APPENDIX III

Alternative 1 LOS Worksheets

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Appendix A

Intersection Analysis

Appendix A Includes:

A1. Year 2020 Alternative 1 Intersection LOS Worksheets

A2. Year 2040 Alternative 1 Intersection LOS Worksheets

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Appendix A1

Year 2020 Alternative 1
Intersection Level of Service (LOS) Worksheets

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Queues
1: Carson St & I-605 SB Off Ramps

11/30/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	1318	1439	75	721	406	323
v/c Ratio	0.53	0.72	0.05	0.42	0.27	0.44
Control Delay	23.4	18.2	0.1	17.3	15.1	18.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	18.2	0.1	17.3	15.1	18.5
Queue Length 50th (ft)	180	209	0	143	75	132
Queue Length 95th (ft)	193	212	0	211	121	238
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2877	2293	1611	1732	1512	734
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.63	0.05	0.42	0.27	0.44

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1190	62	0	1367	0	0	0	71	685	78	615
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.88	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6360			5085				1611	3433	2984	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6360			5085				1611	3433	2984	1441
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)	0	1253	65	0	1439	0	0	0	75	721	82	647
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	7	7
Lane Group Flow (vph)	0	1310	0	0	1439	0	0	0	75	721	399	316
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		39.3			39.3				100.0	50.4	50.4	50.4
Effective Green, g (s)		39.3			39.3				100.0	50.4	50.4	50.4
Actuated g/C Ratio		0.39			0.39				1.00	0.50	0.50	0.50
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2499			1998				1611	1730	1504	726
v/s Ratio Prot		0.21			c0.28					0.21	0.13	
v/s Ratio Perm									0.05			c0.22
v/c Ratio		0.52			0.72				0.05	0.42	0.27	0.44
Uniform Delay, d1		23.2			25.7				0.0	15.6	14.2	15.8
Progression Factor		1.00			0.64				1.00	1.00	1.00	1.00
Incremental Delay, d2		0.4			1.4				0.1	0.7	0.4	1.9
Delay (s)		23.6			17.8				0.1	16.3	14.6	17.7
Level of Service		C			B				A	B	B	B
Approach Delay (s)		23.6			17.8			0.1			16.1	
Approach LOS		C			B			A			B	

Intersection Summary			
HCM Average Control Delay	18.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	60.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	1768	1209	808	655	538
v/c Ratio	0.49	0.60	0.65	0.56	0.56
Control Delay	10.5	6.8	5.3	29.5	28.3
Queue Delay	0.0	0.8	2.7	0.0	0.0
Total Delay	10.5	7.6	8.0	29.5	28.3
Queue Length 50th (ft)	129	105	110	176	151
Queue Length 95th (ft)	159	141	146	234	210
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3691	2038	1254	1167	967
Starvation Cap Reductn	0	481	320	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.48	0.78	0.87	0.56	0.56

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1680	0	0	1149	768	622	0	511	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
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)	0	1768	0	0	1209	808	655	0	538	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	351	0	0	19	0	0	0
Lane Group Flow (vph)	0	1768	0	0	1209	457	655	0	519	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		56.6			56.6	56.6	34.0		34.0			
Effective Green, g (s)		56.6			56.6	56.6	34.0		34.0			
Actuated g/C Ratio		0.57			0.57	0.57	0.34		0.34			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3627			2003	896	1167		948			
v/s Ratio Prot		0.28			c0.34							
v/s Ratio Perm						0.29	c0.19		0.19			
v/c Ratio		0.49			0.60	0.51	0.56		0.55			
Uniform Delay, d1		13.0			14.3	13.2	26.9		26.8			
Progression Factor		0.77			0.41	3.75	1.00		1.00			
Incremental Delay, d2		0.2			0.5	0.7	2.0		2.3			
Delay (s)		10.3			6.4	50.4	28.9		29.0			
Level of Service		B			A	D	C		C			
Approach Delay (s)		10.3			24.0			28.9			0.0	
Approach LOS		B			C			C			A	

Intersection Summary			
HCM Average Control Delay	20.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	557	1271	6	1310	187	193	144	267	262
v/c Ratio	0.86	0.46	0.05	0.76	0.82	0.30	0.48	0.72	0.60
Control Delay	44.3	9.0	44.3	33.7	70.6	34.6	49.2	25.0	11.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.3	9.0	44.3	33.7	70.6	34.6	49.2	25.0	11.1
Queue Length 50th (ft)	185	83	4	268	117	54	45	52	0
Queue Length 95th (ft)	#273	231	17	#350	#232	83	77	138	72
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	645	2785	125	1717	232	783	306	429	486
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.46	0.05	0.76	0.81	0.25	0.47	0.62	0.54

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	529	1127	81	6	1196	48	178	171	12	137	49	453
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.99		1.00	0.99		1.00	0.99		1.00	0.88	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5034		1770	5056		1770	3503		3433	1556	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5034		1770	5056		1770	3503		3433	1556	1504
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)	557	1186	85	6	1259	51	187	180	13	144	52	477
RTOR Reduction (vph)	0	7	0	0	4	0	0	6	0	0	157	226
Lane Group Flow (vph)	557	1264	0	6	1306	0	187	187	0	144	110	36
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	22.7	51.3		1.4	30.0		12.9	18.0		8.7	13.8	13.8
Effective Green, g (s)	22.7	51.3		1.4	30.0		12.9	18.0		8.7	13.8	13.8
Actuated g/C Ratio	0.23	0.51		0.01	0.30		0.13	0.18		0.09	0.14	0.14
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	779	2582		25	1517		228	631		299	215	208
v/s Ratio Prot	c0.16	0.25		0.00	c0.26		c0.11	c0.05		0.04	c0.07	
v/s Ratio Perm												0.02
v/c Ratio	0.72	0.49		0.24	0.86		0.82	0.30		0.48	0.51	0.17
Uniform Delay, d1	35.7	15.8		48.8	33.0		42.4	35.5		43.5	40.0	38.1
Progression Factor	0.77	0.58		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.0	0.6		6.7	6.6		21.3	0.4		1.7	2.7	0.5
Delay (s)	30.5	9.8		55.5	39.7		63.7	35.9		45.2	42.7	38.6
Level of Service	C	A		E	D		E	D		D	D	D
Approach Delay (s)		16.1			39.7			49.6			41.6	
Approach LOS		B			D			D			D	

Intersection Summary			
HCM Average Control Delay	30.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	1280	1389	757	841
v/c Ratio	0.41	0.63	0.77	0.53
Control Delay	10.8	14.3	38.3	1.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	10.8	14.3	38.3	1.3
Queue Length 50th (ft)	138	266	228	0
Queue Length 95th (ft)	206	410	264	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	3155	2196	1710	1583
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	80	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.42	0.63	0.44	0.53

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1216	1320	0	719	799
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1280	1389	0	757	841
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1280	1389	0	757	841
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		62.0	62.0		28.5	100.0
Effective Green, g (s)		62.0	62.0		28.5	100.0
Actuated g/C Ratio		0.62	0.62		0.28	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		3153	2194		978	1583
v/s Ratio Prot		0.25	c0.39		c0.22	
v/s Ratio Perm						0.53
v/c Ratio		0.41	0.63		0.77	0.53
Uniform Delay, d1		9.6	11.9		32.8	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.4	1.3		3.7	1.3
Delay (s)		10.0	13.2		36.5	1.3
Level of Service		B	B		D	A
Approach Delay (s)		10.0	13.2		18.0	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	1864	578	240	1411
v/c Ratio	0.72	0.47	0.75	0.40
Control Delay	12.4	5.6	53.6	0.3
Queue Delay	0.5	0.2	0.0	0.0
Total Delay	12.8	5.9	53.6	0.3
Queue Length 50th (ft)	372	118	145	0
Queue Length 95th (ft)	529	232	221	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2572	1222	389	3539
Starvation Cap Reductn	279	179	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.81	0.55	0.62	0.40

Intersection Summary

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1771	549	228	1340	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1864	578	240	1411	0	0
RTOR Reduction (vph)	0	72	0	0	0	0
Lane Group Flow (vph)	1864	506	240	1411	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	72.7	72.7	18.0	100.0		
Effective Green, g (s)	72.7	72.7	18.0	100.0		
Actuated g/C Ratio	0.73	0.73	0.18	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2573	1151	319	3539		
v/s Ratio Prot	c0.53		c0.14	0.40		
v/s Ratio Perm		0.32				
v/c Ratio	0.72	0.44	0.75	0.40		
Uniform Delay, d1	7.9	5.5	38.9	0.0		
Progression Factor	1.20	1.34	1.00	1.00		
Incremental Delay, d2	1.7	1.2	9.6	0.3		
Delay (s)	11.2	8.5	48.5	0.3		
Level of Service	B	A	D	A		
Approach Delay (s)	10.6			7.3	0.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	9.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	386	0	0	649	0	618	796	0	744	564
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	406	0	0	683	0	651	838	0	783	594
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.96	0.96		0.96	0.96	0.96				0.96		
vC, conflicting volume	1000	1434	261	912	1434	217	783			651		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	835	1289	261	743	1289	15	783			469		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	45	100	100	33	100			100		
cM capacity (veh/h)	81	155	738	130	155	1013	831			1040		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	406	683	260	260	409	559	313	313	355	396
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	406	683	0	0	279	559	0	0	198	396
cSH	738	1013	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.55	0.67	0.15	0.15	0.24	0.33	0.18	0.18	0.21	0.23
Queue Length 95th (ft)	85	137	0	0	0	0	0	0	0	0
Control Delay (s)	15.7	15.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	C								
Approach Delay (s)	15.7	15.6	0.0				0.0			
Approach LOS	C	C								

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	613	0	1359	796	340
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	645	0	1431	838	358
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.90					
vC, conflicting volume	1196	279	838			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	634	279	838			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	10	100			
cM capacity (veh/h)	368	718	792			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	645	358	358	358	358	335	335	287	239
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	645	0	0	0	0	0	0	119	239
cSH	718	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.90	0.21	0.21	0.21	0.21	0.20	0.20	0.17	0.14
Queue Length 95th (ft)	292	0	0	0	0	0	0	0	0
Control Delay (s)	37.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	E								
Approach Delay (s)	37.7	0.0				0.0			
Approach LOS	E								

Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	117	769	132	72	1061	239	246	1178	89	1369
v/c Ratio	0.65	0.50	0.18	0.40	0.74	0.42	0.85	0.55	0.29	0.86
Control Delay	55.5	23.9	10.0	43.7	28.0	6.9	64.3	22.3	37.5	29.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.5	23.9	10.0	43.7	28.0	6.9	64.3	22.3	37.5	29.5
Queue Length 50th (ft)	30	115	25	18	182	8	63	141	21	213
Queue Length 95th (ft)	#68	152	58	39	233	68	#130	170	44	#296
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	180	1602	744	180	1511	579	288	2264	303	1627
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.65	0.48	0.18	0.40	0.70	0.41	0.85	0.52	0.29	0.84

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	111	731	125	68	982	253	234	947	172	85	887	413
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4788	1362	3433	6260		3433	4843	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4788	1362	3433	6260		3433	4843	
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)	117	769	132	72	1034	266	246	997	181	89	934	435
RTOR Reduction (vph)	0	0	26	0	4	155	0	40	0	0	103	0
Lane Group Flow (vph)	117	769	106	72	1057	84	246	1138	0	89	1266	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	3.1	23.1	29.5	3.1	23.1	23.1	6.4	26.0		5.5	25.1	
Effective Green, g (s)	3.1	23.1	29.5	3.1	23.1	23.1	6.4	26.0		5.5	25.1	
Actuated g/C Ratio	0.04	0.29	0.37	0.04	0.29	0.29	0.08	0.33		0.07	0.32	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	134	1481	697	134	1395	397	277	2052		238	1533	
v/s Ratio Prot	0.03	c0.15	0.01	0.02	c0.22		c0.07	0.18		0.03	c0.26	
v/s Ratio Perm			0.05			0.06						
v/c Ratio	0.87	0.52	0.15	0.54	0.76	0.21	0.89	0.55		0.37	0.83	
Uniform Delay, d1	37.9	23.5	16.6	37.4	25.6	21.2	36.1	21.9		35.3	25.1	
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	42.1	0.3	0.1	4.1	2.4	0.3	27.1	0.3		1.0	3.8	
Delay (s)	80.0	23.8	16.7	41.5	28.0	21.5	63.2	22.2		36.2	28.9	
Level of Service	F	C	B	D	C	C	E	C		D	C	
Approach Delay (s)		29.3			27.6			29.3			29.3	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	28.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	79.3	Sum of lost time (s)	16.2
Intersection Capacity Utilization	75.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	570	426	0	807	0	0	0	0	0	0	497
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	600	448	0	849	0	0	0	0	0	0	523
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.90			0.90	0.90	0.90	0.90	0.90	
vC, conflicting volume	849			1048			1107	1674	424	1049	1898	283
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	849			647			713	1345	0	649	1596	283
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	27
cM capacity (veh/h)	784			837			76	135	971	318	95	714

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	240	240	568	283	283	283	523
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	448	0	0	0	523
cSH	1700	1700	1700	1700	1700	1700	714
Volume to Capacity	0.14	0.14	0.33	0.17	0.17	0.17	0.73
Queue Length 95th (ft)	0	0	0	0	0	0	162
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	22.6
Lane LOS							C
Approach Delay (s)	0.0			0.0			22.6
Approach LOS							C

Intersection Summary			
Average Delay	4.9		
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	53	185	181	179	6	1387	416	1306
v/c Ratio	0.37	0.52	0.43	0.42	0.04	0.54	0.31	0.48
Control Delay	22.9	25.0	9.3	9.0	10.8	8.0	0.4	11.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.9	25.0	9.3	9.0	10.8	8.0	0.4	11.0
Queue Length 50th (ft)	7	63	14	12	1	67	0	110
Queue Length 95th (ft)	36	103	54	51	m2	m134	m0	180
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	142	532	557	570	164	2574	1362	2745
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.35	0.32	0.31	0.04	0.54	0.31	0.48

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	0	31	196	1	321	6	953	760	0	1234	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.92		1.00	0.87	0.85	1.00	0.96	0.85		1.00	
Flt Protected		0.98		0.95	0.99	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1675		1681	1463	1504	1770	4606	1362		5081	
Flt Permitted		0.98		0.95	0.99	1.00	0.16	1.00	1.00		1.00	
Satd. Flow (perm)		1675		1681	1463	1504	304	4606	1362		5081	
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)	20	0	33	206	1	338	6	1003	800	0	1299	7
RTOR Reduction (vph)	0	32	0	0	108	108	0	91	0	0	0	0
Lane Group Flow (vph)	0	21	0	185	73	71	6	1296	416	0	1306	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		2.4		12.8	12.8	12.8	30.8	30.8	60.0		30.8	
Effective Green, g (s)		2.4		12.8	12.8	12.8	30.8	30.8	60.0		30.8	
Actuated g/C Ratio		0.04		0.21	0.21	0.21	0.51	0.51	1.00		0.51	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		67		359	312	321	156	2364	1362		2608	
v/s Ratio Prot		0.01		c0.11	0.05			c0.28			0.26	
v/s Ratio Perm						0.05	0.02		c0.31			
v/c Ratio		0.32		0.52	0.23	0.22	0.04	0.55	0.31		0.50	
Uniform Delay, d1		28.0		20.9	19.5	19.5	7.2	9.9	0.0		9.6	
Progression Factor		1.00		1.00	1.00	1.00	0.99	0.83	1.00		1.00	
Incremental Delay, d2		2.7		1.3	0.4	0.4	0.3	0.6	0.4		0.7	
Delay (s)		30.7		22.1	19.9	19.8	7.4	8.8	0.4		10.3	
Level of Service		C		C	B	B	A	A	A		B	
Approach Delay (s)		30.7			20.6			6.8			10.3	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	10.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	52.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	109	784	219	2378	226	1051	65	1006
v/c Ratio	1.06	0.45	0.75	1.05	1.02	0.66	0.73	0.90
Control Delay	159.1	29.8	71.7	52.2	107.5	24.5	90.7	51.9
Queue Delay	0.0	0.0	0.0	15.4	0.0	0.6	0.0	0.0
Total Delay	159.1	29.8	71.7	67.6	107.5	25.2	90.7	51.9
Queue Length 50th (ft)	~92	159	181	~699	~192	280	53	204
Queue Length 95th (ft)	#212	215	m215	#429	#357	282	#135	#290
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	103	1746	384	2275	221	1587	89	1118
Starvation Cap Reductn	0	0	0	79	0	217	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.06	0.45	0.57	1.08	1.02	0.77	0.73	0.90

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	104	591	154	208	1751	508	215	986	12	62	822	134
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	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.97		1.00	0.97		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4928		1770	4914		1770	5076		1770	4978	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4928		1770	4914		1770	5076		1770	4978	
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)	109	622	162	219	1843	535	226	1038	13	65	865	141
RTOR Reduction (vph)	0	36	0	0	44	0	0	1	0	0	19	0
Lane Group Flow (vph)	109	748	0	219	2334	0	226	1050	0	65	987	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	7.0	41.6		19.9	54.5		15.8	36.7		4.8	25.7	
Effective Green, g (s)	7.0	41.6		19.9	54.5		15.8	36.7		4.8	25.7	
Actuated g/C Ratio	0.06	0.35		0.17	0.45		0.13	0.31		0.04	0.21	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	103	1708		294	2232		233	1552		71	1066	
v/s Ratio Prot	c0.06	0.15		0.12	c0.48		c0.13	0.21		0.04	c0.20	
v/s Ratio Perm												
v/c Ratio	1.06	0.44		0.74	1.05		0.97	0.68		0.92	0.93	
Uniform Delay, d1	56.5	30.2		47.6	32.8		51.9	36.5		57.4	46.2	
Progression Factor	1.00	1.00		1.33	0.75		0.88	0.62		0.92	0.92	
Incremental Delay, d2	105.3	0.2		5.5	27.9		44.6	2.0		72.9	13.6	
Delay (s)	161.8	30.4		69.0	52.5		90.3	24.7		125.8	56.3	
Level of Service	F	C		E	D		F	C		F	E	
Approach Delay (s)		46.4			53.9			36.3			60.5	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM Average Control Delay	50.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	95.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	307	1055	307	161	603	14	957	238	1142
v/c Ratio	0.68	0.76	0.58	0.69	0.71	0.09	0.58	0.27	0.49
Control Delay	47.6	38.6	15.9	56.3	38.1	23.5	26.3	3.7	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Total Delay	47.6	38.6	15.9	56.3	38.1	23.5	26.4	3.7	6.9
Queue Length 50th (ft)	213	295	81	133	124	6	287	0	76
Queue Length 95th (ft)	319	249	123	206	145	23	388	49	m85
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	505	1525	566	295	1038	152	1657	868	2332
Starvation Cap Reductn	0	0	0	0	0	0	0	0	310
Spillback Cap Reductn	0	0	0	0	0	0	69	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.61	0.69	0.54	0.55	0.58	0.09	0.60	0.27	0.56

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	292	845	449	153	573	0	13	909	226	0	598	487
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	0.98	0.85	1.00	1.00		1.00	1.00	0.85		0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4692	1362	1770	5085		1770	3539	1583		4743	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.17	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4692	1362	1770	5085		324	3539	1583		4743	
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)	307	889	473	161	603	0	14	957	238	0	629	513
RTOR Reduction (vph)	0	21	134	0	0	0	0	0	127	0	110	0
Lane Group Flow (vph)	307	1034	173	161	603	0	14	957	111	0	1032	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	30.6	35.1	35.1	15.7	20.2		56.2	56.2	56.2		56.2	
Effective Green, g (s)	30.6	35.1	35.1	15.7	20.2		56.2	56.2	56.2		56.2	
Actuated g/C Ratio	0.26	0.29	0.29	0.13	0.17		0.47	0.47	0.47		0.47	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	451	1372	398	232	856		152	1657	741		2221	
v/s Ratio Prot	c0.17	c0.22		0.09	0.12			c0.27			0.22	
v/s Ratio Perm			0.13				0.04		0.07			
v/c Ratio	0.68	0.75	0.43	0.69	0.70		0.09	0.58	0.15		0.46	
Uniform Delay, d1	40.3	38.5	34.4	49.9	47.1		17.7	23.2	18.2		21.7	
Progression Factor	1.01	0.94	0.92	0.88	0.73		1.00	1.00	1.00		0.34	
Incremental Delay, d2	3.8	2.2	0.7	7.0	2.1		1.2	1.5	0.4		0.4	
Delay (s)	44.5	38.5	32.5	50.9	36.6		18.9	24.7	18.7		7.8	
Level of Service	D	D	C	D	D		B	C	B		A	
Approach Delay (s)		38.5			39.6			23.5			7.8	
Approach LOS		D			D			C			A	

Intersection Summary			
HCM Average Control Delay	27.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	185	1061	0	0	1226
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	195	1117	0	0	1291
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked						
vC, conflicting volume	1547	372			1117	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1547	372			1117	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	69			100	
cM capacity (veh/h)	105	625			621	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	195	372	372	372	430	430	430
Volume Left	0	0	0	0	0	0	0
Volume Right	195	0	0	0	0	0	0
cSH	625	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.31	0.22	0.22	0.22	0.25	0.25	0.25
Queue Length 95th (ft)	33	0	0	0	0	0	0
Control Delay (s)	13.3	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B						
Approach Delay (s)	13.3	0.0			0.0		
Approach LOS	B						

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	38.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1202	877	750
v/c Ratio	0.43	0.31	0.70
Control Delay	9.0	4.9	20.2
Queue Delay	0.0	0.0	0.0
Total Delay	9.0	4.9	20.2
Queue Length 50th (ft)	84	41	110
Queue Length 95th (ft)	138	94	140
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	2826	2826	1388
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.43	0.31	0.54

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1142	833	0	568	144
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.97	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3370	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3370	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1202	877	0	598	152
RTOR Reduction (vph)	0	0	0	0	45	0
Lane Group Flow (vph)	0	1202	877	0	705	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		33.3	33.3		18.2	
Effective Green, g (s)		33.3	33.3		18.2	
Actuated g/C Ratio		0.55	0.55		0.30	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		2822	2822		1022	
v/s Ratio Prot		c0.24	0.17		c0.21	
v/s Ratio Perm						
v/c Ratio		0.43	0.31		0.69	
Uniform Delay, d1		7.8	7.2		18.4	
Progression Factor		1.00	0.60		1.00	
Incremental Delay, d2		0.5	0.3		2.0	
Delay (s)		8.3	4.5		20.4	
Level of Service		A	A		C	
Approach Delay (s)		8.3	4.5		20.4	
Approach LOS		A	A		C	

Intersection Summary			
HCM Average Control Delay	10.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	49.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	83	655	334	2439	94	571	435	87	808
v/c Ratio	0.81	0.40	0.63	0.85	0.10	0.60	0.58	0.66	0.58
Control Delay	98.7	14.0	42.5	25.9	3.8	30.2	8.8	64.3	34.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	98.7	14.0	42.5	25.9	3.8	30.2	8.8	64.3	34.4
Queue Length 50th (ft)	68	54	223	554	5	100	16	60	171
Queue Length 95th (ft)	m#158	64	326	627	29	161	131	#142	217
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	103	1631	531	2860	925	958	746	132	1383
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.81	0.40	0.63	0.85	0.10	0.60	0.58	0.66	0.58

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	79	622	0	317	2317	89	0	542	413	83	487	280
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	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4807	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.26	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	488	4807	
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)	83	655	0	334	2439	94	0	571	435	87	513	295
RTOR Reduction (vph)	0	0	0	0	0	35	0	0	317	0	81	0
Lane Group Flow (vph)	83	655	0	334	2439	59	0	571	118	87	727	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	7.0	38.5		36.0	67.5	67.5		32.5	32.5	32.5	32.5	
Effective Green, g (s)	7.0	38.5		36.0	67.5	67.5		32.5	32.5	32.5	32.5	
Actuated g/C Ratio	0.06	0.32		0.30	0.56	0.56		0.27	0.27	0.27	0.27	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	103	1631		531	2860	890		958	429	132	1302	
v/s Ratio Prot	0.05	0.13		c0.19	c0.48			0.16			0.15	
v/s Ratio Perm						0.04			0.07	c0.18		
v/c Ratio	0.81	0.40		0.63	0.85	0.07		0.60	0.27	0.66	0.56	
Uniform Delay, d1	55.8	31.8		36.2	22.1	11.9		38.0	34.5	38.8	37.6	
Progression Factor	0.97	0.42		1.00	1.00	1.00		0.73	1.81	1.00	1.00	
Incremental Delay, d2	32.5	0.7		2.3	3.5	0.1		2.2	1.3	22.9	1.7	
Delay (s)	86.7	13.9		38.6	25.5	12.1		30.0	63.7	61.8	39.3	
Level of Service	F	B		D	C	B		C	E	E	D	
Approach Delay (s)		22.1			26.6			44.6			41.5	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	31.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	83.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	126	1572	169	2815	441	201	65	97	880	199
v/c Ratio	1.22	0.89	0.88	1.39	1.57	0.19	0.12	0.60	1.07	0.45
Control Delay	207.3	43.8	94.2	207.9	309.5	32.4	8.3	67.0	94.3	23.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	207.3	43.8	94.2	207.9	309.5	32.4	8.3	67.0	94.3	23.1
Queue Length 50th (ft)	~120	415	131	~1070	~485	61	0	73	~396	65
Queue Length 95th (ft)	#246	481	#260	#1159	#688	94	34	129	#525	138
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	103	1769	192	2030	280	1061	520	192	826	445
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.22	0.89	0.88	1.39	1.57	0.19	0.13	0.51	1.07	0.45

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	120	1360	133	161	2618	56	419	191	62	92	836	189
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5017		1770	5069		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5017		1770	5069		1770	3539	1583	1770	3539	1583
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)	126	1432	140	169	2756	59	441	201	65	97	880	199
RTOR Reduction (vph)	0	10	0	0	2	0	0	0	46	0	0	75
Lane Group Flow (vph)	126	1562	0	169	2813	0	441	201	20	97	880	124
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	7.0	42.1		12.9	48.0		19.0	36.0	36.0	11.0	28.0	28.0
Effective Green, g (s)	7.0	42.1		12.9	48.0		19.0	36.0	36.0	11.0	28.0	28.0
Actuated g/C Ratio	0.06	0.35		0.11	0.40		0.16	0.30	0.30	0.09	0.23	0.23
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	103	1760		190	2028		280	1062	475	162	826	369
v/s Ratio Prot	c0.07	0.31		0.10	c0.55		c0.25	0.06		0.05	c0.25	
v/s Ratio Perm									0.01			0.08
v/c Ratio	1.22	0.89		0.89	1.39		1.57	0.19	0.04	0.60	1.07	0.34
Uniform Delay, d1	56.5	36.7		52.8	36.0		50.5	31.2	29.8	52.4	46.0	38.3
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	160.4	5.9		35.8	177.4		275.3	0.1	0.0	5.8	50.2	0.5
Delay (s)	216.9	42.6		88.7	213.4		325.8	31.3	29.8	58.2	96.2	38.8
Level of Service	F	D		F	F		F	C	C	E	F	D
Approach Delay (s)		55.5			206.3			214.8			83.4	
Approach LOS		E			F			F			F	

Intersection Summary			
HCM Average Control Delay	146.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.32		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	119.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	166	0	592	0	0	718	472	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	175	0	623	0	0	756	497	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.76		0.76						0.76	0.76
vC, conflicting volume	1876	312	1253			623			1242	1379
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1993	312	1176			623			1162	1341
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	74	100			100			100	100
cM capacity (veh/h)	46	684	450			954			85	115

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	175	312	312	756	497
Volume Left	0	0	0	0	0
Volume Right	175	0	0	0	497
cSH	684	1700	1700	1700	1700
Volume to Capacity	0.26	0.18	0.18	0.44	0.29
Queue Length 95th (ft)	25	0	0	0	0
Control Delay (s)	12.1	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	12.1	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	57.0%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	759	0	0	0	0	0	0	648	54	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	799	0	0	0	0	0	0	682	57	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked												
vC, conflicting volume	1421	1421	57	2220	1421	0	57			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1421	1421	57	2220	1421	0	57			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	21	100	100	100	100			58		
cM capacity (veh/h)	77	79	1009	4	79	1085	1548			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	799	682	57
Volume Left	0	682	0
Volume Right	799	0	0
cSH	1009	1623	1700
Volume to Capacity	0.79	0.42	0.03
Queue Length 95th (ft)	215	53	0
Control Delay (s)	20.6	8.8	0.0
Lane LOS	C	A	
Approach Delay (s)	20.6	8.1	
Approach LOS	C		

Intersection Summary			
Average Delay	14.6		
Intersection Capacity Utilization	57.0%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	524	206	113	899	243	1200
v/c Ratio	0.91	0.34	0.71	0.46	0.25	0.62
Control Delay	45.7	9.6	37.9	9.6	2.0	12.9
Queue Delay	0.0	0.0	0.0	0.1	0.0	0.1
Total Delay	45.7	9.6	37.9	9.8	2.0	12.9
Queue Length 50th (ft)	209	26	27	121	6	175
Queue Length 95th (ft)	#383	72	m#94	m162	m17	237
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	594	624	159	1935	976	1934
Starvation Cap Reductn	0	0	0	278	0	0
Spillback Cap Reductn	0	0	0	0	0	69
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.33	0.71	0.54	0.25	0.64

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	498	28	168	107	854	231	0	1135	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.87		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1623		1770	3539	1583		3537	
Flt Permitted				0.95	1.00		0.16	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1623		293	3539	1583		3537	
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)	0	0	0	524	29	177	113	899	243	0	1195	5
RTOR Reduction (vph)	0	0	0	0	80	0	0	0	110	0	0	0
Lane Group Flow (vph)	0	0	0	524	126	0	113	899	133	0	1200	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				22.7	22.7		38.3	38.3	38.3		38.3	
Effective Green, g (s)				22.7	22.7		38.3	38.3	38.3		38.3	
Actuated g/C Ratio				0.32	0.32		0.55	0.55	0.55		0.55	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				574	526		160	1936	866		1935	
v/s Ratio Prot				c0.30	0.08			0.25			0.34	
v/s Ratio Perm							c0.39		0.08			
v/c Ratio				0.91	0.24		0.71	0.46	0.15		0.62	
Uniform Delay, d1				22.7	17.3		11.7	9.6	7.8		10.9	
Progression Factor				1.00	1.00		0.94	0.89	1.07		1.00	
Incremental Delay, d2				19.0	0.2		19.9	0.7	0.3		1.5	
Delay (s)				41.7	17.6		30.9	9.3	8.7		12.4	
Level of Service				D	B		C	A	A		B	
Approach Delay (s)		0.0			34.9			11.1			12.4	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM Average Control Delay	17.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	435	318	877	1775
v/c Ratio	0.87	0.69	0.41	0.83
Control Delay	43.6	29.7	2.4	10.3
Queue Delay	0.0	0.0	0.1	0.3
Total Delay	43.6	29.7	2.5	10.6
Queue Length 50th (ft)	172	112	19	186
Queue Length 95th (ft)	#319	194	m24	m217
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	531	487	2136	2136
Starvation Cap Reductn	0	0	215	6
Spillback Cap Reductn	0	0	0	67
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.82	0.65	0.46	0.86

Intersection Summary

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

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	413	302	0	833	1686	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		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	435	318	0	877	1775	0
RTOR Reduction (vph)	0	12	0	0	0	0
Lane Group Flow (vph)	435	306	0	877	1775	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	19.8	19.8		42.2	42.2	
Effective Green, g (s)	19.8	19.8		42.2	42.2	
Actuated g/C Ratio	0.28	0.28		0.60	0.60	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	501	448		2134	2134	
v/s Ratio Prot				0.25	c0.50	
v/s Ratio Perm	c0.25	0.19				
v/c Ratio	0.87	0.68		0.41	0.83	
Uniform Delay, d1	23.9	22.3		7.3	11.1	
Progression Factor	1.00	1.00		0.25	0.59	
Incremental Delay, d2	14.7	4.3		0.5	2.9	
Delay (s)	38.6	26.6		2.3	9.4	
Level of Service	D	C		A	A	
Approach Delay (s)	33.5			2.3	9.4	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	12.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	229	348	119	37	266	88	144	478	96	186	1474	438
v/c Ratio	0.92	0.42	0.26	0.18	0.32	0.20	0.81	0.36	0.15	0.49	0.85	0.49
Control Delay	68.4	24.3	6.4	23.6	23.1	6.8	66.7	16.8	4.3	24.4	12.1	2.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.3
Total Delay	68.4	24.3	6.4	23.6	23.1	6.8	66.7	16.8	4.3	24.4	14.0	2.5
Queue Length 50th (ft)	95	66	0	13	49	0	62	76	0	82	127	4
Queue Length 95th (ft)	#219	102	36	36	80	32	#155	113	27	m95	#274	m13
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	257	859	475	215	859	451	177	1337	658	379	1742	898
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	140	101
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.41	0.25	0.17	0.31	0.20	0.81	0.36	0.15	0.49	0.92	0.55

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	218	331	113	35	253	84	137	454	91	177	1400	416
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.57	1.00	1.00	0.48	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1061	3539	1583	885	3539	1583	1770	3539	1583	1770	3539	1583
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)	229	348	119	37	266	88	144	478	96	186	1474	438
RTOR Reduction (vph)	0	0	91	0	0	67	0	0	60	0	0	118
Lane Group Flow (vph)	229	348	28	37	266	21	144	478	36	186	1474	320
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	16.5	16.5	16.5	16.5	16.5	16.5	7.0	26.5	26.5	15.0	34.5	34.5
Effective Green, g (s)	16.5	16.5	16.5	16.5	16.5	16.5	7.0	26.5	26.5	15.0	34.5	34.5
Actuated g/C Ratio	0.24	0.24	0.24	0.24	0.24	0.24	0.10	0.38	0.38	0.21	0.49	0.49
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	250	834	373	209	834	373	177	1340	599	379	1744	780
v/s Ratio Prot		0.10			0.08		c0.08	0.14		0.11	c0.42	
v/s Ratio Perm	c0.22		0.02	0.04		0.01			0.02			0.20
v/c Ratio	0.92	0.42	0.08	0.18	0.32	0.06	0.81	0.36	0.06	0.49	0.85	0.41
Uniform Delay, d1	26.1	22.7	20.8	21.3	22.1	20.7	30.9	15.6	13.8	24.1	15.4	11.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	0.52	0.21
Incremental Delay, d2	34.9	0.3	0.1	0.4	0.2	0.1	24.0	0.7	0.2	0.6	3.1	0.9
Delay (s)	61.0	23.0	20.9	21.7	22.3	20.8	54.9	16.4	14.0	21.8	11.1	3.3
Level of Service	E	C	C	C	C	C	D	B	B	C	B	A
Approach Delay (s)		35.2			21.9			23.8			10.4	
Approach LOS		D			C			C			B	

Intersection Summary			
HCM Average Control Delay	18.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	70.0	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			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	56	490	0	401	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	59	516	0	422	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			575		270	29
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			575		270	29
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			994		697	1038

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	39	192	344	211	211
Volume Left	0	0	0	0	0
Volume Right	0	172	344	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.02	0.11	0.20	0.12	0.12
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	23.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	1	1115	1571	292
v/c Ratio	0.01	0.32	0.46	0.19
Control Delay	21.0	0.2	1.2	0.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	21.0	0.2	1.2	0.5
Queue Length 50th (ft)	0	0	0	0
Queue Length 95th (ft)	m1	0	93	8
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	118	3539	3392	1529
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.01	0.32	0.46	0.19

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	1	1059	1492	277
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	1	1115	1571	292
RTOR Reduction (vph)	0	0	0	0	0	45
Lane Group Flow (vph)	0	0	1	1115	1571	247
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			0.8	60.0	50.7	50.7
Effective Green, g (s)			0.8	60.0	50.7	50.7
Actuated g/C Ratio			0.01	1.00	0.85	0.85
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			24	3539	2990	1338
v/s Ratio Prot			0.00	c0.32	c0.44	
v/s Ratio Perm						0.16
v/c Ratio			0.04	0.32	0.53	0.18
Uniform Delay, d1			29.2	0.0	1.3	0.9
Progression Factor			0.80	1.00	1.00	1.00
Incremental Delay, d2			0.7	0.2	0.7	0.3
Delay (s)			24.0	0.2	2.0	1.2
Level of Service			C	A	A	A
Approach Delay (s)	0.0			0.2	1.8	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	1.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	4.5
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	167	249	0	913	1496	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	176	262	0	961	1575	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.90	0.85	0.85			
vC, conflicting volume	2055	787	1575			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1425	397	1323			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	49	100			
cM capacity (veh/h)	114	512	440			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	117	321	481	481	787	787
Volume Left	117	59	0	0	0	0
Volume Right	0	262	0	0	0	0
cSH	114	313	1700	1700	1700	1700
Volume to Capacity	1.03	1.02	0.28	0.28	0.46	0.46
Queue Length 95th (ft)	170	286	0	0	0	0
Control Delay (s)	163.1	95.1	0.0	0.0	0.0	0.0
Lane LOS	F	F				
Approach Delay (s)	113.3		0.0		0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	16.7		
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	121	117	34	82	149	817	8	1154	488
v/c Ratio	0.51	0.18	0.15	0.13	0.42	0.33	0.02	0.53	0.44
Control Delay	29.1	7.0	20.4	13.5	13.4	6.0	3.1	10.0	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.1	7.0	20.4	13.5	13.4	6.0	3.1	10.0	4.0
Queue Length 50th (ft)	40	3	11	8	15	49	1	136	26
Queue Length 95th (ft)	77	19	28	21	40	141	m1	232	61
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	348	897	337	913	354	2501	458	2172	1100
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.13	0.10	0.09	0.42	0.33	0.02	0.53	0.44

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	115	18	93	32	48	29	142	770	6	8	1096	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.87		1.00	0.94		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3095		1770	3339		1770	3535		1770	3539	1583
Flt Permitted	0.70	1.00		0.68	1.00		0.18	1.00		0.31	1.00	1.00
Satd. Flow (perm)	1306	3095		1263	3339		327	3535		579	3539	1583
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)	121	19	98	34	51	31	149	811	6	8	1154	488
RTOR Reduction (vph)	0	82	0	0	26	0	0	1	0	0	0	155
Lane Group Flow (vph)	121	35	0	34	56	0	149	816	0	8	1154	333
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	9.6	9.6		9.6	9.6		42.4	37.6		32.8	32.0	32.0
Effective Green, g (s)	9.6	9.6		9.6	9.6		42.4	37.6		32.8	32.0	32.0
Actuated g/C Ratio	0.16	0.16		0.16	0.16		0.71	0.63		0.55	0.53	0.53
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	209	495		202	534		385	2215		332	1887	844
v/s Ratio Prot		0.01			0.02		c0.04	c0.23		0.00	c0.33	
v/s Ratio Perm	c0.09			0.03			0.23			0.01		0.21
v/c Ratio	0.58	0.07		0.17	0.10		0.39	0.37		0.02	0.61	0.39
Uniform Delay, d1	23.3	21.4		21.8	21.5		9.6	5.4		7.7	9.7	8.3
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.69	0.93	0.79
Incremental Delay, d2	3.9	0.1		0.4	0.1		0.6	0.5		0.0	1.4	1.3
Delay (s)	27.2	21.5		22.2	21.6		10.2	5.9		5.4	10.5	7.8
Level of Service	C	C		C	C		B	A		A	B	A
Approach Delay (s)		24.4			21.8			6.6			9.7	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	10.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	658	213	581	103	82	796
v/c Ratio	0.71	0.36	0.35	0.13	0.38	0.38
Control Delay	24.0	4.8	8.6	1.5	29.4	7.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.0	4.8	8.6	1.5	29.4	7.7
Queue Length 50th (ft)	107	0	81	0	27	74
Queue Length 95th (ft)	154	40	97	15	64	110
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	1044	629	1728	826	220	2092
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.63	0.34	0.34	0.12	0.37	0.38

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	625	202	552	98	78	756
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	658	213	581	103	82	796
RTOR Reduction (vph)	0	155	0	58	0	0
Lane Group Flow (vph)	658	58	581	45	82	796
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	16.3	16.3	26.3	26.3	4.9	35.2
Effective Green, g (s)	16.3	16.3	26.3	26.3	4.9	35.2
Actuated g/C Ratio	0.27	0.27	0.44	0.44	0.08	0.59
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	933	430	1551	694	145	2076
v/s Ratio Prot	c0.19		0.16		c0.05	c0.22
v/s Ratio Perm		0.04		0.03		
v/c Ratio	0.71	0.13	0.37	0.07	0.57	0.38
Uniform Delay, d1	19.7	16.5	11.3	9.7	26.5	6.6
Progression Factor	1.00	1.00	0.67	0.48	1.00	1.00
Incremental Delay, d2	2.4	0.1	0.7	0.2	5.0	0.5
Delay (s)	22.1	16.7	8.3	4.8	31.5	7.2
Level of Service	C	B	A	A	C	A
Approach Delay (s)	20.8		7.7			9.4
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	13.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	47.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	34	83	667	1334	237	1214
v/c Ratio	0.16	0.48	0.26	0.99	1.14	0.38
Control Delay	54.4	20.6	5.9	31.2	151.5	1.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.4	20.6	5.9	31.2	151.5	1.4
Queue Length 50th (ft)	13	0	81	571	~219	27
Queue Length 95th (ft)	29	50	118	#1180	#386	45
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	629	358	2601	1350	207	3158
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.23	0.26	0.99	1.14	0.38

Intersection Summary

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

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	32	79	634	1267	225	1153
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	34	83	667	1334	237	1214
RTOR Reduction (vph)	0	79	0	191	0	0
Lane Group Flow (vph)	34	4	667	1143	237	1214
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	6.1	6.1	87.4	87.4	14.0	105.4
Effective Green, g (s)	6.1	6.1	87.4	87.4	14.0	105.4
Actuated g/C Ratio	0.05	0.05	0.73	0.73	0.12	0.88
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	175	80	2578	1153	207	3108
v/s Ratio Prot	c0.01		0.19		c0.13	0.34
v/s Ratio Perm		0.00		c0.72		
v/c Ratio	0.19	0.05	0.26	0.99	1.14	0.39
Uniform Delay, d1	54.6	54.2	5.5	15.9	53.0	1.4
Progression Factor	1.00	1.00	1.00	1.00	1.02	0.70
Incremental Delay, d2	0.5	0.3	0.2	24.5	103.5	0.3
Delay (s)	55.1	54.5	5.7	40.4	157.6	1.3
Level of Service	E	D	A	D	F	A
Approach Delay (s)	54.7		28.8			26.8
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	28.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	98.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	148	148	723	63	37	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	156	156	761	66	39	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	872	794			761	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	872	794			761	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	49	60			95	
cM capacity (veh/h)	306	388			851	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	156	156	827	39	0
Volume Left	156	0	0	39	0
Volume Right	0	156	66	0	0
cSH	306	388	1700	851	1700
Volume to Capacity	0.51	0.40	0.49	0.05	0.00
Queue Length 95th (ft)	68	47	0	4	0
Control Delay (s)	28.3	20.4	0.0	9.4	0.0
Lane LOS	D	C		A	
Approach Delay (s)	24.3		0.0	9.4	
Approach LOS	C				

Intersection Summary			
Average Delay	6.7		
Intersection Capacity Utilization	57.7%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2385	1529	536	116	1106	512	663
v/c Ratio	1.05	0.96	0.49	0.49	0.96	0.76	0.45
Control Delay	68.7	44.1	5.3	44.3	63.1	57.7	38.9
Queue Delay	558.1	342.6	7.7	0.0	3.7	0.0	0.0
Total Delay	626.8	386.8	12.9	44.3	66.8	57.7	38.9
Queue Length 50th (ft)	~800	716	112	96	362	212	167
Queue Length 95th (ft)	#892	m684	m75	163	#446	275	207
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2271	1593	1090	236	1150	673	1475
Starvation Cap Reductn	0	730	504	0	0	0	0
Spillback Cap Reductn	1233	0	0	0	28	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	2.30	1.77	0.91	0.49	0.99	0.76	0.45

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2115	151	0	1453	509	110	1005	46	486	629	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5034			3539	1583	1770	5052		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5034			3539	1583	1770	5052		3433	5084	
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)	0	2226	159	0	1529	536	116	1058	48	512	662	1
RTOR Reduction (vph)	0	6	0	0	0	1	0	4	0	0	0	0
Lane Group Flow (vph)	0	2379	0	0	1529	535	116	1102	0	512	663	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		58.5			58.5	84.0	17.3	29.5		25.5	37.7	
Effective Green, g (s)		58.5			58.5	84.0	17.3	29.5		25.5	37.7	
Actuated g/C Ratio		0.45			0.45	0.65	0.13	0.23		0.20	0.29	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2265			1593	1090	236	1146		673	1474	
v/s Ratio Prot		c0.47			0.43	0.10	0.07	c0.22		c0.15	0.13	
v/s Ratio Perm						0.24						
v/c Ratio		1.05			0.96	0.49	0.49	0.96		0.76	0.45	
Uniform Delay, d1		35.8			34.6	11.9	52.3	49.7		49.4	37.7	
Progression Factor		1.00			1.12	0.50	0.71	0.92		1.00	1.00	
Incremental Delay, d2		33.8			4.8	0.1	6.5	17.6		5.1	1.0	
Delay (s)		69.5			43.7	6.0	43.8	63.1		54.4	38.7	
Level of Service		E			D	A	D	E		D	D	
Approach Delay (s)		69.5			33.9			61.3			45.5	
Approach LOS		E			C			E			D	

Intersection Summary			
HCM Average Control Delay	53.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	92.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	466	2284	33	2082	716	125	199	406	361
v/c Ratio	1.05	0.73	0.38	1.08	1.03	0.43	0.95	0.48	0.55
Control Delay	75.2	31.8	89.0	99.3	104.0	31.9	111.5	44.7	7.5
Queue Delay	197.5	214.2	0.0	335.2	0.0	1.0	650.8	0.0	0.8
Total Delay	272.7	246.0	89.0	434.5	104.0	33.0	762.3	44.7	8.3
Queue Length 50th (ft)	~441	618	29	~724	~240	43	87	155	0
Queue Length 95th (ft)	m#450	m627	m39	#809	#330	95	#166	207	82
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	443	3149	91	1926	692	294	209	847	653
Starvation Cap Reductn	135	1600	0	0	0	0	0	0	0
Spillback Cap Reductn	0	190	0	789	0	53	205	0	100
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.51	1.47	0.36	1.83	1.03	0.52	49.75	0.48	0.65

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	443	2155	15	31	1648	330	0	680	119	189	386	343
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.97			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5080		1770	4958			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5080		1770	4958			5085	1583	3433	3539	1583
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)	466	2268	16	33	1735	347	0	716	125	199	406	361
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	79	0	0	275
Lane Group Flow (vph)	466	2284	0	33	2059	0	0	716	46	199	406	86
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	32.5	78.4		4.0	49.9			17.7	17.7	7.9	31.1	31.1
Effective Green, g (s)	32.5	78.4		4.0	49.9			17.7	17.7	7.9	31.1	31.1
Actuated g/C Ratio	0.25	0.60		0.03	0.38			0.14	0.14	0.06	0.24	0.24
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	443	3064		54	1903			692	216	209	847	379
v/s Ratio Prot	c0.26	0.45		0.02	c0.42			c0.14		c0.06	0.11	
v/s Ratio Perm									0.03			0.05
v/c Ratio	1.05	0.75		0.61	1.08			1.03	0.21	0.95	0.48	0.23
Uniform Delay, d1	48.8	18.6		62.2	40.0			56.1	50.0	60.9	42.5	39.8
Progression Factor	0.81	1.74		1.35	1.55			1.17	1.62	1.00	1.00	1.00
Incremental Delay, d2	35.8	0.4		12.8	43.9			41.4	2.0	50.9	1.9	1.4
Delay (s)	75.5	32.7		96.5	106.1			107.1	82.7	111.8	44.4	41.2
Level of Service	E	C		F	F			F	F	F	D	D
Approach Delay (s)		40.0			106.0			103.5			57.1	
Approach LOS		D			F			F			E	

Intersection Summary			
HCM Average Control Delay	71.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	100.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	39	723	44	1122	422	73	429	144	304	13
v/c Ratio	0.26	0.32	0.16	0.49	0.45	0.20	0.58	0.45	0.31	0.04
Control Delay	33.2	28.5	23.4	26.1	3.6	43.9	48.3	80.4	74.7	50.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.2	28.5	23.4	26.1	3.6	43.9	48.3	80.4	74.7	50.4
Queue Length 50th (ft)	29	200	22	239	0	51	167	150	105	4
Queue Length 95th (ft)	m59	m230	49	282	58	96	223	m231	141	m21
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	149	2281	271	2288	944	374	743	322	993	345
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.32	0.16	0.49	0.45	0.20	0.58	0.45	0.31	0.04

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	37	671	16	42	1066	401	69	353	54	274	152	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	1770	5067		1770	5085	1583	1770	3469		1522	4695	1583
Flt Permitted	0.18	1.00		0.32	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	330	5067		601	5085	1583	1770	3469		1522	4695	1583
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)	39	706	17	44	1122	422	73	372	57	288	160	13
RTOR Reduction (vph)	0	2	0	0	0	232	0	9	0	0	0	10
Lane Group Flow (vph)	39	721	0	44	1122	190	73	420	0	144	304	3
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	58.5	58.5		58.5	58.5	58.5	27.5	27.5		27.5	27.5	27.5
Effective Green, g (s)	58.5	58.5		58.5	58.5	58.5	27.5	27.5		27.5	27.5	27.5
Actuated g/C Ratio	0.45	0.45		0.45	0.45	0.45	0.21	0.21		0.21	0.21	0.21
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	149	2280		270	2288	712	374	734		322	993	335
v/s Ratio Prot		0.14			c0.22		0.04	c0.12		c0.09	0.06	
v/s Ratio Perm	0.12			0.07		0.12						0.00
v/c Ratio	0.26	0.32		0.16	0.49	0.27	0.20	0.57		0.45	0.31	0.01
Uniform Delay, d1	22.3	22.9		21.2	25.2	22.3	42.1	46.0		44.6	43.2	40.5
Progression Factor	1.23	1.23		1.00	1.00	1.00	1.00	1.00		1.68	1.70	2.75
Incremental Delay, d2	3.5	0.3		1.3	0.8	0.9	1.2	3.2		4.0	0.7	0.0
Delay (s)	31.0	28.4		22.5	26.0	23.3	43.3	49.2		79.1	74.3	111.2
Level of Service	C	C		C	C	C	D	D		E	E	F
Approach Delay (s)		28.6			25.2			48.3			76.9	
Approach LOS		C			C			D			E	

Intersection Summary			
HCM Average Control Delay	36.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	63.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	98	2439	35	123	2413	88	85	158	44	16	33
v/c Ratio	0.68	0.77	0.04	0.66	0.75	0.64	0.46	0.51	0.24	0.06	0.12
Control Delay	74.7	38.8	15.8	48.9	0.4	76.6	62.7	14.2	47.6	44.9	15.2
Queue Delay	0.0	6.4	0.0	0.0	0.5	671.7	0.0	0.0	0.0	0.0	3.3
Total Delay	74.7	45.1	15.8	48.9	1.0	748.3	62.7	14.2	47.6	44.9	18.5
Queue Length 50th (ft)	73	701	12	111	11	72	68	0	32	12	0
Queue Length 95th (ft)	m107	m761	m22	m106	m12	128	122	66	66	33	30
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	157	3149	988	197	3204	171	229	317	184	344	319
Starvation Cap Reductn	0	672	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	361	169	0	0	0	0	230
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.62	0.98	0.04	0.62	0.85	44.00	0.37	0.50	0.24	0.05	0.37

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	93	2317	33	117	1916	376	84	81	150	42	15	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.98		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	5085	1583	1770	4960		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.75	1.00	1.00	0.52	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	4960		1392	1863	1583	972	1863	1583
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	2439	35	123	2017	396	88	85	158	44	16	33
RTOR Reduction (vph)	0	0	8	0	20	0	0	0	141	0	0	28
Lane Group Flow (vph)	98	2439	27	123	2393	0	88	85	17	44	16	5
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	10.6	79.7	79.7	13.6	82.7		12.8	12.8	13.6	20.2	20.2	20.2
Effective Green, g (s)	10.6	79.7	79.7	13.6	82.7		12.8	12.8	13.6	20.2	20.2	20.2
Actuated g/C Ratio	0.08	0.61	0.61	0.10	0.64		0.10	0.10	0.10	0.16	0.16	0.16
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	144	3117	971	185	3155		137	183	166	172	289	246
v/s Ratio Prot	0.06	0.48		c0.07	c0.48			0.05	0.01	c0.01	0.01	
v/s Ratio Perm			0.02				c0.06			0.03		0.00
v/c Ratio	0.68	0.78	0.03	0.66	0.76		0.64	0.46	0.10	0.26	0.06	0.02
Uniform Delay, d1	58.1	18.7	9.9	56.0	16.6		56.4	55.4	52.7	47.6	46.8	46.5
Progression Factor	1.01	1.92	2.45	0.84	0.02		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.5	1.4	0.0	0.8	0.2		9.9	1.9	0.3	0.8	0.1	0.0
Delay (s)	67.3	37.2	24.3	47.8	0.4		66.3	57.2	52.9	48.4	46.9	46.6
Level of Service	E	D	C	D	A		E	E	D	D	D	D
Approach Delay (s)		38.2			2.7			57.6			47.5	
Approach LOS		D			A			E			D	

Intersection Summary			
HCM Average Control Delay	23.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	101	2437	3116	143
v/c Ratio	0.40	0.73	1.07	0.27
Control Delay	37.8	8.6	52.6	31.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	37.8	8.6	52.6	31.6
Queue Length 50th (ft)	82	137	~1041	32
Queue Length 95th (ft)	m91	279	m#359	68
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	456	3344	2918	528
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.22	0.73	1.07	0.27

Intersection Summary

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

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

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	96	2315	2436	524	81	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.97		0.94	
Flt Protected	0.95	1.00	1.00		0.97	
Satd. Flow (prot)	1770	5085	4950		3296	
Flt Permitted	0.95	1.00	1.00		0.97	
Satd. Flow (perm)	1770	5085	4950		3296	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	101	2437	2564	552	85	58
RTOR Reduction (vph)	0	0	26	0	50	0
Lane Group Flow (vph)	101	2437	3090	0	93	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	18.6	85.5	76.0		18.9	
Effective Green, g (s)	18.6	85.5	76.0		18.9	
Actuated g/C Ratio	0.14	0.66	0.58		0.15	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	253	3344	2894		479	
v/s Ratio Prot	c0.06	c0.48	c0.62		c0.03	
v/s Ratio Perm						
v/c Ratio	0.40	0.73	1.07		0.20	
Uniform Delay, d1	50.6	14.6	27.0		48.9	
Progression Factor	0.70	0.52	0.76		1.00	
Incremental Delay, d2	0.7	0.9	31.4		0.9	
Delay (s)	35.9	8.5	51.8		49.8	
Level of Service	D	A	D		D	
Approach Delay (s)		9.6	51.8		49.8	
Approach LOS		A	D		D	

Intersection Summary			
HCM Average Control Delay	33.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	81.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	139	2314	63	43	3468	167	46	109
v/c Ratio	0.97	0.65	0.06	0.40	1.04	1.02	0.27	0.36
Control Delay	95.0	1.1	0.1	69.6	51.7	131.3	55.1	17.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	95.0	1.1	0.1	69.6	51.7	131.3	55.1	17.1
Queue Length 50th (ft)	112	18	0	35	~1158	~149	35	12
Queue Length 95th (ft)	m#207	22	m0	76	#1231	#298	76	67
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	143	3534	1119	123	3320	163	173	299
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.97	0.65	0.06	0.35	1.04	1.02	0.27	0.36

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	132	2198	60	41	3099	196	113	35	10	44	15	88
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.99		1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5040			1783		1770	1624	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.65		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5040			1197		1287	1624	
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)	139	2314	63	43	3262	206	119	37	11	46	16	93
RTOR Reduction (vph)	0	0	20	0	6	0	0	2	0	0	80	0
Lane Group Flow (vph)	139	2314	43	43	3462	0	0	165	0	46	29	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	11.6	89.3	89.3	6.7	84.4			17.5		17.5	17.5	
Effective Green, g (s)	11.6	89.3	89.3	6.7	84.4			17.5		17.5	17.5	
Actuated g/C Ratio	0.09	0.69	0.69	0.05	0.65			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	158	3493	1087	91	3272			161		173	219	
v/s Ratio Prot	c0.08	0.46		0.02	c0.69						0.02	
v/s Ratio Perm			0.03					c0.14		0.04		
v/c Ratio	0.88	0.66	0.04	0.47	1.06			1.03		0.27	0.13	
Uniform Delay, d1	58.5	11.7	6.6	59.9	22.8			56.2		50.5	49.5	
Progression Factor	0.61	0.04	0.00	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	29.4	0.7	0.0	3.8	33.9			78.1		0.8	0.3	
Delay (s)	64.9	1.1	0.0	63.8	56.7			134.3		51.3	49.8	
Level of Service	E	A	A	E	E			F		D	D	
Approach Delay (s)		4.6			56.8			134.3			50.3	
Approach LOS		A			E			F			D	

Intersection Summary			
HCM Average Control Delay	38.0	HCM Level of Service	D
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	100.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	18	1192	62	1251	88	160	440	41	114	95
v/c Ratio	0.12	0.75	0.24	0.69	0.22	0.27	0.73	0.11	0.19	0.18
Control Delay	16.1	19.0	10.0	13.9	17.3	17.2	19.7	16.0	16.4	11.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.1	19.0	10.0	13.9	17.3	17.2	19.7	16.0	16.4	11.5
Queue Length 50th (ft)	4	193	9	161	26	49	103	12	34	17
Queue Length 95th (ft)	20	#348	31	300	57	89	198	31	66	46
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	183	1996	255	2400	700	1023	938	671	1023	886
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.60	0.24	0.52	0.13	0.16	0.47	0.06	0.11	0.11

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	17	1056	76	59	1181	8	84	152	418	39	108	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3504		1770	3536		1770	1863	1583	1770	1863	1583
Flt Permitted	0.17	1.00		0.14	1.00		0.68	1.00	1.00	0.66	1.00	1.00
Satd. Flow (perm)	322	3504		255	3536		1273	1863	1583	1221	1863	1583
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)	18	1112	80	62	1243	8	88	160	440	41	114	95
RTOR Reduction (vph)	0	7	0	0	0	0	0	0	103	0	0	25
Lane Group Flow (vph)	18	1185	0	62	1251	0	88	160	337	41	114	70
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	26.2	26.2		31.2	31.2		18.5	18.5	18.5	18.5	18.5	18.5
Effective Green, g (s)	26.2	26.2		31.2	31.2		18.5	18.5	18.5	18.5	18.5	18.5
Actuated g/C Ratio	0.45	0.45		0.53	0.53		0.32	0.32	0.32	0.32	0.32	0.32
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	144	1564		187	1879		401	587	499	385	587	499
v/s Ratio Prot		c0.34		0.01	c0.35			0.09			0.06	
v/s Ratio Perm	0.06			0.16			0.07		c0.21	0.03		0.04
v/c Ratio	0.12	0.76		0.33	0.67		0.22	0.27	0.67	0.11	0.19	0.14
Uniform Delay, d1	9.5	13.6		9.0	10.0		14.8	15.1	17.5	14.2	14.7	14.4
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	0.4	2.2		1.0	0.9		0.3	0.3	3.6	0.1	0.2	0.1
Delay (s)	9.9	15.8		10.0	10.9		15.1	15.3	21.1	14.4	14.8	14.5
Level of Service	A	B		B	B		B	B	C	B	B	B
Approach Delay (s)		15.7			10.8			19.0			14.6	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	14.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	58.7	Sum of lost time (s)	14.0
Intersection Capacity Utilization	71.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	NBT	SBT
Lane Group Flow (vph)	438	961	1575
v/c Ratio	0.62	0.41	0.68
Control Delay	23.6	3.5	9.4
Queue Delay	0.0	0.0	0.2
Total Delay	23.6	3.5	9.6
Queue Length 50th (ft)	68	49	154
Queue Length 95th (ft)	101	37	345
Internal Link Dist (ft)	342	302	370
Turn Bay Length (ft)	170		
Base Capacity (vph)	882	2319	2319
Starvation Cap Reductn	0	0	160
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.50	0.41	0.73

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	167	249	0	913	1496	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	
Lane Util. Factor	0.97			0.95	0.95	
Frt	0.91			1.00	1.00	
Flt Protected	0.98			1.00	1.00	
Satd. Flow (prot)	3225			3539	3539	
Flt Permitted	0.98			1.00	1.00	
Satd. Flow (perm)	3225			3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	176	262	0	961	1575	0
RTOR Reduction (vph)	24	0	0	0	0	0
Lane Group Flow (vph)	414	0	0	961	1575	0
Turn Type						
Protected Phases	4			2	6	
Permitted Phases						
Actuated Green, G (s)	12.7			39.3	39.3	
Effective Green, g (s)	12.7			39.3	39.3	
Actuated g/C Ratio	0.21			0.65	0.65	
Clearance Time (s)	4.0			4.0	4.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	683			2318	2318	
v/s Ratio Prot	c0.13			0.27	c0.45	
v/s Ratio Perm						
v/c Ratio	0.61			0.41	0.68	
Uniform Delay, d1	21.4			4.9	6.4	
Progression Factor	1.00			0.55	1.09	
Incremental Delay, d2	1.5			0.5	1.5	
Delay (s)	22.9			3.2	8.5	
Level of Service	C			A	A	
Approach Delay (s)	22.9			3.2	8.5	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	8.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Queues
29: College Park Dr & SR-22 Ramps

11/21/2012

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	156	156	827	39	234
v/c Ratio	0.50	0.38	0.72	0.21	0.18
Control Delay	27.4	7.0	17.1	31.1	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	27.4	7.0	17.1	31.1	3.7
Queue Length 50th (ft)	52	0	128	14	32
Queue Length 95th (ft)	93	38	#503	31	56
Internal Link Dist (ft)	864		215		720
Turn Bay Length (ft)					
Base Capacity (vph)	472	537	1148	183	1288
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.33	0.29	0.72	0.21	0.18

Intersection Summary

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	148	148	723	63	37	222
Ideal Flow (vphpl)	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		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1843		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	1843		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	156	156	761	66	39	234
RTOR Reduction (vph)	0	129	4	0	0	0
Lane Group Flow (vph)	156	27	823	0	39	234
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	10.5	10.5	34.9		2.6	41.5
Effective Green, g (s)	10.5	10.5	34.9		2.6	41.5
Actuated g/C Ratio	0.18	0.18	0.58		0.04	0.69
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	310	277	1072		77	1289
v/s Ratio Prot	c0.09		c0.45		c0.02	0.13
v/s Ratio Perm		0.02				
v/c Ratio	0.50	0.10	0.77		0.51	0.18
Uniform Delay, d1	22.4	20.8	9.5		28.1	3.3
Progression Factor	1.00	1.00	1.00		1.15	0.90
Incremental Delay, d2	1.3	0.2	5.3		5.1	0.3
Delay (s)	23.7	20.9	14.8		37.3	3.3
Level of Service	C	C	B		D	A
Approach Delay (s)	22.3		14.8			8.1
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	15.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Queues
1: Carson St & I-605 SB Off Ramps

11/30/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	2057	1441	544	983	545	246
v/c Ratio	0.74	0.64	0.34	0.61	0.37	0.36
Control Delay	26.9	16.0	0.6	24.4	19.6	20.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.9	16.0	0.6	24.4	19.6	20.1
Queue Length 50th (ft)	327	220	0	268	132	115
Queue Length 95th (ft)	371	246	0	337	178	186
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2893	2316	1611	1603	1491	680
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.71	0.62	0.34	0.61	0.37	0.36

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1776	179	0	1369	0	0	0	517	934	301	450
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.94	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6320			5085				1611	3433	3177	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6320			5085				1611	3433	3177	1441
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)	0	1869	188	0	1441	0	0	0	544	983	317	474
RTOR Reduction (vph)	0	16	0	0	0	0	0	0	0	0	7	7
Lane Group Flow (vph)	0	2041	0	0	1441	0	0	0	544	983	538	239
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		48.3			48.3				110.0	51.4	51.4	51.4
Effective Green, g (s)		48.3			48.3				110.0	51.4	51.4	51.4
Actuated g/C Ratio		0.44			0.44				1.00	0.47	0.47	0.47
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2775			2233				1611	1604	1485	673
v/s Ratio Prot		c0.32			0.28					c0.29	0.17	
v/s Ratio Perm									0.34			0.17
v/c Ratio		0.74			0.65				0.34	0.61	0.36	0.35
Uniform Delay, d1		25.6			24.1				0.0	21.9	18.8	18.7
Progression Factor		1.00			0.62				1.00	1.00	1.00	1.00
Incremental Delay, d2		1.3			0.7				0.6	1.8	0.7	1.5
Delay (s)		26.8			15.6				0.6	23.6	19.5	20.2
Level of Service		C			B				A	C	B	C
Approach Delay (s)		26.8			15.6			0.6			21.9	
Approach LOS		C			B			A			C	

Intersection Summary			
HCM Average Control Delay	20.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	64.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	3106	1209	721	712	292
v/c Ratio	0.79	0.56	0.58	0.69	0.35
Control Delay	12.5	5.6	3.2	38.2	31.5
Queue Delay	0.0	0.9	1.9	0.0	0.0
Total Delay	12.5	6.5	5.1	38.2	31.5
Queue Length 50th (ft)	285	100	51	228	90
Queue Length 95th (ft)	304	147	m89	294	133
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3938	2175	1251	1030	837
Starvation Cap Reductn	32	616	358	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.80	0.78	0.81	0.69	0.35

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2951	0	0	1149	685	676	0	277	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
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)	0	3106	0	0	1209	721	712	0	292	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	278	0	0	1	0	0	0
Lane Group Flow (vph)	0	3106	0	0	1209	443	712	0	291	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		67.6			67.6	67.6	33.0		33.0			
Effective Green, g (s)		67.6			67.6	67.6	33.0		33.0			
Actuated g/C Ratio		0.61			0.61	0.61	0.30		0.30			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3938			2175	973	1030		836			
v/s Ratio Prot		c0.48			0.34							
v/s Ratio Perm						0.28	c0.21		0.10			
v/c Ratio		0.79			0.56	0.46	0.69		0.35			
Uniform Delay, d1		15.9			12.4	11.3	34.0		30.1			
Progression Factor		0.69			0.39	2.49	1.00		1.00			
Incremental Delay, d2		1.1			0.3	0.5	3.8		1.1			
Delay (s)		12.0			5.2	28.7	37.8		31.2			
Level of Service		B			A	C	D		C			
Approach Delay (s)		12.0			14.0			35.9			0.0	
Approach LOS		B			B			D			A	

