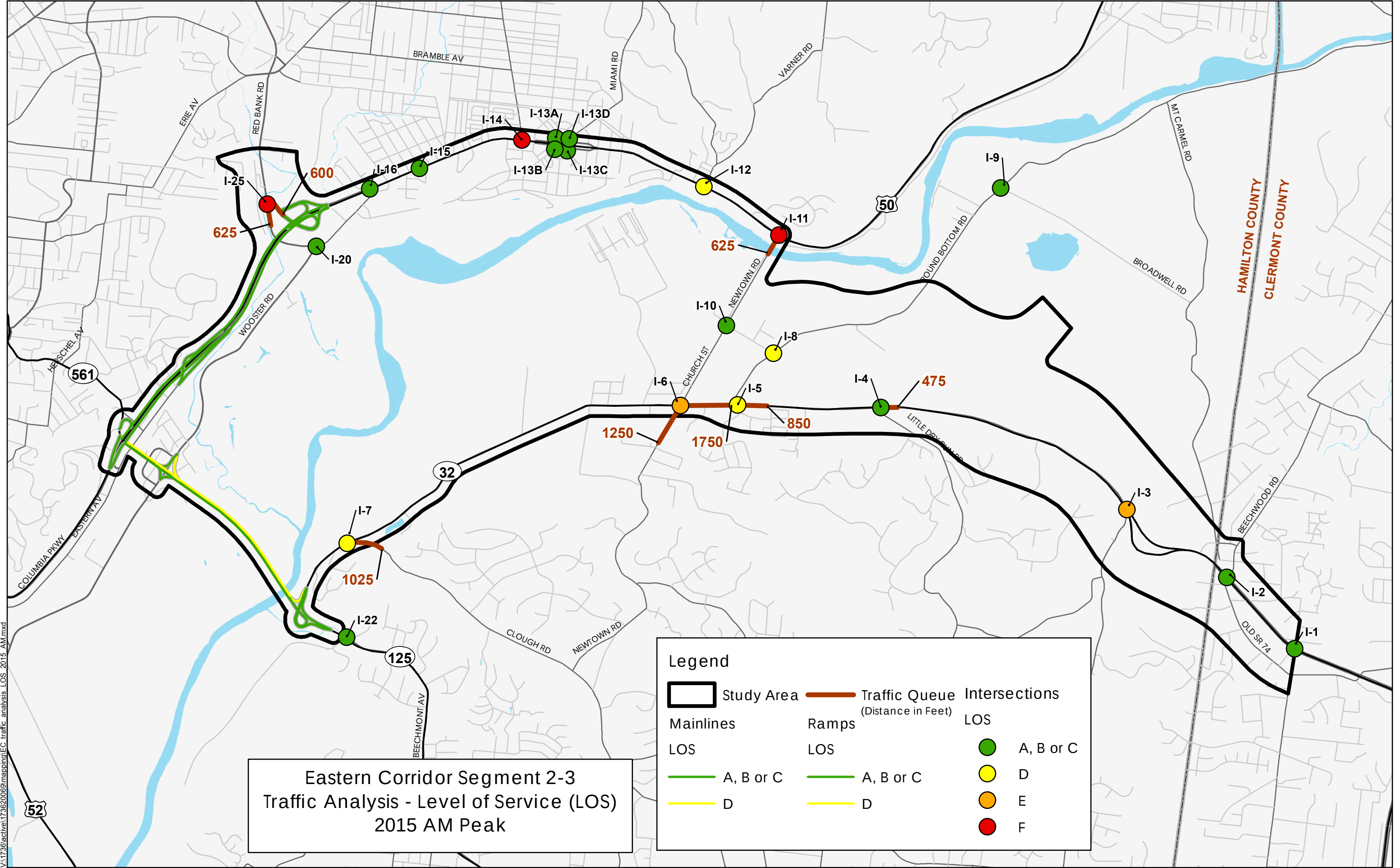
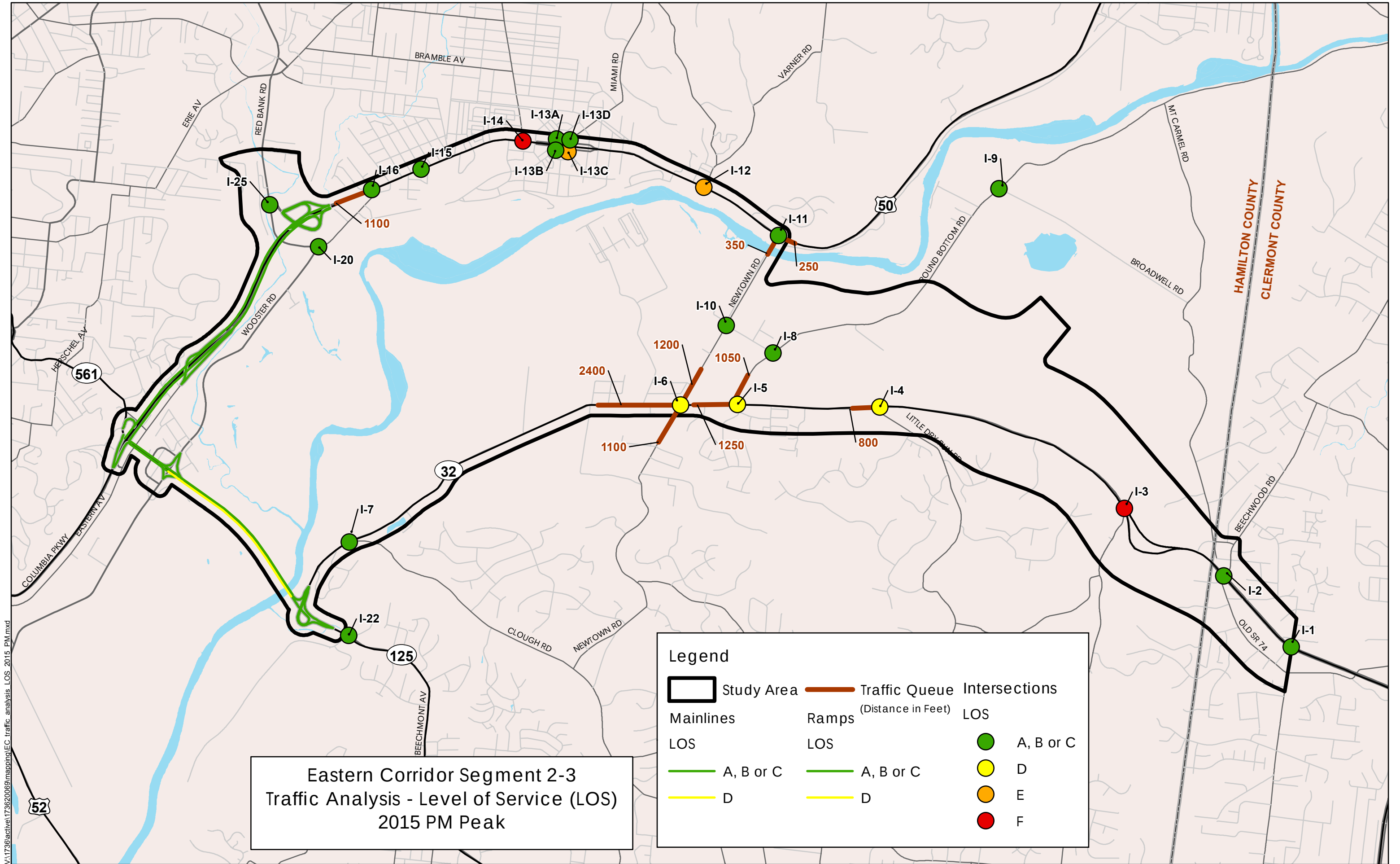


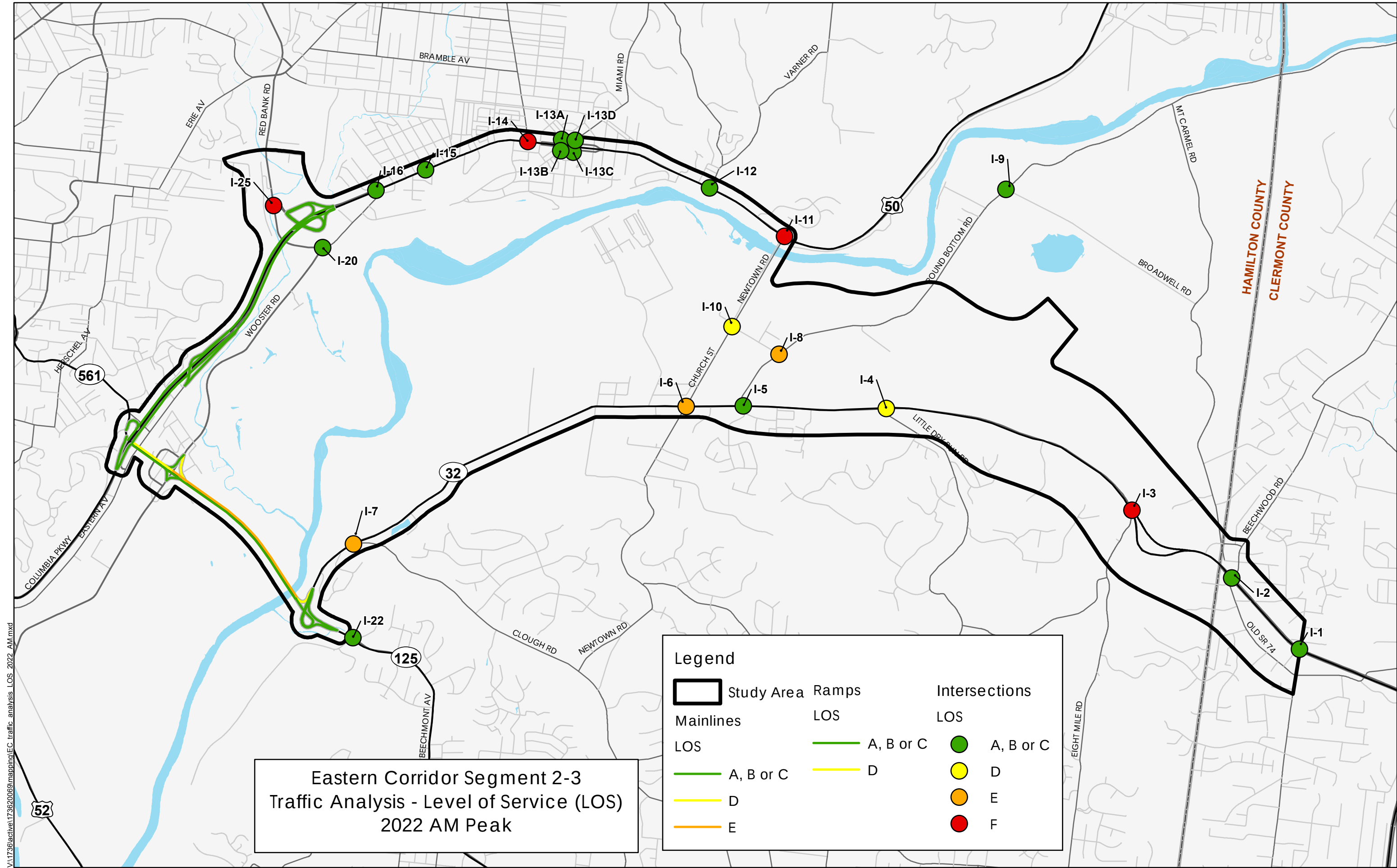
ATTACHMENT A-3

HCS DATA

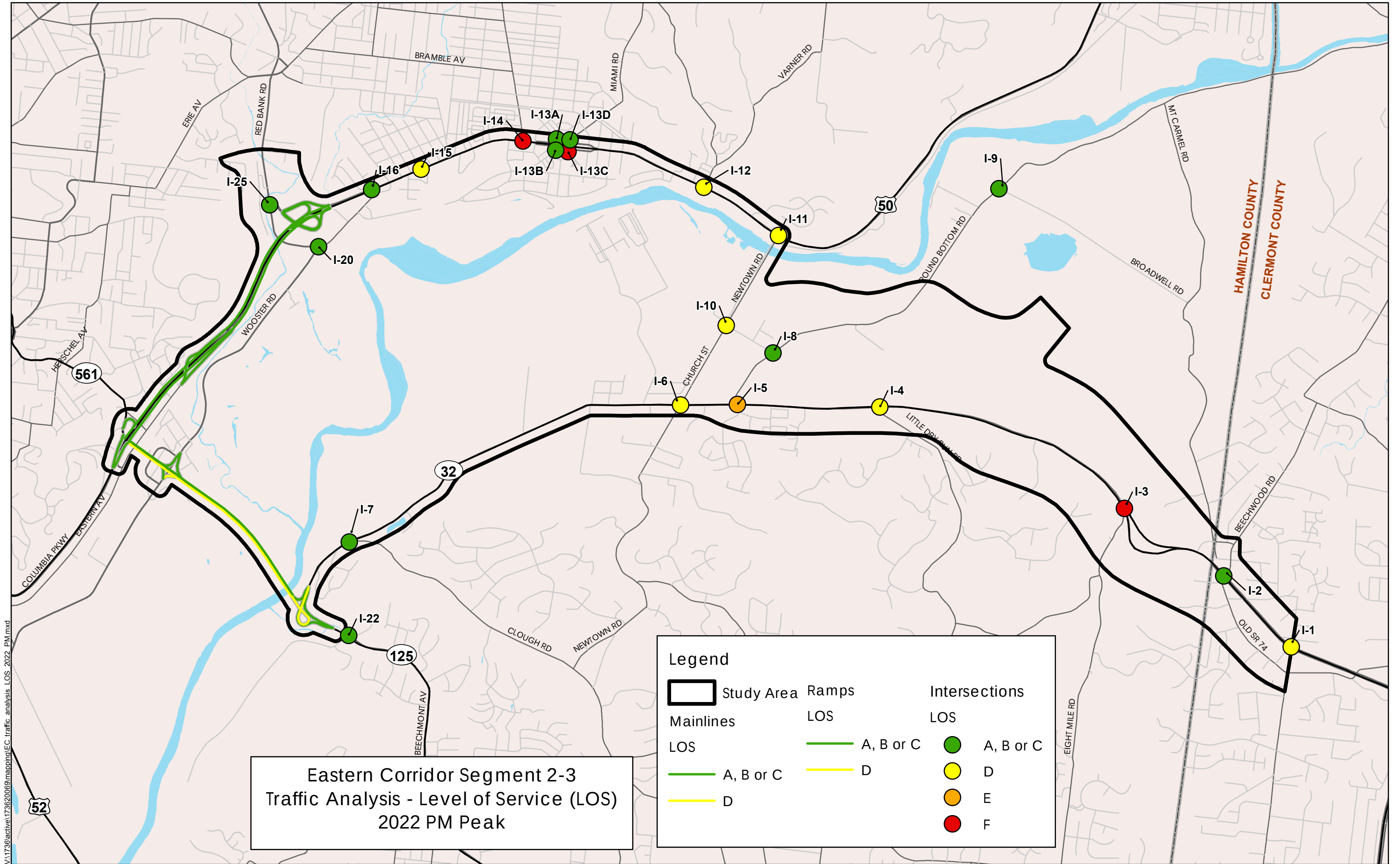


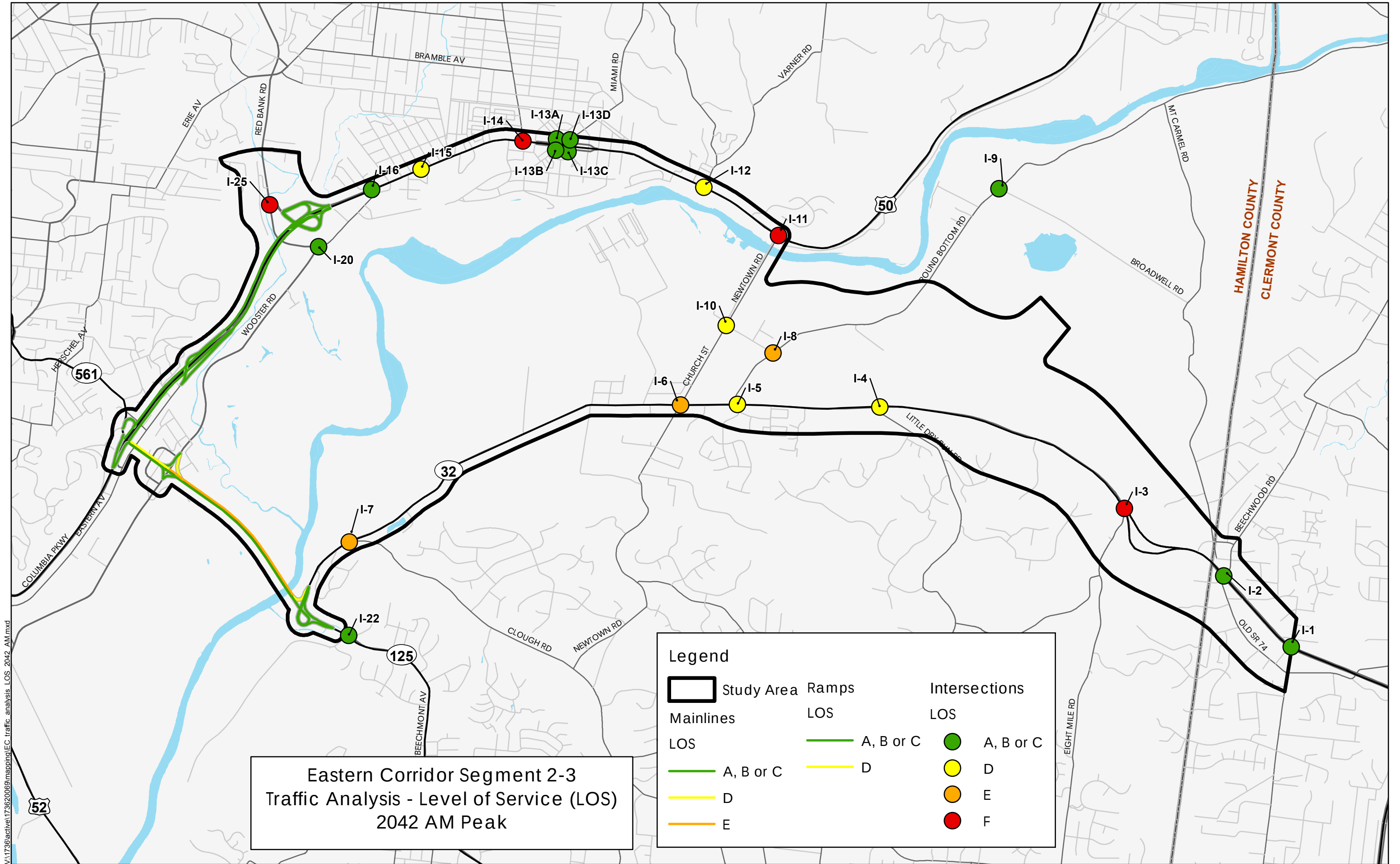
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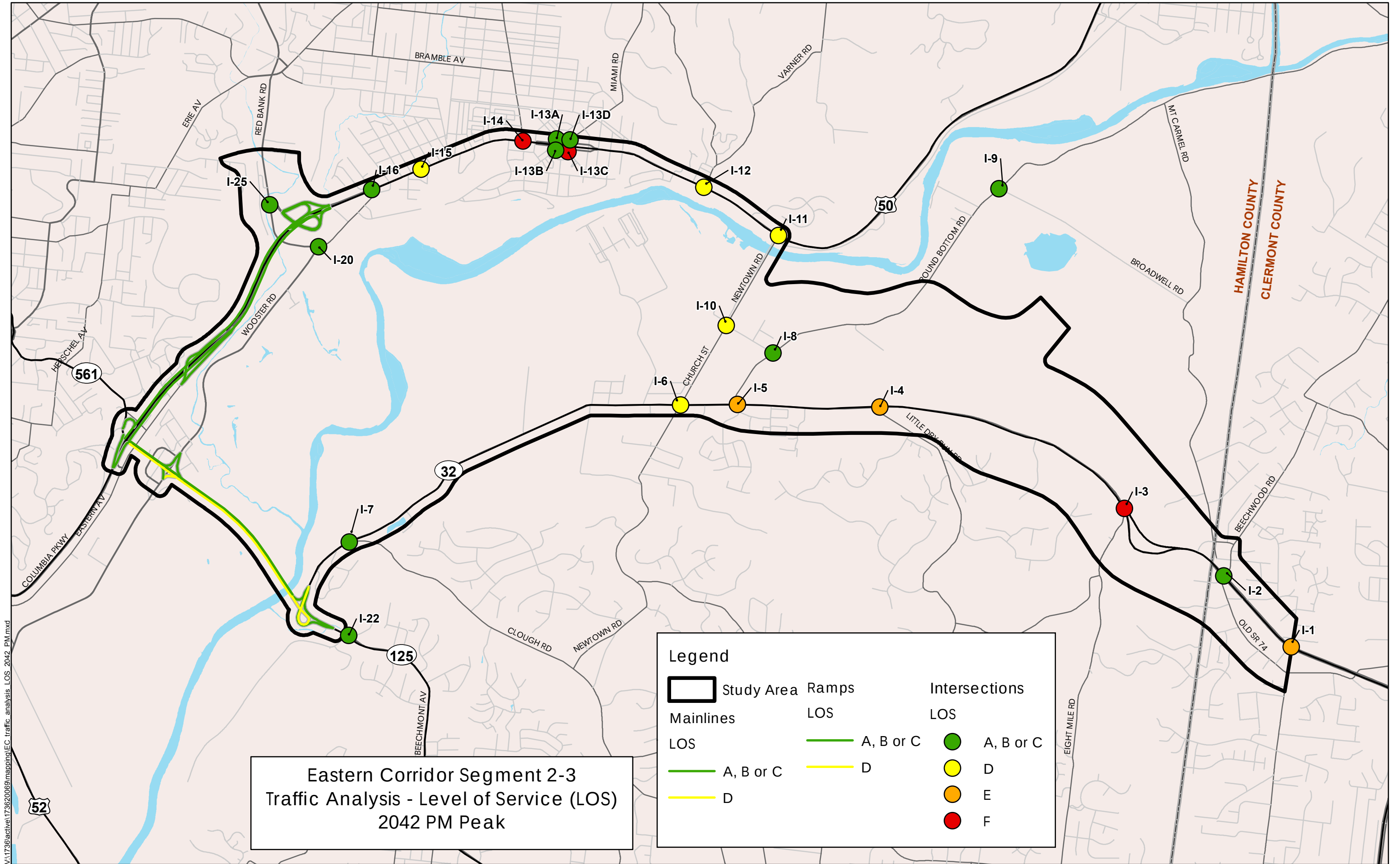




V:\736\active\173620069\mapping\EC traffic analysis LOS 2022 AM.mxd







Area	ID	Description	Existing Queue Lengths				AM Peak-Hour		PM Peak-Hour	
			EBL	WBL	NBL	SBL	Overall LOS	Notes	Overall LOS	Notes
Ancor	I-1	SR 32 & Mt. Carmel-Tobasco Rd/Bells Ln	275	470	175 + TWLTL		2015: C 2022: C 2042: C		2015: C 2022: D 2042: E	2022: WBL queue = 736', LOS F, v/c 1.14 2042: WBL queue = 964', LOS F, v/c 1.23
Ancor	I-2	SR 32 & Old SR 74/Beechwood Rd	200 + Median	175	120 + TWLTL	285 + TWLTL	2015: C 2022: C 2042: C	2015: NBL queue = 195', LOS D, v/c 0.65 2022: NBL queue = 186', LOS D, v/c 0.55 2042: NBL queue = 253', LOS D, v/c 0.68	2015: C 2022: C 2042: C	2015: EBL queue = 348', LOS F, v/c 1.01 2022: EBL queue = 243', LOS D, v/c 0.78 2042: EBL queue = 287', LOS E, v/c 0.89
Ancor	I-3	SR 32 & 8 Mile Rd			30			2015: NBL queue = 118', LOS F, v/c 0.75 2022: NBL queue = 188', LOS F, v/c 1.07 2042: NBL queue = 253', LOS F, v/c 1.39		2015: NBL queue = 88', LOS F, v/c 0.81; NBR queue = 200', LOS F, v/c 0.87 2022: NBL queue = 135', LOS F, v/c 1.72; NBR queue = 343', LOS F, v/c 1.15 2042: NBL queue = 165', LOS F, v/c 3.76; NBR queue = 483', LOS F, v/c 1.41
Ancor	I-4	SR 32 & Little Dry Run Rd		175	135		2015: C 2022: D 2042: D	2015: NBL queue = 258', LOS D, v/c 0.52 2022: NBL queue = 297', LOS D, v/c 0.64; WBT = LOS F, v/c 1.05 2042: NBL queue = 313', LOS E, v/c 0.72; WBT = LOS F, v/c 1.06	2015: D 2022: D 2042: E	2015: EBTR = LOS F, v/c 1.06 2022: EBTR = LOS F, v/c 1.09; NBL queue = 204', LOS E, v/c 0.83 2042: EBTR = LOS F, v/c 1.12; NBL queue = 225', LOS F, v/c 0.90
Newtown	I-5	SR 32 & Round Bottom Rd	155 + TWLTL	185 + TWLTL	150	325	2015: D 2022: C 2042: D	2015: WBT = LOS F, v/c 1.01	2015: D 2022: E 2042: E	2015: SBL queue = 716', LOS E, v/c 0.98 2022: SBL queue = 774', LOS E, v/c 0.99; EBT = LOS F, v/c 1.02 2042: SBL queue = 967', LOS F, v/c 1.08; EBT = LOS F, v/c 1.09
Newtown	I-6	SR 32 & Church St	155 + TWLTL	175 + TWLTL	75	150	2015: E 2022: E 2042: E	2015: WBT = LOS F, v/c 1.06; NBT = LOS F, v/c 0.94 2022: SBL queue = 197', LOS D, v/c 0.67 2042: WBT = LOS F, v/c 1.00; SBL queue = 265', LOS F, v/c 0.89	2015: D 2022: D 2042: D	
SR 125	I-7	SR 32 & Clough Pike					2015: D 2022: E 2042: E	2022: WBLTR = LOS F, v/c 1.01 2042: WBLTR = LOS F, v/c 1.01	2015: C 2022: C 2042: C	
Newtown	I-8	Round Bottom Rd & Valley Ave	150		225		2015: D 2022: E 2042: E	2015: NBL queue = 579', LOS F, v/c 1.02 2022: NBL queue = 897', LOS F, v/c 1.01; EBR = LOS F, v/c 0.91 2042: NBL queue = 908', LOS F, v/c 1.02; EBR = LOS F, v/c 0.93	2015: C 2022: C 2042: C	2015: EBL queue = 192', LOS C, v/c 0.35 2022: EBL queue = 204', LOS C, v/c 0.33 2042: EBL queue = 199', LOS C, v/c 0.35
Ancor	I-9	Round Bottom Rd & Broadwell Rd								
Newtown	I-10	Newtown Rd/Church St & Valley Ave	250	140	155	390	2015: C 2022: D 2042: D		2015: C 2022: D 2042: D	2022: SBL queue = 852', LOS E, v/c 0.98 2042: SBL queue = 963', LOS F, v/c 1.04
US 50	I-11	Newtown Rd & US 50		815	455		2015: F 2022: F 2042: F	2015: NBL queue = 1868', LOS F, v/c 1.25; WBL = LOS F, v/c 1.02 2022: NBL queue = 1788', LOS F, v/c 1.18; WBL = LOS F, v/c 1.30 2042: NBL queue = 1860', LOS F, v/c 1.20; WBL = LOS F, v/c 1.30; WBT = LOS F, v/c 1.00	2015: C 2022: D 2042: D	2015: NBL queue = 864', LOS E, v/c 0.98 2022: NBL queue = 717', LOS D, v/c 0.83 2042: NBL queue = 717', LOS D, v/c 0.84
US 50	I-12	US 50 & Walton Creek Rd	130	200		80	2015: D 2022: C 2042: D	2015: SBL queue = 239', LOS E, v/c 0.53 2022: SBL queue = 169', LOS C, v/c 0.32 2042: SBL queue = 245', LOS E, v/c 0.49	2015: E 2022: D 2042: D	2015: SBL queue = 1063', LOS F, v/c 1.52 2022: SBL queue = 562', LOS E, v/c 0.96 2042: SBL queue = 611', LOS E, v/c 0.97
US 50	I-13 NW	US 50 & Madisonville Rd (Mariemont Square)		140			2015: B 2022: C 2041: C	2015: WB queue = 225', LOS A, v/c 0.64 2022: WB queue = 450', LOS C, v/c 0.89 2042: WB queue = 464', LOS C, v/c 0.90	2015: B 2022: B 2042: B	2015: WB queue = 181', LOS A, v/c 0.48 2022: WB queue = 310', LOS B, v/c 0.65 2042: WB queue = 308', LOS B, v/c 0.64
US 50	I-13 SW	US 50 & Miami Rd (Mariemont Square)				60	2015: B 2022: B 2042: B	2015: SB queue = 186', LOS C, v/c 0.50 2022: SB queue = 162', LOS B, v/c 0.40 2042: SB queue = 162', LOS B, v/c 0.40	2015: C 2022: B 2042: C	2015: SB queue = 445', LOS D, v/c 0.92 2022: SB queue = 337', LOS C, v/c 0.73 2042: SB queue = 347', LOS C, v/c 0.74
US 50	I-13 SE	US 50 & Crystal Springs Rd (Mariemont Square)	150							2022: NBTR = LOS F, v/c 0.51 2042: NBTR = LOS F, v/c 0.53
US 50	I-13 NE	US 50 & Miami Rd (Mariemont Square)			120		2015: A 2022: B 2042: B		2015: B 2022: B 2042: B	
US 50	I-14	US 50 & Plaineville Rd						2015: SBLTR = LOS F, v/c 0.70 2022: SBLTR = LOS F, v/c 0.88; EBLT = LOS B, v/c 1.05 2042: SBLTR = LOS F, v/c 0.91; EBLT = LOS B, v/c 1.08		2015: SBLTR = LOS F, v/c 1.50 2022: SBLTR = LOS F, v/c 2.05 2042: SBLTR = LOS F, v/c 2.51

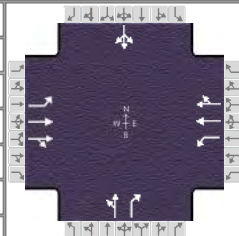
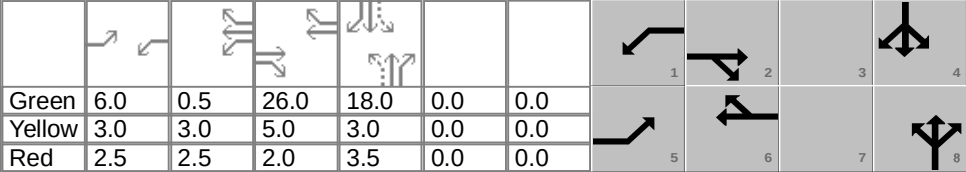
Area	ID	Description	Existing Queue Lengths				AM Peak-Hour		PM Peak-Hour	
			EBL	WBL	NBL	SBL	Overall LOS	Notes	Overall LOS	Notes
US 50	I-15	US 50 & Watterson Rd	125	120		120 + parking	2015: C 2022: C 2042: D	2015: SBL queue = 173' , LOS D, v/c 0.35 2022: SBL queue = 207' , LOS D, v/c 0.45; EBL = LOS F, v/c 0.84 2042: SBL queue = 207' , LOS D, v/c 0.45; EBL queue = 146' , LOS F, v/c 0.93; WBT = LOS F, v/c 1.00	2015: C 2022: D 2042: D	2015: SBL queue = 490' , LOS F, v/c 0.94 2022: SBL queue = 426' , LOS E, v/c 0.84 2042: SBL queue = 452' , LOS E, v/c 0.86
Red Bank	I-16	US 50 & Wooster Pike/Meadowlark Ln	340	185	175	30	2015: B 2022: C 2042: C	2015: SBTL queue = 65' , LOS C, v/c 0.22 2022: SBTL queue = 63' , LOS C, v/c 0.20 2042: SBTL queue = 66' , LOS C, v/c 0.21	2015: C 2022: C 2042: C	2015: NBTL queue = 323' , LOS D, v/c 0.80 2022: NBTL queue = 219' , LOS C, v/c 0.53 2042: NBTL queue = 226' , LOS C, v/c 0.54
Red Bank	I-20	Red Bank Rd/Wooster Pike & Wooster Rd		385	575 + TWLTL		2015: C 2022: C 2042: C	2015: NBL queue = 616', LOS C, v/c 0.88 2022: NBL queue = 710', LOS C, v/c 0.93 2042: NBL queue = 710', LOS C, v/c 0.93	2015: C 2022: B 2042: B	
SR 125	I-22	SR 125 & Elstun Rd	290 + TWLTL	120 + TWLTL	85	175	2015: C 2022: C 2042: C	2015: NBL queue = 150' , LOS C, v/c 0.47 2022: NBL queue = 215' , LOS D, v/c 0.68 2042: NBL queue = 215' , LOS D, v/c 0.68; WBTR = LOS F, v/c 1.00	2015: B 2022: C 2042: C	
Red Bank	I-25	Red Bank Rd & Colbank Rd		350		440	2015: F 2022: F 2042: F	2015 AM: WBR queue = 1051' , LOS F, v/c 1.26 ; NB LOS F, v/c 1.10 2022 AM: WBR queue = 1279' , LOS F, v/c 1.31 ; NB LOS F, v/c 1.31 2042 AM: WBR queue = 1344' , LOS F, v/c 1.33 ; NB LOS F, v/c 1.33	2015: C 2022: C 2042: C	

ANCOR/SR 32 HILL AREA

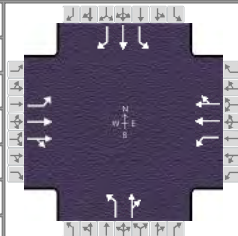
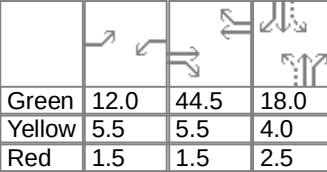
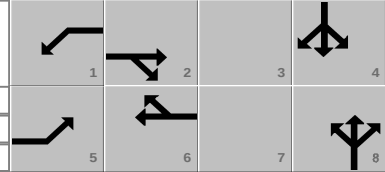
2015

AM

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information									
Agency						Duration, h		0.25							
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type						Other	
Jurisdiction		Union Township (ODOT)		Time Period				PHF						0.90	
Urban Street		SR 32		Analysis Year		2016		Analysis Period						1> 7:00	
Intersection		SR 32 at Bells Lane		File Name		01-Existing-AM.xus									
Project Description		Existing AM Peak Hour													
Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				10	580	40	180	790	30	70	20	50	90	30	30
Signal Information															
Cycle, s	75.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On												
Force Mode	Fixed	Simult. Gap N/S	On												
Green	6.0	0.5	26.0	18.0	0.0	0.0									
Yellow	3.0	3.0	5.0	3.0	0.0	0.0									
Red	2.5	2.5	2.0	3.5	0.0	0.0									
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase				5	2	1	6		8		4				
Case Number				2.0	4.0	2.0	4.0		7.0		8.0				
Phase Duration, s				11.5	33.0	17.5	39.0		24.5		24.5				
Change Period, (Y+R c), s				5.5	7.0	5.5	7.0		6.5		6.5				
Max Allow Headway (MAH), s				3.1	3.0	3.1	3.0		3.2		3.2				
Queue Clearance Time (g s), s				2.4	13.6	10.3	16.6		6.4		9.1				
Green Extension Time (g e), s				0.0	2.9	0.1	2.6		0.5		0.3				
Phase Call Probability				1.00	1.00	1.00	1.00		1.00		1.00				
Max Out Probability				0.35	0.14	1.00	0.27		0.00		0.12				
Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h				11	348	341	200	459	453		100	56		167	
Adjusted Saturation Flow Rate (s), veh/h/ln				1740	1827	1785	1723	1810	1786		1367	1505		1456	
Queue Service Time (g s), s				0.4	11.5	11.6	8.3	14.6	14.6		0.0	2.2		2.8	
Cycle Queue Clearance Time (g c), s				0.4	11.5	11.6	8.3	14.6	14.6		4.4	2.2		7.1	
Green Ratio (g/C)				0.08	0.35	0.35	0.16	0.43	0.43		0.24	0.24		0.24	
Capacity (c), veh/h				139	633	619	276	772	762		413	361		426	
Volume-to-Capacity Ratio (X)				0.080	0.550	0.551	0.725	0.594	0.594		0.242	0.154		0.391	
Back of Queue (Q), ft/ln (95 th percentile)				8.5	209.8	200.4	179.7	245.4	235.4		64.1	33.3		111.9	
Back of Queue (Q), veh/ln (95 th percentile)				0.3	8.1	8.0	7.0	9.5	9.4		2.5	1.3		4.3	
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d 1), s/veh				31.9	19.8	19.8	29.9	16.5	16.5		23.3	22.5		24.3	
Incremental Delay (d 2), s/veh				0.1	0.6	0.6	8.0	0.9	0.9		0.1	0.1		0.2	
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (d), s/veh				32.0	20.4	20.4	37.9	17.4	17.4		23.4	22.6		24.5	
Level of Service (LOS)				C	C	C	D	B	B		C	C		C	
Approach Delay, s/veh / LOS				20.6	C		21.1	C		23.1	C		24.5	C	
Intersection Delay, s/veh / LOS				21.3						C					
Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.3	B		2.1	B		2.8	C		2.8	C	
Bicycle LOS Score / LOS				1.1	A		1.4	A		0.7	A		0.8	A	

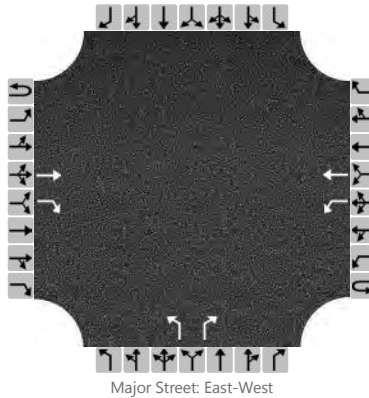
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other									
Jurisdiction		Union Township (ODOT)		Time Period				PHF		0.90									
Urban Street		SR 32		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		SR 32 at Beechwood Rd		File Name		02-Existing-AM.xus													
Project Description		Existing AM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				70	440	60	10	790	90	160	70	10	180	80	130				
Signal Information																			
Cycle, s	95.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	12.0	44.5	18.0	0.0	0.0	0.0									
				Yellow	5.5	5.5	4.0	0.0	0.0	0.0									
				Red	1.5	1.5	2.5	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8				4	
Case Number				2.0		4.0		2.0		4.0				6.0				5.0	
Phase Duration, s				19.0		51.5		19.0		51.5				24.5				24.5	
Change Period, (Y+R c), s				7.0		7.0		7.0		7.0				6.5				6.5	
Max Allow Headway (MAH), s				3.1		3.1		3.1		3.1				3.2				3.2	
Queue Clearance Time (g s), s				5.8		11.1		2.5		20.7				18.3				20.0	
Green Extension Time (g e), s				0.0		3.2		0.0		3.1				0.0				0.0	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00				1.00	
Max Out Probability				0.01		0.00		0.00		0.01				1.00				1.00	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				78	283	273	11	498	480	178	89		200	89	144				
Adjusted Saturation Flow Rate (s), veh/h/ln				1774	1863	1784	1757	1845	1778	1329	1858		1329	1900	1610				
Queue Service Time (g s), s				3.8	9.0	9.1	0.5	18.7	18.7	12.5	3.9		14.1	3.8	7.6				
Cycle Queue Clearance Time (g c), s				3.8	9.0	9.1	0.5	18.7	18.7	16.3	3.9		18.0	3.8	7.6				
Green Ratio (g/C)				0.13	0.47	0.47	0.13	0.47	0.47	0.19	0.19		0.19	0.19	0.19				
Capacity (c), veh/h				224	873	836	222	864	833	275	352		273	360	305				
Volume-to-Capacity Ratio (X)				0.347	0.324	0.326	0.050	0.576	0.576	0.647	0.252		0.731	0.247	0.473				
Back of Queue (Q), ft/ln (95 th percentile)				75.1	167.1	158.8	10.3	307.5	294	194.9	77.4		227	78.5	132				
Back of Queue (Q), veh/ln (95 th percentile)				3.0	6.6	6.4	0.4	12.1	11.8	7.7	3.1		8.9	3.1	5.3				
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00				
Uniform Delay (d 1), s/veh				37.9	15.8	15.8	36.5	18.4	18.4	39.6	32.8		40.5	32.7	34.3				
Incremental Delay (d 2), s/veh				0.3	0.1	0.1	0.0	0.6	0.6	4.1	0.1		8.5	0.1	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		0.0	0.0	0.0				
Control Delay (d), s/veh				38.3	15.9	15.9	36.5	19.0	19.0	43.8	32.9		49.0	32.9	34.7				
Level of Service (LOS)				D	B	B	D	B	B	D	C		D	C	C				
Approach Delay, s/veh / LOS				18.7		B		19.2		B		40.1		D		40.9		D	
Intersection Delay, s/veh / LOS				25.5						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.4		B		2.8		C		2.8		C	
Bicycle LOS Score / LOS				1.0		A		1.3		A		0.9		A		1.2		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	SR 32 @ 8 Mile Rd
Agency/Co.		Jurisdiction	Union Township
Date Performed	4/26/2016	East/West Street	SR 32
Analysis Year	Existing	North/South Street	8 Mile Road
Time Analyzed	AM PEAK HOUR	Peak Hour Factor	1.00
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 3		

Lanes



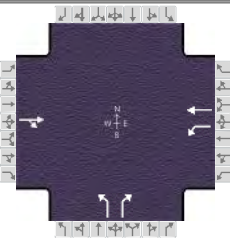
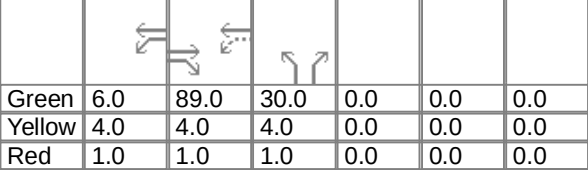
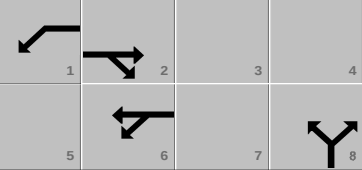
Vehicle Volumes and Adjustments

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	1	1	0	1	1	0		1	0	1		0	0	0
Configuration			T	R		L	T			L		R				
Volume (veh/h)			390	40		220	950			120		170				
Percent Heavy Vehicles						3				2		2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						220					120		170			
Capacity						1123					160		658			
v/c Ratio						0.20					0.75		0.26			
95% Queue Length						0.7					4.7		1.0			
Control Delay (s/veh)						9.0					74.8		12.4			
Level of Service (LOS)						A					F		B			
Approach Delay (s/veh)					1.7				38.2							
Approach LOS									E							

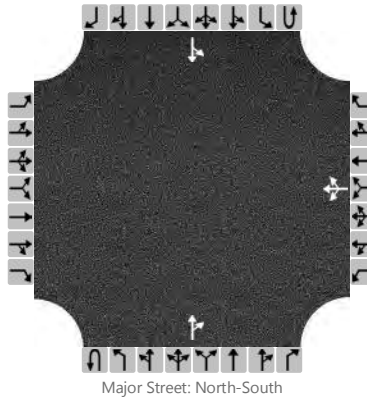
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information									
Agency						Duration, h		0.25							
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other					
Jurisdiction		Anderson Twp (ODOT)		Time Period				PHF		0.90					
Urban Street		SR 32		Analysis Year		2016		Analysis Period		1> 7:00					
Intersection		SR 32 at Little Dry Run...		File Name		04-Existing-AM.xus									
Project Description		Exisitng AM Peak Hour													
Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					430	40	20	1100		180		20			
Signal Information															
															
Cycle, s	140.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On												
Force Mode	Fixed	Simult. Gap N/S	On												
Green	6.0	89.0	30.0	0.0	0.0	0.0									
Yellow	4.0	4.0	4.0	0.0	0.0	0.0									
Red	1.0	1.0	1.0	0.0	0.0	0.0									
Timer Results															
				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase					2	1	6		8						
Case Number					8.3	1.0	4.0		9.0						
Phase Duration, s					94.0	11.0	105.0		35.0						
Change Period, (Y+R c), s					5.0	5.0	5.0		5.0						
Max Allow Headway (MAH), s					3.0	3.1	3.0		3.1						
Queue Clearance Time (g s), s					22.6	2.6	80.5		15.7						
Green Extension Time (g e), s					5.3	0.0	3.5		0.3						
Phase Call Probability					1.00	1.00	1.00		1.00						
Max Out Probability					0.00	0.51	0.46		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					2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h					522		22	1222		200		22			
Adjusted Saturation Flow Rate (s), veh/h/ln					1817		1757	1845		1810		1579			
Queue Service Time (g s), s					20.6		0.6	78.5		13.7		1.6			
Cycle Queue Clearance Time (g c), s					20.6		0.6	78.5		13.7		1.6			
Green Ratio (g/C)					0.64		0.69	0.71		0.21		0.21			
Capacity (c), veh/h					1155		551	1318		388		338			
Volume-to-Capacity Ratio (X)					0.452		0.040	0.928		0.516		0.066			
Back of Queue (Q), ft/ln (95 th percentile)					320.1		9	1091.5		257.9		28			
Back of Queue (Q), veh/ln (95 th percentile)					12.8		0.4	42.6		10.3		1.1			
Queue Storage Ratio (RQ) (95 th percentile)					0.00		0.00	0.00		0.00		0.00			
Uniform Delay (d 1), s/veh					13.0		8.6	16.9		48.6		43.8			
Incremental Delay (d 2), s/veh					0.1		0.0	11.3		0.5		0.0			
Initial Queue Delay (d 3), s/veh					0.0		0.0	0.0		0.0		0.0			
Control Delay (d), s/veh					13.1		8.6	28.2		49.1		43.9			
Level of Service (LOS)					B		A	C		D		D			
Approach Delay, s/veh / LOS				13.1	B	27.9	C	48.6	D	0.0					
Intersection Delay, s/veh / LOS				26.3						C					
Multimodal Results															
				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.2	B	0.7	A	2.3	B	2.2	B				
Bicycle LOS Score / LOS				1.3	A	2.5	B		F						

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	Broadwell Rd at Round Btm
Agency/Co.		Jurisdiction	Newtown
Date Performed	4/13/2016	East/West Street	Broadwell Road
Analysis Year	Existing	North/South Street	Round Bottom Road
Time Analyzed	AM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Intersection 9		

Lanes



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	1	0	0	0	1	0	0	0	1	0
Configuration							LTR					TR		LT		
Volume (veh/h)						90	0	10			110	20		20	350	
Percent Heavy Vehicles						0	17	0						15		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

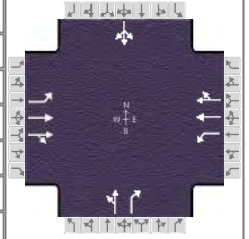
Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						111								411		
Capacity						505								1360		
v/c Ratio						0.22								0.30		
95% Queue Length						0.8								0.0		
Control Delay (s/veh)						14.1								7.7		
Level of Service (LOS)						B								A		
Approach Delay (s/veh)					14.1								0.6			
Approach LOS					B											

PM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Jul 27, 2016	Area Type	Other
Jurisdiction	Union Township (ODOT)	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	SR 32 at Bells Lane	File Name	01-Existing-PM.xus		
Project Description	Existing PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	40	790	90	390	690	110	110	70	100	50	40	10

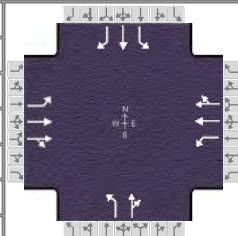
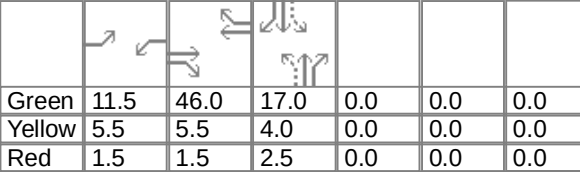
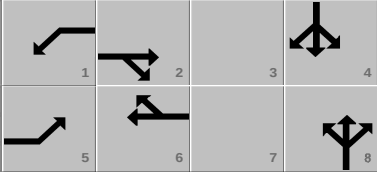
Signal Information											
Cycle, s	85.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On								
Force Mode	Fixed	Simult. Gap N/S	On								

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	4.0	2.0	4.0		7.0		8.0
Phase Duration, s	11.5	34.0	26.5	49.0		24.5		24.5
Change Period, ($Y+R_c$), s	5.5	7.0	5.5	7.0		6.5		6.5
Max Allow Headway (MAH), s	3.1	3.1	3.1	3.1		3.2		3.2
Queue Clearance Time (g_s), s	4.0	23.2	22.2	15.9		12.1		6.8
Green Extension Time (g_e), s	0.0	1.9	0.0	3.4		0.5		0.6
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	0.88	1.00	0.28		0.16		0.04

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	44	498	480	433	455	434		200	111		111	
Adjusted Saturation Flow Rate (s), veh/h/ln	1774	1863	1795	1810	1863	1773		1521	1579		1573	
Queue Service Time (g_s), s	2.0	21.2	21.2	20.2	13.9	13.9		5.3	5.1		0.0	
Cycle Queue Clearance Time (g_c), s	2.0	21.2	21.2	20.2	13.9	13.9		10.1	5.1		4.8	
Green Ratio (g/C)	0.07	0.32	0.32	0.25	0.49	0.49		0.21	0.21		0.21	
Capacity (c), veh/h	125	592	570	447	920	876		390	334		397	
Volume-to-Capacity Ratio (X)	0.355	0.841	0.841	0.969	0.495	0.495		0.512	0.332		0.280	
Back of Queue (Q), ft/ln (95 th percentile)	40.2	400.8	384.2	468.6	233.2	220.8		165	84.2		85.1	
Back of Queue (Q), veh/ln (95 th percentile)	1.6	15.8	15.4	18.4	9.2	8.8		6.5	3.4		3.4	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d_1), s/veh	37.7	27.0	27.0	31.7	14.4	14.4		30.3	28.4		28.2	
Incremental Delay (d_2), s/veh	0.6	10.0	10.4	34.4	0.2	0.2		0.5	0.2		0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (d), s/veh	38.3	37.0	37.4	66.1	14.5	14.6		30.8	28.6		28.3	
Level of Service (LOS)	D	D	D	E	B	B		C	C		C	
Approach Delay, s/veh / LOS	37.2	D		31.4	C		30.0	C		28.3	C	
Intersection Delay, s/veh / LOS	33.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.3	A	1.6	A	1.0	A	0.7	A

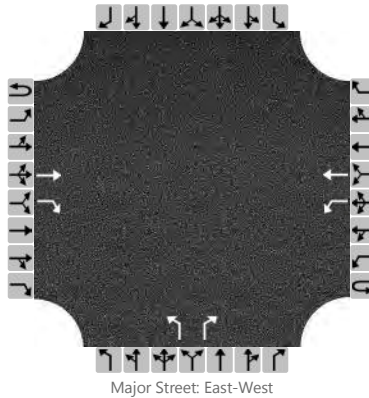
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 27, 2016		Area Type		Other									
Jurisdiction		Union Township (ODOT)		Time Period				PHF		0.90									
Urban Street		SR 32		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		SR 32 at Beechwood Rd		File Name		02-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				200	730	160	30	590	190	80	80	20	170	130	40				
Signal Information																			
Cycle, s	95.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On			Green	11.5	46.0	17.0	0.0	0.0	0.0							
Force Mode	Fixed	Simult. Gap N/S	On			Yellow	5.5	5.5	4.0	0.0	0.0	0.0							
				Red	1.5	1.5	2.5	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8				4	
Case Number				2.0		4.0		2.0		4.0				6.0				5.0	
Phase Duration, s				18.5		53.0		18.5		53.0				23.5				23.5	
Change Period, (Y+R c), s				7.0		7.0		7.0		7.0				6.5				6.5	
Max Allow Headway (MAH), s				3.1		3.1		3.1		3.1				3.2				3.2	
Queue Clearance Time (g s), s				13.5		20.0		3.6		17.3				14.9				19.0	
Green Extension Time (g e), s				0.0		4.2		0.0		4.2				0.3				0.0	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00				1.00	
Max Out Probability				1.00		0.03		0.00		0.02				1.00				1.00	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				222	510	478	33	452	415	89	111		189	144	44				
Adjusted Saturation Flow Rate (s), veh/h/ln				1810	1900	1781	1792	1900	1740	1263	1834		1289	1881	1594				
Queue Service Time (g s), s				11.5	18.0	18.0	1.6	15.3	15.3	6.4	5.0		12.0	6.5	2.2				
Cycle Queue Clearance Time (g c), s				11.5	18.0	18.0	1.6	15.3	15.3	12.9	5.0		17.0	6.5	2.2				
Green Ratio (g/C)				0.12	0.48	0.48	0.12	0.48	0.48	0.18	0.18		0.18	0.18	0.18				
Capacity (c), veh/h				219	920	862	217	920	843	216	328		238	337	285				
Volume-to-Capacity Ratio (X)				1.014	0.555	0.555	0.154	0.491	0.492	0.412	0.339		0.793	0.429	0.156				
Back of Queue (Q), ft/ln (95 th percentile)				348	297.5	282.5	31	259.3	242.1	88.8	99.7		230.6	131.9	38.5				
Back of Queue (Q), veh/ln (95 th percentile)				13.9	11.9	11.3	1.2	10.4	9.7	3.6	4.0		9.2	5.3	1.5				
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00				
Uniform Delay (d 1), s/veh				41.8	17.3	17.3	37.4	16.6	16.6	40.4	34.1		42.4	34.7	32.9				
Incremental Delay (d 2), s/veh				64.6	0.4	0.5	0.1	0.2	0.2	0.5	0.2		15.4	0.3	0.1				
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0				
Control Delay (d), s/veh				106.3	17.7	17.7	37.5	16.7	16.8	40.9	34.3		57.7	35.0	33.0				
Level of Service (LOS)				F	B	B	D	B	B	D	C		E	D	C				
Approach Delay, s/veh / LOS				34.0		C		17.5		B		37.2		D		46.1		D	
Intersection Delay, s/veh / LOS				30.4						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.4		B		2.8		C		2.8		C	
Bicycle LOS Score / LOS				1.5		A		1.2		A		0.8		A		1.1		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	SR 32 @ 8 Mile Rd
Agency/Co.		Jurisdiction	Union Township
Date Performed	4/26/2016	East/West Street	SR 32
Analysis Year	Existing	North/South Street	8 Mile Road
Time Analyzed	PM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 3		

Lanes



Vehicle Volumes and Adjustments

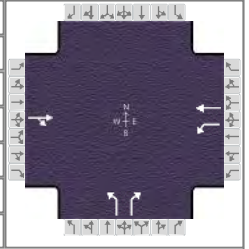
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	1	0	1	1	0		1	0	1		0	0	0
Configuration			T	R		L	T			L		R				
Volume (veh/h)			850	130		330	510			40		250				
Percent Heavy Vehicles						2				2		2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						367				44		278				
Capacity						649				54		318				
v/c Ratio						0.57				0.81		0.87				
95% Queue Length						3.5				3.5		8.0				
Control Delay (s/veh)						17.5				189.5		60.5				
Level of Service (LOS)						C				F		F				
Approach Delay (s/veh)					6.9				78.2							
Approach LOS									F							

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Jul 26, 2016	Area Type	Other
Jurisdiction	Anderson Twp (ODOT)	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	SR 32 at Little Dry Run...	File Name	04-Existing-PM.xus		
Project Description	Existing PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		970	160	50	540		110		40			

Signal Information											
Cycle, s	105.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	6.0	69.0	15.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
				Red	1.0	1.0	1.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		8.3	1.0	4.0		9.0		
Phase Duration, s		74.0	11.0	85.0		20.0		
Change Period, ($Y+R_c$), s		5.0	5.0	5.0		5.0		
Max Allow Headway (MAH), s		3.1	3.1	3.1		3.2		
Queue Clearance Time (g_s), s		71.0	2.9	14.1		8.5		
Green Extension Time (g_e), s		0.0	0.0	6.1		0.2		
Phase Call Probability		1.00	1.00	1.00		1.00		
Max Out Probability		1.00	1.00	0.00		0.03		

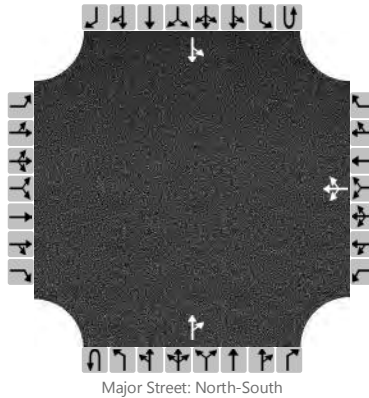
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		1256		56	600		122		44			
Adjusted Saturation Flow Rate (s), veh/h/ln		1799		1757	1845		1810		1579			
Queue Service Time (g_s), s		69.0		0.9	12.1		6.5		2.6			
Cycle Queue Clearance Time (g_c), s		69.0		0.9	12.1		6.5		2.6			
Green Ratio (g/C)		0.66		0.73	0.76		0.14		0.14			
Capacity (c), veh/h		1182		169	1405		259		226			
Volume-to-Capacity Ratio (X)		1.062		0.329	0.427		0.473		0.197			
Back of Queue (Q), ft/ln (95 th percentile)		1277.4		42.4	159.6		130.7		45.4			
Back of Queue (Q), veh/ln (95 th percentile)		51.1		1.7	6.2		5.2		1.8			
Queue Storage Ratio (RQ) (95 th percentile)		0.00		0.00	0.00		0.00		0.00			
Uniform Delay (d_1), s/veh		18.0		27.9	4.4		41.4		39.7			
Incremental Delay (d_2), s/veh		44.4		0.4	0.1		0.5		0.2			
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		62.4		28.3	4.5		41.9		39.8			
Level of Service (LOS)		F		C	A		D		D			
Approach Delay, s/veh / LOS	62.4	E		6.5	A		41.3	D		0.0		
Intersection Delay, s/veh / LOS	43.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	0.6	A	2.3	B	2.2	B
Bicycle LOS Score / LOS	2.6	B	1.6	A		F		

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	Broadwell @ Round Btm
Agency/Co.		Jurisdiction	Newtown
Date Performed	4/13/2016	East/West Street	Broadwell Road
Analysis Year	Existing	North/South Street	Round Bottom Road
Time Analyzed	PM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Intersection 9		

Lanes



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	1	0	0	0	1	0	0	0	1	0
Configuration							LTR					TR		LT		
Volume (veh/h)						50	0	30			330	70		20	140	
Percent Heavy Vehicles						18	0	18						7		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

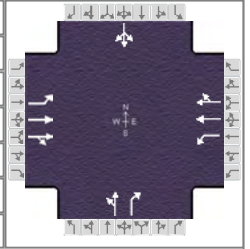
Flow Rate (veh/h)						89								178		
Capacity						475								1070		
v/c Ratio						0.19								0.17		
95% Queue Length						0.7								0.1		
Control Delay (s/veh)						14.3								8.4		
Level of Service (LOS)						B								A		
Approach Delay (s/veh)					14.3								1.2			
Approach LOS					B											

2022

AM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 19, 2016	Area Type	Other
Jurisdiction	Union Township (ODOT)	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	SR 32 at Bells Lane	File Name	01-2022-AM.xus		
Project Description	2022 NO-BUILD - AM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	650	50	210	880	30	90	20	70	90	30	30

Signal Information												
Cycle, s	75.0	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	On	Green	6.0	0.5	26.0	18.0	0.0	0.0		
				Yellow	3.0	3.0	5.0	3.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.5	2.5	2.0	3.5	0.0	0.0		

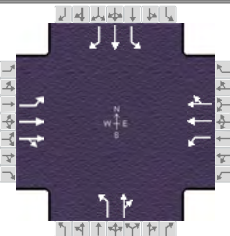
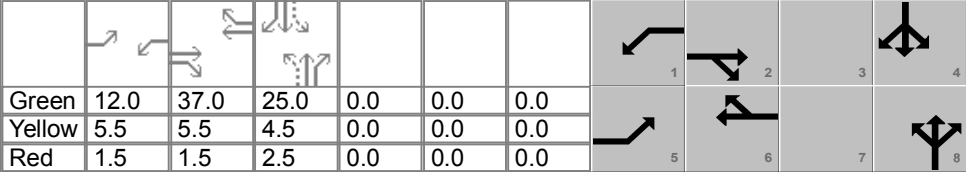
													
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	4.0	2.0	4.0		7.0		8.0
Phase Duration, s	11.5	33.0	17.5	39.0		24.5		24.5
Change Period, ($Y+R_c$), s	5.5	7.0	5.5	7.0		6.5		6.5
Max Allow Headway (MAH), s	3.1	3.0	3.1	3.0		3.2		3.2
Queue Clearance Time (g_s), s	2.4	15.5	11.9	18.8		7.6		8.9
Green Extension Time (g_e), s	0.0	3.1	0.0	2.6		0.6		0.4
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	0.35	0.27	1.00	0.48		0.01		0.13

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	11	394	384	233	509	503		122	78		167	
Adjusted Saturation Flow Rate (s), veh/h/ln	1740	1827	1781	1723	1810	1788		1348	1505		1487	
Queue Service Time (g_s), s	0.4	13.5	13.5	9.9	16.8	16.8		0.0	3.1		1.4	
Cycle Queue Clearance Time (g_c), s	0.4	13.5	13.5	9.9	16.8	16.8		5.6	3.1		6.9	
Green Ratio (g/C)	0.08	0.35	0.35	0.16	0.43	0.43		0.24	0.24		0.24	
Capacity (c), veh/h	139	633	617	276	772	763		411	361		434	
Volume-to-Capacity Ratio (X)	0.080	0.622	0.622	0.846	0.659	0.659		0.298	0.215		0.384	
Back of Queue (Q), ft/ln (95 th percentile)	8.5	241.4	229.6	238.1	279.4	268.3		79.9	47.4		111.7	
Back of Queue (Q), veh/ln (95 th percentile)	0.3	9.4	9.2	9.2	10.8	10.7		3.1	1.9		4.3	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	
Uniform Delay (d_1), s/veh	31.9	20.4	20.4	30.6	17.1	17.1		23.7	22.8		24.2	
Incremental Delay (d_2), s/veh	0.1	1.4	1.5	20.0	1.7	1.7		0.1	0.1		0.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	
Control Delay (d), s/veh	32.0	21.8	21.9	50.6	18.8	18.8		23.9	23.0		24.4	
Level of Service (LOS)	C	C	C	D	B	B		C	C		C	
Approach Delay, s/veh / LOS	22.0	C		24.8	C		23.5	C		24.4	C	
Intersection Delay, s/veh / LOS	23.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.1	A	1.5	A	0.8	A	0.8	A

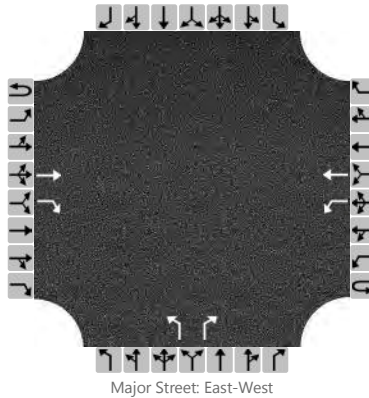
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information															
Agency						Duration, h		0.25													
Analyst		MJH		Analysis Date		Oct 19, 2016		Area Type		Other											
Jurisdiction		Union Township (ODOT)		Time Period				PHF		0.90											
Urban Street		SR 32		Analysis Year		2022		Analysis Period		1> 7:00											
Intersection		SR 32 at Beechwood Rd		File Name		02-2022-AM.xus															
Project Description		2022 NO-BUILD - AM Peak Hour																			
Demand Information						EB			WB			NB			SB						
Approach Movement						L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h						80	500	60	10	890	100	170	80	10	200	90	140				
Signal Information																					
Cycle, s	95.0	Reference Phase	2		Green		12.0	37.0	25.0	0.0	0.0	0.0									
Offset, s	0	Reference Point	End		Yellow		5.5	5.5	4.5	0.0	0.0	0.0									
Uncoordinated	Yes	Simult. Gap E/W	On		Red		1.5	1.5	2.5	0.0	0.0	0.0									
Force Mode	Fixed	Simult. Gap N/S	On																		
Timer Results						EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						5		2		1		6				8				4	
Case Number						2.0		4.0		2.0		4.0				6.0				5.0	
Phase Duration, s						19.0		44.0		19.0		44.0				32.0				32.0	
Change Period, (Y+R c), s						7.0		7.0		7.0		7.0				7.0				7.0	
Max Allow Headway (MAH), s						3.1		3.1		3.1		3.1				3.3				3.3	
Queue Clearance Time (g s), s						6.5		14.2		2.5		28.0				19.5				22.3	
Green Extension Time (g e), s						0.1		3.7		0.0		2.9				1.0				0.6	
Phase Call Probability						1.00		1.00		1.00		1.00				1.00				1.00	
Max Out Probability						0.04		0.03		0.00		0.34				0.42				1.00	
Movement Group Results						EB			WB			NB			SB						
Approach Movement						L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement						5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h						89	316	306	11	560	540	189	100		222	100	156				
Adjusted Saturation Flow Rate (s), veh/h/ln						1740	1827	1758	1723	1810	1745	1229	1741		1253	1810	1533				
Queue Service Time (g s), s						4.5	12.1	12.2	0.5	26.0	26.0	13.5	4.3		16.0	4.1	7.9				
Cycle Queue Clearance Time (g c), s						4.5	12.1	12.2	0.5	26.0	26.0	17.5	4.3		20.3	4.1	7.9				
Green Ratio (g/C)						0.13	0.39	0.39	0.13	0.39	0.39	0.26	0.26		0.26	0.26	0.26				
Capacity (c), veh/h						220	712	685	218	705	680	346	458		349	476	404				
Volume-to-Capacity Ratio (X)						0.404	0.445	0.447	0.051	0.794	0.795	0.545	0.218		0.636	0.210	0.385				
Back of Queue (Q), ft/ln (95 th percentile)						88	223.8	211.3	10.4	445.3	420	185.6	78.4		224.3	80.7	128.3				
Back of Queue (Q), veh/ln (95 th percentile)						3.4	8.7	8.5	0.4	17.3	16.8	7.2	3.1		8.7	3.1	5.1				
Queue Storage Ratio (RQ) (95 th percentile)						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00				
Uniform Delay (d 1), s/veh						38.2	21.4	21.4	36.5	25.6	25.6	34.1	27.4		35.3	27.3	28.7				
Incremental Delay (d 2), s/veh						0.4	0.2	0.2	0.0	5.8	6.0	1.0	0.1		2.9	0.1	0.2				
Initial Queue Delay (d 3), s/veh						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0				
Control Delay (d), s/veh						38.7	21.6	21.6	36.5	31.4	31.6	35.2	27.4		38.2	27.4	28.9				
Level of Service (LOS)						D	C	C	D	C	C	D	C		D	C	C				
Approach Delay, s/veh / LOS						23.7		C		31.6		C		32.5		C		32.9		C	
Intersection Delay, s/veh / LOS						29.8						C									
Multimodal Results						EB			WB			NB			SB						
Pedestrian LOS Score / LOS						2.3		B		2.4		B		2.8		C		2.8		C	
Bicycle LOS Score / LOS						1.1		A		1.4		A		1.0		A		1.3		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	SR 32 @ 8 Mile Rd
Agency/Co.		Jurisdiction	Union Township
Date Performed	7/12/2016	East/West Street	SR 32
Analysis Year	2022	North/South Street	8 Mile Road
Time Analyzed	AM PEAK HOUR	Peak Hour Factor	1.00
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 3		

Lanes



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	1	1	0	1	1	0		1	0	1		0	0	0
Configuration			T	R		L	T			L		R				
Volume (veh/h)			440	40		250	1070			130		190				
Percent Heavy Vehicles						3				2		2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						250				130		190				
Capacity						1076				122		617				
v/c Ratio						0.23				1.07		0.31				
95% Queue Length						0.9				7.5		1.3				
Control Delay (s/veh)						9.4				170.1		13.4				
Level of Service (LOS)						A				F		B				
Approach Delay (s/veh)					1.8				77.1							
Approach LOS									F							

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information				
Agency					Duration, h		0.25		
Analyst		MJH	Analysis Date	Oct 19, 2016		Area Type		Other	
Jurisdiction		Anderson Twp (ODOT)	Time Period				PHF		0.90
Urban Street		SR 32	Analysis Year		2022	Analysis Period		1> 7:00	
Intersection		SR 32 at Little Dry Run...	File Name		04-2022-AM.xus				
Project Description		2022 NO-BUILD - AM Peak Hour							

Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					490	40	20	1240		200		20			

Signal Information														
Cycle, s	140.0	Reference Phase	2	Green	6.0	91.0	28.0	0.0	0.0	0.0				
Offset, s	0	Reference Point	End	Yellow	4.0	4.0	4.0	0.0	0.0	0.0				
Uncoordinated	Yes	Simult. Gap E/W	On	Red	1.0	1.0	1.0	0.0	0.0	0.0				
Force Mode	Fixed	Simult. Gap N/S	On											

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			2	1	6		8		
Case Number			8.3	1.0	4.0		9.0		
Phase Duration, s			96.0	11.0	107.0		33.0		
Change Period, (Y+R c), s			5.0	5.0	5.0		5.0		
Max Allow Headway (MAH), s			3.0	3.1	3.0		3.1		
Queue Clearance Time (g s), s			26.1	2.5	104.0		18.4		
Green Extension Time (g e), s			7.2	0.0	0.0		0.3		
Phase Call Probability			1.00	1.00	1.00		1.00		
Max Out Probability			0.00	0.49	1.00		0.00		

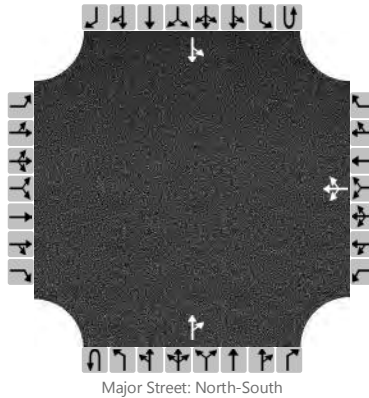
Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement			2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h			589		22	1378		222		22			
Adjusted Saturation Flow Rate (s), veh/h/ln			1785		1723	1810		1740		1548			
Queue Service Time (g s), s			24.1		0.5	102.0		16.4		1.6			
Cycle Queue Clearance Time (g c), s			24.1		0.5	102.0		16.4		1.6			
Green Ratio (g/C)			0.65		0.71	0.73		0.20		0.20			
Capacity (c), veh/h			1160		508	1318		348		310			
Volume-to-Capacity Ratio (X)			0.507		0.044	1.045		0.639		0.072			
Back of Queue (Q), ft/ln (95 th percentile)			356.7		8.4	1669.7		297.2		28.5			
Back of Queue (Q), veh/ln (95 th percentile)			14.3		0.3	64.2		11.9		1.1			
Queue Storage Ratio (RQ) (95 th percentile)			0.00		0.00	0.00		0.00		0.00			
Uniform Delay (d 1), s/veh			12.8		8.6	19.0		51.4		45.5			
Incremental Delay (d 2), s/veh			0.2		0.0	37.4		3.0		0.0			
Initial Queue Delay (d 3), s/veh			0.0		0.0	0.0		0.0		0.0			
Control Delay (d), s/veh			12.9		8.6	56.4		54.4		45.5			
Level of Service (LOS)			B		A	F		D		D			
Approach Delay, s/veh / LOS		12.9	B		55.7	E		53.6	D		0.0		
Intersection Delay, s/veh / LOS		44.2						D					

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.2	B	0.7	A	2.3	B	2.2	B
Bicycle LOS Score / LOS		1.5	A	2.8	C		F		

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	Broadwell Rd at Round Btm
Agency/Co.		Jurisdiction	Newtown
Date Performed	7/12/2016	East/West Street	Broadwell Road
Analysis Year	2022	North/South Street	Round Bottom Road
Time Analyzed	AM PEAK HOUR - NO-BUILD	Peak Hour Factor	0.90
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Intersection 9		

Lanes



Vehicle Volumes and Adjustments

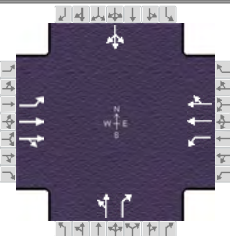
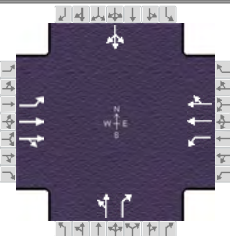
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LTR					TR		LT		
Volume (veh/h)						90	0	10			110	20		20	390	
Percent Heavy Vehicles						0	17	0						15		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

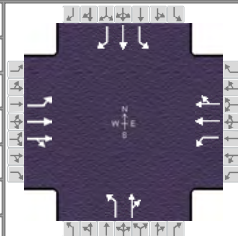
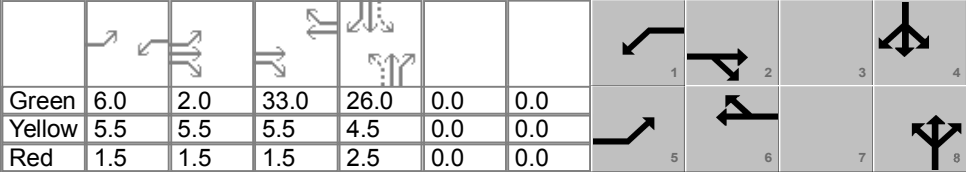
Flow Rate (veh/h)						111								455		
Capacity						478								1360		
v/c Ratio						0.23								0.33		
95% Queue Length						0.9								0.0		
Control Delay (s/veh)						14.8								7.7		
Level of Service (LOS)						B								A		
Approach Delay (s/veh)					14.8								0.5			
Approach LOS					B											

