



Appendix C
EXISTING (2008) ADJACENT FREEWAY
OPERATIONS ANALYSIS WORKSHEETS



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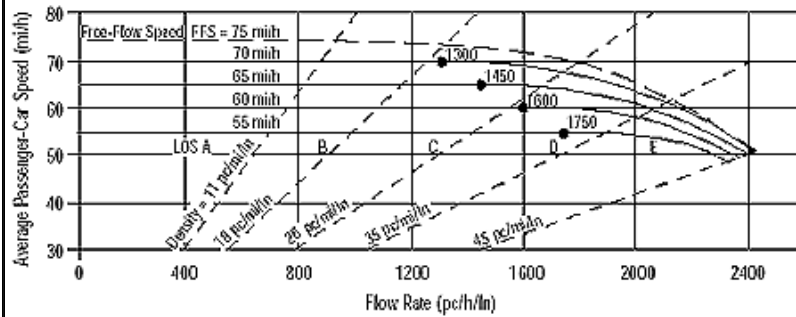


I-405 EXISTING CONDITIONS ANALYSIS



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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	KT	Highway/Direction of Travel	I-405 NB
Agency or Company	URS	From/To	Wardlow
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	9503	veh/h	Peak-Hour Factor, PHF 0.96
AADT		veh/day	%Trucks and Buses, P _T 6
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 %

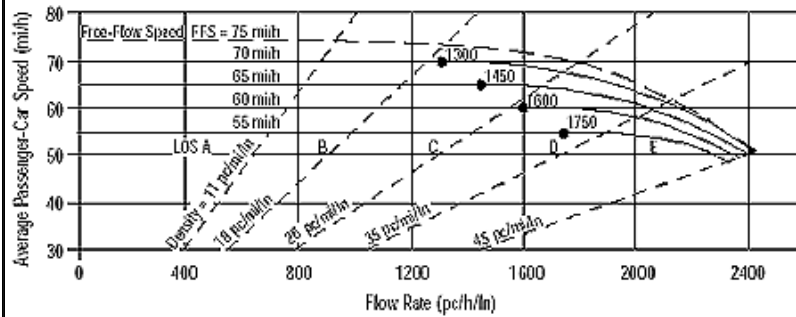
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.943

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 l/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)	2099 pc/h/ln	Design LOS	
S	53.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	39.6 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	I-405 NB
Agency or Company	URS	From/To	Wardlow
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	8319	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

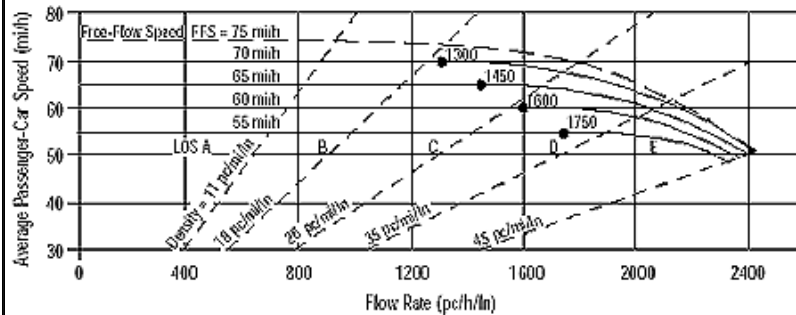
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.952

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 l/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)	1801 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	32.8 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 - Exhibits 23-8, 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			

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	KK	Highway/Direction of Travel	I-405 NB
Agency or Company	URS	From/To	Wardlow
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	8085	veh/h	Peak-Hour Factor, PHF 0.97
AADT		veh/day	%Trucks and Buses, P _T 7
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	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.935

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	5	f _N	mi/h
FFS (measured)	57.0 mi/h	FFS	57.0 mi/h
Base free-flow Speed, BFFS	mi/h		

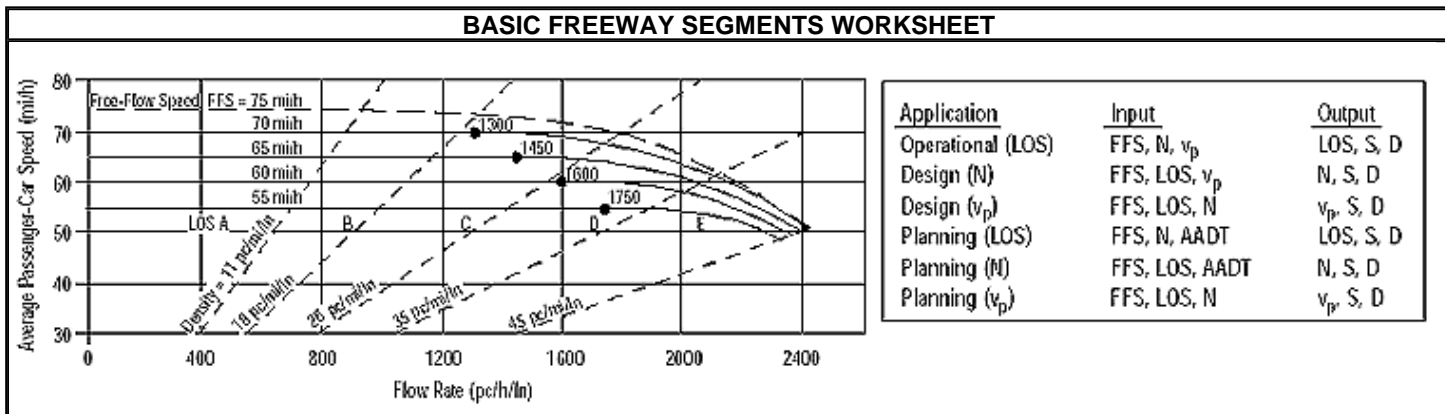
LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1784 pc/h/ln	Design LOS	
S	56.9 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	31.3 pc/mi/ln	S	mi/h
LOS	D	D = v _p / S	pc/mi/ln
		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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			

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB			
Agency/Company	URS				Weaving Seg Location	Wardlow On / I-710 NB Off			
Date Performed	1/21/2010				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	C			
Weaving number of lanes, N	5				Volume ratio, VR	0.22			
Weaving seg length, L (ft)	1478				Weaving ratio, R	0.32			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	6616	0.96	6	0	2.0	1.2	0.943	1.00	7305
V_{o2}	95	0.96	6	0	2.0	1.2	0.943	1.00	104
V_{w1}	1303	0.96	6	0	2.0	1.2	0.943	1.00	1438
V_{w2}	614	0.96	6	0	2.0	1.2	0.943	1.00	677
V_w				2115	V_{nw}				7409
V									9524
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)	2.30		6.00						
c (Exhibit 24-6)	0.80		1.10						
d (Exhibit 24-6)	0.60		0.60						
Weaving intensity factor, W_i	0.67		0.34						
Weaving and non-weaving speeds, S_i (mi/h)	41.96		48.62						
Number of lanes required for unconstrained operation, Nw					2.88				
Maximum number of lanes, Nw (max)					3.00				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	46.96								
Weaving segment density, D (pc/mi/ln)	40.56								
Level of service, LOS	E								
Capacity of base condition, c_b (pc/h)	10022								
Capacity as a 15-minute flow rate, c (veh/h)	9455								
Capacity as a full-hour volume, c_h (veh/h)	9077								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB			
Agency/Company	URS				Weaving Seg Location	Wardlow On / I-710 NB Off			
Date Performed	1/21/2010				Jurisdiction				
Analysis Time Period	PM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	C			
Weaving number of lanes, N	5				Volume ratio, VR	0.26			
Weaving seg length, L (ft)	1478				Weaving ratio, R	0.28			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	5494	0.97	5	0	2.0	1.2	0.952	1.00	5947
V_{o2}	120	0.97	5	0	2.0	1.2	0.952	1.00	129
V_{w1}	1439	0.97	5	0	2.0	1.2	0.952	1.00	1557
V_{w2}	560	0.97	5	0	2.0	1.2	0.952	1.00	606
V_w				2163	V_{nw}				6076
V									8239
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)	2.30		6.00						
c (Exhibit 24-6)	0.80		1.10						
d (Exhibit 24-6)	0.60		0.60						
Weaving intensity factor, W_i	0.64		0.35						
Weaving and non-weaving speeds, S_i (mi/h)	42.40		48.31						
Number of lanes required for unconstrained operation, N_w	2.91								
Maximum number of lanes, N_w (max)	3.00								
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	46.60								
Weaving segment density, D (pc/mi/ln)	35.36								
Level of service, LOS	E								
Capacity of base condition, c_b (pc/h)	9703								
Capacity as a 15-minute flow rate, c (veh/h)	9241								
Capacity as a full-hour volume, c_h (veh/h)	8964								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB			
Agency/Company	URS				Weaving Seg Location	Wardlow On / I-710 NB Off			
Date Performed	1/21/2010				Jurisdiction				
Analysis Time Period	MD				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	C			
Weaving number of lanes, N	5				Volume ratio, VR	0.24			
Weaving seg length, L (ft)	1478				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
V_{o1}	5493	0.97	7	0	2.0	1.2	0.935	1.00	6059
V_{o2}	90	0.97	7	0	2.0	1.2	0.935	1.00	99
V_{w1}	1245	0.97	7	0	2.0	1.2	0.935	1.00	1373
V_{w2}	504	0.97	7	0	2.0	1.2	0.935	1.00	555
V_w				1928	V_{nw}				6158
V									8086
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)	2.30		6.00						
c (Exhibit 24-6)	0.80		1.10						
d (Exhibit 24-6)	0.60		0.60						
Weaving intensity factor, W_i	0.61		0.31						
Weaving and non-weaving speeds, S_i (mi/h)	43.03		49.45						
Number of lanes required for unconstrained operation, N_w	2.89								
Maximum number of lanes, N_w (max)	3.00								
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	47.75								
Weaving segment density, D (pc/mi/ln)	33.87								
Level of service, LOS	D								
Capacity of base condition, c_b (pc/h)	9893								
Capacity as a 15-minute flow rate, c (veh/h)	9246								
Capacity as a full-hour volume, c_h (veh/h)	8969								
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.									



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-710 NB
Agency or Company	URS	From/To	I-710SB Off/I-710&Santa Fe On
Date Performed	1/21/2010	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2008
Project Description I-710 LAMTA PA/ED			

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

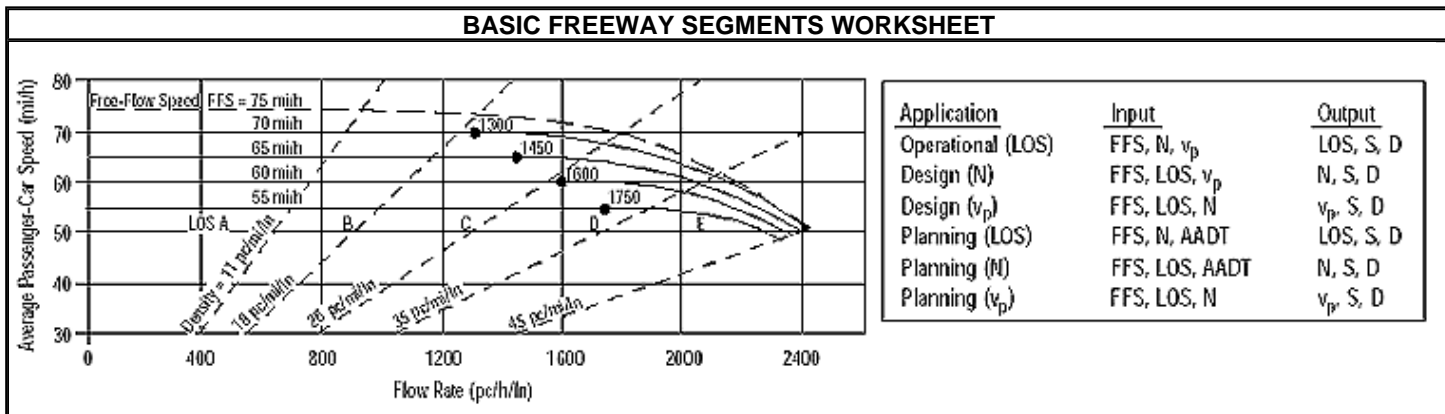
Flow Inputs			
Volume, V	6514	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/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)	1764 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	32.1 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-710 NB
Agency or Company	URS	From/To	I-710SB Off/I-710&Santa Fe On
Date Performed	1/21/2010	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2008
Project Description I-710 LAMTA PA/ED			

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

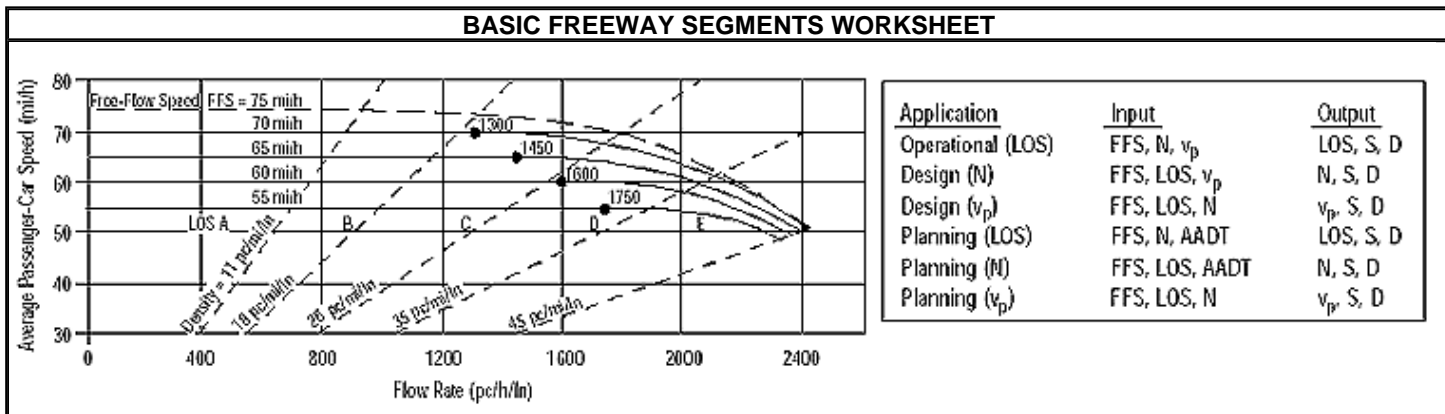
Flow Inputs			
Volume, V	6124	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/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)	1608 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	29.2 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-710 NB
Agency or Company	URS	From/To	I-710SB Off/I-710&Santa Fe On
Date Performed	1/21/2010	Jurisdiction	
Analysis Time Period	MD	Analysis Year	2008
Project Description I-710 LAMTA PA/ED			

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

Flow Inputs				
Volume, V	5960	veh/h	Peak-Hour Factor, PHF	0.98
AADT		veh/day	%Trucks and Buses, P _T	7
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	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.935

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 l/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)	1627 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	29.6 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 - Exhibits 23-8, 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			

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB			
Agency/Company	URS				Weaving Seg Location	Pacific On to I-710 SB Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	A			
Weaving number of lanes, N	5				Volume ratio, VR	0.22			
Weaving seg length, L (ft)	989				Weaving ratio, R	0.13			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	6285	0.96	6	0	2.0	1.2	0.943	1.00	6939
V_{o2}	55	0.96	6	0	2.0	1.2	0.943	1.00	60
V_{w1}	1517	0.96	6	0	2.0	1.2	0.943	1.00	1675
V_{w2}	228	0.96	6	0	2.0	1.2	0.943	1.00	251
V_w				1926	V_{nw}				6999
V									8925
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, W_i					3.08		0.42		
Weaving and non-weaving speeds, S_i (mi/h)					26.03		46.73		
Number of lanes required for unconstrained operation, Nw					1.64				
Maximum number of lanes, Nw (max)					1.40				
<input type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input checked="" type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	39.89								
Weaving segment density, D (pc/mi/ln)	44.75								
Level of service, LOS	F								
Capacity of base condition, c_b (pc/h)	8782								
Capacity as a 15-minute flow rate, c (veh/h)	8285								
Capacity as a full-hour volume, c_h (veh/h)	7954								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB			
Agency/Company	URS				Weaving Seg Location	Pacific On to I-710 SB Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	A			
Weaving number of lanes, N	5				Volume ratio, VR	0.20			
Weaving seg length, L (ft)	989				Weaving ratio, R	0.12			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	5935	0.97	5	0	2.0	1.2	0.952	1.00	6424
V_{o2}	45	0.97	5	0	2.0	1.2	0.952	1.00	48
V_{w1}	1332	0.97	5	0	2.0	1.2	0.952	1.00	1441
V_{w2}	188	0.97	5	0	2.0	1.2	0.952	1.00	203
V_w				1644	V_{nw}				6472
V									8116
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, W_i					2.74		0.35		
Weaving and non-weaving speeds, S_i (mi/h)					27.02		48.24		
Number of lanes required for unconstrained operation, Nw					1.56				
Maximum number of lanes, Nw (max)					1.40				
<input type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input checked="" type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	41.62								
Weaving segment density, D (pc/mi/ln)	39.00								
Level of service, LOS	E								
Capacity of base condition, c_b (pc/h)	8782								
Capacity as a 15-minute flow rate, c (veh/h)	8364								
Capacity as a full-hour volume, c_h (veh/h)	8113								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB			
Agency/Company	URS				Weaving Seg Location	Pacific On to I-710 SB Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	A			
Weaving number of lanes, N	5				Volume ratio, VR	0.19			
Weaving seg length, L (ft)	989				Weaving ratio, R	0.11			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	5815	0.97	7	0	2.0	1.2	0.935	1.00	6414
V_{o2}	30	0.97	7	0	2.0	1.2	0.935	1.00	33
V_{w1}	1249	0.97	7	0	2.0	1.2	0.935	1.00	1377
V_{w2}	149	0.97	7	0	2.0	1.2	0.935	1.00	164
V_w				1541	V_{nw}				6447
V									7988
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, W_i					2.65		0.34		
Weaving and non-weaving speeds, S_i (mi/h)					27.32		48.70		
Number of lanes required for unconstrained operation, N_w					1.51				
Maximum number of lanes, N_w (max)					1.40				
<input type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input checked="" type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	42.31								
Weaving segment density, D (pc/mi/ln)	37.76								
Level of service, LOS	E								
Capacity of base condition, c_b (pc/h)	8823								
Capacity as a 15-minute flow rate, c (veh/h)	8246								
Capacity as a full-hour volume, c_h (veh/h)	7999								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB CD			
Agency/Company	URS				Weaving Seg Location	I-710 NB On to I-710 SB Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	45				Weaving type	A			
Weaving number of lanes, N	2				Volume ratio, VR	0.76			
Weaving seg length, L (ft)	296				Weaving ratio, R	0.37			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	716	0.96	4	0	2.0	1.2	0.962	1.00	775
V_{o2}	0	0.96	4	0	2.0	1.2	0.962	1.00	0
V_{w1}	855	0.96	4	0	2.0	1.2	0.962	1.00	926
V_{w2}	1457	0.96	4	0	2.0	1.2	0.962	1.00	1578
V_w				2504	V_{nw}				775
V									3279
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, W_i	7.23		7.17						
Weaving and non-weaving speeds, S_i (mi/h)	19.25		19.29						
Number of lanes required for unconstrained operation, N_w					1.32				
Maximum number of lanes, N_w (max)					1.40				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	19.26								
Weaving segment density, D (pc/mi/ln)	85.13								
Level of service, LOS	F								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB CD			
Agency/Company	URS				Weaving Seg Location	I-710 NB On to I-710 SB Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	45				Weaving type	A			
Weaving number of lanes, N	2				Volume ratio, VR	0.81			
Weaving seg length, L (ft)	296				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
V_{o1}	462	0.99	4	0	2.0	1.2	0.962	1.00	485
V_{o2}	0	0.99	4	0	2.0	1.2	0.962	1.00	0
V_{w1}	914	0.99	4	0	2.0	1.2	0.962	1.00	960
V_{w2}	1001	0.99	4	0	2.0	1.2	0.962	1.00	1051
V_w				2011	V_{nw}				485
V									2496
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, W_i	5.85		5.52						
Weaving and non-weaving speeds, S_i (mi/h)	20.11		20.36						
Number of lanes required for unconstrained operation, N_w					1.33				
Maximum number of lanes, N_w (max)					1.40				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	20.16								
Weaving segment density, D (pc/mi/ln)	61.91								
Level of service, LOS	F								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB CD			
Agency/Company	URS				Weaving Seg Location	I-710 NB On to I-710 SB Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	45				Weaving type	A			
Weaving number of lanes, N	2				Volume ratio, VR	0.83			
Weaving seg length, L (ft)	296				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
V_{o1}	407	0.98	7	0	2.0	1.2	0.935	1.00	444
V_{o2}	0	0.98	7	0	2.0	1.2	0.935	1.00	0
V_{w1}	876	0.98	7	0	2.0	1.2	0.935	1.00	956
V_{w2}	1074	0.98	7	0	2.0	1.2	0.935	1.00	1172
V_w				2128	V_{nw}				444
V									2572
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, W_i	6.18		6.02						
Weaving and non-weaving speeds, S_i (mi/h)	19.87		19.98						
Number of lanes required for unconstrained operation, N_w					1.36				
Maximum number of lanes, N_w (max)					1.40				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	19.89								
Weaving segment density, D (pc/mi/ln)	64.65								
Level of service, LOS	F								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB CD			
Agency/Company	URS				Weaving Seg Location	I-710 SB On to Santa Fe Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	45				Weaving type	A			
Weaving number of lanes, N	3				Volume ratio, VR	0.51			
Weaving seg length, L (ft)	628				Weaving ratio, R	0.15			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	1825	0.96	4	0	2.0	1.2	0.962	1.00	1977
V_{o2}	370	0.96	4	0	2.0	1.2	0.962	1.00	400
V_{w1}	348	0.96	4	0	2.0	1.2	0.962	1.00	377
V_{w2}	1946	0.96	4	0	2.0	1.2	0.962	1.00	2108
V_w				2485	V_{nw}				2377
V									4862
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, W_i					6.51		1.24		
Weaving and non-weaving speeds, S_i (mi/h)					19.66		30.65		
Number of lanes required for unconstrained operation, Nw					1.69				
Maximum number of lanes, Nw (max)					1.40				
<input type="checkbox"/> If $N_w < N_w(\max)$ unconstrained operation					<input checked="" type="checkbox"/> if $N_w > N_w(\max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	23.84								
Weaving segment density, D (pc/mi/ln)	67.99								
Level of service, LOS	F								
Capacity of base condition, c_b (pc/h)	3957								
Capacity as a 15-minute flow rate, c (veh/h)	3805								
Capacity as a full-hour volume, c_h (veh/h)	3653								
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.									

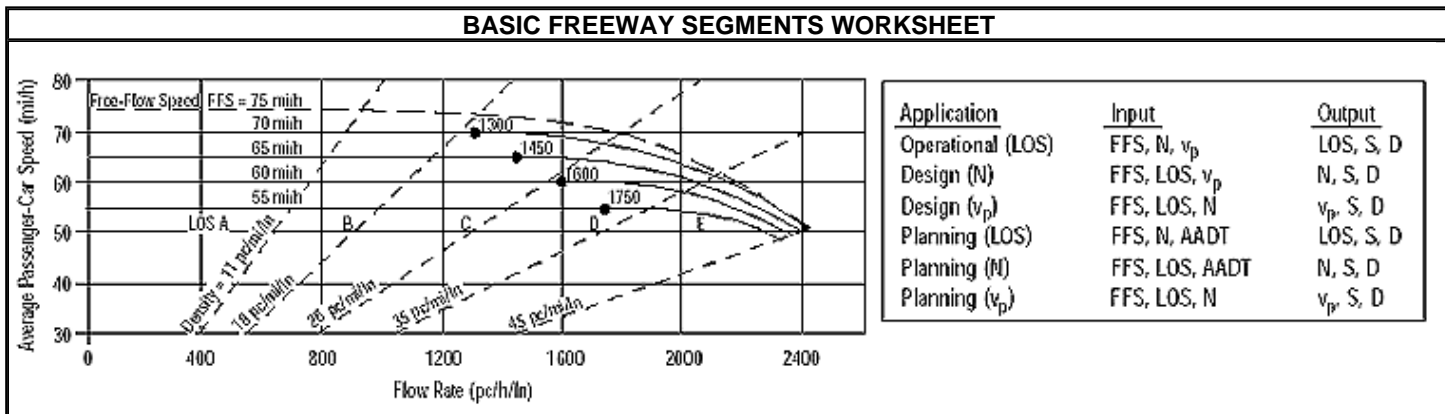
FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB CD			
Agency/Company	URS				Weaving Seg Location	I-710 SB On to Santa Fe Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	45				Weaving type	A			
Weaving number of lanes, N	3				Volume ratio, VR	0.46			
Weaving seg length, L (ft)	628				Weaving ratio, R	0.13			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	1305	0.99	4	0	2.0	1.2	0.962	1.00	1370
V_{o2}	125	0.99	4	0	2.0	1.2	0.962	1.00	131
V_{w1}	158	0.99	4	0	2.0	1.2	0.962	1.00	165
V_{w2}	1045	0.99	4	0	2.0	1.2	0.962	1.00	1097
V_w				1262	V_{nw}				1501
V									2763
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, W_i					3.47		0.51		
Weaving and non-weaving speeds, S_i (mi/h)					22.83		38.14		
Number of lanes required for unconstrained operation, N_w					1.46				
Maximum number of lanes, N_w (max)					1.40				
<input type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input checked="" type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	29.20								
Weaving segment density, D (pc/mi/ln)	31.55								
Level of service, LOS	D								
Capacity of base condition, c_b (pc/h)	3957								
Capacity as a 15-minute flow rate, c (veh/h)	3805								
Capacity as a full-hour volume, c_h (veh/h)	3767								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB CD			
Agency/Company	URS				Weaving Seg Location	I-710 SB On to Santa Fe Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	45				Weaving type	A			
Weaving number of lanes, N	3				Volume ratio, VR	0.45			
Weaving seg length, L (ft)	628				Weaving ratio, R	0.12			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	1340	0.98	7	0	2.0	1.2	0.935	1.00	1463
V_{o2}	110	0.98	7	0	2.0	1.2	0.935	1.00	120
V_{w1}	141	0.98	7	0	2.0	1.2	0.935	1.00	153
V_{w2}	1063	0.98	7	0	2.0	1.2	0.935	1.00	1160
V_w				1313	V_{nw}				1583
V									2896
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, W_i					3.61		0.54		
Weaving and non-weaving speeds, S_i (mi/h)					22.58		37.73		
Number of lanes required for unconstrained operation, N_w					1.47				
Maximum number of lanes, N_w (max)					1.40				
<input type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input checked="" type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	28.93								
Weaving segment density, D (pc/mi/ln)	33.36								
Level of service, LOS	D								
Capacity of base condition, c_b (pc/h)	3957								
Capacity as a 15-minute flow rate, c (veh/h)	3698								
Capacity as a full-hour volume, c_h (veh/h)	3624								
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.									

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-405 NB		Agency or Company	URS	Junction	Santa Fe On	
Date Performed	1/29/2010	Jurisdiction	Caltrans		Analysis Time Period	AM	Analysis Year	2008	
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> On						<input type="checkbox"/> Yes	<input type="checkbox"/> On	
<input type="checkbox"/> No	<input checked="" type="checkbox"/> Off	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Off						
$L_{up} =$	680 ft	$S_{FF} = 55.0$ mph $S_{FR} = 35.0$ mph					$L_{down} =$	ft	
$V_u =$	716 veh/h						$V_o =$		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	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	3773	0.96	Level	4	0	0.962	1.00	4087	
Ramp	281	0.96	Level	4	0	0.962	1.00	304	
UpStream	716	0.96	Level	4	0	0.962	1.00	776	
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)				
$P_{FM} = 1.000$ using Equation (Exhibit 25-5)					$P_{FD} =$ using Equation (Exhibit 25-11)				
$V_{12} = 4087$ pc/h					$V_{12} =$ pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V_{FO}	4391	See Exhibit 25-7	No	$V_{FI} = V_F$					
				V_{12}					
V_{R12}	4391	4600:All	No	$V_{FO} = V_F - V_R$					
				V_R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
$D_R = 35.8$ (pc/mi/ln)					$D_R =$ (pc/mi/ln)				
LOS = E (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
$M_S = 0.594$ (Exhibit 25-19)					$D_S =$ (Exhibit 25-19)				
$S_R = 47.3$ mph (Exhibit 25-19)					$S_R =$ mph (Exhibit 25-19)				
$S_0 =$ N/A mph (Exhibit 25-19)					$S_0 =$ mph (Exhibit 25-19)				
$S = 47.3$ mph (Exhibit 25-14)					$S =$ mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-405 NB						
Agency or Company	URS	Junction	Santa Fe On						
Date Performed	1/29/2010	Jurisdiction	Caltrans						
Analysis Time Period	PM	Analysis Year	2008						
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = 680 ft						L _{down} = ft			
V _u = 285 veh/h		S _{FF} = 55.0 mph		S _{FR} = 35.0 mph		V _o = 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 x f _{HV} x f _p	
Freeway	2348	0.99	Level	4	0	0.962	1.00	2467	
Ramp	343	0.99	Level	4	0	0.962	1.00	360	
UpStream	285	0.99	Level	4	0	0.962	1.00	299	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
L _{EQ} = (Equation 25-2 or 25-3)					L _{EQ} = (Equation 25-8 or 25-9)				
P _{FM} = 1.000 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-11)				
V ₁₂ = 2467 pc/h					V ₁₂ = pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V _{FO}	2827	See Exhibit 25-7	No	V _{F1} = V _F					
				V ₁₂					
V _{R12}	2827	4600:All	No	V _{FO} = V _F - V _R					
				V _R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
D _R = 23.6 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = 0.345 (Exhibit 25-19)					D _S = (Exhibit 25-19)				
S _R = 50.5 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = N/A mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 50.5 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-405 NB		Agency or Company	URS	Junction	Santa Fe On	
Date Performed	01/29/2010	Jurisdiction	Caltrans		Analysis Time Period	MD	Analysis Year	2008	
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> On						<input type="checkbox"/> Yes	<input type="checkbox"/> On	
<input type="checkbox"/> No	<input checked="" type="checkbox"/> Off	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Off	L _{down} =		ft			
L _{up} =	680 ft	S _{FF} = 55.0 mph		S _{FR} = 35.0 mph		V _o =		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 x f _{HV} x f _p	
Freeway	2402	0.98	Level	7	0	0.935	1.00	2623	
Ramp	237	0.98	Level	7	0	0.935	1.00	259	
UpStream	252	0.98	Level	7	0	0.935	1.00	275	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
L _{EQ} = (Equation 25-2 or 25-3)					L _{EQ} = (Equation 25-8 or 25-9)				
P _{FM} = 1.000 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-11)				
V ₁₂ = 2623 pc/h					V ₁₂ = pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V _{FO}	2882	See Exhibit 25-7	No	V _{F1} = V _F					
				V ₁₂					
V _{R12}	2882	4600:All	No	V _{F0} = V _F - V _R					
				V _R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
D _R = 24.1 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = 0.349 (Exhibit 25-19)					D _S = (Exhibit 25-19)				
S _R = 50.5 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = N/A mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 50.5 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-405 NB
Agency or Company	URS	From/To	I-710 Off / I-710 On
Date Performed	2/16/2010	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

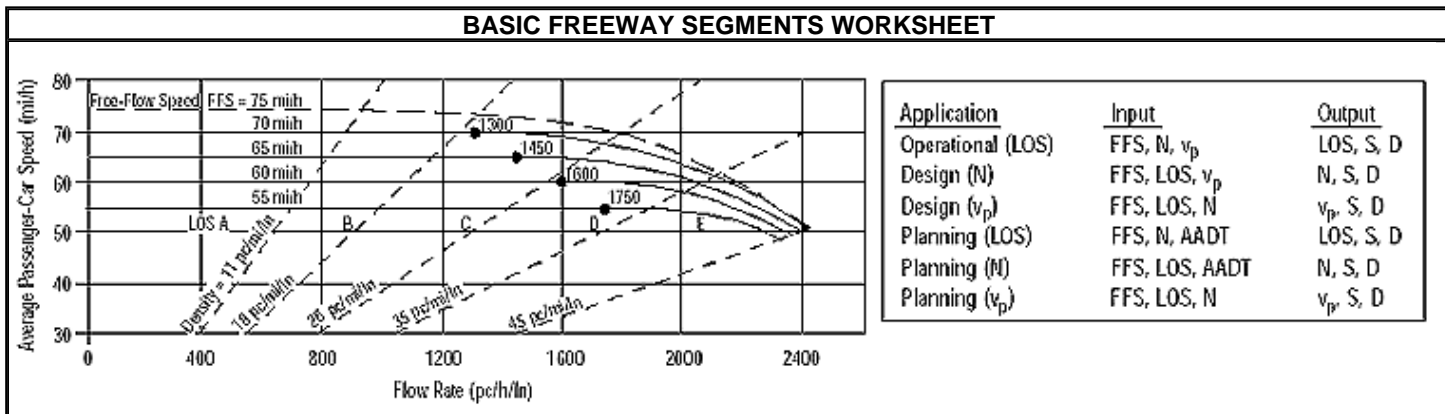
Flow Inputs			
Volume, V	6514	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/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)	1764 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	32.1 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-405 NB
Agency or Company	URS	From/To	I-710 Off / I-710 On
Date Performed	2/16/2010	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

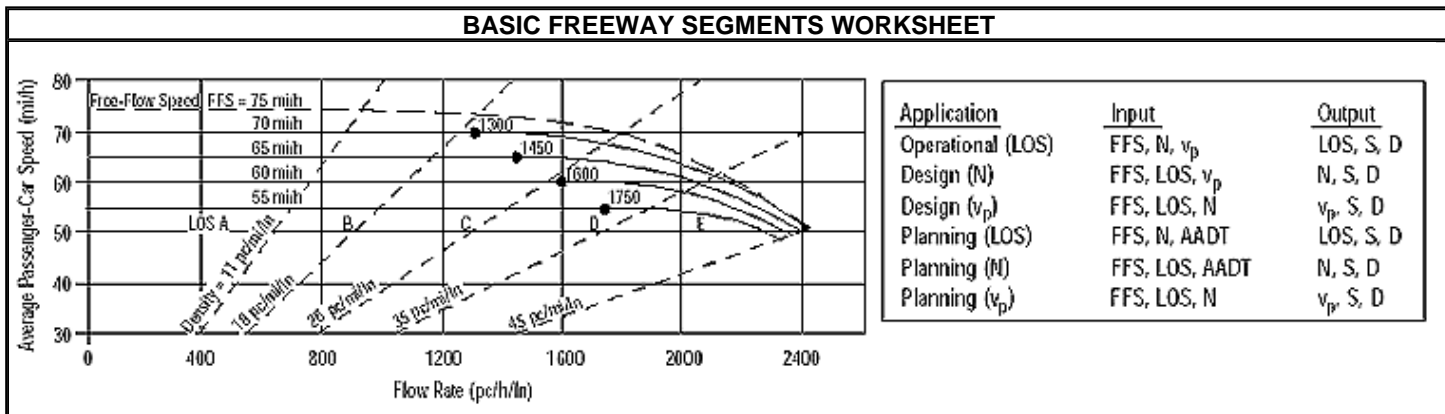
Flow Inputs			
Volume, V	6124	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/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)	1608 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	29.2 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-405 NB
Agency or Company	URS	From/To	I-710 Off / I-710 On
Date Performed	2/16/2010	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

Flow Inputs			
Volume, V	5960	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f_p	1.00	E_R	1.2
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935

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 l/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)	
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1627 pc/h/ln	Design LOS	
S	55.0 mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h
$D = v_p / S$	29.6 pc/mi/ln	S	mi/h
LOS	D	$D = v_p / S$	pc/mi/ln
		Required Number of Lanes, N	

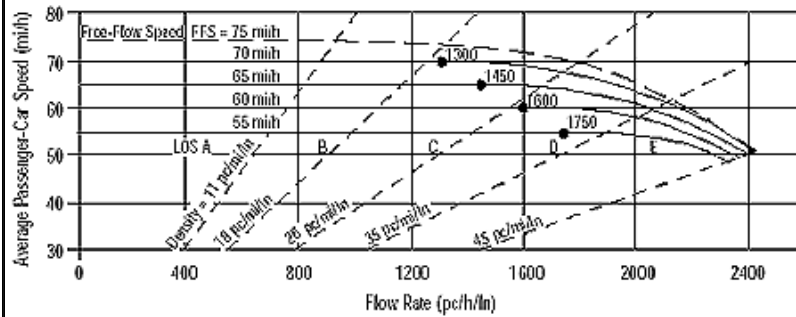
Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base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

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB			
Agency/Company	URS				Weaving Seg Location	I-710 On to Alameda Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	5				Volume ratio, VR	0.39			
Weaving seg length, L (ft)	1954				Weaving ratio, R	0.06			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	6275	0.96	4	0	2.0	1.2	0.962	1.00	6797
V_{o2}	150	0.96	4	0	2.0	1.2	0.962	1.00	162
V_{w1}	239	0.96	4	0	2.0	1.2	0.962	1.00	258
V_{w2}	3904	0.96	4	0	2.0	1.2	0.962	1.00	4229
V_w				4487	V_{nw}				6959
V									11446
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, W_i	0.84		0.75						
Weaving and non-weaving speeds, S_i (mi/h)	39.43		40.66						
Number of lanes required for unconstrained operation, N_w	2.29								
Maximum number of lanes, N_w (max)	3.50								
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	40.17								
Weaving segment density, D (pc/mi/ln)	56.99								
Level of service, LOS	F								
Capacity of base condition, c_b (pc/h)	9109								
Capacity as a 15-minute flow rate, c (veh/h)	8759								
Capacity as a full-hour volume, c_h (veh/h)	8409								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB			
Agency/Company	URS				Weaving Seg Location	I-710 On to Alameda Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	5				Volume ratio, VR	0.32			
Weaving seg length, L (ft)	1954				Weaving ratio, R	0.07			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	5925	0.99	4	0	2.0	1.2	0.962	1.00	6224
V_{o2}	85	0.99	4	0	2.0	1.2	0.962	1.00	89
V_{w1}	199	0.99	4	0	2.0	1.2	0.962	1.00	209
V_{w2}	2606	0.99	4	0	2.0	1.2	0.962	1.00	2737
V_w				2946	V_{nw}				6313
V									9259
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, W_i	0.64		0.44						
Weaving and non-weaving speeds, S_i (mi/h)	42.37		46.26						
Number of lanes required for unconstrained operation, N_w					1.79				
Maximum number of lanes, N_w (max)					3.50				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	44.95								
Weaving segment density, D (pc/mi/ln)	41.20								
Level of service, LOS	E								
Capacity of base condition, c_b (pc/h)	9604								
Capacity as a 15-minute flow rate, c (veh/h)	9235								
Capacity as a full-hour volume, c_h (veh/h)	9143								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 NB			
Agency/Company	URS				Weaving Seg Location	I-710 On to Alameda Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	5				Volume ratio, VR	0.32			
Weaving seg length, L (ft)	1954				Weaving ratio, R	0.06			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	5785	0.96	6	0	2.0	1.2	0.943	1.00	6387
V_{o2}	75	0.96	6	0	2.0	1.2	0.943	1.00	82
V_{w1}	175	0.96	6	0	2.0	1.2	0.943	1.00	193
V_{w2}	2564	0.96	6	0	2.0	1.2	0.943	1.00	2831
V_w				3024	V_{nw}				6469
V									9493
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, W_i	0.66		0.45						
Weaving and non-weaving speeds, S_i (mi/h)	42.18		46.00						
Number of lanes required for unconstrained operation, N_w	1.80								
Maximum number of lanes, N_w (max)	3.50								
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	44.71								
Weaving segment density, D (pc/mi/ln)	42.46								
Level of service, LOS	E								
Capacity of base condition, c_b (pc/h)	9602								
Capacity as a 15-minute flow rate, c (veh/h)	9058								
Capacity as a full-hour volume, c_h (veh/h)	8696								
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.									