Intersection Summary			
HCM Average Control Delay	16.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	824	2027	5	1168	208	102	149	307	305
v/c Ratio	0.93	0.72	0.04	0.83	0.82	0.30	0.24	0.79	0.66
Control Delay	39.9	8.3	49.4	43.4	71.7	45.6	38.9	30.1	12.1
Queue Delay	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.9	8.5	49.4	43.4	71.7	45.6	38.9	30.1	12.1
Queue Length 50th (ft)	305	67	3	287	143	33	45	66	0
Queue Length 95th (ft)	#413	465	16	#367	#285	60	76	172	84
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	886	2811	113	1404	254	724	625	429	501
Starvation Cap Reductn	0	180	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.93	0.77	0.04	0.83	0.82	0.14	0.24	0.72	0.61

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	783	1734	192	5	995	115	198	89	8	142	46	536
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.99		1.00	0.98		1.00	0.99		1.00	0.87	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5009		1770	5006		1770	3498		3433	1546	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5009		1770	5006		1770	3498		3433	1546	1504
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)	824	1825	202	5	1047	121	208	94	8	149	48	564
RTOR Reduction (vph)	0	10	0	0	13	0	0	6	0	0	183	265
Lane Group Flow (vph)	824	2017	0	5	1155	0	208	96	0	149	124	40
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	32.3	57.6		1.4	26.7		15.8	10.4		20.0	14.6	14.6
Effective Green, g (s)	32.3	57.6		1.4	26.7		15.8	10.4		20.0	14.6	14.6
Actuated g/C Ratio	0.29	0.52		0.01	0.24		0.14	0.09		0.18	0.13	0.13
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	1008	2623		23	1215		254	331		624	205	200
v/s Ratio Prot	c0.24	0.40		0.00	c0.23		c0.12	0.03		c0.04	c0.08	
v/s Ratio Perm												0.03
v/c Ratio	0.82	0.77		0.22	0.95		0.82	0.29		0.24	0.60	0.20
Uniform Delay, d1	36.1	20.9		53.8	41.0		45.7	46.4		38.5	45.0	42.5
Progression Factor	0.66	0.36		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.6	1.4		6.4	16.4		19.1	0.7		0.3	5.7	0.7
Delay (s)	27.5	9.0		60.2	57.4		64.8	47.0		38.8	50.7	43.2
Level of Service	C	A		E	E		E	D		D	D	D
Approach Delay (s)		14.4			57.4			58.9			45.4	
Approach LOS		B			E			E			D	

Intersection Summary			
HCM Average Control Delay	31.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	25.5
Intersection Capacity Utilization	85.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	1908	1279	625	855
v/c Ratio	0.62	0.60	0.71	0.54
Control Delay	10.4	10.6	27.8	1.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	10.4	10.6	27.8	1.3
Queue Length 50th (ft)	167	157	125	0
Queue Length 95th (ft)	258	261	160	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	3084	2147	1609	1583
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	12	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.62	0.60	0.39	0.54

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1813	1215	0	594	812
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1908	1279	0	625	855
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1908	1279	0	625	855
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		42.5	42.5		18.0	70.0
Effective Green, g (s)		42.5	42.5		18.0	70.0
Actuated g/C Ratio		0.61	0.61		0.26	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		3087	2149		883	1583
v/s Ratio Prot		c0.38	0.36		c0.18	
v/s Ratio Perm						0.54
v/c Ratio		0.62	0.60		0.71	0.54
Uniform Delay, d1		8.6	8.5		23.6	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.9	1.2		2.4	1.3
Delay (s)		9.6	9.6		26.0	1.3
Level of Service		A	A		C	A
Approach Delay (s)		9.6	9.6		11.8	
Approach LOS		A	A		B	

Intersection Summary			
HCM Average Control Delay	10.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	59.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	2023	967	172	1254
v/c Ratio	0.77	0.79	0.77	0.35
Control Delay	8.9	11.1	54.3	0.3
Queue Delay	0.2	0.1	0.0	0.0
Total Delay	9.1	11.1	54.3	0.3
Queue Length 50th (ft)	303	246	73	0
Queue Length 95th (ft)	432	447	#165	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2623	1223	228	3539
Starvation Cap Reductn	97	9	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.80	0.80	0.75	0.35

Intersection Summary

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

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1922	919	163	1191	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2023	967	172	1254	0	0
RTOR Reduction (vph)	0	49	0	0	0	0
Lane Group Flow (vph)	2023	918	172	1254	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	51.9	51.9	8.8	70.0		
Effective Green, g (s)	51.9	51.9	8.8	70.0		
Actuated g/C Ratio	0.74	0.74	0.13	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2624	1174	223	3539		
v/s Ratio Prot	0.57		c0.10	0.35		
v/s Ratio Perm		c0.58				
v/c Ratio	0.77	0.78	0.77	0.35		
Uniform Delay, d1	5.5	5.6	29.6	0.0		
Progression Factor	1.17	1.18	1.00	1.00		
Incremental Delay, d2	2.0	4.7	15.1	0.3		
Delay (s)	8.4	11.3	44.8	0.3		
Level of Service	A	B	D	A		
Approach Delay (s)	9.3			5.6	0.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	8.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	332	0	0	611	0	820	611	0	703	331
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	349	0	0	643	0	863	643	0	740	348
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.91	0.91		0.91	0.91	0.91				0.91		
vC, conflicting volume	1028	1603	247	1110	1603	288	740			863		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	682	1315	247	772	1315	0	740			501		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	54	100	100	35	100			100		
cM capacity (veh/h)	106	143	754	141	143	986	862			963		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	349	643	345	345	387	429	296	296	264	232
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	349	643	0	0	214	429	0	0	116	232
cSH	754	986	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.46	0.65	0.20	0.20	0.23	0.25	0.17	0.17	0.16	0.14
Queue Length 95th (ft)	62	126	0	0	0	0	0	0	0	0
Control Delay (s)	13.8	15.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B	C								
Approach Delay (s)	13.8	15.2	0.0				0.0			
Approach LOS	B	C								

Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	692	0	1311	590	379
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	728	0	1380	621	399
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.89					
vC, conflicting volume	966	207	621			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	313	207	621			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	9	100			
cM capacity (veh/h)	580	799	956			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	728	345	345	345	345	248	248	257	266
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	728	0	0	0	0	0	0	133	266
cSH	799	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.91	0.20	0.20	0.20	0.20	0.15	0.15	0.15	0.16
Queue Length 95th (ft)	317	0	0	0	0	0	0	0	0
Control Delay (s)	37.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	E								
Approach Delay (s)	37.0	0.0				0.0			
Approach LOS	E								

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	63.7%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	166	1973	302	200	894	228	215	1060	156	1105
v/c Ratio	0.52	1.07	0.39	0.93	0.56	0.38	0.90	0.67	0.53	0.83
Control Delay	44.8	72.5	15.8	89.1	26.3	6.2	81.3	31.3	48.0	36.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.8	72.5	15.8	89.1	26.3	6.2	81.3	31.3	48.0	36.3
Queue Length 50th (ft)	46	~464	100	59	160	6	63	152	44	209
Queue Length 95th (ft)	78	#560	163	#126	205	66	#130	180	#97	263
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	335	1840	783	216	1589	594	238	1810	297	1378
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.50	1.07	0.39	0.93	0.56	0.38	0.90	0.59	0.53	0.80

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	158	1874	287	190	826	240	204	885	122	148	925	124
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4786	1362	3433	6292		3433	4995	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4786	1362	3433	6292		3433	4995	
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)	166	1973	302	200	869	253	215	932	128	156	974	131
RTOR Reduction (vph)	0	0	5	0	3	142	0	29	0	0	19	0
Lane Group Flow (vph)	166	1973	297	200	891	86	215	1031	0	156	1086	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	8.3	32.3	38.5	5.6	29.6	29.6	6.2	22.0		7.8	23.6	
Effective Green, g (s)	8.3	32.3	38.5	5.6	29.6	29.6	6.2	22.0		7.8	23.6	
Actuated g/C Ratio	0.09	0.36	0.43	0.06	0.33	0.33	0.07	0.25		0.09	0.26	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	319	1839	778	215	1586	451	238	1550		300	1320	
v/s Ratio Prot	0.05	c0.39	0.03	c0.06	0.19		0.06	c0.16		0.05	c0.22	
v/s Ratio Perm			0.16			0.06						
v/c Ratio	0.52	1.07	0.38	0.93	0.56	0.19	0.90	0.67		0.52	0.82	
Uniform Delay, d1	38.6	28.5	17.3	41.7	24.5	21.3	41.3	30.3		39.0	30.9	
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	1.5	43.6	0.3	42.3	0.5	0.2	33.5	1.1		1.6	4.3	
Delay (s)	40.1	72.1	17.6	83.9	25.0	21.5	74.8	31.4		40.6	35.2	
Level of Service	D	E	B	F	C	C	E	C		D	D	
Approach Delay (s)		63.2			33.3			38.7			35.8	
Approach LOS		E			C			D			D	

Intersection Summary			
HCM Average Control Delay	46.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	89.3	Sum of lost time (s)	21.6
Intersection Capacity Utilization	86.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	1573	611	0	702	0	0	0	0	0	0	668
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	1656	643	0	739	0	0	0	0	0	0	703
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.66			0.66	0.66	0.66	0.66	0.66	
vC, conflicting volume	739			2299			2224	2716	874	1291	3038	246
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	739			1151			1037	1786	0	0	2276	246
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	7
cM capacity (veh/h)	863			396			8	53	713	672	26	754

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	662	662	974	246	246	246	703
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	643	0	0	0	703
cSH	1700	1700	1700	1700	1700	1700	754
Volume to Capacity	0.39	0.39	0.57	0.14	0.14	0.14	0.93
Queue Length 95th (ft)	0	0	0	0	0	0	334
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	41.9
Lane LOS							E
Approach Delay (s)	0.0			0.0			41.9
Approach LOS							E

Intersection Summary			
Average Delay	7.9		
Intersection Capacity Utilization	61.6%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	45	168	218	208	21	1698	483	1609
v/c Ratio	0.38	0.62	0.70	0.67	0.14	0.53	0.35	0.47
Control Delay	43.3	52.4	37.5	35.0	2.5	1.6	0.3	10.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.3	52.4	37.5	35.0	2.5	1.6	0.3	10.5
Queue Length 50th (ft)	18	118	98	86	1	38	0	192
Queue Length 95th (ft)	56	175	173	156	m2	m37	m0	287
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	126	413	434	433	149	3201	1362	3408
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.41	0.50	0.48	0.14	0.53	0.35	0.47

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	26	0	17	178	40	347	20	1519	553	0	1506	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.95		1.00	0.89	0.85	1.00	0.99	0.85		1.00	
Flt Protected		0.97		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1711		1681	1505	1504	1770	4764	1362		5074	
Flt Permitted		0.97		0.95	1.00	1.00	0.12	1.00	1.00		1.00	
Satd. Flow (perm)		1711		1681	1505	1504	221	4764	1362		5074	
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)	27	0	18	187	42	365	21	1599	582	0	1585	24
RTOR Reduction (vph)	0	17	0	0	71	71	0	4	0	0	1	0
Lane Group Flow (vph)	0	28	0	168	147	137	21	1694	483	0	1608	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		5.4		17.6	17.6	17.6	73.0	73.0	110.0		73.0	
Effective Green, g (s)		5.4		17.6	17.6	17.6	73.0	73.0	110.0		73.0	
Actuated g/C Ratio		0.05		0.16	0.16	0.16	0.66	0.66	1.00		0.66	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		84		269	241	241	147	3162	1362		3367	
v/s Ratio Prot		0.02		c0.10	0.10			c0.36			0.32	
v/s Ratio Perm						0.09	0.10		c0.35			
v/c Ratio		0.33		0.62	0.61	0.57	0.14	0.54	0.35		0.48	
Uniform Delay, d1		50.6		43.1	43.0	42.7	6.9	9.7	0.0		9.1	
Progression Factor		1.00		1.00	1.00	1.00	0.15	0.12	1.00		1.00	
Incremental Delay, d2		2.3		4.5	4.3	3.0	0.8	0.3	0.3		0.5	
Delay (s)		52.9		47.6	47.3	45.7	1.9	1.5	0.3		9.6	
Level of Service		D		D	D	D	A	A	A		A	
Approach Delay (s)		52.9			46.8			1.2			9.6	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM Average Control Delay	10.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	266	1933	125	1017	195	1931	52	1444
v/c Ratio	0.89	1.10	1.29	0.85	1.01	0.91	0.81	0.86
Control Delay	75.9	86.2	213.9	47.8	59.0	13.7	109.8	31.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	47.5	0.0	0.0
Total Delay	75.9	86.2	213.9	47.8	59.0	61.2	109.8	31.4
Queue Length 50th (ft)	187	~558	~115	272	~151	316	37	353
Queue Length 95th (ft)	#342	#657	#239	319	m135	m257	m#113	209
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	300	1765	97	1225	193	2128	64	1678
Starvation Cap Reductn	0	0	0	0	0	379	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	1.10	1.29	0.83	1.01	1.10	0.81	0.86

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	253	1491	346	119	785	181	185	1808	27	49	1281	91
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	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.97		1.00	0.97		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4942		1770	4942		1770	5074		1770	5035	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4942		1770	4942		1770	5074		1770	5035	
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)	266	1569	364	125	826	191	195	1903	28	52	1348	96
RTOR Reduction (vph)	0	34	0	0	34	0	0	1	0	0	7	0
Lane Group Flow (vph)	266	1899	0	125	983	0	195	1930	0	52	1437	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	18.6	38.5		6.0	25.9		12.8	45.3		3.2	35.7	
Effective Green, g (s)	18.6	38.5		6.0	25.9		12.8	45.3		3.2	35.7	
Actuated g/C Ratio	0.17	0.35		0.05	0.24		0.12	0.41		0.03	0.32	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	299	1730		97	1164		206	2090		51	1634	
v/s Ratio Prot	0.15	c0.38		c0.07	0.20		c0.11	c0.38		0.03	0.29	
v/s Ratio Perm												
v/c Ratio	0.89	1.10		1.29	0.84		0.95	0.92		1.02	0.88	
Uniform Delay, d1	44.7	35.8		52.0	40.1		48.3	30.7		53.4	35.1	
Progression Factor	1.00	1.00		0.70	1.07		0.69	0.40		0.83	0.75	
Incremental Delay, d2	25.8	53.5		179.8	4.9		9.1	0.9		125.2	6.4	
Delay (s)	70.5	89.2		216.3	48.0		42.2	13.1		169.5	32.7	
Level of Service	E	F		F	D		D	B		F	C	
Approach Delay (s)		86.9			66.4			15.7			37.5	
Approach LOS		F			E			B			D	

Intersection Summary			
HCM Average Control Delay	51.2	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	96.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	443	1175	299	287	655	21	1754	527	1840
v/c Ratio	1.03	0.93	0.76	0.99	0.70	0.31	1.09	0.57	0.81
Control Delay	93.8	49.4	41.7	77.1	21.2	34.2	81.2	8.5	6.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	93.4	0.0	0.2
Total Delay	93.8	49.4	41.7	77.1	21.2	34.2	174.6	8.5	6.9
Queue Length 50th (ft)	~338	325	210	212	100	9	~736	62	104
Queue Length 95th (ft)	#587	#412	#354	m#263	m97	36	#874	163	m125
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	432	1264	391	290	1109	68	1609	925	2278
Starvation Cap Reductn	0	0	0	0	0	0	0	0	65
Spillback Cap Reductn	0	0	0	0	0	0	262	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.03	0.93	0.76	0.99	0.59	0.31	1.30	0.57	0.83

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	421	1085	315	273	617	6	20	1666	501	0	1269	479
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4786	1362	1770	5078		1770	3539	1583		4876	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.08	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4786	1362	1770	5078		149	3539	1583		4876	
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)	443	1142	332	287	649	6	21	1754	527	0	1336	504
RTOR Reduction (vph)	0	2	32	0	1	0	0	0	206	0	62	0
Lane Group Flow (vph)	443	1173	267	287	654	0	21	1754	321	0	1778	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	26.8	29.0	29.0	18.0	20.2		50.0	50.0	50.0		50.0	
Effective Green, g (s)	26.8	29.0	29.0	18.0	20.2		50.0	50.0	50.0		50.0	
Actuated g/C Ratio	0.24	0.26	0.26	0.16	0.18		0.45	0.45	0.45		0.45	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	431	1262	359	290	933		68	1609	720		2216	
v/s Ratio Prot	c0.25	c0.25		0.16	0.13			c0.50			0.36	
v/s Ratio Perm			0.20				0.14		0.20			
v/c Ratio	1.03	0.93	0.74	0.99	0.70		0.31	1.09	0.45		0.80	
Uniform Delay, d1	41.6	39.5	37.1	45.9	42.1		19.0	30.0	20.5		25.8	
Progression Factor	1.08	0.92	0.88	0.76	0.44		1.00	1.00	1.00		0.23	
Incremental Delay, d2	49.4	11.4	7.7	39.0	1.5		11.4	51.3	2.0		1.1	
Delay (s)	94.3	47.6	40.3	74.0	20.1		30.4	81.3	22.5		7.0	
Level of Service	F	D	D	E	C		C	F	C		A	
Approach Delay (s)		57.3			36.5			67.4			7.0	
Approach LOS		E			D			E			A	

Intersection Summary			
HCM Average Control Delay	44.6	HCM Level of Service	D
HCM Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	95.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	441	1809	0	0	1837
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	464	1904	0	0	1934
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked	0.73					
vC, conflicting volume	2549	635			1904	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1834	635			1904	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	0			100	
cM capacity (veh/h)	49	421			308	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	464	635	635	635	645	645	645
Volume Left	0	0	0	0	0	0	0
Volume Right	464	0	0	0	0	0	0
cSH	421	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.10	0.37	0.37	0.37	0.38	0.38	0.38
Queue Length 95th (ft)	403	0	0	0	0	0	0
Control Delay (s)	105.4	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F						
Approach Delay (s)	105.4	0.0			0.0		
Approach LOS	F						

Intersection Summary			
Average Delay	11.4		
Intersection Capacity Utilization	68.9%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1262	1009	649
v/c Ratio	0.36	0.29	0.78
Control Delay	8.2	3.1	44.4
Queue Delay	0.0	0.0	0.0
Total Delay	8.2	3.1	44.4
Queue Length 50th (ft)	123	38	215
Queue Length 95th (ft)	182	99	257
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	3467	3467	1369
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.36	0.29	0.47

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1199	959	0	530	86
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.98	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3392	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3392	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1262	1009	0	558	91
RTOR Reduction (vph)	0	0	0	0	15	0
Lane Group Flow (vph)	0	1262	1009	0	634	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		75.0	75.0		26.5	
Effective Green, g (s)		75.0	75.0		26.5	
Actuated g/C Ratio		0.68	0.68		0.24	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		3467	3467		817	
v/s Ratio Prot		c0.25	0.20		c0.19	
v/s Ratio Perm						
v/c Ratio		0.36	0.29		0.78	
Uniform Delay, d1		7.4	6.9		39.0	
Progression Factor		1.00	0.39		1.00	
Incremental Delay, d2		0.3	0.2		4.6	
Delay (s)		7.7	2.9		43.6	
Level of Service		A	A		D	
Approach Delay (s)		7.7	2.9		43.6	
Approach LOS		A	A		D	

Intersection Summary			
HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	48.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	173	1444	457	1082	237	797	683	152	600
v/c Ratio	0.73	0.99	1.24	0.59	0.36	0.58	0.75	0.97	0.31
Control Delay	24.9	23.0	165.0	30.5	14.5	8.8	10.6	100.0	21.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0
Total Delay	24.9	23.0	165.0	30.5	14.5	8.8	11.0	100.0	21.9
Queue Length 50th (ft)	84	402	~401	228	56	71	96	104	97
Queue Length 95th (ft)	m72	m371	#599	281	125	m86	m113	#239	127
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	274	1456	370	1840	651	1367	913	157	1943
Starvation Cap Reductn	0	0	0	0	0	0	40	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.63	0.99	1.24	0.59	0.36	0.58	0.78	0.97	0.31

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	164	1372	0	434	1028	225	0	757	649	144	468	102
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	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4949	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.22	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	407	4949	
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)	173	1444	0	457	1082	237	0	797	683	152	493	107
RTOR Reduction (vph)	0	0	0	0	0	78	0	0	301	0	31	0
Lane Group Flow (vph)	173	1444	0	457	1082	159	0	797	382	152	569	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	14.7	31.5		23.0	39.8	39.8		42.5	42.5	42.5	42.5	
Effective Green, g (s)	14.7	31.5		23.0	39.8	39.8		42.5	42.5	42.5	42.5	
Actuated g/C Ratio	0.13	0.29		0.21	0.36	0.36		0.39	0.39	0.39	0.39	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	237	1456		370	1840	573		1367	612	157	1912	
v/s Ratio Prot	0.10	c0.28		c0.26	0.21			0.23			0.11	
v/s Ratio Perm						0.10			0.24	c0.37		
v/c Ratio	0.73	0.99		1.24	0.59	0.28		0.58	0.62	0.97	0.30	
Uniform Delay, d1	45.7	39.1		43.5	28.5	24.9		26.7	27.3	33.1	23.4	
Progression Factor	0.51	0.40		1.00	1.00	1.00		0.29	0.94	1.00	1.00	
Incremental Delay, d2	1.0	5.4		127.1	1.4	1.2		1.0	2.6	63.9	0.4	
Delay (s)	24.2	21.0		170.6	29.8	26.1		8.8	28.2	97.0	23.8	
Level of Service	C	C		F	C	C		A	C	F	C	
Approach Delay (s)		21.4			65.6			17.7			38.6	
Approach LOS		C			E			B			D	

Intersection Summary			
HCM Average Control Delay	36.7	HCM Level of Service	D
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	94.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	144	1778	128	1351	221	323	23	43	582	125
v/c Ratio	0.71	0.94	0.87	0.78	0.92	0.27	0.04	0.39	0.75	0.29
Control Delay	61.2	40.5	92.1	32.7	84.9	24.9	9.7	55.8	41.6	9.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.2	40.5	92.1	32.7	84.9	24.9	9.7	55.8	41.6	9.0
Queue Length 50th (ft)	86	374	79	273	136	80	0	26	175	5
Queue Length 95th (ft)	#173	#515	#194	348	#288	116	18	63	235	50
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	221	1886	147	1734	239	1213	558	111	921	496
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.65	0.94	0.87	0.78	0.92	0.27	0.04	0.39	0.63	0.25

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	137	1411	278	122	1195	88	210	307	22	41	553	119
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.98		1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	4960		1770	5033		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	4960		1770	5033		1770	3539	1583	1770	3539	1583
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)	144	1485	293	128	1258	93	221	323	23	43	582	125
RTOR Reduction (vph)	0	29	0	0	8	0	0	0	15	0	0	87
Lane Group Flow (vph)	144	1749	0	128	1343	0	221	323	8	43	582	38
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	11.1	36.1		8.0	33.0		13.0	32.3	32.3	3.5	22.8	22.8
Effective Green, g (s)	11.1	36.1		8.0	33.0		13.0	32.3	32.3	3.5	22.8	22.8
Actuated g/C Ratio	0.11	0.37		0.08	0.34		0.13	0.33	0.33	0.04	0.23	0.23
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	201	1829		145	1697		235	1168	522	63	824	369
v/s Ratio Prot	0.08	c0.35		c0.07	0.27		c0.12	0.09		0.02	c0.16	
v/s Ratio Perm									0.00			0.02
v/c Ratio	0.72	0.96		0.88	0.79		0.94	0.28	0.01	0.68	0.71	0.10
Uniform Delay, d1	41.9	30.1		44.5	29.3		42.1	24.2	22.1	46.7	34.5	29.5
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	11.5	12.2		42.0	2.6		42.4	0.1	0.0	26.3	2.8	0.1
Delay (s)	53.4	42.3		86.5	31.9		84.4	24.3	22.1	73.0	37.3	29.6
Level of Service	D	D		F	C		F	C	C	E	D	C
Approach Delay (s)		43.2			36.7			47.7			38.0	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	40.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	97.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	224	0	305	0	0	715	315	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	236	0	321	0	0	753	332	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.83		0.83						0.83	0.83
vC, conflicting volume	1405	161	1084			321			1149	1074
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1386	161	1002			321			1079	989
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	72	100			100			100	100
cM capacity (veh/h)	118	856	573			1236			104	205

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	236	161	161	753	332
Volume Left	0	0	0	0	0
Volume Right	236	0	0	0	332
cSH	856	1700	1700	1700	1700
Volume to Capacity	0.28	0.09	0.09	0.44	0.20
Queue Length 95th (ft)	28	0	0	0	0
Control Delay (s)	10.8	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	10.8	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	67.0%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	679	0	0	0	0	0	0	352	347	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	715	0	0	0	0	0	0	371	365	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked	0.94	0.94	0.94	0.94	0.94		0.94					
vC, conflicting volume	1106	1106	365	1821	1106	0	365			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1081	1081	293	1841	1081	0	293			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	0	0	100	100	100			77		
cM capacity (veh/h)	151	158	701	0	158	1085	1193			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	715	371	365
Volume Left	0	371	0
Volume Right	715	0	0
cSH	701	1623	1700
Volume to Capacity	1.02	0.23	0.21
Queue Length 95th (ft)	431	22	0
Control Delay (s)	63.1	7.9	0.0
Lane LOS	F	A	
Approach Delay (s)	63.1	4.0	
Approach LOS	F		

Intersection Summary			
Average Delay	33.1		
Intersection Capacity Utilization	67.0%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	433	406	155	802	312	853
v/c Ratio	0.80	0.70	0.53	0.42	0.31	0.44
Control Delay	32.0	18.5	13.9	6.2	1.2	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.0	18.5	13.9	6.2	1.2	9.5
Queue Length 50th (ft)	136	76	19	52	3	94
Queue Length 95th (ft)	#259	163	m80	68	9	134
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	590	624	290	1931	1006	1928
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	21
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.65	0.53	0.42	0.31	0.45

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	411	11	374	147	762	296	0	800	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.85		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1592		1770	3539	1583		3532	
Flt Permitted				0.95	1.00		0.29	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1592		531	3539	1583		3532	
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)	0	0	0	433	12	394	155	802	312	0	842	11
RTOR Reduction (vph)	0	0	0	0	98	0	0	0	142	0	1	0
Lane Group Flow (vph)	0	0	0	433	308	0	155	802	170	0	852	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				18.3	18.3		32.7	32.7	32.7		32.7	
Effective Green, g (s)				18.3	18.3		32.7	32.7	32.7		32.7	
Actuated g/C Ratio				0.31	0.31		0.55	0.55	0.55		0.55	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				540	486		289	1929	863		1925	
v/s Ratio Prot				c0.24	0.19			0.23			0.24	
v/s Ratio Perm							c0.29		0.11			
v/c Ratio				0.80	0.63		0.54	0.42	0.20		0.44	
Uniform Delay, d1				19.2	18.0		8.8	8.0	7.0		8.2	
Progression Factor				1.00	1.00		0.68	0.66	0.41		1.00	
Incremental Delay, d2				8.4	2.7		5.8	0.6	0.4		0.7	
Delay (s)				27.6	20.7		11.8	5.9	3.3		8.9	
Level of Service				C	C		B	A	A		A	
Approach Delay (s)		0.0			24.2			6.0			8.9	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM Average Control Delay	12.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	432	387	1028	1228
v/c Ratio	0.76	0.73	0.53	0.64
Control Delay	27.1	24.4	3.4	8.1
Queue Delay	0.0	0.0	0.0	0.1
Total Delay	27.1	24.4	3.4	8.2
Queue Length 50th (ft)	133	107	38	120
Queue Length 95th (ft)	209	180	m66	158
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	679	628	1931	1931
Starvation Cap Reductn	0	0	14	46
Spillback Cap Reductn	0	1	0	70
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.64	0.62	0.54	0.66

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	410	368	0	977	1167	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		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	432	387	0	1028	1228	0
RTOR Reduction (vph)	0	24	0	0	0	0
Lane Group Flow (vph)	432	363	0	1028	1228	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	19.3	19.3		32.7	32.7	
Effective Green, g (s)	19.3	19.3		32.7	32.7	
Actuated g/C Ratio	0.32	0.32		0.55	0.55	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	569	509		1929	1929	
v/s Ratio Prot				0.29	c0.35	
v/s Ratio Perm	c0.24	0.23				
v/c Ratio	0.76	0.71		0.53	0.64	
Uniform Delay, d1	18.3	17.9		8.8	9.5	
Progression Factor	1.00	1.00		0.25	0.63	
Incremental Delay, d2	5.8	4.7		0.9	1.4	
Delay (s)	24.0	22.6		3.1	7.4	
Level of Service	C	C		A	A	
Approach Delay (s)	23.4			3.1	7.4	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	10.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	208	541	332	117	354	95	192	768	464	211	1221	273
v/c Ratio	0.89	0.60	0.52	0.78	0.39	0.20	0.81	0.52	0.65	0.89	0.84	0.36
Control Delay	61.1	22.8	6.0	57.5	19.8	5.9	53.6	15.1	16.7	57.6	17.7	2.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.1	22.8	6.0	57.5	19.8	5.9	53.6	15.1	16.7	57.6	17.7	2.7
Queue Length 50th (ft)	71	88	2	39	54	0	69	107	104	82	172	4
Queue Length 95th (ft)	#178	132	55	#117	87	29	#167	154	198	m#173	#326	m11
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	247	944	660	158	944	492	238	1463	710	236	1458	760
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.57	0.50	0.74	0.38	0.19	0.81	0.52	0.65	0.89	0.84	0.36

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	198	514	315	111	336	90	182	730	441	200	1160	259
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.50	1.00	1.00	0.32	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	928	3539	1583	595	3539	1583	1770	3539	1583	1770	3539	1583
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)	208	541	332	117	354	95	192	768	464	211	1221	273
RTOR Reduction (vph)	0	0	242	0	0	71	0	0	55	0	0	108
Lane Group Flow (vph)	208	541	90	117	354	24	192	768	409	211	1221	165
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	15.2	15.2	15.2	15.2	15.2	15.2	8.1	24.8	24.8	8.0	24.7	24.7
Effective Green, g (s)	15.2	15.2	15.2	15.2	15.2	15.2	8.1	24.8	24.8	8.0	24.7	24.7
Actuated g/C Ratio	0.25	0.25	0.25	0.25	0.25	0.25	0.13	0.41	0.41	0.13	0.41	0.41
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	235	897	401	151	897	401	239	1463	654	236	1457	652
v/s Ratio Prot		0.15			0.10		c0.11	0.22		0.12	c0.34	
v/s Ratio Perm	c0.22		0.06	0.20		0.02			0.26			0.10
v/c Ratio	0.89	0.60	0.22	0.77	0.39	0.06	0.80	0.52	0.63	0.89	0.84	0.25
Uniform Delay, d1	21.6	19.7	17.7	20.8	18.6	17.0	25.2	13.2	13.9	25.6	15.9	11.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	0.73	0.34
Incremental Delay, d2	30.1	1.2	0.3	21.6	0.3	0.1	17.5	1.4	4.5	27.2	4.8	0.8
Delay (s)	51.7	20.9	18.0	42.4	18.9	17.0	42.6	14.5	18.4	47.9	16.3	4.7
Level of Service	D	C	B	D	B	B	D	B	B	D	B	A
Approach Delay (s)		25.9			23.4			19.6			18.4	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	21.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	75.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	228	665	0	457	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	240	700	0	481	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			940		481	120
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			940		481	120
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			725		514	909

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	160	313	467	241	241
Volume Left	0	0	0	0	0
Volume Right	0	233	467	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.09	0.18	0.27	0.14	0.14
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	30.8%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	135	1783	1094	167
v/c Ratio	0.38	0.50	0.43	0.14
Control Delay	20.6	0.4	6.1	1.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.6	0.4	6.1	1.3
Queue Length 50th (ft)	52	0	107	1
Queue Length 95th (ft)	m58	0	145	18
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	405	3539	2548	1185
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.33	0.50	0.43	0.14

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	128	1694	1039	159
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	135	1783	1094	167
RTOR Reduction (vph)	0	0	0	0	0	49
Lane Group Flow (vph)	0	0	135	1783	1094	118
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			12.8	70.0	48.7	48.7
Effective Green, g (s)			12.8	70.0	48.7	48.7
Actuated g/C Ratio			0.18	1.00	0.70	0.70
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			324	3539	2462	1101
v/s Ratio Prot			0.08	c0.50	0.31	
v/s Ratio Perm						0.07
v/c Ratio			0.42	0.50	0.44	0.11
Uniform Delay, d1			25.3	0.0	4.7	3.5
Progression Factor			0.78	1.00	1.00	1.00
Incremental Delay, d2			0.7	0.4	0.6	0.2
Delay (s)			20.3	0.4	5.3	3.7
Level of Service			C	A	A	A
Approach Delay (s)	0.0			1.8	5.1	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	3.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	178	128	0	1721	1055	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	187	135	0	1812	1111	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.72	0.86	0.86			
vC, conflicting volume	2016	555	1111			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	763	156	802			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	24	82	100			
cM capacity (veh/h)	246	741	703			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	125	197	906	906	555	555
Volume Left	125	62	0	0	0	0
Volume Right	0	135	0	0	0	0
cSH	246	452	1700	1700	1700	1700
Volume to Capacity	0.51	0.44	0.53	0.53	0.33	0.33
Queue Length 95th (ft)	66	54	0	0	0	0
Control Delay (s)	33.9	19.0	0.0	0.0	0.0	0.0
Lane LOS	D	C				
Approach Delay (s)	24.8		0.0		0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	266	166	26	78	199	1545	19	925	201
v/c Ratio	0.85	0.20	0.09	0.10	0.49	0.70	0.09	0.56	0.25
Control Delay	50.8	7.2	20.8	11.6	9.6	12.4	5.8	11.0	2.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.8	7.2	20.8	11.6	9.6	12.4	5.8	11.0	2.3
Queue Length 50th (ft)	107	6	9	6	31	200	1	149	2
Queue Length 95th (ft)	#223	27	26	21	56	378	m3	219	21
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	337	899	310	868	452	2199	219	1644	809
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.18	0.08	0.09	0.44	0.70	0.09	0.56	0.25

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	253	35	123	25	34	40	189	1429	39	18	879	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.88		1.00	0.92		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3127		1770	3253		1770	3525		1770	3539	1583
Flt Permitted	0.70	1.00		0.65	1.00		0.19	1.00		0.12	1.00	1.00
Satd. Flow (perm)	1311	3127		1205	3253		356	3525		229	3539	1583
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)	266	37	129	26	36	42	199	1504	41	19	925	201
RTOR Reduction (vph)	0	98	0	0	32	0	0	3	0	0	0	74
Lane Group Flow (vph)	266	68	0	26	46	0	199	1542	0	19	925	127
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	16.8	16.8		16.8	16.8		45.2	40.4		33.3	32.5	32.5
Effective Green, g (s)	16.8	16.8		16.8	16.8		45.2	40.4		33.3	32.5	32.5
Actuated g/C Ratio	0.24	0.24		0.24	0.24		0.65	0.58		0.48	0.46	0.46
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	315	750		289	781		406	2034		127	1643	735
v/s Ratio Prot		0.02			0.01		c0.06	c0.44		0.00	0.26	
v/s Ratio Perm	c0.20			0.02			0.26			0.07		0.08
v/c Ratio	0.84	0.09		0.09	0.06		0.49	0.76		0.15	0.56	0.17
Uniform Delay, d1	25.4	20.7		20.7	20.5		7.1	11.1		10.9	13.6	10.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.87	0.66	0.34
Incremental Delay, d2	18.3	0.1		0.1	0.0		0.9	2.7		0.5	1.3	0.5
Delay (s)	43.7	20.7		20.8	20.5		8.0	13.8		10.0	10.4	4.2
Level of Service	D	C		C	C		A	B		A	B	A
Approach Delay (s)		34.8			20.6			13.2			9.3	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	1138	429	908	95	145	1013
v/c Ratio	0.85	0.53	0.67	0.15	0.71	0.54
Control Delay	37.9	8.7	25.7	5.9	65.8	18.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.9	8.7	25.7	5.9	65.8	18.6
Queue Length 50th (ft)	364	50	201	6	98	242
Queue Length 95th (ft)	439	132	241	m21	#176	314
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	1436	847	1356	649	226	1893
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.51	0.67	0.15	0.64	0.54

Intersection Summary

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

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	1081	408	863	90	138	962
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1138	429	908	95	145	1013
RTOR Reduction (vph)	0	195	0	43	0	0
Lane Group Flow (vph)	1138	234	908	52	145	1013
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	42.7	42.7	42.1	42.1	12.7	58.8
Effective Green, g (s)	42.7	42.7	42.1	42.1	12.7	58.8
Actuated g/C Ratio	0.39	0.39	0.38	0.38	0.12	0.53
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1333	614	1354	606	204	1892
v/s Ratio Prot	c0.33		c0.26		c0.08	0.29
v/s Ratio Perm		0.15		0.03		
v/c Ratio	0.85	0.38	0.67	0.09	0.71	0.54
Uniform Delay, d1	30.8	24.2	28.2	21.7	46.9	16.7
Progression Factor	1.00	1.00	0.79	0.58	1.00	1.00
Incremental Delay, d2	5.5	0.4	2.5	0.3	11.1	1.1
Delay (s)	36.3	24.6	24.6	12.9	58.0	17.8
Level of Service	D	C	C	B	E	B
Approach Delay (s)	33.1		23.5			22.8
Approach LOS	C		C			C

Intersection Summary			
HCM Average Control Delay	27.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	317	326	774	1323	176	2012
v/c Ratio	0.63	0.74	0.33	1.00	1.21	0.73
Control Delay	49.5	22.6	9.1	35.3	175.9	4.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.5	22.6	9.1	35.3	175.9	4.9
Queue Length 50th (ft)	110	53	112	~485	~156	83
Queue Length 95th (ft)	146	145	173	#1032	m#257	208
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	687	513	2331	1317	145	2749
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.64	0.33	1.00	1.21	0.73

Intersection Summary

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

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

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	301	310	735	1257	167	1911
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	317	326	774	1323	176	2012
RTOR Reduction (vph)	0	209	0	275	0	0
Lane Group Flow (vph)	317	117	774	1048	176	2012
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	16.1	16.1	72.4	72.4	9.0	85.4
Effective Green, g (s)	16.1	16.1	72.4	72.4	9.0	85.4
Actuated g/C Ratio	0.15	0.15	0.66	0.66	0.08	0.78
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	502	232	2329	1042	145	2748
v/s Ratio Prot	c0.09		0.22		c0.10	0.57
v/s Ratio Perm		0.07		c0.66		
v/c Ratio	0.63	0.50	0.33	1.01	1.21	0.73
Uniform Delay, d1	44.2	43.3	8.2	18.8	50.5	6.4
Progression Factor	1.00	1.00	1.00	1.00	0.95	0.50
Incremental Delay, d2	2.6	1.7	0.4	29.3	133.9	1.3
Delay (s)	46.7	45.0	8.6	48.1	181.9	4.5
Level of Service	D	D	A	D	F	A
Approach Delay (s)	45.9		33.5			18.8
Approach LOS	D		C			B

Intersection Summary			
HCM Average Control Delay	28.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	94.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	55	102	1421	156	74	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	58	107	1496	164	78	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	1734	1578			1496	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1734	1578			1496	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	27	20			83	
cM capacity (veh/h)	80	135			448	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	58	107	1660	78	0
Volume Left	58	0	0	78	0
Volume Right	0	107	164	0	0
cSH	80	135	1700	448	1700
Volume to Capacity	0.73	0.80	0.98	0.17	0.00
Queue Length 95th (ft)	87	121	0	16	0
Control Delay (s)	124.8	94.0	0.0	14.7	0.0
Lane LOS	F	F		B	
Approach Delay (s)	104.8		0.0	14.7	
Approach LOS	F				

Intersection Summary			
Average Delay	9.7		
Intersection Capacity Utilization	97.2%	ICU Level of Service	F
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2081	1565	520	185	1021	643	1020
v/c Ratio	0.93	0.99	0.47	0.71	0.93	0.93	0.75
Control Delay	39.6	22.9	1.7	59.8	51.0	68.8	44.1
Queue Delay	29.4	26.8	0.8	0.0	11.4	0.0	0.0
Total Delay	68.9	49.7	2.5	59.8	62.4	68.8	44.1
Queue Length 50th (ft)	543	125	22	145	287	254	265
Queue Length 95th (ft)	619	m#737	m18	#243	#372	#364	318
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2248	1578	1097	261	1094	689	1369
Starvation Cap Reductn	0	119	294	0	0	0	0
Spillback Cap Reductn	289	0	0	0	80	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.06	1.07	0.65	0.71	1.01	0.93	0.75

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1825	152	0	1487	494	176	924	46	611	968	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5027			3539	1583	1770	5049		3433	5085	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5027			3539	1583	1770	5049		3433	5085	
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)	0	1921	160	0	1565	520	185	973	48	643	1019	1
RTOR Reduction (vph)	0	8	0	0	0	1	0	4	0	0	0	0
Lane Group Flow (vph)	0	2073	0	0	1565	519	185	1017	0	643	1020	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		53.5			53.5	77.6	17.7	25.9		24.1	32.3	
Effective Green, g (s)		53.5			53.5	77.6	17.7	25.9		24.1	32.3	
Actuated g/C Ratio		0.45			0.45	0.65	0.15	0.22		0.20	0.27	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2241			1578	1096	261	1090		689	1369	
v/s Ratio Prot		0.41			c0.44	0.10	0.10	c0.20		c0.19	0.20	
v/s Ratio Perm						0.23						
v/c Ratio		0.93			0.99	0.47	0.71	0.93		0.93	0.75	
Uniform Delay, d1		31.4			33.0	10.8	48.7	46.2		47.2	40.1	
Progression Factor		1.00			0.26	0.13	0.91	0.77		1.00	1.00	
Incremental Delay, d2		7.1			12.1	0.1	14.4	14.8		19.6	3.7	
Delay (s)		38.5			20.6	1.6	59.0	50.5		66.8	43.8	
Level of Service		D			C	A	E	D		E	D	
Approach Delay (s)		38.5			15.8			51.8			52.7	
Approach LOS		D			B			D			D	

Intersection Summary			
HCM Average Control Delay	37.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	391	2194	44	1725	615	98	345	744	531
v/c Ratio	0.96	0.78	0.56	0.98	0.94	0.36	0.93	0.74	0.74
Control Delay	62.1	9.5	75.5	58.8	63.3	15.0	84.8	44.4	18.0
Queue Delay	71.0	7.0	0.0	7.8	0.0	0.0	0.0	0.0	0.1
Total Delay	133.1	16.5	75.5	66.6	63.3	15.0	84.8	44.4	18.1
Queue Length 50th (ft)	324	297	31	521	147	3	138	275	106
Queue Length 95th (ft)	m#365	m348	m#74	#610	m#223	m35	#228	348	250
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	406	2808	78	1766	657	274	372	1003	718
Starvation Cap Reductn	73	583	0	0	0	0	0	0	0
Spillback Cap Reductn	0	166	0	63	0	2	0	0	4
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	0.99	0.56	1.01	0.94	0.36	0.93	0.74	0.74

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	371	2055	29	42	1492	146	0	584	93	328	707	504
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5075		1770	5017			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5075		1770	5017			5085	1583	3433	3539	1583
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)	391	2163	31	44	1571	154	0	615	98	345	744	531
RTOR Reduction (vph)	0	1	0	0	10	0	0	0	70	0	0	269
Lane Group Flow (vph)	391	2193	0	44	1715	0	0	615	28	345	744	262
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	28.6	65.3		4.2	40.9			15.5	15.5	13.0	34.0	34.0
Effective Green, g (s)	28.6	65.3		4.2	40.9			15.5	15.5	13.0	34.0	34.0
Actuated g/C Ratio	0.24	0.54		0.04	0.34			0.13	0.13	0.11	0.28	0.28
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	422	2762		62	1710			657	204	372	1003	449
v/s Ratio Prot	c0.22	0.43		0.02	c0.34			c0.12		c0.10	0.21	
v/s Ratio Perm									0.02			0.17
v/c Ratio	0.93	0.79		0.71	1.00			0.94	0.14	0.93	0.74	0.58
Uniform Delay, d1	44.7	21.9		57.3	39.5			51.8	46.3	53.0	39.0	36.9
Progression Factor	0.91	0.39		0.91	1.14			0.83	0.81	1.00	1.00	1.00
Incremental Delay, d2	12.4	0.9		27.8	21.1			19.6	1.2	31.5	4.9	5.4
Delay (s)	53.1	9.6		79.9	66.2			62.6	38.9	84.5	44.0	42.3
Level of Service	D	A		E	E			E	D	F	D	D
Approach Delay (s)		16.2			66.6			59.3			52.1	
Approach LOS		B			E			E			D	

Intersection Summary			
HCM Average Control Delay	42.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	91.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	176	823	81	1085	362	45	230	157	491	43
v/c Ratio	0.73	0.28	0.24	0.36	0.34	0.34	0.85	0.52	0.52	0.13
Control Delay	39.0	1.1	14.2	13.5	2.0	59.9	81.4	30.1	26.9	15.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.0	1.1	14.2	13.5	2.0	59.9	81.4	30.1	26.9	15.0
Queue Length 50th (ft)	64	9	29	153	0	34	92	151	156	25
Queue Length 95th (ft)	m105	m10	59	182	39	73	#164	m204	199	m33
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	242	2944	338	2983	1078	134	270	304	953	340
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.28	0.24	0.36	0.34	0.34	0.85	0.52	0.52	0.13

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	167	689	93	77	1031	344	43	207	11	237	379	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	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	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (prot)	1770	4994		1770	5085	1583	1770	3512		1522	4761	1583
Flt Permitted	0.22	1.00		0.31	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (perm)	411	4994		575	5085	1583	1770	3512		1522	4761	1583
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)	176	725	98	81	1085	362	45	218	12	249	399	43
RTOR Reduction (vph)	0	14	0	0	0	150	0	4	0	0	0	23
Lane Group Flow (vph)	176	809	0	81	1085	212	45	226	0	157	491	20
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	70.4	70.4		70.4	70.4	70.4	9.1	9.1		24.0	24.0	24.0
Effective Green, g (s)	70.4	70.4		70.4	70.4	70.4	9.1	9.1		24.0	24.0	24.0
Actuated g/C Ratio	0.59	0.59		0.59	0.59	0.59	0.08	0.08		0.20	0.20	0.20
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	241	2930		337	2983	929	134	266		304	952	317
v/s Ratio Prot		0.16			0.21		0.03	c0.06		c0.10	0.10	
v/s Ratio Perm	c0.43			0.14		0.13						0.01
v/c Ratio	0.73	0.28		0.24	0.36	0.23	0.34	0.85		0.52	0.52	0.06
Uniform Delay, d1	17.9	12.2		11.9	13.0	11.8	52.6	54.8		42.8	42.8	38.9
Progression Factor	1.35	0.08		1.00	1.00	1.00	1.00	1.00		0.60	0.59	0.75
Incremental Delay, d2	11.4	0.1		1.7	0.3	0.6	6.6	27.4		4.1	1.3	0.3
Delay (s)	35.6	1.2		13.6	13.4	12.4	59.2	82.2		29.6	26.8	29.3
Level of Service	D	A		B	B	B	E	F		C	C	C
Approach Delay (s)		7.2			13.2			78.4			27.6	
Approach LOS		A			B			E			C	

Intersection Summary			
HCM Average Control Delay	19.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	62.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	26	2456	108	286	1762	55	13	132	258	87	64
v/c Ratio	0.29	0.92	0.13	0.97	0.51	0.57	0.09	0.42	1.07	0.27	0.20
Control Delay	59.7	15.0	2.5	60.5	13.2	76.1	52.6	30.0	123.5	43.8	11.1
Queue Delay	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.7	15.3	2.5	60.5	13.2	76.1	52.6	30.0	123.5	43.8	11.1
Queue Length 50th (ft)	22	137	4	195	225	41	10	51	186	57	0
Queue Length 95th (ft)	m29	#780	m6	m#262	255	#88	30	113	#371	105	38
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	91	2670	859	294	3440	109	155	311	240	373	368
Starvation Cap Reductn	0	30	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.93	0.13	0.97	0.51	0.50	0.08	0.42	1.07	0.23	0.17

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	2333	103	272	1636	38	52	12	125	245	83	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		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	5085	1583	1770	5068		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.70	1.00	1.00	0.49	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	5068		1305	1863	1583	918	1863	1583
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)	26	2456	108	286	1722	40	55	13	132	258	87	64
RTOR Reduction (vph)	0	0	30	0	2	0	0	0	47	0	0	52
Lane Group Flow (vph)	26	2456	78	286	1760	0	55	13	85	258	87	12
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	3.7	59.7	59.7	22.1	78.1		7.7	7.7	22.1	21.7	21.7	21.7
Effective Green, g (s)	3.7	59.7	59.7	22.1	78.1		7.7	7.7	22.1	21.7	21.7	21.7
Actuated g/C Ratio	0.03	0.50	0.50	0.18	0.65		0.06	0.06	0.18	0.18	0.18	0.18
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	55	2530	788	326	3298		84	120	292	237	337	286
v/s Ratio Prot	0.01	c0.48		c0.16	0.35			0.01	0.05	c0.09	0.05	
v/s Ratio Perm			0.05				0.04			c0.11		0.01
v/c Ratio	0.47	0.97	0.10	0.88	0.53		0.65	0.11	0.29	1.09	0.26	0.04
Uniform Delay, d1	57.2	29.3	15.9	47.6	11.2		54.9	52.9	42.2	48.2	42.2	40.6
Progression Factor	0.99	0.35	0.28	0.61	1.17		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.8	8.5	0.1	10.6	0.3		16.9	0.4	0.6	84.1	0.4	0.1
Delay (s)	60.4	18.9	4.7	39.6	13.4		71.7	53.3	42.7	132.3	42.6	40.6
Level of Service	E	B	A	D	B		E	D	D	F	D	D
Approach Delay (s)		18.7			17.1			51.4			98.9	
Approach LOS		B			B			D			F	

Intersection Summary			
HCM Average Control Delay	25.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	94.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	33	2840	2269	470
v/c Ratio	0.21	1.03	0.91	0.45
Control Delay	35.4	29.2	20.1	36.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	35.4	29.2	20.1	36.6
Queue Length 50th (ft)	24	~865	613	158
Queue Length 95th (ft)	m28	m#915	#744	216
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	413	2754	2491	1035
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.08	1.03	0.91	0.45

Intersection Summary

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

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

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	31	2698	1979	177	420	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.99		0.99	
Flt Protected	0.95	1.00	1.00		0.96	
Satd. Flow (prot)	1770	5085	5023		3421	
Flt Permitted	0.95	1.00	1.00		0.96	
Satd. Flow (perm)	1770	5085	5023		3421	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	33	2840	2083	186	442	28
RTOR Reduction (vph)	0	0	9	0	3	0
Lane Group Flow (vph)	33	2840	2260	0	467	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	6.9	62.8	54.9		36.2	
Effective Green, g (s)	6.9	62.8	54.9		36.2	
Actuated g/C Ratio	0.06	0.52	0.46		0.30	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	102	2661	2298		1032	
v/s Ratio Prot	c0.02	c0.56	0.45		c0.14	
v/s Ratio Perm						
v/c Ratio	0.32	1.07	0.98		0.45	
Uniform Delay, d1	54.3	28.6	32.1		33.9	
Progression Factor	1.29	0.23	0.51		1.00	
Incremental Delay, d2	0.8	34.2	12.1		1.4	
Delay (s)	70.7	40.9	28.5		35.3	
Level of Service	E	D	C		D	
Approach Delay (s)		41.2	28.5		35.3	
Approach LOS		D	C		D	

Intersection Summary			
HCM Average Control Delay	35.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	74.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	127	3135	20	67	2320	74	120	201
v/c Ratio	0.64	0.89	0.02	0.77	0.73	0.69	0.74	0.59
Control Delay	41.9	5.5	0.5	104.5	17.0	74.5	77.1	21.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.9	5.5	0.5	104.5	17.0	74.5	77.1	21.2
Queue Length 50th (ft)	95	123	0	52	419	47	91	31
Queue Length 95th (ft)	m102	m120	m0	#135	476	#126	#186	109
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	198	3513	1099	87	3182	107	163	338
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.64	0.89	0.02	0.77	0.73	0.69	0.74	0.59

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	121	2978	19	64	2136	68	27	26	18	114	34	157
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.97		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5062			1765		1770	1633	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.44		0.71	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5062			790		1329	1633	
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)	127	3135	20	67	2248	72	28	27	19	120	36	165
RTOR Reduction (vph)	0	0	6	0	3	0	0	11	0	0	138	0
Lane Group Flow (vph)	127	3135	14	67	2317	0	0	63	0	120	63	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	13.4	82.9	82.9	5.9	75.4			14.7		14.7	14.7	
Effective Green, g (s)	13.4	82.9	82.9	5.9	75.4			14.7		14.7	14.7	
Actuated g/C Ratio	0.11	0.69	0.69	0.05	0.63			0.12		0.12	0.12	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	198	3513	1094	87	3181			97		163	200	
v/s Ratio Prot	0.07	c0.62		0.04	c0.46						0.04	
v/s Ratio Perm			0.01					0.08		c0.09		
v/c Ratio	0.64	0.89	0.01	0.77	0.73			0.65		0.74	0.32	
Uniform Delay, d1	51.0	15.0	5.8	56.4	15.3			50.2		50.8	48.1	
Progression Factor	0.71	0.27	0.20	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	2.3	1.3	0.0	33.4	1.5			29.5		15.8	0.9	
Delay (s)	38.4	5.3	1.2	89.8	16.8			79.7		66.6	49.0	
Level of Service	D	A	A	F	B			E		E	D	
Approach Delay (s)		6.6			18.8			79.7			55.6	
Approach LOS		A			B			E			E	

Intersection Summary			
HCM Average Control Delay	14.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	95.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	27	1537	239	1076	72	253	315	27	298	18
v/c Ratio	0.11	0.90	0.74	0.47	0.51	0.60	0.64	0.15	0.70	0.05
Control Delay	14.0	27.5	28.5	7.9	38.4	31.3	17.7	24.3	35.4	10.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.0	27.5	28.5	7.9	38.4	31.3	17.7	24.3	35.4	10.2
Queue Length 50th (ft)	7	325	48	111	29	104	55	10	126	0
Queue Length 95th (ft)	24	#559	#168	192	70	173	133	30	204	15
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	241	1709	351	2353	197	596	624	247	596	518
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.90	0.68	0.46	0.37	0.42	0.50	0.11	0.50	0.03

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	26	1355	105	227	993	29	68	240	299	26	283	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3501		1770	3524		1770	1863	1583	1770	1863	1583
Flt Permitted	0.27	1.00		0.10	1.00		0.33	1.00	1.00	0.41	1.00	1.00
Satd. Flow (perm)	495	3501		195	3524		614	1863	1583	772	1863	1583
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)	27	1426	111	239	1045	31	72	253	315	27	298	18
RTOR Reduction (vph)	0	7	0	0	2	0	0	0	134	0	0	14
Lane Group Flow (vph)	27	1530	0	239	1074	0	72	253	181	27	298	4
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	35.2	35.2		46.9	46.9		16.5	16.5	16.5	16.5	16.5	16.5
Effective Green, g (s)	35.2	35.2		46.9	46.9		16.5	16.5	16.5	16.5	16.5	16.5
Actuated g/C Ratio	0.49	0.49		0.65	0.65		0.23	0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	241	1702		316	2283		140	425	361	176	425	361
v/s Ratio Prot		c0.44		c0.09	0.30			0.14			c0.16	
v/s Ratio Perm	0.05			0.40			0.12		0.11	0.03		0.00
v/c Ratio	0.11	0.90		0.76	0.47		0.51	0.60	0.50	0.15	0.70	0.01
Uniform Delay, d1	10.1	17.0		16.1	6.5		24.4	25.0	24.4	22.4	25.7	21.6
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	0.2	6.8		9.9	0.2		3.2	2.2	1.1	0.4	5.2	0.0
Delay (s)	10.3	23.7		26.0	6.6		27.6	27.2	25.5	22.8	30.9	21.6
Level of Service	B	C		C	A		C	C	C	C	C	C
Approach Delay (s)		23.5			10.1			26.4			29.7	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM Average Control Delay	20.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	72.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	NBT	SBT
Lane Group Flow (vph)	322	1812	1111
v/c Ratio	0.57	0.69	0.42
Control Delay	21.4	4.1	4.1
Queue Delay	0.0	0.4	0.2
Total Delay	21.4	4.5	4.3
Queue Length 50th (ft)	42	58	0
Queue Length 95th (ft)	74	70	215
Internal Link Dist (ft)	342	302	370
Turn Bay Length (ft)	170		
Base Capacity (vph)	842	2638	2638
Starvation Cap Reductn	0	308	617
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.38	0.78	0.55

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	178	128	0	1721	1055	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	
Lane Util. Factor	0.97			0.95	0.95	
Frt	0.94			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	3291			3539	3539	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	3291			3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	187	135	0	1812	1111	0
RTOR Reduction (vph)	101	0	0	0	0	0
Lane Group Flow (vph)	221	0	0	1812	1111	0
Turn Type						
Protected Phases	4			2	6	
Permitted Phases						
Actuated Green, G (s)	9.8			52.2	52.2	
Effective Green, g (s)	9.8			52.2	52.2	
Actuated g/C Ratio	0.14			0.75	0.75	
Clearance Time (s)	4.0			4.0	4.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	461			2639	2639	
v/s Ratio Prot	c0.07			c0.51	0.31	
v/s Ratio Perm						
v/c Ratio	0.48			0.69	0.42	
Uniform Delay, d1	27.8			4.6	3.3	
Progression Factor	1.00			0.57	0.98	
Incremental Delay, d2	0.8			1.0	0.5	
Delay (s)	28.5			3.7	3.7	
Level of Service	C			A	A	
Approach Delay (s)	28.5			3.7	3.7	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	6.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Queues
29: College Park Dr & SR-22 Ramps

11/21/2012

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	58	107	1660	78	176
v/c Ratio	0.40	0.47	1.27	0.45	0.11
Control Delay	55.2	16.0	146.3	46.0	2.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	55.2	16.0	146.3	46.0	2.7
Queue Length 50th (ft)	40	0	~1489	53	6
Queue Length 95th (ft)	80	52	#1758	m#104	65
Internal Link Dist (ft)	864		215		720
Turn Bay Length (ft)					
Base Capacity (vph)	257	322	1310	175	1575
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.23	0.33	1.27	0.45	0.11

Intersection Summary

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

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

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	55	102	1421	156	74	167
Ideal Flow (vphpl)	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		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1838		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	1838		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	58	107	1496	164	78	176
RTOR Reduction (vph)	0	98	3	0	0	0
Lane Group Flow (vph)	58	9	1657	0	78	176
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	9.0	9.0	78.1		10.9	93.0
Effective Green, g (s)	9.0	9.0	78.1		10.9	93.0
Actuated g/C Ratio	0.08	0.08	0.71		0.10	0.85
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	145	130	1305		175	1575
v/s Ratio Prot	c0.03		c0.90		c0.04	0.09
v/s Ratio Perm		0.01				
v/c Ratio	0.40	0.07	1.27		0.45	0.11
Uniform Delay, d1	47.9	46.6	16.0		46.7	1.5
Progression Factor	1.00	1.00	1.00		0.77	1.56
Incremental Delay, d2	1.8	0.2	127.4		1.7	0.1
Delay (s)	49.7	46.8	143.3		37.8	2.4
Level of Service	D	D	F		D	A
Approach Delay (s)	47.9		143.3			13.3
Approach LOS	D		F			B

Intersection Summary			
HCM Average Control Delay	119.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	156	156	827	39	234
v/c Ratio	0.50	0.38	0.37	0.26	0.18
Control Delay	27.3	7.0	7.3	24.3	1.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	27.3	7.0	7.3	24.3	1.8
Queue Length 50th (ft)	52	0	47	15	8
Queue Length 95th (ft)	93	38	142	29	21
Internal Link Dist (ft)	864		215		720
Turn Bay Length (ft)					
Base Capacity (vph)	502	560	2213	148	1287
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.31	0.28	0.37	0.26	0.18

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	148	148	723	63	37	222
Ideal Flow (vphpl)	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	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	3497		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	3497		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	156	156	761	66	39	234
RTOR Reduction (vph)	0	129	8	0	0	0
Lane Group Flow (vph)	156	27	819	0	39	234
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	10.5	10.5	35.5		2.0	41.5
Effective Green, g (s)	10.5	10.5	35.5		2.0	41.5
Actuated g/C Ratio	0.18	0.18	0.59		0.03	0.69
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	310	277	2069		59	1289
v/s Ratio Prot	c0.09		c0.23		c0.02	0.13
v/s Ratio Perm		0.02				
v/c Ratio	0.50	0.10	0.40		0.66	0.18
Uniform Delay, d1	22.4	20.8	6.5		28.7	3.3
Progression Factor	1.00	1.00	1.00		0.76	0.39
Incremental Delay, d2	1.3	0.2	0.6		24.3	0.3
Delay (s)	23.7	20.9	7.1		46.1	1.6
Level of Service	C	C	A		D	A
Approach Delay (s)	22.3		7.1			7.9
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	43.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Queues
29: College Park Dr & SR-22 Ramps

12/5/2012

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	58	107	1660	78	176
v/c Ratio	0.49	0.52	0.65	0.60	0.11
Control Delay	43.1	17.0	7.0	50.7	1.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	43.1	17.0	7.0	50.7	1.4
Queue Length 50th (ft)	21	0	156	28	8
Queue Length 95th (ft)	#63	#46	223	#88	16
Internal Link Dist (ft)	864		215		720
Turn Bay Length (ft)					
Base Capacity (vph)	118	205	2568	129	1565
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.49	0.52	0.65	0.60	0.11

Intersection Summary

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	55	102	1421	156	74	167
Ideal Flow (vphpl)	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	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	3487		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	3487		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	58	107	1496	164	78	176
RTOR Reduction (vph)	0	101	13	0	0	0
Lane Group Flow (vph)	58	6	1647	0	78	176
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	3.2	3.2	41.6		3.2	48.8
Effective Green, g (s)	3.2	3.2	41.6		3.2	48.8
Actuated g/C Ratio	0.05	0.05	0.69		0.05	0.81
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	94	84	2418		94	1515
v/s Ratio Prot	c0.03		c0.47		c0.04	0.09
v/s Ratio Perm		0.00				
v/c Ratio	0.62	0.07	0.68		0.83	0.12
Uniform Delay, d1	27.8	27.0	5.3		28.1	1.2
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	11.5	0.3	1.6		42.7	0.2
Delay (s)	39.3	27.3	6.9		70.8	1.3
Level of Service	D	C	A		E	A
Approach Delay (s)	31.5		6.9			22.7
Approach LOS	C		A			C

Intersection Summary			
HCM Average Control Delay	10.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	60.0	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			

Queues
30: 7th St & PCH

3/26/2013

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2385	1529	536	116	1106	501	674
v/c Ratio	0.98	0.90	0.50	0.53	0.93	0.93	0.49
Control Delay	47.9	17.6	7.4	43.6	34.5	78.2	41.6
Queue Delay	0.3	2.5	1.3	0.0	0.0	1.5	0.0
Total Delay	48.1	20.1	8.7	43.6	34.5	79.7	41.6
Queue Length 50th (ft)	705	150	80	101	299	217	176
Queue Length 95th (ft)	#841	m221	m134	170	#419	#320	217
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2426	1701	1078	219	1188	541	1365
Starvation Cap Reductn	0	91	326	0	0	0	0
Spillback Cap Reductn	4	0	0	0	0	8	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	0.95	0.71	0.53	0.93	0.94	0.49

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2115	151	0	1453	509	110	1005	46	476	639	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5034			3539	1583	1770	5052		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5034			3539	1583	1770	5052		3433	5084	
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)	0	2226	159	0	1529	536	116	1058	48	501	673	1
RTOR Reduction (vph)	0	6	0	0	0	1	0	3	0	0	0	0
Lane Group Flow (vph)	0	2379	0	0	1529	535	116	1103	0	501	674	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		62.5			62.5	83.0	16.1	30.5		20.5	34.9	
Effective Green, g (s)		62.5			62.5	83.0	16.1	30.5		20.5	34.9	
Actuated g/C Ratio		0.48			0.48	0.64	0.12	0.23		0.16	0.27	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2420			1701	1078	219	1185		541	1365	
v/s Ratio Prot		c0.47			0.43	0.08	0.07	c0.22		c0.15	0.13	
v/s Ratio Perm						0.26						
v/c Ratio		0.98			0.90	0.50	0.53	0.93		0.93	0.49	
Uniform Delay, d1		33.2			30.9	12.4	53.4	48.7		54.0	40.1	
Progression Factor		1.00			0.41	0.65	0.66	0.43		1.00	1.00	
Incremental Delay, d2		14.4			3.5	0.2	7.6	12.5		21.9	1.3	
Delay (s)		47.6			16.3	8.2	43.1	33.6		75.9	41.4	
Level of Service		D			B	A	D	C		E	D	
Approach Delay (s)		47.6			14.2			34.5			56.1	
Approach LOS		D			B			C			E	

Intersection Summary			
HCM Average Control Delay	36.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	92.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	464	2276	33	2082	718	134	199	406	361
v/c Ratio	0.91	0.75	0.49	0.92	0.90	0.43	0.79	0.42	0.56
Control Delay	77.2	8.1	59.1	19.9	74.8	35.9	81.6	40.4	11.7
Queue Delay	0.0	1.1	0.0	1.1	0.0	0.0	0.0	0.0	0.0
Total Delay	77.2	9.2	59.1	20.9	74.8	35.9	81.6	40.4	11.7
Queue Length 50th (ft)	204	232	28	462	224	52	86	148	41
Queue Length 95th (ft)	m209	m246	m37	189	#293	121	#147	198	137
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		
Base Capacity (vph)	515	3019	67	2261	802	310	251	966	648
Starvation Cap Reductn	0	467	0	57	0	0	0	0	0
Spillback Cap Reductn	0	0	0	38	0	0	0	0	2
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.90	0.89	0.49	0.94	0.90	0.43	0.79	0.42	0.56