PM

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Union Township (ODOT)		Time Period				PHF		0.90									
Urban Street		SR 32		Analysis Year		2022		Analysis Period		1> 7:00									
Intersection		SR 32 at Bells Lane		File Name		01-2022-PM.xus													
Project Description		2022 NO-BUILD - PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				40	880	120	460	750	110	150	80	150	50	40	10				
Signal Information																			
Cycle, s	85.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	6.0	13.5	27.7	13.3	0.0	0.0									
				Yellow	3.0	3.0	5.0	3.0	0.0	0.0									
				Red	2.5	2.5	2.0	3.5	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8				4	
Case Number				2.0		4.0		2.0		4.0				7.0				8.0	
Phase Duration, s				11.5		34.7		30.5		53.7				19.8				19.8	
Change Period, (Y+R c), s				5.5		7.0		5.5		7.0				6.5				6.5	
Max Allow Headway (MAH), s				3.1		3.1		3.1		3.1				3.2				3.2	
Queue Clearance Time (g s), s				4.0		27.1		25.6		15.6				15.3				7.2	
Green Extension Time (g e), s				0.0		0.4		0.0		4.0				0.0				0.7	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00				1.00	
Max Out Probability				1.00		1.00		1.00		0.30				1.00				0.20	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				44	567	544	511	489	467		256	167		111					
Adjusted Saturation Flow Rate (s), veh/h/ln				1774	1863	1784	1810	1863	1779		1487	1579		1567					
Queue Service Time (g s), s				2.0	25.1	25.1	23.6	13.6	13.6		8.1	8.5		0.0					
Cycle Queue Clearance Time (g c), s				2.0	25.1	25.1	23.6	13.6	13.6		13.3	8.5		5.2					
Green Ratio (g/C)				0.07	0.33	0.33	0.29	0.55	0.55		0.16	0.16		0.16					
Capacity (c), veh/h				125	607	581	532	1023	977		303	247		309					
Volume-to-Capacity Ratio (X)				0.355	0.935	0.935	0.960	0.478	0.478		0.844	0.675		0.360					
Back of Queue (Q), ft/ln (95 th percentile)				40.2	514.3	492.3	509.4	221.3	210.1		278.6	158.9		92.6					
Back of Queue (Q), veh/ln (95 th percentile)				1.6	20.2	19.7	20.1	8.7	8.4		11.0	6.4		3.6					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00					
Uniform Delay (d 1), s/veh				37.7	27.8	27.8	29.5	11.7	11.7		36.4	33.8		32.3					
Incremental Delay (d 2), s/veh				0.6	21.5	22.3	29.0	0.1	0.1		18.3	5.8		0.3					
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0					
Control Delay (d), s/veh				38.3	49.3	50.1	58.5	11.8	11.8		54.7	39.7		32.6					
Level of Service (LOS)				D	D	D	E	B	B		D	D		C					
Approach Delay, s/veh / LOS				49.3	D		28.1	C		48.8	D		32.6	C					
Intersection Delay, s/veh / LOS				38.8						D									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3	B		2.1	B		2.8	C		2.8	C					
Bicycle LOS Score / LOS				1.4	A		1.7	A		1.2	A		0.7	A					

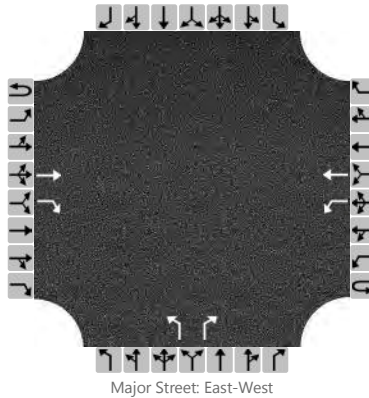
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Union Township (ODOT)		Time Period				PHF		0.90									
Urban Street		SR 32		Analysis Year		2022		Analysis Period		1> 7:00									
Intersection		SR 32 at Beechwood Rd		File Name		02-2022-PM.xus													
Project Description		2022 NO-BUILD - PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				200	820	170	40	650	220	80	90	20	200	140	40				
Signal Information																			
Cycle, s	95.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	6.0	2.0	33.0	26.0	0.0	0.0									
				Yellow	5.5	5.5	5.5	4.5	0.0	0.0									
				Red	1.5	1.5	1.5	2.5	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8				4	
Case Number				2.0		4.0		2.0		4.0				6.0				5.0	
Phase Duration, s				22.0		49.0		13.0		40.0				33.0				33.0	
Change Period, (Y+R c), s				7.0		7.0		7.0		7.0				7.0				7.0	
Max Allow Headway (MAH), s				3.1		3.1		3.1		3.1				3.2				3.2	
Queue Clearance Time (g s), s				13.2		24.6		4.3		24.5				14.0				22.5	
Green Extension Time (g e), s				0.1		3.5		0.0		3.5				1.1				0.6	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00				1.00	
Max Out Probability				1.00		0.50		1.00		0.49				0.01				0.87	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				222	567	533	44	505	461	89	122		222	156	44				
Adjusted Saturation Flow Rate (s), veh/h/ln				1810	1900	1786	1792	1900	1735	1251	1840		1276	1881	1594				
Queue Service Time (g s), s				11.2	22.5	22.6	2.3	22.5	22.5	5.8	4.9		15.6	6.2	2.0				
Cycle Queue Clearance Time (g c), s				11.2	22.5	22.6	2.3	22.5	22.5	12.0	4.9		20.5	6.2	2.0				
Green Ratio (g/C)				0.16	0.44	0.44	0.06	0.35	0.35	0.27	0.27		0.27	0.27	0.27				
Capacity (c), veh/h				286	840	790	113	660	603	336	504		359	515	436				
Volume-to-Capacity Ratio (X)				0.778	0.675	0.675	0.393	0.766	0.766	0.264	0.243		0.619	0.302	0.102				
Back of Queue (Q), ft/ln (95 th percentile)				242.6	373.6	356.2	45.4	398.6	371.9	77.3	95.1		214.3	123.3	33.2				
Back of Queue (Q), veh/ln (95 th percentile)				9.7	14.9	14.2	1.8	15.9	14.9	3.1	3.8		8.6	4.9	1.3				
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00				
Uniform Delay (d 1), s/veh				38.4	21.1	21.1	42.7	27.6	27.6	32.1	26.8		34.8	27.3	25.8				
Incremental Delay (d 2), s/veh				11.7	1.8	1.9	0.8	4.8	5.3	0.2	0.1		2.4	0.1	0.0				
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0				
Control Delay (d), s/veh				50.1	22.8	23.0	43.6	32.4	32.8	32.2	26.9		37.2	27.4	25.8				
Level of Service (LOS)				D	C	C	D	C	C	C	C		D	C	C				
Approach Delay, s/veh / LOS				27.5		C		33.1		C		29.2		C		32.4		C	
Intersection Delay, s/veh / LOS				30.2						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.4		B		2.8		C		2.8		C	
Bicycle LOS Score / LOS				1.6		A		1.3		A		0.8		A		1.2		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	SR 32 @ 8 Mile Rd
Agency/Co.		Jurisdiction	Union Township
Date Performed	7/12/2016	East/West Street	SR 32
Analysis Year	2022	North/South Street	8 Mile Road
Time Analyzed	NO-BUILD - PM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 3		

Lanes



Vehicle Volumes and Adjustments

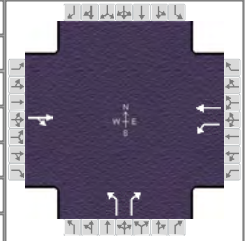
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	1	0	1	1	0		1	0	1		0	0	0
Configuration			T	R		L	T			L		R				
Volume (veh/h)			960	140		370	580			40		280				
Percent Heavy Vehicles						3				2		2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						411				44		311				
Capacity						566				26		270				
v/c Ratio						0.73				1.72		1.15				
95% Queue Length						6.1				5.4		13.7				
Control Delay (s/veh)						26.4				677.9		142.8				
Level of Service (LOS)						D				F		F				
Approach Delay (s/veh)					10.3				209.1							
Approach LOS									F							

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Anderson Twp (ODOT)	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	SR 32 at Little Dry Run...	File Name	04-2022-PM.xus		
Project Description	2022 NO-BUILD - PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		1090	170	50	610		120		40			

Signal Information											
Cycle, s	105.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	6.0	74.7	9.3	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
				Red	1.0	1.0	1.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		8.3	1.0	4.0		9.0		
Phase Duration, s		79.7	11.0	90.7		14.3		
Change Period, ($Y+R_c$), s		5.0	5.0	5.0		5.0		
Max Allow Headway (MAH), s		3.1	3.1	3.1		3.2		
Queue Clearance Time (g_s), s		76.7	2.7	13.2		9.6		
Green Extension Time (g_e), s		0.0	0.0	8.3		0.0		
Phase Call Probability		1.00	1.00	1.00		1.00		
Max Out Probability		1.00	0.78	0.01		1.00		

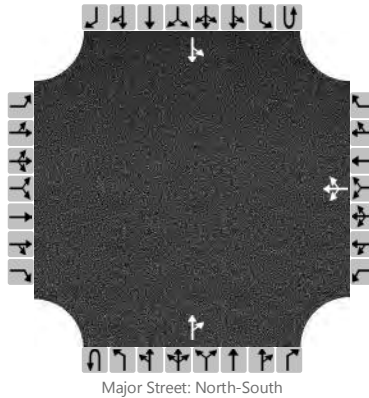
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		1400		56	678		133		44			
Adjusted Saturation Flow Rate (s), veh/h/ln		1801		1757	1845		1810		1579			
Queue Service Time (g_s), s		74.7		0.7	11.2		7.6		2.8			
Cycle Queue Clearance Time (g_c), s		74.7		0.7	11.2		7.6		2.8			
Green Ratio (g/C)		0.71		0.79	0.82		0.09		0.09			
Capacity (c), veh/h		1281		169	1506		160		140			
Volume-to-Capacity Ratio (X)		1.093		0.329	0.450		0.832		0.318			
Back of Queue (Q), ft/ln (95 th percentile)		1454.7		46.4	113.4		203.9		49.1			
Back of Queue (Q), veh/ln (95 th percentile)		58.2		1.9	4.4		8.2		2.0			
Queue Storage Ratio (RQ) (95 th percentile)		0.00		0.00	0.00		0.00		0.00			
Uniform Delay (d_1), s/veh		15.2		30.5	2.8		47.1		44.9			
Incremental Delay (d_2), s/veh		54.4		0.4	0.1		28.0		0.5			
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		69.6		30.9	2.9		75.1		45.4			
Level of Service (LOS)		F		C	A		E		D			
Approach Delay, s/veh / LOS	69.6	E		5.0	A		67.7	E		0.0		
Intersection Delay, s/veh / LOS	48.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	0.6	A	2.3	B	2.2	B
Bicycle LOS Score / LOS	2.8	C	1.7	A		F		

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	Broadwell @ Round Btm
Agency/Co.		Jurisdiction	Newtown
Date Performed	7/12/2016	East/West Street	Broadwell Road
Analysis Year	2022	North/South Street	Round Bottom Road
Time Analyzed	NO-BUILD PM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Intersection 9		

Lanes



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	1	0	0	0	1	0	0	0	1	0
Configuration							LTR					TR		LT		
Volume (veh/h)						50	0	30			360	80		20	150	
Percent Heavy Vehicles						18	0	18						7		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

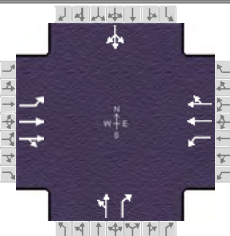
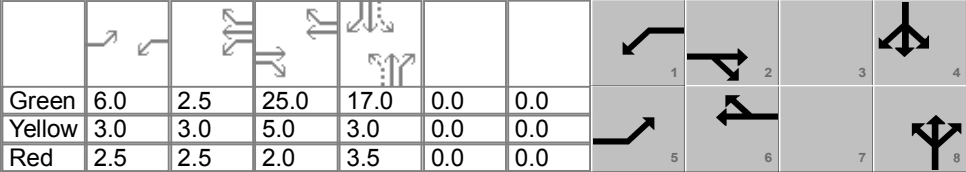
Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						89								189		
Capacity						446								1030		
v/c Ratio						0.20								0.18		
95% Queue Length						0.7								0.1		
Control Delay (s/veh)						15.1								8.6		
Level of Service (LOS)						C								A		
Approach Delay (s/veh)					15.1								1.2			
Approach LOS					C											

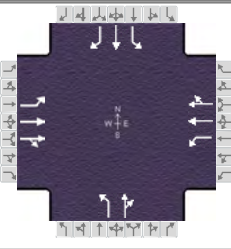
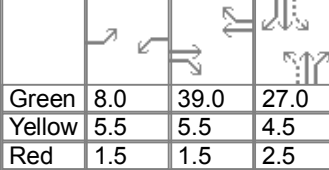
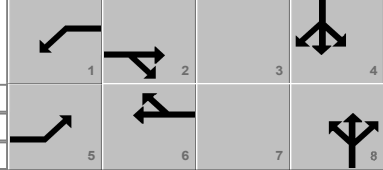
2042

AM

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Union Township (ODOT)		Time Period				PHF		0.90									
Urban Street		SR 32		Analysis Year		2042		Analysis Period		1> 7:00									
Intersection		SR 32 at Bells Lane		File Name		01-2042-AM.xus													
Project Description		2042 NO-BUILD - AM Peak Hour																	
Demand Information																			
Approach Movement				EB			WB			NB			SB						
				L	T	R	L	T	R	L	T	R	L	T	R				
				10	700	80	250	950	30	120	20	100	90	40	30				
Signal Information																			
Cycle, s	75.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	6.0	2.5	25.0	17.0	0.0	0.0									
				Yellow	3.0	3.0	5.0	3.0	0.0	0.0									
				Red	2.5	2.5	2.0	3.5	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8				4	
Case Number				2.0		4.0		2.0		4.0				7.0				8.0	
Phase Duration, s				11.5		32.0		19.5		40.0				23.5				23.5	
Change Period, (Y+R c), s				5.5		7.0		5.5		7.0				6.5				6.5	
Max Allow Headway (MAH), s				3.1		3.0		3.1		3.0				3.2				3.2	
Queue Clearance Time (g s), s				2.4		17.9		13.7		20.2				9.8				9.4	
Green Extension Time (g e), s				0.0		2.9		0.0		2.3				0.6				0.6	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00				1.00	
Max Out Probability				0.35		0.54		1.00		0.77				0.08				0.06	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				11	441	425	278	547	541		156	111		178					
Adjusted Saturation Flow Rate (s), veh/h/ln				1740	1827	1761	1723	1810	1790		1313	1505		1514					
Queue Service Time (g s), s				0.4	15.9	15.9	11.7	18.2	18.2		0.3	4.6		0.0					
Cycle Queue Clearance Time (g c), s				0.4	15.9	15.9	11.7	18.2	18.2		7.8	4.6		7.4					
Green Ratio (g/C)				0.08	0.33	0.33	0.19	0.44	0.44		0.23	0.23		0.23					
Capacity (c), veh/h				139	609	587	322	796	787		387	341		418					
Volume-to-Capacity Ratio (X)				0.080	0.725	0.725	0.863	0.688	0.688		0.402	0.326		0.425					
Back of Queue (Q), ft/ln (95 th percentile)				8.5	288.9	272.6	270.9	299.2	287.6		107.6	71		122.2					
Back of Queue (Q), veh/ln (95 th percentile)				0.3	11.2	10.9	10.5	11.6	11.5		4.2	2.8		4.7					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00					
Uniform Delay (d 1), s/veh				31.9	22.0	22.0	29.6	16.9	16.9		25.4	24.2		25.2					
Incremental Delay (d 2), s/veh				0.1	3.7	3.9	20.0	2.1	2.1		0.3	0.2		0.3					
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0					
Control Delay (d), s/veh				32.0	25.7	25.8	49.6	18.9	19.0		25.6	24.4		25.5					
Level of Service (LOS)				C	C	C	D	B	B		C	C		C					
Approach Delay, s/veh / LOS				25.8		C		25.2		C		25.1		C		25.5		C	
Intersection Delay, s/veh / LOS				25.4						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.1		B		2.8		C		2.8		C	
Bicycle LOS Score / LOS				1.2		A		1.6		A		0.9		A		0.8		A	

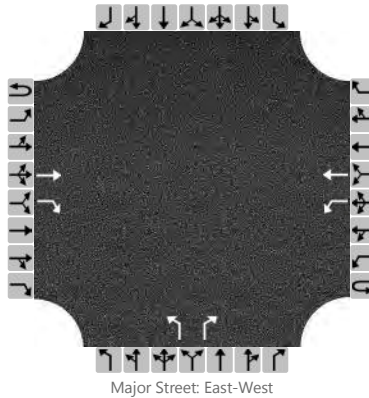
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Union Township (ODOT)		Time Period				PHF		0.90									
Urban Street		SR 32		Analysis Year		2042		Analysis Period		1> 7:00									
Intersection		SR 32 at Beechwood Rd		File Name		02-2042-AM.xus													
Project Description		2042 NO-BUILD - AM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				80	550	60	10	980	110	170	80	10	230	90	150				
Signal Information																			
Cycle, s	95.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	8.0	39.0	27.0	0.0	0.0	0.0									
				Yellow	5.5	5.5	4.5	0.0	0.0	0.0									
				Red	1.5	1.5	2.5	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8				4	
Case Number				2.0		4.0		2.0		4.0				6.0				5.0	
Phase Duration, s				15.0		46.0		15.0		46.0				34.0				34.0	
Change Period, (Y+R c), s				7.0		7.0		7.0		7.0				7.0				7.0	
Max Allow Headway (MAH), s				3.1		3.1		3.1		3.1				3.3				3.3	
Queue Clearance Time (g s), s				6.7		15.1		2.6		31.0				19.0				24.6	
Green Extension Time (g e), s				0.0		4.2		0.0		3.0				1.3				0.6	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00				1.00	
Max Out Probability				1.00		0.04		0.00		0.46				0.17				1.00	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				89	344	333	11	616	595	189	100		256	100	167				
Adjusted Saturation Flow Rate (s), veh/h/ln				1740	1827	1763	1723	1810	1745	1229	1741		1253	1810	1533				
Queue Service Time (g s), s				4.7	13.0	13.1	0.6	28.9	29.0	13.1	4.1		18.5	4.0	8.3				
Cycle Queue Clearance Time (g c), s				4.7	13.0	13.1	0.6	28.9	29.0	17.0	4.1		22.6	4.0	8.3				
Green Ratio (g/C)				0.08	0.41	0.41	0.08	0.41	0.41	0.28	0.28		0.28	0.28	0.28				
Capacity (c), veh/h				147	750	724	145	743	716	374	495		377	514	436				
Volume-to-Capacity Ratio (X)				0.607	0.459	0.461	0.077	0.829	0.831	0.505	0.202		0.678	0.194	0.382				
Back of Queue (Q), ft/ln (95 th percentile)				101.1	234.6	221.7	11.1	492.2	465.5	177.1	75.7		253.4	78	133.8				
Back of Queue (Q), veh/ln (95 th percentile)				3.9	9.1	8.9	0.4	19.1	18.6	6.9	3.0		9.8	3.0	5.4				
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00				
Uniform Delay (d 1), s/veh				42.0	20.3	20.4	40.1	25.0	25.0	32.2	25.8		34.4	25.8	27.3				
Incremental Delay (d 2), s/veh				5.1	0.2	0.2	0.1	7.4	7.7	0.4	0.1		4.0	0.1	0.2				
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0				
Control Delay (d), s/veh				47.1	20.5	20.5	40.2	32.4	32.8	32.7	25.9		38.4	25.8	27.5				
Level of Service (LOS)				D	C	C	D	C	C	C	C		D	C	C				
Approach Delay, s/veh / LOS				23.6		C		32.6		C		30.3		C		32.5		C	
Intersection Delay, s/veh / LOS				29.9						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.4		B		2.8		C		2.8		C	
Bicycle LOS Score / LOS				1.1		A		1.5		A		1.0		A		1.3		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	SR 32 @ 8 Mile Rd
Agency/Co.		Jurisdiction	Union Township
Date Performed	7/14/2016	East/West Street	SR 32
Analysis Year	2042	North/South Street	8 Mile Road
Time Analyzed	AM PEAK HOUR	Peak Hour Factor	1.00
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 3		

Lanes



Vehicle Volumes and Adjustments

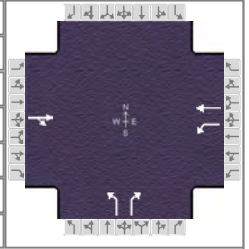
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	1	0	1	1	0		1	0	1		0	0	0
Configuration			T	R		L	T			L		R				
Volume (veh/h)			470	50		270	1150			140		210				
Percent Heavy Vehicles						3				2		2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						270					140		210			
Capacity						1040					101		593			
v/c Ratio						0.26					1.39		0.35			
95% Queue Length						1.0					10.1		1.6			
Control Delay (s/veh)						9.7					300.4		14.4			
Level of Service (LOS)						A					F		B			
Approach Delay (s/veh)					1.8				128.8							
Approach LOS									F							

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Anderson Twp (ODOT)	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2042	Analysis Period	1> 7:00
Intersection	SR 32 at Little Dry Run...	File Name	04-2042-AM.xus		
Project Description	2042 NO-BUILD - AM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		510	40	20	1290		200		20			

Signal Information											
Cycle, s	140.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	6.0	94.0	25.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
				Red	1.0	1.0	1.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		8.3	1.0	4.0		9.0		
Phase Duration, s		99.0	11.0	110.0		30.0		
Change Period, ($Y+R_c$), s		5.0	5.0	5.0		5.0		
Max Allow Headway (MAH), s		3.0	3.1	3.0		3.1		
Queue Clearance Time (g_s), s		25.9	2.5	107.0		18.8		
Green Extension Time (g_e), s		8.2	0.0	0.0		0.2		
Phase Call Probability		1.00	1.00	1.00		1.00		
Max Out Probability		0.00	0.45	1.00		0.07		

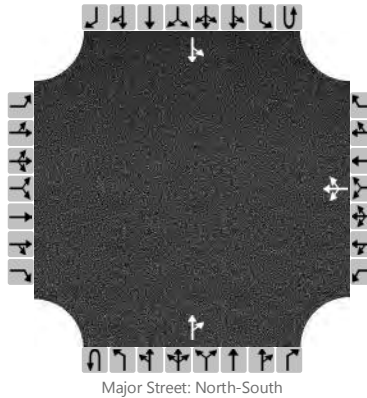
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		611		22	1433		222		22			
Adjusted Saturation Flow Rate (s), veh/h/ln		1786		1723	1810		1740		1548			
Queue Service Time (g_s), s		23.9		0.5	105.0		16.8		1.7			
Cycle Queue Clearance Time (g_c), s		23.9		0.5	105.0		16.8		1.7			
Green Ratio (g/C)		0.67		0.73	0.75		0.18		0.18			
Capacity (c), veh/h		1199		518	1357		311		276			
Volume-to-Capacity Ratio (X)		0.510		0.043	1.056		0.715		0.080			
Back of Queue (Q), ft/ln (95 th percentile)		348.4		7.6	1728.1		313		29.4			
Back of Queue (Q), veh/ln (95 th percentile)		13.9		0.3	66.5		12.5		1.2			
Queue Storage Ratio (RQ) (95 th percentile)		0.00		0.00	0.00		0.00		0.00			
Uniform Delay (d_1), s/veh		11.5		7.7	17.5		54.1		47.9			
Incremental Delay (d_2), s/veh		0.2		0.0	40.7		6.6		0.0			
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		11.6		7.7	58.2		60.7		48.0			
Level of Service (LOS)		B		A	F		E		D			
Approach Delay, s/veh / LOS	11.6	B		57.5	E		59.6	E		0.0		
Intersection Delay, s/veh / LOS	45.6						D					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2	B		0.7	A		2.3	B		2.2	B	
Bicycle LOS Score / LOS	1.5	A		2.9	C			F				

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	Broadwell Rd at Round Btm
Agency/Co.		Jurisdiction	Newtown
Date Performed	7/14/2016	East/West Street	Broadwell Road
Analysis Year	2042	North/South Street	Round Bottom Road
Time Analyzed	AM PEAK HOUR - NO-BUILD	Peak Hour Factor	0.90
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Intersection 9		

Lanes



Vehicle Volumes and Adjustments

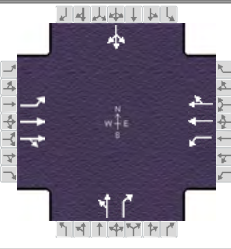
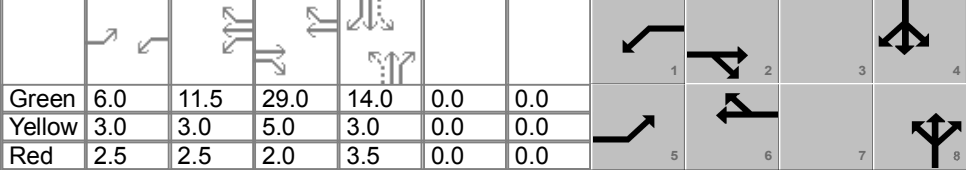
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LTR					TR		LT		
Volume (veh/h)						90	0	10			120	20		20	400	
Percent Heavy Vehicles						0	17	0						15		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						111								466		
Capacity						464								1347		
v/c Ratio						0.24								0.35		
95% Queue Length						0.9								0.0		
Control Delay (s/veh)						15.2								7.7		
Level of Service (LOS)						C								A		
Approach Delay (s/veh)					15.2								0.5			
Approach LOS					C											

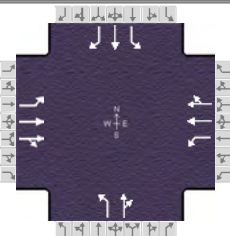
PM

HCS 2010 Signalized Intersection Results Summary

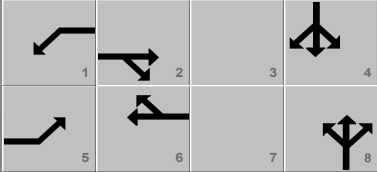
General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Union Township (ODOT)		Time Period				PHF		0.90									
Urban Street		SR 32		Analysis Year		2042		Analysis Period		1> 7:00									
Intersection		SR 32 at Bells Lane		File Name		01-2042-PM.xus													
Project Description		2042 NO-BUILD - PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				40	940	150	540	800	110	190	80	190	50	50	10				
Signal Information																			
Cycle, s	85.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	6.0	11.5	29.0	14.0	0.0	0.0									
				Yellow	3.0	3.0	5.0	3.0	0.0	0.0									
				Red	2.5	2.5	2.0	3.5	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8				4	
Case Number				2.0		4.0		2.0		4.0				7.0				8.0	
Phase Duration, s				11.5		36.0		28.5		53.0				20.5				20.5	
Change Period, (Y+R c), s				5.5		7.0		5.5		7.0				6.5				6.5	
Max Allow Headway (MAH), s				3.1		3.1		3.1		3.1				3.2				3.2	
Queue Clearance Time (g s), s				4.0		30.0		25.0		17.0				16.0				7.5	
Green Extension Time (g e), s				0.0		0.0		0.0		4.4				0.0				0.9	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00				1.00	
Max Out Probability				1.00		1.00		1.00		0.35				1.00				0.20	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				44	620	591	600	517	495		300	211		122					
Adjusted Saturation Flow Rate (s), veh/h/ln				1774	1863	1773	1810	1863	1783		1452	1579		1621					
Queue Service Time (g s), s				2.0	27.9	28.0	23.0	15.0	15.0		8.5	11.0		0.0					
Cycle Queue Clearance Time (g c), s				2.0	27.9	28.0	23.0	15.0	15.0		14.0	11.0		5.5					
Green Ratio (g/C)				0.07	0.34	0.34	0.27	0.54	0.54		0.16	0.16		0.16					
Capacity (c), veh/h				125	636	605	490	1008	965		311	260		329					
Volume-to-Capacity Ratio (X)				0.355	0.975	0.978	1.225	0.512	0.512		0.963	0.812		0.372					
Back of Queue (Q), ft/ln (95 th percentile)				40.2	594.9	570.5	964.2	240.6	228.8		375.2	224.5		100.9					
Back of Queue (Q), veh/ln (95 th percentile)				1.6	23.4	22.8	38.0	9.5	9.2		14.8	9.0		4.0					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00					
Uniform Delay (d 1), s/veh				37.7	27.6	27.7	31.0	12.4	12.4		36.9	34.2		31.9					
Incremental Delay (d 2), s/veh				0.6	29.3	30.8	118.5	0.2	0.2		40.8	16.4		0.3					
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0					
Control Delay (d), s/veh				38.3	56.9	58.5	149.5	12.6	12.6		77.7	50.6		32.1					
Level of Service (LOS)				D	E	E	F	B	B		E	D		C					
Approach Delay, s/veh / LOS				57.0		E		63.6		E		66.5		E		32.1		C	
Intersection Delay, s/veh / LOS				60.6						E									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.1		B		2.8		C		2.8		C	
Bicycle LOS Score / LOS				1.5		A		1.8		A		1.3		A		0.7		A	

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other			
Jurisdiction		Union Township (ODOT)		Time Period				PHF		0.90			
Urban Street		SR 32		Analysis Year		2042		Analysis Period		1> 7:00			
Intersection		SR 32 at Beechwood Rd		File Name		02-2042-PM.xus							
Project Description		2042 NO-BUILD - PM Peak Hour											



Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				200	890	170	40	710	250	80	90	20	220	140	40

Signal Information														
Cycle, s	95.0	Reference Phase	2	Green	6.0	0.0	35.0	26.0	0.0	0.0				
Offset, s	0	Reference Point	End	Yellow	5.5	5.5	5.5	4.5	0.0	0.0				
Uncoordinated	Yes	Simult. Gap E/W	On	Red	1.5	1.5	1.5	2.5	0.0	0.0				
Force Mode	Fixed	Simult. Gap N/S	On											

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		5	2	1	6		8		4
Case Number		2.0	4.0	2.0	4.0		6.0		5.0
Phase Duration, s		20.0	49.0	13.0	42.0		33.0		33.0
Change Period, (Y+R c), s		7.0	7.0	7.0	7.0		7.0		7.0
Max Allow Headway (MAH), s		3.1	3.1	3.1	3.1		3.2		3.2
Queue Clearance Time (g s), s		13.5	26.9	4.3	27.0		14.0		24.4
Green Extension Time (g e), s		0.0	3.7	0.0	3.7		1.2		0.3
Phase Call Probability		1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability		1.00	0.57	1.00	0.57		0.02		1.00

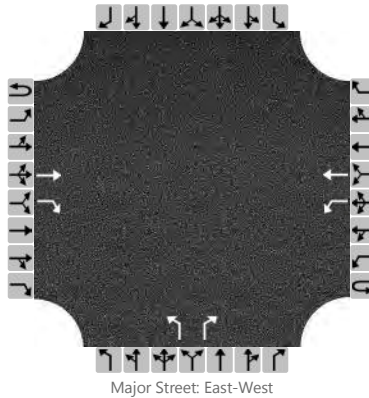
Movement Group Results		EB			WB			NB			SB			
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R	
Assigned Movement		5	2	12	1	6	16	3	8	18	7	4	14	
Adjusted Flow Rate (v), veh/h		222	605	573	44	558	509	89	122		244	156	44	
Adjusted Saturation Flow Rate (s), veh/h/ln		1810	1900	1794	1792	1900	1730	1251	1840		1276	1881	1594	
Queue Service Time (g s), s		11.5	24.8	24.9	2.3	25.0	25.0	5.8	4.9		17.5	6.2	2.0	
Cycle Queue Clearance Time (g c), s		11.5	24.8	24.9	2.3	25.0	25.0	12.0	4.9		22.4	6.2	2.0	
Green Ratio (g/C)		0.14	0.44	0.44	0.06	0.37	0.37	0.27	0.27		0.27	0.27	0.27	
Capacity (c), veh/h		248	840	793	113	700	637	336	504		359	515	436	
Volume-to-Capacity Ratio (X)		0.897	0.720	0.722	0.393	0.797	0.798	0.264	0.243		0.681	0.302	0.102	
Back of Queue (Q), ft/ln (95 th percentile)		287	408.9	392.4	45.4	437.5	408.5	77.3	95.1		240.2	123.3	33.2	
Back of Queue (Q), veh/ln (95 th percentile)		11.5	16.4	15.7	1.8	17.5	16.3	3.1	3.8		9.6	4.9	1.3	
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	
Uniform Delay (d 1), s/veh		40.3	21.7	21.7	42.7	26.8	26.8	32.1	26.8		35.6	27.3	25.8	
Incremental Delay (d 2), s/veh		30.9	2.6	2.8	0.8	6.0	6.5	0.2	0.1		4.3	0.1	0.0	
Initial Queue Delay (d 3), s/veh		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	
Control Delay (d), s/veh		71.3	24.3	24.5	43.6	32.8	33.4	32.2	26.9		39.8	27.4	25.8	
Level of Service (LOS)		E	C	C	D	C	C	C	C		D	C	C	
Approach Delay, s/veh / LOS		31.9		C	33.5		C	29.2		C	34.1		C	
Intersection Delay, s/veh / LOS		32.6							C					

Multimodal Results		EB		WB		NB		SB					
Pedestrian LOS Score / LOS		2.3		B		2.4		B		2.8		C	
Bicycle LOS Score / LOS		1.6		A		1.4		A		0.8		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	SR 32 @ 8 Mile Rd
Agency/Co.		Jurisdiction	Union Township
Date Performed	7/14/2016	East/West Street	SR 32
Analysis Year	2042	North/South Street	8 Mile Road
Time Analyzed	NO-BUILD - PM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 3		

Lanes



Vehicle Volumes and Adjustments

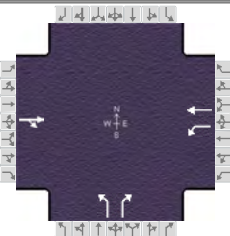
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	1	0	1	1	0		1	0	1		0	0	0
Configuration			T	R		L	T			L		R				
Volume (veh/h)			1030	150		400	620			40		310				
Percent Heavy Vehicles						3				2		2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

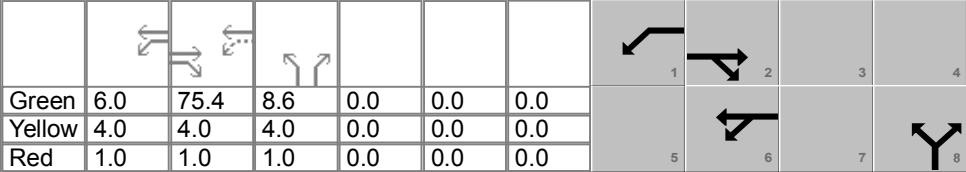
Flow Rate (veh/h)						444				44		344				
Capacity						524				12		243				
v/c Ratio						0.85				3.76		1.41				
95% Queue Length						8.8				6.6		19.3				
Control Delay (s/veh)						39.1				1885.6		247.6				
Level of Service (LOS)						E				F		F				
Approach Delay (s/veh)					15.3				433.4							
Approach LOS									F							

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information					
Agency					Duration, h		0.25			
Analyst		MJH	Analysis Date	Oct 20, 2016		Area Type		Other		
Jurisdiction		Anderson Twp (ODOT)	Time Period				PHF		0.90	
Urban Street		SR 32	Analysis Year		2042		Analysis Period		1> 7:00	
Intersection		SR 32 at Little Dry Run...	File Name		04-2042-PM.xus					
Project Description		2042 NO-BUILD - PM Peak Hour								



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					1140	170	50	630		120		40			

Signal Information				
Cycle, s	105.0	Reference Phase	2	
Offset, s	0	Reference Point	End	
Uncoordinated	Yes	Simult. Gap E/W	On	
Force Mode	Fixed	Simult. Gap N/S	On	

Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase					2	1	6		8		
Case Number					8.3	1.0	4.0		9.0		
Phase Duration, s					80.4	11.0	91.4		13.6		
Change Period, (Y+R _c), s					5.0	5.0	5.0		5.0		
Max Allow Headway (MAH), s					3.1	3.1	3.1		3.2		
Queue Clearance Time (g _s), s					77.4	2.7	13.4		9.7		
Green Extension Time (g _e), s					0.0	0.0	9.3		0.0		
Phase Call Probability					1.00	1.00	1.00		1.00		
Max Out Probability					1.00	0.76	0.01		1.00		

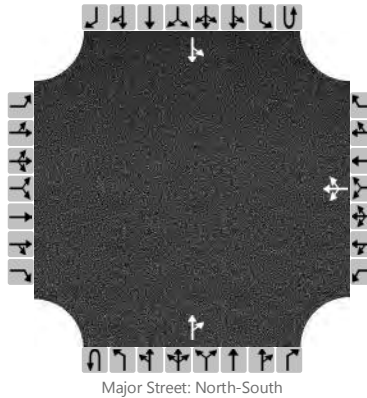
Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement					2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h					1456		56	700		133		44			
Adjusted Saturation Flow Rate (s), veh/h/ln					1803		1757	1845		1810		1579			
Queue Service Time (g _s), s					75.4		0.7	11.4		7.7		2.8			
Cycle Queue Clearance Time (g _c), s					75.4		0.7	11.4		7.7		2.8			
Green Ratio (g/C)					0.72		0.79	0.82		0.08		0.08			
Capacity (c), veh/h					1294		169	1518		148		129			
Volume-to-Capacity Ratio (X)					1.124		0.329	0.461		0.900		0.344			
Back of Queue (Q), ft/ln (95 th percentile)					1625		46.9	109.1		224.9		49.6			
Back of Queue (Q), veh/ln (95 th percentile)					65.0		1.9	4.3		9.0		2.0			
Queue Storage Ratio (RQ) (95 th percentile)					0.00		0.00	0.00		0.00		0.00			
Uniform Delay (d ₁), s/veh					14.8		30.8	2.7		47.8		45.5			
Incremental Delay (d ₂), s/veh					66.6		0.4	0.1		44.6		0.6			
Initial Queue Delay (d ₃), s/veh					0.0		0.0	0.0		0.0		0.0			
Control Delay (d), s/veh					81.4		31.2	2.7		92.4		46.1			
Level of Service (LOS)					F		C	A		F		D			
Approach Delay, s/veh / LOS				81.4	F		4.8	A		80.8	F		0.0		
Intersection Delay, s/veh / LOS				57.1					E						

Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.2	B		0.6	A		2.3	B		2.2	B	
Bicycle LOS Score / LOS				2.9	C		1.7	A			F				

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	Broadwell @ Round Btm
Agency/Co.		Jurisdiction	Newtown
Date Performed	7/14/2016	East/West Street	Broadwell Road
Analysis Year	2042	North/South Street	Round Bottom Road
Time Analyzed	NO-BUILD PM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Intersection 9		

Lanes



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	1	0	0	0	1	0	0	0	1	0
Configuration							LTR					TR		LT		
Volume (veh/h)						50	0	30			370	80		20	150	
Percent Heavy Vehicles						18	0	18						7		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						89								189		
Capacity						439								1021		
v/c Ratio						0.20								0.19		
95% Queue Length						0.7								0.1		
Control Delay (s/veh)						15.3								8.6		
Level of Service (LOS)						C								A		
Approach Delay (s/veh)					15.3								1.2			
Approach LOS					C											

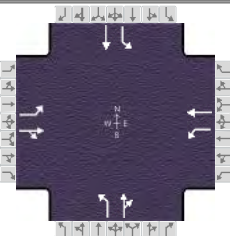
NEWTOWN VILLAGE AREA

2015

AM

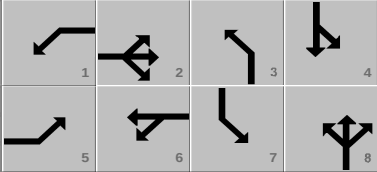
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other			
Jurisdiction		Newtown		Time Period				PHF		0.90			
Urban Street		SR 32		Analysis Year		2016		Analysis Period		1> 7:00			
Intersection		SR 32 at Round Bottom...		File Name		05-Existing-AM.xus							
Project Description		Existing AM Peak Hour											



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				70	270	40	30	660		40	30	20	200	20	

Signal Information														
Cycle, s	125.0	Reference Phase	2											
Offset, s	0	Reference Point	End											
Uncoordinated	Yes	Simult. Gap E/W	On	Green	10.0	50.0	30.0	15.0	0.0	0.0				
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	4.0	0.0	0.0				
				Red	1.0	1.0	1.0	1.0	0.0	0.0				

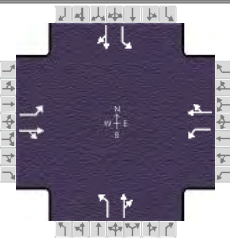
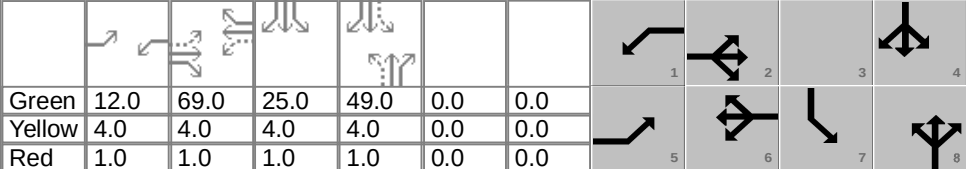
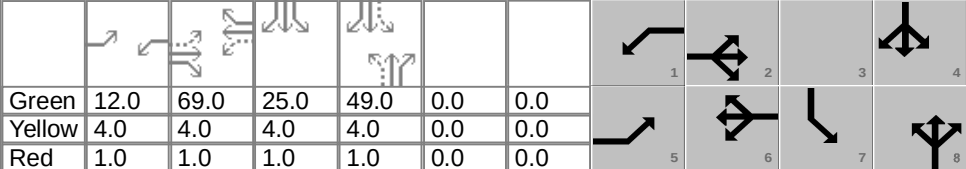
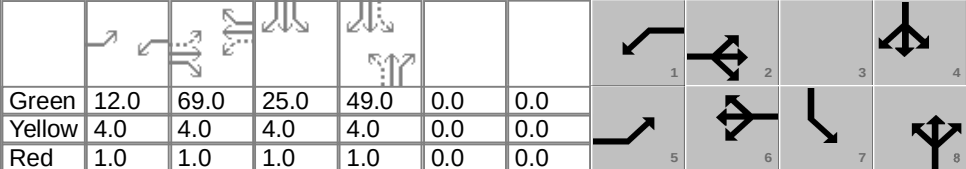
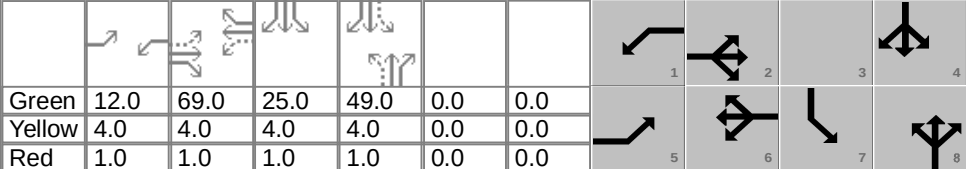
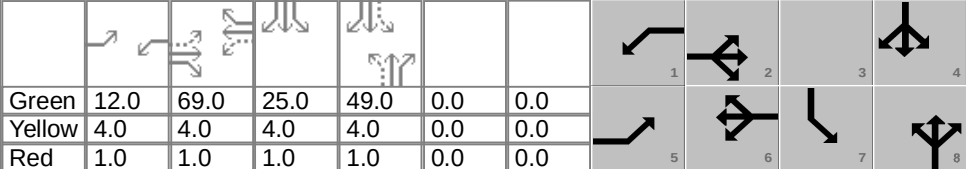
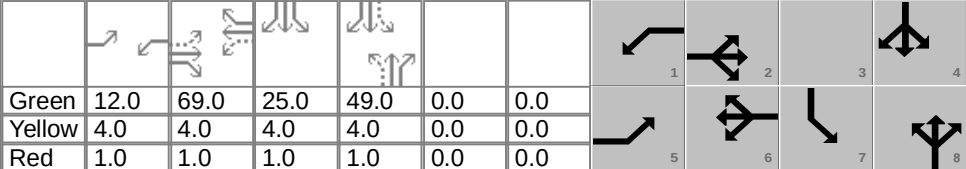
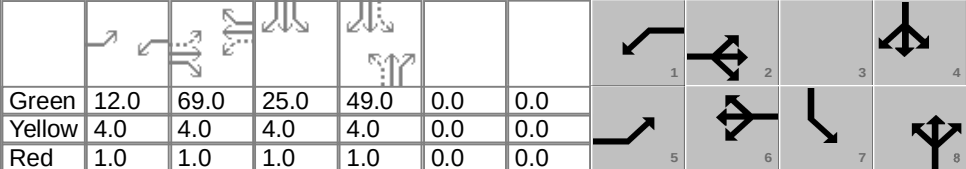
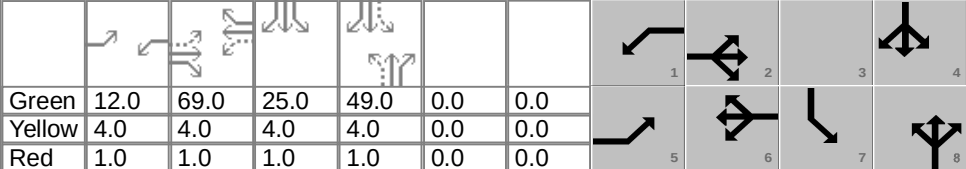
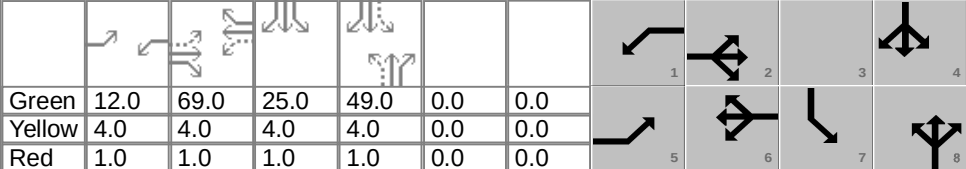
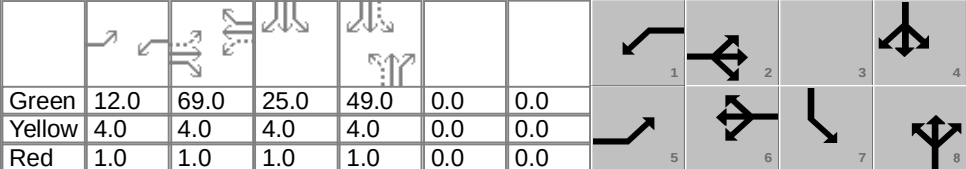
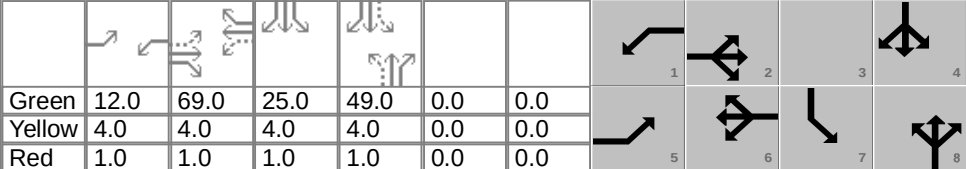


Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		5	2	1	6	3	8	7	4
Case Number		1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s		15.0	55.0	15.0	55.0	35.0	20.0	35.0	20.0
Change Period, (Y+R c), s		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Allow Headway (MAH), s		3.1	3.0	3.1	3.0	3.1	3.1	3.1	3.1
Queue Clearance Time (g s), s		5.1	20.1	3.3	52.0	4.1	5.6	13.8	3.4
Green Extension Time (g e), s		0.0	2.3	0.0	0.0	0.1	0.1	0.4	0.1
Phase Call Probability		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability		0.07	0.00	0.00	1.00	0.00	0.00	0.00	0.00

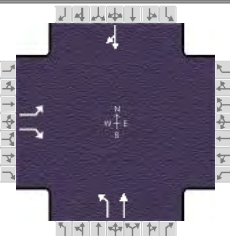
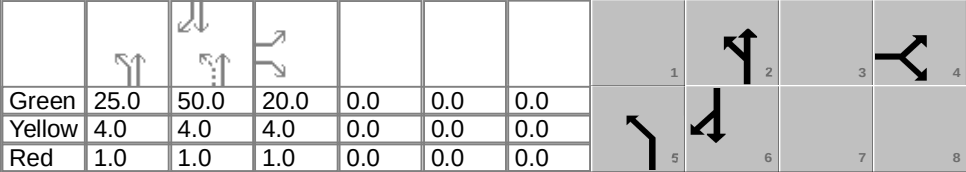
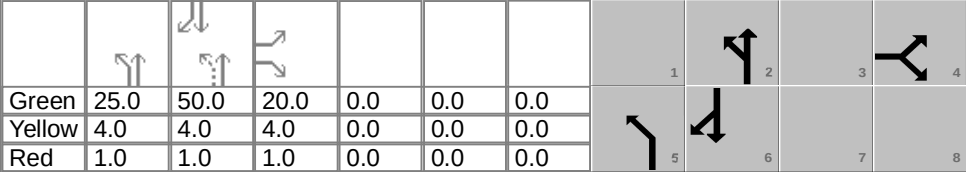
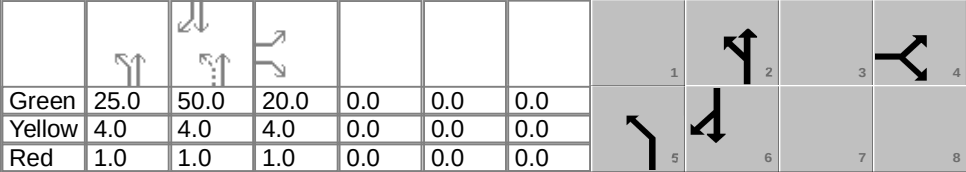
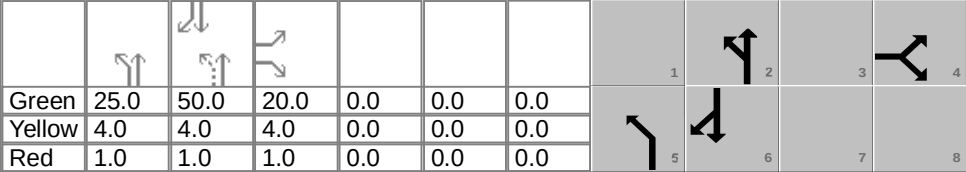
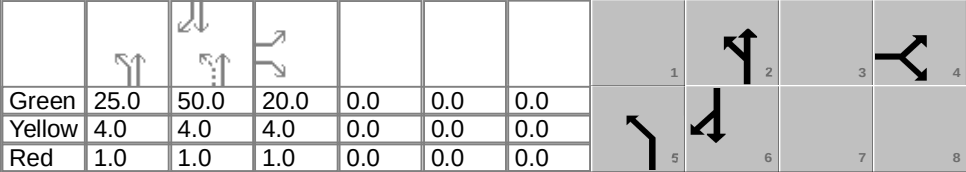
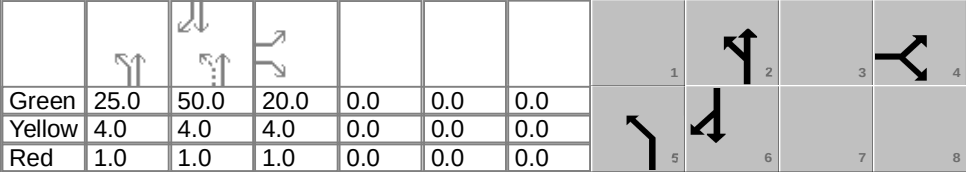
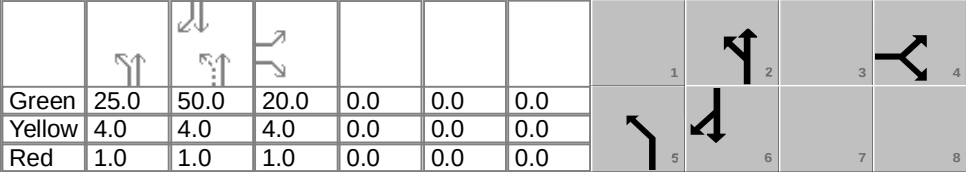
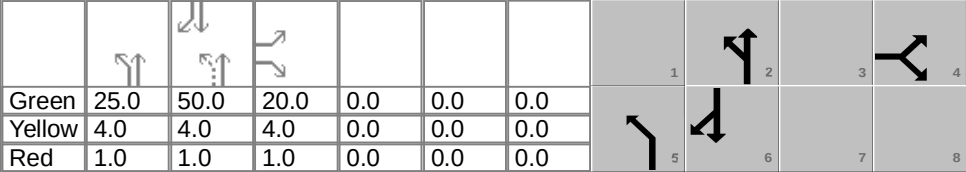
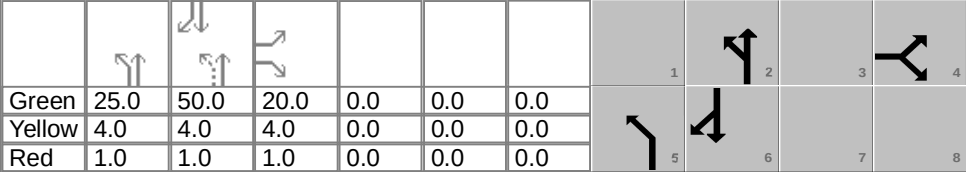
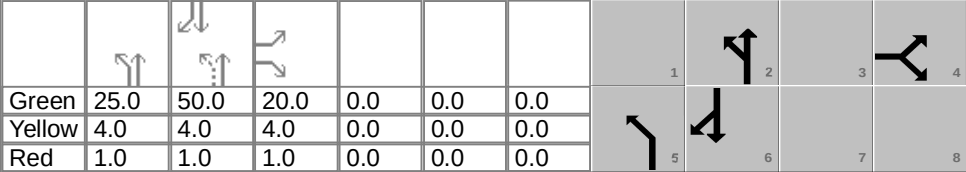
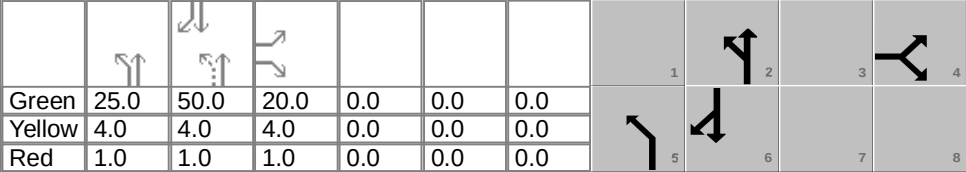
Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		5	2	12	1	6		3	8	18	7	4	
Adjusted Flow Rate (v), veh/h		78	344		33	733		44	56		222	22	
Adjusted Saturation Flow Rate (s), veh/h/ln		1723	1768		1740	1827		1774	1738		1723	1810	
Queue Service Time (g s), s		3.1	18.1		1.3	50.0		2.1	3.6		11.8	1.4	
Cycle Queue Clearance Time (g c), s		3.1	18.1		1.3	50.0		2.1	3.6		11.8	1.4	
Green Ratio (g/C)		0.48	0.40		0.48	0.40		0.36	0.12		0.36	0.12	
Capacity (c), veh/h		195	707		439	731		612	209		569	217	
Volume-to-Capacity Ratio (X)		0.398	0.487		0.076	1.004		0.073	0.266		0.391	0.102	
Back of Queue (Q), ft/ln (95 th percentile)		58	303.5		23.8	971.5		40.8	71.5		221.4	29.1	
Back of Queue (Q), veh/ln (95 th percentile)		2.2	12.1		0.9	37.4		1.6	2.9		8.5	1.1	
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d 1), s/veh		27.7	27.9		18.9	37.5		26.3	50.0		29.5	49.0	
Incremental Delay (d 2), s/veh		0.5	0.2		0.0	34.2		0.0	0.3		0.2	0.1	
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		28.2	28.1		18.9	71.7		26.3	50.3		29.7	49.1	
Level of Service (LOS)		C	C		B	F		C	D		C	D	
Approach Delay, s/veh / LOS		28.1	C		69.4	E		39.6	D		31.5	C	
Intersection Delay, s/veh / LOS		50.0						D					

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS		1.2	A	1.8	A	0.7	A	0.9	A

HCS 2010 Signalized Intersection Results Summary

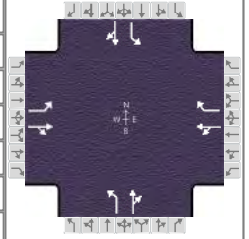
General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other									
Jurisdiction		Newtown		Time Period				PHF		0.90									
Urban Street		SR 32		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		SR 32 at Church St		File Name		06-Existing-AM.xus													
Project Description		Existing AM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				70	240	10	40	580	80	30	360	60	110	150	70				
Signal Information																			
Cycle, s	175.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	12.0	69.0	25.0	49.0	0.0	0.0									
				Yellow	4.0	4.0	4.0	4.0	0.0	0.0									
				Red	1.0	1.0	1.0	1.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8		7		4	
Case Number				1.1		4.0		1.1		4.0				6.3		1.0		4.0	
Phase Duration, s				17.0		74.0		17.0		74.0				54.0		30.0		84.0	
Change Period, (Y+R c), s				5.0		5.0		5.0		5.0				5.0		5.0		5.0	
Max Allow Headway (MAH), s				3.1		3.1		3.1		3.1				3.1		3.1		3.1	
Queue Clearance Time (g s), s				6.5		21.6		4.5		71.0				46.7		9.6		18.0	
Green Extension Time (g e), s				0.0		2.2		0.0		0.0				0.5		0.2		1.1	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00		1.00		1.00	
Max Out Probability				0.03		0.00		0.00		1.00				1.00		0.00		0.18	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				78	278		44	733		33	467		122	244					
Adjusted Saturation Flow Rate (s), veh/h/ln				1707	1780		1707	1754		1109	1781		1723	1712					
Queue Service Time (g s), s				4.5	19.6		2.5	69.0		3.9	44.7		7.6	16.0					
Cycle Queue Clearance Time (g c), s				4.5	19.6		2.5	69.0		3.9	44.7		7.6	16.0					
Green Ratio (g/C)				0.46	0.39		0.46	0.39		0.28	0.28		0.43	0.45					
Capacity (c), veh/h				158	702		444	692		352	499		309	773					
Volume-to-Capacity Ratio (X)				0.492	0.396		0.100	1.060		0.095	0.936		0.395	0.316					
Back of Queue (Q), ft/ln (95 th percentile)				90	338.2		49.6	1313.5		51.9	789.4		152.2	275					
Back of Queue (Q), veh/ln (95 th percentile)				3.4	13.5		1.9	52.5		2.0	31.6		5.8	11.0					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				40.1	38.0		27.3	53.0		46.8	61.5		37.2	30.7					
Incremental Delay (d 2), s/veh				0.9	0.1		0.0	51.3		0.0	24.9		0.3	0.1					
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				40.9	38.2		27.3	104.3		46.8	86.4		37.5	30.8					
Level of Service (LOS)				D	D		C	F		D	F		D	C					
Approach Delay, s/veh / LOS				38.8	D		99.9	F		83.7	F		33.0	C					
Intersection Delay, s/veh / LOS				72.7						E									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3	B		2.3	B		2.3	B		2.3	B					
Bicycle LOS Score / LOS				1.1	A		1.8	A		1.3	A		1.1	A					

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information									
Agency						Duration, h		0.25							
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other					
Jurisdiction		Newtown		Time Period				PHF		0.90					
Urban Street		Round Bottom Road		Analysis Year		2016		Analysis Period		1> 7:00					
Intersection		Round Bottom Road at...		File Name		08-Existing-AM.xus									
Project Description		Existing AM Peak Hour													
Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				80		170				600	120			180	230
Signal Information															
Cycle, s	110.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On												
Force Mode	Fixed	Simult. Gap N/S	On												
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase					4			5	2		6				
Case Number					9.0			1.0	4.0		8.3				
Phase Duration, s					25.0			30.0	85.0		55.0				
Change Period, (Y+R c), s					5.0			5.0	5.0		5.0				
Max Allow Headway (MAH), s					3.3			3.1	3.2		3.2				
Queue Clearance Time (g s), s					14.5			27.0	4.5		27.2				
Green Extension Time (g e), s					0.3			0.0	1.2		1.2				
Phase Call Probability					1.00			1.00	1.00		1.00				
Max Out Probability					0.17			1.00	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				5	2		6	16	
Adjusted Flow Rate (v), veh/h				89		189				667	133		456		
Adjusted Saturation Flow Rate (s), veh/h/ln				1740		1548				1707	1721		1541		
Queue Service Time (g s), s				4.8		12.5				25.0	2.5		25.2		
Cycle Queue Clearance Time (g c), s				4.8		12.5				25.0	2.5		25.2		
Green Ratio (g/C)				0.18		0.18				0.70	0.73		0.45		
Capacity (c), veh/h				316		281				656	1251		700		
Volume-to-Capacity Ratio (X)				0.281		0.671				1.017	0.107		0.650		
Back of Queue (Q), ft/ln (95 th percentile)				95.9		227				578.5	34.8		361.9		
Back of Queue (Q), veh/ln (95 th percentile)				3.7		8.8				22.4	1.4		14.0		
Queue Storage Ratio (RQ) (95 th percentile)				0.00		0.00				0.00	0.00		0.00		
Uniform Delay (d 1), s/veh				38.8		41.9				20.1	4.4		23.2		
Incremental Delay (d 2), s/veh				0.2		5.0				39.4	0.0		1.7		
Initial Queue Delay (d 3), s/veh				0.0		0.0				0.0	0.0		0.0		
Control Delay (d), s/veh				39.0		46.9				59.5	4.4		24.9		
Level of Service (LOS)				D		D				F	A		C		
Approach Delay, s/veh / LOS				44.4	D	0.0				50.4	D	24.9	C		
Intersection Delay, s/veh / LOS				41.7					D						
Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.3	B	2.2	B	0.7	A	2.3	B				
Bicycle LOS Score / LOS					F			1.8	A	1.2	A				

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency				Duration, h	0.25	
Analyst	MJH	Analysis Date	Jul 26, 2016	Area Type	Other	
Jurisdiction	Newtown	Time Period		PHF	0.90	
Urban Street	Church Street	Analysis Year	2016	Analysis Period	1> 7:00	
Intersection	Church St at Valley Ave	File Name	10-Existing-AM.xus			
Project Description	Existing AM Peak Hour					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	1	10	1	80	10	680	10	390	50	230	240	10

Signal Information											
Cycle, s	125.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On								
Force Mode	Fixed	Simult. Gap N/S	On								

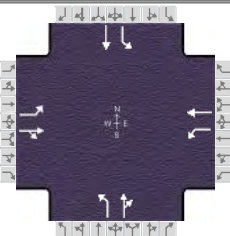
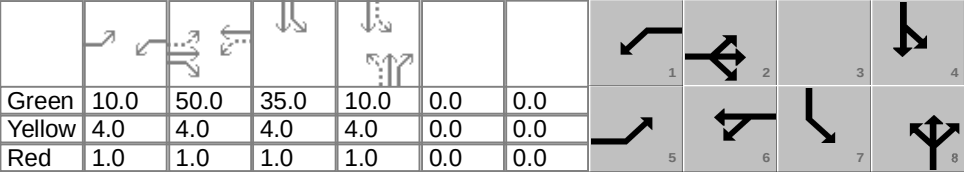
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2	1	6
Case Number		6.0		7.0		6.3	1.0	4.0
Phase Duration, s		55.0		55.0		50.0	20.0	70.0
Change Period, ($Y+R_c$), s		5.0		5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s		3.3		3.3		3.1	3.1	3.1
Queue Clearance Time (g_s), s		8.0		36.6		33.8	12.8	13.4
Green Extension Time (g_e), s		1.4		1.3		1.3	0.1	1.5
Phase Call Probability		1.00		1.00		1.00	1.00	1.00
Max Out Probability		0.00		0.01		0.03	1.00	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	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	1	12			100	489	11	489		256	278	
Adjusted Saturation Flow Rate (s), veh/h/ln	1426	1869			1404	1548	1076	1719		1740	1741	
Queue Service Time (g_s), s	0.1	0.5			5.4	34.6	0.8	31.8		10.8	11.4	
Cycle Queue Clearance Time (g_c), s	6.0	0.5			5.9	34.6	0.8	31.8		10.8	11.4	
Green Ratio (g/C)	0.40	0.40			0.40	0.40	0.36	0.36		0.50	0.52	
Capacity (c), veh/h	560	748			616	619	445	619		360	905	
Volume-to-Capacity Ratio (X)	0.002	0.016			0.162	0.789	0.025	0.790		0.710	0.307	
Back of Queue (Q), ft/ln (95 th percentile)	1	9.8			86.1	495.3	9.7	507.5		211.6	199.5	
Back of Queue (Q), veh/ln (95 th percentile)	0.0	0.4			3.4	19.8	0.4	20.3		8.5	8.0	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	26.2	22.6			24.3	32.9	25.9	35.8		25.0	17.1	
Incremental Delay (d_2), s/veh	0.0	0.0			0.0	6.3	0.0	6.3		5.5	0.1	
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	26.2	22.7			24.4	39.1	25.9	42.1		30.5	17.2	
Level of Service (LOS)	C	C			C	D	C	D		C	B	
Approach Delay, s/veh / LOS	22.9	C		36.6	D		41.7	D		23.6	C	
Intersection Delay, s/veh / LOS	33.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.6	B	2.3	B
Bicycle LOS Score / LOS	0.5	A	1.5	A	1.3	A	1.4	A

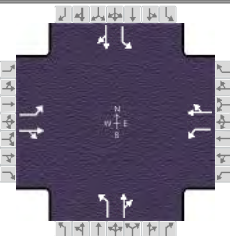
PM

HCS 2010 Signalized Intersection Results Summary

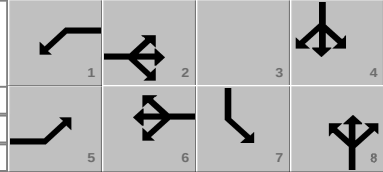
General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type						Other					
Jurisdiction		Newtown		Time Period				PHF						0.90					
Urban Street		SR 32		Analysis Year		2016		Analysis Period						1> 7:00					
Intersection		SR 32 at Round Bottom...		File Name		05-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				100	570	50	30	290		50	50	40	510	50					
Signal Information																			
Cycle, s	125.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	10.0	50.0	35.0	10.0	0.0	0.0									
				Yellow	4.0	4.0	4.0	4.0	0.0	0.0									
				Red	1.0	1.0	1.0	1.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8		7		4	
Case Number				1.1		4.0		1.1		4.0				6.3		1.0		4.0	
Phase Duration, s				15.0		55.0		15.0		55.0				15.0		40.0		55.0	
Change Period, (Y+R c), s				5.0		5.0		5.0		5.0				5.0		5.0		5.0	
Max Allow Headway (MAH), s				3.1		3.0		3.1		3.0				3.1		3.1		3.1	
Queue Clearance Time (g s), s				6.4		47.7		3.2		17.7				9.0		37.0		4.3	
Green Extension Time (g e), s				0.1		0.7		0.0		2.1				0.0		0.0		0.3	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00		1.00		1.00	
Max Out Probability				0.53		1.00		0.00		0.00				1.00		1.00		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				5	2	12	1	6		3	8	18	7	4					
Adjusted Flow Rate (v), veh/h				111	689		33	322		56	100		567	56					
Adjusted Saturation Flow Rate (s), veh/h/ln				1757	1818		1774	1863		1356	1742		1757	1845					
Queue Service Time (g s), s				4.4	45.7		1.2	15.7		4.9	7.0		35.0	2.3					
Cycle Queue Clearance Time (g c), s				4.4	45.7		1.2	15.7		4.9	7.0		35.0	2.3					
Green Ratio (g/C)				0.48	0.40		0.48	0.40		0.08	0.08		0.38	0.40					
Capacity (c), veh/h				468	727		213	745		166	139		580	738					
Volume-to-Capacity Ratio (X)				0.238	0.947		0.156	0.432		0.335	0.718		0.977	0.075					
Back of Queue (Q), ft/ln (95 th percentile)				81.9	798.9		23.6	288		77.9	162.3		716.1	46.9					
Back of Queue (Q), veh/ln (95 th percentile)				3.2	32.0		0.9	11.2		3.0	6.5		28.0	1.8					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				19.4	36.2		26.8	27.2		55.2	56.1		36.8	23.2					
Incremental Delay (d 2), s/veh				0.1	21.2		0.1	0.1		0.4	14.2		31.3	0.0					
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				19.5	57.4		26.9	27.4		55.6	70.3		68.2	23.2					
Level of Service (LOS)				B	E		C	C		E	E		E	C					
Approach Delay, s/veh / LOS				52.1		D		27.3		C		65.1		E		64.1		E	
Intersection Delay, s/veh / LOS				52.5						D									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.3		B		2.3		B		2.3		B	
Bicycle LOS Score / LOS				1.8		A		1.1		A		0.7		A		1.5		A	

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other			
Jurisdiction		Newtown		Time Period				PHF		0.90			
Urban Street		SR 32		Analysis Year		2016		Analysis Period		1> 7:00			
Intersection		SR 32 at Church St		File Name		06-Existing-PM.xus							
Project Description		Existing PM Peak Hour											



Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				100	540	30	100	310	70	20	210	60	100	340	50

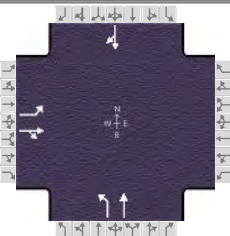
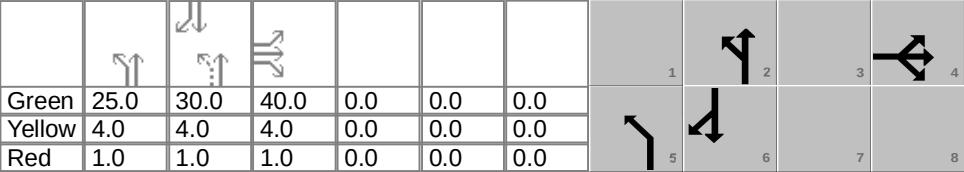
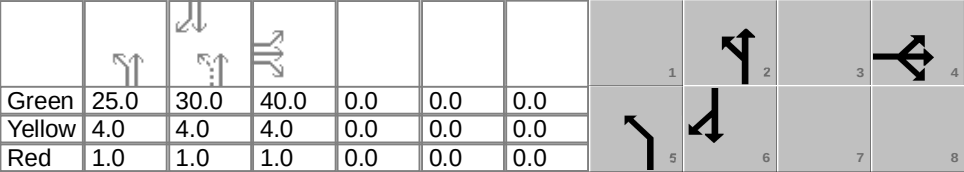
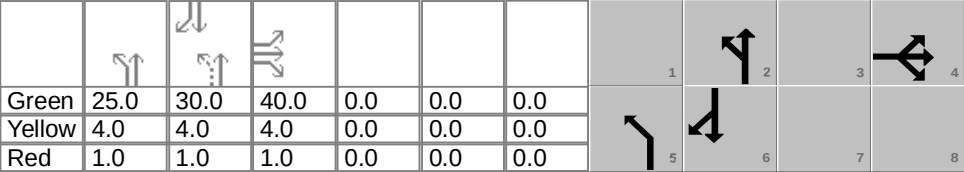
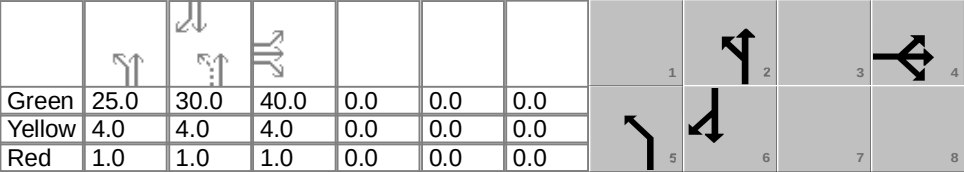
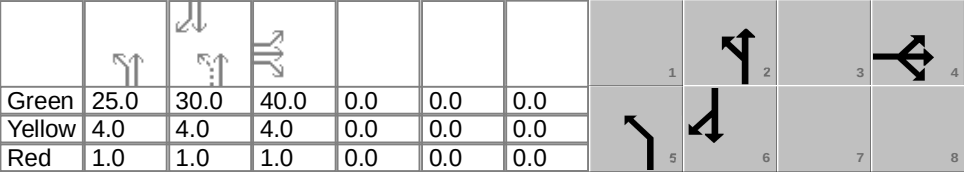
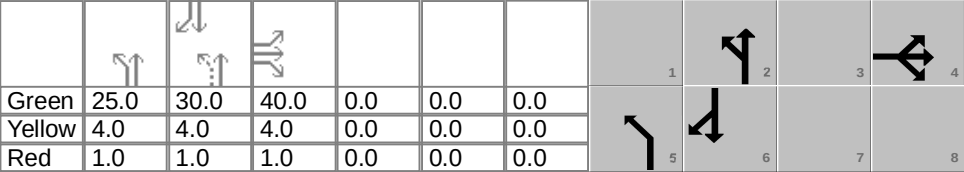
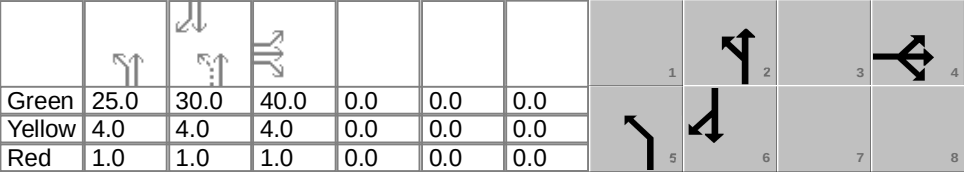
Signal Information						
Cycle, s	130.0	Reference Phase	2			
Offset, s	0	Reference Point	End			
Uncoordinated	Yes	Simult. Gap E/W	On			
Force Mode	Fixed	Simult. Gap N/S	On			
Green	10.0	50.0	20.0	30.0	0.0	0.0
Yellow	4.0	4.0	4.0	4.0	0.0	0.0
Red	1.0	1.0	1.0	1.0	0.0	0.0