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	KT	Highway/Direction of Travel	I-405 NB
Agency or Company	URS	From/To	Alameda
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	8620	veh/h	Peak-Hour Factor, PHF 0.96
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 %

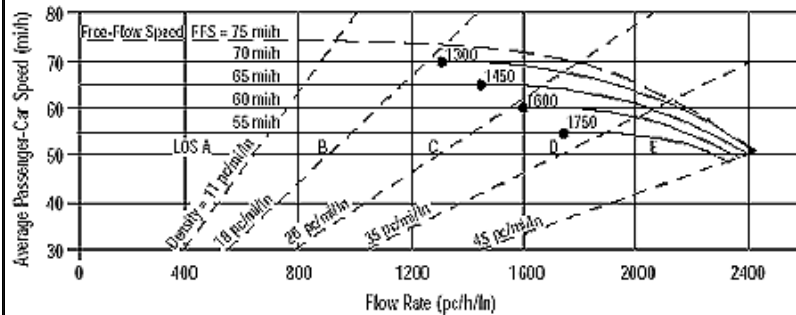
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/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)	1868 pc/h/ln	Design LOS	
S	54.9 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	34.0 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	I-405 NB
Agency or Company	URS	From/To	Alameda
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	8068	veh/h	Peak-Hour Factor, PHF 0.99
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 %

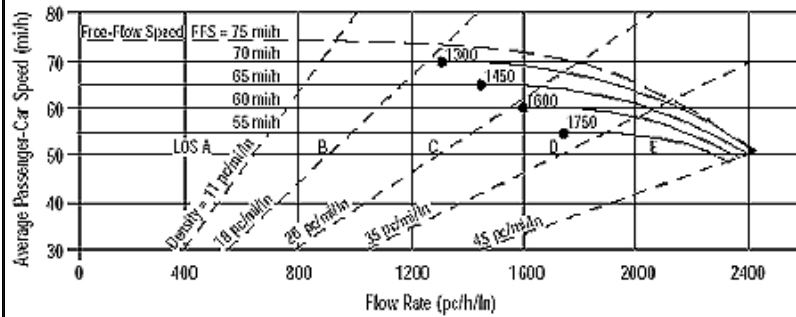
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	5	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)	1695 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	24.6 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 - Exhibits 23-8, 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			

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	KK	Highway/Direction of Travel	I-405 NB
Agency or Company	URS	From/To	Alameda
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	7947	veh/h	Peak-Hour Factor, PHF 0.98
AADT		veh/day	%Trucks and Buses, P _T 7
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 %

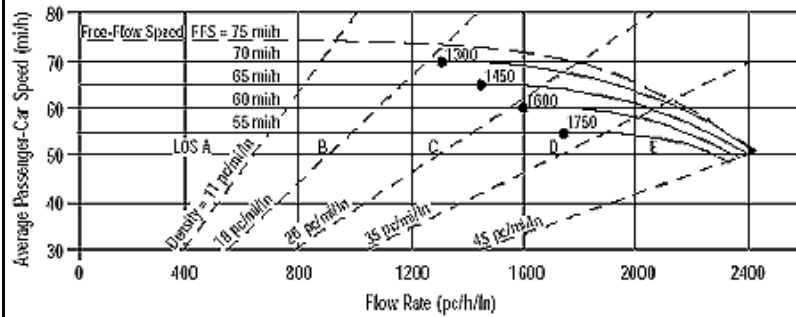
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.935

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	5	f _N	mi/h
FFS (measured)	65.0 mi/h	FFS	65.0 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)	1735 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	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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	
Agency or Company	URS	From/To	Alameda
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	7591	veh/h	Peak-Hour Factor, PHF 0.97
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 %

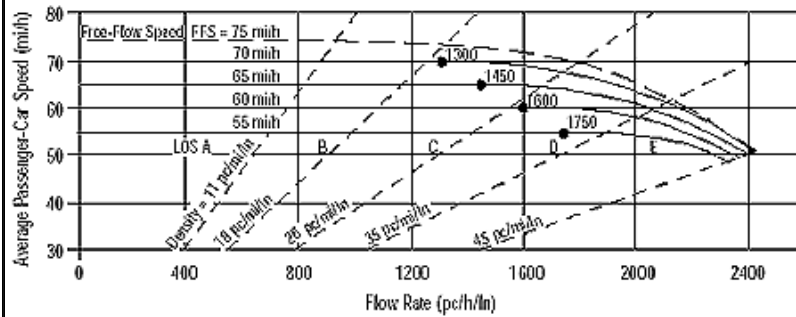
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	5	f _N	mi/h
FFS (measured)	64.0 mi/h	FFS	64.0 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)	1628 pc/h/ln	Design LOS	
S	63.9 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	25.5 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	
Agency or Company	URS	From/To	Alameda
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	7135	veh/h	Peak-Hour Factor, PHF 0.93
AADT		veh/day	%Trucks and Buses, P _T 7
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 %

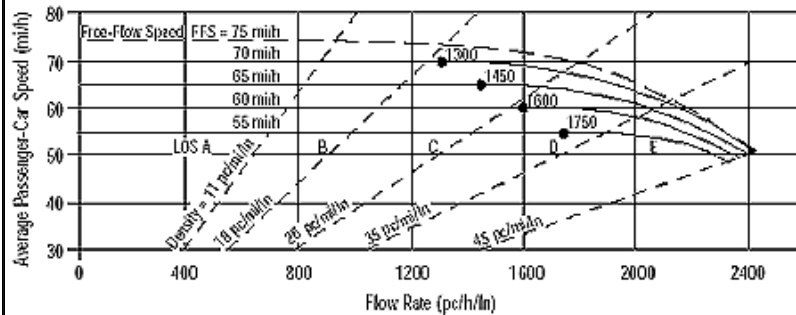
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.935

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	5	f _N	mi/h
FFS (measured)	64.0 mi/h	FFS	64.0 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)	1642 pc/h/ln	Design LOS	
S	63.8 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	25.7 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	
Agency or Company	URS	From/To	Alameda
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	8074	veh/h	Peak-Hour Factor, PHF 0.98
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	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/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)	1714 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	31.2 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 - Exhibits 23-8, 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			

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB CD			
Agency/Company	URS				Weaving Seg Location	Wardlow On / Wardlow Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	45				Weaving type	A			
Weaving number of lanes, N	3				Volume ratio, VR	0.45			
Weaving seg length, L (ft)	234				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
V_{o1}	1179	0.97	4	0	2.0	1.2	0.962	1.00	1264
V_{o2}	0	0.97	4	0	2.0	1.2	0.962	1.00	0
V_{w1}	266	0.97	4	0	2.0	1.2	0.962	1.00	285
V_{w2}	707	0.97	4	0	2.0	1.2	0.962	1.00	758
V_w				1043	V_{nw}				1264
V									2307
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, W_i	2.73		1.47						
Weaving and non-weaving speeds, S_i (mi/h)	24.38		29.18						
Number of lanes required for unconstrained operation, N_w					1.25				
Maximum number of lanes, N_w (max)					1.40				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	26.79								
Weaving segment density, D (pc/mi/ln)	28.70								
Level of service, LOS	C								
Capacity of base condition, c_b (pc/h)	3720								
Capacity as a 15-minute flow rate, c (veh/h)	3577								
Capacity as a full-hour volume, c_h (veh/h)	3470								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB CD			
Agency/Company	URS				Weaving Seg Location	Wardlow On / Wardlow Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	MD				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	45				Weaving type	A			
Weaving number of lanes, N	3				Volume ratio, VR	0.40			
Weaving seg length, L (ft)	234				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
V_{o1}	1400	0.93	7	0	2.0	1.2	0.935	1.00	1610
V_{o2}	0	0.93	7	0	2.0	1.2	0.935	1.00	0
V_{w1}	206	0.93	7	0	2.0	1.2	0.935	1.00	237
V_{w2}	715	0.93	7	0	2.0	1.2	0.935	1.00	822
V_w				1059	V_{nw}				1610
V									2669
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, W_i	2.89		1.52						
Weaving and non-weaving speeds, S_i (mi/h)	24.00		28.89						
Number of lanes required for unconstrained operation, N_w					1.17				
Maximum number of lanes, N_w (max)					1.40				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	26.73								
Weaving segment density, D (pc/mi/ln)	33.28								
Level of service, LOS	D								
Capacity of base condition, c_b (pc/h)	3830								
Capacity as a 15-minute flow rate, c (veh/h)	3579								
Capacity as a full-hour volume, c_h (veh/h)	3328								
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.									

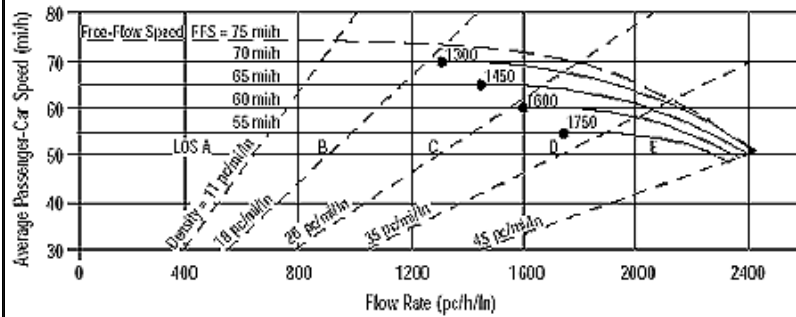
FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB CD			
Agency/Company	URS				Weaving Seg Location	Wardlow On / Wardlow Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	PM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	45				Weaving type	A			
Weaving number of lanes, N	3				Volume ratio, VR	0.41			
Weaving seg length, L (ft)	234				Weaving ratio, R	0.15			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	1734	0.98	4	0	2.0	1.2	0.962	1.00	1840
V_{o2}	0	0.98	4	0	2.0	1.2	0.962	1.00	0
V_{w1}	179	0.98	4	0	2.0	1.2	0.962	1.00	189
V_{w2}	1034	0.98	4	0	2.0	1.2	0.962	1.00	1097
V_w				1286	V_{nw}				1840
V									3126
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, W_i	3.45		1.95						
Weaving and non-weaving speeds, S_i (mi/h)	22.87		26.88						
Number of lanes required for unconstrained operation, N_w					1.22				
Maximum number of lanes, N_w (max)					1.40				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	25.07								
Weaving segment density, D (pc/mi/ln)	41.56								
Level of service, LOS	F								
Capacity of base condition, c_b (pc/h)	3800								
Capacity as a 15-minute flow rate, c (veh/h)	3654								
Capacity as a full-hour volume, c_h (veh/h)	3581								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB			
Agency/Company	URS				Weaving Seg Location	Alameda On to I-710NB Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	5				Volume ratio, VR	0.26			
Weaving seg length, L (ft)	1531				Weaving ratio, R	0.35			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	6149	0.97	4	0	2.0	1.2	0.962	1.00	6592
V_{o2}	0	0.97	4	0	2.0	1.2	0.962	1.00	0
V_{w1}	1445	0.97	4	0	2.0	1.2	0.962	1.00	1549
V_{w2}	765	0.97	4	0	2.0	1.2	0.962	1.00	820
V_w				2369	V_{nw}				6592
V									8961
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, W_i	0.65		0.37						
Weaving and non-weaving speeds, S_i (mi/h)	42.29		47.74						
Number of lanes required for unconstrained operation, N_w					1.63				
Maximum number of lanes, N_w (max)					3.50				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	46.17								
Weaving segment density, D (pc/mi/ln)	38.82								
Level of service, LOS	E								
Capacity of base condition, c_b (pc/h)	9780								
Capacity as a 15-minute flow rate, c (veh/h)	9404								
Capacity as a full-hour volume, c_h (veh/h)	9122								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB			
Agency/Company	URS				Weaving Seg Location	Alameda On to I-710NB Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	5				Volume ratio, VR	0.29			
Weaving seg length, L (ft)	1531				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
V_{o1}	5529	0.93	7	0	2.0	1.2	0.935	1.00	6361
V_{o2}	0	0.93	7	0	2.0	1.2	0.935	1.00	0
V_{w1}	1606	0.93	7	0	2.0	1.2	0.935	1.00	1847
V_{w2}	676	0.93	7	0	2.0	1.2	0.935	1.00	777
V_w				2624	V_{nw}				6361
V									8985
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, W_i	0.68		0.43						
Weaving and non-weaving speeds, S_i (mi/h)	41.76		46.53						
Number of lanes required for unconstrained operation, N_w					1.79				
Maximum number of lanes, N_w (max)					3.50				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	45.03								
Weaving segment density, D (pc/mi/ln)	39.91								
Level of service, LOS	E								
Capacity of base condition, c_b (pc/h)	9567								
Capacity as a 15-minute flow rate, c (veh/h)	8941								
Capacity as a full-hour volume, c_h (veh/h)	8315								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB			
Agency/Company	URS				Weaving Seg Location	Alameda On to I-710NB Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	5				Volume ratio, VR	0.32			
Weaving seg length, L (ft)	1531				Weaving ratio, R	0.35			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	6161	0.98	4	0	2.0	1.2	0.962	1.00	6538
V_{o2}	0	0.98	4	0	2.0	1.2	0.962	1.00	0
V_{w1}	1913	0.98	4	0	2.0	1.2	0.962	1.00	2030
V_{w2}	1026	0.98	4	0	2.0	1.2	0.962	1.00	1088
V_w				3118	V_{nw}				6538
V									9656
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, W_i	0.76		0.53						
Weaving and non-weaving speeds, S_i (mi/h)	40.64		44.43						
Number of lanes required for unconstrained operation, N_w					1.99				
Maximum number of lanes, N_w (max)					3.50				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	43.13								
Weaving segment density, D (pc/mi/ln)	44.78								
Level of service, LOS	F								
Capacity of base condition, c_b (pc/h)	9350								
Capacity as a 15-minute flow rate, c (veh/h)	8990								
Capacity as a full-hour volume, c_h (veh/h)	8810								
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.									

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	KT	Highway/Direction of Travel	
Agency or Company	URS	From/To	Santa Fe
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	6642	veh/h	Peak-Hour Factor, PHF 0.97
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 %

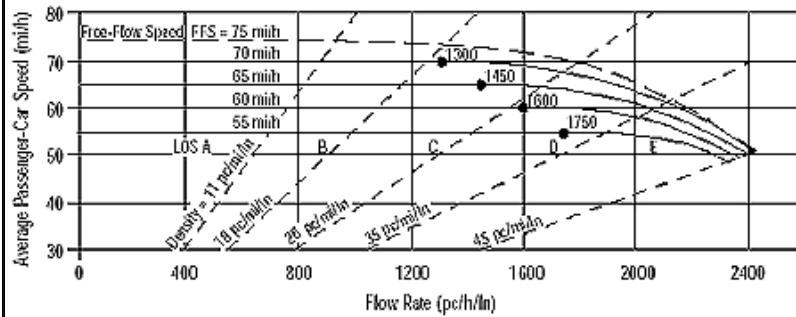
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	4	f _N	mi/h
FFS (measured)	59.0 mi/h	FFS	59.0 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)	1780 pc/h/ln	Design LOS	
S	58.8 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	30.3 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	
Agency or Company	URS	From/To	Santa Fe
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	6205	veh/h	Peak-Hour Factor, PHF 0.93
AADT		veh/day	%Trucks and Buses, P _T 7
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 %

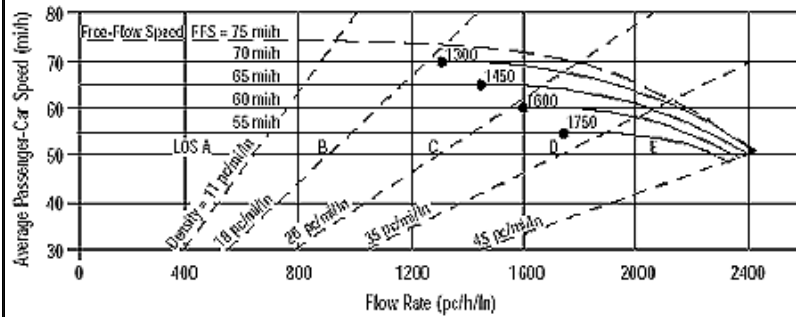
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.935

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	4	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)	1785 pc/h/ln	Design LOS	
S	59.7 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	29.9 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	
Agency or Company	URS	From/To	Santa Fe
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

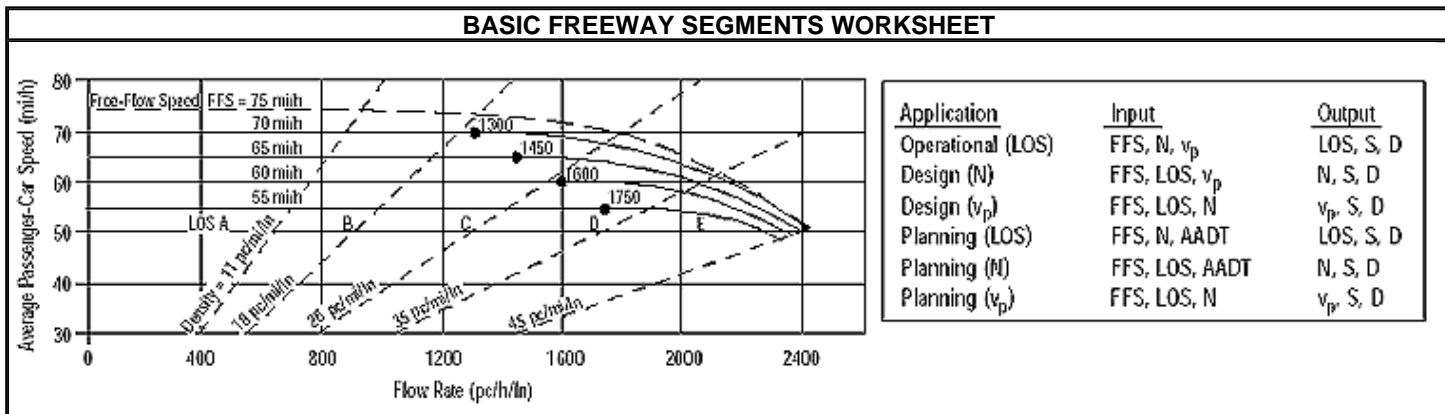
Flow Inputs			
Volume, V	7187	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	4	f _N	mi/h
FFS (measured)	56.0 mi/h	FFS	56.0 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)	1907 pc/h/ln	Design LOS	
S	55.6 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-710 SB
Agency or Company	URS	From/To	I-710 SB Off / Wardlow On
Date Performed	1/28/2010	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2008
Project Description I-710 LAMTA PA/ED			

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

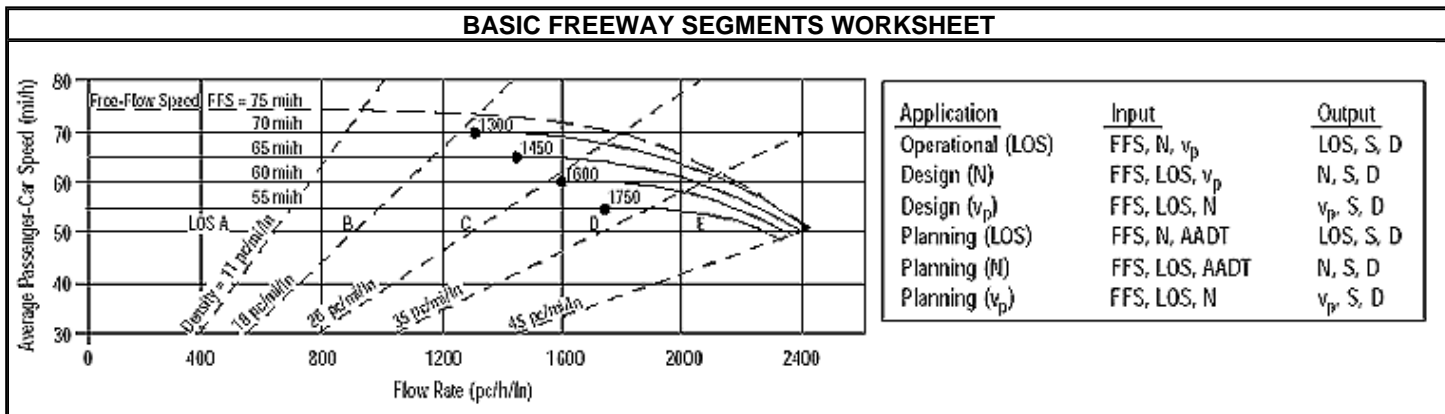
Flow Inputs			
Volume, V	5326	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	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)	1903 pc/h/ln	Design LOS	
S	54.8 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	34.7 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-710 SB
Agency or Company	URS	From/To	I-710 SB Off / Wardlow On
Date Performed	1/28/2010	Jurisdiction	
Analysis Time Period	MD	Analysis Year	2008
Project Description I-710 LAMTA PA/ED			

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

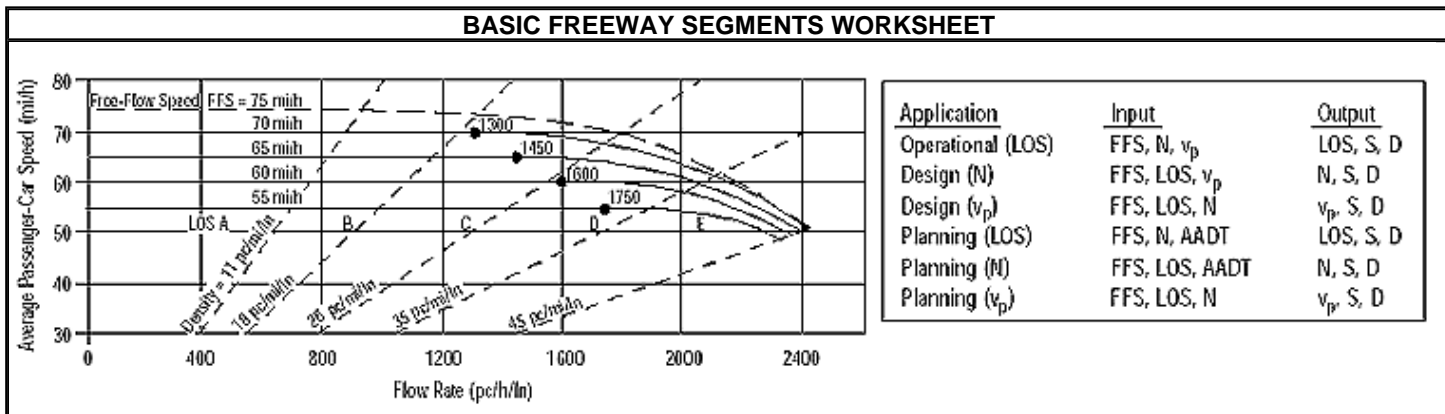
Flow Inputs			
Volume, V	5114	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f_p	1.00	E_R	1.2
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935

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 l/mi	f_{ID}	mi/h
Number of Lanes, N	3	f_N	mi/h
FFS (measured)	55.0 mi/h	FFS	55.0 mi/h
Base free-flow Speed, BFFS			

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1961 pc/h/ln	Design LOS	
S	54.5 mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-710 SB
Agency or Company	URS	From/To	I-710 SB Off / Wardlow On
Date Performed	1/28/2010	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2008
Project Description I-710 LAMTA PA/ED			

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

Flow Inputs			
Volume, V	5743	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	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)	2032 pc/h/ln	Design LOS	
S	53.9 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	37.7 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 - Exhibits 23-8, 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			

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-710NB to I-405SB CD			
Agency/Company	URS				Weaving Seg Location	I-710 NB on to Pacific Off			
Date Performed	1/21/2008				Jurisdiction	Caltrans			
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	A			
Weaving number of lanes, N	3				Volume ratio, VR	0.40			
Weaving seg length, L (ft)	860				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
V_{o1}	1475	0.97	4	0	2.0	1.2	0.962	1.00	1581
V_{o2}	50	0.97	4	0	2.0	1.2	0.962	1.00	53
V_{w1}	82	0.97	4	0	2.0	1.2	0.962	1.00	87
V_{w2}	948	0.97	4	0	2.0	1.2	0.962	1.00	1016
V_w				1103	V_{nw}				1634
V									2737
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, W_i	1.06		0.60						
Weaving and non-weaving speeds, S_i (mi/h)	36.89		43.09						
Number of lanes required for unconstrained operation, N_w					1.32				
Maximum number of lanes, N_w (max)					1.40				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	40.36								
Weaving segment density, D (pc/mi/ln)	22.61								
Level of service, LOS	B								
Capacity of base condition, c_b (pc/h)	4252								
Capacity as a 15-minute flow rate, c (veh/h)	4088								
Capacity as a full-hour volume, c_h (veh/h)	3965								
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.									

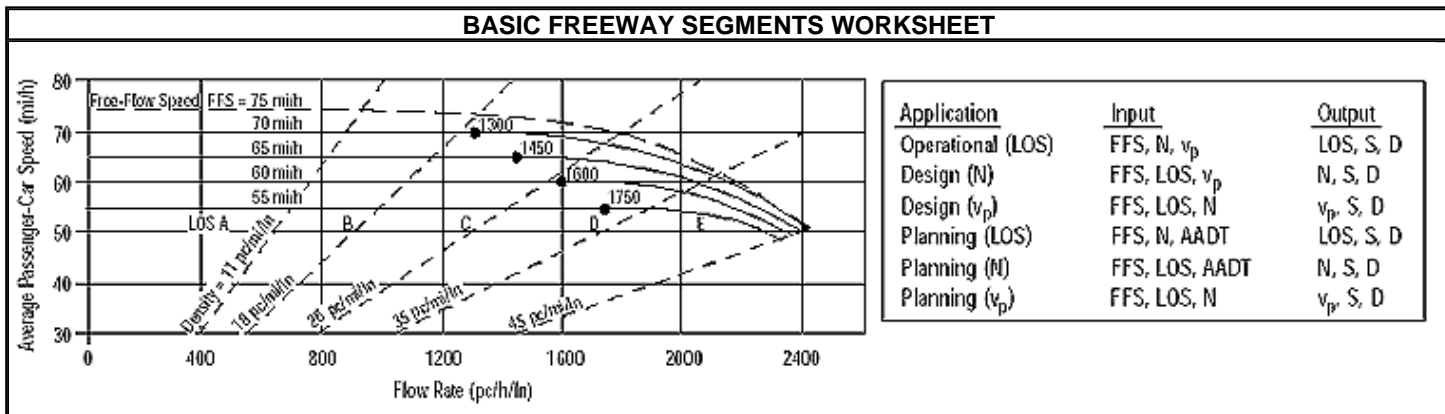
FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-710NB to I-405SB CD			
Agency/Company	URS				Weaving Seg Location	I-710 NB on to Pacific Off			
Date Performed	1/21/2008				Jurisdiction	Caltrans			
Analysis Time Period	MD				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	A			
Weaving number of lanes, N	3				Volume ratio, VR	0.42			
Weaving seg length, L (ft)	860				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
V_{o1}	1525	0.93	7	0	2.0	1.2	0.935	1.00	1754
V_{o2}	65	0.93	7	0	2.0	1.2	0.935	1.00	74
V_{w1}	90	0.93	7	0	2.0	1.2	0.935	1.00	103
V_{w2}	1070	0.93	7	0	2.0	1.2	0.935	1.00	1231
V_w				1334	V_{nw}				1828
V									3162
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, W_i	1.25		0.77						
Weaving and non-weaving speeds, S_i (mi/h)	35.00		40.48						
Number of lanes required for unconstrained operation, N_w					1.39				
Maximum number of lanes, N_w (max)					1.40				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	37.97								
Weaving segment density, D (pc/mi/ln)	27.76								
Level of service, LOS	C								
Capacity of base condition, c_b (pc/h)	4189								
Capacity as a 15-minute flow rate, c (veh/h)	3915								
Capacity as a full-hour volume, c_h (veh/h)	3641								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-710NB to I-405SB CD			
Agency/Company	URS				Weaving Seg Location	I-710 NB on to Pacific Off			
Date Performed	1/21/2008				Jurisdiction	Caltrans			
Analysis Time Period	PM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	A			
Weaving number of lanes, N	3				Volume ratio, VR	0.36			
Weaving seg length, L (ft)	860				Weaving ratio, R	0.18			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	1860	0.98	4	0	2.0	1.2	0.962	1.00	1973
V_{o2}	100	0.98	4	0	2.0	1.2	0.962	1.00	106
V_{w1}	203	0.98	4	0	2.0	1.2	0.962	1.00	215
V_{w2}	914	0.98	4	0	2.0	1.2	0.962	1.00	969
V_w				1184	V_{nw}				2079
V									3263
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, W_i	1.17		0.67						
Weaving and non-weaving speeds, S_i (mi/h)	35.70		41.89						
Number of lanes required for unconstrained operation, N_w					1.26				
Maximum number of lanes, N_w (max)					1.40				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	39.41								
Weaving segment density, D (pc/mi/ln)	27.60								
Level of service, LOS	C								
Capacity of base condition, c_b (pc/h)	4423								
Capacity as a 15-minute flow rate, c (veh/h)	4253								
Capacity as a full-hour volume, c_h (veh/h)	4168								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB			
Agency/Company	URS				Weaving Seg Location	Wardlow On to Pacific Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	4				Volume ratio, VR	0.15			
Weaving seg length, L (ft)	1089				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
V_{o1}	5136	0.97	4	0	2.0	1.2	0.962	1.00	5506
V_{o2}	0	0.97	4	0	2.0	1.2	0.962	1.00	0
V_{w1}	190	0.97	4	0	2.0	1.2	0.962	1.00	203
V_{w2}	707	0.97	4	0	2.0	1.2	0.962	1.00	758
V_w				961	V_{nw}				5506
V									6467
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, W_i	0.58		0.22						
Weaving and non-weaving speeds, S_i (mi/h)	43.49		51.73						
Number of lanes required for unconstrained operation, N_w					1.03				
Maximum number of lanes, N_w (max)					3.50				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	50.32								
Weaving segment density, D (pc/mi/ln)	32.13								
Level of service, LOS	D								
Capacity of base condition, c_b (pc/h)	8330								
Capacity as a 15-minute flow rate, c (veh/h)	8010								
Capacity as a full-hour volume, c_h (veh/h)	7770								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB			
Agency/Company	URS				Weaving Seg Location	Wardlow On to Pacific Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	4				Volume ratio, VR	0.15			
Weaving seg length, L (ft)	1089				Weaving ratio, R	0.16			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	4974	0.93	7	0	2.0	1.2	0.935	1.00	5722
V_{o2}	0	0.93	7	0	2.0	1.2	0.935	1.00	0
V_{w1}	140	0.93	7	0	2.0	1.2	0.935	1.00	161
V_{w2}	715	0.93	7	0	2.0	1.2	0.935	1.00	822
V_w				983	V_{nw}				5722
V									6705
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, W_i	0.59		0.23						
Weaving and non-weaving speeds, S_i (mi/h)	43.27		51.56						
Number of lanes required for unconstrained operation, N_w					1.02				
Maximum number of lanes, N_w (max)					3.50				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	50.15								
Weaving segment density, D (pc/mi/ln)	33.42								
Level of service, LOS	D								
Capacity of base condition, c_b (pc/h)	8344								
Capacity as a 15-minute flow rate, c (veh/h)	7798								
Capacity as a full-hour volume, c_h (veh/h)	7252								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB			
Agency/Company	URS				Weaving Seg Location	Wardlow On to Pacific Off			
Date Performed	8/20/2008				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	4				Volume ratio, VR	0.19			
Weaving seg length, L (ft)	1089				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
V_{o1}	5460	0.98	4	0	2.0	1.2	0.962	1.00	5794
V_{o2}	0	0.98	4	0	2.0	1.2	0.962	1.00	0
V_{w1}	283	0.98	4	0	2.0	1.2	0.962	1.00	300
V_{w2}	1034	0.98	4	0	2.0	1.2	0.962	1.00	1097
V_w				1397	V_{nw}				5794
V									7191
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, W_i	0.68		0.32						
Weaving and non-weaving speeds, S_i (mi/h)	41.79		49.19						
Number of lanes required for unconstrained operation, N_w					1.22				
Maximum number of lanes, N_w (max)					3.50				
<input checked="" type="checkbox"/> If $N_w < N_w(\text{max})$ unconstrained operation					<input type="checkbox"/> if $N_w > N_w(\text{max})$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	47.55								
Weaving segment density, D (pc/mi/ln)	37.80								
Level of service, LOS	E								
Capacity of base condition, c_b (pc/h)	8019								
Capacity as a 15-minute flow rate, c (veh/h)	7711								
Capacity as a full-hour volume, c_h (veh/h)	7557								
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.									



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-405 SB
Agency or Company	URS	From/To	Pacific Off / I-710 On
Date Performed	2/9/2010	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2008
Project Description I-710 LAMTA PA/ED			

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

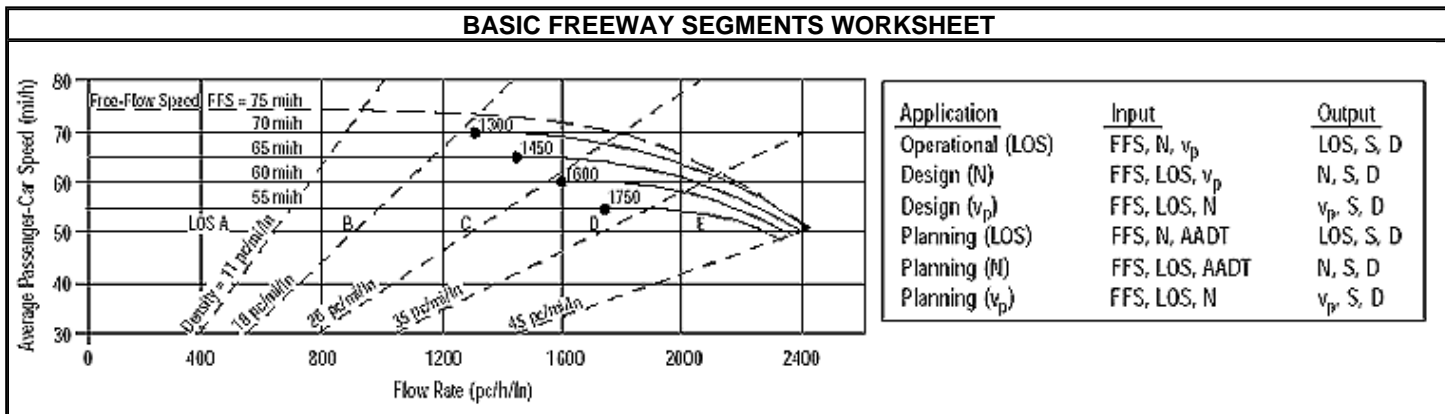
Flow Inputs			
Volume, V	5843	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/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			

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1566 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	28.5 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-405 SB
Agency or Company	URS	From/To	Pacific Off / I-710 On
Date Performed	2/9/2010	Jurisdiction	
Analysis Time Period	MD	Analysis Year	2008
Project Description I-710 LAMTA PA/ED			

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

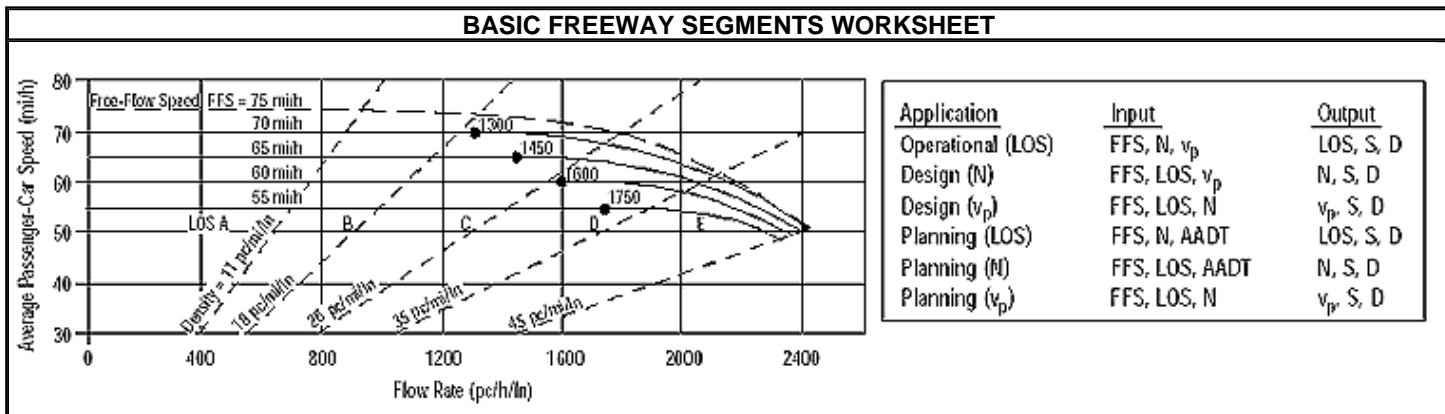
Flow Inputs			
Volume, V	5689	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.935

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 l/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)	1636 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	29.7 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-405 SB
Agency or Company	URS	From/To	Pacific Off / I-710 On
Date Performed	2/9/2010	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2008
Project Description I-710 LAMTA PA/ED			

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

Flow Inputs			
Volume, V	6494	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/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)	1723 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	31.3 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 - Exhibits 23-8, 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			

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB			
Agency/Company	URS				Weaving Seg Location	I-710 On / Long Beach Off			
Date Performed	1/21/2010				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	5				Volume ratio, VR	0.31			
Weaving seg length, L (ft)	2165				Weaving ratio, R	0.06			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	5680	0.95	6	0	2.0	1.2	0.943	1.00	6337
V_{o2}	70	0.97	4	0	2.0	1.2	0.962	1.00	75
V_{w1}	163	0.95	6	0	2.0	1.2	0.943	1.00	181
V_{w2}	2485	0.97	4	0	2.0	1.2	0.962	1.00	2664
V_w				2845	V_{nw}				6412
V									9257
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, W_i	0.60		0.40						
Weaving and non-weaving speeds, S_i (mi/h)	43.11		47.20						
Number of lanes required for unconstrained operation, Nw					1.68				
Maximum number of lanes, Nw (max)					3.50				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	45.87								
Weaving segment density, D (pc/mi/ln)	40.36								
Level of service, LOS	E								
Capacity of base condition, c_b (pc/h)	9764								
Capacity as a 15-minute flow rate, c (veh/h)	9211								
Capacity as a full-hour volume, c_h (veh/h)	8806								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-405 SB			
Agency/Company	URS				Weaving Seg Location	I-710 On / Long Beach Off			
Date Performed	1/21/2010				Jurisdiction				
Analysis Time Period	MD				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	B			
Weaving number of lanes, N	5				Volume ratio, VR	0.33			
Weaving seg length, L (ft)	2165				Weaving ratio, R	0.05			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	5555	0.93	7	0	2.0	1.2	0.935	1.00	6391
V_{o2}	65	0.93	7	0	2.0	1.2	0.935	1.00	74
V_{w1}	134	0.93	7	0	2.0	1.2	0.935	1.00	154
V_{w2}	2685	0.93	7	0	2.0	1.2	0.935	1.00	3089
V_w				3243	V_{nw}				6465
V									9708
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, W_i	0.65		0.47						
Weaving and non-weaving speeds, S_i (mi/h)	42.28		45.60						
Number of lanes required for unconstrained operation, Nw					1.84				
Maximum number of lanes, Nw (max)					3.50				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	44.44								
Weaving segment density, D (pc/mi/ln)	43.69								
Level of service, LOS	F								
Capacity of base condition, c_b (pc/h)	9586								
Capacity as a 15-minute flow rate, c (veh/h)	8959								
Capacity as a full-hour volume, c_h (veh/h)	8332								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst Agency/Company Date Performed Analysis Time Period					Freeway/Dir of Travel Weaving Seg Location Jurisdiction Analysis Year				
KT URS 1/21/2010 PM					I-405 SB I-710 On / Long Beach Off 2008				
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)					Weaving type				
55					B				
Weaving number of lanes, N					Volume ratio, VR				
5					0.32				
Weaving seg length, L (ft)					Weaving ratio, R				
2165					0.04				
Terrain					Level				
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	6370	0.97	5	0	2.0	1.2	0.952	1.00	6895
V_{o2}	60	0.98	4	0	2.0	1.2	0.962	1.00	63
V_{w1}	124	0.97	5	0	2.0	1.2	0.952	1.00	134
V_{w2}	3017	0.98	4	0	2.0	1.2	0.962	1.00	3201
V_w				3335	V_{nw}				6958
V									10293
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, W_i	0.67		0.48						
Weaving and non-weaving speeds, S_i (mi/h)	42.02		45.47						
Number of lanes required for unconstrained operation, Nw					1.80				
Maximum number of lanes, Nw (max)					3.50				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)					44.30				
Weaving segment density, D (pc/mi/ln)					46.47				
Level of service, LOS					F				
Capacity of base condition, c_b (pc/h)					9653				
Capacity as a 15-minute flow rate, c (veh/h)					9193				
Capacity as a full-hour volume, c_h (veh/h)					8947				
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.									