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	441	2147	15	31	1648	330	0	682	127	189	386	343
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	0.97	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.97			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5080		1770	4958			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5080		1770	4958			5085	1583	3433	3539	1583
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)	464	2260	16	33	1735	347	0	718	134	199	406	361
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	61	0	0	216
Lane Group Flow (vph)	464	2276	0	33	2059	0	0	718	73	199	406	145
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	19.3	75.1		2.9	58.7			20.5	20.5	9.5	35.5	35.5
Effective Green, g (s)	19.3	75.1		2.9	58.7			20.5	20.5	9.5	35.5	35.5
Actuated g/C Ratio	0.15	0.58		0.02	0.45			0.16	0.16	0.07	0.27	0.27
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	510	2935		39	2239			802	250	251	966	432
v/s Ratio Prot	c0.14	0.45		0.02	c0.42			c0.14		c0.06	0.11	
v/s Ratio Perm									0.05			0.09
v/c Ratio	0.91	0.78		0.85	0.92			0.90	0.29	0.79	0.42	0.34
Uniform Delay, d1	54.5	21.0		63.3	33.4			53.7	48.4	59.3	38.8	37.8
Progression Factor	1.28	0.37		0.68	0.42			1.15	1.34	1.00	1.00	1.00
Incremental Delay, d2	7.1	0.6		65.1	5.4			13.1	2.6	22.2	1.3	2.1
Delay (s)	76.8	8.4		108.2	19.5			74.9	67.2	81.5	40.1	39.9
Level of Service	E	A		F	B			E	E	F	D	D
Approach Delay (s)		20.0			20.9			73.7			48.6	
Approach LOS		B			C			E			D	

Intersection Summary			
HCM Average Control Delay	31.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	88.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	49	723	44	1122	422	73	429	144	304	13
v/c Ratio	0.25	0.36	0.18	0.57	0.49	0.20	0.58	0.43	0.30	0.04
Control Delay	8.6	5.1	27.3	33.2	5.2	43.9	48.3	73.4	67.8	46.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.6	5.1	27.3	33.2	5.2	43.9	48.3	73.4	67.8	46.2
Queue Length 50th (ft)	7	37	23	276	7	51	167	148	104	4
Queue Length 95th (ft)	m12	m43	49	325	79	96	223	m231	m141	m22
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	194	1992	239	1967	862	374	743	334	1029	357
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.36	0.18	0.57	0.49	0.20	0.58	0.43	0.30	0.04

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	47	671	16	42	1066	401	69	353	54	274	152	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	1770	5067		1770	5085	1583	1770	3469		1522	4695	1583
Flt Permitted	0.19	1.00		0.27	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	345	5067		500	5085	1583	1770	3469		1522	4695	1583
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)	49	706	17	44	1122	422	73	372	57	288	160	13
RTOR Reduction (vph)	0	2	0	0	0	253	0	9	0	0	0	10
Lane Group Flow (vph)	49	721	0	44	1122	169	73	420	0	144	304	3
Turn Type	pm+pt			pm+pt		Perm	Split			Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	51.8	50.3		49.5	49.5	49.5	27.5	27.5		28.5	28.5	28.5
Effective Green, g (s)	51.8	50.3		49.5	49.5	49.5	27.5	27.5		28.5	28.5	28.5
Actuated g/C Ratio	0.40	0.39		0.38	0.38	0.38	0.21	0.21		0.22	0.22	0.22
Clearance Time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	181	1961		222	1936	603	374	734		334	1029	347
v/s Ratio Prot	0.01	c0.14		0.00	c0.22		0.04	c0.12		c0.09	0.06	
v/s Ratio Perm	0.10			0.07		0.11						0.00
v/c Ratio	0.27	0.37		0.20	0.58	0.28	0.20	0.57		0.43	0.30	0.01
Uniform Delay, d1	34.4	28.5		26.2	32.0	27.9	42.1	46.0		43.8	42.4	39.7
Progression Factor	0.20	0.17		1.00	1.00	1.00	1.00	1.00		1.57	1.58	2.56
Incremental Delay, d2	0.7	0.4		0.4	1.3	1.2	1.2	3.2		3.7	0.7	0.0
Delay (s)	7.6	5.2		26.6	33.3	29.1	43.3	49.2		72.2	67.5	101.8
Level of Service	A	A		C	C	C	D	D		E	E	F
Approach Delay (s)		5.3			32.0			48.3			69.9	
Approach LOS		A			C			D			E	

Intersection Summary			
HCM Average Control Delay	33.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	60.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	98	2439	35	123	2413	88	85	158	29	31	33
v/c Ratio	0.81	0.74	0.03	0.86	0.73	0.86	0.79	0.58	0.28	0.30	0.26
Control Delay	84.1	3.8	0.2	78.8	0.9	118.1	104.6	17.4	64.6	64.9	23.0
Queue Delay	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	84.1	3.8	0.2	78.8	0.9	118.1	104.6	17.4	64.6	64.9	23.0
Queue Length 50th (ft)	0	71	1	111	9	75	72	0	25	27	0
Queue Length 95th (ft)	m#126	104	m0	m125	12	#177	#167	69	58	61	34
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270			275		100		350			
Base Capacity (vph)	121	3301	1036	143	3295	102	107	273	310	319	319
Starvation Cap Reductn	0	73	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.81	0.76	0.03	0.86	0.73	0.86	0.79	0.58	0.09	0.10	0.10

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	93	2317	33	117	1916	376	84	81	150	42	15	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	1.00	0.85	1.00	0.98		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	0.98	1.00
Satd. Flow (prot)	1770	5085	1583	1770	4960		1770	1863	1583	1681	1728	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	0.98	1.00
Satd. Flow (perm)	1770	5085	1583	1770	4960		1770	1863	1583	1681	1728	1583
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	2439	35	123	2017	396	88	85	158	44	16	33
RTOR Reduction (vph)	0	0	9	0	16	0	0	0	145	0	0	31
Lane Group Flow (vph)	98	2439	26	123	2397	0	88	85	13	29	31	2
Turn Type	Prot		Perm	Prot			Split		Over	Split		Perm
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases			4									6
Actuated Green, G (s)	8.9	83.3	83.3	10.5	84.9		7.5	7.5	10.5	6.7	6.7	6.7
Effective Green, g (s)	8.9	83.3	83.3	10.5	84.9		7.5	7.5	10.5	6.7	6.7	6.7
Actuated g/C Ratio	0.07	0.64	0.64	0.08	0.65		0.06	0.06	0.08	0.05	0.05	0.05
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	121	3258	1014	143	3239		102	107	128	87	89	82
v/s Ratio Prot	0.06	0.48		c0.07	c0.48		c0.05	0.05	0.01	0.02	c0.02	
v/s Ratio Perm			0.02									0.00
v/c Ratio	0.81	0.75	0.03	0.86	0.74		0.86	0.79	0.10	0.33	0.35	0.02
Uniform Delay, d1	59.7	16.1	8.5	59.0	15.1		60.7	60.5	55.4	59.5	59.5	58.5
Progression Factor	0.88	0.17	0.03	0.90	0.02		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	22.3	1.1	0.0	20.3	0.7		48.3	32.1	0.3	2.3	2.4	0.1
Delay (s)	75.2	3.8	0.3	73.7	1.0		109.0	92.6	55.7	61.8	61.9	58.6
Level of Service	E	A	A	E	A		F	F	E	E	E	E
Approach Delay (s)		6.5			4.5			79.4			60.7	
Approach LOS		A			A			E			E	

Intersection Summary			
HCM Average Control Delay	10.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	101	2437	2564	552	143
v/c Ratio	0.50	0.75	0.90	0.55	0.26
Control Delay	28.2	21.2	15.6	5.1	30.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	28.2	21.2	15.6	5.1	30.8
Queue Length 50th (ft)	53	387	358	75	32
Queue Length 95th (ft)	m75	408	m313	m69	66
Internal Link Dist (ft)		1015	1000		632
Turn Bay Length (ft)	400			150	150
Base Capacity (vph)	385	3247	2863	1005	553
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.26	0.75	0.90	0.55	0.26

Intersection Summary

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	96	2315	2436	524	81	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.91	0.91	1.00	0.97	
Frt	1.00	1.00	1.00	0.85	0.94	
Flt Protected	0.95	1.00	1.00	1.00	0.97	
Satd. Flow (prot)	1770	5085	5085	1583	3296	
Flt Permitted	0.95	1.00	1.00	1.00	0.97	
Satd. Flow (perm)	1770	5085	5085	1583	3296	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	101	2437	2564	552	85	58
RTOR Reduction (vph)	0	0	0	114	49	0
Lane Group Flow (vph)	101	2437	2564	438	94	0
Turn Type	Prot			Perm		
Protected Phases	7 9	4	8		6	
Permitted Phases				8		
Actuated Green, G (s)	14.9	83.0	73.2	73.2	19.9	
Effective Green, g (s)	14.9	83.0	73.2	73.2	19.9	
Actuated g/C Ratio	0.11	0.64	0.56	0.56	0.15	
Clearance Time (s)		5.5	5.5	5.5	5.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	203	3247	2863	891	505	
v/s Ratio Prot	c0.06	c0.48	c0.50		c0.03	
v/s Ratio Perm				0.28		
v/c Ratio	0.50	0.75	0.90	0.49	0.19	
Uniform Delay, d1	54.0	16.3	25.0	17.2	48.0	
Progression Factor	0.68	1.21	0.59	0.56	1.00	
Incremental Delay, d2	1.3	1.1	0.5	0.2	0.8	
Delay (s)	37.9	20.9	15.3	9.8	48.8	
Level of Service	D	C	B	A	D	
Approach Delay (s)		21.6	14.3		48.8	
Approach LOS		C	B		D	

Intersection Summary			
HCM Average Control Delay	18.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	70.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	139	2314	63	43	3468	167	46	109
v/c Ratio	0.92	0.65	0.06	0.41	1.05	1.02	0.27	0.36
Control Delay	84.6	1.2	0.1	70.0	54.7	131.3	55.1	17.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	84.6	1.2	0.1	70.0	54.7	131.3	55.1	17.1
Queue Length 50th (ft)	115	21	0	35	~1167	~149	35	12
Queue Length 95th (ft)	m#192	25	m0	76	#1239	#298	76	67
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150		150	300				
Base Capacity (vph)	151	3538	1115	120	3297	163	173	299
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.92	0.65	0.06	0.36	1.05	1.02	0.27	0.36

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	132	2198	60	41	3099	196	113	35	10	44	15	88
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.99		1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5040			1783		1770	1624	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.65		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5040			1197		1287	1624	
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)	139	2314	63	43	3262	206	119	37	11	46	16	93
RTOR Reduction (vph)	0	0	14	0	5	0	0	2	0	0	80	0
Lane Group Flow (vph)	139	2314	49	43	3463	0	0	165	0	46	29	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	12.2	89.3	89.3	6.7	83.8			17.5		17.5	17.5	
Effective Green, g (s)	12.2	89.3	89.3	6.7	83.8			17.5		17.5	17.5	
Actuated g/C Ratio	0.09	0.69	0.69	0.05	0.64			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	166	3493	1087	91	3249			161		173	219	
v/s Ratio Prot	c0.08	0.46		0.02	c0.69						0.02	
v/s Ratio Perm			0.03					c0.14		0.04		
v/c Ratio	0.84	0.66	0.05	0.47	1.07			1.03		0.27	0.13	
Uniform Delay, d1	57.9	11.7	6.6	59.9	23.1			56.2		50.5	49.5	
Progression Factor	0.68	0.05	0.00	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	20.9	0.7	0.1	3.8	36.8			78.1		0.8	0.3	
Delay (s)	60.4	1.2	0.1	63.8	59.9			134.3		51.3	49.8	
Level of Service	E	A	A	E	E			F		D	D	
Approach Delay (s)		4.5			60.0			134.3			50.3	
Approach LOS		A			E			F			D	

Intersection Summary			
HCM Average Control Delay	39.7	HCM Level of Service	D
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	100.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
30: 7th St & PCH

3/26/2013

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2081	1565	520	185	1021	633	1030
v/c Ratio	0.90	0.97	0.47	0.77	0.92	0.94	0.73
Control Delay	38.9	33.0	3.7	50.9	39.3	74.4	45.9
Queue Delay	5.6	1.4	0.7	0.0	0.9	0.0	0.0
Total Delay	44.5	34.4	4.4	50.9	40.2	74.4	45.9
Queue Length 50th (ft)	579	277	47	153	311	273	288
Queue Length 95th (ft)	653	#812	m78	#268	#393	#387	341
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2307	1620	1103	241	1111	673	1420
Starvation Cap Reductn	0	18	280	0	0	0	0
Spillback Cap Reductn	192	0	0	0	17	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	0.98	0.63	0.77	0.93	0.94	0.73

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1825	152	0	1487	494	176	924	46	601	978	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5027			3539	1583	1770	5049		3433	5085	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5027			3539	1583	1770	5049		3433	5085	
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)	0	1921	160	0	1565	520	185	973	48	633	1029	1
RTOR Reduction (vph)	0	8	0	0	0	1	0	4	0	0	0	0
Lane Group Flow (vph)	0	2073	0	0	1565	519	185	1017	0	633	1030	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		59.5			59.5	85.0	17.7	28.5		25.5	36.3	
Effective Green, g (s)		59.5			59.5	85.0	17.7	28.5		25.5	36.3	
Actuated g/C Ratio		0.46			0.46	0.65	0.14	0.22		0.20	0.28	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2301			1620	1102	241	1107		673	1420	
v/s Ratio Prot		0.41			c0.44	0.09	0.10	c0.20		c0.18	0.20	
v/s Ratio Perm						0.24						
v/c Ratio		0.90			0.97	0.47	0.77	0.92		0.94	0.73	
Uniform Delay, d1		32.5			34.3	11.3	54.2	49.6		51.5	42.3	
Progression Factor		1.00			0.63	0.32	0.57	0.53		1.00	1.00	
Incremental Delay, d2		5.3			10.0	0.2	18.7	12.3		21.3	3.3	
Delay (s)		37.9			31.6	3.7	49.6	38.6		72.8	45.6	
Level of Service		D			C	A	D	D		E	D	
Approach Delay (s)		37.9			24.7			40.3			56.0	
Approach LOS		D			C			D			E	

Intersection Summary			
HCM Average Control Delay	38.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	90.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	388	2186	44	1725	617	106	345	744	531
v/c Ratio	0.82	0.84	0.51	0.84	0.80	0.33	0.75	0.64	0.73
Control Delay	81.1	19.2	54.7	16.1	66.8	18.3	65.0	40.2	21.3
Queue Delay	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	1.7
Total Delay	81.1	24.7	54.7	16.2	66.8	18.3	65.0	40.2	23.1
Queue Length 50th (ft)	167	225	35	72	188	8	146	280	163
Queue Length 95th (ft)	m185	m385	m65	263	237	53	200	348	307
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		
Base Capacity (vph)	494	2605	89	2052	771	320	462	1162	732
Starvation Cap Reductn	0	372	0	7	0	0	0	0	0
Spillback Cap Reductn	0	130	0	1	0	2	0	0	85
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.98	0.49	0.84	0.80	0.33	0.75	0.64	0.82

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	369	2047	29	42	1492	146	0	586	101	328	707	504
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	0.97	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5074		1770	5017			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5074		1770	5017			5085	1583	3433	3539	1583
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)	388	2155	31	44	1571	154	0	617	106	345	744	531
RTOR Reduction (vph)	0	1	0	0	9	0	0	0	81	0	0	212
Lane Group Flow (vph)	388	2185	0	44	1716	0	0	617	25	345	744	319
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	17.9	65.6		5.2	52.9			19.7	19.7	17.5	42.7	42.7
Effective Green, g (s)	17.9	65.6		5.2	52.9			19.7	19.7	17.5	42.7	42.7
Actuated g/C Ratio	0.14	0.50		0.04	0.41			0.15	0.15	0.13	0.33	0.33
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	473	2560		71	2042			771	240	462	1162	520
v/s Ratio Prot	0.11	c0.43		0.02	c0.34			c0.12		c0.10	0.21	
v/s Ratio Perm									0.02			0.20
v/c Ratio	0.82	0.85		0.62	0.84			0.80	0.11	0.75	0.64	0.61
Uniform Delay, d1	54.5	28.0		61.4	34.7			53.3	47.6	54.1	37.1	36.7
Progression Factor	1.37	0.63		0.62	0.35			1.10	1.32	1.00	1.00	1.00
Incremental Delay, d2	4.6	1.6		12.9	3.7			7.7	0.8	10.5	2.7	5.3
Delay (s)	79.5	19.4		50.8	16.1			66.5	63.6	64.6	39.8	42.0
Level of Service	E	B		D	B			E	E	E	D	D
Approach Delay (s)		28.4			16.9			66.1			45.8	
Approach LOS		C			B			E			D	

Intersection Summary			
HCM Average Control Delay	33.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	82.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	186	823	81	1085	362	45	230	157	491	43
v/c Ratio	0.60	0.35	0.24	0.51	0.42	0.21	0.55	0.49	0.49	0.12
Control Delay	42.6	2.6	16.2	29.7	4.5	54.7	58.6	56.3	53.0	35.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.6	2.6	16.2	29.7	4.5	54.7	58.6	56.3	53.0	35.8
Queue Length 50th (ft)	82	24	31	245	4	35	96	162	169	27
Queue Length 95th (ft)	m129	m26	56	307	67	74	140	m246	m212	m49
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	394	2337	334	2113	865	211	421	322	1008	356
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.35	0.24	0.51	0.42	0.21	0.55	0.49	0.49	0.12

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	177	689	93	77	1031	344	43	207	11	237	379	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	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	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (prot)	1770	4994		1770	5085	1583	1770	3512		1522	4761	1583
Flt Permitted	0.16	1.00		0.32	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (perm)	306	4994		591	5085	1583	1770	3512		1522	4761	1583
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)	186	725	98	81	1085	362	45	218	12	249	399	43
RTOR Reduction (vph)	0	13	0	0	0	207	0	3	0	0	0	21
Lane Group Flow (vph)	186	810	0	81	1085	155	45	227	0	157	491	22
Turn Type	pm+pt			pm+pt		Perm	Split			Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	70.5	60.5		60.0	54.0	54.0	15.5	15.5		27.5	27.5	27.5
Effective Green, g (s)	70.5	60.5		60.0	54.0	54.0	15.5	15.5		27.5	27.5	27.5
Actuated g/C Ratio	0.54	0.47		0.46	0.42	0.42	0.12	0.12		0.21	0.21	0.21
Clearance Time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	307	2324		327	2112	658	211	419		322	1007	335
v/s Ratio Prot	c0.06	0.16		0.01	0.21		0.03	c0.06		c0.10	0.10	
v/s Ratio Perm	c0.27			0.10		0.10						0.01
v/c Ratio	0.61	0.35		0.25	0.51	0.24	0.21	0.54		0.49	0.49	0.06
Uniform Delay, d1	17.8	22.2		19.8	28.2	24.6	51.7	53.9		45.1	45.1	41.0
Progression Factor	2.53	0.11		1.00	1.00	1.00	1.00	1.00		1.14	1.14	1.66
Incremental Delay, d2	2.2	0.3		0.4	0.9	0.8	2.3	5.0		4.0	1.3	0.3
Delay (s)	47.2	2.7		20.2	29.1	25.5	54.0	58.9		55.4	52.8	68.4
Level of Service	D	A		C	C	C	D	E		E	D	E
Approach Delay (s)		10.9			27.8			58.1			54.3	
Approach LOS		B			C			E			D	

Intersection Summary			
HCM Average Control Delay	30.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	26	2456	108	286	1762	55	13	132	170	175	64
v/c Ratio	0.29	0.96	0.13	1.06	0.54	0.87	0.20	0.39	0.71	0.72	0.23
Control Delay	79.7	31.2	8.4	86.8	1.6	143.1	67.9	16.0	69.4	69.2	12.6
Queue Delay	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.7	32.7	8.4	86.8	1.6	143.1	67.9	16.0	69.4	69.2	12.6
Queue Length 50th (ft)	23	367	15	~264	9	47	11	15	146	150	0
Queue Length 95th (ft)	m29	#904	m25	m#381	10	#133	34	75	220	224	40
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270			275		100		350			
Base Capacity (vph)	92	2547	826	271	3235	63	66	337	310	318	344
Starvation Cap Reductn	0	36	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	2	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.98	0.13	1.06	0.55	0.87	0.20	0.39	0.55	0.55	0.19

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	2333	103	272	1636	38	52	12	125	245	83	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00		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	0.98	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5068		1770	1863	1583	1681	1726	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	0.98	1.00
Satd. Flow (perm)	1770	5085	1583	1770	5068		1770	1863	1583	1681	1726	1583
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)	26	2456	108	286	1722	40	55	13	132	258	87	64
RTOR Reduction (vph)	0	0	35	0	2	0	0	0	93	0	0	55
Lane Group Flow (vph)	26	2456	73	286	1760	0	55	13	39	170	175	9
Turn Type	Prot		Perm	Prot			Split		Over	Split		Perm
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases			4									6
Actuated Green, G (s)	4.3	62.9	62.9	22.1	80.7		4.6	4.6	22.1	18.4	18.4	18.4
Effective Green, g (s)	4.3	62.9	62.9	22.1	80.7		4.6	4.6	22.1	18.4	18.4	18.4
Actuated g/C Ratio	0.03	0.48	0.48	0.17	0.62		0.04	0.04	0.17	0.14	0.14	0.14
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	59	2460	766	301	3146		63	66	269	238	244	224
v/s Ratio Prot	0.01	c0.48		c0.16	0.35		c0.03	0.01	0.02	0.10	c0.10	
v/s Ratio Perm			0.05									0.01
v/c Ratio	0.44	1.00	0.10	0.95	0.56		0.87	0.20	0.15	0.71	0.72	0.04
Uniform Delay, d1	61.7	33.5	18.2	53.4	14.3		62.4	60.9	45.9	53.3	53.3	48.2
Progression Factor	1.26	0.72	0.99	0.50	0.09		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.9	13.3	0.1	27.2	0.4		69.9	1.5	0.2	9.7	9.6	0.1
Delay (s)	80.7	37.3	18.1	53.7	1.7		132.4	62.4	46.2	63.0	62.9	48.3
Level of Service	F	D	B	D	A		F	E	D	E	E	D
Approach Delay (s)		37.0			8.9			70.9			60.7	
Approach LOS		D			A			E			E	

Intersection Summary			
HCM Average Control Delay	29.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	33	2840	2083	186	470
v/c Ratio	0.16	1.01	0.80	0.22	0.44
Control Delay	33.7	21.3	13.2	3.0	38.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	33.7	21.3	13.2	3.0	38.3
Queue Length 50th (ft)	26	~135	153	11	170
Queue Length 95th (ft)	m30	m#963	217	m20	226
Internal Link Dist (ft)		1015	1000		632
Turn Bay Length (ft)	400			150	150
Base Capacity (vph)	457	2816	2591	851	1059
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.07	1.01	0.80	0.22	0.44

Intersection Summary

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

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

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	31	2698	1979	177	420	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.91	0.91	1.00	0.97	
Frt	1.00	1.00	1.00	0.85	0.99	
Flt Protected	0.95	1.00	1.00	1.00	0.96	
Satd. Flow (prot)	1770	5085	5085	1583	3421	
Flt Permitted	0.95	1.00	1.00	1.00	0.96	
Satd. Flow (perm)	1770	5085	5085	1583	3421	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	33	2840	2083	186	442	28
RTOR Reduction (vph)	0	0	0	48	3	0
Lane Group Flow (vph)	33	2840	2083	138	467	0
Turn Type	Prot			Perm		
Protected Phases	7 9	4	8		6	
Permitted Phases				8		
Actuated Green, G (s)	11.5	69.8	61.8	61.8	40.2	
Effective Green, g (s)	11.5	69.8	61.8	61.8	40.2	
Actuated g/C Ratio	0.09	0.54	0.48	0.48	0.31	
Clearance Time (s)		5.5	5.5	5.5	5.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	157	2730	2417	753	1058	
v/s Ratio Prot	c0.02	c0.56	0.41		c0.14	
v/s Ratio Perm				0.09		
v/c Ratio	0.21	1.04	0.86	0.18	0.44	
Uniform Delay, d1	55.0	30.1	30.3	19.6	35.9	
Progression Factor	0.64	0.21	0.41	0.27	1.00	
Incremental Delay, d2	0.3	23.7	2.9	0.4	1.3	
Delay (s)	35.4	30.1	15.4	5.7	37.3	
Level of Service	D	C	B	A	D	
Approach Delay (s)		30.1	14.6		37.3	
Approach LOS		C	B		D	

Intersection Summary			
HCM Average Control Delay	24.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	74.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	127	3135	20	67	2320	74	120	201
v/c Ratio	0.53	0.87	0.02	0.66	0.75	0.65	0.73	0.60
Control Delay	36.7	5.3	0.9	88.8	20.0	72.2	79.6	24.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.7	5.4	0.9	88.8	20.0	72.2	79.6	24.9
Queue Length 50th (ft)	92	131	1	56	483	51	99	43
Queue Length 95th (ft)	m100	m131	m1	#125	542	#125	#195	126
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150		150	300				
Base Capacity (vph)	238	3596	1123	105	3097	114	165	334
Starvation Cap Reductn	0	7	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.87	0.02	0.64	0.75	0.65	0.73	0.60

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	121	2978	19	64	2136	68	27	26	18	114	34	157
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.97		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5062			1765		1770	1633	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.46		0.70	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5062			823		1302	1633	
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)	127	3135	20	67	2248	72	28	27	19	120	36	165
RTOR Reduction (vph)	0	0	3	0	3	0	0	10	0	0	127	0
Lane Group Flow (vph)	127	3135	17	67	2317	0	0	64	0	120	74	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	18.6	90.8	90.8	6.2	78.4			16.5		16.5	16.5	
Effective Green, g (s)	18.6	90.8	90.8	6.2	78.4			16.5		16.5	16.5	
Actuated g/C Ratio	0.14	0.70	0.70	0.05	0.60			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	253	3552	1106	84	3053			104		165	207	
v/s Ratio Prot	0.07	c0.62		0.04	c0.46						0.05	
v/s Ratio Perm			0.01					0.08		c0.09		
v/c Ratio	0.50	0.88	0.02	0.80	0.76			0.62		0.73	0.36	
Uniform Delay, d1	51.4	15.4	6.0	61.3	18.9			53.8		54.6	51.9	
Progression Factor	0.63	0.26	0.22	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	0.6	1.3	0.0	39.3	1.8			24.6		14.8	1.1	
Delay (s)	33.2	5.3	1.3	100.6	20.7			78.4		69.3	53.0	
Level of Service	C	A	A	F	C			E		E	D	
Approach Delay (s)		6.4			23.0			78.4			59.1	
Approach LOS		A			C			E			E	

Intersection Summary			
HCM Average Control Delay	16.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	95.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Appendix A2

Year 2040 Alternative 1
Intersection Level of Service (LOS) Worksheets

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Queues
1: Carson St & I-605 SB Off Ramps

11/30/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	1426	1556	81	780	438	350
v/c Ratio	0.54	0.74	0.05	0.47	0.30	0.50
Control Delay	22.5	17.6	0.1	19.0	16.6	21.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.5	17.6	0.1	19.0	16.6	21.0
Queue Length 50th (ft)	190	224	0	168	89	159
Queue Length 95th (ft)	212	241	0	231	133	267
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2877	2293	1611	1663	1450	703
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.68	0.05	0.47	0.30	0.50

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1287	67	0	1478	0	0	0	77	741	84	665
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.88	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6360			5085				1611	3433	2984	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6360			5085				1611	3433	2984	1441
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)	0	1355	71	0	1556	0	0	0	81	780	88	700
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	5	5
Lane Group Flow (vph)	0	1418	0	0	1556	0	0	0	81	780	433	345
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		41.2			41.2				100.0	48.5	48.5	48.5
Effective Green, g (s)		41.2			41.2				100.0	48.5	48.5	48.5
Actuated g/C Ratio		0.41			0.41				1.00	0.48	0.48	0.48
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2620			2095				1611	1665	1447	699
v/s Ratio Prot		0.22			c0.31					0.23	0.15	
v/s Ratio Perm									0.05			c0.24
v/c Ratio		0.54			0.74				0.05	0.47	0.30	0.49
Uniform Delay, d1		22.2			24.9				0.0	17.2	15.5	17.4
Progression Factor		1.00			0.63				1.00	1.00	1.00	1.00
Incremental Delay, d2		0.4			1.4				0.1	0.9	0.5	2.5
Delay (s)		22.7			17.2				0.1	18.1	16.0	19.9
Level of Service		C			B				A	B	B	B
Approach Delay (s)		22.7			17.2			0.1			17.9	
Approach LOS		C			B			A			B	

Intersection Summary			
HCM Average Control Delay	18.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	64.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	1912	1307	874	707	581
v/c Ratio	0.52	0.64	0.68	0.62	0.62
Control Delay	10.4	6.9	5.8	31.2	30.7
Queue Delay	0.0	1.3	4.4	0.0	0.0
Total Delay	10.4	8.2	10.2	31.2	30.7
Queue Length 50th (ft)	147	118	131	194	169
Queue Length 95th (ft)	173	153	m172	255	234
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3691	2038	1282	1133	933
Starvation Cap Reductn	0	477	326	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.52	0.84	0.91	0.62	0.62

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1816	0	0	1242	830	672	0	552	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
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)	0	1912	0	0	1307	874	707	0	581	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	371	0	0	13	0	0	0
Lane Group Flow (vph)	0	1912	0	0	1307	503	707	0	568	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		57.6			57.6	57.6	33.0		33.0			
Effective Green, g (s)		57.6			57.6	57.6	33.0		33.0			
Actuated g/C Ratio		0.58			0.58	0.58	0.33		0.33			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3691			2038	912	1133		920			
v/s Ratio Prot		0.30			c0.37							
v/s Ratio Perm						0.32	c0.21		0.20			
v/c Ratio		0.52			0.64	0.55	0.62		0.62			
Uniform Delay, d1		12.8			14.3	13.2	28.3		28.2			
Progression Factor		0.77			0.41	4.27	1.00		1.00			
Incremental Delay, d2		0.2			0.6	0.8	2.6		3.1			
Delay (s)		10.1			6.4	57.1	30.9		31.3			
Level of Service		B			A	E	C		C			
Approach Delay (s)		10.1			26.7			31.1			0.0	
Approach LOS		B			C			C			A	

Intersection Summary			
HCM Average Control Delay	21.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	602	1375	7	1416	202	209	156	288	284
v/c Ratio	0.93	0.50	0.06	0.84	0.87	0.32	0.52	0.76	0.62
Control Delay	52.4	9.4	44.6	37.5	77.4	34.5	50.2	28.6	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.4	9.4	44.6	37.5	77.4	34.5	50.2	28.6	10.9
Queue Length 50th (ft)	205	93	4	305	128	58	50	66	0
Queue Length 95th (ft)	#307	110	18	#420	#256	89	82	161	74
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	645	2747	124	1678	232	783	306	429	504
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.93	0.50	0.06	0.84	0.87	0.27	0.51	0.67	0.56

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	572	1218	88	7	1293	52	192	185	13	148	53	490
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.99		1.00	0.99		1.00	0.99		1.00	0.88	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5034		1770	5056		1770	3504		3433	1556	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5034		1770	5056		1770	3504		3433	1556	1504
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)	602	1282	93	7	1361	55	202	195	14	156	56	516
RTOR Reduction (vph)	0	7	0	0	4	0	0	6	0	0	156	243
Lane Group Flow (vph)	602	1368	0	7	1412	0	202	203	0	156	132	41
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	22.7	50.5		1.4	29.2		13.1	18.8		8.7	14.4	14.4
Effective Green, g (s)	22.7	50.5		1.4	29.2		13.1	18.8		8.7	14.4	14.4
Actuated g/C Ratio	0.23	0.50		0.01	0.29		0.13	0.19		0.09	0.14	0.14
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	779	2542		25	1476		232	659		299	224	217
v/s Ratio Prot	c0.18	0.27		0.00	c0.28		c0.11	c0.06		0.05	c0.08	
v/s Ratio Perm												0.03
v/c Ratio	0.77	0.54		0.28	0.96		0.87	0.31		0.52	0.59	0.19
Uniform Delay, d1	36.2	16.8		48.8	34.8		42.6	35.0		43.7	40.0	37.7
Progression Factor	0.77	0.57		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	4.3	0.7		8.2	15.1		28.6	0.4		2.1	4.8	0.6
Delay (s)	32.4	10.3		57.0	49.9		71.3	35.4		45.8	44.8	38.2
Level of Service	C	B		E	D		E	D		D	D	D
Approach Delay (s)		17.0			49.9			53.0			42.5	
Approach LOS		B			D			D			D	

Intersection Summary			
HCM Average Control Delay	34.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	83.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	1384	1502	818	909
v/c Ratio	0.45	0.71	0.78	0.57
Control Delay	12.3	17.2	36.9	1.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	12.4	17.2	36.9	1.5
Queue Length 50th (ft)	163	323	244	0
Queue Length 95th (ft)	240	493	279	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	3049	2122	1710	1583
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	183	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.48	0.71	0.48	0.57

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1315	1427	0	777	864
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1384	1502	0	818	909
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1384	1502	0	818	909
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		60.0	60.0		30.5	100.0
Effective Green, g (s)		60.0	60.0		30.5	100.0
Actuated g/C Ratio		0.60	0.60		0.30	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		3051	2123		1047	1583
v/s Ratio Prot		0.27	c0.42		c0.24	
v/s Ratio Perm						0.57
v/c Ratio		0.45	0.71		0.78	0.57
Uniform Delay, d1		11.0	13.9		31.7	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.5	1.9		3.7	1.5
Delay (s)		11.5	15.8		35.4	1.5
Level of Service		B	B		D	A
Approach Delay (s)		11.5	15.8		17.6	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	15.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	2016	625	259	1525
v/c Ratio	0.79	0.52	0.78	0.43
Control Delay	14.4	6.6	55.2	0.4
Queue Delay	1.0	0.3	0.0	0.0
Total Delay	15.4	7.0	55.2	0.4
Queue Length 50th (ft)	452	157	157	0
Queue Length 95th (ft)	615	63	239	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2548	1206	389	3539
Starvation Cap Reductn	270	171	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.88	0.60	0.67	0.43

Intersection Summary

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1915	594	246	1449	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2016	625	259	1525	0	0
RTOR Reduction (vph)	0	66	0	0	0	0
Lane Group Flow (vph)	2016	559	259	1525	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	72.0	72.0	18.7	100.0		
Effective Green, g (s)	72.0	72.0	18.7	100.0		
Actuated g/C Ratio	0.72	0.72	0.19	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2548	1140	331	3539		
v/s Ratio Prot	c0.57		c0.15	0.43		
v/s Ratio Perm		0.35				
v/c Ratio	0.79	0.49	0.78	0.43		
Uniform Delay, d1	9.1	6.1	38.7	0.0		
Progression Factor	1.17	1.26	1.00	1.00		
Incremental Delay, d2	2.5	1.4	11.4	0.4		
Delay (s)	13.1	9.0	50.1	0.4		
Level of Service	B	A	D	A		
Approach Delay (s)	12.2			7.6	0.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	10.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	74.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	417	0	0	702	0	668	860	0	804	610
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	439	0	0	739	0	703	905	0	846	642
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.92	0.92		0.92	0.92	0.92				0.92		
vC, conflicting volume	1081	1549	282	985	1549	234	846			703		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	794	1302	282	691	1302	0	846			385		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	39	100	100	26	100			100		
cM capacity (veh/h)	67	147	715	118	147	1001	786			1080		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	439	739	281	281	442	604	339	339	383	428
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	439	739	0	0	302	604	0	0	214	428
cSH	715	1001	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.61	0.74	0.17	0.17	0.26	0.36	0.20	0.20	0.23	0.25
Queue Length 95th (ft)	106	175	0	0	0	0	0	0	0	0
Control Delay (s)	17.7	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	C								
Approach Delay (s)	17.7	18.0	0.0				0.0			
Approach LOS	C	C								

Intersection Summary			
Average Delay	4.9		
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	663	0	1469	861	368
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	698	0	1546	906	387
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.87					
vC, conflicting volume	1293	302	906			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	619	302	906			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	0	100			
cM capacity (veh/h)	368	694	746			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	698	387	387	387	387	363	363	310	258
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	698	0	0	0	0	0	0	129	258
cSH	694	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.01	0.23	0.23	0.23	0.23	0.21	0.21	0.18	0.15
Queue Length 95th (ft)	411	0	0	0	0	0	0	0	0
Control Delay (s)	59.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F								
Approach Delay (s)	59.9	0.0				0.0			
Approach LOS	F								

Intersection Summary			
Average Delay	11.8		
Intersection Capacity Utilization	67.1%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	126	832	142	78	1147	258	266	1274	97	1480
v/c Ratio	0.71	0.55	0.19	0.49	0.89	0.51	0.80	0.57	0.25	0.85
Control Delay	64.7	28.9	13.0	52.9	41.4	12.7	59.0	24.3	38.5	30.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.7	28.9	13.0	52.9	41.4	12.7	59.0	24.3	38.5	30.2
Queue Length 50th (ft)	37	150	37	22	242	37	77	174	25	255
Queue Length 95th (ft)	#80	193	75	45	#328	120	#140	189	52	316
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	177	1509	737	158	1294	504	332	2521	390	1791
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.71	0.55	0.19	0.49	0.89	0.51	0.80	0.51	0.25	0.83

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	120	790	135	74	1062	273	253	1024	186	92	959	447
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4788	1362	3433	6260		3433	4843	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4788	1362	3433	6260		3433	4843	
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)	126	832	142	78	1118	287	266	1078	196	97	1009	471
RTOR Reduction (vph)	0	0	20	0	3	137	0	39	0	0	94	0
Lane Group Flow (vph)	126	832	122	78	1144	121	266	1235	0	97	1386	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	5.7	26.4	35.0	3.2	23.9	23.9	8.6	31.1		8.9	31.4	
Effective Green, g (s)	5.7	26.4	35.0	3.2	23.9	23.9	8.6	31.1		8.9	31.4	
Actuated g/C Ratio	0.06	0.29	0.38	0.04	0.26	0.26	0.09	0.34		0.10	0.34	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	215	1472	701	120	1255	357	324	2135		335	1667	
v/s Ratio Prot	0.04	c0.16	0.02	0.02	c0.24		c0.08	0.20		0.03	c0.29	
v/s Ratio Perm			0.06			0.09						
v/c Ratio	0.59	0.57	0.17	0.65	0.91	0.34	0.82	0.58		0.29	0.83	
Uniform Delay, d1	41.6	27.5	18.6	43.4	32.6	27.2	40.5	24.7		38.2	27.5	
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	4.0	0.5	0.1	11.9	10.1	0.6	15.3	0.4		0.5	3.7	
Delay (s)	45.6	28.0	18.7	55.4	42.7	27.8	55.8	25.1		38.7	31.2	
Level of Service	D	C	B	E	D	C	E	C		D	C	
Approach Delay (s)		28.8			40.8			30.4			31.6	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM Average Control Delay	33.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	91.2	Sum of lost time (s)	16.2
Intersection Capacity Utilization	79.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	616	460	0	872	0	0	0	0	0	0	537
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	648	484	0	918	0	0	0	0	0	0	565
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.88			0.88	0.88	0.88	0.88	0.88	
vC, conflicting volume	918			1133			1196	1808	458	1134	2051	306
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	918			657			730	1428	0	659	1705	306
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	18
cM capacity (veh/h)	739			812			49	117	950	306	79	690

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	259	259	614	306	306	306	565
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	484	0	0	0	565
cSH	1700	1700	1700	1700	1700	1700	690
Volume to Capacity	0.15	0.15	0.36	0.18	0.18	0.18	0.82
Queue Length 95th (ft)	0	0	0	0	0	0	218
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	29.4
Lane LOS							D
Approach Delay (s)	0.0			0.0			29.4
Approach LOS							D

Intersection Summary			
Average Delay	6.3		
Intersection Capacity Utilization	56.8%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	57	201	195	193	7	1499	450	1412
v/c Ratio	0.40	0.54	0.46	0.45	0.05	0.59	0.33	0.52
Control Delay	23.5	25.2	11.1	10.7	12.1	9.5	0.3	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.5	25.2	11.1	10.7	12.1	9.5	0.3	11.8
Queue Length 50th (ft)	8	68	23	21	1	89	0	125
Queue Length 95th (ft)	38	110	65	61	m2	m155	m0	201
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	144	532	549	562	136	2540	1362	2707
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.38	0.36	0.34	0.05	0.59	0.33	0.52

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	0	33	212	1	347	7	1030	822	0	1334	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.92		1.00	0.87	0.85	1.00	0.96	0.85		1.00	
Flt Protected		0.98		0.95	0.99	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1676		1681	1463	1504	1770	4606	1362		5081	
Flt Permitted		0.98		0.95	0.99	1.00	0.14	1.00	1.00		1.00	
Satd. Flow (perm)		1676		1681	1463	1504	256	4606	1362		5081	
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)	22	0	35	223	1	365	7	1084	865	0	1404	8
RTOR Reduction (vph)	0	34	0	0	98	98	0	92	0	0	1	0
Lane Group Flow (vph)	0	23	0	201	97	95	7	1407	450	0	1411	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		2.4		13.2	13.2	13.2	30.4	30.4	60.0		30.4	
Effective Green, g (s)		2.4		13.2	13.2	13.2	30.4	30.4	60.0		30.4	
Actuated g/C Ratio		0.04		0.22	0.22	0.22	0.51	0.51	1.00		0.51	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		67		370	322	331	130	2334	1362		2574	
v/s Ratio Prot		0.01		c0.12	0.07			c0.31			0.28	
v/s Ratio Perm						0.06	0.03		c0.33			
v/c Ratio		0.35		0.54	0.30	0.29	0.05	0.60	0.33		0.55	
Uniform Delay, d1		28.0		20.7	19.5	19.5	7.5	10.5	0.0		10.1	
Progression Factor		1.00		1.00	1.00	1.00	1.04	0.93	1.00		1.00	
Incremental Delay, d2		3.1		1.6	0.5	0.5	0.4	0.6	0.3		0.8	
Delay (s)		31.2		22.4	20.1	20.0	8.2	10.4	0.3		11.0	
Level of Service		C		C	C	B	A	B	A		B	
Approach Delay (s)		31.2			20.8			8.1			11.0	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	11.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	55.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	118	848	237	2571	244	1136	71	1089
v/c Ratio	1.15	0.50	0.77	1.13	1.10	0.76	0.80	0.97
Control Delay	183.1	31.2	69.8	88.2	126.1	24.6	99.4	62.8
Queue Delay	0.0	0.0	0.0	18.0	0.0	1.9	0.0	0.0
Total Delay	183.1	31.2	69.8	106.2	126.1	26.5	99.4	62.8
Queue Length 50th (ft)	~107	178	196	~431	~222	307	58	221
Queue Length 95th (ft)	#230	235	m216	#554	#394	296	#147	#350
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	103	1710	384	2275	221	1502	89	1118
Starvation Cap Reductn	0	0	0	79	0	217	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.15	0.50	0.62	1.17	1.10	0.88	0.80	0.97

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	112	639	166	225	1893	549	232	1066	13	67	889	145
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	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.97		1.00	0.97		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4928		1770	4914		1770	5076		1770	4978	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4928		1770	4914		1770	5076		1770	4978	
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)	118	673	175	237	1993	578	244	1122	14	71	936	153
RTOR Reduction (vph)	0	36	0	0	44	0	0	1	0	0	19	0
Lane Group Flow (vph)	118	812	0	237	2527	0	244	1135	0	71	1070	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	7.0	40.8		20.7	54.5		15.0	35.5		6.0	26.5	
Effective Green, g (s)	7.0	40.8		20.7	54.5		15.0	35.5		6.0	26.5	
Actuated g/C Ratio	0.06	0.34		0.17	0.45		0.12	0.30		0.05	0.22	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	103	1676		305	2232		221	1502		89	1099	
v/s Ratio Prot	c0.07	0.16		0.13	c0.51		c0.14	0.22		0.04	c0.22	
v/s Ratio Perm												
v/c Ratio	1.15	0.48		0.78	1.13		1.10	0.76		0.80	0.97	
Uniform Delay, d1	56.5	31.3		47.4	32.8		52.5	38.3		56.4	46.4	
Progression Factor	1.00	1.00		1.32	0.84		0.85	0.57		0.92	0.94	
Incremental Delay, d2	133.2	0.2		5.4	62.4		83.6	2.7		34.0	19.9	
Delay (s)	189.7	31.5		67.9	89.8		128.0	24.4		85.8	63.6	
Level of Service	F	C		E	F		F	C		F	E	
Approach Delay (s)		50.8			87.9			42.8			64.9	
Approach LOS		D			F			D			E	

Intersection Summary			
HCM Average Control Delay	68.2	HCM Level of Service	E
HCM Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	102.5%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	333	1141	332	174	652	15	1035	257	1236
v/c Ratio	0.71	0.79	0.63	0.72	0.73	0.12	0.65	0.30	0.55
Control Delay	48.3	38.0	19.8	56.9	37.8	25.6	29.0	3.7	7.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.1
Total Delay	48.3	38.0	19.8	56.9	37.8	25.6	29.7	3.7	7.5
Queue Length 50th (ft)	232	293	112	144	133	7	334	0	84
Queue Length 95th (ft)	344	270	166	m217	162	25	431	51	m85
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	502	1525	549	295	1038	121	1597	855	2254
Starvation Cap Reductn	0	0	0	0	0	0	0	0	241
Spillback Cap Reductn	0	0	0	0	0	0	239	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.75	0.60	0.59	0.63	0.12	0.76	0.30	0.61

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	316	914	485	165	619	0	14	983	244	0	647	527
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	0.98	0.85	1.00	1.00		1.00	1.00	0.85		0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4693	1362	1770	5085		1770	3539	1583		4743	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.14	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4693	1362	1770	5085		269	3539	1583		4743	
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)	333	962	511	174	652	0	15	1035	257	0	681	555
RTOR Reduction (vph)	0	21	115	0	0	0	0	0	141	0	113	0
Lane Group Flow (vph)	333	1120	217	174	652	0	15	1035	116	0	1123	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	31.7	36.5	36.5	16.4	21.2		54.1	54.1	54.1		54.1	
Effective Green, g (s)	31.7	36.5	36.5	16.4	21.2		54.1	54.1	54.1		54.1	
Actuated g/C Ratio	0.26	0.30	0.30	0.14	0.18		0.45	0.45	0.45		0.45	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	468	1427	414	242	898		121	1595	714		2138	
v/s Ratio Prot	c0.19	c0.24		0.10	0.13			c0.29			0.24	
v/s Ratio Perm			0.16				0.06		0.07			
v/c Ratio	0.71	0.78	0.52	0.72	0.73		0.12	0.65	0.16		0.53	
Uniform Delay, d1	40.0	38.2	34.6	49.6	46.7		19.2	25.6	19.5		23.7	
Progression Factor	1.01	0.92	0.86	0.89	0.73		1.00	1.00	1.00		0.33	
Incremental Delay, d2	4.4	2.6	1.0	7.5	2.2		2.1	2.1	0.5		0.5	
Delay (s)	44.8	37.7	30.9	51.7	36.4		21.3	27.6	20.0		8.4	
Level of Service	D	D	C	D	D		C	C	C		A	
Approach Delay (s)		37.8			39.6			26.1			8.4	
Approach LOS		D			D			C			A	

Intersection Summary			
HCM Average Control Delay	28.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	200	1147	0	0	1325
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	211	1207	0	0	1395
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked						
vC, conflicting volume	1672	402			1207	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1672	402			1207	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	65			100	
cM capacity (veh/h)	87	597			574	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	211	402	402	402	465	465	465
Volume Left	0	0	0	0	0	0	0
Volume Right	211	0	0	0	0	0	0
cSH	597	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.35	0.24	0.24	0.24	0.27	0.27	0.27
Queue Length 95th (ft)	40	0	0	0	0	0	0
Control Delay (s)	14.3	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B						
Approach Delay (s)	14.3	0.0			0.0		
Approach LOS	B						

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	41.2%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1300	947	810
v/c Ratio	0.47	0.34	0.73
Control Delay	9.9	5.3	20.3
Queue Delay	0.0	0.0	0.0
Total Delay	9.9	5.3	20.3
Queue Length 50th (ft)	98	56	119
Queue Length 95th (ft)	154	101	153
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	2749	2749	1388
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.47	0.34	0.58

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1235	900	0	614	156
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.97	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3370	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3370	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1300	947	0	646	164
RTOR Reduction (vph)	0	0	0	0	44	0
Lane Group Flow (vph)	0	1300	947	0	766	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		32.4	32.4		19.1	
Effective Green, g (s)		32.4	32.4		19.1	
Actuated g/C Ratio		0.54	0.54		0.32	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		2746	2746		1073	
v/s Ratio Prot		c0.26	0.19		c0.23	
v/s Ratio Perm						
v/c Ratio		0.47	0.34		0.71	
Uniform Delay, d1		8.5	7.8		18.0	
Progression Factor		1.00	0.59		1.00	
Incremental Delay, d2		0.6	0.3		2.3	
Delay (s)		9.1	4.9		20.3	
Level of Service		A	A		C	
Approach Delay (s)		9.1	4.9		20.3	
Approach LOS		A	A		C	

Intersection Summary			
HCM Average Control Delay	10.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	89	707	361	2637	101	617	471	95	874
v/c Ratio	0.86	0.43	0.68	0.92	0.11	0.64	0.61	0.83	0.63
Control Delay	107.0	14.2	44.6	30.6	5.1	34.2	10.1	90.3	35.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	107.0	14.2	44.6	30.6	5.1	34.2	10.1	90.3	35.8
Queue Length 50th (ft)	73	58	246	648	11	120	72	69	191
Queue Length 95th (ft)	m#167	72	356	732	36	183	150	#173	239
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	103	1631	531	2860	920	958	772	115	1382
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.43	0.68	0.92	0.11	0.64	0.61	0.83	0.63

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	85	672	0	343	2505	96	0	586	447	90	527	303
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	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4807	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.23	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	425	4807	
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)	89	707	0	361	2637	101	0	617	471	95	555	319
RTOR Reduction (vph)	0	0	0	0	0	30	0	0	343	0	80	0
Lane Group Flow (vph)	89	707	0	361	2637	71	0	617	128	95	794	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	7.0	38.5		36.0	67.5	67.5		32.5	32.5	32.5	32.5	
Effective Green, g (s)	7.0	38.5		36.0	67.5	67.5		32.5	32.5	32.5	32.5	
Actuated g/C Ratio	0.06	0.32		0.30	0.56	0.56		0.27	0.27	0.27	0.27	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	103	1631		531	2860	890		958	429	115	1302	
v/s Ratio Prot	0.05	0.14		c0.20	c0.52			0.17			0.17	
v/s Ratio Perm						0.05			0.08	c0.22		
v/c Ratio	0.86	0.43		0.68	0.92	0.08		0.64	0.30	0.83	0.61	
Uniform Delay, d1	56.0	32.1		36.9	23.9	12.0		38.6	34.7	41.1	38.2	
Progression Factor	0.96	0.42		1.00	1.00	1.00		0.81	2.27	1.00	1.00	
Incremental Delay, d2	43.9	0.7		3.5	6.3	0.2		2.5	1.3	46.6	2.1	
Delay (s)	97.6	14.1		40.4	30.2	12.2		33.9	80.2	87.7	40.3	
Level of Service	F	B		D	C	B		C	F	F	D	
Approach Delay (s)		23.5			30.8			54.0			45.0	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	36.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	137	1699	183	3043	477	218	71	104	952	215
v/c Ratio	1.33	0.96	0.95	1.50	1.70	0.21	0.14	0.63	1.15	0.48
Control Delay	243.9	52.3	107.4	256.5	363.4	32.7	8.0	68.8	123.9	25.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	243.9	52.3	107.4	256.5	363.4	32.7	8.0	68.8	123.9	25.5
Queue Length 50th (ft)	~138	466	143	~1206	~543	67	0	78	~457	77
Queue Length 95th (ft)	#268	#576	#289	#1293	#753	101	35	137	#588	155
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	103	1766	192	2030	280	1054	521	192	826	444
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.33	0.96	0.95	1.50	1.70	0.21	0.14	0.54	1.15	0.48

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	130	1470	144	174	2830	61	453	207	67	99	904	204
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5017		1770	5069		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5017		1770	5069		1770	3539	1583	1770	3539	1583
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)	137	1547	152	183	2979	64	477	218	71	104	952	215
RTOR Reduction (vph)	0	10	0	0	2	0	0	0	50	0	0	74
Lane Group Flow (vph)	137	1689	0	183	3041	0	477	218	21	104	952	141
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	7.0	42.0		13.0	48.0		19.0	35.7	35.7	11.3	28.0	28.0
Effective Green, g (s)	7.0	42.0		13.0	48.0		19.0	35.7	35.7	11.3	28.0	28.0
Actuated g/C Ratio	0.06	0.35		0.11	0.40		0.16	0.30	0.30	0.09	0.23	0.23
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	103	1756		192	2028		280	1053	471	167	826	369
v/s Ratio Prot	c0.08	0.34		0.10	c0.60		c0.27	0.06		0.06	c0.27	
v/s Ratio Perm									0.01			0.09
v/c Ratio	1.33	0.96		0.95	1.50		1.70	0.21	0.04	0.62	1.15	0.38
Uniform Delay, d1	56.5	38.2		53.2	36.0		50.5	31.6	30.0	52.3	46.0	38.7
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	200.7	13.5		51.2	227.5		331.5	0.1	0.0	7.0	82.4	0.7
Delay (s)	257.2	51.8		104.4	263.5		382.0	31.7	30.1	59.3	128.4	39.4
Level of Service	F	D		F	F		F	C	C	E	F	D
Approach Delay (s)		67.1			254.4			249.7			107.7	
Approach LOS		E			F			F			F	

Intersection Summary			
HCM Average Control Delay	179.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.43		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	128.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	179	0	640	0	0	776	510	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	188	0	674	0	0	817	537	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.76		0.76						0.76	0.76
vC, conflicting volume	2027	337	1354			674			1342	1491
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	2194	337	1308			674			1292	1488
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	71	100			100			100	100
cM capacity (veh/h)	34	659	399			913			65	94

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	188	337	337	817	537
Volume Left	0	0	0	0	0
Volume Right	188	0	0	0	537
cSH	659	1700	1700	1700	1700
Volume to Capacity	0.29	0.20	0.20	0.48	0.32
Queue Length 95th (ft)	29	0	0	0	0
Control Delay (s)	12.6	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	12.6	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	60.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	820	0	0	0	0	0	0	700	58	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	863	0	0	0	0	0	0	737	61	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked												
vC, conflicting volume	1535	1535	61	2398	1535	0	61			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1535	1535	61	2398	1535	0	61			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	14	100	100	100	100			55		
cM capacity (veh/h)	61	63	1004	2	63	1085	1542			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	863	737	61
Volume Left	0	737	0
Volume Right	863	0	0
cSH	1004	1623	1700
Volume to Capacity	0.86	0.45	0.04
Queue Length 95th (ft)	281	61	0
Control Delay (s)	25.8	9.0	0.0
Lane LOS	D	A	
Approach Delay (s)	25.8	8.4	
Approach LOS	D		

Intersection Summary			
Average Delay	17.4		
Intersection Capacity Utilization	60.8%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	566	224	122	972	263	1297
v/c Ratio	0.96	0.37	0.97	0.51	0.27	0.68
Control Delay	53.2	11.9	88.0	10.0	1.9	14.2
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.3
Total Delay	53.2	11.9	88.0	10.2	1.9	14.5
Queue Length 50th (ft)	234	38	50	130	6	198
Queue Length 95th (ft)	#426	90	m#118	m172	m17	267
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	594	610	126	1900	972	1899
Starvation Cap Reductn	0	0	0	247	0	0
Spillback Cap Reductn	0	0	0	0	0	143
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.95	0.37	0.97	0.59	0.27	0.74

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	538	30	182	116	923	250	0	1227	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.87		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1623		1770	3539	1583		3537	
Flt Permitted				0.95	1.00		0.13	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1623		235	3539	1583		3537	
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)	0	0	0	566	32	192	122	972	263	0	1292	5
RTOR Reduction (vph)	0	0	0	0	65	0	0	0	122	0	0	0
Lane Group Flow (vph)	0	0	0	566	159	0	122	972	141	0	1297	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				23.4	23.4		37.6	37.6	37.6		37.6	
Effective Green, g (s)				23.4	23.4		37.6	37.6	37.6		37.6	
Actuated g/C Ratio				0.33	0.33		0.54	0.54	0.54		0.54	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				592	543		126	1901	850		1900	
v/s Ratio Prot				c0.32	0.10			0.27			0.37	
v/s Ratio Perm							c0.52		0.09			
v/c Ratio				0.96	0.29		0.97	0.51	0.17		0.68	
Uniform Delay, d1				22.8	17.2		15.6	10.3	8.2		11.8	
Progression Factor				1.00	1.00		0.94	0.87	0.99		1.00	
Incremental Delay, d2				26.2	0.3		64.1	0.8	0.3		2.0	
Delay (s)				49.0	17.5		78.8	9.8	8.5		13.8	
Level of Service				D	B		E	A	A		B	
Approach Delay (s)		0.0			40.1			15.8			13.8	
Approach LOS		A			D			B			B	

Intersection Summary			
HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	469	343	948	1919
v/c Ratio	0.91	0.73	0.45	0.91
Control Delay	48.8	32.2	2.7	14.0
Queue Delay	0.0	0.0	0.1	2.4
Total Delay	48.8	32.2	2.7	16.4
Queue Length 50th (ft)	191	126	21	205
Queue Length 95th (ft)	#355	#238	m26	m#254
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	531	483	2105	2105
Starvation Cap Reductn	0	0	163	5
Spillback Cap Reductn	0	0	0	103
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.88	0.71	0.49	0.96

Intersection Summary

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

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	446	326	0	901	1823	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		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	469	343	0	948	1919	0
RTOR Reduction (vph)	0	9	0	0	0	0
Lane Group Flow (vph)	469	334	0	948	1919	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	20.4	20.4		41.6	41.6	
Effective Green, g (s)	20.4	20.4		41.6	41.6	
Actuated g/C Ratio	0.29	0.29		0.59	0.59	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	516	461		2103	2103	
v/s Ratio Prot				0.27	c0.54	
v/s Ratio Perm	c0.27	0.21				
v/c Ratio	0.91	0.73		0.45	0.91	
Uniform Delay, d1	23.9	22.3		7.9	12.6	
Progression Factor	1.00	1.00		0.25	0.59	
Incremental Delay, d2	19.7	5.6		0.6	5.1	
Delay (s)	43.6	27.9		2.6	12.6	
Level of Service	D	C		A	B	
Approach Delay (s)	37.0			2.6	12.6	
Approach LOS	D			A	B	

Intersection Summary			
HCM Average Control Delay	15.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	248	377	128	40	287	96	156	517	103	201	1593	474
v/c Ratio	1.00	0.44	0.27	0.20	0.33	0.21	0.88	0.39	0.16	0.53	0.93	0.54
Control Delay	89.6	24.4	6.2	24.1	23.2	6.6	77.7	17.3	4.2	23.9	16.0	3.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.4
Total Delay	89.6	24.4	6.2	24.1	23.2	6.6	77.7	17.3	4.2	23.9	27.0	3.5
Queue Length 50th (ft)	~107	72	0	14	53	0	68	84	0	85	148	7
Queue Length 95th (ft)	#245	110	38	39	85	33	#169	122	28	m94	m#323	m18
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	247	859	481	203	859	457	177	1314	653	379	1719	875
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	140	99
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.00	0.44	0.27	0.20	0.33	0.21	0.88	0.39	0.16	0.53	1.01	0.61

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	236	358	122	38	273	91	148	491	98	191	1513	450
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.55	1.00	1.00	0.45	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1019	3539	1583	835	3539	1583	1770	3539	1583	1770	3539	1583
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)	248	377	128	40	287	96	156	517	103	201	1593	474
RTOR Reduction (vph)	0	0	97	0	0	73	0	0	65	0	0	106
Lane Group Flow (vph)	248	377	31	40	287	23	156	517	38	201	1593	368
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	17.0	17.0	17.0	17.0	17.0	17.0	7.0	26.0	26.0	15.0	34.0	34.0
Effective Green, g (s)	17.0	17.0	17.0	17.0	17.0	17.0	7.0	26.0	26.0	15.0	34.0	34.0
Actuated g/C Ratio	0.24	0.24	0.24	0.24	0.24	0.24	0.10	0.37	0.37	0.21	0.49	0.49
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	247	859	384	203	859	384	177	1314	588	379	1719	769
v/s Ratio Prot		0.11			0.08		c0.09	0.15		0.11	c0.45	
v/s Ratio Perm	c0.24		0.02	0.05		0.01			0.02			0.23
v/c Ratio	1.00	0.44	0.08	0.20	0.33	0.06	0.88	0.39	0.07	0.53	0.93	0.48
Uniform Delay, d1	26.5	22.5	20.5	21.1	21.8	20.4	31.1	16.2	14.2	24.4	16.8	12.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.55	0.30
Incremental Delay, d2	58.3	0.4	0.1	0.5	0.2	0.1	36.3	0.9	0.2	0.6	5.2	1.0
Delay (s)	84.8	22.8	20.6	21.6	22.1	20.4	67.4	17.1	14.4	21.6	14.3	4.5
Level of Service	F	C	C	C	C	C	E	B	B	C	B	A
Approach Delay (s)		42.8			21.6			26.8			12.9	
Approach LOS		D			C			C			B	

Intersection Summary			
HCM Average Control Delay	21.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	84.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	60	530	0	433	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	63	558	0	456	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			621		291	32
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			621		291	32
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			956		676	1035

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	42	207	372	228	228
Volume Left	0	0	0	0	0
Volume Right	0	186	372	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.02	0.12	0.22	0.13	0.13
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	25.2%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	1	1205	1698	315
v/c Ratio	0.01	0.34	0.50	0.21
Control Delay	20.0	0.3	1.3	0.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.0	0.3	1.3	0.5
Queue Length 50th (ft)	0	0	0	0
Queue Length 95th (ft)	m1	0	110	9
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	118	3539	3392	1530
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.01	0.34	0.50	0.21

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	1	1145	1613	299
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	1	1205	1698	315
RTOR Reduction (vph)	0	0	0	0	0	49
Lane Group Flow (vph)	0	0	1	1205	1698	266
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			0.8	60.0	50.7	50.7
Effective Green, g (s)			0.8	60.0	50.7	50.7
Actuated g/C Ratio			0.01	1.00	0.85	0.85
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			24	3539	2990	1338
v/s Ratio Prot			0.00	c0.34	c0.48	
v/s Ratio Perm						0.17
v/c Ratio			0.04	0.34	0.57	0.20
Uniform Delay, d1			29.2	0.0	1.4	0.9
Progression Factor			0.74	1.00	1.00	1.00
Incremental Delay, d2			0.7	0.3	0.8	0.3
Delay (s)			22.3	0.3	2.2	1.2
Level of Service			C	A	A	A
Approach Delay (s)	0.0			0.3	2.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	1.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	4.5
Intersection Capacity Utilization	65.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	181	269	0	987	1617	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	191	283	0	1039	1702	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.88	0.81	0.81			
vC, conflicting volume	2222	851	1702			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1477	359	1405			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	45	100			
cM capacity (veh/h)	102	519	392			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	127	347	519	519	851	851
Volume Left	127	64	0	0	0	0
Volume Right	0	283	0	0	0	0
cSH	102	297	1700	1700	1700	1700
Volume to Capacity	1.24	1.17	0.31	0.31	0.50	0.50
Queue Length 95th (ft)	216	373	0	0	0	0
Control Delay (s)	245.5	143.1	0.0	0.0	0.0	0.0
Lane LOS	F	F				
Approach Delay (s)	170.6		0.0		0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	25.1		
Intersection Capacity Utilization	65.0%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	131	125	37	88	162	883	9	1247	528
v/c Ratio	0.54	0.19	0.16	0.14	0.51	0.36	0.02	0.58	0.48
Control Delay	29.5	6.7	20.2	13.3	18.5	6.4	3.4	11.0	4.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.5	6.7	20.2	13.3	18.5	6.4	3.4	11.0	4.7
Queue Length 50th (ft)	43	3	11	8	16	57	1	156	34
Queue Length 95th (ft)	81	19	30	22	#67	158	m2	265	85
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	346	902	334	915	318	2478	423	2150	1093
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	0.14	0.11	0.10	0.51	0.36	0.02	0.58	0.48

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	124	19	100	35	52	31	154	832	7	9	1185	502
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.87		1.00	0.94		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3093		1770	3340		1770	3535		1770	3539	1583
Flt Permitted	0.70	1.00		0.67	1.00		0.15	1.00		0.28	1.00	1.00
Satd. Flow (perm)	1298	3093		1253	3340		273	3535		525	3539	1583
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)	131	20	105	37	55	33	162	876	7	9	1247	528
RTOR Reduction (vph)	0	88	0	0	28	0	0	1	0	0	0	158
Lane Group Flow (vph)	131	38	0	37	61	0	162	882	0	9	1247	370
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	10.0	10.0		10.0	10.0		42.0	37.2		32.4	31.6	31.6
Effective Green, g (s)	10.0	10.0		10.0	10.0		42.0	37.2		32.4	31.6	31.6
Actuated g/C Ratio	0.17	0.17		0.17	0.17		0.70	0.62		0.54	0.53	0.53
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	216	516		209	557		351	2192		300	1864	834
v/s Ratio Prot		0.01			0.02		c0.05	c0.25		0.00	c0.35	
v/s Ratio Perm	c0.10			0.03			0.27			0.02		0.23
v/c Ratio	0.61	0.07		0.18	0.11		0.46	0.40		0.03	0.67	0.44
Uniform Delay, d1	23.2	21.1		21.5	21.2		12.5	5.8		8.4	10.4	8.8
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.70	0.93	0.81
Incremental Delay, d2	4.8	0.1		0.4	0.1		1.0	0.6		0.0	1.8	1.6
Delay (s)	27.9	21.1		21.9	21.3		13.5	6.3		5.9	11.5	8.6
Level of Service	C	C		C	C		B	A		A	B	A
Approach Delay (s)		24.6			21.5			7.4			10.6	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	11.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	712	229	628	112	88	860
v/c Ratio	0.74	0.38	0.42	0.15	0.41	0.42
Control Delay	24.9	4.8	9.7	1.5	30.8	8.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.9	4.8	9.7	1.5	30.8	8.1
Queue Length 50th (ft)	115	0	92	0	29	85
Queue Length 95th (ft)	168	42	103	15	#77	121
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	1032	636	1569	764	218	2054
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.36	0.40	0.15	0.40	0.42

Intersection Summary

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	676	218	597	106	84	817
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	712	229	628	112	88	860
RTOR Reduction (vph)	0	165	0	66	0	0
Lane Group Flow (vph)	712	64	628	46	88	860
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	16.7	16.7	24.6	24.6	6.2	34.8
Effective Green, g (s)	16.7	16.7	24.6	24.6	6.2	34.8
Actuated g/C Ratio	0.28	0.28	0.41	0.41	0.10	0.58
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	956	441	1451	649	183	2053
v/s Ratio Prot	c0.21		0.18		0.05	c0.24
v/s Ratio Perm		0.04		0.03		
v/c Ratio	0.74	0.14	0.43	0.07	0.48	0.42
Uniform Delay, d1	19.7	16.3	12.7	10.8	25.4	7.0
Progression Factor	1.00	1.00	0.66	0.48	1.00	1.00
Incremental Delay, d2	3.2	0.2	0.9	0.2	2.0	0.6
Delay (s)	22.9	16.4	9.3	5.4	27.4	7.6
Level of Service	C	B	A	A	C	A
Approach Delay (s)	21.3		8.7			9.5
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	13.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	50.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	37	89	721	1442	256	1313
v/c Ratio	0.18	0.49	0.28	1.08	1.24	0.43
Control Delay	54.5	20.4	6.5	61.3	180.5	1.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.5	20.4	6.5	61.3	180.5	1.7
Queue Length 50th (ft)	14	0	90	~1088	~250	30
Queue Length 95th (ft)	31	51	130	#1362	#421	50
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	629	363	2542	1334	207	3073
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.25	0.28	1.08	1.24	0.43

