

To: Steve Gramm, SDDOT	
From: HDR	Project: I-190 Silver Street Study
CC:	
Date: 6/21/2010	Job No: SDDOT 410445, W.O. PD-02-09

**RE: Task 300: Develop at-grade intersection options**

This Technical Memo has been prepared to document the data, analysis and findings as outlined in the Task 300 section of the subject work order. The Technical Memo is organized by subtask and the data, analysis and findings related to each subtask are presented in the subtask discussions. The objective of this task is to determine potential at-grade options for the US 16/Silver Street intersection.

**Subtask 301: Develop options for the US 16/Silver St. intersection.** At-grade signalized intersections were developed for the existing interchange area in the event that it is redesignated as an arterial route, rather than a part of the Interstate system. Each of the concepts is discussed below and displayed in the concept drawings that accompany this technical memorandum.

- Option 4 - Shifting the US 16 alignment to the west allows for sufficient room to build all intersection options and provide adequate turn lanes and other geometric features. The intersection in this option suffers from a fairly high degree of skew on the cross-road and subsequent sharp turning paths on some movements. Additional right-of-way will be needed west of the existing US 16, although some of the needed property is already in public ownership. Additional local street connections will be needed west of the intersection to facilitate local traffic movement. The parking lots at Central High School will no longer be allowed to access the Interstate off ramp in this concept. The intersection of North Street and the east frontage road (West Blvd.) has been removed to allow sufficient vehicle storage and remove conflict points.
- Option 4a - This option is similar to Option 4, except the cross-road has been realigned to connect to the new local street west of the intersection. The geometry of the intersection is improved over Option 4.
- Other options - additional options were also considered that realign US 16 to connect to Mt. Rushmore Road at Omaha Street. These options are not reproduced here because they interfere with the planned expansion of Central High School and will likely be screened by environmental considerations. A roundabout option was also considered, but not fully developed because a roundabout at this intersection would also require extensive redesign of the incoming roadways. Particular concern is associated with designing the north leg of the roundabout to give drivers enough visual clues to reduce their speed prior to reaching the roundabout. The roundabout concept has not been dismissed and may be further developed if SDDOT decides to redesignate I-190 as an arterial street.

**INTERSECTION LEVEL OF SERVICE (Projected 2030 traffic)**

INTERSECTION	LEVEL OF SERVICE	
	AM	PM
US 16/SILVER ST./NORTH ST.	C	C

**Subtask 302: Present and review at-grade concepts.** Concepts were presented to SDDOT staff at a meeting held May 13, 2010 in Pierre. Meeting notes were prepared addressing the comments (attached) and the options were finalized for inclusion in this technical memo.