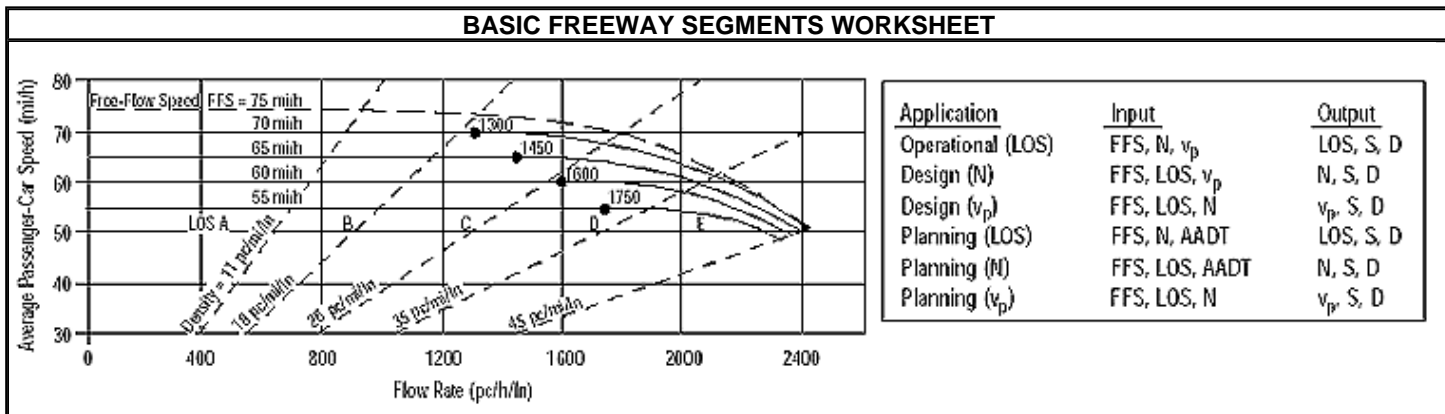
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SR-91 EXISTING CONDITIONS ANALYSIS



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General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 EB
Agency or Company	URS	From/To	W. of Santa Fe On
Date Performed	1/22/2010	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

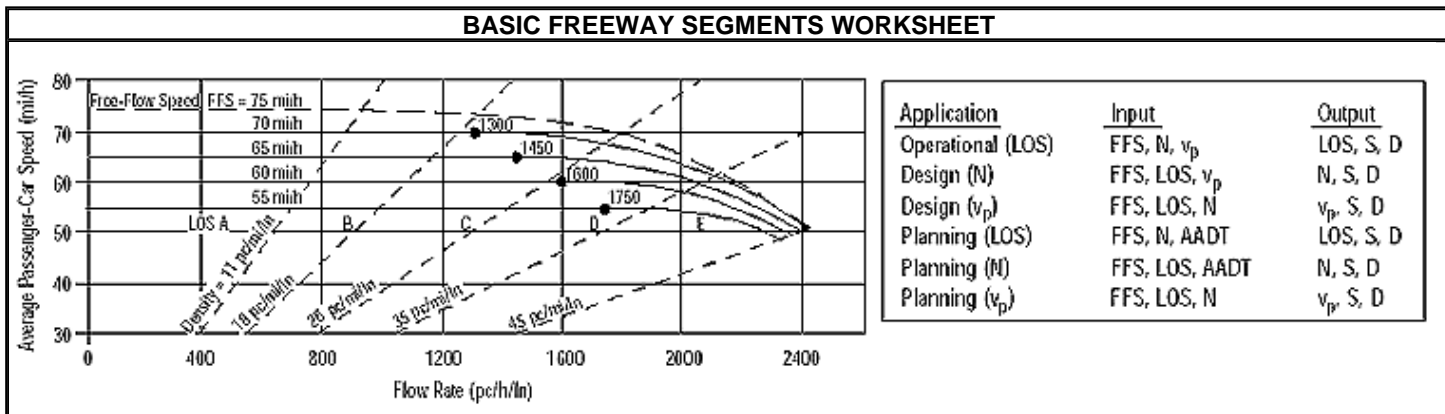
Flow Inputs			
Volume, V	6052	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.901

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 l/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)	1414 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	25.7 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 EB
Agency or Company	URS	From/To	W. of Santa Fe On
Date Performed	1/22/2010	Jurisdiction	
Analysis Time Period	MD	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

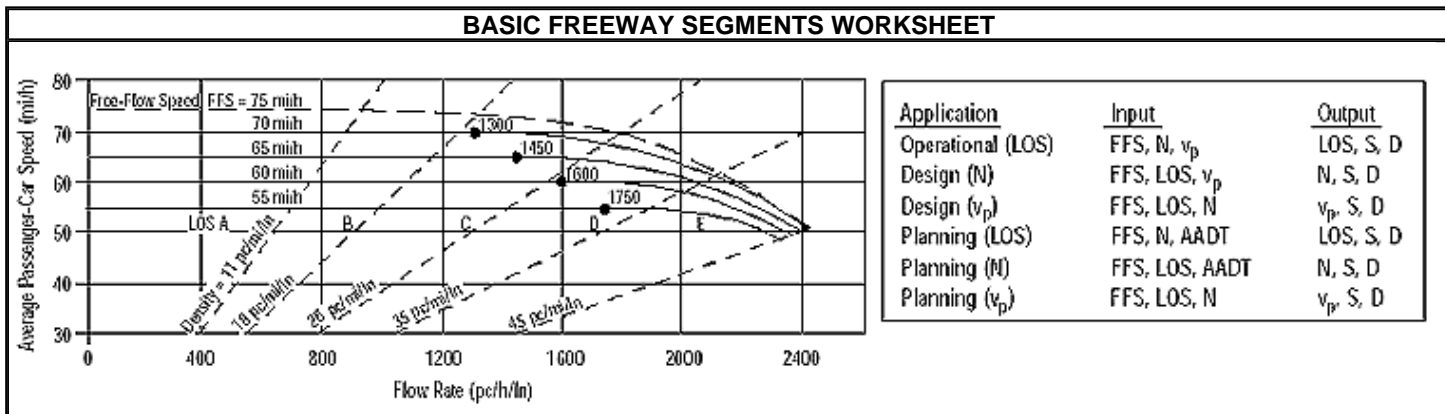
Flow Inputs			
Volume, V	7107	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.847

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 l/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)	1747 pc/h/ln	Design LOS	
S	55.0 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 EB
Agency or Company	URS	From/To	W. of Santa Fe On
Date Performed	1/22/2010	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

Flow Inputs			
Volume, V	7191	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.909

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 l/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			

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1631 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	29.7 pc/mi/ln	S	mi/h
LOS	D	D = v _p / S	pc/mi/ln
		Required Number of Lanes, N	

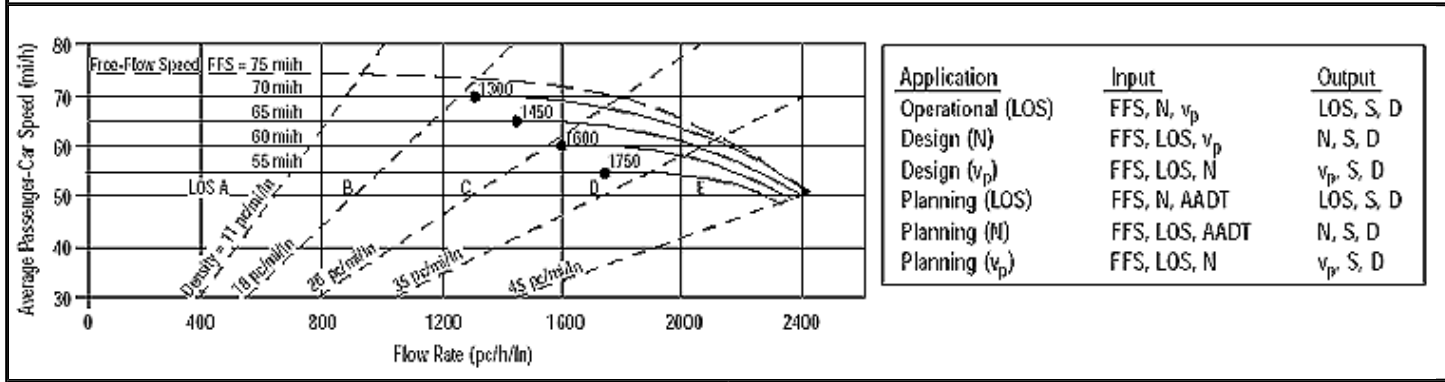
Glossary		Factor Location	
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 23-10	f _{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E _T - Exhibits 23-8, 23-10, 23-11	f _{LC} - Exhibit 23-5
v _p - Flow rate	FFS - Free-flow speed	f _p - Page 23-12	f _N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v _p - Exhibits 23-2, 23-3	f _{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 EB			
Agency/Company	URS				Weaving Seg Location	Santa Fe On/Long Beach Off			
Date Performed	1/22/2010				Jurisdiction	Caltrans			
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	A			
Weaving number of lanes, N	5				Volume ratio, VR	0.08			
Weaving seg length, L (ft)	1361				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
V_{o1}	4864	0.95	11	0	2.0	1.2	0.901	1.00	5683
V_{o2}	0	0.95	11	0	2.0	1.2	0.901	1.00	0
V_{w1}	179	0.95	11	0	2.0	1.2	0.901	1.00	209
V_{w2}	219	0.95	11	0	2.0	1.2	0.901	1.00	255
V_w				464	V_{nw}				5683
V									6147
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, W_i	0.54		0.22						
Weaving and non-weaving speeds, S_i (mi/h)	44.15		51.97						
Number of lanes required for unconstrained operation, Nw					0.87				
Maximum number of lanes, Nw (max)					1.40				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	51.29								
Weaving segment density, D (pc/mi/ln)	23.97								
Level of service, LOS	C								
Capacity of base condition, c_b (pc/h)	9755								
Capacity as a 15-minute flow rate, c (veh/h)	8788								
Capacity as a full-hour volume, c_h (veh/h)	8349								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst		KT			Freeway/Dir of Travel		SR-91 EB		
Agency/Company		URS			Weaving Seg Location		Santa Fe On/Long Beach Off		
Date Performed		1/22/2010			Jurisdiction		Caltrans		
Analysis Time Period		MD			Analysis Year		2008		
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)		55			Weaving type		A		
Weaving number of lanes, N		5			Volume ratio, VR		0.15		
Weaving seg length, L (ft)		1361			Weaving ratio, R		0.50		
Terrain		Level							
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	5422	0.96	18	0	2.0	1.2	0.847	1.00	6664
V_{o2}	0	0.96	18	0	2.0	1.2	0.847	1.00	0
V_{w1}	481	0.96	18	0	2.0	1.2	0.847	1.00	591
V_{w2}	481	0.96	18	0	2.0	1.2	0.847	1.00	591
V_w				1182	V_{nw}				6664
V									7846
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, W_i	0.80		0.39						
Weaving and non-weaving speeds, S_i (mi/h)	40.01		47.36						
Number of lanes required for unconstrained operation, Nw					1.35				
Maximum number of lanes, Nw (max)					1.40				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)					46.08				
Weaving segment density, D (pc/mi/ln)					34.05				
Level of service, LOS					D				
Capacity of base condition, c_b (pc/h)					9462				
Capacity as a 15-minute flow rate, c (veh/h)					8019				
Capacity as a full-hour volume, c_h (veh/h)					7698				
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 EB			
Agency/Company	URS				Weaving Seg Location	Santa Fe On/Long Beach Off			
Date Performed	1/22/2010				Jurisdiction	Caltrans			
Analysis Time Period	PM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	A			
Weaving number of lanes, N	5				Volume ratio, VR	0.17			
Weaving seg length, L (ft)	1361				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
V_{o1}	5481	0.97	10	0	2.0	1.2	0.909	1.00	6215
V_{o2}	0	0.97	10	0	2.0	1.2	0.909	1.00	0
V_{w1}	512	0.97	10	0	2.0	1.2	0.909	1.00	580
V_{w2}	625	0.97	10	0	2.0	1.2	0.909	1.00	708
V_w				1288	V_{nw}				6215
V									7503
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, W_i					1.86		0.23		
Weaving and non-weaving speeds, S_i (mi/h)					30.74		51.69		
Number of lanes required for unconstrained operation, Nw					1.45				
Maximum number of lanes, Nw (max)					1.40				
<input type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input checked="" type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)					46.28				
Weaving segment density, D (pc/mi/ln)					32.43				
Level of service, LOS					D				
Capacity of base condition, c_b (pc/h)					9340				
Capacity as a 15-minute flow rate, c (veh/h)					8491				
Capacity as a full-hour volume, c_h (veh/h)					8236				
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.									

BASIC FREEWAY SEGMENTS WORKSHEET



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 EB
Agency or Company	URS	From/To	Long Beach Off / Long Beach On
Date Performed	2/1/2010	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

Flow Inputs			
Volume, V	6092	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

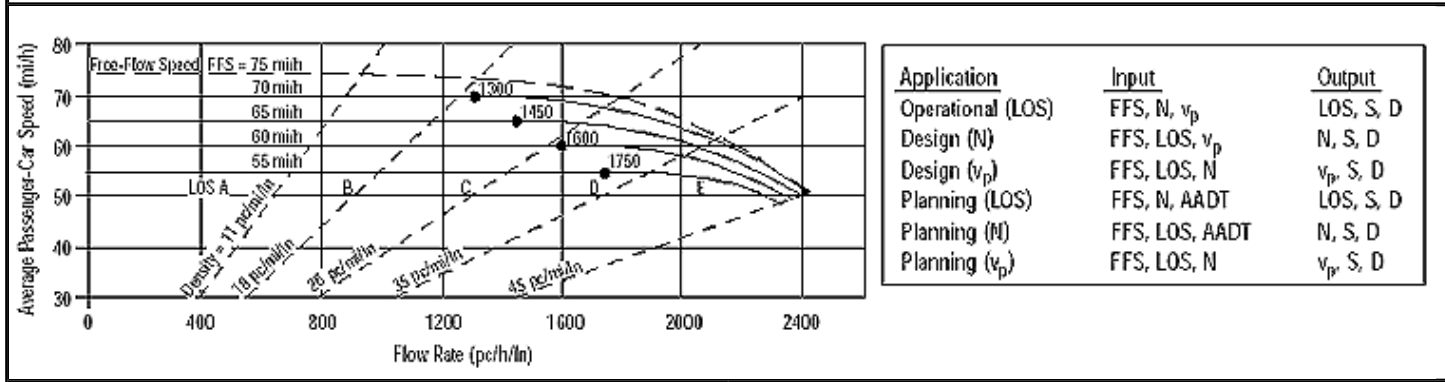
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.901

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 l/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)	1424 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	25.9 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 - Exhibits 23-8, 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			

BASIC FREEWAY SEGMENTS WORKSHEET



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 EB
Agency or Company	URS	From/To	Long Beach Off / Long Beach On
Date Performed	2/1/2010	Jurisdiction	
Analysis Time Period	MD	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

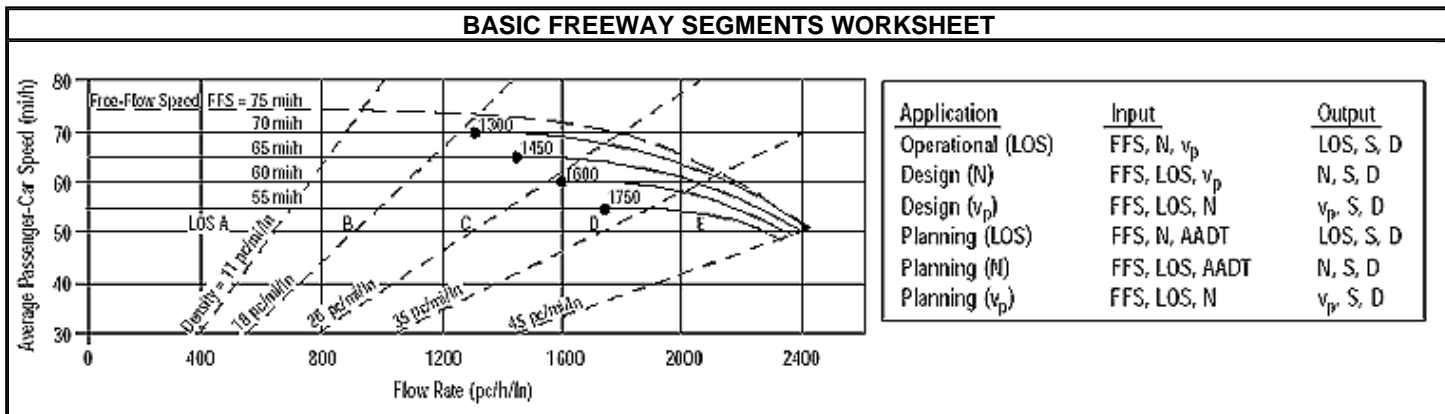
Flow Inputs			
Volume, V	7194	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.847

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 l/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			

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1769 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	32.2 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 EB
Agency or Company	URS	From/To	Long Beach Off / Long Beach On
Date Performed	2/1/2010	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

Flow Inputs			
Volume, V	7304	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.909

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 l/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			

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1657 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	30.1 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 - Exhibits 23-8, 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			

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 EB			
Agency/Company	URS				Weaving Seg Location	Long Beach On/I-710 SB Off			
Date Performed	1/22/2010				Jurisdiction	Caltrans			
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	A			
Weaving number of lanes, N	5				Volume ratio, VR	0.13			
Weaving seg length, L (ft)	1365				Weaving ratio, R	0.28			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	4592	0.95	11	0	2.0	1.2	0.901	1.00	5365
V_{o2}	0	0.95	11	0	2.0	1.2	0.901	1.00	0
V_{w1}	485	0.95	11	0	2.0	1.2	0.901	1.00	566
V_{w2}	187	0.95	11	0	2.0	1.2	0.901	1.00	218
V_w				784	V_{nw}				5365
V									6149
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, W_i	0.60		0.26						
Weaving and non-weaving speeds, S_i (mi/h)	43.09		50.66						
Number of lanes required for unconstrained operation, Nw					1.19				
Maximum number of lanes, Nw (max)					1.40				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	49.55								
Weaving segment density, D (pc/mi/ln)	24.82								
Level of service, LOS	C								
Capacity of base condition, c_b (pc/h)	9600								
Capacity as a 15-minute flow rate, c (veh/h)	8649								
Capacity as a full-hour volume, c_h (veh/h)	8217								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst		KT			Freeway/Dir of Travel		SR-91 EB		
Agency/Company		URS			Weaving Seg Location		Long Beach On/I-710 SB Off		
Date Performed		1/22/2010			Jurisdiction		Caltrans		
Analysis Time Period		MD			Analysis Year		2008		
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)		55			Weaving type		A		
Weaving number of lanes, N		5			Volume ratio, VR		0.16		
Weaving seg length, L (ft)		1365			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
V_{o1}	5385	0.96	18	0	2.0	1.2	0.847	1.00	6619
V_{o2}	0	0.96	18	0	2.0	1.2	0.847	1.00	0
V_{w1}	610	0.96	18	0	2.0	1.2	0.847	1.00	749
V_{w2}	411	0.96	18	0	2.0	1.2	0.847	1.00	505
V_w				1254	V_{nw}				6619
V									7873
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, W_i	0.81		0.40						
Weaving and non-weaving speeds, S_i (mi/h)	39.81		47.06						
Number of lanes required for unconstrained operation, Nw					1.40				
Maximum number of lanes, Nw (max)					1.40				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)					45.74				
Weaving segment density, D (pc/mi/ln)					34.43				
Level of service, LOS					D				
Capacity of base condition, c_b (pc/h)					9416				
Capacity as a 15-minute flow rate, c (veh/h)					7980				
Capacity as a full-hour volume, c_h (veh/h)					7661				
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 EB			
Agency/Company	URS				Weaving Seg Location	Long Beach On/I-710 SB Off			
Date Performed	1/22/2010				Jurisdiction	Caltrans			
Analysis Time Period	PM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	A			
Weaving number of lanes, N	5				Volume ratio, VR	0.17			
Weaving seg length, L (ft)	1365				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
V_{o1}	5494	0.97	10	0	2.0	1.2	0.909	1.00	6230
V_{o2}	0	0.97	10	0	2.0	1.2	0.909	1.00	0
V_{w1}	593	0.97	10	0	2.0	1.2	0.909	1.00	672
V_{w2}	533	0.97	10	0	2.0	1.2	0.909	1.00	604
V_w				1276	V_{nw}				6230
V									7506
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, W_i					1.85		0.22		
Weaving and non-weaving speeds, S_i (mi/h)					30.79		51.74		
Number of lanes required for unconstrained operation, Nw					1.45				
Maximum number of lanes, Nw (max)					1.40				
<input type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input checked="" type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)					46.38				
Weaving segment density, D (pc/mi/ln)					32.37				
Level of service, LOS					D				
Capacity of base condition, c_b (pc/h)					9354				
Capacity as a 15-minute flow rate, c (veh/h)					8504				
Capacity as a full-hour volume, c_h (veh/h)					8249				
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.									

I-710 Corridor Project
Adjacent Freeway Major Diverge Analysis: SR-91
Existing 2008

HCM 2000: Exhibit 25-14. Capacity Values for Diverge Areas

FFS (mi/hr)	Maximum Upstream or Downstream Freeway Flow			
	Number of Lanes in One Direction			
	2	3	4	> 4 (per ln)
55	4500	6750	9000	2250
60	4600	6900	9200	2300
65	4700	7050	9400	2350
70	4800	7200	9600	2400

#11
Year/Time
 2008 AM Peak
Major Diverge Junction

Freeway (V_F)	Diverge Ramp (V_R)	
SR-91 EB	I-710 NB/Atlantic Off	
N_{FU}	5	N_R 2
N_{FD}	3	FFS 55
Approach Leg	Diverge Legs	
V_{FU}	6434	V_{FD} 3127
		V_R 3307
Diverge		
V_F/C_F	0.28	$D_{Upstream}$ LOS
V_R/C_R	0.73	22.52 C
V/C	0.57	

#11
Year/Time
 2008 MD Peak
Major Diverge Junction

Freeway (V_F)	Merge Ramp (V_R)	
SR-91 EB	I-710 NB/Atlantic Off	
N_{FU}	5	N_R 2
N_{FD}	3	FFS 55
Approach Leg	Diverge Legs	
V_{FU}	7942	V_{FD} 4072
		V_R 3870
Diverge		
V_F/C_F	0.36	$D_{Upstream}$ LOS
V_R/C_R	0.86	27.80 C
V/C	0.71	

#11
Year/Time
 2008 PM Peak
Major Diverge Junction

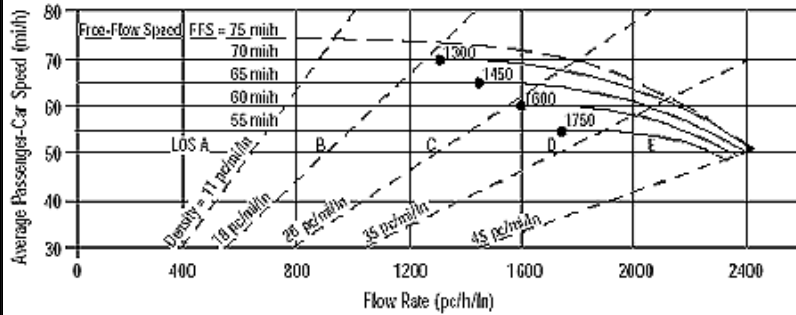
Freeway (V_F)	Merge Ramp (V_R)	
SR-91 EB	I-710 NB/Atlantic Off	
N_{FU}	5	N_R 2
N_{FD}	3	FFS 55
Approach Leg	Diverge Legs	
V_{FU}	7841	V_{FD} 3918
		V_R 3923
Diverge		
V_F/C_F	0.35	$D_{Upstream}$ LOS
V_R/C_R	0.87	27.44 C
V/C	0.70	

RAMPS AND RAMP JUNCTIONS WORKSHEET										
General Information					Site Information					
Analyst	KT	Freeway/Dir of Travel	SR-91 EB		Junction	Atlantic On				
Agency or Company	URS	Jurisdiction	Caltrans				Analysis Year	2008		
Date Performed	1/22/2010	Analysis Year	2008							
Analysis Time Period	AM	Project Description LAMTA I-710 PA-ED								
Inputs										
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp				
<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> On					<input type="checkbox"/> Yes	<input type="checkbox"/> On	L _{down} = ft		
<input type="checkbox"/> No	<input type="checkbox"/> Off					<input checked="" type="checkbox"/> No	<input type="checkbox"/> Off			
L _{up} =	1148 ft	S _{FF} = 55.0 mph S _{FR} = 35.0 mph				V _o = veh/h				
V _u = 1805 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 x f _{HV} x f _p		
Freeway	7824	0.96	Level	5	0	0.976	1.00	8354		
Ramp	482	0.96	Level	5	0	0.976	1.00	515		
UpStream	1805	0.96	Level	5	0	0.976	1.00	1927		
DownStream										
Merge Areas					Diverge Areas					
Estimation of v₁₂					Estimation of v₁₂					
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$					
L _{EQ} = (Equation 25-2 or 25-3)					L _{EQ} = (Equation 25-8 or 25-9)					
P _{FM} = 0.345 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-11)					
V ₁₂ = 2058 pc/h					V ₁₂ = pc/h					
Capacity Checks					Capacity Checks					
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?			
V _{FO}	6489	See Exhibit 25-7	No	V _{F1} = V _F						
				V ₁₂						
V _{R12}	2573	4600:All	No	V _{F0} = V _F - V _R						
				V _R						
Level of Service Determination (if not F)					Level of Service Determination (if not F)					
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$					
D _R = 21.5 (pc/mi/ln)					D _R = (pc/mi/ln)					
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)					
Speed Estimation					Speed Estimation					
M _S = 0.330 (Exhibit 25-19)					D _S = (Exhibit 25-19)					
S _R = 50.7 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)					
S ₀ = 49.8 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)					
S = 50.1 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)					

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 EB			
Agency or Company	URS				Junction	Atlantic On			
Date Performed	1/22/2010				Jurisdiction	Caltrans			
Analysis Time Period	MD				Analysis Year	2008			
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> On						<input type="checkbox"/> Yes	<input type="checkbox"/> On	
<input type="checkbox"/> No	<input type="checkbox"/> Off	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Off						
$L_{up} =$	1148 ft	$S_{FF} = 55.0$ mph $S_{FR} = 35.0$ mph					$L_{down} =$	ft	
$V_u =$	1990 veh/h						$V_o =$		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	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	7339	0.95	Level	8	0	0.962	1.00	8034	
Ramp	434	0.95	Level	8	0	0.962	1.00	475	
UpStream	1990	0.95	Level	8	0	0.962	1.00	2179	
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)				
$P_{FM} = 0.350$ using Equation (Exhibit 25-5)					$P_{FD} =$ using Equation (Exhibit 25-11)				
$V_{12} = 2008$ pc/h					$V_{12} =$ pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V_{FO}	6220	See Exhibit 25-7	No	$V_{FI} = V_F$					
				V_{12}					
V_{R12}	2483	4600:All	No	$V_{FO} = V_F - V_R$					
				V_R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
$D_R = 20.9$ (pc/mi/ln)					$D_R =$ (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
$M_S = 0.326$ (Exhibit 25-19)					$D_S =$ (Exhibit 25-19)				
$S_R = 50.8$ mph (Exhibit 25-19)					$S_R =$ mph (Exhibit 25-19)				
$S_0 = 50.1$ mph (Exhibit 25-19)					$S_0 =$ mph (Exhibit 25-19)				
$S = 50.3$ mph (Exhibit 25-14)					$S =$ mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	SR-91 EB						
Agency or Company	URS	Junction	Atlantic On						
Date Performed	1/22/2010	Jurisdiction	Caltrans						
Analysis Time Period	PM	Analysis Year	2008						
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level			Downstream Adj Ramp				
<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off					<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off				
L _{up} = 1148 ft					L _{down} = ft				
V _u = 2059 veh/h		S _{FF} = 55.0 mph			S _{FR} = 35.0 mph			V _o = 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 x f _{HV} x f _p	
Freeway	7802	0.95	Level	5	0	0.976	1.00	8418	
Ramp	393	0.95	Level	5	0	0.976	1.00	424	
UpStream	2059	0.95	Level	5	0	0.976	1.00	2222	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = 0.356 using Equation (Exhibit 25-5) V ₁₂ = 2142 pc/h					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = using Equation (Exhibit 25-11) V ₁₂ = pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V _{FO}	6443	See Exhibit 25-7	No	V _{F1} = V _F					
				V ₁₂					
V _{R12}	2566	4600:All	No	V _{FO} = V _F - V _R					
				V _R					
Level of Service Determination (if not F)					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 = 21.5 (pc/mi/ln) LOS = C (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S =	0.330 (Exhibit 25-19)				D _S =	(Exhibit 25-19)			
S _R =	50.7 mph (Exhibit 25-19)				S _R =	mph (Exhibit 25-19)			
S ₀ =	49.8 mph (Exhibit 25-19)				S ₀ =	mph (Exhibit 25-19)			
S =	50.2 mph (Exhibit 25-14)				S =	mph (Exhibit 25-15)			

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	KK	Highway/Direction of Travel	SR-91 EB
Agency or Company	URS	From/To	Atlantic On/Cherry Off
Date Performed	8/5/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	7806	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

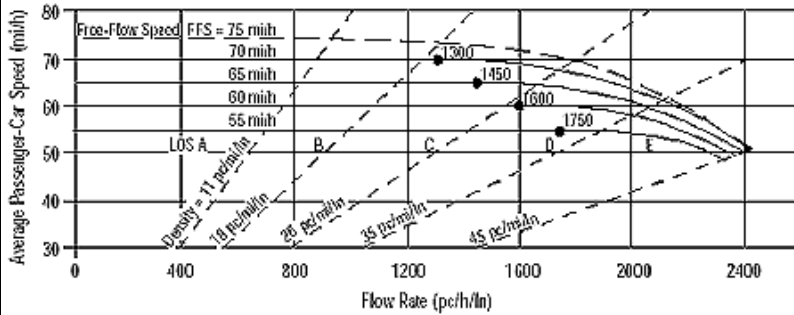
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	1.5	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.976

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	5	f _N	mi/h
FFS (measured)	67.0 mi/h	FFS	67.0 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)	1667 pc/h/ln	Design LOS	
S	66.5 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	25.1 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 - Exhibits 23-8, 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			

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	KK	Highway/Direction of Travel	SR-91 EB
Agency or Company	URS	From/To	Atlantic On/Cherry Off
Date Performed	8/5/2008	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	8681	veh/h	Peak-Hour Factor, PHF 0.95
AADT		veh/day	%Trucks and Buses, P _T 8
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 %

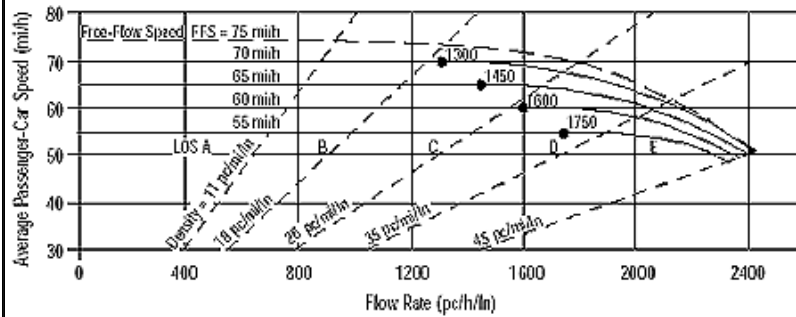
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	1.5	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.962

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	5	f _N	mi/h
FFS (measured)	65.0 mi/h	FFS	65.0 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)	1901 pc/h/ln	Design LOS	
S	62.9 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 - Exhibits 23-8, 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			

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	KK	Highway/Direction of Travel	SR-91 EB
Agency or Company	URS	From/To	Atlantic On/Cherry Off
Date Performed	8/5/2008	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	8210	veh/h	Peak-Hour Factor, PHF 0.95
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

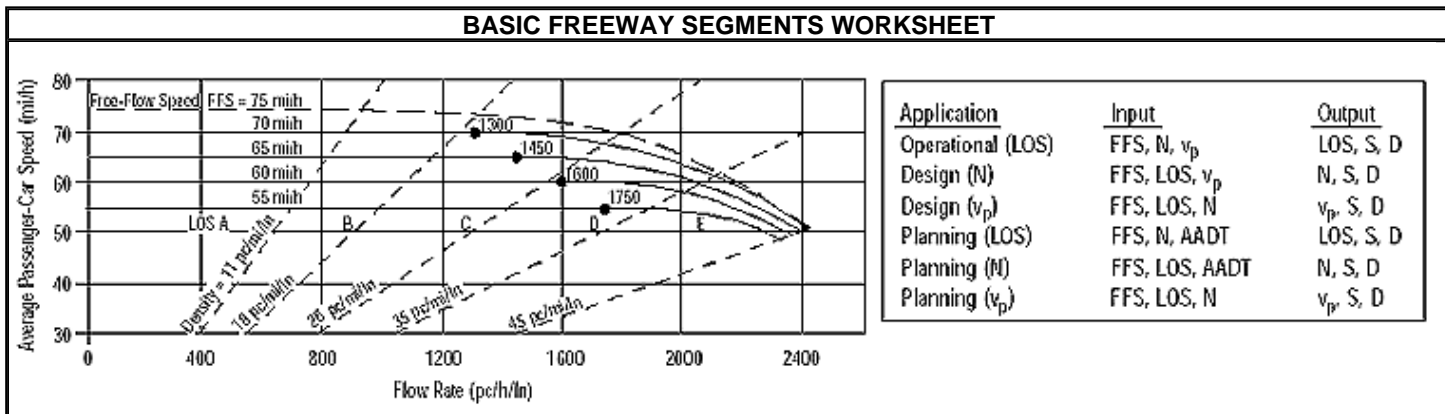
Speed Inputs		Calc Speed Adj and FFS	
Lane Width	12.0 ft	f _{LW}	mi/h
Rt-Shoulder Lat. Clearance	6.0 ft	f _{LC}	mi/h
Interchange Density	0.50 l/mi	f _{ID}	mi/h
Number of Lanes, N	5	f _N	mi/h
FFS (measured)	57.0 mi/h	FFS	57.0 mi/h
Base free-flow Speed, BFFS	mi/h		

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1772 pc/h/ln	Design LOS	
S	57.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	31.1 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 - Exhibits 23-8, 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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General Information		Site Information	
Analyst	KK	Highway/Direction of Travel	SR-91 WB
Agency or Company	URS	From/To	Cherry On/Atlantic Off
Date Performed	2/16/2010	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

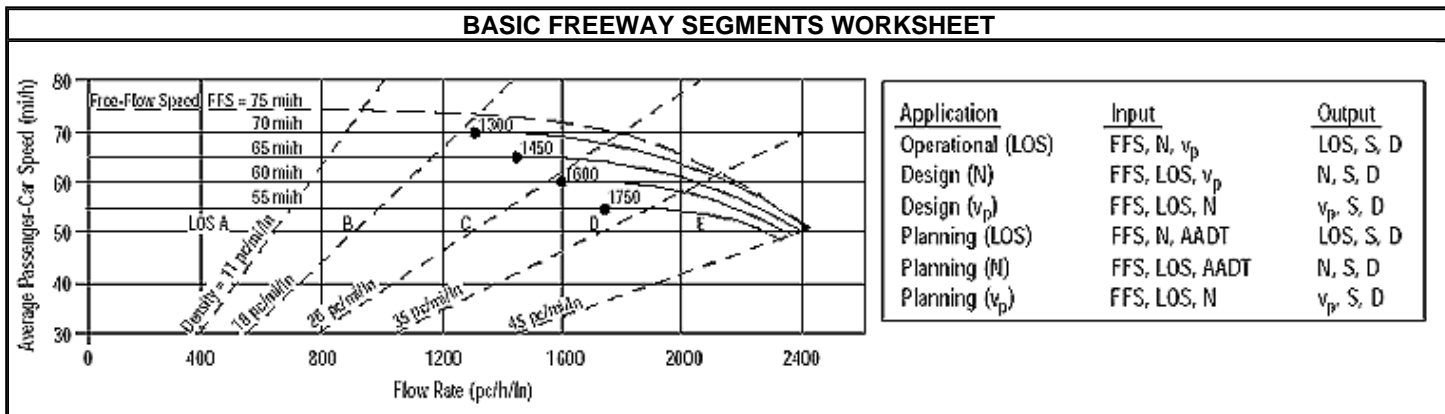
Flow Inputs				
Volume, V	7271	veh/h	Peak-Hour Factor, PHF	0.95
AADT		veh/day	%Trucks and Buses, P _T	8
Peak-Hr Prop. of AADT, K			%RVs, P _R	0
Peak-Hr Direction Prop, D			General Terrain:	Level
DDHV = AADT x K x D		veh/h	Grade % Length	mi
Driver type adjustment	1.00		Up/Down %	

