT	TR	LTR	T
Maximum Queue (ft)	117	304	335	74	142	260	248	314	673
Average Queue (ft)	36	286	300	43	116	231	119	284	643
95th Queue (ft)	94	317	319	95	154	253	261	301	667
Link Distance (ft)		238	238		120	209	209	206	624
Upstream Blk Time (%)		71	92		21	35	5	100	99
Queuing Penalty (veh)		405	525		100	147	20	0	0
Storage Bay Dist (ft)	100			50					
Storage Blk Time (%)	0	16		4	61				
Queuing Penalty (veh)	0	11		16	36				

Intersection: 221: 6th Ave

Movement	NB	NB	NB	NW
Directions Served	T	T	T	R
Maximum Queue (ft)	49	37	29	106
Average Queue (ft)	18	5	1	16
95th Queue (ft)	47	25	11	64
Link Distance (ft)	16	16	16	1031
Upstream Blk Time (%)	4	0	0	
Queuing Penalty (veh)	5	1	0	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 3555

APPENDIX B27

Segment B – Build and No-Build VISSIM Results

MEMORANDUM

DATE: September 29, 2017

TO: Randy Johnson, PE, PTOE, DKS Associates

FROM: Charles Allen PE, PTOE, Parametrix
Tim Peterson, Parametrix

SUBJECT: Terwilliger Interchange (Study Area Segment B) Build & No Build VISSIM Modeling Results Report DRAFT

CC:

PROJECT NUMBER: 274-1919-040

PROJECT NAME: Southwest Corridor Light Rail EIS

INTRODUCTION

As part of the Southwest Corridor Light Rail Extension EIS, Parametrix developed a VISSIM microsimulation model for the Terwilliger interchange area representing 2045 Build and No Build Conditions. This memorandum documents key model setup parameters and assumptions as well as preliminary traffic analysis results.

MODEL SETUP

2045 No Build Model

Parametrix constructed the VISSIM model for 2045 No Build conditions based on the calibrated VISSIM model for existing conditions. Detail regarding the setup and calibration of the existing conditions model can be found in the *Terwilliger Interchange (Study Area Segment B) VISSIM Modeling Calibration Report*.

To modify the existing model to represent 2045 No Build conditions, Parametrix increased traffic volumes according to 2045 No Build traffic forecasts from the project team. Parametrix also made minor signal timing adjustments to reflect changes to traffic volumes. Since there are no planned capacity projects in the area, Parametrix made no significant changes to roadway geometry.

2045 Build Model

Parametrix constructed a 2045 Build conditions VISSIM model. The model incorporated a center-running light rail system on Babur Boulevard with alignment and station locations reflecting current design documents. Geometric changes to Babur Boulevard accompanied the light rail design with the most significant changes occurring at 13th Avenue, 2nd Avenue, and 3rd Avenue. Table 1 summarizes the key assumptions for transit and vehicular operations within the Build model. Table 2 summarizes the model setup parameters.

Table 1. Key 2045 Build Model Transit and Vehicular Assumptions

Assumption	Value/Treatment
Light Rail Operation	
Frequency	6.67 minutes (9 trains per hour)
Station dwell times	18-22 seconds
Signal treatments	Full signal preemption
Bus Service	
Barbur Boulevard bus pull-outs	Eliminated except where specified in design drawings
Bus service changes	Most Babur Boulevard routes eliminated, routes primarily on Terwilliger and Bertha remain (according to info from MTA)
2nd/3rd Avenue Intersections	
Signal Control	Combined to a single-controller intersection with concurrent phasing for approaches on 2 nd Avenue and 3 rd Avenue
I-5 SB Off-ramp	
Queue detection	Added a safe stopping distance queue detection 700 feet from Barbur Boulevard signal. When activated for 10 continuous seconds, queue detection preempts signal to run a ramp clearing phase until 3 seconds of continuous non-detection.

Table 2. Key Model Set Up Parameters

Parameter	Value
Total Simulation Time	9000 seconds
Seeding Time	1800 seconds
Number of Simulation runs	15
Random Seeds	41 through 55

RESULTS

Both the No Build and Build models exhibit significant congestion. The majority of the congestion stems from capacity constraints at the Terwilliger Boulevard/Barbur Boulevard intersection. The congestion leads to significant queues on eastbound and westbound Barbur Boulevard approaches and the northbound Terwilliger approach. These queues perpetuate past the extents of the model and prevent the model from serving the full demand volumes. The No Build model serves only about 85 percent of the demand volume whereas the Build models serves approximately 77 percent of the demand volume.

Tables 3 through 6 summarize delay, volume and queuing outputs by intersection. Because the models do not serve the full traffic demand, caution is required in interpreting detailed results. Most likely, the model outputs understate the actual queuing and delay. For example, many queue lengths on Barbur Boulevard are maxed out by the limits of the link length – often the distance to the next upstream intersection. In actuality, the queues often extend through the upstream intersection.

Table 3. 2045 No Build Model Delay and Volume by Movement

Int	Name	Movement	Peak 15 min Delay (sec)	Peak Hour Output Vol	VISSIM Input Vol	Diff	% Diff	GEH
B1	2nd Ave & Barbur Blvd	EBT	1	1,323	1,619	-296	-18%	7.7
		NBR	127	8	10	-2	-22%	0.7
		WBL	7	26	30	-4	-15%	0.8
		Total	41	1,357	1,659	-302	-18%	7.8
B2	3rd Ave & Barbur Blvd	EBL1	76	3	5	-2	-41%	1.0
		EBL2	72	53	65	-12	-19%	1.6
		EBR1		0	0	0		
		EBR2	9	156	195	-39	-20%	2.9
		EBT	10	1,315	1,624	-309	-19%	8.1
		NBR1		0	0	0		
		NBR2		0	0	0		
		NWBL1		0	0	0		
		NWBL2	156	239	265	-26	-10%	1.7
		SBL1		0	0	0		
		SBL2	65	5	5	0	-5%	0.1
		SBR	69	28	30	-2	-7%	0.4
		SEBL	38	4	5	-1	-20%	0.5
		SEBT		0	0	0		
		WBR1	53	4	5	-1	-29%	0.7
		WBR2		0	0	0		
		WBT	41	1,463	1,615	-152	-9%	3.9
		Total	57	3,268	3,814	-546	-14%	9.2
B3	Terwilliger Blvd & Barbur Blvd	EBL	61	93	110	-17	-16%	1.7
		EBR	24	377	450	-73	-16%	3.6
		EBT	56	1,118	1,345	-227	-17%	6.5
		NBL	103	274	355	-81	-23%	4.6
		NBR	51	365	485	-120	-25%	5.8
		NBT	61	186	250	-64	-26%	4.3
		SBL	140	47	45	2	4%	0.3
		SBR	65	224	225	-1	-1%	0.1
		SBT	76	249	255	-6	-2%	0.4
		WBL	61	325	355	-30	-8%	1.6
		WBR	6	78	85	-7	-9%	0.8
		WBT	38	1,330	1,470	-140	-10%	3.7
		Total	62	4,665	5,430	-765	-14%	10.8
B4	Bertha Blvd & Barbur Blvd	EBL	76	75	105	-30	-29%	3.2
		EBR	57	135	180	-45	-25%	3.6
		EBT	66	958	1,265	-307	-24%	9.2
		NBL	64	114	115	-1	-1%	0.1
		NBR	0	234	235	-1	0%	0.1
		NBT	63	125	125	0	0%	0.0
		SBL	79	398	405	-7	-2%	0.3
		SBR	69	55	55	0	0%	0.0
		SBT	87	122	125	-3	-2%	0.3
		WBL	72	18	20	-2	-9%	0.4
		WBR	4	385	435	-50	-12%	2.5
		WBT	13	1,424	1,595	-171	-11%	4.4
		Total	56	4,041	4,660	-619	-13%	9.4
B8	Multnomah Dr & Barbur Blvd	EBR	60	4	5	-1	-27%	0.6
		NBR	56	8	10	-2	-20%	0.7
		Total	57	12	15	-3	-22%	0.9
B9	I-5 NB Ramps & Terwilliger Blvd	EBL	206	237	485	-248	-51%	13.1
		EBR	25	119	245	-126	-51%	9.3
		NBT	32	593	305	288	94%	13.6
		SBT	9	955	1,060	-105	-10%	3.3
		Total	68	1,904	2,095	-191	-9%	4.3
B10	13th Ave & Barbur Blvd	EBL	39	183	240	-57	-24%	3.9
		EBR	57	8	10	-2	-17%	0.6
		EBT	66	1,161	1,540	-379	-25%	10.3
		NBL	26	4	5	-1	-17%	0.4
		NBR	79	4	5	-1	-16%	0.4
		NBT	48	4	5	-1	-28%	0.7
		SBR	37	226	230	-4	-2%	0.2
		WBL	33	5	5	0	-9%	0.2
		WBR	2	14	15	-1	-7%	0.3
		WBT	2	1,402	1,540	-138	-9%	3.6
		Total	38	3,010	3,595	-585	-16%	10.2

Table 4. 2045 No Build Queue Report

Intersection	Movement	PM Peak Hour Queues (ft)		
		Average Max	St Dev	95th Percentile (rounded to nearest 25 ft)
B2 3rd Ave & Barbur Blvd	Barbur Blvd EB	283	254	700
	Barbur Blvd WB	2,102	295	2,575
B3 Terwilliger Blvd & Barbur Blvd	Barbur Blvd EB	649	54	725
	Barbur Blvd WB	913	121	1,100
	Terwilliger Blvd NB	620	106	800
	Terwilliger Blvd SB	352	190	675
B4 Bertha Blvd & Barbur Blvd	Barbur Blvd EB	1,099	22	1,125
	Barbur Blvd WB	230	92	375
	Bertha Blvd SB	420	337	975
	I-5 SB off Ramp	119	53	200
B9 I-5 NB Ramps & Terwilliger Blvd	I-5 NB off Ramp	2,638	10	2,650
	Terwilliger Blvd NB	404	218	750
	Terwilliger Blvd SB	340	179	625

Table 5. 2045 Build Model Delay and Volume by Movement

Int	Name	Movement	Peak 15 min	Peak Hour	VISSIM			
			Delay (sec)	Output Vol	Input Vol	Diff	% Diff	GEH
B1/B2	2nd-3rd Ave & Barbur Blvd	EBL	108	50	65	-15	-30%	2.0
		EBR1		0	0	0		
		EBR2	11	161	205	-44	-27%	3.3
		EBT	12	1,289	1,600	-311	-24%	8.2
		NBL 3rd		0	0	0		
		NBL FP	357	161	270	-109	-68%	7.4
		NBR		0	0	0		
		NBR FP	371	5	10	-5	-85%	1.7
		NBR2		0	0	0		
		NBT		0	0	0		
		SBL	104	9	10	-1	-11%	0.3
		SBL2		0	0	0		
		SBR	73	19	20	-1	-5%	0.2
		SBT		0	0	0		
		WBL	113	16	20	-4	-25%	0.9
		WBR	16	5	5	0	-10%	0.2
		WBT	17	1,556	1,895	-339	-22%	8.1
		Total	112	3,271	4,100	-829	-25%	13.7
B3	Terwilliger Blvd & Barbur Blvd	EBL	82	95	110	-15	-16%	1.5
		EBR	14	349	405	-56	-16%	2.9
		EBT	40	1,124	1,335	-211	-19%	6.0
		NBL	131	250	355	-105	-42%	6.0
		NBR	53	336	490	-154	-46%	7.6
		NBT	65	174	255	-81	-47%	5.6
		SBL	93	43	45	-2	-4%	0.2
		SBR	65	202	205	-3	-2%	0.2
		SBT	106	241	250	-9	-4%	0.5
		WBL	108	294	355	-61	-21%	3.4
		WBR	7	70	85	-15	-22%	1.7
		WBT	53	1,209	1,475	-266	-22%	7.3
		Total	68	4,387	5,365	-978	-22%	14.0
B4	Bertha Blvd & Barbur Blvd	EBL	263	68	90	-22	-32%	2.5
		EBR	54	151	195	-44	-29%	3.4
		EBT	64	958	1,225	-267	-28%	8.1
		NBL	67	94	95	-1	-1%	0.1
		NBR	167	208	215	-7	-3%	0.5
		NBT	63	116	115	1	1%	0.1
		SBL	106	397	410	-13	-3%	0.6
		SBR	80	45	45	0	0%	0.0
		SBT	99	128	130	-2	-2%	0.2
		WBL	84	21	25	-4	-22%	0.9
		WBR	10	371	455	-84	-23%	4.1
		WBT	34	1,265	1,555	-290	-23%	7.7
		Total	92	3,822	4,555	-733	-19%	11.3
B9	I-5 NB Ramps & Terwilliger Blvd	EBL	170	304	495	-191	-63%	9.5
		EBR	39	137	230	-93	-67%	6.8
		NBT	78	458	605	-147	-32%	6.4
		SBT	11	886	1,010	-124	-14%	4.0
		Total	74	1,785	2,340	-555	-31%	12.2
B10	13th Ave & Barbur Blvd	EBL	106	215	270	-55	-26%	3.5
		EBR	44	8	10	-2	-24%	0.6
		EBT	51	1,176	1,495	-319	-27%	8.7
		NBL	20	2	5	-3	-108%	1.4
		NBR	25	4	10	-6	-138%	2.2
		NBT	36	1	5	-4	-241%	2.0
		SBL	56	5	5	0	4%	0.1
		SBR	42	203	225	-22	-11%	1.5
		SBT	62	5	5	0	-10%	0.2
		WBR	28	47	60	-13	-27%	1.7
		WBT	27	1,258	1,490	-232	-18%	6.2
		Total	47	2,925	3,580	-655	-22%	11.5

Table 6. 2045 Build Queue Report

Intersection	Movement	PM Peak Hour Queues (ft)		
		Average Max	St Dev	95th Percentile (rounded to nearest 25 ft)
B1/B2 2nd-3rd Ave & Barbur Blvd	Barbur Blvd EB	223	243	625
	Barbur Blvd WB	1,956	351	2,525
B3 Terwilliger Blvd & Barbur Blvd	Barbur Blvd EB	487	148	725
	Barbur Blvd WB	901	152	1,150
	Terwilliger Blvd NB	619	120	825
	Terwilliger Blvd SB	479	283	950
B4 Bertha Blvd & Barbur Blvd	Barbur Blvd EB	873	92	1,025
	Barbur Blvd WB	500	243	900
	Bertha Blvd SB	498	613	1,500
	I-5 SB off Ramp	503	248	900
B9 I-5 NB Ramps & Terwilliger Blvd	I-5 NB off Ramp	2,548	10	2,575
	Terwilliger Blvd NB	751	40	825
	Terwilliger Blvd SB	464	218	825
B10 13th Ave & Barbur Blvd	Barbur Blvd EB	3,003	207	3,350
	Barbur Blvd WB	949	712	2,125
	13th Ave SB	262	86	400
	Multnomah Blvd NB	2	6	0

PREEMPTION

Observation of the traffic model suggests that light rail preemption may partially aide progression on Barbur Boulevard as it creates longer green times that through traffic on Barbur Boulevard can utilize. This, however, comes at the expense the preemption abbreviating side-street phases.

I-5 Southbound Queue Clearance Preemption

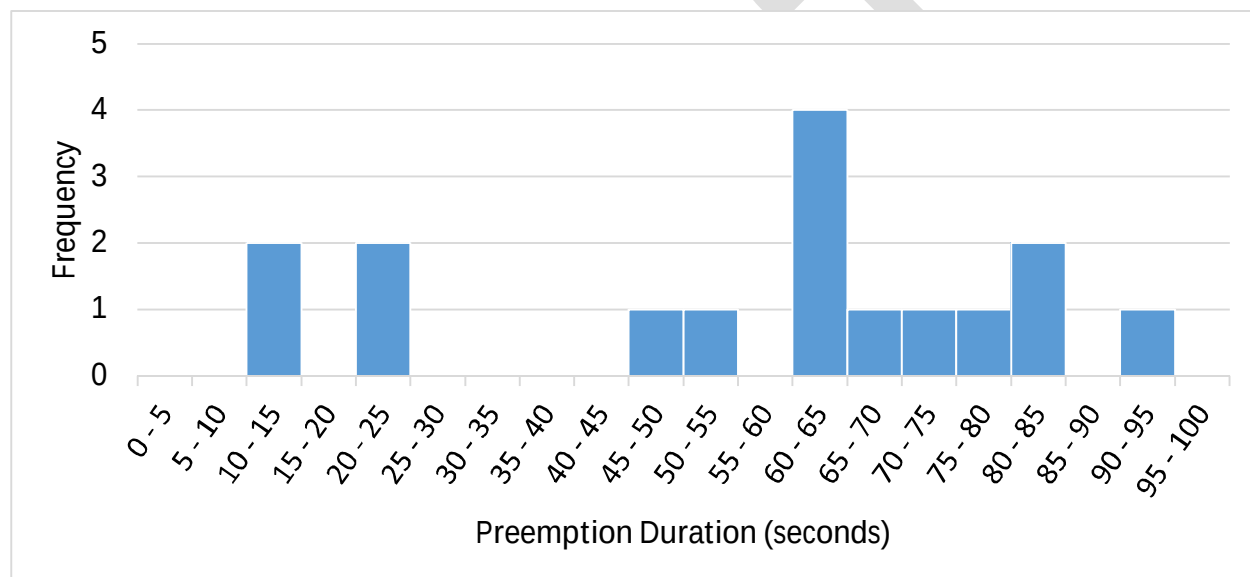
Observation also indicates the southbound I-5 off-ramp queue detector only occasionally triggers the ramp queue clearance phase in the Build model. Significantly worse queuing is experienced on the I-5 northbound off-ramp. This is a manifestation of the northbound off-ramp traffic demand increasing 50 percent over existing volumes with no corresponding increase in capacity.

Table 7 and Figure 1 summarize metrics for the I-5 southbound queue clearance preemption. The queue clearance preemption triggers on an average just once per peak hour over 15 simulation runs. The duration of the clearance preemption is highly variable. The average duration is nearly one minute with the maximum duration reaching 90 seconds.

Observation of the model indicates the effectiveness of the queue clearance preemption is hindered by congestion at the Terwilliger Boulevard/Barbur Boulevard intersection. The queue clearance preemption is usually triggered by queues from the off-ramp right turn onto Barbur Boulevard. These queues form because of eastbound backing at Terwilliger Boulevard extends all the way to the I-5 off-ramp intersection. During preemption, right-turning vehicles at the off-ramp must wait until eastbound queues at Terwilliger Boulevard dissipate before proceeding.

Table 7. I-5 Southbound Off-ramp Queue Clearance Preemption

Preemption Frequency	
Total Runs	15
Total Peak Hour Preemptions	16
Preemptions per Run	1.1
Preemption Duration (sec)	
Average Duration	56.6
Max Duration	94.3
Standard Deviation	25.5

Figure 1. Histogram of I-5 Southbound Off-ramp Queue Clearance Preemption Duration

Effect on Light Rail Operations

The 2045 Build simulation assumed higher priority for the I-5 southbound ramp clearance preemption than the light rail preemption. Thus, ramp queue clearance can potentially result in delay for the light rail vehicles should the light rail vehicles arrive during queue clearance preemption. Results indicate this occurs infrequently during the simulation peak hour – only for about 2 percent of light rail vehicles. The average increase in travel time when a light rail vehicles is delayed is approximately 23 seconds.

