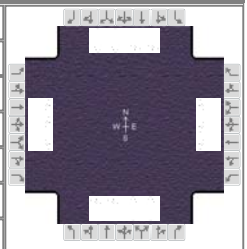
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	7/24/2016	Area Type	Other
Jurisdiction	South Dakota	Time Period	AM Peak	PHF	0.89
Urban Street	Elk Vale	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Interchange I-90	File Name	1.AM peak Elk Vale and I-90 SPUI existing timing....		
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	83		0	378		0	365	160		42	200	

Signal Information			
Cycle, s	84.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

	1	2	3	4	5	6	7	8
Green	0.0	0.0	0.0	0.0	0.0	0.0		
Yellow	0.0	0.0	0.0	0.0	0.0	0.0		
Red	0.0	0.0	0.0	0.0	0.0	0.0		

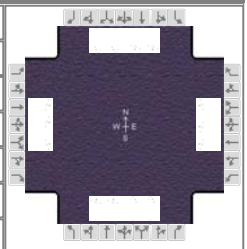
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		5.0		5.0	2.0	4.0	2.0	4.0
Phase Duration, s		19.0		19.0	21.8	49.8	15.2	43.2
Change Period, ($Y+R_c$), s		8.5		8.5	8.5	8.5	8.5	8.5
Max Allow Headway (*MAH*), s		0.0		0.0	0.0	0.0	0.0	0.0
Queue Clearance Time (g_s), s		0.0		0.0	0.0	0.0	0.0	0.0
Green Extension Time (g_e), s		0.0		0.0	0.0	0.0	0.0	0.0
Phase Call Probability		0.00		0.00	0.00	0.00	0.00	0.00
Max Out Probability		0.00		0.00	0.00	0.00	0.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3		18	5	2		1	6	
Adjusted Flow Rate (*v*), veh/h	0		0	0		0	0	0		0	0	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	0		0	0		0	0	0		0	0	
Queue Service Time (g_s), s	0.0		0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Cycle Queue Clearance Time (g_c), s	0.0		0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Green Ratio (*g/C*)	0.12		0.12	0.12		0.12	0.16	0.49		0.08	0.41	
Capacity (*c*), veh/h	545		175	575		175	508	1430		186	1171	
Volume-to-Capacity Ratio (*X*)	0.171		0.000	0.739		0.000	0.808	0.126		0.253	0.192	
Back of Queue (*Q*), ft/ln (50 th percentile)	23.1		0	118		0	103.2	24.1		14.6	38.1	
Back of Queue (*Q*), veh/ln (50 th percentile)	0.8		0.0	4.6		0.0	4.0	0.9		0.4	1.4	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.06		0.00	0.29		0.00	0.34	0.00		0.05	0.00	
Uniform Delay (d_1), s/veh	33.2		0.0	36.9		0.0	34.1	11.6		36.3	15.7	
Incremental Delay (d_2), s/veh	0.1		0.0	4.4		0.0	1.2	0.2		0.3	0.4	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	33.2		0.0	41.3		0.0	35.3	11.7		36.6	16.1	
Level of Service (LOS)	C			D			D	B		D	B	
Approach Delay, s/veh / LOS	33.2		C	41.3		D	28.1		C	19.7		B
Intersection Delay, s/veh / LOS	30.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.0	C	2.8	C	2.8	C
Bicycle LOS Score / LOS		F		F	1.0	A	0.7	A

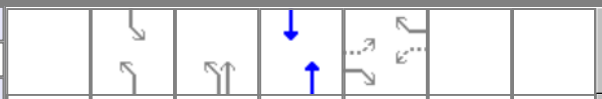
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	7/24/2016	Area Type	Other
Jurisdiction	South Dakota	Time Period	PM Peak	PHF	0.89
Urban Street	Elk Vale	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Interchange I-90	File Name	1.PM peak Elk Vale and I-90 SPUI existing timing....		
Project Description					

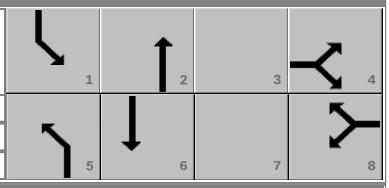


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	227		0	459		0	461	349		25	200	

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.6	2.0	24.4	15.0	0.0	0.0
Yellow	6.5	6.5	6.5	6.5	0.0	0.0
Red	2.0	2.0	2.0	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		5.0		5.0	2.0	4.0	2.0	4.0
Phase Duration, s		23.5		23.5	23.7	43.4	13.1	32.9
Change Period, ($Y+R_c$), s		8.5		8.5	8.5	8.5	8.5	8.5
Max Allow Headway (*MAH*), s		3.0		3.0	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s		7.7		13.7	14.3		2.7	
Green Extension Time (g_e), s		1.6		1.2	0.9	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		0.46	
Max Out Probability		0.01		0.15	0.05		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3		18	5	2		1	6	
Adjusted Flow Rate (*v*), veh/h	255		0	516		0	518	392		28	225	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1548		1403	1639		1403	1626	1608		1639	1595	
Queue Service Time (g_s), s	5.7		0.0	11.7		0.0	12.3	6.3		0.7	4.2	
Cycle Queue Clearance Time (g_c), s	5.7		0.0	11.7		0.0	12.3	6.3		0.7	4.2	
Green Ratio (*g/C*)	0.19		0.19	0.19		0.19	0.19	0.44		0.06	0.30	
Capacity (*c*), veh/h	759		262	793		262	617	1403		190	971	
Volume-to-Capacity Ratio (*X*)	0.336		0.000	0.651		0.000	0.840	0.279		0.148	0.231	
Back of Queue (*Q*), ft/ln (50 th percentile)	55.8		0	116.7		0	124.7	55.9		6.5	39.8	
Back of Queue (*Q*), veh/ln (50 th percentile)	2.1		0.0	4.6		0.0	4.9	2.2		0.3	1.6	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.14		0.00	0.29		0.00	0.42	0.00		0.02	0.00	
Uniform Delay (d_1), s/veh	28.7		0.0	31.2		0.0	31.2	14.5		35.8	20.8	
Incremental Delay (d_2), s/veh	0.1		0.0	0.4		0.0	3.3	0.5		0.1	0.6	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	28.8		0.0	31.6		0.0	34.5	15.0		35.9	21.4	
Level of Service (LOS)	C			C			C	B		D	C	
Approach Delay, s/veh / LOS	28.8		C	31.6		C	26.1		C	23.0		C
Intersection Delay, s/veh / LOS	27.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.0	C	2.8	C	2.8	C
Bicycle LOS Score / LOS		F		F	1.2	A	0.7	A