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		5	2	1	6		8	7	4
Case Number		1.1	4.0	1.1	4.0		6.3	1.0	4.0
Phase Duration, s		15.0	55.0	15.0	55.0		35.0	25.0	60.0
Change Period, (Y+R _c), s		5.0	5.0	5.0	5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s		3.1	3.1	3.1	3.1		3.1	3.1	3.1
Queue Clearance Time (g _s), s		6.7	43.8	6.7	26.5		22.1	7.2	25.4
Green Extension Time (g _e), s		0.0	1.5	0.0	2.2		1.1	0.1	0.0
Phase Call Probability		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Max Out Probability		0.77	0.37	0.77	0.00		0.12	0.00	1.00

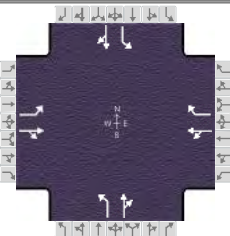
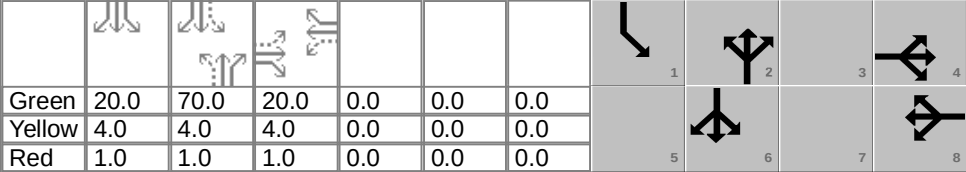
Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h		111	633		111	422		22	300		111	433	
Adjusted Saturation Flow Rate (s), veh/h/ln		1774	1845		1774	1803		951	1791		1774	1821	
Queue Service Time (g _s), s		4.7	41.8		4.7	24.5		2.4	20.1		5.2	23.4	
Cycle Queue Clearance Time (g _c), s		4.7	41.8		4.7	24.5		2.4	20.1		5.2	23.4	
Green Ratio (g/C)		0.46	0.38		0.46	0.38		0.23	0.23		0.40	0.42	
Capacity (c), veh/h		366	710		230	693		275	413		410	770	
Volume-to-Capacity Ratio (X)		0.304	0.892		0.484	0.609		0.081	0.726		0.271	0.563	
Back of Queue (Q), ft/ln (95 th percentile)		89	713.8		89.9	403.1		25.8	364.2		101	386.3	
Back of Queue (Q), veh/ln (95 th percentile)		3.5	28.6		3.5	16.1		1.0	14.6		4.0	15.5	
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d ₁), s/veh		23.2	37.5		28.7	32.1		39.4	46.2		27.1	28.4	
Incremental Delay (d ₂), s/veh		0.2	13.2		0.6	1.1		0.0	5.5		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		23.3	50.7		29.3	33.3		39.4	51.7		27.2	29.0	
Level of Service (LOS)		C	D		C	C		D	D		C	C	
Approach Delay, s/veh / LOS		46.6	D		32.4	C		50.8	D		28.6	C	
Intersection Delay, s/veh / LOS		39.2						D					

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS		1.7	A	1.4	A	1.0	A	1.4	A

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other									
Jurisdiction		Newtown		Time Period				PHF		0.90									
Urban Street		Round Bottom Road		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		Rnd Btm at Valley Ave		File Name		08-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				200	0	480				290	170			170	110				
Signal Information																			
Cycle, s	110.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	25.0	30.0	40.0	0.0	0.0	0.0									
				Yellow	4.0	4.0	4.0	0.0	0.0	0.0									
				Red	1.0	1.0	1.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						4						5		2				6	
Case Number						10.0						1.0		4.0				8.3	
Phase Duration, s						45.0						30.0		65.0				35.0	
Change Period, (Y+R c), s						5.0						5.0		5.0				5.0	
Max Allow Headway (MAH), s						3.3						3.1		3.1				3.1	
Queue Clearance Time (g s), s						24.3						14.0		8.0				20.9	
Green Extension Time (g e), s						1.2						0.5		0.9				0.0	
Phase Call Probability						1.00						1.00		1.00				1.00	
Max Out Probability						0.00						0.00		0.00				1.00	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				7	4	14				5	2			6	16				
Adjusted Flow Rate (v), veh/h				222	378					322	189			311					
Adjusted Saturation Flow Rate (s), veh/h/ln				1757	1563					1740	1754			1628					
Queue Service Time (g s), s				10.1	22.3					12.0	6.0			18.9					
Cycle Queue Clearance Time (g c), s				10.1	22.3					12.0	6.0			18.9					
Green Ratio (g/C)				0.36	0.36					0.52	0.55			0.27					
Capacity (c), veh/h				639	568					566	957			444					
Volume-to-Capacity Ratio (X)				0.348	0.665					0.569	0.197			0.701					
Back of Queue (Q), ft/ln (95 th percentile)				192.4	332.2					211.4	105.4			311.6					
Back of Queue (Q), veh/ln (95 th percentile)				7.5	13.3					8.3	4.1			12.5					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00					0.00	0.00			0.00					
Uniform Delay (d 1), s/veh				25.5	29.4					18.5	12.7			36.0					
Incremental Delay (d 2), s/veh				0.1	2.4					0.9	0.0			4.1					
Initial Queue Delay (d 3), s/veh				0.0	0.0					0.0	0.0			0.0					
Control Delay (d), s/veh				25.6	31.7					19.4	12.8			40.1					
Level of Service (LOS)				C	C					B	B			D					
Approach Delay, s/veh / LOS				29.5		C		0.0				17.0		B		40.1		D	
Intersection Delay, s/veh / LOS				27.3						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.2		B		1.9		A		2.5		B	
Bicycle LOS Score / LOS				1.5		A						1.3		A		1.0		A	

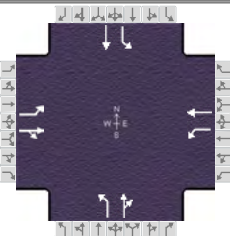
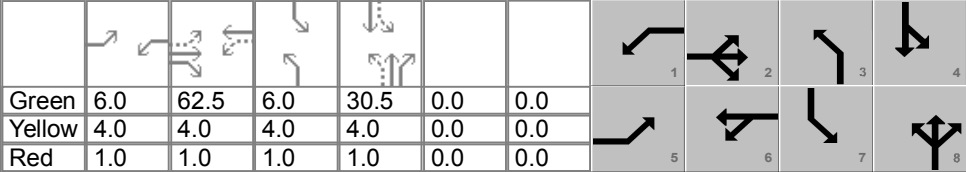
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other									
Jurisdiction		Newtown		Time Period				PHF		0.90									
Urban Street		Church Street		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		Valley Ave		File Name		10-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				10	10	10	60	1	350	1	290	90	570	440	10				
Signal Information																			
Cycle, s	125.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
Green	20.0	70.0	20.0	0.0	0.0	0.0													
Yellow	4.0	4.0	4.0	0.0	0.0	0.0													
Red	1.0	1.0	1.0	0.0	0.0	0.0													
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						4				8				2		1		6	
Case Number						6.0				7.0				6.3		1.0		4.0	
Phase Duration, s						25.0				25.0				75.0		25.0		100.0	
Change Period, (Y+R c), s						5.0				5.0				5.0		5.0		5.0	
Max Allow Headway (MAH), s						3.3				3.3				3.1		3.1		3.1	
Queue Clearance Time (g s), s						9.7				19.2				20.0		20.3		13.7	
Green Extension Time (g e), s						0.5				0.1				1.8		0.0		1.8	
Phase Call Probability						1.00				1.00				1.00		1.00		1.00	
Max Out Probability						0.01				1.00				0.00		1.00		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	4	14	3	8	18	5	2	12	1	6	16				
Adjusted Flow Rate (v), veh/h				11	22			68	222	1	422		633	500					
Adjusted Saturation Flow Rate (s), veh/h/ln				1410	1709			1297	1579	894	1715		1774	1781					
Queue Service Time (g s), s				0.9	1.4			5.4	17.2	0.1	18.0		18.3	11.7					
Cycle Queue Clearance Time (g c), s				7.7	1.4			6.8	17.2	0.1	18.0		18.3	11.7					
Green Ratio (g/C)				0.16	0.16			0.16	0.16	0.56	0.56		0.74	0.76					
Capacity (c), veh/h				207	273			265	253	558	960		741	1354					
Volume-to-Capacity Ratio (X)				0.054	0.081			0.256	0.880	0.002	0.440		0.854	0.369					
Back of Queue (Q), ft/ln (95 th percentile)				14.4	26.5			86.5	336.3	0.6	278.4		314.8	164.8					
Back of Queue (Q), veh/ln (95 th percentile)				0.6	1.1			3.4	13.5	0.0	11.1		12.4	6.6					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				50.4	44.7			47.5	51.3	12.1	16.1		11.5	5.0					
Incremental Delay (d 2), s/veh				0.0	0.0			0.2	27.1	0.0	0.1		9.1	0.1					
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				50.4	44.7			47.7	78.4	12.1	16.2		20.6	5.1					
Level of Service (LOS)				D	D			D	E	B	B		C	A					
Approach Delay, s/veh / LOS				46.6	D		71.2	E		16.2	B		13.7	B					
Intersection Delay, s/veh / LOS				23.7						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3	B		2.3	B		2.5	B		2.2	B					
Bicycle LOS Score / LOS				0.5	A		1.0	A		1.2	A		2.4	B					

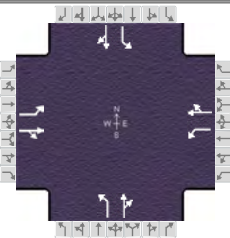
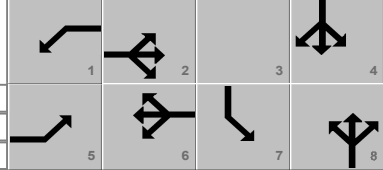
2022

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HCS 2010 Signalized Intersection Results Summary

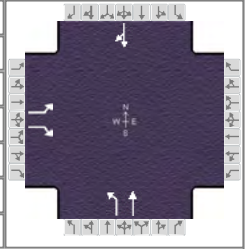
General Information						Intersection Information									
Agency						Duration, h		0.25							
Analyst		MJH		Analysis Date		Oct 19, 2016		Area Type		Other					
Jurisdiction		Newtown		Time Period				PHF		0.90					
Urban Street		SR 32		Analysis Year		2022		Analysis Period		1> 7:00					
Intersection		SR 32 at Round Bottom...		File Name		05-2022-AM.xus									
Project Description		2022 NO-BUILD - AM Peak Hour													
															
Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				70	300	40	30	740		40	30	20	210	20	
Signal Information															
Cycle, s	125.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On												
Force Mode	Fixed	Simult. Gap N/S	On												
Green	6.0	62.5	6.0	30.5	0.0	0.0									
Yellow	4.0	4.0	4.0	4.0	0.0	0.0									
Red	1.0	1.0	1.0	1.0	0.0	0.0									
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase				5	2	1	6	3	8	7	4				
Case Number				1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0				
Phase Duration, s				11.0	67.5	11.0	67.5	11.0	35.5	11.0	35.5				
Change Period, (Y+R c), s				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0				
Max Allow Headway (MAH), s				3.1	3.0	3.1	3.0	3.1	3.1	3.1	3.1				
Queue Clearance Time (g s), s				4.7	18.9	3.1	53.1	4.3	5.1	8.0	3.2				
Green Extension Time (g e), s				0.0	2.7	0.0	2.1	0.0	0.1	0.0	0.1				
Phase Call Probability				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Max Out Probability				1.00	0.00	1.00	0.18	1.00	0.00	1.00	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				5	2	12	1	6		3	8	18	7	4	
Adjusted Flow Rate (v), veh/h				78	378		33	822		44	56		233	22	
Adjusted Saturation Flow Rate (s), veh/h/ln				1723	1772		1740	1827		1774	1738		1723	1810	
Queue Service Time (g s), s				2.7	16.9		1.1	51.1		2.3	3.1		6.0	1.2	
Cycle Queue Clearance Time (g c), s				2.7	16.9		1.1	51.1		2.3	3.1		6.0	1.2	
Green Ratio (g/C)				0.55	0.50		0.55	0.50		0.29	0.24		0.29	0.24	
Capacity (c), veh/h				189	886		483	913		445	424		405	442	
Volume-to-Capacity Ratio (X)				0.413	0.426		0.069	0.900		0.100	0.131		0.576	0.050	
Back of Queue (Q), ft/ln (95 th percentile)				49.5	279.3		20	839.4		45.9	60		170.1	24.5	
Back of Queue (Q), veh/ln (95 th percentile)				1.9	11.2		0.8	32.3		1.8	2.4		6.5	0.9	
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d 1), s/veh				26.2	19.9		14.5	28.4		32.2	36.9		39.5	36.2	
Incremental Delay (d 2), s/veh				0.5	0.1		0.0	11.5		0.0	0.1		1.3	0.0	
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				26.8	20.0		14.5	39.9		32.2	37.0		40.8	36.2	
Level of Service (LOS)				C	B		B	D		C	D		D	D	
Approach Delay, s/veh / LOS				21.1	C		39.0	D		34.8	C		40.4	D	
Intersection Delay, s/veh / LOS				34.1						C					
Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.3	B		2.3	B		2.3	B		2.3	B	
Bicycle LOS Score / LOS				1.2	A		1.9	A		0.7	A		0.9	A	

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information															
Agency					Duration, h		0.25													
Analyst		MJH		Analysis Date		Oct 19, 2016		Area Type					Other							
Jurisdiction		Newtown		Time Period				PHF					0.90							
Urban Street		SR 32		Analysis Year		2022		Analysis Period					1> 7:00							
Intersection		SR 32 at Church St		File Name		06-2022-AM.xus														
Project Description		2022 NO-BUILD - AM Peak Hour																		
Demand Information					EB			WB			NB			SB						
Approach Movement					L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h					70	270	10	40	650	80	30	390	60	120	160	70				
Signal Information																				
Cycle, s	175.0	Reference Phase	2																	
Offset, s	0	Reference Point	End																	
Uncoordinated	Yes	Simult. Gap E/W	On																	
Force Mode	Fixed	Simult. Gap N/S	On																	
					Green	6.0	82.0	12.0	55.0	0.0	0.0									
					Yellow	4.0	4.0	4.0	4.0	0.0	0.0									
					Red	1.0	1.0	1.0	1.0	0.0	0.0									
Timer Results					EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase					5		2		1		6				8		7		4	
Case Number					1.1		4.0		1.1		4.0				6.3		1.0		4.0	
Phase Duration, s					11.0		87.0		11.0		87.0				60.0		17.0		77.0	
Change Period, (Y+R c), s					5.0		5.0		5.0		5.0				5.0		5.0		5.0	
Max Allow Headway (MAH), s					3.1		3.1		3.1		3.1				3.1		3.1		3.1	
Queue Clearance Time (g s), s					6.2		21.7		4.3		81.7				48.7		10.9		20.0	
Green Extension Time (g e), s					0.0		2.5		0.0		0.1				1.1		0.0		1.4	
Phase Call Probability					1.00		1.00		1.00		1.00				1.00		1.00		1.00	
Max Out Probability					1.00		0.00		1.00		1.00				0.27		1.00		0.04	
Movement Group Results					EB			WB			NB			SB						
Approach Movement					L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement					5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h					78	311		44	811		33	500		133	256					
Adjusted Saturation Flow Rate (s), veh/h/ln					1707	1781		1707	1758		1098	1784		1723	1716					
Queue Service Time (g s), s					4.2	19.7		2.3	79.7		3.8	46.7		8.9	18.0					
Cycle Queue Clearance Time (g c), s					4.2	19.7		2.3	79.7		4.8	46.7		8.9	18.0					
Green Ratio (g/C)					0.50	0.47		0.50	0.47		0.31	0.31		0.39	0.41					
Capacity (c), veh/h					101	835		453	824		380	561		200	706					
Volume-to-Capacity Ratio (X)					0.771	0.373		0.098	0.985		0.088	0.892		0.666	0.362					
Back of Queue (Q), ft/ln (95 th percentile)					117	334.9		45.4	1272.9		49.7	785.4		196.5	305.7					
Back of Queue (Q), veh/ln (95 th percentile)					4.5	13.4		1.7	50.9		1.9	31.4		7.5	12.2					
Queue Storage Ratio (RQ) (95 th percentile)					0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00					
Uniform Delay (d 1), s/veh					41.9	29.9		23.6	45.9		43.2	57.2		42.8	35.6					
Incremental Delay (d 2), s/veh					27.5	0.1		0.0	27.4		0.0	15.9		6.6	0.1					
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					69.4	30.0		23.6	73.3		43.2	73.1		49.4	35.7					
Level of Service (LOS)					E	C		C	E		D	E		D	D					
Approach Delay, s/veh / LOS					37.9		D	70.7		E	71.2		E	40.4		D				
Intersection Delay, s/veh / LOS					59.5						E									
Multimodal Results					EB			WB			NB			SB						
Pedestrian LOS Score / LOS					2.3	B		2.3	B		2.3	B		2.3	B					
Bicycle LOS Score / LOS					1.1	A		1.9	A		1.4	A		1.1	A					

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 19, 2016	Area Type	Other
Jurisdiction	Newtown	Time Period		PHF	0.90
Urban Street	Round Bottom Road	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	Round Bottom Road at...	File Name	08-2022-AM.xus		
Project Description	2022 NO-BUILD - AM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	80		190				680	130			180	250

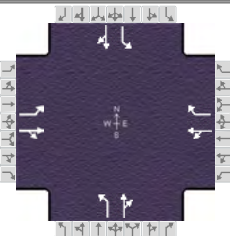
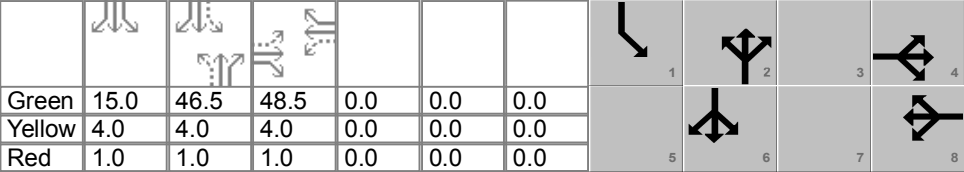
Signal Information											
Cycle, s	110.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	43.0	35.5	16.5	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
				Red	1.0	1.0	1.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		9.0			1.0	4.0		8.3
Phase Duration, s		21.5			48.0	88.5		40.5
Change Period, ($Y+R_c$), s		5.0			5.0	5.0		5.0
Max Allow Headway (MAH), s		3.3			3.1	3.2		3.2
Queue Clearance Time (g_s), s		16.8			45.0	4.4		35.6
Green Extension Time (g_e), s		0.0			0.0	1.3		0.0
Phase Call Probability		1.00			1.00	1.00		1.00
Max Out Probability		1.00			1.00	0.00		1.00

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				5	2			6	16
Adjusted Flow Rate (v), veh/h	89		211				756	144			478	
Adjusted Saturation Flow Rate (s), veh/h/ln	1740		1548				1707	1721			1536	
Queue Service Time (g_s), s	5.0		14.8				43.0	2.4			33.6	
Cycle Queue Clearance Time (g_c), s	5.0		14.8				43.0	2.4			33.6	
Green Ratio (g/C)	0.15		0.15				0.73	0.76			0.32	
Capacity (c), veh/h	261		232				748	1306			496	
Volume-to-Capacity Ratio (X)	0.341		0.909				1.011	0.111			0.964	
Back of Queue (Q), ft/ln (95 th percentile)	100.4		320.4				896.7	31			596.5	
Back of Queue (Q), veh/ln (95 th percentile)	3.9		12.4				34.8	1.2			23.1	
Queue Storage Ratio (RQ) (95 th percentile)	0.00		0.00				0.00	0.00			0.00	
Uniform Delay (d_1), s/veh	41.9		46.0				28.0	3.5			36.6	
Incremental Delay (d_2), s/veh	0.3		34.8				35.6	0.0			31.1	
Initial Queue Delay (d_3), s/veh	0.0		0.0				0.0	0.0			0.0	
Control Delay (d), s/veh	42.2		80.9				63.6	3.5			67.7	
Level of Service (LOS)	D		F				F	A			E	
Approach Delay, s/veh / LOS	69.4		E	0.0			54.0	D		67.7		E
Intersection Delay, s/veh / LOS	60.6						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.2	B	0.6	A	2.3	B
Bicycle LOS Score / LOS		F			2.0	A	1.3	A

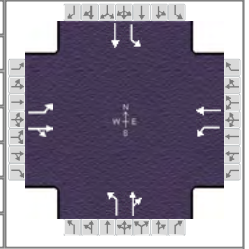
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 19, 2016		Area Type		Other									
Jurisdiction		Newtown		Time Period				PHF		0.90									
Urban Street		Church Street		Analysis Year		2022		Analysis Period		1> 7:00									
Intersection		Church St at Valley Ave		File Name		10-2022-AM.xus													
Project Description		2022 NO-BUILD - AM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				1	10	1	110	10	740	10	440	70	250	270	10				
Signal Information																			
Cycle, s	125.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	15.0	46.5	48.5	0.0	0.0	0.0									
				Yellow	4.0	4.0	4.0	0.0	0.0	0.0									
				Red	1.0	1.0	1.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						4				8				2		1		6	
Case Number						6.0				7.0				6.3		1.0		4.0	
Phase Duration, s						53.5				53.5				51.5		20.0		71.5	
Change Period, (Y+R c), s						5.0				5.0				5.0		5.0		5.0	
Max Allow Headway (MAH), s						3.3				3.3				3.1		3.1		3.1	
Queue Clearance Time (g s), s						10.4				44.8				40.9		13.7		14.7	
Green Extension Time (g e), s						1.7				0.8				1.1		0.1		1.8	
Phase Call Probability						1.00				1.00				1.00		1.00		1.00	
Max Out Probability						0.00				0.86				0.37		1.00		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	4	14	3	8	18	5	2	12	1	6	16				
Adjusted Flow Rate (v), veh/h				1	12			133	556	11	567		278	311					
Adjusted Saturation Flow Rate (s), veh/h/ln				1426	1869			1391	1548	1044	1712		1740	1743					
Queue Service Time (g s), s				0.1	0.5			7.9	42.8	0.8	38.9		11.7	12.7					
Cycle Queue Clearance Time (g c), s				8.4	0.5			8.4	42.8	0.9	38.9		11.7	12.7					
Green Ratio (g/C)				0.39	0.39			0.39	0.39	0.37	0.37		0.51	0.53					
Capacity (c), veh/h				515	725			595	601	446	637		317	927					
Volume-to-Capacity Ratio (X)				0.002	0.017			0.224	0.925	0.025	0.890		0.877	0.336					
Back of Queue (Q), ft/ln (95 th percentile)				1	10.1			120.9	655	9.5	634.2		269.6	216.9					
Back of Queue (Q), veh/ln (95 th percentile)				0.0	0.4			4.8	26.2	0.4	25.4		10.8	8.7					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				28.8	23.6			26.1	36.5	24.9	36.8		26.7	16.7					
Incremental Delay (d 2), s/veh				0.0	0.0			0.1	20.0	0.0	14.2		22.3	0.1					
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	23.6			26.1	56.5	24.9	51.0		49.0	16.7					
Level of Service (LOS)				C	C			C	E	C	D		D	B					
Approach Delay, s/veh / LOS				24.0		C		50.6		D		50.5		D		32.0		C	
Intersection Delay, s/veh / LOS				44.5						D									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.3		B		2.6		B		2.3		B	
Bicycle LOS Score / LOS				0.5		A		1.6		A		1.4		A		1.5		A	

PM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Newtown	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	SR 32 at Round Bottom...	File Name	05-2022-PM.xus		
Project Description	2022 NO-BUILD - PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	110	640	50	30	330		60	50	40	550	50	

Signal Information											
Cycle, s	125.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On								
Force Mode	Fixed	Simult. Gap N/S	On								

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8	7	4
Case Number	1.1	4.0	1.1	4.0		6.3	1.0	4.0
Phase Duration, s	11.0	56.5	11.0	56.5		14.5	43.0	57.5
Change Period, ($Y+R_c$), s	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s	3.1	3.0	3.1	3.0		3.1	3.1	3.1
Queue Clearance Time (g_s), s	7.0	53.5	3.3	20.0		9.0	40.0	4.3
Green Extension Time (g_e), s	0.0	0.0	0.0	2.4		0.0	0.0	0.3
Phase Call Probability	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Max Out Probability	1.00	1.00	1.00	0.00		1.00	1.00	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	5	2	12	1	6		3	8	18	7	4	
Adjusted Flow Rate (v), veh/h	122	767		33	367		67	100		611	56	
Adjusted Saturation Flow Rate (s), veh/h/ln	1757	1821		1774	1863		1356	1742		1757	1845	
Queue Service Time (g_s), s	5.0	51.5		1.3	18.0		6.0	7.0		38.0	2.3	
Cycle Queue Clearance Time (g_c), s	5.0	51.5		1.3	18.0		6.0	7.0		38.0	2.3	
Green Ratio (g/C)	0.46	0.41		0.46	0.41		0.08	0.08		0.40	0.42	
Capacity (c), veh/h	394	750		143	767		160	132		617	775	
Volume-to-Capacity Ratio (X)	0.310	1.022		0.234	0.478		0.415	0.755		0.991	0.072	
Back of Queue (Q), ft/ln (95 th percentile)	95	993.6		24.9	321.2		94.9	170.7		774.8	45.2	
Back of Queue (Q), veh/ln (95 th percentile)	3.7	39.7		1.0	12.5		3.7	6.8		30.3	1.8	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	21.4	36.8		29.2	26.9		56.1	56.6		35.8	21.7	
Incremental Delay (d_2), s/veh	0.2	38.5		0.3	0.2		0.6	19.6		33.8	0.0	
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	21.6	75.3		29.5	27.1		56.8	76.2		69.6	21.7	
Level of Service (LOS)	C	F		C	C		E	E		E	C	
Approach Delay, s/veh / LOS	67.9	E		27.3	C		68.4	E		65.6	E	
Intersection Delay, s/veh / LOS	59.5						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	2.0	A	1.1	A	0.8	A	1.6	A

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other			
Jurisdiction		Newtown		Time Period				PHF		0.90			
Urban Street		SR 32		Analysis Year		2022		Analysis Period		1> 7:00			
Intersection		SR 32 at Church St		File Name		06-2022-PM.xus							
Project Description		2022 - NO-BUILD - PM Peak Hour											

Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				100	610	30	100	340	70	20	230	70	110	370	50

Signal Information						
Cycle, s	130.0	Reference Phase	2			
Offset, s	0	Reference Point	End			
Uncoordinated	Yes	Simult. Gap E/W	On			
Force Mode	Fixed	Simult. Gap N/S	On			
Green	6.0	57.0	6.0	41.0	0.0	0.0
Yellow	4.0	4.0	4.0	4.0	0.0	0.0
Red	1.0	1.0	1.0	1.0	0.0	0.0

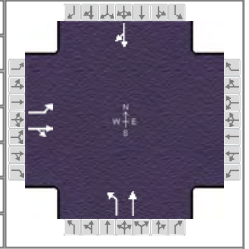
Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		5	2	1	6		8	7	4
Case Number		1.1	4.0	1.1	4.0		6.3	1.0	4.0
Phase Duration, s		11.0	62.0	11.0	62.0		46.0	11.0	57.0
Change Period, (Y+R c), s		5.0	5.0	5.0	5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s		3.1	3.1	3.1	3.1		3.1	3.1	3.1
Queue Clearance Time (g s), s		6.5	47.7	6.5	26.6		22.4	8.0	28.8
Green Extension Time (g e), s		0.0	2.0	0.0	2.5		1.6	0.0	1.5
Phase Call Probability		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Max Out Probability		1.00	0.17	1.00	0.00		0.00	1.00	0.03

Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h		111	711		111	456		22	333		122	467	
Adjusted Saturation Flow Rate (s), veh/h/ln		1774	1847		1774	1807		922	1788		1774	1824	
Queue Service Time (g s), s		4.5	45.7		4.5	24.6		2.6	20.4		6.0	26.8	
Cycle Queue Clearance Time (g c), s		4.5	45.7		4.5	24.6		18.4	20.4		6.0	26.8	
Green Ratio (g/C)		0.48	0.44		0.48	0.44		0.32	0.32		0.38	0.40	
Capacity (c), veh/h		355	810		190	792		234	564		302	729	
Volume-to-Capacity Ratio (X)		0.313	0.878		0.585	0.575		0.095	0.591		0.404	0.640	
Back of Queue (Q), ft/ln (95 th percentile)		84.5	747.5		91.2	398.5		27.3	349		117.3	440.5	
Back of Queue (Q), veh/ln (95 th percentile)		3.3	29.9		3.6	15.9		1.1	14.0		4.6	17.6	
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d 1), s/veh		21.5	33.3		28.7	27.4		43.3	37.4		29.3	31.4	
Incremental Delay (d 2), s/veh		0.2	10.4		3.1	0.7		0.1	1.1		0.3	1.5	
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		21.7	43.8		31.8	28.1		43.4	38.6		29.6	32.9	
Level of Service (LOS)		C	D		C	C		D	D		C	C	
Approach Delay, s/veh / LOS		40.8	D		28.8	C		38.9	D		32.2	C	
Intersection Delay, s/veh / LOS		35.4						D					

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS		1.8	A	1.4	A	1.1	A	1.5	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Newtown	Time Period		PHF	0.90
Urban Street	Round Bottom Road	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	Rnd Btm at Valley Ave	File Name	08-2022-PM.xus		
Project Description	2022 NO-BUILD - PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	210	0	520				310	190			190	110

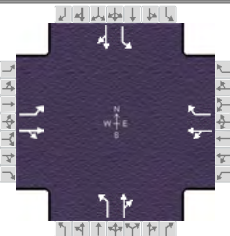
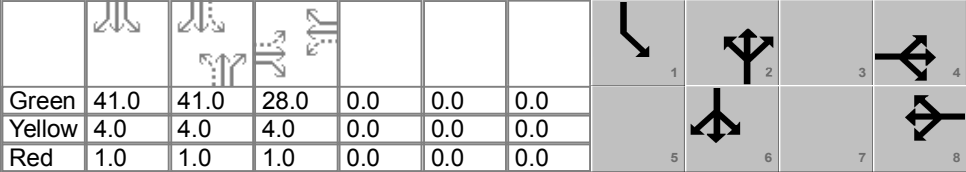
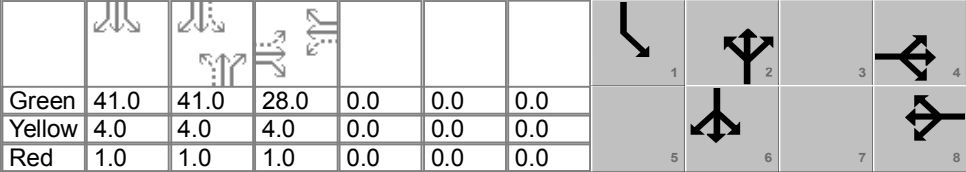
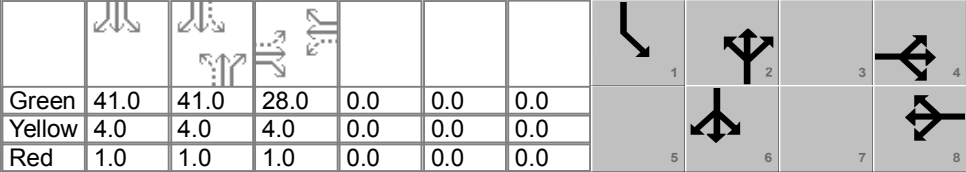
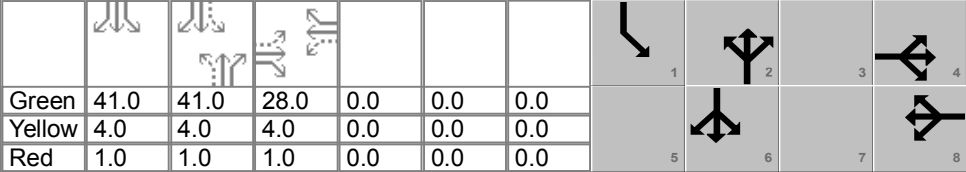
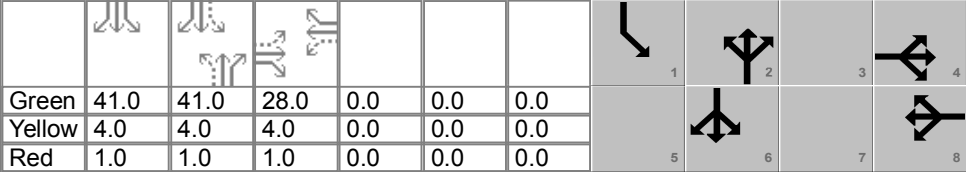
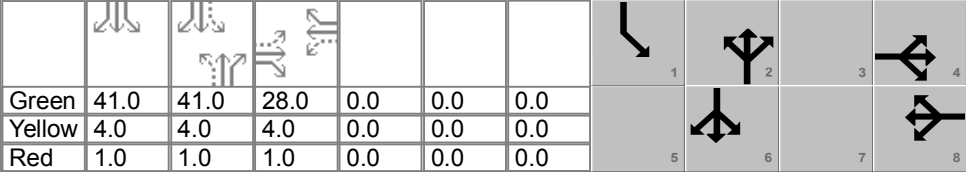
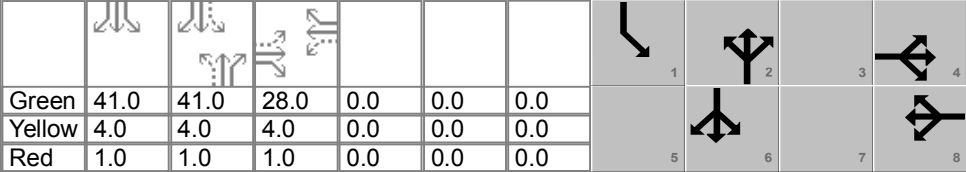
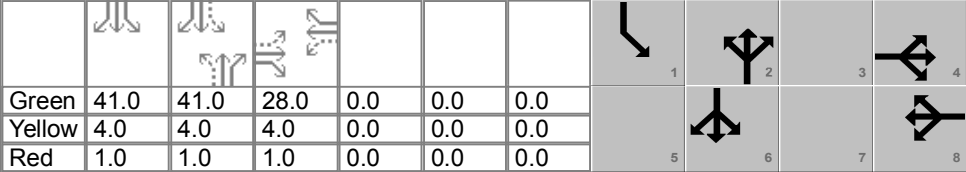
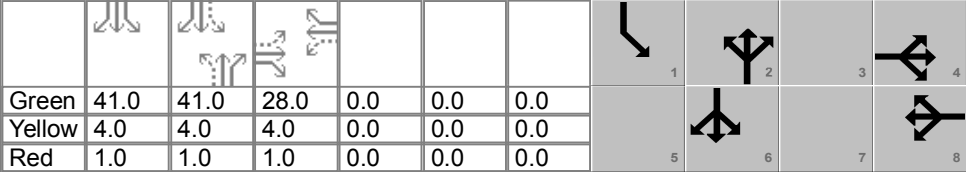
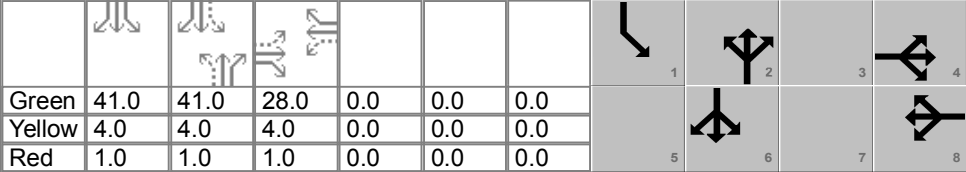
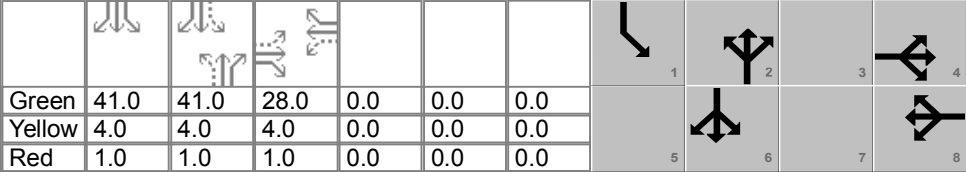
Signal Information											
Cycle, s	120.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	12.0	44.0	49.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
				Red	1.0	1.0	1.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		10.0			1.0	4.0		8.3
Phase Duration, s		54.0			17.0	66.0		49.0
Change Period, ($Y+R_c$), s		5.0			5.0	5.0		5.0
Max Allow Headway (MAH), s		3.3			3.1	3.1		3.1
Queue Clearance Time (g_s), s		28.3			14.0	10.1		21.5
Green Extension Time (g_e), s		1.4			0.0	1.0		1.0
Phase Call Probability		1.00			1.00	1.00		1.00
Max Out Probability		0.00			1.00	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	4	14				5	2		6	16	
Adjusted Flow Rate (v), veh/h	233	422					344	211		333		
Adjusted Saturation Flow Rate (s), veh/h/ln	1757	1563					1740	1754		1635		
Queue Service Time (g_s), s	10.9	26.3					12.0	8.1		19.5		
Cycle Queue Clearance Time (g_c), s	10.9	26.3					12.0	8.1		19.5		
Green Ratio (g/C)	0.41	0.41					0.48	0.51		0.37		
Capacity (c), veh/h	717	638					443	892		600		
Volume-to-Capacity Ratio (X)	0.325	0.661					0.777	0.237		0.556		
Back of Queue (Q), ft/ln (95 th percentile)	203.7	378.7					199.7	147.6		304.4		
Back of Queue (Q), veh/ln (95 th percentile)	8.0	15.1					7.8	5.8		12.2		
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00					0.00	0.00		0.00		
Uniform Delay (d_1), s/veh	24.2	28.8					26.7	16.5		30.2		
Incremental Delay (d_2), s/veh	0.1	2.1					7.8	0.1		0.7		
Initial Queue Delay (d_3), s/veh	0.0	0.0					0.0	0.0		0.0		
Control Delay (d), s/veh	24.3	30.8					34.5	16.5		30.9		
Level of Service (LOS)	C	C					C	B		C		
Approach Delay, s/veh / LOS	28.5	C		0.0			27.6	C		30.9	C	
Intersection Delay, s/veh / LOS	28.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.2	B	1.9	A	2.5	B
Bicycle LOS Score / LOS	1.6	A			1.4	A	1.0	A

HCS 2010 Signalized Intersection Results Summary

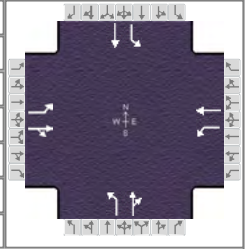
General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Newtown		Time Period				PHF		0.90									
Urban Street		Church Street		Analysis Year		2022		Analysis Period		1> 7:00									
Intersection		Valley Ave		File Name		10-2022-PM.xus													
Project Description		2022 NO-BUILD - PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				10	10	10	70	1	390	1	310	120	620	490	10				
Signal Information																			
Cycle, s	125.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	41.0	41.0	28.0	0.0	0.0	0.0									
				Yellow	4.0	4.0	4.0	0.0	0.0	0.0									
				Red	1.0	1.0	1.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						4				8				2		1		6	
Case Number						6.0				7.0				6.3		1.0		4.0	
Phase Duration, s						33.0				33.0				46.0		46.0		92.0	
Change Period, (Y+R c), s						5.0				5.0				5.0		5.0		5.0	
Max Allow Headway (MAH), s						3.3				3.3				3.1		3.1		3.1	
Queue Clearance Time (g s), s						9.9				21.7				34.3		41.4		19.2	
Green Extension Time (g e), s						0.7				0.5				1.5		0.0		2.1	
Phase Call Probability						1.00				1.00				1.00		1.00		1.00	
Max Out Probability						0.00				0.13				0.31		1.00		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	4	14	3	8	18	5	2	12	1	6	16				
Adjusted Flow Rate (v), veh/h				11	22			79	267	1	478		689	556					
Adjusted Saturation Flow Rate (s), veh/h/ln				1439	1743			1329	1579	858	1720		1774	1782					
Queue Service Time (g s), s				0.8	1.3			5.9	19.7	0.1	32.3		39.4	17.2					
Cycle Queue Clearance Time (g c), s				7.9	1.3			7.1	19.7	0.1	32.3		39.4	17.2					
Green Ratio (g/C)				0.22	0.22			0.22	0.22	0.33	0.33		0.67	0.70					
Capacity (c), veh/h				298	390			355	354	339	564		703	1240					
Volume-to-Capacity Ratio (X)				0.037	0.057			0.222	0.754	0.003	0.847		0.980	0.448					
Back of Queue (Q), ft/ln (95 th percentile)				13.1	24.2			91.2	329.7	1	536.7		851.6	252.1					
Back of Queue (Q), veh/ln (95 th percentile)				0.5	1.0			3.6	13.2	0.0	21.5		34.1	10.1					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				43.7	38.1			40.9	45.3	28.3	39.1		30.4	8.4					
Incremental Delay (d 2), s/veh				0.0	0.0			0.1	8.0	0.0	11.0		28.9	0.1					
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				43.7	38.1			41.0	53.3	28.3	50.0		59.3	8.5					
Level of Service (LOS)				D	D			D	D	C	D		E	A					
Approach Delay, s/veh / LOS				40.0		D		50.5		D		50.0		D		36.6		D	
Intersection Delay, s/veh / LOS				42.0										D					
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.3		B		2.5		B		2.2		B	
Bicycle LOS Score / LOS				0.5		A		1.1		A		1.3		A		2.5		B	

2042

AM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Newtown	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2042	Analysis Period	1> 7:00
Intersection	SR 32 at Round Bottom...	File Name	05-2042-AM.xus		
Project Description	2042 NO-BUILD - AM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	70	310	40	30	780		50	30	20	210	20	

Signal Information											
Cycle, s	125.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	6.0	61.0	32.0	6.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	4.0	0.0	0.0	
				Red	1.0	1.0	1.0	1.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	11.0	66.0	11.0	66.0	37.0	11.0	37.0	11.0
Change Period, ($Y+R_c$), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Allow Headway (MAH), s	3.1	3.0	3.1	3.0	3.1	3.1	3.1	3.1
Queue Clearance Time (g_s), s	4.7	20.0	3.1	59.8	4.8	5.9	15.6	3.5
Green Extension Time (g_e), s	0.0	2.9	0.0	0.5	0.1	0.0	0.4	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	1.00	0.00	1.00	1.00	0.00	1.00	0.00	1.00

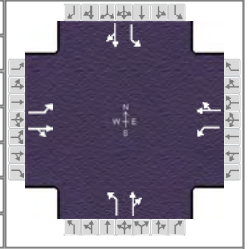
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6		3	8	18	7	4	
Adjusted Flow Rate (v), veh/h	78	389		33	867		56	56		233	22	
Adjusted Saturation Flow Rate (s), veh/h/ln	1723	1773		1740	1827		1774	1738		1723	1810	
Queue Service Time (g_s), s	2.7	18.0		1.1	57.8		2.8	3.9		13.6	1.5	
Cycle Queue Clearance Time (g_c), s	2.7	18.0		1.1	57.8		2.8	3.9		13.6	1.5	
Green Ratio (g/C)	0.54	0.49		0.54	0.49		0.30	0.05		0.30	0.05	
Capacity (c), veh/h	146	865		460	892		540	83		500	87	
Volume-to-Capacity Ratio (X)	0.531	0.449		0.072	0.972		0.103	0.666		0.467	0.256	
Back of Queue (Q), ft/ln (95 th percentile)	54	294.4		20.7	1012.1		56.5	93		250	32.2	
Back of Queue (Q), veh/ln (95 th percentile)	2.1	11.8		0.8	38.9		2.2	3.7		9.6	1.2	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	28.9	21.0		15.4	31.2		31.3	58.5		35.2	57.3	
Incremental Delay (d_2), s/veh	1.9	0.1		0.0	23.3		0.0	15.1		0.3	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	30.8	21.1		15.4	54.5		31.3	73.6		35.4	57.9	
Level of Service (LOS)	C	C		B	D		C	E		D	E	
Approach Delay, s/veh / LOS	22.7	C		53.1	D		52.5	D		37.4	D	
Intersection Delay, s/veh / LOS	42.5						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.3	A	2.0	A	0.7	A	0.9	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Newtown	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2042	Analysis Period	1> 7:00
Intersection	SR 32 at Church St	File Name	06-2042-AM.xus		
Project Description	2042 NO-BUILD - AM Peak Hour				





Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	70	280	10	50	680	90	30	390	70	130	160	70

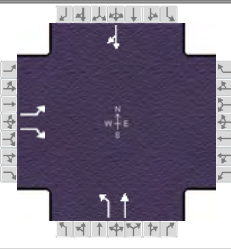
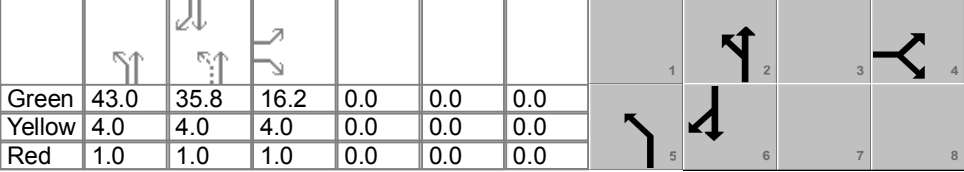
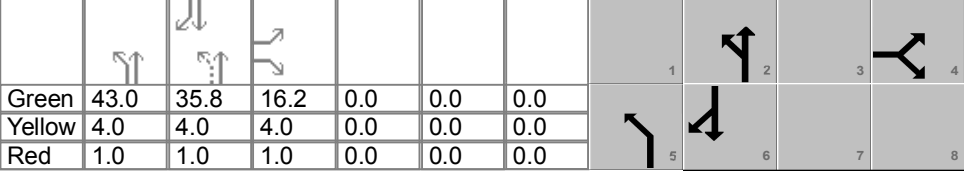
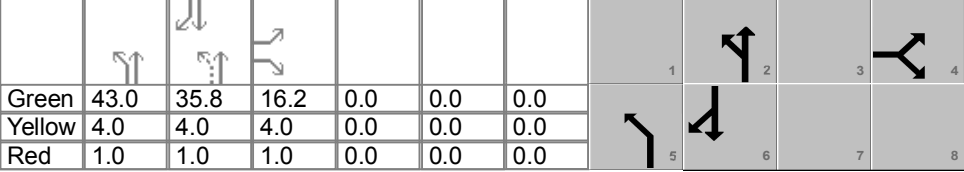
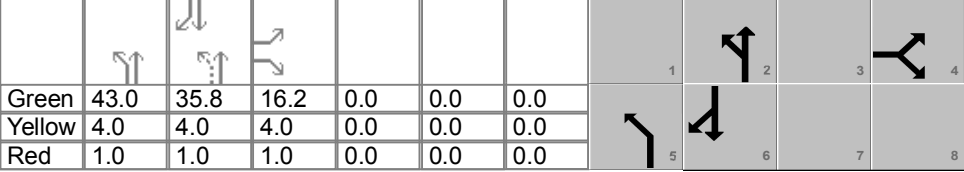
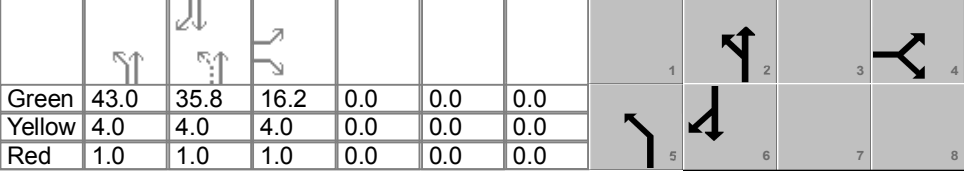
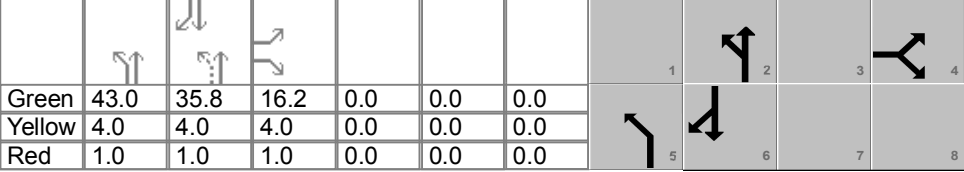
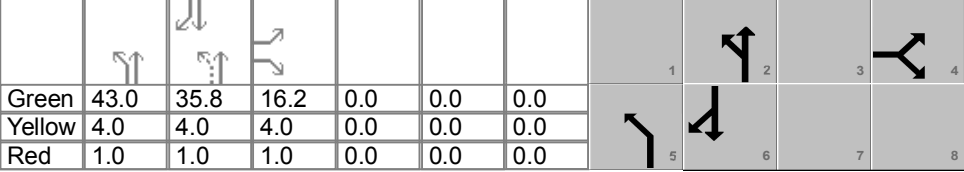
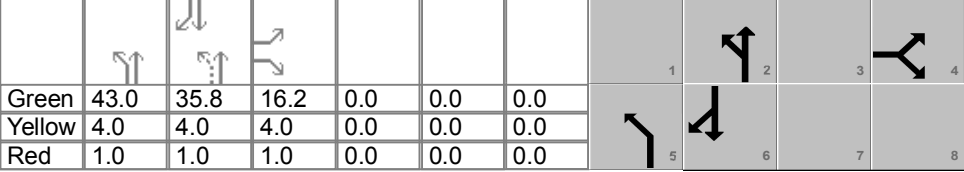
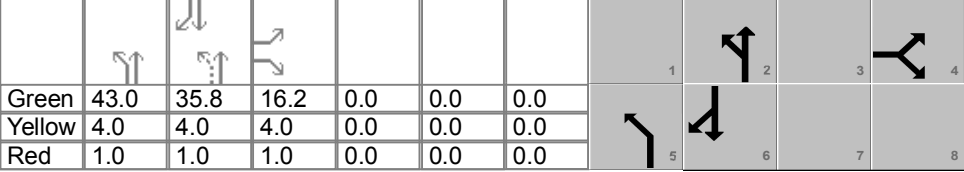
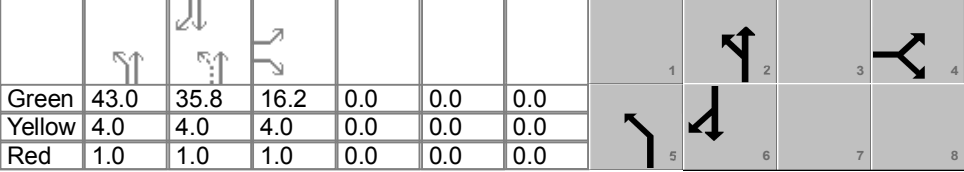
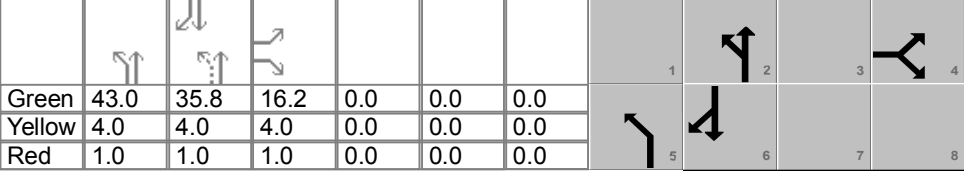
Signal Information											
Cycle, s	175.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On								
Force Mode	Fixed	Simult. Gap N/S	On								

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8	7	4
Case Number	1.1	4.0	1.1	4.0		6.3	1.0	4.0
Phase Duration, s	11.0	90.0	11.0	90.0		60.0	14.0	74.0
Change Period, ($Y+R_c$), s	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s	3.1	3.1	3.1	3.1		3.1	3.1	3.1
Queue Clearance Time (g_s), s	6.0	21.9	4.8	87.0		50.4	11.0	20.6
Green Extension Time (g_e), s	0.0	2.7	0.0	0.0		0.9	0.0	1.6
Phase Call Probability	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Max Out Probability	1.00	0.00	1.00	1.00		0.55	1.00	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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	78	322		56	856		33	511		144	256	
Adjusted Saturation Flow Rate (s), veh/h/ln	1707	1781		1707	1756		1098	1778		1723	1716	
Queue Service Time (g_s), s	4.0	19.9		2.8	85.0		3.9	48.4		9.0	18.6	
Cycle Queue Clearance Time (g_c), s	4.0	19.9		2.8	85.0		8.5	48.4		9.0	18.6	
Green Ratio (g/C)	0.52	0.49		0.52	0.49		0.31	0.31		0.38	0.39	
Capacity (c), veh/h	100	865		465	853		358	559		162	676	
Volume-to-Capacity Ratio (X)	0.780	0.372		0.119	1.003		0.093	0.915		0.891	0.378	
Back of Queue (Q), ft/ln (95 th percentile)	115.9	336.3		54.8	1369.7		51.2	820.3		265.1	314	
Back of Queue (Q), veh/ln (95 th percentile)	4.4	13.5		2.1	54.8		2.0	32.8		10.1	12.6	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	41.8	28.3		22.3	45.0		45.7	57.7		49.0	37.7	
Incremental Delay (d_2), s/veh	29.5	0.1		0.0	31.6		0.0	19.3		39.9	0.1	
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	71.2	28.4		22.3	76.6		45.8	77.1		88.9	37.9	
Level of Service (LOS)	E	C		C	F		D	E		F	D	
Approach Delay, s/veh / LOS	36.7		D	73.3		E	75.2		E	56.3		E
Intersection Delay, s/veh / LOS	64.3						E					

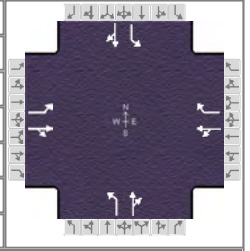
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	2.0	A	1.4	A	1.1	A

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Newtown		Time Period				PHF		0.90									
Urban Street		Round Bottom Road		Analysis Year		2042		Analysis Period		1> 7:00									
Intersection		Round Bottom Road at...		File Name		08-2042-AM.xus													
Project Description		2042 NO-BUILD - AM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				80		190				680	140			190	250				
Signal Information																			
Cycle, s	110.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	43.0	35.8	16.2	0.0	0.0	0.0									
				Yellow	4.0	4.0	4.0	0.0	0.0	0.0									
				Red	1.0	1.0	1.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						4						5		2				6	
Case Number						9.0						1.0		4.0				8.3	
Phase Duration, s						21.2						48.0		88.8				40.8	
Change Period, ($Y+R_c$), s						5.0						5.0		5.0				5.0	
Max Allow Headway (MAH), s						3.3						3.1		3.2				3.2	
Queue Clearance Time (g_s), s						16.8						45.0		4.6				36.5	
Green Extension Time (g_e), s						0.0						0.0		1.4				0.0	
Phase Call Probability						1.00						1.00		1.00				1.00	
Max Out Probability						1.00						1.00		0.00				1.00	
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				5	2			6	16				
Adjusted Flow Rate (v), veh/h				89		211				756	156			489					
Adjusted Saturation Flow Rate (s), veh/h/ln				1740		1548				1707	1721			1539					
Queue Service Time (g_s), s				5.1		14.8				43.0	2.6			34.5					
Cycle Queue Clearance Time (g_c), s				5.1		14.8				43.0	2.6			34.5					
Green Ratio (g/C)				0.15		0.15				0.73	0.76			0.33					
Capacity (c), veh/h				256		228				743	1311			501					
Volume-to-Capacity Ratio (X)				0.347		0.926				1.017	0.119			0.976					
Back of Queue (Q), ft/ln (95 th percentile)				100.7		329				908.2	33			620.9					
Back of Queue (Q), veh/ln (95 th percentile)				3.9		12.8				35.2	1.3			24.1					
Queue Storage Ratio (RQ) (95 th percentile)				0.00		0.00				0.00	0.00			0.00					
Uniform Delay (d_1), s/veh				42.1		46.3				28.4	3.4			36.7					
Incremental Delay (d_2), s/veh				0.3		39.2				37.5	0.0			33.8					
Initial Queue Delay (d_3), s/veh				0.0		0.0				0.0	0.0			0.0					
Control Delay (d), s/veh				42.4		85.5				65.8	3.4			70.5					
Level of Service (LOS)				D		F				F	A			E					
Approach Delay, s/veh / LOS				72.7		E	0.0			55.2		E	70.5		E				
Intersection Delay, s/veh / LOS				62.7						E									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B	2.2		B	0.6		A	2.3		B				
Bicycle LOS Score / LOS						F				2.0		A	1.3		A				

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency				Duration, h	0.25	
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other	
Jurisdiction	Newtown	Time Period		PHF	0.90	
Urban Street	Church Street	Analysis Year	2042	Analysis Period	1> 7:00	
Intersection	Church St at Valley Ave	File Name	10-2042-AM.xus			
Project Description	2042 NO-BUILD - AM Peak Hour					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	1	10	1	120	10	760	10	440	70	250	280	10

Signal Information											
Cycle, s	125.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	14.0	45.9	50.1	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
				Red	1.0	1.0	1.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2	1	6
Case Number		6.0		7.0		6.3	1.0	4.0
Phase Duration, s		55.1		55.1		50.9	19.0	69.9
Change Period, ($Y+R_c$), s		5.0		5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s		3.3		3.3		3.1	3.1	3.1
Queue Clearance Time (g_s), s		11.0		46.6		41.2	14.4	15.6
Green Extension Time (g_e), s		1.8		0.8		1.0	0.0	1.8
Phase Call Probability		1.00		1.00		1.00	1.00	1.00
Max Out Probability		0.00		0.92		0.53	1.00	0.00

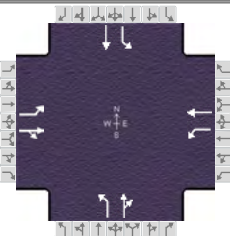
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	1	12			144	578	11	567		278	322	
Adjusted Saturation Flow Rate (s), veh/h/ln	1426	1869			1389	1548	1033	1712		1740	1743	
Queue Service Time (g_s), s	0.1	0.5			8.5	44.6	0.9	39.2		12.4	13.6	
Cycle Queue Clearance Time (g_c), s	9.0	0.5			8.9	44.6	0.9	39.2		12.4	13.6	
Green Ratio (g/C)	0.40	0.40			0.40	0.40	0.37	0.37		0.50	0.52	
Capacity (c), veh/h	527	749			612	621	437	628		297	905	
Volume-to-Capacity Ratio (X)	0.002	0.016			0.236	0.931	0.025	0.902		0.935	0.356	
Back of Queue (Q), ft/ln (95 th percentile)	1	9.8			128.8	679	9.6	646.5		310.7	230.3	
Back of Queue (Q), veh/ln (95 th percentile)	0.0	0.4			5.2	27.2	0.4	25.9		12.4	9.2	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	28.1	22.6			25.2	35.8	25.3	37.4		28.8	17.7	
Incremental Delay (d_2), s/veh	0.0	0.0			0.1	20.6	0.0	15.8		35.1	0.1	
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	28.1	22.6			25.3	56.4	25.3	53.2		63.8	17.8	
Level of Service (LOS)	C	C			C	E	C	D		E	B	
Approach Delay, s/veh / LOS	23.1	C		50.2	D		52.7	D		39.1	D	
Intersection Delay, s/veh / LOS	47.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.6	B	2.3	B
Bicycle LOS Score / LOS	0.5	A	1.7	A	1.4	A	1.5	A

PM

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other	
Jurisdiction		Newtown		Time Period				PHF		0.90	
Urban Street		SR 32		Analysis Year		2042		Analysis Period		1> 7:00	
Intersection		SR 32 at Round Bottom...		File Name		05-2042-PM.xus					
Project Description		2042 NO-BUILD - PM Peak Hour									



Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				120	690	50	50	350		60	50	40	600	50	

Signal Information															
Cycle, s	127.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On	Green	6.0	52.5	39.0	9.5	0.0	0.0					
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	4.0	0.0	0.0					
				Red	1.0	1.0	1.0	1.0	0.0	0.0					

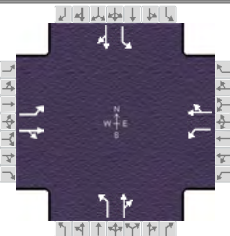
Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		5	2	1	6		8	7	4
Case Number		1.1	4.0	1.1	4.0		6.3	1.0	4.0
Phase Duration, s		11.0	57.5	11.0	57.5		14.5	44.0	58.5
Change Period, (Y+R _c), s		5.0	5.0	5.0	5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s		3.1	3.0	3.1	3.0		3.1	3.1	3.1
Queue Clearance Time (g _s), s		7.6	54.5	4.2	21.7		9.2	41.0	4.3
Green Extension Time (g _e), s		0.0	0.0	0.0	2.7		0.0	0.0	0.2
Phase Call Probability		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Max Out Probability		1.00	1.00	1.00	0.00		1.00	1.00	0.14

Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		5	2	12	1	6		3	8	18	7	4	
Adjusted Flow Rate (v), veh/h		133	822		56	389		67	100		667	56	
Adjusted Saturation Flow Rate (s), veh/h/ln		1757	1822		1774	1863		1356	1742		1757	1845	
Queue Service Time (g _s), s		5.6	52.5		2.2	19.7		6.1	7.2		39.0	2.3	
Cycle Queue Clearance Time (g _c), s		5.6	52.5		2.2	19.7		6.1	7.2		39.0	2.3	
Green Ratio (g/C)		0.46	0.41		0.46	0.41		0.07	0.07		0.40	0.42	
Capacity (c), veh/h		378	753		141	770		158	130		620	777	
Volume-to-Capacity Ratio (X)		0.353	1.091		0.395	0.505		0.422	0.767		1.076	0.071	
Back of Queue (Q), ft/ln (95 th percentile)		106.3	1198.7		43.1	346.1		96.8	176.1		966.5	45.9	
Back of Queue (Q), veh/ln (95 th percentile)		4.2	47.9		1.7	13.5		3.8	7.0		37.8	1.8	
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d ₁), s/veh		22.1	37.3		29.9	27.6		57.2	57.7		36.5	21.9	
Incremental Delay (d ₂), s/veh		0.2	60.5		0.7	0.2		0.7	21.6		58.3	0.0	
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		22.3	97.8		30.6	27.8		57.8	79.3		94.8	21.9	
Level of Service (LOS)		C	F		C	C		E	E		F	C	
Approach Delay, s/veh / LOS		87.2	F		28.2	C		70.7	E		89.2	F	
Intersection Delay, s/veh / LOS		75.2						E					

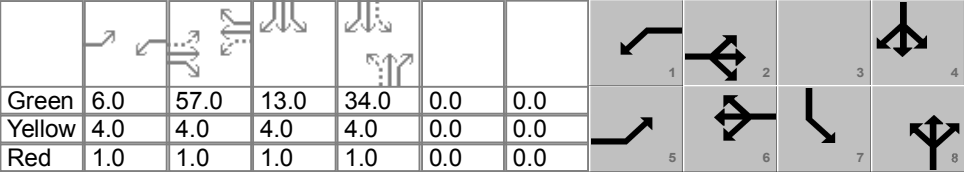
Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS		2.1	B	1.2	A	0.8	A	1.7	A

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other			
Jurisdiction		Newtown		Time Period				PHF		0.90			
Urban Street		SR 32		Analysis Year		2042		Analysis Period		1> 7:00			
Intersection		SR 32 at Church St		File Name		06-2042-PM.xus							
Project Description		2042 - NO-BUILD - PM Peak Hour											



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				100	640	30	110	350	80	20	230	70	120	370	50

Signal Information															
Cycle, s	130.0	Reference Phase	2	Green	6.0	57.0	13.0	34.0	0.0	0.0					
Offset, s	0	Reference Point	End	Yellow	4.0	4.0	4.0	4.0	0.0	0.0					
Uncoordinated	Yes	Simult. Gap E/W	On	Red	1.0	1.0	1.0	1.0	0.0	0.0					
Force Mode	Fixed	Simult. Gap N/S	On												

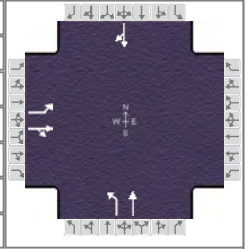
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				5	2	1	6		8	7	4
Case Number				1.1	4.0	1.1	4.0		6.3	1.0	4.0
Phase Duration, s				11.0	62.0	11.0	62.0		39.0	18.0	57.0
Change Period, (Y+R c), s				5.0	5.0	5.0	5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s				3.1	3.1	3.1	3.1		3.1	3.1	3.1
Queue Clearance Time (g s), s				6.5	51.3	7.0	28.3		24.0	8.6	28.8
Green Extension Time (g e), s				0.0	1.7	0.0	2.7		1.4	0.1	1.0
Phase Call Probability				1.00	1.00	1.00	1.00		1.00	1.00	1.00
Max Out Probability				1.00	0.49	1.00	0.00		0.06	0.21	0.43

Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h				111	744		122	478		22	333		133	467	
Adjusted Saturation Flow Rate (s), veh/h/ln				1774	1848		1774	1802		922	1788		1774	1824	
Queue Service Time (g s), s				4.5	49.3		5.0	26.3		2.6	22.0		6.6	26.8	
Cycle Queue Clearance Time (g c), s				4.5	49.3		5.0	26.3		11.4	22.0		6.6	26.8	
Green Ratio (g/C)				0.48	0.44		0.48	0.44		0.26	0.26		0.38	0.40	
Capacity (c), veh/h				339	810		169	790		234	468		329	729	
Volume-to-Capacity Ratio (X)				0.328	0.919		0.724	0.605		0.095	0.713		0.405	0.640	
Back of Queue (Q), ft/ln (95 th percentile)				84.6	823.8		119.5	422		27.3	386.4		128.8	440.5	
Back of Queue (Q), veh/ln (95 th percentile)				3.3	33.0		4.7	16.9		1.1	15.5		5.1	17.6	
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d 1), s/veh				21.9	34.3		30.3	27.9		43.3	43.6		29.8	31.4	
Incremental Delay (d 2), s/veh				0.2	15.1		12.5	0.9		0.1	4.4		0.3	1.5	
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				22.1	49.5		42.8	28.8		43.4	47.9		30.1	32.9	
Level of Service (LOS)				C	D		D	C		D	D		C	C	
Approach Delay, s/veh / LOS				45.9	D		31.7	C		47.7	D		32.3	C	
Intersection Delay, s/veh / LOS				39.2						D					

Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.3	B		2.3	B		2.3	B		2.3	B	
Bicycle LOS Score / LOS				1.9	A		1.5	A		1.1	A		1.5	A	

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Newtown	Time Period		PHF	0.90
Urban Street	Round Bottom Road	Analysis Year	2042	Analysis Period	1> 7:00
Intersection	Rnd Btm at Valley Ave	File Name	08-2042-PM.xus		
Project Description	2042 NO-BUILD - PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	220	0	560				320	190			200	120

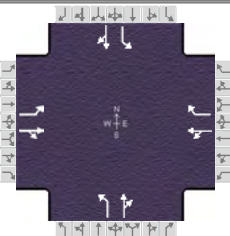
Signal Information											
Cycle, s	110.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	11.0	40.0	44.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
				Red	1.0	1.0	1.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		10.0			1.0	4.0		8.3
Phase Duration, s		49.0			16.0	61.0		45.0
Change Period, ($Y+R_c$), s		5.0			5.0	5.0		5.0
Max Allow Headway (MAH), s		3.3			3.1	3.1		3.1
Queue Clearance Time (g_s), s		30.1			13.0	9.4		21.5
Green Extension Time (g_e), s		1.5			0.0	1.1		1.0
Phase Call Probability		1.00			1.00	1.00		1.00
Max Out Probability		0.01			1.00	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	4	14				5	2		6		16
Adjusted Flow Rate (v), veh/h	244	467					356	211		356		
Adjusted Saturation Flow Rate (s), veh/h/ln	1757	1563					1740	1754		1633		
Queue Service Time (g_s), s	10.7	28.1					11.0	7.4		19.5		
Cycle Queue Clearance Time (g_c), s	10.7	28.1					11.0	7.4		19.5		
Green Ratio (g/C)	0.40	0.40					0.48	0.51		0.36		
Capacity (c), veh/h	703	625					426	893		594		
Volume-to-Capacity Ratio (X)	0.348	0.746					0.834	0.236		0.599		
Back of Queue (Q), ft/ln (95 th percentile)	198.6	407.2					230.1	132.2		303.4		
Back of Queue (Q), veh/ln (95 th percentile)	7.8	16.3					9.0	5.2		12.1		
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00					0.00	0.00		0.00		
Uniform Delay (d_1), s/veh	23.0	28.2					26.4	15.1		28.5		
Incremental Delay (d_2), s/veh	0.1	4.3					12.6	0.1		1.2		
Initial Queue Delay (d_3), s/veh	0.0	0.0					0.0	0.0		0.0		
Control Delay (d), s/veh	23.1	32.6					39.0	15.1		29.7		
Level of Service (LOS)	C	C					D	B		C		
Approach Delay, s/veh / LOS	29.3	C		0.0			30.1	C		29.7	C	
Intersection Delay, s/veh / LOS	29.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.2	B	1.9	A	2.5	B
Bicycle LOS Score / LOS	1.7	A			1.4	A	1.1	A

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Newtown		Time Period				PHF		0.90									
Urban Street		Church Street		Analysis Year		2042		Analysis Period		1> 7:00									
Intersection		Valley Ave		File Name		10-2042-PM.xus													
Project Description		2042 NO-BUILD - PM Peak Hour																	
																			
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				10	10	10	80	1	400	1	310	120	630	500	10				
Signal Information																			
Cycle, s	125.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On	Green	38.0	42.0	30.0	0.0	0.0	0.0									
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0									
				Red	1.0	1.0	1.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						4				8				2		1		6	
Case Number						6.0				7.0				6.3		1.0		4.0	
Phase Duration, s						35.0				35.0				47.0		43.0		90.0	
Change Period, (Y+R c), s						5.0				5.0				5.0		5.0		5.0	
Max Allow Headway (MAH), s						3.3				3.3				3.1		3.1		3.1	
Queue Clearance Time (g s), s						10.7				22.3				33.9		40.0		20.7	
Green Extension Time (g e), s						0.8				0.6				1.7		0.0		2.1	
Phase Call Probability						1.00				1.00				1.00		1.00		1.00	
Max Out Probability						0.00				0.06				0.20		1.00		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	4	14	3	8	18	5	2	12	1	6	16				
Adjusted Flow Rate (v), veh/h				11	22			90	278	1	478		700	567					
Adjusted Saturation Flow Rate (s), veh/h/ln				1439	1743			1333	1579	849	1720		1774	1782					
Queue Service Time (g s), s				0.8	1.2			6.6	20.3	0.1	31.9		38.0	18.7					
Cycle Queue Clearance Time (g c), s				8.7	1.2			7.9	20.3	0.1	31.9		38.0	18.7					
Green Ratio (g/C)				0.24	0.24			0.24	0.24	0.34	0.34		0.66	0.68					
Capacity (c), veh/h				312	418			377	379	343	578		670	1212					
Volume-to-Capacity Ratio (X)				0.036	0.053			0.239	0.733	0.003	0.827		1.044	0.468					
Back of Queue (Q), ft/ln (95 th percentile)				12.9	23.7			102.6	332.2	1	523.2		963.4	273.4					
Back of Queue (Q), veh/ln (95 th percentile)				0.5	0.9			4.1	13.3	0.0	20.9		38.5	10.9					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				42.7	36.6			39.6	43.8	27.6	38.2		30.8	9.4					
Incremental Delay (d 2), s/veh				0.0	0.0			0.1	6.3	0.0	9.1		46.9	0.1					
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				42.7	36.6			39.7	50.1	27.6	47.2		77.7	9.5					
Level of Service (LOS)				D	D			D	D	C	D		F	A					
Approach Delay, s/veh / LOS				38.6	D		47.6	D		47.2	D		47.2	D					
Intersection Delay, s/veh / LOS				47.1						D									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3	B		2.3	B		2.5	B		2.2	B					
Bicycle LOS Score / LOS				0.5	A		1.1	A		1.3	A		2.6	B					

SR 125/SR 32 AREA

2015

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HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other	
Jurisdiction		Anderson Twp (ODOT)		Time Period				PHF		0.90	
Urban Street		SR 32		Analysis Year		2016		Analysis Period		1> 7:00	
Intersection		SR 32 at Clough Pike		File Name		07-Existing-AM.xus					
Project Description		Existing AM Peak Hour									

Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h							690	0	10		310			600	

Signal Information														
Cycle, s	130.0	Reference Phase	2											
Offset, s	0	Reference Point	End											
Uncoordinated	Yes	Simult. Gap E/W	On											
Force Mode	Fixed	Simult. Gap N/S	On											
Green	58.0	58.0	0.0	0.0	0.0	0.0								
Yellow	4.5	4.5	0.0	0.0	0.0	0.0								
Red	2.5	2.5	0.0	0.0	0.0	0.0								

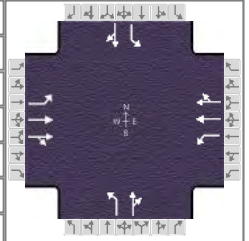
Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase					8		2		6
Case Number					12.0		8.0		8.0
Phase Duration, s					65.0		65.0		65.0
Change Period, (Y+R _c), s					7.0		7.0		7.0
Max Allow Headway (MAH), s					3.1		3.0		3.0
Queue Clearance Time (g _s), s					57.4		18.5		44.6
Green Extension Time (g _e), s					0.2		2.0		1.9
Phase Call Probability					1.00		1.00		1.00
Max Out Probability					1.00		0.00		0.03

Movement Group Results		EB			WB			NB			SB			
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R	
Assigned Movement					3	8	18		2			6		
Adjusted Flow Rate (v), veh/h						778			344			667		
Adjusted Saturation Flow Rate (s), veh/h/ln						1788			1845			1792		
Queue Service Time (g _s), s						55.4			16.5			42.6		
Cycle Queue Clearance Time (g _c), s						55.4			16.5			42.6		
Green Ratio (g/C)						0.45			0.45			0.45		
Capacity (c), veh/h						798			823			800		
Volume-to-Capacity Ratio (X)						0.975			0.419			0.834		
Back of Queue (Q), ft/ln (95 th percentile)						942.6			289.2			668.9		
Back of Queue (Q), veh/ln (95 th percentile)						37.7			11.6			26.8		
Queue Storage Ratio (RQ) (95 th percentile)						0.00			0.00			0.00		
Uniform Delay (d ₁), s/veh						35.3			24.5			31.7		
Incremental Delay (d ₂), s/veh						25.6			0.1			7.1		
Initial Queue Delay (d ₃), s/veh						0.0			0.0			0.0		
Control Delay (d), s/veh						60.8			24.6			38.9		
Level of Service (LOS)						E			C			D		
Approach Delay, s/veh / LOS		0.0			60.8		E	24.6		C	38.9		D	
Intersection Delay, s/veh / LOS		45.7							D					