Calculate Flow Adjustments			
f_p	1.00	E_R	1.2
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.926

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 l/mi	f_{ID}	mi/h
Number of Lanes, N	5	f_N	mi/h
FFS (measured)	69.0 mi/h	FFS	69.0 mi/h
Base free-flow Speed, BFFS	mi/h		

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1653 pc/h/ln	Design LOS	
S	68.3 mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h
$D = v_p / S$	24.2 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KK	Highway/Direction of Travel	SR-91 WB
Agency or Company	URS	From/To	Cherry On/Atlantic Off
Date Performed	2/16/2010	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

Flow Inputs			
Volume, V	7930	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.952

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	5	f _N	mi/h
FFS (measured)	71.0 mi/h	FFS	71.0 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)	1753 pc/h/ln	Design LOS	
S	69.1 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 - Exhibits 23-8, 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			

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	SR-91 WB		Agency or Company	URS	Junction	Cherry On	
Date Performed	2/10/2010	Jurisdiction	Caltrans		Analysis Time Period	AM	Analysis Year	2008	
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes	<input type="checkbox"/> On						<input type="checkbox"/> Yes	<input type="checkbox"/> On	
<input checked="" type="checkbox"/> No	<input type="checkbox"/> Off	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Off						
$L_{up} =$	ft	$S_{FF} = 55.0$ mph $S_{FR} = 35.0$ mph					$L_{down} =$	ft	
$V_u =$	veh/h						$V_o =$		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	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	7461	0.92	Level	5	0	0.952	1.00	8515	
Ramp	515	0.92	Level	5	0	0.952	1.00	588	
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)				
$P_{FM} = 0.335$ using Equation (Exhibit 25-5)					$P_{FD} =$ using Equation (Exhibit 25-11)				
$V_{12} = 2018$ pc/h					$V_{12} =$ pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V_{FO}	6603	See Exhibit 25-7	No	$V_{FI} = V_F$					
				V_{12}					
V_{R12}	2606	4600:All	No	$V_{FO} = V_F - V_R$					
				V_R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
$D_R = 21.8$ (pc/mi/ln)					$D_R =$ (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
$M_S = 0.332$ (Exhibit 25-19)					$D_S =$ (Exhibit 25-19)				
$S_R = 50.7$ mph (Exhibit 25-19)					$S_R =$ mph (Exhibit 25-19)				
$S_0 = 49.6$ mph (Exhibit 25-19)					$S_0 =$ mph (Exhibit 25-19)				
$S = 50.0$ mph (Exhibit 25-14)					$S =$ mph (Exhibit 25-15)				

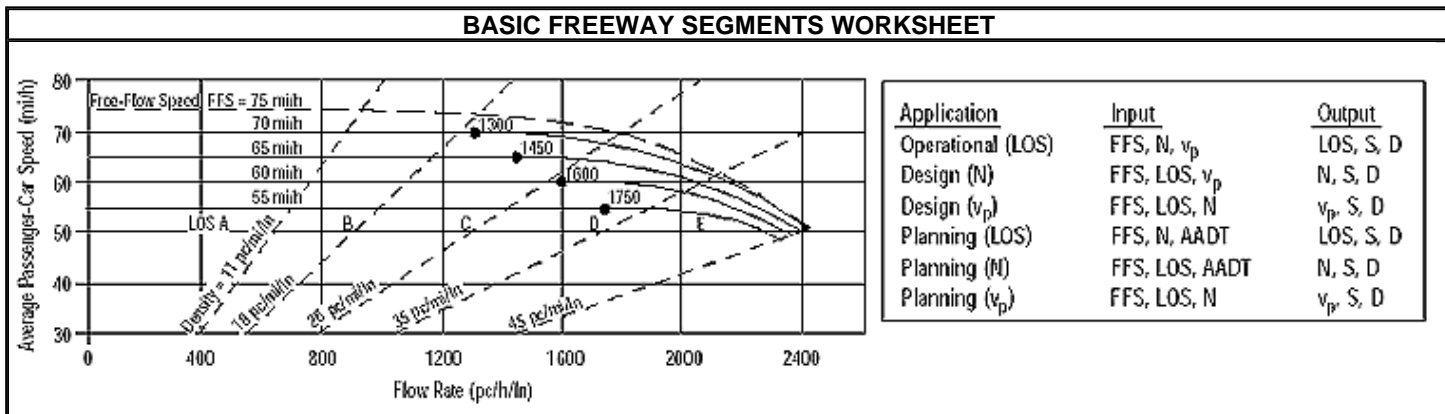
RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 WB			
Agency or Company	URS				Junction	Cherry On			
Date Performed	2/10/2010				Jurisdiction	Caltrans			
Analysis Time Period	MD				Analysis Year	2008			
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off L _{up} = ft V _u = veh/h						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off L _{down} = ft V _o = veh/h			
					S _{FF} = 55.0 mph		S _{FR} = 35.0 mph		
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 x f _{HV} x f _p	
Freeway	6762	0.95	Level	8	0	0.926	1.00	7687	
Ramp	509	0.95	Level	8	0	0.926	1.00	579	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
L _{EQ} = (Equation 25-2 or 25-3)					L _{EQ} = (Equation 25-8 or 25-9)				
P _{FM} = 0.337 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-11)				
V ₁₂ = 1850 pc/h					V ₁₂ = pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V _{FO}	6076	See Exhibit 25-7	No	V _{F1} = V _F					
				V ₁₂					
V _{R12}	2429	4600:All	No	V _{FO} = V _F - V _R					
				V _R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
D _R = 20.4 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = 0.323 (Exhibit 25-19)					D _S = (Exhibit 25-19)				
S _R = 50.8 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 50.2 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 50.5 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	SR-91 WB		Agency or Company	URS	Junction	Cherry On	
Date Performed	2/10/2010	Jurisdiction	Caltrans		Analysis Time Period	PM	Analysis Year	2008	
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off L _{up} = ft V _u = veh/h							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off L _{down} = ft V _o = veh/h		
		S _{FF} = 55.0 mph		S _{FR} = 35.0 mph					
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 x f _{HV} x f _p	
Freeway	7436	0.95	Level	5	0	0.952	1.00	8219	
Ramp	494	0.95	Level	5	0	0.952	1.00	546	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
L _{EQ} = (Equation 25-2 or 25-3)					L _{EQ} = (Equation 25-8 or 25-9)				
P _{FM} = 0.341 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-11)				
V ₁₂ = 2002 pc/h					V ₁₂ = pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V _{FO}	6423	See Exhibit 25-7	No	V _{F1} = V _F					
				V ₁₂					
V _{R12}	2548	4600:All	No	V _{FO} = V _F - V _R					
				V _R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
D _R = 21.3 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = 0.329 (Exhibit 25-19)					D _S = (Exhibit 25-19)				
S _R = 50.7 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 49.8 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 50.2 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KK				Freeway/Dir of Travel	SR-91 WB			
Agency or Company	URS				Junction	Atlantic Off			
Date Performed	02/02/2010				Jurisdiction	Caltrans			
Analysis Time Period	AM				Analysis Year	2008			
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On							<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On		
<input checked="" type="checkbox"/> No <input type="checkbox"/> Off							L _{down} = 840 ft		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 35.0 mph					V _D = 3631 veh/h		
V _u = 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 x f _{HV} x f _p	
Freeway	7976	0.92	Level	5	0	0.976	1.00	8886	
Ramp	790	0.92	Level	5	0	0.976	1.00	880	
UpStream									
DownStream	3631	0.92	Level	5	0	0.976	1.00	4045	
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
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 (Exhibit 25-5)					P _{FD} = 0.260 using Equation (Exhibit 25-11)				
V ₁₂ = pc/h					V ₁₂ = 2962 pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?			Actual	Maximum	LOS F?	
V _{FO}					V _{F1} = V _F	8886	9000	No	
					V ₁₂	2962	4400:All	No	
V _{R12}					V _{FO} = V _F - V _R	8006	9000	No	
					V _R	880	3800	No	
Level of Service Determination (if not F)					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 = 4.252 + 0.0086 V ₁₂ - 0.0009 L _D				
D _R = (pc/mi/ln)					D _R = 18.0 (pc/mi/ln)				
LOS = (Exhibit 25-4)					LOS = B (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = (Exhibit 25-19)					D _s = 0.507 (Exhibit 25-19)				
S _R = mph (Exhibit 25-19)					S _R = 48.4 mph (Exhibit 25-19)				
S ₀ = mph (Exhibit 25-19)					S ₀ = 52.7 mph (Exhibit 25-19)				
S = mph (Exhibit 25-14)					S = 51.2 mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KK				Freeway/Dir of Travel	SR-91 WB			
Agency or Company	URS				Junction	Atlantic Off			
Date Performed	02/02/2010				Jurisdiction	Caltrans			
Analysis Time Period	MD				Analysis Year	2008			
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off		
L _{up} = ft							S _{FF} = 55.0 mph		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					V _D = 3568 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 x f _{HV} x f _p	
Freeway	7271	0.95	Level	8	0	0.962	1.00	7960	
Ramp	368	0.95	Level	8	0	0.962	1.00	403	
UpStream									
DownStream	3568	0.95	Level	8	0	0.962	1.00	3906	
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.260 using Equation (Exhibit 25-11) V ₁₂ = 1954 pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?			Actual	Maximum	LOS F?	
V _{FO}					V _{F1} = V _F	6368	9000	No	
					V ₁₂	1954	4400:All	No	
V _{R12}					V _{FO} = V _F - V _R	5965	9000	No	
					V _R	403	3800	No	
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$ D _R = 9.4 (pc/mi/ln) LOS = A (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.464 (Exhibit 25-19) S _R = 49.0 mph (Exhibit 25-19) S ₀ = 55.6 mph (Exhibit 25-19) S = 53.4 mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KK	Freeway/Dir of Travel	SR-91 WB		Junction	Atlantic Off			
Agency or Company	URS	Jurisdiction	Caltrans		Analysis Year	2008			
Date Performed	02/02/2010	Project Description LAMTA I-710 PA-ED							
Analysis Time Period	PM	Inputs							
Upstream Adj Ramp	Terrain: Level				Downstream Adj Ramp				
<input type="checkbox"/> Yes <input type="checkbox"/> On					<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On				
<input checked="" type="checkbox"/> No <input type="checkbox"/> Off					<input type="checkbox"/> No <input checked="" type="checkbox"/> Off				
$L_{up} =$ ft	$S_{FF} = 55.0$ mph $S_{FR} = 35.0$ mph				$L_{down} =$ 840 ft				
$V_u =$ veh/h					$V_D =$ 3259 veh/h				
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	7930	0.95	Level	5	0	0.976	1.00	8556	
Ramp	404	0.95	Level	5	0	0.976	1.00	436	
UpStream									
DownStream	3259	0.95	Level	5	0	0.976	1.00	3516	
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 (Exhibit 25-5)					$P_{FD} = 0.260$ using Equation (Exhibit 25-11)				
$V_{12} =$ pc/h					$V_{12} = 2102$ pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V_{FO}				$V_{FI} = V_F$	6845	9000	No		
				V_{12}	2102	4400:All	No		
V_{R12}				$V_{FO} = V_F - V_R$	6409	9000	No		
				V_R	436	3800	No		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
$D_R =$ (pc/mi/ln)					$D_R = 10.6$ (pc/mi/ln)				
LOS = (Exhibit 25-4)					LOS = B (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
$M_S =$ (Exhibit 25-19)					$D_s = 0.467$ (Exhibit 25-19)				
$S_R =$ mph (Exhibit 25-19)					$S_R = 48.9$ mph (Exhibit 25-19)				
$S_0 =$ mph (Exhibit 25-19)					$S_0 = 55.0$ mph (Exhibit 25-19)				
$S =$ mph (Exhibit 25-14)					$S = 53.0$ mph (Exhibit 25-15)				



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 WB
Agency or Company	URS	From/To	Atlantic Off / I-710 Off
Date Performed	1/22/2010	Jurisdiction	
Analysis Time Period	MD	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

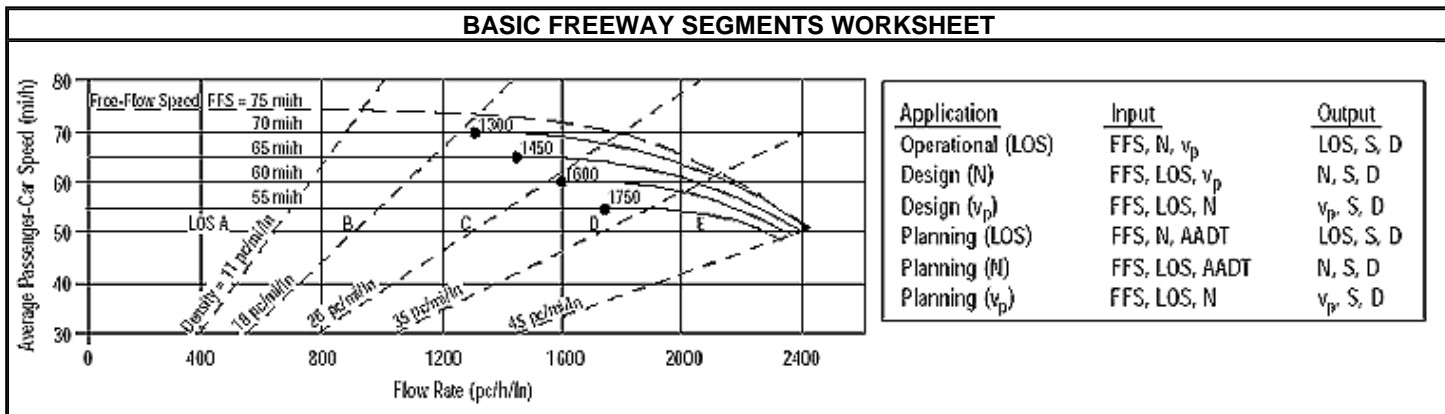
Flow Inputs			
Volume, V	6903	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.926

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 l/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)	1570 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	28.5 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 WB
Agency or Company	URS	From/To	Atlantic Off / I-710 Off
Date Performed	1/22/2010	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

Flow Inputs

Volume, V	7526	veh/h	Peak-Hour Factor, PHF	0.95
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 %	mi
Driver type adjustment	1.00		Up/Down %	

Calculate Flow Adjustments

f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.952

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 l/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)	Design LOS
S	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)
D = v _p / S	S
LOS	D = v _p / S
	Required Number of Lanes, N

Glossary	Factor Location		
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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			

I-710 Corridor Project
Adjacent Freeway Major Diverge Analysis: SR-91
Existing 2008

HCM 2000: Exhibit 25-14. Capacity Values for Diverge Areas

FFS (mi/hr)	Maximum Upstream or Downstream Freeway Flow			
	Number of Lanes in One Direction			
	2	3	4	> 4 (per ln)
55	4500	6750	9000	2250
60	4600	6900	9200	2300
65	4700	7050	9400	2350
70	4800	7200	9600	2400

#7
Year/Time
 2008 AM Peak
Major Diverge Junction
 Freeway (V_F) Diverge Ramp (V_R)
 SR-91 WB I-710

N _{FU}	6	N _R	3
N _{FD}	3	FFS	55

Approach Leg **Diverge Legs**

V _{FU}	8006	V _{FD}	3961
		V _R	4045

Diverge

V _F /C _F	0.29	D _{Upstream}	LOS
V _R /C _R	0.60		23.35 C
V/C	0.59		

#7
Year/Time
 2008 MD Peak
Major Diverge Junction
 Freeway (V_F) Merge Ramp (V_R)
 SR-91 WB I-710

N _{FU}	6	N _R	3
N _{FD}	3	FFS	55

Approach Leg **Diverge Legs**

V _{FU}	7557	V _{FD}	3651
		V _R	3906

Diverge

V _F /C _F	0.27	D _{Upstream}	LOS
V _R /C _R	0.58		22.04 C
V/C	0.56		

#7
Year/Time
 2008 PM Peak
Major Diverge Junction
 Freeway (V_F) Merge Ramp (V_R)
 SR-91 WB I-710

N _{FU}	6	N _R	3
N _{FD}	3	FFS	55

Approach Leg **Diverge Legs**

V _{FU}	8385	V _{FD}	4754
		V _R	3631

Diverge

V _F /C _F	0.35	D _{Upstream}	LOS
V _R /C _R	0.54		24.46 C
V/C	0.62		

BASIC FREEWAY SEGMENTS WORKSHEET																								
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several density curves: 11 pc/mi/h, 18 pc/mi/h, 28 pc/mi/h, 35 pc/mi/h, and 45 pc/mi/h. Regions A, B, C, D, and E are marked along the speed axis. Data points are plotted at (1200, 70), (1450, 65), (1600, 60), and (1750, 55).</p>		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	KT	Highway/Direction of Travel	SR-91 WB																					
Agency or Company	URS	From/To	I-710 Off / I-710 NB On																					
Date Performed	2/16/2010	Jurisdiction																						
Analysis Time Period	PM	Analysis Year	2008																					
Project Description I-710 Corridor Project EIR/EIS																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	4898	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P _T																					
Peak-Hr Prop. of AADT, K			%RVs, P _R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f _p	1.00	E _R	1.2																					
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.952																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f _{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f _{LC}																					
Interchange Density	0.50	l/mi	f _{ID}																					
Number of Lanes, N	3		f _N																					
FFS (measured)	66.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	66.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1805	pc/h/ln	Design LOS																					
S	64.7	mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)																					
D = v _p / S	27.9	pc/mi/ln	S																					
LOS	D		D = v _p / S																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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																								

**I-710 Corridor Project
Adjacent Freeway Major Merge Analysis: SR-91
Existing 2008**

HCM 2000: Exhibit 25-7. Capacity Values for Merge Areas

FFS (mi/hr)	Maximum Downstream Freeway Flow, v (pc/h)			
	Number of Lanes in One Direction			
	2	3	4	> 4 (per ln)
55	4500	6750	9000	2250
60	4600	6900	9200	2300
65	4700	7050	9400	2350
70	4800	7200	9600	2400

**#9
Year/Time**

2008 AM Peak

Major Merge Junction

Freeway (V_F)	Merge Ramp (V_R)	
SR-91 WB	Atlantic/I-710 NB On	
N_F	3	N_R 2
FFS	55	N_{FD} 4
Merge Legs		Departure Leg
V_F	4851	V_{F+R} 6104
V_R	1253	
Merge		
$C_{downstream}$	V_F/C_F	V_R/C_R V/C
9000	0.72	0.28 0.68

**#9
Year/Time**

2008 MD Peak

Major Merge Junction

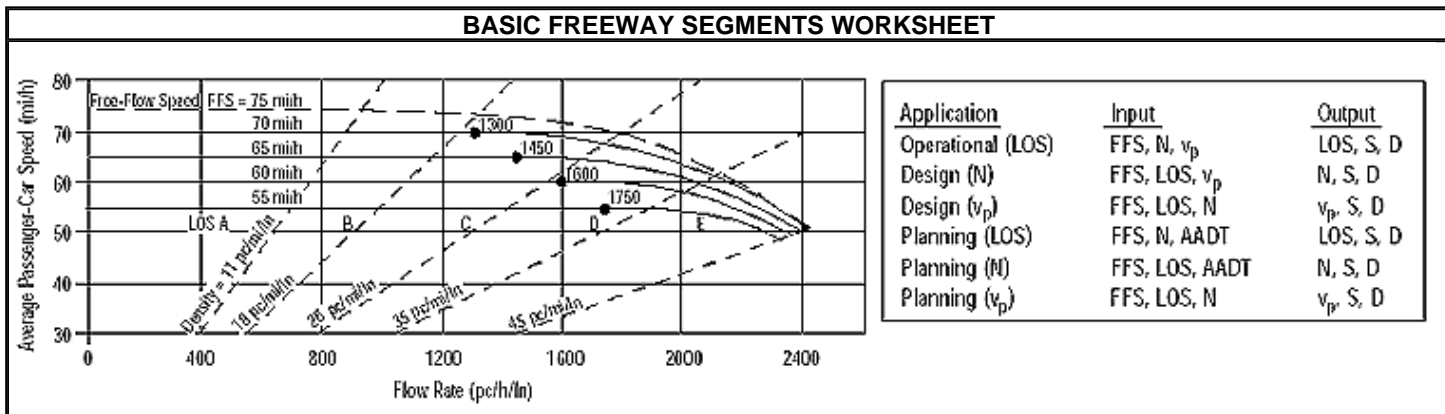
Freeway (V_F)	Merge Ramp (V_R)	
SR-91 WB	Atlantic/I-710 NB On	
N_F	3	N_R 2
FFS	55	N_{FD} 4
Merge Legs		Departure Leg
V_F	5007	V_{F+R} 5970
V_R	963	
Merge		
$C_{downstream}$	V_F/C_F	V_R/C_R V/C
9000	0.74	0.21 0.66

**#9
Year/Time**

2008 PM Peak

Major Merge Junction

Freeway (V_F)	Merge Ramp (V_R)	
SR-91 WB	Atlantic/I-710 NB On	
N_F	3	N_R 2
FFS	55	N_{FD} 4
Merge Legs		Departure Leg
V_F	5285	V_{F+R} 6175
V_R	890	
Merge		
$C_{downstream}$	V_F/C_F	V_R/C_R V/C
9000	0.78	0.20 0.69



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 WB
Agency or Company	URS	From/To	I-710 NB On / I-710 SB On
Date Performed	1/22/2010	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

Flow Inputs			
Volume, V	5723	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P_T
Peak-Hr Prop. of AADT, K			%RVs, P_R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f_p	1.00	E_R	1.2
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.952

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 l/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		

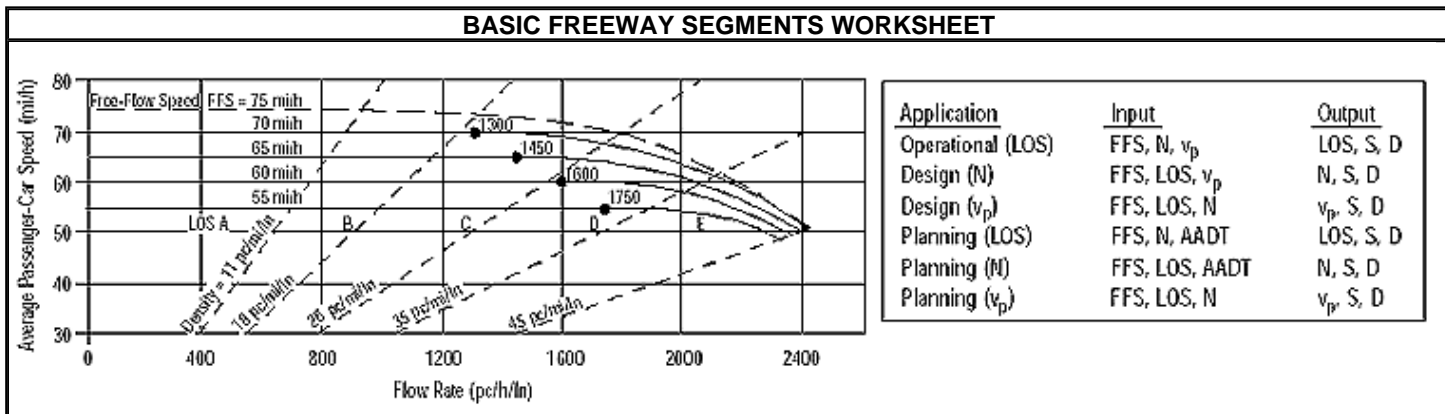
LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1581 pc/h/ln	Design LOS	
S	55.0 mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h
$D = v_p / S$	28.7 pc/mi/ln	S	mi/h
LOS	D	$D = v_p / S$	pc/mi/ln
		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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			

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 WB			
Agency/Company	URS				Weaving Seg Location	710 SB On/Long Beach Off			
Date Performed	1/22/2010				Jurisdiction	Caltrans			
Analysis Time Period	AM				Analysis Year	Existing 2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	C			
Weaving number of lanes, N	5				Volume ratio, VR	0.45			
Weaving seg length, L (ft)	972				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
V_{o1}	3612	0.96	11	0	2.0	1.2	0.901	1.00	4176
V_{o2}	490	0.96	11	0	2.0	1.2	0.901	1.00	566
V_{w1}	954	0.96	11	0	2.0	1.2	0.901	1.00	1103
V_{w2}	2341	0.96	11	0	2.0	1.2	0.901	1.00	2706
V_w				3809	V_{nw}				4742
V									8551
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)					2.30		6.00		
c (Exhibit 24-6)					0.80		1.10		
d (Exhibit 24-6)					0.60		0.60		
Weaving intensity factor, W_i					2.03		0.53		
Weaving and non-weaving speeds, S_i (mi/h)					29.84		44.42		
Number of lanes required for unconstrained operation, Nw					3.35				
Maximum number of lanes, Nw (max)					3.00				
<input type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input checked="" type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)					36.48				
Weaving segment density, D (pc/mi/ln)					46.88				
Level of service, LOS					F				
Capacity of base condition, c_b (pc/h)					7712				
Capacity as a 15-minute flow rate, c (veh/h)					6948				
Capacity as a full-hour volume, c_h (veh/h)					6670				
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 WB			
Agency/Company	URS				Weaving Seg Location	710 SB On/Long Beach Off			
Date Performed	1/22/2010				Jurisdiction	Caltrans			
Analysis Time Period	MD				Analysis Year	Existing 2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	C			
Weaving number of lanes, N	5				Volume ratio, VR	0.30			
Weaving seg length, L (ft)	972				Weaving ratio, R	0.10			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	4346	0.94	18	0	2.0	1.2	0.847	1.00	5455
V_{o2}	65	0.94	18	0	2.0	1.2	0.847	1.00	81
V_{w1}	199	0.94	18	0	2.0	1.2	0.847	1.00	249
V_{w2}	1732	0.94	18	0	2.0	1.2	0.847	1.00	2174
V_w				2423	V_{nw}				5536
V									7959
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)					2.30		6.00		
c (Exhibit 24-6)					0.80		1.10		
d (Exhibit 24-6)					0.60		0.60		
Weaving intensity factor, W_i					1.52		0.26		
Weaving and non-weaving speeds, S_i (mi/h)					32.89		50.59		
Number of lanes required for unconstrained operation, Nw					3.21				
Maximum number of lanes, Nw (max)					3.00				
<input type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input checked="" type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)					43.47				
Weaving segment density, D (pc/mi/ln)					36.62				
Level of service, LOS					E				
Capacity of base condition, c_b (pc/h)					9083				
Capacity as a 15-minute flow rate, c (veh/h)					7697				
Capacity as a full-hour volume, c_h (veh/h)					7235				
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 WB			
Agency/Company	URS				Weaving Seg Location	710 SB On/Long Beach Off			
Date Performed	1/22/2010				Jurisdiction	Caltrans			
Analysis Time Period	PM				Analysis Year	Existing 2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	C			
Weaving number of lanes, N	5				Volume ratio, VR	0.27			
Weaving seg length, L (ft)	972				Weaving ratio, R	0.11			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	4586	0.97	10	0	2.0	1.2	0.909	1.00	5200
V_{o2}	50	0.97	10	0	2.0	1.2	0.909	1.00	56
V_{w1}	183	0.97	10	0	2.0	1.2	0.909	1.00	207
V_{w2}	1523	0.97	10	0	2.0	1.2	0.909	1.00	1727
V_w				1934	V_{nw}				5256
V									7190
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)					2.30		6.00		
c (Exhibit 24-6)					0.80		1.10		
d (Exhibit 24-6)					0.60		0.60		
Weaving intensity factor, W_i					1.31		0.20		
Weaving and non-weaving speeds, S_i (mi/h)					34.47		52.49		
Number of lanes required for unconstrained operation, Nw					3.17				
Maximum number of lanes, Nw (max)					3.00				
<input type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input checked="" type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)					46.02				
Weaving segment density, D (pc/mi/ln)					31.25				
Level of service, LOS					D				
Capacity of base condition, c_b (pc/h)					9409				
Capacity as a 15-minute flow rate, c (veh/h)					8554				
Capacity as a full-hour volume, c_h (veh/h)					8297				
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.									



General Information		Site Information	
Analyst	KK	Highway/Direction of Travel	SR-91 WB
Agency or Company	URS	From/To	Long Beach Off/Long Beach On
Date Performed	8/5/2008	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

Flow Inputs

Volume, V	5399	veh/h	Peak-Hour Factor, PHF	0.97
AADT		veh/day	%Trucks and Buses, P _T	10
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	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.909

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	5	f _N	mi/h
FFS (measured)	69.0 mi/h	FFS	69.0 mi/h
Base free-flow Speed, BFFS	mi/h		

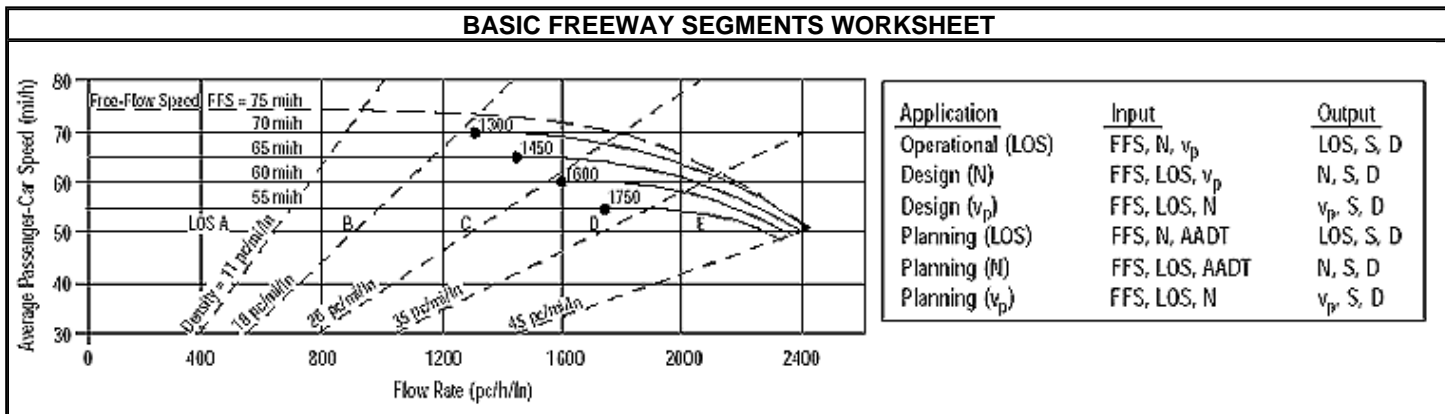
LOS and Performance Measures	Design (N)
Operational (LOS)	Design (N)
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	Design LOS
S	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)
D = v _p / S	S
LOS	D = v _p / S
	Required Number of Lanes, N

Glossary	Factor Location		
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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			

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 WB			
Agency/Company	URS				Weaving Seg Location	Long Beach On / Santa Fe Off			
Date Performed	2/9/2010				Jurisdiction				
Analysis Time Period	AM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	C			
Weaving number of lanes, N	5				Volume ratio, VR	0.24			
Weaving seg length, L (ft)	1480				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
V_{o1}	3441	0.96	11	0	2.0	1.2	0.901	1.00	3978
V_{o2}	0	0.96	11	0	2.0	1.2	0.901	1.00	0
V_{w1}	788	0.96	11	0	2.0	1.2	0.901	1.00	911
V_{w2}	295	0.96	11	0	2.0	1.2	0.901	1.00	341
V_w				1252	V_{nw}				3978
V									5230
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)	2.30		6.00						
c (Exhibit 24-6)	0.80		1.10						
d (Exhibit 24-6)	0.60		0.60						
Weaving intensity factor, W_i	0.43		0.19						
Weaving and non-weaving speeds, S_i (mi/h)	46.52		52.80						
Number of lanes required for unconstrained operation, Nw					2.89				
Maximum number of lanes, Nw (max)					3.00				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	51.15								
Weaving segment density, D (pc/mi/ln)	20.45								
Level of service, LOS	C								
Capacity of base condition, c_b (pc/h)	9886								
Capacity as a 15-minute flow rate, c (veh/h)	8906								
Capacity as a full-hour volume, c_h (veh/h)	8550								
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst		KT			Freeway/Dir of Travel		SR-91 WB		
Agency/Company		URS			Weaving Seg Location		Long Beach On / Santa Fe Off		
Date Performed		2/9/2010			Jurisdiction				
Analysis Time Period		MD			Analysis Year		2008		
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)		55			Weaving type		C		
Weaving number of lanes, N		5			Volume ratio, VR		0.33		
Weaving seg length, L (ft)		1480			Weaving ratio, R		0.17		
Terrain		Level							
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	2460	0.94	18	0	2.0	1.2	0.847	1.00	3088
V_{o2}	0	0.94	18	0	2.0	1.2	0.847	1.00	0
V_{w1}	1028	0.94	18	0	2.0	1.2	0.847	1.00	1290
V_{w2}	208	0.94	18	0	2.0	1.2	0.847	1.00	261
V_w				1551	V_{nw}				3088
V									4639
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)	2.30		6.00						
c (Exhibit 24-6)	0.80		1.10						
d (Exhibit 24-6)	0.60		0.60						
Weaving intensity factor, W_i	0.46		0.26						
Weaving and non-weaving speeds, S_i (mi/h)	45.82		50.72						
Number of lanes required for unconstrained operation, Nw					2.95				
Maximum number of lanes, Nw (max)					3.00				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)					48.97				
Weaving segment density, D (pc/mi/ln)					18.95				
Level of service, LOS					B				
Capacity of base condition, c_b (pc/h)					9178				
Capacity as a 15-minute flow rate, c (veh/h)					7778				
Capacity as a full-hour volume, c_h (veh/h)					7311				
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.									

FREEWAY WEAVING WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	SR-91 WB			
Agency/Company	URS				Weaving Seg Location	Long Beach On / Santa Fe Off			
Date Performed	2/9/2010				Jurisdiction				
Analysis Time Period	PM				Analysis Year	2008			
Inputs									
Freeway free-flow speed, S_{FF} (mi/h)	55				Weaving type	C			
Weaving number of lanes, N	5				Volume ratio, VR	0.35			
Weaving seg length, L (ft)	1480				Weaving ratio, R	0.17			
Terrain	Level								
Conversions to pc/h Under Base Conditions									
(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	2413	0.97	10	0	2.0	1.2	0.909	1.00	2736
V_{o2}	0	0.97	10	0	2.0	1.2	0.909	1.00	0
V_{w1}	1095	0.97	10	0	2.0	1.2	0.909	1.00	1241
V_{w2}	230	0.97	10	0	2.0	1.2	0.909	1.00	260
V_w				1501	V_{nw}				2736
V									4237
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)	2.30		6.00						
c (Exhibit 24-6)	0.80		1.10						
d (Exhibit 24-6)	0.60		0.60						
Weaving intensity factor, W_i	0.44		0.26						
Weaving and non-weaving speeds, S_i (mi/h)	46.19		50.80						
Number of lanes required for unconstrained operation, Nw					2.96				
Maximum number of lanes, Nw (max)					3.00				
<input checked="" type="checkbox"/> If $Nw < Nw(max)$ unconstrained operation					<input type="checkbox"/> if $Nw > Nw(max)$ constrained operation				
Weaving Segment Speed, Density, Level of Service, and Capacity									
Weaving segment speed, S (mi/h)	49.06								
Weaving segment density, D (pc/mi/ln)	17.27								
Level of service, LOS	B								
Capacity of base condition, c_b (pc/h)	9043								
Capacity as a 15-minute flow rate, c (veh/h)	8221								
Capacity as a full-hour volume, c_h (veh/h)	7974								
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.									