HCS7 Two-Way Stop-Control Report

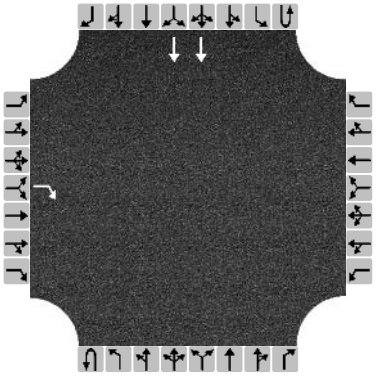
General Information

Analyst	TSF
Agency/Co.	
Date Performed	7/24/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	EB Off Right Turn / Elk V
Jurisdiction	
East/West Street	EB I-90 Off Ramp Right
North/South Street	Elk Vale
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	0	0	0	0	2	0
Configuration				R											T	
Volume, V (veh/h)				480											576	
Percent Heavy Vehicles (%)				3												
Proportion Time Blocked				0.330											0.000	
Percent Grade (%)	0															
Right Turn Channelized	Yes				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				522												
Capacity, c (veh/h)				724												
v/c Ratio				0.72												
95% Queue Length, Q_{95} (veh)				6.2												
Control Delay (s/veh)				21.7												
Level of Service, LOS				C												
Approach Delay (s/veh)	21.7															
Approach LOS	C															

HCS7 Two-Way Stop-Control Report

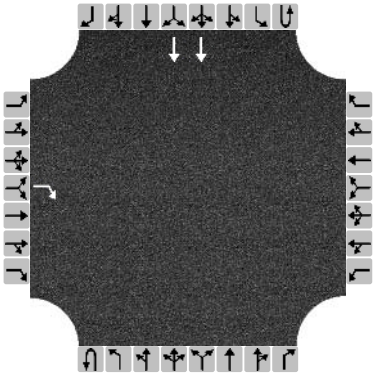
General Information

Analyst	TSF
Agency/Co.	
Date Performed	7/24/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	EB Off Right Turn / Elk V
Jurisdiction	
East/West Street	EB I-90 Off Ramp Right
North/South Street	Elk Vale
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	0	0	0	0	2	0
Configuration				R											T	
Volume, V (veh/h)				549											659	
Percent Heavy Vehicles (%)				3												
Proportion Time Blocked				0.330											0.000	
Percent Grade (%)	0															
Right Turn Channelized	Yes				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				597												
Capacity, c (veh/h)				724												
v/c Ratio				0.82												
95% Queue Length, Q_{95} (veh)				9.0												
Control Delay (s/veh)				28.8												
Level of Service, LOS				D												
Approach Delay (s/veh)	28.8															
Approach LOS	D															

HCS7 Two-Way Stop-Control Report

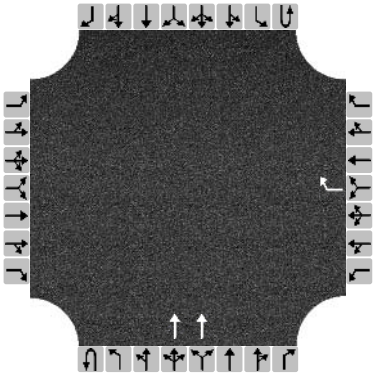
General Information

Analyst	TSF
Agency/Co.	
Date Performed	7/24/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	WB Off Right Turn / Elk V
Jurisdiction	
East/West Street	WB I-90 Off Ramp Right
North/South Street	Elk Vale
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	1	0	0	2	0	0	0	0	0
Configuration								R			T					
Volume, V (veh/h)								111			243					
Percent Heavy Vehicles (%)								3								
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				Yes				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)								121								
Capacity, c (veh/h)								890								
v/c Ratio								0.14								
95% Queue Length, Q_{95} (veh)								0.5								
Control Delay (s/veh)								9.7								
Level of Service, LOS								A								
Approach Delay (s/veh)						9.7										
Approach LOS						A										

HCS7 Two-Way Stop-Control Report

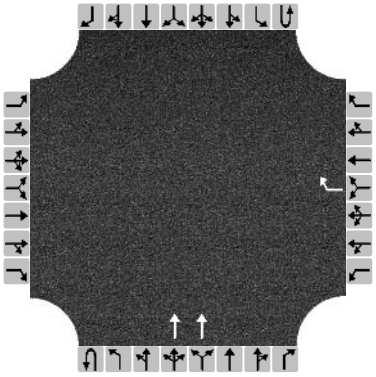
General Information

Analyst	TSF
Agency/Co.	
Date Performed	7/24/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	WB Off Right Turn / Elk V
Jurisdiction	
East/West Street	WB I-90 Off Ramp Right
North/South Street	Elk Vale
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	1	0	0	2	0	0	0	0	0
Configuration								R			T					
Volume, V (veh/h)								140			576					
Percent Heavy Vehicles (%)								3								
Proportion Time Blocked								0.120			0.000					
Percent Grade (%)						0										
Right Turn Channelized		No				Yes				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)								152								
Capacity, c (veh/h)								951								
v/c Ratio								0.16								
95% Queue Length, Q_{95} (veh)								0.6								
Control Delay (s/veh)								9.5								
Level of Service, LOS								A								
Approach Delay (s/veh)						9.5										
Approach LOS						A										

HCS7 Two-Way Stop-Control Report

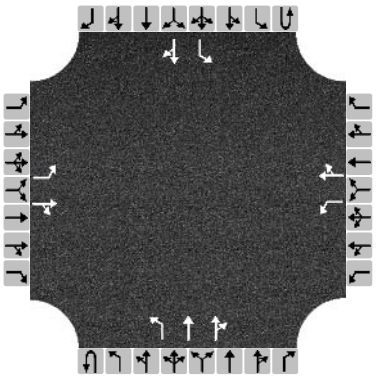
General Information

Analyst	
Agency/Co.	
Date Performed	6/24/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Elk Vale Rd & Mall Dr
Jurisdiction	
East/West Street	Mall Dr
North/South Street	Elk Vale Rd
Peak Hour Factor	0.84
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		1	1	0	0	1	2	0	0	1	1	0
Configuration		L		TR		L		TR		L	T	TR		L		TR
Volume, V (veh/h)		8	1	74		6	2	1		119	121	18		2	202	11
Percent Heavy Vehicles (%)		0	0	12		100	100	0		4				0		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		10		89		7		3		142				2		
Capacity, c (veh/h)		348		749		142		263		1295				1426		
v/c Ratio		0.03		0.12		0.05		0.01		0.11				0.00		
95% Queue Length, Q_{95} (veh)		0.1		0.4		0.2		0.0		0.4				0.0		
Control Delay (s/veh)		15.6		10.5		31.6		18.8		8.1				7.5		
Level of Service, LOS		C		B		D		C		A				A		
Approach Delay (s/veh)		11.0				27.8				3.8				0.1		
Approach LOS		B				D										

HCS7 Two-Way Stop-Control Report

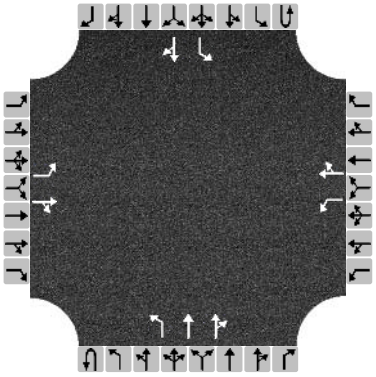
General Information

Analyst	
Agency/Co.	
Date Performed	6/24/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Elk Vale Rd & Mall Dr
Jurisdiction	
East/West Street	Mall Dr
North/South Street	Elk Vale Rd
Peak Hour Factor	0.71
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		1	1	0	0	1	2	0	0	1	1	0
Configuration		L		TR		L		TR		L	T	TR		L		TR
Volume, V (veh/h)		50	1	224		4	2	4		159	422	18		2	225	31
Percent Heavy Vehicles (%)		2	0	2		11	0	100		5				0		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		70		316		6		9		224				3		
Capacity, c (veh/h)		139		690		33		225		1173				971		
v/c Ratio		0.50		0.46		0.18		0.04		0.19				0.00		
95% Queue Length, Q_{95} (veh)		2.8		2.5		0.6		0.1		0.7				0.0		
Control Delay (s/veh)		56.3		14.6		140.3		21.6		8.8				8.7		
Level of Service, LOS		F		B		F		C		A				A		
Approach Delay (s/veh)		22.2				69.1				2.3				0.1		
Approach LOS		C				F										