Intersection Summary

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

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	35	85	685	1370	243	1247
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	37	89	721	1442	256	1313
RTOR Reduction (vph)	0	84	0	197	0	0
Lane Group Flow (vph)	37	5	721	1245	256	1313
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	7.3	7.3	86.2	86.2	14.0	104.2
Effective Green, g (s)	7.3	7.3	86.2	86.2	14.0	104.2
Actuated g/C Ratio	0.06	0.06	0.72	0.72	0.12	0.87
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	209	96	2542	1137	207	3073
v/s Ratio Prot	c0.01		0.20		c0.14	0.37
v/s Ratio Perm		0.00		c0.79		
v/c Ratio	0.18	0.06	0.28	1.10	1.24	0.43
Uniform Delay, d1	53.5	53.1	6.0	16.9	53.0	1.7
Progression Factor	1.00	1.00	1.00	1.00	0.99	0.74
Incremental Delay, d2	0.4	0.2	0.3	56.7	136.6	0.4
Delay (s)	53.9	53.4	6.3	73.6	189.3	1.6
Level of Service	D	D	A	E	F	A
Approach Delay (s)	53.5		51.1			32.2
Approach LOS	D		D			C

Intersection Summary			
HCM Average Control Delay	43.5	HCM Level of Service	D
HCM Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	105.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	160	160	782	68	40	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	168	168	823	72	42	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	943	859			823	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	943	859			823	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	39	53			95	
cM capacity (veh/h)	276	356			807	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	168	168	895	42	0
Volume Left	168	0	0	42	0
Volume Right	0	168	72	0	0
cSH	276	356	1700	807	1700
Volume to Capacity	0.61	0.47	0.53	0.05	0.00
Queue Length 95th (ft)	92	61	0	4	0
Control Delay (s)	36.5	23.9	0.0	9.7	0.0
Lane LOS	E	C		A	
Approach Delay (s)	30.2		0.0	9.7	
Approach LOS	D				

Intersection Summary			
Average Delay	8.3		
Intersection Capacity Utilization	61.9%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2578	1654	579	125	1197	553	717
v/c Ratio	1.14	1.04	0.53	0.53	1.04	0.82	0.49
Control Delay	100.8	57.8	5.4	45.1	80.4	61.3	39.5
Queue Delay	612.2	381.0	11.6	0.0	14.8	0.0	0.0
Total Delay	713.0	438.8	17.1	45.1	95.2	61.3	39.5
Queue Length 50th (ft)	~926	~809	139	105	~408	232	183
Queue Length 95th (ft)	#1015	m725	m80	174	#506	#303	225
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2271	1593	1090	236	1150	673	1475
Starvation Cap Reductn	0	721	485	0	0	0	0
Spillback Cap Reductn	1275	0	0	0	41	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	2.59	1.90	0.96	0.53	1.08	0.82	0.49

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2286	163	0	1571	550	119	1087	50	525	680	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5034			3539	1583	1770	5052		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5034			3539	1583	1770	5052		3433	5084	
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)	0	2406	172	0	1654	579	125	1144	53	553	716	1
RTOR Reduction (vph)	0	6	0	0	0	0	0	4	0	0	0	0
Lane Group Flow (vph)	0	2572	0	0	1654	579	125	1193	0	553	717	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		58.5			58.5	84.0	17.3	29.5		25.5	37.7	
Effective Green, g (s)		58.5			58.5	84.0	17.3	29.5		25.5	37.7	
Actuated g/C Ratio		0.45			0.45	0.65	0.13	0.23		0.20	0.29	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2265			1593	1090	236	1146		673	1474	
v/s Ratio Prot		c0.51			0.47	0.10	0.07	c0.24		c0.16	0.14	
v/s Ratio Perm						0.26						
v/c Ratio		1.14			1.04	0.53	0.53	1.04		0.82	0.49	
Uniform Delay, d1		35.8			35.8	12.4	52.6	50.2		50.1	38.1	
Progression Factor		1.00			1.09	0.51	0.71	0.91		1.00	1.00	
Incremental Delay, d2		67.0			19.6	0.0	7.3	36.3		8.0	1.2	
Delay (s)		102.8			58.6	6.4	44.6	81.9		58.1	39.3	
Level of Service		F			E	A	D	F		E	D	
Approach Delay (s)		102.8			45.1			78.3			47.5	
Approach LOS		F			D			E			D	

Intersection Summary			
HCM Average Control Delay	71.5	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	98.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	504	2470	35	2252	774	136	215	439	391
v/c Ratio	1.17	0.78	0.51	1.11	1.20	0.52	1.09	0.55	0.59
Control Delay	117.9	32.2	94.7	106.8	156.9	43.0	144.7	47.3	8.0
Queue Delay	204.4	276.8	0.0	377.9	0.0	1.5	614.4	0.0	0.9
Total Delay	322.3	309.0	94.7	484.7	156.9	44.6	759.0	47.3	8.9
Queue Length 50th (ft)	~521	665	30	~780	~294	60	~104	173	0
Queue Length 95th (ft)	m#473	m615	m37	#870	#384	127	#188	228	87
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	429	3167	69	2026	645	261	198	803	661
Starvation Cap Reductn	121	1637	0	16	0	0	0	0	0
Spillback Cap Reductn	0	572	0	874	0	39	198	0	92
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.64	1.61	0.51	1.95	1.20	0.61	215.00	0.55	0.69

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	479	2330	16	33	1782	357	0	735	129	204	417	371
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.97			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5080		1770	4958			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5080		1770	4958			5085	1583	3433	3539	1583
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)	504	2453	17	35	1876	376	0	774	136	215	439	391
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	60	0	0	302
Lane Group Flow (vph)	504	2470	0	35	2229	0	0	774	76	215	439	89
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	31.5	79.9		4.1	52.5			16.5	16.5	7.5	29.5	29.5
Effective Green, g (s)	31.5	79.9		4.1	52.5			16.5	16.5	7.5	29.5	29.5
Actuated g/C Ratio	0.24	0.61		0.03	0.40			0.13	0.13	0.06	0.23	0.23
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	429	3122		56	2002			645	201	198	803	359
v/s Ratio Prot	c0.28	0.49		0.02	c0.45			c0.15		c0.06	0.12	
v/s Ratio Perm									0.05			0.06
v/c Ratio	1.17	0.79		0.62	1.11			1.20	0.38	1.09	0.55	0.25
Uniform Delay, d1	49.2	18.8		62.2	38.8			56.8	52.0	61.2	44.3	41.2
Progression Factor	0.81	1.71		1.31	1.52			1.17	1.35	1.00	1.00	1.00
Incremental Delay, d2	81.1	0.2		11.9	55.6			102.6	4.6	88.7	2.7	1.6
Delay (s)	121.0	32.3		93.3	114.6			169.2	74.9	150.0	47.0	42.8
Level of Service	F	C		F	F			F	E	F	D	D
Approach Delay (s)		47.4			114.3			155.1			66.6	
Approach LOS		D			F			F			E	

Intersection Summary			
HCM Average Control Delay	84.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.14		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	107.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	42	781	47	1213	457	79	463	156	329	14
v/c Ratio	0.33	0.34	0.19	0.53	0.47	0.21	0.62	0.48	0.33	0.04
Control Delay	36.9	28.8	24.1	26.9	3.6	44.1	49.5	78.4	72.1	49.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.9	28.8	24.1	26.9	3.6	44.1	49.5	78.4	72.1	49.4
Queue Length 50th (ft)	32	217	23	265	0	55	183	162	113	5
Queue Length 95th (ft)	m62	m245	52	310	60	102	242	m247	m150	m19
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	127	2283	249	2288	964	374	743	322	993	345
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.33	0.34	0.19	0.53	0.47	0.21	0.62	0.48	0.33	0.04

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	725	17	45	1152	434	75	382	58	296	164	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	1770	5068		1770	5085	1583	1770	3469		1522	4695	1583
Flt Permitted	0.15	1.00		0.30	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	284	5068		553	5085	1583	1770	3469		1522	4695	1583
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)	42	763	18	47	1213	457	79	402	61	312	173	14
RTOR Reduction (vph)	0	2	0	0	0	251	0	9	0	0	0	10
Lane Group Flow (vph)	42	779	0	47	1213	206	79	454	0	156	329	4
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	58.5	58.5		58.5	58.5	58.5	27.5	27.5		27.5	27.5	27.5
Effective Green, g (s)	58.5	58.5		58.5	58.5	58.5	27.5	27.5		27.5	27.5	27.5
Actuated g/C Ratio	0.45	0.45		0.45	0.45	0.45	0.21	0.21		0.21	0.21	0.21
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	128	2281		249	2288	712	374	734		322	993	335
v/s Ratio Prot		0.15			c0.24		0.04	c0.13		c0.10	0.07	
v/s Ratio Perm	0.15			0.08		0.13						0.00
v/c Ratio	0.33	0.34		0.19	0.53	0.29	0.21	0.62		0.48	0.33	0.01
Uniform Delay, d1	23.1	23.2		21.5	25.8	22.6	42.3	46.5		45.0	43.5	40.5
Progression Factor	1.23	1.22		1.00	1.00	1.00	1.00	1.00		1.62	1.63	2.56
Incremental Delay, d2	5.3	0.3		1.7	0.9	1.0	1.3	3.9		4.4	0.8	0.1
Delay (s)	33.8	28.8		23.2	26.7	23.6	43.6	50.4		77.2	71.8	103.9
Level of Service	C	C		C	C	C	D	D		E	E	F
Approach Delay (s)		29.0			25.8			49.4			74.4	
Approach LOS		C			C			D			E	

Intersection Summary			
HCM Average Control Delay	36.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	105	2637	38	133	2607	96	93	171	47	17	35
v/c Ratio	0.71	0.84	0.04	0.71	0.82	0.68	0.49	0.53	0.26	0.06	0.13
Control Delay	77.1	40.8	15.1	49.6	0.5	79.1	63.4	14.3	48.0	44.9	14.7
Queue Delay	0.0	33.2	0.0	0.0	1.5	671.0	0.0	0.0	0.0	0.0	391.6
Total Delay	77.1	74.0	15.1	49.6	2.0	750.1	63.4	14.3	48.0	44.9	406.3
Queue Length 50th (ft)	80	787	13	120	13	79	75	1	34	12	0
Queue Length 95th (ft)	m107	m831	m21	m107	m12	138	130	70	69	34	30
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	157	3129	982	197	3186	171	229	328	180	344	321
Starvation Cap Reductn	0	662	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	372	171	0	0	0	0	301
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.67	1.07	0.04	0.68	0.93	96.00	0.41	0.52	0.26	0.05	1.75

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	2505	36	126	2071	406	91	88	162	45	16	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.98		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	5085	1583	1770	4960		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.75	1.00	1.00	0.50	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	4960		1390	1863	1583	931	1863	1583
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)	105	2637	38	133	2180	427	96	93	171	47	17	35
RTOR Reduction (vph)	0	0	8	0	21	0	0	0	152	0	0	30
Lane Group Flow (vph)	105	2637	30	133	2586	0	96	93	19	47	17	5
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	10.8	79.3	79.3	13.8	82.3		13.2	13.2	13.8	20.4	20.4	20.4
Effective Green, g (s)	10.8	79.3	79.3	13.8	82.3		13.2	13.2	13.8	20.4	20.4	20.4
Actuated g/C Ratio	0.08	0.61	0.61	0.11	0.63		0.10	0.10	0.11	0.16	0.16	0.16
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	147	3102	966	188	3140		141	189	168	167	292	248
v/s Ratio Prot	0.06	0.52		c0.08	c0.52			0.05	0.01	c0.01	0.01	
v/s Ratio Perm			0.02				c0.07			0.04		0.00
v/c Ratio	0.71	0.85	0.03	0.71	0.82		0.68	0.49	0.11	0.28	0.06	0.02
Uniform Delay, d1	58.1	20.5	10.1	56.1	18.3		56.4	55.2	52.6	47.6	46.6	46.4
Progression Factor	1.06	1.82	2.24	0.84	0.01		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.3	1.9	0.0	1.1	0.2		12.7	2.0	0.3	0.9	0.1	0.0
Delay (s)	70.6	39.3	22.7	48.2	0.5		69.1	57.2	52.9	48.5	46.7	46.4
Level of Service	E	D	C	D	A		E	E	D	D	D	D
Approach Delay (s)		40.3			2.8			58.3			47.4	
Approach LOS		D			A			E			D	

Intersection Summary			
HCM Average Control Delay	24.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	109	2635	3368	155
v/c Ratio	0.42	0.79	1.15	0.30
Control Delay	34.4	10.9	92.2	32.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	34.4	10.9	92.2	32.4
Queue Length 50th (ft)	81	223	~1204	36
Queue Length 95th (ft)	m85	334	m#361	73
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	456	3344	2918	521
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.24	0.79	1.15	0.30

Intersection Summary

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

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

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	104	2503	2633	566	88	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.97		0.94	
Flt Protected	0.95	1.00	1.00		0.97	
Satd. Flow (prot)	1770	5085	4950		3298	
Flt Permitted	0.95	1.00	1.00		0.97	
Satd. Flow (perm)	1770	5085	4950		3298	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	109	2635	2772	596	93	62
RTOR Reduction (vph)	0	0	26	0	53	0
Lane Group Flow (vph)	109	2635	3342	0	102	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	19.1	85.5	76.0		18.4	
Effective Green, g (s)	19.1	85.5	76.0		18.4	
Actuated g/C Ratio	0.15	0.66	0.58		0.14	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	260	3344	2894		467	
v/s Ratio Prot	c0.06	c0.52	c0.68		c0.03	
v/s Ratio Perm						
v/c Ratio	0.42	0.79	1.15		0.22	
Uniform Delay, d1	50.4	15.8	27.0		49.4	
Progression Factor	0.64	0.61	0.78		1.00	
Incremental Delay, d2	0.6	1.1	70.1		1.1	
Delay (s)	32.7	10.7	91.2		50.5	
Level of Service	C	B	F		D	
Approach Delay (s)		11.6	91.2		50.5	
Approach LOS		B	F		D	

Intersection Summary			
HCM Average Control Delay	55.3	HCM Level of Service	E
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	87.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	151	2501	68	46	3749	180	51	117
v/c Ratio	1.06	0.71	0.06	0.43	1.13	1.15	0.29	0.38
Control Delay	113.4	1.2	0.1	70.5	86.0	167.9	55.9	17.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	113.4	1.2	0.1	70.5	86.0	167.9	55.9	17.0
Queue Length 50th (ft)	~136	20	0	38	~1342	~178	39	13
Queue Length 95th (ft)	m#212	24	m0	80	#1408	#331	82	71
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	143	3531	1120	123	3320	156	173	305
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.06	0.71	0.06	0.37	1.13	1.15	0.29	0.38

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	143	2376	65	44	3350	212	122	38	11	48	16	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.99		1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5040			1783		1770	1624	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.62		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5040			1147		1287	1624	
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)	151	2501	68	46	3526	223	128	40	12	51	17	100
RTOR Reduction (vph)	0	0	21	0	6	0	0	2	0	0	87	0
Lane Group Flow (vph)	151	2501	47	46	3743	0	0	178	0	51	30	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	11.6	89.2	89.2	6.8	84.4			17.5		17.5	17.5	
Effective Green, g (s)	11.6	89.2	89.2	6.8	84.4			17.5		17.5	17.5	
Actuated g/C Ratio	0.09	0.69	0.69	0.05	0.65			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	158	3489	1086	93	3272			154		173	219	
v/s Ratio Prot	c0.09	0.49		0.03	c0.74						0.02	
v/s Ratio Perm			0.03					c0.16		0.04		
v/c Ratio	0.96	0.72	0.04	0.49	1.14			1.16		0.29	0.14	
Uniform Delay, d1	58.9	12.6	6.6	59.9	22.8			56.2		50.7	49.6	
Progression Factor	0.62	0.03	0.00	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	43.5	0.8	0.0	4.1	68.9			121.2		1.0	0.3	
Delay (s)	80.1	1.2	0.0	64.0	91.7			177.4		51.6	49.9	
Level of Service	F	A	A	E	F			F		D	D	
Approach Delay (s)		5.6			91.4			177.4			50.4	
Approach LOS		A			F			F			D	

Intersection Summary			
HCM Average Control Delay	58.6	HCM Level of Service	E
HCM Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	107.2%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	19	1288	67	1353	96	173	476	44	123	102
v/c Ratio	0.16	0.80	0.28	0.74	0.23	0.28	0.77	0.11	0.20	0.19
Control Delay	18.3	21.8	11.2	15.8	17.4	17.4	22.6	16.0	16.5	13.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.3	21.8	11.2	15.8	17.4	17.4	22.6	16.0	16.5	13.0
Queue Length 50th (ft)	5	235	11	200	29	53	123	13	37	22
Queue Length 95th (ft)	22	#426	33	340	61	96	230	33	71	52
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	136	1819	236	2256	632	932	863	589	932	805
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.71	0.28	0.60	0.15	0.19	0.55	0.07	0.13	0.13

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	1142	82	64	1277	9	91	164	452	42	117	97
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3504		1770	3536		1770	1863	1583	1770	1863	1583
Flt Permitted	0.14	1.00		0.13	1.00		0.68	1.00	1.00	0.63	1.00	1.00
Satd. Flow (perm)	263	3504		238	3536		1263	1863	1583	1177	1863	1583
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)	19	1202	86	67	1344	9	96	173	476	44	123	102
RTOR Reduction (vph)	0	7	0	0	0	0	0	0	97	0	0	18
Lane Group Flow (vph)	19	1281	0	67	1353	0	96	173	379	44	123	84
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	28.3	28.3		33.4	33.4		20.4	20.4	20.4	20.4	20.4	20.4
Effective Green, g (s)	28.3	28.3		33.4	33.4		20.4	20.4	20.4	20.4	20.4	20.4
Actuated g/C Ratio	0.45	0.45		0.53	0.53		0.32	0.32	0.32	0.32	0.32	0.32
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	119	1579		178	1881		410	605	514	382	605	514
v/s Ratio Prot		c0.37		0.01	c0.38			0.09			0.07	
v/s Ratio Perm	0.07			0.19			0.08		c0.24	0.04		0.05
v/c Ratio	0.16	0.81		0.38	0.72		0.23	0.29	0.74	0.12	0.20	0.16
Uniform Delay, d1	10.2	14.9		10.3	11.1		15.5	15.8	18.8	14.9	15.3	15.1
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	0.6	3.3		1.3	1.3		0.3	0.3	5.5	0.1	0.2	0.1
Delay (s)	10.8	18.2		11.7	12.5		15.8	16.0	24.3	15.0	15.5	15.3
Level of Service	B	B		B	B		B	B	C	B	B	B
Approach Delay (s)		18.1			12.4			21.3			15.3	
Approach LOS		B			B			C			B	

Intersection Summary			
HCM Average Control Delay	16.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	62.8	Sum of lost time (s)	14.0
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	NBT	SBT
Lane Group Flow (vph)	474	1039	1702
v/c Ratio	0.65	0.45	0.75
Control Delay	24.3	3.8	10.8
Queue Delay	0.0	0.1	0.2
Total Delay	24.3	3.9	11.1
Queue Length 50th (ft)	75	53	187
Queue Length 95th (ft)	111	40	401
Internal Link Dist (ft)	342	302	370
Turn Bay Length (ft)	170		
Base Capacity (vph)	876	2284	2284
Starvation Cap Reductn	0	183	129
Spillback Cap Reductn	0	0	29
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.54	0.49	0.79

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	181	269	0	987	1617	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	
Lane Util. Factor	0.97			0.95	0.95	
Frt	0.91			1.00	1.00	
Flt Protected	0.98			1.00	1.00	
Satd. Flow (prot)	3225			3539	3539	
Flt Permitted	0.98			1.00	1.00	
Satd. Flow (perm)	3225			3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	191	283	0	1039	1702	0
RTOR Reduction (vph)	18	0	0	0	0	0
Lane Group Flow (vph)	456	0	0	1039	1702	0
Turn Type						
Protected Phases	4			2	6	
Permitted Phases						
Actuated Green, G (s)	13.3			38.7	38.7	
Effective Green, g (s)	13.3			38.7	38.7	
Actuated g/C Ratio	0.22			0.65	0.65	
Clearance Time (s)	4.0			4.0	4.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	715			2283	2283	
v/s Ratio Prot	c0.14			0.29	c0.48	
v/s Ratio Perm						
v/c Ratio	0.64			0.46	0.75	
Uniform Delay, d1	21.2			5.4	7.3	
Progression Factor	1.00			0.54	1.08	
Incremental Delay, d2	1.9			0.6	2.0	
Delay (s)	23.0			3.5	9.8	
Level of Service	C			A	A	
Approach Delay (s)	23.0			3.5	9.8	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	9.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues
29: College Park Dr & SR-22 Ramps

11/21/2012

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	168	168	895	42	253
v/c Ratio	0.52	0.40	0.78	0.23	0.20
Control Delay	27.4	6.8	20.2	31.2	3.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	27.4	6.8	20.2	31.2	3.9
Queue Length 50th (ft)	56	0	154	15	35
Queue Length 95th (ft)	98	39	#563	33	60
Internal Link Dist (ft)	864		215		720
Turn Bay Length (ft)					
Base Capacity (vph)	472	545	1141	181	1276
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.36	0.31	0.78	0.23	0.20

Intersection Summary

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	160	160	782	68	40	240
Ideal Flow (vphpl)	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		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1843		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	1843		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	168	168	823	72	42	253
RTOR Reduction (vph)	0	137	4	0	0	0
Lane Group Flow (vph)	168	31	891	0	42	253
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	10.9	10.9	34.6		2.5	41.1
Effective Green, g (s)	10.9	10.9	34.6		2.5	41.1
Actuated g/C Ratio	0.18	0.18	0.58		0.04	0.69
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	322	288	1063		74	1276
v/s Ratio Prot	c0.09		c0.48		c0.02	0.14
v/s Ratio Perm		0.02				
v/c Ratio	0.52	0.11	0.84		0.57	0.20
Uniform Delay, d1	22.2	20.5	10.4		28.2	3.4
Progression Factor	1.00	1.00	1.00		1.12	0.90
Incremental Delay, d2	1.5	0.2	7.9		9.5	0.3
Delay (s)	23.7	20.6	18.3		41.2	3.5
Level of Service	C	C	B		D	A
Approach Delay (s)	22.2		18.3			8.8
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	17.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Queues
1: Carson St & I-605 SB Off Ramps

11/30/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	2225	1558	588	1063	588	266
v/c Ratio	0.78	0.68	0.36	0.68	0.40	0.40
Control Delay	27.6	16.0	0.6	26.4	20.7	21.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.6	16.0	0.6	26.4	20.7	21.6
Queue Length 50th (ft)	368	247	0	300	147	129
Queue Length 95th (ft)	416	280	0	374	195	205
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2893	2316	1611	1569	1457	664
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.67	0.36	0.68	0.40	0.40

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1920	194	0	1480	0	0	0	559	1010	325	486
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.94	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6320			5085				1611	3433	3177	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6320			5085				1611	3433	3177	1441
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)	0	2021	204	0	1558	0	0	0	588	1063	342	512
RTOR Reduction (vph)	0	15	0	0	0	0	0	0	0	0	5	5
Lane Group Flow (vph)	0	2210	0	0	1558	0	0	0	588	1063	583	261
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		49.4			49.4				110.0	50.3	50.3	50.3
Effective Green, g (s)		49.4			49.4				110.0	50.3	50.3	50.3
Actuated g/C Ratio		0.45			0.45				1.00	0.46	0.46	0.46
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2838			2284				1611	1570	1453	659
v/s Ratio Prot		c0.35			0.31					c0.31	0.18	
v/s Ratio Perm									0.36			0.18
v/c Ratio		0.78			0.68				0.36	0.68	0.40	0.40
Uniform Delay, d1		25.7			24.1				0.0	23.5	19.8	19.8
Progression Factor		1.00			0.61				1.00	1.00	1.00	1.00
Incremental Delay, d2		1.6			0.9				0.6	2.4	0.8	1.8
Delay (s)		27.3			15.5				0.6	25.8	20.7	21.6
Level of Service		C			B				A	C	C	C
Approach Delay (s)		27.3			15.5			0.6			23.7	
Approach LOS		C			B			A			C	

Intersection Summary			
HCM Average Control Delay	20.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	3358	1307	779	769	315
v/c Ratio	0.85	0.60	0.61	0.75	0.38
Control Delay	13.7	5.8	3.6	40.1	31.9
Queue Delay	0.0	1.3	2.8	0.0	0.0
Total Delay	13.7	7.1	6.4	40.1	31.9
Queue Length 50th (ft)	314	102	61	252	99
Queue Length 95th (ft)	330	m156	m91	322	143
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3938	2175	1273	1030	837
Starvation Cap Reductn	26	611	366	0	0
Spillback Cap Reductn	1	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.86	0.84	0.86	0.75	0.38

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	3190	0	0	1242	740	731	0	299	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
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)	0	3358	0	0	1307	779	769	0	315	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	300	0	0	1	0	0	0
Lane Group Flow (vph)	0	3358	0	0	1307	479	769	0	314	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		67.6			67.6	67.6	33.0		33.0			
Effective Green, g (s)		67.6			67.6	67.6	33.0		33.0			
Actuated g/C Ratio		0.61			0.61	0.61	0.30		0.30			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3938			2175	973	1030		836			
v/s Ratio Prot		c0.52			0.37							
v/s Ratio Perm						0.30	c0.22		0.11			
v/c Ratio		0.85			0.60	0.49	0.75		0.38			
Uniform Delay, d1		17.2			13.0	11.7	34.7		30.4			
Progression Factor		0.67			0.39	3.08	1.00		1.00			
Incremental Delay, d2		1.7			0.4	0.5	4.9		1.3			
Delay (s)		13.2			5.4	36.5	39.7		31.7			
Level of Service		B			A	D	D		C			
Approach Delay (s)		13.2			17.0			37.3			0.0	
Approach LOS		B			B			D			A	

Intersection Summary			
HCM Average Control Delay	18.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	891	2193	5	1264	225	110	162	333	329
v/c Ratio	1.01	0.80	0.04	0.94	0.87	0.32	0.25	0.84	0.66
Control Delay	52.1	9.6	49.4	53.1	78.4	45.6	38.6	36.3	11.7
Queue Delay	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.1	10.1	49.4	53.1	78.4	45.6	38.6	36.3	11.7
Queue Length 50th (ft)	~337	73	3	320	160	36	49	89	0
Queue Length 95th (ft)	m#452	#113	16	#420	#313	63	81	#236	88
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	886	2755	113	1348	258	725	660	426	521
Starvation Cap Reductn	0	179	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.01	0.85	0.04	0.94	0.87	0.15	0.25	0.78	0.63

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	846	1875	208	5	1076	124	214	96	9	154	50	579
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.99		1.00	0.98		1.00	0.99		1.00	0.87	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5009		1770	5006		1770	3496		3433	1546	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5009		1770	5006		1770	3496		3433	1546	1504
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)	891	1974	219	5	1133	131	225	101	9	162	53	609
RTOR Reduction (vph)	0	11	0	0	13	0	0	7	0	0	178	282
Lane Group Flow (vph)	891	2182	0	5	1251	0	225	103	0	162	155	47
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	32.3	56.3		1.4	25.4		16.1	10.5		21.2	15.6	15.6
Effective Green, g (s)	32.3	56.3		1.4	25.4		16.1	10.5		21.2	15.6	15.6
Actuated g/C Ratio	0.29	0.51		0.01	0.23		0.15	0.10		0.19	0.14	0.14
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	1008	2564		23	1156		259	334		662	219	213
v/s Ratio Prot	0.26	c0.44		0.00	c0.25		c0.13	0.03		c0.05	c0.10	
v/s Ratio Perm												0.03
v/c Ratio	0.88	0.85		0.22	1.08		0.87	0.31		0.24	0.71	0.22
Uniform Delay, d1	37.1	23.2		53.8	42.3		45.9	46.4		37.6	45.0	41.8
Progression Factor	0.65	0.35		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.7	2.2		6.4	51.6		25.8	0.7		0.3	10.8	0.7
Delay (s)	29.7	10.3		60.2	93.9		71.7	47.1		37.9	55.8	42.5
Level of Service	C	B		E	F		E	D		D	E	D
Approach Delay (s)		15.9			93.8			63.6			47.0	
Approach LOS		B			F			E			D	

Intersection Summary			
HCM Average Control Delay	41.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	20.6
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	2063	1382	676	924
v/c Ratio	0.69	0.66	0.72	0.58
Control Delay	12.3	12.5	27.0	1.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	12.3	12.5	27.0	1.6
Queue Length 50th (ft)	200	187	135	0
Queue Length 95th (ft)	313	317	167	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	2996	2085	1609	1583
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	41	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.69	0.66	0.43	0.58

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1960	1313	0	642	878
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2063	1382	0	676	924
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2063	1382	0	676	924
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		41.2	41.2		19.3	70.0
Effective Green, g (s)		41.2	41.2		19.3	70.0
Actuated g/C Ratio		0.59	0.59		0.28	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		2993	2083		947	1583
v/s Ratio Prot		c0.41	0.39		c0.20	
v/s Ratio Perm						0.58
v/c Ratio		0.69	0.66		0.71	0.58
Uniform Delay, d1		10.0	9.7		22.9	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		1.3	1.6		2.4	1.6
Delay (s)		11.3	11.3		25.3	1.6
Level of Service		B	B		C	A
Approach Delay (s)		11.3	11.3		11.6	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	11.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	2187	1046	185	1356
v/c Ratio	0.84	0.86	0.81	0.38
Control Delay	10.2	14.8	59.1	0.3
Queue Delay	0.3	0.1	0.0	0.0
Total Delay	10.6	14.9	59.1	0.3
Queue Length 50th (ft)	355	302	79	0
Queue Length 95th (ft)	513	#606	#181	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2615	1212	228	3539
Starvation Cap Reductn	93	8	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.87	0.87	0.81	0.38

Intersection Summary

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

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	2078	994	176	1288	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2187	1046	185	1356	0	0
RTOR Reduction (vph)	0	43	0	0	0	0
Lane Group Flow (vph)	2187	1003	185	1356	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	51.7	51.7	9.0	70.0		
Effective Green, g (s)	51.7	51.7	9.0	70.0		
Actuated g/C Ratio	0.74	0.74	0.13	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2614	1169	228	3539		
v/s Ratio Prot	0.62		c0.10	0.38		
v/s Ratio Perm		c0.63				
v/c Ratio	0.84	0.86	0.81	0.38		
Uniform Delay, d1	6.3	6.5	29.7	0.0		
Progression Factor	1.08	1.08	1.00	1.00		
Incremental Delay, d2	2.9	7.2	19.3	0.3		
Delay (s)	9.7	14.2	48.9	0.3		
Level of Service	A	B	D	A		
Approach Delay (s)	11.2			6.2	0.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	9.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	79.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	359	0	0	661	0	886	660	0	760	358
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	378	0	0	696	0	933	695	0	800	377
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.88	0.88		0.88	0.88	0.88				0.88		
vC, conflicting volume	1111	1733	267	1199	1733	311	800			933		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	631	1341	267	732	1341	0	800			428		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	48	100	100	27	100			100		
cM capacity (veh/h)	86	132	731	131	132	950	819			988		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	378	696	373	373	418	463	320	320	286	251
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	378	696	0	0	232	463	0	0	126	251
cSH	731	950	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.52	0.73	0.22	0.22	0.25	0.27	0.19	0.19	0.17	0.15
Queue Length 95th (ft)	75	169	0	0	0	0	0	0	0	0
Control Delay (s)	15.1	18.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	C								
Approach Delay (s)	15.1	18.4	0.0				0.0			
Approach LOS	C	C								

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	748	0	1417	638	410
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	787	0	1492	672	432
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.86					
vC, conflicting volume	1044	224	672			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	240	224	672			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	0	100			
cM capacity (veh/h)	626	779	915			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	787	373	373	373	373	269	269	278	288
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	787	0	0	0	0	0	0	144	288
cSH	779	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.01	0.22	0.22	0.22	0.22	0.16	0.16	0.16	0.17
Queue Length 95th (ft)	442	0	0	0	0	0	0	0	0
Control Delay (s)	57.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F								
Approach Delay (s)	57.8	0.0				0.0			
Approach LOS	F								

Intersection Summary			
Average Delay	13.4		
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	180	2133	326	216	967	246	232	1146	168	1194
v/c Ratio	0.58	1.03	0.39	0.91	0.52	0.36	0.89	0.75	0.55	0.94
Control Delay	55.4	60.6	16.5	91.0	27.3	4.6	83.6	41.1	56.4	54.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.4	60.6	16.5	91.0	27.3	4.6	83.6	41.1	56.4	54.7
Queue Length 50th (ft)	63	~592	127	79	202	0	85	209	60	299
Queue Length 95th (ft)	100	#688	193	#152	248	59	#157	249	#103	#391
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	337	2071	846	237	1846	676	262	1624	304	1269
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	1.03	0.39	0.91	0.52	0.36	0.89	0.71	0.55	0.94

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	171	2026	310	205	893	259	220	957	132	160	1000	134
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4786	1362	3433	6291		3433	4995	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4786	1362	3433	6291		3433	4995	
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)	180	2133	326	216	940	273	232	1007	139	168	1053	141
RTOR Reduction (vph)	0	0	3	0	2	151	0	23	0	0	16	0
Lane Group Flow (vph)	180	2133	323	216	965	95	232	1123	0	168	1178	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	10.0	44.8	53.2	7.6	42.4	42.4	8.4	26.3		9.7	27.6	
Effective Green, g (s)	10.0	44.8	53.2	7.6	42.4	42.4	8.4	26.3		9.7	27.6	
Actuated g/C Ratio	0.09	0.41	0.48	0.07	0.39	0.39	0.08	0.24		0.09	0.25	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	312	2071	843	237	1845	525	262	1504		303	1253	
v/s Ratio Prot	0.05	c0.42	0.03	c0.06	0.20		0.07	c0.18		0.05	c0.24	
v/s Ratio Perm			0.17			0.07						
v/c Ratio	0.58	1.03	0.38	0.91	0.52	0.18	0.89	0.75		0.55	0.94	
Uniform Delay, d1	48.0	32.6	18.0	50.9	26.0	22.3	50.3	38.8		48.1	40.4	
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	2.6	27.9	0.3	35.4	0.3	0.2	27.9	2.1		2.2	13.6	
Delay (s)	50.5	60.5	18.3	86.3	26.3	22.5	78.2	40.8		50.3	54.0	
Level of Service	D	E	B	F	C	C	E	D		D	D	
Approach Delay (s)		54.6			34.7			47.1			53.5	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM Average Control Delay	48.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.2
Intersection Capacity Utilization	91.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	1701	660	0	759	0	0	0	0	0	0	722
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	1791	695	0	799	0	0	0	0	0	0	760
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.61			0.61	0.61	0.61	0.61	0.61	
vC, conflicting volume	799			2485			2404	2937	944	1396	3284	266
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	799			1187			1054	1929	0	0	2501	266
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			0	100	100	100	100	0
cM capacity (veh/h)	819			355			0	40	659	622	17	732

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	716	716	1053	266	266	266	760
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	695	0	0	0	760
cSH	1700	1700	1700	1700	1700	1700	732
Volume to Capacity	0.42	0.42	0.62	0.16	0.16	0.16	1.04
Queue Length 95th (ft)	0	0	0	0	0	0	468
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	67.3
Lane LOS							F
Approach Delay (s)	0.0			0.0			67.3
Approach LOS							F

Intersection Summary			
Average Delay	12.6		
Intersection Capacity Utilization	66.0%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	48	182	235	225	23	1835	522	1740
v/c Ratio	0.40	0.63	0.73	0.70	0.19	0.58	0.38	0.52
Control Delay	44.2	51.3	41.4	38.9	2.0	1.4	0.1	11.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.2	51.3	41.4	38.9	2.0	1.4	0.1	11.7
Queue Length 50th (ft)	20	128	118	105	1	41	0	223
Queue Length 95th (ft)	59	187	196	176	m1	m36	m0	329
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	127	413	427	427	121	3147	1362	3350
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	0.44	0.55	0.53	0.19	0.58	0.38	0.52

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	28	0	18	192	43	375	22	1642	598	0	1628	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.95		1.00	0.89	0.85	1.00	0.99	0.85		1.00	
Flt Protected		0.97		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1712		1681	1505	1504	1770	4764	1362		5074	
Flt Permitted		0.97		0.95	1.00	1.00	0.10	1.00	1.00		1.00	
Satd. Flow (perm)		1712		1681	1505	1504	182	4764	1362		5074	
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)	29	0	19	202	45	395	23	1728	629	0	1714	26
RTOR Reduction (vph)	0	18	0	0	64	64	0	5	0	0	1	0
Lane Group Flow (vph)	0	30	0	182	171	161	23	1830	522	0	1739	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		5.4		18.8	18.8	18.8	71.8	71.8	110.0		71.8	
Effective Green, g (s)		5.4		18.8	18.8	18.8	71.8	71.8	110.0		71.8	
Actuated g/C Ratio		0.05		0.17	0.17	0.17	0.65	0.65	1.00		0.65	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		84		287	257	257	119	3110	1362		3312	
v/s Ratio Prot		0.02		0.11	c0.11			c0.38			0.34	
v/s Ratio Perm						0.11	0.13		c0.38			
v/c Ratio		0.36		0.63	0.67	0.63	0.19	0.59	0.38		0.53	
Uniform Delay, d1		50.6		42.4	42.7	42.3	7.6	10.8	0.0		10.1	
Progression Factor		1.00		1.00	1.00	1.00	0.14	0.11	1.00		1.00	
Incremental Delay, d2		2.6		4.5	6.4	4.7	0.3	0.1	0.1		0.6	
Delay (s)		53.2		46.9	49.0	47.1	1.4	1.3	0.1		10.7	
Level of Service		D		D	D	D	A	A	A		B	
Approach Delay (s)		53.2			47.7			1.0			10.7	
Approach LOS		D			D			A			B	

Intersection Summary			
HCM Average Control Delay	11.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	287	2091	136	1100	211	2089	56	1561
v/c Ratio	0.98	1.18	1.40	0.90	1.09	1.02	0.88	0.93
Control Delay	94.7	121.8	254.0	50.5	85.2	25.9	120.6	36.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	97.0	0.0	0.0
Total Delay	94.7	121.8	254.0	50.5	85.2	123.0	120.6	36.7
Queue Length 50th (ft)	205	~645	~132	295	~176	~442	41	391
Queue Length 95th (ft)	#377	#743	m#247	#356	m135	m253	m#115	#369
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	293	1765	97	1225	193	2054	64	1678
Starvation Cap Reductn	0	0	0	0	0	378	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	1.18	1.40	0.90	1.09	1.25	0.88	0.93

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	273	1612	374	129	849	196	200	1955	29	53	1385	98
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	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.97		1.00	0.97		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4942		1770	4942		1770	5074		1770	5035	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4942		1770	4942		1770	5074		1770	5035	
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)	287	1697	394	136	894	206	211	2058	31	56	1458	103
RTOR Reduction (vph)	0	34	0	0	34	0	0	1	0	0	7	0
Lane Group Flow (vph)	287	2057	0	136	1066	0	211	2088	0	56	1554	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	18.2	38.5		6.0	26.3		12.0	44.5		4.0	36.5	
Effective Green, g (s)	18.2	38.5		6.0	26.3		12.0	44.5		4.0	36.5	
Actuated g/C Ratio	0.17	0.35		0.05	0.24		0.11	0.40		0.04	0.33	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	293	1730		97	1182		193	2053		64	1671	
v/s Ratio Prot	0.16	c0.42		c0.08	0.22		c0.12	c0.41		0.03	0.31	
v/s Ratio Perm												
v/c Ratio	0.98	1.19		1.40	0.90		1.09	1.02		0.88	0.93	
Uniform Delay, d1	45.7	35.8		52.0	40.6		49.0	32.8		52.8	35.5	
Progression Factor	1.00	1.00		0.69	1.06		0.68	0.40		0.81	0.75	
Incremental Delay, d2	46.4	91.1		222.4	7.8		50.2	10.9		63.8	9.6	
Delay (s)	92.1	126.8		258.3	50.7		83.5	23.9		106.5	36.2	
Level of Service	F	F		F	D		F	C		F	D	
Approach Delay (s)		122.6			73.6			29.3			38.7	
Approach LOS		F			E			C			D	

Intersection Summary			
HCM Average Control Delay	68.1	HCM Level of Service	E
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	102.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	479	1271	322	311	708	23	1896	571	1989
v/c Ratio	1.14	1.00	0.84	1.07	0.73	0.34	1.18	0.62	0.87
Control Delay	128.4	61.6	48.0	95.9	20.8	36.3	116.4	10.2	7.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	141.7	0.0	0.5
Total Delay	128.4	61.6	48.0	95.9	20.8	36.3	258.1	10.2	7.6
Queue Length 50th (ft)	~406	~359	166	~249	110	10	~846	89	116
Queue Length 95th (ft)	#647	#448	#391	m#286	m104	39	#985	203	m134
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	419	1265	384	290	1109	68	1609	926	2279
Starvation Cap Reductn	0	0	0	0	0	0	0	0	65
Spillback Cap Reductn	0	0	0	0	0	0	341	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.14	1.00	0.84	1.07	0.64	0.34	1.50	0.62	0.90

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	455	1173	340	295	667	6	22	1801	542	0	1372	518
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4785	1362	1770	5079		1770	3539	1583		4876	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.08	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4785	1362	1770	5079		149	3539	1583		4876	
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)	479	1235	358	311	702	6	23	1896	571	0	1444	545
RTOR Reduction (vph)	0	3	25	0	1	0	0	0	206	0	62	0
Lane Group Flow (vph)	479	1268	297	311	707	0	23	1896	365	0	1927	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	26.0	29.0	29.0	18.0	21.0		50.0	50.0	50.0		50.0	
Effective Green, g (s)	26.0	29.0	29.0	18.0	21.0		50.0	50.0	50.0		50.0	
Actuated g/C Ratio	0.24	0.26	0.26	0.16	0.19		0.45	0.45	0.45		0.45	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	418	1262	359	290	970		68	1609	720		2216	
v/s Ratio Prot	c0.27	c0.26		0.18	0.14			c0.54			0.40	
v/s Ratio Perm			0.22				0.15		0.23			
v/c Ratio	1.15	1.00	0.83	1.07	0.73		0.34	1.18	0.51		0.87	
Uniform Delay, d1	42.0	40.5	38.1	46.0	41.8		19.3	30.0	21.3		27.1	
Progression Factor	1.04	0.88	0.84	0.76	0.43		1.00	1.00	1.00		0.25	
Incremental Delay, d2	88.8	25.5	13.5	60.0	1.5		13.0	87.1	2.5		0.5	
Delay (s)	132.4	61.0	45.4	94.9	19.7		32.3	117.1	23.8		7.3	
Level of Service	F	E	D	F	B		C	F	C		A	
Approach Delay (s)		75.1			42.7			94.9			7.3	
Approach LOS		E			D			F			A	

Intersection Summary			
HCM Average Control Delay	59.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	102.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	477	1956	0	0	1986
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	502	2059	0	0	2091
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked	0.69					
vC, conflicting volume	2756	686			2059	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1957	686			2059	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	0			100	
cM capacity (veh/h)	38	390			268	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	502	686	686	686	697	697	697
Volume Left	0	0	0	0	0	0	0
Volume Right	502	0	0	0	0	0	0
cSH	390	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.29	0.40	0.40	0.40	0.41	0.41	0.41
Queue Length 95th (ft)	561	0	0	0	0	0	0
Control Delay (s)	176.9	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F						
Approach Delay (s)	176.9	0.0			0.0		
Approach LOS	F						

Intersection Summary			
Average Delay	19.1		
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1364	1092	701
v/c Ratio	0.40	0.32	0.79
Control Delay	9.4	4.4	43.4
Queue Delay	0.0	0.0	0.0
Total Delay	9.4	4.4	43.4
Queue Length 50th (ft)	145	49	232
Queue Length 95th (ft)	212	m134	274
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	3381	3381	1369
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.40	0.32	0.51

Intersection Summary

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1296	1037	0	573	93
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.98	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3392	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3392	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1364	1092	0	603	98
RTOR Reduction (vph)	0	0	0	0	15	0
Lane Group Flow (vph)	0	1364	1092	0	686	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		73.1	73.1		28.4	
Effective Green, g (s)		73.1	73.1		28.4	
Actuated g/C Ratio		0.66	0.66		0.26	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		3379	3379		876	
v/s Ratio Prot		c0.27	0.21		c0.20	
v/s Ratio Perm						
v/c Ratio		0.40	0.32		0.78	
Uniform Delay, d1		8.5	7.9		37.9	
Progression Factor		1.00	0.50		1.00	
Incremental Delay, d2		0.4	0.2		4.6	
Delay (s)		8.8	4.2		42.6	
Level of Service		A	A		D	
Approach Delay (s)		8.8	4.2		42.6	
Approach LOS		A	A		D	

Intersection Summary			
HCM Average Control Delay	14.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	51.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	186	1561	494	1169	256	861	739	164	649
v/c Ratio	0.76	1.07	1.34	0.64	0.41	0.63	0.81	1.21	0.33
Control Delay	25.3	52.3	203.9	31.9	18.0	9.0	13.5	179.2	22.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0
Total Delay	25.3	52.3	203.9	31.9	18.0	9.0	14.3	179.2	22.3
Queue Length 50th (ft)	88	~464	~455	256	78	79	101	~142	106
Queue Length 95th (ft)	m71	m371	#660	308	152	m90	m121	#279	138
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	274	1456	370	1815	632	1367	913	135	1943
Starvation Cap Reductn	0	0	0	0	0	0	40	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	1.07	1.34	0.64	0.41	0.63	0.85	1.21	0.33

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	177	1483	0	469	1111	243	0	818	702	156	506	110
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	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4949	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.19	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	350	4949	
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)	186	1561	0	494	1169	256	0	861	739	164	533	116
RTOR Reduction (vph)	0	0	0	0	0	67	0	0	301	0	31	0
Lane Group Flow (vph)	186	1561	0	494	1169	189	0	861	438	164	618	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	15.2	31.5		23.0	39.3	39.3		42.5	42.5	42.5	42.5	
Effective Green, g (s)	15.2	31.5		23.0	39.3	39.3		42.5	42.5	42.5	42.5	
Actuated g/C Ratio	0.14	0.29		0.21	0.36	0.36		0.39	0.39	0.39	0.39	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	245	1456		370	1817	566		1367	612	135	1912	
v/s Ratio Prot	0.11	c0.31		c0.28	0.23			0.24			0.12	
v/s Ratio Perm						0.12			0.28	c0.47		
v/c Ratio	0.76	1.07		1.34	0.64	0.33		0.63	0.72	1.21	0.32	
Uniform Delay, d1	45.6	39.2		43.5	29.5	25.8		27.4	28.6	33.8	23.7	
Progression Factor	0.50	0.40		1.00	1.00	1.00		0.29	0.98	1.00	1.00	
Incremental Delay, d2	1.3	34.0		168.2	1.8	1.6		1.0	3.2	146.4	0.4	
Delay (s)	24.1	49.7		211.7	31.3	27.4		8.9	31.2	180.2	24.1	
Level of Service	C	D		F	C	C		A	C	F	C	
Approach Delay (s)		47.0			77.2			19.2			55.6	
Approach LOS		D			E			B			E	

Intersection Summary			
HCM Average Control Delay	50.4	HCM Level of Service	D
HCM Volume to Capacity ratio	1.20		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	100.5%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	156	1922	139	1460	239	349	25	46	629	136
v/c Ratio	0.75	1.03	0.95	0.86	1.01	0.29	0.04	0.43	0.78	0.30
Control Delay	65.4	59.5	110.1	36.9	105.3	24.9	9.9	57.7	42.7	10.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.4	59.5	110.1	36.9	105.3	24.9	9.9	57.7	42.7	10.3
Queue Length 50th (ft)	96	~482	89	317	~163	87	0	29	193	11
Queue Length 95th (ft)	#193	#588	#212	#410	#318	125	19	66	256	58
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	219	1867	146	1700	237	1218	561	109	911	492
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.71	1.03	0.95	0.86	1.01	0.29	0.04	0.42	0.69	0.28

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	148	1525	301	132	1292	95	227	332	24	44	598	129
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.98		1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	4959		1770	5033		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	4959		1770	5033		1770	3539	1583	1770	3539	1583
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)	156	1605	317	139	1360	100	239	349	25	46	629	136
RTOR Reduction (vph)	0	29	0	0	8	0	0	0	16	0	0	87
Lane Group Flow (vph)	156	1893	0	139	1452	0	239	349	9	46	629	49
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	11.4	36.1		8.0	32.7		13.0	33.3	33.3	3.5	23.8	23.8
Effective Green, g (s)	11.4	36.1		8.0	32.7		13.0	33.3	33.3	3.5	23.8	23.8
Actuated g/C Ratio	0.12	0.37		0.08	0.33		0.13	0.34	0.34	0.04	0.24	0.24
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	204	1810		143	1664		233	1192	533	63	852	381
v/s Ratio Prot	0.09	c0.38		c0.08	0.29		c0.14	0.10		0.03	c0.18	
v/s Ratio Perm									0.01			0.03
v/c Ratio	0.76	1.05		0.97	0.87		1.03	0.29	0.02	0.73	0.74	0.13
Uniform Delay, d1	42.4	31.4		45.3	31.1		43.0	24.1	21.9	47.2	34.7	29.4
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	15.6	34.2		66.4	5.4		65.8	0.1	0.0	34.9	3.4	0.2
Delay (s)	58.0	65.6		111.7	36.5		108.7	24.3	21.9	82.2	38.0	29.6
Level of Service	E	E		F	D		F	C	C	F	D	C
Approach Delay (s)		65.1			43.0			57.1			39.1	
Approach LOS		E			D			E			D	

Intersection Summary			
HCM Average Control Delay	53.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	98.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	87.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	242	0	330	0	0	773	340	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	255	0	347	0	0	814	358	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.82		0.82						0.82	0.82
vC, conflicting volume	1519	174	1172			347			1242	1161
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1523	174	1100			347			1186	1087
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	70	100			100			100	100
cM capacity (veh/h)	96	840	517			1208			82	176

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	255	174	174	814	358
Volume Left	0	0	0	0	0
Volume Right	255	0	0	0	358
cSH	840	1700	1700	1700	1700
Volume to Capacity	0.30	0.10	0.10	0.48	0.21
Queue Length 95th (ft)	32	0	0	0	0
Control Delay (s)	11.1	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	11.1	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	734	0	0	0	0	0	0	380	375	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	773	0	0	0	0	0	0	400	395	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked	0.92	0.92	0.92	0.92	0.92		0.92					
vC, conflicting volume	1195	1195	395	1967	1195	0	395			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1170	1170	304	2006	1170	0	304			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	0	0	100	100	100			75		
cM capacity (veh/h)	127	134	680	0	134	1085	1161			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	773	400	395
Volume Left	0	400	0
Volume Right	773	0	0
cSH	680	1623	1700
Volume to Capacity	1.14	0.25	0.23
Queue Length 95th (ft)	595	24	0
Control Delay (s)	101.5	7.9	0.0
Lane LOS	F	A	
Approach Delay (s)	101.5	4.0	
Approach LOS	F		

Intersection Summary			
Average Delay	52.0		
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	467	438	167	867	337	923
v/c Ratio	0.84	0.75	0.66	0.46	0.34	0.49
Control Delay	34.5	22.6	21.7	6.4	1.1	10.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.5	22.6	21.7	6.4	1.1	10.2
Queue Length 50th (ft)	150	97	21	56	2	104
Queue Length 95th (ft)	#290	#225	m#122	73	m7	148
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	590	610	252	1893	1004	1891
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	41
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.72	0.66	0.46	0.34	0.50

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	444	12	404	159	824	320	0	865	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.85		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1592		1770	3539	1583		3532	
Flt Permitted				0.95	1.00		0.25	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1592		472	3539	1583		3532	
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)	0	0	0	467	13	425	167	867	337	0	911	12
RTOR Reduction (vph)	0	0	0	0	82	0	0	0	157	0	1	0
Lane Group Flow (vph)	0	0	0	467	356	0	167	867	180	0	922	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				18.9	18.9		32.1	32.1	32.1		32.1	
Effective Green, g (s)				18.9	18.9		32.1	32.1	32.1		32.1	
Actuated g/C Ratio				0.31	0.31		0.54	0.54	0.54		0.54	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				558	501		253	1893	847		1890	
v/s Ratio Prot				c0.26	0.22			0.24			0.26	
v/s Ratio Perm							c0.35		0.11			
v/c Ratio				0.84	0.71		0.66	0.46	0.21		0.49	
Uniform Delay, d1				19.1	18.1		10.0	8.6	7.3		8.8	
Progression Factor				1.00	1.00		0.67	0.63	0.29		1.00	
Incremental Delay, d2				10.5	4.7		10.2	0.6	0.5		0.9	
Delay (s)				29.7	22.9		16.9	6.1	2.6		9.7	
Level of Service				C	C		B	A	A		A	
Approach Delay (s)		0.0			26.4			6.5			9.7	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM Average Control Delay	13.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	466	419	1112	1328
v/c Ratio	0.80	0.77	0.59	0.70
Control Delay	28.7	27.0	3.7	9.0
Queue Delay	0.0	0.0	0.0	0.1
Total Delay	28.7	27.0	3.7	9.2
Queue Length 50th (ft)	143	120	42	133
Queue Length 95th (ft)	231	204	m70	168
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	679	623	1897	1897
Starvation Cap Reductn	0	0	13	20
Spillback Cap Reductn	0	0	0	82
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.69	0.67	0.59	0.73

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	443	398	0	1056	1262	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		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	466	419	0	1112	1328	0
RTOR Reduction (vph)	0	17	0	0	0	0
Lane Group Flow (vph)	466	402	0	1112	1328	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	19.8	19.8		32.2	32.2	
Effective Green, g (s)	19.8	19.8		32.2	32.2	
Actuated g/C Ratio	0.33	0.33		0.54	0.54	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	584	522		1899	1899	
v/s Ratio Prot				0.31	c0.38	
v/s Ratio Perm	c0.26	0.25				
v/c Ratio	0.80	0.77		0.59	0.70	
Uniform Delay, d1	18.3	18.0		9.4	10.3	
Progression Factor	1.00	1.00		0.25	0.63	
Incremental Delay, d2	7.5	6.7		1.0	1.8	
Delay (s)	25.8	24.8		3.4	8.3	
Level of Service	C	C		A	A	
Approach Delay (s)	25.3			3.4	8.3	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	11.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	225	585	358	126	382	102	207	831	502	227	1320	295
v/c Ratio	0.95	0.62	0.54	0.86	0.40	0.21	0.88	0.59	0.74	0.96	0.93	0.41
Control Delay	75.3	22.7	7.2	73.2	19.7	5.6	64.1	16.2	21.2	68.8	24.2	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	75.3	22.7	7.2	73.2	19.7	5.6	64.1	16.2	21.2	68.8	24.2	3.5
Queue Length 50th (ft)	80	97	10	43	59	0	75	119	125	89	218	6
Queue Length 95th (ft)	#199	144	68	#132	94	30	#181	170	#268	m#162	#357	m14
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	236	944	657	146	944	497	236	1416	679	236	1416	728
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.95	0.62	0.54	0.86	0.40	0.21	0.88	0.59	0.74	0.96	0.93	0.41

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	214	556	340	120	363	97	197	789	477	216	1254	280
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.48	1.00	1.00	0.29	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	885	3539	1583	548	3539	1583	1770	3539	1583	1770	3539	1583
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)	225	585	358	126	382	102	207	831	502	227	1320	295
RTOR Reduction (vph)	0	0	235	0	0	75	0	0	46	0	0	95
Lane Group Flow (vph)	225	585	123	126	382	27	207	831	456	227	1320	200
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	16.0	16.0	16.0	16.0	16.0	16.0	8.0	24.0	24.0	8.0	24.0	24.0
Effective Green, g (s)	16.0	16.0	16.0	16.0	16.0	16.0	8.0	24.0	24.0	8.0	24.0	24.0
Actuated g/C Ratio	0.27	0.27	0.27	0.27	0.27	0.27	0.13	0.40	0.40	0.13	0.40	0.40
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	236	944	422	146	944	422	236	1416	633	236	1416	633
v/s Ratio Prot		0.17			0.11		c0.12	0.23		0.13	c0.37	
v/s Ratio Perm	c0.25		0.08	0.23		0.02			0.29			0.13
v/c Ratio	0.95	0.62	0.29	0.86	0.40	0.06	0.88	0.59	0.72	0.96	0.93	0.32
Uniform Delay, d1	21.6	19.3	17.5	21.0	18.1	16.4	25.5	14.1	15.2	25.8	17.2	12.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.79	0.71	0.36
Incremental Delay, d2	45.4	1.2	0.4	37.5	0.3	0.1	28.5	1.8	6.9	40.2	9.9	1.0
Delay (s)	67.0	20.5	17.9	58.4	18.4	16.5	54.0	15.9	22.1	60.6	22.1	5.5
Level of Service	E	C	B	E	B	B	D	B	C	E	C	A
Approach Delay (s)		28.7			26.3			23.0			24.2	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	25.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	247	719	0	494	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	260	757	0	520	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			1017		520	130
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1017		520	130
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			678		486	896

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	173	339	505	260	260
Volume Left	0	0	0	0	0
Volume Right	0	252	505	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.10	0.20	0.30	0.15	0.15
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	33.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	145	1927	1182	181
v/c Ratio	0.41	0.54	0.46	0.15
Control Delay	20.5	0.5	6.4	1.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.5	0.5	6.4	1.5
Queue Length 50th (ft)	56	0	120	2
Queue Length 95th (ft)	m57	0	162	20
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	405	3539	2548	1185
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.36	0.54	0.46	0.15

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	138	1831	1123	172
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	145	1927	1182	181
RTOR Reduction (vph)	0	0	0	0	0	49
Lane Group Flow (vph)	0	0	145	1927	1182	132
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			12.8	70.0	48.7	48.7
Effective Green, g (s)			12.8	70.0	48.7	48.7
Actuated g/C Ratio			0.18	1.00	0.70	0.70
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			324	3539	2462	1101
v/s Ratio Prot			0.08	c0.54	0.33	
v/s Ratio Perm						0.08
v/c Ratio			0.45	0.54	0.48	0.12
Uniform Delay, d1			25.5	0.0	4.9	3.5
Progression Factor			0.76	1.00	1.00	1.00
Incremental Delay, d2			0.7	0.4	0.7	0.2
Delay (s)			20.1	0.4	5.5	3.8
Level of Service			C	A	A	A
Approach Delay (s)	0.0			1.8	5.3	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	3.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	192	138	0	1861	1141	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	202	145	0	1959	1201	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.67	0.84	0.84			
vC, conflicting volume	2181	601	1201			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	688	142	857			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	20	80	100			
cM capacity (veh/h)	253	739	654			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	135	213	979	979	601	601
Volume Left	135	67	0	0	0	0
Volume Right	0	145	0	0	0	0
cSH	253	460	1700	1700	1700	1700
Volume to Capacity	0.53	0.46	0.58	0.58	0.35	0.35
Queue Length 95th (ft)	71	60	0	0	0	0
Control Delay (s)	34.3	19.4	0.0	0.0	0.0	0.0
Lane LOS	D	C				
Approach Delay (s)	25.2		0.0		0.0	
Approach LOS	D					

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	287	180	28	84	215	1670	20	1000	218
v/c Ratio	0.89	0.21	0.10	0.10	0.57	0.77	0.09	0.62	0.27
Control Delay	57.1	7.1	20.9	11.6	12.7	14.4	5.8	12.1	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.1	7.1	20.9	11.6	12.7	14.4	5.8	12.1	2.5
Queue Length 50th (ft)	118	6	9	6	34	231	1	168	4
Queue Length 95th (ft)	#248	28	28	22	75	#497	m3	243	21
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	335	908	305	871	422	2174	216	1605	793
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.20	0.09	0.10	0.51	0.77	0.09	0.62	0.27

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	273	38	133	27	37	43	204	1545	42	19	950	207
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.88		1.00	0.92		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3126		1770	3255		1770	3525		1770	3539	1583
Flt Permitted	0.70	1.00		0.64	1.00		0.16	1.00		0.13	1.00	1.00
Satd. Flow (perm)	1303	3126		1189	3255		297	3525		235	3539	1583
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)	287	40	140	28	39	45	215	1626	44	20	1000	218
RTOR Reduction (vph)	0	105	0	0	34	0	0	3	0	0	0	76
Lane Group Flow (vph)	287	75	0	28	50	0	215	1667	0	20	1000	142
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	17.3	17.3		17.3	17.3		44.7	39.9		32.5	31.7	31.7
Effective Green, g (s)	17.3	17.3		17.3	17.3		44.7	39.9		32.5	31.7	31.7
Actuated g/C Ratio	0.25	0.25		0.25	0.25		0.64	0.57		0.46	0.45	0.45
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	322	773		294	804		379	2009		127	1603	717
v/s Ratio Prot		0.02			0.02		c0.07	c0.47		0.00	0.28	
v/s Ratio Perm	c0.22			0.02			0.29			0.07		0.09
v/c Ratio	0.89	0.10		0.10	0.06		0.57	0.83		0.16	0.62	0.20
Uniform Delay, d1	25.4	20.3		20.3	20.1		8.2	12.3		12.2	14.6	11.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.84	0.67	0.32
Incremental Delay, d2	25.0	0.1		0.1	0.0		1.9	4.1		0.5	1.7	0.6
Delay (s)	50.4	20.4		20.5	20.2		10.1	16.4		10.8	11.5	4.2
Level of Service	D	C		C	C		B	B		B	B	A
Approach Delay (s)		38.9			20.3			15.7			10.2	
Approach LOS		D			C			B			B	

Intersection Summary			
HCM Average Control Delay	16.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	1231	464	982	102	157	1095
v/c Ratio	0.89	0.56	0.76	0.16	0.75	0.60
Control Delay	39.6	10.3	28.3	6.3	69.3	20.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.6	10.3	28.3	6.3	69.3	20.4
Queue Length 50th (ft)	398	68	215	7	108	281
Queue Length 95th (ft)	494	166	261	m22	#199	349
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	1436	844	1293	622	225	1838
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.55	0.76	0.16	0.70	0.60

Intersection Summary

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

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	1169	441	933	97	149	1040
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1231	464	982	102	157	1095
RTOR Reduction (vph)	0	186	0	44	0	0
Lane Group Flow (vph)	1231	278	982	58	157	1095
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	44.4	44.4	40.1	40.1	13.0	57.1
Effective Green, g (s)	44.4	44.4	40.1	40.1	13.0	57.1
Actuated g/C Ratio	0.40	0.40	0.36	0.36	0.12	0.52
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1386	639	1290	577	209	1837
v/s Ratio Prot	c0.36		c0.28		c0.09	0.31
v/s Ratio Perm		0.18		0.04		
v/c Ratio	0.89	0.43	0.76	0.10	0.75	0.60
Uniform Delay, d1	30.5	23.7	30.7	23.1	46.9	18.4
Progression Factor	1.00	1.00	0.77	0.57	1.00	1.00
Incremental Delay, d2	7.3	0.5	3.9	0.3	14.1	1.4
Delay (s)	37.8	24.2	27.5	13.5	61.0	19.9
Level of Service	D	C	C	B	E	B
Approach Delay (s)	34.1		26.2			25.0
Approach LOS	C		C			C

Intersection Summary			
HCM Average Control Delay	29.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	77.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	342	353	837	1431	191	2175
v/c Ratio	0.65	0.78	0.36	1.09	1.32	0.80
Control Delay	49.5	26.6	9.7	65.5	209.9	5.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.5	26.6	9.7	65.5	209.9	5.9
Queue Length 50th (ft)	119	71	127	~933	~179	98
Queue Length 95th (ft)	157	174	190	#1198	m#270	416
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	687	513	2307	1310	145	2726
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.69	0.36	1.09	1.32	0.80

Intersection Summary

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

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

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	325	335	795	1359	181	2066
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	342	353	837	1431	191	2175
RTOR Reduction (vph)	0	208	0	279	0	0
Lane Group Flow (vph)	342	145	837	1152	191	2175
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	16.8	16.8	71.7	71.7	9.0	84.7
Effective Green, g (s)	16.8	16.8	71.7	71.7	9.0	84.7
Actuated g/C Ratio	0.15	0.15	0.65	0.65	0.08	0.77
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	524	242	2307	1032	145	2725
v/s Ratio Prot	c0.10		0.24		c0.11	0.61
v/s Ratio Perm		0.09		c0.73		
v/c Ratio	0.65	0.60	0.36	1.12	1.32	0.80
Uniform Delay, d1	43.9	43.4	8.7	19.1	50.5	7.5
Progression Factor	1.00	1.00	1.00	1.00	0.92	0.48
Incremental Delay, d2	2.9	3.9	0.4	65.8	171.7	1.7
Delay (s)	46.8	47.4	9.2	85.0	218.0	5.3
Level of Service	D	D	A	F	F	A
Approach Delay (s)	47.1		57.0			22.5
Approach LOS	D		E			C

Intersection Summary			
HCM Average Control Delay	40.4	HCM Level of Service	D
HCM Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	101.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	59	110	1536	169	80	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	62	116	1617	178	84	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	1874	1706			1617	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1874	1706			1617	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	0			79	
cM capacity (veh/h)	62	113			403	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	62	116	1795	84	0
Volume Left	62	0	0	84	0
Volume Right	0	116	178	0	0
cSH	62	113	1700	403	1700
Volume to Capacity	1.00	1.02	1.06	0.21	0.00
Queue Length 95th (ft)	120	169	0	19	0
Control Delay (s)	222.3	163.8	0.0	16.3	0.0
Lane LOS	F	F		C	
Approach Delay (s)	184.2		0.0	16.3	
Approach LOS	F				