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 WB
Agency or Company	URS	From/To	Atlantic Off / I-710 Off
Date Performed	02/02/2010	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

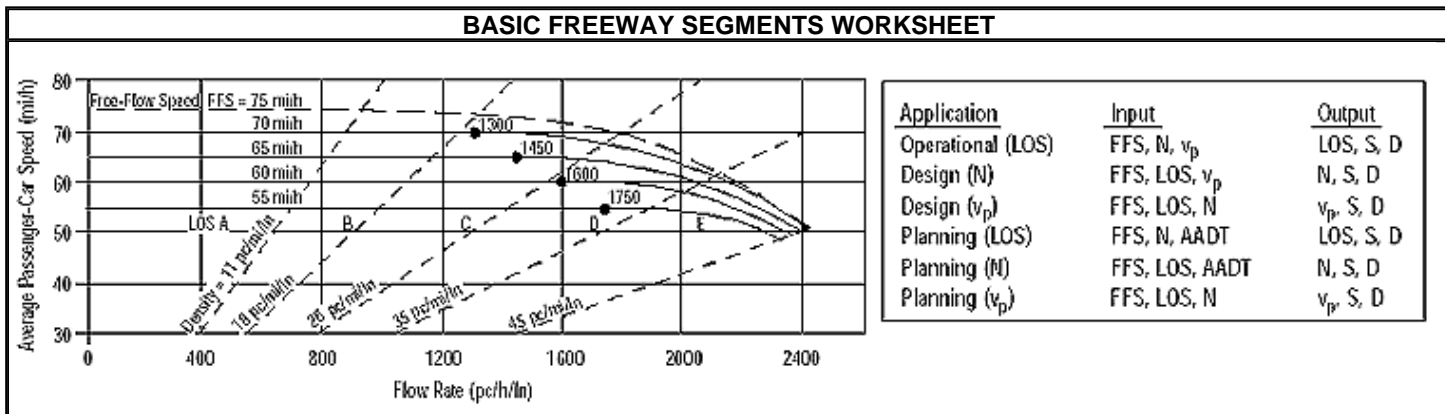
Flow Inputs			
Volume, V	6461	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f_p	1.00	E_R	1.2
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.901

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 l/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)	
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1868 pc/h/ln	Design LOS	
S	54.9 mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h
$D = v_p / S$	34.0 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 WB
Agency or Company	URS	From/To	Atlantic Off / I-710 Off
Date Performed	02/02/2010	Jurisdiction	
Analysis Time Period	MD	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

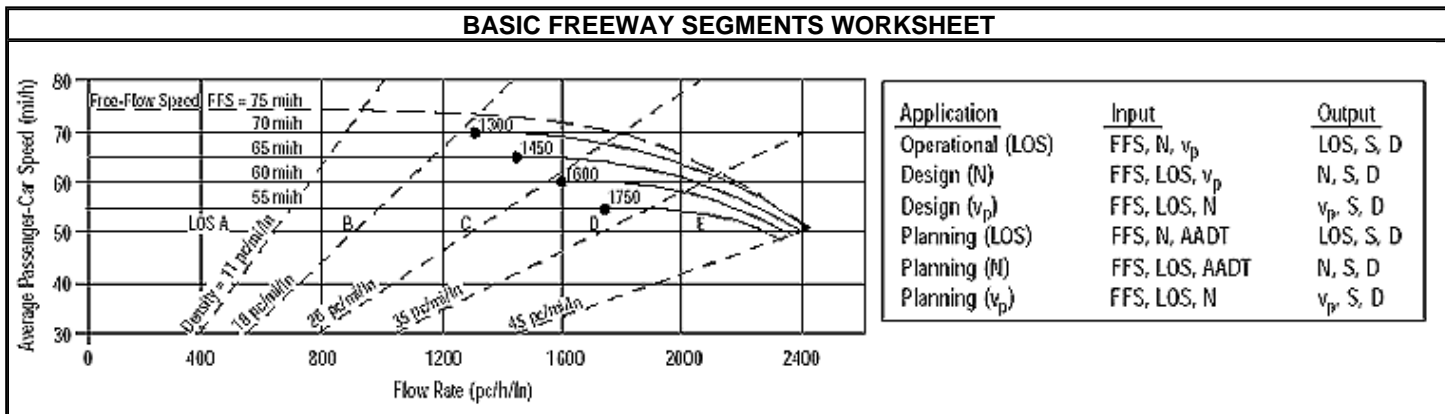
Flow Inputs			
Volume, V	4685	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.847

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 l/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)	1470 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	26.7 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	SR-91 WB
Agency or Company	URS	From/To	Atlantic Off / I-710 Off
Date Performed	02/02/2010	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

Flow Inputs			
Volume, V	4534	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f_p	1.00	E_R	1.2
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.909

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 l/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)	
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1285 pc/h/ln	Design LOS	
S	55.0 mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h
$D = v_p / S$	23.4 pc/mi/ln	S	mi/h
LOS	C	$D = v_p / S$	pc/mi/ln
		Required Number of Lanes, N	

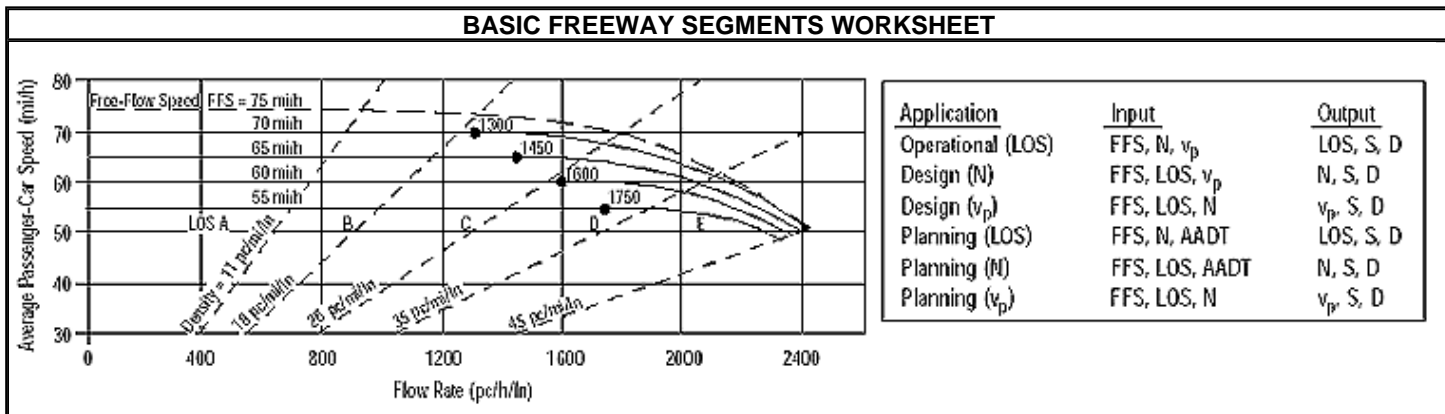
Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base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



I-105 EXISTING CONDITIONS ANALYSIS



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General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	Harris
Date Performed	2/16/2010	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

Flow Inputs			
Volume, V	6064	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

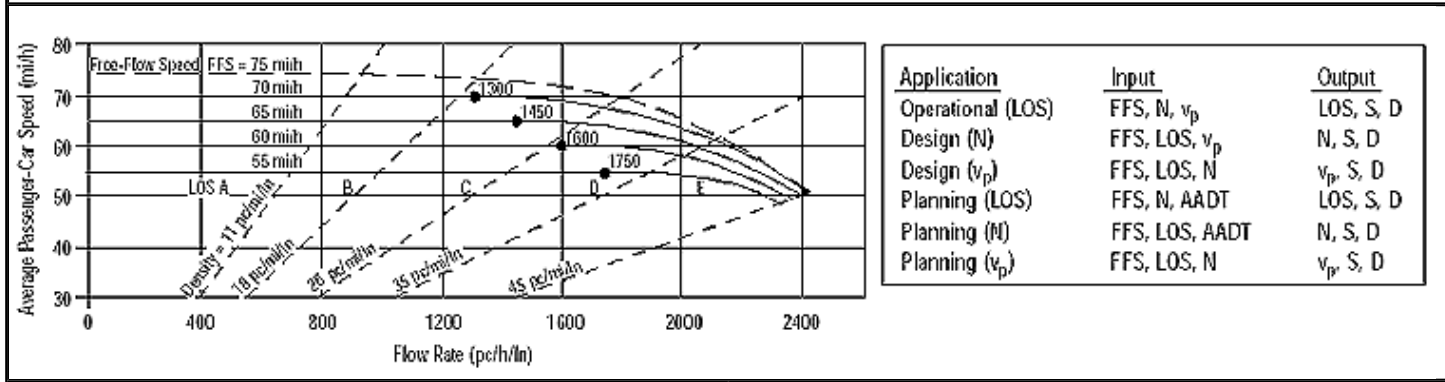
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.943

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	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)	2209 pc/h/ln	Design LOS	
S	51.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	43.3 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 - Exhibits 23-8, 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			

BASIC FREEWAY SEGMENTS WORKSHEET



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	Harris
Date Performed	2/16/2010	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

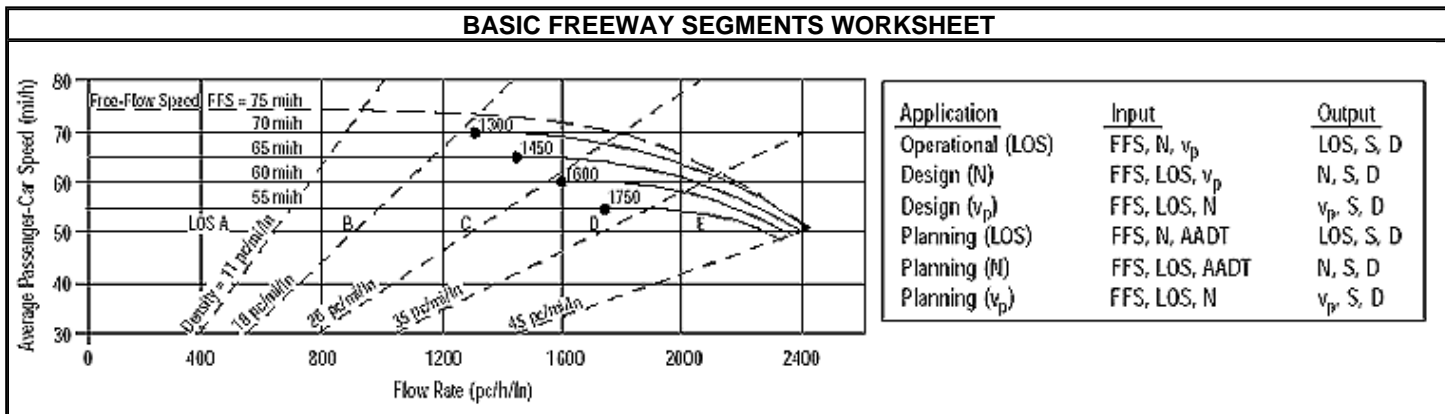
Flow Inputs			
Volume, V	5959	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.901

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	f _N	mi/h
FFS (measured)	55.0 mi/h	FFS	55.0 mi/h
Base free-flow Speed, BFFS			

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	2297 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	Harris
Date Performed	2/16/2010	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

Flow Inputs

Volume, V	5879	veh/h	Peak-Hour Factor, PHF	0.98
AADT		veh/day	%Trucks and Buses, P _T	7
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

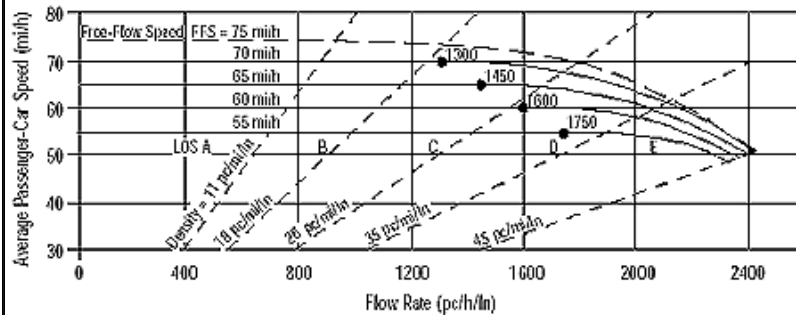
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.935

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	f _N	mi/h
FFS (measured)	55.0 mi/h	FFS	55.0 mi/h
Base free-flow Speed, BFFS			

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	2140 pc/h/ln	Design LOS	
S	52.4 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	40.9 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	Harris
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	6064	veh/h	Peak-Hour Factor, PHF 0.97
AADT		veh/day	%Trucks and Buses, P _T 6
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 %

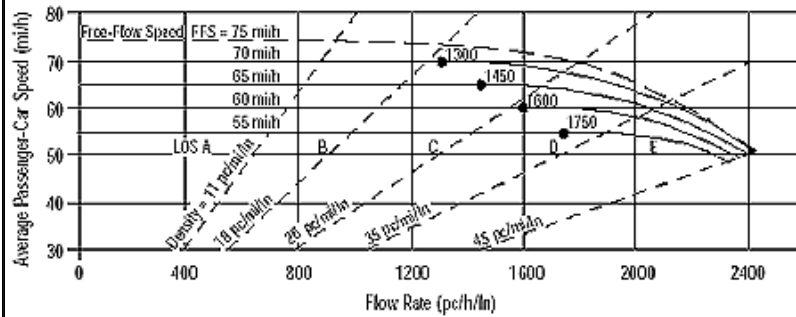
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.943

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 l/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)	1657 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	30.1 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	Harris
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	5959	veh/h	Peak-Hour Factor, PHF 0.96
AADT		veh/day	%Trucks and Buses, P _T 11
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 %

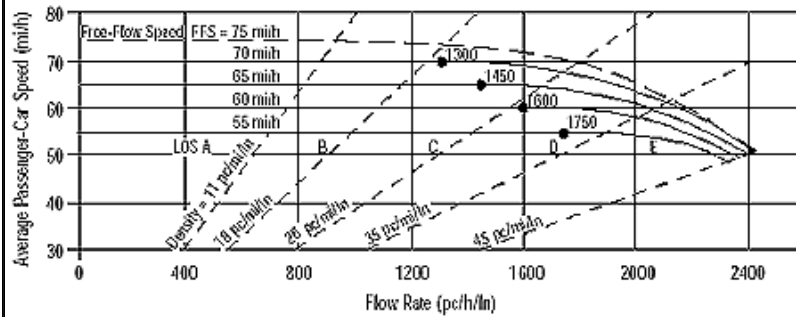
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.901

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 l/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)	1723 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	31.3 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	Harris
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	5879	veh/h	Peak-Hour Factor, PHF 0.98
AADT		veh/day	%Trucks and Buses, P _T 7
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	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.935

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 l/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)	1605 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	29.2 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 - Exhibits 23-8, 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			

I-710 Corridor Project
Adjacent Freeway Major Diverge Analysis: I-105
Existing 2008

HCM 2000: Exhibit 25-14. Capacity Values for Diverge Areas

FFS (mi/hr)	Maximum Upstream or Downstream Freeway Flow			
	Number of Lanes in One Direction			
	2	3	4	> 4 (per ln)
55	4500	6750	9000	2250
60	4600	6900	9200	2300
65	4700	7050	9400	2350
70	4800	7200	9600	2400

#4
Year/Time
 2008 AM Peak
Major Diverge Junction

Freeway (V_F)	I-105 EB	Diverge Ramp (V_R)	I-710 Off
N_{FU}	4	N_R	2
N_{FD}	3	FFS	66
Approach Leg		Diverge Legs	
V_{FU}	6627	V_{FD}	5075
		V_R	1552
Diverge			
V_F/C_F	0.54	$D_{Upstream}$	LOS
V_R/C_R	0.33	28.99	D
V/C	0.71		

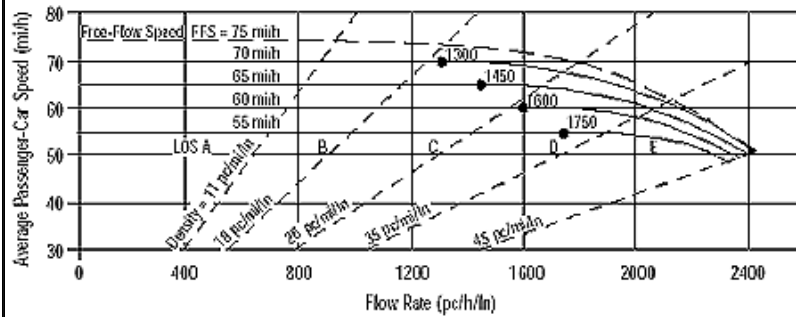
#4
Year/Time
 2008 MD Peak
Major Diverge Junction

Freeway (V_F)	I-105 EB	Merge Ramp (V_R)	I-710 Off
N_{FU}	4	N_R	2
N_{FD}	3	FFS	68
Approach Leg		Diverge Legs	
V_{FU}	6890	V_{FD}	4081
		V_R	2809
Diverge			
V_F/C_F	0.43	$D_{Upstream}$	LOS
V_R/C_R	0.60	30.14	D
V/C	0.73		

#4
Year/Time
 2008 PM Peak
Major Diverge Junction

Freeway (V_F)	I-105 EB	Merge Ramp (V_R)	I-710 Off
N_{FU}	4	N_R	2
N_{FD}	3	FFS	65
Approach Leg		Diverge Legs	
V_{FU}	6419	V_{FD}	4702
		V_R	1717
Diverge			
V_F/C_F	0.50	$D_{Upstream}$	LOS
V_R/C_R	0.37	28.08	D
V/C	0.68		

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	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	Wright
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	4188	veh/h	Peak-Hour Factor, PHF 0.97
AADT		veh/day	%Trucks and Buses, P _T 6
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 %

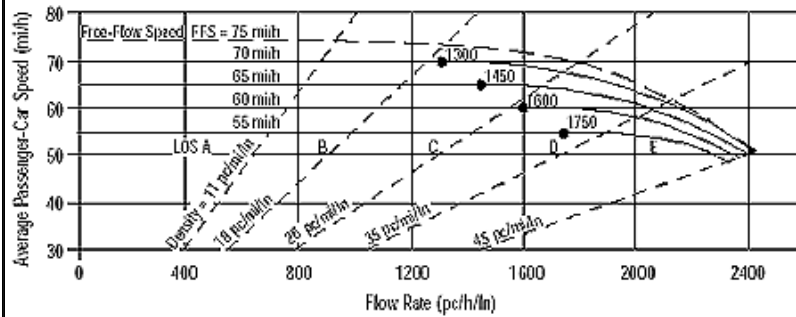
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.943

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	f _N	mi/h
FFS (measured)	68.0 mi/h	FFS	68.0 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	67.9 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	22.5 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	Wright
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	3770	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

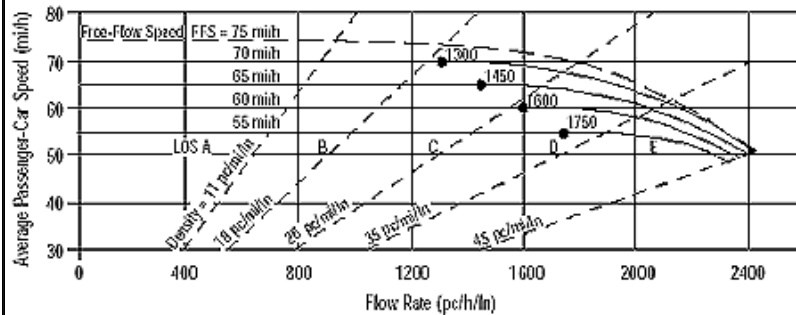
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.901

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	f _N	mi/h
FFS (measured)	68.0 mi/h	FFS	68.0 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)	1453 pc/h/ln	Design LOS	
S	68.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	21.4 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	Wright
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	3849	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.935

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	f _N	mi/h
FFS (measured)	67.0 mi/h	FFS	67.0 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)	1401 pc/h/ln	Design LOS	
S	67.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	20.9 pc/mi/ln	S	mi/h
LOS	C	D = v _p / S	pc/mi/ln
		Required Number of Lanes, N	

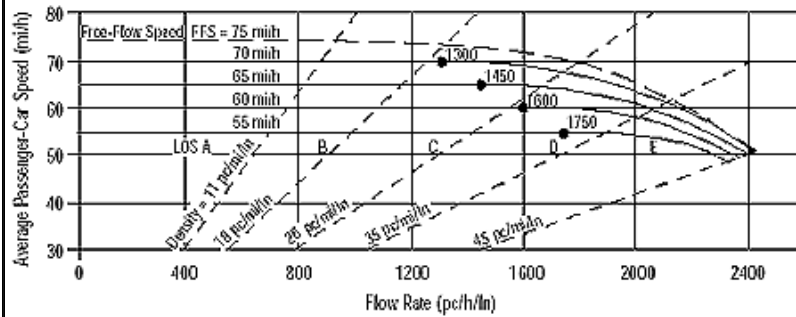
Glossary		Factor Location	
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 23-10	f _{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E _T - Exhibits 23-8, 23-10, 23-11	f _{LC} - Exhibit 23-5
v _p - Flow rate	FFS - Free-flow speed	f _p - Page 23-12	f _N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v _p - Exhibits 23-2, 23-3	f _{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-105 EB						
Agency or Company	URS	Junction	Garfield Off						
Date Performed	8/21/2008	Jurisdiction	Caltrans						
Analysis Time Period	AM	Analysis Year	2008						
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level			Downstream Adj Ramp				
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off					<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off				
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 35.0 mph			L _{down} = ft				
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)			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 x f _{HV} x f _p	
Freeway	4188	0.96	Level	5	0	0.952	1.00	4581	
Ramp	853	0.96	Level	5	0	0.952	1.00	933	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
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 (Exhibit 25-5)					P _{FD} = 0.450 using Equation (Exhibit 25-11)				
V ₁₂ = pc/h					V ₁₂ = 2575 pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?			Actual	Maximum	LOS F?	
V _{FO}					V _{FI} = V _F	4581	6750	No	
					V ₁₂	2575	4400:All	No	
V _{R12}					V _{FO} = V _F -	3648	6750	No	
					V _R	933	3800	No	
Level of Service Determination (if not F)					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 = 4.252 + 0.0086 V ₁₂ - 0.0009 L _D				
D _R = (pc/mi/ln)					D _R = 11.3 (pc/mi/ln)				
LOS = (Exhibit 25-4)					LOS = B (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = (Exhibit 25-19)					D _s = 0.512 (Exhibit 25-19)				
S _R = mph (Exhibit 25-19)					S _R = 48.3 mph (Exhibit 25-19)				
S ₀ = mph (Exhibit 25-19)					S ₀ = 56.4 mph (Exhibit 25-19)				
S = mph (Exhibit 25-14)					S = 51.6 mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-105 EB						
Agency or Company	URS	Junction	Garfield Off						
Date Performed	8/21/2008	Jurisdiction	Caltrans						
Analysis Time Period	MD	Analysis Year	2008						
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level			Downstream Adj Ramp				
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off					<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off				
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 35.0 mph			L _{down} = ft				
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)			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 x f _{HV} x f _p	
Freeway	3770	0.96	Level	9	0	0.917	1.00	4281	
Ramp	678	0.95	Level	9	0	0.917	1.00	778	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
L _{EQ} = (Equation 25-2 or 25-3)					L _{EQ} = (Equation 25-8 or 25-9)				
P _{FM} = using Equation (Exhibit 25-5)					P _{FD} = 0.450 using Equation (Exhibit 25-11)				
V ₁₂ = pc/h					V ₁₂ = 2354 pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V _{FO}				V _{FI} = V _F	4281	6750	No		
				V ₁₂	2354	4400:All	No		
V _{R12}				V _{FO} = V _F -	3503	6750	No		
				V _R	778	3800	No		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
D _R = (pc/mi/ln)					D _R = 9.4 (pc/mi/ln)				
LOS = (Exhibit 25-4)					LOS = A (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = (Exhibit 25-19)					D _s = 0.498 (Exhibit 25-19)				
S _R = mph (Exhibit 25-19)					S _R = 48.5 mph (Exhibit 25-19)				
S ₀ = mph (Exhibit 25-19)					S ₀ = 56.7 mph (Exhibit 25-19)				
S = mph (Exhibit 25-14)					S = 51.9 mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-105 EB						
Agency or Company	URS	Junction	Garfield Off						
Date Performed	8/21/2008	Jurisdiction	Caltrans						
Analysis Time Period	PM	Analysis Year	2008						
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level			Downstream Adj Ramp				
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off					<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off				
$L_{up} =$	ft	$S_{FF} = 55.0$ mph			$S_{FR} = 35.0$ mph		$L_{down} =$	ft	
$V_u =$	veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)							
$V_D =$	veh/h								
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	3849	0.98	Level	3	0	0.971	1.00	4045	
Ramp	918	0.98	Level	3	0	0.971	1.00	965	
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 (Exhibit 25-5)					$P_{FD} = 0.450$ using Equation (Exhibit 25-11)				
$V_{12} =$ pc/h					$V_{12} = 2351$ pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V_{FO}				$V_{FI} = V_F$	4045	6750	No		
				V_{12}	2351	4400:All	No		
V_{R12}				$V_{FO} = V_F -$	3080	6750	No		
				V_R	965	3800	No		
				V_R	965	3800	No		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
$D_R =$ (pc/mi/ln)					$D_R = 9.4$ (pc/mi/ln)				
LOS = (Exhibit 25-4)					LOS = A (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
$M_s =$ (Exhibit 25-19)					$D_s = 0.515$ (Exhibit 25-19)				
$S_R =$ mph (Exhibit 25-19)					$S_R = 48.3$ mph (Exhibit 25-19)				
$S_0 =$ mph (Exhibit 25-19)					$S_0 = 57.6$ mph (Exhibit 25-19)				
$S =$ mph (Exhibit 25-14)					$S = 51.8$ mph (Exhibit 25-15)				

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	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	West of Garfield
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008

Project Description LAMTA I-710 PA-ED

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

Flow Inputs			
Volume, V	3462	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

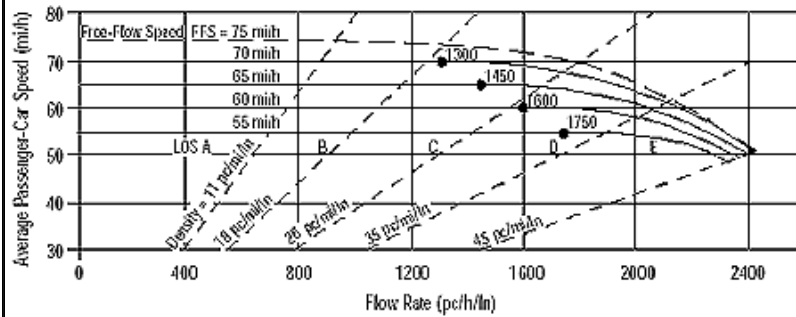
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.952

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	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)	1262 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	22.9 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	West of Garfield
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period		Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

<input checked="" type="checkbox"/> Oper.(LOS)	<input type="checkbox"/> Des.(N)	<input type="checkbox"/> Planning Data
------------------------------------------------	----------------------------------	----------------------------------------

Flow Inputs			
Volume, V	3362	veh/h	Peak-Hour Factor, PHF 0.95
AADT		veh/day	%Trucks and Buses, P _T 9
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 %

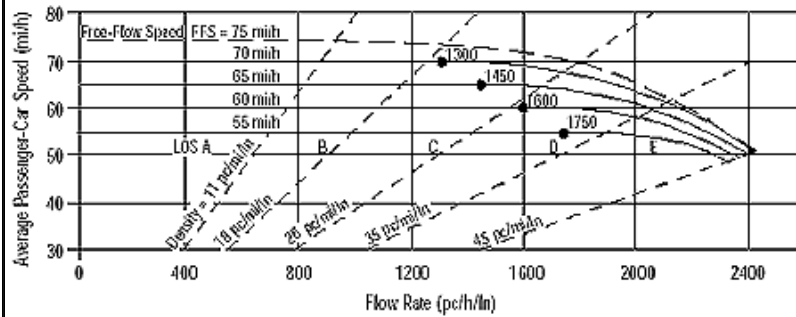
Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.917

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	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)	1286 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	23.4 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 - Exhibits 23-8, 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			

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	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	West of Garfield
Date Performed	8/20/2008	Jurisdiction	Caltrans
Analysis Time Period		Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

<input checked="" type="checkbox"/> Oper.(LOS)	<input type="checkbox"/> Des.(N)	<input type="checkbox"/> Planning Data
------------------------------------------------	----------------------------------	----------------------------------------

Flow Inputs			
Volume, V	3214	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00		E _R
E _T	2.0		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	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)	1126 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	20.5 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 - Exhibits 23-8, 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			

**I-710 Corridor Project
Adjcent Freeway Major Merge Analysis: I-105
Existing 2008**

HCM 2000: Exhibit 25-7. Capacity Values for Merge Areas

FFS (mi/hr)	Maximum Downstream Freeway Flow, v (pc/h)			
	Number of Lanes in One Direction			
	2	3	4	> 4 (per ln)
55	4500	6750	9000	2250
60	4600	6900	9200	2300
65	4700	7050	9400	2350
70	4800	7200	9600	2400

**#8
Year/Time
2008 AM Peak**

Major Merge Junction

Freeway (V_F) I-105 EB	Merge Ramp (V_R) I-710 NB
N_{FU} 3	N_R 2
FFS 63	N_{FD} 5

Merge Legs	Departure Leg
V_F 3787	V_{F+R} 4821
V_R 1034	

Merge

$C_{downstream}$	V_F/C_F	V_R/C_R	V/C
11500	0.55	0.22	0.42

**#8
Year/Time
2008 MD Peak**

Major Merge Junction

Freeway (V_F) I-105 EB	Merge Ramp (V_R) I-710 NB
N_{FU} 3	N_R 2
FFS 69	N_{FD} 5

Merge Legs	Departure Leg
V_F 3857	V_{F+R} 4665
V_R 808	

Merge

$C_{downstream}$	V_F/C_F	V_R/C_R	V/C
11750	0.55	0.17	0.40

**#8
Year/Time
2008 PM Peak**

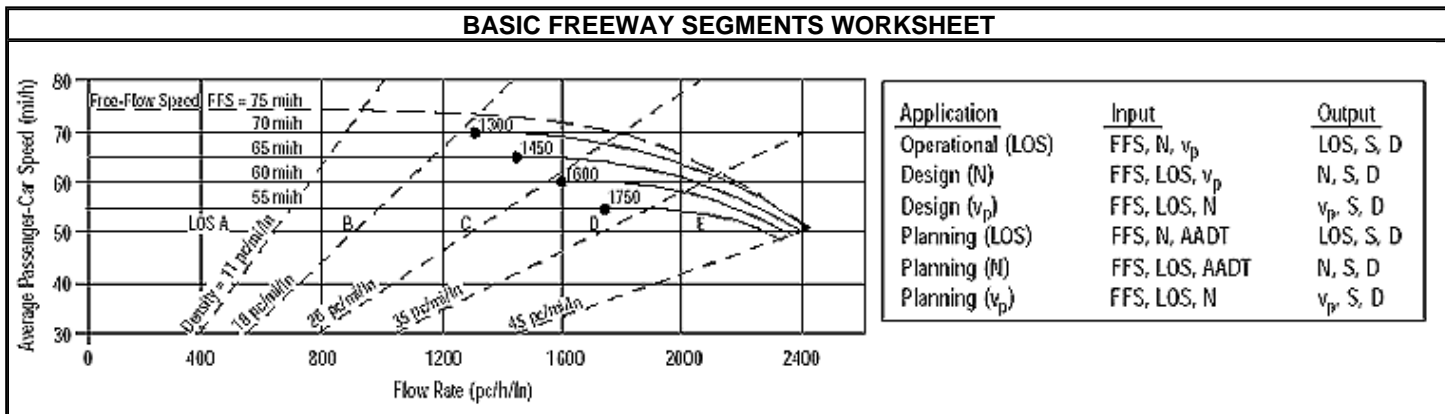
Major Merge Junction

Freeway (V_F) I-105 EB	Merge Ramp (V_R) I-710 NB
N_{FU} 3	N_R 2
FFS 55	N_{FD} 5

Merge Legs	Departure Leg
V_F 3378	V_{F+R} 4094
V_R 716	

Merge

$C_{downstream}$	V_F/C_F	V_R/C_R	V/C
11250	0.50	0.16	0.36



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	I-710 NB On / I-710 SB On
Date Performed	1/26/2010	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

Flow Inputs				
Volume, V	4407	veh/h	Peak-Hour Factor, PHF	0.96
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	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.952

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 l/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		

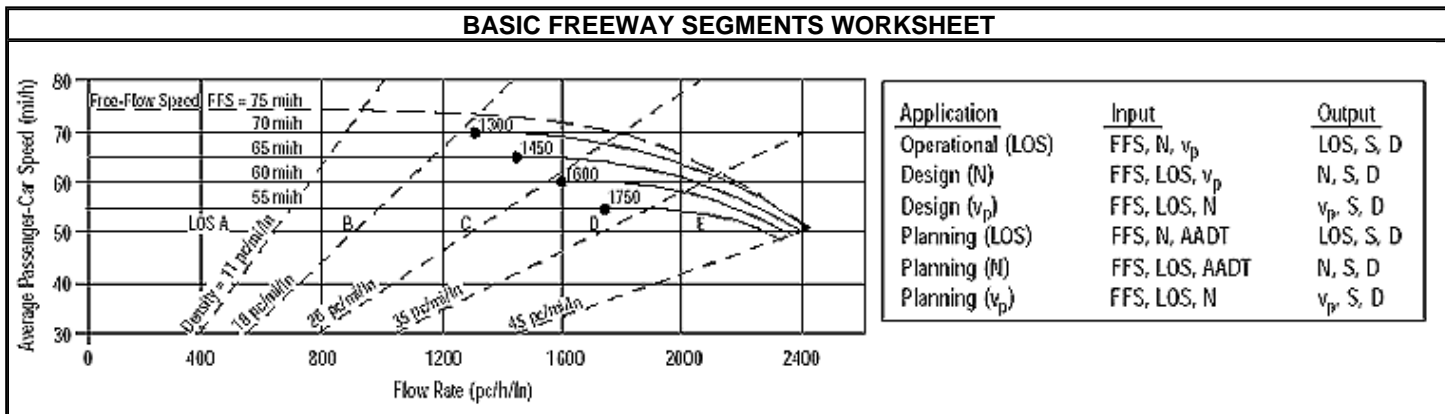
LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	964 pc/h/ln	Design LOS	
S	55.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	17.5 pc/mi/ln	S	mi/h
LOS	B	D = v _p / S	pc/mi/ln
		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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			

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-105 EB		Agency or Company	URS	Junction	I-710 SB On	
Date Performed	8/21/2008	Jurisdiction	Caltrans		Analysis Time Period	AM	Analysis Year	2008	
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> On						<input type="checkbox"/> Yes	<input type="checkbox"/> On	
<input type="checkbox"/> No	<input type="checkbox"/> Off						<input checked="" type="checkbox"/> No	<input type="checkbox"/> Off	
$L_{up} =$	460 ft						$L_{down} =$	ft	
$V_u =$	945 veh/h	$S_{FF} = 63.0$ 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	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	4407	0.96	Level	5	0	0.952	1.00	4820	
Ramp	1058	0.96	Level	5	0	0.952	1.00	1157	
UpStream	945	0.96	Level	5	0	0.952	1.00	1034	
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)				
$P_{FM} = 0.264$ using Equation (Exhibit 25-5)					$P_{FD} =$ using Equation (Exhibit 25-11)				
$V_{12} = 994$ pc/h					$V_{12} =$ pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V_{FO}	4917	See Exhibit 25-7	No	$V_{FI} = V_F$					
				V_{12}					
V_{R12}	2151	4600:All	No	$V_{FO} = V_F -$					
				V_R					
				V_R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
$D_R = 18.0$ (pc/mi/ln)					$D_R =$ (pc/mi/ln)				
LOS = B (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
$M_S = 0.313$ (Exhibit 25-19)					$D_s =$ (Exhibit 25-19)				
$S_R = 56.4$ mph (Exhibit 25-19)					$S_R =$ mph (Exhibit 25-19)				
$S_0 = 59.8$ mph (Exhibit 25-19)					$S_0 =$ mph (Exhibit 25-19)				
$S = 58.3$ mph (Exhibit 25-14)					$S =$ mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET											
General Information				Site Information							
Analyst	KT	Freeway/Dir of Travel	I-105 EB	Agency or Company	URS	Junction	I-710 SB On	Date Performed	8/21/2008	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008	Project Description	LAMTA I-710 PA-ED						
Inputs											
Upstream Adj Ramp	Terrain: Level				Downstream Adj Ramp						
<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On					<input type="checkbox"/> Yes <input type="checkbox"/> On						
<input type="checkbox"/> No <input type="checkbox"/> Off					<input checked="" type="checkbox"/> No <input type="checkbox"/> Off						
$L_{up} =$ 460 ft					$L_{down} =$ ft						
$V_u =$ 704 veh/h	$S_{FF} =$ 69.0 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	$v = V/PHF \times f_{HV} \times f_p$			
Freeway	4066	0.95	Level	9	0	0.917	1.00	4665			
Ramp	793	0.95	Level	9	0	0.917	1.00	910			
UpStream	704	0.95	Level	9	0	0.917	1.00	808			
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)						
$P_{FM} =$ 0.295 using Equation (Exhibit 25-5)					$P_{FD} =$ using Equation (Exhibit 25-11)						
$V_{12} =$ 1074 pc/h					$V_{12} =$ pc/h						
Capacity Checks					Capacity Checks						
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?				
V_{FO}	4549	See Exhibit 25-7	No	$V_{FI} = V_F$							
				V_{12}							
V_{R12}	1984	4600:All	No	$V_{FO} = V_F -$							
				V_R							
				V_R							
Level of Service Determination (if not F)					Level of Service Determination (if not F)						
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$						
$D_R =$ 16.8 (pc/mi/ln)					$D_R =$ (pc/mi/ln)						
LOS = B (Exhibit 25-4)					LOS = (Exhibit 25-4)						
Speed Estimation					Speed Estimation						
$M_S =$ 0.307 (Exhibit 25-19)					$D_S =$ (Exhibit 25-19)						
$S_R =$ 60.7 mph (Exhibit 25-19)					$S_R =$ mph (Exhibit 25-19)						
$S_0 =$ 66.2 mph (Exhibit 25-19)					$S_0 =$ mph (Exhibit 25-19)						
$S =$ 63.7 mph (Exhibit 25-14)					$S =$ mph (Exhibit 25-15)						

RAMPS AND RAMP JUNCTIONS WORKSHEET								
General Information				Site Information				
Analyst	KT			Freeway/Dir of Travel	I-105 EB			
Agency or Company	URS			Junction	I-710 SB On			
Date Performed	8/21/2008			Jurisdiction	Caltrans			
Analysis Time Period	MD			Analysis Year	2008			
Project Description LAMTA I-710 PA-ED								
Inputs								
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = 460 ft						L _{down} = ft		
V _u = 704 veh/h		S _{FF} = 69.0 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 x f _{HV} x f _p
Freeway	4066	0.95	Level	9	0	0.917	1.00	4665
Ramp	793	0.95	Level	9	0	0.917	1.00	910
UpStream	704	0.95	Level	9	0	0.917	1.00	808
DownStream								
Merge Areas				Diverge Areas				
Estimation of v₁₂				Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$				$V_{12} = V_R + (V_F - V_R)P_{FD}$				
L _{EQ} = (Equation 25-2 or 25-3)				L _{EQ} = (Equation 25-8 or 25-9)				
P _{FM} = 0.295 using Equation (Exhibit 25-5)				P _{FD} = using Equation (Exhibit 25-11)				
V ₁₂ = 1074 pc/h				V ₁₂ = pc/h				
Capacity Checks				Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?	
V _{FO}	4549	See Exhibit 25-7	No	V _{FI} = V _F				
				V ₁₂				
V _{R12}	1984	4600:All	No	V _{FO} = V _F -				
				V _R				
				V _R				
Level of Service Determination (if not F)				Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$				$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
D _R = 16.8 (pc/mi/ln)				D _R = (pc/mi/ln)				
LOS = B (Exhibit 25-4)				LOS = (Exhibit 25-4)				
Speed Estimation				Speed Estimation				
M _S = 0.307 (Exhibit 25-19)				D _s = (Exhibit 25-19)				
S _R = 60.7 mph (Exhibit 25-19)				S _R = mph (Exhibit 25-19)				
S ₀ = 66.2 mph (Exhibit 25-19)				S ₀ = mph (Exhibit 25-19)				
S = 63.7 mph (Exhibit 25-14)				S = mph (Exhibit 25-15)				



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-105 EB
Agency or Company	URS	From/To	Facade
Date Performed	02/02/2010	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

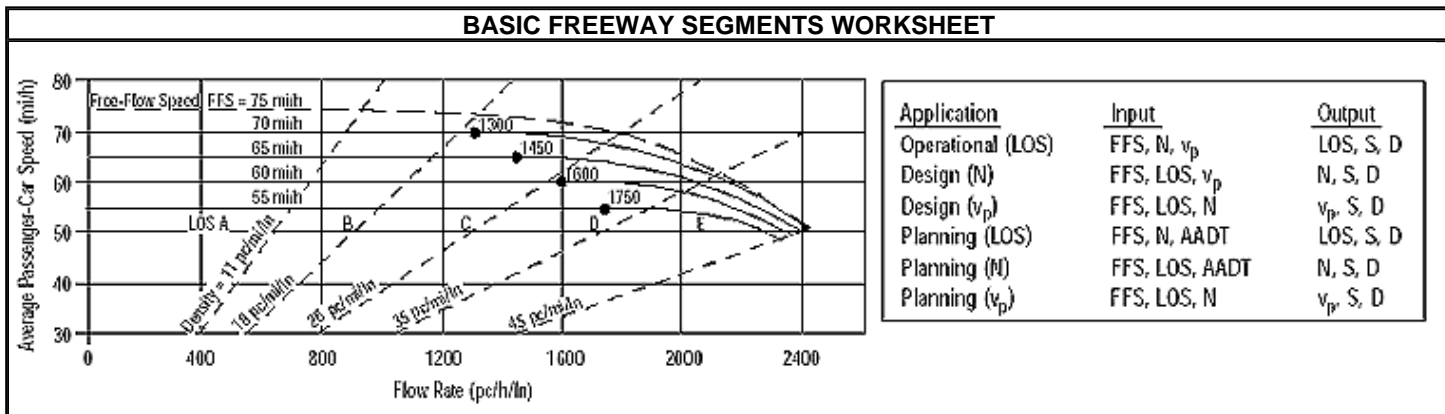
Flow Inputs			
Volume, V	4669	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.952