HCS7 Two-Way Stop-Control Report

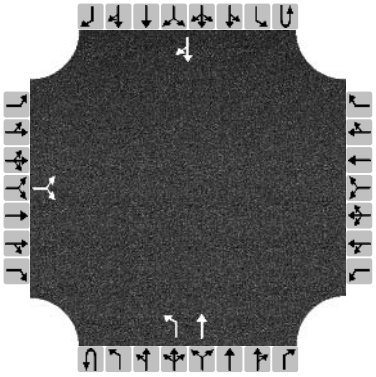
General Information

Analyst	
Agency/Co.	
Date Performed	6/24/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	I-90 Service Rd & W Gate
Jurisdiction	
East/West Street	I-90 Service Rd
North/South Street	W Gate Rd
Peak Hour Factor	0.84
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	1	1	0	0	0	1	0
Configuration			LR							L	T					TR
Volume, V (veh/h)		4		4						20	59				298	23
Percent Heavy Vehicles (%)		0		0						0						
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			10							24						
Capacity, c (veh/h)			598							1188						
v/c Ratio			0.02							0.02						
95% Queue Length, Q_{95} (veh)			0.1							0.1						
Control Delay (s/veh)			11.1							8.1						
Level of Service, LOS			B							A						
Approach Delay (s/veh)		11.1								2.1						
Approach LOS		B														

HCS7 Two-Way Stop-Control Report

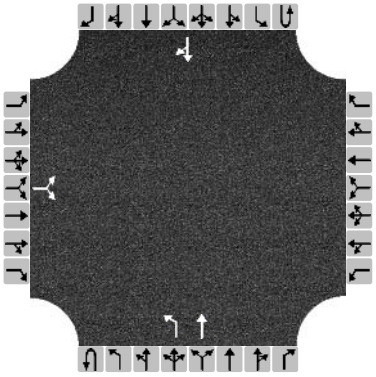
General Information

Analyst	
Agency/Co.	
Date Performed	6/24/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	I-90 Service Rd & W Gate
Jurisdiction	
East/West Street	I-90 Service Rd
North/South Street	W Gate Rd
Peak Hour Factor	0.83
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	1	1	0	0	0	1	0
Configuration			LR							L	T					TR
Volume, V (veh/h)		7		3						7	235				112	8
Percent Heavy Vehicles (%)		0		0						0						
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			12							8						
Capacity, c (veh/h)			657							1450						
v/c Ratio			0.02							0.01						
95% Queue Length, Q_{95} (veh)			0.1							0.0						
Control Delay (s/veh)			10.6							7.5						
Level of Service, LOS			B							A						
Approach Delay (s/veh)		10.6								0.2						
Approach LOS		B														

HCS7 Two-Way Stop-Control Report

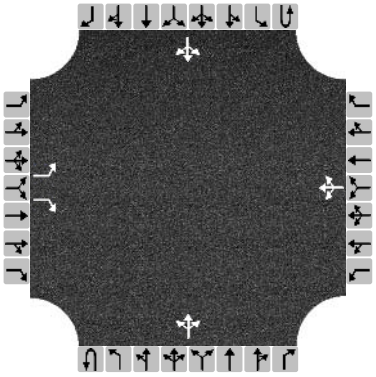
General Information

Analyst	
Agency/Co.	
Date Performed	6/24/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	West Gate & Bluebird
Jurisdiction	
East/West Street	Bluebird Dr
North/South Street	West Gate
Peak Hour Factor	0.79
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	0	1		0	1	0	0	0	1	0	0	0	1	0
Configuration		L		R			LTR				LTR				LTR	
Volume, V (veh/h)		1		32		160	1	0		6	27	20		4	112	1
Percent Heavy Vehicles (%)		0		6		3	100	3		0				25		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		1		41			204			8				5		
Capacity, c (veh/h)		738		896			677			1452				1407		
v/c Ratio		0.00		0.05			0.30			0.01				0.00		
95% Queue Length, Q_{95} (veh)		0.0		0.1			1.3			0.0				0.0		
Control Delay (s/veh)		9.9		9.2			12.6			7.5				7.6		
Level of Service, LOS		A		A			B			A				A		
Approach Delay (s/veh)		9.2				12.6				0.9				0.3		
Approach LOS		A				B										

HCS7 Two-Way Stop-Control Report

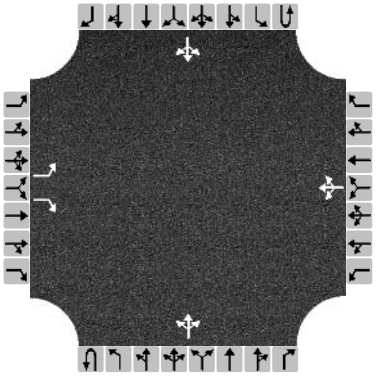
General Information

Analyst	
Agency/Co.	
Date Performed	6/24/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	West Gate & Bluebird
Jurisdiction	
East/West Street	Bluebird Dr
North/South Street	West Gate
Peak Hour Factor	0.86
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	0	1		0	1	0	0	0	1	0	0	0	1	0
Configuration		L		R			LTR				LTR				LTR	
Volume, V (veh/h)		3		10		58	0	1		22	100	125		3	59	0
Percent Heavy Vehicles (%)		0		0		2	0	0		0				0		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		3		12			68			26				3		
Capacity, c (veh/h)		629		1000			615			1545				1315		
v/c Ratio		0.00		0.01			0.11			0.02				0.00		
95% Queue Length, Q_{95} (veh)		0.0		0.0			0.4			0.1				0.0		
Control Delay (s/veh)		10.8		8.6			11.6			7.4				7.7		
Level of Service, LOS		B		A			B			A				A		
Approach Delay (s/veh)		9.1				11.6				0.8				0.3		
Approach LOS		A				B										

HCS7 Two-Way Stop-Control Report

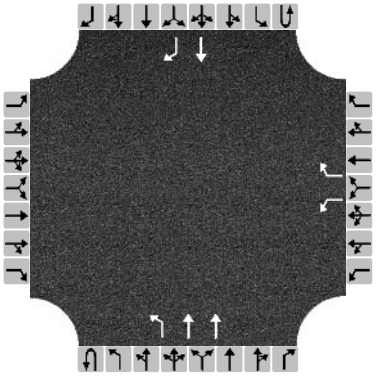
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Liberty and I-90 N Ramp
Jurisdiction	
East/West Street	I-90 Ramp
North/South Street	Liberty
Peak Hour Factor	0.84
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	1	2	0	0	0	1	1
Configuration						L		R		L	T				T	R
Volume, V (veh/h)						3		29		114	444				57	306
Percent Heavy Vehicles (%)						0		31		4						
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						4		35		136						
Capacity, c (veh/h)						226		654		1110						
v/c Ratio						0.02		0.05		0.12						
95% Queue Length, Q_{95} (veh)						0.1		0.2		0.4						
Control Delay (s/veh)						21.2		10.8		8.7						
Level of Service, LOS						C		B		A						
Approach Delay (s/veh)						11.9				1.8						
Approach LOS						B										