Intersection Summary			
Average Delay	16.6		
Intersection Capacity Utilization	104.6%	ICU Level of Service	G
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2250	1693	562	200	1105	695	1103
v/c Ratio	1.00	1.07	0.51	0.77	1.01	1.01	0.81
Control Delay	52.4	84.4	20.3	63.4	65.7	84.3	46.4
Queue Delay	363.5	327.1	120.9	0.0	120.0	109.4	0.0
Total Delay	416.0	411.5	141.2	63.4	185.8	193.7	46.4
Queue Length 50th (ft)	~624	~786	394	158	~321	~283	292
Queue Length 95th (ft)	#757	m#755	m401	#269	#426	#411	348
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2248	1578	1097	261	1093	689	1369
Starvation Cap Reductn	0	641	650	0	0	0	0
Spillback Cap Reductn	1018	0	0	0	243	146	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.83	1.81	1.26	0.77	1.30	1.28	0.81

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1973	164	0	1608	534	190	999	50	660	1047	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5027			3539	1583	1770	5049		3433	5085	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5027			3539	1583	1770	5049		3433	5085	
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)	0	2077	173	0	1693	562	200	1052	53	695	1102	1
RTOR Reduction (vph)	0	8	0	0	0	0	0	3	0	0	0	0
Lane Group Flow (vph)	0	2242	0	0	1693	562	200	1102	0	695	1103	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		53.5			53.5	77.6	17.7	25.9		24.1	32.3	
Effective Green, g (s)		53.5			53.5	77.6	17.7	25.9		24.1	32.3	
Actuated g/C Ratio		0.45			0.45	0.65	0.15	0.22		0.20	0.27	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2241			1578	1096	261	1090		689	1369	
v/s Ratio Prot		0.45			c0.48	0.10	0.11	c0.22		c0.20	0.22	
v/s Ratio Perm						0.25						
v/c Ratio		1.00			1.07	0.51	0.77	1.01		1.01	0.81	
Uniform Delay, d1		33.2			33.2	11.2	49.2	47.0		48.0	40.9	
Progression Factor		1.00			1.55	2.20	0.90	0.76		1.00	1.00	
Incremental Delay, d2		19.1			36.4	0.1	18.2	29.2		36.5	5.1	
Delay (s)		52.4			87.9	24.7	62.5	65.1		84.4	46.1	
Level of Service		D			F	C	E	E		F	D	
Approach Delay (s)		52.4			72.1			64.7			60.9	
Approach LOS		D			E			E			E	

Intersection Summary			
HCM Average Control Delay	62.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
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			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	422	2372	47	1864	664	106	374	804	574
v/c Ratio	1.04	0.85	0.53	1.06	1.01	0.37	1.00	0.80	0.80
Control Delay	78.1	34.6	89.2	61.6	86.4	18.5	99.5	46.8	22.7
Queue Delay	48.6	190.3	0.0	286.4	0.0	3.3	650.2	0.0	10.6
Total Delay	126.7	224.9	89.2	348.0	86.4	21.8	749.6	46.8	33.3
Queue Length 50th (ft)	~346	544	39	~597	~195	9	151	304	148
Queue Length 95th (ft)	m#345	m542	m70	#696	m#261	m29	#254	381	310
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	406	2776	90	1762	657	283	375	1006	719
Starvation Cap Reductn	44	1109	0	0	0	0	0	0	0
Spillback Cap Reductn	0	430	0	667	0	106	375	0	124
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	1.42	0.52	1.70	1.01	0.60	374.00	0.80	0.96

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	401	2222	31	45	1613	158	0	631	101	355	764	545
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5075		1770	5017			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5075		1770	5017			5085	1583	3433	3539	1583
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)	422	2339	33	47	1698	166	0	664	106	374	804	574
RTOR Reduction (vph)	0	1	0	0	10	0	0	0	78	0	0	269
Lane Group Flow (vph)	422	2371	0	47	1854	0	0	664	28	374	804	305
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	28.6	64.5		4.9	40.8			15.5	15.5	13.1	34.1	34.1
Effective Green, g (s)	28.6	64.5		4.9	40.8			15.5	15.5	13.1	34.1	34.1
Actuated g/C Ratio	0.24	0.54		0.04	0.34			0.13	0.13	0.11	0.28	0.28
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	422	2728		72	1706			657	204	375	1006	450
v/s Ratio Prot	c0.24	0.47		0.03	c0.37			c0.13		c0.11	0.23	
v/s Ratio Perm									0.02			0.19
v/c Ratio	1.00	0.87		0.65	1.09			1.01	0.14	1.00	0.80	0.68
Uniform Delay, d1	45.7	24.1		56.7	39.6			52.2	46.3	53.4	39.8	38.1
Progression Factor	1.20	1.42		1.27	0.60			1.02	1.16	1.00	1.00	1.00
Incremental Delay, d2	13.1	0.4		16.6	48.2			33.3	1.1	45.8	6.6	8.0
Delay (s)	67.9	34.7		88.5	71.9			86.9	54.6	99.3	46.4	46.0
Level of Service	E	C		F	E			F	D	F	D	D
Approach Delay (s)		39.7			72.3			82.4			57.6	
Approach LOS		D			E			F			E	

Intersection Summary			
HCM Average Control Delay	57.2	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	97.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	189	889	87	1174	392	48	249	169	532	46
v/c Ratio	0.88	0.30	0.28	0.39	0.36	0.36	0.92	0.56	0.56	0.14
Control Delay	56.9	1.5	15.3	13.8	2.1	60.7	92.4	82.6	79.7	55.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.9	1.5	15.3	13.8	2.1	60.7	92.4	82.6	79.7	55.2
Queue Length 50th (ft)	78	9	32	169	0	36	101	154	162	28
Queue Length 95th (ft)	m#127	m19	66	200	40	76	#183	m195	m202	m35
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	214	2944	310	2983	1091	134	270	304	953	339
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.30	0.28	0.39	0.36	0.36	0.92	0.56	0.56	0.14

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	180	745	100	83	1115	372	46	224	12	256	410	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	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	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (prot)	1770	4995		1770	5085	1583	1770	3511		1522	4761	1583
Flt Permitted	0.20	1.00		0.28	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (perm)	365	4995		529	5085	1583	1770	3511		1522	4761	1583
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)	189	784	105	87	1174	392	48	236	13	269	432	46
RTOR Reduction (vph)	0	14	0	0	0	162	0	4	0	0	0	22
Lane Group Flow (vph)	189	875	0	87	1174	230	48	245	0	169	532	24
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	70.4	70.4		70.4	70.4	70.4	9.1	9.1		24.0	24.0	24.0
Effective Green, g (s)	70.4	70.4		70.4	70.4	70.4	9.1	9.1		24.0	24.0	24.0
Actuated g/C Ratio	0.59	0.59		0.59	0.59	0.59	0.08	0.08		0.20	0.20	0.20
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	214	2930		310	2983	929	134	266		304	952	317
v/s Ratio Prot		0.18			0.23		0.03	c0.07		0.11	c0.11	
v/s Ratio Perm	c0.52			0.16		0.15						0.01
v/c Ratio	0.88	0.30		0.28	0.39	0.25	0.36	0.92		0.56	0.56	0.07
Uniform Delay, d1	21.3	12.4		12.3	13.3	12.0	52.7	55.1		43.2	43.2	39.0
Progression Factor	1.44	0.11		1.00	1.00	1.00	1.00	1.00		1.78	1.80	2.62
Incremental Delay, d2	23.2	0.1		2.2	0.4	0.6	7.3	38.3		4.3	1.4	0.3
Delay (s)	53.9	1.6		14.5	13.7	12.6	60.0	93.4		81.2	79.3	102.5
Level of Service	D	A		B	B	B	E	F		F	E	F
Approach Delay (s)		10.7			13.5			88.0			81.1	
Approach LOS		B			B			F			F	

Intersection Summary			
HCM Average Control Delay	32.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	28	2655	117	309	1905	59	14	142	279	95	69
v/c Ratio	0.31	1.00	0.14	1.05	0.55	0.61	0.10	0.47	1.16	0.30	0.21
Control Delay	66.0	56.0	17.7	74.4	13.4	79.2	52.7	34.2	148.4	44.2	10.9
Queue Delay	0.0	64.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.0	120.3	17.7	74.4	13.4	79.2	52.7	34.2	148.4	44.2	10.9
Queue Length 50th (ft)	20	~849	54	~252	253	45	10	63	~215	63	0
Queue Length 95th (ft)	m24	m#930	m61	m#264	m256	#98	32	129	#407	113	40
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	91	2666	858	294	3437	108	155	305	241	373	372
Starvation Cap Reductn	0	374	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	1.16	0.14	1.05	0.55	0.55	0.09	0.47	1.16	0.25	0.19

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	2522	111	294	1769	41	56	13	135	265	90	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		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	5085	1583	1770	5068		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.70	1.00	1.00	0.49	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	5068		1295	1863	1583	921	1863	1583
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)	28	2655	117	309	1862	43	59	14	142	279	95	69
RTOR Reduction (vph)	0	0	30	0	2	0	0	0	42	0	0	56
Lane Group Flow (vph)	28	2655	87	309	1903	0	59	14	100	279	95	13
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	3.7	59.6	59.6	22.1	78.0		7.8	7.8	22.1	21.8	21.8	21.8
Effective Green, g (s)	3.7	59.6	59.6	22.1	78.0		7.8	7.8	22.1	21.8	21.8	21.8
Actuated g/C Ratio	0.03	0.50	0.50	0.18	0.65		0.06	0.06	0.18	0.18	0.18	0.18
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	55	2526	786	326	3294		84	121	292	238	338	288
v/s Ratio Prot	0.02	c0.52		c0.17	0.38			0.01	0.06	c0.10	0.05	
v/s Ratio Perm			0.06				0.05			c0.12		0.01
v/c Ratio	0.51	1.05	0.11	0.95	0.58		0.70	0.12	0.34	1.17	0.28	0.04
Uniform Delay, d1	57.3	30.2	16.1	48.4	11.8		55.0	52.9	42.6	48.1	42.3	40.5
Progression Factor	1.11	1.60	2.06	0.61	1.14		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.6	28.7	0.1	14.9	0.2		23.3	0.4	0.7	112.9	0.5	0.1
Delay (s)	67.1	77.2	33.3	44.5	13.7		78.2	53.3	43.3	161.0	42.8	40.6
Level of Service	E	E	C	D	B		E	D	D	F	D	D
Approach Delay (s)		75.2			18.0			53.6			116.9	
Approach LOS		E			B			D			F	

Intersection Summary			
HCM Average Control Delay	55.3	HCM Level of Service	E
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	100.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	36	3071	2453	509
v/c Ratio	0.22	1.12	0.98	0.49
Control Delay	35.0	65.7	28.2	37.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	35.0	65.7	28.2	37.4
Queue Length 50th (ft)	26	~983	~758	174
Queue Length 95th (ft)	m28	m#971	#835	235
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	413	2754	2491	1033
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.09	1.12	0.98	0.49

Intersection Summary

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

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

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	34	2917	2139	191	454	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.99		0.99	
Flt Protected	0.95	1.00	1.00		0.96	
Satd. Flow (prot)	1770	5085	5023		3420	
Flt Permitted	0.95	1.00	1.00		0.96	
Satd. Flow (perm)	1770	5085	5023		3420	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	36	3071	2252	201	478	31
RTOR Reduction (vph)	0	0	9	0	3	0
Lane Group Flow (vph)	36	3071	2444	0	506	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	7.0	62.8	54.9		36.1	
Effective Green, g (s)	7.0	62.8	54.9		36.1	
Actuated g/C Ratio	0.06	0.52	0.46		0.30	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	103	2661	2298		1029	
v/s Ratio Prot	c0.02	c0.60	0.49		c0.15	
v/s Ratio Perm						
v/c Ratio	0.35	1.15	1.06		0.49	
Uniform Delay, d1	54.3	28.6	32.5		34.4	
Progression Factor	1.29	0.29	0.50		1.00	
Incremental Delay, d2	0.6	70.7	35.1		1.7	
Delay (s)	70.4	79.1	51.4		36.1	
Level of Service	E	E	D		D	
Approach Delay (s)		79.0	51.4		36.1	
Approach LOS		E	D		D	

Intersection Summary			
HCM Average Control Delay	64.3	HCM Level of Service	E
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	79.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	138	3388	22	73	2508	80	129	218
v/c Ratio	0.70	0.96	0.02	0.84	0.79	0.94	0.81	0.64
Control Delay	39.1	7.5	0.5	116.4	18.7	128.7	86.8	25.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.1	7.5	0.5	116.4	18.7	128.7	86.8	25.2
Queue Length 50th (ft)	104	137	0	57	487	54	99	44
Queue Length 95th (ft)	m104	m121	m0	#147	550	#159	#207	128
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	198	3513	1099	87	3182	85	159	338
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.70	0.96	0.02	0.84	0.79	0.94	0.81	0.64

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	131	3219	21	69	2309	73	29	28	19	123	37	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.97		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5062			1766		1770	1633	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.34		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5062			618		1294	1633	
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)	138	3388	22	73	2431	77	31	29	20	129	39	179
RTOR Reduction (vph)	0	0	6	0	3	0	0	10	0	0	138	0
Lane Group Flow (vph)	138	3388	16	73	2505	0	0	70	0	129	80	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	13.4	82.9	82.9	5.9	75.4			14.7		14.7	14.7	
Effective Green, g (s)	13.4	82.9	82.9	5.9	75.4			14.7		14.7	14.7	
Actuated g/C Ratio	0.11	0.69	0.69	0.05	0.63			0.12		0.12	0.12	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	198	3513	1094	87	3181			76		159	200	
v/s Ratio Prot	0.08	c0.67		0.04	c0.49						0.05	
v/s Ratio Perm			0.01					c0.11		0.10		
v/c Ratio	0.70	0.96	0.01	0.84	0.79			0.93		0.81	0.40	
Uniform Delay, d1	51.3	17.2	5.8	56.6	16.4			52.1		51.3	48.6	
Progression Factor	0.70	0.32	0.17	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	1.0	1.2	0.0	47.4	2.1			84.0		25.9	1.3	
Delay (s)	37.1	6.6	1.0	104.0	18.5			136.1		77.2	49.9	
Level of Service	D	A	A	F	B			F		E	D	
Approach Delay (s)		7.7			20.9			136.1			60.1	
Approach LOS		A			C			F			E	

Intersection Summary			
HCM Average Control Delay	17.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	101.8%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	29	1661	258	1162	78	273	340	29	322	19
v/c Ratio	0.12	0.92	0.84	0.49	0.74	0.66	0.73	0.20	0.78	0.05
Control Delay	14.0	30.3	43.8	8.1	69.8	38.3	26.9	30.6	44.7	14.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.0	30.3	43.8	8.1	69.8	38.3	26.9	30.6	44.7	14.4
Queue Length 50th (ft)	8	424	83	144	40	136	97	13	165	2
Queue Length 95th (ft)	26	#641	#224	211	#110	217	193	37	258	19
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	238	1841	322	2438	131	511	541	178	511	445
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.90	0.80	0.48	0.60	0.53	0.63	0.16	0.63	0.04

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	28	1465	113	245	1073	31	74	259	323	28	306	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3501		1770	3524		1770	1863	1583	1770	1863	1583
Flt Permitted	0.24	1.00		0.09	1.00		0.26	1.00	1.00	0.35	1.00	1.00
Satd. Flow (perm)	454	3501		161	3524		477	1863	1583	649	1863	1583
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)	29	1542	119	258	1129	33	78	273	340	29	322	19
RTOR Reduction (vph)	0	6	0	0	2	0	0	0	114	0	0	12
Lane Group Flow (vph)	29	1655	0	258	1160	0	78	273	226	29	322	7
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	43.3	43.3		56.6	56.6		18.8	18.8	18.8	18.8	18.8	18.8
Effective Green, g (s)	43.3	43.3		56.6	56.6		18.8	18.8	18.8	18.8	18.8	18.8
Actuated g/C Ratio	0.51	0.51		0.67	0.67		0.22	0.22	0.22	0.22	0.22	0.22
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	233	1796		304	2363		106	415	353	145	415	353
v/s Ratio Prot		c0.47		c0.10	0.33			0.15			c0.17	
v/s Ratio Perm	0.06			0.47			0.16		0.14	0.04		0.00
v/c Ratio	0.12	0.92		0.85	0.49		0.74	0.66	0.64	0.20	0.78	0.02
Uniform Delay, d1	10.7	19.0		23.5	6.8		30.5	29.9	29.7	26.7	30.8	25.6
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	0.2	8.3		19.3	0.2		23.1	3.7	3.8	0.7	8.8	0.0
Delay (s)	10.9	27.3		42.7	7.0		53.6	33.6	33.5	27.4	39.6	25.6
Level of Service	B	C		D	A		D	C	C	C	D	C
Approach Delay (s)		27.0			13.5			35.8			38.0	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM Average Control Delay	24.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	84.4	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			

Lane Group	EBL	NBT	SBT
Lane Group Flow (vph)	347	1959	1201
v/c Ratio	0.59	0.76	0.46
Control Delay	23.6	5.5	4.9
Queue Delay	0.0	0.7	0.2
Total Delay	23.6	6.2	5.1
Queue Length 50th (ft)	51	64	161
Queue Length 95th (ft)	84	75	250
Internal Link Dist (ft)	342	302	370
Turn Bay Length (ft)	170		
Base Capacity (vph)	827	2593	2593
Starvation Cap Reductn	0	306	593
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.42	0.86	0.60

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	192	138	0	1861	1141	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	
Lane Util. Factor	0.97			0.95	0.95	
Frt	0.94			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	3291			3539	3539	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	3291			3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	202	145	0	1959	1201	0
RTOR Reduction (vph)	82	0	0	0	0	0
Lane Group Flow (vph)	265	0	0	1959	1201	0
Turn Type						
Protected Phases	4			2	6	
Permitted Phases						
Actuated Green, G (s)	10.7			51.3	51.3	
Effective Green, g (s)	10.7			51.3	51.3	
Actuated g/C Ratio	0.15			0.73	0.73	
Clearance Time (s)	4.0			4.0	4.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	503			2594	2594	
v/s Ratio Prot	c0.08			c0.55	0.34	
v/s Ratio Perm						
v/c Ratio	0.53			0.76	0.46	
Uniform Delay, d1	27.3			5.6	3.8	
Progression Factor	1.00			0.64	1.04	
Incremental Delay, d2	1.0			1.3	0.5	
Delay (s)	28.3			4.9	4.5	
Level of Service	C			A	A	
Approach Delay (s)	28.3			4.9	4.5	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	7.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues
29: College Park Dr & SR-22 Ramps

11/21/2012

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	62	116	1795	84	191
v/c Ratio	0.42	0.51	1.37	0.49	0.12
Control Delay	55.5	20.2	192.8	46.7	3.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	55.5	20.2	192.8	46.7	3.0
Queue Length 50th (ft)	42	9	~1692	58	12
Queue Length 95th (ft)	83	63	#1962	m#115	m69
Internal Link Dist (ft)	864		215		720
Turn Bay Length (ft)					
Base Capacity (vph)	257	317	1308	173	1571
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.24	0.37	1.37	0.49	0.12

Intersection Summary

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

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

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	59	110	1536	169	80	181
Ideal Flow (vphpl)	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		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1838		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	1838		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	62	116	1617	178	84	191
RTOR Reduction (vph)	0	93	3	0	0	0
Lane Group Flow (vph)	62	23	1792	0	84	191
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	9.2	9.2	78.0		10.8	92.8
Effective Green, g (s)	9.2	9.2	78.0		10.8	92.8
Actuated g/C Ratio	0.08	0.08	0.71		0.10	0.84
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	148	132	1303		174	1572
v/s Ratio Prot	c0.04		c0.97		c0.05	0.10
v/s Ratio Perm		0.01				
v/c Ratio	0.42	0.17	1.37		0.48	0.12
Uniform Delay, d1	47.9	46.9	16.0		47.0	1.5
Progression Factor	1.00	1.00	1.00		0.75	1.68
Incremental Delay, d2	1.9	0.6	173.6		1.9	0.1
Delay (s)	49.8	47.5	189.6		37.1	2.7
Level of Service	D	D	F		D	A
Approach Delay (s)	48.3		189.6			13.2
Approach LOS	D		F			B

Intersection Summary			
HCM Average Control Delay	156.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.19		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	104.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
13: Los Coyotes Diagonal & Bellflower St

3/27/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	333	1141	332	174	652	15	1035	257	1236
v/c Ratio	0.38	0.80	0.63	0.72	0.70	0.12	0.64	0.30	0.54
Control Delay	38.2	39.1	20.4	64.5	24.1	24.8	28.4	3.6	5.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.2
Total Delay	38.2	39.1	20.4	64.5	24.1	24.8	29.0	3.6	5.6
Queue Length 50th (ft)	112	219	112	144	110	7	329	0	72
Queue Length 95th (ft)	165	268	165	m217	133	24	424	50	m39
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	868	1487	539	295	1674	124	1616	862	2279
Starvation Cap Reductn	0	0	0	0	0	0	0	0	295
Spillback Cap Reductn	0	0	0	0	0	0	253	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	0.77	0.62	0.59	0.39	0.12	0.76	0.30	0.62

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	316	914	485	165	619	0	14	983	244	0	647	527
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	0.97	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	0.98	0.85	1.00	1.00		1.00	1.00	0.85		0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	3433	4693	1362	1770	5085		1770	3539	1583		4743	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.15	1.00	1.00		1.00	
Satd. Flow (perm)	3433	4693	1362	1770	5085		272	3539	1583		4743	
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)	333	962	511	174	652	0	15	1035	257	0	681	555
RTOR Reduction (vph)	0	21	116	0	0	0	0	0	140	0	113	0
Lane Group Flow (vph)	333	1120	216	174	652	0	15	1035	117	0	1123	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	30.4	35.9	35.9	16.4	21.9		54.7	54.7	54.7		54.7	
Effective Green, g (s)	30.4	35.9	35.9	16.4	21.9		54.7	54.7	54.7		54.7	
Actuated g/C Ratio	0.25	0.30	0.30	0.14	0.18		0.46	0.46	0.46		0.46	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	870	1404	407	242	928		124	1613	722		2162	
v/s Ratio Prot	0.10	c0.24		c0.10	0.13			c0.29			0.24	
v/s Ratio Perm			0.16				0.06		0.07			
v/c Ratio	0.38	0.80	0.53	0.72	0.70		0.12	0.64	0.16		0.52	
Uniform Delay, d1	37.0	38.7	35.0	49.6	46.0		18.8	25.1	19.2		23.3	
Progression Factor	1.00	0.92	0.87	1.05	0.45		1.00	1.00	1.00		0.25	
Incremental Delay, d2	0.2	2.9	1.2	7.5	1.8		2.0	2.0	0.5		0.5	
Delay (s)	37.4	38.6	31.5	59.3	22.7		20.8	27.1	19.7		6.2	
Level of Service	D	D	C	E	C		C	C	B		A	
Approach Delay (s)		37.1			30.4			25.6			6.2	
Approach LOS		D			C			C			A	

Intersection Summary			
HCM Average Control Delay	25.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues
13: Los Coyotes Diagonal & Bellflower St

3/27/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	479	1271	322	311	708	23	1896	571	1989
v/c Ratio	0.75	1.14	0.95	1.21	0.73	0.34	1.06	0.57	0.79
Control Delay	50.3	113.0	73.3	145.2	21.0	33.2	67.5	7.1	6.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	158.7	0.0	0.2
Total Delay	50.3	113.0	73.3	145.2	21.0	33.2	226.2	7.1	6.4
Queue Length 50th (ft)	173	~394	188	~274	107	9	~777	58	97
Queue Length 95th (ft)	#270	#506	#391	m#310	m102	38	#916	153	m130
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	636	1112	340	257	1132	68	1786	1005	2523
Starvation Cap Reductn	0	0	0	0	0	0	0	0	78
Spillback Cap Reductn	0	0	0	0	0	0	452	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	1.14	0.95	1.21	0.63	0.34	1.42	0.57	0.81

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	455	1173	340	295	667	6	22	1801	542	0	1372	518
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	0.97	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	3433	4785	1362	1770	5079		1770	3539	1583		4876	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.07	1.00	1.00		1.00	
Satd. Flow (perm)	3433	4785	1362	1770	5079		134	3539	1583		4876	
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)	479	1235	358	311	702	6	23	1896	571	0	1444	545
RTOR Reduction (vph)	0	2	24	0	1	0	0	0	206	0	62	0
Lane Group Flow (vph)	479	1269	298	311	707	0	23	1896	365	0	1927	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	20.4	25.5	25.5	16.0	21.1		55.5	55.5	55.5		55.5	
Effective Green, g (s)	20.4	25.5	25.5	16.0	21.1		55.5	55.5	55.5		55.5	
Actuated g/C Ratio	0.19	0.23	0.23	0.15	0.19		0.50	0.50	0.50		0.50	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	637	1109	316	257	974		68	1786	799		2460	
v/s Ratio Prot	c0.14	c0.27		c0.18	0.14			c0.54			0.40	
v/s Ratio Perm			0.22				0.17		0.23			
v/c Ratio	0.75	1.14	0.94	1.21	0.73		0.34	1.06	0.46		0.78	
Uniform Delay, d1	42.4	42.2	41.5	47.0	41.7		16.3	27.2	17.5		22.3	
Progression Factor	0.98	0.99	1.00	0.70	0.44		1.00	1.00	1.00		0.29	
Incremental Delay, d2	4.5	74.8	33.4	113.1	1.5		13.0	39.8	1.9		0.2	
Delay (s)	46.2	116.8	74.8	146.2	20.1		29.2	67.1	19.4		6.6	
Level of Service	D	F	E	F	C		C	E	B		A	
Approach Delay (s)		93.9			58.6			55.8			6.6	
Approach LOS		F			E			E			A	

Intersection Summary			
HCM Average Control Delay	53.7	HCM Level of Service	D
HCM Volume to Capacity ratio	1.14		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	102.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	168	168	895	42	253
v/c Ratio	0.52	0.40	0.41	0.28	0.20
Control Delay	27.4	6.8	7.8	24.8	2.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	27.4	6.8	7.8	24.8	2.2
Queue Length 50th (ft)	56	0	55	17	18
Queue Length 95th (ft)	98	39	160	26	25
Internal Link Dist (ft)	864		215		720
Turn Bay Length (ft)					
Base Capacity (vph)	472	545	2193	148	1276
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.36	0.31	0.41	0.28	0.20

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	160	160	782	68	40	240
Ideal Flow (vphpl)	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	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	3497		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	3497		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	168	168	823	72	42	253
RTOR Reduction (vph)	0	137	8	0	0	0
Lane Group Flow (vph)	168	31	887	0	42	253
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	10.9	10.9	35.1		2.0	41.1
Effective Green, g (s)	10.9	10.9	35.1		2.0	41.1
Actuated g/C Ratio	0.18	0.18	0.59		0.03	0.69
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	322	288	2046		59	1276
v/s Ratio Prot	c0.09		c0.25		c0.02	0.14
v/s Ratio Perm		0.02				
v/c Ratio	0.52	0.11	0.43		0.71	0.20
Uniform Delay, d1	22.2	20.5	6.9		28.7	3.4
Progression Factor	1.00	1.00	1.00		0.77	0.48
Incremental Delay, d2	1.5	0.2	0.7		33.0	0.3
Delay (s)	23.7	20.6	7.6		55.1	2.0
Level of Service	C	C	A		E	A
Approach Delay (s)	22.2		7.6			9.6
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	11.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	46.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	62	116	1795	84	191
v/c Ratio	0.97	0.69	0.63	1.31	0.12
Control Delay	158.5	30.8	4.8	248.1	0.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	158.5	30.8	4.8	248.1	0.4
Queue Length 50th (ft)	45	0	183	~76	1
Queue Length 95th (ft)	#132	#78	226	m#156	m5
Internal Link Dist (ft)	864		215		720
Turn Bay Length (ft)					
Base Capacity (vph)	64	169	2860	64	1660
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.97	0.69	0.63	1.31	0.12

Intersection Summary

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

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

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	59	110	1536	169	80	181
Ideal Flow (vphpl)	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	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	3487		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	3487		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	62	116	1617	178	84	191
RTOR Reduction (vph)	0	112	8	0	0	0
Lane Group Flow (vph)	62	4	1787	0	84	191
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	4.0	4.0	90.0		4.0	98.0
Effective Green, g (s)	4.0	4.0	90.0		4.0	98.0
Actuated g/C Ratio	0.04	0.04	0.82		0.04	0.89
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	64	58	2853		64	1660
v/s Ratio Prot	c0.04		c0.51		c0.05	0.10
v/s Ratio Perm		0.00				
v/c Ratio	0.97	0.07	0.63		1.31	0.12
Uniform Delay, d1	52.9	51.2	3.7		53.0	0.7
Progression Factor	1.00	1.00	1.00		0.77	0.33
Incremental Delay, d2	100.3	0.5	1.1		211.6	0.1
Delay (s)	153.3	51.7	4.8		252.6	0.4
Level of Service	F	D	A		F	A
Approach Delay (s)	87.1		4.8			77.4
Approach LOS	F		A			E

Intersection Summary			
HCM Average Control Delay	20.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2578	2233	125	1197	542	727
v/c Ratio	1.08	0.95	0.53	0.98	1.00	0.54
Control Delay	77.4	28.5	79.4	41.9	93.6	42.7
Queue Delay	3.9	10.2	0.0	0.0	0.0	0.0
Total Delay	81.3	38.7	79.4	41.9	93.6	42.7
Queue Length 50th (ft)	~887	302	84	370	~238	193
Queue Length 95th (ft)	#977	m318	141	#470	#360	236
Internal Link Dist (ft)	1037	280		562		836
Turn Bay Length (ft)			330		290	
Base Capacity (vph)	2388	2360	238	1226	541	1349
Starvation Cap Reductn	0	154	0	0	0	0
Spillback Cap Reductn	20	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	1.09	1.01	0.53	0.98	1.00	0.54

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2286	163	0	1571	550	119	1087	50	515	690	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5		5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.91		1.00	0.91		0.97	0.91	
Frt		0.99			0.96		1.00	0.99		1.00	1.00	
Flt Protected		1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5034			4888		1770	5052		3433	5084	
Flt Permitted		1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5034			4888		1770	5052		3433	5084	
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)	0	2406	172	0	1654	579	125	1144	53	542	726	1
RTOR Reduction (vph)	0	6	0	0	48	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	2572	0	0	2185	0	125	1195	0	542	727	0
Turn Type							Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)		61.5			61.5		17.5	31.5		20.5	34.5	
Effective Green, g (s)		61.5			61.5		17.5	31.5		20.5	34.5	
Actuated g/C Ratio		0.47			0.47		0.13	0.24		0.16	0.27	
Clearance Time (s)		5.5			5.5		5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2381			2312		238	1224		541	1349	
v/s Ratio Prot		c0.51			0.45		0.07	c0.24		c0.16	c0.14	
v/s Ratio Perm												
v/c Ratio		1.08			0.94		0.53	0.98		1.00	0.54	
Uniform Delay, d1		34.2			32.6		52.4	48.9		54.8	40.9	
Progression Factor		1.00			0.76		1.37	0.45		1.00	1.00	
Incremental Delay, d2		44.3			3.8		6.7	18.4		39.1	1.5	
Delay (s)		78.6			28.7		78.5	40.4		93.9	42.5	
Level of Service		E			C		E	D		F	D	
Approach Delay (s)		78.6			28.7			44.0			64.4	
Approach LOS		E			C			D			E	

Intersection Summary			
HCM Average Control Delay	54.9	HCM Level of Service	D
HCM Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	98.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	502	2461	35	2252	776	144	215	439	391
v/c Ratio	0.96	0.83	0.52	1.00	0.97	0.47	0.90	0.46	0.61
Control Delay	79.1	9.6	62.7	32.9	85.1	39.1	97.7	41.5	14.5
Queue Delay	0.0	7.0	0.0	7.3	0.0	0.0	0.0	0.0	1.4
Total Delay	79.1	16.6	62.7	40.3	85.1	39.1	97.7	41.5	15.9
Queue Length 50th (ft)	213	176	29	523	249	66	94	163	61
Queue Length 95th (ft)	m201	m165	m36	#548	#334	137	#170	215	171
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		
Base Capacity (vph)	523	2957	67	2262	802	308	238	953	644
Starvation Cap Reductn	0	472	0	59	0	0	0	0	0
Spillback Cap Reductn	0	7	0	14	0	0	0	0	109
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.99	0.52	1.02	0.97	0.47	0.90	0.46	0.73

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	477	2322	16	33	1782	357	0	737	137	204	417	371
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	0.97	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.97			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5080		1770	4958			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5080		1770	4958			5085	1583	3433	3539	1583
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)	502	2444	17	35	1876	376	0	776	144	215	439	391
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	58	0	0	218
Lane Group Flow (vph)	502	2461	0	35	2229	0	0	776	86	215	439	173
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	19.8	74.6		3.9	58.7			20.5	20.5	9.0	35.0	35.0
Effective Green, g (s)	19.8	74.6		3.9	58.7			20.5	20.5	9.0	35.0	35.0
Actuated g/C Ratio	0.15	0.57		0.03	0.45			0.16	0.16	0.07	0.27	0.27
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	523	2915		53	2239			802	250	238	953	426
v/s Ratio Prot	0.15	c0.48		0.02	c0.45			c0.15		c0.06	0.12	
v/s Ratio Perm									0.05			0.11
v/c Ratio	0.96	0.84		0.66	1.00			0.97	0.34	0.90	0.46	0.41
Uniform Delay, d1	54.7	22.9		62.4	35.5			54.4	48.8	60.1	39.6	39.0
Progression Factor	1.37	0.41		0.74	0.52			1.17	1.32	1.00	1.00	1.00
Incremental Delay, d2	5.3	0.3		16.7	13.6			22.3	3.1	37.8	1.6	2.9
Delay (s)	80.4	9.6		62.9	32.2			85.8	67.5	97.9	41.2	41.8
Level of Service	F	A		E	C			F	E	F	D	D
Approach Delay (s)		21.6			32.7			82.9			53.1	
Approach LOS		C			C			F			D	

Intersection Summary			
HCM Average Control Delay	37.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	94.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	53	781	47	1213	457	79	463	156	329	14
v/c Ratio	0.30	0.38	0.21	0.60	0.52	0.21	0.62	0.48	0.33	0.04
Control Delay	15.9	11.6	27.0	33.3	6.4	44.1	49.5	75.2	68.6	47.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.9	11.6	27.0	33.3	6.4	44.1	49.5	75.2	68.6	47.3
Queue Length 50th (ft)	11	63	25	301	23	55	183	161	113	5
Queue Length 95th (ft)	m19	m72	51	352	107	102	242	m246	m150	m22
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	179	2033	227	2006	875	374	743	322	993	345
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.38	0.21	0.60	0.52	0.21	0.62	0.48	0.33	0.04

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	725	17	45	1152	434	75	382	58	296	164	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	1770	5068		1770	5085	1583	1770	3469		1522	4695	1583
Flt Permitted	0.16	1.00		0.25	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	297	5068		460	5085	1583	1770	3469		1522	4695	1583
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)	53	763	18	47	1213	457	79	402	61	312	173	14
RTOR Reduction (vph)	0	2	0	0	0	253	0	9	0	0	0	10
Lane Group Flow (vph)	53	779	0	47	1213	204	79	454	0	156	329	4
Turn Type	pm+pt			pm+pt		Perm	Split			Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	52.8	51.3		50.5	50.5	50.5	27.5	27.5		27.5	27.5	27.5
Effective Green, g (s)	52.8	51.3		50.5	50.5	50.5	27.5	27.5		27.5	27.5	27.5
Actuated g/C Ratio	0.41	0.39		0.39	0.39	0.39	0.21	0.21		0.21	0.21	0.21
Clearance Time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	166	2000		211	1975	615	374	734		322	993	335
v/s Ratio Prot	0.01	c0.15		0.01	c0.24		0.04	c0.13		c0.10	0.07	
v/s Ratio Perm	0.12			0.08		0.13						0.00
v/c Ratio	0.32	0.39		0.22	0.61	0.33	0.21	0.62		0.48	0.33	0.01
Uniform Delay, d1	36.2	28.1		25.7	31.9	27.9	42.3	46.5		45.0	43.5	40.5
Progression Factor	0.40	0.40		1.00	1.00	1.00	1.00	1.00		1.54	1.55	2.45
Incremental Delay, d2	0.9	0.4		0.5	1.4	1.4	1.3	3.9		4.6	0.8	0.1
Delay (s)	15.4	11.7		26.3	33.4	29.3	43.6	50.4		74.0	68.3	99.4
Level of Service	B	B		C	C	C	D	D		E	E	F
Approach Delay (s)		12.0			32.1			49.4			70.9	
Approach LOS		B			C			D			E	

Intersection Summary			
HCM Average Control Delay	35.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	105	2637	38	133	2607	96	93	171	31	33	35
v/c Ratio	0.89	0.80	0.04	0.95	0.79	0.91	0.85	0.60	0.30	0.31	0.27
Control Delay	92.7	3.4	0.2	84.9	1.1	127.4	111.9	17.7	64.7	64.9	22.4
Queue Delay	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	92.7	3.5	0.2	84.9	1.2	127.4	111.9	17.7	64.7	64.9	22.4
Queue Length 50th (ft)	95	90	1	120	9	82	79	0	27	28	0
Queue Length 95th (ft)	m#124	115	m1	m#130	13	#194	#180	72	61	65	34
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270			275		100		350			
Base Capacity (vph)	118	3293	1034	140	3288	105	110	283	310	319	321
Starvation Cap Reductn	0	72	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	88	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.82	0.04	0.95	0.81	0.91	0.85	0.60	0.10	0.10	0.11

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	2505	36	126	2071	406	91	88	162	45	16	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	1.00	0.85	1.00	0.98		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	0.98	1.00
Satd. Flow (prot)	1770	5085	1583	1770	4960		1770	1863	1583	1681	1728	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	0.98	1.00
Satd. Flow (perm)	1770	5085	1583	1770	4960		1770	1863	1583	1681	1728	1583
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)	105	2637	38	133	2180	427	96	93	171	47	17	35
RTOR Reduction (vph)	0	0	9	0	16	0	0	0	157	0	0	33
Lane Group Flow (vph)	105	2637	29	133	2591	0	96	93	14	31	33	2
Turn Type	Prot		Perm	Prot			Split		Over	Split		Perm
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases			4									6
Actuated Green, G (s)	8.7	83.1	83.1	10.3	84.7		7.7	7.7	10.3	6.9	6.9	6.9
Effective Green, g (s)	8.7	83.1	83.1	10.3	84.7		7.7	7.7	10.3	6.9	6.9	6.9
Actuated g/C Ratio	0.07	0.64	0.64	0.08	0.65		0.06	0.06	0.08	0.05	0.05	0.05
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	118	3250	1012	140	3232		105	110	125	89	92	84
v/s Ratio Prot	0.06	0.52		c0.08	c0.52		c0.05	0.05	0.01	0.02	c0.02	
v/s Ratio Perm			0.02									0.00
v/c Ratio	0.89	0.81	0.03	0.95	0.80		0.91	0.85	0.11	0.35	0.36	0.02
Uniform Delay, d1	60.2	17.6	8.6	59.6	16.5		60.8	60.6	55.6	59.4	59.4	58.4
Progression Factor	0.90	0.13	0.03	0.83	0.02		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	32.7	1.3	0.0	32.3	0.8		60.8	41.7	0.4	2.4	2.4	0.1
Delay (s)	86.6	3.5	0.3	81.5	1.2		121.6	102.2	56.0	61.7	61.8	58.5
Level of Service	F	A	A	F	A		F	F	E	E	E	E
Approach Delay (s)		6.6			5.1			85.4			60.6	
Approach LOS		A			A			F			E	

Intersection Summary			
HCM Average Control Delay	11.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	109	2635	2772	596	155
v/c Ratio	0.52	0.80	0.95	0.58	0.31
Control Delay	29.4	19.0	12.6	1.6	32.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	29.4	19.0	12.6	1.6	32.7
Queue Length 50th (ft)	63	371	431	23	36
Queue Length 95th (ft)	m80	418	m281	m18	72
Internal Link Dist (ft)		1015	1000		632
Turn Bay Length (ft)	400			150	150
Base Capacity (vph)	383	3305	2930	1026	506
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.28	0.80	0.95	0.58	0.31

Intersection Summary

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	104	2503	2633	566	88	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.91	0.91	1.00	0.97	
Frt	1.00	1.00	1.00	0.85	0.94	
Flt Protected	0.95	1.00	1.00	1.00	0.97	
Satd. Flow (prot)	1770	5085	5085	1583	3298	
Flt Permitted	0.95	1.00	1.00	1.00	0.97	
Satd. Flow (perm)	1770	5085	5085	1583	3298	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	109	2635	2772	596	93	62
RTOR Reduction (vph)	0	0	0	114	54	0
Lane Group Flow (vph)	109	2635	2772	482	101	0
Turn Type	Prot			Perm		
Protected Phases	7 9	4	8		6	
Permitted Phases				8		
Actuated Green, G (s)	15.3	84.5	74.9	74.9	17.8	
Effective Green, g (s)	15.3	84.5	74.9	74.9	17.8	
Actuated g/C Ratio	0.12	0.65	0.58	0.58	0.14	
Clearance Time (s)		5.5	5.5	5.5	5.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	208	3305	2930	912	452	
v/s Ratio Prot	c0.06	c0.52	c0.55		c0.03	
v/s Ratio Perm				0.30		
v/c Ratio	0.52	0.80	0.95	0.53	0.22	
Uniform Delay, d1	53.9	16.5	25.7	16.8	50.0	
Progression Factor	0.70	1.06	0.43	0.15	1.00	
Incremental Delay, d2	1.4	1.3	0.9	0.2	1.1	
Delay (s)	39.3	18.7	11.9	2.8	51.1	
Level of Service	D	B	B	A	D	
Approach Delay (s)		19.5	10.3		51.1	
Approach LOS		B	B		D	

Intersection Summary			
HCM Average Control Delay	15.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	151	2501	68	46	3749	180	51	117
v/c Ratio	1.06	0.71	0.06	0.43	1.13	1.15	0.29	0.38
Control Delay	119.0	6.0	1.6	70.5	86.0	167.9	55.9	17.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	119.0	6.0	1.6	70.5	86.0	167.9	55.9	17.0
Queue Length 50th (ft)	~138	120	2	38	~1342	~178	39	13
Queue Length 95th (ft)	m#208	143	m4	80	#1408	#331	82	71
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150		150	300				
Base Capacity (vph)	143	3531	1113	123	3320	156	173	305
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.06	0.71	0.06	0.37	1.13	1.15	0.29	0.38

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	143	2376	65	44	3350	212	122	38	11	48	16	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.99		1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5040			1783		1770	1624	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.62		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5040			1147		1287	1624	
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)	151	2501	68	46	3526	223	128	40	12	51	17	100
RTOR Reduction (vph)	0	0	14	0	6	0	0	2	0	0	87	0
Lane Group Flow (vph)	151	2501	54	46	3743	0	0	178	0	51	30	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	11.6	89.2	89.2	6.8	84.4			17.5		17.5	17.5	
Effective Green, g (s)	11.6	89.2	89.2	6.8	84.4			17.5		17.5	17.5	
Actuated g/C Ratio	0.09	0.69	0.69	0.05	0.65			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	158	3489	1086	93	3272			154		173	219	
v/s Ratio Prot	c0.09	0.49		0.03	c0.74						0.02	
v/s Ratio Perm			0.03					c0.16		0.04		
v/c Ratio	0.96	0.72	0.05	0.49	1.14			1.16		0.29	0.14	
Uniform Delay, d1	58.9	12.6	6.6	59.9	22.8			56.2		50.7	49.6	
Progression Factor	0.76	0.41	0.47	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	43.0	0.8	0.1	4.1	68.9			121.2		1.0	0.3	
Delay (s)	87.7	6.0	3.2	64.0	91.7			177.4		51.6	49.9	
Level of Service	F	A	A	E	F			F		D	D	
Approach Delay (s)		10.4			91.4			177.4			50.4	
Approach LOS		B			F			F			D	

Intersection Summary			
HCM Average Control Delay	60.6	HCM Level of Service	E
HCM Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	107.2%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2250	2255	200	1105	684	1114
v/c Ratio	1.03	1.04	0.76	0.93	0.98	0.76
Control Delay	62.6	44.3	57.1	37.0	80.3	45.9
Queue Delay	17.1	3.9	0.0	0.0	69.8	0.0
Total Delay	79.7	48.2	57.1	37.0	150.1	45.9
Queue Length 50th (ft)	~738	~717	174	336	297	312
Queue Length 95th (ft)	#832	#806	#286	#395	#423	368
Internal Link Dist (ft)	1037	280		562		836
Turn Bay Length (ft)			330		290	
Base Capacity (vph)	2191	2174	263	1188	700	1475
Starvation Cap Reductn	0	21	0	0	0	0
Spillback Cap Reductn	90	0	0	0	117	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	1.07	1.05	0.76	0.93	1.17	0.76

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1973	164	0	1608	534	190	999	50	650	1057	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5		5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.91		1.00	0.91		0.97	0.91	
Frt		0.99			0.96		1.00	0.99		1.00	1.00	
Flt Protected		1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5027			4895		1770	5049		3433	5085	
Flt Permitted		1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5027			4895		1770	5049		3433	5085	
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)	0	2077	173	0	1693	562	200	1052	53	684	1113	1
RTOR Reduction (vph)	0	7	0	0	46	0	0	3	0	0	0	0
Lane Group Flow (vph)	0	2243	0	0	2209	0	200	1102	0	684	1114	0
Turn Type							Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)		56.5			56.5		19.3	30.5		26.5	37.7	
Effective Green, g (s)		56.5			56.5		19.3	30.5		26.5	37.7	
Actuated g/C Ratio		0.43			0.43		0.15	0.23		0.20	0.29	
Clearance Time (s)		5.5			5.5		5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2185			2127		263	1185		700	1475	
v/s Ratio Prot		0.45			c0.45		0.11	c0.22		c0.20	0.22	
v/s Ratio Perm												
v/c Ratio		1.03			1.04		0.76	0.93		0.98	0.76	
Uniform Delay, d1		36.8			36.8		53.1	48.7		51.4	42.0	
Progression Factor		1.00			0.53		0.75	0.49		1.00	1.00	
Incremental Delay, d2		26.3			24.8		16.4	12.5		28.1	3.6	
Delay (s)		63.1			44.2		56.2	36.2		79.5	45.6	
Level of Service		E			D		E	D		E	D	
Approach Delay (s)		63.1			44.2			39.3			58.5	
Approach LOS		E			D			D			E	

Intersection Summary			
HCM Average Control Delay	52.3	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	95.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	420	2364	47	1864	666	115	374	804	574
v/c Ratio	0.88	0.88	0.63	0.89	0.87	0.38	0.86	0.71	0.80
Control Delay	70.1	13.1	65.7	16.2	72.4	27.2	74.9	43.2	28.1
Queue Delay	0.0	18.4	0.0	1.4	0.0	0.0	0.0	0.0	0.7
Total Delay	70.1	31.5	65.7	17.5	72.4	27.2	74.9	43.2	28.9
Queue Length 50th (ft)	184	319	38	242	207	27	161	313	221
Queue Length 95th (ft)	m180	m315	m#69	m345	#271	94	#242	388	387
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		
Base Capacity (vph)	489	2683	75	2089	763	304	436	1130	714
Starvation Cap Reductn	0	392	0	10	0	0	0	0	0
Spillback Cap Reductn	0	260	0	93	0	4	0	0	25
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	1.03	0.63	0.93	0.87	0.38	0.86	0.71	0.83

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	399	2214	31	45	1613	158	0	633	109	355	764	545
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	0.97	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5075		1770	5017			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5075		1770	5017			5085	1583	3433	3539	1583
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)	420	2331	33	47	1698	166	0	666	115	374	804	574
RTOR Reduction (vph)	0	1	0	0	9	0	0	0	66	0	0	208
Lane Group Flow (vph)	420	2363	0	47	1855	0	0	666	49	374	804	366
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	18.1	67.6		4.4	53.9			19.5	19.5	16.5	41.5	41.5
Effective Green, g (s)	18.1	67.6		4.4	53.9			19.5	19.5	16.5	41.5	41.5
Actuated g/C Ratio	0.14	0.52		0.03	0.41			0.15	0.15	0.13	0.32	0.32
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	478	2639		60	2080			763	237	436	1130	505
v/s Ratio Prot	0.12	c0.47		0.03	c0.37			c0.13		c0.11	0.23	
v/s Ratio Perm									0.03			0.23
v/c Ratio	0.88	0.90		0.78	0.89			0.87	0.21	0.86	0.71	0.72
Uniform Delay, d1	54.9	28.0		62.3	35.3			54.0	48.5	55.6	39.0	39.2
Progression Factor	1.24	0.44		0.58	0.30			1.12	1.27	1.00	1.00	1.00
Incremental Delay, d2	1.9	0.5		40.5	5.2			11.8	1.7	19.2	3.8	8.7
Delay (s)	70.0	12.9		76.7	15.8			72.4	63.2	74.8	42.8	47.9
Level of Service	E	B		E	B			E	E	E	D	D
Approach Delay (s)		21.5			17.3			71.1			51.3	
Approach LOS		C			B			E			D	

Intersection Summary			
HCM Average Control Delay	33.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	87.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	200	889	87	1174	392	48	249	169	532	46
v/c Ratio	0.66	0.37	0.27	0.56	0.46	0.23	0.59	0.55	0.55	0.13
Control Delay	50.7	8.0	16.4	30.9	6.2	55.0	59.9	48.2	44.7	29.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.7	8.0	16.4	30.9	6.2	55.0	59.9	48.2	44.7	29.4
Queue Length 50th (ft)	114	31	32	268	21	37	104	175	184	30
Queue Length 95th (ft)	m161	m79	59	348	102	77	151	m246	m227	m47
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	402	2376	317	2104	860	211	421	310	971	343
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.37	0.27	0.56	0.46	0.23	0.59	0.55	0.55	0.13

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	190	745	100	83	1115	372	46	224	12	256	410	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	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	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (prot)	1770	4995		1770	5085	1583	1770	3511		1522	4761	1583
Flt Permitted	0.14	1.00		0.30	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (perm)	261	4995		553	5085	1583	1770	3511		1522	4761	1583
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)	200	784	105	87	1174	392	48	236	13	269	432	46
RTOR Reduction (vph)	0	13	0	0	0	205	0	3	0	0	0	21
Lane Group Flow (vph)	200	876	0	87	1174	187	48	246	0	169	532	25
Turn Type	pm+pt			pm+pt		Perm	Split			Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	71.5	61.5		59.8	53.8	53.8	15.5	15.5		26.5	26.5	26.5
Effective Green, g (s)	71.5	61.5		59.8	53.8	53.8	15.5	15.5		26.5	26.5	26.5
Actuated g/C Ratio	0.55	0.47		0.46	0.41	0.41	0.12	0.12		0.20	0.20	0.20
Clearance Time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	303	2363		311	2104	655	211	419		310	971	323
v/s Ratio Prot	c0.07	0.18		0.01	0.23		0.03	c0.07		0.11	c0.11	
v/s Ratio Perm	c0.29			0.12		0.12						0.02
v/c Ratio	0.66	0.37		0.28	0.56	0.29	0.23	0.59		0.55	0.55	0.08
Uniform Delay, d1	18.5	21.9		20.0	29.0	25.3	51.8	54.2		46.4	46.4	41.9
Progression Factor	2.85	0.36		1.00	1.00	1.00	1.00	1.00		0.92	0.93	1.24
Incremental Delay, d2	3.1	0.3		0.5	1.1	1.1	2.5	5.9		4.7	1.5	0.3
Delay (s)	55.8	8.2		20.4	30.1	26.4	54.3	60.2		47.4	44.4	52.1
Level of Service	E	A		C	C	C	D	E		D	D	D
Approach Delay (s)		17.0			28.7			59.2			45.6	
Approach LOS		B			C			E			D	

Intersection Summary			
HCM Average Control Delay	31.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	28	2655	117	309	1905	59	14	142	184	190	69
v/c Ratio	0.31	1.05	0.14	1.16	0.59	0.97	0.22	0.44	0.74	0.75	0.24
Control Delay	78.8	57.8	12.3	120.9	2.4	168.1	69.2	21.2	70.5	70.4	12.1
Queue Delay	0.0	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	78.8	63.7	12.3	120.9	2.4	168.1	69.2	21.2	70.5	70.4	12.1
Queue Length 50th (ft)	25	~873	23	~310	16	51	12	30	157	163	0
Queue Length 95th (ft)	m30	#1023	m34	m#394	28	#144	35	95	235	242	42
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270			275		100		350			
Base Capacity (vph)	92	2535	823	266	3212	61	64	324	310	319	349
Starvation Cap Reductn	0	35	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	44	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	1.06	0.14	1.16	0.60	0.97	0.22	0.44	0.59	0.60	0.20

Intersection Summary

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

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	2522	111	294	1769	41	56	13	135	265	90	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00		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	0.98	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5068		1770	1863	1583	1681	1726	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	0.98	1.00
Satd. Flow (perm)	1770	5085	1583	1770	5068		1770	1863	1583	1681	1726	1583
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)	28	2655	117	309	1862	43	59	14	142	279	95	69
RTOR Reduction (vph)	0	0	35	0	2	0	0	0	85	0	0	59
Lane Group Flow (vph)	28	2655	82	309	1903	0	59	14	57	184	190	10
Turn Type	Prot		Perm	Prot			Split		Over	Split		Perm
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases			4									6
Actuated Green, G (s)	4.2	62.6	62.6	21.7	80.1		4.5	4.5	21.7	19.2	19.2	19.2
Effective Green, g (s)	4.2	62.6	62.6	21.7	80.1		4.5	4.5	21.7	19.2	19.2	19.2
Actuated g/C Ratio	0.03	0.48	0.48	0.17	0.62		0.03	0.03	0.17	0.15	0.15	0.15
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	57	2449	762	295	3123		61	64	264	248	255	234
v/s Ratio Prot	0.02	c0.52		c0.17	0.38		c0.03	0.01	0.04	0.11	c0.11	
v/s Ratio Perm			0.05									0.01
v/c Ratio	0.49	1.08	0.11	1.05	0.61		0.97	0.22	0.22	0.74	0.75	0.04
Uniform Delay, d1	61.8	33.7	18.4	54.1	15.3		62.7	61.0	46.8	53.0	53.1	47.5
Progression Factor	1.24	0.93	1.38	0.50	0.13		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.2	42.0	0.1	49.9	0.4		102.5	1.7	0.4	11.3	11.2	0.1
Delay (s)	80.0	73.5	25.5	77.1	2.4		165.2	62.8	47.2	64.4	64.3	47.6
Level of Service	F	E	C	E	A		F	E	D	E	E	D
Approach Delay (s)		71.5			12.9			80.6			61.7	
Approach LOS		E			B			F			E	

Intersection Summary			
HCM Average Control Delay	48.2	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	95.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	36	3071	2252	201	509
v/c Ratio	0.17	1.08	0.86	0.23	0.49
Control Delay	34.1	46.2	14.6	4.1	40.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	34.1	46.2	14.6	4.1	40.1
Queue Length 50th (ft)	28	~1032	165	13	189
Queue Length 95th (ft)	m31	m#254	402	m32	250
Internal Link Dist (ft)		1015	1000		632
Turn Bay Length (ft)	400			150	150
Base Capacity (vph)	456	2855	2632	864	1031
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.08	1.08	0.86	0.23	0.49

Intersection Summary

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

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

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	34	2917	2139	191	454	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.91	0.91	1.00	0.97	
Frt	1.00	1.00	1.00	0.85	0.99	
Flt Protected	0.95	1.00	1.00	1.00	0.96	
Satd. Flow (prot)	1770	5085	5085	1583	3420	
Flt Permitted	0.95	1.00	1.00	1.00	0.96	
Satd. Flow (perm)	1770	5085	5085	1583	3420	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	36	3071	2252	201	478	31
RTOR Reduction (vph)	0	0	0	47	3	0
Lane Group Flow (vph)	36	3071	2252	154	506	0
Turn Type	Prot			Perm		
Protected Phases	7 9	4	8		6	
Permitted Phases				8		
Actuated Green, G (s)	11.5	70.8	62.9	62.9	39.1	
Effective Green, g (s)	11.5	70.8	62.9	62.9	39.1	
Actuated g/C Ratio	0.09	0.54	0.48	0.48	0.30	
Clearance Time (s)		5.5	5.5	5.5	5.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	157	2769	2460	766	1029	
v/s Ratio Prot	c0.02	c0.60	0.44		c0.15	
v/s Ratio Perm				0.10		
v/c Ratio	0.23	1.11	0.92	0.20	0.49	
Uniform Delay, d1	55.1	29.6	31.1	19.2	37.3	
Progression Factor	0.65	0.22	0.43	0.38	1.00	
Incremental Delay, d2	0.2	50.9	4.1	0.3	1.7	
Delay (s)	35.9	57.4	17.4	7.5	39.0	
Level of Service	D	E	B	A	D	
Approach Delay (s)		57.1	16.6		39.0	
Approach LOS		E	B		D	

Intersection Summary			
HCM Average Control Delay	39.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	79.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	138	3388	22	73	2508	80	129	218
v/c Ratio	0.56	0.96	0.02	0.82	0.82	0.86	0.80	0.65
Control Delay	35.9	8.6	0.8	116.1	22.6	109.3	88.7	28.7
Queue Delay	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.9	8.8	0.8	116.1	22.6	109.3	88.7	28.7
Queue Length 50th (ft)	102	169	1	62	568	58	107	56
Queue Length 95th (ft)	m103	m133	m1	#154	634	#158	#216	145
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150		150	300				
Base Capacity (vph)	245	3540	1105	89	3077	93	161	335
Starvation Cap Reductn	0	13	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.56	0.96	0.02	0.82	0.82	0.86	0.80	0.65

Intersection Summary

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

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	131	3219	21	69	2309	73	29	28	19	123	37	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.97		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5062			1766		1770	1633	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.36		0.68	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5062			656		1270	1633	
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)	138	3388	22	73	2431	77	31	29	20	129	39	179
RTOR Reduction (vph)	0	0	3	0	2	0	0	10	0	0	127	0
Lane Group Flow (vph)	138	3388	19	73	2506	0	0	70	0	129	91	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	18.0	90.5	90.5	6.5	79.0			16.5		16.5	16.5	
Effective Green, g (s)	18.0	90.5	90.5	6.5	79.0			16.5		16.5	16.5	
Actuated g/C Ratio	0.14	0.70	0.70	0.05	0.61			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	245	3540	1102	89	3076			83		161	207	
v/s Ratio Prot	0.08	c0.67		0.04	c0.50						0.06	
v/s Ratio Perm			0.01					c0.11		0.10		
v/c Ratio	0.56	0.96	0.02	0.82	0.81			0.85		0.80	0.44	
Uniform Delay, d1	52.3	18.0	6.1	61.2	19.8			55.5		55.2	52.5	
Progression Factor	0.64	0.31	0.21	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	0.7	2.3	0.0	42.9	2.5			63.0		24.1	1.5	
Delay (s)	34.0	7.8	1.3	104.1	22.3			118.5		79.3	53.9	
Level of Service	C	A	A	F	C			F		E	D	
Approach Delay (s)		8.8			24.6			118.5			63.4	
Approach LOS		A			C			F			E	

Intersection Summary			
HCM Average Control Delay	19.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	101.8%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Appendix B

Freeway Analyses

Appendix B Includes:

B1. Year 2020 Alternative 1 Freeway Peak Hour LOS Worksheets

B2. Year 2040 Alternative 1 Freeway Peak Hour LOS Worksheets

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Appendix B1

Year 2020 Alternative 1
Freeway Level of Service (LOS) Worksheets

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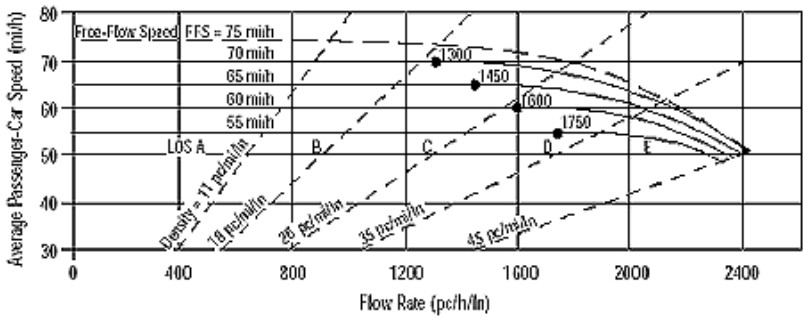
2020 Alternative 1

Freeway Mainline, Ramps, and Ramp-Freeway Junctions and Weaving Level of Service Analysis Worksheets

AM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 1

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	9680 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	72.6	mi/h	FFS	72.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2194	pc/h/ln	Design LOS		
S	60.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	36.0	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9680	0.90	Level	4	0	0.980	1.00	10971
Ramp	1110	0.90	Level	4	0	0.980	1.00	1258
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3213 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8777	9600	No
V_{12}	3213	4400:All	No
V_{FO} = V_F - V_R	7519	9600	No
V_R	1258	3800	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 17.5 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.606 (Exhibit 25-19)

S_R= 53.0 mph (Exhibit 25-19)

S_0= 69.8 mph (Exhibit 25-19)

S = 62.6 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	390	0.90	4	0	1.5	1.2	0.980	1.00	442
Vw2	330	0.90	4	0	1.5	1.2	0.980	1.00	374
Vw				816	Vnw				0
V									816

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.31	0.47
Weaving and non-weaving speeds, Si (mi/h)			22.55	32.00

Number of lanes required for unconstrained operation, Nw 1.71
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	22.55
Weaving segment density, D (pc/mi/ln)	18.09
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 69.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8560	0.90	Level	4	0	0.980	1.00	9701
Ramp	310	0.90	Level	4	0	0.980	1.00	351
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.556 using Equation 4

V_{12}= 5396 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10052	See Exhibit 25-7	Yes
V_{R12}	5747	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 42.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.459 (Exibit 25-19)

S_R= 29.2 mph (Exhibit 25-19)

S_0= 63.9 mph (Exhibit 25-19)

S= 38.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.19
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.21
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7503	0.90	4	0	1.5	1.2	0.980	1.00	8503
Vo2	73	0.90	4	0	1.5	1.2	0.980	1.00	82
Vw1	1377	0.90	4	0	1.5	1.2	0.980	1.00	1560
Vw2	357	0.90	4	0	1.5	1.2	0.980	1.00	404
Vw				1964	Vnw				8585
V									10549

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.94	0.41
Weaving and non-weaving speeds, Si (mi/h)			28.96	54.09

Number of lanes required for unconstrained operation, Nw 1.49
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	46.56
Weaving segment density, D (pc/mi/ln)	45.31
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10045
Capacity as a 15-minute flow rate, c (veh/h)	9848
Capacity as a full-hour volume, c_h (veh/h)	8863

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.42
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	140	0.90	4	0	1.5	1.2	0.980	1.00	158
Vw2	100	0.90	4	0	1.5	1.2	0.980	1.00	113
Vw				271	Vnw				0
V									271

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.06	0.15
Weaving and non-weaving speeds, Si (mi/h)			27.15	36.80

Number of lanes required for unconstrained operation, Nw 1.47
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	27.15
Weaving segment density, D (pc/mi/ln)	4.99
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	68	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.18
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.45
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7128	0.90	4	0	1.5	1.2	0.980	1.00	8078
Vo2	38	0.90	4	0	1.5	1.2	0.980	1.00	43
Vw1	722	0.90	4	0	1.5	1.2	0.980	1.00	818
Vw2	892	0.90	4	0	1.5	1.2	0.980	1.00	1010
Vw				1828	Vnw				8121
V									9949

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.96	0.40
Weaving and non-weaving speeds, Si (mi/h)			29.63	56.44

Number of lanes required for unconstrained operation, Nw 1.43
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	48.40
Weaving segment density, D (pc/mi/ln)	41.11
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	10200
Capacity as a 15-minute flow rate, c (veh/h)	10000
Capacity as a full-hour volume, c_h (veh/h)	9000

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 22

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 69.2 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8030	0.90	Level	4	0	0.980	1.00	9101
Ramp	640	0.90	Level	4	0	0.980	1.00	725
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.191 using Equation 4

V_{12}= 1737 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9826	See Exhibit 25-7	Yes
V_{R12}	2462	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 23.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.353 (Exibit 25-19)

S_R= 59.6 mph (Exhibit 25-19)

S_0= 54.4 mph (Exhibit 25-19)

S= 55.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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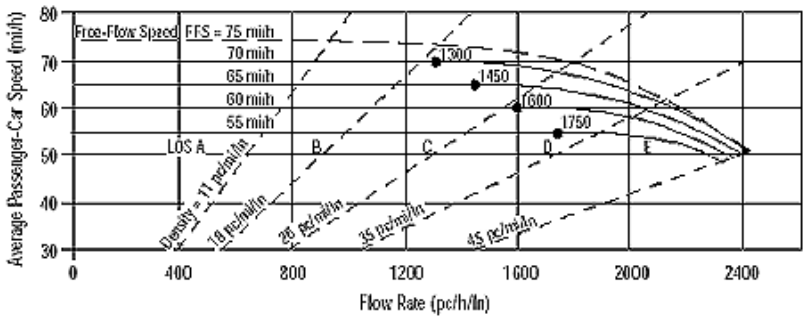
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 23

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8670 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.2	mi/h	FFS	68.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2457	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	69	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.45
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8281	0.90	4	0	1.5	1.2	0.980	1.00	9385
Vo2	21	0.90	4	0	1.5	1.2	0.980	1.00	23
Vw1	389	0.90	4	0	1.5	1.2	0.980	1.00	440
Vw2	469	0.90	4	0	1.5	1.2	0.980	1.00	531
Vw				971	Vnw				9408
V									10379

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.62	0.21		
Weaving and non-weaving speeds, Si (mi/h)	51.50	63.60		

Number of lanes required for unconstrained operation, Nw 0.73
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	62.23
Weaving segment density, D (pc/mi/ln)	33.36
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11850
Capacity as a 15-minute flow rate, c (veh/h)	11618
Capacity as a full-hour volume, c_h (veh/h)	10456

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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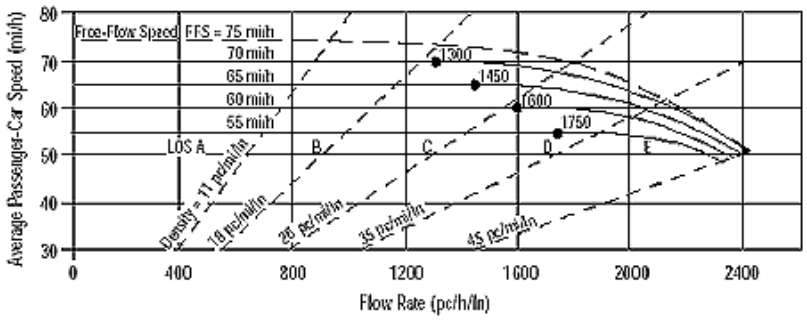
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 25