APPENDIX B28

Segment B – AM LPA HCM Results

HCM Signalized Intersection Capacity Analysis

1: SW Barbur Blvd (Hwy 99W)/SW Barbur Blvd (Hwy 99 W) & SW 2nd Ave

04/21/2020



Movement	WBL	WBR	NBT	NBR	SBU	SBL	SBT
Lane Configurations	W	R	T	R	L	R	T
Traffic Volume (vph)	130	10	1760	165	5	20	515
Future Volume (vph)	130	10	1760	165	5	20	515
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0
Lane Util. Factor	1.00		0.95			1.00	0.95
Frpb, ped/bikes	1.00		1.00			1.00	1.00
Flpb, ped/bikes	1.00		1.00			1.00	1.00
Frt	0.99		0.99			1.00	1.00
Flt Protected	0.96		1.00			0.95	1.00
Satd. Flow (prot)	1763		3480			1770	3539
Flt Permitted	0.96		1.00			1.00	1.00
Satd. Flow (perm)	1763		3480			1863	3539
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	130	10	1760	165	5	20	515
RTOR Reduction (vph)	3	0	4	0	0	0	0
Lane Group Flow (vph)	137	0	1921	0	0	25	515
Confl. Bikes (#/hr)				50			
Turn Type	Prot		NA		custom	Prot	NA
Protected Phases	8		6			5	2
Permitted Phases					5		
Actuated Green, G (s)	15.4		88.5			3.6	96.1
Effective Green, g (s)	15.4		89.0			3.6	96.6
Actuated g/C Ratio	0.13		0.74			0.03	0.80
Clearance Time (s)	4.0		4.5			4.0	4.5
Vehicle Extension (s)	3.0		3.0			0.2	3.0
Lane Grp Cap (vph)	226		2581			55	2848
v/s Ratio Prot	c0.08		c0.55				0.15
v/s Ratio Perm						c0.01	
v/c Ratio	0.61		0.74			0.45	0.18
Uniform Delay, d1	49.4		8.9			57.2	2.7
Progression Factor	1.00		0.15			1.00	1.00
Incremental Delay, d2	4.6		1.5			2.2	0.1
Delay (s)	54.0		2.8			59.4	2.8
Level of Service	D		A			E	A
Approach Delay (s)	54.0		2.8				5.4
Approach LOS	D		A				A
Intersection Summary							
HCM 2000 Control Delay			6.1		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio			0.71				
Actuated Cycle Length (s)			120.0		Sum of lost time (s)		12.0
Intersection Capacity Utilization			68.4%		ICU Level of Service		C
Analysis Period (min)			15				
c Critical Lane Group							

HCM Signalized Intersection Capacity Analysis

2: SW Barbur Blvd (Hwy 99W) & SW 3rd Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	0	15	0	0	5	15	1900	0	0	640	5
Future Volume (vph)	20	0	15	0	0	5	15	1900	0	0	640	5
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	
Lane Util. Factor		1.00			1.00		1.00	0.95			0.95	
Frpb, ped/bikes		0.99			0.98		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.94			0.86		1.00	1.00			1.00	
Flt Protected		0.97			1.00		0.95	1.00			1.00	
Satd. Flow (prot)		1722			1615		1805	3505			3371	
Flt Permitted		0.87			1.00		0.95	1.00			1.00	
Satd. Flow (perm)		1535			1615		1805	3505			3371	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	20	0	15	0	0	5	15	1900	0	0	640	5
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	35	0	0	5	0	15	1900	0	0	645	0
Confl. Peds. (#/hr)	5		5	5		5	10					10
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	7%	0%
Turn Type	Perm	NA			NA		Prot	NA			NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8								
Actuated Green, G (s)		15.4			15.4		3.6	96.1			88.5	
Effective Green, g (s)		15.4			15.4		3.6	96.6			89.0	
Actuated g/C Ratio		0.13			0.13		0.03	0.80			0.74	
Clearance Time (s)		4.0			4.0		4.0	4.5			4.5	
Vehicle Extension (s)		3.0			3.0		0.2	3.0			3.0	
Lane Grp Cap (vph)		196			207		54	2821			2500	
v/s Ratio Prot					0.00		0.01	c0.54			0.19	
v/s Ratio Perm		c0.02										
v/c Ratio		0.18			0.02		0.28	0.67			0.26	
Uniform Delay, d1		46.7			45.7		56.9	5.0			5.0	
Progression Factor		1.00			1.00		0.92	0.40			0.96	
Incremental Delay, d2		0.4			0.0		0.4	0.5			0.2	
Delay (s)		47.1			45.8		52.6	2.4			5.0	
Level of Service		D			D		D	A			A	
Approach Delay (s)		47.1			45.8			2.8			5.0	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		4.0			HCM 2000 Level of Service			A				
HCM 2000 Volume to Capacity ratio		0.63										
Actuated Cycle Length (s)		120.0			Sum of lost time (s)			12.0				
Intersection Capacity Utilization		71.0%			ICU Level of Service			C				
Analysis Period (min)		15										

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

3: SW Barbur Blvd (Hwy 99W) & SW Terwilliger Blvd

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	160	140	280	215	340	160	1470	345	85	515	55
Future Volume (vph)	105	160	140	280	215	340	160	1470	345	85	515	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.95	1.00	1.00	0.91	0.91
Frpb, ped/bikes	1.00	1.00	0.97	1.00	0.99		1.00	1.00	0.95	1.00	1.00	0.95
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.91		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1900	1534	1736	1650		1736	3539	1438	1752	3317	1320
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1900	1534	1736	1650		1736	3539	1438	1752	3317	1320
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	105	160	140	280	215	340	160	1470	345	85	515	55
RTOR Reduction (vph)	0	0	117	0	47	0	0	0	0	0	1	31
Lane Group Flow (vph)	105	160	23	280	508	0	160	1470	345	85	520	18
Confl. Peds. (#/hr)	10		15	15		10	5		10	10		5
Confl. Bikes (#/hr)			5			5			50			50
Heavy Vehicles (%)	2%	0%	2%	4%	3%	3%	4%	2%	7%	3%	4%	6%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pm+ov	Prot	NA	Perm
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases			8						6			2
Actuated Green, G (s)	8.9	19.4	19.4	26.6	37.1		14.1	52.5	79.1	5.0	43.4	43.4
Effective Green, g (s)	8.9	19.4	19.4	26.6	37.1		14.1	53.0	79.1	5.0	43.9	43.9
Actuated g/C Ratio	0.07	0.16	0.16	0.22	0.31		0.12	0.44	0.66	0.04	0.37	0.37
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.5	4.0	4.0	4.5	4.5
Vehicle Extension (s)	0.5	1.0	1.0	0.5	1.0		0.5	0.5	0.5	0.5	0.5	0.5
Lane Grp Cap (vph)	131	307	247	384	510		203	1563	995	73	1213	482
v/s Ratio Prot	c0.06	0.08		0.16	c0.31		0.09	c0.42	0.08	c0.05	0.16	
v/s Ratio Perm			0.01						0.16			0.01
v/c Ratio	0.80	0.52	0.09	0.73	1.00		0.79	0.94	0.35	1.16	0.43	0.04
Uniform Delay, d1	54.7	46.0	42.8	43.4	41.4		51.5	32.0	9.0	57.5	28.6	24.5
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.67	0.40	0.83	0.65	1.00
Incremental Delay, d2	27.2	0.7	0.1	5.8	38.6		8.1	6.5	0.0	155.5	1.1	0.1
Delay (s)	81.9	46.8	42.9	49.1	79.9		59.7	28.0	3.6	203.2	19.8	24.6
Level of Service	F	D	D	D	E		E	C	A	F	B	C
Approach Delay (s)		54.5			69.6			26.3			44.0	
Approach LOS		D			E			C			D	
Intersection Summary												
HCM 2000 Control Delay			41.6			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.96									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			97.7%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd/I-5 Ramps

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	365	285	20	70	120	205	15	1405	295	60	600	275
Future Volume (vph)	365	285	20	70	120	205	15	1405	295	60	600	275
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.5
Lane Util. Factor	0.95	0.95		1.00	1.00	1.00	1.00	0.95		1.00	*0.98	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1649	1699		1770	1776	1495	1805	3410		1719	3581	1538
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1649	1699		1770	1776	1495	1805	3410		1719	3581	1538
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	365	285	20	70	120	205	15	1405	295	60	600	275
RTOR Reduction (vph)	0	2	0	0	0	102	0	15	0	0	0	53
Lane Group Flow (vph)	328	340	0	70	120	103	15	1685	0	60	600	222
Confl. Peds. (#/hr)			15	15			10					10
Confl. Bikes (#/hr)									50			50
Heavy Vehicles (%)	4%	4%	14%	2%	7%	8%	0%	2%	3%	5%	4%	5%
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	pt+ov
Protected Phases	3	3		4	4		1	6		5	2	2 3
Permitted Phases						4						
Actuated Green, G (s)	26.4	26.4		5.0	5.0	5.0	2.0	66.7		5.4	70.1	100.5
Effective Green, g (s)	26.4	26.4		5.0	5.0	5.0	2.0	67.2		5.4	70.6	96.5
Actuated g/C Ratio	0.22	0.22		0.04	0.04	0.04	0.02	0.56		0.05	0.59	0.80
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.5		4.0	4.5	
Vehicle Extension (s)	1.0	1.0		1.0	1.0	1.0	1.5	0.5		1.0	0.5	
Lane Grp Cap (vph)	362	373		73	74	62	30	1909		77	2106	1236
v/s Ratio Prot	0.20	c0.20		0.04	0.07		0.01	c0.49		c0.03	0.17	0.14
v/s Ratio Perm						c0.07						
v/c Ratio	0.91	0.91		0.96	1.62	1.67	0.50	0.88		0.78	0.28	0.18
Uniform Delay, d1	45.6	45.7		57.4	57.5	57.5	58.5	23.0		56.7	12.2	2.7
Progression Factor	1.00	1.00		1.00	1.00	1.00	0.69	0.16		0.87	1.35	11.49
Incremental Delay, d2	24.8	25.6		89.6	333.0	361.0	3.7	5.1		31.9	0.3	0.0
Delay (s)	70.4	71.3		147.0	390.5	418.5	44.1	8.8		81.2	16.8	30.9
Level of Service	E	E		F	F	F	D	A		F	B	C
Approach Delay (s)		70.8			361.9			9.1			25.1	
Approach LOS		E			F			A			C	
Intersection Summary												
HCM 2000 Control Delay			61.8									
HCM 2000 Volume to Capacity ratio			0.93									
Actuated Cycle Length (s)			120.0									
Intersection Capacity Utilization			93.5%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

9: SW Terwilliger Blvd

04/21/2020



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	240	160	0	595	590	0
Future Volume (vph)	240	160	0	595	590	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		1863	1863	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		1863	1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	240	160	0	595	590	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	240	160	0	595	590	0
Turn Type	Prot	custom		NA	NA	
Protected Phases	4	1		6	2	
Permitted Phases		4				
Actuated Green, G (s)	17.2	27.4		43.1	28.3	
Effective Green, g (s)	18.1	28.6		43.7	28.9	
Actuated g/C Ratio	0.26	0.41		0.63	0.41	
Clearance Time (s)	4.9	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	458	648		1166	771	
v/s Ratio Prot	c0.14	0.04		c0.32	c0.32	
v/s Ratio Perm		0.06				
v/c Ratio	0.52	0.25		0.51	0.77	
Uniform Delay, d1	22.2	13.5		7.2	17.5	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.1	0.2		0.4	4.6	
Delay (s)	23.2	13.7		7.5	22.1	
Level of Service	C	B		A	C	
Approach Delay (s)	19.4			7.5	22.1	
Approach LOS	B			A	C	

Intersection Summary

HCM 2000 Control Delay	16.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	69.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

10: SW Barbur Blvd (Hwy 99W) & SW 13th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	5	5	235	5	5	10	25	225	1690	10	0	600
Future Volume (vph)	5	5	235	5	5	10	25	225	1690	10	0	600
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0			4.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	0.95			0.95
Frpb, ped/bikes	1.00	0.98		1.00	1.00			1.00	1.00			1.00
Flpb, ped/bikes	0.90	1.00		1.00	1.00			1.00	1.00			1.00
Frt	1.00	0.85		1.00	0.90			1.00	1.00			1.00
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00			1.00
Satd. Flow (prot)	1628	1590		1770	1676			1773	3536			3443
Flt Permitted	0.75	1.00		0.28	1.00			0.95	1.00			1.00
Satd. Flow (perm)	1281	1590		521	1676			1773	3536			3443
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	5	235	5	5	10	25	225	1690	10	0	600
RTOR Reduction (vph)	0	194	0	0	0	0	0	0	0	0	0	1
Lane Group Flow (vph)	5	46	0	5	15	0	0	250	1700	0	0	609
Confl. Peds. (#/hr)	100							5				
Confl. Bikes (#/hr)			5									
Heavy Vehicles (%)	0%	4%	0%	2%	2%	2%	0%	2%	2%	2%	0%	4%
Turn Type	Perm	NA		Perm	NA		Prot	Prot	NA			NA
Protected Phases		4			8		1	1	6			2
Permitted Phases	4			8								
Actuated Green, G (s)	20.8	20.8		20.8	20.8			20.9	90.7			65.8
Effective Green, g (s)	20.8	20.8		20.8	20.8			20.9	91.2			66.3
Actuated g/C Ratio	0.17	0.17		0.17	0.17			0.17	0.76			0.55
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.5			4.5
Vehicle Extension (s)	2.0	2.0		3.0	3.0			2.0	2.0			2.0
Lane Grp Cap (vph)	222	275		90	290			308	2687			1902
v/s Ratio Prot		c0.03			0.01			c0.14	c0.48			0.18
v/s Ratio Perm	0.00			0.01								
v/c Ratio	0.02	0.17		0.06	0.05			0.81	0.63			0.32
Uniform Delay, d1	41.2	42.2		41.4	41.4			47.7	6.7			14.6
Progression Factor	1.00	1.00		1.00	1.00			1.22	0.14			0.65
Incremental Delay, d2	0.0	0.1		0.3	0.1			5.3	0.4			0.4
Delay (s)	41.2	42.3		41.7	41.4			63.3	1.3			9.9
Level of Service	D	D		D	D			E	A			A
Approach Delay (s)		42.3			41.5				9.3			9.9
Approach LOS		D			D				A			A
Intersection Summary												
HCM 2000 Control Delay			12.5			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			68.5%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

10: SW Barbur Blvd (Hwy 99W) & SW 13th Ave

04/21/2020

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	10
Future Volume (vph)	10
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	10
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	5
Confl. Bikes (#/hr)	50
Heavy Vehicles (%)	33%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

13: SW Barbur Blvd (Hwy 99W) & SW Capitol Hill Rd/SW 19th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations												
Traffic Volume (vph)	100	85	115	195	115	110	30	80	1710	20	50	70
Future Volume (vph)	100	85	115	195	115	110	30	80	1710	20	50	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0		4.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	0.95	1.00		1.00
Frpb, ped/bikes	1.00	0.94		1.00	0.95			1.00	1.00	0.66		1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00	1.00		1.00
Frt	1.00	0.91		1.00	0.93			1.00	1.00	0.85		1.00
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (prot)	1787	1607		1719	1630			1754	3539	927		1744
Flt Permitted	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (perm)	1787	1607		1719	1630			1754	3539	927		1744
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	100	85	115	195	115	110	30	80	1710	20	50	70
RTOR Reduction (vph)	0	42	0	0	20	0	0	0	0	10	0	0
Lane Group Flow (vph)	100	158	0	195	205	0	0	110	1710	10	0	120
Confl. Peds. (#/hr)	100		100	100		100				100		
Confl. Bikes (#/hr)										50		
Heavy Vehicles (%)	1%	1%	1%	5%	1%	4%	0%	4%	2%	15%	0%	6%
Turn Type	Prot	NA		Prot	NA		Prot	Prot	NA	Perm	Prot	Prot
Protected Phases	3	8		7	4		1	1	6		5	5
Permitted Phases										6		
Actuated Green, G (s)	7.0	25.7		10.0	28.7			13.0	59.5	59.5		8.3
Effective Green, g (s)	7.0	25.7		10.0	28.7			13.0	60.0	60.0		8.3
Actuated g/C Ratio	0.06	0.21		0.08	0.24			0.11	0.50	0.50		0.07
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.5	4.5		4.0
Vehicle Extension (s)	2.0	2.0		2.0	2.0			2.0	0.5	0.5		0.5
Lane Grp Cap (vph)	104	344		143	389			190	1769	463		120
v/s Ratio Prot	0.06	0.10		c0.11	c0.13			0.06	c0.48			c0.07
v/s Ratio Perm										0.01		
v/c Ratio	0.96	0.46		1.36	0.53			0.58	0.97	0.02		1.00
Uniform Delay, d1	56.4	41.1		55.0	39.7			50.9	29.0	15.2		55.9
Progression Factor	1.00	1.00		1.00	1.00			0.78	0.63	1.00		0.91
Incremental Delay, d2	75.2	0.4		201.9	0.6			2.2	12.9	0.1		80.5
Delay (s)	131.5	41.4		256.9	40.3			41.7	31.3	15.2		131.4
Level of Service	F	D		F	D			D	C	B		F
Approach Delay (s)		71.5			140.9				31.7			
Approach LOS		E			F				C			
Intersection Summary												
HCM 2000 Control Delay			48.6			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.89									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			106.7%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: SW Barbur Blvd (Hwy 99W) & SW Capitol Hill Rd/SW 19th Ave

04/21/2020



Movement	SBT	SBR
Lane Configurations	↑↑	→
Traffic Volume (vph)	765	40
Future Volume (vph)	765	40
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	
Lane Util. Factor	0.95	
Frpb, ped/bikes	0.98	
Flpb, ped/bikes	1.00	
Frt	0.99	
Flt Protected	1.00	
Satd. Flow (prot)	3374	
Flt Permitted	1.00	
Satd. Flow (perm)	3374	
Peak-hour factor, PHF	1.00	1.00
Adj. Flow (vph)	765	40
RTOR Reduction (vph)	3	0
Lane Group Flow (vph)	802	0
Confl. Peds. (#/hr)		100
Confl. Bikes (#/hr)		50
Heavy Vehicles (%)	4%	12%
Turn Type	NA	
Protected Phases	2	
Permitted Phases		
Actuated Green, G (s)	54.8	
Effective Green, g (s)	55.3	
Actuated g/C Ratio	0.46	
Clearance Time (s)	4.5	
Vehicle Extension (s)	0.5	
Lane Grp Cap (vph)	1554	
v/s Ratio Prot	0.24	
v/s Ratio Perm		
v/c Ratio	0.52	
Uniform Delay, d1	22.9	
Progression Factor	0.74	
Incremental Delay, d2	1.2	
Delay (s)	18.1	
Level of Service	B	
Approach Delay (s)	32.8	
Approach LOS	C	
Intersection Summary		