# ATTACHMENTS

Option concept drawings

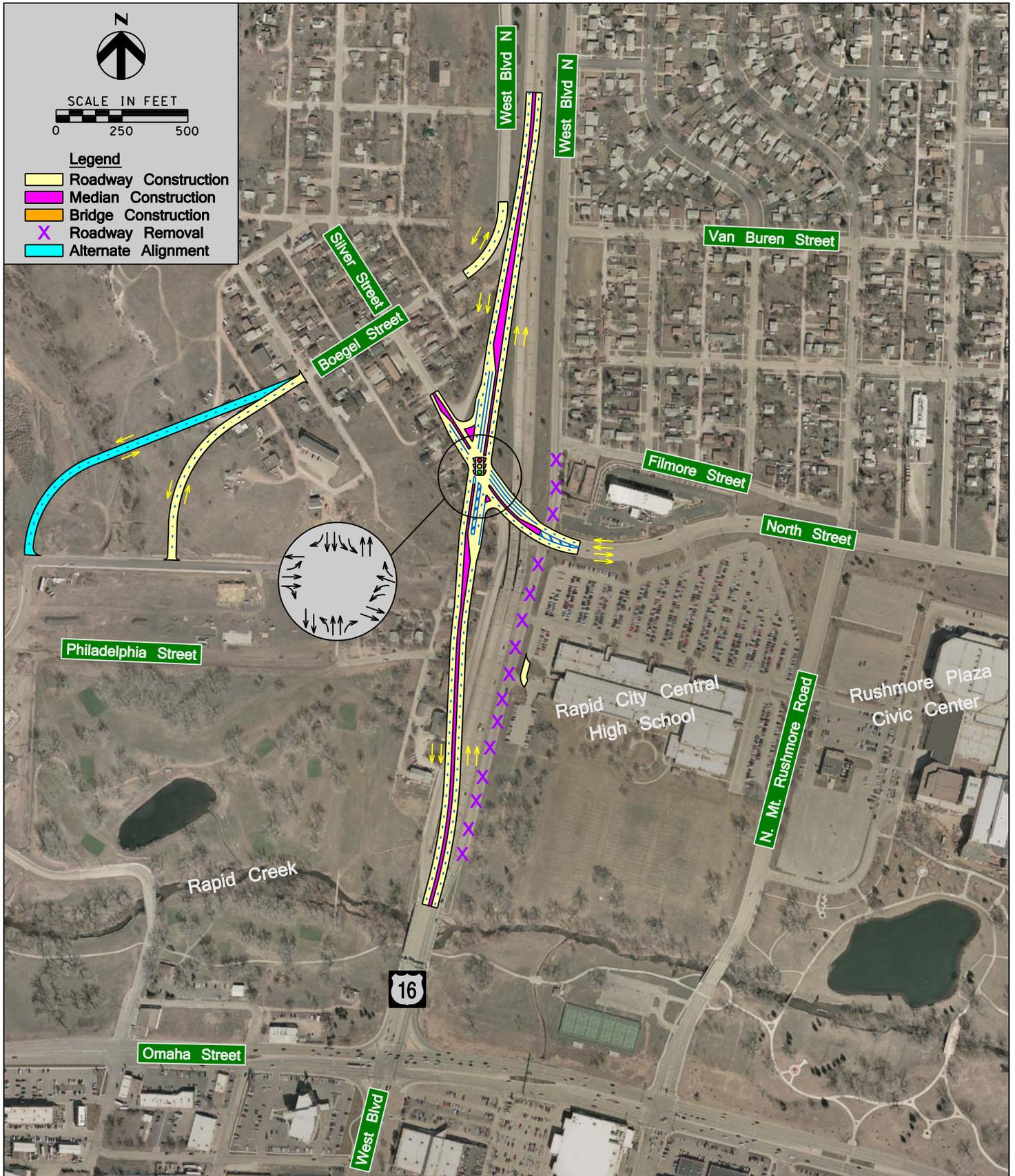
Meeting notes

Synchro output



**Legend**

- Roadway Construction
- Median Construction
- Bridge Construction
- Roadway Removal
- Alternate Alignment