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.2	B	2.2	B	1.4	A	1.9	A
Bicycle LOS Score / LOS				1.8	A	1.1	A	1.6	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Jul 26, 2016	Area Type	Other
Jurisdiction	Anderson Twp (ODOT)	Time Period		PHF	0.90
Urban Street	Beechmont Avenue (SR...	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	SR 125 at Elstun Road	File Name	22-Existing-AM.xus		
Project Description	Existing AM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	570	10	90	1950	60	150	10	40	30	10	10

Signal Information																																																																																																													
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Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		64.5		64.5		25.5		25.5
Change Period, ($Y+R_c$), s		5.5		5.5		6.5		6.5
Max Allow Headway (MAH), s		3.1		3.1		3.2		3.2
Queue Clearance Time (g_s), s		57.8		52.1		13.0		6.5
Green Extension Time (g_e), s		1.0		4.9		0.3		0.4
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		1.00		0.84		0.10		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	11	323	321	100	1117	1117	167	56		33	22	
Adjusted Saturation Flow Rate (s), veh/h/ln	169	1845	1833	767	1827	1807	1370	1612		1256	1599	
Queue Service Time (g_s), s	5.7	6.6	6.6	5.6	48.7	50.1	10.0	2.5		2.0	1.0	
Cycle Queue Clearance Time (g_c), s	55.8	6.6	6.6	12.2	48.7	50.1	11.0	2.5		4.5	1.0	
Green Ratio (g/C)	0.66	0.66	0.66	0.66	0.66	0.66	0.21	0.21		0.21	0.21	
Capacity (c), veh/h	97	1209	1202	527	1198	1185	354	340		310	338	
Volume-to-Capacity Ratio (X)	0.115	0.267	0.267	0.190	0.932	0.942	0.471	0.163		0.108	0.066	
Back of Queue (Q), ft/ln (95 th percentile)	10.9	99.9	97.1	39.2	701	706.4	149.5	43.3		27.6	17	
Back of Queue (Q), veh/ln (95 th percentile)	0.4	3.9	3.9	1.5	27.4	28.3	5.8	1.7		1.1	0.7	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	39.1	6.5	6.5	9.0	13.7	14.0	32.8	29.0		30.9	28.4	
Incremental Delay (d_2), s/veh	0.2	0.0	0.0	0.1	12.8	14.3	0.4	0.1		0.1	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	39.3	6.5	6.5	9.1	26.5	28.3	33.2	29.1		30.9	28.4	
Level of Service (LOS)	D	A	A	A	C	C	C	C		C	C	
Approach Delay, s/veh / LOS	7.1	A		26.6	C		32.1	C		29.9	C	
Intersection Delay, s/veh / LOS	23.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.0	A	2.4	B	0.9	A	0.6	A

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to EB SR 125			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		Existing			
Project Description Ramp X1-A									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 440 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				540			
		Ramp Volume, V _R				50			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	540	0.90	Level	3	0	0.985	1.00	609	
Ramp	50	0.90	Level	3	0	0.985	1.00	56	
UpStream	440	0.90	Level	3	0	0.985	1.00	496	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 609 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	665	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	665	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 7.5 (pc/mi/ln) LOS = A (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.294 (Exhibit 13-11) S _R = 51.2 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.2 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		EB SR 125 off-ramp to NB SR 32			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X1-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 50 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				980			
		Ramp Volume, V_R				440			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				30.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	980	0.90	Level	3	0	0.985	1.00	1105	
Ramp	440	0.90	Level	3	0	0.985	1.00	496	
UpStream									
DownStream	50	0.90	Level	3	0	0.985	1.00	56	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1105 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1105	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	609	Exhibit 13-8	4500	No		
			V_R	496	Exhibit 13-10	2000	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1105	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 9.3 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.538 (Exhibit 13-12) $S_R =$ 48.0 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 48.0 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		WB SR 125 off-ramp to NB SR 32			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X1-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1100 ft $V_D =$ 1240 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				2110			
		Ramp Volume, V_R				110			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	2110	0.90	Level	3	0	0.985	1.00	2380	
Ramp	110	0.90	Level	3	0	0.985	1.00	124	
UpStream									
DownStream	1240	0.90	Level	3	0	0.985	1.00	1398	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 2380 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	2380	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	2256	Exhibit 13-8	4500	No	
				V_R	124	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	2380	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 20.2 (pc/mi/ln) LOS = C (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.309 (Exhibit 13-12) $S_R =$ 51.0 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 51.0 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to WB SR 125			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		Existing			
Project Description Ramp X1-D									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off	
		Ramp Number of Lanes, N				1			
L _{up} = 1100 ft V _u = 110 veh/h		Acceleration Lane Length, L _A				500		L _{down} = ft V _D = veh/h	
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				2000			
		Ramp Volume, V _R				1240			
		Freeway Free-Flow Speed, S _{FF}				55.0			
		Ramp Free-Flow Speed, S _{FR}				35.0			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2000	0.90	Level	3	0	0.985	1.00	2256	
Ramp	1240	0.90	Level	3	0	0.985	1.00	1398	
UpStream	110	0.90	Level	3	0	0.985	1.00	124	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 2256 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	3654	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3654	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
D _R = 30.2 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = D (Exhibit 13-2)					LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.437 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 49.3 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 49.3 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

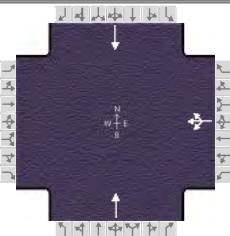
BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>Wooster Rd to SR 32</i>		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year <i>Existing</i>		
Project Description <i>F4 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	980	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	<i>Level</i>	
DDHV = AADT x K x D		veh/h	Grade % Length	<i>mi</i>	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	553	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	10.1	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To Wooster Rd to SR 32		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year Existing		
Project Description F4 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	3240	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	1827	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	33.2	pc/mi/ln	D = v _p / S		
LOS	D		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

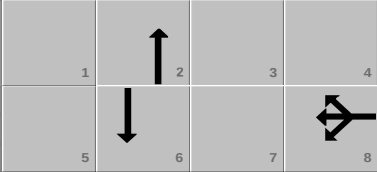
PM

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other	
Jurisdiction		Newtown		Time Period				PHF		0.90	
Urban Street		SR 32		Analysis Year		2016		Analysis Period		1> 7:00	
Intersection		SR 32 at Clough Pike		File Name		07-Existing-PM.xus					
Project Description		Existing PM Peak Hour									



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h							370	0	10		650			350	

Signal Information															
Cycle, s	105.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On												
Force Mode	Fixed	Simult. Gap N/S	On												
Green	62.0	30.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

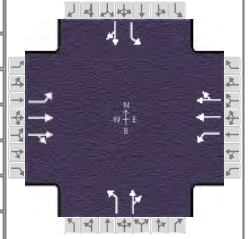
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase							8		2		6
Case Number							12.0		8.0		8.0
Phase Duration, s							36.0		69.0		69.0
Change Period, (Y+R _c), s							5.5		7.0		7.0
Max Allow Headway (MAH), s							3.1		3.0		3.0
Queue Clearance Time (g _s), s							25.1		28.8		13.3
Green Extension Time (g _e), s							0.5		2.3		2.3
Phase Call Probability							1.00		1.00		1.00
Max Out Probability							0.22		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							3	8	18		2			6	
Adjusted Flow Rate (v), veh/h								422			722			389	
Adjusted Saturation Flow Rate (s), veh/h/ln								1786			1881			1863	
Queue Service Time (g _s), s								23.1			26.8			11.3	
Cycle Queue Clearance Time (g _c), s								23.1			26.8			11.3	
Green Ratio (g/C)								0.29			0.59			0.59	
Capacity (c), veh/h								519			1111			1100	
Volume-to-Capacity Ratio (X)								0.814			0.650			0.354	
Back of Queue (Q), ft/ln (95 th percentile)								411.7			401			194.4	
Back of Queue (Q), veh/ln (95 th percentile)								16.5			16.0			7.8	
Queue Storage Ratio (RQ) (95 th percentile)								0.00			0.00			0.00	
Uniform Delay (d ₁), s/veh								34.6			14.3			11.1	
Incremental Delay (d ₂), s/veh								9.0			1.1			0.1	
Initial Queue Delay (d ₃), s/veh								0.0			0.0			0.0	
Control Delay (d), s/veh								43.6			15.4			11.2	
Level of Service (LOS)								D			B			B	
Approach Delay, s/veh / LOS				0.0			43.6		D	15.4		B	11.2		B
Intersection Delay, s/veh / LOS				22.1						C					

Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.2		B	2.2		B	1.4		A	1.9		A
Bicycle LOS Score / LOS							1.2		A	1.7		A	1.1		A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Jul 26, 2016	Area Type	Other
Jurisdiction	Anderson Twp (ODOT)	Time Period		PHF	0.90
Urban Street	Beechmont Avenue (SR...	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	SR 125 at Elstun Road	File Name	22-Existing-PM.xus		
Project Description	Existing PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	40	1670	80	60	730	50	70	10	90	80	30	30

Signal Information											
Cycle, s	110.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	79.0	19.0	0.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.5	3.0	0.0	0.0	0.0	0.0	
				Red	2.0	3.5	0.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		84.5		84.5		25.5		25.5
Change Period, ($Y+R_c$), s		5.5		5.5		6.5		6.5
Max Allow Headway (MAH), s		3.3		3.3		3.3		3.3
Queue Clearance Time (g_s), s		36.3		63.2		11.5		15.9
Green Extension Time (g_e), s		12.9		8.8		0.5		0.2
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.17		0.57		0.05		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	44	972	972	67	438	428	78	111		89	67	
Adjusted Saturation Flow Rate (s), veh/h/ln	642	1881	1851	229	1881	1838	1342	1619		1289	1726	
Queue Service Time (g_s), s	3.0	33.2	34.3	26.9	9.4	9.4	5.8	6.7		7.2	3.7	
Cycle Queue Clearance Time (g_c), s	12.4	33.2	34.3	61.2	9.4	9.4	9.5	6.7		13.9	3.7	
Green Ratio (g/C)	0.72	0.72	0.72	0.72	0.72	0.72	0.17	0.17		0.17	0.17	
Capacity (c), veh/h	472	1351	1329	158	1351	1320	253	280		210	298	
Volume-to-Capacity Ratio (X)	0.094	0.720	0.731	0.421	0.324	0.324	0.308	0.397		0.424	0.224	
Back of Queue (Q), ft/ln (95 th percentile)	17.8	434.9	440.2	65.6	143.3	139	87.6	120.1		105.5	69.7	
Back of Queue (Q), veh/ln (95 th percentile)	0.7	17.3	17.6	2.6	5.7	5.6	3.5	4.8		4.2	2.8	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	8.0	9.0	9.2	27.4	5.7	5.7	43.2	40.4		46.6	39.2	
Incremental Delay (d_2), s/veh	0.0	1.6	1.8	0.7	0.1	0.1	0.3	0.3		0.5	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.0	10.7	11.0	28.0	5.7	5.7	43.5	40.8		47.1	39.3	
Level of Service (LOS)	A	B	B	C	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	10.8	B		7.3	A		41.9	D		43.8	D	
Intersection Delay, s/veh / LOS	13.2						B					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2	B		2.2	B		2.9	C		2.9	C	
Bicycle LOS Score / LOS	2.1	B		1.3	A		0.8	A		0.7	A	

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to EB SR 125			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		Existing			
Project Description Ramp X1-A									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 1190 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				1680			
		Ramp Volume, V _R				110			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1680	0.90	Level	1	0	0.995	1.00	1876	
Ramp	110	0.90	Level	1	0	0.995	1.00	123	
UpStream	1190	0.90	Level	1	0	0.995	1.00	1329	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 1876 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1999	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1999	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 17.9 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.315 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 50.9 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 50.9 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		EB SR 125 off-ramp to NB SR 32			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X1-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 110 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				2870			
		Ramp Volume, V_R				1190			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				30.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	2870	0.90	Level	1	0	0.995	1.00	3205	
Ramp	1190	0.90	Level	1	0	0.995	1.00	1329	
UpStream									
DownStream	110	0.90	Level	1	0	0.995	1.00	123	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 3205 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	3205	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	1876	Exhibit 13-8	4500	No		
			V_R	1329	Exhibit 13-10	2000	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	3205	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 27.3 (pc/mi/ln) LOS = C (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.613 (Exhibit 13-12) $S_R =$ 47.0 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 47.0 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		WB SR 125 off-ramp to NB SR 32			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X1-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1100 ft $V_D =$ 610 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				830			
		Ramp Volume, V_R				140			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	830	0.90	Level	1	0	0.995	1.00	927	
Ramp	140	0.90	Level	1	0	0.995	1.00	156	
UpStream									
DownStream	610	0.90	Level	1	0	0.995	1.00	681	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 927 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	927	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	771	Exhibit 13-8	4500	No	
				V_R	156	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	927	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 7.7 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.312 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to WB SR 125			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		Existing			
Project Description Ramp X1-D									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 1100 ft V _u = 140 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				690			
		Ramp Volume, V _R				610			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	690	0.90	Level	1	0	0.995	1.00	771	
Ramp	610	0.90	Level	1	0	0.995	1.00	681	
UpStream	140	0.90	Level	1	0	0.995	1.00	156	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 771 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1452	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1452	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 13.4 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.303 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>Wooster Rd to SR 32</i>		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year <i>Existing</i>		
Project Description <i>F4 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	2870	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	<i>Level</i>	
DDHV = AADT x K x D		veh/h	Grade % Length	<i>mi</i>	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.995	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	1602	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	29.1	pc/mi/ln	D = v _p / S		
LOS	D		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

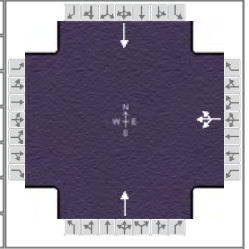
BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To Wooster Rd to SR 32		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year Existing		
Project Description F4 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1300	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.995	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	726	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	13.2	pc/mi/ln	D = v _p / S		
LOS	B		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

2022

AM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 19, 2016	Area Type	Other
Jurisdiction	Anderson Twp (ODOT)	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	SR 32 at Clough Pike	File Name	07-2022-AM.xus		
Project Description	2022 NO-BUILD - AM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				760	0	10		340			670	

Signal Information											
Cycle, s	130.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	54.5	61.5	0.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.5	4.5	0.0	0.0	0.0	0.0	
				Red	2.5	2.5	0.0	0.0	0.0	0.0	

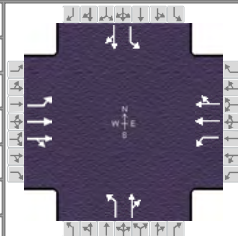
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2		6
Case Number				12.0		8.0		8.0
Phase Duration, s				68.5		61.5		61.5
Change Period, ($Y+R_c$), s				7.0		7.0		7.0
Max Allow Headway (MAH), s				3.1		3.0		3.0
Queue Clearance Time (g_s), s				63.5		21.4		55.6
Green Extension Time (g_e), s				0.0		2.4		0.0
Phase Call Probability				1.00		1.00		1.00
Max Out Probability				1.00		0.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18		2			6	
Adjusted Flow Rate (v), veh/h					856			378			744	
Adjusted Saturation Flow Rate (s), veh/h/ln					1789			1845			1792	
Queue Service Time (g_s), s					61.5			19.4			53.6	
Cycle Queue Clearance Time (g_c), s					61.5			19.4			53.6	
Green Ratio (g/C)					0.47			0.42			0.42	
Capacity (c), veh/h					846			773			751	
Volume-to-Capacity Ratio (X)					1.011			0.489			0.991	
Back of Queue (Q), ft/ln (95 th percentile)					1083.6			332.6			947.7	
Back of Queue (Q), veh/ln (95 th percentile)					43.3			13.3			37.9	
Queue Storage Ratio (RQ) (95 th percentile)					0.00			0.00			0.00	
Uniform Delay (d_1), s/veh					34.3			27.6			37.5	
Incremental Delay (d_2), s/veh					33.7			0.2			30.4	
Initial Queue Delay (d_3), s/veh					0.0			0.0			0.0	
Control Delay (d), s/veh					67.9			27.7			67.9	
Level of Service (LOS)					F			C			E	
Approach Delay, s/veh / LOS	0.0			67.9	E		27.7	C		67.9	E	
Intersection Delay, s/veh / LOS	60.2						E					

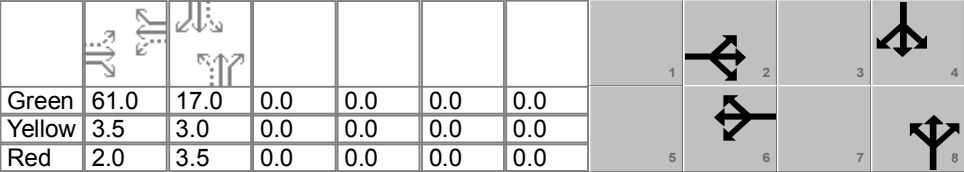
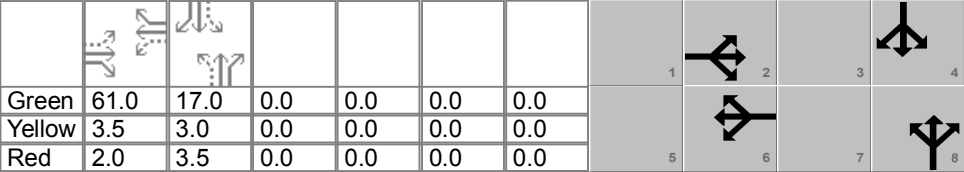
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	1.4	A	1.9	A
Bicycle LOS Score / LOS			1.9	A	1.1	A	1.7	A

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Oct 19, 2016		Area Type		Other			
Jurisdiction		Anderson Twp (ODOT)		Time Period				PHF		0.90			
Urban Street		Beechmont Avenue (SR...		Analysis Year		2022		Analysis Period		1> 7:00			
Intersection		SR 125 at Elstun Road		File Name		22-2022-AM.xus							
Project Description		2022 NO-BUILD - AM Peak Hour											



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				40	580	30	90	2140	60	190	10	40	30	10	20

Signal Information															
Cycle, s	90.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On												
Force Mode	Fixed	Simult. Gap N/S	On												
Green	61.0	17.0	0.0	0.0	0.0	0.0	0.0								
Yellow	3.5	3.0	0.0	0.0	0.0	0.0	0.0								
Red	2.0	3.5	0.0	0.0	0.0	0.0	0.0								

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			2		6		8		4
Case Number			6.0		6.0		6.0		6.0
Phase Duration, s			66.5		66.5		23.5		23.5
Change Period, (Y+R c), s			5.5		5.5		6.5		6.5
Max Allow Headway (MAH), s			3.3		3.3		3.2		3.2
Queue Clearance Time (g s), s			63.0		62.4		17.3		6.7
Green Extension Time (g e), s			0.0		0.0		0.0		0.5
Phase Call Probability			1.00		1.00		1.00		1.00
Max Out Probability			1.00		1.00		1.00		0.01

Movement Group Results		EB			WB			NB			SB						
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement		5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h		44	342	336	100	1222	1222	211	56		33	33					
Adjusted Saturation Flow Rate (s), veh/h/ln		137	1845	1812	744	1827	1809	1357	1612		1256	1556					
Queue Service Time (g s), s		0.6	6.6	6.6	5.5	58.6	60.4	13.7	2.6		2.1	1.6					
Cycle Queue Clearance Time (g c), s		61.0	6.6	6.6	12.1	58.6	60.4	15.3	2.6		4.7	1.6					
Green Ratio (g/C)		0.68	0.68	0.68	0.68	0.68	0.68	0.19	0.19		0.19	0.19					
Capacity (c), veh/h		81	1250	1228	530	1238	1226	312	305		281	294					
Volume-to-Capacity Ratio (X)		0.549	0.273	0.274	0.189	0.987	0.997	0.676	0.182		0.119	0.113					
Back of Queue (Q), ft/ln (95 th percentile)		49.5	96	92.3	36.7	877.4	890.1	215.1	44.8		28.5	26.5					
Back of Queue (Q), veh/ln (95 th percentile)		1.9	3.8	3.7	1.4	34.3	35.6	8.4	1.8		1.1	1.1					
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00					
Uniform Delay (d 1), s/veh		45.0	5.7	5.7	8.1	14.1	14.4	36.6	30.7		32.6	30.3					
Incremental Delay (d 2), s/veh		4.5	0.0	0.0	0.1	22.4	24.9	4.7	0.1		0.1	0.1					
Initial Queue Delay (d 3), s/veh		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0					
Control Delay (d), s/veh		49.5	5.8	5.8	8.2	36.5	39.3	41.3	30.8		32.7	30.3					
Level of Service (LOS)		D	A	A	A	D	D	D	C		C	C					
Approach Delay, s/veh / LOS		8.5		A		36.7		D		39.1		D		31.5		C	
Intersection Delay, s/veh / LOS		31.1												C			

Multimodal Results		EB		WB		NB		SB									
Pedestrian LOS Score / LOS		2.2		B		2.2		B		2.8		C		2.8		C	
Bicycle LOS Score / LOS		1.1		A		2.6		B		0.9		A		0.6		A	

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to EB SR 125			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X1-A									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 490 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				590			
		Ramp Volume, V _R				60			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	590	0.90	Level	3	0	0.985	1.00	665	
Ramp	60	0.90	Level	3	0	0.985	1.00	68	
UpStream	490	0.90	Level	3	0	0.985	1.00	553	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 665 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	733	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	733	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 8.0 (pc/mi/ln) LOS = A (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.294 (Exhibit 13-11) S _R = 51.2 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.2 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		EB SR 125 off-ramp to NB SR 32			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X1-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 60 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				1080			
		Ramp Volume, V_R				490			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				30.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	1080	0.90	Level	3	0	0.985	1.00	1218	
Ramp	490	0.90	Level	3	0	0.985	1.00	553	
UpStream									
DownStream	60	0.90	Level	3	0	0.985	1.00	68	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1218 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1218	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	665	Exhibit 13-8	4500	No		
			V_R	553	Exhibit 13-10	2000	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1218	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 10.2 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.543 (Exhibit 13-12) $S_R =$ 47.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 47.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		WB SR 125 off-ramp to NB SR 32			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X1-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1100 ft $V_D =$ 1370 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				2350			
		Ramp Volume, V_R				110			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	2350	0.90	Level	3	0	0.985	1.00	2650	
Ramp	110	0.90	Level	3	0	0.985	1.00	124	
UpStream									
DownStream	1370	0.90	Level	3	0	0.985	1.00	1545	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 2650 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	2650	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	2526	Exhibit 13-8	4500	No	
				V_R	124	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	2650	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 22.5 (pc/mi/ln) LOS = C (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.309 (Exhibit 13-12) $S_R =$ 51.0 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 51.0 mph (Exhibit 13-13)				

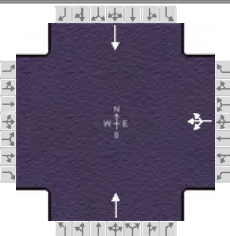
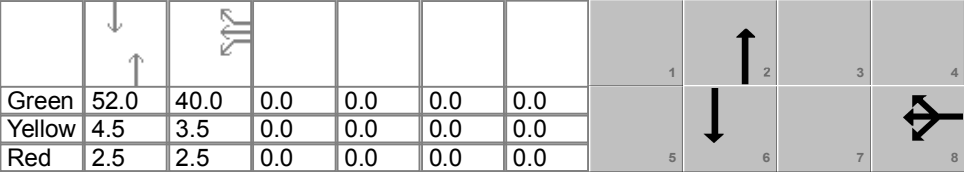
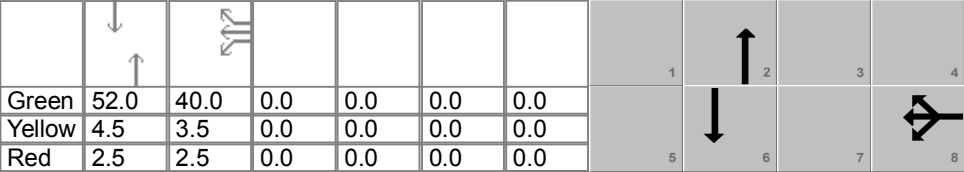
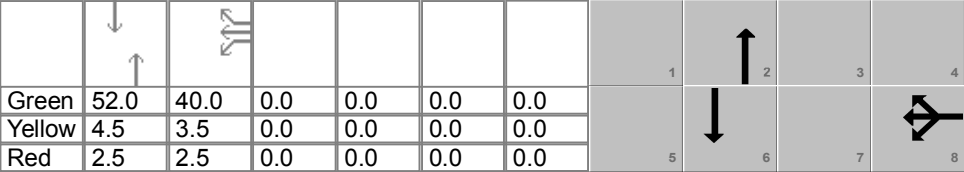
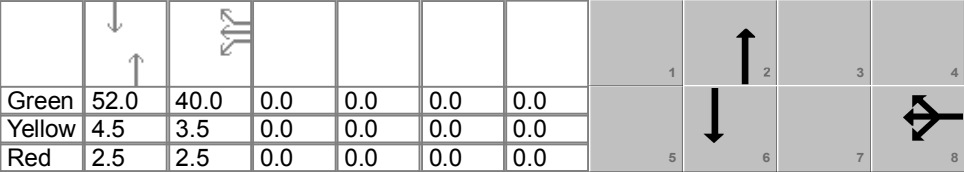
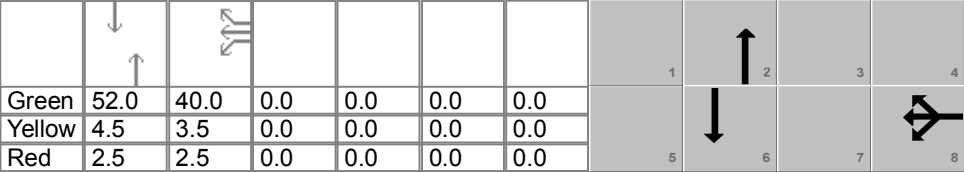
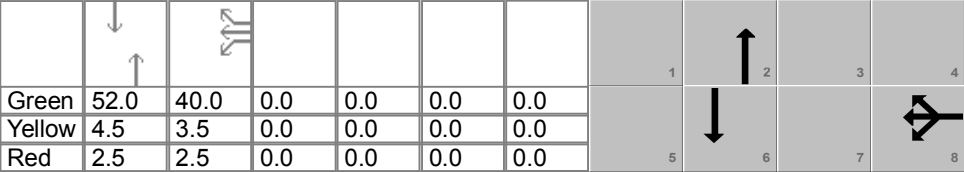
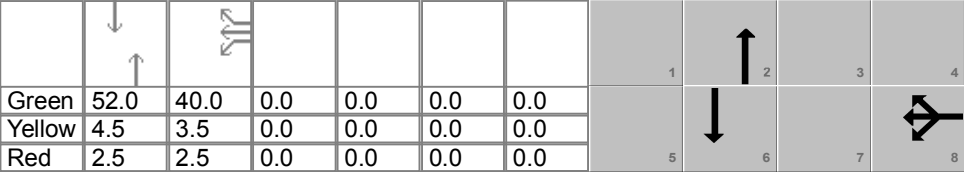
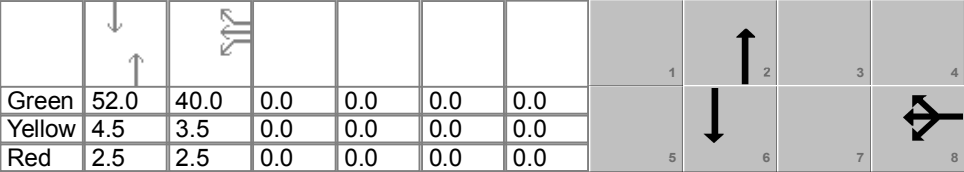
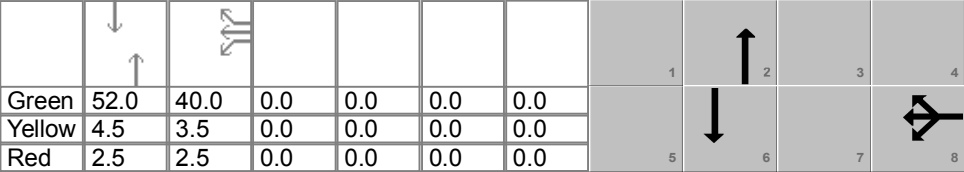
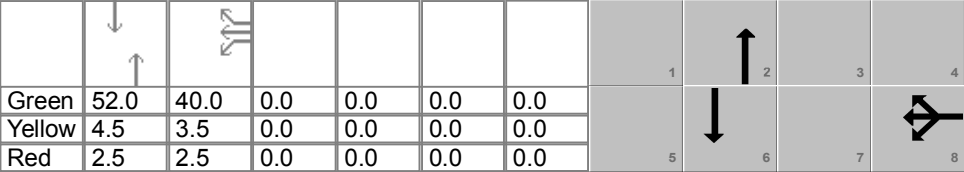
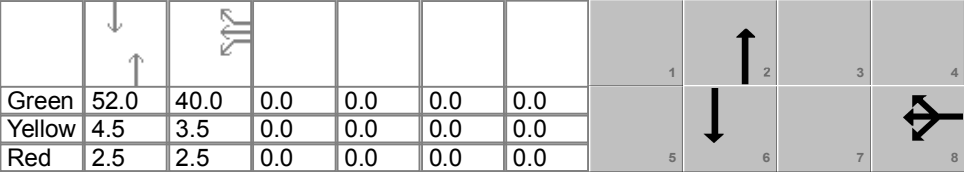
RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to WB SR 125			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X1-D									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 1100 ft V _u = 110 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				2240			
		Ramp Volume, V _R				1370			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2240	0.90	Level	3	0	0.985	1.00	2526	
Ramp	1370	0.90	Level	3	0	0.985	1.00	1545	
UpStream	110	0.90	Level	3	0	0.985	1.00	124	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 2526 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	4071	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	4071	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 33.4 (pc/mi/ln) LOS = D (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.515 (Exhibit 13-11) S _R = 48.3 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 48.3 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>Wooster Rd to SR 32</i>		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year <i>2022 NO-BUILD</i>		
Project Description <i>F4 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1080	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	609	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	11.1	pc/mi/ln	D = v _p / S		
LOS	B		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

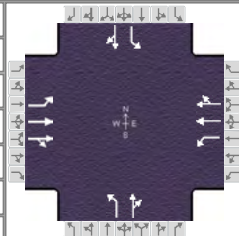
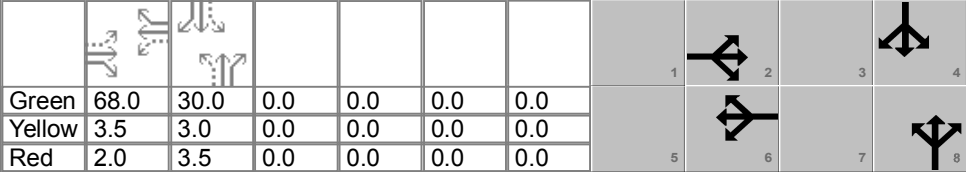
BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To Wooster Rd to SR 32		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F4 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	3610	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	2036	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	53.6	mph	S		
D = v _p / S	38.0	pc/mi/ln	D = v _p / S		
LOS	E		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

PM

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Newtown		Time Period				PHF		0.90									
Urban Street		SR 32		Analysis Year		2022		Analysis Period		1> 7:00									
Intersection		SR 32 at Clough Pike		File Name		07-2022-PM.xus													
Project Description		2022 NO-BUILD - PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h							400	0	10		720			390					
Signal Information																			
Cycle, s	105.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	52.0	40.0	0.0	0.0	0.0	0.0									
				Yellow	4.5	3.5	0.0	0.0	0.0	0.0									
				Red	2.5	2.5	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase										8				2				6	
Case Number										12.0				8.0				8.0	
Phase Duration, s										46.0				59.0				59.0	
Change Period, (Y+R c), s										6.0				7.0				7.0	
Max Allow Headway (MAH), s										3.1				3.0				3.0	
Queue Clearance Time (g s), s										24.3				41.2				18.1	
Green Extension Time (g e), s										0.8				2.3				2.7	
Phase Call Probability										1.00				1.00				1.00	
Max Out Probability										0.00				0.13				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							3	8	18		2			6					
Adjusted Flow Rate (v), veh/h								456			800			433					
Adjusted Saturation Flow Rate (s), veh/h/ln								1786			1881			1863					
Queue Service Time (g s), s								22.3			39.2			16.1					
Cycle Queue Clearance Time (g c), s								22.3			39.2			16.1					
Green Ratio (g/C)								0.38			0.50			0.50					
Capacity (c), veh/h								680			932			923					
Volume-to-Capacity Ratio (X)								0.669			0.859			0.470					
Back of Queue (Q), ft/ln (95 th percentile)								364.8			628.7			269.8					
Back of Queue (Q), veh/ln (95 th percentile)								14.6			25.1			10.8					
Queue Storage Ratio (RQ) (95 th percentile)								0.00			0.00			0.00					
Uniform Delay (d 1), s/veh								27.0			23.3			17.4					
Incremental Delay (d 2), s/veh								2.1			7.7			0.1					
Initial Queue Delay (d 3), s/veh								0.0			0.0			0.0					
Control Delay (d), s/veh								29.1			31.0			17.6					
Level of Service (LOS)								C			C			B					
Approach Delay, s/veh / LOS				0.0				29.1		C		31.0		C		17.6		B	
Intersection Delay, s/veh / LOS				27.0										C					
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.2		B		2.2		B		1.4		A		1.9		A	
Bicycle LOS Score / LOS								1.2		A		1.8		A		1.2		A	

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Anderson Twp (ODOT)		Time Period				PHF		0.90									
Urban Street		Beechmont Avenue (SR...		Analysis Year		2022		Analysis Period		1> 7:00									
Intersection		SR 125 at Elstun Road		File Name		22-2022-PM.xus													
Project Description		2022 NO-BUILD - PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				50	1860	90	60	820	50	80	10	90	80	30	40				
Signal Information																			
Cycle, s	110.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On		Green	68.0	30.0	0.0	0.0	0.0	0.0								
Force Mode	Fixed	Simult. Gap N/S	On		Yellow	3.5	3.0	0.0	0.0	0.0	0.0								
				Red	2.0	3.5	0.0	0.0	0.0	0.0	0.0								
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2				6				8				4	
Case Number						6.0				6.0				6.0				6.0	
Phase Duration, s						73.5				73.5				36.5				36.5	
Change Period, (Y+R c), s						5.5				5.5				6.5				6.5	
Max Allow Headway (MAH), s						3.4				3.4				3.3				3.3	
Queue Clearance Time (g s), s						61.3				70.0				11.8				14.3	
Green Extension Time (g e), s						5.3				0.0				0.7				0.7	
Phase Call Probability						1.00				1.00				1.00				1.00	
Max Out Probability						0.91				1.00				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				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				56	1083	1083	67	488	478	89	111		89	78					
Adjusted Saturation Flow Rate (s), veh/h/ln				585	1881	1850	184	1881	1843	1329	1619		1289	1706					
Queue Service Time (g s), s				6.0	57.0	59.3	8.7	14.7	14.7	6.0	5.9		6.4	3.8					
Cycle Queue Clearance Time (g c), s				20.7	57.0	59.3	68.0	14.7	14.7	9.8	5.9		12.3	3.8					
Green Ratio (g/C)				0.62	0.62	0.62	0.62	0.62	0.62	0.27	0.27		0.27	0.27					
Capacity (c), veh/h				349	1163	1144	80	1163	1139	382	442		348	465					
Volume-to-Capacity Ratio (X)				0.159	0.932	0.947	0.834	0.420	0.420	0.233	0.252		0.255	0.167					
Back of Queue (Q), ft/ln (95 th percentile)				35.6	866.9	894.6	131.1	240.9	235.1	87.8	103.1		90.4	70.4					
Back of Queue (Q), veh/ln (95 th percentile)				1.4	34.4	35.8	5.2	9.6	9.4	3.5	4.1		3.6	2.8					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				16.2	18.9	19.3	54.1	10.8	10.8	34.2	31.2		36.0	30.5					
Incremental Delay (d 2), s/veh				0.1	13.0	15.4	47.8	0.1	0.1	0.1	0.1		0.1	0.1					
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0					
Control Delay (d), s/veh				16.2	31.9	34.8	101.8	10.9	10.9	34.3	31.3		36.2	30.5					
Level of Service (LOS)				B	C	C	F	B	B	C	C		D	C					
Approach Delay, s/veh / LOS				32.9		C		16.8		B		32.7		C		33.5		C	
Intersection Delay, s/veh / LOS				28.3						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.2		B		2.2		B		2.8		C		2.8		C	
Bicycle LOS Score / LOS				2.3		B		1.3		A		0.8		A		0.8		A	

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to EB SR 125			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X1-A									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 1310 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				1880			
		Ramp Volume, V _R				120			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1880	0.90	Level	1	0	0.995	1.00	2099	
Ramp	120	0.90	Level	1	0	0.995	1.00	134	
UpStream	1310	0.90	Level	1	0	0.995	1.00	1463	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 2099 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	2233	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	2233	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 19.7 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.322 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 50.8 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 50.8 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		EB SR 125 off-ramp to NB SR 32			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X1-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 120 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				3190			
		Ramp Volume, V_R				1310			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				30.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	3190	0.90	Level	1	0	0.995	1.00	3562	
Ramp	1310	0.90	Level	1	0	0.995	1.00	1463	
UpStream									
DownStream	120	0.90	Level	1	0	0.995	1.00	134	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 3562 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	3562	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	2099	Exhibit 13-8	4500	No		
			V_R	1463	Exhibit 13-10	2000	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	3562	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 30.4 (pc/mi/ln) LOS = D (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.625 (Exhibit 13-12) $S_R =$ 46.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 46.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		WB SR 125 off-ramp to NB SR 32			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X1-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1100 ft $V_D =$ 670 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				940			
		Ramp Volume, V_R				160			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	940	0.90	Level	1	0	0.995	1.00	1050	
Ramp	160	0.90	Level	1	0	0.995	1.00	179	
UpStream									
DownStream	670	0.90	Level	1	0	0.995	1.00	748	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1050 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1050	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	871	Exhibit 13-8	4500	No	
				V_R	179	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1050	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 8.8 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.314 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to WB SR 125			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X1-D									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 1100 ft V _u = 160 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				780			
		Ramp Volume, V _R				670			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	780	0.90	Level	1	0	0.995	1.00	871	
Ramp	670	0.90	Level	1	0	0.995	1.00	748	
UpStream	160	0.90	Level	1	0	0.995	1.00	179	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 871 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1619	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1619	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 14.6 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.306 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 51.0 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 51.0 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>Wooster Rd to SR 32</i>		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year <i>2022 NO-BUILD</i>		
Project Description <i>F4 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	3190	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.995	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	1781	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	32.4	pc/mi/ln	D = v _p / S		
LOS	D		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

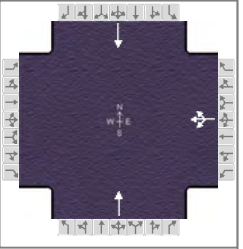
BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To Wooster Rd to SR 32		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F4 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1450	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)] 0.995		
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	810	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	14.7	pc/mi/ln	D = v _p / S		
LOS	B		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

2042

AM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Anderson Twp (ODOT)	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2042	Analysis Period	1> 7:00
Intersection	SR 32 at Clough Pike	File Name	07-2042-AM.xus		
Project Description	2042 NO-BUILD - AM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				760	0	10		350			680	

Signal Information											
Cycle, s	130.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	55.0	61.0	0.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.5	4.5	0.0	0.0	0.0	0.0	
				Red	2.5	2.5	0.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2		6
Case Number				12.0		8.0		8.0
Phase Duration, s				68.0		62.0		62.0
Change Period, ($Y+R_c$), s				7.0		7.0		7.0
Max Allow Headway (MAH), s				3.1		3.0		3.0
Queue Clearance Time (g_s), s				63.0		22.0		56.7
Green Extension Time (g_e), s				0.0		2.4		0.0
Phase Call Probability				1.00		1.00		1.00
Max Out Probability				1.00		0.00		1.00

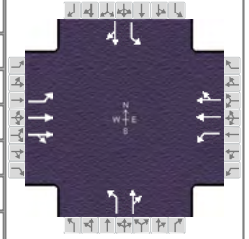
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18		2			6	
Adjusted Flow Rate (v), veh/h					856			389			756	
Adjusted Saturation Flow Rate (s), veh/h/ln					1789			1845			1792	
Queue Service Time (g_s), s					61.0			20.0			54.7	
Cycle Queue Clearance Time (g_c), s					61.0			20.0			54.7	
Green Ratio (g/C)					0.47			0.42			0.42	
Capacity (c), veh/h					839			780			758	
Volume-to-Capacity Ratio (X)					1.019			0.498			0.996	
Back of Queue (Q), ft/ln (95 th percentile)					1099.2			340.6			969	
Back of Queue (Q), veh/ln (95 th percentile)					44.0			13.6			38.8	
Queue Storage Ratio (RQ) (95 th percentile)					0.00			0.00			0.00	
Uniform Delay (d_1), s/veh					34.5			27.4			37.4	
Incremental Delay (d_2), s/veh					36.0			0.2			31.7	
Initial Queue Delay (d_3), s/veh					0.0			0.0			0.0	
Control Delay (d), s/veh					70.5			27.6			69.1	
Level of Service (LOS)					F			C			E	
Approach Delay, s/veh / LOS	0.0			70.5	E		27.6	C		69.1	E	
Intersection Delay, s/veh / LOS	61.6						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	1.4	A	1.9	A
Bicycle LOS Score / LOS			1.9	A	1.1	A	1.7	A

HCS 2010 Signalized Intersection Results Summary

General Information

Agency				Intersection Information		
Analyst	MJH	Analysis Date	Oct 20, 2016	Duration, h	0.25	
Jurisdiction	Anderson Twp (ODOT)	Time Period		Area Type	Other	
Urban Street	Beechmont Avenue (SR...	Analysis Year	2042	PHF	0.90	
Intersection	SR 125 at Elstun Road	File Name	22-2042-AM.xus	Analysis Period	1> 7:00	
Project Description	2042 NO-BUILD - AM Peak Hour					



Demand Information

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	40	580	40	90	2160	60	190	10	40	30	10	20

Signal Information

Cycle, s	90.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	61.0	17.0	0.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.5	3.0	0.0	0.0	0.0	0.0	
				Red	2.0	3.5	0.0	0.0	0.0	0.0	

Timer Results

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		66.5		66.5		23.5		23.5
Change Period, ($Y+R_c$), s		5.5		5.5		6.5		6.5
Max Allow Headway (MAH), s		3.3		3.3		3.2		3.2
Queue Clearance Time (g_s), s		63.0		63.0		17.3		6.7
Green Extension Time (g_e), s		0.0		0.0		0.0		0.5
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		1.00		1.00		1.00		0.01

Movement Group Results

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	44	348	341	100	1233	1233	211	56		33	33	
Adjusted Saturation Flow Rate (s), veh/h/ln	134	1845	1802	736	1827	1809	1357	1612		1256	1556	
Queue Service Time (g_s), s	0.0	6.7	6.8	5.6	60.3	61.0	13.7	2.6		2.1	1.6	
Cycle Queue Clearance Time (g_c), s	61.0	6.7	6.8	12.4	60.3	61.0	15.3	2.6		4.7	1.6	
Green Ratio (g/C)	0.68	0.68	0.68	0.68	0.68	0.68	0.19	0.19		0.19	0.19	
Capacity (c), veh/h	80	1250	1222	524	1238	1226	312	305		281	294	
Volume-to-Capacity Ratio (X)	0.556	0.278	0.279	0.191	0.996	1.006	0.676	0.182		0.119	0.113	
Back of Queue (Q), ft/ln (95 th percentile)	49.9	98.3	94	36.8	914.9	922.6	215.1	44.8		28.5	26.5	
Back of Queue (Q), veh/ln (95 th percentile)	1.9	3.8	3.8	1.4	35.7	36.9	8.4	1.8		1.1	1.1	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	45.0	5.8	5.8	8.2	14.4	14.5	36.6	30.7		32.6	30.3	
Incremental Delay (d_2), s/veh	5.0	0.0	0.0	0.1	24.6	27.1	4.7	0.1		0.1	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	50.0	5.8	5.8	8.3	38.9	41.6	41.3	30.8		32.7	30.3	
Level of Service (LOS)	D	A	A	A	D	F	D	C		C	C	
Approach Delay, s/veh / LOS	8.5		A	39.0		D	39.1		D	31.5		C
Intersection Delay, s/veh / LOS	32.7						C					

Multimodal Results

	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.1	A	2.6	B	0.9	A	0.6	A

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to EB SR 125			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X1-A									
Inputs									
Upstream Adj Ramp		Freeway Number of Lanes, N				2		Downstream Adj Ramp	
☒ Yes ☐ On		Ramp Number of Lanes, N				1		☐ Yes ☐ On	
☐ No ☒ Off		Acceleration Lane Length, L_A				500		☒ No ☐ Off	
		Deceleration Lane Length L_D							
$L_{up} =$ 600 ft		Freeway Volume, V_F				600		$L_{down} =$ ft	
		Ramp Volume, V_R				60			
$V_u =$ 490 veh/h		Freeway Free-Flow Speed, S_{FF}				55.0		$V_D =$ veh/h	
		Ramp Free-Flow Speed, S_{FR}				35.0			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	600	0.90	Level	3	0	0.985	1.00	677	
Ramp	60	0.90	Level	3	0	0.985	1.00	68	
UpStream	490	0.90	Level	3	0	0.985	1.00	553	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
(Equation 13-6 or 13-7)					(Equation 13-12 or 13-13)				
$P_{FM} =$ 1.000 using Equation (Exhibit 13-6)					$P_{FD} =$ using Equation (Exhibit 13-7)				
$V_{12} =$ 677 pc/h					$V_{12} =$ pc/h				
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)					V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)				
Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No					Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No				
Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No					Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No				
If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	745	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	745	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
$D_R =$ 8.1 (pc/mi/ln)					$D_R =$ (pc/mi/ln)				
LOS = A (Exhibit 13-2)					LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.294 (Exhibit 13-11)					$D_S =$ (Exhibit 13-12)				
$S_R =$ 51.2 mph (Exhibit 13-11)					$S_R =$ mph (Exhibit 13-12)				
$S_0 =$ N/A mph (Exhibit 13-11)					$S_0 =$ mph (Exhibit 13-12)				
$S =$ 51.2 mph (Exhibit 13-13)					$S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		EB SR 125 off-ramp to NB SR 32			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X1-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 60 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				1090			
		Ramp Volume, V_R				490			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				30.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	1090	0.90	Level	3	0	0.985	1.00	1229	
Ramp	490	0.90	Level	3	0	0.985	1.00	553	
UpStream									
DownStream	60	0.90	Level	3	0	0.985	1.00	68	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1229 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1229	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	676	Exhibit 13-8	4500	No		
			V_R	553	Exhibit 13-10	2000	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1229	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 10.3 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.543 (Exhibit 13-12) $S_R =$ 47.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 47.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		WB SR 125 off-ramp to NB SR 32			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X1-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1100 ft $V_D =$ 1380 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				2370			
		Ramp Volume, V_R				120			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	2370	0.90	Level	3	0	0.985	1.00	2673	
Ramp	120	0.90	Level	3	0	0.985	1.00	135	
UpStream									
DownStream	1380	0.90	Level	3	0	0.985	1.00	1556	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 2673 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	2673	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	2538	Exhibit 13-8	4500	No	
				V_R	135	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	2673	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 22.7 (pc/mi/ln) LOS = C (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.310 (Exhibit 13-12) $S_R =$ 51.0 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 51.0 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to WB SR 125			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X1-D									
Inputs									
Upstream Adj Ramp		Freeway Number of Lanes, N				2		Downstream Adj Ramp	
☒ Yes ☐ On		Ramp Number of Lanes, N				1		☐ Yes ☐ On	
☐ No ☒ Off		Acceleration Lane Length, L_A				500		☒ No ☐ Off	
		Deceleration Lane Length L_D							
$L_{up} =$ 1100 ft		Freeway Volume, V_F				2250		$L_{down} =$ ft	
		Ramp Volume, V_R				1380			
$V_u =$ 120 veh/h		Freeway Free-Flow Speed, S_{FF}				55.0		$V_D =$ veh/h	
		Ramp Free-Flow Speed, S_{FR}				35.0			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	2250	0.90	Level	3	0	0.985	1.00	2538	
Ramp	1380	0.90	Level	3	0	0.985	1.00	1556	
UpStream	120	0.90	Level	3	0	0.985	1.00	135	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
(Equation 13-6 or 13-7)					(Equation 13-12 or 13-13)				
$P_{FM} =$ 1.000 using Equation (Exhibit 13-6)					$P_{FD} =$ using Equation (Exhibit 13-7)				
$V_{12} =$ 2538 pc/h					$V_{12} =$ pc/h				
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)					V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)				
Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No					Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No				
Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No					Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No				
If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	4094	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	4094	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
$D_R =$ 33.6 (pc/mi/ln)					$D_R =$ (pc/mi/ln)				
LOS = D (Exhibit 13-2)					LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.520 (Exhibit 13-11)					$D_S =$ (Exhibit 13-12)				
$S_R =$ 48.2 mph (Exhibit 13-11)					$S_R =$ mph (Exhibit 13-12)				
$S_0 =$ N/A mph (Exhibit 13-11)					$S_0 =$ mph (Exhibit 13-12)				
$S =$ 48.2 mph (Exhibit 13-13)					$S =$ mph (Exhibit 13-13)				

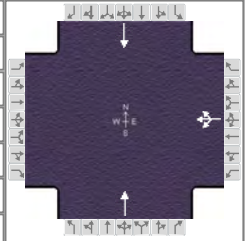
BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>Wooster Rd to SR 32</i>		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year <i>2042 NO-BUILD</i>		
Project Description <i>F4 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1090	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	615	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	11.2	pc/mi/ln	D = v _p / S		
LOS	B		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To Wooster Rd to SR 32		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F4 - Freeway Segment					
☒ Oper.(LOS) ☐ Des.(N) ☐ Planning Data					
Flow Inputs					
Volume, V	3630	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade %	Length	mi
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)] 0.985		
Speed Inputs			Calc Speed Adj and FFS		
Lane Width	ft		f _{LW} mph f _{LC} mph TRD Adjustment mph FFS 55.0 mph		
Rt-Side Lat. Clearance	ft				
Number of Lanes, N	2				
Total Ramp Density, TRD	ramps/mi				
FFS (measured)	55.0 mph				
Base free-flow Speed, BFFS	mph				
LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v _p = (V or DDHV) / (PHF x N x f _{HV}) 2047 pc/h/ln			Design LOS		
S 53.5 mph			v _p = (V or DDHV) / (PHF x N x f _{HV}) pc/h/ln		
D = v _p / S 38.3 pc/mi/ln			S mph		
LOS E			D = v _p / S pc/mi/ln		
			Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes			E _R - Exhibits 11-10, 11-12		
V - Hourly volume			E _T - Exhibits 11-10, 11-11, 11-13		
v _p - Flow rate			f _p - Page 11-18		
LOS - Level of service			LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume			f _{LW} - Exhibit 11-8		
			f _{LC} - Exhibit 11-9		
			TRD - Page 11-11		

PM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Newtown	Time Period		PHF	0.90
Urban Street	SR 32	Analysis Year	2042	Analysis Period	1> 7:00
Intersection	SR 32 at Clough Pike	File Name	07-2042-PM.xus		
Project Description	2042 NO-BUILD - PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				400	0	10		740			400	

Signal Information												
Cycle, s	105.0	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	On	Green	53.0	39.0	0.0	0.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.5	3.5	0.0	0.0	0.0	0.0		
				Red	2.5	2.5	0.0	0.0	0.0	0.0		

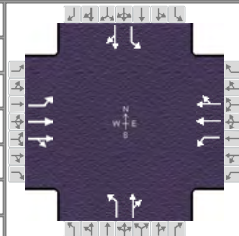
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2		6
Case Number				12.0		8.0		8.0
Phase Duration, s				45.0		60.0		60.0
Change Period, ($Y+R_c$), s				6.0		7.0		7.0
Max Allow Headway (MAH), s				3.1		3.0		3.0
Queue Clearance Time (g_s), s				24.6		42.4		18.3
Green Extension Time (g_e), s				0.8		2.3		2.8
Phase Call Probability				1.00		1.00		1.00
Max Out Probability				0.00		0.14		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				3	8	18		2			6	
Adjusted Flow Rate (v), veh/h				456			822			444		
Adjusted Saturation Flow Rate (s), veh/h/ln				1786			1881			1863		
Queue Service Time (g_s), s				22.6			40.4			16.3		
Cycle Queue Clearance Time (g_c), s				22.6			40.4			16.3		
Green Ratio (g/C)				0.37			0.50			0.50		
Capacity (c), veh/h				663			950			940		
Volume-to-Capacity Ratio (X)				0.687			0.866			0.473		
Back of Queue (Q), ft/ln (95 th percentile)				372			644.2			271.7		
Back of Queue (Q), veh/ln (95 th percentile)				14.9			25.8			10.9		
Queue Storage Ratio (RQ) (95 th percentile)				0.00			0.00			0.00		
Uniform Delay (d_1), s/veh				27.8			22.9			16.9		
Incremental Delay (d_2), s/veh				2.5			8.1			0.1		
Initial Queue Delay (d_3), s/veh				0.0			0.0			0.0		
Control Delay (d), s/veh				30.3			31.0			17.0		
Level of Service (LOS)					C			C			B	
Approach Delay, s/veh / LOS	0.0			30.3		C	31.0		C	17.0		B
Intersection Delay, s/veh / LOS	27.2						C					

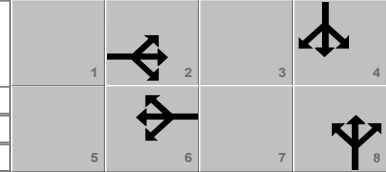
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	1.4	A	1.9	A
Bicycle LOS Score / LOS			1.2	A	1.8	A	1.2	A

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other			
Jurisdiction		Anderson Twp (ODOT)		Time Period				PHF		0.90			
Urban Street		Beechmont Avenue (SR...		Analysis Year		2042		Analysis Period		1> 7:00			
Intersection		SR 125 at Elstun Road		File Name		22-2042-PM.xus							
Project Description		2042 NO-BUILD - PM Peak Hour											



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				50	1860	90	60	830	50	80	10	90	80	30	40

Signal Information							
Cycle, s	110.0	Reference Phase	2				
Offset, s	0	Reference Point	End				
Uncoordinated	Yes	Simult. Gap E/W	On				
Force Mode	Fixed	Simult. Gap N/S	On				
Green	68.0	30.0	0.0	0.0	0.0	0.0	
Yellow	3.5	3.0	0.0	0.0	0.0	0.0	
Red	2.0	3.5	0.0	0.0	0.0	0.0	

Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase					2		6		8		4
Case Number					6.0		6.0		6.0		6.0
Phase Duration, s					73.5		73.5		36.5		36.5
Change Period, (Y+R c), s					5.5		5.5		6.5		6.5
Max Allow Headway (MAH), s					3.4		3.4		3.3		3.3
Queue Clearance Time (g s), s					61.3		70.0		11.8		14.3
Green Extension Time (g e), s					5.3		0.0		0.7		0.7
Phase Call Probability					1.00		1.00		1.00		1.00
Max Out Probability					0.91		1.00		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				5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h				56	1083	1083	67	494	484	89	111		89	78	
Adjusted Saturation Flow Rate (s), veh/h/ln				579	1881	1850	184	1881	1843	1329	1619		1289	1706	
Queue Service Time (g s), s				6.0	57.0	59.3	8.7	15.0	15.0	6.0	5.9		6.4	3.8	
Cycle Queue Clearance Time (g c), s				21.0	57.0	59.3	68.0	15.0	15.0	9.8	5.9		12.3	3.8	
Green Ratio (g/C)				0.62	0.62	0.62	0.62	0.62	0.62	0.27	0.27		0.27	0.27	
Capacity (c), veh/h				344	1163	1144	80	1163	1139	382	442		348	465	
Volume-to-Capacity Ratio (X)				0.161	0.932	0.947	0.834	0.425	0.425	0.233	0.252		0.255	0.167	
Back of Queue (Q), ft/ln (95 th percentile)				35.8	866.9	894.6	131.1	244	238.2	87.8	103.1		90.4	70.4	
Back of Queue (Q), veh/ln (95 th percentile)				1.4	34.4	35.8	5.2	9.7	9.5	3.5	4.1		3.6	2.8	
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d 1), s/veh				16.3	18.9	19.3	54.1	10.9	10.9	34.2	31.2		36.0	30.5	
Incremental Delay (d 2), s/veh				0.1	13.0	15.4	47.8	0.1	0.1	0.1	0.1		0.1	0.1	
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh				16.4	31.9	34.8	101.8	11.0	11.0	34.3	31.3		36.2	30.5	
Level of Service (LOS)				B	C	C	F	B	B	C	C		D	C	
Approach Delay, s/veh / LOS				32.9	C		16.8	B		32.7	C		33.5	C	
Intersection Delay, s/veh / LOS				28.3						C					

Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.2	B		2.2	B		2.8	C		2.8	C	
Bicycle LOS Score / LOS				2.3	B		1.3	A		0.8	A		0.8	A	

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to EB SR 125			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X1-A									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 1320 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				1880			
		Ramp Volume, V _R				120			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1880	0.90	Level	1	0	0.995	1.00	2099	
Ramp	120	0.90	Level	1	0	0.995	1.00	134	
UpStream	1320	0.90	Level	1	0	0.995	1.00	1474	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 2099 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	2233	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	2233	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 19.7 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.322 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 50.8 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 50.8 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		EB SR 125 off-ramp to NB SR 32			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X1-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 120 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				3200			
		Ramp Volume, V_R				1320			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				30.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	3200	0.90	Level	1	0	0.995	1.00	3573	
Ramp	1320	0.90	Level	1	0	0.995	1.00	1474	
UpStream									
DownStream	120	0.90	Level	1	0	0.995	1.00	134	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 3573 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	3573	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	2099	Exhibit 13-8	4500	No		
			V_R	1474	Exhibit 13-10	2000	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	3573	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 30.5 (pc/mi/ln) LOS = D (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.626 (Exhibit 13-12) $S_R =$ 46.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 46.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		WB SR 125 off-ramp to NB SR 32			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X1-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1100 ft $V_D =$ 680 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				950			
		Ramp Volume, V_R				170			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	950	0.90	Level	1	0	0.995	1.00	1061	
Ramp	170	0.90	Level	1	0	0.995	1.00	190	
UpStream									
DownStream	680	0.90	Level	1	0	0.995	1.00	759	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1061 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1061	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	871	Exhibit 13-8	4500	No	
				V_R	190	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1061	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 8.9 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.315 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB SR 32 to WB SR 125			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X1-D									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 1100 ft V _u = 170 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				780			
		Ramp Volume, V _R				680			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	780	0.90	Level	1	0	0.995	1.00	871	
Ramp	680	0.90	Level	1	0	0.995	1.00	759	
UpStream	170	0.90	Level	1	0	0.995	1.00	190	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 871 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1630	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1630	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 14.7 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.306 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 51.0 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 51.0 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>Wooster Rd to SR 32</i>		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year <i>2042 NO-BUILD</i>		
Project Description <i>F4 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	3200	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)] 0.995		
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	1787	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	32.5	pc/mi/ln	D = v _p / S		
LOS	D		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To Wooster Rd to SR 32		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F4 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1460	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.995	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	815	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	14.8	pc/mi/ln	D = v _p / S		
LOS	B		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

LINWOOD/EASTERN INTERCHANGE AREA

2015

AM

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		NB Wilmer to EB SR 125			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		Existing			
Project Description Ramp X2-A									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 190 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				690			
		Ramp Volume, V _R				290			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	690	0.90	Level	3	0	0.985	1.00	778	
Ramp	290	0.90	Level	3	0	0.985	1.00	327	
UpStream	190	0.90	Level	3	0	0.985	1.00	214	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 778 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1105	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1105	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 10.8 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.298 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		EB SR 125 to SB Wilmer Rd			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X2-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 290 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				880			
		Ramp Volume, V_R				190			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	880	0.90	Level	3	0	0.985	1.00	992	
Ramp	190	0.90	Level	3	0	0.985	1.00	214	
UpStream									
DownStream	290	0.90	Level	3	0	0.985	1.00	327	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 992 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	992	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	778	Exhibit 13-8	4500	No		
			V_R	214	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	992	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 8.3 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.317 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to NB Wooster Rd			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X2-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 110 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				3240			
		Ramp Volume, V_R				780			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	3240	0.90	Level	3	0	0.985	1.00	3654	
Ramp	780	0.90	Level	3	0	0.985	1.00	880	
UpStream									
DownStream	110	0.90	Level	3	0	0.985	1.00	124	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 3654 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	3654	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	2774	Exhibit 13-8	4500	No		
			V_R	880	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	3654	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 31.2 (pc/mi/ln) LOS = D (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.377 (Exhibit 13-12) $S_R =$ 50.1 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.1 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB Wooster Rd to WB SR 125			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		Existing			
Project Description Ramp X2-D									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 780 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				2460			
		Ramp Volume, V _R				110			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2460	0.90	Level	3	0	0.985	1.00	2774	
Ramp	110	0.90	Level	3	0	0.985	1.00	124	
UpStream	780	0.90	Level	3	0	0.985	1.00	880	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 2774 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	2898	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	2898	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 24.9 (pc/mi/ln) LOS = C (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.357 (Exhibit 13-11) S _R = 50.4 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 50.4 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB US 50 off-ramp to EB SR 125			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X3-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N 2 Ramp Number of Lanes, N 1 Acceleration Lane Length, L_A Deceleration Lane Length L_D 500 Freeway Volume, V_F 790 Ramp Volume, V_R 360 Freeway Free-Flow Speed, S_{FF} 55.0 Ramp Free-Flow Speed, S_{FR} 45.0				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	790	0.90	Level	3	0	0.985	1.00	891	
Ramp	360	0.90	Level	3	0	0.985	1.00	406	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 891 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	891	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	485	Exhibit 13-8	4500	No	
				V_R	406	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	891	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) $LOS =$ (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 7.4 (pc/mi/ln) $LOS =$ A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.335 (Exhibit 13-12) $S_R =$ 50.7 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.7 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		EB SR 125 to SB US 50			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		Existing			
Project Description Ramp X3-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off L _{up} = 1000 ft V _u = 900 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				1530			
		Ramp Volume, V _R				40			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1530	0.90	Level	3	0	0.985	1.00	1726	
Ramp	40	0.90	Level	3	0	0.985	1.00	45	
UpStream	900	0.90	Level	3	0	0.985	1.00	1015	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 1726 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1771	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1771	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 16.1 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.309 (Exhibit 13-11) S _R = 51.0 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.0 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to SB US 50 Diverge			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X3-C - DIVERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D				500			
		Freeway Volume, V _F				2570			
		Ramp Volume, V _R				900			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				25.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2570	0.90	Level	3	0	0.985	1.00	2898	
Ramp	900	0.90	Level	3	0	0.985	1.00	1015	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 2898 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	2898	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	1883	Exhibit 13-8	4500	No	
				V _R	1015	Exhibit 13-10	1900	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	2898	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 24.7 (pc/mi/ln) LOS = C (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.649 (Exhibit 13-12) S _R = 46.6 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 46.6 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		SB and NB			
Agency or Company				Junction		WB SR 125 to SB US 50 Merge			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		Existing			
Project Description Ramp X3-C - MERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1000 ft $V_D =$ 40 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A				500			
		Deceleration Lane Length L_D							
		Freeway Volume, V_F				630			
		Ramp Volume, V_R				900			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				25.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	630	0.90	Level	3	0	0.985	1.00	711	
Ramp	900	0.90	Level	3	0	0.985	1.00	1015	
UpStream									
DownStream	40	0.90	Level	3	0	0.985	1.00	45	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ 1.000 using Equation (Exhibit 13-6) $V_{12} =$ 711 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ using Equation (Exhibit 13-7) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1726	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1726	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ 15.3 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.318 (Exhibit 13-11) $S_R =$ 50.9 mph (Exhibit 13-11) $S_0 =$ N/A mph (Exhibit 13-11) $S =$ 50.9 mph (Exhibit 13-13)					$D_S =$ (Exhibit 13-12) $S_R =$ mph (Exhibit 13-12) $S_0 =$ mph (Exhibit 13-12) $S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB Eastern Ave to NB US 50			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		Existing			
Project Description Ramp X3-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N 2				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h			
		Ramp Number of Lanes, N 1							
		Acceleration Lane Length, L _A 500							
		Deceleration Lane Length L _D							
		Freeway Volume, V _F 430							
		Ramp Volume, V _R 470							
Freeway Free-Flow Speed, S _{FF} 55.0				Ramp Free-Flow Speed, S _{FR} 35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	430	0.90	Level	3	0	0.985	1.00	485	
Ramp	470	0.90	Level	3	0	0.985	1.00	530	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 485 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1015	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1015	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 V_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 10.0 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.297 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		SB US 50 to Eastern Ave			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X3-E									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N 2 Ramp Number of Lanes, N 1 Acceleration Lane Length, L_A Deceleration Lane Length L_D 500 Freeway Volume, V_F 820 Ramp Volume, V_R 190 Freeway Free-Flow Speed, S_{FF} 55.0 Ramp Free-Flow Speed, S_{FR} 45.0				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	820	0.90	Level	3	0	0.985	1.00	925	
Ramp	190	0.90	Level	3	0	0.985	1.00	214	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 925 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	925	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	711	Exhibit 13-8	4500	No	
				V_R	214	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	925	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) $LOS =$ (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 7.7 (pc/mi/ln) $LOS =$ A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.317 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>US 50 to Wooster Rd</i>		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year <i>Existing</i>		
Project Description <i>F3 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	880	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	<i>Level</i>	
DDHV = AADT x K x D		veh/h	Grade % Length	<i>mi</i>	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	496	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	9.0	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To US 50 to Wooster Rd		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year Existing		
Project Description F3 - Freeway Segment					
☒ Oper.(LOS) ☐ Des.(N) ☐ Planning Data					
Flow Inputs					
Volume, V	2570	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade %	Length	mi
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)] 0.985		
Speed Inputs			Calc Speed Adj and FFS		
Lane Width	ft		f _{LW} mph f _{LC} mph TRD Adjustment mph FFS 55.0 mph		
Rt-Side Lat. Clearance	ft				
Number of Lanes, N	2				
Total Ramp Density, TRD	ramps/mi				
FFS (measured)	55.0 mph				
Base free-flow Speed, BFFS	mph				
LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)			Design LOS		
S 55.0 mph			v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)		
D = v _p / S			S mph		
LOS D			D = v _p / S		
			Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes			E _R - Exhibits 11-10, 11-12		
V - Hourly volume			f _{LW} - Exhibit 11-8		
v _p - Flow rate			E _T - Exhibits 11-10, 11-11, 11-13		
LOS - Level of service			f _{LC} - Exhibit 11-9		
DDHV - Directional design hour volume			f _p - Page 11-18		
			TRD - Page 11-11		
			LOS, S, FFS, v _p - Exhibits 11-2, 11-3		

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year Existing		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	430	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)] 0.985		
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	242	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	4.4	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year Existing		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	630	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	3		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	237	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	4.3	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year Existing		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	900	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
v _p	508	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	9.2	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year Existing		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	820	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade %	Length	mi
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	462	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	8.4	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

PM

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		NB Wilmer to EB SR 125			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		Existing			
Project Description Ramp X2-A									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 180 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				2220			
		Ramp Volume, V _R				650			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2220	0.90	Level	1	0	0.995	1.00	2479	
Ramp	650	0.90	Level	1	0	0.995	1.00	726	
UpStream	180	0.90	Level	1	0	0.995	1.00	201	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 2479 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	3205	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3205	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 27.0 (pc/mi/ln) LOS = C (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.382 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 50.0 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 50.0 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		EB SR 125 to SB Wilmer Rd			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X2-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off L _{down} = 600 ft V _D = 650 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D				500			
		Freeway Volume, V _F				2400			
		Ramp Volume, V _R				180			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2400	0.90	Level	1	0	0.995	1.00	2680	
Ramp	180	0.90	Level	1	0	0.995	1.00	201	
UpStream									
DownStream	650	0.90	Level	1	0	0.995	1.00	726	
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
V ₁₂ = V _F (P _{FM}) L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					V ₁₂ = V _R + (V _F - V _R)P _{FD} L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 2680 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	2680	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	2479	Exhibit 13-8	4500	No	
				V _R	201	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	2680	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
D _R = 5.475 + 0.00734 v _R + 0.0078 V ₁₂ - 0.00627 L _A D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					D _R = 4.252 + 0.0086 V ₁₂ - 0.009 L _D D _R = 22.8 (pc/mi/ln) LOS = C (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.316 (Exhibit 13-12) S _R = 50.9 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 50.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to NB Wooster Rd			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X2-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 230 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				1300			
		Ramp Volume, V_R				370			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	1300	0.90	Level	1	0	0.995	1.00	1452	
Ramp	370	0.90	Level	1	0	0.995	1.00	413	
UpStream									
DownStream	230	0.90	Level	1	0	0.995	1.00	257	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1452 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1452	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	1039	Exhibit 13-8	4500	No	
				V_R	413	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1452	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 12.2 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.335 (Exhibit 13-12) $S_R =$ 50.6 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.6 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB Wooster Rd to WB SR 125			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		Existing			
Project Description Ramp X2-D									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 370 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				930			
		Ramp Volume, V _R				230			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	930	0.90	Level	1	0	0.995	1.00	1039	
Ramp	230	0.90	Level	1	0	0.995	1.00	257	
UpStream	370	0.90	Level	1	0	0.995	1.00	413	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 1039 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1296	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1296	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 12.3 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.300 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB US 50 off-ramp to EB SR 125			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X3-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D				500			
		Freeway Volume, V _F				1650			
		Ramp Volume, V _R				900			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1650	0.90	Level	2	0	0.990	1.00	1852	
Ramp	900	0.90	Level	2	0	0.990	1.00	1010	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
V ₁₂ = V _F (P _{FM}) (Equation 13-6 or 13-7) P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					V ₁₂ = V _R + (V _F - V _R)P _{FD} (Equation 13-12 or 13-13) P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 1852 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	1852	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	842	Exhibit 13-8	4500	No	
				V _R	1010	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	1852	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
D _R = 5.475 + 0.00734 v _R + 0.0078 V ₁₂ - 0.00627 L _A D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					D _R = 4.252 + 0.0086 V ₁₂ - 0.009 L _D D _R = 15.7 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.389 (Exhibit 13-12) S _R = 49.9 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 49.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		EB SR 125 to SB US 50			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		Existing			
Project Description Ramp X3-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off L _{up} = 1000 ft V _u = 370 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				850			
		Ramp Volume, V _R				40			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	850	0.90	Level	2	0	0.990	1.00	954	
Ramp	40	0.90	Level	2	0	0.990	1.00	45	
UpStream	370	0.90	Level	2	0	0.990	1.00	415	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 954 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	999	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	999	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 10.1 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.297 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 51.1 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 51.1 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to SB US 50 Diverge			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X3-C - DIVERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N 2				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h			
		Ramp Number of Lanes, N 1							
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D 500							
		Freeway Volume, V _F 1160							
		Ramp Volume, V _R 370							
Freeway Free-Flow Speed, S _{FF} 55.0									
Ramp Free-Flow Speed, S _{FR} 25.0									
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1160	0.90	Level	2	0	0.990	1.00	1302	
Ramp	370	0.90	Level	2	0	0.990	1.00	415	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
V ₁₂ = V _F (P _{FM}) (Equation 13-6 or 13-7) P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					V ₁₂ = V _R + (V _F - V _R)P _{FD} (Equation 13-12 or 13-13) P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 1302 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	1302	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	887	Exhibit 13-8	4500	No	
				V _R	415	Exhibit 13-10	1900	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	1302	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
D _R = 5.475 + 0.00734 v _R + 0.0078 V ₁₂ - 0.00627 L _A D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					D _R = 4.252 + 0.0086 V ₁₂ - 0.009 L _D D _R = 10.9 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.595 (Exhibit 13-12) S _R = 47.3 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 47.3 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		SB and NB			
Agency or Company				Junction		WB SR 125 to SB US 50 Merge			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		Existing			
Project Description Ramp X3-C - MERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1000 ft $V_D =$ 40 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A				500			
		Deceleration Lane Length L_D							
		Freeway Volume, V_F				480			
		Ramp Volume, V_R				370			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				25.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	480	0.90	Level	2	0	0.990	1.00	539	
Ramp	370	0.90	Level	2	0	0.990	1.00	415	
UpStream									
DownStream	40	0.90	Level	2	0	0.990	1.00	45	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ 1.000 using Equation (Exhibit 13-6) $V_{12} =$ 539 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ using Equation (Exhibit 13-7) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	954	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	954	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ 9.6 (pc/mi/ln) LOS = A (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.306 (Exhibit 13-11) $S_R =$ 51.0 mph (Exhibit 13-11) $S_0 =$ N/A mph (Exhibit 13-11) $S =$ 51.0 mph (Exhibit 13-13)					$D_S =$ (Exhibit 13-12) $S_R =$ mph (Exhibit 13-12) $S_0 =$ mph (Exhibit 13-12) $S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB Eastern Ave to NB US 50			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		Existing			
Project Description Ramp X3-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N		2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h			
		Ramp Number of Lanes, N		1					
		Acceleration Lane Length, L_A		500					
		Deceleration Lane Length L_D							
		Freeway Volume, V_F		750					
		Ramp Volume, V_R		230					
		Freeway Free-Flow Speed, S_{FF}		55.0					
		Ramp Free-Flow Speed, S_{FR}		35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	750	0.90	Level	2	0	0.990	1.00	842	
Ramp	230	0.90	Level	2	0	0.990	1.00	258	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ 1.000 using Equation (Exhibit 13-6) $V_{12} =$ 842 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ using Equation (Exhibit 13-7) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1100	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1100	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ 10.8 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.298 (Exhibit 13-11) $S_R =$ 51.1 mph (Exhibit 13-11) $S_0 =$ N/A mph (Exhibit 13-11) $S =$ 51.1 mph (Exhibit 13-13)					$D_S =$ (Exhibit 13-12) $S_R =$ mph (Exhibit 13-12) $S_0 =$ mph (Exhibit 13-12) $S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		SB US 50 to Eastern Ave			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X3-E									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N 2 Ramp Number of Lanes, N 1 Acceleration Lane Length, L_A Deceleration Lane Length L_D 500 Freeway Volume, V_F 880 Ramp Volume, V_R 400 Freeway Free-Flow Speed, S_{FF} 55.0 Ramp Free-Flow Speed, S_{FR} 45.0				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	880	0.90	Level	2	0	0.990	1.00	988	
Ramp	400	0.90	Level	2	0	0.990	1.00	449	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 988 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	988	Exhibit 13-8	4500	No
					$V_{FO} = V_F - V_R$	539	Exhibit 13-8	4500	No
					V_R	449	Exhibit 13-10	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	988	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) $LOS =$ (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 8.2 (pc/mi/ln) $LOS =$ A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.338 (Exhibit 13-12) $S_R =$ 50.6 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.6 mph (Exhibit 13-13)				