HCM Signalized Intersection Capacity Analysis

15: SW Barbur Blvd (Hwy 99W) & SW 22nd Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↕			↕	
Traffic Volume (vph)	55	15	35	65	60	15	0	1740	5	0	810	5
Future Volume (vph)	55	15	35	65	60	15	0	1740	5	0	810	5
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	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frpb, ped/bikes		1.00			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.95			0.99			1.00			1.00	
Flt Protected		0.97			0.98			1.00			1.00	
Satd. Flow (prot)		1732			1810			3537			3501	
Flt Permitted		0.71			0.77			1.00			1.00	
Satd. Flow (perm)		1254			1431			3537			3501	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	55	15	35	65	60	15	0	1740	5	0	810	5
RTOR Reduction (vph)	0	19	0	0	4	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	86	0	0	136	0	0	1745	0	0	815	0
Confl. Peds. (#/hr)							5					5
Confl. Bikes (#/hr)									50			50
Heavy Vehicles (%)	4%	0%	0%	1%	0%	6%	0%	2%	0%	0%	3%	0%
Turn Type	Perm	NA		Perm	NA			NA			NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4								
Actuated Green, G (s)		16.0			16.0			95.5			95.5	
Effective Green, g (s)		16.0			16.0			96.0			96.0	
Actuated g/C Ratio		0.13			0.13			0.80			0.80	
Clearance Time (s)		4.0			4.0			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		167			190			2829			2800	
v/s Ratio Prot								0.49			0.23	
v/s Ratio Perm		0.07			0.09							
v/c Ratio		0.51			0.71			0.62			0.29	
Uniform Delay, d1		48.4			49.8			4.7			3.1	
Progression Factor		1.00			1.00			0.20			0.35	
Incremental Delay, d2		2.7			12.0			0.6			0.2	
Delay (s)		51.1			61.8			1.5			1.3	
Level of Service		D			E			A			A	
Approach Delay (s)		51.1			61.8			1.5			1.3	
Approach LOS		D			E			A			A	
Intersection Summary												
HCM 2000 Control Delay			6.3									A
HCM 2000 Volume to Capacity ratio			0.63									
Actuated Cycle Length (s)			120.0								8.0	
Intersection Capacity Utilization			64.0%								C	
ICU Level of Service												
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	170	5	30	110	10	30	10	30	2125	5	0	885
Future Volume (vph)	170	5	30	110	10	30	10	30	2125	5	0	885
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0			4.0
Lane Util. Factor		1.00			1.00	1.00		1.00	0.95			0.95
Frpb, ped/bikes		1.00			1.00	0.97		1.00	1.00			1.00
Flpb, ped/bikes		0.99			1.00	1.00		1.00	1.00			1.00
Frt		0.98			1.00	0.85		1.00	1.00			1.00
Flt Protected		0.96			0.96	1.00		0.95	1.00			1.00
Satd. Flow (prot)		1718			1678	1524		1683	3538			3501
Flt Permitted		0.60			0.74	1.00		0.95	1.00			1.00
Satd. Flow (perm)		1069			1293	1524		1683	3538			3501
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	170	5	30	110	10	30	10	30	2125	5	0	885
RTOR Reduction (vph)	0	5	0	0	0	24	0	0	0	0	0	0
Lane Group Flow (vph)	0	200	0	0	120	6	0	40	2130	0	0	890
Confl. Peds. (#/hr)	10					10		5		10	10	
Confl. Bikes (#/hr)						5				50		
Heavy Vehicles (%)	4%	0%	0%	9%	0%	3%	2%	9%	2%	0%	0%	3%
Turn Type	Perm	NA		Perm	NA	Perm	Prot	Prot	NA			NA
Protected Phases		8			4		1	1	6			2
Permitted Phases	8			4		4						
Actuated Green, G (s)		23.4			23.4	23.4		16.0	88.1			68.1
Effective Green, g (s)		23.4			23.4	23.4		16.0	88.6			68.6
Actuated g/C Ratio		0.19			0.19	0.19		0.13	0.74			0.57
Clearance Time (s)		4.0			4.0	4.0		4.0	4.5			4.5
Vehicle Extension (s)		2.0			2.0	2.0		3.0	2.0			2.0
Lane Grp Cap (vph)		208			252	297		224	2612			2001
v/s Ratio Prot								0.02	c0.60			0.25
v/s Ratio Perm		c0.19			0.09	0.00						
v/c Ratio		0.96			0.48	0.02		0.18	0.82			0.44
Uniform Delay, d1		47.9			42.9	39.0		46.2	10.3			14.8
Progression Factor		1.00			1.00	1.00		0.59	0.52			1.19
Incremental Delay, d2		51.1			0.5	0.0		0.3	2.2			0.7
Delay (s)		99.0			43.4	39.0		27.5	7.5			18.3
Level of Service		F			D	D		C	A			B
Approach Delay (s)		99.0			42.5				7.9			18.3
Approach LOS		F			D				A			B
Intersection Summary												
HCM 2000 Control Delay			17.6				HCM 2000 Level of Service		B			
HCM 2000 Volume to Capacity ratio			0.88									
Actuated Cycle Length (s)			120.0				Sum of lost time (s)		12.0			
Intersection Capacity Utilization			91.2%				ICU Level of Service		F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/21/2020

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	5
Future Volume (vph)	5
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	5
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	5
Confl. Bikes (#/hr)	50
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

22: SW Barbur Blvd (Hwy 99W) & SW 30th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations												
Traffic Volume (vph)	100	5	185	10	5	20	10	35	1775	5	15	10
Future Volume (vph)	100	5	185	10	5	20	10	35	1775	5	15	10
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
Lane Util. Factor		1.00			1.00			1.00	0.95			1.00
Frpb, ped/bikes		0.97			0.97			1.00	1.00			1.00
Flpb, ped/bikes		0.99			0.99			1.00	1.00			1.00
Frt		0.91			0.92			1.00	1.00			1.00
Flt Protected		0.98			0.99			0.95	1.00			0.95
Satd. Flow (prot)		1604			1666			1573	3537			1805
Flt Permitted		0.88			0.91			0.95	1.00			0.95
Satd. Flow (perm)		1428			1538			1573	3537			1805
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	100	5	185	10	5	20	10	35	1775	5	15	10
RTOR Reduction (vph)	0	59	0	0	14	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	231	0	0	21	0	0	45	1780	0	0	25
Confl. Peds. (#/hr)	50		50	50		50						
Confl. Bikes (#/hr)										50		
Heavy Vehicles (%)	3%	0%	1%	0%	0%	0%	0%	19%	2%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Prot	Prot	NA		Prot	Prot
Protected Phases		4			8		1	1	6		5	5
Permitted Phases	4			8								
Actuated Green, G (s)		30.8			30.8			5.4	74.8			1.6
Effective Green, g (s)		30.8			30.8			5.4	75.6			1.6
Actuated g/C Ratio		0.26			0.26			0.05	0.63			0.01
Clearance Time (s)		4.0			4.0			4.0	4.8			4.0
Vehicle Extension (s)		2.0			2.0			0.5	0.5			0.5
Lane Grp Cap (vph)		366			394			70	2228			24
v/s Ratio Prot								0.03	c0.50			0.01
v/s Ratio Perm		c0.16			0.01							
v/c Ratio		0.63			0.05			0.64	0.80			1.04
Uniform Delay, d1		39.5			33.6			56.4	16.5			59.2
Progression Factor		1.00			1.00			1.25	0.33			0.65
Incremental Delay, d2		2.4			0.0			12.0	2.6			188.2
Delay (s)		42.0			33.6			82.2	8.1			227.0
Level of Service		D			C			F	A			F
Approach Delay (s)		42.0			33.6				10.0			
Approach LOS		D			C				A			
Intersection Summary												
HCM 2000 Control Delay			14.3									
HCM 2000 Volume to Capacity ratio			0.76									
Actuated Cycle Length (s)			120.0									
Intersection Capacity Utilization			93.3%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

22: SW Barbur Blvd (Hwy 99W) & SW 30th Ave

04/21/2020



Movement	SBT	SBR
Lane Configurations	↑↑	↑
Traffic Volume (vph)	920	15
Future Volume (vph)	920	15
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	
Lane Util. Factor	0.95	
Frpb, ped/bikes	1.00	
Flpb, ped/bikes	1.00	
Frt	1.00	
Flt Protected	1.00	
Satd. Flow (prot)	3449	
Flt Permitted	1.00	
Satd. Flow (perm)	3449	
Peak-hour factor, PHF	1.00	1.00
Adj. Flow (vph)	920	15
RTOR Reduction (vph)	1	0
Lane Group Flow (vph)	934	0
Confl. Peds. (#/hr)		50
Confl. Bikes (#/hr)		50
Heavy Vehicles (%)	4%	9%
Turn Type	NA	
Protected Phases	2	
Permitted Phases		
Actuated Green, G (s)	71.0	
Effective Green, g (s)	71.8	
Actuated g/C Ratio	0.60	
Clearance Time (s)	4.8	
Vehicle Extension (s)	0.5	
Lane Grp Cap (vph)	2063	
v/s Ratio Prot	c0.27	
v/s Ratio Perm		
v/c Ratio	0.45	
Uniform Delay, d1	13.3	
Progression Factor	0.53	
Incremental Delay, d2	0.7	
Delay (s)	7.7	
Level of Service	A	
Approach Delay (s)	13.4	
Approach LOS	B	
Intersection Summary		

HCM Signalized Intersection Capacity Analysis

24: SW Barbur Blvd (Hwy 99W) & SW Alice St

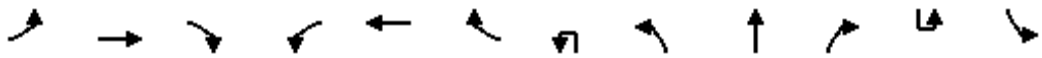
04/21/2020



Movement	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Lane Configurations	W			W	↑↑	↑↑	
Traffic Volume (vph)	15	5	10	5	1805	1095	15
Future Volume (vph)	15	5	10	5	1805	1095	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	4.0	
Lane Util. Factor	1.00			1.00	0.95	0.95	
Frpb, ped/bikes	1.00			1.00	1.00	1.00	
Flpb, ped/bikes	1.00			1.00	1.00	1.00	
Frt	0.97			1.00	1.00	1.00	
Flt Protected	0.96			0.95	1.00	1.00	
Satd. Flow (prot)	1761			1805	3539	3496	
Flt Permitted	0.96			0.95	1.00	1.00	
Satd. Flow (perm)	1761			1805	3539	3496	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	5	10	5	1805	1095	15
RTOR Reduction (vph)	5	0	0	0	0	0	0
Lane Group Flow (vph)	15	0	0	15	1805	1110	0
Confl. Peds. (#/hr)		5		5			5
Confl. Bikes (#/hr)							50
Heavy Vehicles (%)	0%	0%	0%	0%	2%	3%	0%
Turn Type	Prot		Prot	Prot	NA	NA	
Protected Phases	7		5	5	2	6	
Permitted Phases							
Actuated Green, G (s)	7.2			2.0	104.0	98.0	
Effective Green, g (s)	7.2			2.0	104.8	98.8	
Actuated g/C Ratio	0.06			0.02	0.87	0.82	
Clearance Time (s)	4.0			4.0	4.8	4.8	
Vehicle Extension (s)	3.0			3.0	3.0	3.0	
Lane Grp Cap (vph)	105			30	3090	2878	
v/s Ratio Prot	c0.01			0.01	c0.51	0.32	
v/s Ratio Perm							
v/c Ratio	0.15			0.50	0.58	0.39	
Uniform Delay, d1	53.5			58.5	2.0	2.7	
Progression Factor	1.00			0.72	0.10	1.39	
Incremental Delay, d2	0.6			10.2	0.7	0.4	
Delay (s)	54.1			52.5	0.8	4.2	
Level of Service	D			D	A	A	
Approach Delay (s)	54.1				1.3	4.2	
Approach LOS	D				A	A	
Intersection Summary							
HCM 2000 Control Delay			2.7		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio			0.58				
Actuated Cycle Length (s)			120.0		Sum of lost time (s)		12.0
Intersection Capacity Utilization			63.0%		ICU Level of Service		B
Analysis Period (min)			15				
c Critical Lane Group							

HCM Signalized Intersection Capacity Analysis

25: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd (Baird St)/SW Taylors Ferry Rd 04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations		↔			↔			↔	↕			↔
Traffic Volume (vph)	35	5	15	30	5	40	10	5	1740	10	20	5
Future Volume (vph)	35	5	15	30	5	40	10	5	1740	10	20	5
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
Lane Util. Factor		1.00			1.00			1.00	0.95			1.00
Frpb, ped/bikes		1.00			1.00			1.00	1.00			1.00
Flpb, ped/bikes		1.00			1.00			1.00	1.00			1.00
Frt		0.96			0.93			1.00	1.00			1.00
Flt Protected		0.97			0.98			0.95	1.00			0.95
Satd. Flow (prot)		1711			1726			1805	3532			1805
Flt Permitted		0.75			0.88			0.95	1.00			0.95
Satd. Flow (perm)		1318			1554			1805	3532			1805
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	35	5	15	30	5	40	10	5	1740	10	20	5
RTOR Reduction (vph)	0	14	0	0	36	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	41	0	0	39	0	0	15	1750	0	0	25
Confl. Peds. (#/hr)			5	5				5				
Confl. Bikes (#/hr)										50		
Heavy Vehicles (%)	5%	0%	0%	0%	0%	0%	0%	0%	2%	20%	0%	0%
Turn Type	Perm	NA		Perm	NA		Prot	Prot	NA		Prot	Prot
Protected Phases		4			8		5	5	2		1	1
Permitted Phases	4			8								
Actuated Green, G (s)		11.6			11.6			2.0	91.8			3.8
Effective Green, g (s)		11.6			11.6			2.0	92.6			3.8
Actuated g/C Ratio		0.10			0.10			0.02	0.77			0.03
Clearance Time (s)		4.0			4.0			4.0	4.8			4.0
Vehicle Extension (s)		3.0			3.0			3.0	3.0			3.0
Lane Grp Cap (vph)		127			150			30	2725			57
v/s Ratio Prot								0.01	c0.50			0.01
v/s Ratio Perm		c0.03			0.03							
v/c Ratio		0.33			0.26			0.50	0.64			0.44
Uniform Delay, d1		50.6			50.2			58.5	6.2			57.1
Progression Factor		1.00			1.00			0.73	0.32			1.07
Incremental Delay, d2		1.5			0.9			9.4	0.9			5.1
Delay (s)		52.1			51.1			52.0	2.9			66.3
Level of Service		D			D			D	A			E
Approach Delay (s)		52.1			51.1				3.3			
Approach LOS		D			D				A			
Intersection Summary												
HCM 2000 Control Delay			5.7									
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			120.0									
Intersection Capacity Utilization			64.7%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

25: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd (Baird St)/SW Taylors Ferry Rd 04/21/2020



Movement	SBT	SBR
Lane Configurations	↑↑	↑
Traffic Volume (vph)	1095	15
Future Volume (vph)	1095	15
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	
Lane Util. Factor	0.95	
Frpb, ped/bikes	1.00	
Flpb, ped/bikes	1.00	
Frt	1.00	
Flt Protected	1.00	
Satd. Flow (prot)	3496	
Flt Permitted	1.00	
Satd. Flow (perm)	3496	
Peak-hour factor, PHF	1.00	1.00
Adj. Flow (vph)	1095	15
RTOR Reduction (vph)	0	0
Lane Group Flow (vph)	1110	0
Confl. Peds. (#/hr)		5
Confl. Bikes (#/hr)		50
Heavy Vehicles (%)	3%	0%
Turn Type	NA	
Protected Phases	6	
Permitted Phases		
Actuated Green, G (s)	93.6	
Effective Green, g (s)	94.4	
Actuated g/C Ratio	0.79	
Clearance Time (s)	4.8	
Vehicle Extension (s)	3.0	
Lane Grp Cap (vph)	2750	
v/s Ratio Prot	c0.32	
v/s Ratio Perm		
v/c Ratio	0.40	
Uniform Delay, d1	4.0	
Progression Factor	0.58	
Incremental Delay, d2	0.4	
Delay (s)	2.7	
Level of Service	A	
Approach Delay (s)	4.1	
Approach LOS	A	
Intersection Summary		

HCM Signalized Intersection Capacity Analysis

27: SW Barbur Blvd (Hwy 99W) & BTC Vehicle In/Out

04/21/2020



Movement	WBL	WBR	NBT	NBR	SBU	SBL	SBT
Lane Configurations	WT		WT			WT	WT
Traffic Volume (vph)	45	10	1740	0	55	25	1115
Future Volume (vph)	45	10	1740	0	55	25	1115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0
Lane Util. Factor	0.97		0.95			1.00	0.95
Frpb, ped/bikes	0.99		1.00			1.00	1.00
Flpb, ped/bikes	1.00		1.00			1.00	1.00
Frt	0.97		1.00			1.00	1.00
Flt Protected	0.96		1.00			0.95	1.00
Satd. Flow (prot)	3421		3539			1805	3505
Flt Permitted	0.96		1.00			0.95	1.00
Satd. Flow (perm)	3421		3539			1805	3505
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	45	10	1740	0	55	25	1115
RTOR Reduction (vph)	9	0	0	0	0	0	0
Lane Group Flow (vph)	46	0	1740	0	0	80	1115
Confl. Peds. (#/hr)	10	1		10		10	
Confl. Bikes (#/hr)		5		50			
Heavy Vehicles (%)	0%	0%	2%	0%	0%	0%	3%
Turn Type	Prot		NA		Prot	Prot	NA
Protected Phases	4		2		1	1	6
Permitted Phases							
Actuated Green, G (s)	13.5		86.5			7.2	97.7
Effective Green, g (s)	13.5		87.3			7.2	98.5
Actuated g/C Ratio	0.11		0.73			0.06	0.82
Clearance Time (s)	4.0		4.8			4.0	4.8
Vehicle Extension (s)	4.0		1.5			0.5	1.5
Lane Grp Cap (vph)	384		2574			108	2877
v/s Ratio Prot	c0.01		c0.49			c0.04	0.32
v/s Ratio Perm							
v/c Ratio	0.12		0.68			0.74	0.39
Uniform Delay, d1	47.9		8.8			55.5	2.8
Progression Factor	1.00		0.37			1.19	0.22
Incremental Delay, d2	0.2		1.0			20.1	0.4
Delay (s)	48.1		4.2			85.8	1.0
Level of Service	D		A			F	A
Approach Delay (s)	48.1		4.2				6.7
Approach LOS	D		A				A
Intersection Summary							
HCM 2000 Control Delay			6.0		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio			0.61				
Actuated Cycle Length (s)			120.0		Sum of lost time (s)		12.0
Intersection Capacity Utilization			66.6%		ICU Level of Service		C
Analysis Period (min)			15				
c Critical Lane Group							