### Intersection Option 4

SD190 shifted west with at-grade intersection at Silver Street/North Street

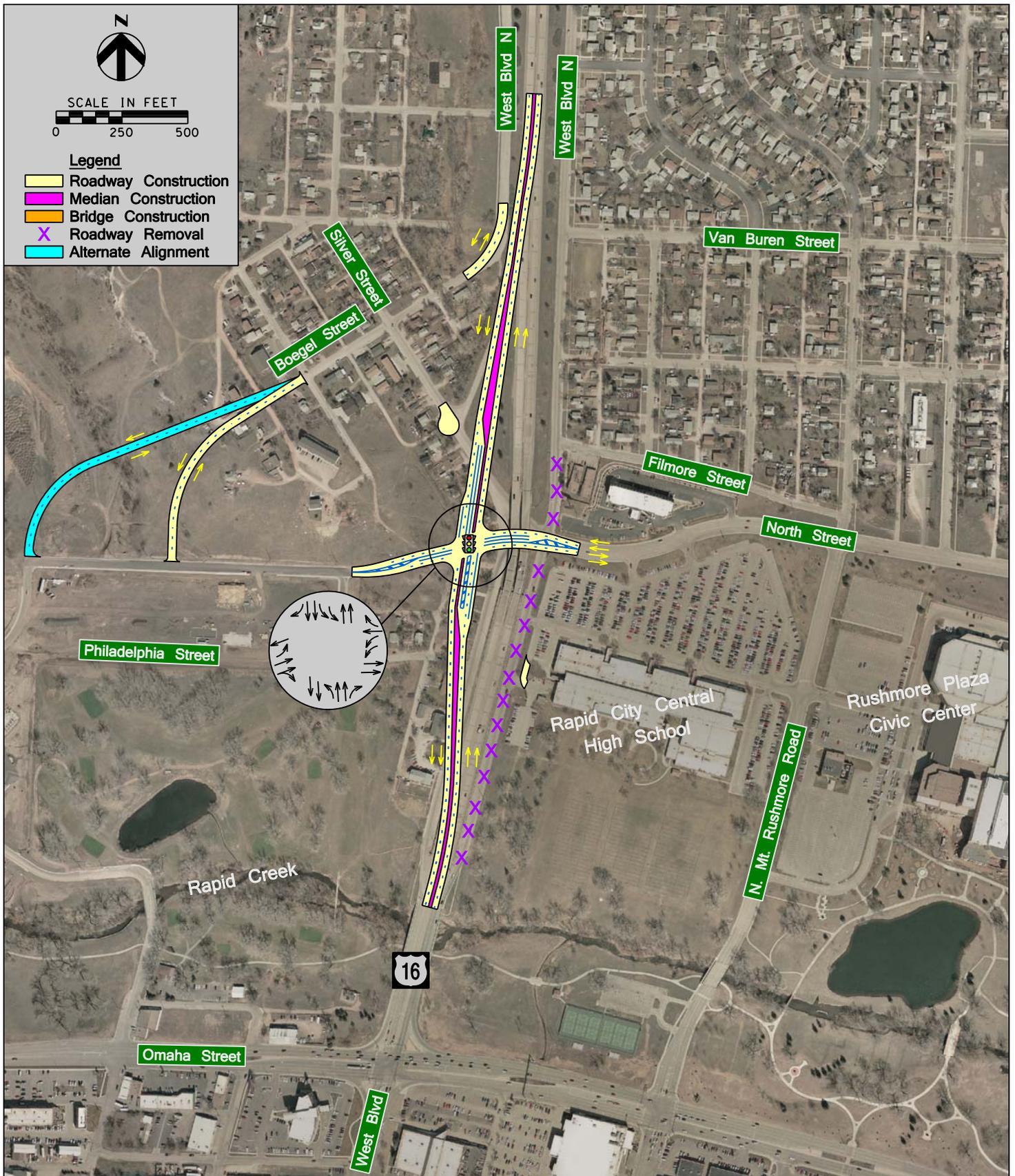
Interstate 190/Silver Street Interchange Study  
Rapid City, South Dakota

May 27,  
2010



**Legend**

- Roadway Construction
- Median Construction
- Bridge Construction
- Roadway Removal
- Alternate Alignment



### Intersection Option 4a

SD190 shifted west with at-grade intersection at North Street

Interstate 190/Silver Street Interchange Study  
Rapid City, South Dakota

May 27,  
2010

Subject: <b>Concept review meeting</b>	
Client: <b>SDDOT</b>	
Project: <b>I-190/Silver Street Study</b>	Project No: <b>137390, HP 5596(12)</b>
Meeting Date: <b>5/13/2010</b>	Meeting Location: <b>SDDOT Central Office</b>
Notes by: <b>R Laughlin</b>	