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>US 50 to Wooster Rd</i>		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year <i>Existing</i>		
Project Description <i>F3 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	2400	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	<i>Level</i>	
DDHV = AADT x K x D		veh/h	Grade % Length	<i>mi</i>	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.995	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	1340	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	24.4	pc/mi/ln	D = v _p / S		
LOS	C		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To US 50 to Wooster Rd		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year Existing		
Project Description F3 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1160	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.995	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	648	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	11.8	pc/mi/ln	D = v _p / S		
LOS	B		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year Existing		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	750	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	2	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	421	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	7.7	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year Existing		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	480	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	2	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	269	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	4.9	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year Existing		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	980	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P_T	2	
Peak-Hr Prop. of AADT, K			%RVs, P_R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f_p	1.00		E_R	1.2	
E_T	1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}	mph	
Number of Lanes, N	2		f_{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	550	pc/h/ln	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$		
S	55.0	mph	S		
$D = v_p / S$	10.0	pc/mi/ln	$D = v_p / S$		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9	
v_p - Flow rate	FFS - Free-flow speed		f_p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v_p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	4/21/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year Existing		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	880	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P_T	2	
Peak-Hr Prop. of AADT, K			%RVs, P_R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f_p	1.00		E_R	1.2	
E_T	1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}	mph	
Number of Lanes, N	2		f_{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	494	pc/h/ln	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$		
S	55.0	mph	S		
$D = v_p / S$	9.0	pc/mi/ln	$D = v_p / S$		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9	
v_p - Flow rate	FFS - Free-flow speed		f_p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v_p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

2022

AM

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		NB Wilmer to EB SR 125			
Date Performed				Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X2-A									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 220 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				750			
		Ramp Volume, V _R				330			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	750	0.90	Level	3	0	0.985	1.00	846	
Ramp	330	0.90	Level	3	0	0.985	1.00	372	
UpStream	220	0.90	Level	3	0	0.985	1.00	248	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 846 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1218	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1218	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 11.7 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.299 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		EB SR 125 to SB Wilmer Rd			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X2-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 330 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				970			
		Ramp Volume, V_R				220			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	970	0.90	Level	3	0	0.985	1.00	1094	
Ramp	220	0.90	Level	3	0	0.985	1.00	248	
UpStream									
DownStream	330	0.90	Level	3	0	0.985	1.00	372	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1094 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1094	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	846	Exhibit 13-8	4500	No	
				V_R	248	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1094	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 9.2 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.320 (Exhibit 13-12) $S_R =$ 50.8 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.8 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to NB Wooster Rd			
Date Performed				Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X2-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 120 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				3610			
		Ramp Volume, V_R				870			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	3610	0.90	Level	3	0	0.985	1.00	4071	
Ramp	870	0.90	Level	3	0	0.985	1.00	981	
UpStream									
DownStream	120	0.90	Level	3	0	0.985	1.00	135	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 4071 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	4071	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	3090	Exhibit 13-8	4500	No		
			V_R	981	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	4071	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 34.8 (pc/mi/ln) LOS = D (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.386 (Exhibit 13-12) $S_R =$ 50.0 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.0 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB Wooster Rd to WB SR 125			
Date Performed				Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X2-D									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 870 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				2740			
		Ramp Volume, V _R				120			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2740	0.90	Level	3	0	0.985	1.00	3090	
Ramp	120	0.90	Level	3	0	0.985	1.00	135	
UpStream	870	0.90	Level	3	0	0.985	1.00	981	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 3090 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	3225	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3225	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 27.4 (pc/mi/ln) LOS = C (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.384 (Exhibit 13-11) S _R = 50.0 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 50.0 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB US 50 off-ramp to EB SR 125			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N 2 Ramp Number of Lanes, N 1 Acceleration Lane Length, L_A Deceleration Lane Length L_D 500 Freeway Volume, V_F 880 Ramp Volume, V_R 400 Freeway Free-Flow Speed, S_{FF} 55.0 Ramp Free-Flow Speed, S_{FR} 45.0				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	880	0.90	Level	3	0	0.985	1.00	992	
Ramp	400	0.90	Level	3	0	0.985	1.00	451	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 992 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	992	Exhibit 13-8	4500	No
					$V_{FO} = V_F - V_R$	541	Exhibit 13-8	4500	No
					V_R	451	Exhibit 13-10	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	992	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) $LOS =$ (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 8.3 (pc/mi/ln) $LOS =$ A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.339 (Exhibit 13-12) $S_R =$ 50.6 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.6 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		EB SR 125 to SB US 50			
Date Performed				Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off L _{up} = 1000 ft V _u = 990 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				1690			
		Ramp Volume, V _R				40			
		Freeway Free-Flow Speed, S _{FF}				55.0			
		Ramp Free-Flow Speed, S _{FR}				35.0			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1690	0.90	Level	3	0	0.985	1.00	1906	
Ramp	40	0.90	Level	3	0	0.985	1.00	45	
UpStream	990	0.90	Level	3	0	0.985	1.00	1117	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 1906 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1951	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1951	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 17.5 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.313 (Exhibit 13-11) S _R = 50.9 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 50.9 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to SB US 50 Diverge			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-C - DIVERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N 2 Ramp Number of Lanes, N 1 Acceleration Lane Length, L_A Deceleration Lane Length L_D 500 Freeway Volume, V_F 2860 Ramp Volume, V_R 990 Freeway Free-Flow Speed, S_{FF} 55.0 Ramp Free-Flow Speed, S_{FR} 25.0				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	2860	0.90	Level	3	0	0.985	1.00	3225	
Ramp	990	0.90	Level	3	0	0.985	1.00	1117	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 3225 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	3225	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	2108	Exhibit 13-8	4500	No	
				V_R	1117	Exhibit 13-10	1900	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	3225	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) $LOS =$ (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 27.5 (pc/mi/ln) $LOS =$ C (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.659 (Exhibit 13-12) $S_R =$ 46.4 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 46.4 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		SB and NB			
Agency or Company				Junction		WB SR 125 to SB US 50 Merge			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-C - MERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1000 ft $V_D =$ 40 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A				500			
		Deceleration Lane Length L_D							
		Freeway Volume, V_F				700			
		Ramp Volume, V_R				990			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				25.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	700	0.90	Level	3	0	0.985	1.00	789	
Ramp	990	0.90	Level	3	0	0.985	1.00	1117	
UpStream									
DownStream	40	0.90	Level	3	0	0.985	1.00	45	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $P_{FM} =$ 1.000 using Equation (Exhibit 13-6) $V_{12} =$ 789 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $P_{FD} =$ using Equation (Exhibit 13-7) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1906	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1906	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ 16.7 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.322 (Exhibit 13-11) $S_R =$ 50.8 mph (Exhibit 13-11) $S_0 =$ N/A mph (Exhibit 13-11) $S =$ 50.8 mph (Exhibit 13-13)					$D_S =$ (Exhibit 13-12) $S_R =$ mph (Exhibit 13-12) $S_0 =$ mph (Exhibit 13-12) $S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB Eastern Ave to NB US 50			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N 2				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h			
		Ramp Number of Lanes, N 1							
		Acceleration Lane Length, L _A 500							
		Deceleration Lane Length L _D							
		Freeway Volume, V _F 480							
		Ramp Volume, V _R 530							
Freeway Free-Flow Speed, S _{FF} 55.0									
Ramp Free-Flow Speed, S _{FR} 35.0									
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	480	0.90	Level	3	0	0.985	1.00	541	
Ramp	530	0.90	Level	3	0	0.985	1.00	598	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 541 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1139	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1139	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 10.9 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.298 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		SB US 50 to Eastern Ave			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-E									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D				500			
		Freeway Volume, V _F				910			
		Ramp Volume, V _R				210			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	910	0.90	Level	3	0	0.985	1.00	1026	
Ramp	210	0.90	Level	3	0	0.985	1.00	237	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 1026 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	1026	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	789	Exhibit 13-8	4500	No	
				V _R	237	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	1026	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
D _R = 5.475 + 0.00734 v _R + 0.0078 V ₁₂ - 0.00627 L _A D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					D _R = 4.252 + 0.0086 V ₁₂ - 0.009 L _D D _R = 8.6 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.319 (Exhibit 13-12) S _R = 50.8 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 50.8 mph (Exhibit 13-13)				

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>US 50 to Wooster Rd</i>		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year <i>2022 NO-BUILD</i>		
Project Description <i>F3 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	970	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	<i>Level</i>	
DDHV = AADT x K x D		veh/h	Grade % Length	<i>mi</i>	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	547	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	9.9	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To US 50 to Wooster Rd		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F3 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	2860	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)			Design LOS		
	1613	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV} x f _p)		
S	55.0	mph	S		
D = v _p / S	29.3	pc/mi/ln	D = v _p / S		
LOS	D		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	480	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	271	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	4.9	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	700	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	395	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	7.2	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	7/27/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1010	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
v _p	570	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	10.4	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	910	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
v _p	513	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	9.3	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

PM

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		NB Wilmer to EB SR 125			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X2-A									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 210 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				2460			
		Ramp Volume, V _R				730			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2460	0.90	Level	1	0	0.995	1.00	2747	
Ramp	730	0.90	Level	1	0	0.995	1.00	815	
UpStream	210	0.90	Level	1	0	0.995	1.00	235	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 2747 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	3562	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3562	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 29.7 (pc/mi/ln) LOS = D (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.423 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 49.5 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 49.5 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		EB SR 125 to SB Wilmer Rd			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X2-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 730 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				2670			
		Ramp Volume, V_R				210			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	2670	0.90	Level	1	0	0.995	1.00	2982	
Ramp	210	0.90	Level	1	0	0.995	1.00	235	
UpStream									
DownStream	730	0.90	Level	1	0	0.995	1.00	815	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 2982 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	2982	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	2747	Exhibit 13-8	4500	No		
			V_R	235	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	2982	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 25.4 (pc/mi/ln) LOS = C (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.319 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to NB Wooster Rd			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		202 NO-BUILD			
Project Description Ramp X2-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 250 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				1450			
		Ramp Volume, V_R				410			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	1450	0.90	Level	1	0	0.995	1.00	1619	
Ramp	410	0.90	Level	1	0	0.995	1.00	458	
UpStream									
DownStream	250	0.90	Level	1	0	0.995	1.00	279	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1619 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1619	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	1161	Exhibit 13-8	4500	No		
			V_R	458	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1619	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 13.7 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.339 (Exhibit 13-12) $S_R =$ 50.6 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.6 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB Wooster Rd to WB SR 125			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X2-D									
Inputs									
Upstream Adj Ramp		Freeway Number of Lanes, N				2		Downstream Adj Ramp	
☒ Yes ☐ On		Ramp Number of Lanes, N				1		☐ Yes ☐ On	
☐ No ☒ Off		Acceleration Lane Length, L_A				500		☒ No ☐ Off	
		Deceleration Lane Length L_D							
$L_{up} = 600$ ft		Freeway Volume, V_F				1040		$L_{down} =$ ft	
		Ramp Volume, V_R				250			
$V_u = 410$ veh/h		Freeway Free-Flow Speed, S_{FF}				55.0		$V_D =$ veh/h	
		Ramp Free-Flow Speed, S_{FR}				35.0			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	1040	0.90	Level	1	0	0.995	1.00	1161	
Ramp	250	0.90	Level	1	0	0.995	1.00	279	
UpStream	410	0.90	Level	1	0	0.995	1.00	458	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
(Equation 13-6 or 13-7)					(Equation 13-12 or 13-13)				
$P_{FM} = 1.000$ using Equation (Exhibit 13-6)					using Equation (Exhibit 13-7)				
$V_{12} = 1161$ pc/h					pc/h				
V_3 or $V_{av34} = 0$ pc/h (Equation 13-14 or 13-17)					pc/h (Equation 13-14 or 13-17)				
Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No					Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No				
Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No					Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No				
If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1440	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1440	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
$D_R = 13.4$ (pc/mi/ln)					$D_R =$ (pc/mi/ln)				
LOS = B (Exhibit 13-2)					LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S = 0.302$ (Exhibit 13-11)					$D_S =$ (Exhibit 13-12)				
$S_R = 51.1$ mph (Exhibit 13-11)					$S_R =$ mph (Exhibit 13-12)				
$S_0 =$ N/A mph (Exhibit 13-11)					$S_0 =$ mph (Exhibit 13-12)				
$S = 51.1$ mph (Exhibit 13-13)					$S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB US 50 off-ramp to EB SR 125			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D				500			
		Freeway Volume, V _F				1850			
		Ramp Volume, V _R				1010			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1850	0.90	Level	2	0	0.990	1.00	2076	
Ramp	1010	0.90	Level	2	0	0.990	1.00	1133	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 2076 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	2076	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	943	Exhibit 13-8	4500	No	
				V _R	1133	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	2076	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 17.6 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.400 (Exhibit 13-12) S _R = 49.8 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 49.8 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		EB SR 125 to SB US 50			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off L _{up} = 1000 ft V _u = 410 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				950			
		Ramp Volume, V _R				50			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	950	0.90	Level	2	0	0.990	1.00	1066	
Ramp	50	0.90	Level	2	0	0.990	1.00	56	
UpStream	410	0.90	Level	2	0	0.990	1.00	460	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 1066 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1122	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1122	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 11.1 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.298 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 51.1 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 51.1 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to SB US 50 Diverge			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-C - DIVERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N 2				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h			
		Ramp Number of Lanes, N 1							
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D 500							
		Freeway Volume, V _F 1290							
		Ramp Volume, V _R 410							
Freeway Free-Flow Speed, S _{FF} 55.0									
Ramp Free-Flow Speed, S _{FR} 25.0									
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1290	0.90	Level	2	0	0.990	1.00	1448	
Ramp	410	0.90	Level	2	0	0.990	1.00	460	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
V ₁₂ = V _F (P _{FM}) (Equation 13-6 or 13-7) L _{EQ} = P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					V ₁₂ = V _R + (V _F - V _R)P _{FD} (Equation 13-12 or 13-13) L _{EQ} = P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 1448 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	1448	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	988	Exhibit 13-8	4500	No	
				V _R	460	Exhibit 13-10	1900	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	1448	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
D _R = 5.475 + 0.00734 v _R + 0.0078 V ₁₂ - 0.00627 L _A D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					D _R = 4.252 + 0.0086 V ₁₂ - 0.009 L _D D _R = 12.2 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.599 (Exhibit 13-12) S _R = 47.2 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 47.2 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		SB and NB			
Agency or Company				Junction		WB SR 125 to SB US 50 Merge			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-C - MERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1000 ft $V_D =$ 50 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A				500			
		Deceleration Lane Length L_D							
		Freeway Volume, V_F				540			
		Ramp Volume, V_R				410			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				25.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	540	0.90	Level	2	0	0.990	1.00	606	
Ramp	410	0.90	Level	2	0	0.990	1.00	460	
UpStream									
DownStream	50	0.90	Level	2	0	0.990	1.00	56	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $P_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ 1.000 using Equation (Exhibit 13-6) $V_{12} =$ 606 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $P_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ using Equation (Exhibit 13-7) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1066	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1066	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ 10.4 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.307 (Exhibit 13-11) $S_R =$ 51.0 mph (Exhibit 13-11) $S_0 =$ N/A mph (Exhibit 13-11) $S =$ 51.0 mph (Exhibit 13-13)					$D_S =$ (Exhibit 13-12) $S_R =$ mph (Exhibit 13-12) $S_0 =$ mph (Exhibit 13-12) $S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB Eastern Ave to NB US 50			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N 2				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h			
		Ramp Number of Lanes, N 1							
		Acceleration Lane Length, L _A 500							
		Deceleration Lane Length L _D							
		Freeway Volume, V _F 840							
		Ramp Volume, V _R 260							
Freeway Free-Flow Speed, S _{FF} 55.0									
Ramp Free-Flow Speed, S _{FR} 35.0									
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	840	0.90	Level	2	0	0.990	1.00	943	
Ramp	260	0.90	Level	2	0	0.990	1.00	292	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
V ₁₂ = V _F (P _{FM}) (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 943 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					V ₁₂ = V _R + (V _F - V _R)P _{FD} (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1235	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1235	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
D _R = 5.475 + 0.00734 v _R + 0.0078 V ₁₂ - 0.00627 L _A D _R = 11.8 (pc/mi/ln) LOS = B (Exhibit 13-2)					D _R = 4.252 + 0.0086 V ₁₂ - 0.009 L _D D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.299 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		SB US 50 to Eastern Ave			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X3-E									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				980			
		Ramp Volume, V_R				440			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	980	0.90	Level	2	0	0.990	1.00	1100	
Ramp	440	0.90	Level	2	0	0.990	1.00	494	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1100 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1100	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	606	Exhibit 13-8	4500	No	
				V_R	494	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1100	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 9.2 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.342 (Exhibit 13-12) $S_R =$ 50.5 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.5 mph (Exhibit 13-13)				

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>US 50 to Wooster Rd</i>		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year <i>2022 NO-BUILD</i>		
Project Description <i>F3 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	2670	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.995	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	1491	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	27.1	pc/mi/ln	D = v _p / S		
LOS	D		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To US 50 to Wooster Rd		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F3 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1290	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.995	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	720	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	13.1	pc/mi/ln	D = v _p / S		
LOS	B		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	840	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	2	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	471	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	8.6	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	540	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	2	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	303	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	5.5	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1100	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	2	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade %	Length	mi
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)] 0.990		
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}		mph
Number of Lanes, N	2		f _{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	617	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	11.2	pc/mi/ln	D = v _p / S		
LOS	B		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	7/12/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2022 NO-BUILD		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	980	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	2	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
v _p	550	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	10.0	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

2042

AM

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		NB Wilmer to EB SR 125			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X2-A									
Inputs									
Upstream Adj Ramp		Freeway Number of Lanes, N				2		Downstream Adj Ramp	
☒ Yes ☐ On		Ramp Number of Lanes, N				1		☐ Yes ☐ On	
☐ No ☒ Off		Acceleration Lane Length, L_A				500		☒ No ☐ Off	
		Deceleration Lane Length L_D							
$L_{up} = 600$ ft		Freeway Volume, V_F				760		$L_{down} =$ ft	
		Ramp Volume, V_R				330			
$V_u = 220$ veh/h		Freeway Free-Flow Speed, S_{FF}				55.0		$V_D =$ veh/h	
		Ramp Free-Flow Speed, S_{FR}				35.0			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	760	0.90	Level	3	0	0.985	1.00	857	
Ramp	330	0.90	Level	3	0	0.985	1.00	372	
UpStream	220	0.90	Level	3	0	0.985	1.00	248	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$					$V_{12} = V_R + (V_F - V_R)P_{FD}$				
(Equation 13-6 or 13-7)					(Equation 13-12 or 13-13)				
$P_{FM} = 1.000$ using Equation (Exhibit 13-6)					using Equation (Exhibit 13-7)				
$V_{12} = 857$ pc/h					pc/h				
V_3 or $V_{av34} = 0$ pc/h (Equation 13-14 or 13-17)					pc/h (Equation 13-14 or 13-17)				
Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No					Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No				
Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No					Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No				
If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1229	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1229	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
$D_R = 11.8$ (pc/mi/ln)					$D_R =$ (pc/mi/ln)				
LOS = B (Exhibit 13-2)					LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S = 0.299$ (Exhibit 13-11)					$D_S =$ (Exhibit 13-12)				
$S_R = 51.1$ mph (Exhibit 13-11)					$S_R =$ mph (Exhibit 13-12)				
$S_0 =$ N/A mph (Exhibit 13-11)					$S_0 =$ mph (Exhibit 13-12)				
$S = 51.1$ mph (Exhibit 13-13)					$S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		EB SR 125 to SB Wilmer Rd			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X2-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 330 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				980			
		Ramp Volume, V_R				220			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	980	0.90	Level	3	0	0.985	1.00	1105	
Ramp	220	0.90	Level	3	0	0.985	1.00	248	
UpStream									
DownStream	330	0.90	Level	3	0	0.985	1.00	372	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1105 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1105	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	857	Exhibit 13-8	4500	No	
				V_R	248	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1105	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 9.3 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.320 (Exhibit 13-12) $S_R =$ 50.8 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.8 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to NB Wooster Rd			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X2-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 120 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				3630			
		Ramp Volume, V_R				880			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	3630	0.90	Level	3	0	0.985	1.00	4094	
Ramp	880	0.90	Level	3	0	0.985	1.00	992	
UpStream									
DownStream	120	0.90	Level	3	0	0.985	1.00	135	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 4094 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	4094	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	3102	Exhibit 13-8	4500	No		
			V_R	992	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	4094	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 35.0 (pc/mi/ln) LOS = D (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.387 (Exhibit 13-12) $S_R =$ 50.0 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.0 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB Wooster Rd to WB SR 125			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X2-D									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 880 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				2750			
		Ramp Volume, V _R				120			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2750	0.90	Level	3	0	0.985	1.00	3101	
Ramp	120	0.90	Level	3	0	0.985	1.00	135	
UpStream	880	0.90	Level	3	0	0.985	1.00	992	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 3101 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	3236	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3236	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 27.5 (pc/mi/ln) LOS = C (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.385 (Exhibit 13-11) S _R = 50.0 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 50.0 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB US 50 off-ramp to EB SR 125			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N 2 Ramp Number of Lanes, N 1 Acceleration Lane Length, L_A Deceleration Lane Length L_D 500 Freeway Volume, V_F 870 Ramp Volume, V_R 400 Freeway Free-Flow Speed, S_{FF} 55.0 Ramp Free-Flow Speed, S_{FR} 45.0				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	870	0.90	Level	3	0	0.985	1.00	981	
Ramp	400	0.90	Level	3	0	0.985	1.00	451	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 981 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	981	Exhibit 13-8	4500	No
					$V_{FO} = V_F - V_R$	530	Exhibit 13-8	4500	No
					V_R	451	Exhibit 13-10	2100	No
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	981	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) $LOS =$ (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 8.2 (pc/mi/ln) $LOS =$ A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.339 (Exhibit 13-12) $S_R =$ 50.6 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.6 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		EB SR 125 to SB US 50			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off	
		Ramp Number of Lanes, N				1			
L _{up} = 1000 ft V _u = 1000 veh/h		Acceleration Lane Length, L _A				500		L _{down} = ft V _D = veh/h	
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				1720			
		Ramp Volume, V _R				40			
		Freeway Free-Flow Speed, S _{FF}				55.0			
		Ramp Free-Flow Speed, S _{FR}				35.0			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1720	0.90	Level	3	0	0.985	1.00	1940	
Ramp	40	0.90	Level	3	0	0.985	1.00	45	
UpStream	1000	0.90	Level	3	0	0.985	1.00	1128	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 1940 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1985	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1985	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
D _R = 17.8 (pc/mi/ln)					D _R = (pc/mi/ln)				
LOS = B (Exhibit 13-2)					LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.314 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 50.9 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 50.9 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to SB US 50 Diverge			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-C - DIVERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D				500			
		Freeway Volume, V _F				2870			
		Ramp Volume, V _R				1000			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				25.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2870	0.90	Level	3	0	0.985	1.00	3237	
Ramp	1000	0.90	Level	3	0	0.985	1.00	1128	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 3237 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	3237	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	2109	Exhibit 13-8	4500	No	
				V _R	1128	Exhibit 13-10	1900	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	3237	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 27.6 (pc/mi/ln) LOS = C (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.660 (Exhibit 13-12) S _R = 46.4 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 46.4 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		SB and NB			
Agency or Company				Junction		WB SR 125 to SB US 50 Merge			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-C - MERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1000 ft $V_D =$ 40 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A				500			
		Deceleration Lane Length L_D							
		Freeway Volume, V_F				720			
		Ramp Volume, V_R				1000			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				25.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	720	0.90	Level	3	0	0.985	1.00	812	
Ramp	1000	0.90	Level	3	0	0.985	1.00	1128	
UpStream									
DownStream	40	0.90	Level	3	0	0.985	1.00	45	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
$P_{FM} =$ 1.000 using Equation (Exhibit 13-6)					$P_{FD} =$ using Equation (Exhibit 13-7)				
$V_{12} =$ 812 pc/h					$V_{12} =$ pc/h				
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)					V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)				
Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No					Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No				
Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No					Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No				
If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1940	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1940	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$				
$D_R =$ 17.0 (pc/mi/ln)					$D_R =$ (pc/mi/ln)				
LOS = B (Exhibit 13-2)					LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.323 (Exhibit 13-11)					$D_S =$ (Exhibit 13-12)				
$S_R =$ 50.8 mph (Exhibit 13-11)					$S_R =$ mph (Exhibit 13-12)				
$S_0 =$ N/A mph (Exhibit 13-11)					$S_0 =$ mph (Exhibit 13-12)				
$S =$ 50.8 mph (Exhibit 13-13)					$S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB Eastern Ave to NB US 50			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A				500			
		Deceleration Lane Length L_D							
		Freeway Volume, V_F				470			
		Ramp Volume, V_R				560			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	470	0.90	Level	3	0	0.985	1.00	530	
Ramp	560	0.90	Level	3	0	0.985	1.00	632	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ 1.000 using Equation (Exhibit 13-6) $V_{12} =$ 530 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ using Equation (Exhibit 13-7) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1162	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1162	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ 11.1 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.298 (Exhibit 13-11) $S_R =$ 51.1 mph (Exhibit 13-11) $S_0 =$ N/A mph (Exhibit 13-11) $S =$ 51.1 mph (Exhibit 13-13)					$D_S =$ (Exhibit 13-12) $S_R =$ mph (Exhibit 13-12) $S_0 =$ mph (Exhibit 13-12) $S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		SB US 50 to Eastern Ave			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-E									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N 2 Ramp Number of Lanes, N 1 Acceleration Lane Length, L_A Deceleration Lane Length L_D 500 Freeway Volume, V_F 930 Ramp Volume, V_R 210 Freeway Free-Flow Speed, S_{FF} 55.0 Ramp Free-Flow Speed, S_{FR} 45.0				Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	930	0.90	Level	3	0	0.985	1.00	1049	
Ramp	210	0.90	Level	3	0	0.985	1.00	237	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1049 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1049	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	812	Exhibit 13-8	4500	No	
				V_R	237	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1049	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) $LOS =$ (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 8.8 (pc/mi/ln) $LOS =$ A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.319 (Exhibit 13-12) $S_R =$ 50.8 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.8 mph (Exhibit 13-13)				

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>US 50 to Wooster Rd</i>		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year <i>2042 NO-BUILD</i>		
Project Description <i>F3 - Freeway Segment</i>					
☒ Oper.(LOS) ☐ Des.(N) ☐ Planning Data					
Flow Inputs					
Volume, V	980	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade %	Length	mi
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)] 0.985		
Speed Inputs			Calc Speed Adj and FFS		
Lane Width	ft				
Rt-Side Lat. Clearance	ft				
Number of Lanes, N	2				
Total Ramp Density, TRD	ramps/mi				
FFS (measured)	55.0 mph				
Base free-flow Speed, BFFS	mph				
f _{LW}			mph		
f _{LC}			mph		
TRD Adjustment			mph		
FFS			55.0 mph		
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
553	pc/h/ln		v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			pc/h/ln		
S	55.0	mph	S		
D = v _p / S	10.1	pc/mi/ln	S		
LOS	A		D = v _p / S		
			pc/mi/ln		
			Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12		
V - Hourly volume	D - Density		f _{LW} - Exhibit 11-8		
v _p - Flow rate	FFS - Free-flow speed		E _T - Exhibits 11-10, 11-11, 11-13		
LOS - Level of service	BFFS - Base free-flow speed		f _{LC} - Exhibit 11-9		
DDHV - Directional design hour volume			f _p - Page 11-18		
			TRD - Page 11-11		
			LOS, S, FFS, v _p - Exhibits 11-2, 11-3		

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To US 50 to Wooster Rd		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F3 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	2870	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	1618	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	29.4	pc/mi/ln	D = v _p / S		
LOS	D		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	470	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	265	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	4.8	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	720	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	406	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	7.4	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	7/27/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1030	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade %	Length	mi
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.985	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
v _p	581	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	10.6	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>SB US 50</i>		
Agency or Company			From/To <i>Eastern Avenue to Wooster Pk</i>		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	AM Peak Hour		Analysis Year <i>2042 NO-BUILD</i>		
Project Description <i>F2 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	930	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	3	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade %	Length	mi
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)] 0.985		
Speed Inputs			Calc Speed Adj and FFS		
Lane Width	ft				
Rt-Side Lat. Clearance	ft				
Number of Lanes, N	2				
Total Ramp Density, TRD	ramps/mi				
FFS (measured)	55.0 mph				
Base free-flow Speed, BFFS	mph				
f _{LW}			mph		
f _{LC}			mph		
TRD Adjustment			mph		
FFS			55.0 mph		
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
524	pc/h/ln		v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			pc/h/ln		
S	55.0	mph	x f _p)		
D = v _p / S	9.5	pc/mi/ln	S		
LOS	A		D = v _p / S		
			pc/mi/ln		
			Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12		f _{LW} - Exhibit 11-8
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13		f _{LC} - Exhibit 11-9
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18		TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

PM

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		NB Wilmer to EB SR 125			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X2-A									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 220 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				2450			
		Ramp Volume, V _R				750			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	2450	0.90	Level	1	0	0.995	1.00	2736	
Ramp	750	0.90	Level	1	0	0.995	1.00	838	
UpStream	220	0.90	Level	1	0	0.995	1.00	246	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 2736 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	3574	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	3574	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 29.8 (pc/mi/ln) LOS = D (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.425 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 49.5 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 49.5 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		EB SR 125 to SB Wilmer Rd			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X2-B									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 750 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				2670			
		Ramp Volume, V_R				220			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	2670	0.90	Level	1	0	0.995	1.00	2982	
Ramp	220	0.90	Level	1	0	0.995	1.00	246	
UpStream									
DownStream	750	0.90	Level	1	0	0.995	1.00	838	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 2982 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	2982	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	2736	Exhibit 13-8	4500	No		
			V_R	246	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	2982	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 25.4 (pc/mi/ln) LOS = C (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.320 (Exhibit 13-12) $S_R =$ 50.8 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.8 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to NB Wooster Rd			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X2-C									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 600 ft $V_D =$ 260 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				1460			
		Ramp Volume, V_R				420			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	1460	0.90	Level	1	0	0.995	1.00	1630	
Ramp	420	0.90	Level	1	0	0.995	1.00	469	
UpStream									
DownStream	260	0.90	Level	1	0	0.995	1.00	290	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1630 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1630	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	1161	Exhibit 13-8	4500	No	
				V_R	469	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1630	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 13.8 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.340 (Exhibit 13-12) $S_R =$ 50.6 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.6 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		SB Wooster Rd to WB SR 125			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X2-D									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 600 ft V _u = 420 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				1040			
		Ramp Volume, V _R				260			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1040	0.90	Level	1	0	0.995	1.00	1161	
Ramp	260	0.90	Level	1	0	0.995	1.00	290	
UpStream	420	0.90	Level	1	0	0.995	1.00	469	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 1161 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1451	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1451	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 13.5 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.303 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 51.1 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 51.1 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB US 50 off-ramp to EB SR 125			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D				500			
		Freeway Volume, V _F				1870			
		Ramp Volume, V _R				1020			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1870	0.90	Level	2	0	0.990	1.00	2099	
Ramp	1020	0.90	Level	2	0	0.990	1.00	1145	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
V ₁₂ = V _F (P _{FM}) (Equation 13-6 or 13-7) P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					V ₁₂ = V _R + (V _F - V _R)P _{FD} (Equation 13-12 or 13-13) P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 2099 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	2099	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	954	Exhibit 13-8	4500	No	
				V _R	1145	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	2099	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
D _R = 5.475 + 0.00734 v _R + 0.0078 V ₁₂ - 0.00627 L _A D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					D _R = 4.252 + 0.0086 V ₁₂ - 0.009 L _D D _R = 17.8 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.401 (Exhibit 13-12) S _R = 49.8 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 49.8 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		EB SR 125 to SB US 50			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off L _{up} = 1000 ft V _u = 410 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				960			
		Ramp Volume, V _R				50			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	960	0.90	Level	2	0	0.990	1.00	1077	
Ramp	50	0.90	Level	2	0	0.990	1.00	56	
UpStream	410	0.90	Level	2	0	0.990	1.00	460	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 1077 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1133	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1133	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 11.2 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.298 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		EB and WB			
Agency or Company				Junction		WB SR 125 to SB US 50 Diverge			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-C - DIVERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D				500			
		Freeway Volume, V _F				1300			
		Ramp Volume, V _R				410			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				25.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1300	0.90	Level	2	0	0.990	1.00	1459	
Ramp	410	0.90	Level	2	0	0.990	1.00	460	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 1459 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	1459	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	999	Exhibit 13-8	4500	No	
				V _R	460	Exhibit 13-10	1900	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	1459	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 12.3 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.599 (Exhibit 13-12) S _R = 47.2 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 47.2 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		SB and NB			
Agency or Company				Junction		WB SR 125 to SB US 50 Merge			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-C - MERGE									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 1000 ft $V_D =$ 50 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A				500			
		Deceleration Lane Length L_D							
		Freeway Volume, V_F				550			
		Ramp Volume, V_R				410			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				25.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	550	0.90	Level	2	0	0.990	1.00	617	
Ramp	410	0.90	Level	2	0	0.990	1.00	460	
UpStream									
DownStream	50	0.90	Level	2	0	0.990	1.00	56	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ 1.000 using Equation (Exhibit 13-6) $V_{12} =$ 617 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ using Equation (Exhibit 13-7) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1077	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1077	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ 10.5 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.307 (Exhibit 13-11) $S_R =$ 51.0 mph (Exhibit 13-11) $S_0 =$ N/A mph (Exhibit 13-11) $S =$ 51.0 mph (Exhibit 13-13)					$D_S =$ (Exhibit 13-12) $S_R =$ mph (Exhibit 13-12) $S_0 =$ mph (Exhibit 13-12) $S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		NB Eastern Ave to NB US 50			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{down} =$ ft $V_D =$ veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A				500			
		Deceleration Lane Length L_D							
		Freeway Volume, V_F				850			
		Ramp Volume, V_R				270			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	850	0.90	Level	2	0	0.990	1.00	954	
Ramp	270	0.90	Level	2	0	0.990	1.00	303	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) $P_{FM} =$ 1.000 using Equation (Exhibit 13-6) $V_{12} =$ 954 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☒ Yes ☐ No If Yes, $V_{12a} =$ 954 pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) $P_{FD} =$ using Equation (Exhibit 13-7) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1257	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1257	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ 12.0 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.300 (Exhibit 13-11) $S_R =$ 51.1 mph (Exhibit 13-11) $S_0 =$ N/A mph (Exhibit 13-11) $S =$ 51.1 mph (Exhibit 13-13)					$D_S =$ (Exhibit 13-12) $S_R =$ mph (Exhibit 13-12) $S_0 =$ mph (Exhibit 13-12) $S =$ mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		SB US 50 to Eastern Ave			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X3-E									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{up} = ft V _u = veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A							
		Deceleration Lane Length L _D				500			
		Freeway Volume, V _F				1000			
		Ramp Volume, V _R				450			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	1000	0.90	Level	2	0	0.990	1.00	1122	
Ramp	450	0.90	Level	2	0	0.990	1.00	505	
UpStream									
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = using Equation (Exhibit 13-6) V ₁₂ = pc/h V ₃ or V _{av34} pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = 1.000 using Equation (Exhibit 13-7) V ₁₂ = 1122 pc/h V ₃ or V _{av34} 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}		Exhibit 13-8			V _F	1122	Exhibit 13-8	4500	No
				V _{FO} = V _F - V _R	617	Exhibit 13-8	4500	No	
				V _R	505	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}		Exhibit 13-8			V ₁₂	1122	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = 9.4 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = (Exhibit 13-11) S _R = mph (Exhibit 13-11) S ₀ = mph (Exhibit 13-11) S = mph (Exhibit 13-13)					D _S = 0.343 (Exhibit 13-12) S _R = 50.5 mph (Exhibit 13-12) S ₀ = N/A mph (Exhibit 13-12) S = 50.5 mph (Exhibit 13-13)				

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel <i>EB SR 125</i>		
Agency or Company			From/To <i>US 50 to Wooster Rd</i>		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year <i>2042 NO-BUILD</i>		
Project Description <i>F3 - Freeway Segment</i>					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	2670	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.995	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	1491	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	27.1	pc/mi/ln	D = v _p / S		
LOS	D		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel WB SR 125		
Agency or Company			From/To US 50 to Wooster Rd		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F3 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1300	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	1	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.995	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	726	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	13.2	pc/mi/ln	D = v _p / S		
LOS	B		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	850	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	2	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	477	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	8.7	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To SR 125 to Eastern Avenue		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F1 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	550	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	2	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
	309	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	5.6	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel NB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1120	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P_T	2	
Peak-Hr Prop. of AADT, K			%RVs, P_R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f_p	1.00		E_R	1.2	
E_T	1.5		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}	mph	
Number of Lanes, N	2		f_{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$	628	pc/h/ln	$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV} \times f_p)$		
S	55.0	mph	S		
$D = v_p / S$	11.4	pc/mi/ln	$D = v_p / S$		
LOS	B		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9	
v_p - Flow rate	FFS - Free-flow speed		f_p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v_p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

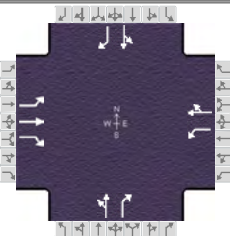
BASIC FREEWAY SEGMENTS WORKSHEET					
General Information			Site Information		
Analyst	MJH		Highway/Direction of Travel SB US 50		
Agency or Company			From/To Eastern Avenue to Wooster Pk		
Date Performed	7/14/2016		Jurisdiction		
Analysis Time Period	PM Peak Hour		Analysis Year 2042 NO-BUILD		
Project Description F2 - Freeway Segment					
☒ Oper.(LOS)		☐ Des.(N)		☐ Planning Data	
Flow Inputs					
Volume, V	1000	veh/h	Peak-Hour Factor, PHF	0.90	
AADT		veh/day	%Trucks and Buses, P _T	2	
Peak-Hr Prop. of AADT, K			%RVs, P _R	0	
Peak-Hr Direction Prop, D			General Terrain:	Level	
DDHV = AADT x K x D		veh/h	Grade % Length	mi	
			Up/Down %		
Calculate Flow Adjustments					
f _p	1.00		E _R	1.2	
E _T	1.5		f _{HV} = 1/[1+P _T (E _T - 1) + P _R (E _R - 1)]	0.990	
Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f _{LW}	mph	
Number of Lanes, N	2		f _{LC}	mph	
Total Ramp Density, TRD		ramps/mi	TRD Adjustment	mph	
FFS (measured)	55.0	mph	FFS	55.0	mph
Base free-flow Speed, BFFS		mph			
LOS and Performance Measures			Design (N)		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
v _p = (V or DDHV) / (PHF x N x f _{HV})			Design LOS		
v _p	561	pc/h/ln	v _p = (V or DDHV) / (PHF x N x f _{HV})		
x f _p)			x f _p)		
S	55.0	mph	S		
D = v _p / S	10.2	pc/mi/ln	D = v _p / S		
LOS	A		Required Number of Lanes, N		
Glossary			Factor Location		
N - Number of lanes	S - Speed		E _R - Exhibits 11-10, 11-12	f _{LW} - Exhibit 11-8	
V - Hourly volume	D - Density		E _T - Exhibits 11-10, 11-11, 11-13	f _{LC} - Exhibit 11-9	
v _p - Flow rate	FFS - Free-flow speed		f _p - Page 11-18	TRD - Page 11-11	
LOS - Level of service	BFFS - Base free-flow speed		LOS, S, FFS, v _p - Exhibits 11-2, 11-3		
DDHV - Directional design hour volume					

US 50/RED BANK INTERCHANGE AREA

2015

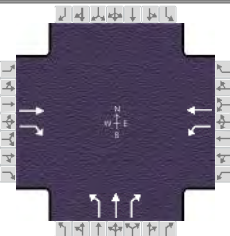
AM

HCS 2010 Signalized Intersection Results Summary

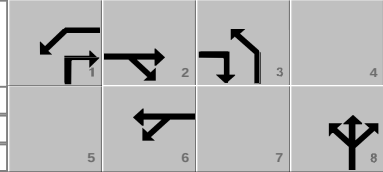
General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 19, 2016		Area Type		Other									
Jurisdiction		Fairfax		Time Period				PHF		0.90									
Urban Street		US 50		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		US 50 at Wooster Pike		File Name		16-Existing-AM.xus													
Project Description		Existing AM Peak Hour																	
Demand Information																			
				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				30	430	50	130	740	30	20	20	140	60	20	90				
Signal Information																			
Cycle, s				85.0	Reference Phase		2												
Offset, s				0	Reference Point		End												
Uncoordinated				Yes	Simult. Gap E/W		On												
Force Mode				Fixed	Simult. Gap N/S		On												
				Green	9.0	38.0	19.0	0.0	0.0	0.0									
				Yellow	3.5	4.5	3.6	0.0	0.0	0.0									
				Red	2.5	2.5	2.4	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2		1		6				8				4	
Case Number						5.3		2.0		4.0				7.0				7.0	
Phase Duration, s						45.0		15.0		60.0				25.0				25.0	
Change Period, (Y+R c), s						7.0		6.0		7.0				6.0				6.0	
Max Allow Headway (MAH), s						3.1		3.1		3.1				3.3				3.3	
Queue Clearance Time (g s), s						17.8		8.6		28.5				8.1				6.4	
Green Extension Time (g e), s						3.3		0.0		2.7				0.6				0.7	
Phase Call Probability						1.00		1.00		1.00				1.00				1.00	
Max Out Probability						0.03		1.00		0.26				0.01				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				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				33	478	56	144	856			44	156		89	100				
Adjusted Saturation Flow Rate (s), veh/h/ln				655	1900	1610	1810	1887			1649	1610		1522	1610				
Queue Service Time (g s), s				3.1	15.8	1.7	6.6	26.5			0.0	6.1		2.4	4.4				
Cycle Queue Clearance Time (g c), s				14.7	15.8	1.7	6.6	26.5			1.6	6.1		3.9	4.4				
Green Ratio (g/C)				0.45	0.45	0.45	0.11	0.62			0.22	0.33		0.22	0.22				
Capacity (c), veh/h				289	849	720	192	1176			432	530		414	360				
Volume-to-Capacity Ratio (X)				0.116	0.562	0.077	0.754	0.727			0.103	0.293		0.215	0.278				
Back of Queue (Q), ft/ln (95 th percentile)				21	266	25.8	160.6	371.2			31.4	99.1		64.9	73.7				
Back of Queue (Q), veh/ln (95 th percentile)				0.8	10.6	1.0	6.4	14.8			1.3	4.0		2.6	2.9				
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00			0.00	0.00		0.00	0.00				
Uniform Delay (d 1), s/veh				21.3	17.4	13.5	36.9	11.0			26.2	21.2		27.1	27.3				
Incremental Delay (d 2), s/veh				0.1	0.5	0.0	14.0	2.0			0.0	0.1		0.1	0.2				
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0			0.0	0.0		0.0	0.0				
Control Delay (d), s/veh				21.3	17.9	13.5	50.9	13.0			26.3	21.3		27.2	27.5				
Level of Service (LOS)				C	B	B	D	B			C	C		C	C				
Approach Delay, s/veh / LOS				17.7	B		18.5	B		22.4	C		27.3	C					
Intersection Delay, s/veh / LOS				19.5						B									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3	B		2.2	B		2.3	B		2.4	B					
Bicycle LOS Score / LOS				1.4	A		2.1	B		0.8	A		0.8	A					

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other	
Jurisdiction		Fairfax		Time Period				PHF		0.90	
Urban Street		Red Bank Road		Analysis Year		2016		Analysis Period		1> 7:00	
Intersection		Red Bank Rd at Wooste...		File Name		20-Existing-AM.xus					
Project Description		Existing AM Peak Hour									



Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					60	280	100	30		760	0	160			

Signal Information						
Cycle, s	100.0	Reference Phase	2			
Offset, s	0	Reference Point	End			
Uncoordinated	Yes	Simult. Gap E/W	On			
Force Mode	Fixed	Simult. Gap N/S	On			
Green	7.0	21.0	56.0	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.5	1.5	1.5	0.0	0.0	0.0

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			2	1	6		8		
Case Number			7.3	1.0	4.0		9.0		
Phase Duration, s			26.0	13.0	39.0		61.0		
Change Period, (Y+R _c), s			5.0	6.0	5.0		5.0		
Max Allow Headway (MAH), s			3.3	3.1	3.3		3.2		
Queue Clearance Time (g _s), s			7.9	6.9	3.3		45.1		
Green Extension Time (g _e), s			0.8	0.0	0.8		2.1		
Phase Call Probability			1.00	1.00	1.00		1.00		
Max Out Probability			0.00	1.00	0.00		0.10		

Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement			2	12	1	6		3	8	18			
Adjusted Flow Rate (v), veh/h			67	311	111	33		844	0	178			
Adjusted Saturation Flow Rate (s), veh/h/ln			1792	1519	1707	1792		1707	1792	1519			
Queue Service Time (g _s), s			3.1	5.9	4.9	1.3		43.1	0.0	4.9			
Cycle Queue Clearance Time (g _c), s			3.1	5.9	4.9	1.3		43.1	0.0	4.9			
Green Ratio (g/C)			0.21	0.77	0.30	0.34		0.56	0.56	0.63			
Capacity (c), veh/h			376	1170	421	609		956	1004	957			
Volume-to-Capacity Ratio (X)			0.177	0.266	0.264	0.055		0.883	0.000	0.186			
Back of Queue (Q), ft/ln (95 th percentile)			61.9	61	87.7	24.5		616.2	0	68.4			
Back of Queue (Q), veh/ln (95 th percentile)			2.4	2.3	3.5	0.9		24.6	0.0	2.6			
Queue Storage Ratio (RQ) (95 th percentile)			0.00	0.00	0.00	0.00		0.00	0.00	0.00			
Uniform Delay (d ₁), s/veh			32.4	3.3	26.3	22.2		19.2	0.0	7.8			
Incremental Delay (d ₂), s/veh			0.1	0.0	0.1	0.0		9.5	0.0	0.0			
Initial Queue Delay (d ₃), s/veh			0.0	0.0	0.0	0.0		0.0	0.0	0.0			
Control Delay (d), s/veh			32.5	3.4	26.5	22.2		28.6	0.0	7.8			
Level of Service (LOS)			C	A	C	C		C		A			
Approach Delay, s/veh / LOS		8.5	A		25.5	C		25.0	C		0.0		
Intersection Delay, s/veh / LOS		21.0							C				

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.4	B	1.9	A	2.3	B	2.3	B
Bicycle LOS Score / LOS		1.1	A	0.7	A	2.2	B		

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information				
Agency					Duration, h		0.25		
Analyst		MJH	Analysis Date	Jul 26, 2016		Area Type		Other	
Jurisdiction		Fairfax	Time Period			PHF		0.90	
Urban Street		Red Bank Road	Analysis Year	2016		Analysis Period		1> 7:00	
Intersection		Red Bank Rd at US 50...	File Name	25-Existing-AM.xus					
Project Description		Existing AM Peak Hour							

Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h							10		640		750	10	220	380	

Signal Information															
Cycle, s	70.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	Off	Green	13.0	30.0	12.0	0.0	0.0	0.0					
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0					
				Red	1.0	1.0	1.0	0.0	0.0	0.0					

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase					8		2	1	6
Case Number					9.0		8.3	2.0	4.0
Phase Duration, s					17.0		35.0	18.0	53.0
Change Period, (Y+R _c), s					5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s					3.4		3.0	3.1	3.0
Queue Clearance Time (g _s), s					14.0		32.0	6.4	9.0
Green Extension Time (g _e), s					0.0		0.0	0.3	2.8
Phase Call Probability					1.00		1.00	1.00	1.00
Max Out Probability					1.00		1.00	0.03	0.01

Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement					3		18		2	12	1	6	
Adjusted Flow Rate (v), veh/h					11		711		844		244	422	
Adjusted Saturation Flow Rate (s), veh/h/ln					1774		1579		1788		1689	1754	
Queue Service Time (g _s), s					0.4		12.0		30.0		4.4	7.0	
Cycle Queue Clearance Time (g _c), s					0.4		12.0		30.0		4.4	7.0	
Green Ratio (g/C)					0.17		0.36		0.43		0.19	0.69	
Capacity (c), veh/h					304		564		766		628	1203	
Volume-to-Capacity Ratio (X)					0.037		1.261		1.102		0.390	0.351	
Back of Queue (Q), ft/ln (95 th percentile)					6.6		1050.6		868.6		75.9	77.7	
Back of Queue (Q), veh/ln (95 th percentile)					0.3		42.0		34.7		3.0	3.1	
Queue Storage Ratio (RQ) (95 th percentile)					0.00		0.00		0.00		0.00	0.00	
Uniform Delay (d ₁), s/veh					24.2		22.5		20.0		25.0	4.6	
Incremental Delay (d ₂), s/veh					0.0		131.4		64.0		0.1	0.1	
Initial Queue Delay (d ₃), s/veh					0.0		0.0		0.0		0.0	0.0	
Control Delay (d), s/veh					24.2		153.9		84.0		25.2	4.6	
Level of Service (LOS)					C		F		F		C	A	
Approach Delay, s/veh / LOS		0.0			151.9		F	84.0		F	12.2		B
Intersection Delay, s/veh / LOS		84.5							F				

Multimodal Results		EB		WB		NB		SB					
Pedestrian LOS Score / LOS		2.1		B	2.5		B	2.7		B	0.6		A
Bicycle LOS Score / LOS					F			1.9		A	1.6		A

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		NB US 50 off-ramp to Red Bank			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X4-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 90 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				900			
		Ramp Volume, V_R				480			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	900	0.90	Level	3	0	0.985	1.00	1015	
Ramp	480	0.90	Level	3	0	0.985	1.00	541	
UpStream									
DownStream	90	0.90	Level	3	0	0.985	1.00	102	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1015 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1015	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	474	Exhibit 13-8	4500	No		
			V_R	541	Exhibit 13-10	2000	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1015	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 8.5 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.477 (Exhibit 13-12) $S_R =$ 48.8 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 48.8 mph (Exhibit 13-13)				

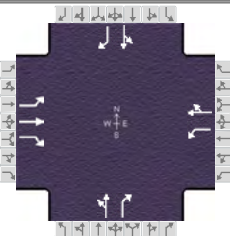
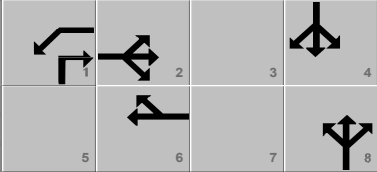
RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to NB US 50			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		Existing			
Project Description Ramp X4-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 480 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				420			
		Ramp Volume, V _R				90			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	420	0.90	Level	3	0	0.985	1.00	474	
Ramp	90	0.90	Level	3	0	0.985	1.00	102	
UpStream	480	0.90	Level	3	0	0.985	1.00	541	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 474 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	576	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	576	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 6.8 (pc/mi/ln) LOS = A (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.293 (Exhibit 13-11) S _R = 51.2 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.2 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to SB US 50			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		Existing			
Project Description Ramp X4-C									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 170 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				680			
		Ramp Volume, V _R				140			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	680	0.90	Level	3	0	0.985	1.00	767	
Ramp	140	0.90	Level	3	0	0.985	1.00	158	
UpStream	170	0.90	Level	3	0	0.985	1.00	192	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 767 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	925	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	925	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 9.5 (pc/mi/ln) LOS = A (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.296 (Exhibit 13-11) S _R = 51.2 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.2 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB ans SB			
Agency or Company				Junction		SB US 50 off-ramp to Red Bank			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X4-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 140 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				850			
		Ramp Volume, V_R				170			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	850	0.90	Level	3	0	0.985	1.00	959	
Ramp	170	0.90	Level	3	0	0.985	1.00	192	
UpStream									
DownStream	140	0.90	Level	3	0	0.985	1.00	158	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 959 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	959	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	767	Exhibit 13-8	4500	No		
			V_R	192	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	959	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) $LOS =$ (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 8.0 (pc/mi/ln) $LOS =$ A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.315 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

PM

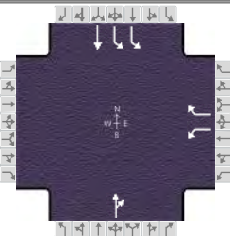
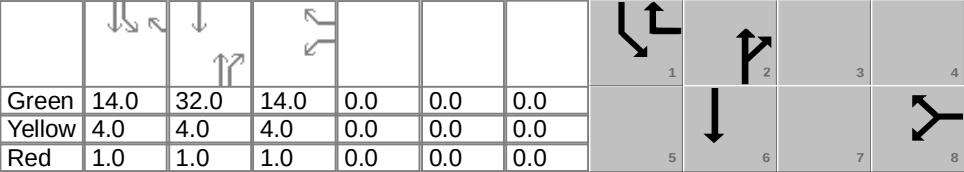
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type						Other					
Jurisdiction		Fairfax		Time Period				PHF						0.90					
Urban Street		US 50		Analysis Year		2016		Analysis Period						1> 7:00					
Intersection		US 50 at Wooster Pike		File Name		16-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				70	590	270	110	500	20	190	90	290	20	20	50				
Signal Information																			
Cycle, s	95.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On	Green	10.0	46.0	20.0	0.0	0.0	0.0	0.0	5	6	7	8				
				Yellow	3.5	4.5	3.6	0.0	0.0	0.0	0.0								
				Red	2.5	2.5	2.4	0.0	0.0	0.0	0.0								
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2		1		6				8				4	
Case Number						5.3		2.0		4.0				7.0				7.0	
Phase Duration, s						53.0		16.0		69.0				26.0				26.0	
Change Period, (Y+R c), s						7.0		6.0		7.0				6.0				6.0	
Max Allow Headway (MAH), s						3.2		3.1		3.2				3.2				3.2	
Queue Clearance Time (g s), s						28.6		8.3		17.0				21.0				4.7	
Green Extension Time (g e), s						3.7		0.0		3.9				0.0				1.4	
Phase Call Probability						1.00		1.00		1.00				1.00				1.00	
Max Out Probability						0.08		1.00		0.01				1.00				0.01	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				78	656	300	122	578			311	322		44	56				
Adjusted Saturation Flow Rate (s), veh/h/ln				832	1863	1579	1774	1850			1539	1610		1577	1610				
Queue Service Time (g s), s				5.1	26.6	11.5	6.3	15.0			17.2	16.3		0.0	2.7				
Cycle Queue Clearance Time (g c), s				5.1	26.6	11.5	6.3	15.0			19.0	16.3		1.8	2.7				
Green Ratio (g/C)				0.48	0.48	0.48	0.11	0.65			0.21	0.32		0.21	0.21				
Capacity (c), veh/h				479	902	764	187	1207			388	508		389	339				
Volume-to-Capacity Ratio (X)				0.162	0.727	0.392	0.655	0.479			0.803	0.634		0.114	0.164				
Back of Queue (Q), ft/ln (95 th percentile)				41.6	425.9	178.7	138.1	225			323.1	264.4		37.1	46.9				
Back of Queue (Q), veh/ln (95 th percentile)				1.6	16.8	7.0	5.4	8.9			12.7	10.4		1.5	1.8				
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00			0.00	0.00		0.00	0.00				
Uniform Delay (d 1), s/veh				13.9	19.5	15.6	40.8	8.3			37.1	27.8		30.3	30.7				
Incremental Delay (d 2), s/veh				0.1	2.6	0.1	6.4	0.1			10.8	2.0		0.0	0.1				
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0			0.0	0.0		0.0	0.0				
Control Delay (d), s/veh				14.0	22.1	15.7	47.2	8.4			47.9	29.8		30.4	30.7				
Level of Service (LOS)				B	C	B	D	A			D	C		C	C				
Approach Delay, s/veh / LOS				19.6		B		15.2		B		38.7		D		30.6		C	
Intersection Delay, s/veh / LOS				23.7						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.2		B		2.3		B		2.4		B	
Bicycle LOS Score / LOS				2.2		B		1.6		A		1.5		A		0.7		A	

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information														
Agency							Duration, h		0.25										
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type						Other					
Jurisdiction		Fsirfax		Time Period				PHF						0.90					
Urban Street		Red Bank Road		Analysis Year		2016		Analysis Period						1> 7:00					
Intersection		Red Bank Rd at Wooste...		File Name		20-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h					70	710	150	40		420	0	180							
Signal Information																			
Cycle, s	105.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	10.0	49.0	30.0	0.0	0.0	0.0									
				Yellow	3.5	3.5	3.5	0.0	0.0	0.0									
				Red	2.5	1.5	1.5	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2		1		6				8					
Case Number						7.3		1.0		4.0				9.0					
Phase Duration, s						54.0		16.0		70.0				35.0					
Change Period, (Y+R _c), s						5.0		6.0		5.0				5.0					
Max Allow Headway (MAH), s						3.3		3.1		3.3				3.2					
Queue Clearance Time (g _s), s						29.5		6.8		3.0				29.5					
Green Extension Time (g _e), s						2.4		0.1		2.5				0.1					
Phase Call Probability						1.00		1.00		1.00				1.00					
Max Out Probability						0.01		0.93		0.00				1.00					
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement					2	12	1	6		3	8	18							
Adjusted Flow Rate (v), veh/h					78	789	167	44		467	0	200							
Adjusted Saturation Flow Rate (s), veh/h/ln					1810	1533	1691	1776		1740	1827	1548							
Queue Service Time (g _s), s					2.5	27.5	4.8	1.0		27.5	0.0	9.6							
Cycle Queue Clearance Time (g _c), s					2.5	27.5	4.8	1.0		27.5	0.0	9.6							
Green Ratio (g/C)					0.47	0.75	0.58	0.62		0.29	0.29	0.38							
Capacity (c), veh/h					844	1154	785	1099		497	522	590							
Volume-to-Capacity Ratio (X)					0.092	0.684	0.212	0.040		0.939	0.000	0.339							
Back of Queue (Q), ft/ln (95 th percentile)					47.5	298.5	75.9	17.2		528.3	0	161.4							
Back of Queue (Q), veh/ln (95 th percentile)					1.8	11.5	3.0	0.7		21.1	0.0	6.2							
Queue Storage Ratio (RQ) (95 th percentile)					0.00	0.00	0.00	0.00		0.00	0.00	0.00							
Uniform Delay (d ₁), s/veh					15.6	6.6	10.3	7.8		36.6	0.0	23.1							
Incremental Delay (d ₂), s/veh					0.0	1.4	0.0	0.0		25.6	0.0	0.1							
Initial Queue Delay (d ₃), s/veh					0.0	0.0	0.0	0.0		0.0	0.0	0.0							
Control Delay (d), s/veh					15.6	8.0	10.4	7.8		62.2	0.0	23.2							
Level of Service (LOS)					B	A	B	A		E		C							
Approach Delay, s/veh / LOS				8.7		A		9.8		A		50.5		D		0.0			
Intersection Delay, s/veh / LOS				24.8						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.4		B		1.9		A		2.3		B		2.3		B	
Bicycle LOS Score / LOS				1.9		A		0.8		A		1.6		A					

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information														
Agency					Duration, h		0.25												
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type						Other					
Jurisdiction		Fairfax		Time Period				PHF						0.90					
Urban Street		Red Bank Road		Analysis Year		2016		Analysis Period						1> 7:00					
Intersection		Red Bank Rd at US 50...		File Name		25-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information																			
Approach Movement				EB			WB			NB			SB						
				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h							10		470		520	30	560	770					
Signal Information																			
Cycle, s	75.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	Off																
Force Mode	Fixed	Simult. Gap N/S	On																
Green	14.0	32.0	14.0	0.0	0.0	0.0													
Yellow	4.0	4.0	4.0	0.0	0.0	0.0													
Red	1.0	1.0	1.0	0.0	0.0	0.0													
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase										8				2		1		6	
Case Number										9.0				8.3		2.0		4.0	
Phase Duration, s										19.0				37.0		19.0		56.0	
Change Period, (Y+R c), s										5.0				5.0		5.0		5.0	
Max Allow Headway (MAH), s										3.4				3.0		3.1		3.0	
Queue Clearance Time (g s), s										16.0				23.6		15.4		24.0	
Green Extension Time (g e), s										0.0				2.5		0.0		2.5	
Phase Call Probability										1.00				1.00		1.00		1.00	
Max Out Probability										1.00				0.32		1.00		0.35	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement							3		18		2	12	1	6					
Adjusted Flow Rate (v), veh/h							11		522		611		622	856					
Adjusted Saturation Flow Rate (s), veh/h/ln							1774		1579		1827		1723	1788					
Queue Service Time (g s), s							0.4		14.0		21.6		13.4	22.0					
Cycle Queue Clearance Time (g c), s							0.4		14.0		21.6		13.4	22.0					
Green Ratio (g/C)							0.19		0.37		0.43		0.19	0.68					
Capacity (c), veh/h							331		589		779		643	1216					
Volume-to-Capacity Ratio (X)							0.034		0.886		0.784		0.968	0.704					
Back of Queue (Q), ft/ln (95 th percentile)							7		384		352.4		305.8	268.1					
Back of Queue (Q), veh/ln (95 th percentile)							0.3		15.4		14.1		12.2	10.6					
Queue Storage Ratio (RQ) (95 th percentile)							0.00		0.00		0.00		0.00	0.00					
Uniform Delay (d 1), s/veh							25.0		22.0		18.5		30.3	7.4					
Incremental Delay (d 2), s/veh							0.0		14.6		4.8		27.3	1.6					
Initial Queue Delay (d 3), s/veh							0.0		0.0		0.0		0.0	0.0					
Control Delay (d), s/veh							25.0		36.6		23.3		57.6	8.9					
Level of Service (LOS)							C		D		C		E	A					
Approach Delay, s/veh / LOS				0.0			36.4		D	23.3		C	29.4		C				
Intersection Delay, s/veh / LOS				29.4						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.1		B	2.5		B	2.7		B	0.7		A				
Bicycle LOS Score / LOS							F			1.5		A	2.9		C				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		NB US 50 off-ramp to Red Bank			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X4-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 140 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				980			
		Ramp Volume, V_R				300			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	980	0.90	Level	2	0	0.990	1.00	1100	
Ramp	300	0.90	Level	2	0	0.990	1.00	337	
UpStream									
DownStream	140	0.90	Level	2	0	0.990	1.00	157	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1100 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1100	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	763	Exhibit 13-8	4500	No		
			V_R	337	Exhibit 13-10	2000	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1100	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 9.2 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.458 (Exhibit 13-12) $S_R =$ 49.0 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 49.0 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to NB US 50			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		Existing			
Project Description Ramp X4-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 300 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				680			
		Ramp Volume, V _R				140			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	680	0.90	Level	2	0	0.990	1.00	763	
Ramp	140	0.90	Level	2	0	0.990	1.00	157	
UpStream	300	0.90	Level	2	0	0.990	1.00	337	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 763 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	920	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	920	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 9.4 (pc/mi/ln) LOS = A (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.296 (Exhibit 13-11) S _R = 51.2 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.2 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

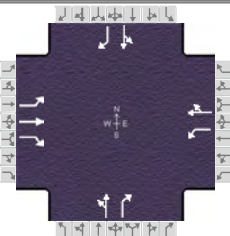
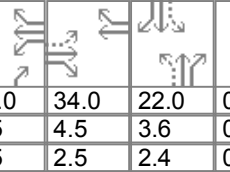
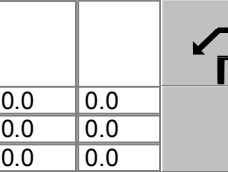
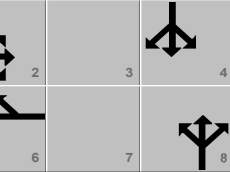
RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to SB US 50			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		Existing			
Project Description Ramp X4-C									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 180 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				430			
		Ramp Volume, V _R				450			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	430	0.90	Level	2	0	0.990	1.00	483	
Ramp	450	0.90	Level	2	0	0.990	1.00	505	
UpStream	180	0.90	Level	2	0	0.990	1.00	202	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 483 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	988	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	988	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 9.8 (pc/mi/ln) LOS = A (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.296 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 51.1 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 51.1 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB ans SB			
Agency or Company				Junction		SB US 50 off-ramp to Red Bank			
Date Performed		4/20/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		Existing			
Project Description Ramp X4-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 450 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				610			
		Ramp Volume, V_R				180			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	610	0.90	Level	2	0	0.990	1.00	685	
Ramp	180	0.90	Level	2	0	0.990	1.00	202	
UpStream									
DownStream	450	0.90	Level	2	0	0.990	1.00	505	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 685 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	685	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	483	Exhibit 13-8	4500	No		
			V_R	202	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	685	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 5.6 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.316 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

2022

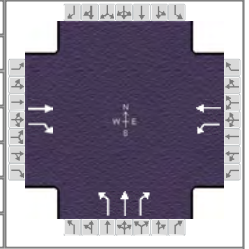
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HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information									
Agency						Duration, h		0.25							
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other					
Jurisdiction		Fairfax		Time Period				PHF		0.90					
Urban Street		US 50		Analysis Year		2022		Analysis Period		1> 7:00					
Intersection		US 50 at Wooster Pike		File Name		16-2022-AM.xus									
Project Description		2022 NO-BUILD- AM Peak Hour													
Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (ν), veh/h				30	470	70	130	820	30	30	20	140	60	20	100
Signal Information															
Cycle, s	85.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On												
Force Mode	Fixed	Simult. Gap N/S	On												
Green	10.0	34.0	22.0	0.0	0.0	0.0									
Yellow	3.5	4.5	3.6	0.0	0.0	0.0									
Red	2.5	2.5	2.4	0.0	0.0	0.0									
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase					2	1	6		8		4				
Case Number					5.3	2.0	4.0		7.0		7.0				
Phase Duration, s					41.0	16.0	57.0		28.0		28.0				
Change Period, ($Y+R_c$), s					7.0	6.0	7.0		6.0		6.0				
Max Allow Headway (MAH), s					3.1	3.1	3.1		3.3		3.3				
Queue Clearance Time (g_s), s					28.4	8.8	40.0		8.2		6.9				
Green Extension Time (g_e), s					2.3	0.0	0.0		0.7		0.8				
Phase Call Probability					1.00	1.00	1.00		1.00		1.00				
Max Out Probability					0.64	1.00	1.00		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				5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (ν), veh/h				33	522	78	144	944		56	156		89	111	
Adjusted Saturation Flow Rate (s), veh/h/ln				585	1845	1563	1740	1815		1475	1491		1448	1533	
Queue Service Time (g_s), s				4.4	20.1	2.7	6.8	38.0		0.0	6.2		1.8	4.9	
Cycle Queue Clearance Time (g_c), s				26.4	20.1	2.7	6.8	38.0		2.2	6.2		4.0	4.9	
Green Ratio (g/C)				0.40	0.40	0.40	0.12	0.59		0.26	0.38		0.26	0.26	
Capacity (c), veh/h				168	738	625	205	1068		450	561		449	397	
Volume-to-Capacity Ratio (X)				0.199	0.708	0.124	0.706	0.884		0.124	0.277		0.198	0.280	
Back of Queue (Q), ft/ln (95 th percentile)				28.4	343.3	41.9	152.2	566.6		38.3	93.5		62.9	80.1	
Back of Queue (Q), veh/ln (95 th percentile)				1.1	13.4	1.6	5.9	22.1		1.5	3.7		2.5	3.1	
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh				33.2	21.3	16.1	36.1	15.0		24.1	18.4		24.8	25.2	
Incremental Delay (d_2), s/veh				0.2	2.7	0.0	9.0	8.7		0.0	0.1		0.1	0.1	
Initial Queue Delay (d_3), s/veh				0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh				33.4	24.0	16.1	45.1	23.7		24.2	18.5		24.8	25.3	
Level of Service (LOS)				C	C	B	D	C		C	B		C	C	
Approach Delay, s/veh / LOS				23.5	C		26.6	C		20.0	C		25.1	C	
Intersection Delay, s/veh / LOS				24.9						C					
Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.3	B		2.2	B		2.3	B		2.4	B	
Bicycle LOS Score / LOS				1.5	A		2.3	B		0.8	A		0.8	A	

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 19, 2016	Area Type	Other
Jurisdiction	Fairfax	Time Period		PHF	0.90
Urban Street	Red Bank Road	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	Red Bank Rd at Wooste...	File Name	20-2022-AM.xus		
Project Description	2022 NO-BUILD - AM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		60	300	110	30		840	0	180			

Signal Information											
Cycle, s	100.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	6.0	19.0	59.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.5	3.5	3.5	0.0	0.0	0.0	
				Red	2.5	1.5	1.5	0.0	0.0	0.0	

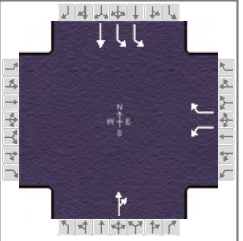
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	1.0	4.0		9.0		
Phase Duration, s		24.0	12.0	36.0		64.0		
Change Period, ($Y+R_c$), s		5.0	6.0	5.0		5.0		
Max Allow Headway (MAH), s		3.3	3.1	3.3		3.2		
Queue Clearance Time (g_s), s		8.2	7.6	3.3		51.5		
Green Extension Time (g_e), s		0.8	0.0	0.9		2.1		
Phase Call Probability		1.00	1.00	1.00		1.00		
Max Out Probability		0.01	1.00	0.00		0.32		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8	18			
Adjusted Flow Rate (v), veh/h		67	333	122	33		933	0	200			
Adjusted Saturation Flow Rate (s), veh/h/ln		1792	1519	1707	1792		1707	1792	1519			
Queue Service Time (g_s), s		3.1	6.2	5.6	1.3		49.5	0.0	5.3			
Cycle Queue Clearance Time (g_c), s		3.1	6.2	5.6	1.3		49.5	0.0	5.3			
Green Ratio (g/C)		0.19	0.78	0.27	0.31		0.59	0.59	0.65			
Capacity (c), veh/h		341	1185	377	556		1007	1058	987			
Volume-to-Capacity Ratio (X)		0.196	0.281	0.324	0.060		0.927	0.000	0.203			
Back of Queue (Q), ft/ln (95 th percentile)		63.7	61	102.3	25.8		709.6	0	72.3			
Back of Queue (Q), veh/ln (95 th percentile)		2.4	2.3	4.1	1.0		28.4	0.0	2.8			
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00	0.00	0.00		0.00	0.00	0.00			
Uniform Delay (d_1), s/veh		34.1	3.1	28.8	24.3		18.5	0.0	7.1			
Incremental Delay (d_2), s/veh		0.1	0.0	0.2	0.0		13.8	0.0	0.0			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0	0.0	0.0			
Control Delay (d), s/veh		34.2	3.1	29.0	24.3		32.3	0.0	7.1			
Level of Service (LOS)		C	A	C	C		C		A			
Approach Delay, s/veh / LOS	8.3	A		28.0	C		27.9	C		0.0		
Intersection Delay, s/veh / LOS	23.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	1.9	A	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	0.7	A	2.4	B		

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 19, 2016	Area Type	Other
Jurisdiction	Fairfax	Time Period		PHF	0.90
Urban Street	Red Bank Road	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	Red Bank Rd at US 50...	File Name	25-2022-AM.xus		
Project Description	2022 NO-BUILD - AM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				10		720		830	10	240	410	

Signal Information											
Cycle, s	70.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	Off	Green	6.0	27.9	21.1	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0	
				Red	1.0	1.0	1.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	2.0	4.0
Phase Duration, s				26.1		32.9	11.0	43.9
Change Period, ($Y+R_c$), s				5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s				3.4		3.0	3.1	3.0
Queue Clearance Time (g_s), s				23.1		29.9	7.5	12.9
Green Extension Time (g_e), s				0.0		0.0	0.0	3.2
Phase Call Probability				1.00		1.00	1.00	1.00
Max Out Probability				1.00		1.00	1.00	0.01

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18	2	12		1	6	
Adjusted Flow Rate (v), veh/h				11		800	933			267	456	
Adjusted Saturation Flow Rate (s), veh/h/ln				1774		1579	1789			1689	1754	
Queue Service Time (g_s), s				0.3		21.1	27.9			5.5	10.9	
Cycle Queue Clearance Time (g_c), s				0.3		21.1	27.9			5.5	10.9	
Green Ratio (g/C)				0.30		0.39	0.40			0.09	0.56	
Capacity (c), veh/h				535		611	713			290	975	
Volume-to-Capacity Ratio (X)				0.021		1.309	1.309			0.921	0.467	
Back of Queue (Q), ft/ln (95 th percentile)				5.3		1278.8	1480			154	157.8	
Back of Queue (Q), veh/ln (95 th percentile)				0.2		51.2	59.2			6.2	6.2	
Queue Storage Ratio (RQ) (95 th percentile)				0.00		0.00	0.00			0.00	0.00	
Uniform Delay (d_1), s/veh				17.2		21.5	21.1			31.8	9.3	
Incremental Delay (d_2), s/veh				0.0		150.6	149.1			32.3	0.1	
Initial Queue Delay (d_3), s/veh				0.0		0.0	0.0			0.0	0.0	
Control Delay (d), s/veh				17.2		172.0	170.2			64.1	9.5	
Level of Service (LOS)				B		F	F			E	A	
Approach Delay, s/veh / LOS	0.0			169.9		F	170.2		F	29.6		C
Intersection Delay, s/veh / LOS	128.9						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.5	B	2.7	B	0.7	A
Bicycle LOS Score / LOS			F		2.0	B	1.7	A