HCS7 Two-Way Stop-Control Report

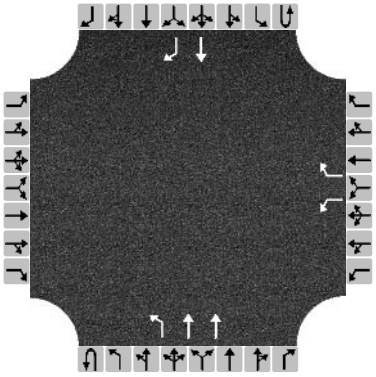
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Liberty and I-90 N Ramp
Jurisdiction	
East/West Street	I-90 Ramp
North/South Street	Liberty
Peak Hour Factor	0.95
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	1	2	0	0	0	1	1
Configuration						L		R		L	T				T	R
Volume, V (veh/h)						8		39		44	242				55	370
Percent Heavy Vehicles (%)						38		46		7						
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						8		41		46						
Capacity, c (veh/h)						357		775		1075						
v/c Ratio						0.02		0.05		0.04						
95% Queue Length, Q_{95} (veh)						0.1		0.2		0.1						
Control Delay (s/veh)						15.3		9.9		8.5						
Level of Service, LOS						C		A		A						
Approach Delay (s/veh)						10.8				1.3						
Approach LOS						B										

HCS7 Two-Way Stop-Control Report

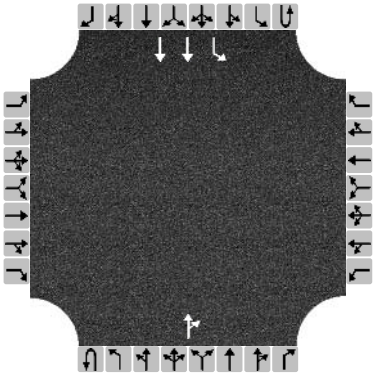
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Liberty & I90 EB On Ramp
Jurisdiction	
East/West Street	I90 EB On Ramp
North/South Street	Liberty
Peak Hour Factor	0.74
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	1	2	0
Configuration												TR		L	T	
Volume, V (veh/h)											248	6		36	35	
Percent Heavy Vehicles (%)														42		
Proportion Time Blocked																
Percent Grade (%)																
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)														49		
Capacity, c (veh/h)														970		
v/c Ratio														0.05		
95% Queue Length, Q_{95} (veh)														0.2		
Control Delay (s/veh)														8.9		
Level of Service, LOS														A		
Approach Delay (s/veh)														4.5		
Approach LOS																

HCS7 Two-Way Stop-Control Report

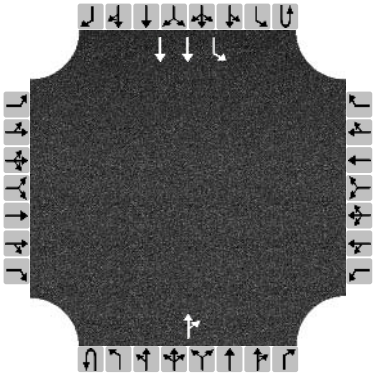
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Liberty & I90 EB On Ramp
Jurisdiction	
East/West Street	I90 EB On Ramp
North/South Street	Liberty
Peak Hour Factor	0.87
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	1	2	0
Configuration												TR		L	T	
Volume, V (veh/h)											85	5		19	100	
Percent Heavy Vehicles (%)														26		
Proportion Time Blocked																
Percent Grade (%)																
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)														22		
Capacity, c (veh/h)														1327		
v/c Ratio														0.02		
95% Queue Length, Q_{95} (veh)														0.1		
Control Delay (s/veh)														7.8		
Level of Service, LOS														A		
Approach Delay (s/veh)														1.2		
Approach LOS																

HCS7 Two-Way Stop-Control Report

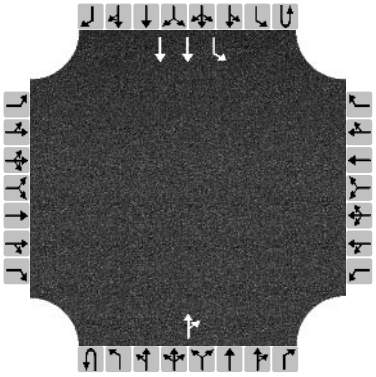
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Liberty & I90 EB On Ramp
Jurisdiction	
East/West Street	I90 EB On Ramp
North/South Street	Liberty
Peak Hour Factor	0.74
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	1	0	0	1	2	0
Configuration												TR		L	T	
Volume, V (veh/h)											248	6		36	35	
Percent Heavy Vehicles (%)														42		
Proportion Time Blocked																
Percent Grade (%)																
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)														49		
Capacity, c (veh/h)														970		
v/c Ratio														0.05		
95% Queue Length, Q_{95} (veh)														0.2		
Control Delay (s/veh)														8.9		
Level of Service, LOS														A		
Approach Delay (s/veh)														4.5		
Approach LOS																

HCS7 Two-Way Stop-Control Report

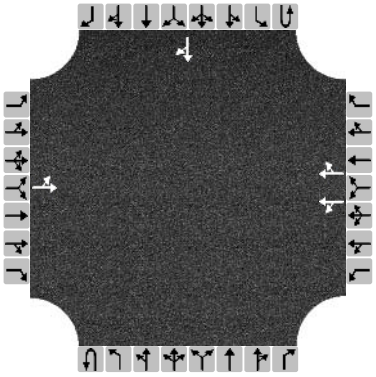
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Ellsworth and W 1416
Jurisdiction	
East/West Street	1416 W
North/South Street	Ellsworth
Peak Hour Factor	0.87
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	2	0	0	0	0	0	0	0	1	0
Configuration		LT				LT		TR								TR
Volume, V (veh/h)		582	82			0	32	10							28	144
Percent Heavy Vehicles (%)		2	1			3	6	50								
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		763				19		30								
Capacity, c (veh/h)		984				691		772								
v/c Ratio		0.78				0.03		0.04								
95% Queue Length, Q_{95} (veh)		9.5				0.1		0.1								
Control Delay (s/veh)		20.9				10.4		9.8								
Level of Service, LOS		C				B		A								
Approach Delay (s/veh)	20.9				10.3											
Approach LOS	C				B											