<b>Attendees:</b>	Steve Johnson	Bridge Design Engineer	SDDOT	605-773-3285	<a href="mailto:steve.johnson@state.sd.us">steve.johnson@state.sd.us</a>
	Kevin Goeden	Chief Bridge Engineer	SDDOT	605-773-3285	<a href="mailto:kevin.goeden@state.sd.us">kevin.goeden@state.sd.us</a>
	Dean VanDeWiele	Bid Letting Supervisor	SDDOT	605-773-3938	<a href="mailto:dean.vandeweile@state.sd.us">dean.vandeweile@state.sd.us</a>
	Brad Remmich	Transportation Specialist	SDDOT	605-773-3093	<a href="mailto:bradley.remmich@state.sd.us">bradley.remmich@state.sd.us</a>
	Dan Staton	Access Mgmt. Engineer	SDDOT	605-394-2244	<a href="mailto:daniel.staton@state.sd.us">daniel.staton@state.sd.us</a>
	Gary Engel	Area Engineer	SDDOT	605-394-2248	<a href="mailto:gary.engel@state.sd.us">gary.engel@state.sd.us</a>
	Mark Leiferman	Road Design Engineer	SDDOT	605-773-3452	<a href="mailto:mark.leiferman@state.sd.us">mark.leiferman@state.sd.us</a>
	Steve Gramm	Data Analysis Engineer	SDDOT	605-773-6641	<a href="mailto:steve.gramm@state.sd.us">steve.gramm@state.sd.us</a>
	Todd Seaman	Region Engineer	SDDOT	605-394-1620	<a href="mailto:todd.seaman@state.sd.us">todd.seaman@state.sd.us</a>
	Steve Hoff	Asst. Dept. Manager	HDR	605-977-7740	<a href="mailto:steve.hoff@hdrinc.com">steve.hoff@hdrinc.com</a>
	Jody Page	RC Manager	HDR	605-791-6100	<a href="mailto:jody.page@hdrinc.com">jody.page@hdrinc.com</a>
	Chris Bailey	Project Engineer	HDR	605-791-6100	<a href="mailto:chris.bailey@hdrinc.com">chris.bailey@hdrinc.com</a>
	Rick Laughlin	Sr. Transp. Engineer	HDR	605-977-7740	<a href="mailto:rick.laughlin@hdrinc.com">rick.laughlin@hdrinc.com</a>

**Topics Discussed:**

1. Study Synopsis – Laughlin provided background information and design history. Recent information was provided regarding the impending closure of the low-clearance portion of the crossroad under the Silver St. interchange.
2. Interstate improvement concepts – attendees reviewed improvement concepts for the I-190/Silver St. interchange.
  - a. SDDOT's position is that I-190 will remain as a state-jurisdiction route, whether or not it remains on the Interstate system. The main intent of the study is stated as addressing the interchange, while exploring other options. SDDOT intends to retain interstate standards north of the Silver St. interchange under any option.
  - b. Show the US 16 shield on all concept drawings, remove reference to SD 190.
  - c. The connections from Boegel St. to the new development road near Philadelphia St. should be shown on all options where it is possible. It may also be helpful to show a greater distinction between these two alternative connections so there is no confusion that they are an either/or choice.
  - d. Options 2, 2a (curved connection to Mt. Rushmore Rd.) should be considered dismissed. It is deemed infeasible due to conflicts with Central High expansion, environmental impacts and high relative cost. At the upcoming public meeting, we'll show the concept from the 2000 Interstate Corridor Study and talk about potential challenges for such a connection.
  - e. Any alternatives that show a connection between Central High parking lots using the existing ramp roadway should be revised to show a direct connection solely on Central High property.
  - f. Provide an Option 3 using the existing Silver St./North St. crossroad configuration for purposes of discussing the difficulties of this option. Renumber the existing Option 3 as Option 3a.
3. Intersection improvement concepts – attendees reviewed improvement concepts revising the I-190/Silver St. interchange into an at-grade intersection.
  - a. Revise Options 5, 5a to show no intersection connection to West Blvd., east of I-190.
  - b. Dismiss Options 6, 6a (see 2d).

- c. See 2a, 2b, 2c, 2e.
  - d. Mention the roundabout option at the public meeting and explain that the option would require a more extensive redesign of the entire corridor than currently contemplated.
4. Interstate designation – the issue of redesignating the I-190 route was discussed and a Pro/Con list was reviewed. Provide more detail regarding multi-modal use in the reasons to redesignate.
5. Evaluation criteria – a list of possible evaluation criteria were reviewed. Criteria for compliance with planned transportation networks and development impacts will be added. The following criteria will also receive higher weight in the evaluation:
- a. Preliminary environmental impacts
  - b. Overall cost and public sector cost
  - c. Traffic operations
  - d. Safety

**Action/Notes:**

- 1. HDR will revise the concepts as noted above and circulate within SDDOT at least one week prior to the public meeting.
- 2. HDR will continue to prepare for the public meeting and produce the technical memos.