HCM Signalized Intersection Capacity Analysis

29: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/BTC Bus/Vehicle In

04/21/2020

												
Movement	EBL	EBT	EBR2	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	235	50	110	15	0	15	110	1490	110	20	965	200
Future Volume (vph)	235	50	110	15	0	15	110	1490	110	20	965	200
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	4.8
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	*0.79	1.00
Frpb, ped/bikes		1.00	0.98		1.00		1.00	0.99		1.00	1.00	0.89
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.93		1.00	0.99		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1810	1357		864		1687	3488		902	2915	1336
Flt Permitted		0.96	1.00		0.82		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1810	1357		731		1687	3488		902	2915	1336
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	235	50	110	15	0	15	110	1490	110	20	965	200
RTOR Reduction (vph)	0	0	89	0	24	0	0	0	0	0	0	81
Lane Group Flow (vph)	0	285	21	0	6	0	110	1600	0	20	965	119
Confl. Peds. (#/hr)			5									15
Confl. Bikes (#/hr)									50			50
Heavy Vehicles (%)	1%	0%	17%	100%	4%	100%	7%	2%	0%	100%	3%	7%
Turn Type	Split	NA	Perm	Perm	NA		Prot	NA		Prot	NA	Perm
Protected Phases	4	4			8		5	2		1	6	
Permitted Phases			4	8								6
Actuated Green, G (s)		23.0	23.0		25.2		11.3	37.0		18.0	43.7	43.7
Effective Green, g (s)		23.0	23.0		25.2		11.3	37.8		18.0	44.5	43.7
Actuated g/C Ratio		0.19	0.19		0.21		0.09	0.31		0.15	0.37	0.36
Clearance Time (s)		4.0	4.0		4.0		4.0	4.8		4.0	4.8	4.8
Vehicle Extension (s)		3.0	3.0		3.0		0.5	1.5		3.0	3.0	3.0
Lane Grp Cap (vph)		346	260		153		158	1098		135	1080	486
v/s Ratio Prot		c0.16					c0.07	c0.46		0.02	c0.33	
v/s Ratio Perm			0.02		c0.01							0.09
v/c Ratio		0.82	0.08		0.04		0.70	1.46		0.15	0.89	0.25
Uniform Delay, d1		46.6	39.8		37.8		52.7	41.1		44.3	35.5	26.6
Progression Factor		1.00	1.00		1.00		0.99	0.84		0.95	0.70	0.97
Incremental Delay, d2		14.6	0.1		0.1		7.5	209.4		0.5	10.3	1.1
Delay (s)		61.2	40.0		37.9		59.6	244.1		42.5	35.1	26.9
Level of Service		E	D		D		E	F		D	D	C
Approach Delay (s)		55.3			37.9			232.2			33.8	
Approach LOS		E			D			F			C	
Intersection Summary												
HCM 2000 Control Delay			138.1				HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio			0.84									
Actuated Cycle Length (s)			120.0				Sum of lost time (s)			16.0		
Intersection Capacity Utilization			102.9%				ICU Level of Service			G		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

29: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/BTC Bus/Vehicle In

04/21/2020



Movement	NWR
Lane Configurations	
Traffic Volume (vph)	20
Future Volume (vph)	20
Ideal Flow (vphpl)	1900
Total Lost time (s)	4.0
Lane Util. Factor	1.00
Frpb, ped/bikes	1.00
Flpb, ped/bikes	1.00
Frt	0.86
Flt Protected	1.00
Satd. Flow (prot)	822
Flt Permitted	1.00
Satd. Flow (perm)	822
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	20
RTOR Reduction (vph)	0
Lane Group Flow (vph)	20
Confl. Peds. (#/hr)	
Confl. Bikes (#/hr)	
Heavy Vehicles (%)	100%
Turn Type	Over
Protected Phases	1
Permitted Phases	
Actuated Green, G (s)	18.0
Effective Green, g (s)	18.0
Actuated g/C Ratio	0.15
Clearance Time (s)	4.0
Vehicle Extension (s)	3.0
Lane Grp Cap (vph)	123
v/s Ratio Prot	0.02
v/s Ratio Perm	
v/c Ratio	0.16
Uniform Delay, d1	44.4
Progression Factor	1.00
Incremental Delay, d2	0.6
Delay (s)	45.1
Level of Service	D
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

30: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

04/21/2020



Movement	EBT	EBR	EBR2	WBT	WBR	NBT	SBL	SBT	SBR
Lane Configurations	↑↑			↑↑		↑↑	↘	↑↑	↘
Traffic Volume (vph)	720	75	295	430	425	1285	5	435	655
Future Volume (vph)	720	75	295	430	425	1285	5	435	655
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.1			6.1		5.3	4.0	5.3	5.3
Lane Util. Factor	0.95			0.95		0.95	1.00	0.95	1.00
Frpb, ped/bikes	1.00			0.99		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00			1.00		1.00	1.00	1.00	1.00
Frt	0.95			0.93		1.00	1.00	1.00	0.85
Flt Protected	1.00			1.00		1.00	0.95	1.00	1.00
Satd. Flow (prot)	3337			3209		3471	902	3505	1568
Flt Permitted	1.00			1.00		1.00	0.95	1.00	1.00
Satd. Flow (perm)	3337			3209		3471	902	3505	1568
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	720	75	295	430	425	1285	5	435	655
RTOR Reduction (vph)	0	0	0	73	0	0	0	0	0
Lane Group Flow (vph)	1090	0	0	782	0	1285	5	435	655
Confl. Peds. (#/hr)					10		5		
Heavy Vehicles (%)	3%	6%	1%	4%	2%	4%	100%	3%	3%
Turn Type	NA			NA		NA	Prot	NA	Perm
Protected Phases	4			8		2	1	6	
Permitted Phases									6
Actuated Green, G (s)	42.3			42.3		60.1	1.4	65.5	65.5
Effective Green, g (s)	42.3			42.3		60.9	1.4	66.3	66.3
Actuated g/C Ratio	0.35			0.35		0.51	0.01	0.55	0.55
Clearance Time (s)	6.1			6.1		6.1	4.0	6.1	6.1
Vehicle Extension (s)	0.2			0.2		0.2	0.5	0.2	0.2
Lane Grp Cap (vph)	1176			1131		1761	10	1936	866
v/s Ratio Prot	c0.33			0.24		0.37	0.01	0.12	
v/s Ratio Perm									c0.42
v/c Ratio	0.93			0.69		0.73	0.50	0.22	0.76
Uniform Delay, d1	37.4			33.3		23.1	59.0	13.7	20.6
Progression Factor	1.00			1.00		1.00	1.18	1.78	1.75
Incremental Delay, d2	12.1			1.5		2.7	8.4	0.2	3.8
Delay (s)	49.5			34.8		25.8	77.9	24.6	39.9
Level of Service	D			C		C	E	C	D
Approach Delay (s)	49.5			34.8		25.8		34.0	
Approach LOS	D			C		C		C	
Intersection Summary									
HCM 2000 Control Delay			35.6			HCM 2000 Level of Service			D
HCM 2000 Volume to Capacity ratio			0.85						
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			15.4
Intersection Capacity Utilization			81.8%			ICU Level of Service			D
Analysis Period (min)			15						
c Critical Lane Group									

Intersection

Int Delay, s/veh 2.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↑	
Traffic Vol, veh/h	630	0	0	280	95	0
Future Vol, veh/h	630	0	0	280	95	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	0	0	0	0	1
Mvmt Flow	630	0	0	280	95	0

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	-	- 910
Stage 1	-	-	- 630
Stage 2	-	-	- 280
Critical Hdwy	-	-	- 6.4
Critical Hdwy Stg 1	-	-	- 5.4
Critical Hdwy Stg 2	-	-	- 5.4
Follow-up Hdwy	-	-	- 3.5
Pot Cap-1 Maneuver	-	0	0 - 307
Stage 1	-	0	0 - 535
Stage 2	-	0	0 - 772
Platoon blocked, %	-		-
Mov Cap-1 Maneuver	-	-	- 307
Mov Cap-2 Maneuver	-	-	- 307
Stage 1	-	-	- 535
Stage 2	-	-	- 772

Approach	EB	WB	NB
HCM Control Delay, s	0	0	21.9
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	WBT
Capacity (veh/h)	307	-	-
HCM Lane V/C Ratio	0.309	-	-
HCM Control Delay (s)	21.9	-	-
HCM Lane LOS	C	-	-
HCM 95th %tile Q(veh)	1.3	-	-

Intersection

Intersection Delay, s/veh 52.1

Intersection LOS F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	70	235	200	85	125	55	120	190	120	15	395	25
Future Vol, veh/h	70	235	200	85	125	55	120	190	120	15	395	25
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	0	2	1	0	1	0	0	2	0	10	2	0
Mvmt Flow	70	235	200	85	125	55	120	190	120	15	395	25
Number of Lanes	1	1	0	1	1	0	0	2	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	2	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	1	2	2
HCM Control Delay	60.2	18.2	21.2	93.8
HCM LOS	F	C	C	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	56%	0%	100%	0%	100%	0%	3%
Vol Thru, %	44%	44%	0%	54%	0%	69%	91%
Vol Right, %	0%	56%	0%	46%	0%	31%	6%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	215	215	70	435	85	180	435
LT Vol	120	0	70	0	85	0	15
Through Vol	95	95	0	235	0	125	395
RT Vol	0	120	0	200	0	55	25
Lane Flow Rate	215	215	70	435	85	180	435
Geometry Grp	7	7	7	7	7	7	6
Degree of Util (X)	0.538	0.5	0.174	0.979	0.228	0.447	1.066
Departure Headway (Hd)	9.38	8.717	9.279	8.456	10.115	9.381	8.826
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	387	417	389	431	357	387	409
Service Time	7.08	6.417	6.979	6.156	7.815	7.081	6.899
HCM Lane V/C Ratio	0.556	0.516	0.18	1.009	0.238	0.465	1.064
HCM Control Delay	22.5	19.8	13.9	67.6	15.8	19.4	93.8
HCM Lane LOS	C	C	B	F	C	C	F
HCM 95th-tile Q	3.1	2.7	0.6	12	0.9	2.2	14.5

HCM Signalized Intersection Capacity Analysis

36: SW Barbur (Hwy 99w) & SW 53rd Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	35	5	255	50	50	120	1305	250	20	370	15
Future Volume (vph)	15	35	5	255	50	50	120	1305	250	20	370	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99			0.99		1.00	0.95		1.00	0.99	
Flpb, ped/bikes	0.97	1.00			0.94		1.00	1.00		1.00	1.00	
Frt	1.00	0.98			0.98		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1756	1668			1635		1805	3125		1805	3232	
Flt Permitted	0.64	1.00			0.76		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1175	1668			1290		1805	3125		1805	3232	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	35	5	255	50	50	120	1305	250	20	370	15
RTOR Reduction (vph)	0	4	0	0	4	0	0	9	0	0	2	0
Lane Group Flow (vph)	15	36	0	0	351	0	120	1546	0	20	383	0
Confl. Peds. (#/hr)	50		50	50		50			50			50
Confl. Bikes (#/hr)									50			50
Heavy Vehicles (%)	0%	9%	20%	3%	0%	0%	0%	7%	6%	0%	10%	0%
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4								
Actuated Green, G (s)	44.0	44.0			44.0		14.7	90.4		2.8	78.5	
Effective Green, g (s)	44.0	44.0			44.0		14.7	91.2		2.8	79.3	
Actuated g/C Ratio	0.29	0.29			0.29		0.10	0.61		0.02	0.53	
Clearance Time (s)	4.0	4.0			4.0		4.0	4.8		4.0	4.8	
Vehicle Extension (s)	2.5	2.5			2.5		3.0	4.8		3.0	4.8	
Lane Grp Cap (vph)	344	489			378		176	1900		33	1708	
v/s Ratio Prot		0.02					c0.07	c0.49		0.01	0.12	
v/s Ratio Perm	0.01				c0.27							
v/c Ratio	0.04	0.07			0.93		0.68	0.81		0.61	0.22	
Uniform Delay, d1	37.9	38.3			51.5		65.4	22.8		73.1	18.9	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.0	0.0			28.5		10.4	3.9		27.6	0.3	
Delay (s)	38.0	38.3			79.9		75.8	26.7		100.6	19.2	
Level of Service	D	D			E		E	C		F	B	
Approach Delay (s)		38.2			79.9			30.3			23.2	
Approach LOS		D			E			C			C	
Intersection Summary												
HCM 2000 Control Delay			36.4				HCM 2000 Level of Service			D		
HCM 2000 Volume to Capacity ratio			0.85									
Actuated Cycle Length (s)			150.0				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			85.4%				ICU Level of Service			E		
Analysis Period (min)			15									
c Critical Lane Group												

APPENDIX B29

Segment B – PM LPA HCM Results

HCM Signalized Intersection Capacity Analysis

1: SW Barbur Blvd (Hwy 99W)/SW Barbur Blvd (Hwy 99 W) & SW 2nd Ave

04/21/2020



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		↑↑		W	↑↑
Traffic Volume (vph)	190	20	1320	155	35	1565
Future Volume (vph)	190	20	1320	155	35	1565
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0	4.0
Lane Util. Factor	1.00		0.95		1.00	0.95
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.99		0.98		1.00	1.00
Flt Protected	0.96		1.00		0.95	1.00
Satd. Flow (prot)	1794		3443		1805	3539
Flt Permitted	0.96		1.00		0.95	1.00
Satd. Flow (perm)	1794		3443		1805	3539
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	190	20	1320	155	35	1565
RTOR Reduction (vph)	3	0	6	0	0	0
Lane Group Flow (vph)	207	0	1469	0	35	1565
Confl. Bikes (#/hr)				50		
Heavy Vehicles (%)	0%	0%	3%	0%	0%	2%
Turn Type	Prot		NA		Prot	NA
Protected Phases	8		6		5	2
Permitted Phases						
Actuated Green, G (s)	19.9		84.4		3.2	91.6
Effective Green, g (s)	19.9		84.9		3.2	92.1
Actuated g/C Ratio	0.17		0.71		0.03	0.77
Clearance Time (s)	4.0		4.5		4.0	4.5
Vehicle Extension (s)	3.0		3.0		0.2	3.0
Lane Grp Cap (vph)	297		2435		48	2716
v/s Ratio Prot	c0.12		c0.43		0.02	c0.44
v/s Ratio Perm						
v/c Ratio	0.70		0.60		0.73	0.58
Uniform Delay, d1	47.2		9.0		58.0	5.8
Progression Factor	1.00		0.22		1.00	1.00
Incremental Delay, d2	6.9		1.0		37.1	0.9
Delay (s)	54.1		2.9		95.1	6.7
Level of Service	D		A		F	A
Approach Delay (s)	54.1		2.9			8.6
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			9.0		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.63			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			61.7%		ICU Level of Service	B
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

2: SW Barbur Blvd (Hwy 99W) & SW 3rd Ave

04/21/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↔			↔	
Traffic Volume (vph)	5	0	10	0	0	5	20	1465	0	0	1745	10
Future Volume (vph)	5	0	10	0	0	5	20	1465	0	0	1745	10
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	
Lane Util. Factor		1.00			1.00		1.00	0.95			0.95	
Frpb, ped/bikes		0.99			0.98		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.91			0.86		1.00	1.00			1.00	
Flt Protected		0.98			1.00		0.95	1.00			1.00	
Satd. Flow (prot)		1681			1610		1805	3505			3535	
Flt Permitted		0.95			1.00		0.95	1.00			1.00	
Satd. Flow (perm)		1623			1610		1805	3505			3535	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	0	10	0	0	5	20	1465	0	0	1745	10
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	15	0	0	5	0	20	1465	0	0	1755	0
Confl. Peds. (#/hr)			5	5		10	30					30
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	2%	0%
Turn Type	Perm	NA			NA		Prot	NA			NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8								
Actuated Green, G (s)		19.9			19.9		3.2	91.6			84.4	
Effective Green, g (s)		19.9			19.9		3.2	92.1			84.9	
Actuated g/C Ratio		0.17			0.17		0.03	0.77			0.71	
Clearance Time (s)		4.0			4.0		4.0	4.5			4.5	
Vehicle Extension (s)		3.0			3.0		0.2	3.0			3.0	
Lane Grp Cap (vph)		269			266		48	2690			2501	
v/s Ratio Prot					0.00		0.01	c0.42			c0.50	
v/s Ratio Perm		c0.01										
v/c Ratio		0.06			0.02		0.42	0.54			0.70	
Uniform Delay, d1		42.1			41.9		57.5	5.6			10.2	
Progression Factor		1.00			1.00		0.77	0.24			0.71	
Incremental Delay, d2		0.1			0.0		1.1	0.4			1.4	
Delay (s)		42.2			41.9		45.6	1.7			8.6	
Level of Service		D			D		D	A			A	
Approach Delay (s)		42.2			41.9			2.3			8.6	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			6.0									
HCM 2000 Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			120.0									
Intersection Capacity Utilization			67.3%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

3: SW Barbur Blvd (Hwy 99W) & SW Terwilliger Blvd

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	165	240	365	210	410	95	1025	455	350	1355	50
Future Volume (vph)	50	165	240	365	210	410	95	1025	455	350	1355	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	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.95	1.00	1.00	0.91	0.91
Frpb, ped/bikes	1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.95	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.90		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1881	1530	1787	1652		1770	3539	1523	1787	3388	1380
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1881	1530	1787	1652		1770	3539	1523	1787	3388	1380
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	50	165	240	365	210	410	95	1025	455	350	1355	50
RTOR Reduction (vph)	0	0	131	0	57	0	0	0	0	0	0	26
Lane Group Flow (vph)	50	165	109	365	563	0	95	1025	455	350	1360	19
Confl. Peds. (#/hr)			20			10			10			20
Confl. Bikes (#/hr)			5			5			50			50
Heavy Vehicles (%)	2%	1%	2%	1%	2%	2%	2%	2%	1%	1%	2%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pm+ov	Prot	NA	Perm
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases			8						6			2
Actuated Green, G (s)	4.8	23.8	23.8	25.0	44.0		5.0	40.7	65.7	14.0	49.7	49.7
Effective Green, g (s)	4.8	23.8	23.8	25.0	44.0		5.0	41.2	65.7	14.0	50.2	50.2
Actuated g/C Ratio	0.04	0.20	0.20	0.21	0.37		0.04	0.34	0.55	0.12	0.42	0.42
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.5	4.0	4.0	4.5	4.5
Vehicle Extension (s)	0.5	1.0	1.0	0.5	1.0		0.5	0.5	0.5	0.5	0.5	0.5
Lane Grp Cap (vph)	70	373	303	372	605		73	1215	884	208	1417	577
v/s Ratio Prot	0.03	0.09		c0.20	c0.34		0.05	0.29	0.11	c0.20	c0.40	
v/s Ratio Perm			0.07						0.19			0.01
v/c Ratio	0.71	0.44	0.36	0.98	0.93		1.30	0.84	0.51	1.68	0.96	0.03
Uniform Delay, d1	56.9	42.3	41.5	47.3	36.5		57.5	36.4	17.1	53.0	33.9	20.6
Progression Factor	1.00	1.00	1.00	1.00	1.00		0.81	0.56	0.47	0.81	0.71	1.00
Incremental Delay, d2	24.8	0.3	0.3	41.3	20.9		191.4	5.5	0.2	321.7	12.7	0.1
Delay (s)	81.7	42.6	41.8	88.6	57.4		237.9	25.8	8.2	364.8	36.7	20.7
Level of Service	F	D	D	F	E		F	C	A	F	D	C
Approach Delay (s)		46.5			69.0			33.5			101.7	
Approach LOS		D			E			C			F	
Intersection Summary												
HCM 2000 Control Delay			67.2			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.08									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			103.2%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd/I-5 Ramps