HCS7 Two-Way Stop-Control Report

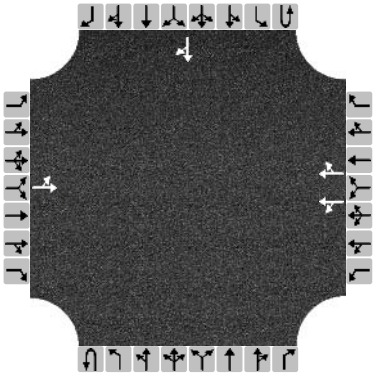
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Ellsworth and W 1416
Jurisdiction	
East/West Street	1416 W
North/South Street	Ellsworth
Peak Hour Factor	0.98
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	2	0	0	0	0	0	0	0	1	0
Configuration		LT				LT		TR								TR
Volume, V (veh/h)		256	65			2	40	7							86	259
Percent Heavy Vehicles (%)		3	0			0	10	14								
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		327				23		28								
Capacity, c (veh/h)		927				571		636								
v/c Ratio		0.35				0.04		0.04								
95% Queue Length, Q_{95} (veh)		1.6				0.1		0.1								
Control Delay (s/veh)		11.0				11.6		10.9								
Level of Service, LOS		B				B		B								
Approach Delay (s/veh)	11.0				11.5											
Approach LOS	B				B											

HCS7 Two-Way Stop-Control Report

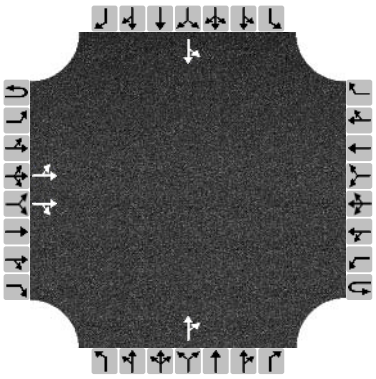
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	I-90 Corridor Study

Site Information

Intersection	Ellsworth and 1416 E
Jurisdiction	
East/West Street	1416 E
North/South Street	Ellsworth
Peak Hour Factor	0.87
Analysis Time Period (hrs)	1.00

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration		LT		TR								TR		LT		
Volume, V (veh/h)		493	95	15							171	12		2	26	
Percent Heavy Vehicles (%)		2									2	0		50	0	
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		567										211		32		
Capacity, c (veh/h)		1622										113		101		
v/c Ratio		0.35										1.86		0.32		
95% Queue Length, Q_{95} (veh)		1.6										54.6		1.3		
Control Delay (s/veh)		8.4										1653.6		57.2		
Level of Service, LOS		A										F		F		
Approach Delay (s/veh)	6.9								1653.6				57.2			
Approach LOS									F				F			

HCS7 Two-Way Stop-Control Report

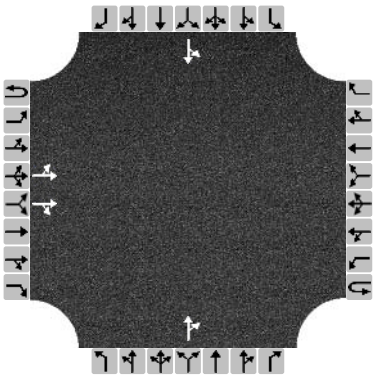
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	I-90 Corridor Study

Site Information

Intersection	Ellsworth and 1416 E
Jurisdiction	
East/West Street	1416 E
North/South Street	Ellsworth
Peak Hour Factor	0.98
Analysis Time Period (hrs)	1.00

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration		LT		TR								TR		LT		
Volume, V (veh/h)		221	87	124							100	10		10	78	
Percent Heavy Vehicles (%)		3									2	0		0	1	
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		226										112		90		
Capacity, c (veh/h)		1614										365		323		
v/c Ratio		0.14										0.31		0.28		
95% Queue Length, Q_{95} (veh)		0.5										1.3		1.1		
Control Delay (s/veh)		7.6										19.2		20.4		
Level of Service, LOS		A										C		C		
Approach Delay (s/veh)		3.9								19.2				20.4		
Approach LOS										C				C		

HCS7 Two-Way Stop-Control Report

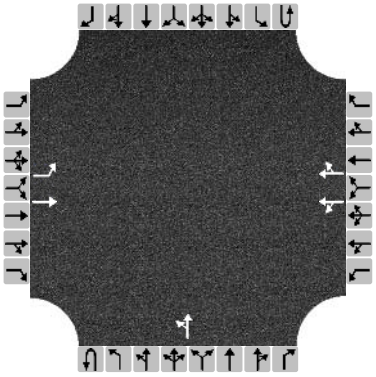
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Commercial Gate & 1416 W
Jurisdiction	
East/West Street	1416 W
North/South Street	Commercial Gate
Peak Hour Factor	0.91
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	2	0	0	0	1	0	0	0	0	0
Configuration		L	T			LT		TR		LT						
Volume, V (veh/h)		12	101			1	253	3		0	248					
Percent Heavy Vehicles (%)		17	5			0	4	67		0						
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		13	111			140		142		0						
Capacity, c (veh/h)		524	630			632		630		1636						
v/c Ratio		0.02	0.18			0.22		0.23		0.00						
95% Queue Length, Q_{95} (veh)		0.1	0.6			0.9		0.9		0.0						
Control Delay (s/veh)		12.1	11.9			12.3		12.4		7.2						
Level of Service, LOS		B	B			B		B		A						
Approach Delay (s/veh)		12.0				12.4				0.0						
Approach LOS		B				B										

HCS7 Two-Way Stop-Control Report

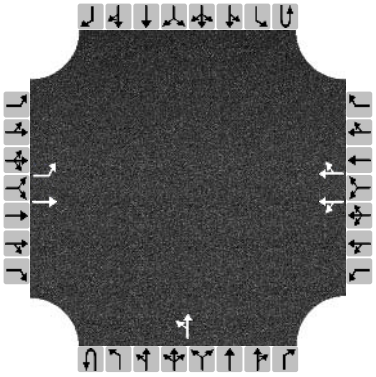
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Commercial Gate & 1416 W
Jurisdiction	
East/West Street	1416 W
North/South Street	Commercial Gate
Peak Hour Factor	0.90
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		1	1	0		0	2	0	0	0	1	0	0	0	0	0
Configuration		L	T			LT		TR		LT						
Volume, V (veh/h)		0	343			0	352	4		0	80					
Percent Heavy Vehicles (%)		17	0			0	2	0		0						
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		0	381			196		200		0						
Capacity, c (veh/h)		638	805			801		804		1636						
v/c Ratio		0.00	0.47			0.24		0.25		0.00						
95% Queue Length, Q_{95} (veh)		0.0	2.7			1.0		1.0		0.0						
Control Delay (s/veh)		10.6	13.5			10.9		11.0		7.2						
Level of Service, LOS		B	B			B		B		A						
Approach Delay (s/veh)		13.5				11.0				0.0						
Approach LOS		B				B										

HCS7 Two-Way Stop-Control Report

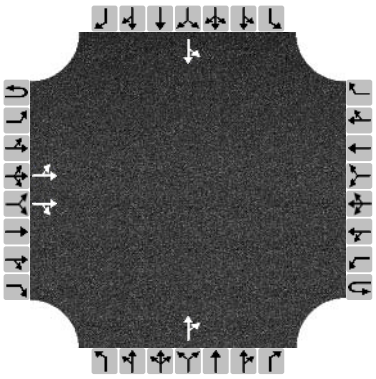
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	I-90 Corridor Study

Site Information

Intersection	Radar Hill & 1416 E
Jurisdiction	
East/West Street	1416 East
North/South Street	Radar Hill Rd
Peak Hour Factor	0.92
Analysis Time Period (hrs)	1.00

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration		LT		TR								TR		LT		
Volume, V (veh/h)		4	638	33							151	268		4	60	
Percent Heavy Vehicles (%)		0									2	4		0	7	
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