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8740 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1981	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	64.5	mi/h	S	mi/h
D = v_p / S	30.7	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	D		Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.9 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8740	0.90	Level	4	0	0.980	1.00	9905
Ramp	1290	0.90	Level	4	0	0.980	1.00	1462
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3142 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7924	9556	No
V_{12}	3142	4400:All	No
V_{FO} = V_F - V_R	6462	9556	No
V_R	1462	4100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 5.2 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.365 (Exhibit 25-19)

S_R= 59.1 mph (Exhibit 25-19)

S_0= 70.2 mph (Exhibit 25-19)

S = 65.3 mph (Exhibit 25-15)

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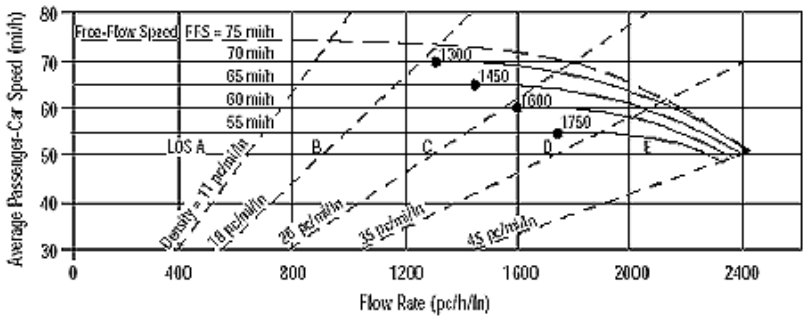
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 27

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7460 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2114	pc/h/ln	Design LOS		
S	61.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	34.3	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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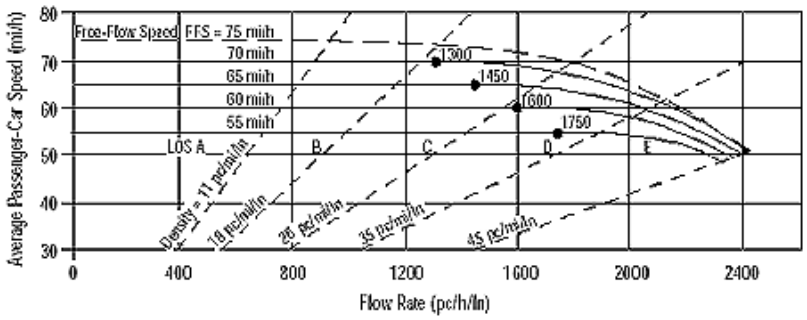
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 29

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7380 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2091	pc/h/ln	Design LOS		
S	62.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	33.6	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 30

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 68.9 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7380	0.90	Level	4	0	0.980	1.00	8364
Ramp	3060	0.90	Level	4	0	0.980	1.00	3468
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1748 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11832	See Exhibit 25-7	Yes
V_{R12}	5216	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 26.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.836 (Exibit 25-19)

S_R= 46.4 mph (Exhibit 25-19)

S_0= 56.3 mph (Exhibit 25-19)

S= 51.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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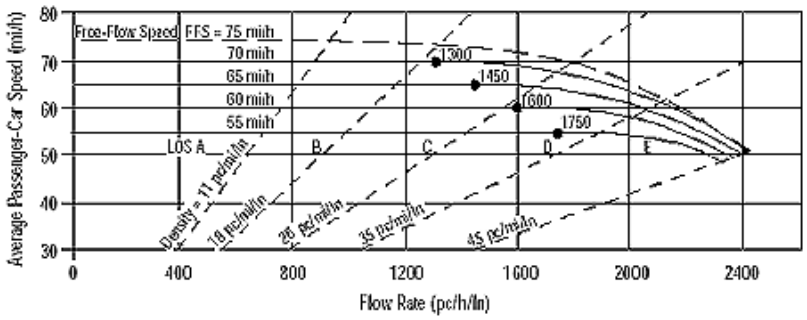
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 31

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	10440 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2366	pc/h/ln	Design LOS		
S	54.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	43.8	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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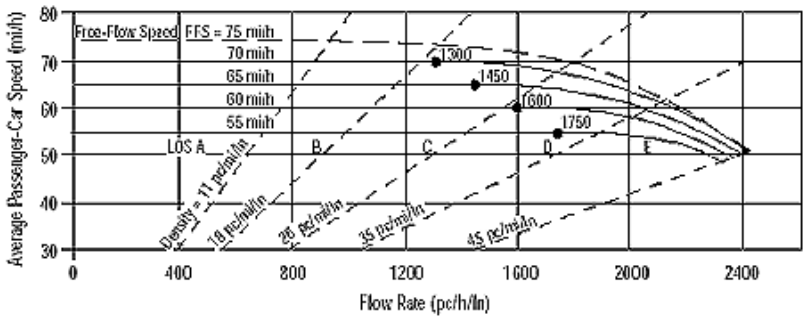
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 32

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8550 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1938	pc/h/ln	Design LOS		
S	54.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	35.5	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8550	0.90	Level	4	0	0.980	1.00	9690
Ramp	1290	0.90	Level	4	0	0.980	1.00	1462
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3097 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7752	9000	No
V_{12}	3097	4400:All	No
V_{FO} = V_F - V_R	6290	9000	No
V_R	1462	4100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = -12.3 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.365 (Exhibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 55.2 mph (Exhibit 25-19)

S = 53.1 mph (Exhibit 25-15)

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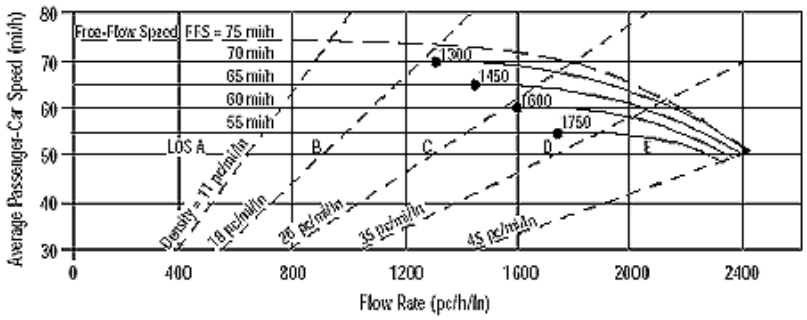
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 34

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7260 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2057	pc/h/ln	Design LOS		
S	53.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	38.4	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7260	0.90	Level	4	0	0.980	1.00	8228
Ramp	1550	0.90	Level	4	0	0.980	1.00	1757
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.380 using Equation 4

V_{12}= 3130 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9985	See Exhibit 25-7	Yes
V_{R12}	4887	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 35.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.754 (Exibit 25-19)

S_R= 47.4 mph (Exhibit 25-19)

S_0= 55.8 mph (Exhibit 25-19)

S= 51.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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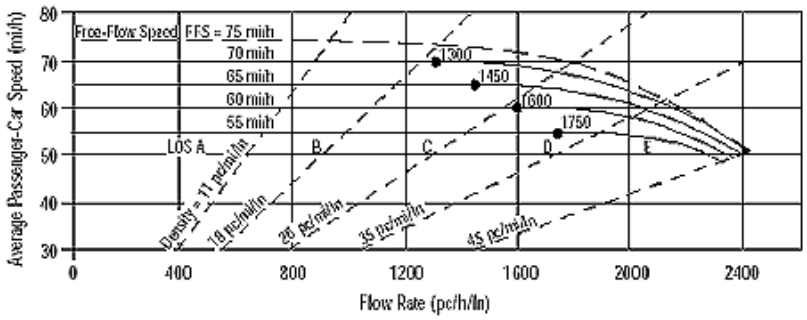
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 36

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8810 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2496	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	55	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.10
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.26
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	35	0.90	4	0	1.5	1.2	0.980	1.00	39
Vo2	8155	0.90	4	0	1.5	1.2	0.980	1.00	9242
Vw1	235	0.90	4	0	1.5	1.2	0.980	1.00	266
Vw2	655	0.90	4	0	1.5	1.2	0.980	1.00	742
Vw				1008	Vnw				9281
V									10289

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.79	0.39		
Weaving and non-weaving speeds, Si (mi/h)	40.21	47.38		

Number of lanes required for unconstrained operation, Nw 1.11
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	46.56
Weaving segment density, D (pc/mi/ln)	44.20
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10036
Capacity as a 15-minute flow rate, c (veh/h)	9839
Capacity as a full-hour volume, c_h (veh/h)	8855

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	47	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.26
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	30	0.90	4	0	1.5	1.2	0.980	1.00	34
Vo2	7820	0.90	4	0	1.5	1.2	0.980	1.00	8862
Vw1	200	0.90	4	0	1.5	1.2	0.980	1.00	226
Vw2	570	0.90	4	0	1.5	1.2	0.980	1.00	646
Vw				872	Vnw				8896
V									9768

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.72	0.35		
Weaving and non-weaving speeds, Si (mi/h)	36.55	42.50		

Number of lanes required for unconstrained operation, Nw 1.11
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	41.89
Weaving segment density, D (pc/mi/ln)	46.64
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10070
Capacity as a 15-minute flow rate, c (veh/h)	9873
Capacity as a full-hour volume, c_h (veh/h)	8886

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	46	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.11
Weaving seg length, L (ft)	890	Weaving ratio, R	0.47
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	26	0.90	4	0	1.5	1.2	0.980	1.00	29
Vo2	7526	0.90	4	0	1.5	1.2	0.980	1.00	8529
Vw1	444	0.90	4	0	1.5	1.2	0.980	1.00	503
Vw2	494	0.90	4	0	1.5	1.2	0.980	1.00	559
Vw				1062	Vnw				8558
V									9620

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.27	0.61		
Weaving and non-weaving speeds, Si (mi/h)	30.89	37.40		

Number of lanes required for unconstrained operation, Nw 1.15
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	36.55
Weaving segment density, D (pc/mi/ln)	52.64
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9123
Capacity as a 15-minute flow rate, c (veh/h)	8944
Capacity as a full-hour volume, c_h (veh/h)	8050

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.23
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.45
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	50	0.90	4	0	1.5	1.2	0.980	1.00	56
Vo2	7020	0.90	4	0	1.5	1.2	0.980	1.00	7956
Vw1	1150	0.90	4	0	1.5	1.2	0.980	1.00	1303
Vw2	940	0.90	4	0	1.5	1.2	0.980	1.00	1065
Vw				2368	Vnw				8012
V									10380

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.73	0.40		
Weaving and non-weaving speeds, Si (mi/h)	39.25	45.10		

Number of lanes required for unconstrained operation, Nw 1.60
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	43.62
Weaving segment density, D (pc/mi/ln)	47.59
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9903
Capacity as a 15-minute flow rate, c (veh/h)	9709
Capacity as a full-hour volume, c_h (veh/h)	8738

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8970	0.90	Level	4	0	0.980	1.00	10166
Ramp	570	0.90	Level	4	0	0.980	1.00	646
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.296 using Equation 4

V_{12}= 2272 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8312	See Exhibit 25-7	No
V_{R12}	2918	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 24.8 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.358 (Exibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 46.1 mph (Exhibit 25-19)

S= 47.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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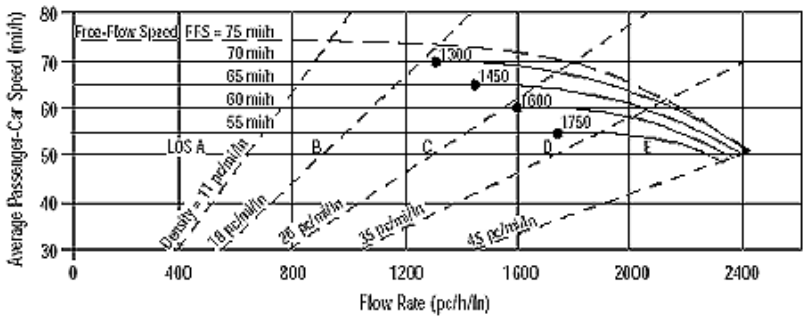
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 47

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	9540 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2162	pc/h/ln	Design LOS		
S	52.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	41.6	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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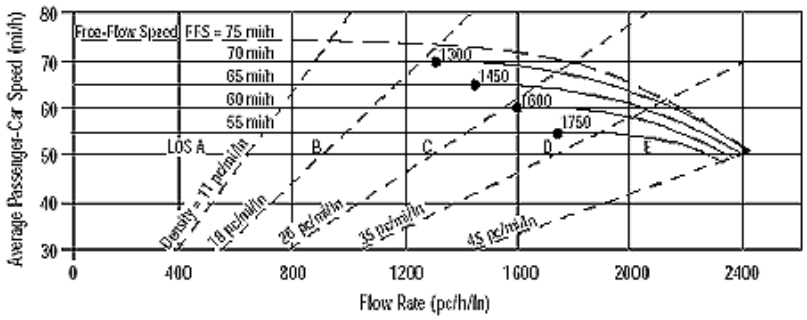
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 48

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4410 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2475	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4410	0.90	Level	5	0	0.976	1.00	5023
Ramp	3360	0.90	Level	5	0	0.976	1.00	3827
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 5023 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5023	4500	Yes
V_{12}	5023	4400:All	Yes
$V_{FO} = V_F - V_R$	1196	4500	No
V_R	3827	3800	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 28.5 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.772 (Exhibit 25-19)

S_R= 45.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 45.0 mph (Exhibit 25-15)

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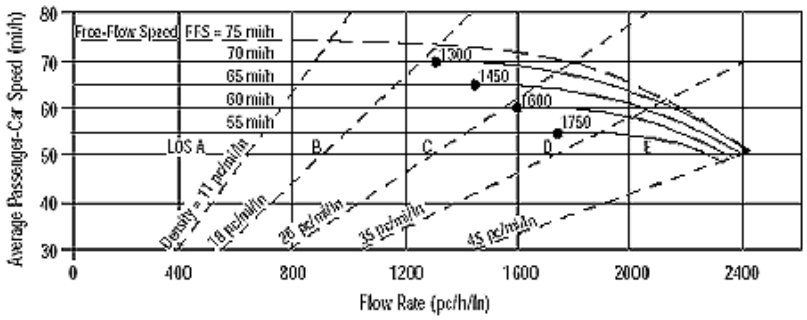

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 50

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	1200 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	683	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	11.4	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1200	0.90	Level	5	0	0.976	1.00	1367
Ramp	750	0.90	Level	5	0	0.976	1.00	854
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 1367 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	1367	4775	No
V_{12}	1367	4400:All	No
$V_{FO} = V_F - V_R$	513	4775	No
V_R	854	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 6.1 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.310 (Exhibit 25-19)

S_R= 60.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 60.5 mph (Exhibit 25-15)

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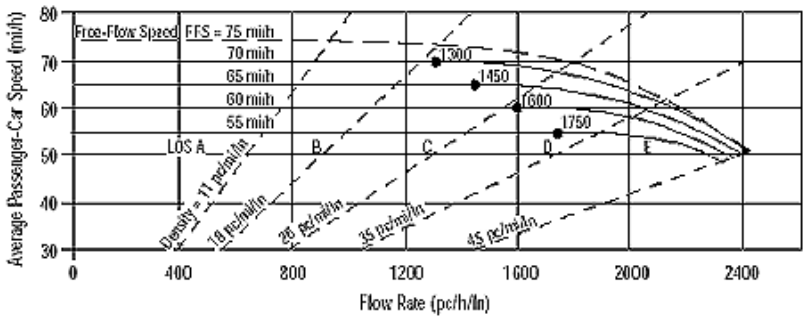

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 52

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	490 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	279	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	4.1	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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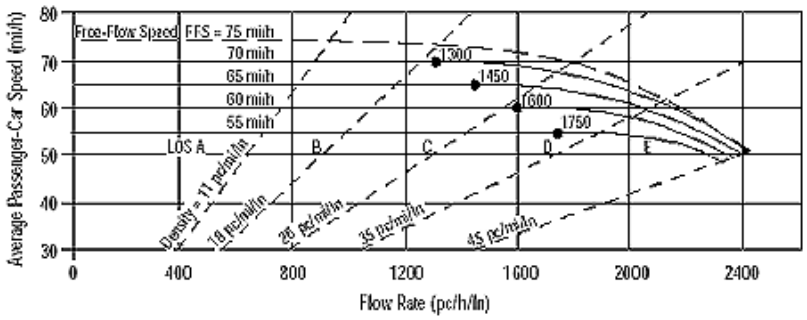
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 54

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4030 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1147	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	16.7	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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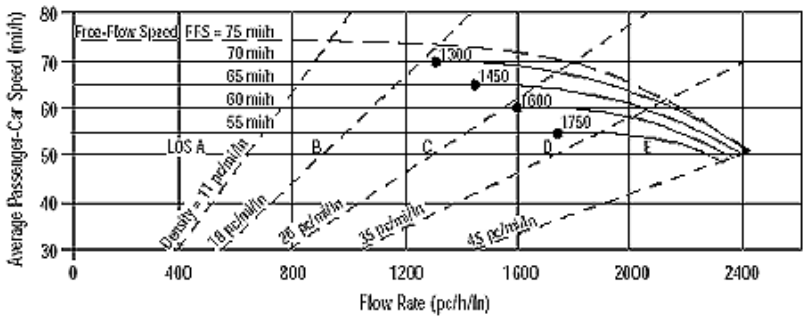
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 56

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5320 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1212	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	17.6	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5320	0.90	Level	5	0	0.976	1.00	6059
Ramp	1060	0.90	Level	5	0	0.976	1.00	1207
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 2927 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5151	9552	No
V_{12}	2927	4400:All	No
$V_{FO} = V_F - V_R$	3944	9552	No
V_R	1207	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 0.6 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.472 (Exhibit 25-19)

S_R= 56.2 mph (Exhibit 25-19)

S_0= 75.0 mph (Exhibit 25-19)

S = 63.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4260	0.90	Level	5	0	0.976	1.00	4852
Ramp	1100	0.90	Level	5	0	0.976	1.00	1253
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.244 using Equation 4

V_{12}= 1186 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6105	See Exhibit 25-7	No
V_{R12}	2439	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 20.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.325 (Exibit 25-19)

S_R= 60.9 mph (Exhibit 25-19)

S_0= 65.2 mph (Exhibit 25-19)

S= 63.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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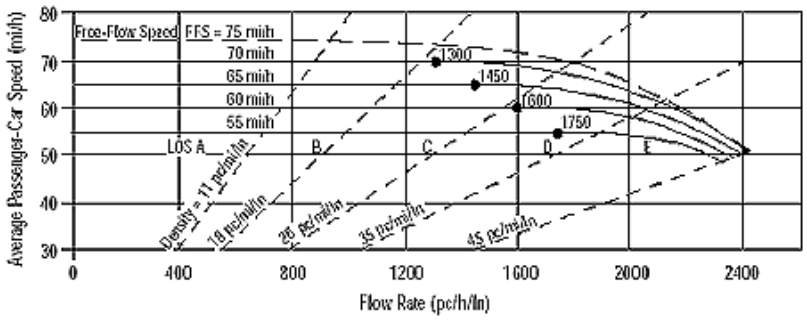
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 60

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5360 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1526	pc/h/ln	Design LOS		
S	69.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	21.9	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5360	0.90	Level	5	0	0.976	1.00	6104
Ramp	780	0.90	Level	5	0	0.976	1.00	888
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.171 using Equation 4

V_{12}= 1041 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6992	See Exhibit 25-7	No
V_{R12}	1929	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 18.9 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.334 (Exibit 25-19)

S_R= 58.1 mph (Exhibit 25-19)

S_0= 58.2 mph (Exhibit 25-19)

S= 58.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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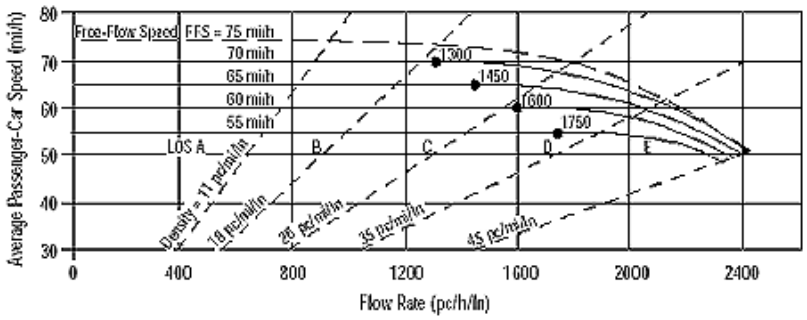
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 62

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6140 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	65.5	mi/h	FFS	65.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1748	pc/h/ln	Design LOS		
S	64.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	27.0	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.5 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6140	0.90	Level	5	0	0.976	1.00	6993
Ramp	1010	0.90	Level	5	0	0.976	1.00	1150
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3698 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	6993	9420	No
V_{12}	3698	4400:All	No
V_{FO} = V_F - V_R	5843	9420	No
V_R	1150	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.4 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.531 (Exhibit 25-19)

S_R= 53.0 mph (Exhibit 25-19)

S_0= 69.3 mph (Exhibit 25-19)

S = 59.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 65

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5130	0.90	Level	5	0	0.976	1.00	5843
Ramp	450	0.90	Level	5	0	0.976	1.00	513
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.337 using Equation 4

V_{12}= 1968 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6356	See Exhibit 25-7	No
V_{R12}	2481	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.327 (Exibit 25-19)

S_R= 54.8 mph (Exhibit 25-19)

S_0= 55.8 mph (Exhibit 25-19)

S= 55.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 68

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7100	0.90	Level	5	0	0.976	1.00	8086
Ramp	530	0.90	Level	5	0	0.976	1.00	604
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.222 using Equation 4

V_{12}= 1795 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8690	See Exhibit 25-7	No
V_{R12}	2399	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 22.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.346 (Exibit 25-19)

S_R= 58.7 mph (Exhibit 25-19)

S_0= 56.0 mph (Exhibit 25-19)

S= 56.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7620	0.90	Level	5	0	0.976	1.00	8678
Ramp	270	0.90	Level	5	0	0.976	1.00	308
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\ (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.243 using Equation 4

V_{12}= 2109 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8986	See Exhibit 25-7	No
V_{R12}	2417	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 22.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.351 (Exibit 25-19)

S_R= 57.6 mph (Exhibit 25-19)

S_0= 53.7 mph (Exhibit 25-19)

S= 54.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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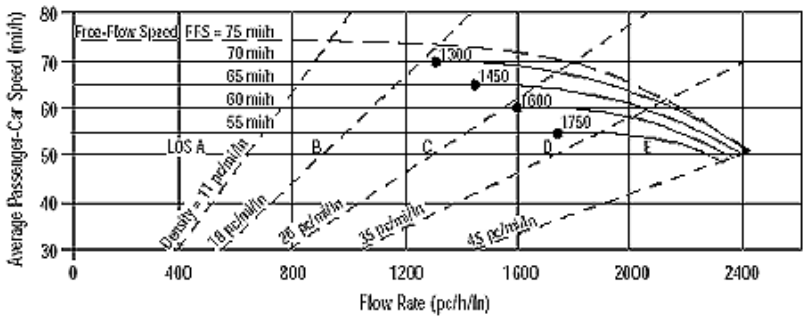
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 71

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7890 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2246	pc/h/ln	Design LOS		
S	57.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	39.1	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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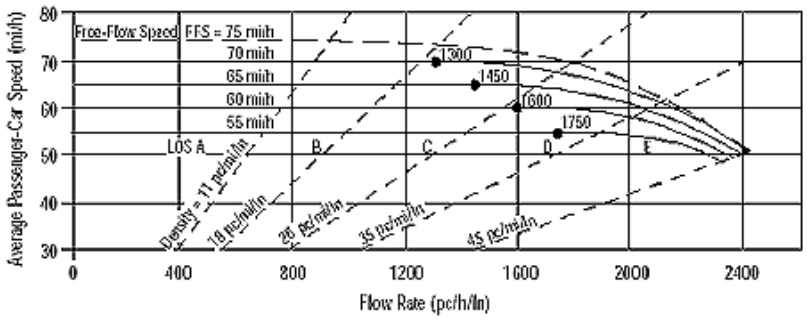
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 72

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7890 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1797	pc/h/ln	Design LOS		
S	66.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	27.1	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 67.9 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7890	0.90	Level	5	0	0.976	1.00	8986
Ramp	1020	0.90	Level	5	0	0.976	1.00	1162
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3790 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7189	9516	No
V_{12}	3790	4400:All	No
V_{FO} = V_F - V_R	6027	9516	No
V_R	1162	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 35.0 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.598 (Exhibit 25-19)

S_R= 52.4 mph (Exhibit 25-19)

S_0= 71.8 mph (Exhibit 25-19)

S = 60.1 mph (Exhibit 25-15)

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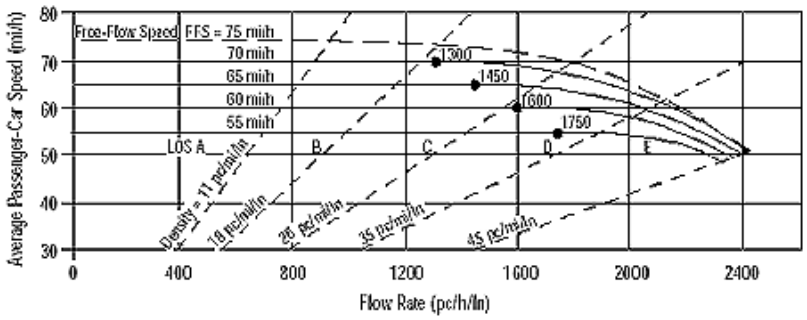
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 74

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6870 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1956	pc/h/ln	Design LOS		
S	65.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	29.8	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 66.2 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6870	0.90	Level	5	0	0.976	1.00	7824
Ramp	560	0.90	Level	5	0	0.976	1.00	638
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3771 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7824	9447	No
V_{12}	3771	4400:All	No
V_{FO} = V_F - V_R	7186	9447	No
V_R	638	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.7 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.550 (Exhibit 25-19)

S_R= 52.9 mph (Exhibit 25-19)

S_0= 68.6 mph (Exhibit 25-19)

S = 60.0 mph (Exhibit 25-15)

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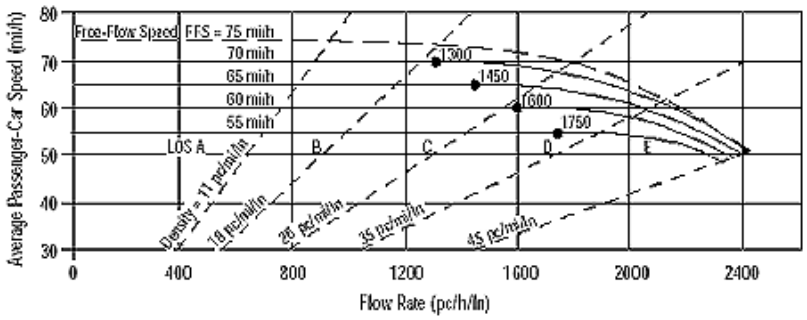

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 76

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6300 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.2	mi/h	FFS	66.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1794	pc/h/ln	Design LOS	
S	64.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	27.6	pc/mi/ln	S	mi/h
LOS	D		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 63.9 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6300	0.90	Level	5	0	0.976	1.00	7175
Ramp	1120	0.90	Level	5	0	0.976	1.00	1276
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3848 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7175	9356	No
V_{12}	3848	4400:All	No
$V_{FO} = V_F - V_R$	5899	9356	No
V_R	1276	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 35.3 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.608 (Exhibit 25-19)

S_R= 50.6 mph (Exhibit 25-19)

S_0= 67.5 mph (Exhibit 25-19)

S = 57.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.9 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5190	0.90	Level	5	0	0.976	1.00	5911
Ramp	590	0.90	Level	5	0	0.976	1.00	672
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.421 using Equation 4

V_{12}= 2486 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6583	See Exhibit 25-7	No
V_{R12}	3158	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 24.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.350 (Exibit 25-19)

S_R= 56.2 mph (Exhibit 25-19)

S_0= 59.5 mph (Exhibit 25-19)

S= 57.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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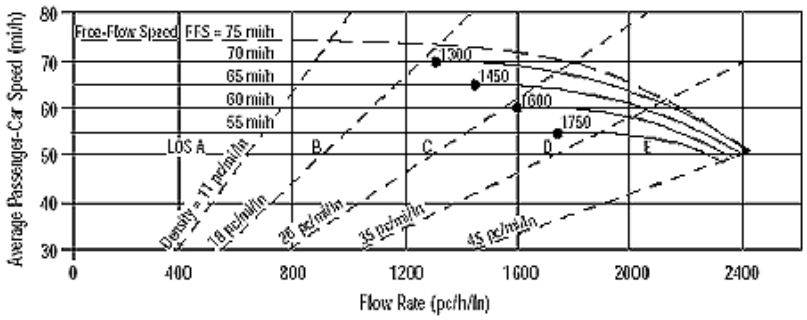
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 84

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5770 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1643	pc/h/ln	Design LOS	
S	66.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	24.8	pc/mi/ln	S	mi/h
LOS	C		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 66.5 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5770	0.90	Level	5	0	0.976	1.00	6571
Ramp	800	0.90	Level	5	0	0.976	1.00	911
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3379 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6571	9460	No
V_{12}	3379	4400:All	No
$V_{FO} = V_F - V_R$	5660	9460	No
V_R	911	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 30.8 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.315 (Exhibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= 70.6 mph (Exhibit 25-19)

S = 64.0 mph (Exhibit 25-15)

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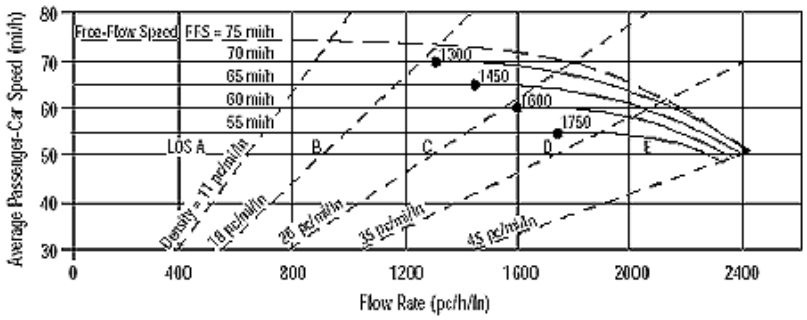
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 86

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4970 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1415	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.2	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.5 mph S_{FR} = 66.5 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4970	0.90	Level	5	0	0.976	1.00	5660
Ramp	3060	0.90	Level	5	0	0.976	1.00	3485
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 4050 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5660	9460	No
V_{12}	4050	4400:All	No
$V_{FO} = V_F - V_R$	2175	9460	No
V_R	3485	4400	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = -47.3 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.332 (Exhibit 25-19)

S_R= 58.4 mph (Exhibit 25-19)

S_0= 73.0 mph (Exhibit 25-19)

S = 61.9 mph (Exhibit 25-15)

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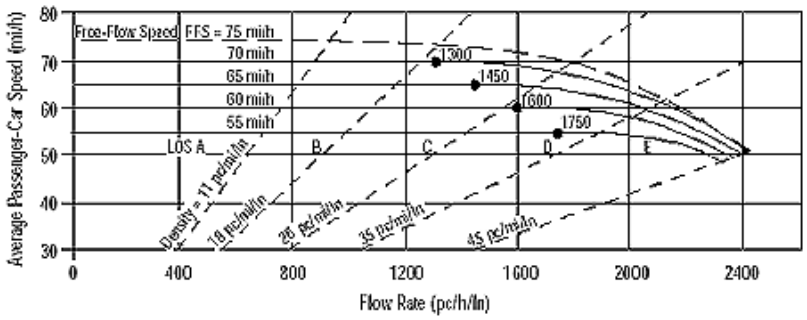
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 88 coded as 2 lanes, double volume

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4140 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2358	pc/h/ln	Design LOS		
S	52.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	44.6	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 66.5 mph S_{FR} = 50.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4140	0.90	Level	5	0	0.976	1.00	4715
Ramp	80	0.90	Level	5	0	0.976	1.00	91
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 4715 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4806	See Exhibit 25-7	Yes
V_{R12}	4806	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 40.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.763 (Exibit 25-19)

S_R= 47.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 47.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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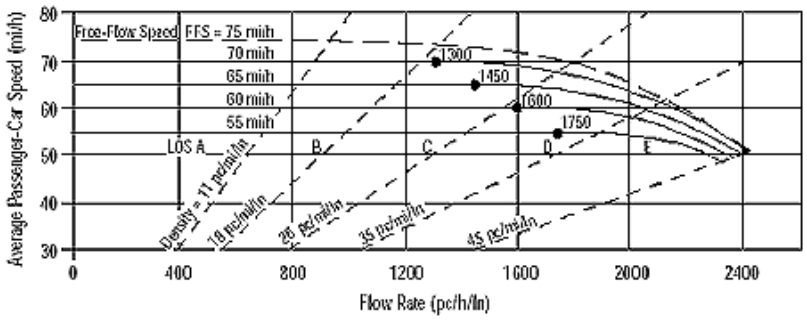
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 90 coded as 2 lanes, double volume

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4300 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2449	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1930	0.90	Level	2	0	0.990	1.00	2166
Ramp	2150	0.90	Level	2	0	0.990	1.00	2413
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2166 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4579	See Exhibit 25-7	Yes
V_{R12}	4579	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 38.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.673 (Exibit 25-19)

S_R= 46.2 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 46.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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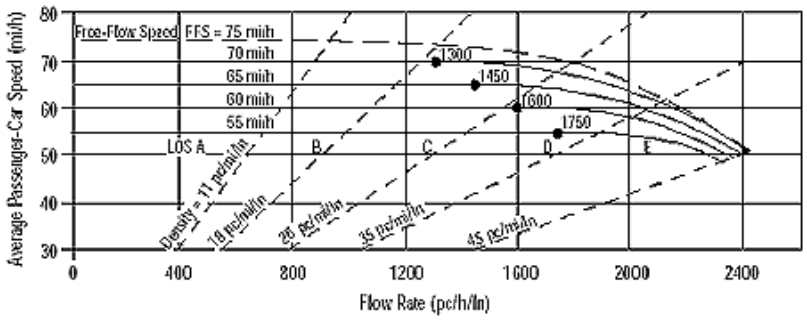
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 92

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4240 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2379	pc/h/ln	Design LOS		
S	54.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	43.9	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3390	0.90	Level	2	0	0.990	1.00	3804
Ramp	550	0.90	Level	2	0	0.990	1.00	617
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3804 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4421	See Exhibit 25-7	No
V_{R12}	4421	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 30.3 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.540 (Exibit 25-19)

S_R= 48.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 48.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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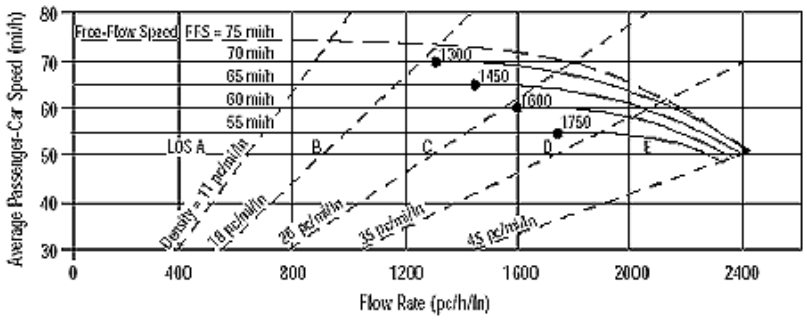
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 96

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	3980 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1489	pc/h/ln	Design LOS		
S	69.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	21.3	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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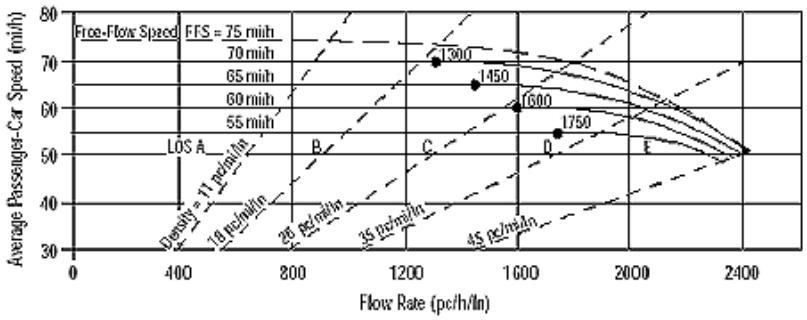
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 97

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	3160 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1182	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	16.9	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3160	0.90	Level	5	0	0.976	1.00	3599
Ramp	110	0.90	Level	5	0	0.976	1.00	125
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 3599 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	3599	4500	No
V_{12}	3599	4400:All	No
V_{FO} = V_F - V_R	3474	4500	No
V_R	125	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.504 (Exhibit 25-19)

S_R= 48.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 48.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3040	0.90	Level	2	0	0.990	1.00	3412
Ramp	1270	0.90	Level	2	0	0.990	1.00	1425
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3412 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4837	See Exhibit 25-7	Yes
V_{R12}	4837	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 40.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.785 (Exibit 25-19)

S_R= 44.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 44.8 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9160	0.90	Level	4	0	0.980	1.00	10381
Ramp	990	0.90	Level	4	0	0.980	1.00	1122
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 2990 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8305	9000	No
V_{12}	2990	4400:All	No
$V_{FO} = V_F - V_R$	7183	9000	No
V_R	1122	3500	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 13.8 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.724 (Exhibit 25-19)

S_R= 45.6 mph (Exhibit 25-19)

S_0= 53.9 mph (Exhibit 25-19)

S = 50.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8610	0.90	Level	4	0	0.980	1.00	9758
Ramp	600	0.90	Level	4	0	0.980	1.00	680
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3787 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7807	9000	No
V_{12}	3787	4400:All	No
$V_{FO} = V_F - V_R$	7127	9000	No
V_R	680	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 23.3 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

D_s = 0.359 (Exhibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 56.4 mph (Exhibit 25-19)

S = 53.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.0 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8780	0.90	Level	4	0	0.980	1.00	9951
Ramp	760	0.90	Level	4	0	0.980	1.00	861
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3957 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7961	9520	No
V_{12}	3957	4400:All	No
V_{FO} = V_F - V_R	7100	9520	No
V_R	861	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 29.3 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.635 (Exhibit 25-19)

S_R= 51.5 mph (Exhibit 25-19)

S_0= 70.7 mph (Exhibit 25-19)

S = 59.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8480	0.90	Level	4	0	0.980	1.00	9611
Ramp	520	0.90	Level	4	0	0.980	1.00	589
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3685 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7689	9000	No
V_{12}	3685	4400:All	No
V_{FO} = V_F - V_R	7100	9000	No
V_R	589	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 26.9 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.676 (Exhibit 25-19)

S_R= 46.2 mph (Exhibit 25-19)

S_0= 56.4 mph (Exhibit 25-19)

S = 51.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.3 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9300	0.90	Level	4	0	0.980	1.00	10540
Ramp	1450	0.90	Level	4	0	0.980	1.00	1643
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3408 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8432	9412	No
V_{12}	3408	4400:All	No
$V_{FO} = V_F - V_R$	6789	9412	No
V_R	1643	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 17.4 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

D_s = 0.576 (Exhibit 25-19)

S_R= 51.9 mph (Exhibit 25-19)

S_0= 65.7 mph (Exhibit 25-19)

S = 59.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9080	0.90	Level	4	0	0.980	1.00	10291
Ramp	690	0.90	Level	4	0	0.980	1.00	782
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4031 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8233	9000	No
V_{12}	4031	4400:All	No
V_{FO} = V_F - V_R	7451	9000	No
V_R	782	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 24.5 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.693 (Exhibit 25-19)

S_R= 46.0 mph (Exhibit 25-19)

S_0= 56.0 mph (Exhibit 25-19)

S = 50.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.5 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9160	0.90	Level	4	0	0.980	1.00	10381
Ramp	410	0.90	Level	4	0	0.980	1.00	465
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3883 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8305	9540	No
V_{12}	3883	4400:All	No
V_{FO} = V_F - V_R	7840	9540	No
V_R	465	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 35.4 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.600 (Exhibit 25-19)

S_R= 52.6 mph (Exhibit 25-19)

S_0= 70.4 mph (Exhibit 25-19)

S = 60.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.9 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7460	0.90	Level	4	0	0.980	1.00	8455
Ramp	80	0.90	Level	4	0	0.980	1.00	91
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3738 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8455	9556	No
V_{12}	3738	4400:All	No
V_{FO} = V_F - V_R	8364	9556	No
V_R	91	2100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.6 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.306 (Exhibit 25-19)

S_R= 60.7 mph (Exhibit 25-19)

S_0= 70.3 mph (Exhibit 25-19)

S = 65.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 67.6 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8300	0.90	Level	5	0	0.976	1.00	9453
Ramp	1210	0.90	Level	5	0	0.976	1.00	1378
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 2986 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7563	9503	No
V_{12}	2986	4400:All	No
V_{FO} = V_F - V_R	6185	9503	No
V_R	1378	3500	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 13.7 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.682 (Exhibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 69.1 mph (Exhibit 25-19)

S = 60.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4240	0.90	Level	5	0	0.976	1.00	4829
Ramp	790	0.90	Level	5	0	0.976	1.00	900
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 4829 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	4829	4500	Yes
V_{12}	4829	4400:All	Yes
V_{FO} = V_F - V_R	3929	4500	No
V_R	900	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 43.8 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.574 (Exhibit 25-19)

S_R= 47.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8880	0.90	Level	4	0	0.980	1.00	10064
Ramp	430	0.90	Level	4	0	0.980	1.00	487
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.252 using Equation 4

V_{12}= 1910 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8051	See Exhibit 25-7	No
V_{R12}	2397	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 22.1 (pc/ m/ln)

LOS = C (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.343 (Exibit 25-19)

S_R= 54.9 mph (Exhibit 25-19)

S_0= 51.9 mph (Exhibit 25-19)

S= 52.8 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8180	0.90	Level	4	0	0.980	1.00	9271
Ramp	790	0.90	Level	4	0	0.980	1.00	895
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.584 using Equation 4

V_{12}= 5412 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10166	See Exhibit 25-7	Yes
V_{R12}	6307	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 44.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 2.355 (Exibit 25-19)

S_R= 24.4 mph (Exhibit 25-19)

S_0= 49.9 mph (Exhibit 25-19)

S= 30.3 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 113

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7960	0.90	Level	4	0	0.980	1.00	9021
Ramp	1200	0.90	Level	4	0	0.980	1.00	1360
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1885 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10381	See Exhibit 25-7	Yes
V_{R12}	3245	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 13.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.239 (Exibit 25-19)

S_R= 51.9 mph (Exhibit 25-19)

S_0= 40.9 mph (Exhibit 25-19)

S= 43.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 114

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 66.7 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7850	0.90	Level	4	0	0.980	1.00	8897
Ramp	930	0.90	Level	4	0	0.980	1.00	1054
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.405 using Equation 4

V_{12}= 3600 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9951	See Exhibit 25-7	Yes
V_{R12}	4654	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 35.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.661 (Exibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 58.1 mph (Exhibit 25-19)

S= 54.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 115

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8020	0.90	Level	4	0	0.980	1.00	9089
Ramp	470	0.90	Level	4	0	0.980	1.00	533
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.438 using Equation 4

V_{12}= 3980 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9622	See Exhibit 25-7	Yes
V_{R12}	4513	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 34.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.614 (Exibit 25-19)

S_R= 47.0 mph (Exhibit 25-19)

S_0= 46.9 mph (Exhibit 25-19)

S= 47.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 116

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8390	0.90	Level	4	0	0.980	1.00	9509
Ramp	230	0.90	Level	4	0	0.980	1.00	261
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.759 using Equation 4

V_{12}= 7214 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9770	See Exhibit 25-7	Yes
V_{R12}	7475	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 52.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 7.072 (Exibit 25-19)

S_R= -36.9 mph (Exhibit 25-19)

S_0= 52.7 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 68.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8670	0.90	Level	4	0	0.980	1.00	9826
Ramp	490	0.90	Level	4	0	0.980	1.00	555
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.244 using Equation 4

V_{12}= 2398 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10381	See Exhibit 25-7	Yes
V_{R12}	2953	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 26.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.375 (Exibit 25-19)

S_R= 58.4 mph (Exhibit 25-19)

S_0= 53.2 mph (Exhibit 25-19)

S= 54.6 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 118

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8810	0.90	Level	4	0	0.980	1.00	9985
Ramp	270	0.90	Level	4	0	0.980	1.00	306
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.753 using Equation 4

V_{12}= 7518 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10291	See Exhibit 25-7	Yes
V_{R12}	7824	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 55.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 9.945 (Exibit 25-19)

S_R= -74.3 mph (Exhibit 25-19)

S_0= 52.4 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5580	0.90	Level	5	0	0.976	1.00	6355
Ramp	770	0.90	Level	5	0	0.976	1.00	877
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.236 using Equation 4

V_{12}= 1497 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7232	See Exhibit 25-7	No
V_{R12}	2374	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.1 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.335 (Exibit 25-19)

S_R= 53.8 mph (Exhibit 25-19)

S_0= 52.5 mph (Exhibit 25-19)

S= 52.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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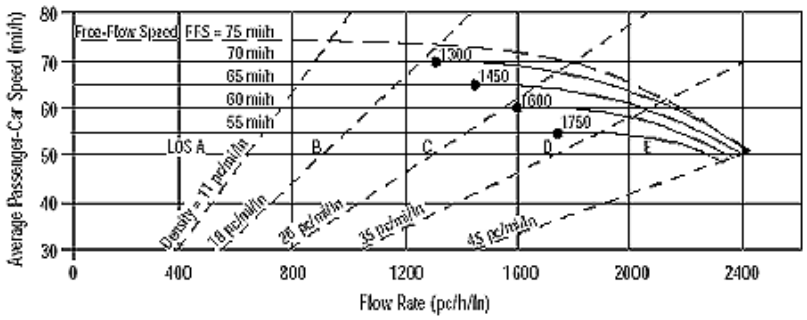
PM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 1

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	10050 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2278	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10050	0.90	Level	4	0	0.980	1.00	11390
Ramp	1360	0.90	Level	4	0	0.980	1.00	1541
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3509 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9112	9000	Yes
V_{12}	3509	4400:All	No
V_{FO} = V_F - V_R	7571	9000	No
V_R	1541	3800	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 20.0 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.632 (Exhibit 25-19)

S_R= 46.8 mph (Exhibit 25-19)

S_0= 53.3 mph (Exhibit 25-19)

S = 50.6 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.40
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	340	0.90	4	0	1.5	1.2	0.980	1.00	385
Vw2	520	0.90	4	0	1.5	1.2	0.980	1.00	589
Vw				974	Vnw				0
V									974

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.74	0.59
Weaving and non-weaving speeds, Si (mi/h)			21.68	30.70

Number of lanes required for unconstrained operation, Nw 1.74
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	21.68
Weaving segment density, D (pc/mi/ln)	22.47
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8690	0.90	Level	4	0	0.980	1.00	9849
Ramp	380	0.90	Level	4	0	0.980	1.00	431
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.546 using Equation 4

V_{12}= 5380 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10280	See Exhibit 25-7	Yes
V_{R12}	5811	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 43.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 1.539 (Exibit 25-19)

S_R= 35.0 mph (Exhibit 25-19)

S_0= 48.8 mph (Exhibit 25-19)

S= 39.9 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	41	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.27
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.30
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7198	0.90	4	0	1.5	1.2	0.980	1.00	8157
Vo2	98	0.90	4	0	1.5	1.2	0.980	1.00	111
Vw1	1862	0.90	4	0	1.5	1.2	0.980	1.00	2110
Vw2	812	0.90	4	0	1.5	1.2	0.980	1.00	920
Vw				3030	Vnw				8268
V									11298

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.64	0.58
Weaving and non-weaving speeds, Si (mi/h)			21.68	34.60

Number of lanes required for unconstrained operation, Nw 2.16
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	29.83
Weaving segment density, D (pc/mi/ln)	75.74
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9008
Capacity as a 15-minute flow rate, c (veh/h)	8831
Capacity as a full-hour volume, c_h (veh/h)	7948

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.08
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	220	0.90	4	0	1.5	1.2	0.980	1.00	249
Vw2	20	0.90	4	0	1.5	1.2	0.980	1.00	22
Vw				271	Vnw				0
V									271

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.06	0.15
Weaving and non-weaving speeds, Si (mi/h)			27.15	36.80

Number of lanes required for unconstrained operation, Nw 1.47
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	27.15
Weaving segment density, D (pc/mi/ln)	4.99
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	39	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.21
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.29
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7150	0.90	4	0	1.5	1.2	0.980	1.00	8103
Vo2	30	0.90	4	0	1.5	1.2	0.980	1.00	34
Vw1	570	0.90	4	0	1.5	1.2	0.980	1.00	646
Vw2	1380	0.90	4	0	1.5	1.2	0.980	1.00	1564
Vw				2210	Vnw				8137
V									10347

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.25	0.46
Weaving and non-weaving speeds, Si (mi/h)			21.82	34.80

Number of lanes required for unconstrained operation, Nw 1.86
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	30.88
Weaving segment density, D (pc/mi/ln)	67.02
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	8904
Capacity as a 15-minute flow rate, c (veh/h)	8729
Capacity as a full-hour volume, c_h (veh/h)	7856

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 22

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8520	0.90	Level	4	0	0.980	1.00	9656
Ramp	290	0.90	Level	4	0	0.980	1.00	329
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.240 using Equation 4

V_{12}= 2321 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9985	See Exhibit 25-7	Yes
V_{R12}	2650	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 24.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.362 (Exibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 40.3 mph (Exhibit 25-19)

S= 42.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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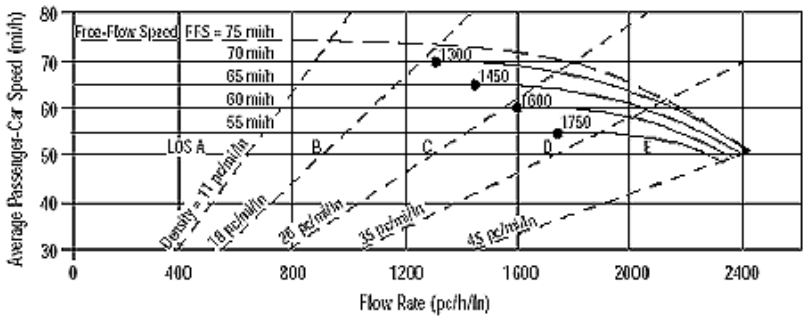
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 23

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8810 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2496	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.34
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8516	0.90	4	0	1.5	1.2	0.980	1.00	9651
Vo2	16	0.90	4	0	1.5	1.2	0.980	1.00	18
Vw1	294	0.90	4	0	1.5	1.2	0.980	1.00	333
Vw2	574	0.90	4	0	1.5	1.2	0.980	1.00	650
Vw				983	Vnw				9669
V									10652

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.63	0.22		
Weaving and non-weaving speeds, Si (mi/h)	40.83	49.48		

Number of lanes required for unconstrained operation, Nw 1.04
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	48.53
Weaving segment density, D (pc/mi/ln)	43.90
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10836
Capacity as a 15-minute flow rate, c (veh/h)	10624
Capacity as a full-hour volume, c_h (veh/h)	9562

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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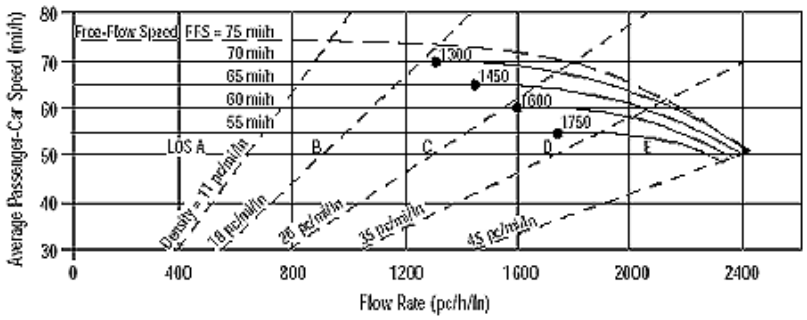
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 25

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	9090 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2060	pc/h/ln	Design LOS		
S	53.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	38.5	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9090	0.90	Level	4	0	0.980	1.00	10302
Ramp	1440	0.90	Level	4	0	0.980	1.00	1632
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3351 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8242	9000	No
V_{12}	3351	4400:All	No
$V_{FO} = V_F - V_R$	6610	9000	No
V_R	1632	4100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 7.0 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.380 (Exhibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 54.7 mph (Exhibit 25-19)

S = 52.7 mph (Exhibit 25-15)

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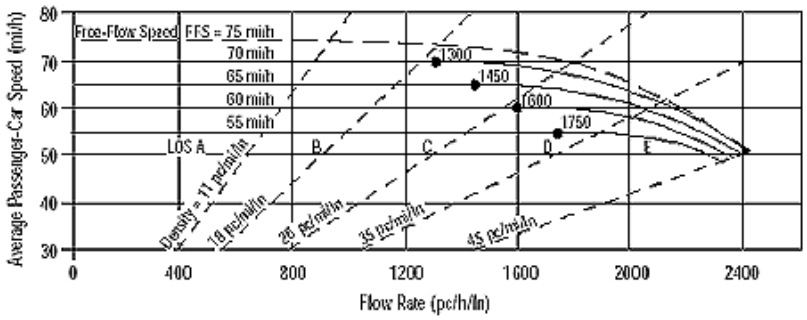
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 27

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7650 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2168	pc/h/ln	Design LOS		
S	51.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	41.8	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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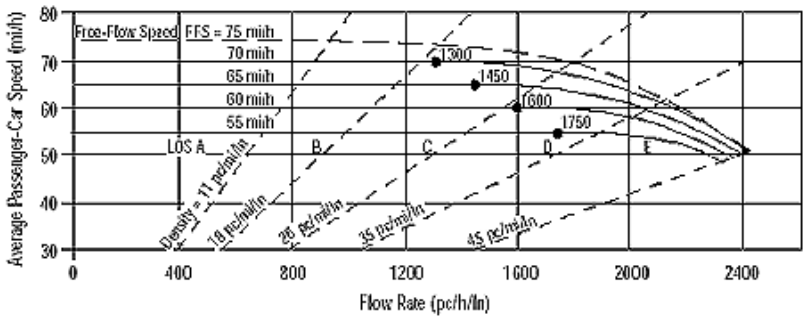
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 29

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7530 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2134	pc/h/ln	Design LOS		
S	52.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	40.7	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 30

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7530	0.90	Level	4	0	0.980	1.00	8534
Ramp	3310	0.90	Level	4	0	0.980	1.00	3751
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1784 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12285	See Exhibit 25-7	Yes
V_{R12}	5535	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 28.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 1.106 (Exibit 25-19)

S_R= 40.6 mph (Exhibit 25-19)

S_0= 42.0 mph (Exhibit 25-19)

S= 41.4 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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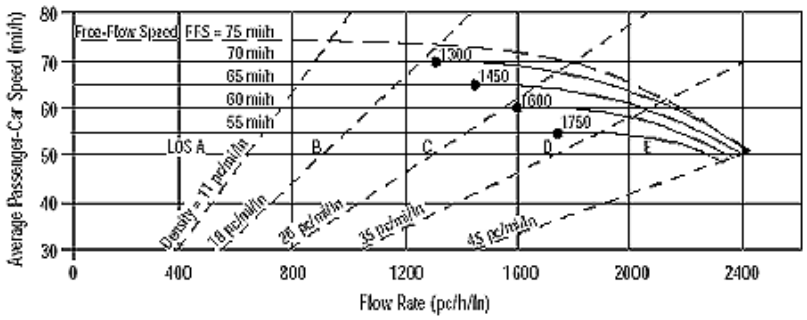
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 31

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	11220 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2543	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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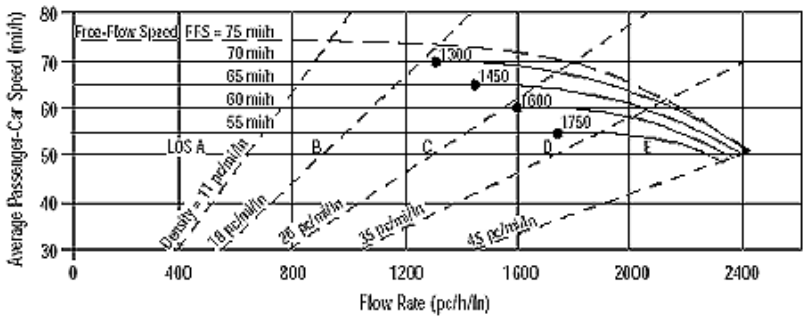
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 32

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	10340 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2344	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10340	0.90	Level	4	0	0.980	1.00	11719
Ramp	1440	0.90	Level	4	0	0.980	1.00	1632
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3645 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9376	9351	Yes
V_{12}	3645	4400:All	No
V_{FO} = V_F - V_R	7744	9351	No
V_R	1632	4100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = -7.6 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.380 (Exhibit 25-19)

S_R= 55.5 mph (Exhibit 25-19)

S_0= 62.7 mph (Exhibit 25-19)

S = 59.7 mph (Exhibit 25-15)

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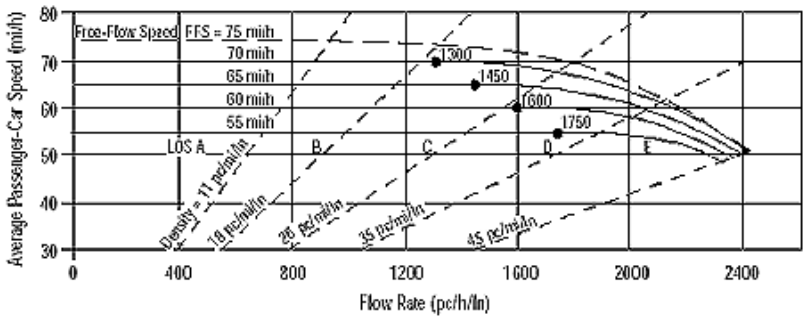

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 34

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8900 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2522	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8900	0.90	Level	4	0	0.980	1.00	10087
Ramp	1480	0.90	Level	4	0	0.980	1.00	1677
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.390 using Equation 4

V_{12}= 3939 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11764	See Exhibit 25-7	Yes
V_{R12}	5616	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 41.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 1.309 (Exibit 25-19)

S_R= 35.3 mph (Exhibit 25-19)

S_0= 52.6 mph (Exhibit 25-19)

S= 42.6 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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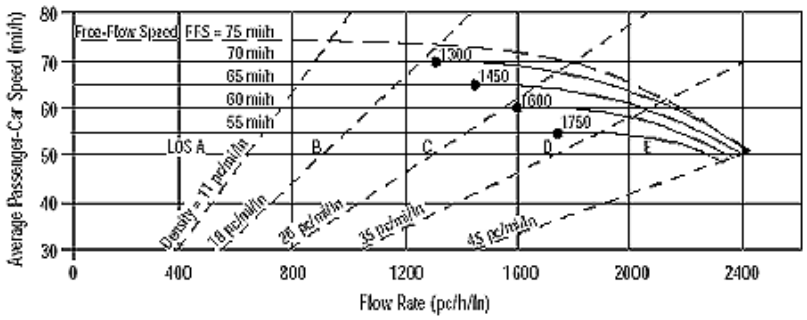

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 36

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	10380 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2941	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.10
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.24
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	40	0.90	4	0	1.5	1.2	0.980	1.00	45
Vo2	9260	0.90	4	0	1.5	1.2	0.980	1.00	10494
Vw1	240	0.90	4	0	1.5	1.2	0.980	1.00	272
Vw2	760	0.90	4	0	1.5	1.2	0.980	1.00	861
Vw				1133	Vnw				10539
V									11672

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.89	0.46		
Weaving and non-weaving speeds, Si (mi/h)	44.16	52.72		

Number of lanes required for unconstrained operation, Nw 1.06
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	51.75
Weaving segment density, D (pc/mi/ln)	45.11
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11220
Capacity as a 15-minute flow rate, c (veh/h)	11000
Capacity as a full-hour volume, c_h (veh/h)	9900

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.06
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.49
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	15	0.90	4	0	1.5	1.2	0.980	1.00	17
Vo2	9585	0.90	4	0	1.5	1.2	0.980	1.00	10863
Vw1	275	0.90	4	0	1.5	1.2	0.980	1.00	311
Vw2	285	0.90	4	0	1.5	1.2	0.980	1.00	323
Vw				634	Vnw				10880
V									11514

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.78	0.38		
Weaving and non-weaving speeds, Si (mi/h)	46.39	55.68		

Number of lanes required for unconstrained operation, Nw 0.76
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	55.07
Weaving segment density, D (pc/mi/ln)	41.81
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11339
Capacity as a 15-minute flow rate, c (veh/h)	11117
Capacity as a full-hour volume, c_h (veh/h)	10005

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.08
Weaving seg length, L (ft)	890	Weaving ratio, R	0.34
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	30	0.90	4	0	1.5	1.2	0.980	1.00	34
Vo2	9300	0.90	4	0	1.5	1.2	0.980	1.00	10540
Vw1	290	0.90	4	0	1.5	1.2	0.980	1.00	328
Vw2	560	0.90	4	0	1.5	1.2	0.980	1.00	634
Vw				962	Vnw				10574
V									11536

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.43	0.70		
Weaving and non-weaving speeds, Si (mi/h)	37.63	47.41		

Number of lanes required for unconstrained operation, Nw 0.90
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	46.41
Weaving segment density, D (pc/mi/ln)	49.72
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10148
Capacity as a 15-minute flow rate, c (veh/h)	9949
Capacity as a full-hour volume, c_h (veh/h)	8954

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2020 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.16
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	48	0.90	4	0	1.5	1.2	0.980	1.00	54
Vo2	8688	0.90	4	0	1.5	1.2	0.980	1.00	9846
Vw1	782	0.90	4	0	1.5	1.2	0.980	1.00	886
Vw2	902	0.90	4	0	1.5	1.2	0.980	1.00	1022
Vw				1908	Vnw				9900
V									11808

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.71	0.32		
Weaving and non-weaving speeds, Si (mi/h)	47.77	57.37		

Number of lanes required for unconstrained operation, Nw 1.03
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	55.56
Weaving segment density, D (pc/mi/ln)	42.50
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11569
Capacity as a 15-minute flow rate, c (veh/h)	11342
Capacity as a full-hour volume, c_h (veh/h)	10208

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10080	0.90	Level	4	0	0.980	1.00	11424
Ramp	320	0.90	Level	4	0	0.980	1.00	363
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.332 using Equation 4

V_{12}= 2960 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9287	See Exhibit 25-7	No
V_{R12}	3323	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 28.1 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.394 (Exibit 25-19)

S_R= 56.4 mph (Exhibit 25-19)

S_0= 55.2 mph (Exhibit 25-19)

S= 55.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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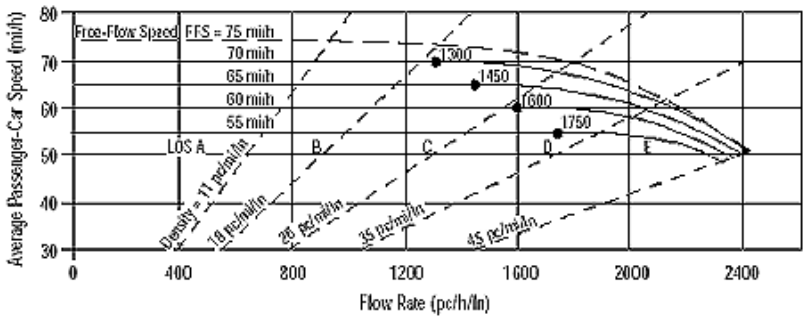
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 47

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	10400 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	60.9	mi/h	FFS	60.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2357	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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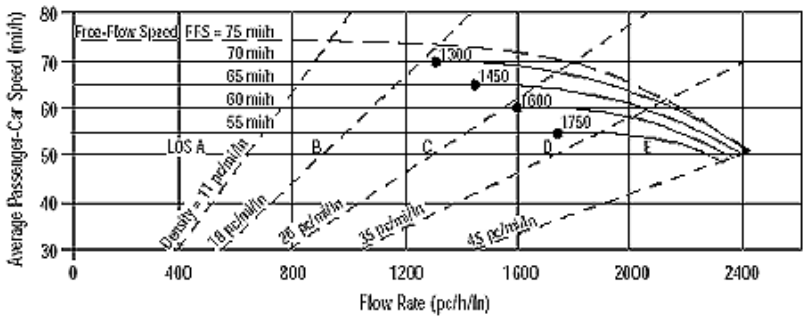
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 48

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	3630 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2037	pc/h/ln	Design LOS		
S	64.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	31.8	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3630	0.90	Level	5	0	0.976	1.00	4134
Ramp	2840	0.90	Level	5	0	0.976	1.00	3234
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4134 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4134	4500	No
V_{12}	4134	4400:All	No
$V_{FO} = V_F - V_R$	900	4500	No
V_R	3234	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 20.9 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

D_s = 0.719 (Exhibit 25-19)

S_R= 45.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 45.7 mph (Exhibit 25-15)

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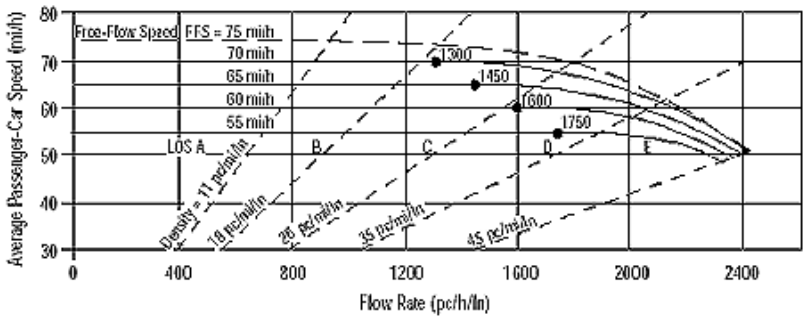
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 50

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	1330 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	757	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	12.6	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 62.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1330	0.90	Level	5	0	0.976	1.00	1515
Ramp	430	0.90	Level	5	0	0.976	1.00	490
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 1515 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	1515	4655	No
V_{12}	1515	4400:All	No
$V_{FO} = V_F - V_R$	1025	4655	No
V_R	490	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 7.4 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.277 (Exhibit 25-19)

S_R= 57.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 57.0 mph (Exhibit 25-15)

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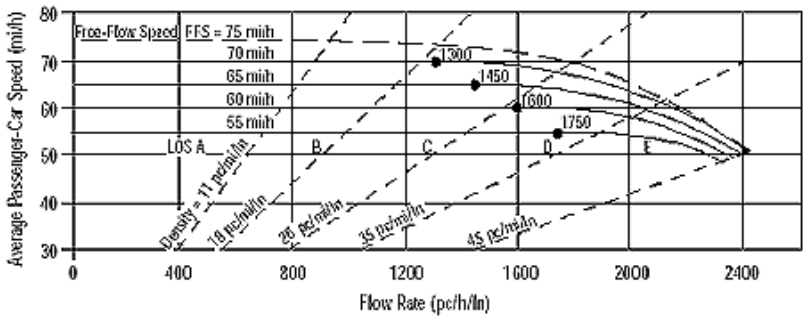
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 52