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	f _N	mi/h
FFS (measured)	64.0 mi/h	FFS	64.0 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)	1702 pc/h/ln	Design LOS	
S	63.6 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	26.7 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	EB	Highway/Direction of Travel	I-105 WB
Agency or Company	URS	From/To	Merkel
Date Performed	8/21/2008	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

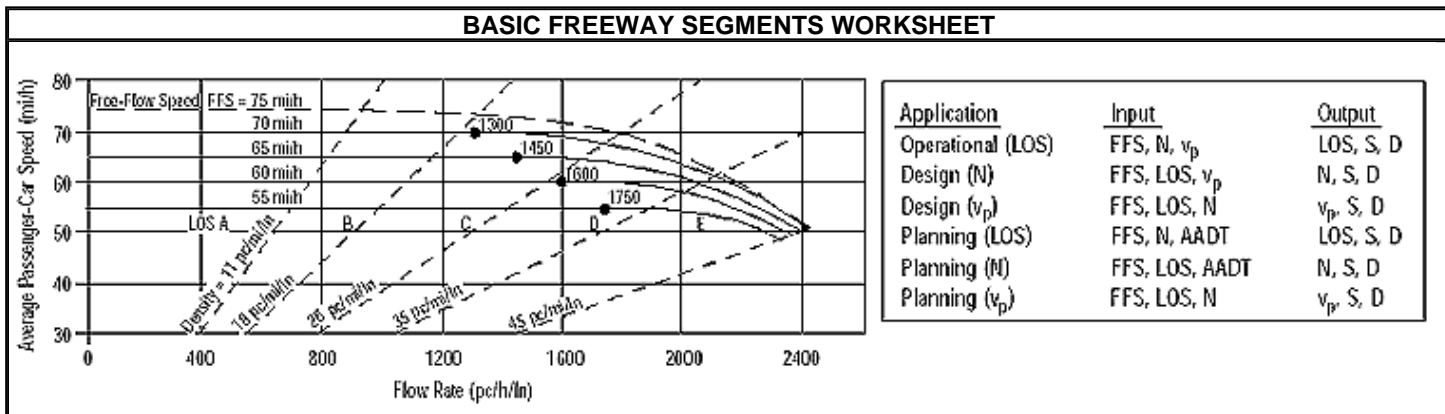
Flow Inputs				
Volume, V	5645	veh/h	Peak-Hour Factor, PHF	0.94
AADT		veh/day	%Trucks and Buses, P _T	5
Peak-Hr Prop. of AADT, K			%RVs, P _R	0
Peak-Hr Direction Prop, D			General Terrain:	Level
DDHV = AADT x K x D		veh/h	Grade % Length	mi
Driver type adjustment	1.00		Up/Down %	

Calculate Flow Adjustments			
f_p	1.00	E_R	1.2
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.952

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 l/mi	f_{ID}	mi/h
Number of Lanes, N	3	f_N	mi/h
FFS (measured)	58.0 mi/h	FFS	58.0 mi/h
Base free-flow Speed, BFFS	mi/h		

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	2102 pc/h/ln	Design LOS	
S	55.0 mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h
$D = v_p / S$	38.2 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	EB	Highway/Direction of Travel	I-105 WB
Agency or Company	URS	From/To	Merkel
Date Performed	8/21/2008	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

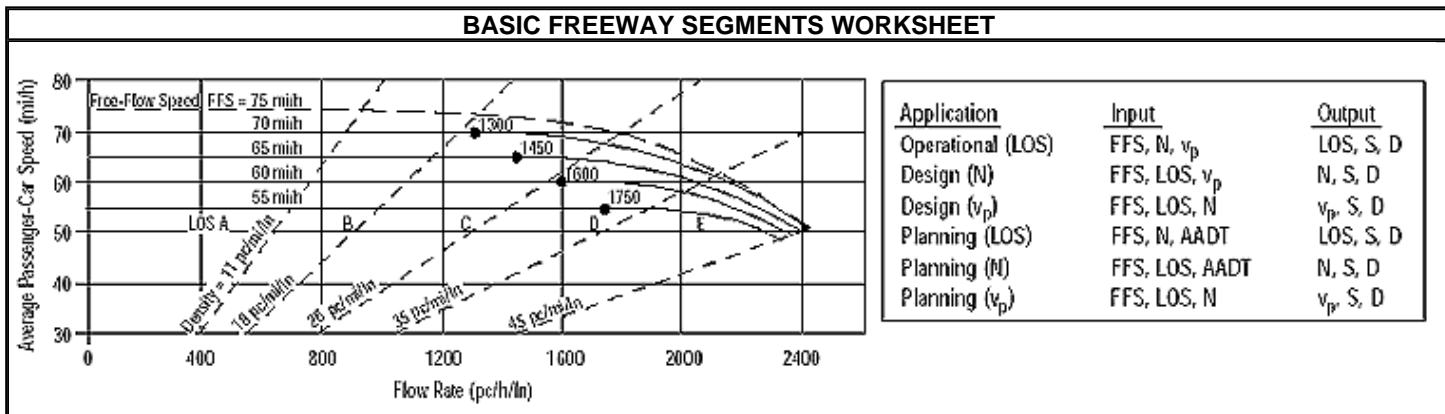
Flow Inputs			
Volume, V	5107	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.917

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	f _N	mi/h
FFS (measured)	63.0 mi/h	FFS	63.0 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)	1953 pc/h/ln	Design LOS	
S	60.7 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	32.2 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	EB	Highway/Direction of Travel	I-105 WB
Agency or Company	URS	From/To	Merkel
Date Performed	8/21/2008	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

<input checked="" type="checkbox"/> Oper.(LOS)	<input type="checkbox"/> Des.(N)	<input type="checkbox"/> Planning Data
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Flow Inputs			
Volume, V	5024	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f_p	1.00	E_R	1.2
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.971

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 l/mi	f_{ID}	mi/h
Number of Lanes, N	3	f_N	mi/h
FFS (measured)	68.0 mi/h	FFS	68.0 mi/h
Base free-flow Speed, BFFS	mi/h		

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1778 pc/h/ln	Design LOS	
S	66.5 mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h
$D = v_p / S$	26.7 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 - Exhibits 23-8, 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			

**I-710 Corridor Project
Adjacent Freeway Major Diverge Analysis: I-105
Existing 2008**

HCM 2000: Exhibit 25-14. Capacity Values for Diverge Areas

FFS (mi/hr)	Maximum Upstream or Downstream Freeway Flow			
	Number of Lanes in One Direction			
	2	3	4	> 4 (per ln)
55	4500	6750	9000	2250
60	4600	6900	9200	2300
65	4700	7050	9400	2350
70	4800	7200	9600	2400

**#4
Year/Time**

2008 AM Peak

Major Diverge Junction

Freeway (V_F)	Diverge Ramp (V_R)	
I-105 WB	I-710 Off	
N_{FU}	5	N_R 2
N_{FD}	3	FFS 55

Approach Leg

V_{FU} 6306

Diverge Legs

V_{FD} 4559

V_R 1747

Diverge

V_F/C_F	0.41	$D_{Upstream}$	LOS
V_R/C_R	0.39	22.07	C
V/C	0.56		

**#4
Year/Time**

2008 MD Peak

Major Diverge Junction

Freeway (V_F)	Merge Ramp (V_R)	
I-105 WB	I-710 Off	
N_{FU}	5	N_R 2
N_{FD}	3	FFS 55

Approach Leg

V_{FU} 5860

Diverge Legs

V_{FD} 3540

V_R 2320

Diverge

V_F/C_F	0.31	$D_{Upstream}$	LOS
V_R/C_R	0.52	20.51	C
V/C	0.52		

**#4
Year/Time**

2008 PM Peak

Major Diverge Junction

Freeway (V_F)	Merge Ramp (V_R)	
I-105 WB	I-710 Off	
N_{FU}	5	N_R 2
N_{FD}	3	FFS 55

Approach Leg

V_{FU} 5335

Diverge Legs

V_{FD} 3016

V_R 2319

Diverge

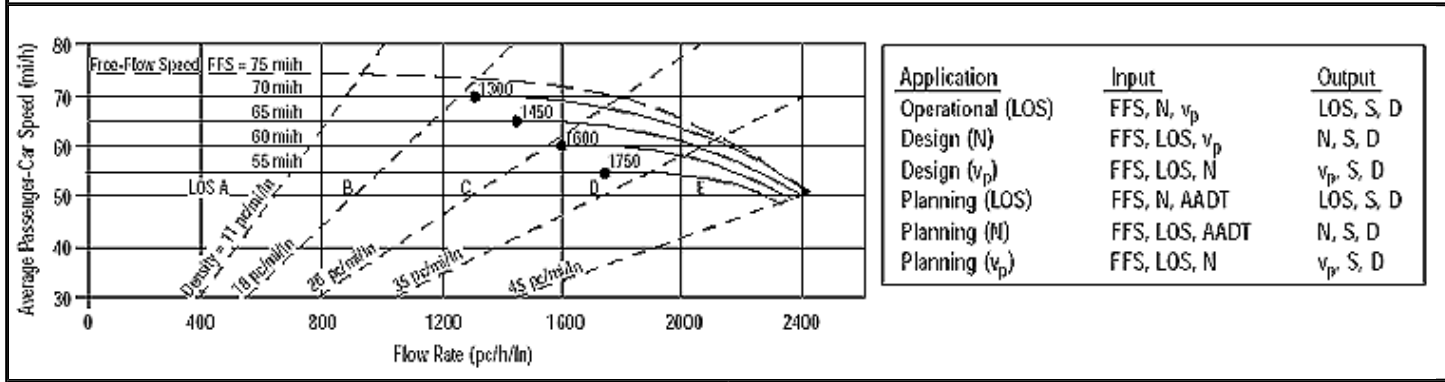
V_F/C_F	0.27	$D_{Upstream}$	LOS
V_R/C_R	0.52	18.67	B
V/C	0.47		

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-105 WB		Agency or Company	URS	Junction	Garfield On	
Date Performed	8/21/2008	Jurisdiction	Caltrans		Analysis Time Period	AM	Analysis Year	2008	
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes	<input type="checkbox"/> On						<input type="checkbox"/> Yes	<input type="checkbox"/> On	
<input checked="" type="checkbox"/> No	<input type="checkbox"/> Off	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Off						
$L_{up} =$	ft	$S_{FF} = 55.0$ mph $S_{FR} = 35.0$ mph					$L_{down} =$	ft	
$V_u =$	veh/h						$V_o =$		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	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	2910	0.94	Level	5	0	0.952	1.00	3251	
Ramp	877	0.94	Level	5	0	0.952	1.00	980	
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)				
$P_{FM} = 0.619$ using Equation (Exhibit 25-5)					$P_{FD} =$ using Equation (Exhibit 25-11)				
$V_{12} = 2014$ pc/h					$V_{12} =$ pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V_{FO}	4231	See Exhibit 25-7	No	$V_{FI} = V_F$					
				V_{12}					
V_{R12}	2994	4600:All	No	$V_{FO} = V_F - V_R$					
				V_R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
$D_R = 19.0$ (pc/mi/ln)					$D_R =$ (pc/mi/ln)				
LOS = B (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
$M_S = 0.294$ (Exhibit 25-19)					$D_S =$ (Exhibit 25-19)				
$S_R = 51.2$ mph (Exhibit 25-19)					$S_R =$ mph (Exhibit 25-19)				
$S_0 = 52.3$ mph (Exhibit 25-19)					$S_0 =$ mph (Exhibit 25-19)				
$S = 51.5$ mph (Exhibit 25-14)					$S =$ mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-105 WB		Agency or Company	URS	Junction	Garfield On	
Date Performed	8/21/2008	Jurisdiction	Caltrans		Analysis Time Period	MD	Analysis Year	2008	
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 35.0 mph					L _{down} = ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					V _o = 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 x f _{HV} x f _p	
Freeway	3191	0.95	Level	9	0	0.917	1.00	3661	
Ramp	926	0.95	Level	9	0	0.917	1.00	1062	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
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} = 0.619 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-11)				
V ₁₂ = 2268 pc/h					V ₁₂ = pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V _{F0}	4723	See Exhibit 25-7	No	V _{F1} = V _F					
				V ₁₂					
V _{R12}	3330	4600:All	No	V _{F0} = V _F - V _R					
				V _R					
Level of Service Determination (if not F)					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 = 4.252 + 0.0086 V ₁₂ - 0.0009 L _D				
D _R = 21.6 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = 0.325 (Exhibit 25-19)					D _S = (Exhibit 25-19)				
S _R = 50.8 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 51.8 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 51.1 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-105 WB		Agency or Company	URS	Junction	Garfield On	
Date Performed	8/21/2008	Jurisdiction	Caltrans		Analysis Time Period	PM	Analysis Year	2008	
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 35.0 mph					L _{down} = ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					V _o = 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 x f _{HV} x f _p	
Freeway	3140	0.97	Level	3	0	0.971	1.00	3334	
Ramp	1081	0.97	Level	3	0	0.971	1.00	1148	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
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} = 0.619 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-11)				
V ₁₂ = 2065 pc/h					V ₁₂ = pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V _{F0}	4482	See Exhibit 25-7	No	V _{F1} = V _F					
				V ₁₂					
V _{R12}	3213	4600:All	No	V _{F0} = V _F - V _R					
				V _R					
Level of Service Determination (if not F)					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 = 4.252 + 0.0086 V ₁₂ - 0.0009 L _D				
D _R = 20.6 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = 0.313 (Exhibit 25-19)					D _S = (Exhibit 25-19)				
S _R = 50.9 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 52.2 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 51.3 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-105 WB
Agency or Company	URS	From/To	Garfield On / I-710 SB On
Date Performed	1/26/2010	Jurisdiction	
Analysis Time Period	MD	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

Flow Inputs			
Volume, V	4117	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.917

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	f _N	mi/h
FFS (measured)	61.0 mi/h	FFS	61.0 mi/h
Base free-flow Speed, BFFS			

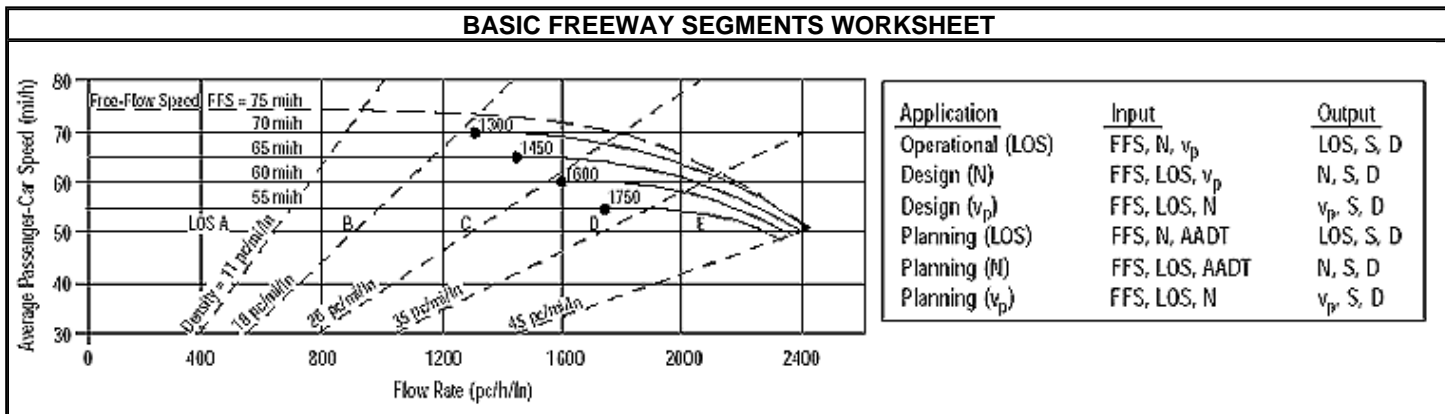
LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1575 pc/h/ln	Design LOS	
S	61.0 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	25.8 pc/mi/ln	S	mi/h
LOS	C	D = v _p / S	pc/mi/ln
		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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			

RAMPS AND RAMP JUNCTIONS WORKSHEET										
General Information					Site Information					
Analyst	KT	Freeway/Dir of Travel	I-105 WB		Agency or Company	URS	Junction	I-710 SB On		
Date Performed	8/21/2008	Jurisdiction	Caltrans		Analysis Time Period	AM	Analysis Year	2008		
Project Description LAMTA I-710 PA-ED										
Inputs										
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On	<input type="checkbox"/> No <input type="checkbox"/> Off						<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On	<input type="checkbox"/> No <input type="checkbox"/> Off	L _{down} = 1353 ft	
L _{up} =	ft	S _{FF} = 55.0 mph S _{FR} = 35.0 mph					V _o = 945 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 x f _{HV} x f _p		
Freeway	3787	0.94	Level	5	0	0.952	1.00	4230		
Ramp	898	0.94	Level	5	0	0.952	1.00	1003		
UpStream										
DownStream	945	0.94	Level	5	0	0.952	1.00	1056		
Merge Areas					Diverge Areas					
Estimation of v₁₂					Estimation of v₁₂					
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$					
L _{EQ} = (Equation 25-2 or 25-3)					L _{EQ} = (Equation 25-8 or 25-9)					
P _{FM} = 0.284 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-11)					
V ₁₂ = 1199 pc/h					V ₁₂ = pc/h					
Capacity Checks					Capacity Checks					
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?			
V _{FO}	5233	See Exhibit 25-7	No	V _{F1} = V _F						
				V ₁₂						
V _{R12}	2202	4600:All	No	V _{F0} = V _F - V _R						
				V _R						
Level of Service Determination (if not F)					Level of Service Determination (if not F)					
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$					
D _R = 18.4 (pc/mi/ln)					D _R = (pc/mi/ln)					
LOS = B (Exhibit 25-4)					LOS = (Exhibit 25-4)					
Speed Estimation					Speed Estimation					
M _S = 0.314 (Exhibit 25-19)					D _S = (Exhibit 25-19)					
S _R = 50.9 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)					
S ₀ = 51.3 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)					
S = 51.2 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)					

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT				Freeway/Dir of Travel	I-105 WB			
Agency or Company	URS				Junction	I-710 NB On			
Date Performed	8/21/2008				Jurisdiction	Caltrans			
Analysis Time Period	MD				Analysis Year	2008			
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 35.0 mph					L _{down} = 1353 ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					V _o = 704 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 x f _{HV} x f _p	
Freeway	4117	0.95	Level	9	0	0.917	1.00	4724	
Ramp	1311	0.95	Level	9	0	0.917	1.00	1504	
UpStream									
DownStream	704	0.95	Level	9	0	0.917	1.00	808	
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
L _{EQ} = (Equation 25-2 or 25-3)					L _{EQ} = (Equation 25-8 or 25-9)				
P _{FM} = 0.221 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-11)				
V ₁₂ = 1044 pc/h					V ₁₂ = pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V _{FO}	6228	See Exhibit 25-7	No	V _{F1} = V _F					
				V ₁₂					
V _{R12}	2548	4600:All	No	V _{F0} = V _F - V _R					
				V _R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
D _R = 20.9 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = 0.329 (Exhibit 25-19)					D _S = (Exhibit 25-19)				
S _R = 50.7 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 50.2 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 50.4 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	KT	Freeway/Dir of Travel	I-105 WB		Agency or Company	URS	Junction	I-710 NB On	
Date Performed	8/21/2008	Jurisdiction	Caltrans		Analysis Time Period	MD	Analysis Year	2008	
Project Description LAMTA I-710 PA-ED									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes	<input type="checkbox"/> On						<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> On	
<input checked="" type="checkbox"/> No	<input type="checkbox"/> Off	<input type="checkbox"/> No	<input type="checkbox"/> Off	L _{down} = 1353 ft					
L _{up} =	ft	S _{FF} = 55.0 mph		S _{FR} = 35.0 mph		V _o = 704 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)	
V _u =	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 x f _{HV} x f _p	
Freeway	4117	0.95	Level	9	0	0.917	1.00	4724	
Ramp	1311	0.95	Level	9	0	0.917	1.00	1504	
UpStream									
DownStream	704	0.95	Level	9	0	0.917	1.00	808	
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
L _{EQ} = (Equation 25-2 or 25-3)					L _{EQ} = (Equation 25-8 or 25-9)				
P _{FM} = 0.221 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-11)				
V ₁₂ = 1044 pc/h					V ₁₂ = pc/h				
Capacity Checks					Capacity Checks				
	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?		
V _{FO}	6228	See Exhibit 25-7	No	V _{F1} = V _F					
				V ₁₂					
V _{R12}	2548	4600:All	No	V _{F0} = V _F - V _R					
				V _R					
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$				
D _R = 20.9 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Estimation					Speed Estimation				
M _S = 0.329 (Exhibit 25-19)					D _S = (Exhibit 25-19)				
S _R = 50.7 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 50.2 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 50.4 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-105 WB
Agency or Company	URS	From/To	I-710 SB On / I-710 NB On
Date Performed	1/26/2010	Jurisdiction	
Analysis Time Period	MD	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

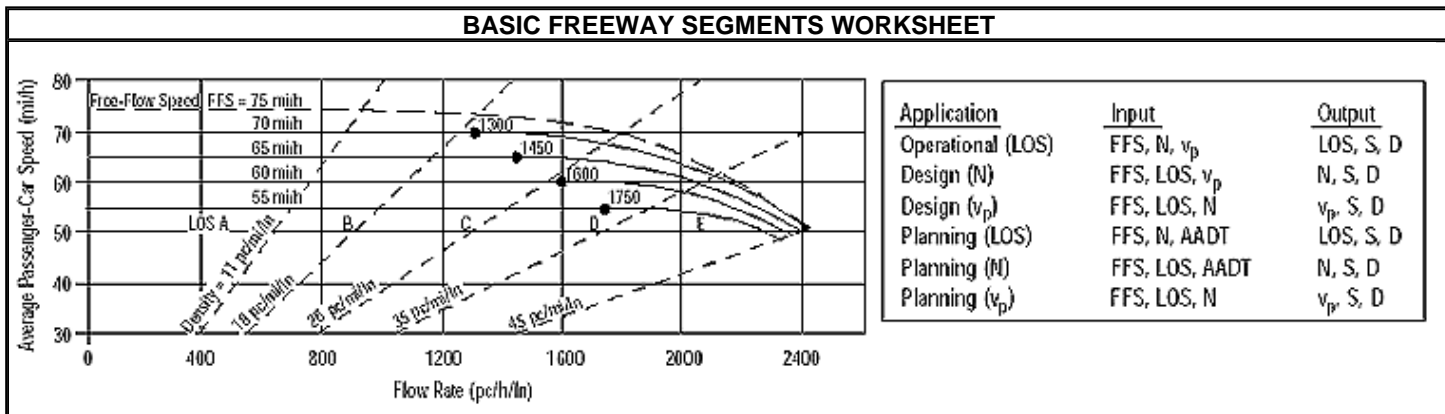
Flow Inputs			
Volume, V	5428	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.901

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	f _N	mi/h
FFS (measured)	63.0 mi/h	FFS	63.0 mi/h
Base free-flow Speed, BFFS			

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	2092 pc/h/ln	Design LOS	
S	58.4 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	35.8 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-105 WB
Agency or Company	URS	From/To	I-710 SB On / I-710 NB On
Date Performed	1/26/2010	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2008
Project Description I-710 Corridor Project EIR/EIS			

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

Flow Inputs

Volume, V	5523	veh/h	Peak-Hour Factor, PHF	0.96
AADT		veh/day	%Trucks and Buses, P _T	7
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 %	

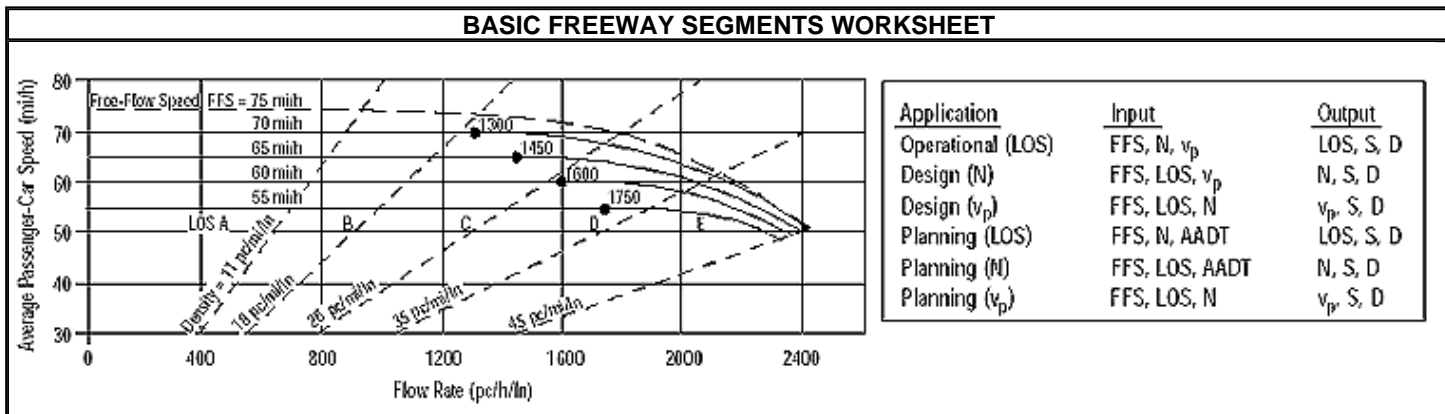
Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935

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 l/mi	f_{ID}	mi/h
Number of Lanes, N	3	f_N	mi/h
FFS (measured)	58.0 mi/h	FFS	58.0 mi/h
Base free-flow Speed, BFFS	mi/h		

LOS and Performance Measures	Design (N)
Operational (LOS)	Design (N)
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	Design LOS
S	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$
$D = v_p / S$	S
LOS	$D = v_p / S$
	Required Number of Lanes, N

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



General Information		Site Information	
Analyst	EB	Highway/Direction of Travel	I-105 WB
Agency or Company	URS	From/To	Harris
Date Performed	8/21/2008	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

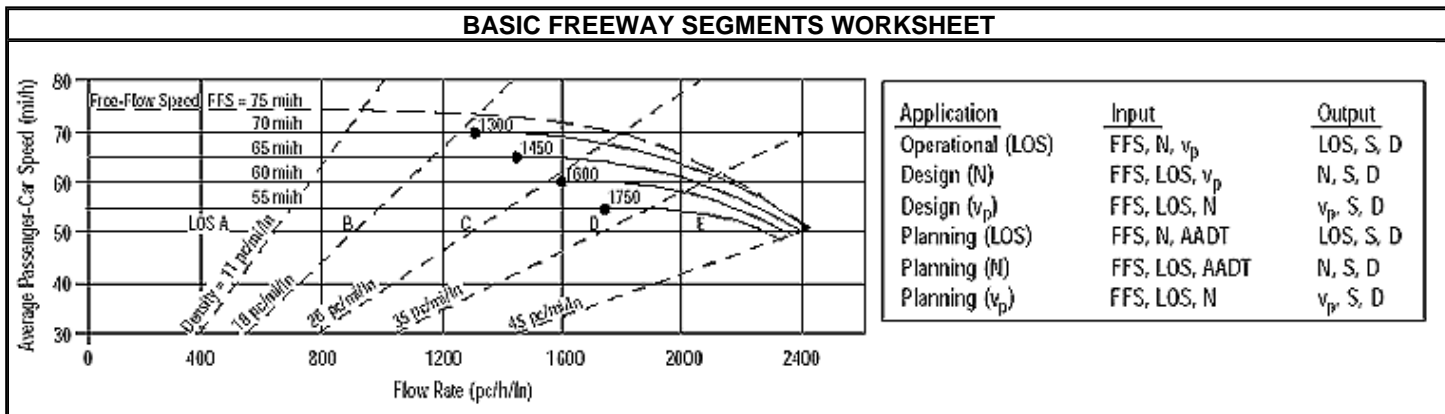
Flow Inputs			
Volume, V	6079	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.901

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	4	f _N	mi/h
FFS (measured)	61.0 mi/h	FFS	61.0 mi/h
Base free-flow Speed, BFFS			

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1757 pc/h/ln	Design LOS	
S	60.7 mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	pc/h
D = v _p / S	28.9 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 - Exhibits 23-8, 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			



General Information		Site Information	
Analyst	KT	Highway/Direction of Travel	I-105 WB
Agency or Company	URS	From/To	West of I-710 NB On (3 Lane)
Date Performed	2/16/2010	Jurisdiction	Caltrans
Analysis Time Period	MD	Analysis Year	2008
Project Description LAMTA I-710 PA-ED			

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

Flow Inputs			
Volume, V	6079	veh/h	Peak-Hour Factor, PHF
AADT		veh/day	%Trucks and Buses, P _T
Peak-Hr Prop. of AADT, K			%RVs, P _R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f _p	1.00	E _R	1.2
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.901

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 l/mi	f _{ID}	mi/h
Number of Lanes, N	3	f _N	mi/h
FFS (measured)	61.0 mi/h	FFS	61.0 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 - Exhibits 23-8, 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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I-5 EXISTING CONDITIONS ANALYSIS



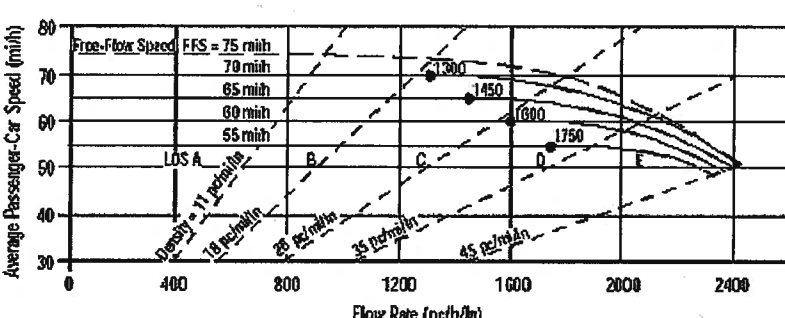
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BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different density levels: 11 pc/mi/h, 18 pc/mi/h, 25 pc/mi/h, 35 pc/mi/h, and 45 pc/mi/h. A horizontal line at 55 mi/h is labeled 'Free-Flow Speed'. Other labels include 'LOS A', 'B', 'C', 'D', and 'E' along the x-axis.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	North of Dennison St																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	7632	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00		E_R																			
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	5		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1719	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	31.3	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB						
Agency or Company	LSA	Junction	Dennison On						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	AM	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = 675 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = 213 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					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 x f _{HV} x f _p	
Freeway	7535	0.95	Level	7	0	0.935	1.00	8487	
Ramp	97	0.95	Level	12	0	0.893	1.00	114	
UpStream	213	0.95	Level	4	0	0.962	1.00	233	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.204 using Equation (Exhibit 25-5) V ₁₂ = 1235 pc/h V ₃ or V _{av34} = 2417 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 2427 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	6183	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	2541	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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 = 21.2 (pc/mi/ln) LOS = C (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = 0.313 (Exhibit 25-19) S _R = 50.9 mph (Exhibit 25-19) S ₀ = 50.2 mph (Exhibit 25-19) S = 50.5 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)				

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several density curves for different free-flow speeds (FFS): 75, 70, 65, 60, and 55 mi/h. Regions A through F are marked on the graph, representing different levels of service (LOS). Density curves are labeled with values like 11 pc/mi/h, 18 pc/mi/h, 28 pc/mi/h, 35 pc/mi/h, and 45 pc/mi/h.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	Dennison Off to Dennison On																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	7535	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	5		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1697	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	30.9	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB						
Agency or Company	LSA	Junction	Dennison Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	AM	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off						<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = ft						L _{down} = 675 ft			
V _u = veh/h		S _{FF} = 55.0 mph		S _{FR} = 45.0 mph		V _D = 97 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 x f _{HV} x f _p	
Freeway	7535	0.95	Level	7	0	0.935	1.00	8487	
Ramp	213	0.95	Level	4	0	0.962	1.00	233	
UpStream									
DownStream	97	0.95	Level	12	0	0.893	1.00	114	
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3092 pc/h V ₃ or V _{av34} 1849 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	6790	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	6557	Exhibit 25-14	9000	No
					V _R	233	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	3092	Exhibit 25-14 4400:All		No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 28.6 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.319 (Exhibit 25-19) S _R = 50.9 mph (Exhibit 25-19) S ₀ = 57.0 mph (Exhibit 25-19) S = 54.0 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																						
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application</th> <th style="text-align: left;">Input</th> <th style="text-align: left;">Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (#)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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 (#)	FFS, LOS, AADT	N, S, D	Planning (v_p)	FFS, LOS, N	v_p , S, D
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 (#)	FFS, LOS, AADT	N, S, D																				
Planning (v_p)	FFS, LOS, N	v_p , S, D																				
General Information		Site Information																				
Analyst	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	Downey On to Dennison Off																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	7748	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	5		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1745	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	31.7	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Agency or Company	LSA	Junction	Downey On	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	AM	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = ft			
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _F)				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 x f _{HV} x f _p	
Freeway	7441	0.95	Level	7	0	0.935	1.00	8381	
Ramp	307	0.95	Level	12	0	0.893	1.00	362	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.173 using Equation (Exhibit 25-5) V ₁₂ = 1034 pc/h V ₃ or V _{av34} = 2479 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 2397 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	6355	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	2759	Exhibit 25-7	4600:All	No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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/mi/ln) LOS = C (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = 0.345 (Exhibit 25-19) S _R = 50.5 mph (Exhibit 25-19) S ₀ = 50.3 mph (Exhibit 25-19) S = 50.4 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)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	NB 710 On to Downey On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	AM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	7441	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1676	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	30.5	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different Levels of Service (LOS) from A to E. Dashed lines represent constant densities: 11 pc/mi, 18 pc/mi, 28 pc/mi, 35 pc/mi, and 45 pc/mi. A 'Free-Flow Speed' (FFS) of 75 mi/h is indicated at the top left.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (#)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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 (#)	FFS, LOS, AADT	N, S, D	Planning (v_p)	FFS, LOS, N	v_p , S, D
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 (#)	FFS, LOS, AADT	N, S, D																				
Planning (v_p)	FFS, LOS, N	v_p , S, D																				
General Information		Site Information																				
Analyst	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	NB 710 Off to NB 710 On																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	4713	veh/h	Peak-Hour Factor, PHF																			
AA DT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.926																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	4		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1339	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	24.3	pc/mi/ln	S																			
LOS	C		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several density curves for different speeds: 75, 70, 65, 60, and 55 mi/h. Regions A through F are marked on the graph, corresponding to different levels of service (LOS). Density values are also indicated: 11 pc/mi/h, 18 pc/mi/h, 28 pc/mi/h, 35 pc/mi/h, and 45 pc/mi/h.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	Telegraph Off to NB 710 Off																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	6276	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	5		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1414	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	25.7	pc/mi/ln	S																			
LOS	C		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Agency or Company	LSA	Junction	Telegraph Off	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	AM	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = ft			
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)				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 x f _{HV} x f _p	
Freeway	6276	0.95	Level	7	0	0.935	1.00	7069	
Ramp	131	0.95	Level	4	0	0.962	1.00	143	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 2547 pc/h V ₃ or V _{av34} 1554 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	5656	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	5513	Exhibit 25-14	9000	No
					V _R	143	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	2547	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 24.6 (pc/mi/ln) LOS = C (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S =	(Exhibit 25-19)				D _S =	0.311 (Exhibit 25-19)			
S _R =	mph (Exhibit 25-19)				S _R =	51.0 mph (Exhibit 25-19)			
S ₀ =	mph (Exhibit 25-19)				S ₀ =	58.2 mph (Exhibit 25-19)			
S =	mph (Exhibit 25-14)				S =	54.7 mph (Exhibit 25-15)			

BASIC FREEWAY SEGMENTS WORKSHEET																								
	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application</th> <th style="text-align: left;">Input</th> <th style="text-align: left;">Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>			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
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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	Lane Addition to Telegraph Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	AM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6407	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1443	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	26.2	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different density levels: 11 pc/mi/ln, 18 pc/mi/ln, 28 pc/mi/ln, 35 pc/mi/ln, and 45 pc/mi/ln. A horizontal line at 55 mi/h is labeled 'Free-Flow Speed'. A vertical line at 400 pc/h/ln is labeled 'FFS = 75 mi/h'. Points on the curves are labeled with flow rates: 1300, 1450, 1600, and 1750. The graph is divided into sections A, B, C, D, and E.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	Woods On to Lane Addition																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	6407	veh/h	Peak-Hour Factor, PHF																			
AAVT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00		E_R																			
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	4		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1804	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	32.8	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Junction	Woods On			
Agency or Company	LSA	Jurisdiction	Existing						
Date Performed	11/25/2009	Analysis Year	Existing						
Analysis Time Period	AM								
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = 605 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = ft			
V _u = 210 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _F)				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 x f _{HV} x f _p	
Freeway	6218	0.95	Level	7	0	0.935	1.00	7003	
Ramp	189	0.95	Level	12	0	0.893	1.00	223	
UpStream	210	0.95	Level	4	0	0.962	1.00	230	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.190 using Equation (Exhibit 25-5) V ₁₂ = 1330 pc/h V ₃ or V _{av34} = 2836 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 2801 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	7226	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3024	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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 = 27.3 (pc/mi/ln) LOS = C (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = 0.377 (Exhibit 25-19) S _R = 50.1 mph (Exhibit 25-19) S ₀ = 49.2 mph (Exhibit 25-19) S = 49.6 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)				