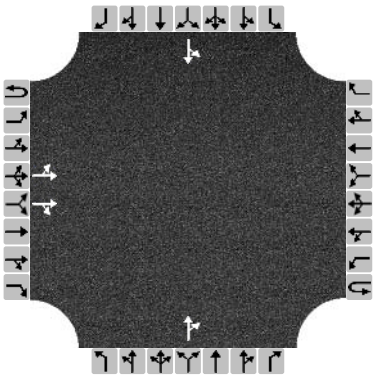
Flow Rate, v (veh/h)		4										455		69		
Capacity, c (veh/h)		1636										489		340		
v/c Ratio		0.00										0.93		0.20		
95% Queue Length, Q_{95} (veh)		0.0										19.0		0.8		
Control Delay (s/veh)		7.2										77.3		18.3		
Level of Service, LOS		A										F		C		
Approach Delay (s/veh)		0.1								77.3				18.3		
Approach LOS										F				C		

HCS7 Two-Way Stop-Control Report

General Information

Analyst		Intersection	Radar Hill & 1416 E
Agency/Co.		Jurisdiction	
Date Performed	6/27/2016	East/West Street	1416 East
Analysis Year	2016	North/South Street	Radar Hill Rd
Time Analyzed	PM Peak	Peak Hour Factor	0.94
Intersection Orientation	East-West	Analysis Time Period (hrs)	1.00
Project Description	I-90 Corridor Study		

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration		LT		TR								TR		LT		
Volume, V (veh/h)		25	436	176							113	71		2	170	
Percent Heavy Vehicles (%)		0									3	1		0	1	
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		27										196		183		
Capacity, c (veh/h)		1636										469		353		
v/c Ratio		0.02										0.42		0.52		
95% Queue Length, Q_{95} (veh)		0.1										2.1		3.1		
Control Delay (s/veh)		7.2										18.1		26.0		
Level of Service, LOS		A										C		D		
Approach Delay (s/veh)	0.3								18.1				26.0			
Approach LOS									C				D			

HCS7 Two-Way Stop-Control Report

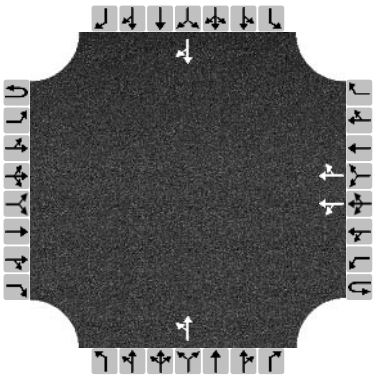
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	I-90 Corridor Study

Site Information

Intersection	Radar Hill and 1416 W
Jurisdiction	
East/West Street	1416 W
North/South Street	Radar Hill
Peak Hour Factor	0.92
Analysis Time Period (hrs)	1.00

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	0	0	0	0	2	0		0	1	0		0	1	0
Configuration						LT		TR		LT						TR
Volume, V (veh/h)						54	295	4		153	2				10	36
Percent Heavy Vehicles (%)						7				2	0				0	0
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						59				168						50
Capacity, c (veh/h)						1586				620						738
v/c Ratio						0.04				0.27						0.07
95% Queue Length, Q_{95} (veh)						0.1				1.1						0.2
Control Delay (s/veh)						7.4				13.0						10.2
Level of Service, LOS						A				B						B
Approach Delay (s/veh)					1.2				13.0				10.2			
Approach LOS									B				B			

HCS7 Two-Way Stop-Control Report

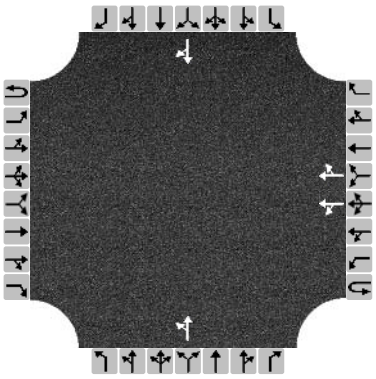
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	I-90 Corridor Study

Site Information

Intersection	Radar Hill and 1416 W
Jurisdiction	
East/West Street	1416 W
North/South Street	Radar Hill
Peak Hour Factor	0.94
Analysis Time Period (hrs)	1.00

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	0	0	0	0	2	0		0	1	0		0	1	0
Configuration						LT		TR		LT						TR
Volume, V (veh/h)						160	505	7		110	28				12	7
Percent Heavy Vehicles (%)						1				3	0				0	0
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						170				147						20
Capacity, c (veh/h)						1629				311						319
v/c Ratio						0.10				0.47						0.06
95% Queue Length, Q_{95} (veh)						0.3				2.6						0.2
Control Delay (s/veh)						7.5				26.9						17.0
Level of Service, LOS						A				D						C
Approach Delay (s/veh)						2.0				26.9				17.0		
Approach LOS										D				C		

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 6/27/2016
Analysis Time Period: AM Peak
Intersection: W Gate & 1416 W
Jurisdiction:
Units: U. S. Customary
Analysis Year:
Project ID:
East/West Street: 1416 W
North/South Street: W Gate

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	4	441	48	2	24	0	0	120	172
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration			LT	R	LT		TR	
PHF			0.95	0.95	0.95		0.95	
Flow Rate			468	50	27		307	
% Heavy Veh			3	8	0		0	
No. Lanes			2		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		2		2	
Geometry group			1		2		2	

Duration, T 1.00 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane			468	50	27		307	
Left-Turn			4	0	2		0	
Right-Turn			0	50	0		181	
Prop. Left-Turns			0.0	0.0	0.1		0.0	
Prop. Right-Turns			0.0	1.0	0.0		0.6	
Prop. Heavy Vehicle			0.0	0.1	0.0		0.0	
Geometry Group			1		2		2	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	

hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.1	-0.5	0.0		-0.4	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate			468	50	27		307	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.42	0.04	0.02		0.27	
hd, final value			4.81	4.29	5.62		4.83	
x, final value			0.626	0.060	0.042		0.412	
Move-up time, m			2.0		2.0		2.0	
Service Time			2.8	2.3	3.6		2.8	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate			468	50	27		307	
Service Time			2.8	2.3	3.6		2.8	
Utilization, x			0.626	0.060	0.042		0.412	
Dep. headway, hd			4.81	4.29	5.62		4.83	
Capacity			743	833	675		749	
95% Queue Length								
Delay			15.8	7.6	8.9		11.2	
LOS			C	A	A		B	
Approach:								
Delay				15.0-		8.9		11.2
LOS				B		A		B

Intersection Delay 13.4 Intersection LOS B

Phone: Fax:
E-Mail:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 6/27/2016
Analysis Time Period: AM Peak
Intersection: W Gate & 1416 W
Jurisdiction:
Units: U. S. Customary
Analysis Year:
Project ID: I-90 Corridor Study
East/West Street: 1416 W
North/South Street: W Gate

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	2	513	90	2	24	0	0	52	82
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration			LT	R	LT		TR	
PHF			0.94	0.87	0.95		0.76	
Flow Rate			547	103	27		175	
% Heavy Veh			0	0	0		2	
No. Lanes			2		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		2		2	
Geometry group			1		2		2	