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	415	100	45	105	120	290	10	25	870	55	20	1585
Future Volume (vph)	415	100	45	105	120	290	10	25	870	55	20	1585
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	0.95	0.95		1.00	1.00	1.00		1.00	0.95		1.00	*0.98
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	1.00		1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85		1.00	0.99		1.00	1.00
Flt Protected	0.95	0.98		0.95	1.00	1.00		0.95	1.00		0.95	1.00
Satd. Flow (prot)	1698	1674		1805	1863	1599		1662	3486		1703	3687
Flt Permitted	0.95	0.98		0.95	1.00	1.00		0.95	1.00		0.95	1.00
Satd. Flow (perm)	1698	1674		1805	1863	1599		1662	3486		1703	3687
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	415	100	45	105	120	290	10	25	870	55	20	1585
RTOR Reduction (vph)	0	6	0	0	0	154	0	0	3	0	0	0
Lane Group Flow (vph)	282	272	0	105	120	136	0	35	922	0	20	1585
Confl. Peds. (#/hr)			10	10				25		5	5	
Confl. Bikes (#/hr)										50		
Heavy Vehicles (%)	1%	4%	3%	0%	2%	1%	0%	12%	2%	7%	6%	1%
Turn Type	Split	NA		Split	NA	Perm	Prot	Prot	NA		Prot	NA
Protected Phases	3	3		4	4		1	1	6		5	2
Permitted Phases						4						
Actuated Green, G (s)	22.2	22.2		6.4	6.4	6.4		4.0	73.1		1.8	70.9
Effective Green, g (s)	22.2	22.2		6.4	6.4	6.4		4.0	73.6		1.8	71.4
Actuated g/C Ratio	0.18	0.18		0.05	0.05	0.05		0.03	0.61		0.02	0.60
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.5		4.0	4.5
Vehicle Extension (s)	1.0	1.0		1.0	1.0	1.0		1.5	0.5		1.0	0.5
Lane Grp Cap (vph)	314	309		96	99	85		55	2138		25	2193
v/s Ratio Prot	c0.17	0.16		0.06	0.06			c0.02	0.26		0.01	c0.43
v/s Ratio Perm						c0.08						
v/c Ratio	0.90	0.88		1.09	1.21	1.60		0.64	0.43		0.80	0.72
Uniform Delay, d1	47.8	47.6		56.8	56.8	56.8		57.3	12.2		58.9	17.3
Progression Factor	1.00	1.00		1.00	1.00	1.00		0.98	0.28		0.88	0.27
Incremental Delay, d2	25.9	23.5		119.4	158.2	316.4		15.6	0.6		49.9	0.9
Delay (s)	73.7	71.1		176.2	215.0	373.2		71.8	4.0		101.7	5.5
Level of Service	E	E		F	F	F		E	A		F	A
Approach Delay (s)		72.4			296.2				6.4			5.6
Approach LOS		E			F				A			A
Intersection Summary												
HCM 2000 Control Delay			52.6				HCM 2000 Level of Service		D			
HCM 2000 Volume to Capacity ratio			0.81									
Actuated Cycle Length (s)			120.0				Sum of lost time (s)		16.5			
Intersection Capacity Utilization			97.4%				ICU Level of Service		F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd/I-5 Ramps

04/21/2020

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	355
Future Volume (vph)	355
Ideal Flow (vphpl)	1900
Total Lost time (s)	4.5
Lane Util. Factor	1.00
Frpb, ped/bikes	1.00
Flpb, ped/bikes	1.00
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1599
Flt Permitted	1.00
Satd. Flow (perm)	1599
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	355
RTOR Reduction (vph)	38
Lane Group Flow (vph)	317
Confl. Peds. (#/hr)	25
Confl. Bikes (#/hr)	50
Heavy Vehicles (%)	1%
Turn Type	pt+ov
Protected Phases	2 3
Permitted Phases	
Actuated Green, G (s)	97.1
Effective Green, g (s)	93.1
Actuated g/C Ratio	0.78
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	1240
v/s Ratio Prot	0.20
v/s Ratio Perm	
v/c Ratio	0.26
Uniform Delay, d1	3.8
Progression Factor	0.08
Incremental Delay, d2	0.0
Delay (s)	0.3
Level of Service	A
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

9: SW Terwilliger Blvd

04/21/2020

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	335	255	0	650	970	0
Future Volume (vph)	335	255	0	650	970	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.3	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1599		1881	1881	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1599		1881	1881	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	335	255	0	650	970	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	335	255	0	650	970	0
Heavy Vehicles (%)	2%	1%	0%	1%	1%	0%
Turn Type	Prot	custom		NA	NA	
Protected Phases	4	1		6	2	
Permitted Phases		4				
Actuated Green, G (s)	27.5	37.9		81.5	66.5	
Effective Green, g (s)	28.1	39.1		82.1	67.1	
Actuated g/C Ratio	0.24	0.33		0.69	0.57	
Clearance Time (s)	4.9	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	419	527		1303	1065	
v/s Ratio Prot	c0.19	0.04		c0.35	c0.52	
v/s Ratio Perm		0.11				
v/c Ratio	0.80	0.48		0.50	0.91	
Uniform Delay, d1	42.5	31.7		8.5	23.0	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	10.2	0.7		0.3	11.5	
Delay (s)	52.8	32.4		8.8	34.5	
Level of Service	D	C		A	C	
Approach Delay (s)	44.0			8.8	34.5	
Approach LOS	D			A	C	
Intersection Summary						
HCM 2000 Control Delay		29.5		HCM 2000 Level of Service		C
HCM 2000 Volume to Capacity ratio		0.85				
Actuated Cycle Length (s)		118.5		Sum of lost time (s)		12.3
Intersection Capacity Utilization		76.5%		ICU Level of Service		D
Analysis Period (min)		15				
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

10: SW Barbur Blvd (Hwy 99W) & SW 13th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	55	5	240	5	5	5	30	255	935	10	0	1585
Future Volume (vph)	55	5	240	5	5	5	30	255	935	10	0	1585
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0			4.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	0.95			0.95
Frpb, ped/bikes	1.00	0.98		1.00	0.95			1.00	1.00			1.00
Flpb, ped/bikes	0.90	1.00		1.00	1.00			1.00	1.00			1.00
Frt	1.00	0.85		1.00	0.93			1.00	1.00			1.00
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00			1.00
Satd. Flow (prot)	1627	1593		1770	1628			1770	3534			3533
Flt Permitted	0.75	1.00		0.35	1.00			0.95	1.00			1.00
Satd. Flow (perm)	1286	1593		658	1628			1770	3534			3533
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	55	5	240	5	5	5	30	255	935	10	0	1585
RTOR Reduction (vph)	0	161	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	55	84	0	5	10	0	0	285	945	0	0	1600
Confl. Peds. (#/hr)	100					100		5				
Confl. Bikes (#/hr)			5									
Heavy Vehicles (%)	0%	2%	0%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA		Prot	Prot	NA			NA
Protected Phases		4			8		1	1	6			2
Permitted Phases	4			8								
Actuated Green, G (s)	25.9	25.9		25.9	25.9			20.2	85.6			61.4
Effective Green, g (s)	25.9	25.9		25.9	25.9			20.2	86.1			61.9
Actuated g/C Ratio	0.22	0.22		0.22	0.22			0.17	0.72			0.52
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.5			4.5
Vehicle Extension (s)	2.0	2.0		3.0	3.0			2.0	2.0			2.0
Lane Grp Cap (vph)	277	343		142	351			297	2535			1822
v/s Ratio Prot		c0.05			0.01			c0.16	0.27			c0.45
v/s Ratio Perm	0.04			0.01								
v/c Ratio	0.20	0.25		0.04	0.03			0.96	0.37			0.88
Uniform Delay, d1	38.5	39.0		37.2	37.1			49.5	6.5			25.7
Progression Factor	1.00	1.00		1.00	1.00			0.52	1.24			0.55
Incremental Delay, d2	0.1	0.1		0.1	0.0			33.8	0.3			4.4
Delay (s)	38.7	39.1		37.3	37.2			59.6	8.4			18.5
Level of Service	D	D		D	D			E	A			B
Approach Delay (s)		39.0			37.2				20.3			18.5
Approach LOS		D			D				C			B
Intersection Summary												
HCM 2000 Control Delay			21.3			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			99.2%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

10: SW Barbur Blvd (Hwy 99W) & SW 13th Ave

04/21/2020

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	15
Future Volume (vph)	15
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	15
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	5
Confl. Bikes (#/hr)	50
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

13: SW Barbur Blvd (Hwy 99W) & SW Capitol Hill Rd/SW 19th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations												
Traffic Volume (vph)	65	90	110	170	100	70	30	105	1065	20	35	110
Future Volume (vph)	65	90	110	170	100	70	30	105	1065	20	35	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0		4.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	0.95	1.00		1.00
Frpb, ped/bikes	1.00	0.94		1.00	0.96			1.00	1.00	0.66		1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00	1.00		1.00
Frt	1.00	0.92		1.00	0.94			1.00	1.00	0.85		1.00
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (prot)	1770	1635		1787	1678			1805	3539	1060		1739
Flt Permitted	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (perm)	1770	1635		1787	1678			1805	3539	1060		1739
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	65	90	110	170	100	70	30	105	1065	20	35	110
RTOR Reduction (vph)	0	39	0	0	21	0	0	0	0	11	0	0
Lane Group Flow (vph)	65	161	0	170	149	0	0	135	1065	9	0	145
Confl. Peds. (#/hr)	100		100	100		100				100		
Confl. Bikes (#/hr)										50		
Heavy Vehicles (%)	2%	0%	0%	1%	0%	4%	0%	0%	2%	0%	0%	5%
Turn Type	Prot	NA		Prot	NA		Prot	Prot	NA	Perm	Prot	Prot
Protected Phases	3	8		7	4		1	1	6		5	5
Permitted Phases										6		
Actuated Green, G (s)	4.8	25.7		13.0	33.9			7.0	51.8	51.8		13.0
Effective Green, g (s)	4.8	25.7		13.0	33.9			7.0	52.3	52.3		13.0
Actuated g/C Ratio	0.04	0.21		0.11	0.28			0.06	0.44	0.44		0.11
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.5	4.5		4.0
Vehicle Extension (s)	2.0	2.0		2.0	2.0			2.0	0.5	0.5		0.5
Lane Grp Cap (vph)	70	350		193	474			105	1542	461		188
v/s Ratio Prot	c0.04	c0.10		c0.10	0.09			c0.07	0.30			0.08
v/s Ratio Perm										0.01		
v/c Ratio	0.93	0.46		0.88	0.31			1.29	0.69	0.02		0.77
Uniform Delay, d1	57.4	41.1		52.7	33.9			56.5	27.3	19.3		52.1
Progression Factor	1.00	1.00		1.00	1.00			0.78	1.18	1.00		0.70
Incremental Delay, d2	81.2	0.4		33.3	0.1			179.3	2.3	0.1		9.4
Delay (s)	138.6	41.5		86.1	34.0			223.5	34.5	19.3		45.6
Level of Service	F	D		F	C			F	C	B		D
Approach Delay (s)		65.3			60.1				55.2			
Approach LOS		E			E				E			
Intersection Summary												
HCM 2000 Control Delay			41.4			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.89									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			106.1%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: SW Barbur Blvd (Hwy 99W) & SW Capitol Hill Rd/SW 19th Ave

04/21/2020



Movement	SBT	SBR
Lane Configurations	↑↑	→
Traffic Volume (vph)	1620	70
Future Volume (vph)	1620	70
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	
Lane Util. Factor	0.95	
Frpb, ped/bikes	0.99	
Flpb, ped/bikes	1.00	
Frt	0.99	
Flt Protected	1.00	
Satd. Flow (prot)	3470	
Flt Permitted	1.00	
Satd. Flow (perm)	3470	
Peak-hour factor, PHF	1.00	1.00
Adj. Flow (vph)	1620	70
RTOR Reduction (vph)	3	0
Lane Group Flow (vph)	1687	0
Confl. Peds. (#/hr)		100
Confl. Bikes (#/hr)		50
Heavy Vehicles (%)	2%	0%
Turn Type	NA	
Protected Phases	2	
Permitted Phases		
Actuated Green, G (s)	57.8	
Effective Green, g (s)	58.3	
Actuated g/C Ratio	0.49	
Clearance Time (s)	4.5	
Vehicle Extension (s)	0.5	
Lane Grp Cap (vph)	1685	
v/s Ratio Prot	c0.49	
v/s Ratio Perm		
v/c Ratio	1.00	
Uniform Delay, d1	30.9	
Progression Factor	0.23	
Incremental Delay, d2	16.5	
Delay (s)	23.6	
Level of Service	C	
Approach Delay (s)	25.3	
Approach LOS	C	
Intersection Summary		

HCM Signalized Intersection Capacity Analysis

15: SW Barbur Blvd (Hwy 99W) & SW 22nd Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↕			↕	
Traffic Volume (vph)	25	15	55	120	75	25	0	1155	10	0	1420	10
Future Volume (vph)	25	15	55	120	75	25	0	1155	10	0	1420	10
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	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frpb, ped/bikes		0.99			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.92			0.98			1.00			1.00	
Flt Protected		0.99			0.97			1.00			1.00	
Satd. Flow (prot)		1694			1817			3533			3569	
Flt Permitted		0.88			0.73			1.00			1.00	
Satd. Flow (perm)		1510			1364			3533			3569	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	25	15	55	120	75	25	0	1155	10	0	1420	10
RTOR Reduction (vph)	0	42	0	0	4	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	53	0	0	216	0	0	1165	0	0	1430	0
Confl. Peds. (#/hr)			5	5			5		10	10		5
Confl. Bikes (#/hr)									50			50
Heavy Vehicles (%)	4%	0%	0%	0%	0%	0%	0%	2%	0%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA			NA			NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4								
Actuated Green, G (s)		21.0			21.0			90.5			90.5	
Effective Green, g (s)		21.0			21.0			91.0			91.0	
Actuated g/C Ratio		0.18			0.18			0.76			0.76	
Clearance Time (s)		4.0			4.0			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		264			238			2679			2706	
v/s Ratio Prot								0.33			c0.40	
v/s Ratio Perm		0.04			c0.16							
v/c Ratio		0.20			0.91			0.43			0.53	
Uniform Delay, d1		42.3			48.5			5.2			5.8	
Progression Factor		1.00			1.00			0.89			0.18	
Incremental Delay, d2		0.4			34.1			0.5			0.2	
Delay (s)		42.7			82.7			5.1			1.3	
Level of Service		D			F			A			A	
Approach Delay (s)		42.7			82.7			5.1			1.3	
Approach LOS		D			F			A			A	
Intersection Summary												
HCM 2000 Control Delay			10.3									
HCM 2000 Volume to Capacity ratio			0.60									
Actuated Cycle Length (s)			120.0								8.0	
Intersection Capacity Utilization			65.0%								C	
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	110	5	60	130	25	50	20	60	1285	5	0	1490
Future Volume (vph)	110	5	60	130	25	50	20	60	1285	5	0	1490
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0			4.0
Lane Util. Factor		1.00			1.00	1.00		1.00	0.95			0.95
Frpb, ped/bikes		1.00			1.00	0.98		1.00	1.00			1.00
Flpb, ped/bikes		1.00			1.00	1.00		1.00	1.00			1.00
Frt		0.95			1.00	0.85		1.00	1.00			1.00
Flt Protected		0.97			0.96	1.00		0.95	1.00			1.00
Satd. Flow (prot)		1740			1808	1577		1796	3572			3537
Flt Permitted		0.54			0.66	1.00		0.95	1.00			1.00
Satd. Flow (perm)		962			1242	1577		1796	3572			3537
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	110	5	60	130	25	50	20	60	1285	5	0	1490
RTOR Reduction (vph)	0	16	0	0	0	41	0	0	0	0	0	0
Lane Group Flow (vph)	0	159	0	0	155	9	0	80	1290	0	0	1495
Confl. Peds. (#/hr)	5					5	5			5	5	
Confl. Bikes (#/hr)						5				50		
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	2%	0%	1%	0%	0%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Prot	Prot	NA			NA
Protected Phases		8			4		1	1	6			2
Permitted Phases	8			4		4						
Actuated Green, G (s)		20.9			20.9	20.9		8.8	90.6			77.8
Effective Green, g (s)		20.9			20.9	20.9		8.8	91.1			78.3
Actuated g/C Ratio		0.17			0.17	0.17		0.07	0.76			0.65
Clearance Time (s)		4.0			4.0	4.0		4.0	4.5			4.5
Vehicle Extension (s)		2.0			2.0	2.0		3.0	2.0			2.0
Lane Grp Cap (vph)		167			216	274		131	2711			2307
v/s Ratio Prot								0.04	c0.36			c0.42
v/s Ratio Perm		c0.17			0.12	0.01						
v/c Ratio		0.95			0.72	0.03		0.61	0.48			0.65
Uniform Delay, d1		49.1			46.8	41.1		53.9	5.4			12.6
Progression Factor		1.00			1.00	1.00		1.04	1.82			0.31
Incremental Delay, d2		55.3			9.1	0.0		7.8	0.6			1.2
Delay (s)		104.4			55.9	41.2		64.1	10.5			5.1
Level of Service		F			E	D		E	B			A
Approach Delay (s)		104.4			52.3				13.6			5.1
Approach LOS		F			D				B			A
Intersection Summary												
HCM 2000 Control Delay			17.1				HCM 2000 Level of Service		B			
HCM 2000 Volume to Capacity ratio			0.70									
Actuated Cycle Length (s)			120.0				Sum of lost time (s)		12.0			
Intersection Capacity Utilization			72.5%				ICU Level of Service		C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/21/2020

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	5
Future Volume (vph)	5
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	5
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	5
Confl. Bikes (#/hr)	50
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

22: SW Barbur Blvd (Hwy 99W) & SW 30th Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations												
Traffic Volume (vph)	45	5	140	5	5	20	50	110	1030	5	20	5
Future Volume (vph)	45	5	140	5	5	20	50	110	1030	5	20	5
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
Lane Util. Factor		1.00			1.00			1.00	0.95			1.00
Frpb, ped/bikes		0.96			0.96			1.00	1.00			1.00
Flpb, ped/bikes		0.99			1.00			1.00	1.00			1.00
Frt		0.90			0.91			1.00	1.00			1.00
Flt Protected		0.99			0.99			0.95	1.00			0.95
Satd. Flow (prot)		1580			1647			1805	3536			1805
Flt Permitted		0.93			0.96			0.95	1.00			0.95
Satd. Flow (perm)		1483			1597			1805	3536			1805
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	45	5	140	5	5	20	50	110	1030	5	20	5
RTOR Reduction (vph)	0	77	0	0	15	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	113	0	0	15	0	0	160	1035	0	0	25
Confl. Peds. (#/hr)	50		50	50		50						
Confl. Bikes (#/hr)										50		
Heavy Vehicles (%)	3%	0%	2%	0%	0%	0%	0%	0%	2%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Prot	Prot	NA		Prot	Prot
Protected Phases		4			8		1	1	6		5	5
Permitted Phases	4			8								
Actuated Green, G (s)		30.0			30.0			12.0	73.8			3.4
Effective Green, g (s)		30.0			30.0			12.0	74.6			3.4
Actuated g/C Ratio		0.25			0.25			0.10	0.62			0.03
Clearance Time (s)		4.0			4.0			4.0	4.8			4.0
Vehicle Extension (s)		2.0			2.0			0.5	0.5			0.5
Lane Grp Cap (vph)		370			399			180	2198			51
v/s Ratio Prot								c0.09	0.29			0.01
v/s Ratio Perm		c0.08			0.01							
v/c Ratio		0.30			0.04			0.89	0.47			0.49
Uniform Delay, d1		36.5			34.1			53.3	12.1			57.4
Progression Factor		1.00			1.00			1.00	0.90			1.26
Incremental Delay, d2		0.2			0.0			35.0	0.7			2.0
Delay (s)		36.7			34.1			88.6	11.6			74.6
Level of Service		D			C			F	B			E
Approach Delay (s)		36.7			34.1				21.9			
Approach LOS		D			C				C			
Intersection Summary												
HCM 2000 Control Delay			18.5			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.65									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			95.3%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