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		NB US 50 off-ramp to Red Bank			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X4-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 100 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				1010			
		Ramp Volume, V_R				540			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	1010	0.90	Level	3	0	0.985	1.00	1139	
Ramp	540	0.90	Level	3	0	0.985	1.00	609	
UpStream									
DownStream	100	0.90	Level	3	0	0.985	1.00	113	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1139 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1139	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	530	Exhibit 13-8	4500	No		
			V_R	609	Exhibit 13-10	2000	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1139	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 9.5 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.483 (Exhibit 13-12) $S_R =$ 48.7 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 48.7 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to NB US 50			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X4-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 540 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				470			
		Ramp Volume, V _R				100			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	470	0.90	Level	3	0	0.985	1.00	530	
Ramp	100	0.90	Level	3	0	0.985	1.00	113	
UpStream	540	0.90	Level	3	0	0.985	1.00	609	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 530 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	643	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	643	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 7.3 (pc/mi/ln) LOS = A (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.293 (Exhibit 13-11) S _R = 51.2 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.2 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

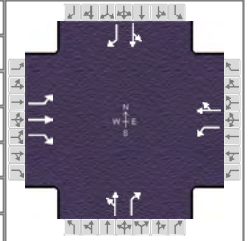
RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to SB US 50			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X4-C									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 190 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				760			
		Ramp Volume, V _R				150			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	760	0.90	Level	3	0	0.985	1.00	857	
Ramp	150	0.90	Level	3	0	0.985	1.00	169	
UpStream	190	0.90	Level	3	0	0.985	1.00	214	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 857 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1026	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1026	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 10.3 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.297 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB ans SB			
Agency or Company				Junction		SB US 50 off-ramp to Red Bank			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X4-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 150 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				950			
		Ramp Volume, V_R				190			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	950	0.90	Level	3	0	0.985	1.00	1071	
Ramp	190	0.90	Level	3	0	0.985	1.00	214	
UpStream									
DownStream	150	0.90	Level	3	0	0.985	1.00	169	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1071 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1071	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	857	Exhibit 13-8	4500	No		
			V_R	214	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1071	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 9.0 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.317 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

PM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Fairfax	Time Period		PHF	0.90
Urban Street	US 50	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	US 50 at Wooster Pike	File Name	16-2022-PM.xus		
Project Description	2022 NO-BUILD - PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	70	590	270	110	500	20	140	90	290	20	20	50

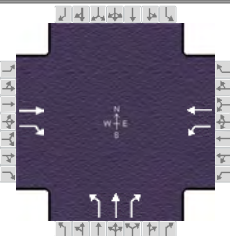
Signal Information											
Cycle, s	95.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	10.0	40.0	26.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.5	4.5	3.6	0.0	0.0	0.0	
				Red	2.5	2.5	2.4	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		5.3	2.0	4.0		7.0		7.0
Phase Duration, s		47.0	16.0	63.0		32.0		32.0
Change Period, ($Y+R_c$), s		7.0	6.0	7.0		6.0		6.0
Max Allow Headway (MAH), s		3.2	3.1	3.2		3.2		3.2
Queue Clearance Time (g_s), s		31.9	8.3	19.7		17.1		4.5
Green Extension Time (g_e), s		2.8	0.0	3.8		1.1		1.4
Phase Call Probability		1.00	1.00	1.00		1.00		1.00
Max Out Probability		0.41	1.00	0.05		0.08		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	78	656	300	122	578			256	322		44	56
Adjusted Saturation Flow Rate (s), veh/h/ln	832	1863	1579	1774	1850			1542	1579		1548	1610
Queue Service Time (g_s), s	5.8	29.9	12.9	6.3	17.7			12.0	15.1		0.0	2.5
Cycle Queue Clearance Time (g_c), s	7.6	29.9	12.9	6.3	17.7			13.7	15.1		1.7	2.5
Green Ratio (g/C)	0.42	0.42	0.42	0.11	0.59			0.27	0.38		0.27	0.27
Capacity (c), veh/h	411	784	665	187	1090			483	598		481	441
Volume-to-Capacity Ratio (X)	0.189	0.836	0.451	0.655	0.530			0.529	0.539		0.092	0.126
Back of Queue (Q), ft/ln (95 th percentile)	50.1	508.6	203.8	138.1	273.9			219.2	236		33.5	42.5
Back of Queue (Q), veh/ln (95 th percentile)	2.0	20.0	8.0	5.4	10.8			8.6	9.3		1.3	1.7
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00			0.00	0.00		0.00	0.00
Uniform Delay (d_1), s/veh	18.7	24.6	19.7	40.8	11.6			30.0	23.0		25.7	26.0
Incremental Delay (d_2), s/veh	0.1	7.4	0.2	6.4	0.3			0.6	0.5		0.0	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0			0.0	0.0		0.0	0.0
Control Delay (d), s/veh	18.8	32.0	19.8	47.2	11.9			30.6	23.6		25.7	26.0
Level of Service (LOS)	B	C	B	D	B			C	C		C	C
Approach Delay, s/veh / LOS	27.5	C		18.1	B		26.6	C		25.9	C	
Intersection Delay, s/veh / LOS	24.5						C					

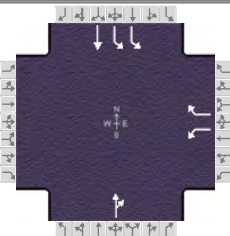
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.2	B	2.3	B	2.4	B
Bicycle LOS Score / LOS	2.2	B	1.6	A	1.4	A	0.7	A

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information																		
Agency					Duration, h		0.25																
Analyst		MJH	Analysis Date	Oct 20, 2016		Area Type		Other															
Jurisdiction		Fairfax	Time Period			PHF		0.90															
Urban Street		Red Bank Road	Analysis Year	2022		Analysis Period		1> 7:00															
Intersection		Red Bank Rd at Wooste...	File Name	20-2022-PM.xus																			
Project Description		2022 NO-BUILD - PM Peak Hour																					
																							
Demand Information				EB			WB			NB			SB										
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R								
Demand (v), veh/h					80	780	160	40		460	0	190											
Signal Information																							
Cycle, s		110.0	Reference Phase	2																			
Offset, s		0	Reference Point	End																			
Uncoordinated		Yes	Simult. Gap E/W	On	Green	6.0	38.0	50.0	0.0	0.0	0.0												
					Yellow	3.5	3.5	3.5	0.0	0.0	0.0												
Force Mode		Fixed	Simult. Gap N/S	On	Red	2.5	1.5	1.5	0.0	0.0	0.0												
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT					
Assigned Phase						2		1		6				8									
Case Number						7.3		1.0		4.0				9.0									
Phase Duration, s						43.0		12.0		55.0				55.0									
Change Period, (Y+R c), s						5.0		6.0		5.0				5.0									
Max Allow Headway (MAH), s						3.3		3.1		3.3				3.2									
Queue Clearance Time (g s), s						30.6		8.0		3.5				27.0									
Green Extension Time (g e), s						2.0		0.0		2.9				1.5									
Phase Call Probability						1.00		1.00		1.00				1.00									
Max Out Probability						0.33		1.00		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					2	12	1	6		3	8	18											
Adjusted Flow Rate (v), veh/h					89	867	178	44		511	0	211											
Adjusted Saturation Flow Rate (s), veh/h/ln					1810	1533	1691	1776		1740	1827	1548											
Queue Service Time (g s), s					3.7	28.6	6.0	1.5		25.0	0.0	8.5											
Cycle Queue Clearance Time (g c), s					3.7	28.6	6.0	1.5		25.0	0.0	8.5											
Green Ratio (g/C)					0.35	0.80	0.42	0.45		0.45	0.45	0.51											
Capacity (c), veh/h					625	1227	545	807		791	830	788											
Volume-to-Capacity Ratio (X)					0.142	0.706	0.326	0.055		0.646	0.000	0.268											
Back of Queue (Q), ft/ln (95 th percentile)					74.2	278.3	20.3	29.1		383.2	0	136.5											
Back of Queue (Q), veh/ln (95 th percentile)					2.9	10.7	0.8	1.1		15.3	0.0	5.3											
Queue Storage Ratio (RQ) (95 th percentile)					0.00	0.00	0.00	0.00		0.00	0.00	0.00											
Uniform Delay (d 1), s/veh					24.8	5.1	21.8	16.8		23.2	0.0	15.3											
Incremental Delay (d 2), s/veh					0.0	1.6	0.1	0.0		1.4	0.0	0.1											
Initial Queue Delay (d 3), s/veh					0.0	0.0	0.0	0.0		0.0	0.0	0.0											
Control Delay (d), s/veh					24.8	6.7	21.9	16.8		24.6	0.0	15.4											
Level of Service (LOS)					C	A	C	B		C		B											
Approach Delay, s/veh / LOS				8.4		A		20.9		C		21.9		C		0.0							
Intersection Delay, s/veh / LOS				15.0						B													
Multimodal Results				EB			WB			NB			SB										
Pedestrian LOS Score / LOS				2.4		B		1.9		A		2.3		B		2.3		B					
Bicycle LOS Score / LOS				2.1		B		0.9		A		1.7		A									

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other			
Jurisdiction		Fairfax		Time Period				PHF		0.90			
Urban Street		Red Bank Road		Analysis Year		2022		Analysis Period		1> 7:00			
Intersection		Red Bank Rd at US 50...		File Name		25-2022-PM.xus							
Project Description		2022 NO-BUILD - PM Peak Hour											



Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h							20		510		530	30	620	840	

Signal Information															
Cycle, s	75.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	Off	Green	17.0	29.0	14.0	0.0	0.0	0.0					
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0					
				Red	1.0	1.0	1.0	0.0	0.0	0.0					

Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase										8				2		1		6	
Case Number										9.0				8.3		2.0		4.0	
Phase Duration, s										19.0				34.0		22.0		56.0	
Change Period, (Y+R c), s										5.0				5.0		5.0		5.0	
Max Allow Headway (MAH), s										3.4				3.0		3.1		3.0	
Queue Clearance Time (g s), s										16.0				25.8		16.5		28.2	
Green Extension Time (g e), s										0.0				1.5		0.1		0.4	
Phase Call Probability										1.00				1.00		1.00		1.00	
Max Out Probability										1.00				0.96		1.00		1.00	

Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement							3		18		2	12	1	6	
Adjusted Flow Rate (v), veh/h							22		567		622		689	933	
Adjusted Saturation Flow Rate (s), veh/h/ln							1774		1579		1827		1723	1788	
Queue Service Time (g s), s							0.8		14.0		23.8		14.5	26.2	
Cycle Queue Clearance Time (g c), s							0.8		14.0		23.8		14.5	26.2	
Green Ratio (g/C)							0.19		0.41		0.39		0.23	0.68	
Capacity (c), veh/h							331		652		706		781	1216	
Volume-to-Capacity Ratio (X)							0.067		0.868		0.881		0.882	0.768	
Back of Queue (Q), ft/ln (95 th percentile)							14.1		384		425.4		276.9	317.6	
Back of Queue (Q), veh/ln (95 th percentile)							0.6		15.4		17.0		11.1	12.5	
Queue Storage Ratio (RQ) (95 th percentile)							0.00		0.00		0.00		0.00	0.00	
Uniform Delay (d 1), s/veh							25.1		20.1		21.4		28.0	8.0	
Incremental Delay (d 2), s/veh							0.0		11.6		12.0		11.2	2.7	
Initial Queue Delay (d 3), s/veh							0.0		0.0		0.0		0.0	0.0	
Control Delay (d), s/veh							25.2		31.7		33.4		39.2	10.8	
Level of Service (LOS)							C		C		C		D	B	
Approach Delay, s/veh / LOS				0.0			31.4		C	33.4		C	22.8		C
Intersection Delay, s/veh / LOS				26.9						C					

Multimodal Results				EB		WB		NB		SB	
Pedestrian LOS Score / LOS				2.1		B		2.5		B	
Bicycle LOS Score / LOS						F		1.5		A	

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		NB US 50 off-ramp to Red Bank			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X4-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 160 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				1100			
		Ramp Volume, V_R				330			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	1100	0.90	Level	2	0	0.990	1.00	1234	
Ramp	330	0.90	Level	2	0	0.990	1.00	370	
UpStream									
DownStream	160	0.90	Level	2	0	0.990	1.00	180	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1234 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1234	Exhibit 13-8	4500	No
				$V_{FO} = V_F - V_R$	864	Exhibit 13-8	4500	No	
				V_R	370	Exhibit 13-10	2000	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1234	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 10.4 (pc/mi/ln) LOS = B (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.461 (Exhibit 13-12) $S_R =$ 49.0 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 49.0 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to NB US 50			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X4-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off	
		Ramp Number of Lanes, N				1			
$L_{up} =$ 800 ft $V_u =$ 330 veh/h		Acceleration Lane Length, L_A				500		$L_{down} =$ ft $V_D =$ veh/h	
		Deceleration Lane Length L_D							
		Freeway Volume, V_F				770			
		Ramp Volume, V_R				160			
		Freeway Free-Flow Speed, S_{FF}				55.0			
		Ramp Free-Flow Speed, S_{FR}				35.0			
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	770	0.90	Level	2	0	0.990	1.00	864	
Ramp	160	0.90	Level	2	0	0.990	1.00	180	
UpStream	330	0.90	Level	2	0	0.990	1.00	370	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $P_{FM} =$ 1.000 using Equation (Exhibit 13-6) $V_{12} =$ 864 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $P_{FD} =$ using Equation (Exhibit 13-7) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}	1044	Exhibit 13-8		No	V_F		Exhibit 13-8		
					$V_{FO} = V_F - V_R$		Exhibit 13-8		
					V_R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}	1044	Exhibit 13-8	4600:All	No	V_{12}		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ 10.4 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ 0.297 (Exhibit 13-11) $S_R =$ 51.1 mph (Exhibit 13-11) $S_0 =$ N/A mph (Exhibit 13-11) $S =$ 51.1 mph (Exhibit 13-13)					$D_S =$ (Exhibit 13-12) $S_R =$ mph (Exhibit 13-12) $S_0 =$ mph (Exhibit 13-12) $S =$ mph (Exhibit 13-13)				

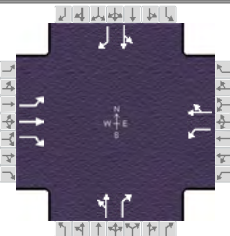
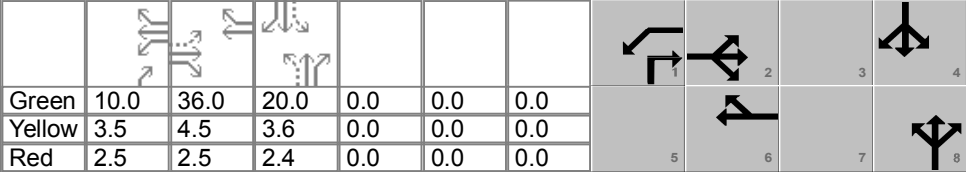
RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to SB US 50			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2022 NO-BUILD			
Project Description Ramp X4-C									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 200 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				490			
		Ramp Volume, V _R				490			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	490	0.90	Level	2	0	0.990	1.00	550	
Ramp	490	0.90	Level	2	0	0.990	1.00	550	
UpStream	200	0.90	Level	2	0	0.990	1.00	224	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 550 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1100	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1100	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 10.7 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.298 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 51.1 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 51.1 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB ans SB			
Agency or Company				Junction		SB US 50 off-ramp to Red Bank			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2022 NO-BUILD			
Project Description Ramp X4-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 490 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				690			
		Ramp Volume, V_R				200			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	690	0.90	Level	2	0	0.990	1.00	774	
Ramp	200	0.90	Level	2	0	0.990	1.00	224	
UpStream									
DownStream	490	0.90	Level	2	0	0.990	1.00	550	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 774 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	774	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	550	Exhibit 13-8	4500	No		
			V_R	224	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	774	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 6.4 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.318 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

2042

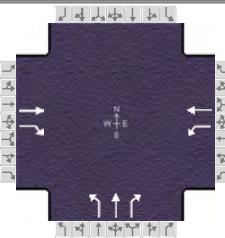
AM

HCS 2010 Signalized Intersection Results Summary

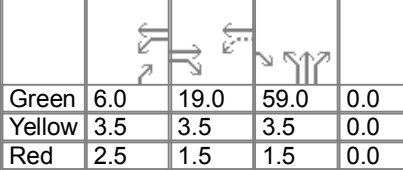
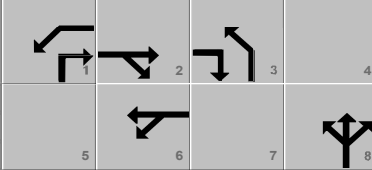
General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Fairfax		Time Period				PHF		0.90									
Urban Street		US 50		Analysis Year		2042		Analysis Period		1> 7:00									
Intersection		US 50 at Wooster Pike		File Name		16-2042-AM.xus													
Project Description		2042 NO-BUILD- AM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				30	470	70	130	840	30	30	20	150	60	20	100				
Signal Information																			
Cycle, s	85.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	10.0	36.0	20.0	0.0	0.0	0.0									
				Yellow	3.5	4.5	3.6	0.0	0.0	0.0									
				Red	2.5	2.5	2.4	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2		1		6				8				4	
Case Number						5.3		2.0		4.0				7.0				7.0	
Phase Duration, s						43.0		16.0		59.0				26.0				26.0	
Change Period, (Y+R c), s						7.0		6.0		7.0				6.0				6.0	
Max Allow Headway (MAH), s						3.1		3.1		3.1				3.3				3.3	
Queue Clearance Time (g s), s						28.0		8.8		39.6				8.9				7.1	
Green Extension Time (g e), s						2.9		0.0		0.0				0.7				0.7	
Phase Call Probability						1.00		1.00		1.00				1.00				1.00	
Max Out Probability						0.43		1.00		1.00				0.01				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				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				33	522	78	144	967			56	167		89	111				
Adjusted Saturation Flow Rate (s), veh/h/ln				573	1845	1563	1740	1816			1477	1491		1449	1533				
Queue Service Time (g s), s				4.4	19.3	2.6	6.8	37.6			0.0	6.9		1.8	5.1				
Cycle Queue Clearance Time (g c), s				26.0	19.3	2.6	6.8	37.6			2.3	6.9		4.1	5.1				
Green Ratio (g/C)				0.42	0.42	0.42	0.12	0.61			0.24	0.35		0.24	0.24				
Capacity (c), veh/h				182	781	662	205	1111			415	526		415	361				
Volume-to-Capacity Ratio (X)				0.183	0.668	0.117	0.706	0.870			0.134	0.317		0.214	0.308				
Back of Queue (Q), ft/ln (95 th percentile)				27.3	324.6	39.8	152.2	541.5			39.8	106		65.5	83.3				
Back of Queue (Q), veh/ln (95 th percentile)				1.1	12.7	1.6	5.9	21.2			1.6	4.1		2.6	3.3				
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00			0.00	0.00		0.00	0.00				
Uniform Delay (d 1), s/veh				31.1	19.7	14.9	36.1	13.7			25.7	20.0		26.4	26.8				
Incremental Delay (d 2), s/veh				0.2	1.8	0.0	9.0	7.4			0.1	0.1		0.1	0.2				
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0			0.0	0.0		0.0	0.0				
Control Delay (d), s/veh				31.3	21.5	14.9	45.1	21.1			25.7	20.2		26.5	27.0				
Level of Service (LOS)				C	C	B	D	C			C	C		C	C				
Approach Delay, s/veh / LOS				21.2		C		24.2		C		21.6		C		26.7		C	
Intersection Delay, s/veh / LOS				23.3						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.2		B		2.3		B		2.4		B	
Bicycle LOS Score / LOS				1.5		A		2.3		B		0.9		A		0.8		A	

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other			
Jurisdiction		Fairfax		Time Period				PHF		0.90			
Urban Street		Red Bank Road		Analysis Year		2042		Analysis Period		1> 7:00			
Intersection		Red Bank Rd at Wooste...		File Name		20-2042-AM.xus							
Project Description		2042 NO-BUILD - AM Peak Hour											



Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					60	310	110	30		840	0	180			

Signal Information						
Cycle, s	100.0	Reference Phase	2			
Offset, s	0	Reference Point	End			
Uncoordinated	Yes	Simult. Gap E/W	On			
Force Mode	Fixed	Simult. Gap N/S	On			
Green	6.0	19.0	59.0	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.5	1.5	1.5	0.0	0.0	0.0

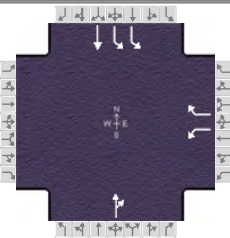
Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			2	1	6		8		
Case Number			7.3	1.0	4.0		9.0		
Phase Duration, s			24.0	12.0	36.0		64.0		
Change Period, (Y+R c), s			5.0	6.0	5.0		5.0		
Max Allow Headway (MAH), s			3.3	3.1	3.3		3.2		
Queue Clearance Time (g s), s			8.5	7.6	3.3		51.5		
Green Extension Time (g e), s			0.8	0.0	0.9		2.1		
Phase Call Probability			1.00	1.00	1.00		1.00		
Max Out Probability			0.01	1.00	0.00		0.32		

Movement Group Results		EB			WB			NB			SB			
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R	
Assigned Movement			2	12	1	6		3	8	18				
Adjusted Flow Rate (v), veh/h			67	344	122	33		933	0	200				
Adjusted Saturation Flow Rate (s), veh/h/ln			1792	1519	1707	1792		1707	1792	1519				
Queue Service Time (g s), s			3.1	6.5	5.6	1.3		49.5	0.0	5.3				
Cycle Queue Clearance Time (g c), s			3.1	6.5	5.6	1.3		49.5	0.0	5.3				
Green Ratio (g/C)			0.19	0.78	0.27	0.31		0.59	0.59	0.65				
Capacity (c), veh/h			341	1185	377	556		1007	1058	987				
Volume-to-Capacity Ratio (X)			0.196	0.291	0.324	0.060		0.927	0.000	0.203				
Back of Queue (Q), ft/ln (95 th percentile)			63.7	63.5	102.3	25.8		709.6	0	72.3				
Back of Queue (Q), veh/ln (95 th percentile)			2.4	2.4	4.1	1.0		28.4	0.0	2.8				
Queue Storage Ratio (RQ) (95 th percentile)			0.00	0.00	0.00	0.00		0.00	0.00	0.00				
Uniform Delay (d 1), s/veh			34.1	3.1	28.8	24.3		18.5	0.0	7.1				
Incremental Delay (d 2), s/veh			0.1	0.0	0.2	0.0		13.8	0.0	0.0				
Initial Queue Delay (d 3), s/veh			0.0	0.0	0.0	0.0		0.0	0.0	0.0				
Control Delay (d), s/veh			34.2	3.2	29.0	24.3		32.3	0.0	7.1				
Level of Service (LOS)			C	A	C	C		C		A				
Approach Delay, s/veh / LOS		8.2	A		28.0	C		27.9	C		0.0			
Intersection Delay, s/veh / LOS		23.1							C					

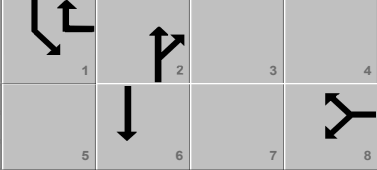
Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.5	B	1.9	A	2.3	B	2.3	B
Bicycle LOS Score / LOS		1.2	A	0.7	A	2.4	B		

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information						
Agency					Duration, h		0.25				
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other	
Jurisdiction		Fairfax		Time Period				PHF		0.90	
Urban Street		Red Bank Road		Analysis Year		2042		Analysis Period		1> 7:00	
Intersection		Red Bank Rd at US 50...		File Name		25-2042-AM.xus					
Project Description		2042 NO-BUILD - AM Peak Hour									



Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h							10		740		830	10	240	410	

Signal Information																
Cycle, s	70.0	Reference Phase	2													
Offset, s	0	Reference Point	End													
Uncoordinated	Yes	Simult. Gap E/W	Off	Green	6.0	27.5	21.5	0.0	0.0	0.0						
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0						
				Red	1.0	1.0	1.0	0.0	0.0	0.0						

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase					8		2	1	6
Case Number					9.0		8.3	2.0	4.0
Phase Duration, s					26.5		32.5	11.0	43.5
Change Period, (Y+R _c), s					5.0		5.0	5.0	5.0
Max Allow Headway (MAH), s					3.4		3.0	3.1	3.0
Queue Clearance Time (g _s), s					23.5		29.5	7.5	13.1
Green Extension Time (g _e), s					0.0		0.0	0.0	3.0
Phase Call Probability					1.00		1.00	1.00	1.00
Max Out Probability					1.00		1.00	1.00	0.08

Movement Group Results		EB			WB			NB			SB			
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R	
Assigned Movement					3		18		2	12	1	6		
Adjusted Flow Rate (v), veh/h					11		822		933		267	456		
Adjusted Saturation Flow Rate (s), veh/h/ln					1774		1579		1789		1689	1754		
Queue Service Time (g _s), s					0.3		21.5		27.5		5.5	11.1		
Cycle Queue Clearance Time (g _c), s					0.3		21.5		27.5		5.5	11.1		
Green Ratio (g/C)					0.31		0.39		0.39		0.09	0.55		
Capacity (c), veh/h					545		620		703		290	965		
Volume-to-Capacity Ratio (X)					0.020		1.326		1.328		0.921	0.472		
Back of Queue (Q), ft/ln (95 th percentile)					5.2		1344		1524.9		154	160.7		
Back of Queue (Q), veh/ln (95 th percentile)					0.2		53.8		61.0		6.2	6.3		
Queue Storage Ratio (RQ) (95 th percentile)					0.00		0.00		0.00		0.00	0.00		
Uniform Delay (d ₁), s/veh					16.9		21.3		21.3		31.8	9.6		
Incremental Delay (d ₂), s/veh					0.0		157.6		157.4		32.3	0.1		
Initial Queue Delay (d ₃), s/veh					0.0		0.0		0.0		0.0	0.0		
Control Delay (d), s/veh					16.9		178.9		178.7		64.1	9.7		
Level of Service (LOS)					B		F		F		E	A		
Approach Delay, s/veh / LOS		0.0			176.7		F	178.7		F	29.8		C	
Intersection Delay, s/veh / LOS		134.8											F	

Multimodal Results		EB		WB		NB		SB					
Pedestrian LOS Score / LOS		2.1		B	2.5		B	2.7		B	0.7		A
Bicycle LOS Score / LOS					F			2.0		B	1.7		A

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		Westbound			
Agency or Company				Junction		NB US 50 off-ramp to Red Bank			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X4-A									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 100 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				1030			
		Ramp Volume, V_R				560			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	1030	0.90	Level	3	0	0.985	1.00	1162	
Ramp	560	0.90	Level	3	0	0.985	1.00	632	
UpStream									
DownStream	100	0.90	Level	3	0	0.985	1.00	113	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1162 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	1162	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	530	Exhibit 13-8	4500	No		
			V_R	632	Exhibit 13-10	2000	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	1162	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 9.7 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.485 (Exhibit 13-12) $S_R =$ 48.7 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 48.7 mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to NB US 50			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X4-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 560 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				470			
		Ramp Volume, V _R				100			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	470	0.90	Level	3	0	0.985	1.00	530	
Ramp	100	0.90	Level	3	0	0.985	1.00	113	
UpStream	560	0.90	Level	3	0	0.985	1.00	632	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 530 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	643	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	643	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 7.3 (pc/mi/ln) LOS = A (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.293 (Exhibit 13-11) S _R = 51.2 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.2 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

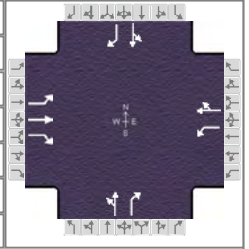
RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to SB US 50			
Date Performed		7/27/2016		Jurisdiction					
Analysis Time Period		AM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X4-C									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 190 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				780			
		Ramp Volume, V _R				150			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	780	0.90	Level	3	0	0.985	1.00	880	
Ramp	150	0.90	Level	3	0	0.985	1.00	169	
UpStream	190	0.90	Level	3	0	0.985	1.00	214	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 880 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1049	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1049	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 10.4 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.297 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET										
General Information					Site Information					
Analyst		MJH		Freeway/Dir of Travel		NB ans SB				
Agency or Company				Junction		SB US 50 off-ramp to Red Bank				
Date Performed		7/27/2016		Jurisdiction						
Analysis Time Period		AM PEAK HOUR		Analysis Year		2042 NO-BUILD				
Project Description Ramp X4-D										
Inputs										
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N 2 Ramp Number of Lanes, N 1 Acceleration Lane Length, L_A Deceleration Lane Length L_D 500 Freeway Volume, V_F 970 Ramp Volume, V_R 190 Freeway Free-Flow Speed, S_{FF} 55.0 Ramp Free-Flow Speed, S_{FR} 45.0				Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 150 veh/h				
Conversion to pc/h Under Base Conditions										
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$		
Freeway	970	0.90	Level	3	0	0.985	1.00	1094		
Ramp	190	0.90	Level	3	0	0.985	1.00	214		
UpStream										
DownStream	150	0.90	Level	3	0	0.985	1.00	169		
Merge Areas					Diverge Areas					
Estimation of v_{12}					Estimation of v_{12}					
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1094 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					
Capacity Checks					Capacity Checks					
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?	
V_{FO}		Exhibit 13-8				V_F	1094	Exhibit 13-8	4500	No
					$V_{FO} = V_F - V_R$	880	Exhibit 13-8	4500	No	
					V_R	214	Exhibit 13-10	2100	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area					
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?	
V_{R12}		Exhibit 13-8			V_{12}	1094	Exhibit 13-8	4400:All	No	
Level of Service Determination (if not F)					Level of Service Determination (if not F)					
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) $LOS =$ (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 9.2 (pc/mi/ln) $LOS =$ A (Exhibit 13-2)					
Speed Determination					Speed Determination					
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.317 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)					

PM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Fairfax	Time Period		PHF	0.90
Urban Street	US 50	Analysis Year	2042	Analysis Period	1> 7:00
Intersection	US 50 at Wooster Pike	File Name	16-2042-PM.xus		
Project Description	2042 NO-BUILD - PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	70	600	270	110	500	20	150	90	290	20	20	60

Signal Information											
Cycle, s	95.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	9.0	40.0	27.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.5	4.5	3.6	0.0	0.0	0.0	
				Red	2.5	2.5	2.4	0.0	0.0	0.0	

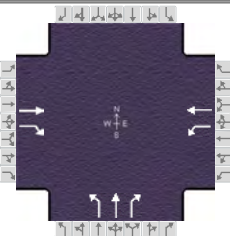
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		5.3	2.0	4.0		7.0		7.0
Phase Duration, s		47.0	15.0	62.0		33.0		33.0
Change Period, ($Y+R_c$), s		7.0	6.0	7.0		6.0		6.0
Max Allow Headway (MAH), s		3.2	3.1	3.2		3.2		3.2
Queue Clearance Time (g_s), s		32.7	8.4	20.2		17.1		4.9
Green Extension Time (g_e), s		2.7	0.0	3.8		1.2		1.4
Phase Call Probability		1.00	1.00	1.00		1.00		1.00
Max Out Probability		0.48	1.00	0.05		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	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	78	667	300	122	578			267	322		44	67
Adjusted Saturation Flow Rate (s), veh/h/ln	832	1863	1579	1774	1850			1533	1579		1552	1610
Queue Service Time (g_s), s	6.0	30.7	12.9	6.4	18.2			12.7	15.1		0.0	2.9
Cycle Queue Clearance Time (g_c), s	9.2	30.7	12.9	6.4	18.2			14.3	15.1		1.6	2.9
Green Ratio (g/C)	0.42	0.42	0.42	0.09	0.58			0.28	0.38		0.28	0.28
Capacity (c), veh/h	398	784	665	168	1071			497	598		498	458
Volume-to-Capacity Ratio (X)	0.195	0.850	0.451	0.727	0.539			0.536	0.539		0.089	0.146
Back of Queue (Q), ft/ln (95 th percentile)	51.6	525.5	203.8	152.1	282.4			225.7	236		33	50.4
Back of Queue (Q), veh/ln (95 th percentile)	2.0	20.7	8.0	6.0	11.1			8.9	9.3		1.3	2.0
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00			0.00	0.00		0.00	0.00
Uniform Delay (d_1), s/veh	19.7	24.8	19.7	41.8	12.2			29.4	23.0		24.9	25.4
Incremental Delay (d_2), s/veh	0.1	8.4	0.2	12.9	0.3			0.6	0.5		0.0	0.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0			0.0	0.0		0.0	0.0
Control Delay (d), s/veh	19.7	33.2	19.8	54.7	12.5			30.1	23.6		24.9	25.4
Level of Service (LOS)	B	C	B	D	B			C	C		C	C
Approach Delay, s/veh / LOS	28.3	C		19.9	B		26.5	C		25.2	C	
Intersection Delay, s/veh / LOS	25.3						C					

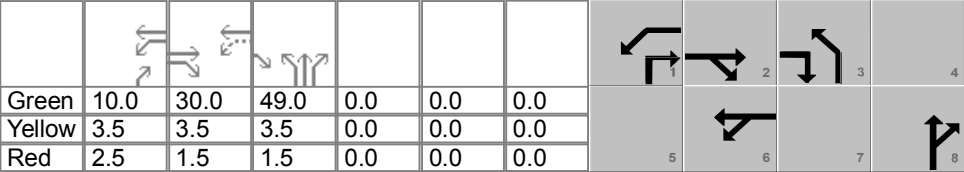
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.2	B	2.3	B	2.4	B
Bicycle LOS Score / LOS	2.2	B	1.6	A	1.5	A	0.7	A

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information				
Agency					Duration, h		0.25		
Analyst		MJH	Analysis Date	Oct 20, 2016	Area Type		Other		
Jurisdiction		Fairfax	Time Period		PHF		0.90		
Urban Street		Red Bank Road	Analysis Year	2042	Analysis Period		1> 7:00		
Intersection		Red Bank Rd at Wooste...	File Name	20-2042-PM.xus					
Project Description		2042 NO-BUILD - PM Peak Hour							



Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					80	790	160	40		460	0	200			

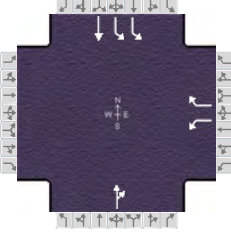
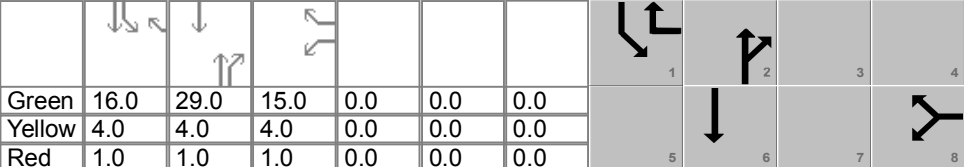
Signal Information						
Cycle, s	105.0	Reference Phase	2			
Offset, s	0	Reference Point	End			
Uncoordinated	Yes	Simult. Gap E/W	On			
Force Mode	Fixed	Simult. Gap N/S	On			
Green	10.0	30.0	49.0	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.5	1.5	1.5	0.0	0.0	0.0

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			2	1	6		8		
Case Number			7.3	1.0	4.0		9.0		
Phase Duration, s			35.0	16.0	51.0		54.0		
Change Period, (Y+R c), s			5.0	6.0	5.0		5.0		
Max Allow Headway (MAH), s			3.3	3.1	3.3		3.2		
Queue Clearance Time (g s), s			32.0	9.4	3.5		25.3		
Green Extension Time (g e), s			0.0	0.0	2.9		1.6		
Phase Call Probability			1.00	1.00	1.00		1.00		
Max Out Probability			1.00	1.00	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			2	12	1	6		3	8	18			
Adjusted Flow Rate (v), veh/h			89	878	178	44		511	0	222			
Adjusted Saturation Flow Rate (s), veh/h/ln			1810	1533	1691	1776		1740	1827	1548			
Queue Service Time (g s), s			3.9	30.0	7.4	1.5		23.3	0.0	7.7			
Cycle Queue Clearance Time (g c), s			3.9	30.0	7.4	1.5		23.3	0.0	7.7			
Green Ratio (g/C)			0.29	0.75	0.40	0.44		0.47	0.47	0.56			
Capacity (c), veh/h			517	1154	539	778		812	853	870			
Volume-to-Capacity Ratio (X)			0.172	0.761	0.330	0.057		0.629	0.000	0.255			
Back of Queue (Q), ft/ln (95 th percentile)			77.8	372	129.1	28.5		356.6	0	117.9			
Back of Queue (Q), veh/ln (95 th percentile)			3.0	14.3	5.2	1.1		14.3	0.0	4.5			
Queue Storage Ratio (RQ) (95 th percentile)			0.00	0.00	0.00	0.00		0.00	0.00	0.00			
Uniform Delay (d 1), s/veh			28.2	7.5	21.3	17.0		21.1	0.0	11.8			
Incremental Delay (d 2), s/veh			0.1	2.7	0.1	0.0		1.2	0.0	0.1			
Initial Queue Delay (d 3), s/veh			0.0	0.0	0.0	0.0		0.0	0.0	0.0			
Control Delay (d), s/veh			28.2	10.2	21.4	17.0		22.3	0.0	11.8			
Level of Service (LOS)			C	B	C	B		C		B			
Approach Delay, s/veh / LOS		11.9	B		20.6	C		19.1	B		0.0		
Intersection Delay, s/veh / LOS		15.7							B				

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.4	B	1.9	A	2.3	B	2.3	B
Bicycle LOS Score / LOS		2.1	B	0.9	A	1.7	A		

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information									
Agency						Duration, h		0.25							
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other					
Jurisdiction		Fairfax		Time Period				PHF		0.90					
Urban Street		Red Bank Road		Analysis Year		2042		Analysis Period		1> 7:00					
Intersection		Red Bank Rd at US 50...		File Name		25-2042-PM.xus									
Project Description		2042 NO-BUILD - PM Peak Hour													
Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h							20		520		530	30	620	850	
Signal Information															
Cycle, s	75.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	Off												
Force Mode	Fixed	Simult. Gap N/S	On												
Green	16.0	29.0	15.0	0.0	0.0	0.0									
Yellow	4.0	4.0	4.0	0.0	0.0	0.0									
Red	1.0	1.0	1.0	0.0	0.0	0.0									
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase							8		2	1	6				
Case Number							9.0		8.3	2.0	4.0				
Phase Duration, s							20.0		34.0	21.0	55.0				
Change Period, (Y+R c), s							5.0		5.0	5.0	5.0				
Max Allow Headway (MAH), s							3.4		3.0	3.1	3.0				
Queue Clearance Time (g s), s							17.0		25.8	16.7	30.0				
Green Extension Time (g e), s							0.0		1.5	0.0	0.0				
Phase Call Probability							1.00		1.00	1.00	1.00				
Max Out Probability							1.00		0.96	1.00	1.00				
Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement							3		18		2	12	1	6	
Adjusted Flow Rate (v), veh/h							22		578		622		689	944	
Adjusted Saturation Flow Rate (s), veh/h/ln							1774		1579		1827		1723	1788	
Queue Service Time (g s), s							0.8		15.0		23.8		14.7	28.0	
Cycle Queue Clearance Time (g c), s							0.8		15.0		23.8		14.7	28.0	
Green Ratio (g/C)							0.20		0.41		0.39		0.21	0.67	
Capacity (c), veh/h							355		652		706		735	1192	
Volume-to-Capacity Ratio (X)							0.063		0.886		0.881		0.937	0.792	
Back of Queue (Q), ft/ln (95 th percentile)							13.8		402.3		425.4		305.5	348.7	
Back of Queue (Q), veh/ln (95 th percentile)							0.6		16.1		17.0		12.2	13.7	
Queue Storage Ratio (RQ) (95 th percentile)							0.00		0.00		0.00		0.00	0.00	
Uniform Delay (d 1), s/veh							24.3		20.4		21.4		29.0	8.8	
Incremental Delay (d 2), s/veh							0.0		13.4		12.0		19.3	3.4	
Initial Queue Delay (d 3), s/veh							0.0		0.0		0.0		0.0	0.0	
Control Delay (d), s/veh							24.3		33.7		33.4		48.3	12.3	
Level of Service (LOS)							C		C		C		D	B	
Approach Delay, s/veh / LOS				0.0			33.4	C		33.4	C		27.4		C
Intersection Delay, s/veh / LOS				30.0						C					
Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.1		B	2.5		B	2.7		B	0.7		A
Bicycle LOS Score / LOS									F	1.5		A	3.2		C

RAMPS AND RAMP JUNCTIONS WORKSHEET										
General Information					Site Information					
Analyst		MJH		Freeway/Dir of Travel		Westbound				
Agency or Company				Junction		NB US 50 off-ramp to Red Bank				
Date Performed		7/14/2016		Jurisdiction						
Analysis Time Period		PM PEAK HOUR		Analysis Year		2042 NO-BUILD				
Project Description Ramp X4-A										
Inputs										
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N 2 Ramp Number of Lanes, N 1 Acceleration Lane Length, L_A Deceleration Lane Length L_D 500 Freeway Volume, V_F 1120 Ramp Volume, V_R 340 Freeway Free-Flow Speed, S_{FF} 55.0 Ramp Free-Flow Speed, S_{FR} 35.0				Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 160 veh/h				
Conversion to pc/h Under Base Conditions										
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$		
Freeway	1120	0.90	Level	2	0	0.990	1.00	1257		
Ramp	340	0.90	Level	2	0	0.990	1.00	382		
UpStream										
DownStream	160	0.90	Level	2	0	0.990	1.00	180		
Merge Areas					Diverge Areas					
Estimation of v_{12}					Estimation of v_{12}					
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 1257 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					
Capacity Checks					Capacity Checks					
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?	
V_{FO}		Exhibit 13-8				V_F	1257	Exhibit 13-8	4500	No
					$V_{FO} = V_F - V_R$	875	Exhibit 13-8	4500	No	
					V_R	382	Exhibit 13-10	2000	No	
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area					
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?	
V_{R12}		Exhibit 13-8			V_{12}	1257	Exhibit 13-8	4400:All	No	
Level of Service Determination (if not F)					Level of Service Determination (if not F)					
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) $LOS =$ (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 10.6 (pc/mi/ln) $LOS =$ B (Exhibit 13-2)					
Speed Determination					Speed Determination					
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.462 (Exhibit 13-12) $S_R =$ 49.0 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 49.0 mph (Exhibit 13-13)					

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to NB US 50			
Date Performed		7/12/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X4-B									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 340 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				780			
		Ramp Volume, V _R				170			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	780	0.90	Level	2	0	0.990	1.00	875	
Ramp	170	0.90	Level	2	0	0.990	1.00	191	
UpStream	340	0.90	Level	2	0	0.990	1.00	382	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ (Equation 13-6 or 13-7)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ (Equation 13-12 or 13-13)				
P _{FM} = 1.000 using Equation (Exhibit 13-6)					P _{FD} = using Equation (Exhibit 13-7)				
V ₁₂ = 875 pc/h					V ₁₂ = pc/h				
V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17)					V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17)				
Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No					Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No				
Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No					Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No				
If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1066	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1066	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 10.6 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.297 (Exhibit 13-11)					D _S = (Exhibit 13-12)				
S _R = 51.1 mph (Exhibit 13-11)					S _R = mph (Exhibit 13-12)				
S ₀ = N/A mph (Exhibit 13-11)					S ₀ = mph (Exhibit 13-12)				
S = 51.1 mph (Exhibit 13-13)					S = mph (Exhibit 13-13)				

RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB and SB			
Agency or Company				Junction		Red Bank Rd to SB US 50			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM Peak Hour		Analysis Year		2042 NO-BUILD			
Project Description Ramp X4-C									
Inputs									
Upstream Adj Ramp ☒ Yes ☐ On ☐ No ☒ Off L _{up} = 800 ft V _u = 200 veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off L _{down} = ft V _D = veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L _A				500			
		Deceleration Lane Length L _D							
		Freeway Volume, V _F				510			
		Ramp Volume, V _R				490			
Freeway Free-Flow Speed, S _{FF}				55.0					
Ramp Free-Flow Speed, S _{FR}				35.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f _{HV}	f _p	v = V/PHF x f _{HV} x f _p	
Freeway	510	0.90	Level	2	0	0.990	1.00	572	
Ramp	490	0.90	Level	2	0	0.990	1.00	550	
UpStream	200	0.90	Level	2	0	0.990	1.00	224	
DownStream									
Merge Areas					Diverge Areas				
Estimation of v₁₂					Estimation of v₁₂				
$V_{12} = V_F (P_{FM})$ L _{EQ} = (Equation 13-6 or 13-7) P _{FM} = 1.000 using Equation (Exhibit 13-6) V ₁₂ = 572 pc/h V ₃ or V _{av34} = 0 pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☒ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☒ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ L _{EQ} = (Equation 13-12 or 13-13) P _{FD} = using Equation (Exhibit 13-7) V ₁₂ = pc/h V ₃ or V _{av34} = pc/h (Equation 13-14 or 13-17) Is V ₃ or V _{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V ₃ or V _{av34} > 1.5 * V ₁₂ /2 ☐ Yes ☐ No If Yes, V _{12a} = pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V _{FO}	1122	Exhibit 13-8		No	V _F		Exhibit 13-8		
					V _{FO} = V _F - V _R		Exhibit 13-8		
					V _R		Exhibit 13-10		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V _{R12}	1122	Exhibit 13-8	4600:All	No	V ₁₂		Exhibit 13-8		
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ D _R = 10.8 (pc/mi/ln) LOS = B (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D _R = (pc/mi/ln) LOS = (Exhibit 13-2)				
Speed Determination					Speed Determination				
M _S = 0.298 (Exhibit 13-11) S _R = 51.1 mph (Exhibit 13-11) S ₀ = N/A mph (Exhibit 13-11) S = 51.1 mph (Exhibit 13-13)					D _S = (Exhibit 13-12) S _R = mph (Exhibit 13-12) S ₀ = mph (Exhibit 13-12) S = mph (Exhibit 13-13)				

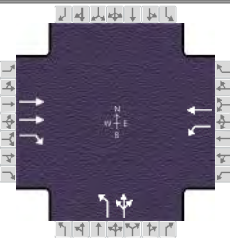
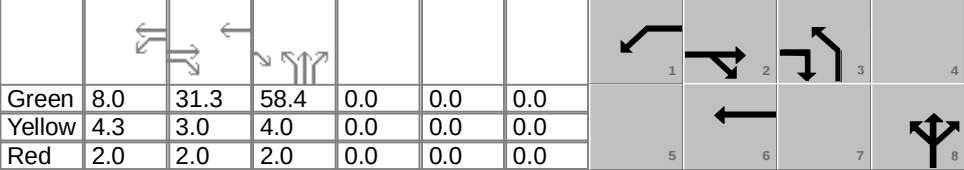
RAMPS AND RAMP JUNCTIONS WORKSHEET									
General Information					Site Information				
Analyst		MJH		Freeway/Dir of Travel		NB ans SB			
Agency or Company				Junction		SB US 50 off-ramp to Red Bank			
Date Performed		7/14/2016		Jurisdiction					
Analysis Time Period		PM PEAK HOUR		Analysis Year		2042 NO-BUILD			
Project Description Ramp X4-D									
Inputs									
Upstream Adj Ramp ☐ Yes ☐ On ☒ No ☐ Off $L_{up} =$ ft $V_u =$ veh/h		Freeway Number of Lanes, N				2		Downstream Adj Ramp ☒ Yes ☒ On ☐ No ☐ Off $L_{down} =$ 800 ft $V_D =$ 490 veh/h	
		Ramp Number of Lanes, N				1			
		Acceleration Lane Length, L_A							
		Deceleration Lane Length L_D				500			
		Freeway Volume, V_F				710			
		Ramp Volume, V_R				200			
Freeway Free-Flow Speed, S_{FF}				55.0					
Ramp Free-Flow Speed, S_{FR}				45.0					
Conversion to pc/h Under Base Conditions									
(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$	
Freeway	710	0.90	Level	2	0	0.990	1.00	797	
Ramp	200	0.90	Level	2	0	0.990	1.00	224	
UpStream									
DownStream	490	0.90	Level	2	0	0.990	1.00	550	
Merge Areas					Diverge Areas				
Estimation of v_{12}					Estimation of v_{12}				
$V_{12} = V_F (P_{FM})$ $L_{EQ} =$ (Equation 13-6 or 13-7) $P_{FM} =$ using Equation (Exhibit 13-6) $V_{12} =$ pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☐ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☐ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)					$V_{12} = V_R + (V_F - V_R)P_{FD}$ $L_{EQ} =$ (Equation 13-12 or 13-13) $P_{FD} =$ 1.000 using Equation (Exhibit 13-7) $V_{12} =$ 797 pc/h V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17) Is V_3 or $V_{av34} > 2,700$ pc/h? ☐ Yes ☒ No Is V_3 or $V_{av34} > 1.5 * V_{12}/2$ ☐ Yes ☒ No If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)				
Capacity Checks					Capacity Checks				
	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8			V_F	797	Exhibit 13-8	4500	No
			$V_{FO} = V_F - V_R$	573	Exhibit 13-8	4500	No		
			V_R	224	Exhibit 13-10	2100	No		
Flow Entering Merge Influence Area					Flow Entering Diverge Influence Area				
	Actual	Max Desirable		Violation?		Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8			V_{12}	797	Exhibit 13-8	4400:All	No
Level of Service Determination (if not F)					Level of Service Determination (if not F)				
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$ $D_R =$ (pc/mi/ln) LOS = (Exhibit 13-2)					$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ $D_R =$ 6.6 (pc/mi/ln) LOS = A (Exhibit 13-2)				
Speed Determination					Speed Determination				
$M_S =$ (Exhibit 13-11) $S_R =$ mph (Exhibit 13-11) $S_0 =$ mph (Exhibit 13-11) $S =$ mph (Exhibit 13-13)					$D_S =$ 0.318 (Exhibit 13-12) $S_R =$ 50.9 mph (Exhibit 13-12) $S_0 =$ N/A mph (Exhibit 13-12) $S =$ 50.9 mph (Exhibit 13-13)				

US 50 CORRIDOR AREA

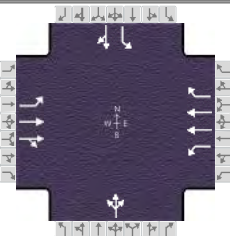
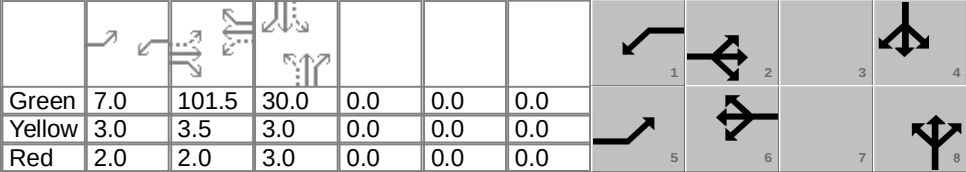
2015

AM

HCS 2010 Signalized Intersection Results Summary

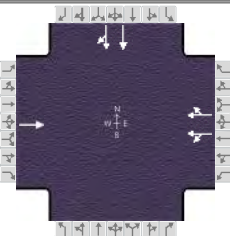
General Information					Intersection Information											
Agency					Duration, h		0.25									
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type						Other		
Jurisdiction		Columbia Twp (ODOT)		Time Period				PHF						0.90		
Urban Street		US 50		Analysis Year		2016		Analysis Period						1> 7:00		
Intersection		US 50 at Newtown Road		File Name		11-Existing-AM.xus										
Project Description		Existing AM Peak Hour														
Demand Information					EB			WB			NB			SB		
Approach Movement					L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h						190	370	110	480		990	0	80			
Signal Information																
Cycle, s	115.0	Reference Phase	2													
Offset, s	0	Reference Point	End													
Uncoordinated	Yes	Simult. Gap E/W	On													
Force Mode	Fixed	Simult. Gap N/S	On													
					Green	8.0	31.3	58.4	0.0	0.0	0.0					
					Yellow	4.3	3.0	4.0	0.0	0.0	0.0					
					Red	2.0	2.0	2.0	0.0	0.0	0.0					
Timer Results					EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase						2	1	6		8						
Case Number						7.3	2.0	4.0		10.0						
Phase Duration, s						36.3	14.3	50.6		64.4						
Change Period, (Y+R c), s						6.3	6.3	6.3		6.0						
Max Allow Headway (MAH), s						3.1	3.1	3.1		3.1						
Queue Clearance Time (g s), s						11.6	10.0	31.5		60.4						
Green Extension Time (g e), s						2.5	0.0	2.2		0.0						
Phase Call Probability						1.00	1.00	1.00		1.00						
Max Out Probability						0.01	1.00	0.12		1.00						
Movement Group Results					EB			WB			NB			SB		
Approach Movement					L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement						2	12	1	6		3	8	18			
Adjusted Flow Rate (v), veh/h						211	411	122	533		1100	89				
Adjusted Saturation Flow Rate (s), veh/h/ln						1739	1548	1723	1810		1740	1548				
Queue Service Time (g s), s						5.5	9.6	8.0	29.5		58.4	3.4				
Cycle Queue Clearance Time (g c), s						5.5	9.6	8.0	29.5		58.4	3.4				
Green Ratio (g/C)						0.26	0.77	0.07	0.39		0.51	0.51				
Capacity (c), veh/h						907	1190	120	697		884	786				
Volume-to-Capacity Ratio (X)						0.233	0.345	1.019	0.765		1.245	0.113				
Back of Queue (Q), ft/ln (95 th percentile)						107.2	111.8	263.4	500.8		1868.4	55.4				
Back of Queue (Q), veh/ln (95 th percentile)						4.2	4.3	10.5	19.4		74.7	2.1				
Queue Storage Ratio (RQ) (95 th percentile)						0.00	0.00	0.00	0.00		0.00	0.00				
Uniform Delay (d 1), s/veh						33.4	4.2	53.5	30.8		28.3	14.8				
Incremental Delay (d 2), s/veh						0.0	0.1	87.5	4.6		119.8	0.0				
Initial Queue Delay (d 3), s/veh						0.0	0.0	0.0	0.0		0.0	0.0				
Control Delay (d), s/veh						33.5	4.3	141.0	35.4		148.1	14.8				
Level of Service (LOS)						C	A	F	D		F	B				
Approach Delay, s/veh / LOS					14.2	B		55.1	E		138.1	F		0.0		
Intersection Delay, s/veh / LOS					84.8						F					
Multimodal Results					EB			WB			NB			SB		
Pedestrian LOS Score / LOS					2.3	B		1.9	A		2.7	B		2.5	B	
Bicycle LOS Score / LOS					1.0	A		1.6	A		2.4	B				

HCS 2010 Signalized Intersection Results Summary

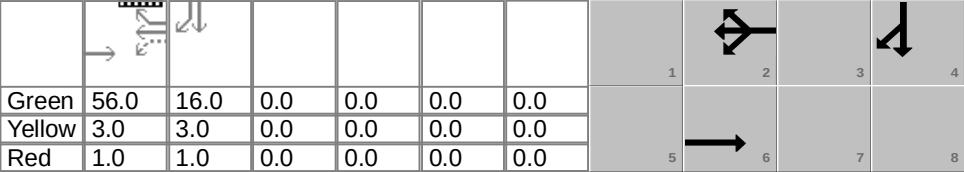
General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other									
Jurisdiction		Columbia Twp (ODOT)		Time Period				PHF		0.90									
Urban Street		US 50		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		US 50 at Walton Creek...		File Name		12-Existing-AM.xus													
Project Description		Existing AM Peak Hour																	
Demand Information																			
				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				40	480	20	40	1120	380	10	10	30	130	10	20				
Signal Information																			
Cycle, s		155.0	Reference Phase		2														
Offset, s		0	Reference Point		End		Green	7.0	101.5	30.0	0.0	0.0	0.0						
Uncoordinated		Yes	Simult. Gap E/W		On		Yellow	3.0	3.5	3.0	0.0	0.0	0.0						
Force Mode		Fixed	Simult. Gap N/S		On		Red	2.0	2.0	3.0	0.0	0.0	0.0						
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8				4	
Case Number				1.1		4.0		1.1		3.0				8.0				6.0	
Phase Duration, s				12.0		107.0		12.0		107.0				36.0				36.0	
Change Period, (Y+R c), s				5.0		37.0		5.0		37.0				6.0				6.0	
Max Allow Headway (MAH), s				3.1		3.1		3.1		3.1				3.2				3.2	
Queue Clearance Time (g s), s				4.1		17.6		4.1		50.1				6.4				21.8	
Green Extension Time (g e), s				0.0		6.7		0.0		6.0				0.4				0.3	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00				1.00	
Max Out Probability				1.00		0.00		1.00		0.12				0.00				0.01	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				44	279	276	44	1244	422		56		144	33					
Adjusted Saturation Flow Rate (s), veh/h/ln				1723	1810	1784	1723	1723	1533		1559		1356	1663					
Queue Service Time (g s), s				2.1	15.5	15.6	2.1	48.1	32.3		0.0		15.4	2.6					
Cycle Queue Clearance Time (g c), s				2.1	15.5	15.6	2.1	48.1	32.3		4.4		19.8	2.6					
Green Ratio (g/C)				0.50	0.45	0.45	0.50	0.45	0.45		0.19		0.19	0.19					
Capacity (c), veh/h				180	817	806	403	1556	693		330		270	322					
Volume-to-Capacity Ratio (X)				0.247	0.342	0.343	0.110	0.800	0.610		0.169		0.534	0.104					
Back of Queue (Q), ft/ln (95 th percentile)				40.1	287.9	274.5	39.7	728.4	446.9		85.5		239.3	48.6					
Back of Queue (Q), veh/ln (95 th percentile)				1.5	11.1	11.0	1.5	28.0	17.9		3.3		9.2	1.9					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				29.2	27.6	27.6	21.2	36.5	32.2		52.2		60.5	51.4					
Incremental Delay (d 2), s/veh				0.3	0.1	0.1	0.0	2.8	1.1		0.1		1.1	0.1					
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0					
Control Delay (d), s/veh				29.4	27.7	27.7	21.2	39.3	33.3		52.3		61.5	51.5					
Level of Service (LOS)				C	C	C	C	D	C		D		E	D					
Approach Delay, s/veh / LOS				27.8		C		37.4		D		52.3		D		59.7		E	
Intersection Delay, s/veh / LOS				37.0						D									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.1		B		2.3		B		3.0		C		2.9		C	
Bicycle LOS Score / LOS				1.0		A		1.9		A		0.6		A		0.8		A	

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other	
Jurisdiction		Mariemont		Time Period				PHF		0.90	
Urban Street		WB US 50		Analysis Year		2016		Analysis Period		1> 7:00	
Intersection		WB US 50 at Madisonvil...		File Name		13A-Existing-AM.xus					
Project Description		Existing AM Peak Hour									



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					0		20	780	520					270	30

Signal Information											
Cycle, s	80.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On								
Force Mode	Fixed	Simult. Gap N/S	On								
Green	56.0	16.0	0.0	0.0	0.0	0.0	0.0	1	2	3	4
Yellow	3.0	3.0	0.0	0.0	0.0	0.0	0.0	5	6	7	8
Red	1.0	1.0	0.0	0.0	0.0	0.0	0.0				

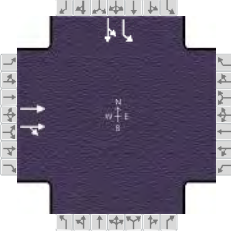
Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			6		2				4
Case Number			8.0		8.0				12.0
Phase Duration, s			60.0		60.0				20.0
Change Period, (Y+R _c), s			4.0		4.0				4.0
Max Allow Headway (MAH), s			0.0		3.2				3.1
Queue Clearance Time (g _s), s					21.7				8.5
Green Extension Time (g _e), s			0.0		3.8				0.4
Phase Call Probability					1.00				1.00
Max Out Probability					0.00				0.03

Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement			6		5	2	12					4	14
Adjusted Flow Rate (v), veh/h			0		808		659					168	165
Adjusted Saturation Flow Rate (s), veh/h/ln			1845		1855		1464					1863	1797
Queue Service Time (g _s), s			0.0		0.0		19.7					6.4	6.5
Cycle Queue Clearance Time (g _c), s			0.0		18.4		19.7					6.4	6.5
Green Ratio (g/C)			0.70		0.70		0.70					0.20	0.20
Capacity (c), veh/h			1291		1345		1025					373	359
Volume-to-Capacity Ratio (X)			0.000		0.600		0.643					0.452	0.459
Back of Queue (Q), ft/ln (95 th percentile)			0		225		201.4					126.5	121.3
Back of Queue (Q), veh/ln (95 th percentile)			0.0		9.0		8.1					4.9	4.9
Queue Storage Ratio (RQ) (95 th percentile)			0.00		0.00		0.00					0.00	0.00
Uniform Delay (d ₁), s/veh			0.0		6.4		6.5					28.1	28.2
Incremental Delay (d ₂), s/veh			0.0		0.5		1.1					0.3	0.3
Initial Queue Delay (d ₃), s/veh			0.0		0.0		0.0					0.0	0.0
Control Delay (d), s/veh			0.0		6.9		7.6					28.5	28.5
Level of Service (LOS)					A		A					C	C
Approach Delay, s/veh / LOS		0.0			7.2		A	0.0				28.5	C
Intersection Delay, s/veh / LOS		11.2						B					

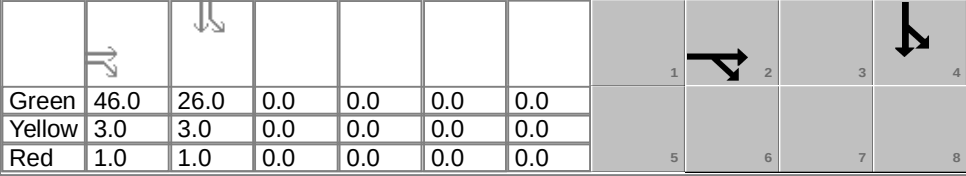
Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.4	B	1.6	A	2.3	B	2.6	B
Bicycle LOS Score / LOS		0.5	A	1.7	A			0.8	A

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other	
Jurisdiction		Mariemont		Time Period				PHF		0.90	
Urban Street		EB US 50		Analysis Year		2016		Analysis Period		1> 7:00	
Intersection		EB US 50 at Miami Road		File Name		13B-Existing-AM.xus					
Project Description		Existing AM Peak Hour									



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					400	10							260	30	

Signal Information														
Cycle, s	80.0	Reference Phase	2											
Offset, s	0	Reference Point	End											
Uncoordinated	Yes	Simult. Gap E/W	On											
Force Mode	Fixed	Simult. Gap N/S	On											
Green	46.0	26.0	0.0	0.0	0.0	0.0								
Yellow	3.0	3.0	0.0	0.0	0.0	0.0								
Red	1.0	1.0	0.0	0.0	0.0	0.0								

Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase					2						4
Case Number					8.0						10.0
Phase Duration, s					50.0						30.0
Change Period, (Y+R c), s					4.0						4.0
Max Allow Headway (MAH), s					3.0						3.1
Queue Clearance Time (g s), s					7.0						12.5
Green Extension Time (g e), s					0.8						0.5
Phase Call Probability					1.00						1.00
Max Out Probability					0.00						0.00

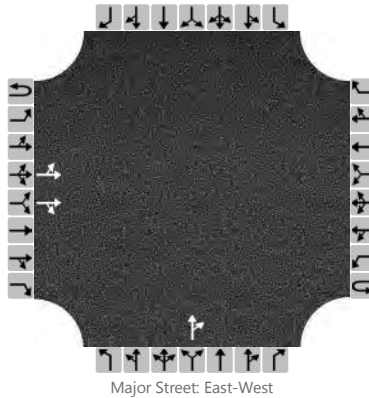
Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement					2	12							7	4	
Adjusted Flow Rate (v), veh/h					228	227							289	33	
Adjusted Saturation Flow Rate (s), veh/h/ln					1792	1777							1774	1863	
Queue Service Time (g s), s					5.0	5.0							10.5	1.0	
Cycle Queue Clearance Time (g c), s					5.0	5.0							10.5	1.0	
Green Ratio (g/C)					0.57	0.57							0.32	0.32	
Capacity (c), veh/h					1031	1022							577	605	
Volume-to-Capacity Ratio (X)					0.222	0.222							0.501	0.055	
Back of Queue (Q), ft/ln (95 th percentile)					78.7	74.6							186.4	19.1	
Back of Queue (Q), veh/ln (95 th percentile)					3.0	3.0							7.5	0.7	
Queue Storage Ratio (RQ) (95 th percentile)					0.00	0.00							0.00	0.00	
Uniform Delay (d 1), s/veh					8.3	8.3							21.8	18.6	
Incremental Delay (d 2), s/veh					0.0	0.0							0.3	0.0	
Initial Queue Delay (d 3), s/veh					0.0	0.0							0.0	0.0	
Control Delay (d), s/veh					8.3	8.3							22.0	18.6	
Level of Service (LOS)					A	A							C	B	
Approach Delay, s/veh / LOS				8.3	A		0.0			0.0			21.7	C	
Intersection Delay, s/veh / LOS				13.9						B					

Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				1.9	A		1.7	A		2.5	B		1.7	A	
Bicycle LOS Score / LOS				0.9	A								1.0	A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Crystal Springs
Agency/Co.		Jurisdiction	Union Township
Date Performed	8/3/2016	East/West Street	US 50
Analysis Year	Existing	North/South Street	Crystal Springs Rd
Time Analyzed	AM PEAK HOUR	Peak Hour Factor	1.00
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 13C		

Lanes



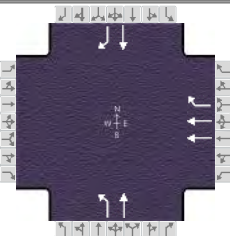
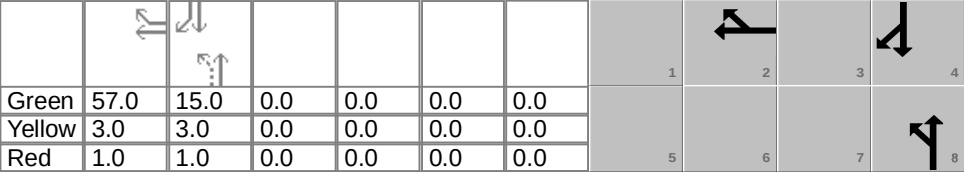
Vehicle Volumes and Adjustments

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	0	0
Configuration		LT		TR								TR				
Volume (veh/h)		90	580	20							60	10				
Percent Heavy Vehicles		4									4	4				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		380										70				
Capacity												352				
v/c Ratio												0.20				
95% Queue Length												0.7				
Control Delay (s/veh)												17.7				
Level of Service (LOS)												C				
Approach Delay (s/veh)									17.7							
Approach LOS									C							

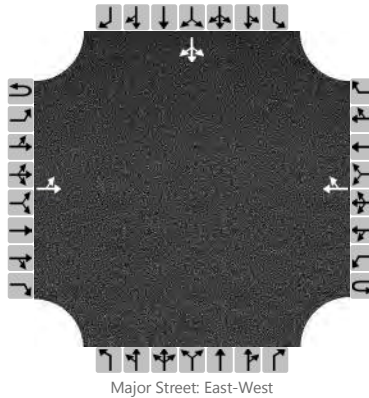
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other									
Jurisdiction		Mariemont		Time Period				PHF		0.90									
Urban Street		WB US 50		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		WB US 50 at Miami Road		File Name		13D-Existing-AM.xus													
Project Description		Existing AM Peak Hour																	
Demand Information																			
Approach Movement				EB			WB			NB			SB						
				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h								1160	10	50	100			0	110				
Signal Information																			
Cycle, s	80.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	57.0	15.0	0.0	0.0	0.0	0.0									
				Yellow	3.0	3.0	0.0	0.0	0.0	0.0									
				Red	1.0	1.0	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase										2				8				4	
Case Number										7.0				6.0				7.0	
Phase Duration, s										61.0				19.0				19.0	
Change Period, (Y+R c), s										4.0				4.0				4.0	
Max Allow Headway (MAH), s										3.0				3.2				3.2	
Queue Clearance Time (g s), s										15.1				6.3				7.5	
Green Extension Time (g e), s										3.7				0.4				0.3	
Phase Call Probability										1.00				1.00				1.00	
Max Out Probability										0.00				0.01				0.03	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement								2	12	3	8			4	14				
Adjusted Flow Rate (v), veh/h								1289	11	56	111			0	122				
Adjusted Saturation Flow Rate (s), veh/h/ln								1773	1579	1723	1810			1845	1563				
Queue Service Time (g s), s								13.1	0.2	2.2	4.3			0.0	5.5				
Cycle Queue Clearance Time (g c), s								13.1	0.2	2.2	4.3			0.0	5.5				
Green Ratio (g/C)								0.71	0.71	0.19	0.19			0.19	0.19				
Capacity (c), veh/h								2527	1125	413	339			346	293				
Volume-to-Capacity Ratio (X)								0.510	0.010	0.134	0.327			0.000	0.417				
Back of Queue (Q), ft/ln (95 th percentile)								150.2	1.7	38.9	80.5			0	90.4				
Back of Queue (Q), veh/ln (95 th percentile)								6.0	0.1	1.6	3.2			0.0	3.6				
Queue Storage Ratio (RQ) (95 th percentile)								0.00	0.00	0.00	0.00			0.00	0.00				
Uniform Delay (d 1), s/veh								5.2	3.3	27.3	28.1			0.0	28.6				
Incremental Delay (d 2), s/veh								0.1	0.0	0.1	0.2			0.0	0.4				
Initial Queue Delay (d 3), s/veh								0.0	0.0	0.0	0.0			0.0	0.0				
Control Delay (d), s/veh								5.3	3.3	27.3	28.3			0.0	29.0				
Level of Service (LOS)								A	A	C	C				C				
Approach Delay, s/veh / LOS				0.0		5.3		A		28.0		C		29.0		C			
Intersection Delay, s/veh / LOS				9.5						A									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.2		B		1.9		A		2.4		B	
Bicycle LOS Score / LOS								1.6		A		0.8		A		0.7		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Plainville
Agency/Co.		Jurisdiction	
Date Performed	7/27/2016	East/West Street	US 50
Analysis Year	Existing	North/South Street	Plainville Rd
Time Analyzed	AM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 14		

Lanes



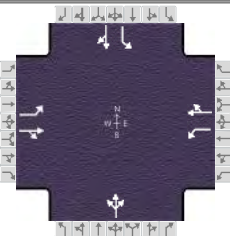
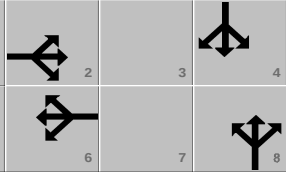
Vehicle Volumes and Adjustments

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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LTR	
Volume (veh/h)		150	440				780	70						20	0	120
Percent Heavy Vehicles		3												4	4	4
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

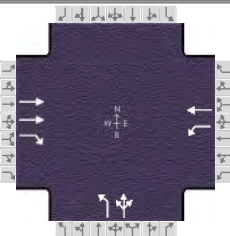
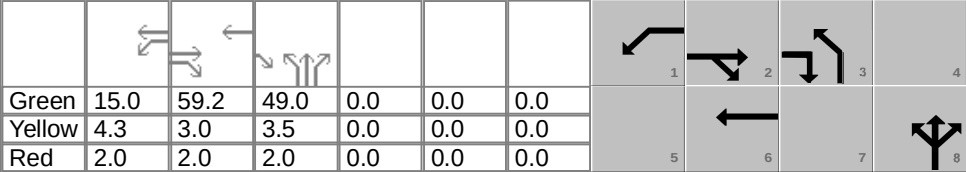
Flow Rate (veh/h)		656													155	
Capacity		734													222	
v/c Ratio		0.89													0.70	
95% Queue Length		0.9													4.5	
Control Delay (s/veh)		11.3													51.8	
Level of Service (LOS)		B													F	
Approach Delay (s/veh)	5.6												51.8			
Approach LOS													F			