Duration, T 1.00 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane			547	103	27		175	
Left-Turn			2	0	2		0	
Right-Turn			0	103	0		107	
Prop. Left-Turns			0.0	0.0	0.1		0.0	
Prop. Right-Turns			0.0	1.0	0.0		0.6	
Prop. Heavy Vehicle			0.0	0.0	0.0		0.0	
Geometry Group			1		2		2	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	

hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.0	-0.6	0.0		-0.3	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate			547	103	27		175	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.49	0.09	0.02		0.16	
hd, final value			4.44	3.84	5.55		4.97	
x, final value			0.674	0.110	0.042		0.241	
Move-up time, m			2.0		2.0		2.0	
Service Time			2.4	1.8	3.6		3.0	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate			547	103	27		175	
Service Time			2.4	1.8	3.6		3.0	
Utilization, x			0.674	0.110	0.042		0.241	
Dep. headway, hd			4.44	3.84	5.55		4.97	
Capacity			816	936	675		729	
95% Queue Length								
Delay			16.5	7.3	8.8		9.5	
LOS			C	A	A		A	
Approach:								
Delay				15.0+		8.8		9.5
LOS				C		A		A

Intersection Delay 13.7 Intersection LOS B

HCS7 Two-Way Stop-Control Report

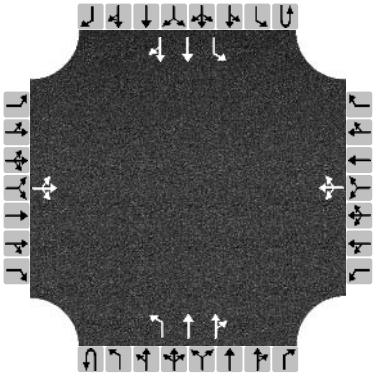
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	S. Service and Elk Vale
Jurisdiction	
East/West Street	Edward St/S. Service Road
North/South Street	Elk Vale
Peak Hour Factor	0.88
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	1	2	0	0	1	2	0
Configuration			LTR				LTR			L	T	TR		L	T	TR
Volume, V (veh/h)		9	4	10		46	4	43	1	15	936	14		19	897	25
Percent Heavy Vehicles (%)		0	0	11		2	0	11	0	0				4		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			26				106			18				22		
Capacity, c (veh/h)			78				89			631				630		
v/c Ratio			0.33				1.19			0.03				0.03		
95% Queue Length, Q_{95} (veh)			1.4				17.5			0.1				0.1		
Control Delay (s/veh)			73.7				554.4			10.9				10.9		
Level of Service, LOS			F				F			B				B		
Approach Delay (s/veh)		73.7				554.4				0.2				0.2		
Approach LOS		F				F										

HCS7 Two-Way Stop-Control Report

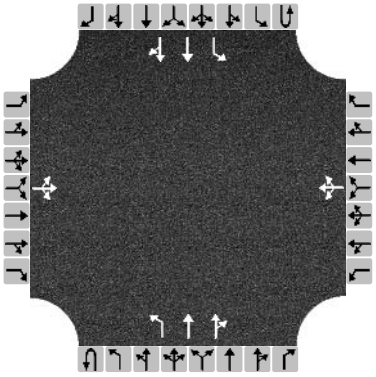
General Information

Analyst	
Agency/Co.	
Date Performed	6/27/2016
Analysis Year	2016
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	S. Service and Elk Vale
Jurisdiction	
East/West Street	Edward St/S. Service Road
North/South Street	Elk Vale
Peak Hour Factor	0.94
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	1	2	0	0	1	2	0
Configuration			LTR				LTR			L	T	TR		L	T	TR
Volume, V (veh/h)		11	2	18		42	3	66		11	1119	64	2	53	1090	27
Percent Heavy Vehicles (%)		9	0	0		2	0	0		0			0	2		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			33				118			12				58		
Capacity, c (veh/h)			56				68			594				516		
v/c Ratio			0.59				1.73			0.02				0.11		
95% Queue Length, Q_{95} (veh)			3.4				30.6			0.1				0.4		
Control Delay (s/veh)			153.6				1478.3			11.2				12.9		
Level of Service, LOS			F				F			B				B		
Approach Delay (s/veh)		153.6				1478.3				0.1				0.6		
Approach LOS		F				F										

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 60 to Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1150	veh/h
Peak-hour factor, PHF	0.81	
Peak 15-min volume, v15	355	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	749	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	749	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	11.5	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 60 to Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1610	veh/h
Peak-hour factor, PHF	0.92	
Peak 15-min volume, v15	437	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	923	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	923	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	14.2	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1150	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	83	vph
Length of first accel/decel lane	660	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1150	83		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	355	26		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1498	108	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1498 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1498	4700	No
$v_{FO} = v_F - v_R$	1390	4700	No
v_R	108	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 1498 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1498	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_R - 0.009 L_{12}$ = 11.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.438	
Space mean speed in ramp influence area,	S_R = 54.9	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 54.9	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1610	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	275	vph
Length of first accel/decel lane	660	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1610	275		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	437	75		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1846	315	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1846 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1846	4700	No
$v_{FO} = v_F - v_R$	1531	4700	No
v_R	315	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 1846 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1846	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_R - 0.009 L_{12}$ = 14.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.456

Space mean speed in ramp influence area, S_R = 54.5 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 54.5 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1067	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	21	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1067	21		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	329	6		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1390	27	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1390 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1417	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1390 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1417	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 9.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	M_S = 0.260	
Space mean speed in ramp influence area,	S_R = 59.0	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 59.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1335	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	21	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1335	21		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	363	6		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1531	24	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1531 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1555	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1531 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1555	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 10.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.262	
Space mean speed in ramp influence area,	S_R = 59.0	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 59.0	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 61 to Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1190	veh/h
Peak-hour factor, PHF	0.81	
Peak 15-min volume, v15	367	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	775	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	775	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	11.9	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 61 to Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1330	veh/h
Peak-hour factor, PHF	0.92	
Peak 15-min volume, v15	361	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	763	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	763	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	11.7	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1190	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	565	vph
Length of first accel/decel lane	275	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1190	565		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	367	174		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1550	736	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1550 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1550	4700	No
$v_{FO} = v_F - v_R$	814	4700	No
v_R	736	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 1550 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1550	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 15.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.494

Space mean speed in ramp influence area, S_R = 53.6 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 53.6 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1330	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	617	vph
Length of first accel/decel lane	275	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1330	617		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	361	168		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1525	708	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1525 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1525	4700	No
$v_{FO} = v_F - v_R$	817	4700	No
v_R	708	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 1525 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1525	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 14.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.492