22: SW Barbur Blvd (Hwy 99W) & SW 30th Ave

04/21/2020



Movement	SBT	SBR
Lane Configurations	↑↑	↑
Traffic Volume (vph)	1390	50
Future Volume (vph)	1390	50
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	
Lane Util. Factor	0.95	
Frpb, ped/bikes	0.99	
Flpb, ped/bikes	1.00	
Frt	0.99	
Flt Protected	1.00	
Satd. Flow (prot)	3432	
Flt Permitted	1.00	
Satd. Flow (perm)	3432	
Peak-hour factor, PHF	1.00	1.00
Adj. Flow (vph)	1390	50
RTOR Reduction (vph)	2	0
Lane Group Flow (vph)	1438	0
Confl. Peds. (#/hr)		50
Confl. Bikes (#/hr)		50
Heavy Vehicles (%)	4%	2%
Turn Type	NA	
Protected Phases	2	
Permitted Phases		
Actuated Green, G (s)	65.2	
Effective Green, g (s)	66.0	
Actuated g/C Ratio	0.55	
Clearance Time (s)	4.8	
Vehicle Extension (s)	0.5	
Lane Grp Cap (vph)	1887	
v/s Ratio Prot	c0.42	
v/s Ratio Perm		
v/c Ratio	0.76	
Uniform Delay, d1	20.9	
Progression Factor	0.47	
Incremental Delay, d2	2.3	
Delay (s)	12.0	
Level of Service	B	
Approach Delay (s)	13.1	
Approach LOS	B	
Intersection Summary		

HCM Signalized Intersection Capacity Analysis

24: SW Barbur Blvd (Hwy 99W) & SW Alice St

04/21/2020



Movement	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	10	10	60	10	1165	1490	30
Future Volume (vph)	10	10	60	10	1165	1490	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	4.0	
Lane Util. Factor	1.00			1.00	0.95	0.95	
Frpb, ped/bikes	1.00			1.00	1.00	1.00	
Flpb, ped/bikes	1.00			1.00	1.00	1.00	
Frt	0.93			1.00	1.00	1.00	
Flt Protected	0.98			0.95	1.00	1.00	
Satd. Flow (prot)	1729			1805	3505	3527	
Flt Permitted	0.98			0.95	1.00	1.00	
Satd. Flow (perm)	1729			1805	3505	3527	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	10	10	60	10	1165	1490	30
RTOR Reduction (vph)	9	0	0	0	0	1	0
Lane Group Flow (vph)	11	0	0	70	1165	1519	0
Confl. Bikes (#/hr)							50
Heavy Vehicles (%)	0%	0%	0%	0%	3%	2%	0%
Turn Type	Prot		Prot	Prot	NA	NA	
Protected Phases	7		5	5	2	6	
Permitted Phases							
Actuated Green, G (s)	7.2			8.0	104.0	92.0	
Effective Green, g (s)	7.2			8.0	104.8	92.8	
Actuated g/C Ratio	0.06			0.07	0.87	0.77	
Clearance Time (s)	4.0			4.0	4.8	4.8	
Vehicle Extension (s)	3.0			3.0	3.0	3.0	
Lane Grp Cap (vph)	103			120	3061	2727	
v/s Ratio Prot	c0.01			c0.04	0.33	c0.43	
v/s Ratio Perm							
v/c Ratio	0.10			0.58	0.38	0.56	
Uniform Delay, d1	53.3			54.4	1.4	5.4	
Progression Factor	1.00			1.05	0.23	0.07	
Incremental Delay, d2	0.4			6.6	0.3	0.6	
Delay (s)	53.8			63.8	0.7	0.9	
Level of Service	D			E	A	A	
Approach Delay (s)	53.8				4.2	0.9	
Approach LOS	D				A	A	
Intersection Summary							
HCM 2000 Control Delay	2.8			HCM 2000 Level of Service			A
HCM 2000 Volume to Capacity ratio	0.53						
Actuated Cycle Length (s)	120.0			Sum of lost time (s)			12.0
Intersection Capacity Utilization	59.4%			ICU Level of Service			B
Analysis Period (min)	15						
c Critical Lane Group							

HCM Signalized Intersection Capacity Analysis

25: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd (Baird St)/SW Taylors Ferry Rd 04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations												
Traffic Volume (vph)	25	5	25	25	5	30	50	30	1120	10	55	5
Future Volume (vph)	25	5	25	25	5	30	50	30	1120	10	55	5
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
Lane Util. Factor		1.00			1.00			1.00	0.95			1.00
Frpb, ped/bikes		0.99			0.99			1.00	1.00			1.00
Flpb, ped/bikes		1.00			1.00			1.00	1.00			1.00
Frt		0.94			0.93			1.00	1.00			1.00
Flt Protected		0.98			0.98			0.95	1.00			0.95
Satd. Flow (prot)		1728			1677			1783	3518			1733
Flt Permitted		0.87			0.89			0.95	1.00			0.95
Satd. Flow (perm)		1543			1522			1783	3518			1733
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	25	5	25	25	5	30	50	30	1120	10	55	5
RTOR Reduction (vph)	0	23	0	0	27	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	32	0	0	33	0	0	80	1130	0	0	60
Confl. Peds. (#/hr)	5		5	5		5		5		5		5
Confl. Bikes (#/hr)										50		
Heavy Vehicles (%)	0%	0%	0%	6%	0%	0%	2%	0%	2%	50%	0%	50%
Turn Type	Perm	NA		Perm	NA		Prot	Prot	NA		Prot	Prot
Protected Phases		4			8		5	5	2		1	1
Permitted Phases	4			8								
Actuated Green, G (s)		11.5			11.5			9.7	88.5			7.2
Effective Green, g (s)		11.5			11.5			9.7	89.3			7.2
Actuated g/C Ratio		0.10			0.10			0.08	0.74			0.06
Clearance Time (s)		4.0			4.0			4.0	4.8			4.0
Vehicle Extension (s)		3.0			3.0			3.0	3.0			3.0
Lane Grp Cap (vph)		147			145			144	2617			103
v/s Ratio Prot								c0.04	0.32			0.03
v/s Ratio Perm		0.02			c0.02							
v/c Ratio		0.22			0.23			0.56	0.43			0.58
Uniform Delay, d1		50.1			50.1			53.1	5.8			54.9
Progression Factor		1.00			1.00			0.72	1.81			0.62
Incremental Delay, d2		0.8			0.8			4.3	0.5			7.0
Delay (s)		50.9			50.9			42.5	11.0			41.0
Level of Service		D			D			D	B			D
Approach Delay (s)		50.9			50.9				13.0			
Approach LOS		D			D				B			
Intersection Summary												
HCM 2000 Control Delay		9.5			HCM 2000 Level of Service				A			
HCM 2000 Volume to Capacity ratio		0.54										
Actuated Cycle Length (s)		120.0			Sum of lost time (s)				12.0			
Intersection Capacity Utilization		64.8%			ICU Level of Service				C			
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

25: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd (Baird St)/SW Taylors Ferry Rd 04/21/2020



Movement	SBT	SBR
Lane Configurations	↑↑	↑
Traffic Volume (vph)	1465	25
Future Volume (vph)	1465	25
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	
Lane Util. Factor	0.95	
Frpb, ped/bikes	1.00	
Flpb, ped/bikes	1.00	
Frt	1.00	
Flt Protected	1.00	
Satd. Flow (prot)	3562	
Flt Permitted	1.00	
Satd. Flow (perm)	3562	
Peak-hour factor, PHF	1.00	1.00
Adj. Flow (vph)	1465	25
RTOR Reduction (vph)	1	0
Lane Group Flow (vph)	1489	0
Confl. Peds. (#/hr)		5
Confl. Bikes (#/hr)		50
Heavy Vehicles (%)	1%	0%
Turn Type	NA	
Protected Phases	6	
Permitted Phases		
Actuated Green, G (s)	86.0	
Effective Green, g (s)	86.8	
Actuated g/C Ratio	0.72	
Clearance Time (s)	4.8	
Vehicle Extension (s)	3.0	
Lane Grp Cap (vph)	2576	
v/s Ratio Prot	c0.42	
v/s Ratio Perm		
v/c Ratio	0.58	
Uniform Delay, d1	7.9	
Progression Factor	0.17	
Incremental Delay, d2	0.8	
Delay (s)	2.1	
Level of Service	A	
Approach Delay (s)	3.6	
Approach LOS	A	
Intersection Summary		

HCM Signalized Intersection Capacity Analysis

27: SW Barbur Blvd (Hwy 99W) & BTC Vehicle In/Out

04/21/2020



Movement	WBL	WBR	NBT	NBR	SBU	SBL	SBT
Lane Configurations	WT		WT			WT	WT
Traffic Volume (vph)	140	30	1110	0	35	10	1505
Future Volume (vph)	140	30	1110	0	35	10	1505
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0
Lane Util. Factor	0.97		0.95			1.00	0.95
Frpb, ped/bikes	0.99		1.00			1.00	1.00
Flpb, ped/bikes	1.00		1.00			1.00	1.00
Frt	0.97		1.00			1.00	1.00
Flt Protected	0.96		1.00			0.95	1.00
Satd. Flow (prot)	3424		3539			1805	3539
Flt Permitted	0.96		1.00			0.95	1.00
Satd. Flow (perm)	3424		3539			1805	3539
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	140	30	1110	0	35	10	1505
RTOR Reduction (vph)	16	0	0	0	0	0	0
Lane Group Flow (vph)	154	0	1110	0	0	45	1505
Confl. Peds. (#/hr)	10			10		10	
Confl. Bikes (#/hr)		5		50			
Heavy Vehicles (%)	0%	0%	2%	0%	0%	0%	2%
Turn Type	Prot		NA		Prot	Prot	NA
Protected Phases	4		2		1	1	6
Permitted Phases							
Actuated Green, G (s)	12.5		86.7			8.0	98.7
Effective Green, g (s)	12.5		87.5			8.0	99.5
Actuated g/C Ratio	0.10		0.73			0.07	0.83
Clearance Time (s)	4.0		4.8			4.0	4.8
Vehicle Extension (s)	4.0		1.5			0.5	1.5
Lane Grp Cap (vph)	356		2580			120	2934
v/s Ratio Prot	c0.04		0.31			0.02	c0.43
v/s Ratio Perm							
v/c Ratio	0.43		0.43			0.38	0.51
Uniform Delay, d1	50.4		6.4			53.6	3.0
Progression Factor	1.00		0.02			1.09	0.77
Incremental Delay, d2	1.1		0.5			0.6	0.5
Delay (s)	51.6		0.6			59.2	2.9
Level of Service	D		A			E	A
Approach Delay (s)	51.6		0.6				4.5
Approach LOS	D		A				A
Intersection Summary							
HCM 2000 Control Delay			5.8		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio			0.52				
Actuated Cycle Length (s)			120.0		Sum of lost time (s)		12.0
Intersection Capacity Utilization			53.2%		ICU Level of Service		A
Analysis Period (min)			15				
c Critical Lane Group							

HCM Signalized Intersection Capacity Analysis

29: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/BTC Bus/Vehicle In

04/21/2020

												
Movement	EBL	EBT	EBR2	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	215	25	100	15	0	5	215	905	30	20	1340	315
Future Volume (vph)	215	25	100	15	0	5	215	905	30	20	1340	315
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	4.8
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	*0.79	1.00
Frpb, ped/bikes		1.00	0.98		0.97		1.00	1.00		1.00	1.00	0.86
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.97		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.96	1.00		0.96		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1802	1533		860		1736	3494		902	2887	1368
Flt Permitted		0.96	1.00		0.79		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1802	1533		704		1736	3494		902	2887	1368
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	215	25	100	15	0	5	215	905	30	20	1340	315
RTOR Reduction (vph)	0	0	83	0	16	0	0	0	0	0	0	92
Lane Group Flow (vph)	0	240	17	0	4	0	215	935	0	20	1340	223
Confl. Peds. (#/hr)			10			100	25					25
Confl. Bikes (#/hr)									50			50
Heavy Vehicles (%)	1%	0%	3%	100%	0%	100%	4%	2%	20%	100%	4%	1%
Turn Type	Split	NA	Perm	Perm	NA		Prot	NA		Prot	NA	Perm
Protected Phases	4	4			8		5	2		1	6	
Permitted Phases			4	8								6
Actuated Green, G (s)		20.9	20.9		26.3		12.6	38.0		18.0	43.4	43.4
Effective Green, g (s)		20.9	20.9		26.3		12.6	38.8		18.0	44.2	43.4
Actuated g/C Ratio		0.17	0.17		0.22		0.10	0.32		0.15	0.37	0.36
Clearance Time (s)		4.0	4.0		4.0		4.0	4.8		4.0	4.8	4.8
Vehicle Extension (s)		3.0	3.0		3.0		0.5	1.5		3.0	3.0	3.0
Lane Grp Cap (vph)		313	266		154		182	1129		135	1063	494
v/s Ratio Prot		c0.13					c0.12	0.27		0.02	c0.46	
v/s Ratio Perm			0.01		c0.01							0.16
v/c Ratio		0.77	0.07		0.03		1.18	0.83		0.15	1.26	0.45
Uniform Delay, d1		47.2	41.4		36.8		53.7	37.5		44.3	37.9	29.2
Progression Factor		1.00	1.00		1.00		0.85	0.81		1.48	1.13	1.43
Incremental Delay, d2		10.7	0.1		0.1		119.8	6.2		0.4	123.1	2.2
Delay (s)		57.9	41.5		36.9		165.6	36.7		66.0	166.0	43.9
Level of Service		E	D		D		F	D		E	F	D
Approach Delay (s)		53.1			36.9			60.8			141.8	
Approach LOS		D			D			E			F	
Intersection Summary												
HCM 2000 Control Delay			102.1				HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio			0.84									
Actuated Cycle Length (s)			120.0				Sum of lost time (s)			16.0		
Intersection Capacity Utilization			90.2%				ICU Level of Service			E		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

29: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/BTC Bus/Vehicle In

04/21/2020



Movement	NWR
Lane Configurations	
Traffic Volume (vph)	20
Future Volume (vph)	20
Ideal Flow (vphpl)	1900
Total Lost time (s)	4.0
Lane Util. Factor	1.00
Frpb, ped/bikes	1.00
Flpb, ped/bikes	1.00
Frt	0.86
Flt Protected	1.00
Satd. Flow (prot)	1611
Flt Permitted	1.00
Satd. Flow (perm)	1611
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	20
RTOR Reduction (vph)	0
Lane Group Flow (vph)	20
Confl. Peds. (#/hr)	
Confl. Bikes (#/hr)	
Heavy Vehicles (%)	2%
Turn Type	Over
Protected Phases	1
Permitted Phases	
Actuated Green, G (s)	18.0
Effective Green, g (s)	18.0
Actuated g/C Ratio	0.15
Clearance Time (s)	4.0
Vehicle Extension (s)	3.0
Lane Grp Cap (vph)	241
v/s Ratio Prot	0.01
v/s Ratio Perm	
v/c Ratio	0.08
Uniform Delay, d1	43.9
Progression Factor	1.00
Incremental Delay, d2	0.1
Delay (s)	44.0
Level of Service	D
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

30: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

04/21/2020

	→	↘	↶	←	↙	↑	↗	↘	↓	↙	↘
Movement	EBT	EBR	EBR2	WBT	WBR	NBT	NBR	SBL	SBT	SBR	SBR2
Lane Configurations	↑↑			↑↑		↑↑		↘	↑↑	↘	
Traffic Volume (vph)	785	105	165	750	255	895	5	5	720	715	10
Future Volume (vph)	785	105	165	750	255	895	5	5	720	715	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0		4.0		4.0	4.0	4.0	
Lane Util. Factor	0.95			0.95		0.95		1.00	0.95	1.00	
Frpb, ped/bikes	1.00			0.99		1.00		1.00	1.00	0.95	
Flpb, ped/bikes	1.00			1.00		1.00		1.00	1.00	1.00	
Frt	0.96			0.96		1.00		1.00	1.00	0.85	
Flt Protected	1.00			1.00		1.00		0.95	1.00	1.00	
Satd. Flow (prot)	3432			3384		3535		902	3539	1496	
Flt Permitted	1.00			1.00		1.00		0.95	1.00	1.00	
Satd. Flow (perm)	3432			3384		3535		902	3539	1496	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	785	105	165	750	255	895	5	5	720	715	10
RTOR Reduction (vph)	0	0	0	29	0	0	0	0	0	4	0
Lane Group Flow (vph)	1055	0	0	976	0	900	0	5	720	721	0
Confl. Peds. (#/hr)					20		25	25		10	10
Confl. Bikes (#/hr)					5		50				
Heavy Vehicles (%)	1%	1%	2%	2%	1%	2%	0%	100%	2%	3%	3%
Turn Type	NA			NA		NA		Prot	NA	Perm	
Protected Phases	4			8		2		1	6		
Permitted Phases											6
Actuated Green, G (s)	39.9			39.9		66.3		1.0	71.3	71.3	
Effective Green, g (s)	39.9			39.9		67.1		1.0	72.1	72.1	
Actuated g/C Ratio	0.33			0.33		0.56		0.01	0.60	0.60	
Clearance Time (s)	4.0			4.0		4.8		4.0	4.8	4.8	
Vehicle Extension (s)	0.2			0.2		0.2		3.0	0.2	0.2	
Lane Grp Cap (vph)	1141			1125		1976		7	2126	898	
v/s Ratio Prot	c0.31			0.29		0.25		0.01	0.20		
v/s Ratio Perm											c0.48
v/c Ratio	0.92			0.87		0.46		0.71	0.34	0.80	
Uniform Delay, d1	38.6			37.6		15.6		59.4	12.0	18.5	
Progression Factor	1.00			1.00		1.00		1.30	0.37	0.88	
Incremental Delay, d2	12.2			7.0		0.8		26.6	0.0	0.7	
Delay (s)	50.8			44.6		16.4		103.8	4.5	17.1	
Level of Service	D			D		B		F	A	B	
Approach Delay (s)	50.8			44.6		16.4			11.1		
Approach LOS	D			D		B			B		
Intersection Summary											
HCM 2000 Control Delay			29.3			HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.88								
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			12.0		
Intersection Capacity Utilization			83.1%			ICU Level of Service			E		
Analysis Period (min)			15								
c Critical Lane Group											

Intersection						
Int Delay, s/veh	36.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↖	
Traffic Vol, veh/h	485	0	0	650	280	0
Future Vol, veh/h	485	0	0	650	280	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	0	0	0	0	1
Mvmt Flow	485	0	0	650	280	0
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	-	-	-	1135	-
Stage 1	-	-	-	-	485	-
Stage 2	-	-	-	-	650	-
Critical Hdwy	-	-	-	-	6.4	-
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	-	-	3.5	-
Pot Cap-1 Maneuver	-	0	0	-	~ 226	0
Stage 1	-	0	0	-	623	0
Stage 2	-	0	0	-	523	0
Platoon blocked, %	-			-		
Mov Cap-1 Maneuver	-	-	-	-	~ 226	-
Mov Cap-2 Maneuver	-	-	-	-	~ 226	-
Stage 1	-	-	-	-	623	-
Stage 2	-	-	-	-	523	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0		183.2	
HCM LOS					F	
Minor Lane/Major Mvmt	NBLn1		EBT	WBT		
Capacity (veh/h)	226		-	-		
HCM Lane V/C Ratio	1.239		-	-		
HCM Control Delay (s)	183.2		-	-		
HCM Lane LOS	F		-	-		
HCM 95th %tile Q(veh)	14.2		-	-		
Notes						
~: Volume exceeds capacity		\$: Delay exceeds 300s		+: Computation Not Defined		*: All major volume in platoon