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	960 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	547	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	8.7	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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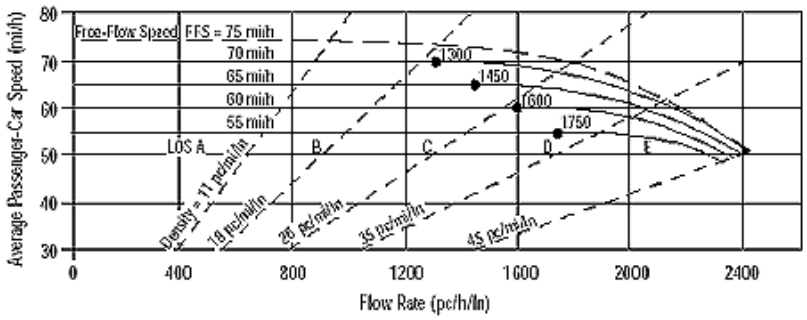
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 54

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5190 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1478	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	23.5	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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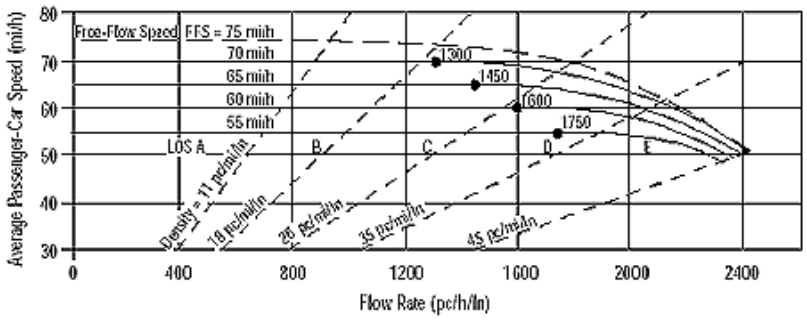
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 56

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6630 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1510	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	24.0	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 62.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6630	0.90	Level	5	0	0.976	1.00	7551
Ramp	1630	0.90	Level	5	0	0.976	1.00	1856
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3681 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6041	9311	No
V_{12}	3681	4400:All	No
$V_{FO} = V_F - V_R$	4185	9311	No
V_R	1856	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 7.1 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.530 (Exhibit 25-19)

S_R= 51.8 mph (Exhibit 25-19)

S_0= 68.2 mph (Exhibit 25-19)

S = 57.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5010	0.90	Level	5	0	0.976	1.00	5706
Ramp	1400	0.90	Level	5	0	0.976	1.00	1594
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.202 using Equation 4

V_{12}= 1151 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7300	See Exhibit 25-7	No
V_{R12}	2745	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 22.5 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.341 (Exibit 25-19)

S_R= 59.0 mph (Exhibit 25-19)

S_0= 61.4 mph (Exhibit 25-19)

S= 60.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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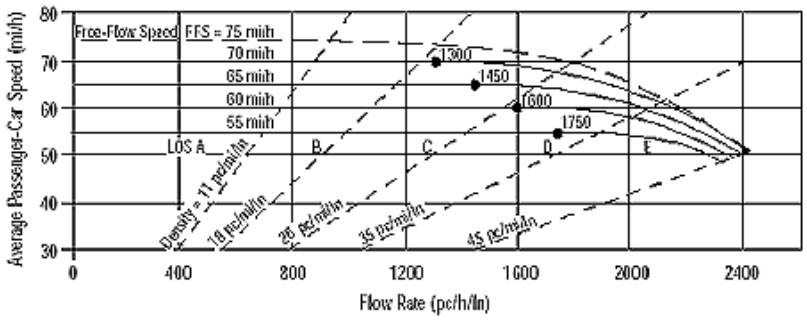

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 60

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6410 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1825	pc/h/ln	Design LOS		
S	67.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	27.0	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 60.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6410	0.90	Level	5	0	0.976	1.00	7300
Ramp	1090	0.90	Level	5	0	0.976	1.00	1241
UpStream								
DownStream								

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.126 using Equation 4

V_{12}= 923 pc/h

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8541	See Exhibit 25-7	No
V_{R12}	2164	4600:All	No

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 20.5 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.341 (Exibit 25-19)

S_R= 54.2 mph (Exhibit 25-19)

S_0= 48.6 mph (Exhibit 25-19)

S= 49.9 mph (Exhibit 25-14)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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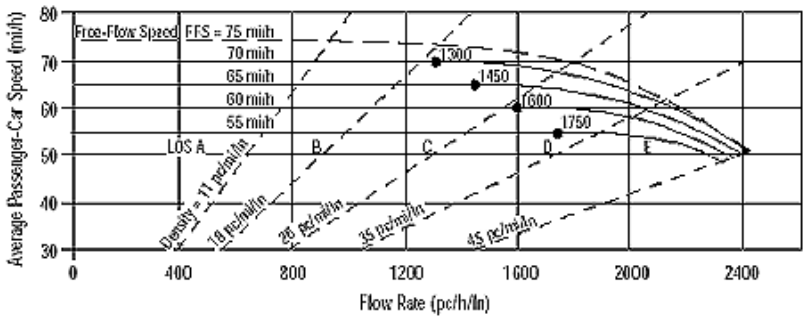
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 62

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7490 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.6	mi/h	FFS	59.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2133	pc/h/ln	Design LOS		
S	55.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	38.5	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.6 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7490	0.90	Level	5	0	0.976	1.00	8530
Ramp	960	0.90	Level	5	0	0.976	1.00	1093
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4336 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8530	9183	No
V_{12}	4336	4400:All	No
$V_{FO} = V_F - V_R$	7437	9183	No
V_R	1093	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 38.8 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.526 (Exhibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 61.1 mph (Exhibit 25-19)

S = 55.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 65

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 58.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6540	0.90	Level	5	0	0.976	1.00	7448
Ramp	520	0.90	Level	5	0	0.976	1.00	592
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.327 using Equation 4

V_{12}= 2435 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8040	See Exhibit 25-7	No
V_{R12}	3027	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 25.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.361 (Exibit 25-19)

S_R= 52.2 mph (Exhibit 25-19)

S_0= 50.2 mph (Exhibit 25-19)

S= 51.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 68

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.4 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6620	0.90	Level	5	0	0.976	1.00	7539
Ramp	440	0.90	Level	5	0	0.976	1.00	501
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.235 using Equation 4

V_{12}= 1770 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8040	See Exhibit 25-7	No
V_{R12}	2271	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.341 (Exibit 25-19)

S_R= 57.4 mph (Exhibit 25-19)

S_0= 55.4 mph (Exhibit 25-19)

S= 55.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7070	0.90	Level	5	0	0.976	1.00	8052
Ramp	350	0.90	Level	5	0	0.976	1.00	399
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.232 using Equation 4

V_{12}= 1865 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8451	See Exhibit 25-7	No
V_{R12}	2264	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.7 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.345 (Exibit 25-19)

S_R= 56.1 mph (Exhibit 25-19)

S_0= 52.2 mph (Exhibit 25-19)

S= 53.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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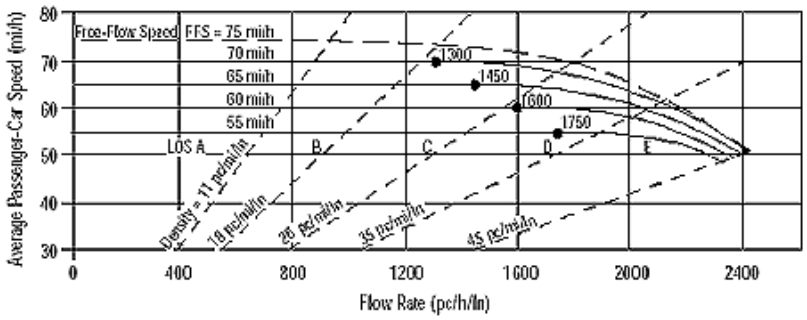
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 71

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7420 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2113	pc/h/ln	Design LOS		
S	58.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	36.1	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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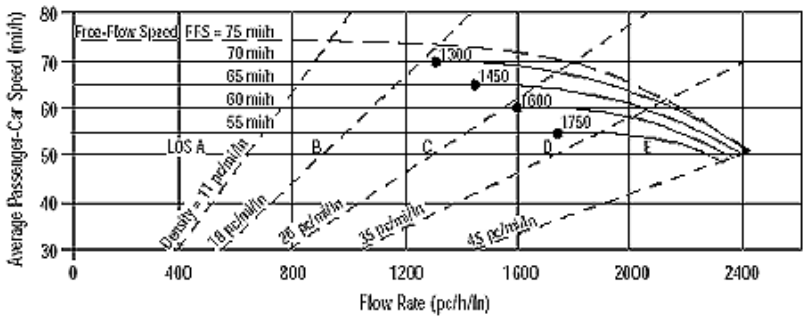
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 72

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7420 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1690	pc/h/ln	Design LOS		
S	63.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.6	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.8 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7420	0.90	Level	5	0	0.976	1.00	8451
Ramp	1410	0.90	Level	5	0	0.976	1.00	1606
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3854 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6761	9351	No
V_{12}	3854	4400:All	No
$V_{FO} = V_F - V_R$	5155	9351	No
V_R	1606	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 35.6 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.638 (Exhibit 25-19)

S_R= 49.9 mph (Exhibit 25-19)

S_0= 68.2 mph (Exhibit 25-19)

S = 56.4 mph (Exhibit 25-15)

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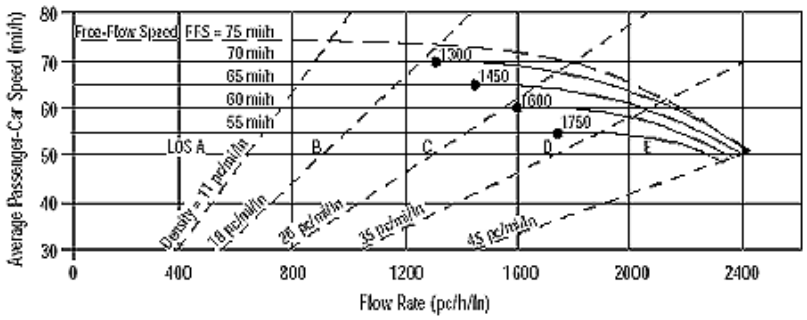
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 74

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6010 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1711	pc/h/ln	Design LOS		
S	68.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	24.9	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 61.4 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6010	0.90	Level	5	0	0.976	1.00	6845
Ramp	570	0.90	Level	5	0	0.976	1.00	649
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3350 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	6845	9256	No
V_{12}	3350	4400:All	No
V_{FO} = V_F - V_R	6196	9256	No
V_R	649	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.551 (Exhibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

S_0= 64.4 mph (Exhibit 25-19)

S = 56.9 mph (Exhibit 25-15)

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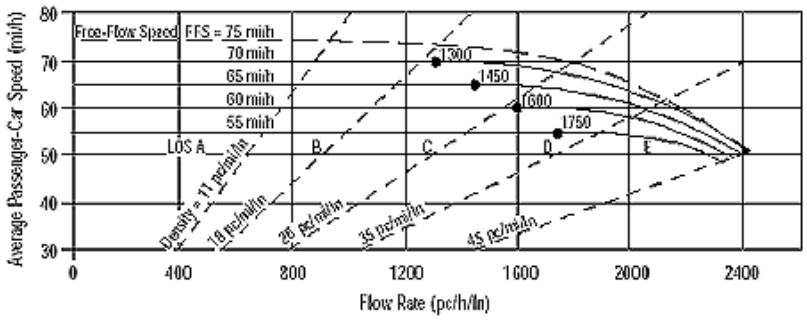
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 76

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5440 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	61.4	mi/h	FFS	61.4	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1549	pc/h/ln	Design LOS		
S	61.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	25.2	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5440	0.90	Level	5	0	0.976	1.00	6196
Ramp	1020	0.90	Level	5	0	0.976	1.00	1162
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3357 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6196	9000	No
V_{12}	3357	4400:All	No
$V_{FO} = V_F - V_R$	5034	9000	No
V_R	1162	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.598 (Exhibit 25-19)

S_R= 47.2 mph (Exhibit 25-19)

S_0= 58.7 mph (Exhibit 25-19)

S = 51.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4420	0.90	Level	5	0	0.976	1.00	5034
Ramp	800	0.90	Level	5	0	0.976	1.00	911
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.391 using Equation 4

V_{12}= 1966 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5945	See Exhibit 25-7	No
V_{R12}	2877	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.327 (Exibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

S_0= 51.3 mph (Exhibit 25-19)

S= 51.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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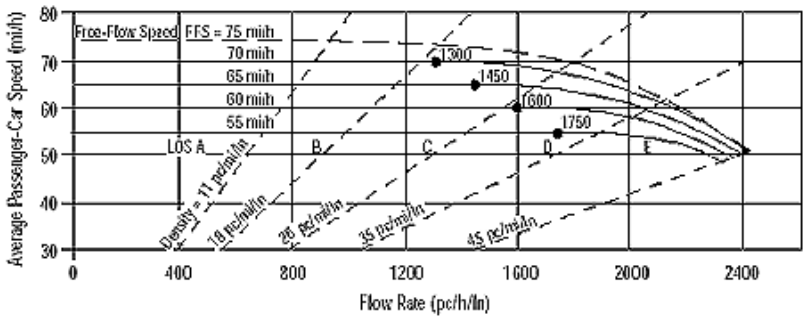

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information		***Site Information***	
Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 84

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs			
Volume, V	5220 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments			
f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures			**Design (N)**		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1486	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	24.8	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		**Factor Location**	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5220	0.90	Level	5	0	0.976	1.00	5945
Ramp	1000	0.90	Level	5	0	0.976	1.00	1139
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3234 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5945	9191	No
V_{12}	3234	4400:All	No
$V_{FO} = V_F - V_R$	4806	9191	No
V_R	1139	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 29.6 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.336 (Exhibit 25-19)

S_R= 53.8 mph (Exhibit 25-19)

S_0= 64.2 mph (Exhibit 25-19)

S = 58.1 mph (Exhibit 25-15)

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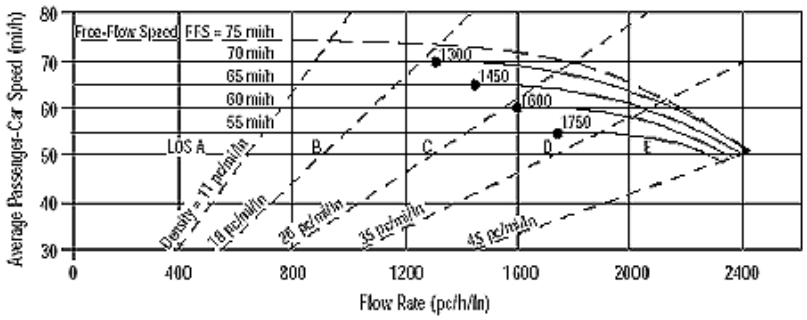

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 86

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4230 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1204	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	17.2	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 59.8 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4230	0.90	Level	5	0	0.976	1.00	4818
Ramp	3310	0.90	Level	5	0	0.976	1.00	3770
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 4042 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4818	9191	No
V_{12}	4042	4400:All	No
$V_{FO} = V_F - V_R$	1048	9191	No
V_R	3770	4400	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = -47.4 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.445 (Exhibit 25-19)

S_R= 51.9 mph (Exhibit 25-19)

S_0= 65.6 mph (Exhibit 25-19)

S = 53.7 mph (Exhibit 25-15)

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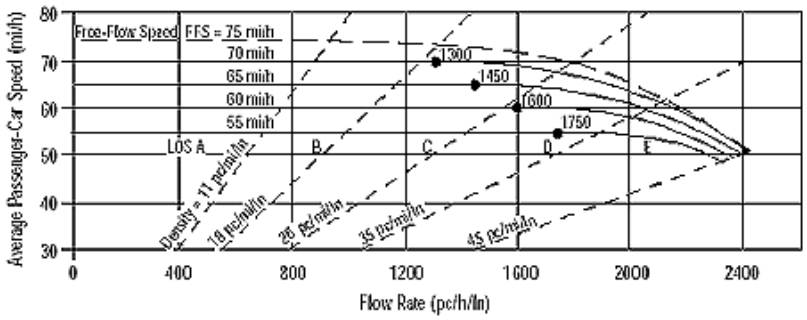
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 88 coded as 2 lanes, double volume

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	1980 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1128	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	18.9	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	1980	0.90	Level	5	0	0.976	1.00	2255
Ramp	120	0.90	Level	5	0	0.976	1.00	137
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2255 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	2392	See Exhibit 25-7	No
V_{R12}	2392	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.329 (Exibit 25-19)

S_R= 54.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 54.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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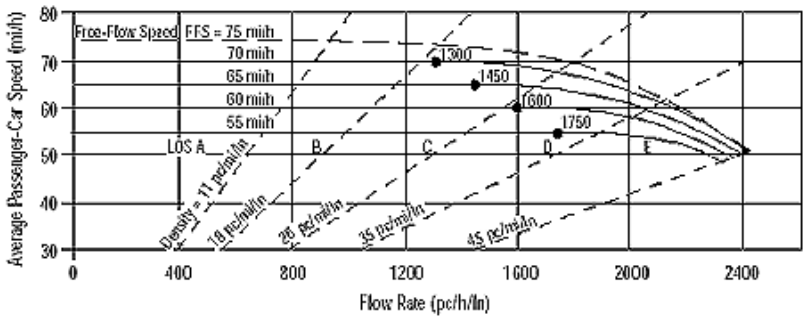

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 90 coded as 2 lanes, double volume

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	2240 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1276	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	21.3	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2690	0.90	Level	2	0	0.990	1.00	3019
Ramp	1120	0.90	Level	2	0	0.990	1.00	1257
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3019 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4276	See Exhibit 25-7	No
V_{R12}	4276	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 36.7 (pc/ m/ln)

LOS = E (Exhibit 25-4)

Speed Estimation

M_S = 0.574 (Exibit 25-19)

S_R= 47.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 47.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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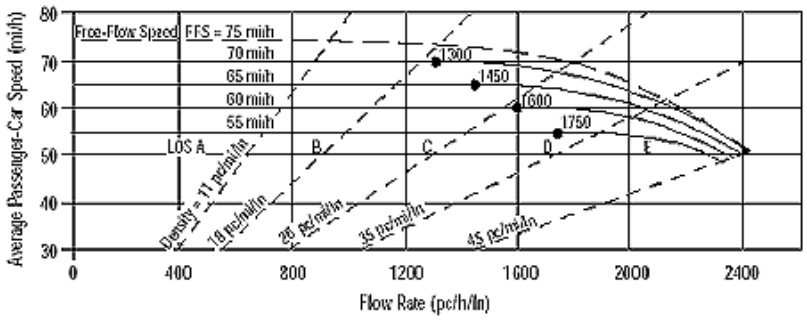

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 92

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4030 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2261	pc/h/ln	Design LOS		
S	58.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	38.8	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2480	0.90	Level	2	0	0.990	1.00	2783
Ramp	390	0.90	Level	2	0	0.990	1.00	438
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2783 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3221	See Exhibit 25-7	No
V_{R12}	3221	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.314 (Exibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 50.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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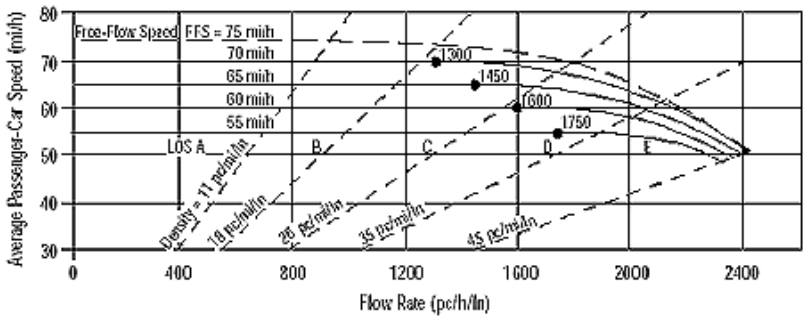
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 96

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	2900 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1085	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	15.5	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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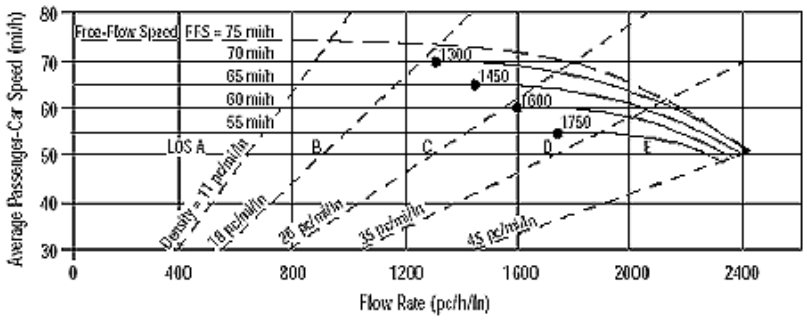
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 97

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	2750 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1029	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	14.7	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2750	0.90	Level	5	0	0.976	1.00	3132
Ramp	610	0.90	Level	5	0	0.976	1.00	695
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 3132 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	3132	4500	No
V_{12}	3132	4400:All	No
$V_{FO} = V_F - V_R$	2437	4500	No
V_R	695	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 30.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.556 (Exhibit 25-19)

S_R= 47.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2100	0.90	Level	2	0	0.990	1.00	2357
Ramp	1420	0.90	Level	2	0	0.990	1.00	1594
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2357 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3951	See Exhibit 25-7	No
V_{R12}	3951	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 33.1 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.496 (Exibit 25-19)

S_R= 48.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 48.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 66.2 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10420	0.90	Level	4	0	0.980	1.00	11809
Ramp	950	0.90	Level	4	0	0.980	1.00	1077
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3253 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9448	9447	Yes
V_{12}	3253	4400:All	No
V_{FO} = V_F - V_R	8371	9447	No
V_R	1077	3500	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 16.0 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.720 (Exhibit 25-19)

S_R= 48.8 mph (Exhibit 25-19)

S_0= 64.4 mph (Exhibit 25-19)

S = 58.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.8 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10160	0.90	Level	4	0	0.980	1.00	11515
Ramp	300	0.90	Level	4	0	0.980	1.00	340
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4208 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9212	9432	No
V_{12}	4208	4400:All	No
V_{FO} = V_F - V_R	8872	9432	No
V_R	340	2100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 26.9 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.329 (Exhibit 25-19)

S_R= 58.0 mph (Exhibit 25-19)

S_0= 66.3 mph (Exhibit 25-19)

S = 62.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9120	0.90	Level	4	0	0.980	1.00	10336
Ramp	600	0.90	Level	4	0	0.980	1.00	680
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3989 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8269	9000	No
V_{12}	3989	4400:All	No
V_{FO} = V_F - V_R	7589	9000	No
V_R	680	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 29.6 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.619 (Exhibit 25-19)

S_R= 47.0 mph (Exhibit 25-19)

S_0= 55.9 mph (Exhibit 25-19)

S = 51.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 64.7 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10180	0.90	Level	4	0	0.980	1.00	11537
Ramp	590	0.90	Level	4	0	0.980	1.00	669
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4402 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9230	9387	No
V_{12}	4402	4400:All	Yes
V_{FO} = V_F - V_R	8561	9387	No
V_R	669	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.1 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.683 (Exhibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

S_0= 65.5 mph (Exhibit 25-19)

S = 56.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9680	0.90	Level	4	0	0.980	1.00	10971
Ramp	1960	0.90	Level	4	0	0.980	1.00	2221
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3926 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8777	9000	No
V_{12}	3926	4400:All	No
$V_{FO} = V_F - V_R$	6556	9000	No
V_R	2221	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 21.8 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

D_s = 0.628 (Exhibit 25-19)

S_R= 46.8 mph (Exhibit 25-19)

S_0= 54.8 mph (Exhibit 25-19)

S = 50.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10660	0.90	Level	4	0	0.980	1.00	12081
Ramp	800	0.90	Level	4	0	0.980	1.00	907
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4725 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9665	9400	Yes
V_{12}	4725	4400:All	Yes
V_{FO} = V_F - V_R	8758	9400	No
V_R	907	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 30.5 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.705 (Exhibit 25-19)

S_R= 48.8 mph (Exhibit 25-19)

S_0= 65.6 mph (Exhibit 25-19)

S = 56.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9400	0.90	Level	4	0	0.980	1.00	10653
Ramp	310	0.90	Level	4	0	0.980	1.00	351
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3914 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		V_{FI}=V_F	8523	9000	No
				V_{12}	3914	4400:All	No
V_{R12}		4600:All		V_{FO} = V_F - V_R	8172	9000	No
				V_R	351	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 35.7 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.590 (Exhibit 25-19)

S_R= 47.3 mph (Exhibit 25-19)

S_0= 55.2 mph (Exhibit 25-19)

S = 51.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7650	0.90	Level	4	0	0.980	1.00	8670
Ramp	120	0.90	Level	4	0	0.980	1.00	136
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3857 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8670	9000	No
V_{12}	3857	4400:All	No
$V_{FO} = V_F - V_R$	8534	9000	No
V_R	136	2100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 35.6 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.310 (Exhibit 25-19)

S_R= 51.0 mph (Exhibit 25-19)

S_0= 54.9 mph (Exhibit 25-19)

S = 53.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.4 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8010	0.90	Level	5	0	0.976	1.00	9123
Ramp	1390	0.90	Level	5	0	0.976	1.00	1583
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3069 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7299	9416	No
V_{12}	3069	4400:All	No
$V_{FO} = V_F - V_R$	5716	9416	No
V_R	1583	3500	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 14.4 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

D_s = 0.700 (Exhibit 25-19)

S_R= 49.0 mph (Exhibit 25-19)

S_0= 67.4 mph (Exhibit 25-19)

S = 58.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4030	0.90	Level	5	0	0.976	1.00	4590
Ramp	1440	0.90	Level	5	0	0.976	1.00	1640
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4590 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4590	4500	Yes
V_{12}	4590	4400:All	Yes
$V_{FO} = V_F - V_R$	2950	4500	No
V_R	1640	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 41.7 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.641 (Exhibit 25-19)

S_R= 46.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 46.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9060	0.90	Level	4	0	0.980	1.00	10268
Ramp	610	0.90	Level	4	0	0.980	1.00	691
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.227 using Equation 4

V_{12}= 1763 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8459	See Exhibit 25-7	No
V_{R12}	2454	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 22.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.345 (Exibit 25-19)

S_R= 50.5 mph (Exhibit 25-19)

S_0= 44.3 mph (Exhibit 25-19)

S= 45.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9470	0.90	Level	4	0	0.980	1.00	10733
Ramp	610	0.90	Level	4	0	0.980	1.00	691
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.609 using Equation 4

V_{12}= 6539 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11424	See Exhibit 25-7	Yes
V_{R12}	7230	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 52.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 5.599 (Exibit 25-19)

S_R= -69.3 mph (Exhibit 25-19)

S_0= 60.5 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 113

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.4 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9590	0.90	Level	4	0	0.980	1.00	10869
Ramp	830	0.90	Level	4	0	0.980	1.00	941
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 2272 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11810	See Exhibit 25-7	Yes
V_{R12}	3213	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 13.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.236 (Exibit 25-19)

S_R= 58.4 mph (Exhibit 25-19)

S_0= 44.9 mph (Exhibit 25-19)

S= 47.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 114

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7720	0.90	Level	4	0	0.980	1.00	8749
Ramp	1410	0.90	Level	4	0	0.980	1.00	1598
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.337 using Equation 4

V_{12}= 2945 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10347	See Exhibit 25-7	Yes
V_{R12}	4543	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 33.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.617 (Exibit 25-19)

S_R= 47.0 mph (Exhibit 25-19)

S_0= 44.9 mph (Exhibit 25-19)

S= 45.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 115

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9860	0.90	Level	4	0	0.980	1.00	11175
Ramp	320	0.90	Level	4	0	0.980	1.00	363
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.459 using Equation 4

V_{12}= 5131 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11538	See Exhibit 25-7	Yes
V_{R12}	5494	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 42.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.207 (Exibit 25-19)

S_R= 37.0 mph (Exhibit 25-19)

S_0= 55.1 mph (Exhibit 25-19)

S= 44.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 116

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 65.6 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9870	0.90	Level	4	0	0.980	1.00	11186
Ramp	290	0.90	Level	4	0	0.980	1.00	329
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.750 using Equation 4

V_{12}= 8391 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11515	See Exhibit 25-7	Yes
V_{R12}	8720	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 62.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 24.079 (Exibit 25-19)

S_R= -502.7 mph (Exhibit 25-19)

S_0= 62.4 mph (Exhibit 25-19)

S= 419.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8810	0.90	Level	4	0	0.980	1.00	9985
Ramp	590	0.90	Level	4	0	0.980	1.00	669
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.230 using Equation 4

V_{12}= 2294 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10654	See Exhibit 25-7	Yes
V_{R12}	2963	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 26.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.375 (Exibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 39.2 mph (Exhibit 25-19)

S= 41.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10380	0.90	Level	4	0	0.980	1.00	11764
Ramp	280	0.90	Level	4	0	0.980	1.00	317
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.752 using Equation 4

V_{12}= 8842 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12081	See Exhibit 25-7	Yes
V_{R12}	9159	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 65.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 37.243 (Exibit 25-19)

S_R= -748.1 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S= 333.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 1

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 57.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7050	0.90	Level	5	0	0.976	1.00	8029
Ramp	690	0.90	Level	5	0	0.976	1.00	786
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.247 using Equation 4

V_{12}= 1983 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8815	See Exhibit 25-7	No
V_{R12}	2769	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 24.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.355 (Exibit 25-19)

S_R= 51.7 mph (Exhibit 25-19)

S_0= 46.1 mph (Exhibit 25-19)

S= 47.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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Appendix B2

Year 2040 Alternative 1
Freeway Level of Service (LOS) Worksheets

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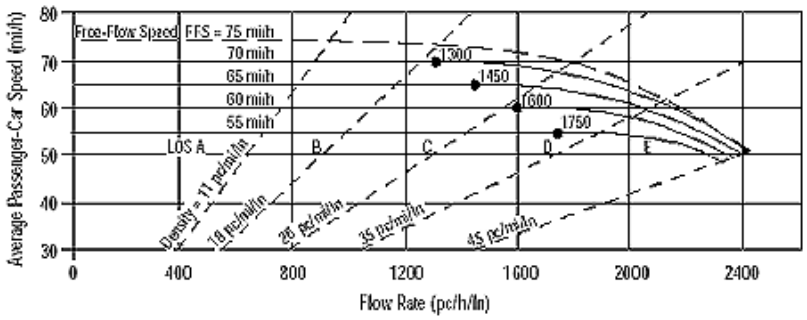
2040 Alternative 1

Freeway Mainline, Ramps, and Ramp-Freeway Junctions and Weaving Level of Service Analysis Worksheets

AM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 1

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	10460 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	72.6	mi/h	FFS	72.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2371	pc/h/ln	Design LOS		
S	54.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	43.5	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 70.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10460	0.90	Level	4	0	0.980	1.00	11855
Ramp	1200	0.90	Level	4	0	0.980	1.00	1360
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3472 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9484	9600	No
V_{12}	3472	4400:All	No
V_{FO} = V_F - V_R	8124	9600	No
V_R	1360	3800	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 19.7 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.615 (Exhibit 25-19)

S_R= 52.8 mph (Exhibit 25-19)

S_0= 69.0 mph (Exhibit 25-19)

S = 62.0 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	390	0.90	4	0	1.5	1.2	0.980	1.00	442
Vw2	330	0.90	4	0	1.5	1.2	0.980	1.00	374
Vw				816	Vnw				0
V									816

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.31	0.47
Weaving and non-weaving speeds, Si (mi/h)			22.55	32.00

Number of lanes required for unconstrained operation, Nw 1.71
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	22.55
Weaving segment density, D (pc/mi/ln)	18.09
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 69.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9260	0.90	Level	4	0	0.980	1.00	10495
Ramp	340	0.90	Level	4	0	0.980	1.00	385
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.552 using Equation 4

V_{12}= 5793 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10880	See Exhibit 25-7	Yes
V_{R12}	6178	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 46.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 2.117 (Exibit 25-19)

S_R= 11.0 mph (Exhibit 25-19)

S_0= 63.0 mph (Exhibit 25-19)

S= 17.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.16
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.24
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8411	0.90	4	0	1.5	1.2	0.980	1.00	9532
Vo2	79	0.90	4	0	1.5	1.2	0.980	1.00	89
Vw1	1189	0.90	4	0	1.5	1.2	0.980	1.00	1347
Vw2	381	0.90	4	0	1.5	1.2	0.980	1.00	431
Vw				1778	Vnw				9621
V									11399

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.28	0.71		
Weaving and non-weaving speeds, Si (mi/h)	39.09	47.15		

Number of lanes required for unconstrained operation, Nw 1.35
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	45.68
Weaving segment density, D (pc/mi/ln)	49.91
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10257
Capacity as a 15-minute flow rate, c (veh/h)	10056
Capacity as a full-hour volume, c_h (veh/h)	9050

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.42
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	140	0.90	4	0	1.5	1.2	0.980	1.00	158
Vw2	100	0.90	4	0	1.5	1.2	0.980	1.00	113
Vw				271	Vnw				0
V									271

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.06	0.15
Weaving and non-weaving speeds, Si (mi/h)			27.15	36.80

Number of lanes required for unconstrained operation, Nw 1.47
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	27.15
Weaving segment density, D (pc/mi/ln)	4.99
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	68	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.18
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.45
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7711	0.90	4	0	1.5	1.2	0.980	1.00	8739
Vo2	41	0.90	4	0	1.5	1.2	0.980	1.00	46
Vw1	779	0.90	4	0	1.5	1.2	0.980	1.00	882
Vw2	969	0.90	4	0	1.5	1.2	0.980	1.00	1098
Vw				1980	Vnw				8785
V									10765

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.20	0.44
Weaving and non-weaving speeds, Si (mi/h)			28.81	55.20

Number of lanes required for unconstrained operation, Nw 1.45
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	47.24
Weaving segment density, D (pc/mi/ln)	45.58
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10199
Capacity as a 15-minute flow rate, c (veh/h)	9999
Capacity as a full-hour volume, c_h (veh/h)	8999

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 22

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 69.2 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8680	0.90	Level	4	0	0.980	1.00	9837
Ramp	700	0.90	Level	4	0	0.980	1.00	793
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.182 using Equation 4

V_{12}= 1794 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10630	See Exhibit 25-7	Yes
V_{R12}	2587	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 24.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.359 (Exibit 25-19)

S_R= 59.4 mph (Exhibit 25-19)

S_0= 52.3 mph (Exhibit 25-19)

S= 53.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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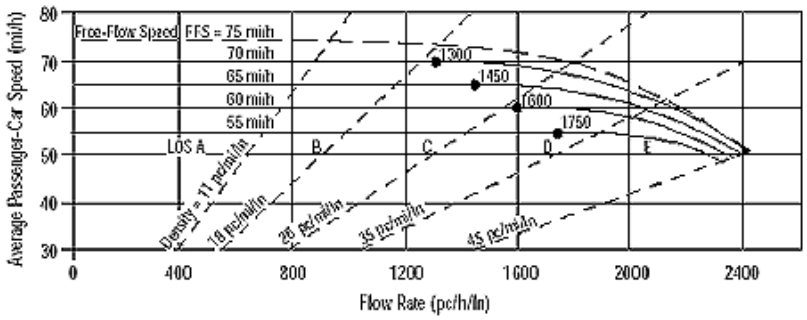
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 23

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	9370 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.2	mi/h	FFS	68.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2655	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	69	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8943	0.90	4	0	1.5	1.2	0.980	1.00	10135
Vo2	23	0.90	4	0	1.5	1.2	0.980	1.00	26
Vw1	427	0.90	4	0	1.5	1.2	0.980	1.00	483
Vw2	507	0.90	4	0	1.5	1.2	0.980	1.00	574
Vw				1057	Vnw				10161
V									11218

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.65	0.23		
Weaving and non-weaving speeds, Si (mi/h)	50.72	62.88		

Number of lanes required for unconstrained operation, Nw 0.73
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	61.49
Weaving segment density, D (pc/mi/ln)	36.49
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11850
Capacity as a 15-minute flow rate, c (veh/h)	11618
Capacity as a full-hour volume, c_h (veh/h)	10456

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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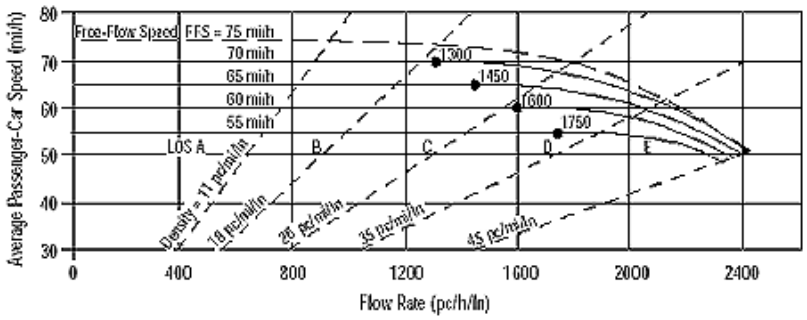
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 25

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	9450 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2142	pc/h/ln	Design LOS		
S	61.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	35.1	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.9 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9450	0.90	Level	4	0	0.980	1.00	10710
Ramp	1390	0.90	Level	4	0	0.980	1.00	1575
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3393 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8568	9556	No
V_{12}	3393	4400:All	No
V_{FO} = V_F - V_R	6993	9556	No
V_R	1575	4100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 7.3 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.375 (Exhibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= 69.4 mph (Exhibit 25-19)

S = 64.8 mph (Exhibit 25-15)

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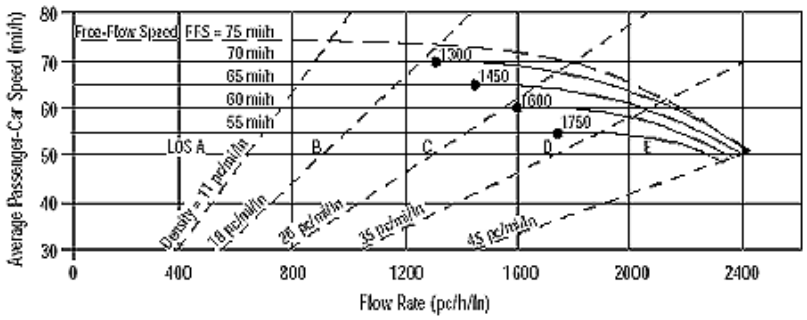
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 27

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8060 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2284	pc/h/ln	Design LOS	
S	56.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	40.2	pc/mi/ln	S	mi/h
LOS	E		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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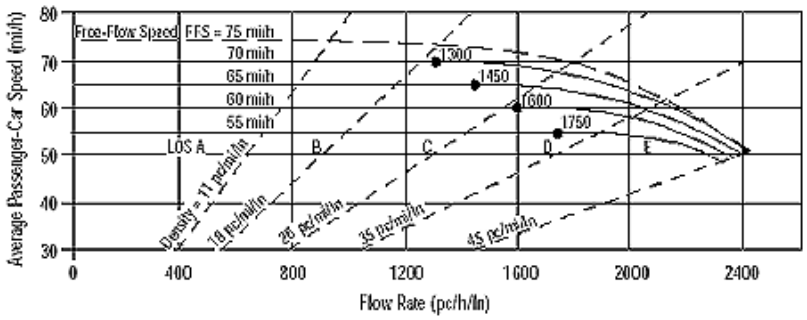
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 29

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7980 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2261	pc/h/ln	Design LOS		
S	57.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	39.3	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 30

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 68.9 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7980	0.90	Level	4	0	0.980	1.00	9044
Ramp	3310	0.90	Level	4	0	0.980	1.00	3751
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1890 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12795	See Exhibit 25-7	Yes
V_{R12}	5641	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 29.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.217 (Exibit 25-19)

S_R= 36.2 mph (Exhibit 25-19)

S_0= 54.7 mph (Exhibit 25-19)

S= 44.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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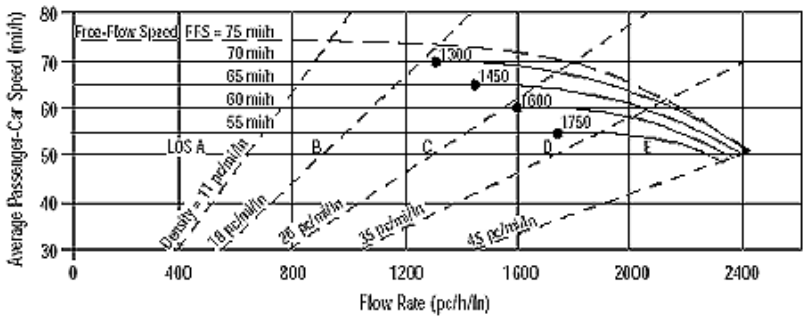

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 31

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	11290 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2559	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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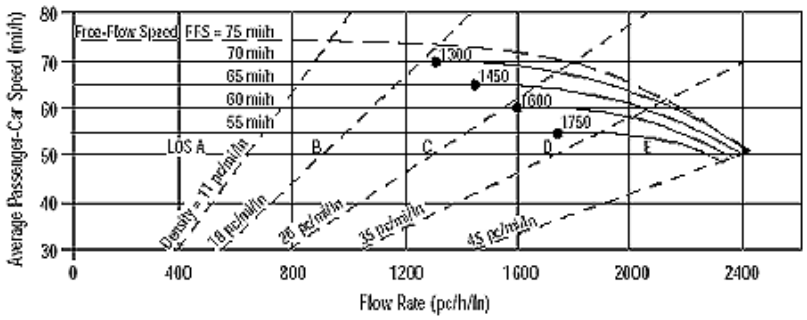
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 32

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	9240 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2094	pc/h/ln	Design LOS		
S	53.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	39.4	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9240	0.90	Level	4	0	0.980	1.00	10472
Ramp	1390	0.90	Level	4	0	0.980	1.00	1575
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3344 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8378	9000	No
V_{12}	3344	4400:All	No
V_{FO} = V_F - V_R	6803	9000	No
V_R	1575	4100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = -10.2 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.375 (Exhibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 54.4 mph (Exhibit 25-19)

S = 52.6 mph (Exhibit 25-15)

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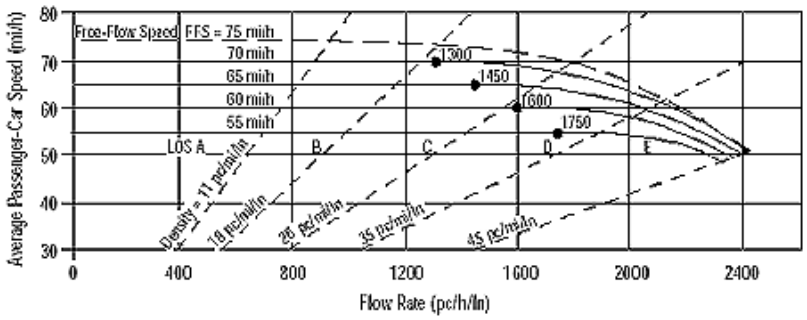
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 34

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7850 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2224	pc/h/ln	Design LOS		
S	50.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	43.9	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7850	0.90	Level	4	0	0.980	1.00	8897
Ramp	1670	0.90	Level	4	0	0.980	1.00	1893
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.363 using Equation 4

V_{12}= 3234 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10790	See Exhibit 25-7	Yes
V_{R12}	5127	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 37.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.894 (Exibit 25-19)

S_R= 44.3 mph (Exhibit 25-19)

S_0= 54.1 mph (Exhibit 25-19)

S= 49.0 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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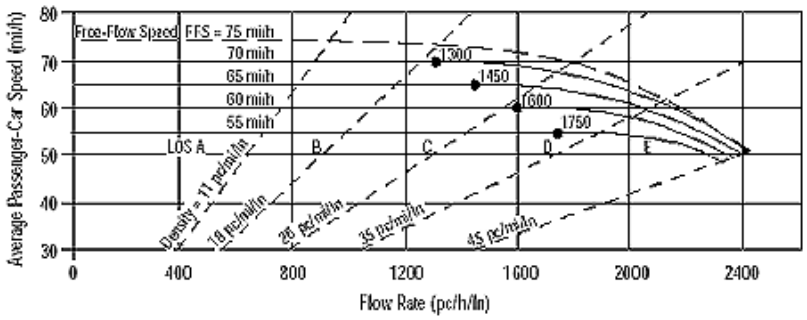
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 36

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	9520 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2697	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	55	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.10
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.27
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	38	0.90	4	0	1.5	1.2	0.980	1.00	43
Vo2	8808	0.90	4	0	1.5	1.2	0.980	1.00	9982
Vw1	262	0.90	4	0	1.5	1.2	0.980	1.00	296
Vw2	712	0.90	4	0	1.5	1.2	0.980	1.00	806
Vw				1102	Vnw				10025
V									11127

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.85	0.43		
Weaving and non-weaving speeds, Si (mi/h)	39.34	46.39		

Number of lanes required for unconstrained operation, Nw 1.13
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	45.58
Weaving segment density, D (pc/mi/ln)	48.82
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10036
Capacity as a 15-minute flow rate, c (veh/h)	9839
Capacity as a full-hour volume, c_h (veh/h)	8855

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	47	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.26
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	32	0.90	4	0	1.5	1.2	0.980	1.00	36
Vo2	8462	0.90	4	0	1.5	1.2	0.980	1.00	9590
Vw1	218	0.90	4	0	1.5	1.2	0.980	1.00	247
Vw2	608	0.90	4	0	1.5	1.2	0.980	1.00	689
Vw				936	Vnw				9626
V									10562

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.77	0.38		
Weaving and non-weaving speeds, Si (mi/h)	35.88	41.78		

Number of lanes required for unconstrained operation, Nw 1.11
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	41.18
Weaving segment density, D (pc/mi/ln)	51.29
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10070
Capacity as a 15-minute flow rate, c (veh/h)	9873
Capacity as a full-hour volume, c_h (veh/h)	8886

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	46	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.11
Weaving seg length, L (ft)	890	Weaving ratio, R	0.48
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	28	0.90	4	0	1.5	1.2	0.980	1.00	31
Vo2	8138	0.90	4	0	1.5	1.2	0.980	1.00	9223
Vw1	482	0.90	4	0	1.5	1.2	0.980	1.00	546
Vw2	532	0.90	4	0	1.5	1.2	0.980	1.00	602
Vw				1148	Vnw				9254
V									10402

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.37	0.67		
Weaving and non-weaving speeds, Si (mi/h)	30.22	36.53		

Number of lanes required for unconstrained operation, Nw 1.16
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	35.71
Weaving segment density, D (pc/mi/ln)	58.26
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9123
Capacity as a 15-minute flow rate, c (veh/h)	8944
Capacity as a full-hour volume, c_h (veh/h)	8050

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.23
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.45
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	54	0.90	4	0	1.5	1.2	0.980	1.00	61
Vo2	7594	0.90	4	0	1.5	1.2	0.980	1.00	8606
Vw1	1246	0.90	4	0	1.5	1.2	0.980	1.00	1412
Vw2	1016	0.90	4	0	1.5	1.2	0.980	1.00	1151
Vw				2563	Vnw				8667
V									11230

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.77	0.43		
Weaving and non-weaving speeds, Si (mi/h)	38.68	44.42		

Number of lanes required for unconstrained operation, Nw 1.61
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	42.96
Weaving segment density, D (pc/mi/ln)	52.28
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9902
Capacity as a 15-minute flow rate, c (veh/h)	9708
Capacity as a full-hour volume, c_h (veh/h)	8737

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9700	0.90	Level	4	0	0.980	1.00	10993
Ramp	610	0.90	Level	4	0	0.980	1.00	691
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.291 using Equation 4

V_{12}= 2469 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9184	See Exhibit 25-7	Yes
V_{R12}	3160	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 26.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.378 (Exibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 44.2 mph (Exhibit 25-19)

S= 46.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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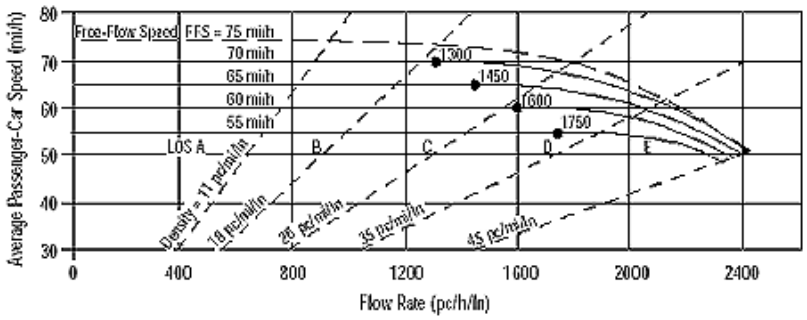
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 47

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	10310 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2337	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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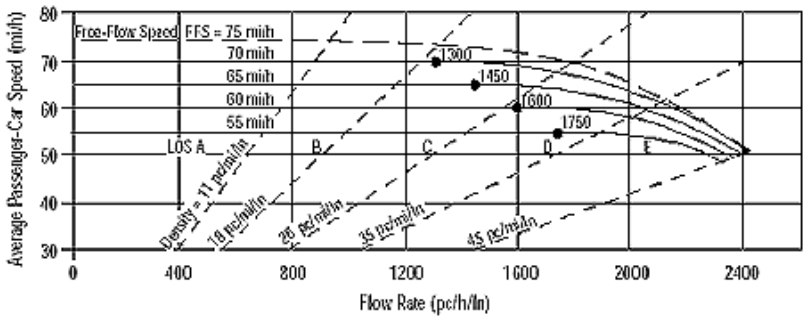

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 48

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4410 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2475	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4410	0.90	Level	5	0	0.976	1.00	5023
Ramp	3630	0.90	Level	5	0	0.976	1.00	4134
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 5023 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5023	4500	Yes
V_{12}	5023	4400:All	Yes
$V_{FO} = V_F - V_R$	889	4500	No
V_R	4134	3800	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 28.5 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.800 (Exhibit 25-19)

S_R= 44.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 44.6 mph (Exhibit 25-15)

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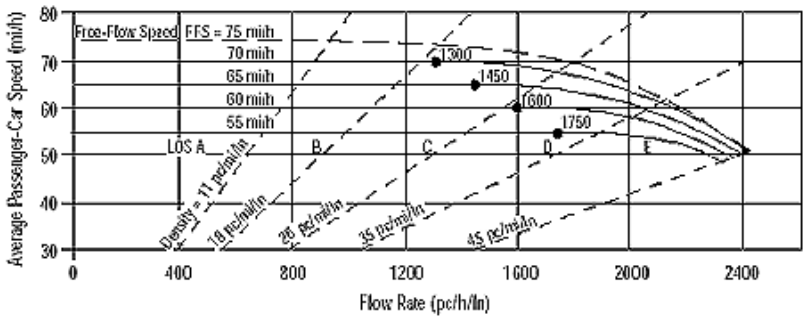
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 50

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	1200 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	683	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	11.4	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1200	0.90	Level	5	0	0.976	1.00	1367
Ramp	810	0.90	Level	5	0	0.976	1.00	923
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 1367 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	1367	4775	No
V_{12}	1367	4400:All	No
$V_{FO} = V_F - V_R$	444	4775	No
V_R	923	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 6.1 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.316 (Exhibit 25-19)

S_R= 60.3 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 60.3 mph (Exhibit 25-15)

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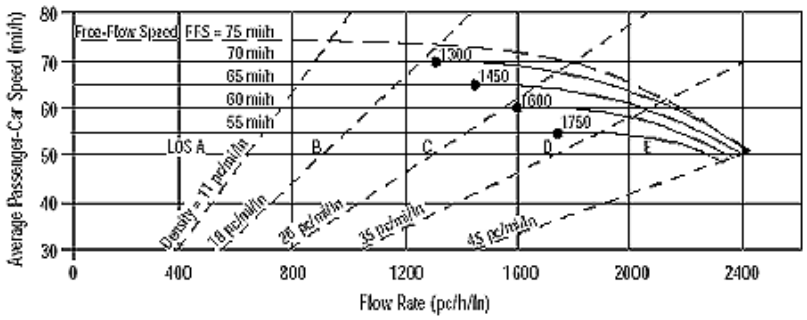

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 52

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	490 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	279	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	4.1	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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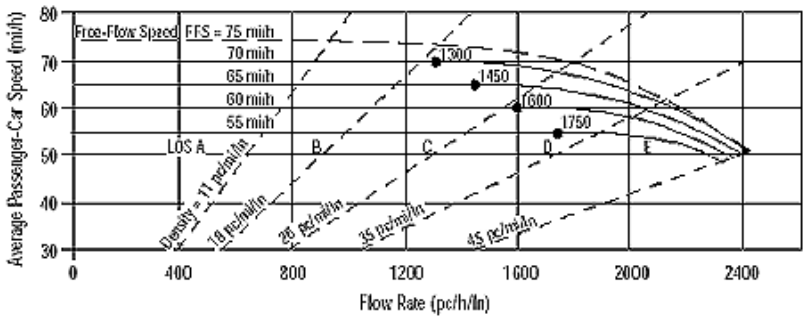

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 54

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4360 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1241	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	18.0	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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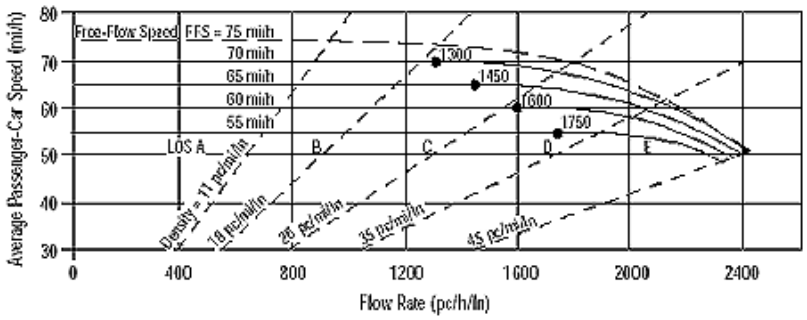

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 56

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5750 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1310	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	19.0	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5750	0.90	Level	5	0	0.976	1.00	6549
Ramp	1140	0.90	Level	5	0	0.976	1.00	1298
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3159 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	5567	9552	No
V_{12}	3159	4400:All	No
V_{FO} = V_F - V_R	4269	9552	No
V_R	1298	2100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 2.6 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.480 (Exhibit 25-19)

S_R= 55.9 mph (Exhibit 25-19)

S_0= 74.7 mph (Exhibit 25-19)

S = 62.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4610	0.90	Level	5	0	0.976	1.00	5250
Ramp	1190	0.90	Level	5	0	0.976	1.00	1355
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.232 using Equation 4

V_{12}= 1216 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6605	See Exhibit 25-7	No
V_{R12}	2571	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.332 (Exibit 25-19)

S_R= 60.7 mph (Exhibit 25-19)

S_0= 64.5 mph (Exhibit 25-19)

S= 63.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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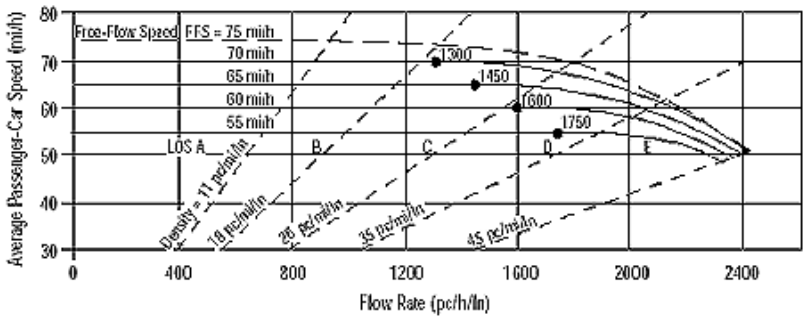
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 60

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5790 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1649	pc/h/ln	Design LOS		
S	69.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	23.8	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5790	0.90	Level	5	0	0.976	1.00	6594
Ramp	840	0.90	Level	5	0	0.976	1.00	957
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\ (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.162 using Equation 4

V_{12}= 1067 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7551	See Exhibit 25-7	No
V_{R12}	2024	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 19.6 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.337 (Exibit 25-19)

S_R= 58.0 mph (Exhibit 25-19)

S_0= 56.8 mph (Exhibit 25-19)

S= 57.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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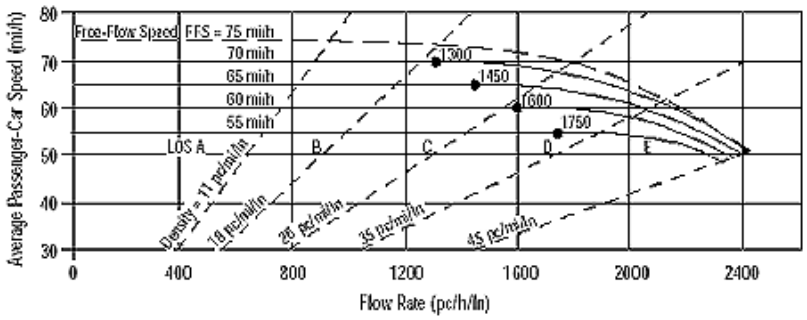
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 62

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6640 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	65.5	mi/h	FFS	65.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1891	pc/h/ln	Design LOS		
S	63.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	29.8	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.5 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6640	0.90	Level	5	0	0.976	1.00	7562
Ramp	1090	0.90	Level	5	0	0.976	1.00	1241
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3997 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7562	9420	No
V_{12}	3997	4400:All	No
$V_{FO} = V_F - V_R$	6321	9420	No
V_R	1241	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 35.9 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.540 (Exhibit 25-19)

S_R= 52.8 mph (Exhibit 25-19)

S_0= 68.8 mph (Exhibit 25-19)

S = 59.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 65

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5500	0.90	Level	5	0	0.976	1.00	6264
Ramp	490	0.90	Level	5	0	0.976	1.00	558
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.331 using Equation 4

V_{12}= 2075 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6822	See Exhibit 25-7	No
V_{R12}	2633	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 22.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.335 (Exibit 25-19)

S_R= 54.6 mph (Exhibit 25-19)

S_0= 55.3 mph (Exhibit 25-19)

S= 55.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 68

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7670	0.90	Level	5	0	0.976	1.00	8735
Ramp	570	0.90	Level	5	0	0.976	1.00	649
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.216 using Equation 4

V_{12}= 1890 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9384	See Exhibit 25-7	No
V_{R12}	2539	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 23.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.353 (Exibit 25-19)

S_R= 58.6 mph (Exhibit 25-19)

S_0= 54.3 mph (Exhibit 25-19)

S= 55.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8240	0.90	Level	5	0	0.976	1.00	9384
Ramp	290	0.90	Level	5	0	0.976	1.00	330
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.240 using Equation 4

V_{12}= 2255 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9714	See Exhibit 25-7	Yes
V_{R12}	2585	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 24.2 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.359 (Exibit 25-19)

S_R= 57.5 mph (Exhibit 25-19)

S_0= 52.0 mph (Exhibit 25-19)

S= 53.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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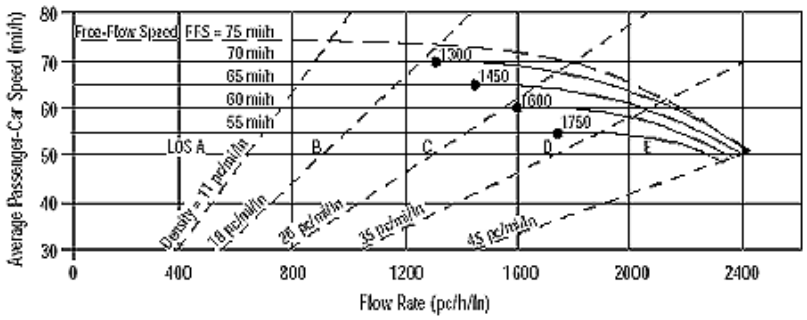
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 71

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8530 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2429	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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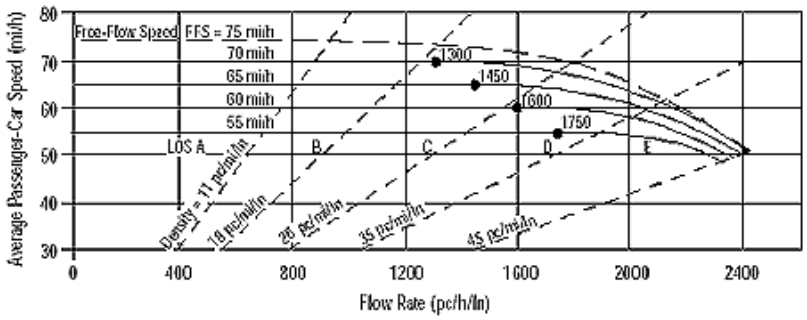
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 72

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8530 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1943	pc/h/ln	Design LOS		
S	64.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	30.2	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 67.9 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8530	0.90	Level	5	0	0.976	1.00	9715
Ramp	1110	0.90	Level	5	0	0.976	1.00	1264
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4101 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7772	9516	No
V_{12}	4101	4400:All	No
V_{FO} = V_F - V_R	6508	9516	No
V_R	1264	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 37.7 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.607 (Exhibit 25-19)

S_R= 52.2 mph (Exhibit 25-19)

S_0= 71.2 mph (Exhibit 25-19)

S = 59.7 mph (Exhibit 25-15)

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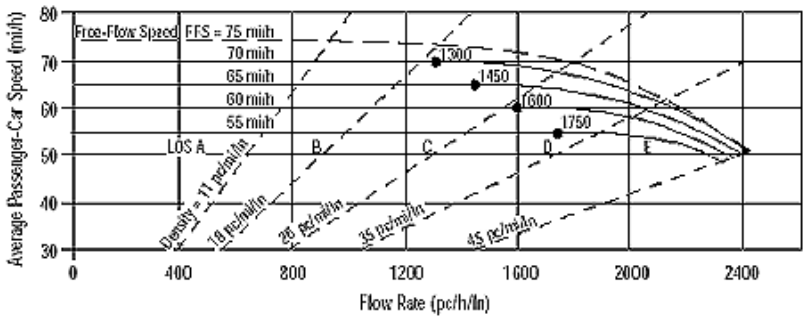

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 74

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7420 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2113	pc/h/ln	Design LOS		
S	62.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	33.9	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.2 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7420	0.90	Level	5	0	0.976	1.00	8451
Ramp	610	0.90	Level	5	0	0.976	1.00	695
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4077 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8451	9447	No
V_{12}	4077	4400:All	No
V_{FO} = V_F - V_R	7756	9447	No
V_R	695	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 37.3 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.556 (Exhibit 25-19)

S_R= 52.8 mph (Exhibit 25-19)

S_0= 68.0 mph (Exhibit 25-19)

S = 59.7 mph (Exhibit 25-15)

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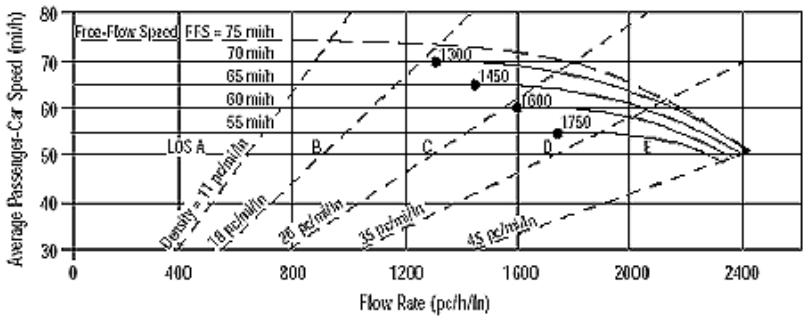

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 76

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6810 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.2	mi/h	FFS	66.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1939	pc/h/ln	Design LOS		
S	63.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	30.7	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 77

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☐ No ☐ Off
L_{up} = ft
Vu = veh/h

Terrain
S_{FF} = 63.9 mph S_{FR} = 30.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☐ No ☐ Off
L_{down} = ft
VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6810	0.90	Level	5	0	0.976	1.00	7756
Ramp	1210	0.90	Level	5	0	0.976	1.00	1378
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4159 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7756	9356	No
V_{12}	4159	4400:All	No
$V_{FO} = V_F - V_R$	6378	9356	No
V_R	1378	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 38.0 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.617 (Exhibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 67.0 mph (Exhibit 25-19)

S = 56.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.9 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5610	0.90	Level	5	0	0.976	1.00	6389
Ramp	630	0.90	Level	5	0	0.976	1.00	718
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.415 using Equation 4

V_{12}= 2650 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7107	See Exhibit 25-7	No
V_{R12}	3368	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 25.8 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.371 (Exibit 25-19)

S_R= 55.8 mph (Exhibit 25-19)

S_0= 59.0 mph (Exhibit 25-19)

S= 57.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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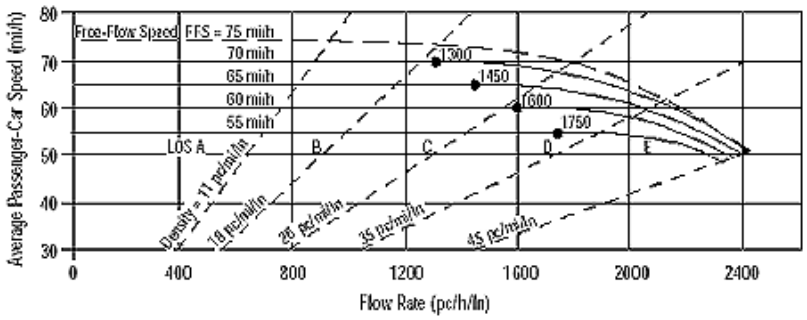

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 84

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6240 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1777	pc/h/ln	Design LOS		
S	65.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	27.2	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.5 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6240	0.90	Level	5	0	0.976	1.00	7107
Ramp	870	0.90	Level	5	0	0.976	1.00	991
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3658 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7107	9460	No
V_{12}	3658	4400:All	No
$V_{FO} = V_F - V_R$	6116	9460	No
V_R	991	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.2 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.322 (Exhibit 25-19)

S_R= 58.6 mph (Exhibit 25-19)

S_0= 70.1 mph (Exhibit 25-19)

S = 63.7 mph (Exhibit 25-15)

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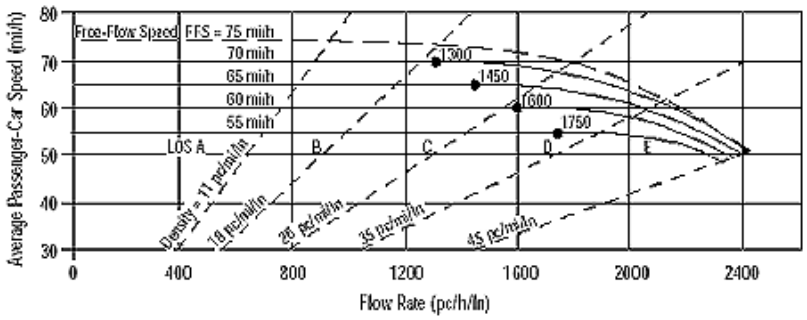