Space mean speed in ramp influence area, S_R = 53.7 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 53.7 mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 63 to Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	600	veh/h
Peak-hour factor, PHF	0.81	
Peak 15-min volume, v15	185	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	391	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	391	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	6.0	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 63 to Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	560	veh/h
Peak-hour factor, PHF	0.92	
Peak 15-min volume, v15	152	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	321	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	321	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	4.9	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67A
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	600	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	7	vph
Length of first accel/decel lane	325	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	600	7		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	185	2		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	781	9	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 781 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	781	4700	No
$v_{FO} = v_F - v_R$	772	4700	No
v_R	9	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 781 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	781	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 8.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.429	
Space mean speed in ramp influence area,	S_R = 55.1	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 55.1	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67A
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	560	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	58	vph
Length of first accel/decel lane	325	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	560	58		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	152	16		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	642	67	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 642 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	642	4700	No
$v_{FO} = v_F - v_R$	575	4700	No
v_R	67	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 642 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	642	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086\, v_R - 0.009\, L_{12}$ = 6.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.434	
Space mean speed in ramp influence area,	S_R = 55.0	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 55.0	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67B
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	593	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	324	vph
Length of first accel/decel lane	675	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	593	324		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	183	100		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	772	422	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 772 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	772	4700	No
$v_{FO} = v_F - v_R$	350	4700	No
v_R	422	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 772 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	772	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 4.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.466	
Space mean speed in ramp influence area,	S_R = 54.3	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 54.3	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67B
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	502	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	206	vph
Length of first accel/decel lane	675	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	502	206		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	136	56		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	576	236	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 576 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	576	4700	No
$v_{FO} = v_F - v_R$	340	4700	No
v_R	236	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 576 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	576	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_R - 0.009 L_{12}$ = 3.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.449	
Space mean speed in ramp influence area,	S_R = 54.7	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 54.7	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	269	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	42	vph
Length of first accel/decel lane	800	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	269	42		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	83	13		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	350	55	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 350 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	405	4700	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	

If yes, v_{12A} = 350 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	405	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 3.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	M_S = 0.271	
Space mean speed in ramp influence area,	S_R = 58.8	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.8	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.80

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	296	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	24	vph
Length of first accel/decel lane	800	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	296	24		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	80	7		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	339	28	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 339 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	367	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 339 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	367	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 3.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	M_S = 0.271	
Space mean speed in ramp influence area,	S_R = 58.8	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.8	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 67 to Pull Off
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	310	veh/h
Peak-hour factor, PHF	0.81	
Peak 15-min volume, v15	96	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	202	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	202	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	3.1	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	EB I-90
From/To:	East of Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	325	veh/h
Peak-hour factor, PHF	0.92	
Peak 15-min volume, v15	88	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	186	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	186	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	2.9	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	WB I-90
From/To:	East of Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	260	veh/h
Peak-hour factor, PHF	0.84	
Peak 15-min volume, v15	77	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	163	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	163	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	2.5	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	WB I-90
From/To:	East of Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	410	veh/h
Peak-hour factor, PHF	0.89	
Peak 15-min volume, v15	115	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	243	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	243	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	3.7	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	260	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	32	vph
Length of first accel/decel lane	350	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	260	32		vph
Peak-hour factor, PHF	0.84	0.84		
Peak 15-min volume, v15	77	10		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	327	40	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 327 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	327	4700	No
$v_{FO} = v_F - v_R$	287	4700	No
v_R	40	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 327 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	327	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 3.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.432

Space mean speed in ramp influence area, S_R = 55.1 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 55.1 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	410	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	47	vph
Length of first accel/decel lane	350	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	410	47		vph
Peak-hour factor, PHF	0.89	0.89		
Peak 15-min volume, v15	115	13		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	486	56	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 486 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	486	4700	No
$v_{FO} = v_F - v_R$	430	4700	No
v_R	56	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 486 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	486	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 5.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.433	
Space mean speed in ramp influence area,	S_R = 55.0	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 55.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	228	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	420	vph
Length of first accel/decel lane	875	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	228	420		vph
Peak-hour factor, PHF	0.84	0.84		
Peak 15-min volume, v15	68	125		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	286	528	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 286 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	814	4700	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	

If yes, v_{12A} = 286 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	814	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 6.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	M_S = 0.269	
Space mean speed in ramp influence area,	S_R = 58.8	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.8	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	363	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	414	vph
Length of first accel/decel lane	875	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	363	414		vph
Peak-hour factor, PHF	0.89	0.89		
Peak 15-min volume, v15	102	116		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	430	491	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 430 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	921	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 430 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	921	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 6.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	M_S = 0.270	
Space mean speed in ramp influence area,	S_R = 58.8	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.8	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 67 to Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	680	veh/h
Peak-hour factor, PHF	0.84	
Peak 15-min volume, v15	202	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	427	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	427	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	6.6	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 67 to Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	980	veh/h
Peak-hour factor, PHF	0.89	
Peak 15-min volume, v15	275	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	581	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	581	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	8.9	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	680	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	615	vph
Length of first accel/decel lane	1050	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	680	615		vph
Peak-hour factor, PHF	0.84	0.84		
Peak 15-min volume, v15	202	183		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	854	772	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 854 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1626	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 854 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1626	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 11.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.267	
Space mean speed in ramp influence area,	S_R = 58.9	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.9	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	980	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	595	vph
Length of first accel/decel lane	1050	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	980	595		vph
Peak-hour factor, PHF	0.89	0.89		
Peak 15-min volume, v15	275	167		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1162	705	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1162 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1867	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1162 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1867	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 13.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.273	
Space mean speed in ramp influence area,	S_R = 58.7	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.7	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 63 to Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1270	veh/h
Peak-hour factor, PHF	0.84	
Peak 15-min volume, v15	378	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	798	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	798	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	12.3	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 63 to Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1580	veh/h
Peak-hour factor, PHF	0.89	
Peak 15-min volume, v15	444	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	936	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	936	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	14.4	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1270	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	9	vph
Length of first accel/decel lane	710	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1270	9		vph
Peak-hour factor, PHF	0.84	0.84		
Peak 15-min volume, v15	378	3		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1595	11	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1595 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1595	4700	No
$v_{FO} = v_F - v_R$	1584	4700	No
v_R	11	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 1595 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1595	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086\, v_R - 0.009\, L_{12}$ = 11.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.429

Space mean speed in ramp influence area, S_R = 55.1 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 55.1 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1580	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	10	vph
Length of first accel/decel lane	710	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1580	10		vph
Peak-hour factor, PHF	0.89	0.89		
Peak 15-min volume, v15	444	3		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1873	12	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1873 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1873	4700	No
$v_{FO} = v_F - v_R$	1861	4700	No
v_R	12	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 1873 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1873	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086\, v_R - 0.009\, L_D$ = 14.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.429

Space mean speed in ramp influence area, S_R = 55.1 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 55.1 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1261	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	132	vph
Length of first accel/decel lane	1150	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1261	132		vph
Peak-hour factor, PHF	0.84	0.84		
Peak 15-min volume, v15	375	39		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1584	166	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1584 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1750	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1584 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1750	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 11.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.263	
Space mean speed in ramp influence area,	S_R = 59.0	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 59.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1570	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	192	vph
Length of first accel/decel lane	1150	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1570	192		vph
Peak-hour factor, PHF	0.89	0.89		
Peak 15-min volume, v15	441	54		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1861	228	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1861 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2089	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1861 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2089	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 14.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.272	
Space mean speed in ramp influence area,	S_R = 58.7	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.7	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 61 to Exit 60
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1350	veh/h
Peak-hour factor, PHF	0.84	
Peak 15-min volume, v15	402	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	848	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	848	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	13.0	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 61 to Exit 60
Jurisdiction:	SDDOT
Analysis Year:	2016
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1640	veh/h
Peak-hour factor, PHF	0.89	
Peak 15-min volume, v15	461	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	972	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	972	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	15.0	pc/mi/ln
Level of service, LOS	B	