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It features several curves representing different density and free-flow speed (FFS) conditions. Dashed lines indicate density levels: 11 pc/mi/ln, 18 pc/mi/ln, 25 pc/mi/ln, 35 pc/mi/ln, and 45 pc/mi/ln. Solid lines represent FFS values: 75 mi/h, 70 mi/h, 65 mi/h, 60 mi/h, and 55 mi/h. Points A, B, C, D, and E are marked on the graph, corresponding to specific flow rates and speeds.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	Woods Off to Woods On																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	6218	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00		E_R																			
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	4		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1751	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	31.8	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Agency or Company	LSA	Junction	Woods Off	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	AM	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level			Downstream Adj Ramp				
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off					<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off				
L _{up} = ft					L _{down} = 605 ft				
V _u = veh/h		S _{FF} = 55.0 mph			S _{FR} = 45.0 mph				
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 x f _{HV} x f _p	
Freeway	6218	0.95	Level	7	0	0.935	1.00	7003	
Ramp	210	0.95	Level	4	0	0.962	1.00	230	
UpStream									
DownStream	189	0.95	Level	12	0	0.893	1.00	223	
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3183 pc/h V ₃ or V _{av34} 1910 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	7003	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	6773	Exhibit 25-14	9000	No
					V _R	230	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	3183	Exhibit 25-14 4400:All		No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 30.6 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.319 (Exhibit 25-19) S _R = 50.9 mph (Exhibit 25-19) S ₀ = 56.8 mph (Exhibit 25-19) S = 53.9 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different density levels: 11 pc/mi, 18 pc/mi, 25 pc/mi, 35 pc/mi, and 45 pc/mi. A horizontal line at 55 mi/h is labeled 'Free-Flow Speed'. A vertical line at 400 pc/h/ln is labeled 'FFS = 75 mi/h'. Points A, B, C, D, and E are marked on the curves at flow rates of approximately 1300, 1450, 1600, 1750, and 2000 pc/h/ln respectively.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	Camfield On to Woods Off																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	6428	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	4		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1810	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	32.9	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Junction	Camfield On			
Agency or Company	LSA	Jurisdiction	Existing						
Date Performed	11/25/2009	Analysis Year	Existing						
Analysis Time Period	AM	Project Description							
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = 810 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = ft			
V _u = 521 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)				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 x f _{HV} x f _p	
Freeway	6143	0.95	Level	7	0	0.935	1.00	6919	
Ramp	285	0.95	Level	12	0	0.893	1.00	336	
UpStream	521	0.95	Level	4	0	0.962	1.00	570	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.176 using Equation (Exhibit 25-5) V ₁₂ = 1216 pc/h V ₃ or V _{av34} = 2851 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 2767 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	7255	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3103	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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 = 28.6 (pc/mi/ln) LOS = D (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = 0.394 (Exhibit 25-19) S _R = 49.9 mph (Exhibit 25-19) S ₀ = 49.3 mph (Exhibit 25-19) S = 49.6 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)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>			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
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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	Camfield Off to Camfield On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	AM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6143	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1730	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	31.5	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB						
Agency or Company	LSA	Junction	Camfield Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	AM	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off						<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = 810 ft			
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _F)				V _D = 285 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 x f _{HV} x f _p	
Freeway	6143	0.95	Level	7	0	0.935	1.00	6919	
Ramp	521	0.95	Level	4	0	0.962	1.00	570	
UpStream									
DownStream	285	0.95	Level	12	0	0.893	1.00	336	
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3338 pc/h V ₃ or V _{av34} 1790 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	6919	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	6349	Exhibit 25-14	9000	No
					V _R	570	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	3338	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 31.4 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.349 (Exhibit 25-19) S _R = 50.5 mph (Exhibit 25-19) S ₀ = 57.3 mph (Exhibit 25-19) S = 53.8 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different density levels: 11 pc/mi/ln, 18 pc/mi/ln, 25 pc/mi/ln, 35 pc/mi/ln, and 45 pc/mi/ln. A horizontal line at 55 mi/h is labeled 'Free-Flow Speed'. Points A, B, C, D, and E are marked on the curves at flow rates of approximately 400, 800, 1200, 1600, and 2000 pc/h/ln respectively.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	South of Camfield Off																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																				
<input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	6664	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P _T																			
Peak-Hr Prop. of AADT, K			%RVs, P _R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f _p	1.00	E _R	1.2																			
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.935																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f _{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f _{LC}																			
Interchange Density	0.50	l/mi	f _{ID}																			
Number of Lanes, N	4		f _N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1876	pc/h/ln	Design LOS																			
S	54.9	mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)																			
D = v _p / S	34.2	pc/mi/ln	S																			
LOS	D		D = v _p / S																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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																						

BASIC FREEWAY SEGMENTS WORKSHEET																						
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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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	North of Dennison St																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	PM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	4994	veh/h	Peak-Hour Factor, PHF	0.95																		
AADT		veh/day	% Trucks and Buses, P_T	7																		
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	2.0		$f_{HV} = 1/(1+P_T(E_T - 1) + P_R(E_R - 1))$	0.935																		
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	1/mi	f_{ID}	mi/h																		
Number of Lanes, N	5		f_N	mi/h																		
FFS (measured)	55.0	mi/h	FFS	55.0																		
Base free-flow Speed, BFFS		mi/h																				
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1125	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h																		
$D = v_p / S$	20.5	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 - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB						
Agency or Company	LSA	Junction	Dennison On						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	PM	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = 675 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = 141 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					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 x f _{HV} x f _p	
Freeway	4823	0.95	Level	7	0	0.935	1.00	5432	
Ramp	171	0.95	Level	2	0	0.980	1.00	184	
UpStream	141	0.95	Level	3	0	0.971	1.00	153	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = 0.195 using Equation (Exhibit 25-5) V ₁₂ = 825 pc/h V ₃ or V _{av34} = 1706 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 1694 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	4421	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1878	Exhibit 25-7	4600:All	No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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 = 16.0 (pc/mi/ln) LOS = B (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s	0.289 (Exhibit 25-19)				D _s	(Exhibit 25-19)			
S _R	51.2 mph (Exhibit 25-19)				S _R	mph (Exhibit 25-19)			
S ₀	52.2 mph (Exhibit 25-19)				S ₀	mph (Exhibit 25-19)			
S	51.8 mph (Exhibit 25-14)				S	mph (Exhibit 25-15)			

BASIC FREEWAY SEGMENTS WORKSHEET																																																																																																																																																																																
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Clearance	6.0	ft	f _{LC}	Interchange Density	0.50	l/mi	f _{ID}	Number of Lanes, N	5		f _N	FFS (measured)	55.0	mi/h	FFS	Base free-flow Speed, BFFS		mi/h	55.0	LOS and Performance Measures		Design (N)		Operational (LOS)		Design (N)		v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1086	Design LOS		S	55.0	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)		D = v _p / S	19.7	S		LOS	C	D = v _p / S				Required Number of Lanes, N		Glossary		Factor Location		N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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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Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = 675 ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _D)					V _D = 171 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 x f _{HV} x f _p	
Freeway	4823	0.95	Level	7	0	0.935	1.00	5432	
Ramp	141	0.95	Level	3	0	0.971	1.00	153	
UpStream									
DownStream	171	0.95	Level	2	0	0.980	1.00	184	
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 2218 pc/h V ₃ or V _{av34} 1335 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	4889	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	4736	Exhibit 25-14	9000	No
					V _R	153	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	2218	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ D _R = 21.1 (pc/mi/ln) LOS = C (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S =	(Exhibit 25-19)				D _S =	0.312 (Exhibit 25-19)			
S _R =	mph (Exhibit 25-19)				S _R =	50.9 mph (Exhibit 25-19)			
S ₀ =	mph (Exhibit 25-19)				S ₀ =	59.0 mph (Exhibit 25-19)			
S =	mph (Exhibit 25-14)				S =	55.1 mph (Exhibit 25-15)			

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LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1118	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	20.3	pc/mi/ln	S																					
LOS	C		$D = v_p / S$																					
		Required Number of Lanes, N																						
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V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)							
					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 x f _{HV} x f _p	
Freeway	4758	0.95	Level	8	0	0.926	1.00	5409	
Ramp	206	0.95	Level	4	0	0.962	1.00	226	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9)				
L _{EQ} =					L _{EQ} =				
P _{FM} = 0.190 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-12)				
V ₁₂ = 800 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 1710 pc/h (Equation 25-4 or 25-5)					V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16)				
Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No					Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No				
If Yes, V _{12a} = 1688 pc/h (Equation 25-8)					If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	4446	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1914	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
D _R = 17.7 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = B (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = 0.310 (Exhibit 25-19)					D _s = (Exhibit 25-19)				
S _R = 51.0 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 52.2 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 51.7 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																										
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different Free-Flow Speeds (FFS) and Levels of Service (LOS). The curves are labeled with FFS values: 75 mi/h, 70 mi/h, 65 mi/h, 60 mi/h, and 55 mi/h. Corresponding LOS values are also indicated: LOS A, B, C, D, and E. The curves show that as flow rate increases, the speed decreases, and higher FFS values result in higher speeds for the same flow rate.</p>			<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>			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
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	AB		Highway/Direction of Travel	I-5 NB																						
Agency or Company	LSA		From/To	NB 710 On to Downey On																						
Date Performed	11/25/2009		Jurisdiction																							
Analysis Time Period	PM		Analysis Year	Existing																						
Project Description																										
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																										
Flow Inputs																										
Volume, V	4758	veh/h	Peak-Hour Factor, PHF	0.95																						
AADT		veh/day	%Trucks and Buses, P_T	8																						
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	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.926																						
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	l/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)																							
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1082	pc/h/ln	Design LOS																							
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h																						
$D = v_p / S$	19.7	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 - Exhibits 23-8, 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																										

BASIC FREEWAY SEGMENTS WORKSHEET																								
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (veh/h/ln) on the x-axis (0 to 2400). It shows several density curves for different speeds: 78 mi/h, 65 mi/h, 60 mi/h, 55 mi/h, 45 mi/h, and 35 mi/h. The regions between these curves are labeled LOS A, B, C, D, and E. A point is plotted at approximately (1450, 70) and another at (1750, 55).</p>		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	NB 710 Off to NB 710 On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	PM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	2896	veh/h	Peak-Hour Factor, PHF																					
AAADT		veh/day	% Trucks and Buses, P_T																					
Peak-Hr Prop. of AAADT, K			% RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AAADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.926																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	823	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	15.0	pc/mi/ln	S																					
LOS	B		$D = v_p / S$																					
			Required Number of Lanes, N																					
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	Telegraph Off to NB 710 Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	PM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	4911	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P _T																					
Peak-Hr Prop. of AADT, K			%RVs, P _R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f _p	1.00	E _R	1.2																					
E _T	2.0	f _{HV} = 1/[1+P _T (E _T -1) + P _R (E _R -1)]	0.926																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f _{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f _{LC}																					
Interchange Density	0.50	l/mi	f _{ID}																					
Number of Lanes, N	5		f _N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1117	Design LOS																						
S	55.0	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)																						
D = v _p / S	20.3	S																						
LOS	C	D = v _p / S																						
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Agency or Company	LSA	Junction	Telegraph Off	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	PM	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					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 x f _{HV} x f _p	
Freeway	4911	0.95	Level	8	0	0.926	1.00	5583	
Ramp	130	0.95	Level	5	0	0.952	1.00	144	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 2150 pc/h V ₃ or V _{av34} 1298 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	4746	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	4602	Exhibit 25-14	9000	No
					V _R	144	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	2150	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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 = 4.252 + 0.0086 V ₁₂ - 0.009 L _D				
D _R = (pc/mi/ln)					D _R = 21.2 (pc/mi/ln)				
LOS = (Exhibit 25-4)					LOS = C (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = (Exhibit 25-19)					D _s = 0.311 (Exhibit 25-19)				
S _R = mph (Exhibit 25-19)					S _R = 51.0 mph (Exhibit 25-19)				
S ₀ = mph (Exhibit 25-19)					S ₀ = 59.2 mph (Exhibit 25-19)				
S = mph (Exhibit 25-14)					S = 55.1 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	Lane Addition to Telegraph Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	PM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	5041	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop. D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1/(1+P_T(E_T - 1) + P_R(E_R - 1))$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1146	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	20.8	pc/mi/ln	S																					
LOS	C		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	Woods On to Lane Addition																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	PM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	5041	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/(1+P_T(E_T - 1) + P_R(E_R - 1))$	0.926																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1433	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	26.1	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Agency or Company	LSA	Junction	Woods On	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	PM	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On							<input type="checkbox"/> Yes <input type="checkbox"/> On		
<input type="checkbox"/> No <input checked="" type="checkbox"/> Off							<input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = 605 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph Sketch (show lanes, L _A , L _D , V _R , V _f)					L _{down} = ft		
V _u = 240 veh/h							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 x f _{HV} x f _p	
Freeway	4803	0.95	Level	8	0	0.926	1.00	5460	
Ramp	238	0.95	Level	4	0	0.962	1.00	261	
UpStream	240	0.95	Level	4	0	0.962	1.00	263	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.185 using Equation (Exhibit 25-5) V ₁₂ = 1011 pc/h V ₃ or V _{av34} = 2224 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 2184 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	5721	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	2445	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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/mi/ln) LOS = C (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S	0.342 (Exhibit 25-19)				D _S	(Exhibit 25-19)			
S _R	50.6 mph (Exhibit 25-19)				S _R	mph (Exhibit 25-19)			
S ₀	50.9 mph (Exhibit 25-19)				S ₀	mph (Exhibit 25-19)			
S	50.8 mph (Exhibit 25-14)				S	mph (Exhibit 25-15)			

BASIC FREEWAY SEGMENTS WORKSHEET																										
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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	AB		Highway/Direction of Travel	I-5 NB																						
Agency or Company	LSA		From/To	Woods Off to Woods On																						
Date Performed	11/25/2009		Jurisdiction																							
Analysis Time Period	PM		Analysis Year	Existing																						
Project Description																										
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																										
Flow Inputs																										
Volume, V	4803	veh/h	Peak-Hour Factor, PHF	0.95																						
AADT		veh/day	%Trucks and Buses, P_T	8																						
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	2.0		$f_{HV} = 1/(1+P_T(E_T-1) + P_R(E_R-1))$	0.926																						
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	l/mi	f_{ID}	mi/h																						
Number of Lanes, N	4		f_N	mi/h																						
FFS (measured)	55.0	mi/h	FFS	55.0																						
Base free-flow Speed, BFFS		mi/h																								
LOS and Performance Measures			Design (N)																							
Operational (LOS)			Design (N)																							
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1365	pc/h/ln	Design LOS																							
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	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 - Exhibits 23-8, 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																										

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB						
Agency or Company	LSA	Junction	Woods Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	PM	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off						<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = 605 ft			
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)				V _D = 238 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 x f _{HV} x f _p	
Freeway	4803	0.95	Level	8	0	0.926	1.00	5460	
Ramp	240	0.95	Level	4	0	0.962	1.00	263	
UpStream									
DownStream	238	0.95	Level	4	0	0.962	1.00	261	
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 2529 pc/h V ₃ or V _{av34} 1465 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	5460	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	5197	Exhibit 25-14	9000	No
					V _R	263	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	2529	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 25.0 (pc/mi/ln) LOS = C (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.322 (Exhibit 25-19) S _R = 50.8 mph (Exhibit 25-19) S ₀ = 58.5 mph (Exhibit 25-19) S = 54.7 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	Camfield On to Woods Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	PM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	5043	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1433	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	26.1	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Agency or Company	LSA	Junction	Camfield On	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	PM	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = 810 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = 504 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)					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 x f _{HV} x f _p	
Freeway	4464	0.95	Level	8	0	0.926	1.00	5075	
Ramp	579	0.95	Level	5	0	0.952	1.00	640	
UpStream	504	0.95	Level	5	0	0.952	1.00	557	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.138 using Equation (Exhibit 25-5) V ₁₂ = 699 pc/h V ₃ or V _{av34} = 2188 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 2030 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	5715	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	2670	Exhibit 25-7	4600:All	No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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 = 25.1 (pc/mi/ln) LOS = C (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s	0.364 (Exhibit 25-19)				D _s	(Exhibit 25-19)			
S _R	50.3 mph (Exhibit 25-19)				S _R	mph (Exhibit 25-19)			
S ₀	51.3 mph (Exhibit 25-19)				S ₀	mph (Exhibit 25-19)			
S	50.8 mph (Exhibit 25-14)				S	mph (Exhibit 25-15)			

BASIC FREEWAY SEGMENTS WORKSHEET																										
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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	AB		Highway/Direction of Travel	I-5 NB																						
Agency or Company	LSA		From/To	Camfield Off to Camfield On																						
Date Performed	11/25/2009		Jurisdiction																							
Analysis Time Period	PM		Analysis Year	Existing																						
Project Description																										
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																										
Flow Inputs																										
Volume, V	4464	veh/h	Peak-Hour Factor, PHF	0.95																						
AADT		veh/day	% Trucks and Buses, P _T	8																						
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	2.0		f _{HV} = 1/[1+P _T (E _T -1) + P _R (E _R -1)]	0.926																						
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	l/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)	1269	pc/h/ln	Design LOS																							
S	55.0	mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)																							
D = v _p / S	23.1	pc/mi/ln	S																							
LOS	C		D = v _p / S																							
			Required Number of Lanes, N																							
Glossary			Factor Location																							
N - Number of lanes	S - Speed		E _R - Exhibits 23-8, 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																										

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		AB			Freeway/Dir of Travel		I-5 NB		
Agency or Company		LSA			Junction		Camfield Off		
Date Performed		11/25/2009			Jurisdiction				
Analysis Time Period		PM			Analysis Year		Existing		
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = 810 ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _D)					V _D = 579 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 x f _{HV} x f _p	
Freeway	4464	0.95	Level	8	0	0.926	1.00	5075	
Ramp	504	0.95	Level	5	0	0.952	1.00	557	
UpStream									
DownStream	579	0.95	Level	8	0	0.926	1.00	658	
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 2527 pc/h V ₃ or V _{av34} 1274 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	5075	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	4518	Exhibit 25-14	9000	No
					V _R	557	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	2527	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 24.4 (pc/mi/ln) LOS = C (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _S = 0.348 (Exhibit 25-19) S _R = 50.5 mph (Exhibit 25-19) S ₀ = 59.3 mph (Exhibit 25-19) S = 54.5 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	South of Camfield Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	PM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	4968	veh/h	Peak-Hour Factor, PHF																					
AAADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AAADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AAADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1412	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	25.7	pc/mi/ln	S																					
LOS	C		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																						
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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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	North of Dennison St																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	MD	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																				
<input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	8781	veh/h	Peak-Hour Factor, PHF																			
AAADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AAADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AAADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.901																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	5		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	2052	Design LOS																				
S	53.7	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h																			
$D = v_p / S$	38.2	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 - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Agency or Company	LSA	Junction	Dennison On	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	MD	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On							<input type="checkbox"/> Yes <input type="checkbox"/> On		
<input type="checkbox"/> No <input checked="" type="checkbox"/> Off							<input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = 675 ft		S _{FF} = 55.0 mph					S _{FR} = 45.0 mph		
V _u = 0 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _D)					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 x f _{HV} x f _p	
Freeway	8644	0.95	Level	11	0	0.901	1.00	10100	
Ramp	137	0.95	Level	3	0	0.971	1.00	149	
UpStream	0	0.95	Level	0	0	1.000	1.00	0	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9)				
L _{EQ} =					L _{EQ} =				
P _{FM} = 0.199 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-12)				
V ₁₂ = 1514 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 3043 pc/h (Equation 25-4 or 25-5)					V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16)				
Is V ₃ or V _{av34} > 2,700 pc/h? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No				
If Yes, V _{12a} = 3040 pc/h (Equation 25-8)					If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	7749	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3189	Exhibit 25-7	4600:All	No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$				
D _R = 26.3 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = C (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = 0.358 (Exhibit 25-19)					D _S = (Exhibit 25-19)				
S _R = 50.3 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 48.6 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 49.3 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	Dennison Off to Dennison On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	8644	veh/h	Peak-Hour Factor, PHF																					
AAADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AAADT, K			%RVs, P_R																					
Peak-Hr Direction Prop. D			General Terrain:																					
DDHV = AAADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	2020	pc/h/ln	Design LOS																					
S	54.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	37.4	pc/mi/ln	S																					
LOS	E		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information				Site Information					
Analyst	AB	Freeway/Dir of Travel	I-5 NB						
Agency or Company	LSA	Junction	Dennison Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	MD	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp <input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off L _{up} = ft V _u = veh/h		Terrain: Level S _{FF} = 55.0 mph S _{FR} = 45.0 mph Sketch (show lanes, L _A , L _D , V _R , V _I)			Downstream Adj Ramp <input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off L _{down} = 675 ft V _D = 137 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 x f _{HV} x f _p	
Freeway	8644	0.95	Level	11	0	0.901	1.00	10100	
Ramp	0	0.95	Level	0	0	1.000	1.00	0	
UpStream									
DownStream	137	0.95	Level	3	0	0.971	1.00	149	
Merge Areas				Diverge Areas					
Estimation of v₁₂				Estimation of v₁₂					
V ₁₂ = V _F (P _{FM}) (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)				V ₁₂ = V _R + (V _F - V _R)P _{FD} (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3523 pc/h V ₃ or V _{av34} 2278 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)					
Capacity Checks				Capacity Checks					
		Actual	Capacity	LOS F?			Actual	Capacity	LOS F?
V _{FO}			Exhibit 25-7		V _F	8080	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	8080	Exhibit 25-14	9000	No
					V _R	0	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area				Flow Entering Diverge Influence Area					
		Actual	Max Desirable	Violation?			Actual	Max Desirable	Violation?
V _{R12}			Exhibit 25-7		V ₁₂	3523	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)				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)				D _R = 4.252 + 0.0086 V ₁₂ - 0.009 L _D D _R = 32.3 (pc/mi/ln) LOS = D (Exhibit 25-4)					
Speed Determination				Speed Determination					
M _S = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)				D _S = 0.298 (Exhibit 25-19) S _R = 51.1 mph (Exhibit 25-19) S ₀ = 55.4 mph (Exhibit 25-19) S = 53.4 mph (Exhibit 25-15)					

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different flow rates (1200, 1450, 1750, 2000) and free-flow speeds (FFS) of 75, 70, 65, 60, and 55 mi/h. The curves show that as flow rate increases, the speed decreases, and higher FFS values result in higher speeds for the same flow rate.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	Downey On to Dennison Off																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	MD	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	8644	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.901																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	1/mi	f_{ID}																			
Number of Lanes, N	5		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	2020	Design LOS																				
S	54.0	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h																			
$D = v_p / S$	37.4	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 - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB						
Agency or Company	LSA	Junction	Downey On						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	MD	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)					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 x f _{HV} x f _p	
Freeway	8143	0.95	Level	11	0	0.901	1.00	9514	
Ramp	501	0.95	Level	8	0	0.926	1.00	570	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9)				
L _{EQ} =	0.147 using Equation (Exhibit 25-5)				L _{EQ} =	using Equation (Exhibit 25-12)			
P _{FM} =	1028 pc/h				P _{FD} =	pc/h			
V ₁₂ =	2993 pc/h (Equation 25-4 or 25-5)				V ₁₂ =	pc/h (Equation 25-15 or 25-16)			
V ₃ or V _{av34}	Is V ₃ or V _{av34} > 2,700 pc/h? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No				V ₃ or V _{av34}	Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			
	Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			
If Yes, V _{12a} =	2805 pc/h (Equation 25-8)				If Yes, V _{12a} =	pc/h (Equation 25-18)			
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	7584	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3375	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
D _R =	28.9 (pc/mi/ln)				D _R =	(pc/mi/ln)			
LOS =	D (Exhibit 25-4)				LOS =	(Exhibit 25-4)			
Speed Determination					Speed Determination				
M _S =	0.397 (Exhibit 25-19)				D _S =	(Exhibit 25-19)			
S _R =	49.8 mph (Exhibit 25-19)				S _R =	mph (Exhibit 25-19)			
S ₀ =	49.2 mph (Exhibit 25-19)				S ₀ =	mph (Exhibit 25-19)			
S =	49.5 mph (Exhibit 25-14)				S =	mph (Exhibit 25-15)			

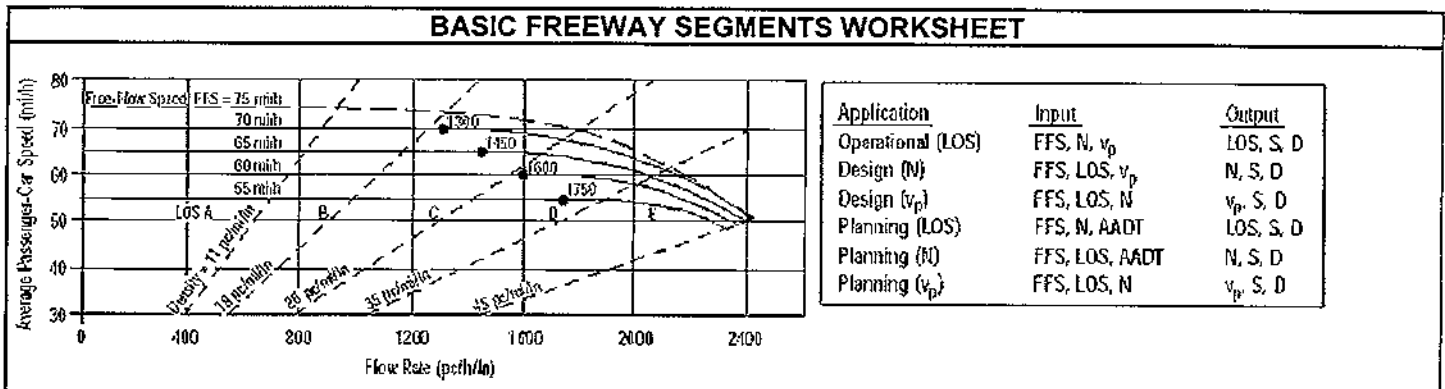
BASIC FREEWAY SEGMENTS WORKSHEET																								
		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (ff)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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 (ff)	FFS, LOS, AADT	N, S, D	Planning (v_p)	FFS, LOS, N	v_p , S, D
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 (ff)	FFS, LOS, AADT	N, S, D																						
Planning (v_p)	FFS, LOS, N	v_p , S, D																						
General Information		Site Information																						
Analyst	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	NB 710 On to Downey On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	8143	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.901																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1903	pc/h/ln	Design LOS																					
S	54.8	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	34.7	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows density curves for 11, 15, 20, 25, 30, 35, and 45 pc/mi/ln. Regions A through F are defined based on these curves and LOS A through F.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	NB 710 Off to NB 710 On																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	MD	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																				
<input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	5329	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.893																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	4		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1571	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	28.6	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

BASIC FREEWAY SEGMENTS WORKSHEET																								
		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	Telegraph Off to NB 710 Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper. (LOS)		<input type="checkbox"/> Des. (N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6720	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/(1+P_T(E_T-1) + P_R(E_R-1))$	0.893																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1585	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	28.8	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB						
Agency or Company	LSA	Junction	Telegraph Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	MD	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = ft			
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _P)				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 x f _{HV} x f _p	
Freeway	6720	0.95	Level	12	0	0.893	1.00	7923	
Ramp	105	0.95	Level	7	0	0.935	1.00	118	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 2830 pc/h V ₃ or V _{av34} 1754 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	6339	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	6221	Exhibit 25-14	9000	No
					V _R	118	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	2830	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 27.0 (pc/mi/ln) LOS = C (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _S = 0.309 (Exhibit 25-19) S _R = 51.0 mph (Exhibit 25-19) S ₀ = 57.4 mph (Exhibit 25-19) S = 54.3 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different levels of service (LOS) and free-flow speeds (FFS). Key points include: FFS = 75 mi/h, 70 mi/h, 65 mi/h, 60 mi/h, 55 mi/h; LOS A, B, C, D, E; and density levels of 11, 18, 26, 35, and 45 pc/mi/ln.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	Lane Addition to Telegraph Off																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	MD	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																				
<input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	6824	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	% Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			% RVs, P_R																			
Peak-Hr Direction Prop. D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/(1+P_T(E_T - 1) + P_R(E_R - 1))$	0.893																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	5		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1609	Design LOS																				
S	55.0	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h																			
$D = v_p / S$	29.3	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 - Exhibits 23-8, 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																						



General Information		Site Information	
Analyst	AB	Highway/Direction of Travel	I-5 NB
Agency or Company	LSA	From/To	Woods On to Lane Addition
Date Performed	11/25/2009	Jurisdiction	
Analysis Time Period	MD	Analysis Year	Existing

Project Description

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

Flow Inputs			
Volume, V	6824	veh/h	Peak-Hour Factor, PHF
AAADT		veh/day	%Trucks and Buses, P_T
Peak-Hr Prop. of AAADT, K			%RVs, P_R
Peak-Hr Direction Prop, D			General Terrain:
DDHV = AAADT x K x D		veh/h	Grade % Length
Driver type adjustment	1.00		Up/Down %

Calculate Flow Adjustments			
f_p	1.00	E_R	1.2
E_T	2.0	$f_{HV} = 1/(1+P_T(E_T - 1) + P_R(E_R - 1))$	0.893

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 l/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			

LOS and Performance Measures		Design (N)	
Operational (LOS)		Design (N)	
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	2011 pc/h/ln	Design LOS	
S	54.1 mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h
$D = v_p / S$	37.2 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 - Exhibits 23-8, 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			

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB						
Agency or Company	LSA	Junction	Woods On						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	MD	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = 605 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = 0 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					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 x f _{HV} x f _p	
Freeway	6710	0.95	Level	12	0	0.893	1.00	7911	
Ramp	115	0.95	Level	9	0	0.917	1.00	132	
UpStream	0	0.95	Level	0	0	1.000	1.00	0	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.201 using Equation (Exhibit 25-5) V ₁₂ = 1592 pc/h V ₃ or V _{av34} = 3159 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 3164 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	8043	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3296	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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 = 29.5 (pc/mi/ln) LOS = D (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = 0.402 (Exhibit 25-19) S _R = 49.8 mph (Exhibit 25-19) S ₀ = 48.0 mph (Exhibit 25-19) S = 48.7 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)				

BASIC FREEWAY SEGMENTS WORKSHEET																						
	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 NB																			
Agency or Company	LSA	From/To	Woods Off to Woods On																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	MD	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	6710	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P _T																			
Peak-Hr Prop. of AADT, K			%RVs, P _R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f _p	1.00		E _R																			
E _T	2.0		f _{HV} = 1/[1+P _T (E _T -1) + P _R (E _R -1)]																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f _{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f _{LC}																			
Interchange Density	0.50	l/mi	f _{ID}																			
Number of Lanes, N	4		f _N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1978	pc/h/ln	Design LOS																			
S	54.4	mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)																			
D = v _p / S	36.4	pc/mi/ln	S																			
LOS	E		D = v _p / S																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Agency or Company	LSA	Junction	Woods Off	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	MD	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = 605 ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)					V _D = 115 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 x f _{HV} x f _p	
Freeway	6710	0.95	Level	12	0	0.893	1.00	7911	
Ramp	0	0.95	Level	0	0	1.000	1.00	0	
UpStream									
DownStream	115	0.95	Level	9	0	0.917	1.00	132	
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3449 pc/h V ₃ or V _{av34} 2231 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	7911	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	7911	Exhibit 25-14	9000	No
					V _R	0	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	3449	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 32.9 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.298 (Exhibit 25-19) S _R = 51.1 mph (Exhibit 25-19) S ₀ = 55.5 mph (Exhibit 25-19) S = 53.5 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>			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
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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	Camfield On to Woods Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper. (LOS) <input type="checkbox"/> Des. (N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6710	veh/h	Peak-Hour Factor, PHF																					
AAADT		veh/day	% Trucks and Buses, P_T																					
Peak-Hr Prop. of AAADT, K			% RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AAADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1 / (1 + P_T(E_T - 1) + P_R(E_R - 1))$	0.893																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1978	Design LOS																						
S	54.4	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h																					
$D = v_p / S$	36.4	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 - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB						
Agency or Company	LSA	Junction	Camfield On						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	MD	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = 810 ft		S _{FF} = 55.0 mph				S _{FR} = 45.0 mph			
V _u = 483 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _D)							
						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 x f _{HV} x f _p	
Freeway	6710	0.95	Level	12	0	0.893	1.00	7911	
Ramp	0	0.95	Level	0	0	1.000	1.00	0	
UpStream	483	0.95	Level	7	0	0.935	1.00	544	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.218 using Equation (Exhibit 25-5) V ₁₂ = 1723 pc/h V ₃ or V _{av34} = 3094 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 3164 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	7911	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3164	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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 = 29.2 (pc/mi/ln) LOS = D (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S	0.400 (Exhibit 25-19)				D _S	(Exhibit 25-19)			
S _R	49.8 mph (Exhibit 25-19)				S _R	mph (Exhibit 25-19)			
S _O	48.0 mph (Exhibit 25-19)				S _O	mph (Exhibit 25-19)			
S	48.7 mph (Exhibit 25-14)				S	mph (Exhibit 25-15)			

BASIC FREEWAY SEGMENTS WORKSHEET																								
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different levels of service (LOS) and free-flow speeds (FFS). Key points on the graph include: <ul style="list-style-type: none"> LOS A: 75 mi/h FFS, 1200 pc/h/ln LOS B: 65 mi/h FFS, 1450 pc/h/ln LOS C: 60 mi/h FFS, 1600 pc/h/ln LOS D: 55 mi/h FFS, 1750 pc/h/ln Dashed lines indicate density values: 11 pc/mi/ln, 16 pc/mi/ln, 20 pc/mi/ln, 25 pc/mi/ln, 35 pc/mi/ln, and 45 pc/mi/ln. </p>		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	Camfield Off to Camfield On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper. (LOS)		<input type="checkbox"/> Des. (N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6710	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	% Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			% RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.893																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1978	pc/h/ln	Design LOS																					
S	54.4	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	36.4	pc/mi/ln	S																					
LQS	E		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 NB		Agency or Company	LSA	Junction	Camfield Off	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	MD	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = 810 ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _D)					V _D = 0 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 x f _{HV} x f _p	
Freeway	6710	0.95	Level	12	0	0.893	1.00	7911	
Ramp	483	0.95	Level	7	0	0.935	1.00	544	
UpStream									
DownStream	0	0.95	Level	12	0	0.893	1.00	0	
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3756 pc/h V ₃ or V _{av34} 2077 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity	LOS F?			Actual	Capacity	LOS F?	
V _{FO}		Exhibit 25-7			V _F	7911	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	7367	Exhibit 25-14	9000	No
					V _R	544	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable	Violation?			Actual	Max Desirable	Violation?	
V _{R12}		Exhibit 25-7			V ₁₂	3756	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 35.0 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = (Exhibit 25-19)					D _S = 0.347 (Exhibit 25-19)				
S _R = mph (Exhibit 25-19)					S _R = 50.5 mph (Exhibit 25-19)				
S ₀ = mph (Exhibit 25-19)					S ₀ = 56.1 mph (Exhibit 25-19)				
S = mph (Exhibit 25-14)					S = 53.3 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>			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
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	AB	Highway/Direction of Travel	I-5 NB																					
Agency or Company	LSA	From/To	South of Camfield Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	7193	veh/h	Peak-Hour Factor, PHF																					
AAADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AAADT, K			%RVs, P_R																					
Peak-Hr Direction Prop., D			General Terrain:																					
DDHV = AAADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.893																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	2120	pc/h/ln	Design LOS																					
S	52.7	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	40.2	pc/mi/ln	S																					
LOS	E		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows five Level of Service (LOS) curves: LOS A (top), LOS B, LOS C, LOS D, and LOS E (bottom). Dashed lines represent density values: 11 pc/mi/ln, 16 pc/mi/ln, 22 pc/mi/ln, 28 pc/mi/ln, and 45 pc/mi/ln. Specific flow rate points are marked: 1300, 1450, 1600, and 1750.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 SB																			
Agency or Company	LSA	From/To	North of Ditman Ave																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																				
<input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	7008	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.917																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	5		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1608	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	29.2	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB		Junction	Ditman Off			
Agency or Company	LSA	Jurisdiction	Existing						
Date Performed	11/25/2009	Analysis Year	Existing						
Analysis Time Period	AM	Project Description							
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off						<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = 975 ft			
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _D)				V _D = 105 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 x f _{HV} x f _p	
Freeway	6890	0.95	Level	9	0	0.917	1.00	7905	
Ramp	118	0.95	Level	3	0	0.971	1.00	128	
UpStream									
DownStream	105	0.95	Level	1	0	0.990	1.00	112	
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 2829 pc/h V ₃ or V _{av34} 1747 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity	LOS F?			Actual	Capacity	LOS F?	
V _{FO}		Exhibit 25-7			V _F	6324	Exhibit 25-14	9000	No
			V _{FO} = V _F - V _R	6196	Exhibit 25-14	9000	No		
			V _R	128	Exhibit 25-3	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable	Violation?			Actual	Max Desirable	Violation?	
V _{R12}		Exhibit 25-7			V ₁₂	2829	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 26.6 (pc/mi/ln) LOS = C (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.310 (Exhibit 25-19) S _R = 51.0 mph (Exhibit 25-19) S ₀ = 57.4 mph (Exhibit 25-19) S = 54.3 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different levels of service (LOS) and densities. Key points on the curves are labeled with flow rates: 1300, 1450, 1600, and 1750. Density levels are indicated as 11 pc/mi/ln, 18 pc/mi/ln, 28 pc/mi/ln, 35 pc/mi/ln, and 45 pc/mi/ln. Free-Flow Speed (FFS) values are listed as 75 mi/h, 70 mi/h, 65 mi/h, 60 mi/h, and 55 mi/h. LOS A is also indicated.</p>		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Ditman Ave Off to Ditman On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	AM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6890	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.917																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1581	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	28.7	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB						
Agency or Company	LSA	Junction	Ditman On						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	AM	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = 975 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = ft			
V _u = 118 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _F)				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 x f _{HV} x f _p	
Freeway	6890	0.95	Level	9	0	0.917	1.00	7905	
Ramp	105	0.95	Level	1	0	0.990	1.00	112	
UpStream	118	0.95	Level	3	0	0.971	1.00	128	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.204 using Equation (Exhibit 25-5) V ₁₂ = 1152 pc/h V ₃ or V _{av34} = 2250 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 2261 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity	LOS F?		Actual	Capacity	LOS F?		
V _{FO}	5765	Exhibit 25-7	No		V _F	Exhibit 25-14			
					V _{FO} = V _F - V _R	Exhibit 25-14			
					V _R	Exhibit 25-3			
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable	Violation?		Actual	Max Desirable	Violation?		
V _{R12}	2373	Exhibit 25-7	4600:All	No	V ₁₂	Exhibit 25-14			
Level of Service Determination (if not F)					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 = 20.6 (pc/mi/ln) LOS = C (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = 0.315 (Exhibit 25-19) S _R = 50.9 mph (Exhibit 25-19) S ₀ = 50.7 mph (Exhibit 25-19) S = 50.8 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)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several dashed curves representing different Free-Flow Speeds (FFS): 75, 70, 65, 60, and 55 mi/h. Points A, B, C, D, and E are marked on these curves. Dashed lines from the origin represent densities of 11, 18, 29, 35, and 45 pc/mi/ln.</p>		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Ditman Ave On to Boswell Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	AM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6995	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.917																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1605	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	29.2	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB		Junction	Boswell Off			
Agency or Company	LSA	Jurisdiction	Existing						
Date Performed	11/25/2009	Analysis Year	Existing						
Analysis Time Period	AM	Project Description							
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = ft			
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)				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 x f _{HV} x f _p	
Freeway	6858	0.95	Level	9	0	0.917	1.00	7869	
Ramp	137	0.95	Level	5	0	0.952	1.00	151	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 2830 pc/h V ₃ or V _{av34} 1733 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	6296	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	6145	Exhibit 25-14	9000	No
					V _R	151	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	2830	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 27.4 (pc/mi/ln) LOS = C (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S =	(Exhibit 25-19)				D _S =	0.312 (Exhibit 25-19)			
S _R =	mph (Exhibit 25-19)				S _R =	50.9 mph (Exhibit 25-19)			
S ₀ =	mph (Exhibit 25-19)				S ₀ =	57.5 mph (Exhibit 25-19)			
S =	mph (Exhibit 25-14)				S =	54.3 mph (Exhibit 25-15)			