Intersection

Intersection Delay, s/veh 101.2

Intersection LOS F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	65	165	230	50	320	45	290	350	120	45	315	40
Future Vol, veh/h	65	165	230	50	320	45	290	350	120	45	315	40
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	0	2	1	0	1	0	0	2	0	10	2	0
Mvmt Flow	65	165	230	50	320	45	290	350	120	45	315	40
Number of Lanes	1	1	0	1	1	0	0	2	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	2	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	1	2	2
HCM Control Delay	75	69.1	122.3	124.5
HCM LOS	F	F	F	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	62%	0%	100%	0%	100%	0%	11%
Vol Thru, %	38%	59%	0%	42%	0%	88%	79%
Vol Right, %	0%	41%	0%	58%	0%	12%	10%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	465	295	65	395	50	365	400
LT Vol	290	0	65	0	50	0	45
Through Vol	175	175	0	165	0	320	315
RT Vol	0	120	0	230	0	45	40
Lane Flow Rate	465	295	65	395	50	365	400
Geometry Grp	7	7	7	7	7	7	6
Degree of Util (X)	1.276	0.771	0.183	1.019	0.142	0.98	1.136
Departure Headway (Hd)	10.563	9.97	10.895	9.968	10.977	10.373	10.743
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	349	366	331	367	329	354	340
Service Time	8.263	7.67	8.595	7.668	8.677	8.073	8.743
HCM Lane V/C Ratio	1.332	0.806	0.196	1.076	0.152	1.031	1.176
HCM Control Delay	175	39.3	16	84.7	15.5	76.4	124.5
HCM Lane LOS	F	E	C	F	C	F	F
HCM 95th-tile Q	19.9	6.3	0.7	12.2	0.5	10.9	15.1

HCM Signalized Intersection Capacity Analysis

36: SW Barbur Blvd (Hwy 99W) & SW 53rd Ave

04/21/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	80	10	195	25	25	50	1185	325	5	490	30
Future Volume (vph)	40	80	10	195	25	25	50	1185	325	5	490	30
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	4.3		4.0	4.3	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99			0.99		1.00	0.93		1.00	0.98	
Flpb, ped/bikes	0.96	1.00			0.94		1.00	1.00		1.00	1.00	
Frt	1.00	0.98			0.99		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00			0.96		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1741	1800			1646		1805	3170		1805	3379	
Flt Permitted	0.70	1.00			0.67		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1284	1800			1147		1805	3170		1805	3379	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	40	80	10	195	25	25	50	1185	325	5	490	30
RTOR Reduction (vph)	0	3	0	0	3	0	0	12	0	0	2	0
Lane Group Flow (vph)	40	87	0	0	242	0	50	1498	0	5	518	0
Confl. Peds. (#/hr)	50		50	50		50			50			50
Confl. Bikes (#/hr)									50			50
Heavy Vehicles (%)	0%	3%	0%	2%	0%	4%	0%	3%	1%	0%	4%	3%
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4								
Actuated Green, G (s)	35.8	35.8			35.8		7.7	100.4		1.0	93.7	
Effective Green, g (s)	35.8	35.8			35.8		7.7	100.9		1.0	94.2	
Actuated g/C Ratio	0.24	0.24			0.24		0.05	0.67		0.01	0.63	
Clearance Time (s)	4.0	4.0			4.0		4.0	4.8		4.0	4.8	
Vehicle Extension (s)	2.5	2.5			2.5		3.0	4.8		3.0	4.8	
Lane Grp Cap (vph)	306	429			273		92	2132		12	2122	
v/s Ratio Prot		0.05					c0.03	c0.47		0.00	0.15	
v/s Ratio Perm	0.03				c0.21							
v/c Ratio	0.13	0.20			0.89		0.54	0.70		0.42	0.24	
Uniform Delay, d1	44.9	45.7			55.1		69.4	15.2		74.2	12.3	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.2			27.0		6.4	2.0		21.8	0.3	
Delay (s)	45.0	45.9			82.2		75.8	17.2		96.0	12.5	
Level of Service	D	D			F		E	B		F	B	
Approach Delay (s)		45.6			82.2			19.1			13.3	
Approach LOS		D			F			B			B	
Intersection Summary												
HCM 2000 Control Delay			25.5				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.75									
Actuated Cycle Length (s)			150.0				Sum of lost time (s)			12.3		
Intersection Capacity Utilization			77.1%				ICU Level of Service			D		
Analysis Period (min)			15									
c Critical Lane Group												

APPENDIX B30**Segment B – Pedestrian V/C Ratio Adjustment
Methodology**



PEDESTRIAN V/C ADJUSTMENT METHODOLOGY

DATE: May 19, 2020

TO: Anthony Buczek, PE, PTOE | Metro

FROM: Randy Johnson, PE, PTOE | DKS Associates
Aaron Berger, PE (WA) | DKS Associates
Dock Rosenthal, PE | DKS Associates

SUBJECT: TriMet Southwest Corridor FEIS P# 17017-001

This memorandum describes the process used to adjust the HCM results to reflect the impacts of high pedestrian activity at selected study intersections defined for the Southwest Corridor Final Environmental Impact Analysis (FEIS).

LIMITATIONS OF HCM RESULTS

The Transportation Analysis Methods report (June 9, 2017) states that Highway Capacity Manual (HCM) methods will be used to calculate LOS and v/c ratio results for signalized intersections in the FEIS. This methodology has limitations related to adequately analyzing the impact of pedestrian calls on signal operations. While delay and LOS measures do capture the impact of pedestrian calls, intersection v/c ratios in the HCM 2000 methodology are calculated based on the critical movement for each phase of the cycle. The signal timing impacts of pedestrian calls do not impact either the vehicle demand or the saturation flow rate for a critical movement at an intersection. Therefore, the actual v/c ratio of an intersection with a low minor street approach volume coupled with a high activity major street approach pedestrian crossing with a long Flashing Don't Walk (FDW) interval is not fully captured. In reality, the pedestrian calls at such an intersection will result in increased effective (and unused) vehicle green time for the minor street phase. Under the HCM 2000 methodology, this increase in effective green time can result in only minor changes to the overall intersection v/c ratio due to changes in the identified critical phases of the cycle. In field operations, this additional green time required to serve the pedestrian demand is effectively vehicle lost time, as it is not needed to serve the vehicle demand for the approach and impedes other critical movement phases from receiving their expected green time. With the HCM methodology, such intersection may have an accurately depicted LOS measure of F, but a v/c ratio well below 1.0.

PEDESTRIAN ADJUSTMENT METHODOLOGY

As stated above, the additional effective green time resulting from pedestrian calls is effectively lost time for vehicles in the cycle. The HCM formula for intersection v/c ratio subtracts the lost time from the cycle before calculating the utilization of the useable cycle length from the remaining time. The adjustment to account for pedestrian calls simply increases the lost time by the same increase in effective green for the phase with the effective green with pedestrians relative to effective green without any pedestrians. Note that when HCM calculates an effective green with pedestrian impacts, the calculation accounts for cycles where pedestrians will not arrive. For example, the side street effective green will be significantly less than the pedestrian crossing time (FDW plus Walk time) if the number of pedestrian calls is low (10 or less). As the pedestrian calls increase, the effective green time increases until it reaches the pedestrian crossing time. Therefore, the approach outlined here is sensitive to the number of pedestrian calls per hour for an intersection.

EXAMPLE

A two-phase signal has a cycle of 60 seconds with 8 seconds of initial lost time and a v/c ratio of 0.80. The minor phase of this signal has an effective green of 20 seconds with pedestrian calls. If these pedestrian calls are removed the minor phase has an effective green of 10 seconds. The pedestrian adjustment scales the v/c by the ratio of the cycle minus lost time to the cycle length minus lost time and the difference in the minor street effective green. The v/c scales as follows in this example:

$$0.8 * \frac{60 - 8}{60 - 8 - 10} = 0.99$$

APPLICATION

As shown above, the pedestrian adjustment can result in significant changes to the average intersection v/c ratio result. As noted previously, this situation only occurs at intersections where the minor street vehicle demand does not result in an effective green time that approaches the maximum split (pedestrian crossing time), or is well under the saturation flow. Therefore the adjustment described above is only applicable at locations with low minor street volume and high pedestrian activity, which are included in Table 1 (AM) and Table 2 (PM) below.

TABLE 1: AM PEAK HOUR FEIS STUDY INTERSECTIONS ADJUSTED FOR PEDESTRIAN IMPACT

INTERSECTION	ALTERNATIVE	INITIAL V/C	EFFECTIVE GREEN W/O PED (SECONDS)	EFFECTIVE GREEN WITH PED (SECONDS)	ADDITIONAL LOST TIME (SECONDS)	ADJUSTED V/C
SW BARBUR BLVD./SW HOOKER ST.	Preferred Alternative	0.82	11.3	22.9	11.6	0.92
	Bridgehead Alternative	0.86	11.4	22.9	11.5	0.96
SW BARBUR BLVD./SW WHITAKER ST.	Preferred Alternative	0.79	2	13.7	11.7	0.89
	Bridgehead Alternative	0.85	12.5	17.9	5.4	0.89
SW BARBUR BLVD/SW 19TH ST.	Preferred Alternative	0.89	29.4	40.6	11.2	1.00
SW BARBUR BLVD/SW TAYLORS FERRY RD./BARBUR TRANSIT CENTER	Preferred Alternative	0.83	23.6	48.0	24.4	1.08

TABLE 2: PM PEAK HOUR FEIS STUDY INTERSECTIONS ADJUSTED FOR PEDESTRIAN IMPACT

INTERSECTION	ALTERNATIVE	INITIAL V/C	EFFECTIVE GREEN W/O PED (SECONDS)	EFFECTIVE GREEN WITH PED (SECONDS)	ADDITIONAL LOST TIME (SECONDS)	ADJUSTED V/C
SW BARBUR BLVD./SW HOOKER ST.	Preferred Alternative	0.55	6.5	21.3	14.8	0.64
	Bridgehead Alternative	0.55	6.5	21.3	14.8	0.64
SW BARBUR BLVD./SW WHITAKER ST.	Preferred Alternative	0.65	9.1	12.3	3.2	0.67
	Bridgehead Alternative	0.63	9.1	12.3	3.2	0.65
SW BARBUR BLVD/SW 19TH ST.	Preferred Alternative	0.83	27.5	42.7	15.2	1.04
SW BARBUR BLVD/SW TAYLORS FERRY RD./BARBUR TRANSIT CENTER	Preferred Alternative	0.84	19.9	47.2	27.3	1.14

APPENDIX B31

Segment B – 2045 LPA HCM SimTraffic

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd/I-5 Ramps

06/08/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	400	300	20	60	135	205	20	1445	295	60	600	350
Future Volume (vph)	400	300	20	60	135	205	20	1445	295	60	600	350
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.5
Lane Util. Factor	0.95	0.95		1.00	1.00	1.00	1.00	0.95		1.00	*0.98	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1649	1699		1770	1776	1495	1805	3412		1719	3581	1538
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1649	1699		1770	1776	1495	1805	3412		1719	3581	1538
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	400	300	20	60	135	205	20	1445	295	60	600	350
RTOR Reduction (vph)	0	2	0	0	0	108	0	13	0	0	0	45
Lane Group Flow (vph)	356	362	0	60	135	97	20	1727	0	60	600	305
Confl. Peds. (#/hr)			15	15			10					10
Confl. Bikes (#/hr)									50			50
Heavy Vehicles (%)	4%	4%	14%	2%	7%	8%	0%	2%	3%	5%	4%	5%
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	pt+ov
Protected Phases	3	3		4	4		1	6		5	2	2 3
Permitted Phases						4						
Actuated Green, G (s)	29.1	29.1		5.0	5.0	5.0	2.0	64.0		5.4	67.4	100.5
Effective Green, g (s)	29.1	29.1		5.0	5.0	5.0	2.0	64.5		5.4	67.9	96.5
Actuated g/C Ratio	0.24	0.24		0.04	0.04	0.04	0.02	0.54		0.05	0.57	0.80
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.5		4.0	4.5	
Vehicle Extension (s)	1.0	1.0		1.0	1.0	1.0	1.5	0.5		1.0	0.5	
Lane Grp Cap (vph)	399	412		73	74	62	30	1833		77	2026	1236
v/s Ratio Prot	c0.22	0.21		0.03	c0.08		0.01	c0.51		c0.03	0.17	0.20
v/s Ratio Perm						0.06						
v/c Ratio	0.89	0.88		0.82	1.82	1.56	0.67	0.94		0.78	0.30	0.25
Uniform Delay, d1	43.9	43.8		57.1	57.5	57.5	58.7	26.0		56.7	13.6	2.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	20.9	18.3		48.1	418.6	316.3	35.7	11.2		35.3	0.4	0.0
Delay (s)	64.9	62.1		105.1	476.1	373.8	94.3	37.2		92.0	14.0	2.9
Level of Service	E	E		F	F	F	F	D		F	B	A
Approach Delay (s)		63.4			368.1			37.8			14.8	
Approach LOS		E			F			D			B	
Intersection Summary												
HCM 2000 Control Delay			70.5									HCM 2000 Level of Service E
HCM 2000 Volume to Capacity ratio			0.97									
Actuated Cycle Length (s)			120.0									Sum of lost time (s) 16.5
Intersection Capacity Utilization			95.4%									ICU Level of Service F
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

9: SW Terwilliger Blvd

06/08/2020



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	240	180	0	595	625	0
Future Volume (vph)	240	180	0	595	625	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		1863	1863	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		1863	1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	240	180	0	595	625	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	240	180	0	595	625	0
Turn Type	Prot	custom		NA	NA	
Protected Phases	4	1		6	2	
Permitted Phases		4				
Actuated Green, G (s)	16.1	26.6		47.6	32.5	
Effective Green, g (s)	17.0	27.8		48.2	33.1	
Actuated g/C Ratio	0.23	0.38		0.66	0.45	
Clearance Time (s)	4.9	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	411	601		1226	842	
v/s Ratio Prot	c0.14	0.05		c0.32	c0.34	
v/s Ratio Perm		0.07				
v/c Ratio	0.58	0.30		0.49	0.74	
Uniform Delay, d1	25.0	15.9		6.3	16.5	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.1	0.3		0.3	3.6	
Delay (s)	27.1	16.2		6.6	20.1	
Level of Service	C	B		A	C	
Approach Delay (s)	22.4			6.6	20.1	
Approach LOS	C			A	C	

Intersection Summary

HCM 2000 Control Delay	15.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	73.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

06/08/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	170	5	30	115	10	30	10	30	2155	5	0	920
Future Volume (vph)	170	5	30	115	10	30	10	30	2155	5	0	920
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0			4.0
Lane Util. Factor		1.00			1.00	1.00		1.00	0.95			0.95
Frpb, ped/bikes		1.00			1.00	0.97		1.00	1.00			1.00
Flpb, ped/bikes		0.99			1.00	1.00		1.00	1.00			1.00
Frt		0.98			1.00	0.85		1.00	1.00			1.00
Flt Protected		0.96			0.96	1.00		0.95	1.00			1.00
Satd. Flow (prot)		1718			1678	1524		1683	3538			3501
Flt Permitted		0.59			0.73	1.00		0.95	1.00			1.00
Satd. Flow (perm)		1065			1272	1524		1683	3538			3501
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	170	5	30	115	10	30	10	30	2155	5	0	920
RTOR Reduction (vph)	0	6	0	0	0	24	0	0	0	0	0	0
Lane Group Flow (vph)	0	199	0	0	125	6	0	40	2160	0	0	925
Confl. Peds. (#/hr)	10					10		5		10	10	
Confl. Bikes (#/hr)						5				50		
Heavy Vehicles (%)	4%	0%	0%	9%	0%	3%	2%	9%	2%	0%	0%	3%
Turn Type	Perm	NA		Perm	NA	Perm	Prot	Prot	NA			NA
Protected Phases		8			4		1	1	6			2
Permitted Phases	8			4		4						
Actuated Green, G (s)		25.0			25.0	25.0		5.6	86.5			76.9
Effective Green, g (s)		25.0			25.0	25.0		5.6	87.0			77.4
Actuated g/C Ratio		0.21			0.21	0.21		0.05	0.72			0.65
Clearance Time (s)		4.0			4.0	4.0		4.0	4.5			4.5
Vehicle Extension (s)		2.0			2.0	2.0		3.0	2.0			2.0
Lane Grp Cap (vph)		221			265	317		78	2565			2258
v/s Ratio Prot								0.02	c0.61			0.26
v/s Ratio Perm		c0.19			0.10	0.00						
v/c Ratio		0.90			0.47	0.02		0.51	0.84			0.41
Uniform Delay, d1		46.3			41.7	37.8		55.9	11.7			10.3
Progression Factor		1.00			1.00	1.00		1.00	1.00			1.00
Incremental Delay, d2		34.6			0.5	0.0		5.6	3.6			0.6
Delay (s)		80.9			42.2	37.8		61.5	15.2			10.8
Level of Service		F			D	D		E	B			B
Approach Delay (s)		80.9			41.3				16.1			10.8
Approach LOS		F			D				B			B
Intersection Summary												
HCM 2000 Control Delay			19.6				HCM 2000 Level of Service		B			
HCM 2000 Volume to Capacity ratio			0.89									
Actuated Cycle Length (s)			120.0				Sum of lost time (s)		12.0			
Intersection Capacity Utilization			92.0%				ICU Level of Service		F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

06/08/2020

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	5
Future Volume (vph)	5
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	5
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	5
Confl. Bikes (#/hr)	50
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM 2010 TWSC
31: I5 Off Ramp & Taylors Ferry

06/08/2020

Intersection						
Int Delay, s/veh	2.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↓	
Traffic Vol, veh/h	690	0	0	350	95	0
Future Vol, veh/h	690	0	0	350	95	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	0	0	0	0	1
Mvmt Flow	690	0	0	350	95	0
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	-	-	-	1040	-
Stage 1	-	-	-	-	690	-
Stage 2	-	-	-	-	350	-
Critical Hdwy	-	-	-	-	6.4	-
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	-	-	3.5	-
Pot Cap-1 Maneuver	-	0	0	-	257	0
Stage 1	-	0	0	-	502	0
Stage 2	-	0	0	-	718	0
Platoon blocked, %	-			-		
Mov Cap-1 Maneuver	-	-	-	-	257	-
Mov Cap-2 Maneuver	-	-	-	-	257	-
Stage 1	-	-	-	-	502	-
Stage 2	-	-	-	-	718	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0		27	
HCM LOS					D	
Minor Lane/Major Mvmt	NBLn1		EBT	WBT		
Capacity (veh/h)	257		-	-		
HCM Lane V/C Ratio	0.37		-	-		
HCM Control Delay (s)	27		-	-		
HCM Lane LOS	D		-	-		
HCM 95th %tile Q(veh)	1.6		-	-		