# HCM Signalized Intersection Capacity Analysis

## 3: Silver Street & I-190

6/21/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	44	23	447	20	64	10	1213	422	217	1020	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	3433	3539	1583	1770	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1583	3433	3539	1583	1770	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	48	25	486	22	70	11	1318	459	236	1109	3
RTOR Reduction (vph)	0	0	23	0	0	54	0	0	0	0	0	0
Lane Group Flow (vph)	16	48	2	486	22	16	11	1318	459	236	1109	3
Turn Type	Prot		Perm	Prot		Perm	Prot		Free	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			Free
Actuated Green, G (s)	1.6	7.2	7.2	14.9	20.5	20.5	1.5	39.7	90.0	12.2	50.4	90.0
Effective Green, g (s)	1.6	7.2	7.2	14.9	20.5	20.5	1.5	39.7	90.0	12.2	50.4	90.0
Actuated g/C Ratio	0.02	0.08	0.08	0.17	0.23	0.23	0.02	0.44	1.00	0.14	0.56	1.00
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	31	283	127	568	806	361	30	1561	1583	465	1982	1583
v/s Ratio Prot	0.01	0.01		c0.14	0.01		0.01	c0.37		c0.07	0.31	
v/s Ratio Perm			0.00			0.01			c0.29			0.00
v/c Ratio	0.52	0.17	0.02	0.86	0.03	0.04	0.37	0.84	0.29	0.51	0.56	0.00
Uniform Delay, d1	43.8	38.6	38.1	36.5	27.0	27.1	43.8	22.4	0.0	36.1	12.7	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.7	0.3	0.0	12.0	0.0	0.1	7.4	5.8	0.5	0.9	1.1	0.0
Delay (s)	57.6	38.9	38.2	48.5	27.0	27.2	51.2	28.2	0.5	37.0	13.8	0.0
Level of Service	E	D	D	D	C	C	D	C	A	D	B	A
Approach Delay (s)		42.1			45.1			21.2			17.9	
Approach LOS		D			D			C			B	

### Intersection Summary

HCM Average Control Delay	24.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 3: Silver Street & I-190

6/21/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	88	30	380	33	39	10	1640	157	67	1020	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	3433	3539	1583	1770	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1583	3433	3539	1583	1770	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	12	96	33	413	36	42	11	1783	171	73	1109	3
RTOR Reduction (vph)	0	0	30	0	0	34	0	0	0	0	0	0
Lane Group Flow (vph)	12	96	3	413	36	8	11	1783	171	73	1109	3
Turn Type	Prot		Perm	Prot		Perm	Prot		Free	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			Free
Actuated Green, G (s)	0.8	9.0	9.0	10.0	18.2	18.2	1.5	48.8	90.0	6.2	53.5	90.0
Effective Green, g (s)	0.8	9.0	9.0	10.0	18.2	18.2	1.5	48.8	90.0	6.2	53.5	90.0
Actuated g/C Ratio	0.01	0.10	0.10	0.11	0.20	0.20	0.02	0.54	1.00	0.07	0.59	1.00
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	16	354	158	381	716	320	30	1919	1583	236	2104	1583
v/s Ratio Prot	0.01	c0.03		c0.12	0.01		0.01	c0.50		c0.02	c0.31	
v/s Ratio Perm			0.00			0.01			0.11			0.00
v/c Ratio	0.75	0.27	0.02	1.08	0.05	0.03	0.37	0.93	0.11	0.31	0.53	0.00
Uniform Delay, d1	44.5	37.5	36.5	40.0	28.9	28.8	43.8	19.0	0.0	39.9	10.8	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	106.0	0.4	0.1	70.5	0.0	0.0	7.4	9.5	0.1	0.7	0.9	0.0
Delay (s)	150.5	37.9	36.6	110.5	29.0	28.8	51.2	28.5	0.1	40.6	11.7	0.0
Level of Service	F	D	D	F	C	C	D	C	A	D	B	A
Approach Delay (s)		47.2			97.5			26.1			13.5	
Approach LOS		D			F			C			B	

### Intersection Summary

HCM Average Control Delay	32.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			