BASIC FREEWAY SEGMENTS WORKSHEET																								
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows density curves for various speeds: 75, 70, 65, 60, and 55 mi/h. Level of Service (LOS) boundaries A, B, C, D, and E are marked. Density values are also indicated: 11 pc/mi/h, 18 pc/mi/h, 28 pc/mi/h, 35 pc/mi/h, and 45 pc/mi/h.</p>		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Boswell Off to SB 710 Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	AM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6858	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1574	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	28.6	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different density levels: 11 pc/mi/h, 18 pc/mi/h, 25 pc/mi/h, 35 pc/mi/h, and 45 pc/mi/h. A horizontal line at 55 mi/h is labeled 'Free-Flow Speed'. Points on the curves are labeled with flow rates: 1300, 1450, 1600, and 1750. The graph is divided into sections A, B, C, D, and E.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 SB																			
Agency or Company	LSA	From/To	SB 710 Off to SB 710 On																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	AM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																				
<input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	4427	veh/h	Peak-Hour Factor, PHF																			
AAADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AAADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AAADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.909																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	3		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1709	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	31.1	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

BASIC FREEWAY SEGMENTS WORKSHEET																								
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different density levels: 11 pc/mi/h, 18 pc/mi/h, 26 pc/mi/h, 35 pc/mi/h, and 45 pc/mi/h. Free-flow speeds (FFS) are marked at 75, 70, 65, 60, and 55 mi/h. Points A, B, C, D, and E are marked on the curves.</p>		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	SB 710 On to Triggs Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	AM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6435	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.917																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1846	pc/h/ln	Design LOS																					
S	54.9	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	33.6	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB						
Agency or Company	LSA	Junction	Triggs Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	AM	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = 666 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = ft			
V _u = 249 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)				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 x f _{HV} x f _p	
Freeway	6321	0.95	Level	9	0	0.917	1.00	7253	
Ramp	114	0.95	Level	5	0	0.952	1.00	126	
UpStream	249	0.95	Level	2	0	0.980	1.00	267	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3233 pc/h V ₃ or V _{av34} 2010 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity	LOS F?			Actual	Capacity	LOS F?	
V _{FO}		Exhibit 25-7			V _F	7253	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	7127	Exhibit 25-14	9000	No
					V _R	126	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable	Violation?			Actual	Max Desirable	Violation?	
V _{R12}		Exhibit 25-7			V ₁₂	3233	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 30.8 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.309 (Exhibit 25-19) S _R = 51.0 mph (Exhibit 25-19) S ₀ = 56.4 mph (Exhibit 25-19) S = 53.8 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application</th> <th style="text-align: left;">Input</th> <th style="text-align: left;">Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>			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
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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Triggs Off to Triggs On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	AM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6321	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.917																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1813	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	33.0	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB		Junction	Triggs On			
Agency or Company	LSA	Jurisdiction	Existing						
Date Performed	11/25/2009	Analysis Year	Existing						
Analysis Time Period	AM	Project Description							
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = 666 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = ft			
V _u = 114 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)				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 x f _{HV} x f _p	
Freeway	6321	0.95	Level	9	0	0.917	1.00	7253	
Ramp	249	0.95	Level	1	0	0.990	1.00	265	
UpStream	114	0.95	Level	3	0	0.971	1.00	124	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9)				
L _{EQ} =					L _{EQ} =				
P _{FM} = 0.185 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-12)				
V ₁₂ = 1339 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 2957 pc/h (Equation 25-4 or 25-5)					V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16)				
Is V ₃ or V _{av34} > 2,700 pc/h? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No				
If Yes, V _{12a} = 2901 pc/h (Equation 25-8)					If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	7518	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3166	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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 = 4.252 + 0.0086 V ₁₂ - 0.009 L _D				
D _R = 29.0 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = D (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = 0.398 (Exhibit 25-19)					D _s = (Exhibit 25-19)				
S _R = 49.8 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 49.0 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 49.3 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Triggs On to Eastern Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	AM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6570	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P _T																					
Peak-Hr Prop. of AADT, K			%RVs, P _R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f _p	1.00	E _R	1.2																					
E _T	2.0	f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.917																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f _{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f _{LC}																					
Interchange Density	0.50	l/mi	f _{ID}																					
Number of Lanes, N	4		f _N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)	1885	pc/h/ln	Design LOS																					
S	54.8	mi/h	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)																					
D = v _p / S	34.4	pc/mi/ln	S																					
LOS	D		D = v _p / S																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E _R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB						
Agency or Company	LSA	Junction	Eastern Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	AM	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					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 x f _{HV} x f _p	
Freeway	5985	0.95	Level	9	0	0.917	1.00	6867	
Ramp	585	0.95	Level	5	0	0.952	1.00	647	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3359 pc/h V ₃ or V _{av34} 1754 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	6867	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	6220	Exhibit 25-14	9000	No
					V _R	647	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	3359	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 31.3 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S =	(Exhibit 25-19)				D _S =	0.356 (Exhibit 25-19)			
S _R =	mph (Exhibit 25-19)				S _R =	50.4 mph (Exhibit 25-19)			
S ₀ =	mph (Exhibit 25-19)				S ₀ =	57.4 mph (Exhibit 25-19)			
S =	mph (Exhibit 25-14)				S =	53.7 mph (Exhibit 25-15)			

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Eastern Off to Eastern On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	AM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	5985	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.917																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1717	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	31.2	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																						
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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	AB	Highway/Direction of Travel	I-5 SB																			
Agency or Company	LSA	From/To	North of Ditman Ave																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	PM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																				
<input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	6068	veh/h	Peak-Hour Factor, PHF																			
AAADT		veh/day	% Trucks and Buses, P_T																			
Peak-Hr Prop. of AAADT, K			% RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AAADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.935																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	1/mi	f_{ID}																			
Number of Lanes, N	5		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1367	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	24.9	pc/mi/ln	S																			
LOS	C		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		AB			Freeway/Dir of Travel		I-5 SB		
Agency or Company		LSA			Junction		Ditman Off		
Date Performed		11/25/2009			Jurisdiction				
Analysis Time Period		PM			Analysis Year		Existing		
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		$S_{FF} = 55.0$ mph $S_{FR} = 45.0$ mph Sketch (show lanes, L_A, L_D, V_R, V_f)					<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off		
$L_{up} =$ ft							$L_{down} =$ 975 ft		
$V_u =$ veh/h		$V_D =$ 156 veh/h							
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	5986	0.95	Level	7	0	0.935	1.00	6742	
Ramp	82	0.95	Level	2	0	0.980	1.00	88	
UpStream									
DownStream	156	0.95	Level	2	0	0.980	1.00	167	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 25-2 or 25-3) $P_{FM} =$ using Equation (Exhibit 25-5) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 25-4 or 25-5) Is V_3 or $V_{av34} > 2,700$ pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, $V_{12a} =$ pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 25-8 or 25-9) $P_{FD} =$ 0.436 using Equation (Exhibit 25-12) $V_{12} =$ 2548 pc/h V_3 or V_{av34} 1591 pc/h (Equation 25-15 or 25-16) Is V_3 or $V_{av34} > 2,700$ pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, $V_{12a} =$ pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7			V_F	5731	Exhibit 25-14	9000	No
					$V_{FO} = V_F - V_R$	5643	Exhibit 25-14	9000	No
					V_R	88	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7			V_{12}	2548	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 24.1 (pc/mi/ln) LOS = C (Exhibit 25-4)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 25-19) $S_R =$ mph (Exhibit 25-19) $S_0 =$ mph (Exhibit 25-19) $S =$ mph (Exhibit 25-14)					$D_s =$ 0.306 (Exhibit 25-19) $S_R =$ 51.0 mph (Exhibit 25-19) $S_0 =$ 58.0 mph (Exhibit 25-19) $S =$ 54.7 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																										
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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	AB	Highway/Direction of Travel	I-5 SB																							
Agency or Company	LSA	From/To	Ditman Ave Off to Ditman On																							
Date Performed	11/25/2009	Jurisdiction																								
Analysis Time Period	PM	Analysis Year	Existing																							
Project Description																										
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)		<input type="checkbox"/> Planning Data																						
Flow Inputs																										
Volume, V	5986	veh/h	Peak-Hour Factor, PHF	0.95																						
AADT		veh/day	% Trucks and Buses, P_T	7																						
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	2.0		$f_{HV} = 1/(1+P_T(E_T - 1) + P_R(E_R - 1))$	0.935																						
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	l/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)																							
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1348	pc/h/ln	Design LOS																							
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																							
$D = v_p / S$	24.5	pc/mi/ln	S																							
LOS	C		$D = v_p / S$																							
			Required Number of Lanes, N																							
Glossary			Factor Location																							
N - Number of lanes	S - Speed		E_R - Exhibits 23-8, 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																										

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB		Junction	Ditman On			
Agency or Company	LSA	Jurisdiction							
Date Performed	11/25/2009	Analysis Year	Existing						
Analysis Time Period	PM								
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On							<input type="checkbox"/> Yes <input type="checkbox"/> On		
<input type="checkbox"/> No <input checked="" type="checkbox"/> Off							<input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
$L_{up} =$	975 ft	$S_{FF} = 55.0$ mph					$S_{FR} = 45.0$ mph		
$V_u =$	82 veh/h	Sketch (show lanes, L_A, L_D, V_R, V_l)							
							$L_{down} =$	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	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	5986	0.95	Level	7	0	0.935	1.00	6742	
Ramp	156	0.95	Level	2	0	0.980	1.00	167	
UpStream	82	0.95	Level	2	0	0.980	1.00	88	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9)				
$L_{EQ} =$	0.197 using Equation (Exhibit 25-5)				$L_{EQ} =$	using Equation (Exhibit 25-12)			
$P_{FM} =$	969 pc/h				$P_{FD} =$	pc/h			
$V_{12} =$	1976 pc/h (Equation 25-4 or 25-5)				$V_{12} =$	pc/h (Equation 25-15 or 25-16)			
V_3 or V_{av34}	Is V_3 or $V_{av34} > 2,700$ pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No				V_3 or V_{av34}	Is V_3 or $V_{av34} > 2,700$ pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No			
	Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ <input type="checkbox"/> Yes <input type="checkbox"/> No			
If Yes, $V_{12a} =$	1968 pc/h (Equation 25-8)				If Yes, $V_{12a} =$	pc/h (Equation 25-18)			
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	5089	Exhibit 25-7		No	V_F		Exhibit 25-14		
					$V_{FO} = V_F - V_R$		Exhibit 25-14		
					V_R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	2135	Exhibit 25-7		No	V_{12}		Exhibit 25-14		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
$D_R =$	18.7 (pc/mi/ln)				$D_R =$	(pc/mi/ln)			
LOS =	B (Exhibit 25-4)				LOS =	(Exhibit 25-4)			
Speed Determination					Speed Determination				
$M_S =$	0.306 (Exhibit 25-19)				$D_S =$	(Exhibit 25-19)			
$S_R =$	51.0 mph (Exhibit 25-19)				$S_R =$	mph (Exhibit 25-19)			
$S_0 =$	51.5 mph (Exhibit 25-19)				$S_0 =$	mph (Exhibit 25-19)			
$S =$	51.3 mph (Exhibit 25-14)				$S =$	mph (Exhibit 25-15)			

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Ditman Ave On to Boswell Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	PM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6142	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	% Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			% RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1384	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	25.2	pc/mi/ln	S																					
LOS	C		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB		Agency or Company	LSA	Junction	Boswell Off	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	PM	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)					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 x f _{HV} x f _p	
Freeway	5996	0.95	Level	7	0	0.935	1.00	6753	
Ramp	146	0.95	Level	7	0	0.935	1.00	164	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 2596 pc/h V ₃ or V _{av34} 1572 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	5741	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	5577	Exhibit 25-14	9000	No
					V _R	164	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	2596	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 25.4 (pc/mi/ln) LOS = C (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.313 (Exhibit 25-19) S _R = 50.9 mph (Exhibit 25-19) S ₀ = 58.1 mph (Exhibit 25-19) S = 54.6 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Boswell Off to SB 710 Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	PM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	5996	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	% Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			% RVs, P_R																					
Peak-Hr Direction Prop. D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1351	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	24.6	pc/mi/ln	S																					
LOS	C		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	SB 710 Off to SB 710 On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	PM	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
		<input type="checkbox"/> Planning Data																						
Flow Inputs																								
Volume, V	3554	veh/h	Peak-Hour Factor, PHF																					
AAADT		veh/day	% Trucks and Buses, P_T																					
Peak-Hr Prop. of AAADT, K			% RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AAADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T-1) + P_R(E_R-1)]$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	3		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1359	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	24.7	pc/mi/ln	S																					
LOS	C		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different levels of service (LOS) and free-flow speeds (FFS). Key points on the curves are labeled with flow rates: 1300, 1450, 1600, and 1750. Dashed lines indicate density values: 11 pc/mi/ln, 7.8 pc/mi/ln, 28 pc/mi/ln, 35 pc/mi/ln, and 45 pc/mi/ln. A legend in the top right corner defines the application, input, and output for various analysis types.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 SB																			
Agency or Company	LSA	From/To	SB 710 On to Triggs Off																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	PM	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	6083	veh/h	Peak-Hour Factor, PHF																			
AAADT		veh/day	% Trucks and Buses, P_T																			
Peak-Hr Prop. of AAADT, K			% RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AAADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00		E_R																			
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	1/mi	f_{ID}																			
Number of Lanes, N	4		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1729	pc/h/ln	Design LOS																			
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	31.4	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET										
General Information				Site Information						
Analyst	AB			Freeway/Dir of Travel	I-5 SB					
Agency or Company	LSA			Junction	Triggs Off					
Date Performed	11/25/2009			Jurisdiction						
Analysis Time Period	PM			Analysis Year	Existing					
Project Description										
Inputs										
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp				
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off						<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off				
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = 666 ft				
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)				V _D = 293 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 x f _{HV} x f _p		
Freeway	6006	0.95	Level	8	0	0.926	1.00	6828		
Ramp	77	0.95	Level	7	0	0.935	1.00	87		
UpStream										
DownStream	293	0.95	Level	3	0	0.971	1.00	318		
Merge Areas				Diverge Areas						
Estimation of v₁₂				Estimation of v₁₂						
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)				$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3026 pc/h V ₃ or V _{av34} 1901 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)						
Capacity Checks				Capacity Checks						
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?	
V _{FO}		Exhibit 25-7				V _F	6828	Exhibit 25-14	9000	No
						V _{FO} = V _F - V _R	6741	Exhibit 25-14	9000	No
						V _R	87	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area				Flow Entering Diverge Influence Area						
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?	
	V _{R12}	Exhibit 25-7				V ₁₂	3026	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)				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)				$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 29.0 (pc/mi/ln) LOS = D (Exhibit 25-4)						
Speed Determination				Speed Determination						
M _S = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)				D _S = 0.306 (Exhibit 25-19) S _R = 51.0 mph (Exhibit 25-19) S ₀ = 56.8 mph (Exhibit 25-19) S = 54.1 mph (Exhibit 25-15)						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB		Junction	Triggs On			
Agency or Company	LSA	Jurisdiction							
Date Performed	11/25/2009	Analysis Year	Existing						
Analysis Time Period	PM								
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = 666 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = 77 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _D)					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 x f _{HV} x f _p	
Freeway	6006	0.95	Level	8	0	0.926	1.00	6828	
Ramp	293	0.95	Level	3	0	0.971	1.00	318	
UpStream	77	0.95	Level	7	0	0.935	1.00	87	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9)				
L _{EQ} =					L _{EQ} =				
P _{FM} = 0.178 using Equation (Exhibit 25-5)					P _{FD} = using Equation (Exhibit 25-12)				
V ₁₂ = 1216 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 2806 pc/h (Equation 25-4 or 25-5)					V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16)				
Is V ₃ or V _{av34} > 2,700 pc/h? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No				
If Yes, V _{12a} = 2731 pc/h (Equation 25-8)					If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	7146	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3049	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
D _R = 28.0 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = D (Exhibit 25-4)					LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = 0.388 (Exhibit 25-19)					D _s = (Exhibit 25-19)				
S _R = 50.0 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 49.4 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 49.7 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																																																																																																																																																																																
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different Levels of Service (LOS) from A to F. Dashed lines indicate density values: 11 pc/mi/ln, 10 pc/mi/ln, 25 pc/mi/ln, 35 pc/mi/ln, and 45 pc/mi/ln. A table in the top right corner lists applications and their corresponding inputs and outputs.</p> <table border="1" style="float: right; margin-top: 10px;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: left;">General Information</th> <th colspan="2" style="text-align: left;">Site Information</th> </tr> </thead> <tbody> <tr> <td>Analyst</td> <td>AB</td> <td>Highway/Direction of Travel</td> <td>I-5 SB</td> </tr> <tr> <td>Agency or Company</td> <td>LSA</td> <td>From/To</td> <td>Triggs On to Eastern Off</td> </tr> <tr> <td>Date Performed</td> <td>11/25/2009</td> <td>Jurisdiction</td> <td></td> </tr> <tr> <td>Analysis Time Period</td> <td>PM</td> <td>Analysis Year</td> <td>Existing</td> </tr> <tr> <td colspan="4">Project Description</td> </tr> <tr> <td colspan="2"><input checked="" type="checkbox"/> Oper.(LOS)</td> <td colspan="2"><input type="checkbox"/> Des.(N)</td> </tr> <tr> <td colspan="2"></td> <td colspan="2"><input type="checkbox"/> Planning Data</td> </tr> <tr> <td colspan="4">Flow Inputs</td> </tr> <tr> <td>Volume, V</td> <td>6299</td> <td>veh/h</td> <td>Peak-Hour Factor, PHF</td> </tr> <tr> <td>AAADT</td> <td></td> <td>veh/day</td> <td>%Trucks and Buses, P_T</td> </tr> <tr> <td>Peak-Hr Prop. of AAADT, K</td> <td></td> <td></td> <td>%RVs, P_R</td> </tr> <tr> <td>Peak-Hr Direction Prop, D</td> <td></td> <td></td> <td>General Terrain:</td> </tr> <tr> <td>DDHV = AAADT x K x D</td> <td></td> <td>veh/h</td> <td>Grade % Length</td> </tr> <tr> <td>Driver type adjustment</td> <td>1.00</td> <td></td> <td>Up/Down %</td> </tr> <tr> <td colspan="4">Calculate Flow Adjustments</td> </tr> <tr> <td>f_p</td> <td>1.00</td> <td>E_R</td> <td>1.2</td> </tr> <tr> <td>E_T</td> <td>2.0</td> <td>$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$</td> <td>0.926</td> </tr> <tr> <td colspan="2">Speed Inputs</td> <td colspan="2">Calc Speed Adj and FFS</td> </tr> <tr> <td>Lane Width</td> <td>12.0</td> <td>ft</td> <td>f_{LW}</td> </tr> <tr> <td>Rt-Shoulder Lat. 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Clearance	6.0	ft	f_{LC}	Interchange Density	0.50	l/mi	f_{ID}	Number of Lanes, N	4		f_N	FFS (measured)	55.0	mi/h	FFS	Base free-flow Speed, BFFS		mi/h	55.0	LOS and Performance Measures		Design (N)		Operational (LOS)		Design (N)		$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1790	pc/h/ln	Design LOS	S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	$D = v_p / S$	32.5	pc/mi/ln	S	LOS	D		$D = v_p / S$			Required Number of Lanes, N		Glossary		Factor Location		N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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	AB	Freeway/Dir of Travel	I-5 SB		Agency or Company	LSA	Junction	Eastern Off	
Date Performed	11/25/2009	Jurisdiction			Analysis Time Period	PM	Analysis Year	Existing	
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)					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 x f _{HV} x f _p	
Freeway	6035	0.95	Level	8	0	0.926	1.00	6861	
Ramp	264	0.95	Level	7	0	0.935	1.00	297	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3159 pc/h V ₃ or V _{av34} 1851 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	6861	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	6564	Exhibit 25-14	9000	No
					V _R	297	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	3159	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ D _R = 29.6 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S =	(Exhibit 25-19)				D _S =	0.325 (Exhibit 25-19)			
S _R =	mph (Exhibit 25-19)				S _R =	50.8 mph (Exhibit 25-19)			
S ₀ =	mph (Exhibit 25-19)				S ₀ =	57.0 mph (Exhibit 25-19)			
S =	mph (Exhibit 25-14)				S =	54.0 mph (Exhibit 25-15)			

BASIC FREEWAY SEGMENTS WORKSHEET																						
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AA DT		veh/day	% Trucks and Buses, P_T																			
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Operational (LOS)		Design (N)																				
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S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	31.2	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
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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																						

BASIC FREEWAY SEGMENTS WORKSHEET																								
		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	North of Ditman Ave																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	7598	veh/h	Peak-Hour Factor, PHF	0.95																				
AADT		veh/day	%Trucks and Buses, P_T	13																				
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	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.885																				
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	l/mi	f_{ID}	mi/h																				
Number of Lanes, N	5		f_N	mi/h																				
FFS (measured)	55.0	mi/h	FFS	55.0																				
Base free-flow Speed, BFFS		mi/h																						
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1808	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h																				
$D = v_p / S$	32.9	pc/mi/ln	S	mi/h																				
LOS	D		$D = v_p / S$	pc/mi/ln																				
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB						
Agency or Company	LSA	Junction	Ditman Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	MD	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input type="checkbox"/> Yes <input type="checkbox"/> On						<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On			
<input checked="" type="checkbox"/> No <input type="checkbox"/> Off						<input type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = ft		S _{FF} = 55.0 mph				S _{FR} = 45.0 mph			
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _D)				L _{down} = 975 ft			
						V _D = 0 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 x f _{HV} x f _p	
Freeway	7589	0.95	Level	13	0	0.885	1.00	9027	
Ramp	8	0.95	Level	3	0	0.971	1.00	9	
UpStream									
DownStream	0	0.95	Level	0	0	1.000	1.00	0	
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3154 pc/h V ₃ or V _{av34} = 2034 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	7222	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	7213	Exhibit 25-14	9000	No
					V _R	9	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	3154	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 29.4 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.299 (Exhibit 25-19) S _R = 51.1 mph (Exhibit 25-19) S ₀ = 56.3 mph (Exhibit 25-19) S = 53.9 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different density and flow rate conditions: Density = 11 pc/mi/ln, 16 pc/mi/ln, 25 pc/mi/ln, 35 pc/mi/ln, and 45 pc/mi/ln. Specific points are marked on the curves with flow rates of 1300, 1450, 1580, and 1750. A horizontal line for LOS A is drawn at approximately 55 mi/h.</p>		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Ditman Ave Off to Ditman On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	7589	veh/h	Peak-Hour Factor, PHF	0.95																				
AADT		veh/day	% Trucks and Buses, P_T	13																				
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	2.0	$f_{HV} = 1/[1+P_T(E_T-1) + P_R(E_R-1)]$	0.885																					
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	l/mi	f_{ID}	mi/h																				
Number of Lanes, N	5		f_N	mi/h																				
FFS (measured)	55.0	mi/h	FFS	55.0																				
Base free-flow Speed, BFFS		mi/h																						
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1805	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h																				
$D = v_p / S$	32.8	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 - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		AB			Freeway/Dir of Travel		I-5 SB		
Agency or Company		LSA			Junction		Ditman On		
Date Performed		11/25/2009			Jurisdiction				
Analysis Time Period		MD			Analysis Year		Existing		
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = 975 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = 8 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					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 x f _{HV} x f _p	
Freeway	7589	0.95	Level	13	0	0.885	1.00	9027	
Ramp	0	0.95	Level	0	0	1.000	1.00	0	
UpStream	8	0.95	Level	3	0	0.971	1.00	9	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.218 using Equation (Exhibit 25-5) V ₁₂ = 1422 pc/h V ₃ or V _{av34} = 2552 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 2610 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	6527	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	2610	Exhibit 25-7		No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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/mi/ln) LOS = C (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = 0.326 (Exhibit 25-19)					D _s = (Exhibit 25-19)				
S _R = 50.8 mph (Exhibit 25-19)					S _R = mph (Exhibit 25-19)				
S ₀ = 49.8 mph (Exhibit 25-19)					S ₀ = mph (Exhibit 25-19)				
S = 50.1 mph (Exhibit 25-14)					S = mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several density curves for different speeds: 75, 70, 65, 60, and 55 mi/h. Points are marked on these curves with flow rates: 1750, 1750, 1600, and 1750. A dashed line represents a density of 11 pc/mi/ln.</p>		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Ditman Ave On to Boswell Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper. (LOS) <input type="checkbox"/> Des. (N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	7589	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	% Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			% RVs, P_R																					
Peak-Hr Direction Prop., D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1 / (1 + P_T(E_T - 1) + P_R(E_R - 1))$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1805	Design LOS																						
S	55.0	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h																					
$D = v_p / S$	32.8	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 - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB						
Agency or Company	LSA	Junction	Boswell Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	MD	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)					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 x f _{HV} x f _p	
Freeway	7459	0.95	Level	13	0	0.885	1.00	8872	
Ramp	130	0.95	Level	12	0	0.893	1.00	153	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3181 pc/h V ₃ or V _{av34} 1958 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	7098	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	6945	Exhibit 25-14	9000	No
					V _R	153	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	3181	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 30.4 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.312 (Exhibit 25-19) S _R = 50.9 mph (Exhibit 25-19) S ₀ = 56.6 mph (Exhibit 25-19) S = 53.9 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
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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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Boswell Off to SB 710 Off																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	7459	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			%RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	5		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1774	pc/h/ln	Design LOS																					
S	55.0	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	32.3	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

BASIC FREEWAY SEGMENTS WORKSHEET																						
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different density and speed levels: Density = 11 pc/mi/ln, 16 pc/mi/ln, 26 pc/mi/ln, 35 pc/mi/ln, and 45 pc/mi/ln. Specific points are marked at flow rates of 1200, 1450, 1600, and 1750. A horizontal line for LOS A is shown at approximately 55 mi/h.</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>	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
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	AB	Highway/Direction of Travel	I-5 SB																			
Agency or Company	LSA	From/To	SB 710 Off to SB 710 On																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	MD	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																				
<input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	5005	veh/h	Peak-Hour Factor, PHF																			
AADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AADT, K			%RVs, P_R																			
Peak-Hr Direction Prop, D			General Terrain:																			
DDHV = AADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.877																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	3		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	2002	pc/h/ln	Design LOS																			
S	54.2	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	37.0	pc/mi/ln	S																			
LOS	E		$D = v_p / S$																			
			Required Number of Lanes, N																			
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

BASIC FREEWAY SEGMENTS WORKSHEET																						
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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	AB	Highway/Direction of Travel	I-5 SB																			
Agency or Company	LSA	From/To	SB 710 On to Triggs Off																			
Date Performed	11/25/2009	Jurisdiction																				
Analysis Time Period	MD	Analysis Year	Existing																			
Project Description																						
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																						
Flow Inputs																						
Volume, V	6412	veh/h	Peak-Hour Factor, PHF																			
AAADT		veh/day	%Trucks and Buses, P_T																			
Peak-Hr Prop. of AAADT, K			%RVs, P_R																			
Peak-Hr Direction Prop., D			General Terrain:																			
DDHV = AAADT x K x D		veh/h	Grade % Length																			
Driver type adjustment	1.00		Up/Down %																			
Calculate Flow Adjustments																						
f_p	1.00	E_R	1.2																			
E_T	2.0	$f_{HV} = 1/(1+P_T(E_T - 1) + P_R(E_R - 1))$	0.885																			
Speed Inputs		Calc Speed Adj and FFS																				
Lane Width	12.0	ft	f_{LW}																			
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																			
Interchange Density	0.50	l/mi	f_{ID}																			
Number of Lanes, N	4		f_N																			
FFS (measured)	55.0	mi/h	FFS																			
Base free-flow Speed, BFFS		mi/h	55.0																			
LOS and Performance Measures		Design (N)																				
Operational (LOS)		Design (N)																				
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1907	pc/h/ln	Design LOS																			
S	54.8	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																			
$D = v_p / S$	34.8	pc/mi/ln	S																			
LOS	D		$D = v_p / S$																			
		Required Number of Lanes, N																				
Glossary		Factor Location																				
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB						
Agency or Company	LSA	Junction	Triggs Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	MD	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> On <input type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = 666 ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)					V _D = 65 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 x f _{HV} x f _p	
Freeway	6412	0.95	Level	13	0	0.885	1.00	7627	
Ramp	0	0.95	Level	0	0	1.000	1.00	0	
UpStream									
DownStream	65	0.95	Level	3	0	0.971	1.00	70	
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3325 pc/h V ₃ or V _{av34} 2151 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	7627	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	7627	Exhibit 25-14	9000	No
					V _R	0	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	3325	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 31.6 (pc/mi/ln) LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = (Exhibit 25-19) S _R = mph (Exhibit 25-19) S ₀ = mph (Exhibit 25-19) S = mph (Exhibit 25-14)					D _s = 0.298 (Exhibit 25-19) S _R = 51.1 mph (Exhibit 25-19) S ₀ = 55.8 mph (Exhibit 25-19) S = 53.7 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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Triggs Off to Triggs On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS) <input type="checkbox"/> Des.(N) <input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6412	veh/h	Peak-Hour Factor, PHF																					
AADT		veh/day	% Trucks and Buses, P_T																					
Peak-Hr Prop. of AADT, K			% RVs, P_R																					
Peak-Hr Direction Prop, D			General Terrain:																					
DDHV = AADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00	E_R	1.2																					
E_T	2.0	$f_{HV} = 1/[1+P_T(E_T-1) + P_R(E_R-1)]$	0.885																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1907	pc/h/ln	Design LOS																					
S	54.8	mi/h	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$																					
$D = v_p / S$	34.8	pc/mi/ln	S																					
LOS	D		$D = v_p / S$																					
		Required Number of Lanes, N																						
Glossary		Factor Location																						
N - Number of lanes	S - Speed	E_R - Exhibits 23-8, 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																								

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB		Junction	Triggs On			
Agency or Company	LSA	Jurisdiction	Existing						
Date Performed	11/25/2009	Analysis Year	Existing						
Analysis Time Period	MD	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level				Downstream Adj Ramp			
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> On <input type="checkbox"/> No <input checked="" type="checkbox"/> Off						<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off			
L _{up} = 666 ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph				L _{down} = ft			
V _u = 0 veh/h		Sketch (show lanes, L _A , L _D , V _R , V _f)				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 x f _{HV} x f _p	
Freeway	6412	0.95	Level	13	0	0.885	1.00	7627	
Ramp	65	0.95	Level	3	0	0.971	1.00	70	
UpStream	0	0.95	Level	0	0	1.000	1.00	0	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v ₁₂					Estimation of v ₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 25-2 or 25-3) L _{EQ} = P _{FM} = 0.209 using Equation (Exhibit 25-5) V ₁₂ = 1594 pc/h V ₃ or V _{av34} = 3016 pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = 3050 pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 25-8 or 25-9) L _{EQ} = P _{FD} = using Equation (Exhibit 25-12) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	7697	Exhibit 25-7		No	V _F		Exhibit 25-14		
					V _{FO} = V _F - V _R		Exhibit 25-14		
					V _R		Exhibit 25-3		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3120	Exhibit 25-7	4600:All	No	V ₁₂		Exhibit 25-14		
Level of Service Determination (if not F)					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/mi/ln) LOS = D (Exhibit 25-4)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _S	0.394 (Exhibit 25-19)				D _S	(Exhibit 25-19)			
S _R	49.9 mph (Exhibit 25-19)				S _R	mph (Exhibit 25-19)			
S ₀	48.6 mph (Exhibit 25-19)				S ₀	mph (Exhibit 25-19)			
S	49.1 mph (Exhibit 25-14)				S	mph (Exhibit 25-15)			

BASIC FREEWAY SEGMENTS WORKSHEET																										
<p>The graph plots Average Passenger-Car Speed (mi/h) on the y-axis (30 to 80) against Flow Rate (pc/h/ln) on the x-axis (0 to 2400). It shows several curves representing different density and free-flow speed (FFS) conditions. Key points on the curves are labeled with flow rates: 1300, 1450, 1600, and 1750. Density values are indicated as 11 pc/mi/ln, 19 pc/mi/ln, 29 pc/mi/ln, 35 pc/mi/ln, and 45 pc/mi/ln. A 'Free-Flow Speed' of 75 mi/h is noted at the top left.</p>			<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>			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
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: AB		Highway/Direction of Travel: I-5 SB																								
Agency or Company: LSA		From/To: Triggs On to Eastern Off																								
Date Performed: 11/25/2009		Jurisdiction:																								
Analysis Time Period: MD		Analysis Year: Existing																								
Project Description:																										
<input checked="" type="checkbox"/> Oper. (LOS) <input type="checkbox"/> Des. (N) <input type="checkbox"/> Planning Data																										
Flow Inputs																										
Volume, V: 6477 veh/h		Peak-Hour Factor, PHF: 0.95																								
AADT: veh/day		% Trucks and Buses, P_T : 13																								
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 : 2.0		$f_{HV} = 1/(1+P_T(E_T-1) + P_R(E_R-1))$: 0.885																								
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 l/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):																							
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$: 1926 pc/h/ln		Design LOS:		$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$: pc/h																						
S: 54.7 mi/h		S:		mi/h																						
$D = v_p / S$: 35.2 pc/mi/ln		$D = v_p / S$:		pc/mi/ln																						
LOS: E		Required Number of Lanes, N:																								
Glossary			Factor Location																							
N - Number of lanes		S - Speed		E_R - Exhibits 23-8, 23-10																						
V - Hourly volume		D - Density		f_{LW} - Exhibit 23-4																						
v_p - Flow rate		FFS - Free-flow speed		E_T - Exhibits 23-8, 23-10, 23-11																						
LOS - Level of service		BFFS - Base free-flow speed		f_{LC} - Exhibit 23-5																						
DDHV - Directional design hour volume				f_p - Page 23-12																						
				LOS, S, FFS, v_p - Exhibits 23-2, 23-3																						
				f_{ID} - Exhibit 23-7																						

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst	AB	Freeway/Dir of Travel	I-5 SB						
Agency or Company	LSA	Junction	Eastern Off						
Date Performed	11/25/2009	Jurisdiction							
Analysis Time Period	MD	Analysis Year	Existing						
Project Description									
Inputs									
Upstream Adj Ramp		Terrain: Level					Downstream Adj Ramp		
<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off							<input type="checkbox"/> Yes <input type="checkbox"/> On <input checked="" type="checkbox"/> No <input type="checkbox"/> Off		
L _{up} = ft		S _{FF} = 55.0 mph S _{FR} = 45.0 mph					L _{down} = ft		
V _u = veh/h		Sketch (show lanes, L _A , L _D , V _R , V _I)					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 x f _{HV} x f _p	
Freeway	6160	0.95	Level	13	0	0.885	1.00	7327	
Ramp	317	0.95	Level	11	0	0.901	1.00	370	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 25-2 or 25-3) P _{FM} = using Equation (Exhibit 25-5) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 25-4 or 25-5) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-8)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 25-8 or 25-9) P _{FD} = 0.436 using Equation (Exhibit 25-12) V ₁₂ = 3403 pc/h V ₃ or V _{av34} 1962 pc/h (Equation 25-15 or 25-16) Is V ₃ or V _{av34} > 2,700 pc/h? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, V _{12a} = pc/h (Equation 25-18)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 25-7			V _F	7327	Exhibit 25-14	9000	No
					V _{FO} = V _F - V _R	6957	Exhibit 25-14	9000	No
					V _R	370	Exhibit 25-3	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 25-7			V ₁₂	3403	Exhibit 25-14	4400:All	No
Level of Service Determination (if not F)					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 = 4.252 + 0.0086 V ₁₂ - 0.009 L _D				
D _R = (pc/mi/ln)					D _R = 31.7 (pc/mi/ln)				
LOS = (Exhibit 25-4)					LOS = D (Exhibit 25-4)				
Speed Determination					Speed Determination				
M _s = (Exhibit 25-19)					D _s = 0.331 (Exhibit 25-19)				
S _R = mph (Exhibit 25-19)					S _R = 50.7 mph (Exhibit 25-19)				
S ₀ = mph (Exhibit 25-19)					S ₀ = 56.6 mph (Exhibit 25-19)				
S = mph (Exhibit 25-14)					S = 53.7 mph (Exhibit 25-15)				

BASIC FREEWAY SEGMENTS WORKSHEET																								
		<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Application</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Operational (LOS)</td> <td>FFS, N, v_p</td> <td>LOS, S, D</td> </tr> <tr> <td>Design (N)</td> <td>FFS, LOS, v_p</td> <td>N, S, D</td> </tr> <tr> <td>Design (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> <tr> <td>Planning (LOS)</td> <td>FFS, N, AADT</td> <td>LOS, S, D</td> </tr> <tr> <td>Planning (N)</td> <td>FFS, LOS, AADT</td> <td>N, S, D</td> </tr> <tr> <td>Planning (v_p)</td> <td>FFS, LOS, N</td> <td>v_p, S, D</td> </tr> </tbody> </table>		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
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	AB	Highway/Direction of Travel	I-5 SB																					
Agency or Company	LSA	From/To	Eastern Off to Eastern On																					
Date Performed	11/25/2009	Jurisdiction																						
Analysis Time Period	MD	Analysis Year	Existing																					
Project Description																								
<input checked="" type="checkbox"/> Oper.(LOS)		<input type="checkbox"/> Des.(N)																						
<input type="checkbox"/> Planning Data																								
Flow Inputs																								
Volume, V	6160	veh/h	Peak-Hour Factor, PHF																					
AAADT		veh/day	%Trucks and Buses, P_T																					
Peak-Hr Prop. of AAADT, K			%RVs, P_R																					
Peak-Hr Direction Prop. D			General Terrain:																					
DDHV = AAADT x K x D		veh/h	Grade % Length																					
Driver type adjustment	1.00		Up/Down %																					
Calculate Flow Adjustments																								
f_p	1.00		E_R																					
E_T	2.0		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$																					
Speed Inputs		Calc Speed Adj and FFS																						
Lane Width	12.0	ft	f_{LW}																					
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}																					
Interchange Density	0.50	l/mi	f_{ID}																					
Number of Lanes, N	4		f_N																					
FFS (measured)	55.0	mi/h	FFS																					
Base free-flow Speed, BFFS		mi/h	55.0																					
LOS and Performance Measures		Design (N)																						
Operational (LOS)		Design (N)																						
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	1832	Design LOS																						
S	55.0	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	pc/h																					
$D = v_p / S$	33.3	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 - Exhibits 23-8, 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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