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 86

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5380 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1532	pc/h/ln	Design LOS		
S	69.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	22.0	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.5 mph S_{FR} = 66.5 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5380	0.90	Level	5	0	0.976	1.00	6127
Ramp	3310	0.90	Level	5	0	0.976	1.00	3770
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 4383 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	6127	9460	No
V_{12}	4383	4400:All	No
V_{FO} = V_F - V_R	2357	9460	No
V_R	3770	4400	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = -44.5 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.358 (Exhibit 25-19)

S_R= 57.7 mph (Exhibit 25-19)

S_0= 73.0 mph (Exhibit 25-19)

S = 61.4 mph (Exhibit 25-15)

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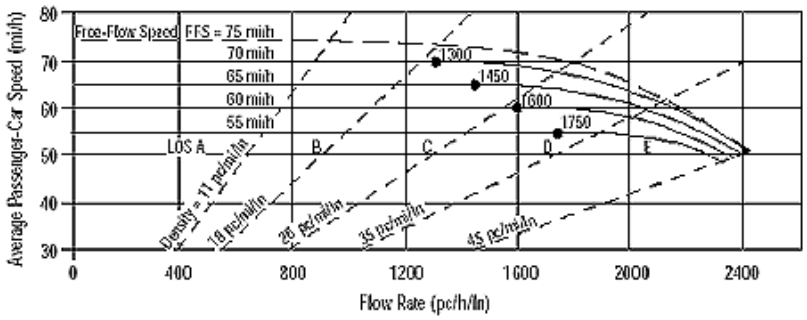

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 88 coded as 2 lanes, double volume

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4140 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2358	pc/h/ln	Design LOS		
S	52.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	44.6	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.5 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4140	0.90	Level	5	0	0.976	1.00	4715
Ramp	80	0.90	Level	5	0	0.976	1.00	91
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 4715 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4806	See Exhibit 25-7	Yes
V_{R12}	4806	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 40.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.763 (Exibit 25-19)

S_R= 47.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 47.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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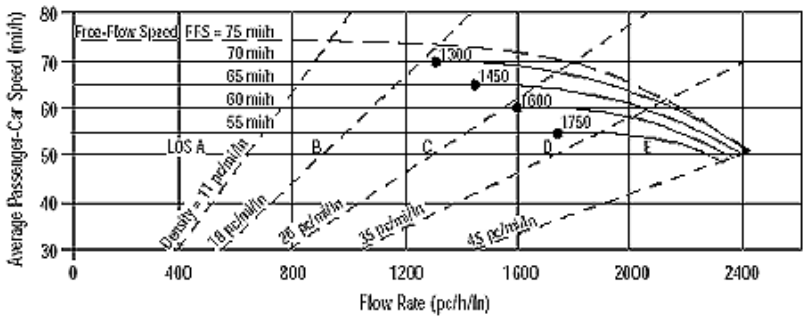

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 90 coded as 2 lanes, double volume

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4300 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2449	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2090	0.90	Level	2	0	0.990	1.00	2345
Ramp	2150	0.90	Level	2	0	0.990	1.00	2413
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2345 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4758	See Exhibit 25-7	Yes
V_{R12}	4758	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 39.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.748 (Exibit 25-19)

S_R= 45.3 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 45.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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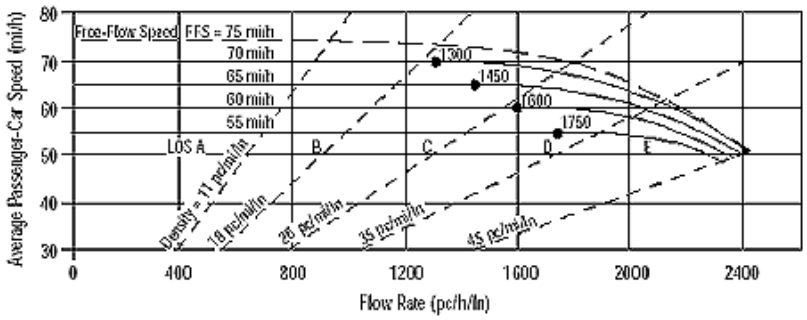
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 92

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4240 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2379	pc/h/ln	Design LOS		
S	54.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	43.9	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3390	0.90	Level	2	0	0.990	1.00	3804
Ramp	600	0.90	Level	2	0	0.990	1.00	673
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3804 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4477	See Exhibit 25-7	No
V_{R12}	4477	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 30.7 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.559 (Exibit 25-19)

S_R= 47.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 47.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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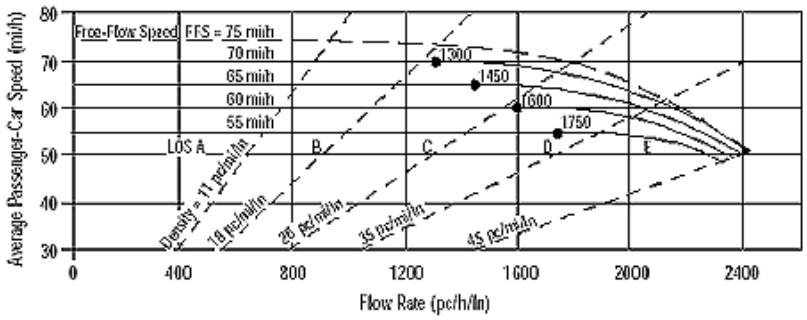
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 96

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	3980 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1489	pc/h/ln	Design LOS		
S	69.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	21.3	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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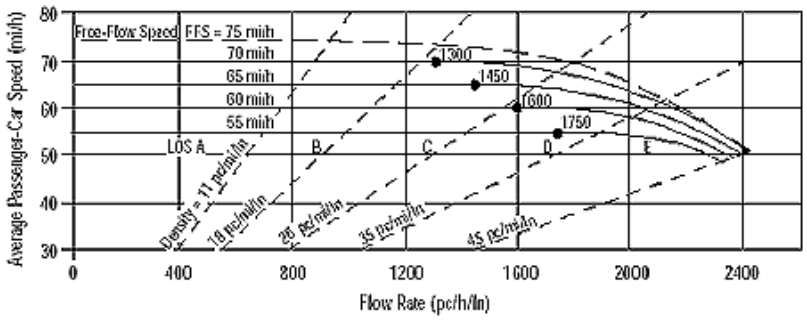
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 97

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	3160 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1182	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	16.9	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3160	0.90	Level	5	0	0.976	1.00	3599
Ramp	120	0.90	Level	5	0	0.976	1.00	137
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 3599 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	3599	4500	No
V_{12}	3599	4400:All	No
V_{FO} = V_F - V_R	3462	4500	No
V_R	137	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.505 (Exhibit 25-19)

S_R= 48.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 48.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3040	0.90	Level	2	0	0.990	1.00	3412
Ramp	1370	0.90	Level	2	0	0.990	1.00	1537
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3412 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4949	See Exhibit 25-7	Yes
V_{R12}	4949	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 40.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.843 (Exibit 25-19)

S_R= 44.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 44.0 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9910	0.90	Level	4	0	0.980	1.00	11231
Ramp	1070	0.90	Level	4	0	0.980	1.00	1213
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3234 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8985	9000	No
V_{12}	3234	4400:All	No
V_{FO} = V_F - V_R	7772	9000	No
V_R	1213	3500	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 15.9 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.732 (Exhibit 25-19)

S_R= 45.5 mph (Exhibit 25-19)

S_0= 53.0 mph (Exhibit 25-19)

S = 50.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9310	0.90	Level	4	0	0.980	1.00	10551
Ramp	640	0.90	Level	4	0	0.980	1.00	725
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4089 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8441	9000	No
V_{12}	4089	4400:All	No
V_{FO} = V_F - V_R	7716	9000	No
V_R	725	2100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 25.9 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.363 (Exhibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 55.7 mph (Exhibit 25-19)

S = 53.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.0 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9500	0.90	Level	4	0	0.980	1.00	10767
Ramp	820	0.90	Level	4	0	0.980	1.00	929
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4280 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8614	9520	No
V_{12}	4280	4400:All	No
V_{FO} = V_F - V_R	7685	9520	No
V_R	929	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 32.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.642 (Exhibit 25-19)

S_R= 51.3 mph (Exhibit 25-19)

S_0= 70.0 mph (Exhibit 25-19)

S = 59.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9170	0.90	Level	4	0	0.980	1.00	10393
Ramp	560	0.90	Level	4	0	0.980	1.00	635
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3983 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8315	9000	No
V_{12}	3983	4400:All	No
V_{FO} = V_F - V_R	7680	9000	No
V_R	635	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 29.5 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.680 (Exhibit 25-19)

S_R= 46.2 mph (Exhibit 25-19)

S_0= 55.8 mph (Exhibit 25-19)

S = 50.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.3 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10060	0.90	Level	4	0	0.980	1.00	11401
Ramp	1570	0.90	Level	4	0	0.980	1.00	1779
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3688 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9121	9412	No
V_{12}	3688	4400:All	No
V_{FO} = V_F - V_R	7342	9412	No
V_R	1779	3800	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 19.8 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.588 (Exhibit 25-19)

S_R= 51.6 mph (Exhibit 25-19)

S_0= 64.9 mph (Exhibit 25-19)

S = 58.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9810	0.90	Level	4	0	0.980	1.00	11118
Ramp	750	0.90	Level	4	0	0.980	1.00	850
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4358 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8895	9000	No
V_{12}	4358	4400:All	No
V_{FO} = V_F - V_R	8045	9000	No
V_R	850	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 27.3 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.700 (Exhibit 25-19)

S_R= 45.9 mph (Exhibit 25-19)

S_0= 55.4 mph (Exhibit 25-19)

S = 50.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.5 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9900	0.90	Level	4	0	0.980	1.00	11220
Ramp	450	0.90	Level	4	0	0.980	1.00	510
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4201 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8976	9540	No
V_{12}	4201	4400:All	No
V_{FO} = V_F - V_R	8466	9540	No
V_R	510	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 38.1 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.604 (Exhibit 25-19)

S_R= 52.5 mph (Exhibit 25-19)

S_0= 69.7 mph (Exhibit 25-19)

S = 60.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.9 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8060	0.90	Level	4	0	0.980	1.00	9135
Ramp	80	0.90	Level	4	0	0.980	1.00	91
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4034 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9135	9556	No
V_{12}	4034	4400:All	No
V_{FO} = V_F - V_R	9044	9556	No
V_R	91	2100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 37.1 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.306 (Exhibit 25-19)

S_R= 60.7 mph (Exhibit 25-19)

S_0= 69.5 mph (Exhibit 25-19)

S = 65.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 67.6 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8980	0.90	Level	5	0	0.976	1.00	10227
Ramp	1300	0.90	Level	5	0	0.976	1.00	1481
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3223 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8182	9503	No
V_{12}	3223	4400:All	No
V_{FO} = V_F - V_R	6701	9503	No
V_R	1481	3500	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 15.8 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.691 (Exhibit 25-19)

S_R= 49.9 mph (Exhibit 25-19)

S_0= 68.4 mph (Exhibit 25-19)

S = 59.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4240	0.90	Level	5	0	0.976	1.00	4829
Ramp	850	0.90	Level	5	0	0.976	1.00	968
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4829 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4829	4500	Yes
V_{12}	4829	4400:All	Yes
$V_{FO} = V_F - V_R$	3861	4500	No
V_R	968	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 43.8 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.580 (Exhibit 25-19)

S_R= 47.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9600	0.90	Level	4	0	0.980	1.00	10880
Ramp	460	0.90	Level	4	0	0.980	1.00	521
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.248 using Equation 4

V_{12}= 2080 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8901	See Exhibit 25-7	No
V_{R12}	2601	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 23.6 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.353 (Exibit 25-19)

S_R= 54.7 mph (Exhibit 25-19)

S_0= 50.0 mph (Exhibit 25-19)

S= 51.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8840	0.90	Level	4	0	0.980	1.00	10019
Ramp	860	0.90	Level	4	0	0.980	1.00	975
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.574 using Equation 4

V_{12}= 5749 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10994	See Exhibit 25-7	Yes
V_{R12}	6724	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 48.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 3.461 (Exibit 25-19)

S_R= 10.0 mph (Exhibit 25-19)

S_0= 49.1 mph (Exhibit 25-19)

S= 14.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 113

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8610	0.90	Level	4	0	0.980	1.00	9758
Ramp	1300	0.90	Level	4	0	0.980	1.00	1473
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 2039 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11231	See Exhibit 25-7	Yes
V_{R12}	3512	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 15.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.270 (Exibit 25-19)

S_R= 51.5 mph (Exhibit 25-19)

S_0= 39.1 mph (Exhibit 25-19)

S= 42.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 114

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.7 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8490	0.90	Level	4	0	0.980	1.00	9622
Ramp	1010	0.90	Level	4	0	0.980	1.00	1145
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.393 using Equation 4

V_{12}= 3784 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10767	See Exhibit 25-7	Yes
V_{R12}	4929	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 37.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.790 (Exibit 25-19)

S_R= 47.2 mph (Exhibit 25-19)

S_0= 56.5 mph (Exhibit 25-19)

S= 51.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 115

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8670	0.90	Level	4	0	0.980	1.00	9826
Ramp	510	0.90	Level	4	0	0.980	1.00	578
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.432 using Equation 4

V_{12}= 4247 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10404	See Exhibit 25-7	Yes
V_{R12}	4825	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 37.2 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.744 (Exibit 25-19)

S_R= 45.3 mph (Exhibit 25-19)

S_0= 45.5 mph (Exhibit 25-19)

S= 45.4 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 116

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9070	0.90	Level	4	0	0.980	1.00	10279
Ramp	250	0.90	Level	4	0	0.980	1.00	283
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.756 using Equation 4

V_{12}= 7769 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10562	See Exhibit 25-7	Yes
V_{R12}	8052	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 56.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 12.441 (Exibit 25-19)

S_R= -106.7 mph (Exhibit 25-19)

S_0= 52.3 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 68.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9370	0.90	Level	4	0	0.980	1.00	10619
Ramp	530	0.90	Level	4	0	0.980	1.00	601
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.238 using Equation 4

V_{12}= 2530 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11220	See Exhibit 25-7	Yes
V_{R12}	3131	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 27.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.389 (Exibit 25-19)

S_R= 58.0 mph (Exhibit 25-19)

S_0= 51.2 mph (Exhibit 25-19)

S= 52.9 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9520	0.90	Level	4	0	0.980	1.00	10789
Ramp	300	0.90	Level	4	0	0.980	1.00	340
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.749 using Equation 4

V_{12}= 8078 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11129	See Exhibit 25-7	Yes
V_{R12}	8418	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 59.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 17.854 (Exibit 25-19)

S_R= -177.1 mph (Exhibit 25-19)

S_0= 51.9 mph (Exhibit 25-19)

S= 2378.2 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6040	0.90	Level	5	0	0.976	1.00	6879
Ramp	830	0.90	Level	5	0	0.976	1.00	945
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.227 using Equation 4

V_{12}= 1562 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7824	See Exhibit 25-7	No
V_{R12}	2507	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 22.1 (pc/ m/ln)

LOS = C (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.341 (Exibit 25-19)

S_R= 53.7 mph (Exhibit 25-19)

S_0= 51.1 mph (Exhibit 25-19)

S= 51.9 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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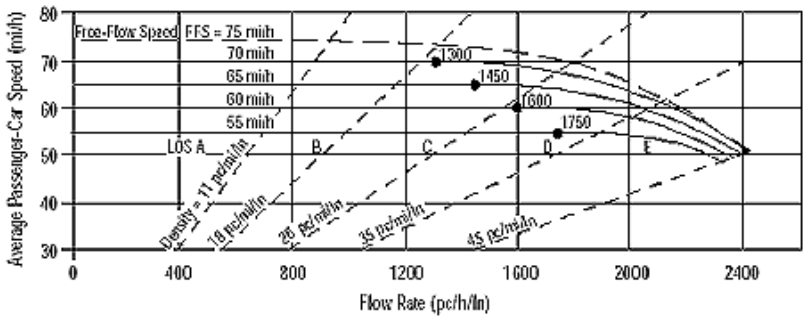
PM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 1

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	10860 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2462	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10860	0.90	Level	4	0	0.980	1.00	12308
Ramp	1470	0.90	Level	4	0	0.980	1.00	1666
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3793 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9847	9000	Yes
V_{12}	3793	4400:All	No
V_{FO} = V_F - V_R	8181	9000	No
V_R	1666	3800	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 22.5 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.643 (Exhibit 25-19)

S_R= 46.6 mph (Exhibit 25-19)

S_0= 52.4 mph (Exhibit 25-19)

S = 50.0 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.40
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	340	0.90	4	0	1.5	1.2	0.980	1.00	385
Vw2	520	0.90	4	0	1.5	1.2	0.980	1.00	589
Vw				974	Vnw				0
V									974

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.74	0.59
Weaving and non-weaving speeds, Si (mi/h)			21.68	30.70

Number of lanes required for unconstrained operation, Nw 1.74
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	21.68
Weaving segment density, D (pc/mi/ln)	22.47
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9390	0.90	Level	4	0	0.980	1.00	10642
Ramp	410	0.90	Level	4	0	0.980	1.00	465
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.542 using Equation 4

V_{12}= 5768 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11107	See Exhibit 25-7	Yes
V_{R12}	6233	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 46.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 2.223 (Exibit 25-19)

S_R= 26.1 mph (Exhibit 25-19)

S_0= 47.6 mph (Exhibit 25-19)

S= 32.6 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	41	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.25
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.22
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7786	0.90	4	0	1.5	1.2	0.980	1.00	8824
Vo2	106	0.90	4	0	1.5	1.2	0.980	1.00	120
Vw1	2014	0.90	4	0	1.5	1.2	0.980	1.00	2282
Vw2	554	0.90	4	0	1.5	1.2	0.980	1.00	627
Vw				2909	Vnw				8944
V									11853

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.66	0.58
Weaving and non-weaving speeds, Si (mi/h)			21.65	34.67

Number of lanes required for unconstrained operation, Nw 2.06
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	30.21
Weaving segment density, D (pc/mi/ln)	78.47
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9008
Capacity as a 15-minute flow rate, c (veh/h)	8831
Capacity as a full-hour volume, c_h (veh/h)	7948

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.08
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	220	0.90	4	0	1.5	1.2	0.980	1.00	249
Vw2	20	0.90	4	0	1.5	1.2	0.980	1.00	22
Vw				271	Vnw				0
V									271

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.06	0.15
Weaving and non-weaving speeds, Si (mi/h)			27.15	36.80

Number of lanes required for unconstrained operation, Nw 1.47
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	27.15
Weaving segment density, D (pc/mi/ln)	4.99
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	39	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.21
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.29
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7723	0.90	4	0	1.5	1.2	0.980	1.00	8752
Vo2	33	0.90	4	0	1.5	1.2	0.980	1.00	37
Vw1	617	0.90	4	0	1.5	1.2	0.980	1.00	699
Vw2	1487	0.90	4	0	1.5	1.2	0.980	1.00	1685
Vw				2384	Vnw				8789
V									11173

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.50	0.51
Weaving and non-weaving speeds, Si (mi/h)			21.44	34.17

Number of lanes required for unconstrained operation, Nw 1.87
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	30.33
Weaving segment density, D (pc/mi/ln)	73.68
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	8904
Capacity as a 15-minute flow rate, c (veh/h)	8729
Capacity as a full-hour volume, c_h (veh/h)	7856

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 22

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9210	0.90	Level	4	0	0.980	1.00	10438
Ramp	320	0.90	Level	4	0	0.980	1.00	363
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.236 using Equation 4

V_{12}= 2465 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10801	See Exhibit 25-7	Yes
V_{R12}	2828	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 26.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.373 (Exibit 25-19)

S_R= 50.2 mph (Exhibit 25-19)

S_0= 38.4 mph (Exhibit 25-19)

S= 40.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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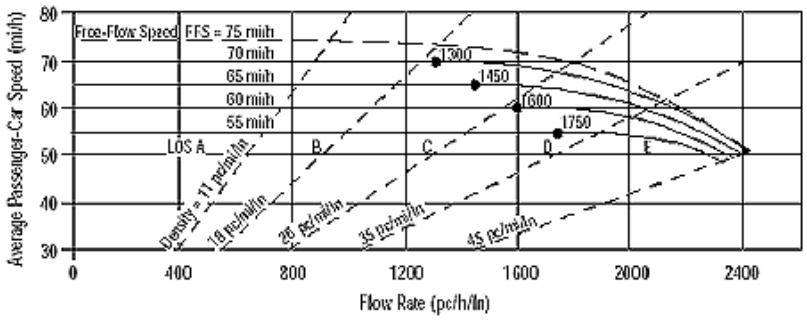
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 23

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	9530 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2700	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.33
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	9217	0.90	4	0	1.5	1.2	0.980	1.00	10445
Vo2	17	0.90	4	0	1.5	1.2	0.980	1.00	19
Vw1	313	0.90	4	0	1.5	1.2	0.980	1.00	354
Vw2	623	0.90	4	0	1.5	1.2	0.980	1.00	706
Vw				1060	Vnw				10464
V									11524

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.66	0.24		
Weaving and non-weaving speeds, Si (mi/h)	40.28	48.99		

Number of lanes required for unconstrained operation, Nw 1.03
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	48.04
Weaving segment density, D (pc/mi/ln)	47.98
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10836
Capacity as a 15-minute flow rate, c (veh/h)	10624
Capacity as a full-hour volume, c_h (veh/h)	9562

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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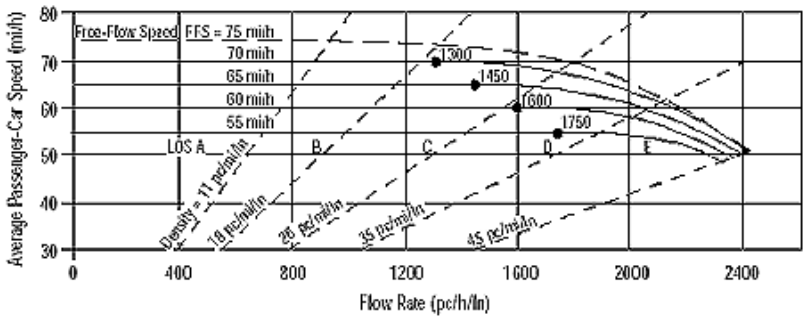
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 25

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	9830 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2228	pc/h/ln	Design LOS		
S	50.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	44.1	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9830	0.90	Level	4	0	0.980	1.00	11141
Ramp	1560	0.90	Level	4	0	0.980	1.00	1768
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3626 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8913	9000	No
V_{12}	3626	4400:All	No
$V_{FO} = V_F - V_R$	7145	9000	No
V_R	1768	4100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 9.3 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.392 (Exhibit 25-19)

S_R= 49.9 mph (Exhibit 25-19)

S_0= 53.9 mph (Exhibit 25-19)

S = 52.2 mph (Exhibit 25-15)

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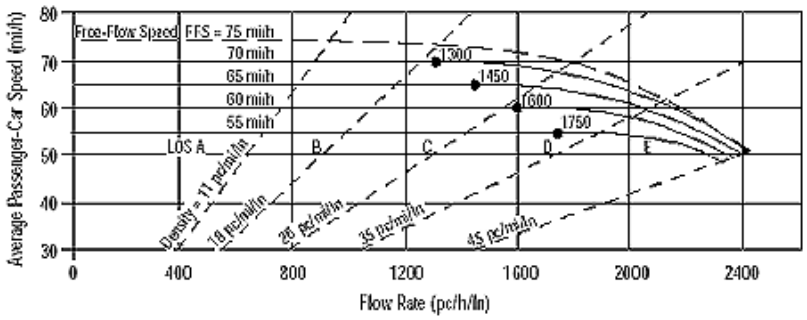
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 27

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8270 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2343	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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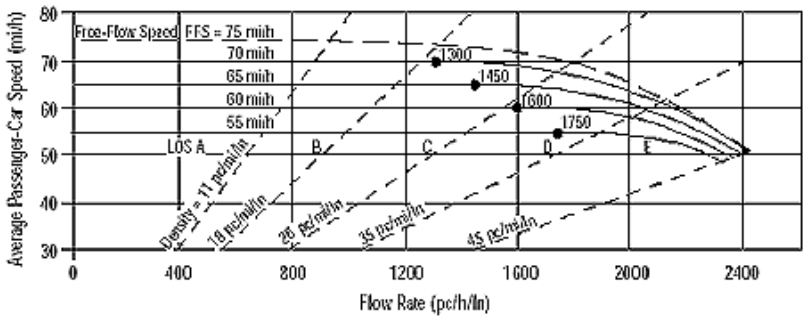

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 29

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8140 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2306	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 30

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	VD = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8140	0.90	Level	4	0	0.980	1.00	9225
Ramp	3580	0.90	Level	4	0	0.980	1.00	4057
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1928 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	13282	See Exhibit 25-7	Yes
V_{R12}	5985	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 32.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.668 (Exibit 25-19)

S_R= 33.3 mph (Exhibit 25-19)

S_0= 40.4 mph (Exhibit 25-19)

S= 36.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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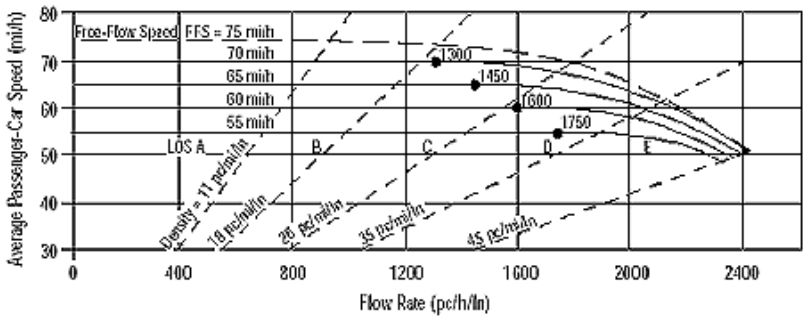

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 31

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	11720 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2657	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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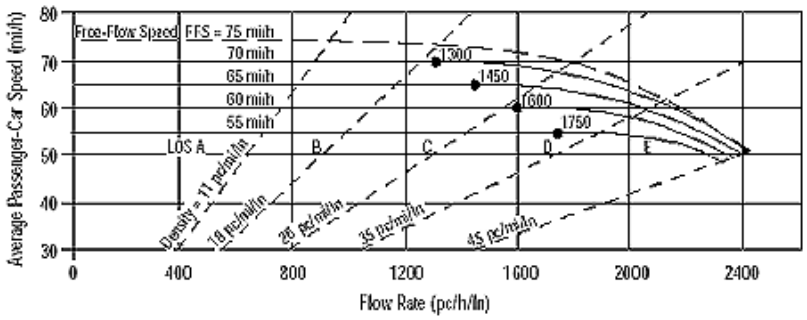
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 32

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	11180 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2534	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	11180	0.90	Level	4	0	0.980	1.00	12671
Ramp	1560	0.90	Level	4	0	0.980	1.00	1768
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3944 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	10137	9351	Yes
V_{12}	3944	4400:All	No
$V_{FO} = V_F - V_R$	8369	9351	No
V_R	1768	4100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = -5.0 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.392 (Exhibit 25-19)

S_R= 55.3 mph (Exhibit 25-19)

S_0= 61.8 mph (Exhibit 25-19)

S = 59.1 mph (Exhibit 25-15)

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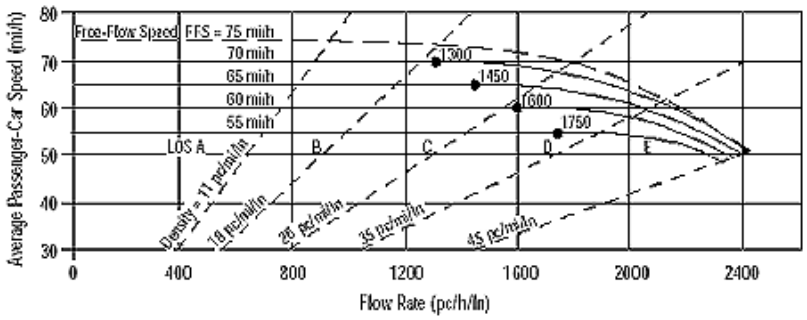
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 34

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	9620 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2726	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9620	0.90	Level	4	0	0.980	1.00	10903
Ramp	1600	0.90	Level	4	0	0.980	1.00	1813
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.373 using Equation 4

V_{12}= 4072 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12716	See Exhibit 25-7	Yes
V_{R12}	5885	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 43.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.639 (Exibit 25-19)

S_R= 28.1 mph (Exhibit 25-19)

S_0= 50.6 mph (Exhibit 25-19)

S= 36.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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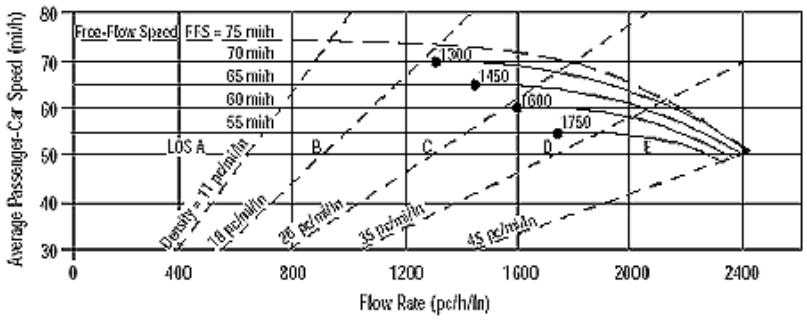
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 36

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	11220 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	3179	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.25
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	43	0.90	4	0	1.5	1.2	0.980	1.00	48
Vo2	10953	0.90	4	0	1.5	1.2	0.980	1.00	12413
Vw1	267	0.90	4	0	1.5	1.2	0.980	1.00	302
Vw2	817	0.90	4	0	1.5	1.2	0.980	1.00	925
Vw				1227	Vnw				12461
V									13688

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.02	0.55		
Weaving and non-weaving speeds, Si (mi/h)	42.25	50.52		

Number of lanes required for unconstrained operation, Nw 1.03
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	49.65
Weaving segment density, D (pc/mi/ln)	55.13
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11220
Capacity as a 15-minute flow rate, c (veh/h)	11000
Capacity as a full-hour volume, c_h (veh/h)	9900

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.06
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.49
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	17	0.90	4	0	1.5	1.2	0.980	1.00	19
Vo2	10357	0.90	4	0	1.5	1.2	0.980	1.00	11737
Vw1	303	0.90	4	0	1.5	1.2	0.980	1.00	343
Vw2	313	0.90	4	0	1.5	1.2	0.980	1.00	354
Vw				697	Vnw				11756
V									12453

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.85	0.42		
Weaving and non-weaving speeds, Si (mi/h)	45.31	54.48		

Number of lanes required for unconstrained operation, Nw 0.77
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	53.87
Weaving segment density, D (pc/mi/ln)	46.23
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11339
Capacity as a 15-minute flow rate, c (veh/h)	11117
Capacity as a full-hour volume, c_h (veh/h)	10005

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.05
Weaving seg length, L (ft)	890	Weaving ratio, R	0.48
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	32	0.90	4	0	1.5	1.2	0.980	1.00	36
Vo2	10370	0.90	4	0	1.5	1.2	0.980	1.00	11752
Vw1	308	0.90	4	0	1.5	1.2	0.980	1.00	349
Vw2	290	0.90	4	0	1.5	1.2	0.980	1.00	328
Vw				677	Vnw				11788
V									12465

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.45	0.69		
Weaving and non-weaving speeds, Si (mi/h)	37.43	47.52		

Number of lanes required for unconstrained operation, Nw 0.70
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	46.83
Weaving segment density, D (pc/mi/ln)	53.23
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10148
Capacity as a 15-minute flow rate, c (veh/h)	9949
Capacity as a full-hour volume, c_h (veh/h)	8954

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2040 Alt 1

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.16
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.47
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	51	0.90	4	0	1.5	1.2	0.980	1.00	57
Vo2	9401	0.90	4	0	1.5	1.2	0.980	1.00	10654
Vw1	849	0.90	4	0	1.5	1.2	0.980	1.00	962
Vw2	969	0.90	4	0	1.5	1.2	0.980	1.00	1098
Vw				2060	Vnw				10711
V									12771

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.75	0.35		
Weaving and non-weaving speeds, Si (mi/h)	47.03	56.56		

Number of lanes required for unconstrained operation, Nw 1.04
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	54.77
Weaving segment density, D (pc/mi/ln)	46.64
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11570
Capacity as a 15-minute flow rate, c (veh/h)	11343
Capacity as a full-hour volume, c_h (veh/h)	10209

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10900	0.90	Level	4	0	0.980	1.00	12353
Ramp	340	0.90	Level	4	0	0.980	1.00	385
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.329 using Equation 4

V_{12}= 3241 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10238	See Exhibit 25-7	Yes
V_{R12}	3626	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 30.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.432 (Exibit 25-19)

S_R= 55.5 mph (Exhibit 25-19)

S_0= 53.2 mph (Exhibit 25-19)

S= 54.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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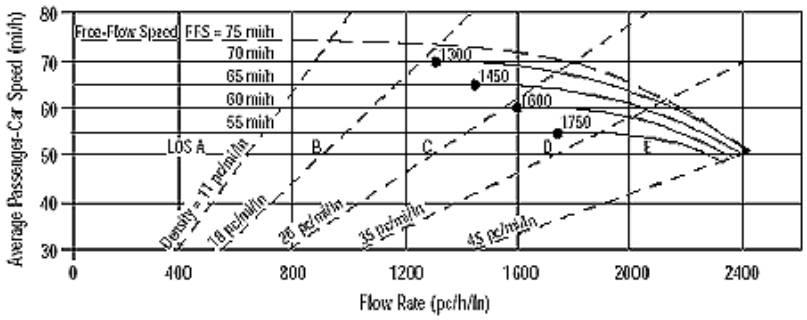
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 47

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	11240 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	60.9	mi/h	FFS	60.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2548	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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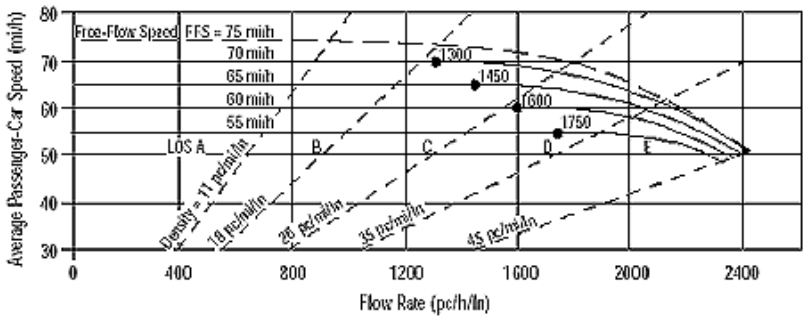
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 48

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	3630 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2037	pc/h/ln	Design LOS		
S	64.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	31.8	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3630	0.90	Level	5	0	0.976	1.00	4134
Ramp	3070	0.90	Level	5	0	0.976	1.00	3496
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4134 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4134	4500	No
V_{12}	4134	4400:All	No
$V_{FO} = V_F - V_R$	638	4500	No
V_R	3496	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 20.9 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

D_s = 0.743 (Exhibit 25-19)

S_R= 45.3 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 45.3 mph (Exhibit 25-15)

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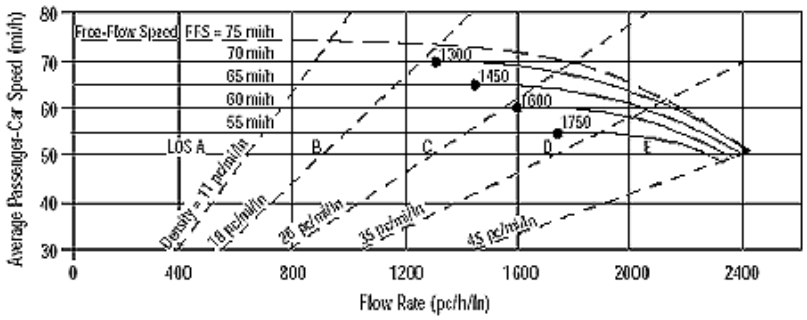
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 50

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	1330 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	757	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	12.6	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 62.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1330	0.90	Level	5	0	0.976	1.00	1515
Ramp	470	0.90	Level	5	0	0.976	1.00	535
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 1515 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	1515	4655	No
V_{12}	1515	4400:All	No
$V_{FO} = V_F - V_R$	980	4655	No
V_R	535	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 7.4 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.281 (Exhibit 25-19)

S_R= 56.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 56.9 mph (Exhibit 25-15)

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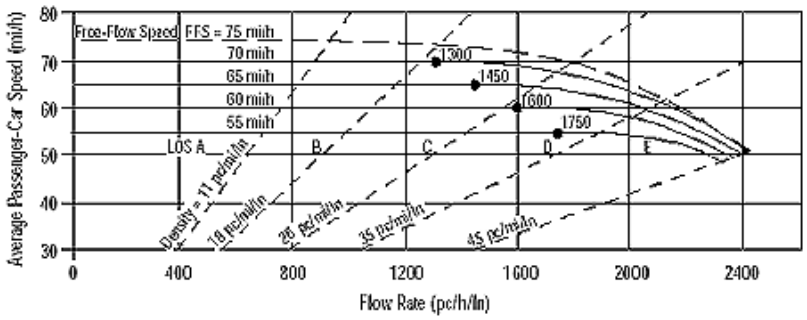
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 52

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	960 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	547	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	8.7	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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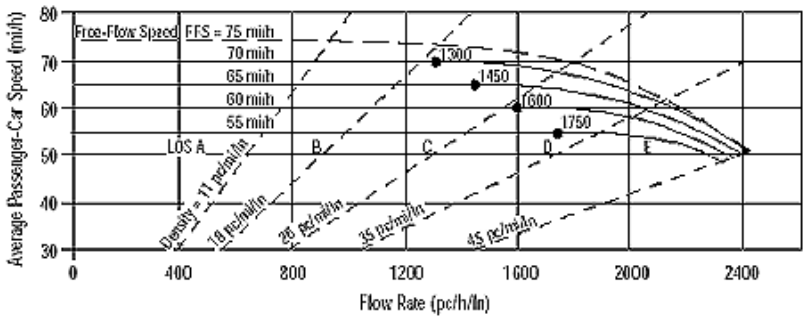
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 54

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5610 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1597	pc/h/ln	Design LOS	
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	25.4	pc/mi/ln	S	mi/h
LOS	C		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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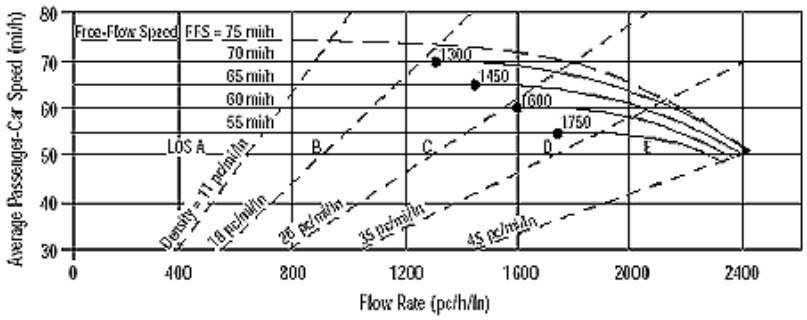

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 56

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	7170 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1633	pc/h/ln	Design LOS		
S	62.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.0	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 62.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7170	0.90	Level	5	0	0.976	1.00	8166
Ramp	1760	0.90	Level	5	0	0.976	1.00	2004
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3979 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	6533	9311	No
V_{12}	3979	4400:All	No
V_{FO} = V_F - V_R	4529	9311	No
V_R	2004	2100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 9.7 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.543 (Exhibit 25-19)

S_R= 51.5 mph (Exhibit 25-19)

S_0= 67.8 mph (Exhibit 25-19)

S = 56.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5410	0.90	Level	5	0	0.976	1.00	6161
Ramp	1520	0.90	Level	5	0	0.976	1.00	1731
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.185 using Equation 4

V_{12}= 1137 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7892	See Exhibit 25-7	No
V_{R12}	2868	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 23.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.349 (Exibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= 60.0 mph (Exhibit 25-19)

S= 59.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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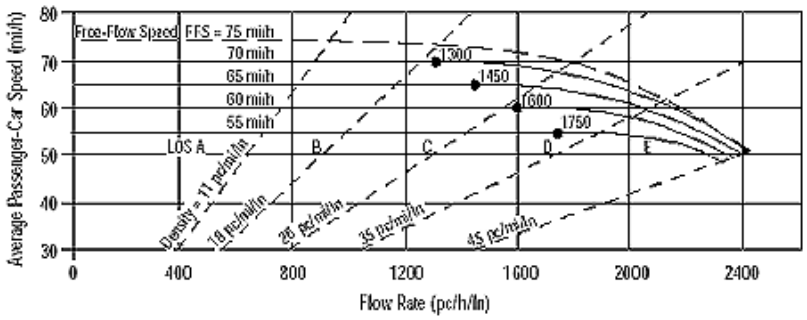

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 60

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6930 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1973	pc/h/ln	Design LOS		
S	65.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	30.2	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 60.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6930	0.90	Level	5	0	0.976	1.00	7893
Ramp	1170	0.90	Level	5	0	0.976	1.00	1333
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.115 using Equation 4

V_{12}= 907 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9226	See Exhibit 25-7	Yes
V_{R12}	2240	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.344 (Exibit 25-19)

S_R= 54.1 mph (Exhibit 25-19)

S_0= 46.8 mph (Exhibit 25-19)

S= 48.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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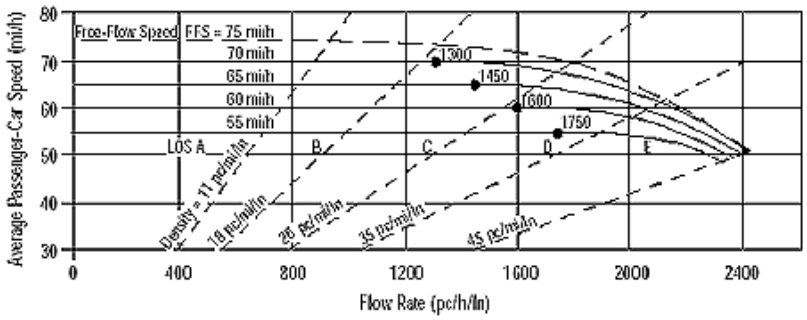

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 62

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8100 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.6	mi/h	FFS	59.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2306	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.6 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8100	0.90	Level	5	0	0.976	1.00	9225
Ramp	1030	0.90	Level	5	0	0.976	1.00	1173
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4684 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9225	9183	Yes
V_{12}	4684	4400:All	Yes
V_{FO} = V_F - V_R	8052	9183	No
V_R	1173	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 41.8 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.534 (Exhibit 25-19)

S_R= 50.2 mph (Exhibit 25-19)

S_0= 60.4 mph (Exhibit 25-19)

S = 54.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 65

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 58.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7070	0.90	Level	5	0	0.976	1.00	8052
Ramp	560	0.90	Level	5	0	0.976	1.00	638
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.321 using Equation 4

V_{12}= 2587 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8690	See Exhibit 25-7	No
V_{R12}	3225	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 26.7 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.379 (Exibit 25-19)

S_R= 51.9 mph (Exhibit 25-19)

S_0= 48.9 mph (Exhibit 25-19)

S= 50.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 68

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.4 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7160	0.90	Level	5	0	0.976	1.00	8154
Ramp	480	0.90	Level	5	0	0.976	1.00	547
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.229 using Equation 4

V_{12}= 1868 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8701	See Exhibit 25-7	No
V_{R12}	2415	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 22.5 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.347 (Exibit 25-19)

S_R= 57.3 mph (Exhibit 25-19)

S_0= 53.8 mph (Exhibit 25-19)

S= 54.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7640	0.90	Level	5	0	0.976	1.00	8701
Ramp	380	0.90	Level	5	0	0.976	1.00	433
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.227 using Equation 4

V_{12}= 1979 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9134	See Exhibit 25-7	No
V_{R12}	2412	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 22.8 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.351 (Exibit 25-19)

S_R= 56.0 mph (Exhibit 25-19)

S_0= 50.6 mph (Exhibit 25-19)

S= 51.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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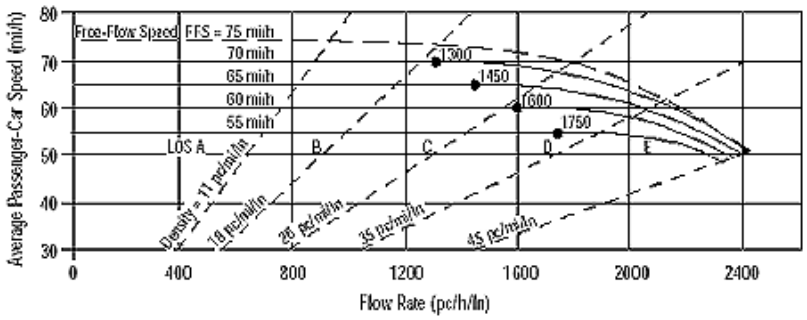
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 71

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8020 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2283	pc/h/ln	Design LOS		
S	53.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	42.4	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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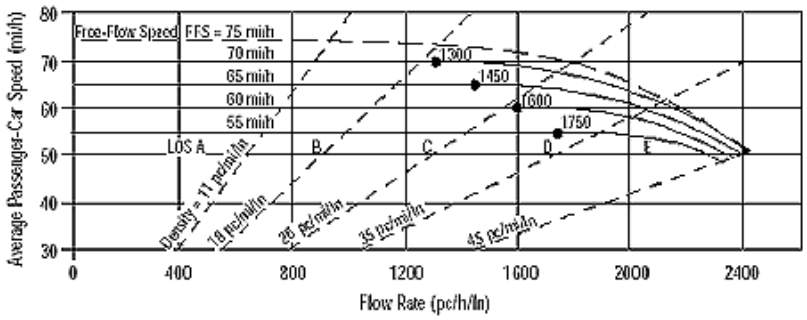
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 72

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	8020 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1827	pc/h/ln	Design LOS		
S	62.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	29.1	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.8 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8020	0.90	Level	5	0	0.976	1.00	9134
Ramp	1520	0.90	Level	5	0	0.976	1.00	1731
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4163 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7308	9351	No
V_{12}	4163	4400:All	No
$V_{FO} = V_F - V_R$	5577	9351	No
V_R	1731	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 38.3 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.649 (Exhibit 25-19)

S_R= 49.7 mph (Exhibit 25-19)

S_0= 67.8 mph (Exhibit 25-19)

S = 56.1 mph (Exhibit 25-15)

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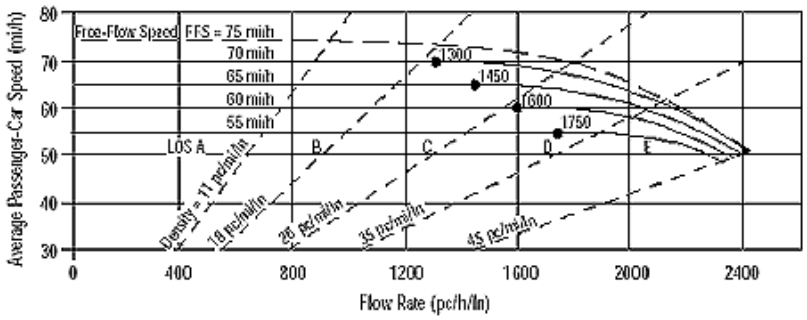
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 74

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	6500 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1851	pc/h/ln	Design LOS		
S	67.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	27.5	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 61.4 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6500	0.90	Level	5	0	0.976	1.00	7403
Ramp	620	0.90	Level	5	0	0.976	1.00	706
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3626 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7403	9256	No
V_{12}	3626	4400:All	No
$V_{FO} = V_F - V_R$	6697	9256	No
V_R	706	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.5 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.557 (Exhibit 25-19)

S_R= 50.6 mph (Exhibit 25-19)

S_0= 63.9 mph (Exhibit 25-19)

S = 56.6 mph (Exhibit 25-15)

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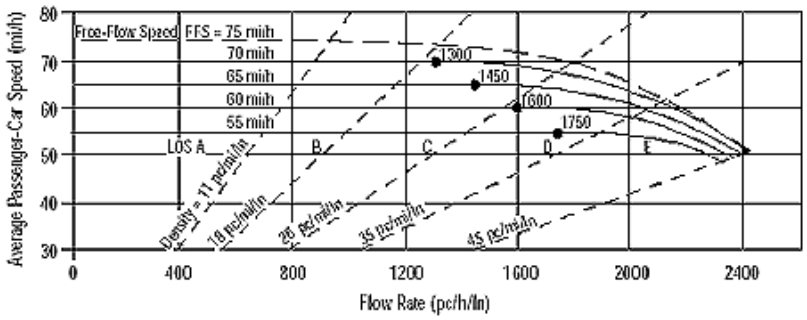
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 76

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5880 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	61.4	mi/h	FFS	61.4	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1674	pc/h/ln	Design LOS		
S	61.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	27.3	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5880	0.90	Level	5	0	0.976	1.00	6697
Ramp	1110	0.90	Level	5	0	0.976	1.00	1264
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3633 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6697	9000	No
V_{12}	3633	4400:All	No
$V_{FO} = V_F - V_R$	5433	9000	No
V_R	1264	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.5 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.607 (Exhibit 25-19)

S_R= 47.1 mph (Exhibit 25-19)

S_0= 58.3 mph (Exhibit 25-19)

S = 51.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4780	0.90	Level	5	0	0.976	1.00	5444
Ramp	870	0.90	Level	5	0	0.976	1.00	991
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.381 using Equation 4

V_{12}= 2072 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6435	See Exhibit 25-7	No
V_{R12}	3063	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 23.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.341 (Exibit 25-19)

S_R= 50.6 mph (Exhibit 25-19)

S_0= 50.7 mph (Exhibit 25-19)

S= 50.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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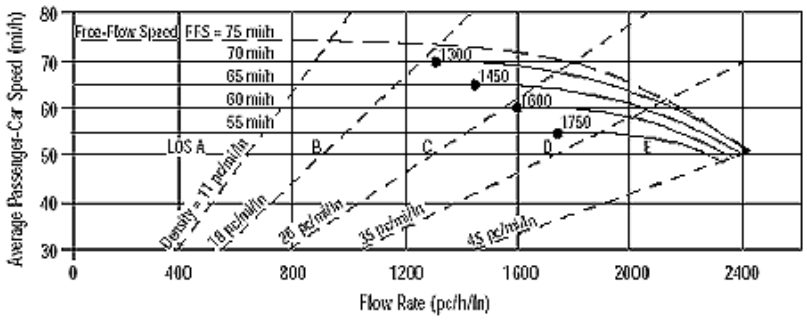

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 84

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	5650 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1609	pc/h/ln	Design LOS	
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	26.9	pc/mi/ln	S	mi/h
LOS	D		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5650	0.90	Level	5	0	0.976	1.00	6435
Ramp	1080	0.90	Level	5	0	0.976	1.00	1230
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3499 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6435	9191	No
V_{12}	3499	4400:All	No
$V_{FO} = V_F - V_R$	5205	9191	No
V_R	1230	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.9 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.344 (Exhibit 25-19)

S_R= 53.7 mph (Exhibit 25-19)

S_0= 63.8 mph (Exhibit 25-19)

S = 57.9 mph (Exhibit 25-15)

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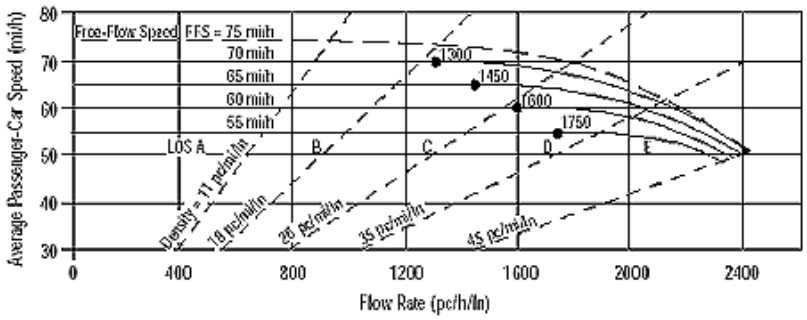

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 86

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4570 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1301	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	18.6	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 59.8 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4570	0.90	Level	5	0	0.976	1.00	5205
Ramp	3580	0.90	Level	5	0	0.976	1.00	4077
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 4370 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	5205	9191	No
V_{12}	4370	4400:All	No
V_{FO} = V_F - V_R	1128	9191	No
V_R	4077	4400	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = -44.6 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.473 (Exhibit 25-19)

S_R= 51.4 mph (Exhibit 25-19)

S_0= 65.6 mph (Exhibit 25-19)

S = 53.2 mph (Exhibit 25-15)

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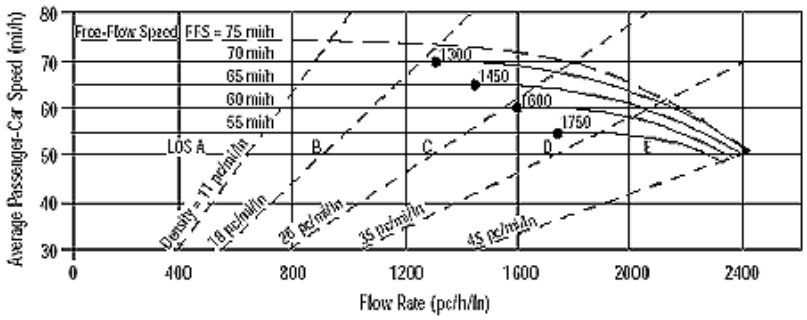

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 88 coded as 2 lanes, double volume

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	1980 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1128	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	18.9	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1980	0.90	Level	5	0	0.976	1.00	2255
Ramp	130	0.90	Level	5	0	0.976	1.00	148
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2255 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	2403	See Exhibit 25-7	No
V_{R12}	2403	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 22.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.329 (Exibit 25-19)

S_R= 53.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 53.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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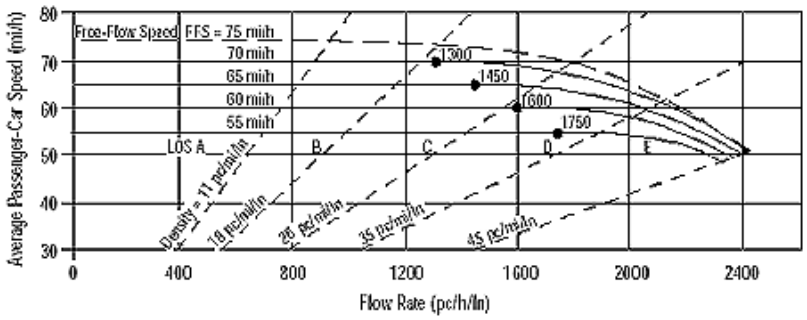

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 90 coded as 2 lanes, double volume

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	2240 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1276	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	21.3	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2910	0.90	Level	2	0	0.990	1.00	3266
Ramp	1120	0.90	Level	2	0	0.990	1.00	1257
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3266 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4523	See Exhibit 25-7	Yes
V_{R12}	4523	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 38.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.653 (Exibit 25-19)

S_R= 46.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 46.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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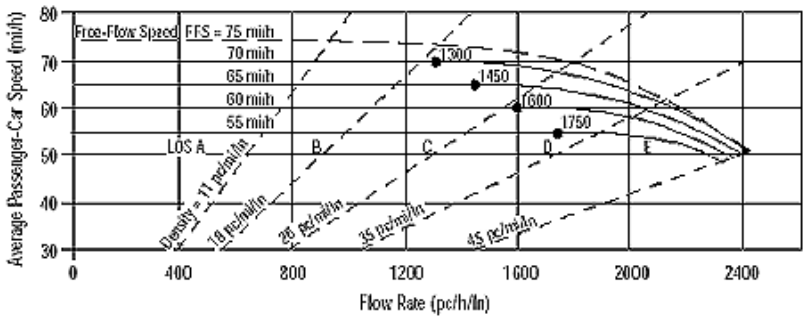

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 92

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4030 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2261	pc/h/ln	Design LOS		
S	58.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	38.8	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2480	0.90	Level	2	0	0.990	1.00	2783
Ramp	430	0.90	Level	2	0	0.990	1.00	483
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2783 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3266	See Exhibit 25-7	No
V_{R12}	3266	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 21.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.318 (Exibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 50.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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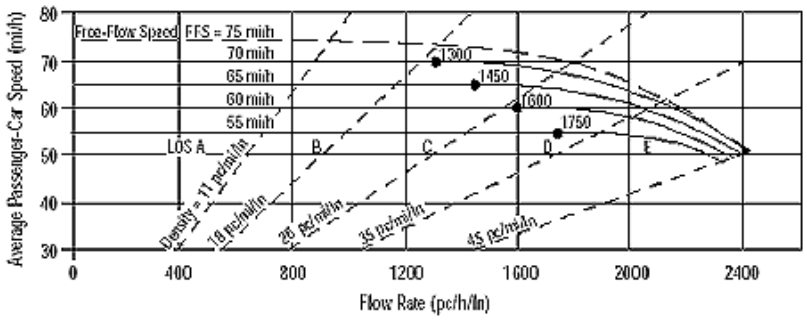

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 96

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	2900 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1085	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	15.5	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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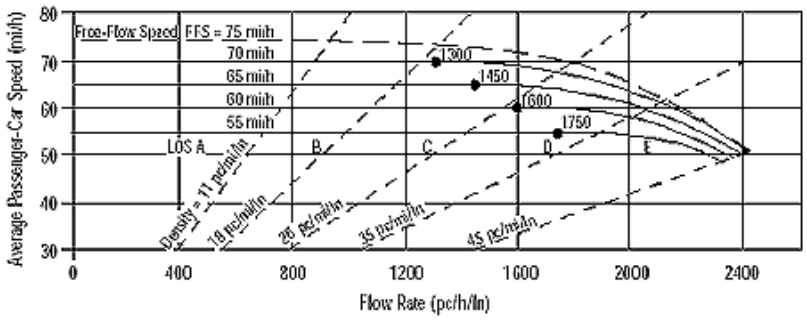
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 97

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	2750 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1029	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	14.7	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2750	0.90	Level	5	0	0.976	1.00	3132
Ramp	660	0.90	Level	5	0	0.976	1.00	752
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 3132 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	3132	4500	No
V_{12}	3132	4400:All	No
$V_{FO} = V_F - V_R$	2380	4500	No
V_R	752	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 30.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.561 (Exhibit 25-19)

S_R= 47.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2100	0.90	Level	2	0	0.990	1.00	2357
Ramp	1540	0.90	Level	2	0	0.990	1.00	1728
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2357 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4085	See Exhibit 25-7	No
V_{R12}	4085	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 34.0 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.525 (Exibit 25-19)

S_R= 48.2 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 48.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.2 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	11270	0.90	Level	4	0	0.980	1.00	12773
Ramp	1020	0.90	Level	4	0	0.980	1.00	1156
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3512 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		V_{FI}=V_F	10219	9447	Yes
				V_{12}	3512	4400:All	No
V_{R12}		4600:All		V_{FO} = V_F - V_R	9063	9447	No
				V_R	1156	3500	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 18.3 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.727 (Exhibit 25-19)

S_R= 48.6 mph (Exhibit 25-19)

S_0= 63.4 mph (Exhibit 25-19)

S = 57.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.8 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10980	0.90	Level	4	0	0.980	1.00	12444
Ramp	330	0.90	Level	4	0	0.980	1.00	374
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4552 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9956	9432	Yes
V_{12}	4552	4400:All	Yes
V_{FO} = V_F - V_R	9582	9432	Yes
V_R	374	2100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 29.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.332 (Exhibit 25-19)

S_R= 57.9 mph (Exhibit 25-19)

S_0= 65.5 mph (Exhibit 25-19)

S = 61.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9860	0.90	Level	4	0	0.980	1.00	11175
Ramp	650	0.90	Level	4	0	0.980	1.00	737
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4314 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8940	9000	No
V_{12}	4314	4400:All	No
V_{FO} = V_F - V_R	8203	9000	No
V_R	737	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 32.4 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.624 (Exhibit 25-19)

S_R= 46.9 mph (Exhibit 25-19)

S_0= 55.2 mph (Exhibit 25-19)

S = 50.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 64.7 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	11000	0.90	Level	4	0	0.980	1.00	12467
Ramp	630	0.90	Level	4	0	0.980	1.00	714
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4751 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9974	9387	Yes
V_{12}	4751	4400:All	Yes
V_{FO} = V_F - V_R	9260	9387	No
V_R	714	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 36.1 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.687 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

S_0= 64.7 mph (Exhibit 25-19)

S = 56.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10460	0.90	Level	4	0	0.980	1.00	11855
Ramp	2120	0.90	Level	4	0	0.980	1.00	2403
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 4244 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9484	9000	Yes
V_{12}	4244	4400:All	No
$V_{FO} = V_F - V_R$	7081	9000	No
V_R	2403	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 24.6 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.644 (Exhibit 25-19)

S_R= 46.6 mph (Exhibit 25-19)

S_0= 54.0 mph (Exhibit 25-19)

S = 50.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	11530	0.90	Level	4	0	0.980	1.00	13067
Ramp	860	0.90	Level	4	0	0.980	1.00	975
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 5108 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	10454	9400	Yes
V_{12}	5108	4400:All	Yes
V_{FO} = V_F - V_R	9479	9400	Yes
V_R	975	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.8 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.711 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

S_0= 64.8 mph (Exhibit 25-19)

S = 55.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10170	0.90	Level	4	0	0.980	1.00	11526
Ramp	330	0.90	Level	4	0	0.980	1.00	374
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4231 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9221	9000	Yes
V_{12}	4231	4400:All	No
V_{FO} = V_F - V_R	8847	9000	No
V_R	374	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 38.4 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.592 (Exhibit 25-19)

S_R= 47.3 mph (Exhibit 25-19)

S_0= 54.5 mph (Exhibit 25-19)

S = 50.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8270	0.90	Level	4	0	0.980	1.00	9373
Ramp	130	0.90	Level	4	0	0.980	1.00	147
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4170 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9373	9000	Yes
V_{12}	4170	4400:All	No
V_{FO} = V_F - V_R	9226	9000	Yes
V_R	147	2100	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 38.3 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.311 (Exhibit 25-19)

S_R= 51.0 mph (Exhibit 25-19)

S_0= 54.1 mph (Exhibit 25-19)

S = 52.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.4 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8660	0.90	Level	5	0	0.976	1.00	9863
Ramp	1500	0.90	Level	5	0	0.976	1.00	1708
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3316 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7891	9416	No
V_{12}	3316	4400:All	No
V_{FO} = V_F - V_R	6183	9416	No
V_R	1708	3500	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 16.6 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.712 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

S_0= 66.7 mph (Exhibit 25-19)

S = 57.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4030	0.90	Level	5	0	0.976	1.00	4590
Ramp	1560	0.90	Level	5	0	0.976	1.00	1777
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4590 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4590	4500	Yes
V_{12}	4590	4400:All	Yes
$V_{FO} = V_F - V_R$	2813	4500	No
V_R	1777	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 41.7 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.653 (Exhibit 25-19)

S_R= 46.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 46.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9800	0.90	Level	4	0	0.980	1.00	11107
Ramp	660	0.90	Level	4	0	0.980	1.00	748
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.220 using Equation 4

V_{12}= 1892 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9355	See Exhibit 25-7	Yes
V_{R12}	2640	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 23.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.355 (Exibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 42.1 mph (Exhibit 25-19)

S= 44.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10240	0.90	Level	4	0	0.980	1.00	11605
Ramp	660	0.90	Level	4	0	0.980	1.00	748
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.602 using Equation 4

V_{12}= 6988 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12353	See Exhibit 25-7	Yes
V_{R12}	7736	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 56.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 9.144 (Exibit 25-19)

S_R= -155.1 mph (Exhibit 25-19)

S_0= 59.6 mph (Exhibit 25-19)

S= 448.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 113

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.4 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10370	0.90	Level	4	0	0.980	1.00	11753
Ramp	900	0.90	Level	4	0	0.980	1.00	1020
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 2456 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12773	See Exhibit 25-7	Yes
V_{R12}	3476	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 15.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.265 (Exibit 25-19)

S_R= 57.7 mph (Exhibit 25-19)

S_0= 42.8 mph (Exhibit 25-19)

S= 46.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 114

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8340	0.90	Level	4	0	0.980	1.00	9452
Ramp	1520	0.90	Level	4	0	0.980	1.00	1723
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.321 using Equation 4

V_{12}= 3034 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11175	See Exhibit 25-7	Yes
V_{R12}	4757	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 35.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.705 (Exibit 25-19)

S_R= 45.8 mph (Exhibit 25-19)

S_0= 43.0 mph (Exhibit 25-19)

S= 44.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 115

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10660	0.90	Level	4	0	0.980	1.00	12081
Ramp	340	0.90	Level	4	0	0.980	1.00	385
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.456 using Equation 4

V_{12}= 5514 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12466	See Exhibit 25-7	Yes
V_{R12}	5899	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 45.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 1.680 (Exibit 25-19)

S_R= 25.7 mph (Exhibit 25-19)

S_0= 53.6 mph (Exhibit 25-19)

S= 35.4 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 116

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10670	0.90	Level	4	0	0.980	1.00	12093
Ramp	320	0.90	Level	4	0	0.980	1.00	363
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.746 using Equation 4

V_{12}= 9020 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12456	See Exhibit 25-7	Yes
V_{R12}	9383	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 67.2 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 46.545 (Exibit 25-19)

S_R= -1032.9 mph (Exhibit 25-19)

S_0= 61.9 mph (Exhibit 25-19)

S= 306.9 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9530	0.90	Level	4	0	0.980	1.00	10801
Ramp	640	0.90	Level	4	0	0.980	1.00	725
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.223 using Equation 4

V_{12}= 2406 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11526	See Exhibit 25-7	Yes
V_{R12}	3131	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 27.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.389 (Exibit 25-19)

S_R= 49.9 mph (Exhibit 25-19)

S_0= 37.1 mph (Exhibit 25-19)

S= 39.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	11220	0.90	Level	4	0	0.980	1.00	12716
Ramp	310	0.90	Level	4	0	0.980	1.00	351
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.747 using Equation 4

V_{12}= 9503 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	13067	See Exhibit 25-7	Yes
V_{R12}	9854	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 70.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 74.429 (Exibit 25-19)

S_R= -1558.8 mph (Exhibit 25-19)

S_0= 59.8 mph (Exhibit 25-19)

S= 275.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 1

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 57.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7560	0.90	Level	5	0	0.976	1.00	8610
Ramp	740	0.90	Level	5	0	0.976	1.00	843
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.240 using Equation 4

V_{12}= 2065 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9453	See Exhibit 25-7	Yes
V_{R12}	2908	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 25.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.364 (Exibit 25-19)

S_R= 51.5 mph (Exhibit 25-19)

S_0= 44.6 mph (Exhibit 25-19)

S= 46.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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