HCS 2010 Signalized Intersection Results Summary

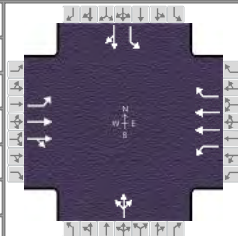
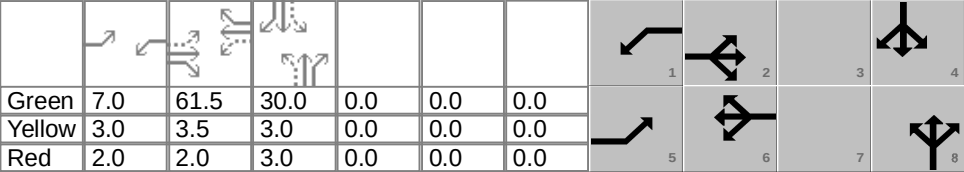
General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type						Other					
Jurisdiction		Fairfax		Time Period				PHF						0.90					
Urban Street		US 50		Analysis Year		2016		Analysis Period						1> 7:00					
Intersection		US 50 at Watterson Road		File Name		15-Existing-AM.xus													
Project Description		Existing AM Peak Hour																	
Demand Information																			
				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				50	530	10	10	900	110	10	0	0	130	10	70				
Signal Information																			
Cycle, s	120.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	80.3	30.0	0.0	0.0	0.0	0.0									
				Yellow	3.6	3.6	0.0	0.0	0.0	0.0									
				Red	1.4	1.1	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2				6				8				4	
Case Number						6.0				6.0				8.0				6.0	
Phase Duration, s						85.3				85.3				34.7				34.7	
Change Period, (Y+R c), s						5.0				5.0				4.7				4.7	
Max Allow Headway (MAH), s						3.2				3.2				3.1				3.1	
Queue Clearance Time (g s), s						82.1				68.5				8.0				16.4	
Green Extension Time (g e), s						0.0				4.4				0.4				0.4	
Phase Call Probability						1.00				1.00				1.00				1.00	
Max Out Probability						1.00				0.33				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				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				56	600		11	1122			11		144	89					
Adjusted Saturation Flow Rate (s), veh/h/ln				490	1821		800	1792			1098		1792	1625					
Queue Service Time (g s), s				13.6	19.5		0.8	66.5			0.8		8.4	5.2					
Cycle Queue Clearance Time (g c), s				80.1	19.5		20.3	66.5			6.0		14.4	5.2					
Green Ratio (g/C)				0.67	0.67		0.67	0.67			0.25		0.25	0.25					
Capacity (c), veh/h				116	1218		465	1199			335		418	406					
Volume-to-Capacity Ratio (X)				0.478	0.492		0.024	0.936			0.033		0.345	0.219					
Back of Queue (Q), ft/ln (95 th percentile)				78.5	287.5		7	921.8			12.2		173	93.1					
Back of Queue (Q), veh/ln (95 th percentile)				3.0	11.5		0.3	36.9			0.5		6.7	3.7					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00		0.00	0.00			0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				53.0	9.8		14.8	17.6			38.1		41.8	35.7					
Incremental Delay (d 2), s/veh				1.1	0.1		0.0	13.3			0.0		0.2	0.1					
Initial Queue Delay (d 3), s/veh				0.0	0.0		0.0	0.0			0.0		0.0	0.0					
Control Delay (d), s/veh				54.2	9.9		14.8	30.8			38.1		42.0	35.8					
Level of Service (LOS)				D	A		B	C			D		D	D					
Approach Delay, s/veh / LOS				13.7	B		30.7	C		38.1	D		39.6	D					
Intersection Delay, s/veh / LOS				26.3						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.1	B		2.2	B		2.3	B		2.3	B					
Bicycle LOS Score / LOS				1.6	A		2.4	B		0.5	A		0.9	A					

PM

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information															
Agency					Duration, h		0.25													
Analyst		MJH	Analysis Date	Jul 26, 2016		Area Type		Other												
Jurisdiction		Columbia Twp (ODOT)	Time Period			PHF		0.90												
Urban Street		US 50	Analysis Year	2016		Analysis Period		1> 7:00												
Intersection		US 50 at Newtown Road	File Name	11-Existing-PM.xus																
Project Description		Existing PM Peak Hour																		
Demand Information					EB			WB			NB			SB						
Approach Movement					L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h						560	930	90	280		550	0	100							
Signal Information																				
Cycle, s	140.0	Reference Phase	2																	
Offset, s	0	Reference Point	End																	
Uncoordinated	Yes	Simult. Gap E/W	On																	
Force Mode	Fixed	Simult. Gap N/S	On	Green	15.0	59.2	49.0	0.0	0.0	0.0										
				Yellow	4.3	3.0	3.5	0.0	0.0	0.0										
				Red	2.0	2.0	2.0	0.0	0.0	0.0										
Timer Results					EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase							2		1		6				8					
Case Number							7.3		2.0		4.0				10.0					
Phase Duration, s							64.2		21.3		85.5				54.5					
Change Period, (Y+R _c), s							6.3		6.3		6.3				5.5					
Max Allow Headway (MAH), s							3.2		3.1		3.2				3.2					
Queue Clearance Time (g _s), s							59.9		9.4		14.0				49.8					
Green Extension Time (g _e), s							0.0		0.1		6.7				0.0					
Phase Call Probability							1.00		1.00		1.00				1.00					
Max Out Probability							1.00		0.04		0.01				1.00					
Movement Group Results					EB			WB			NB			SB						
Approach Movement					L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement						2	12	1	6		3	8	18							
Adjusted Flow Rate (v), veh/h						622	1033	100	311		611	111								
Adjusted Saturation Flow Rate (s), veh/h/ln						1791	1594	1792	1881		1774	1579								
Queue Service Time (g _s), s						17.3	57.9	7.4	12.0		47.8	6.9								
Cycle Queue Clearance Time (g _c), s						17.3	57.9	7.4	12.0		47.8	6.9								
Green Ratio (g/C)						0.41	0.76	0.11	0.57		0.35	0.35								
Capacity (c), veh/h						1481	1217	192	1064		621	553								
Volume-to-Capacity Ratio (X)						0.420	0.849	0.521	0.292		0.984	0.201								
Back of Queue (Q), ft/ln (95 th percentile)						300.1	680.7	153.5	223.9		863.9	120.6								
Back of Queue (Q), veh/ln (95 th percentile)						11.9	27.0	6.1	8.9		34.6	4.8								
Queue Storage Ratio (RQ) (95 th percentile)						0.00	0.00	0.00	0.00		0.00	0.00								
Uniform Delay (d ₁), s/veh						29.1	11.1	59.1	15.8		45.1	31.8								
Incremental Delay (d ₂), s/veh						0.1	5.5	1.2	0.1		31.9	0.1								
Initial Queue Delay (d ₃), s/veh						0.0	0.0	0.0	0.0		0.0	0.0								
Control Delay (d), s/veh						29.2	16.7	60.3	15.9		77.0	31.9								
Level of Service (LOS)						C	B	E	B		E	C								
Approach Delay, s/veh / LOS					21.4	C		26.7	C		70.1	E		0.0						
Intersection Delay, s/veh / LOS					34.8						C									
Multimodal Results					EB			WB			NB			SB						
Pedestrian LOS Score / LOS					2.3	B		1.9	A		2.8	C		2.5	B					
Bicycle LOS Score / LOS					1.9	A		1.2	A		1.7	A								

HCS 2010 Signalized Intersection Results Summary

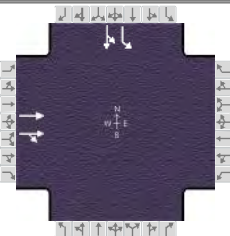
General Information						Intersection Information													
Agency								Duration, h		0.25									
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other									
Jurisdiction		Columbia Twp (ODOT)		Time Period				PHF		0.90									
Urban Street		US 50		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		US 50 at Walton Creek Rd		File Name		12-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information																			
Approach Movement				EB			WB			NB			SB						
				L	T	R	L	T	R	L	T	R	L	T	R				
				40	1060	50	70	600	150	40	50	90	360	50	40				
Signal Information																			
Cycle, s	115.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
Green				7.0	61.5	30.0	0.0	0.0	0.0										
Yellow				3.0	3.5	3.0	0.0	0.0	0.0										
Red				2.0	2.0	3.0	0.0	0.0	0.0										
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase				5		2		1		6				8				4	
Case Number				1.1		4.0		1.1		3.0				8.0				6.0	
Phase Duration, s				12.0		67.0		12.0		67.0				36.0				36.0	
Change Period, (Y+R c), s				5.0		5.5		5.0		5.5				6.0				6.0	
Max Allow Headway (MAH), s				3.1		3.1		3.1		3.1				3.3				3.3	
Queue Clearance Time (g s), s				3.2		28.8		4.1		14.4				13.4				32.0	
Green Extension Time (g e), s				0.0		5.3		0.0		5.4				1.5				0.0	
Phase Call Probability				1.00		1.00		1.00		1.00				1.00				1.00	
Max Out Probability				0.31		0.02		1.00		0.00				0.00				1.00	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				44	621	612	78	667	167		200		400	100					
Adjusted Saturation Flow Rate (s), veh/h/ln				1774	1863	1833	1774	1773	1579		1631		1238	1742					
Queue Service Time (g s), s				1.2	26.8	26.8	2.1	12.4	6.3		4.6		18.6	5.2					
Cycle Queue Clearance Time (g c), s				1.2	26.8	26.8	2.1	12.4	6.3		11.4		30.0	5.2					
Green Ratio (g/C)				0.60	0.53	0.53	0.60	0.53	0.53		0.26		0.26	0.26					
Capacity (c), veh/h				485	996	980	298	1897	844		464		262	454					
Volume-to-Capacity Ratio (X)				0.092	0.624	0.624	0.261	0.351	0.197		0.431		1.525	0.220					
Back of Queue (Q), ft/ln (95 th percentile)				20.5	423.7	412.6	36.9	214.1	98.8		208.8		1062.9	98.3					
Back of Queue (Q), veh/ln (95 th percentile)				0.8	16.7	16.5	1.5	8.4	4.0		8.2		41.8	3.9					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				10.6	18.7	18.7	14.2	15.3	13.9		35.5		50.4	33.3					
Incremental Delay (d 2), s/veh				0.0	0.9	0.9	0.2	0.0	0.0		0.2		254.6	0.1					
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0					
Control Delay (d), s/veh				10.6	19.6	19.6	14.4	15.4	14.0		35.8		305.0	33.4					
Level of Service (LOS)				B	B	B	B	B	B		D		F	C					
Approach Delay, s/veh / LOS				19.3		B	15.0		B	35.8		D	250.7		F				
Intersection Delay, s/veh / LOS				59.1						E									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.1		B	2.3		B	3.0		C	2.8		C				
Bicycle LOS Score / LOS				1.5		A	1.2		A	0.8		A	1.3		A				

HCS 2010 Signalized Intersection Results Summary

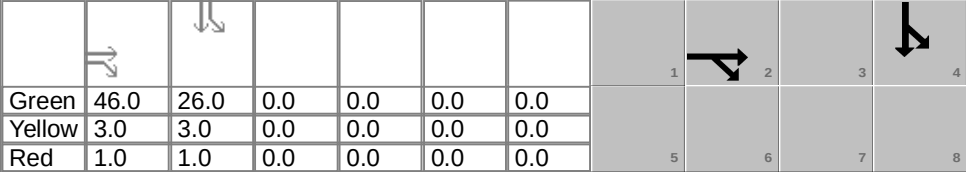
General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other									
Jurisdiction		Mariemont		Time Period				PHF		0.90									
Urban Street		WB US 50		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		WB US 50 at Madisonvil...		File Name		13A-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information																			
Approach Movement				EB			WB			NB			SB						
				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h					0		40	570	310					480	30				
Signal Information																			
Cycle, s	80.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	51.0	21.0	0.0	0.0	0.0	0.0									
				Yellow	3.0	3.0	0.0	0.0	0.0	0.0									
				Red	1.0	1.0	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						6				2								4	
Case Number						8.0				8.0								12.0	
Phase Duration, s						55.0				55.0								25.0	
Change Period, (Y+R c), s						4.0				4.0								4.0	
Max Allow Headway (MAH), s						0.0				3.1								3.0	
Queue Clearance Time (g s), s										14.8								12.6	
Green Extension Time (g e), s						0.0				2.2								0.8	
Phase Call Probability										1.00								1.00	
Max Out Probability										0.00								0.05	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement					6		5	2	12					4	14				
Adjusted Flow Rate (v), veh/h					0		564		458					286	281				
Adjusted Saturation Flow Rate (s), veh/h/ln					1863		1834		1493					1881	1842				
Queue Service Time (g s), s					0.0		0.0		12.8					10.6	10.6				
Cycle Queue Clearance Time (g c), s					0.0		12.6		12.8					10.6	10.6				
Green Ratio (g/C)					0.64		0.64		0.64					0.26	0.26				
Capacity (c), veh/h					1188		1218		952					494	483				
Volume-to-Capacity Ratio (X)					0.000		0.463		0.481					0.579	0.581				
Back of Queue (Q), ft/ln (95 th percentile)					0		181.4		148.2					207	201.5				
Back of Queue (Q), veh/ln (95 th percentile)					0.0		7.3		5.9					8.1	8.1				
Queue Storage Ratio (RQ) (95 th percentile)					0.00		0.00		0.00					0.00	0.00				
Uniform Delay (d 1), s/veh					0.0		7.5		7.6					25.7	25.7				
Incremental Delay (d 2), s/veh					0.0		0.1		0.1					1.1	1.2				
Initial Queue Delay (d 3), s/veh					0.0		0.0		0.0					0.0	0.0				
Control Delay (d), s/veh					0.0		7.6		7.7					26.8	26.8				
Level of Service (LOS)							A		A					C	C				
Approach Delay, s/veh / LOS				0.0				7.7		A		0.0				26.8		C	
Intersection Delay, s/veh / LOS				14.5						B									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.4		B		1.6		A		2.3		B		2.6		B	
Bicycle LOS Score / LOS				0.5		A		1.3		A						1.0		A	

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other	
Jurisdiction		Mariemont		Time Period				PHF		0.90	
Urban Street		EB US 50		Analysis Year		2016		Analysis Period		1> 7:00	
Intersection		EB US 50 at Miami Road		File Name		13B-Existing-PM.xus					
Project Description		Existing PM Peak Hour									



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					920	10							480	40	

Signal Information														
Cycle, s	80.0	Reference Phase	2											
Offset, s	0	Reference Point	End											
Uncoordinated	Yes	Simult. Gap E/W	On											
Force Mode	Fixed	Simult. Gap N/S	On											
Green	46.0	26.0	0.0	0.0	0.0	0.0								
Yellow	3.0	3.0	0.0	0.0	0.0	0.0								
Red	1.0	1.0	0.0	0.0	0.0	0.0								

Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase					2						4
Case Number					8.0						10.0
Phase Duration, s					50.0						30.0
Change Period, (Y+R _c), s					4.0						4.0
Max Allow Headway (MAH), s					3.0						3.1
Queue Clearance Time (g _s), s					15.1						24.9
Green Extension Time (g _e), s					2.0						0.2
Phase Call Probability					1.00						1.00
Max Out Probability					0.00						1.00

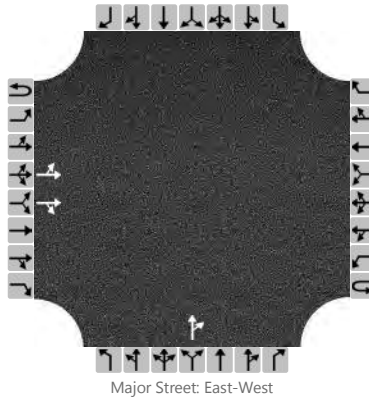
Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement					2	12							7	4	
Adjusted Flow Rate (v), veh/h					518	516							533	44	
Adjusted Saturation Flow Rate (s), veh/h/ln					1863	1856							1792	1881	
Queue Service Time (g _s), s					13.1	13.1							22.9	1.3	
Cycle Queue Clearance Time (g _c), s					13.1	13.1							22.9	1.3	
Green Ratio (g/C)					0.57	0.57							0.32	0.32	
Capacity (c), veh/h					1071	1067							582	611	
Volume-to-Capacity Ratio (X)					0.483	0.483							0.916	0.073	
Back of Queue (Q), ft/ln (95 th percentile)					205	201.2							444.8	24.9	
Back of Queue (Q), veh/ln (95 th percentile)					8.1	8.0							17.8	1.0	
Queue Storage Ratio (RQ) (95 th percentile)					0.00	0.00							0.00	0.00	
Uniform Delay (d ₁), s/veh					10.0	10.0							25.9	18.7	
Incremental Delay (d ₂), s/veh					0.1	0.1							19.0	0.0	
Initial Queue Delay (d ₃), s/veh					0.0	0.0							0.0	0.0	
Control Delay (d), s/veh					10.1	10.1							44.9	18.7	
Level of Service (LOS)					B	B							D	B	
Approach Delay, s/veh / LOS				10.1	B		0.0			0.0			42.9	D	
Intersection Delay, s/veh / LOS				21.9						C					

Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				1.9	A		1.7	A		2.5	B		1.7	A	
Bicycle LOS Score / LOS				1.3	A								1.4	A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Crystal Springs
Agency/Co.		Jurisdiction	Union Township
Date Performed	8/3/2016	East/West Street	US 50
Analysis Year	Existing	North/South Street	Crystal Springs Rd
Time Analyzed	PM PEAK HOUR	Peak Hour Factor	1.00
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 13C		

Lanes



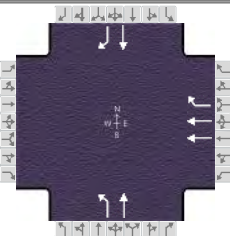
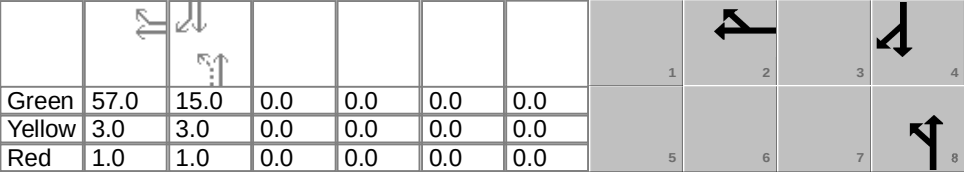
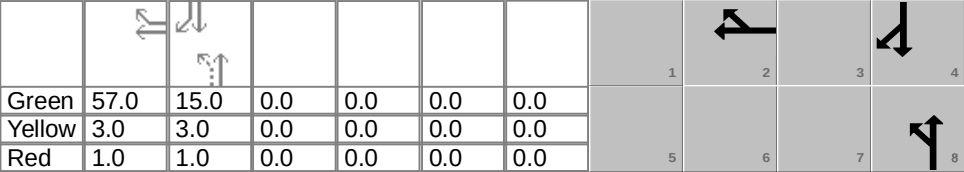
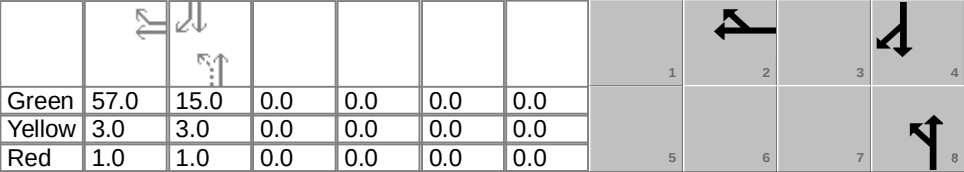
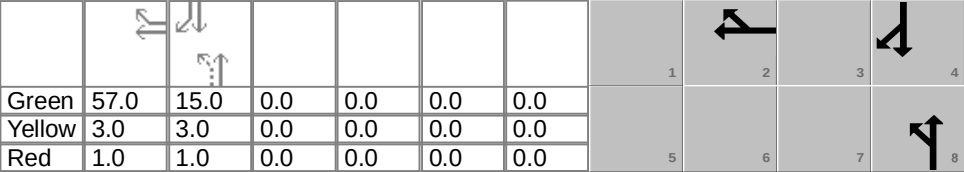
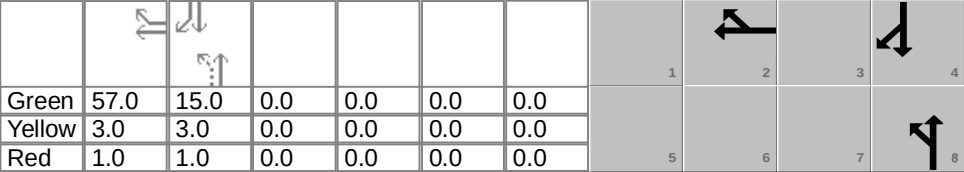
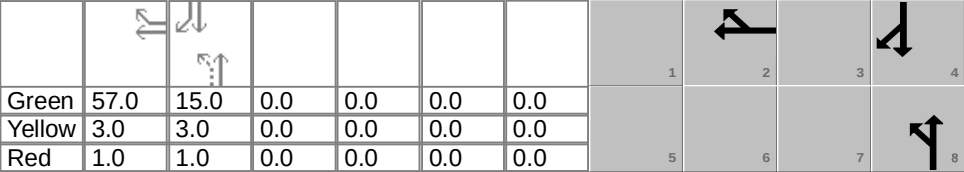
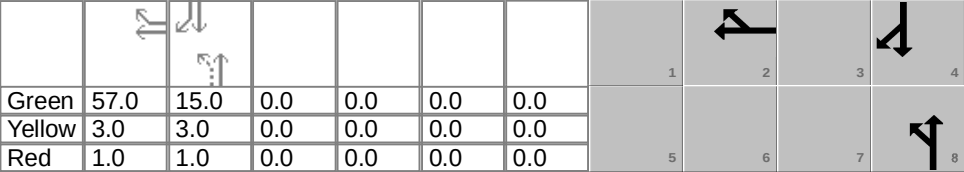
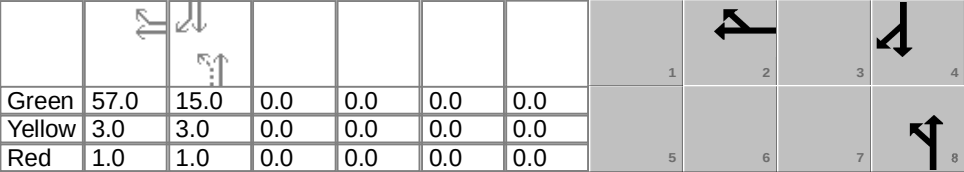
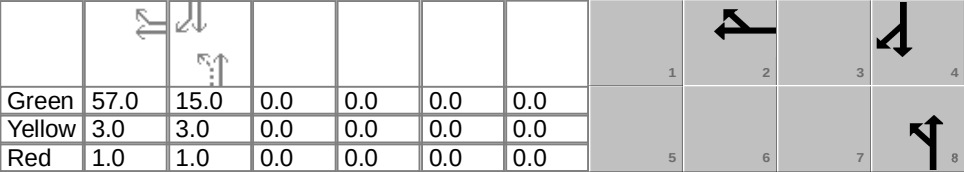
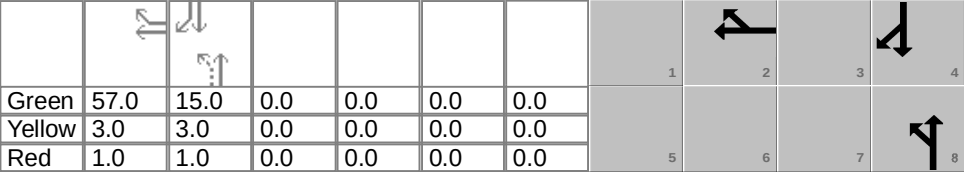
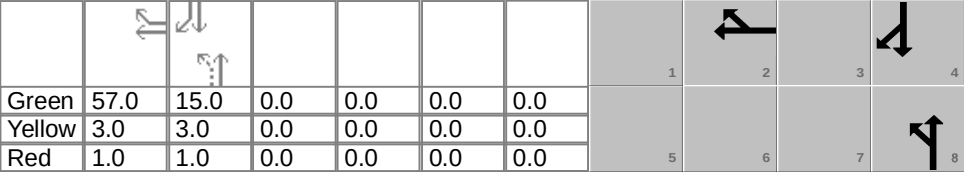
Vehicle Volumes and Adjustments

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	0	0
Configuration		LT		TR								TR				
Volume (veh/h)		140	1260	40							40	20				
Percent Heavy Vehicles		1									2	2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		770										60				
Capacity												147				
v/c Ratio												0.41				
95% Queue Length												1.8				
Control Delay (s/veh)												45.4				
Level of Service (LOS)												E				
Approach Delay (s/veh)									45.4							
Approach LOS									E							

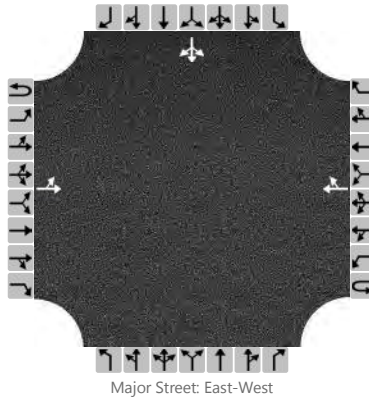
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other									
Jurisdiction		Mariemont		Time Period				PHF		0.90									
Urban Street		WB US 50		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		WB US 50 at Miami Road		File Name		13D-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h								750	10	50	130			0	120				
Signal Information																			
Cycle, s	80.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	57.0	15.0	0.0	0.0	0.0	0.0									
				Yellow	3.0	3.0	0.0	0.0	0.0	0.0									
				Red	1.0	1.0	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase										2				8				4	
Case Number										7.0				6.0				7.0	
Phase Duration, s										61.0				19.0				19.0	
Change Period, (Y+R c), s										4.0				4.0				4.0	
Max Allow Headway (MAH), s										3.0				3.2				3.2	
Queue Clearance Time (g s), s										9.1				7.4				7.9	
Green Extension Time (g e), s										2.1				0.4				0.4	
Phase Call Probability										1.00				1.00				1.00	
Max Out Probability										0.00				0.03				0.05	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement								2	12	3	8			4	14				
Adjusted Flow Rate (v), veh/h								833	11	56	144			0	133				
Adjusted Saturation Flow Rate (s), veh/h/ln								1773	1579	1792	1881			1881	1594				
Queue Service Time (g s), s								7.1	0.2	2.1	5.4			0.0	5.9				
Cycle Queue Clearance Time (g c), s								7.1	0.2	2.1	5.4			0.0	5.9				
Green Ratio (g/C)								0.71	0.71	0.19	0.19			0.19	0.19				
Capacity (c), veh/h								2527	1125	426	353			353	299				
Volume-to-Capacity Ratio (X)								0.330	0.010	0.130	0.410			0.000	0.446				
Back of Queue (Q), ft/ln (95 th percentile)								80.7	1.7	38.9	106.3			0	99.3				
Back of Queue (Q), veh/ln (95 th percentile)								3.2	0.1	1.6	4.3			0.0	4.0				
Queue Storage Ratio (RQ) (95 th percentile)								0.00	0.00	0.00	0.00			0.00	0.00				
Uniform Delay (d 1), s/veh								4.3	3.3	27.3	28.6			0.0	28.8				
Incremental Delay (d 2), s/veh								0.0	0.0	0.1	0.3			0.0	0.4				
Initial Queue Delay (d 3), s/veh								0.0	0.0	0.0	0.0			0.0	0.0				
Control Delay (d), s/veh								4.3	3.3	27.3	28.9			0.0	29.2				
Level of Service (LOS)								A	A	C	C				C				
Approach Delay, s/veh / LOS				0.0				4.3		A		28.4		C		29.2		C	
Intersection Delay, s/veh / LOS				11.2						B									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.2		B		1.9		A		2.4		B	
Bicycle LOS Score / LOS								1.2		A		0.8		A		0.7		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Plainville Rd
Agency/Co.		Jurisdiction	Mariemont
Date Performed	4/13/2016	East/West Street	US 50
Analysis Year	Existing	North/South Street	Plainville Rd
Time Analyzed	PM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 14		

Lanes



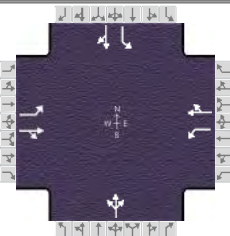
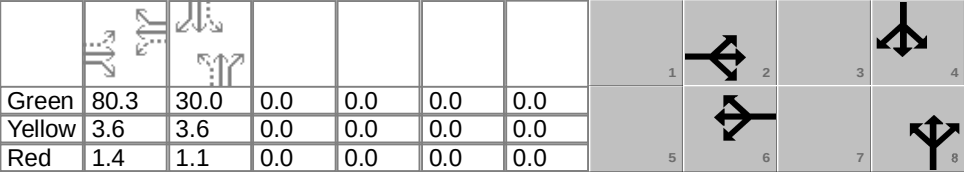
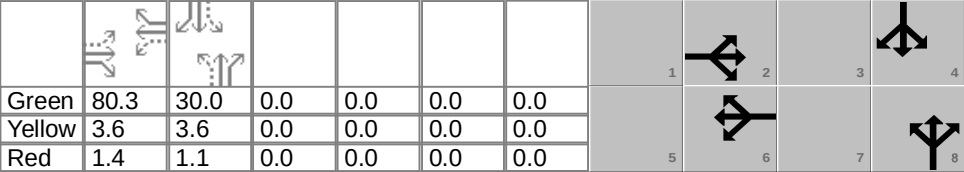
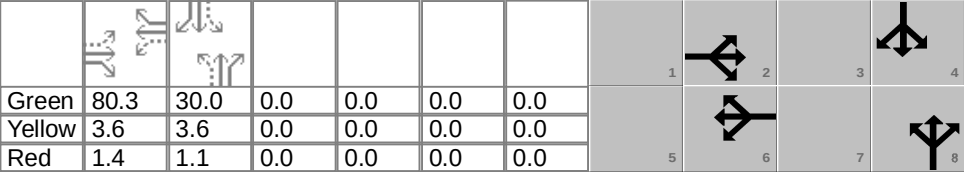
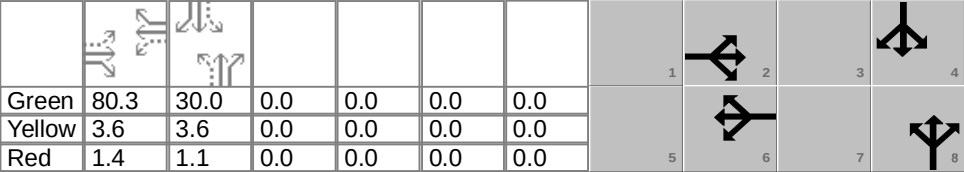
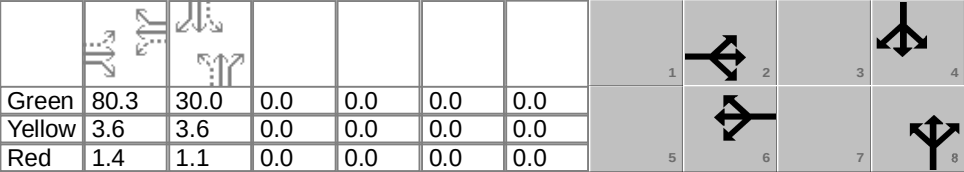
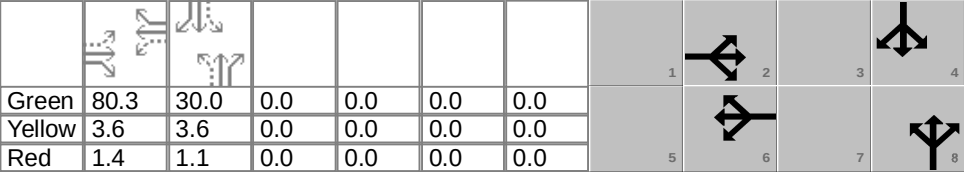
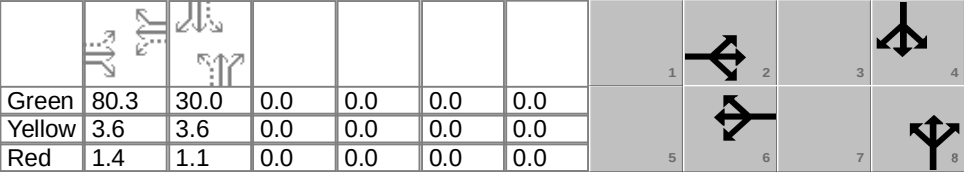
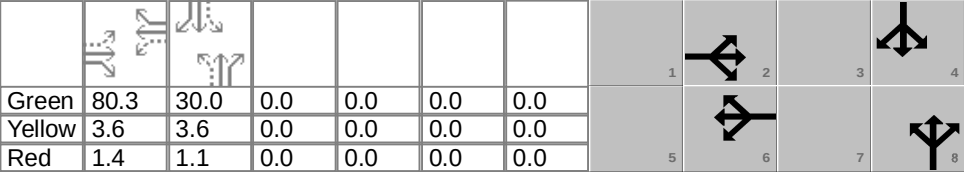
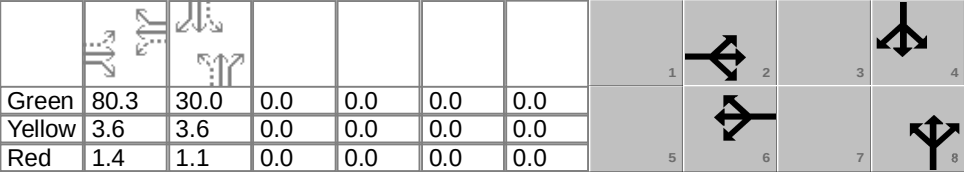
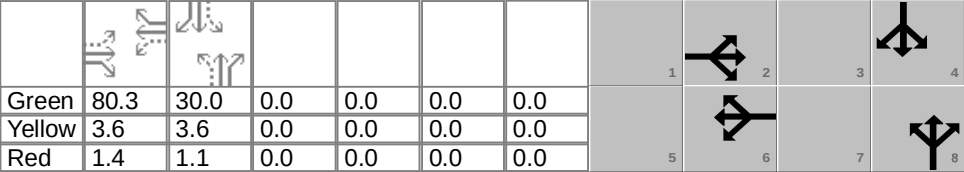
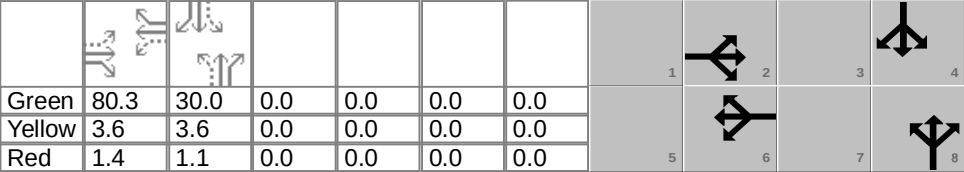
Vehicle Volumes and Adjustments

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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LTR	
Volume (veh/h)		180	950				530	40						50	0	140
Percent Heavy Vehicles		2												2	2	2
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		1256													212	
Capacity		960													142	
v/c Ratio		1.31													1.50	
95% Queue Length		0.8													14.3	
Control Delay (s/veh)		9.7													314.1	
Level of Service (LOS)		A													F	
Approach Delay (s/veh)	6.1												314.1			
Approach LOS													F			

HCS 2010 Signalized Intersection Results Summary

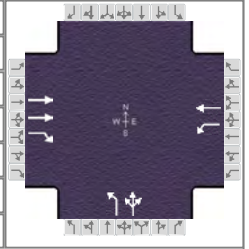
General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Jul 26, 2016		Area Type		Other									
Jurisdiction		Fairfax		Time Period				PHF		0.90									
Urban Street		US 50		Analysis Year		2016		Analysis Period		1> 7:00									
Intersection		US 50 at Watterson Rd		File Name		15-Existing-PM.xus													
Project Description		Existing PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				30	1080	0	10	640	90	10	0	10	300	0	80				
Signal Information																			
Cycle, s	120.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	80.3	30.0	0.0	0.0	0.0	0.0									
				Yellow	3.6	3.6	0.0	0.0	0.0	0.0									
				Red	1.4	1.1	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2				6				8				4	
Case Number						6.0				6.0				8.0				6.0	
Phase Duration, s						85.3				85.3				34.7				34.7	
Change Period, (Y+R c), s						5.0				5.0				4.7				4.7	
Max Allow Headway (MAH), s						3.1				3.1				3.1				3.1	
Queue Clearance Time (g s), s						73.9				76.6				7.3				32.0	
Green Extension Time (g e), s						3.5				2.3				0.8				0.0	
Phase Call Probability						1.00				1.00				1.00				1.00	
Max Out Probability						0.71				0.94				0.00				1.00	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				33	0		11	811			22		333	89					
Adjusted Saturation Flow Rate (s), veh/h/ln				670	0		464	1822			1317		1426	1610					
Queue Service Time (g s), s				3.7	0.0		2.7	31.8			0.1		24.7	5.3					
Cycle Queue Clearance Time (g c), s				35.6	0.0		74.6	31.8			5.3		30.0	5.3					
Green Ratio (g/C)				0.67			0.67	0.67			0.25		0.25	0.25					
Capacity (c), veh/h				331			93	1219			374		353	403					
Volume-to-Capacity Ratio (X)				0.101	0.000		0.120	0.665			0.059		0.943	0.221					
Back of Queue (Q), ft/ln (95 th percentile)				27.1	0		14.8	440.1			22.6		490.1	93.2					
Back of Queue (Q), veh/ln (95 th percentile)				1.1	0.0		0.6	17.6			0.9		19.3	3.7					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00		0.00	0.00			0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				22.4			53.2	11.8			34.2		49.1	35.7					
Incremental Delay (d 2), s/veh				0.0	0.0		0.2	1.1			0.0		33.1	0.1					
Initial Queue Delay (d 3), s/veh				0.0	0.0		0.0	0.0			0.0		0.0	0.0					
Control Delay (d), s/veh				22.5			53.4	13.0			34.3		82.2	35.8					
Level of Service (LOS)				C			D	B			C		F	D					
Approach Delay, s/veh / LOS				35.3		D		13.5		B		34.3		C		72.5		E	
Intersection Delay, s/veh / LOS				34.4						C									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.1		B		2.2		B		2.3		B		2.3		B	
Bicycle LOS Score / LOS				2.5		B		1.8		A		0.5		A		1.2		A	

2022

AM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 19, 2016	Area Type	Other
Jurisdiction	Columbia Twp (ODOT)	Time Period		PHF	0.90
Urban Street	US 50	Analysis Year	2022	Analysis Period	1> 7:00
Intersection	US 50 at Newtown Road	File Name	11-2022-AM.xus		
Project Description	2022 NO-BUILD - AM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		190	390	140	480		1080	0	100			

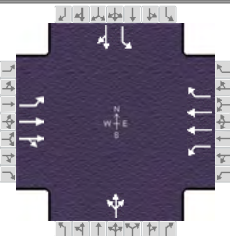
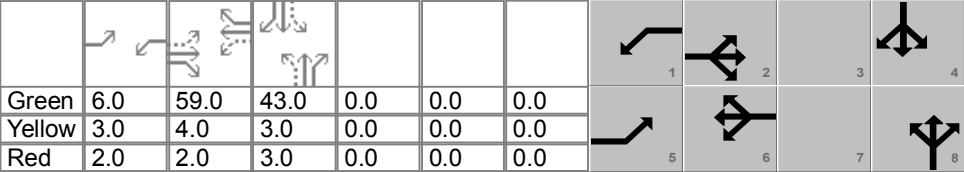
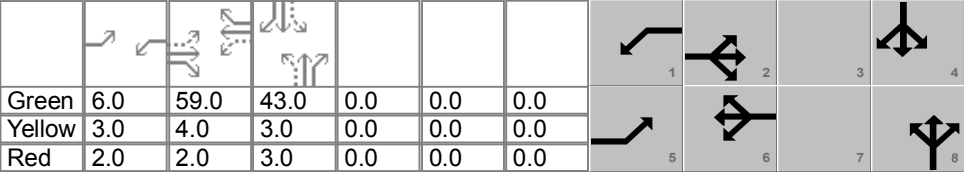
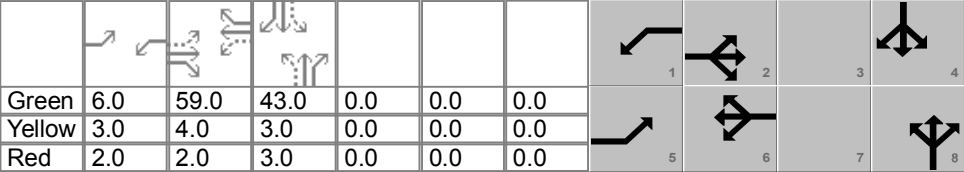
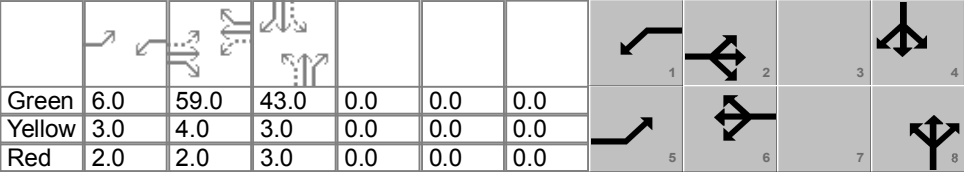
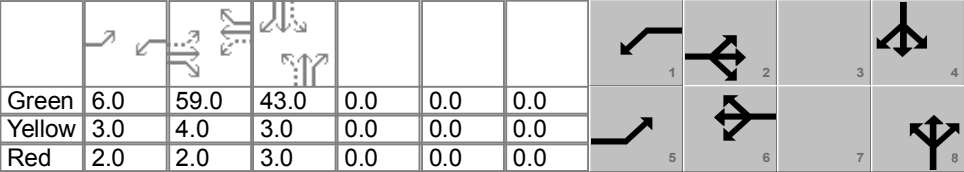
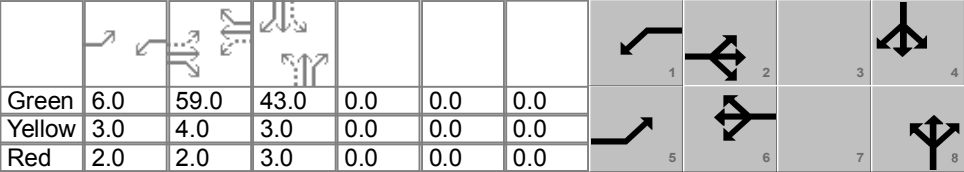
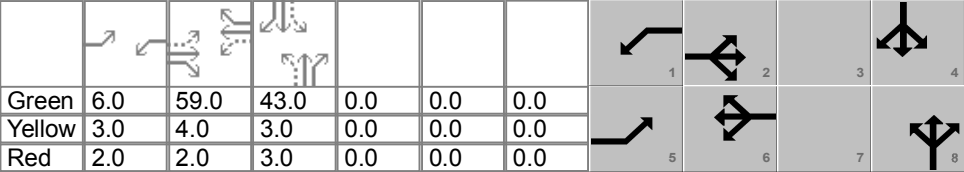
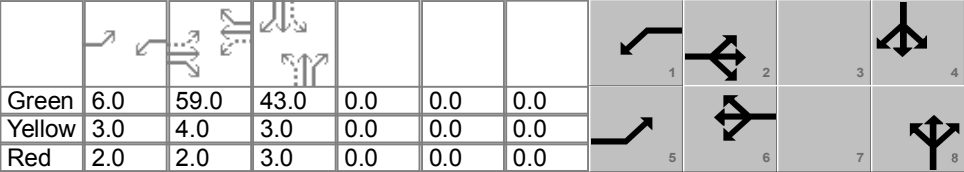
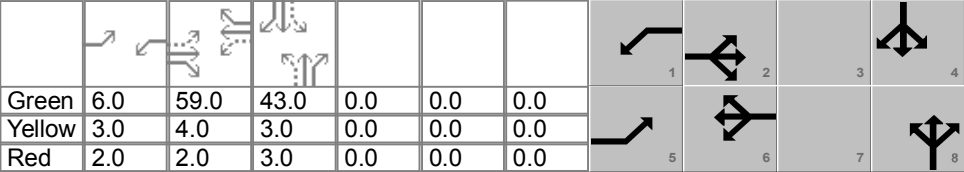
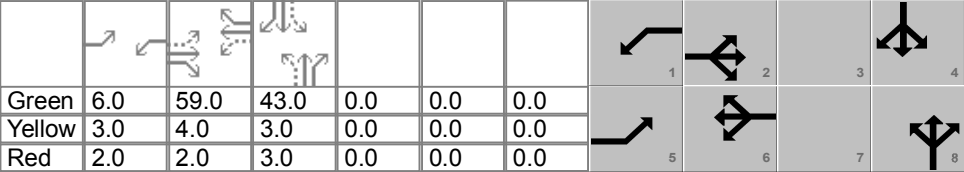
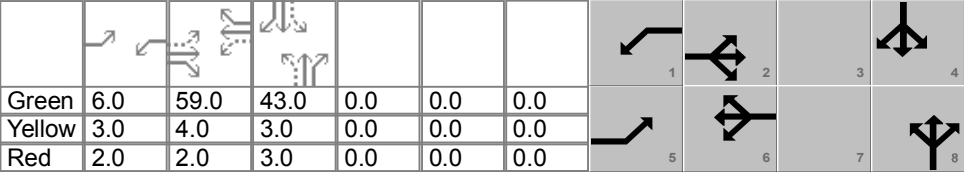
Signal Information											
Cycle, s	115.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	8.0	22.0	67.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	5.0	3.0	4.0	0.0	0.0	0.0	
				Red	2.0	2.0	2.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	2.0	4.0		10.0		
Phase Duration, s		27.0	15.0	42.0		73.0		
Change Period, ($Y+R_c$), s		7.0	7.0	7.0		6.0		
Max Allow Headway (MAH), s		3.2	3.1	3.2		3.1		
Queue Clearance Time (g_s), s		12.9	10.0	35.4		69.0		
Green Extension Time (g_e), s		1.9	0.0	0.0		0.0		
Phase Call Probability		1.00	1.00	1.00		1.00		
Max Out Probability		0.33	1.00	1.00		1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8	18			
Adjusted Flow Rate (v), veh/h		211	433	156	533		1200	111				
Adjusted Saturation Flow Rate (s), veh/h/ln		1739	1548	1723	1810		1740	1548				
Queue Service Time (g_s), s		6.1	10.9	8.0	33.4		67.0	3.7				
Cycle Queue Clearance Time (g_c), s		6.1	10.9	8.0	33.4		67.0	3.7				
Green Ratio (g/C)		0.17	0.76	0.07	0.30		0.58	0.58				
Capacity (c), veh/h		605	1171	120	551		1014	902				
Volume-to-Capacity Ratio (X)		0.349	0.370	1.298	0.968		1.184	0.123				
Back of Queue (Q), ft/ln (95 th percentile)		122	131.3	393.4	677.1		1788.3	57				
Back of Queue (Q), veh/ln (95 th percentile)		4.7	5.1	15.7	26.2		71.5	2.2				
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00	0.00	0.00		0.00	0.00				
Uniform Delay (d_1), s/veh		41.8	4.7	53.5	39.5		24.0	10.8				
Incremental Delay (d_2), s/veh		0.1	0.1	182.0	30.2		92.9	0.0				
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0	0.0				
Control Delay (d), s/veh		41.9	4.8	235.5	69.7		116.9	10.8				
Level of Service (LOS)		D	A	F	E		F	B				
Approach Delay, s/veh / LOS	17.0	B		107.1	F		107.9	F		0.0		
Intersection Delay, s/veh / LOS	85.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	1.9	A	2.7	B	2.5	B
Bicycle LOS Score / LOS	1.0	A	1.6	A	2.7	B		

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information									
Agency						Duration, h		0.25							
Analyst		MJH		Analysis Date		Oct 19, 2016		Area Type		Other					
Jurisdiction		Columbia Twp (ODOT)		Time Period				PHF		0.90					
Urban Street		US 50		Analysis Year		2022		Analysis Period		1> 7:00					
Intersection		US 50 at Walton Creek...		File Name		12-2022-AM.xus									
Project Description		2022 NO-BUILD - AM Peak Hour													
Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				40	530	20	40	1240	420	10	10	30	140	10	20
Signal Information															
Cycle, s	125.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On												
Force Mode	Fixed	Simult. Gap N/S	On												
				Green	6.0	59.0	43.0	0.0	0.0	0.0					
				Yellow	3.0	4.0	3.0	0.0	0.0	0.0					
				Red	2.0	2.0	3.0	0.0	0.0	0.0					
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase				5	2	1	6		8		4				
Case Number				1.1	4.0	1.1	3.0		8.0		6.0				
Phase Duration, s				11.0	65.0	11.0	65.0		49.0		49.0				
Change Period, (Y+R c), s				5.0	6.0	5.0	6.0		6.0		6.0				
Max Allow Headway (MAH), s				3.1	3.1	3.1	3.1		3.2		3.2				
Queue Clearance Time (g s), s				3.6	15.5	3.6	46.0		4.9		15.9				
Green Extension Time (g e), s				0.0	8.0	0.0	5.9		0.5		0.5				
Phase Call Probability				1.00	1.00	1.00	1.00		1.00		1.00				
Max Out Probability				1.00	0.02	1.00	0.37		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				5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h				44	307	304	44	1378	467		56		156	33	
Adjusted Saturation Flow Rate (s), veh/h/ln				1723	1810	1786	1723	1723	1533		1552		1356	1663	
Queue Service Time (g s), s				1.6	13.5	13.5	1.6	44.0	28.9		0.0		11.0	1.7	
Cycle Queue Clearance Time (g c), s				1.6	13.5	13.5	1.6	44.0	28.9		2.9		13.9	1.7	
Green Ratio (g/C)				0.52	0.47	0.47	0.52	0.47	0.47		0.34		0.34	0.34	
Capacity (c), veh/h				180	854	843	413	1626	724		568		493	572	
Volume-to-Capacity Ratio (X)				0.247	0.360	0.360	0.108	0.847	0.645		0.098		0.316	0.058	
Back of Queue (Q), ft/ln (95 th percentile)				29.4	248.5	236.8	29	661.6	395.8		53.1		169.1	30.2	
Back of Queue (Q), veh/ln (95 th percentile)				1.1	9.6	9.5	1.1	25.4	15.8		2.0		6.5	1.2	
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00	
Uniform Delay (d 1), s/veh				24.4	21.0	21.0	15.8	29.0	25.0		27.8		32.6	27.4	
Incremental Delay (d 2), s/veh				0.3	0.1	0.1	0.0	4.2	1.5		0.0		0.1	0.0	
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Control Delay (d), s/veh				24.6	21.1	21.1	15.8	33.2	26.6		27.9		32.7	27.5	
Level of Service (LOS)				C	C	C	B	C	C		C		C	C	
Approach Delay, s/veh / LOS				21.3	C		31.2	C		27.9	C		31.8	C	
Intersection Delay, s/veh / LOS				28.8						C					
Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.1	B		2.3	B		3.0	C		2.8	C	
Bicycle LOS Score / LOS				1.0	A		2.0	B		0.6	A		0.8	A	

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information				
Agency					Duration, h		0.25		
Analyst		MJH	Analysis Date	Oct 19, 2016	Area Type		Other		
Jurisdiction		Mariemont	Time Period		PHF		0.90		
Urban Street		WB US 50	Analysis Year	2022	Analysis Period		1> 7:00		
Intersection		WB US 50 at Madisonvil...	File Name	13A-2022-AM.xus					
Project Description		2022 NO-BUILD - AM Peak Hour							

Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					0		20	900	550					300	30

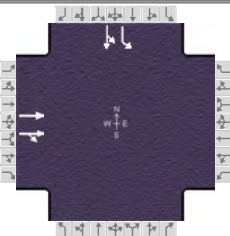
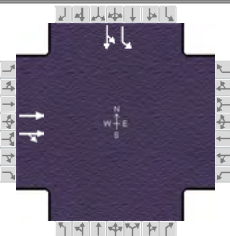
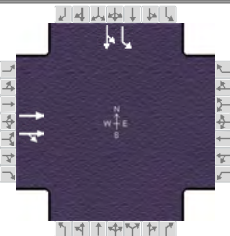
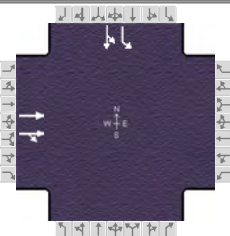
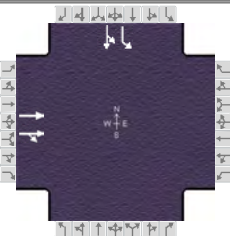
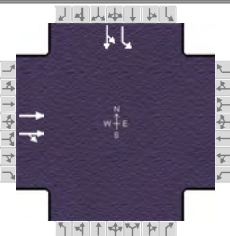
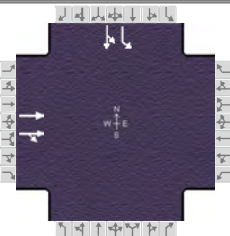
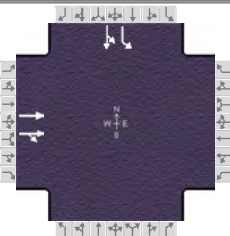
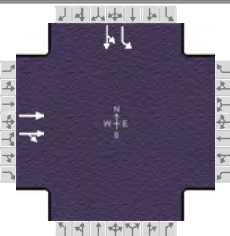
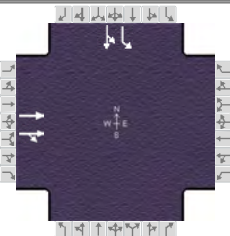
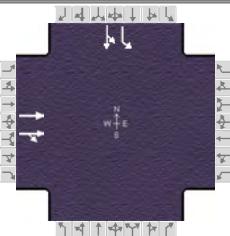
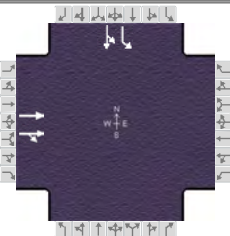
Signal Information										
Cycle, s	80.0	Reference Phase	2							
Offset, s	0	Reference Point	End							
Uncoordinated	Yes	Simult. Gap E/W	On							
Force Mode	Fixed	Simult. Gap N/S	On							
Green	46.0	26.0	0.0	0.0	0.0	0.0				
Yellow	3.0	3.0	0.0	0.0	0.0	0.0				
Red	1.0	1.0	0.0	0.0	0.0	0.0				

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			6		2				4
Case Number			8.0		8.0				12.0
Phase Duration, s			50.0		50.0				30.0
Change Period, (Y+R c), s			4.0		4.0				4.0
Max Allow Headway (MAH), s			0.0		3.2				3.1
Queue Clearance Time (g s), s					37.5				8.0
Green Extension Time (g e), s			0.0		3.2				0.6
Phase Call Probability					1.00				1.00
Max Out Probability					0.42				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			6		5	2	12					4	14	
Adjusted Flow Rate (v), veh/h			0		886		747					185	181	
Adjusted Saturation Flow Rate (s), veh/h/ln			1845		1838		1463					1863	1803	
Queue Service Time (g s), s			0.0		6.5		35.5					6.0	6.0	
Cycle Queue Clearance Time (g c), s			0.0		31.5		35.5					6.0	6.0	
Green Ratio (g/C)			0.57		0.57		0.57					0.32	0.32	
Capacity (c), veh/h			1061		1103		841					605	586	
Volume-to-Capacity Ratio (X)			0.000		0.803		0.888					0.306	0.310	
Back of Queue (Q), ft/ln (95 th percentile)			0		442.7		450.3					113.4	108.6	
Back of Queue (Q), veh/ln (95 th percentile)			0.0		17.7		18.0					4.4	4.3	
Queue Storage Ratio (RQ) (95 th percentile)			0.00		0.00		0.00					0.00	0.00	
Uniform Delay (d 1), s/veh			0.0		13.9		14.8					20.2	20.3	
Incremental Delay (d 2), s/veh			0.0		4.1		11.1					0.1	0.1	
Initial Queue Delay (d 3), s/veh			0.0		0.0		0.0					0.0	0.0	
Control Delay (d), s/veh			0.0		18.0		25.9					20.3	20.4	
Level of Service (LOS)					B		C					C	C	
Approach Delay, s/veh / LOS		0.0			21.6		C	0.0				20.4		C
Intersection Delay, s/veh / LOS		21.4							C					

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.4	B	1.7	A	2.3	B	2.6	B
Bicycle LOS Score / LOS		0.5	A	1.8	A			0.8	A

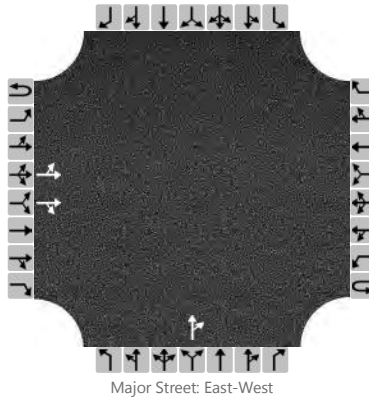
HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information														
Agency					Duration, h		0.25												
Analyst		MJH		Analysis Date		Oct 19, 2016		Area Type						Other					
Jurisdiction		Mariemont		Time Period				PHF						0.90					
Urban Street		EB US 50		Analysis Year		2022		Analysis Period						1> 7:00					
Intersection		EB US 50 at Miami Road		File Name		13B-2022-AM.xus													
Project Description		2022 NO-BUILD - AM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h					450	10							290	30					
Signal Information																			
Cycle, s	80.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	36.0	36.0	0.0	0.0	0.0	0.0									
				Yellow	3.0	3.0	0.0	0.0	0.0	0.0									
				Red	1.0	1.0	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2												4	
Case Number						8.0												10.0	
Phase Duration, s						40.0												40.0	
Change Period, (Y+R c), s						4.0												4.0	
Max Allow Headway (MAH), s						3.0												3.1	
Queue Clearance Time (g s), s						9.4												11.8	
Green Extension Time (g e), s						0.9												0.7	
Phase Call Probability						1.00												1.00	
Max Out Probability						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					2	12							7	4					
Adjusted Flow Rate (v), veh/h					256	255							322	33					
Adjusted Saturation Flow Rate (s), veh/h/ln					1792	1778							1774	1863					
Queue Service Time (g s), s					7.3	7.4							9.8	0.8					
Cycle Queue Clearance Time (g c), s					7.3	7.4							9.8	0.8					
Green Ratio (g/C)					0.45	0.45							0.45	0.45					
Capacity (c), veh/h					807	800							798	838					
Volume-to-Capacity Ratio (X)					0.318	0.318							0.404	0.040					
Back of Queue (Q), ft/ln (95 th percentile)					129.2	122.5							162.3	14.6					
Back of Queue (Q), veh/ln (95 th percentile)					4.9	4.9							6.5	0.6					
Queue Storage Ratio (RQ) (95 th percentile)					0.00	0.00							0.00	0.00					
Uniform Delay (d 1), s/veh					14.1	14.1							14.8	12.3					
Incremental Delay (d 2), s/veh					0.1	0.1							0.1	0.0					
Initial Queue Delay (d 3), s/veh					0.0	0.0							0.0	0.0					
Control Delay (d), s/veh					14.2	14.2							14.9	12.3					
Level of Service (LOS)					B	B							B	B					
Approach Delay, s/veh / LOS				14.2	B		0.0			0.0			14.7	B					
Intersection Delay, s/veh / LOS				14.4						B									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				1.9	A		1.7	A		2.5	B		1.7	A					
Bicycle LOS Score / LOS				0.9	A								1.1	A					

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Crystal Springs
Agency/Co.		Jurisdiction	Union Township
Date Performed	8/3/2016	East/West Street	US 50
Analysis Year	2022	North/South Street	Crystal Springs Rd
Time Analyzed	AM PEAK HOUR - NO-BUILD	Peak Hour Factor	1.00
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 13C		

Lanes



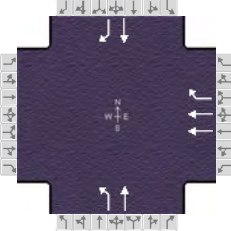
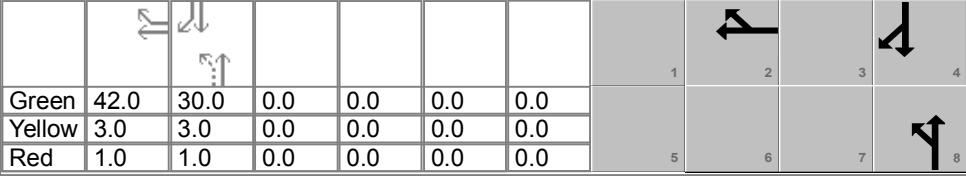
Vehicle Volumes and Adjustments

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	0	0
Configuration		LT		TR								TR				
Volume (veh/h)		90	660	20							60	10				
Percent Heavy Vehicles		4									4	4				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		420										70				
Capacity												317				
v/c Ratio												0.22				
95% Queue Length												0.8				
Control Delay (s/veh)												19.5				
Level of Service (LOS)												C				
Approach Delay (s/veh)									19.5							
Approach LOS									C							

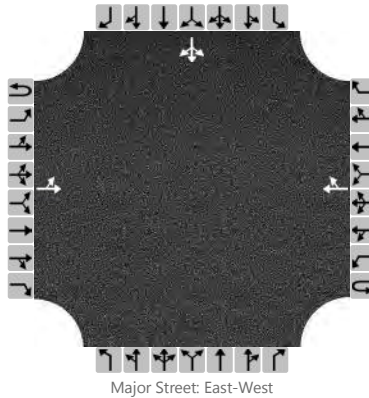
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information									
Agency						Duration, h		0.25							
Analyst		MJH		Analysis Date		Oct 19, 2016		Area Type		Other					
Jurisdiction		Mariemont		Time Period				PHF		0.90					
Urban Street		WB US 50		Analysis Year		2022		Analysis Period		1> 7:00					
Intersection		WB US 50 at Miami Road		File Name		13D-2022-AM.xus									
Project Description		2022 NO-BUILD - AM Peak Hour													
Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h								1300	10	50	100			0	120
Signal Information															
Cycle, s	80.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On												
Force Mode	Fixed	Simult. Gap N/S	On												
				Green	42.0	30.0	0.0	0.0	0.0	0.0					
				Yellow	3.0	3.0	0.0	0.0	0.0	0.0					
				Red	1.0	1.0	0.0	0.0	0.0	0.0					
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase							2		8		4				
Case Number							7.0		6.0		7.0				
Phase Duration, s							46.0		34.0		34.0				
Change Period, (Y+R c), s							4.0		4.0		4.0				
Max Allow Headway (MAH), s							3.0		3.2		3.2				
Queue Clearance Time (g s), s							28.1		5.2		6.7				
Green Extension Time (g e), s							3.8		0.6		0.5				
Phase Call Probability							1.00		1.00		1.00				
Max Out Probability							0.07		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								2	12	3	8			4	14
Adjusted Flow Rate (v), veh/h								1444	11	56	111			0	133
Adjusted Saturation Flow Rate (s), veh/h/ln								1773	1579	1757	1845			1845	1563
Queue Service Time (g s), s								26.1	0.3	1.6	3.2			0.0	4.7
Cycle Queue Clearance Time (g c), s								26.1	0.3	1.6	3.2			0.0	4.7
Green Ratio (g/C)								0.52	0.52	0.38	0.38			0.38	0.38
Capacity (c), veh/h								1862	829	749	692			692	586
Volume-to-Capacity Ratio (X)								0.776	0.013	0.074	0.161			0.000	0.227
Back of Queue (Q), ft/ln (95 th percentile)								366	3.8	28	57.6			0	71.2
Back of Queue (Q), veh/ln (95 th percentile)								14.6	0.2	1.1	2.3			0.0	2.8
Queue Storage Ratio (RQ) (95 th percentile)								0.00	0.00	0.00	0.00			0.00	0.00
Uniform Delay (d 1), s/veh								15.2	9.1	16.1	16.6			0.0	17.1
Incremental Delay (d 2), s/veh								1.9	0.0	0.0	0.0			0.0	0.1
Initial Queue Delay (d 3), s/veh								0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (d), s/veh								17.2	9.1	16.2	16.7			0.0	17.2
Level of Service (LOS)								B	A	B	B				B
Approach Delay, s/veh / LOS				0.0				17.1		B		16.5		B	
Intersection Delay, s/veh / LOS				17.0						B					
Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.3		B		2.2		B		1.9		A	
Bicycle LOS Score / LOS								1.7		A		0.8		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Plainville
Agency/Co.		Jurisdiction	
Date Performed	4/26/2016	East/West Street	US 50
Analysis Year	2022	North/South Street	Plainville Rd
Time Analyzed	AM PEAK HOUR - NO-BUILD	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 14		

Lanes



Vehicle Volumes and Adjustments

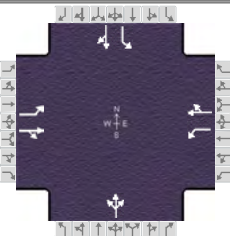
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LTR	
Volume (veh/h)		160	480				860	70						20	0	130
Percent Heavy Vehicles		3												4	4	4
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

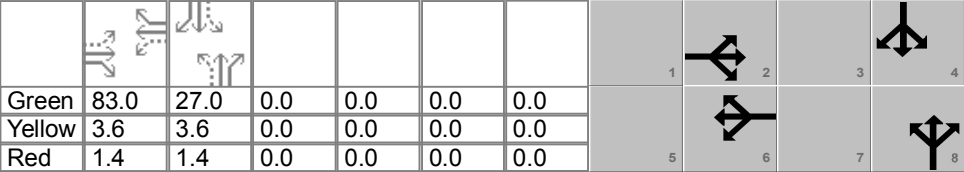
Flow Rate (veh/h)		711													166	
Capacity		680													189	
v/c Ratio		1.05													0.88	
95% Queue Length		1.0													6.6	
Control Delay (s/veh)		12.2													87.3	
Level of Service (LOS)		B													F	
Approach Delay (s/veh)	6.5												87.3			
Approach LOS													F			

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Oct 19, 2016		Area Type		Other	
Jurisdiction		Fairfax		Time Period				PHF		0.90	
Urban Street		US 50		Analysis Year		2022		Analysis Period		1> 7:00	
Intersection		US 50 at Watterson Road		File Name		15-2022-AM.xus					
Project Description		2022 NO-BUILD - AM Peak Hour									



Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				50	590	10	10	1000	110	10	0	0	150	10	70

Signal Information											
Cycle, s	120.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On								
Force Mode	Fixed	Simult. Gap N/S	On								
Green	83.0	27.0	0.0	0.0	0.0	0.0	0.0	1	2	3	4
Yellow	3.6	3.6	0.0	0.0	0.0	0.0	0.0	5	6	7	8
Red	1.4	1.4	0.0	0.0	0.0	0.0	0.0				

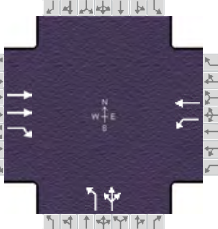
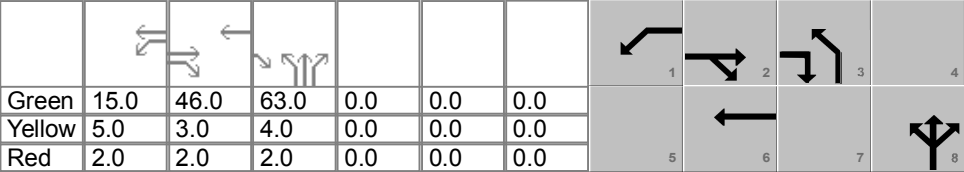
Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			2		6		8		4
Case Number			6.0		6.0		8.0		6.0
Phase Duration, s			88.0		88.0		32.0		32.0
Change Period, (Y+R c), s			5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s			3.2		3.2		3.1		3.1
Queue Clearance Time (g s), s			85.0		83.3		8.2		18.4
Green Extension Time (g e), s			0.0		0.0		0.4		0.3
Phase Call Probability			1.00		1.00		1.00		1.00
Max Out Probability			1.00		1.00		0.00		0.01

Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h		56	667		11	1233			11		167	89	
Adjusted Saturation Flow Rate (s), veh/h/ln		441	1821		752	1795			1064		1792	1625	
Queue Service Time (g s), s		1.7	21.4		0.9	81.3			0.8		10.2	5.4	
Cycle Queue Clearance Time (g c), s		83.0	21.4		22.2	81.3			6.2		16.4	5.4	
Green Ratio (g/C)		0.69	0.69		0.69	0.69			0.22		0.22	0.22	
Capacity (c), veh/h		66	1260		446	1241			299		370	366	
Volume-to-Capacity Ratio (X)		0.837	0.529		0.025	0.993			0.037		0.450	0.243	
Back of Queue (Q), ft/ln (95 th percentile)		125.4	302.8		6.9	1159.1			12.6		206.9	96.7	
Back of Queue (Q), veh/ln (95 th percentile)		4.9	12.1		0.3	46.4			0.5		8.0	3.9	
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00		0.00	0.00			0.00		0.00	0.00	
Uniform Delay (d 1), s/veh		59.9	9.0		14.4	18.2			40.7		45.2	38.1	
Incremental Delay (d 2), s/veh		55.4	0.2		0.0	23.9			0.0		0.3	0.1	
Initial Queue Delay (d 3), s/veh		0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Control Delay (d), s/veh		115.3	9.2		14.4	42.1			40.7		45.5	38.2	
Level of Service (LOS)		F	A		B	D			D		D	D	
Approach Delay, s/veh / LOS		17.4	B		41.9	D		40.7	D		43.0	D	
Intersection Delay, s/veh / LOS		34.1						C					

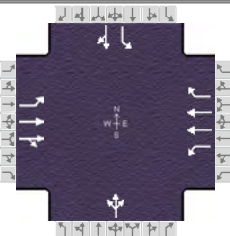
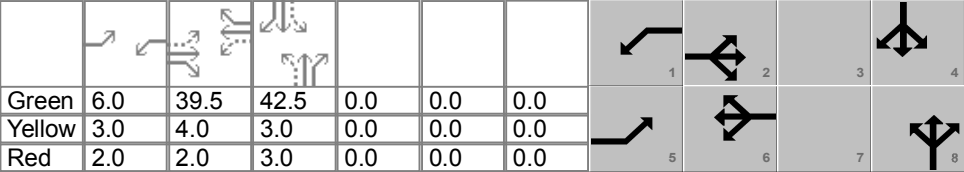
Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.1	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS		1.7	A	2.5	B	0.5	A	0.9	A

PM

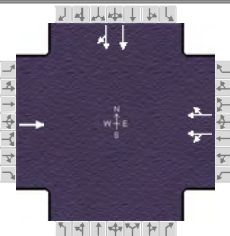
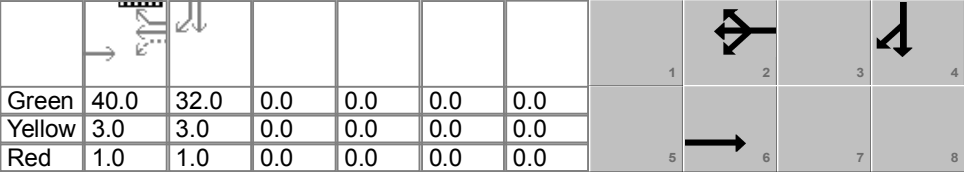
HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information														
Agency					Duration, h		0.25												
Analyst		MJH	Analysis Date	Oct 20, 2016		Area Type		Other											
Jurisdiction		Columbia Twp (ODOT)	Time Period				PHF		0.90										
Urban Street		US 50	Analysis Year		2022		Analysis Period		1> 7:00										
Intersection		US 50 at Newtown Road	File Name		11-2022-PM.xus														
Project Description		2022 NO-BUILD - PM Peak Hour																	
Demand Information																			
Approach Movement				EB			WB			NB			SB						
				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h					600	1010	110	300		590	0	120							
Signal Information																			
Cycle, s	142.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	15.0	46.0	63.0	0.0	0.0	0.0									
				Yellow	5.0	3.0	4.0	0.0	0.0	0.0									
				Red	2.0	2.0	2.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2		1		6				8					
Case Number						7.3		2.0		4.0				10.0					
Phase Duration, s						51.0		22.0		73.0				69.0					
Change Period, (Y+R c), s						7.0		7.0		7.0				6.0					
Max Allow Headway (MAH), s						3.2		3.1		3.2				3.2					
Queue Clearance Time (g s), s						46.0		11.3		18.4				48.3					
Green Extension Time (g e), s						0.0		0.1		7.3				1.6					
Phase Call Probability						1.00		1.00		1.00				1.00					
Max Out Probability						1.00		0.49		0.11				0.01					
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement					2	12	1	6		3	8	18							
Adjusted Flow Rate (v), veh/h					667	1122	122	333		656	133								
Adjusted Saturation Flow Rate (s), veh/h/ln					1791	1594	1792	1881		1774	1579								
Queue Service Time (g s), s					22.4	44.0	9.3	16.4		46.3	7.3								
Cycle Queue Clearance Time (g c), s					22.4	44.0	9.3	16.4		46.3	7.3								
Green Ratio (g/C)					0.31	0.75	0.11	0.46		0.44	0.44								
Capacity (c), veh/h					1110	1201	189	874		787	700								
Volume-to-Capacity Ratio (X)					0.601	0.934	0.646	0.381		0.833	0.190								
Back of Queue (Q), ft/ln (95 th percentile)					381.7	964	200.3	296.3		717.3	124.7								
Back of Queue (Q), veh/ln (95 th percentile)					15.1	38.3	8.0	11.8		28.7	5.0								
Queue Storage Ratio (RQ) (95 th percentile)					0.00	0.00	0.00	0.00		0.00	0.00								
Uniform Delay (d 1), s/veh					41.6	14.6	61.0	24.7		34.9	24.0								
Incremental Delay (d 2), s/veh					0.6	13.0	5.8	0.1		7.2	0.0								
Initial Queue Delay (d 3), s/veh					0.0	0.0	0.0	0.0		0.0	0.0								
Control Delay (d), s/veh					42.2	27.6	66.8	24.8		42.1	24.1								
Level of Service (LOS)					D	C	E	C		D	C								
Approach Delay, s/veh / LOS				33.0		C		36.1		D		39.0		D		0.0			
Intersection Delay, s/veh / LOS				35.0								D							
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		1.9		A		2.8		C		2.5		B	
Bicycle LOS Score / LOS				2.0		A		1.2		A		1.8		A					