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd/I-5 Ramps

04/22/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	445	110	45	115	145	290	10	30	890	55	25	1600
Future Volume (vph)	445	110	45	115	145	290	10	30	890	55	25	1600
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	0.95	0.95		1.00	1.00	1.00		1.00	0.95		1.00	*0.98
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	1.00		1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85		1.00	0.99		1.00	1.00
Flt Protected	0.95	0.98		0.95	1.00	1.00		0.95	1.00		0.95	1.00
Satd. Flow (prot)	1698	1677		1805	1863	1599		1656	3487		1703	3687
Flt Permitted	0.95	0.98		0.95	1.00	1.00		0.95	1.00		0.95	1.00
Satd. Flow (perm)	1698	1677		1805	1863	1599		1656	3487		1703	3687
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	445	110	45	115	145	290	10	30	890	55	25	1600
RTOR Reduction (vph)	0	6	0	0	0	142	0	0	3	0	0	0
Lane Group Flow (vph)	298	296	0	115	145	148	0	40	942	0	25	1600
Confl. Peds. (#/hr)			10	10				25		5	5	
Confl. Bikes (#/hr)										50		
Heavy Vehicles (%)	1%	4%	3%	0%	2%	1%	0%	12%	2%	7%	6%	1%
Turn Type	Split	NA		Split	NA	Perm	Prot	Prot	NA		Prot	NA
Protected Phases	3	3		4	4		1	1	6		5	2
Permitted Phases						4						
Actuated Green, G (s)	25.2	25.2		6.4	6.4	6.4		4.8	70.1		1.8	67.1
Effective Green, g (s)	25.2	25.2		6.4	6.4	6.4		4.8	70.6		1.8	67.6
Actuated g/C Ratio	0.21	0.21		0.05	0.05	0.05		0.04	0.59		0.02	0.56
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.5		4.0	4.5
Vehicle Extension (s)	1.0	1.0		1.0	1.0	1.0		1.5	0.5		1.0	0.5
Lane Grp Cap (vph)	356	352		96	99	85		66	2051		25	2077
v/s Ratio Prot	0.18	c0.18		0.06	0.08			c0.02	0.27		0.01	c0.43
v/s Ratio Perm						c0.09						
v/c Ratio	0.84	0.84		1.20	1.46	1.74		0.61	0.46		1.00	0.77
Uniform Delay, d1	45.4	45.5		56.8	56.8	56.8		56.7	13.9		59.1	20.2
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00		0.79	0.25
Incremental Delay, d2	15.0	15.9		154.5	255.9	377.5		10.3	0.7		54.0	0.3
Delay (s)	60.4	61.4		211.3	312.7	434.3		67.0	14.7		100.5	5.2
Level of Service	E	E		F	F	F		E	B		F	A
Approach Delay (s)		60.9			355.6				16.8			5.3
Approach LOS		E			F				B			A
Intersection Summary												
HCM 2000 Control Delay			61.9				HCM 2000 Level of Service		E			
HCM 2000 Volume to Capacity ratio			0.84									
Actuated Cycle Length (s)			120.0				Sum of lost time (s)		16.5			
Intersection Capacity Utilization			98.2%				ICU Level of Service		F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: SW Barbur Blvd (Hwy 99W) & SW Bertha Blvd/I-5 Ramps

04/22/2020

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	435
Future Volume (vph)	435
Ideal Flow (vphpl)	1900
Total Lost time (s)	4.5
Lane Util. Factor	1.00
Frpb, ped/bikes	1.00
Flpb, ped/bikes	1.00
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1599
Flt Permitted	1.00
Satd. Flow (perm)	1599
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	435
RTOR Reduction (vph)	39
Lane Group Flow (vph)	396
Confl. Peds. (#/hr)	25
Confl. Bikes (#/hr)	50
Heavy Vehicles (%)	1%
Turn Type	pt+ov
Protected Phases	2 3
Permitted Phases	
Actuated Green, G (s)	96.3
Effective Green, g (s)	92.3
Actuated g/C Ratio	0.77
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	1229
v/s Ratio Prot	0.25
v/s Ratio Perm	
v/c Ratio	0.32
Uniform Delay, d1	4.3
Progression Factor	0.07
Incremental Delay, d2	0.0
Delay (s)	0.3
Level of Service	A
Approach Delay (s)	
Approach LOS	
Intersection Summary	

HCM Signalized Intersection Capacity Analysis

9: SW Terwilliger Blvd

04/22/2020



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	365	255	0	705	1025	0
Future Volume (vph)	365	255	0	705	1025	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.3	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1599		1881	1881	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1599		1881	1881	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	365	255	0	705	1025	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	365	255	0	705	1025	0
Heavy Vehicles (%)	2%	1%	0%	1%	1%	0%
Turn Type	Prot	custom		NA	NA	
Protected Phases	4	1		6	2	
Permitted Phases		4				
Actuated Green, G (s)	29.2	39.4		88.9	74.1	
Effective Green, g (s)	29.8	40.6		89.5	74.7	
Actuated g/C Ratio	0.23	0.32		0.70	0.59	
Clearance Time (s)	4.9	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	413	508		1319	1101	
v/s Ratio Prot	c0.21	0.04		c0.37	c0.54	
v/s Ratio Perm		0.12				
v/c Ratio	0.88	0.50		0.53	0.93	
Uniform Delay, d1	47.2	35.3		9.1	24.1	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	19.5	0.8		0.4	13.6	
Delay (s)	66.7	36.1		9.5	37.7	
Level of Service	E	D		A	D	
Approach Delay (s)	54.1			9.5	37.7	
Approach LOS	D			A	D	

Intersection Summary

HCM 2000 Control Delay	33.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	127.6	Sum of lost time (s)	12.3
Intersection Capacity Utilization	81.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/22/2020

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	120	5	55	130	25	60	20	60	1300	5	0	1520
Future Volume (vph)	120	5	55	130	25	60	20	60	1300	5	0	1520
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0			4.0
Lane Util. Factor		1.00			1.00	1.00		1.00	0.95			0.95
Frpb, ped/bikes		1.00			1.00	0.98		1.00	1.00			1.00
Flpb, ped/bikes		1.00			1.00	1.00		1.00	1.00			1.00
Frt		0.96			1.00	0.85		1.00	1.00			1.00
Flt Protected		0.97			0.96	1.00		0.95	1.00			1.00
Satd. Flow (prot)		1747			1808	1577		1796	3572			3537
Flt Permitted		0.54			0.68	1.00		0.95	1.00			1.00
Satd. Flow (perm)		977			1273	1577		1796	3572			3537
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	120	5	55	130	25	60	20	60	1300	5	0	1520
RTOR Reduction (vph)	0	15	0	0	0	49	0	0	0	0	0	0
Lane Group Flow (vph)	0	165	0	0	155	11	0	80	1305	0	0	1525
Confl. Peds. (#/hr)	5					5	5			5	5	
Confl. Bikes (#/hr)						5				50		
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	2%	0%	1%	0%	0%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Prot	Prot	NA			NA
Protected Phases		8			4		1	1	6			2
Permitted Phases	8			4		4						
Actuated Green, G (s)		22.2			22.2	22.2		8.0	89.3			77.3
Effective Green, g (s)		22.2			22.2	22.2		8.0	89.8			77.8
Actuated g/C Ratio		0.18			0.18	0.18		0.07	0.75			0.65
Clearance Time (s)		4.0			4.0	4.0		4.0	4.5			4.5
Vehicle Extension (s)		2.0			2.0	2.0		3.0	2.0			2.0
Lane Grp Cap (vph)		180			235	291		119	2673			2293
v/s Ratio Prot								c0.04	0.37			c0.43
v/s Ratio Perm		c0.17			0.12	0.01						
v/c Ratio		0.92			0.66	0.04		0.67	0.49			0.67
Uniform Delay, d1		48.0			45.4	40.1		54.7	6.0			13.0
Progression Factor		1.00			1.00	1.00		1.00	1.00			1.00
Incremental Delay, d2		43.3			5.0	0.0		13.9	0.6			1.5
Delay (s)		91.3			50.4	40.2		68.7	6.6			14.6
Level of Service		F			D	D		E	A			B
Approach Delay (s)		91.3			47.6				10.2			14.6
Approach LOS		F			D				B			B
Intersection Summary												
HCM 2000 Control Delay			19.1				HCM 2000 Level of Service		B			
HCM 2000 Volume to Capacity ratio			0.72									
Actuated Cycle Length (s)			120.0				Sum of lost time (s)		12.0			
Intersection Capacity Utilization			73.5%				ICU Level of Service		D			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

16: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

04/22/2020

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	5
Future Volume (vph)	5
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	5
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	5
Confl. Bikes (#/hr)	50
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

Intersection						
Int Delay, s/veh	88.8					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↑	
Traffic Vol, veh/h	635	0	0	760	305	0
Future Vol, veh/h	635	0	0	760	305	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	0	0	0	0	1
Mvmt Flow	635	0	0	760	305	0

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	-	- 1395
Stage 1	-	-	- 635
Stage 2	-	-	- 760
Critical Hdwy	-	-	- 6.4
Critical Hdwy Stg 1	-	-	- 5.4
Critical Hdwy Stg 2	-	-	- 5.4
Follow-up Hdwy	-	-	- 3.5
Pot Cap-1 Maneuver	-	0	0 ~ 157
Stage 1	-	0	0 532
Stage 2	-	0	0 465
Platoon blocked, %	-		-
Mov Cap-1 Maneuver	-	-	- ~ 157
Mov Cap-2 Maneuver	-	-	- ~ 157
Stage 1	-	-	- 532
Stage 2	-	-	- 465

Approach	EB	WB	NB
HCM Control Delay, s	0	0	\$ 495
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	WBT
Capacity (veh/h)	157	-	-
HCM Lane V/C Ratio	1.943	-	-
HCM Control Delay (s)	\$ 495	-	-
HCM Lane LOS	F	-	-
HCM 95th %tile Q(veh)	23.4	-	-

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

Queuing and Blocking Report
2045 Ramp Queuing Analysis Build

03/20/2020

Intersection: 112: SW Barbur Blvd (Hwy 99W) & SW 24th Ave/I-5 Off SB Off Ramp

Movement	EB	WB	WB	NB	NB	NB	B18	B18	SB	SB	B49	B49
Directions Served	LTR	LT	R	UL	T	TR	T	T	T	TR	T	T
Maximum Queue (ft)	259	264	116	206	289	288	47	48	394	371	237	190
Average Queue (ft)	114	111	34	90	158	160	2	2	308	256	51	15
95th Queue (ft)	206	203	80	173	265	269	21	21	432	380	182	93
Link Distance (ft)	400	611			227	227	1535	1535	294	294	218	218
Upstream Blk Time (%)				0	2	2			11	4	1	0
Queuing Penalty (veh)				0	0	0			0	0	0	0
Storage Bay Dist (ft)			200	205								
Storage Blk Time (%)		2		0	3							
Queuing Penalty (veh)		1		1	2							

Intersection: 119: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/BTC Bus/Vehicle In

Movement	EB	EB	WB	NB	NB	NB	B79	B79	SB	SB	SB	SB
Directions Served	LT	>	LTR	L	T	TR	T	T	L	T	T	R
Maximum Queue (ft)	126	109	122	118	217	210	370	396	144	444	502	225
Average Queue (ft)	90	39	28	106	185	120	275	170	29	156	472	137
95th Queue (ft)	157	104	115	129	206	272	357	438	95	398	489	314
Link Distance (ft)	112		182		118	118	190	190		454	454	
Upstream Blk Time (%)	38	8	8	57	96	24	96	19		0	70	
Queuing Penalty (veh)	136	0	0	0	609	155	612	118		0	0	
Storage Bay Dist (ft)		100		350					100			200
Storage Blk Time (%)	42	9		57	96				3	13	66	3
Queuing Penalty (veh)	44	24		283	240				22	3	205	20

Intersection: 119: SW Barbur Blvd (Hwy 99W) & SW Taylors Ferry Rd/BTC Bus/Vehicle In

Movement	NW
Directions Served	R
Maximum Queue (ft)	80
Average Queue (ft)	19
95th Queue (ft)	58
Link Distance (ft)	165
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Queuing and Blocking Report
2045 Ramp Queueing Analysis Build

03/20/2020

Intersection: 120: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

Movement	EB	EB	WB	WB	NB	NB	B33	B33	SB	SB	SB	SB
Directions Served	T	TR>	T	TR	T	TR	T	T	L	T	T	R>
Maximum Queue (ft)	223	276	512	518	499	491	2422	2434	55	277	305	190
Average Queue (ft)	182	237	468	494	469	367	2018	2006	3	120	258	179
95th Queue (ft)	289	371	641	515	488	664	3066	3061	30	297	329	229
Link Distance (ft)	201	201	489	489	398	398	2380	2380		190	190	
Upstream Blk Time (%)	40	60	88	96	98	51	63	59		16	47	31
Queuing Penalty (veh)	251	381	0	0	0	0	0	0		123	355	0
Storage Bay Dist (ft)									100			300
Storage Blk Time (%)										21	47	31
Queuing Penalty (veh)										1	368	109

Intersection: 120: SW Barbur Blvd (Hwy 99W) & SW Capitol Hwy

Movement	B79	B79
Directions Served	T	T
Maximum Queue (ft)	178	277
Average Queue (ft)	57	232
95th Queue (ft)	174	353
Link Distance (ft)	118	118
Upstream Blk Time (%)	5	48
Queuing Penalty (veh)	37	362
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 122: I5 Off Ramp & Taylors Ferry

Movement	EB	NB	NB
Directions Served	T	L	R
Maximum Queue (ft)	442	225	2337
Average Queue (ft)	419	173	2307
95th Queue (ft)	435	326	2482
Link Distance (ft)	403		2306
Upstream Blk Time (%)	98		95
Queuing Penalty (veh)	0		0
Storage Bay Dist (ft)		200	
Storage Blk Time (%)		4	88
Queuing Penalty (veh)		17	268

Intersection: 123: SW Capitol Hwy & Taylors Ferry/SW Taylors Ferry Rd

Movement	EB	EB	EB	WB	WB	NB	NB	SB
Directions Served	L	T	R	L	TR	LT	TR	LTR
Maximum Queue (ft)	108	329	341	91	123	186	210	300
Average Queue (ft)	26	306	302	29	61	37	78	259
95th Queue (ft)	83	341	442	75	117	134	290	284
Link Distance (ft)		265	265		111	201	201	238
Upstream Blk Time (%)		77	85	0	4	0	5	100
Queuing Penalty (veh)		423	469	0	21	1	18	0
Storage Bay Dist (ft)	100			75				
Storage Blk Time (%)	0	21		6	4			
Queuing Penalty (veh)	0	14		24	2			

Network Summary

Network wide Queuing Penalty: 5905

APPENDIX B32

Segment B – Fulton Park Circulation Study

Southwest Corridor

Fulton Park Area Circulation Study

February 24, 2020

Prepared by:

Garth Appanaitis, PE

Randy Johnson, PE, PTOE



720 SW Washington St.

Suite 500

Portland, OR 97205

503.243.3500

www.dksassociates.com

Fulton Park Area Circulation Study

The following sections summarize circulation impacts to residential neighborhoods between SW 5th Avenue and SW Briar Place (the Fulton Park Area) with the access modifications that are proposed as part of the locally preferred alternative (LPA). The LPA access modifications (Figure 2) include:

- North of SW Barbur Boulevard: Remove frontage road connections to SW 3rd Ave and cul-de-sac SW 2nd Avenue. A new street will retain connection between SW 4th Avenue and SW 5th Avenue.
- South of SW Barbur Boulevard: Close connection of SW Miles Street and combine SW Barbur Boulevard access with SW 2nd Avenue. The existing traffic signal at SW 3rd Avenue will be reconstructed to include the SW 2nd Avenue approach with full signalized access.

The street network north of SW Barbur Boulevard will experience modifications to vehicle circulation due to the closure of the frontage road. The street network south of SW Barbur Boulevard will not include changes to the circulation patterns other than a minor redirection of traffic from SW Miles Street to SW 2nd Avenue. The following sections describe the existing traffic circulation patterns and potential impacts with the LPA access modifications.

Existing Circulation Patterns

Southwest 3rd Avenue provides signalized access to SW Barbur Boulevard for neighborhoods located to the north. Frontage Road runs along the north side of SW Barbur Boulevard and provides connections to several local streets (SW 2nd Avenue, SW 4th Avenue, and SW 5th Avenue) via the traffic signal at SW 3rd Avenue. As shown in Figure 2, drivers traveling between SW 2nd Avenue, SW 4th Avenue, and SW 5th Avenue connect to SW 3rd Avenue using SW Nevada Street, SW Nevada Court, or Frontage Road in order to access SW Barbur Boulevard and local streets south of Barbur Boulevard.

Existing peak hour traffic volumes that access each leg of Frontage Road from SW 3rd Avenue are low (two-way combined volume of 15 vehicles or less per hour). Figure 1 summarizes the existing peak hour vehicle movements at the SW 3rd Avenue/SW Frontage Road intersection north of SW Barbur Boulevard.



Figure 1: Existing Peak Hour Vehicle Turn Movements at SW 3rd Avenue/SW Frontage Road

LPA Circulation Patterns

Figure 2 summarizes the LPA changes to the roadway connectivity within the study area, which include:

- North of SW Barbur Boulevard, close Frontage Road segments that connect between SW 2nd Avenue, SW 3rd Avenue, SW 4th Avenue, and SW 5th Avenue. Add cul-de-sac treatment to the southern extents to SW 2nd Avenue and construct a new connection between SW 4th Avenue and SW 5th Avenue west of the existing Frontage Road location.
- South of SW Barbur Boulevard, close segment of SW Miles Street that connects between SW Barbur Boulevard and SW 2nd Avenue. Reconstruct SW 3rd Avenue traffic signal to include SW 2nd Avenue full movement approach at SW Barbur Boulevard.

Several circulation modifications will result north of SW Barbur Boulevard due to the closure of Frontage Road, as shown in Figure 2, including:

- East of SW 3rd Avenue - Vehicles traveling to/from SW 2nd Avenue will use SW Nevada Street to connect to SW 3rd Avenue. Southwest Nevada Street will provide the only connection between SW 2nd Avenue and SW 3rd Avenue. Up to ten vehicles will be added to this segment of SW Nevada Street during the peak hour.
- West of SW 3rd Avenue - Vehicles traveling to/from SW 4th Avenue and SW 5th Avenue will connect to SW 3rd Street via SW Nevada Street or SW Nevada Court. While drivers will have two potential routes, neither route provides an ideal driving experience based on existing infrastructure - both segments of SW Nevada Street and SW Nevada Court connecting SW 3rd Avenue and SW 4th Avenue are unpaved and narrow (14 feet or less). It is projected that this segment of SW Nevada Street could have up to ten additional vehicles during the peak hour with the closure of Frontage Street. The segment of SW Nevada Court may serve up to 15 additional vehicles during the peak hour. However, it is likely that a combination of these two street segments will be used and the total traffic added to each will be approximately five to ten vehicles during each peak hour.

Traffic added to streets in the neighborhood during peak periods of the day are projected to be generally ten hourly vehicles or less based on existing traffic counts. Some road segments (primarily SW 3rd Avenue) may experience up to 20 additional vehicles during the peak hour. The limited shift of existing traffic volumes results in no significant impact over current transportation operations.

The closure of the SW Miles Street connection to SW Barbur Boulevard will result in a minor realignment of traffic accessing neighborhoods south of SW Barbur Boulevard but will not result in additional traffic on the local street system. Full movement access for through traffic using the SW Miles Street over the Brier Place I-5 overpass is maintained. Metro's regional travel demand model shows no significant change in traffic volumes using the Brier Place overcrossing as compared to the future no-build model.



Figure 2: Existing Roadway Characteristics and Added Peak Hour Traffic with LPA Circulation Modifications