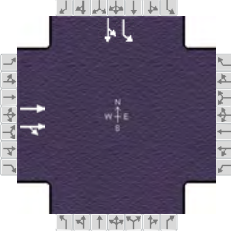
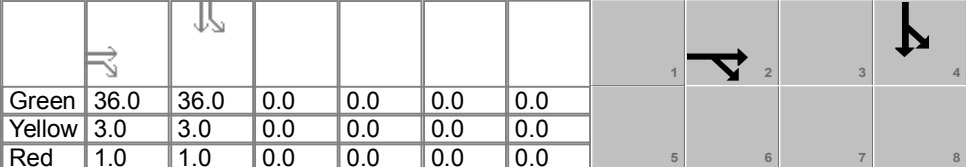
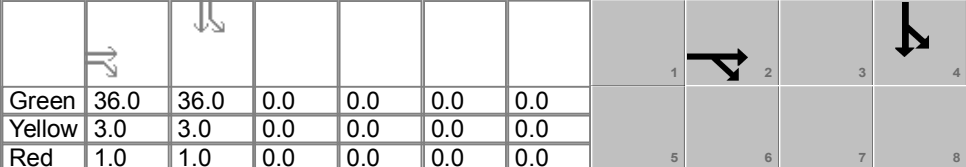
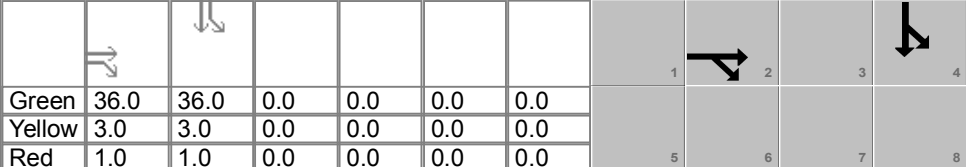
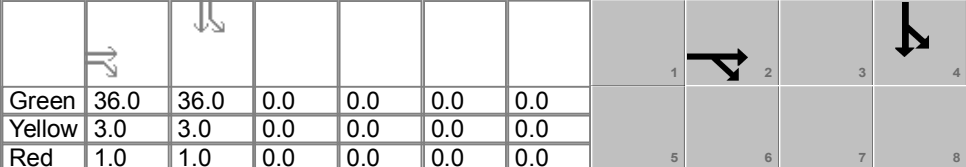
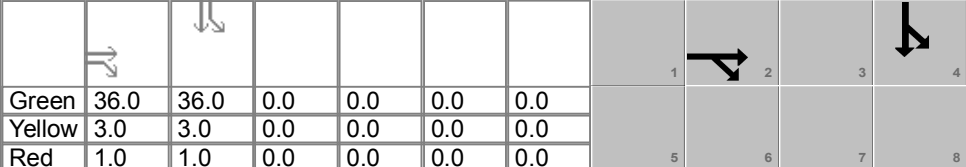
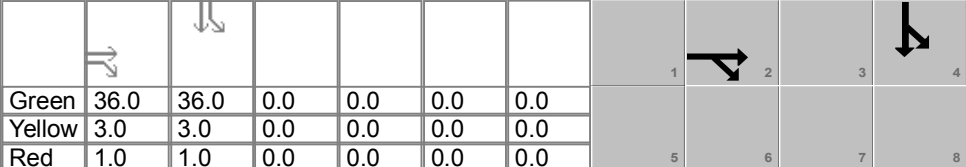
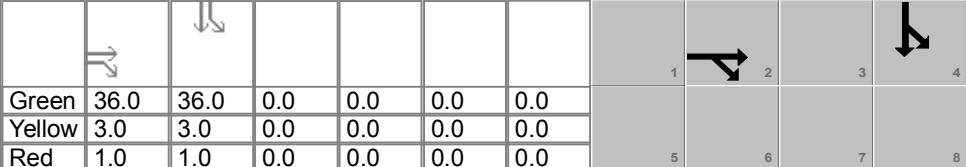
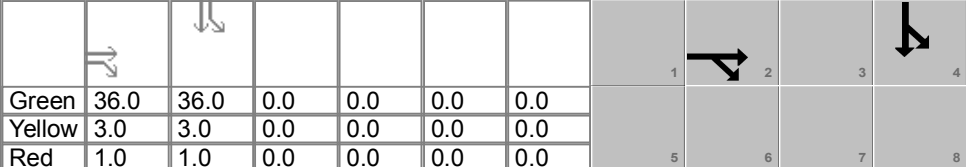
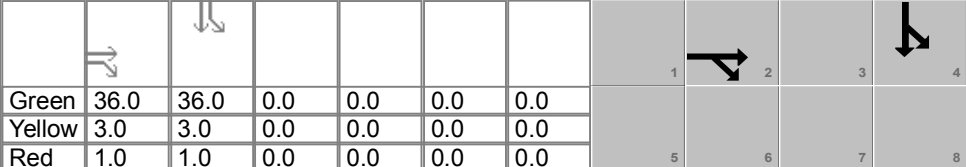
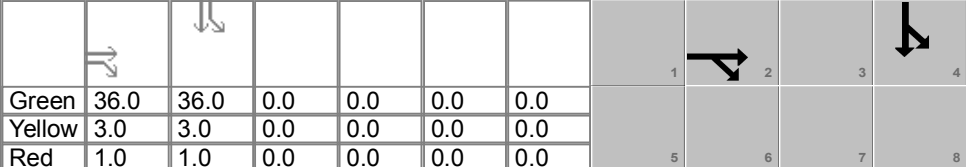
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information									
Agency						Duration, h		0.25							
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other					
Jurisdiction		Columbia Twp (ODOT)		Time Period				PHF		0.90					
Urban Street		US 50		Analysis Year		2022		Analysis Period		1> 7:00					
Intersection		US 50 at Walton Creek Rd		File Name		12-2022-PM.xus									
Project Description		2022 NO-BUILD - PM Peak Hour													
Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				40	1190	50	80	670	160	40	50	100	400	50	40
Signal Information															
Cycle, s	105.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On												
Force Mode	Fixed	Simult. Gap N/S	On												
				Green	6.0	39.5	42.5	0.0	0.0	0.0					
				Yellow	3.0	4.0	3.0	0.0	0.0	0.0					
				Red	2.0	2.0	3.0	0.0	0.0	0.0					
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase				5	2	1	6		8		4				
Case Number				1.1	4.0	1.1	3.0		8.0		6.0				
Phase Duration, s				11.0	45.5	11.0	45.5		48.5		48.5				
Change Period, (Y+R c), s				5.0	6.0	5.0	6.0		6.0		6.0				
Max Allow Headway (MAH), s				3.1	3.1	3.1	3.1		3.4		3.4				
Queue Clearance Time (g s), s				3.5	41.0	5.1	19.4		10.8		44.5				
Green Extension Time (g e), s				0.0	0.0	0.0	5.7		1.8		0.0				
Phase Call Probability				1.00	1.00	1.00	1.00		1.00		1.00				
Max Out Probability				1.00	1.00	1.00	0.18		0.00		1.00				
Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h				44	693	685	89	744	178		211		444	100	
Adjusted Saturation Flow Rate (s), veh/h/ln				1774	1863	1836	1774	1773	1579		1623		1226	1742	
Queue Service Time (g s), s				1.5	38.8	39.0	3.1	17.4	8.3		1.3		33.7	3.8	
Cycle Queue Clearance Time (g c), s				1.5	38.8	39.0	3.1	17.4	8.3		8.8		42.5	3.8	
Green Ratio (g/C)				0.43	0.38	0.38	0.43	0.38	0.38		0.40		0.40	0.40	
Capacity (c), veh/h				306	701	691	170	1334	594		698		462	705	
Volume-to-Capacity Ratio (X)				0.145	0.989	0.991	0.523	0.558	0.299		0.302		0.961	0.142	
Back of Queue (Q), ft/ln (95 th percentile)				28.1	774.5	759.4	60.3	293.7	137		157.4		562.3	68.3	
Back of Queue (Q), veh/ln (95 th percentile)				1.1	30.5	30.4	2.4	11.6	5.5		6.2		22.1	2.7	
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00	
Uniform Delay (d 1), s/veh				19.2	32.5	32.6	25.2	25.9	23.0		21.2		37.6	19.7	
Incremental Delay (d 2), s/veh				0.1	31.1	32.0	1.4	0.3	0.1		0.1		31.8	0.0	
Initial Queue Delay (d 3), s/veh				0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Control Delay (d), s/veh				19.3	63.6	64.5	26.6	26.2	23.1		21.3		69.4	19.8	
Level of Service (LOS)				B	E	E	C	C	C		C		E	B	
Approach Delay, s/veh / LOS				62.7	E	25.7	C	21.3	C	60.2	E				
Intersection Delay, s/veh / LOS				47.8						D					
Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.1	B	2.3	B	2.9	C	2.8	C				
Bicycle LOS Score / LOS				1.7	A	1.3	A	0.8	A	1.4	A				

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information														
Agency					Duration, h		0.25												
Analyst		MJH	Analysis Date	Oct 20, 2016		Area Type		Other											
Jurisdiction		Mariemont	Time Period			PHF		0.90											
Urban Street		WB US 50	Analysis Year	2022		Analysis Period		1> 7:00											
Intersection		WB US 50 at Madisonvil...	File Name	13A-2022-PM.xus															
Project Description		2022 NO-BUILD - PM Peak Hour																	
Demand Information																			
Approach Movement				EB			WB			NB			SB						
				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h					0		50	630	340					520	30				
Signal Information																			
Cycle, s	80.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	40.0	32.0	0.0	0.0	0.0	0.0									
				Yellow	3.0	3.0	0.0	0.0	0.0	0.0									
				Red	1.0	1.0	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						6				2								4	
Case Number						8.0				8.0								12.0	
Phase Duration, s						44.0				44.0								36.0	
Change Period, (Y+R c), s						4.0				4.0								4.0	
Max Allow Headway (MAH), s						0.0				3.1								3.0	
Queue Clearance Time (g s), s										22.7								11.4	
Green Extension Time (g e), s						0.0				2.4								1.1	
Phase Call Probability										1.00								1.00	
Max Out Probability										0.02								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					6		5	2	12					4	14				
Adjusted Flow Rate (v), veh/h					0		624		510					308	303				
Adjusted Saturation Flow Rate (s), veh/h/ln					1863		1827		1496					1881	1845				
Queue Service Time (g s), s					0.0		8.1		20.7					9.4	9.4				
Cycle Queue Clearance Time (g c), s					0.0		20.5		20.7					9.4	9.4				
Green Ratio (g/C)					0.50		0.50		0.50					0.40	0.40				
Capacity (c), veh/h					931		963		748					752	738				
Volume-to-Capacity Ratio (X)					0.000		0.648		0.681					0.410	0.411				
Back of Queue (Q), ft/ln (95 th percentile)					0		310.3		270.6					173.5	167.9				
Back of Queue (Q), veh/ln (95 th percentile)					0.0		12.4		10.8					6.8	6.7				
Queue Storage Ratio (RQ) (95 th percentile)					0.00		0.00		0.00					0.00	0.00				
Uniform Delay (d 1), s/veh					0.0		15.1		15.2					17.2	17.2				
Incremental Delay (d 2), s/veh					0.0		1.2		2.1					0.1	0.1				
Initial Queue Delay (d 3), s/veh					0.0		0.0		0.0					0.0	0.0				
Control Delay (d), s/veh					0.0		16.3		17.3					17.4	17.4				
Level of Service (LOS)							B		B					B	B				
Approach Delay, s/veh / LOS				0.0				16.7		B		0.0				17.4		B	
Intersection Delay, s/veh / LOS				16.9						B									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.4		B		1.7		A		2.3		B		2.6		B	
Bicycle LOS Score / LOS				0.5		A		1.4		A						1.0		A	

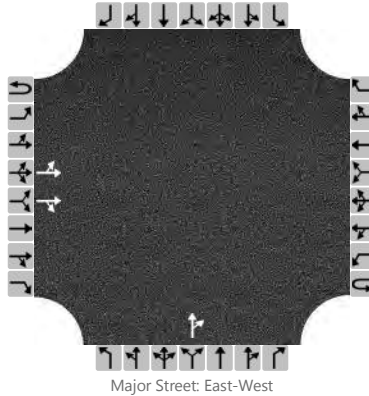
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Mariemont		Time Period				PHF		0.90									
Urban Street		EB US 50		Analysis Year		2022		Analysis Period		1> 7:00									
Intersection		EB US 50 at Miami Road		File Name		13B-2022-PM.xus													
Project Description		2022 NO-BUILD - PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h					1030	10							530	40					
Signal Information																			
Cycle, s	80.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	36.0	36.0	0.0	0.0	0.0	0.0									
				Yellow	3.0	3.0	0.0	0.0	0.0	0.0									
				Red	1.0	1.0	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2												4	
Case Number						8.0												10.0	
Phase Duration, s						40.0												40.0	
Change Period, (Y+R c), s						4.0												4.0	
Max Allow Headway (MAH), s						3.0												3.1	
Queue Clearance Time (g s), s						21.8												23.5	
Green Extension Time (g e), s						2.2												1.2	
Phase Call Probability						1.00												1.00	
Max Out Probability						0.04												0.01	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement					2	12							7	4					
Adjusted Flow Rate (v), veh/h					579	577							589	44					
Adjusted Saturation Flow Rate (s), veh/h/ln					1863	1856							1792	1881					
Queue Service Time (g s), s					19.8	19.8							21.5	1.1					
Cycle Queue Clearance Time (g c), s					19.8	19.8							21.5	1.1					
Green Ratio (g/C)					0.45	0.45							0.45	0.45					
Capacity (c), veh/h					838	835							806	847					
Volume-to-Capacity Ratio (X)					0.690	0.691							0.730	0.053					
Back of Queue (Q), ft/ln (95 th percentile)					324.6	318.7							336.8	19					
Back of Queue (Q), veh/ln (95 th percentile)					12.8	12.7							13.5	0.7					
Queue Storage Ratio (RQ) (95 th percentile)					0.00	0.00							0.00	0.00					
Uniform Delay (d 1), s/veh					17.6	17.6							18.0	12.4					
Incremental Delay (d 2), s/veh					2.0	2.0							3.0	0.0					
Initial Queue Delay (d 3), s/veh					0.0	0.0							0.0	0.0					
Control Delay (d), s/veh					19.6	19.6							21.0	12.4					
Level of Service (LOS)					B	B							C	B					
Approach Delay, s/veh / LOS				19.6	B		0.0			0.0			20.4	C					
Intersection Delay, s/veh / LOS				19.9						B									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				1.9	A		1.7	A		2.5	B		1.7	A					
Bicycle LOS Score / LOS				1.4	A								1.5	A					

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Crystal Springs
Agency/Co.		Jurisdiction	Union Township
Date Performed	8/3/2016	East/West Street	US 50
Analysis Year	2022	North/South Street	Crystal Springs Rd
Time Analyzed	PM PEAK HOUR - NO-BUILD	Peak Hour Factor	1.00
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 13C		

Lanes



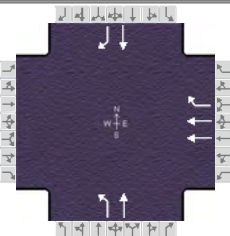
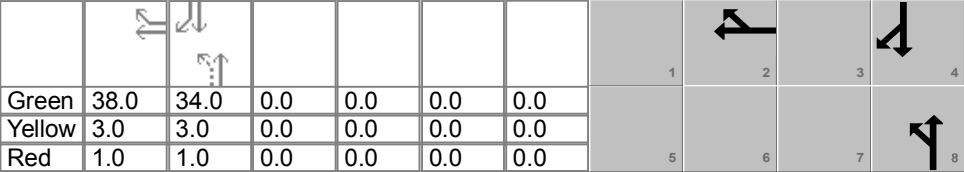
Vehicle Volumes and Adjustments

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	0	0
Configuration		LT		TR								TR				
Volume (veh/h)		150	1410	40							40	20				
Percent Heavy Vehicles		1									2	2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		855										60				
Capacity												117				
v/c Ratio												0.51				
95% Queue Length												2.4				
Control Delay (s/veh)												64.3				
Level of Service (LOS)												F				
Approach Delay (s/veh)									64.3							
Approach LOS									F							

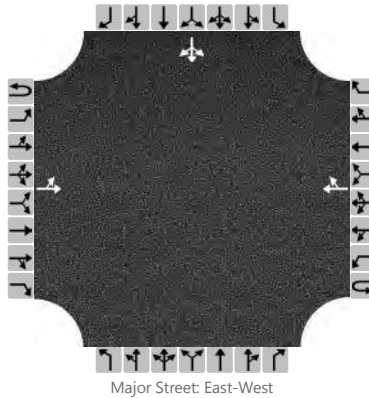
HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Mariemont		Time Period				PHF		0.90									
Urban Street		WB US 50		Analysis Year		2022		Analysis Period		1> 7:00									
Intersection		WB US 50 at Miami Road		File Name		13D-2022-PM.xus													
Project Description		2022 NO-BUILD - PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h								830	10	60	130			0	130				
Signal Information																			
Cycle, s	80.0	Reference Phase	2		Green	38.0	34.0	0.0	0.0	0.0	0.0	1	2	3	4				
Offset, s	0	Reference Point	End			Yellow	3.0	3.0	0.0	0.0	0.0					0.0			
Uncoordinated	Yes	Simult. Gap E/W	On			Red	1.0	1.0	0.0	0.0	0.0					0.0			
Force Mode	Fixed	Simult. Gap N/S	On																
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase										2				8				4	
Case Number										7.0				6.0				7.0	
Phase Duration, s										42.0				38.0				38.0	
Change Period, (Y+R c), s										4.0				4.0				4.0	
Max Allow Headway (MAH), s										3.0				3.2				3.2	
Queue Clearance Time (g s), s										16.8				5.8				6.6	
Green Extension Time (g e), s										2.3				0.7				0.7	
Phase Call Probability										1.00				1.00				1.00	
Max Out Probability										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								2	12	3	8			4	14				
Adjusted Flow Rate (v), veh/h								922	11	67	144			0	144				
Adjusted Saturation Flow Rate (s), veh/h/ln								1773	1579	1792	1881			1881	1594				
Queue Service Time (g s), s								14.8	0.3	1.8	3.8			0.0	4.6				
Cycle Queue Clearance Time (g c), s								14.8	0.3	1.8	3.8			0.0	4.6				
Green Ratio (g/C)								0.48	0.48	0.42	0.42			0.42	0.42				
Capacity (c), veh/h								1685	750	851	800			800	678				
Volume-to-Capacity Ratio (X)								0.547	0.015	0.078	0.181			0.000	0.213				
Back of Queue (Q), ft/ln (95 th percentile)								229.6	4.3	30.3	68.3			0	69.5				
Back of Queue (Q), veh/ln (95 th percentile)								9.2	0.2	1.2	2.7			0.0	2.8				
Queue Storage Ratio (RQ) (95 th percentile)								0.00	0.00	0.00	0.00			0.00	0.00				
Uniform Delay (d 1), s/veh								14.9	11.1	13.7	14.3			0.0	14.5				
Incremental Delay (d 2), s/veh								0.2	0.0	0.0	0.0			0.0	0.1				
Initial Queue Delay (d 3), s/veh								0.0	0.0	0.0	0.0			0.0	0.0				
Control Delay (d), s/veh								15.1	11.1	13.8	14.4			0.0	14.6				
Level of Service (LOS)								B	B	B	B				B				
Approach Delay, s/veh / LOS				0.0				15.1		B		14.2		B		14.6		B	
Intersection Delay, s/veh / LOS				14.9						B									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.3		B		2.3		B		1.9		A		2.4		B	
Bicycle LOS Score / LOS								1.3		A		0.8		A		0.7		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Plainville Rd
Agency/Co.		Jurisdiction	Mariemont
Date Performed	7/12/2016	East/West Street	US 50
Analysis Year	2022	North/South Street	Plainville Rd
Time Analyzed	NO-BUILD PM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 14		

Lanes



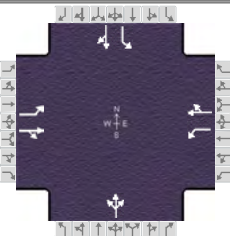
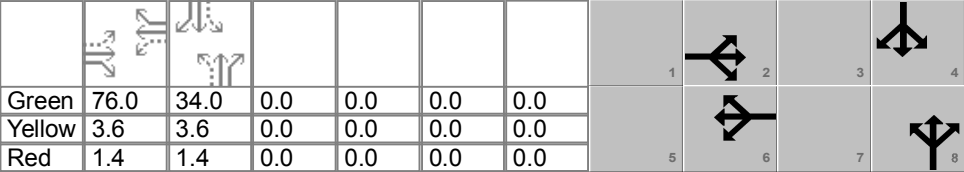
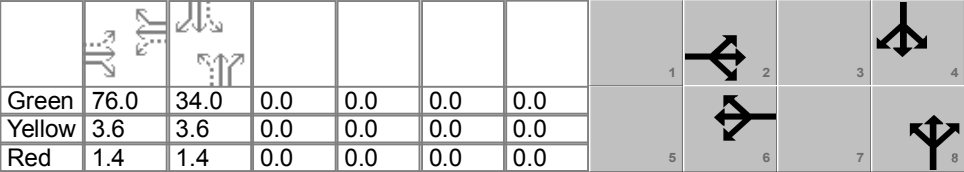
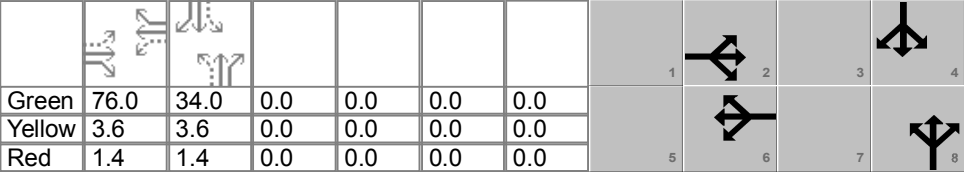
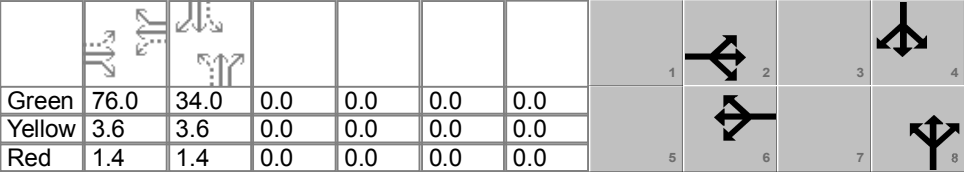
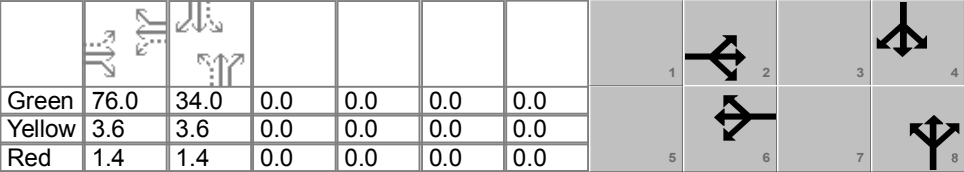
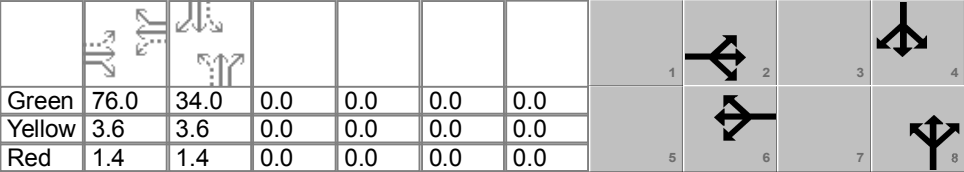
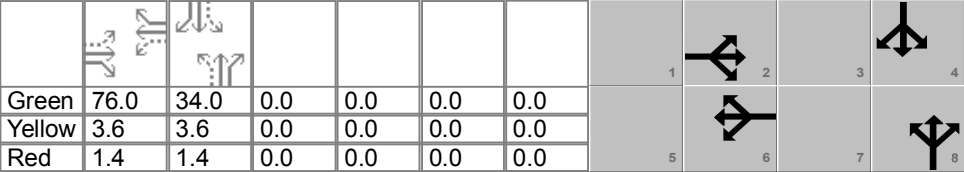
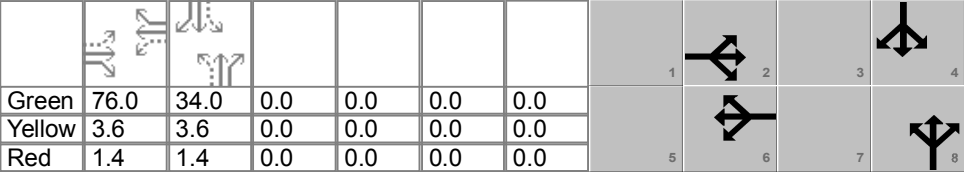
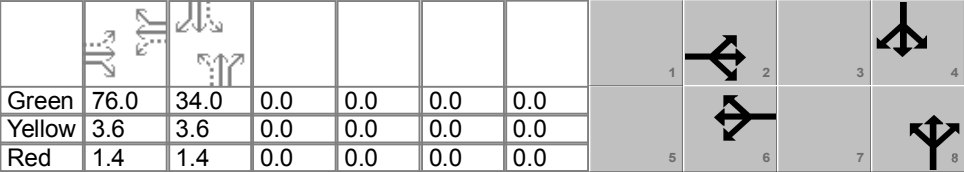
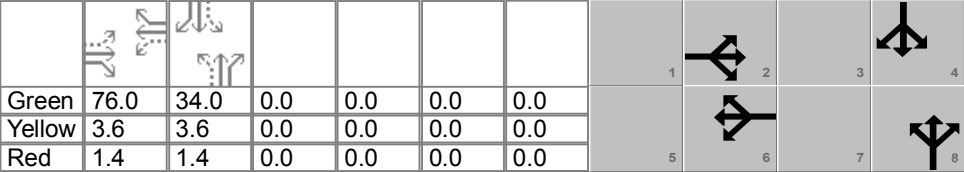
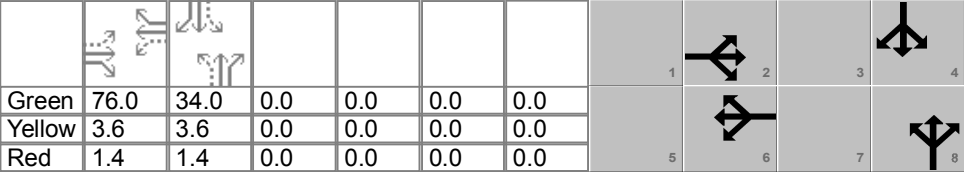
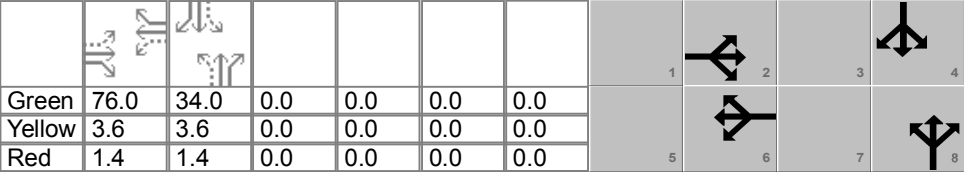
Vehicle Volumes and Adjustments

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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LTR	
Volume (veh/h)		190	1060				590	50						50	0	150
Percent Heavy Vehicles		2												2	2	2
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		1389													223	
Capacity		897													109	
v/c Ratio		1.55													2.05	
95% Queue Length		0.9													18.7	
Control Delay (s/veh)		10.2													567.6	
Level of Service (LOS)		B													F	
Approach Delay (s/veh)	8.2												567.6			
Approach LOS													F			

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information													
Agency						Duration, h		0.25											
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other									
Jurisdiction		Fairfax		Time Period				PHF		0.90									
Urban Street		US 50		Analysis Year		2022		Analysis Period		1> 7:00									
Intersection		US 50 at Watterson Rd		File Name		15-2022-PM.xus													
Project Description		2022 NO-BUILD - PM Peak Hour																	
Demand Information				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h				30	1080	0	10	640	90	10	0	10	300	10	80				
Signal Information																			
Cycle, s	120.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	76.0	34.0	0.0	0.0	0.0	0.0									
				Yellow	3.6	3.6	0.0	0.0	0.0	0.0									
				Red	1.4	1.4	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2				6				8				4	
Case Number						6.0				6.0				8.0				6.0	
Phase Duration, s						81.0				81.0				39.0				39.0	
Change Period, (Y+R c), s						5.0				5.0				5.0				5.0	
Max Allow Headway (MAH), s						3.1				3.1				3.1				3.1	
Queue Clearance Time (g s), s						78.0				78.0				7.6				35.6	
Green Extension Time (g e), s						0.0				0.0				0.9				0.0	
Phase Call Probability						1.00				1.00				1.00				1.00	
Max Out Probability						1.00				1.00				0.00				1.00	
Movement Group Results				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14				
Adjusted Flow Rate (v), veh/h				33	0		11	811			22		333	100					
Adjusted Saturation Flow Rate (s), veh/h/ln				670	0		464	1822			1312		1426	1638					
Queue Service Time (g s), s				4.2	0.0		0.0	35.3			0.1		28.0	5.6					
Cycle Queue Clearance Time (g c), s				39.4	0.0		76.0	35.3			5.6		33.6	5.6					
Green Ratio (g/C)				0.63			0.63	0.63			0.28		0.28	0.28					
Capacity (c), veh/h				287			60	1154			417		397	464					
Volume-to-Capacity Ratio (X)				0.116	0.000		0.185	0.703			0.053		0.840	0.215					
Back of Queue (Q), ft/ln (95 th percentile)				30.6	0		15.8	498.7			21.5		426.2	100					
Back of Queue (Q), veh/ln (95 th percentile)				1.2	0.0		0.6	19.9			0.8		16.8	4.0					
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00		0.00	0.00			0.00		0.00	0.00					
Uniform Delay (d 1), s/veh				27.6			60.0	14.5			31.3		45.7	32.8					
Incremental Delay (d 2), s/veh				0.1	0.0		0.5	1.7			0.0		14.1	0.1					
Initial Queue Delay (d 3), s/veh				0.0	0.0		0.0	0.0			0.0		0.0	0.0					
Control Delay (d), s/veh				27.6			60.5	16.2			31.3		59.7	32.9					
Level of Service (LOS)				C			E	B			C		E	C					
Approach Delay, s/veh / LOS				51.9		D		16.8		B		31.3		C		53.5		D	
Intersection Delay, s/veh / LOS				40.5						D									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				2.1		B		2.2		B		2.3		B		2.3		B	
Bicycle LOS Score / LOS				2.5		B		1.8		A		0.5		A		1.2		A	

2042

AM

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information				
Agency					Duration, h		0.25		
Analyst		MJH	Analysis Date	Oct 20, 2016		Area Type		Other	
Jurisdiction		Columbia Twp (ODOT)	Time Period			PHF		0.90	
Urban Street		US 50	Analysis Year	2042		Analysis Period		1> 7:00	
Intersection		US 50 at Newtown Road	File Name	11-2042-AM.xus					
Project Description		2042 NO-BUILD - AM Peak Hour							

Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					190	400	140	490		1100	0	100			

Signal Information														
Cycle, s	115.0	Reference Phase	2	Green	8.0	21.5	67.5	0.0	0.0	0.0	1	2	3	4
Offset, s	0	Reference Point	End	Yellow	5.0	3.0	4.0	0.0	0.0	0.0	5	6	7	8
Uncoordinated	Yes	Simult. Gap E/W	On	Red	2.0	2.0	2.0	0.0	0.0	0.0				
Force Mode	Fixed	Simult. Gap N/S	On											

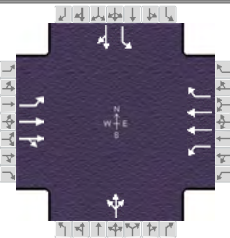
Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			2	1	6		8		
Case Number			7.3	2.0	4.0		10.0		
Phase Duration, s			26.5	15.0	41.5		73.5		
Change Period, (Y+R _c), s			7.0	7.0	7.0		6.0		
Max Allow Headway (MAH), s			3.2	3.1	3.2		3.1		
Queue Clearance Time (g _s), s			13.3	10.0	36.5		69.5		
Green Extension Time (g _e), s			1.8	0.0	0.0		0.0		
Phase Call Probability			1.00	1.00	1.00		1.00		
Max Out Probability			0.43	1.00	1.00		1.00		

Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement			2	12	1	6		3	8	18			
Adjusted Flow Rate (v), veh/h			211	444	156	544		1222	111				
Adjusted Saturation Flow Rate (s), veh/h/ln			1739	1548	1723	1810		1740	1548				
Queue Service Time (g _s), s			6.2	11.3	8.0	34.5		67.5	3.7				
Cycle Queue Clearance Time (g _c), s			6.2	11.3	8.0	34.5		67.5	3.7				
Green Ratio (g/C)			0.17	0.76	0.07	0.30		0.59	0.59				
Capacity (c), veh/h			590	1171	120	543		1021	909				
Volume-to-Capacity Ratio (X)			0.358	0.379	1.298	1.003		1.197	0.122				
Back of Queue (Q), ft/ln (95 th percentile)			122.7	135.9	393.4	733.4		1860.3	56.3				
Back of Queue (Q), veh/ln (95 th percentile)			4.8	5.3	15.7	28.4		74.4	2.2				
Queue Storage Ratio (RQ) (95 th percentile)			0.00	0.00	0.00	0.00		0.00	0.00				
Uniform Delay (d ₁), s/veh			42.2	4.8	53.5	40.3		23.7	10.6				
Incremental Delay (d ₂), s/veh			0.1	0.1	182.0	39.4		98.2	0.0				
Initial Queue Delay (d ₃), s/veh			0.0	0.0	0.0	0.0		0.0	0.0				
Control Delay (d), s/veh			42.4	4.9	235.5	79.6		122.0	10.6				
Level of Service (LOS)			D	A	F	F		F	B				
Approach Delay, s/veh / LOS		16.9	B		114.3	F		112.7	F		0.0		
Intersection Delay, s/veh / LOS		89.7							F				

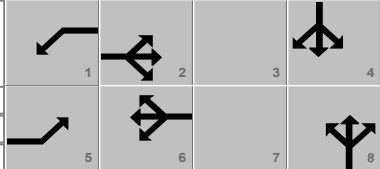
Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.3	B	1.9	A	2.7	B	2.5	B
Bicycle LOS Score / LOS		1.0	A	1.6	A	2.7	B		

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other	
Jurisdiction		Columbia Twp (ODOT)		Time Period				PHF		0.90	
Urban Street		US 50		Analysis Year		2042		Analysis Period		1> 7:00	
Intersection		US 50 at Walton Creek...		File Name		12-2042-AM.xus					
Project Description		2042 NO-BUILD - AM Peak Hour									



Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				40	540	20	40	1270	420	10	10	30	140	10	20

Signal Information						
Cycle, s	155.0	Reference Phase	2			
Offset, s	0	Reference Point	End			
Uncoordinated	Yes	Simult. Gap E/W	On			
Force Mode	Fixed	Simult. Gap N/S	On			
Green	7.0	96.5	35.0	0.0	0.0	0.0
Yellow	3.0	3.5	3.0	0.0	0.0	0.0
Red	2.0	2.0	3.0	0.0	0.0	0.0

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		5	2	1	6		8		4
Case Number		1.1	4.0	1.1	3.0		8.0		6.0
Phase Duration, s		12.0	102.0	12.0	102.0		41.0		41.0
Change Period, (Y+R c), s		5.0	37.0	5.0	37.0		6.0		6.0
Max Allow Headway (MAH), s		3.1	3.1	3.1	3.1		3.2		3.2
Queue Clearance Time (g s), s		4.2	20.9	4.2	64.4		6.2		22.3
Green Extension Time (g e), s		0.0	8.2	0.0	0.4		0.5		0.4
Phase Call Probability		1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability		1.00	0.02	1.00	1.00		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		5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h		44	313	309	44	1411	467		56		156	33	
Adjusted Saturation Flow Rate (s), veh/h/ln		1723	1810	1786	1723	1723	1533		1556		1356	1663	
Queue Service Time (g s), s		2.2	18.8	18.9	2.2	62.4	39.4		0.0		16.1	2.5	
Cycle Queue Clearance Time (g c), s		2.2	18.8	18.9	2.2	62.4	39.4		4.2		20.3	2.5	
Green Ratio (g/C)		0.46	0.42	0.42	0.46	0.42	0.42		0.23		0.23	0.23	
Capacity (c), veh/h		126	759	749	345	1445	643		379		316	376	
Volume-to-Capacity Ratio (X)		0.354	0.412	0.413	0.129	0.977	0.726		0.147		0.493	0.089	
Back of Queue (Q), ft/ln (95 th percentile)		43.5	339	323.3	42.7	1007.7	543.2		81.6		245	46.4	
Back of Queue (Q), veh/ln (95 th percentile)		1.7	13.0	12.9	1.6	38.8	21.7		3.1		9.4	1.9	
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00	
Uniform Delay (d 1), s/veh		36.4	31.6	31.6	24.3	44.3	37.6		48.1		56.2	47.4	
Incremental Delay (d 2), s/veh		0.6	0.1	0.1	0.1	18.2	3.6		0.1		0.4	0.0	
Initial Queue Delay (d 3), s/veh		0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Control Delay (d), s/veh		37.1	31.7	31.7	24.4	62.5	41.1		48.2		56.7	47.4	
Level of Service (LOS)		D	C	C	C	E	D		D		E	D	
Approach Delay, s/veh / LOS		32.1		C	56.4		E	48.2		D	55.0		E
Intersection Delay, s/veh / LOS		50.4						D					

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.1	B	2.3	B	3.0	C	2.9	C
Bicycle LOS Score / LOS		1.0	A	2.1	B	0.6	A	0.8	A

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other	
Jurisdiction		Mariemont		Time Period				PHF		0.90	
Urban Street		WB US 50		Analysis Year		2042		Analysis Period		1> 7:00	
Intersection		WB US 50 at Madisonvil...		File Name		13A-2042-AM.xus					
Project Description		2042 NO-BUILD - AM Peak Hour									

Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					0		20	920	570					300	30

Signal Information												
Cycle, s	80.0	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
Green	47.0	25.0	0.0	0.0	0.0	0.0						
Yellow	3.0	3.0	0.0	0.0	0.0	0.0						
Red	1.0	1.0	0.0	0.0	0.0	0.0						

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			6		2				4
Case Number			8.0		8.0				12.0
Phase Duration, s			51.0		51.0				29.0
Change Period, (Y+R c), s			4.0		4.0				4.0
Max Allow Headway (MAH), s			0.0		3.2				3.1
Queue Clearance Time (g s), s					38.8				8.2
Green Extension Time (g e), s			0.0		3.2				0.6
Phase Call Probability					1.00				1.00
Max Out Probability					0.46				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			6		5	2	12					4	14
Adjusted Flow Rate (v), veh/h			0		907		771					185	181
Adjusted Saturation Flow Rate (s), veh/h/ln			1845		1838		1462					1863	1803
Queue Service Time (g s), s			0.0		6.4		36.8					6.1	6.2
Cycle Queue Clearance Time (g c), s			0.0		32.0		36.8					6.1	6.2
Green Ratio (g/C)			0.59		0.59		0.59					0.31	0.31
Capacity (c), veh/h			1084		1126		859					582	563
Volume-to-Capacity Ratio (X)			0.000		0.805		0.898					0.318	0.322
Back of Queue (Q), ft/ln (95 th percentile)			0		443.4		463.8					116.1	111.3
Back of Queue (Q), veh/ln (95 th percentile)			0.0		17.7		18.6					4.5	4.5
Queue Storage Ratio (RQ) (95 th percentile)			0.00		0.00		0.00					0.00	0.00
Uniform Delay (d 1), s/veh			0.0		13.4		14.4					21.0	21.0
Incremental Delay (d 2), s/veh			0.0		4.0		11.9					0.1	0.1
Initial Queue Delay (d 3), s/veh			0.0		0.0		0.0					0.0	0.0
Control Delay (d), s/veh			0.0		17.4		26.3					21.1	21.1
Level of Service (LOS)					B		C					C	C
Approach Delay, s/veh / LOS		0.0			21.5		C	0.0			21.1		C
Intersection Delay, s/veh / LOS		21.4						C					

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.4	B	1.6	A	2.3	B	2.6	B
Bicycle LOS Score / LOS		0.5	A	1.9	A			0.8	A

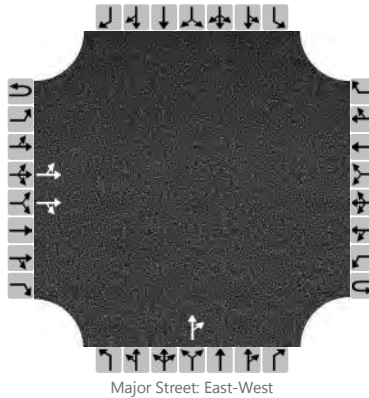
HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information														
Agency					Duration, h		0.25												
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type						Other					
Jurisdiction		Mariemont		Time Period				PHF						0.90					
Urban Street		EB US 50		Analysis Year		2042		Analysis Period						1> 7:00					
Intersection		EB US 50 at Miami Road		File Name		13B-2042-AM.xus													
Project Description		2042 NO-BUILD - AM Peak Hour																	
Demand Information																			
				EB			WB			NB			SB						
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R				
Demand (v), veh/h					460	10							290	30					
Signal Information																			
Cycle, s	80.0	Reference Phase	2																
Offset, s	0	Reference Point	End																
Uncoordinated	Yes	Simult. Gap E/W	On																
Force Mode	Fixed	Simult. Gap N/S	On																
				Green	36.0	36.0	0.0	0.0	0.0	0.0									
				Yellow	3.0	3.0	0.0	0.0	0.0	0.0									
				Red	1.0	1.0	0.0	0.0	0.0	0.0									
Timer Results				EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
Assigned Phase						2												4	
Case Number						8.0												10.0	
Phase Duration, s						40.0												40.0	
Change Period, (Y+R c), s						4.0												4.0	
Max Allow Headway (MAH), s						3.0												3.1	
Queue Clearance Time (g s), s						9.5												11.8	
Green Extension Time (g e), s						0.9												0.7	
Phase Call Probability						1.00												1.00	
Max Out Probability						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					2	12							7	4					
Adjusted Flow Rate (v), veh/h					262	260							322	33					
Adjusted Saturation Flow Rate (s), veh/h/ln					1792	1779							1774	1863					
Queue Service Time (g s), s					7.5	7.5							9.8	0.8					
Cycle Queue Clearance Time (g c), s					7.5	7.5							9.8	0.8					
Green Ratio (g/C)					0.45	0.45							0.45	0.45					
Capacity (c), veh/h					807	800							798	838					
Volume-to-Capacity Ratio (X)					0.325	0.325							0.404	0.040					
Back of Queue (Q), ft/ln (95 th percentile)					132.7	125.8							162.3	14.6					
Back of Queue (Q), veh/ln (95 th percentile)					5.1	5.0							6.5	0.6					
Queue Storage Ratio (RQ) (95 th percentile)					0.00	0.00							0.00	0.00					
Uniform Delay (d 1), s/veh					14.2	14.2							14.8	12.3					
Incremental Delay (d 2), s/veh					0.1	0.1							0.1	0.0					
Initial Queue Delay (d 3), s/veh					0.0	0.0							0.0	0.0					
Control Delay (d), s/veh					14.3	14.3							14.9	12.3					
Level of Service (LOS)					B	B							B	B					
Approach Delay, s/veh / LOS				14.3	B		0.0			0.0			14.7	B					
Intersection Delay, s/veh / LOS				14.4						B									
Multimodal Results				EB			WB			NB			SB						
Pedestrian LOS Score / LOS				1.9	A		1.7	A		2.5	B		1.7	A					
Bicycle LOS Score / LOS				0.9	A								1.1	A					

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Crystal Springs
Agency/Co.		Jurisdiction	Union Township
Date Performed	8/3/2016	East/West Street	US 50
Analysis Year	2042	North/South Street	Crystal Springs Rd
Time Analyzed	AM PEAK HOUR - NO-BUILD	Peak Hour Factor	1.00
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 13C		

Lanes



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	0	0
Configuration		LT		TR								TR				
Volume (veh/h)		100	660	20							60	10				
Percent Heavy Vehicles		4									4	4				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		430										70				
Capacity												310				
v/c Ratio												0.23				
95% Queue Length												0.9				
Control Delay (s/veh)												20.0				
Level of Service (LOS)												C				
Approach Delay (s/veh)									20.0							
Approach LOS									C							

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other			
Jurisdiction		Mariemont		Time Period				PHF		0.90			
Urban Street		WB US 50		Analysis Year		2042		Analysis Period		1> 7:00			
Intersection		WB US 50 at Miami Road		File Name		13D-2042-AM.xus							
Project Description		2042 NO-BUILD - AM Peak Hour											

Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h								1330	10	60	100			0	120

Signal Information														
Cycle, s	80.0	Reference Phase	2											
Offset, s	0	Reference Point	End											
Uncoordinated	Yes	Simult. Gap E/W	On											
Force Mode	Fixed	Simult. Gap N/S	On											
Green	42.0	30.0	0.0	0.0	0.0	0.0								
Yellow	3.0	3.0	0.0	0.0	0.0	0.0								
Red	1.0	1.0	0.0	0.0	0.0	0.0								

Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase					2		8		4
Case Number					7.0		6.0		7.0
Phase Duration, s					46.0		34.0		34.0
Change Period, (Y+R c), s					4.0		4.0		4.0
Max Allow Headway (MAH), s					3.0		3.2		3.2
Queue Clearance Time (g s), s					29.1		5.2		6.7
Green Extension Time (g e), s					3.8		0.6		0.6
Phase Call Probability					1.00		1.00		1.00
Max Out Probability					0.10		0.00		0.00

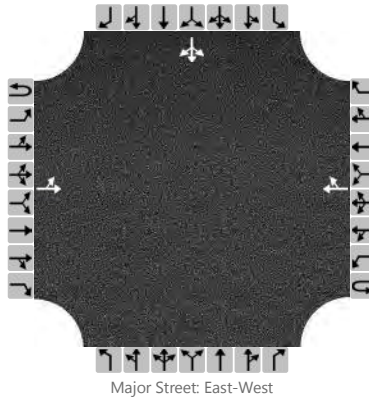
Movement Group Results		EB			WB			NB			SB		
Approach Movement		L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement						2	12	3	8			4	14
Adjusted Flow Rate (v), veh/h						1478	11	67	111			0	133
Adjusted Saturation Flow Rate (s), veh/h/ln						1773	1579	1757	1845			1845	1563
Queue Service Time (g s), s						27.1	0.3	2.0	3.2			0.0	4.7
Cycle Queue Clearance Time (g c), s						27.1	0.3	2.0	3.2			0.0	4.7
Green Ratio (g/C)						0.52	0.52	0.38	0.38			0.38	0.38
Capacity (c), veh/h						1862	829	749	692			692	586
Volume-to-Capacity Ratio (X)						0.794	0.013	0.089	0.161			0.000	0.227
Back of Queue (Q), ft/ln (95 th percentile)						379.8	3.8	33.8	57.6			0	71.2
Back of Queue (Q), veh/ln (95 th percentile)						15.2	0.2	1.4	2.3			0.0	2.8
Queue Storage Ratio (RQ) (95 th percentile)						0.00	0.00	0.00	0.00			0.00	0.00
Uniform Delay (d 1), s/veh						15.5	9.1	16.2	16.6			0.0	17.1
Incremental Delay (d 2), s/veh						2.3	0.0	0.0	0.0			0.0	0.1
Initial Queue Delay (d 3), s/veh						0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (d), s/veh						17.7	9.1	16.3	16.7			0.0	17.2
Level of Service (LOS)						B	A	B	B				B
Approach Delay, s/veh / LOS		0.0			17.7	B		16.5	B		17.2	B	
Intersection Delay, s/veh / LOS		17.5						B					

Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.3	B	2.2	B	1.9	A	2.4	B
Bicycle LOS Score / LOS				1.7	A	0.8	A	0.7	A

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Plainville
Agency/Co.		Jurisdiction	
Date Performed	7/14/2016	East/West Street	US 50
Analysis Year	2042	North/South Street	Plainville Rd
Time Analyzed	AM PEAK HOUR - NO-BUILD	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 14		

Lanes



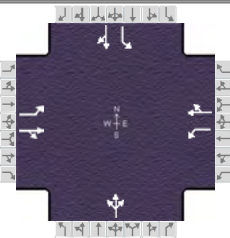
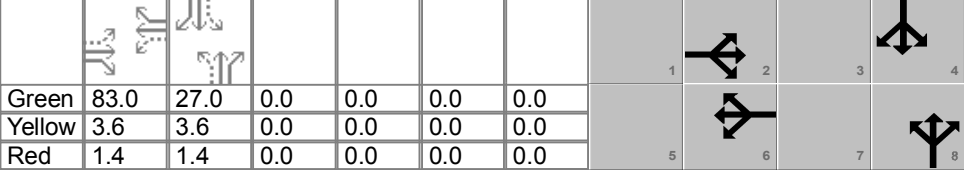
Vehicle Volumes and Adjustments

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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LTR	
Volume (veh/h)		160	490				870	80						20	0	130
Percent Heavy Vehicles		3												4	4	4
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		722													166	
Capacity		667													183	
v/c Ratio		1.08													0.91	
95% Queue Length		1.1													6.9	
Control Delay (s/veh)		12.3													95.8	
Level of Service (LOS)		B													F	
Approach Delay (s/veh)	6.7												95.8			
Approach LOS													F			

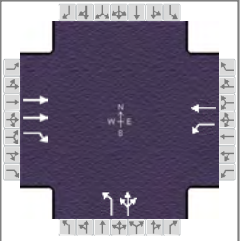
HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information										
Agency					Duration, h		0.25								
Analyst		MJH	Analysis Date	Oct 20, 2016		Area Type		Other							
Jurisdiction		Fairfax	Time Period			PHF		0.90							
Urban Street		US 50	Analysis Year	2042		Analysis Period		1> 7:00							
Intersection		US 50 at Watterson Road	File Name	15-2042-AM.xus											
Project Description		2042 NO-BUILD - AM Peak Hour													
															
Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				50	600	10	10	1010	110	10	0	0	150	10	70
Signal Information															
Cycle, s	120.0	Reference Phase	2	Green	83.0	27.0	0.0	0.0	0.0	0.0					
Offset, s	0	Reference Point	End	Yellow	3.6	3.6	0.0	0.0	0.0	0.0					
Uncoordinated	Yes	Simult. Gap E/W	On	Red	1.4	1.4	0.0	0.0	0.0	0.0					
Force Mode	Fixed	Simult. Gap N/S	On												
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase					2		6		8		4				
Case Number					6.0		6.0		8.0		6.0				
Phase Duration, s					88.0		88.0		32.0		32.0				
Change Period, (Y+R c), s					5.0		5.0		5.0		5.0				
Max Allow Headway (MAH), s					3.2		3.2		3.1		3.1				
Queue Clearance Time (g s), s					85.0		85.0		8.2		18.4				
Green Extension Time (g e), s					0.0		0.0		0.4		0.3				
Phase Call Probability					1.00		1.00		1.00		1.00				
Max Out Probability					1.00		1.00		0.00		0.01				
Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h				56	678		11	1244		11		167	89		
Adjusted Saturation Flow Rate (s), veh/h/ln				437	1822		744	1795		1064		1792	1625		
Queue Service Time (g s), s				0.0	21.9		0.9	83.0		0.8		10.2	5.4		
Cycle Queue Clearance Time (g c), s				83.0	21.9		22.8	83.0		6.2		16.4	5.4		
Green Ratio (g/C)				0.69	0.69		0.69	0.69		0.22		0.22	0.22		
Capacity (c), veh/h				60	1260		439	1242		299		370	366		
Volume-to-Capacity Ratio (X)				0.926	0.538		0.025	1.002		0.037		0.450	0.243		
Back of Queue (Q), ft/ln (95 th percentile)				146.4	309.7		7	1200.4		12.6		206.9	96.7		
Back of Queue (Q), veh/ln (95 th percentile)				5.7	12.4		0.3	48.0		0.5		8.0	3.9		
Queue Storage Ratio (RQ) (95 th percentile)				0.00	0.00		0.00	0.00		0.00		0.00	0.00		
Uniform Delay (d 1), s/veh				60.0	9.1		14.7	18.5		40.7		45.2	38.1		
Incremental Delay (d 2), s/veh				88.6	0.2		0.0	26.1		0.0		0.3	0.1		
Initial Queue Delay (d 3), s/veh				0.0	0.0		0.0	0.0		0.0		0.0	0.0		
Control Delay (d), s/veh				148.6	9.3		14.7	44.6		40.7		45.5	38.2		
Level of Service (LOS)				F	A		B	F		D		D	D		
Approach Delay, s/veh / LOS				19.9	B		44.3	D		40.7	D	43.0	D		
Intersection Delay, s/veh / LOS				36.2					D						
Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.1	B		2.2	B		2.3	B		2.3	B	
Bicycle LOS Score / LOS				1.7	A		2.6	B		0.5	A		0.9	A	

PM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other
Jurisdiction	Columbia Twp (ODOT)	Time Period		PHF	0.90
Urban Street	US 50	Analysis Year	2042	Analysis Period	1> 7:00
Intersection	US 50 at Newtown Road	File Name	11-2042-PM.xus		
Project Description	2042 NO-BUILD - PM Peak Hour				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		610	1030	110	310		600	0	120			

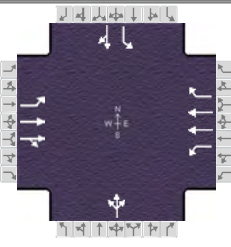
Signal Information											
Cycle, s	140.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	15.0	44.0	63.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	5.0	3.0	4.0	0.0	0.0	0.0	
				Red	2.0	2.0	2.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	2.0	4.0		10.0		
Phase Duration, s		49.0	22.0	71.0		69.0		
Change Period, ($Y+R_c$), s		7.0	7.0	7.0		6.0		
Max Allow Headway (MAH), s		3.2	3.1	3.2		3.2		
Queue Clearance Time (g_s), s		44.0	11.2	19.0		48.4		
Green Extension Time (g_e), s		0.0	0.1	7.4		1.7		
Phase Call Probability		1.00	1.00	1.00		1.00		
Max Out Probability		1.00	0.41	0.16		0.01		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8	18			
Adjusted Flow Rate (v), veh/h		678	1144	122	344		667	133				
Adjusted Saturation Flow Rate (s), veh/h/ln		1791	1594	1792	1881		1774	1579				
Queue Service Time (g_s), s		22.9	42.0	9.2	17.0		46.4	7.1				
Cycle Queue Clearance Time (g_c), s		22.9	42.0	9.2	17.0		46.4	7.1				
Green Ratio (g/C)		0.30	0.75	0.11	0.46		0.45	0.45				
Capacity (c), veh/h		1075	1196	192	860		798	710				
Volume-to-Capacity Ratio (X)		0.631	0.957	0.637	0.401		0.835	0.188				
Back of Queue (Q), ft/ln (95 th percentile)		389.3	1049.5	196.9	306.2		716.6	121				
Back of Queue (Q), veh/ln (95 th percentile)		15.4	41.6	7.9	12.2		28.7	4.8				
Queue Storage Ratio (RQ) (95 th percentile)		0.00	0.00	0.00	0.00		0.00	0.00				
Uniform Delay (d_1), s/veh		42.3	15.5	59.9	25.3		33.9	23.1				
Incremental Delay (d_2), s/veh		0.9	16.6	5.3	0.1		7.2	0.0				
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0	0.0				
Control Delay (d), s/veh		43.2	32.1	65.2	25.4		41.2	23.2				
Level of Service (LOS)		D	C	E	C		D	C				
Approach Delay, s/veh / LOS	36.3	D		35.8	D		38.2	D		0.0		
Intersection Delay, s/veh / LOS	36.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	1.9	A	2.8	C	2.5	B
Bicycle LOS Score / LOS	2.0	A	1.3	A	1.8	A		

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency				Duration, h	0.25	
Analyst	MJH	Analysis Date	Oct 20, 2016	Area Type	Other	
Jurisdiction	Columbia Twp (ODOT)	Time Period		PHF	0.90	
Urban Street	US 50	Analysis Year	2042	Analysis Period	1> 7:00	
Intersection	US 50 at Walton Creek Rd	File Name	12-2042-PM.xus			
Project Description	2042 NO-BUILD - PM Peak Hour					

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	40	1220	50	80	690	160	40	50	100	400	50	40

Signal Information											
Cycle, s	115.0	Reference Phase	2								
Offset, s	0	Reference Point	End								
Uncoordinated	Yes	Simult. Gap E/W	On	Green	7.0	44.4	46.6	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.0	4.0	3.0	0.0	0.0	0.0	
				Red	2.0	2.0	3.0	0.0	0.0	0.0	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	3.0		8.0		6.0
Phase Duration, s	12.0	50.4	12.0	50.4		52.6		52.6
Change Period, ($Y+R_c$), s	5.0	6.0	5.0	6.0		6.0		6.0
Max Allow Headway (MAH), s	3.1	3.1	3.1	3.1		3.4		3.4
Queue Clearance Time (g_s), s	3.6	45.6	5.4	21.5		11.7		48.6
Green Extension Time (g_e), s	0.0	0.0	0.0	6.3		1.8		0.0
Phase Call Probability	1.00	1.00	1.00	1.00		1.00		1.00
Max Out Probability	0.66	1.00	1.00	0.12		0.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	44	710	702	89	767	178		211		444	100	
Adjusted Saturation Flow Rate (s), veh/h/ln	1774	1863	1837	1774	1773	1579		1621		1226	1742	
Queue Service Time (g_s), s	1.6	43.4	43.6	3.4	19.5	9.0		2.2		36.9	4.2	
Cycle Queue Clearance Time (g_c), s	1.6	43.4	43.6	3.4	19.5	9.0		9.7		46.6	4.2	
Green Ratio (g/C)	0.45	0.39	0.39	0.45	0.39	0.39		0.41		0.41	0.41	
Capacity (c), veh/h	310	719	709	171	1369	609		695		456	706	
Volume-to-Capacity Ratio (X)	0.143	0.987	0.989	0.521	0.560	0.292		0.304		0.974	0.142	
Back of Queue (Q), ft/ln (95 th percentile)	30.6	841.6	825.7	65	325.7	149.6		175.3		611.4	76	
Back of Queue (Q), veh/ln (95 th percentile)	1.2	33.1	33.0	2.6	12.8	6.0		6.9		24.1	3.0	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	20.2	35.0	35.1	27.1	27.6	24.4		23.2		41.1	21.6	
Incremental Delay (d_2), s/veh	0.1	30.0	31.0	1.4	0.3	0.1		0.1		35.2	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Control Delay (d), s/veh	20.3	65.0	66.1	28.4	28.0	24.5		23.3		76.3	21.6	
Level of Service (LOS)	C	E	E	C	C	C		C		E	C	
Approach Delay, s/veh / LOS	64.2	E		27.4	C		23.3	C		66.3	E	
Intersection Delay, s/veh / LOS	50.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.3	B	2.9	C	2.8	C
Bicycle LOS Score / LOS	1.7	A	1.3	A	0.8	A	1.4	A

HCS 2010 Signalized Intersection Results Summary

General Information					Intersection Information				
Agency					Duration, h		0.25		
Analyst		MJH	Analysis Date	Oct 20, 2016	Area Type		Other		
Jurisdiction		Mariemont	Time Period		PHF		0.90		
Urban Street		WB US 50	Analysis Year	2042	Analysis Period		1> 7:00		
Intersection		WB US 50 at Madisonvil...	File Name	13A-2042-PM.xus					
Project Description		2042 NO-BUILD - PM Peak Hour							

Demand Information				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					0		50	650	340					530	30

Signal Information							
Cycle, s	80.0	Reference Phase	2				
Offset, s	0	Reference Point	End				
Uncoordinated	Yes	Simult. Gap E/W	On				
Force Mode	Fixed	Simult. Gap N/S	On				
Green	41.0	31.0	0.0	0.0	0.0	0.0	0.0
Yellow	3.0	3.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	1.0	0.0	0.0	0.0	0.0	0.0

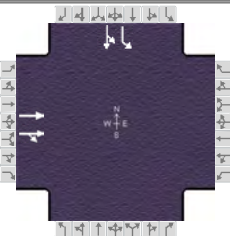
Timer Results		EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase			6		2				4
Case Number			8.0		8.0				12.0
Phase Duration, s			45.0		45.0				35.0
Change Period, (Y+R c), s			4.0		4.0				4.0
Max Allow Headway (MAH), s			0.0		3.1				3.0
Queue Clearance Time (g s), s					22.7				11.8
Green Extension Time (g e), s			0.0		2.5				1.1
Phase Call Probability					1.00				1.00
Max Out Probability					0.02				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			6		5	2	12					4	14	
Adjusted Flow Rate (v), veh/h			0		635		520					314	309	
Adjusted Saturation Flow Rate (s), veh/h/ln			1863		1828		1499					1881	1845	
Queue Service Time (g s), s			0.0		7.8		20.7					9.8	9.8	
Cycle Queue Clearance Time (g c), s			0.0		20.5		20.7					9.8	9.8	
Green Ratio (g/C)			0.51		0.51		0.51					0.39	0.39	
Capacity (c), veh/h			955		986		768					729	715	
Volume-to-Capacity Ratio (X)			0.000		0.644		0.677					0.430	0.431	
Back of Queue (Q), ft/ln (95 th percentile)			0		308.1		269.2					181.9	176.1	
Back of Queue (Q), veh/ln (95 th percentile)			0.0		12.3		10.8					7.2	7.0	
Queue Storage Ratio (RQ) (95 th percentile)			0.00		0.00		0.00					0.00	0.00	
Uniform Delay (d 1), s/veh			0.0		14.5		14.6					18.0	18.0	
Incremental Delay (d 2), s/veh			0.0		1.1		2.0					0.1	0.2	
Initial Queue Delay (d 3), s/veh			0.0		0.0		0.0					0.0	0.0	
Control Delay (d), s/veh			0.0		15.6		16.5					18.2	18.2	
Level of Service (LOS)					B		B					B	B	
Approach Delay, s/veh / LOS		0.0			16.0		B	0.0				18.2		B
Intersection Delay, s/veh / LOS		16.8							B					

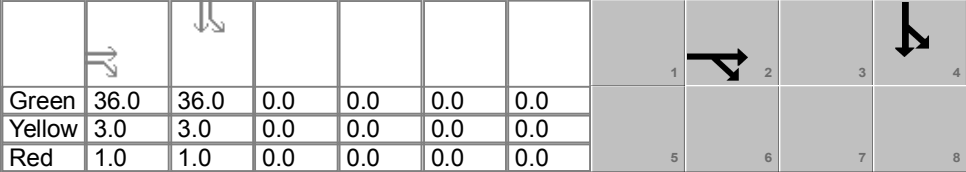
Multimodal Results		EB		WB		NB		SB	
Pedestrian LOS Score / LOS		2.4	B	1.7	A	2.3	B	2.6	B
Bicycle LOS Score / LOS		0.5	A	1.4	A			1.0	A

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency						Duration, h		0.25					
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other			
Jurisdiction		Mariemont		Time Period				PHF		0.90			
Urban Street		EB US 50		Analysis Year		2042		Analysis Period		1> 7:00			
Intersection		EB US 50 at Miami Road		File Name		13B-2042-PM.xus							
Project Description		2042 NO-BUILD - PM Peak Hour											



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h					1040	10							540	40	

Signal Information														
Cycle, s	80.0	Reference Phase	2											
Offset, s	0	Reference Point	End											
Uncoordinated	Yes	Simult. Gap E/W	On											
Force Mode	Fixed	Simult. Gap N/S	On											
Green	36.0	36.0	0.0	0.0	0.0	0.0								
Yellow	3.0	3.0	0.0	0.0	0.0	0.0								
Red	1.0	1.0	0.0	0.0	0.0	0.0								

Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase					2						4
Case Number					8.0						10.0
Phase Duration, s					40.0						40.0
Change Period, (Y+R c), s					4.0						4.0
Max Allow Headway (MAH), s					3.0						3.1
Queue Clearance Time (g s), s					22.1						24.2
Green Extension Time (g e), s					2.2						1.2
Phase Call Probability					1.00						1.00
Max Out Probability					0.04						0.02

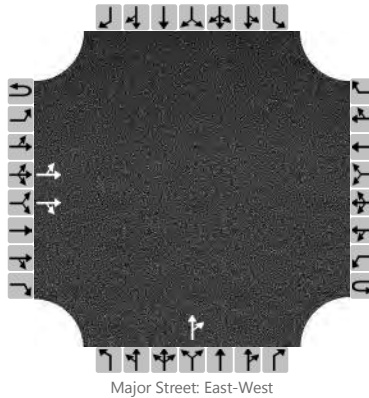
Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement					2	12							7	4	
Adjusted Flow Rate (v), veh/h					584	582							600	44	
Adjusted Saturation Flow Rate (s), veh/h/ln					1863	1856							1792	1881	
Queue Service Time (g s), s					20.1	20.1							22.2	1.1	
Cycle Queue Clearance Time (g c), s					20.1	20.1							22.2	1.1	
Green Ratio (g/C)					0.45	0.45							0.45	0.45	
Capacity (c), veh/h					838	835							806	847	
Volume-to-Capacity Ratio (X)					0.697	0.697							0.744	0.053	
Back of Queue (Q), ft/ln (95 th percentile)					329	323							346.9	19	
Back of Queue (Q), veh/ln (95 th percentile)					13.0	12.9							13.9	0.7	
Queue Storage Ratio (RQ) (95 th percentile)					0.00	0.00							0.00	0.00	
Uniform Delay (d 1), s/veh					17.6	17.6							18.2	12.4	
Incremental Delay (d 2), s/veh					2.2	2.2							3.3	0.0	
Initial Queue Delay (d 3), s/veh					0.0	0.0							0.0	0.0	
Control Delay (d), s/veh					19.8	19.8							21.5	12.4	
Level of Service (LOS)					B	B							C	B	
Approach Delay, s/veh / LOS				19.8	B		0.0			0.0			20.9	C	
Intersection Delay, s/veh / LOS				20.2						C					

Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				1.9	A		1.7	A		2.5	B		1.7	A	
Bicycle LOS Score / LOS				1.5	A								1.6	A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Crystal Springs
Agency/Co.		Jurisdiction	Union Township
Date Performed	8/3/2016	East/West Street	US 50
Analysis Year	2042	North/South Street	Crystal Springs Rd
Time Analyzed	PM PEAK HOUR - NO-BUILD	Peak Hour Factor	1.00
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 13C		

Lanes



Vehicle Volumes and Adjustments

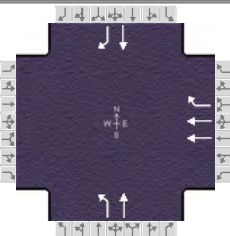
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	0	0	0		0	1	0		0	0	0
Configuration		LT		TR								TR				
Volume (veh/h)		160	1420	40							40	20				
Percent Heavy Vehicles		1									2	2				
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

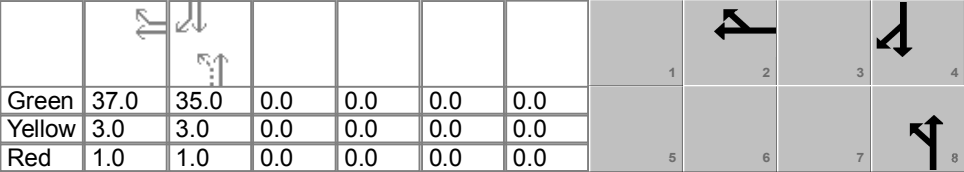
Flow Rate (veh/h)		870										60				
Capacity												113				
v/c Ratio												0.53				
95% Queue Length												2.5				
Control Delay (s/veh)												68.7				
Level of Service (LOS)												F				
Approach Delay (s/veh)									68.7							
Approach LOS									F							

HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information					
Agency						Duration, h		0.25			
Analyst		MJH		Analysis Date		Oct 20, 2016		Area Type		Other	
Jurisdiction		Mariemont		Time Period				PHF		0.90	
Urban Street		WB US 50		Analysis Year		2042		Analysis Period		1> 7:00	
Intersection		WB US 50 at Miami Road		File Name		13D-2042-PM.xus					
Project Description		2042 NO-BUILD - PM Peak Hour									



Demand Information															
				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h								850	10	60	140			0	130

Signal Information															
Cycle, s	80.0	Reference Phase	2												
Offset, s	0	Reference Point	End												
Uncoordinated	Yes	Simult. Gap E/W	On	Green	37.0	35.0	0.0	0.0	0.0	0.0					
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.0	3.0	0.0	0.0	0.0	0.0					
				Red	1.0	1.0	0.0	0.0	0.0	0.0					

Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase							2		8		4
Case Number							7.0		6.0		7.0
Phase Duration, s							41.0		39.0		39.0
Change Period, (Y+R c), s							4.0		4.0		4.0
Max Allow Headway (MAH), s							3.0		3.2		3.2
Queue Clearance Time (g s), s							17.6		6.1		6.5
Green Extension Time (g e), s							2.4		0.7		0.7
Phase Call Probability							1.00		1.00		1.00
Max Out Probability							0.00		0.00		0.00

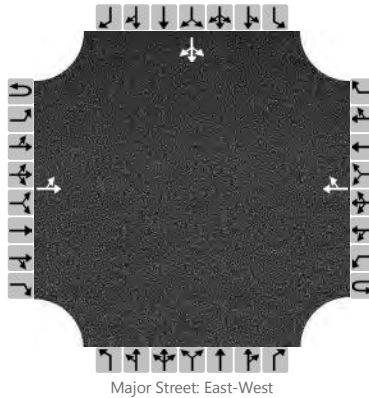
Movement Group Results				EB			WB			NB			SB		
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement								2	12	3	8			4	14
Adjusted Flow Rate (v), veh/h								944	11	67	156			0	144
Adjusted Saturation Flow Rate (s), veh/h/ln								1773	1579	1792	1881			1881	1594
Queue Service Time (g s), s								15.6	0.3	1.7	4.1			0.0	4.5
Cycle Queue Clearance Time (g c), s								15.6	0.3	1.7	4.1			0.0	4.5
Green Ratio (g/C)								0.46	0.46	0.44	0.44			0.44	0.44
Capacity (c), veh/h								1640	730	874	823			823	697
Volume-to-Capacity Ratio (X)								0.576	0.015	0.076	0.189			0.000	0.207
Back of Queue (Q), ft/ln (95 th percentile)								242.2	4.5	29.5	72			0	67.5
Back of Queue (Q), veh/ln (95 th percentile)								9.7	0.2	1.2	2.9			0.0	2.7
Queue Storage Ratio (RQ) (95 th percentile)								0.00	0.00	0.00	0.00			0.00	0.00
Uniform Delay (d 1), s/veh								15.8	11.6	13.1	13.8			0.0	13.9
Incremental Delay (d 2), s/veh								0.3	0.0	0.0	0.0			0.0	0.1
Initial Queue Delay (d 3), s/veh								0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (d), s/veh								16.1	11.6	13.2	13.8			0.0	14.0
Level of Service (LOS)								B	B	B	B				B
Approach Delay, s/veh / LOS				0.0				16.0		B		13.6		B	
Intersection Delay, s/veh / LOS				15.4						B					

Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS Score / LOS				2.3		B		2.3		B		1.9		A	
Bicycle LOS Score / LOS								1.3		A		0.9		A	

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	MJH	Intersection	US 50 at Plainville Rd
Agency/Co.		Jurisdiction	Mariemont
Date Performed	7/14/2016	East/West Street	US 50
Analysis Year	2042	North/South Street	Plainville Rd
Time Analyzed	NO-BUILD PM PEAK HOUR	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Intersection 14		

Lanes



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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LTR	
Volume (veh/h)		190	1080				600	60						60	0	150
Percent Heavy Vehicles		2												2	2	2
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		1411													234	
Capacity		880													93	
v/c Ratio		1.60													2.51	
95% Queue Length		0.9													21.7	
Control Delay (s/veh)		10.4													783.9	
Level of Service (LOS)		B													F	
Approach Delay (s/veh)	8.7												783.9			
Approach LOS													F			

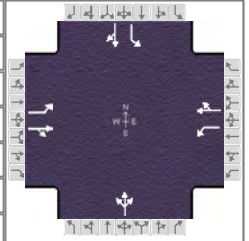
HCS 2010 Signalized Intersection Results Summary

General Information

Agency		Analysis Date	Oct 20, 2016
Analyst	MJH	Time Period	
Jurisdiction	Fairfax	Analysis Year	2042
Urban Street	US 50	File Name	15-2042-PM.xus
Intersection	US 50 at Watterson Rd		
Project Description	2042 NO-BUILD - PM Peak Hour		

Intersection Information

Duration, h	0.25
Area Type	Other
PHF	0.90
Analysis Period	1> 7:00

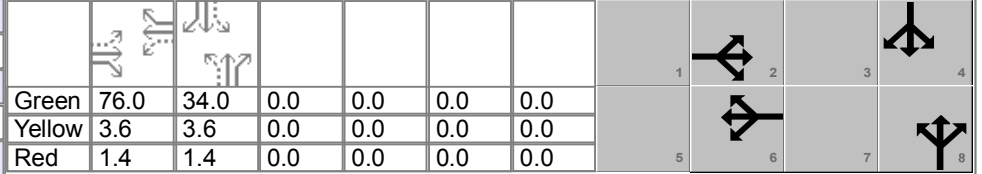


Demand Information

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	30	1090	0	10	650	90	10	0	10	310	10	80

Signal Information

Cycle, s	120.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Timer Results

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		8.0		6.0
Phase Duration, s		81.0		81.0		39.0		39.0
Change Period, ($Y+R_c$), s		5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s		3.1		3.1		3.1		3.1
Queue Clearance Time (g_s), s		78.0		78.0		7.6		36.0
Green Extension Time (g_e), s		0.0		0.0		0.9		0.0
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		1.00		1.00		0.00		1.00

Movement Group Results

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	33	0		11	822			22		344	100	
Adjusted Saturation Flow Rate (s), veh/h/ln	663	0		459	1823			1312		1426	1638	
Queue Service Time (g_s), s	4.2	0.0		0.0	36.2			0.1		28.4	5.6	
Cycle Queue Clearance Time (g_c), s	40.4	0.0		76.0	36.2			5.6		34.0	5.6	
Green Ratio (g/C)	0.63			0.63	0.63			0.28		0.28	0.28	
Capacity (c), veh/h	280			60	1154			417		397	464	
Volume-to-Capacity Ratio (X)	0.119	0.000		0.185	0.712			0.053		0.868	0.215	
Back of Queue (Q), ft/ln (95 th percentile)	31	0		15.8	509.8			21.5		451.5	100	
Back of Queue (Q), veh/ln (95 th percentile)	1.2	0.0		0.6	20.4			0.8		17.8	4.0	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00		0.00	0.00			0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	28.2			60.0	14.7			31.3		46.1	32.8	
Incremental Delay (d_2), s/veh	0.1	0.0		0.5	1.8			0.0		17.5	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Control Delay (d), s/veh	28.3			60.5	16.5			31.3		63.6	32.9	
Level of Service (LOS)	C			E	B			C		E	C	
Approach Delay, s/veh / LOS	54.5		D	17.1		B	31.3		C	56.7		E
Intersection Delay, s/veh / LOS	42.4						D					

Multimodal Results

	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.1		B	2.2		B	2.3		B	2.3		B
Bicycle LOS Score / LOS	2.5		B	1.9		A	0.5		A	1.2		A