Technical Memo

Date:	Thursday, July 18, 2019
Project:	US16 Corridor Study
To:	Study Advisory Team
From:	HDR
Subject:	2050 No-Build Conditions Traffic Operations

Introduction

This memorandum presents the 2050 No-Build Conditions traffic operations analysis along the US16 corridor and other study area roadways for the US16 Corridor Study. The future-year No-Build conditions scenario analyzes 2050 traffic forecasts with existing roadway conditions such as number of lanes, intersection traffic control, speed limits, etc. Traffic volumes represent traffic counts factored to a summer design season (June).

The purpose of this memorandum is to identify future traffic operational needs along the study corridor. Methodology used to develop traffic forecasts is presented in the *Traffic Forecasts* technical memorandum.

Traffic Data

Traffic volumes presented in this technical memorandum reflect future-year traffic forecasts for a 2050 No-Build Conditions design season (June) as presented in the *Traffic Forecasts* technical memorandum. These forecasts are based on output from the Rapid City Area Metropolitan Planning Organization (RCAMPO) travel demand model and 2019 traffic counts. The following model versions were used to develop forecasts for this study:

- 2013 – base year
- 2040 – planning horizon

Intersection turning movements/percentages and heavy vehicle percentages (trucks, RVs, and lights pulling boats/cambers/trailers) were obtained from peak hour intersection turning movement counts obtained by the consultant team on Thursday, May 30, 2019. These counts were supplemented by SDDOT 24-hour roadway segment counts collected from Thursday, May 20, 2019, through the weekend. SDDOT segment counts were the basis for estimating free-flow speed. Peak hour factors (PHF) were adjusted to 0.90 within the urban area and 0.80 outside of the urban area (see Level of Service Goals section for discussion on urban and rural areas).

The intersection and roadway segment count locations are summarized in **Table 1** and **Table 2**, respectively.

Table 1: Study Area Intersection Turning Movement Count Locations (Analysis Intersections)

Ref #	Street #1	Street #2
1	US16	Cosmos Road
2	US16	Beretta Road
3	US16	Silver Mountain Road
4	US16 E	16 E1 55.42 (Off-Ramp to Rockerville)
5	US16 W	Silver Mountain Road – Main Street – 16 WF 55.70
6	US16 W	Pine Haven Drive / Private Road
7	US16 E	Rockerville Road / 16 EF 55.78
8	US16 W	16 W2 55.67 (On-Ramp from Rockerville)
9	US16 W	16 W1 56.16 (Off-Ramp to Rockerville)
10	US16 E	Golden Hills Drive / 16 EF 55.93
11	US16 W	Main Street / 16WF 55.70
12	US16 E	16 E2 56.09 (On-Ramp from Rockerville)
13	US16	Strato Bowl Road
14	US16	Strato Rim Drive
15	US16	Busted Five Lane
16	US16	Wilderness Canyon Road
17	US16	Bear Country Exit
18	US16	Bear Country Entrance
19	US16	Croell Pit West/Main Entrance
20	US16	Neck Yoke Road / Reptile Gardens South
21	US16	Reptile Gardens Center
22	US16	Reptile Gardens North
23	US16	unknown road
24	US16	Sammis Trail
25	US16	Moon Meadows Drive
26	US16	Addison Avenue
27	US16	US16B / Catron Blvd
28	US16	Tucker Street
29	US16	Promise Road
30	US16	Table Rock Road
31	US16	Enchantment Road
32	US16	Service Road / school entrances
33	US16	Echo Ridge Drive
34	US16	Fairmont Blvd / Cathedral Drive
35	US16B / Catron Blvd	Healing Way
36	Catron Boulevard	Les Hollers Way
37	US16B / Catron Blvd	Wellington Drive (west)
38	US16B / Catron Blvd	Wellington Drive (east)
39	Neck Yoke Road	Spring Creek Road / Rockerville Road

See traffic volume figures for map.

Table 2: US16 Segment Count Locations

Ref #	MRM	US16 Segment Area Description
A	55.00	2.5 miles east of US16/US16A junction (Keystone Wye)
B	63.00	South of Moon Meadows Drive
C	63.89	Between Moon Meadows Drive and US16B/Catron Blvd
D	64.00	Between Promise Road and Tablerock Road
E	64.90	Between Tower Road and Echo Ridge Drive

See traffic volume figures for map.
Traffic data collected in eastbound and westbound directions at all locations.

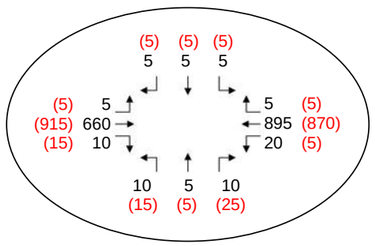
2050 No-Build Conditions Traffic Forecasts

Traffic forecasts for 2045 were prepared using the most current version of the Rapid City Area MPO travel demand model (year 2040). Methodology used in the development of segment and intersection peak hour forecasts was consistent with *NCHRP 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design*.

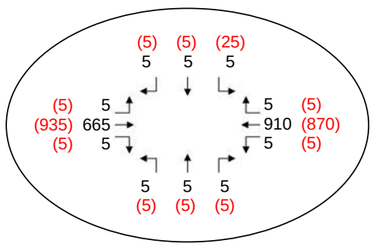
Analysis traffic volumes for the 2050 No-Build Conditions are summarized in **Figure 1**. *Traffic Forecasts* technical memorandum presents more details regarding the methodology and process of developing future-year peak hour and daily traffic volumes.

US16 Corridor

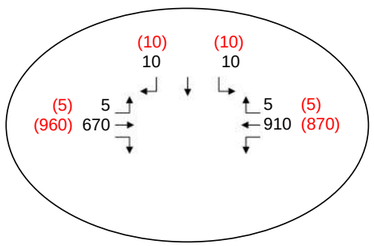
1. US16 & Cosmos Road



2. US16 & Beretta Road



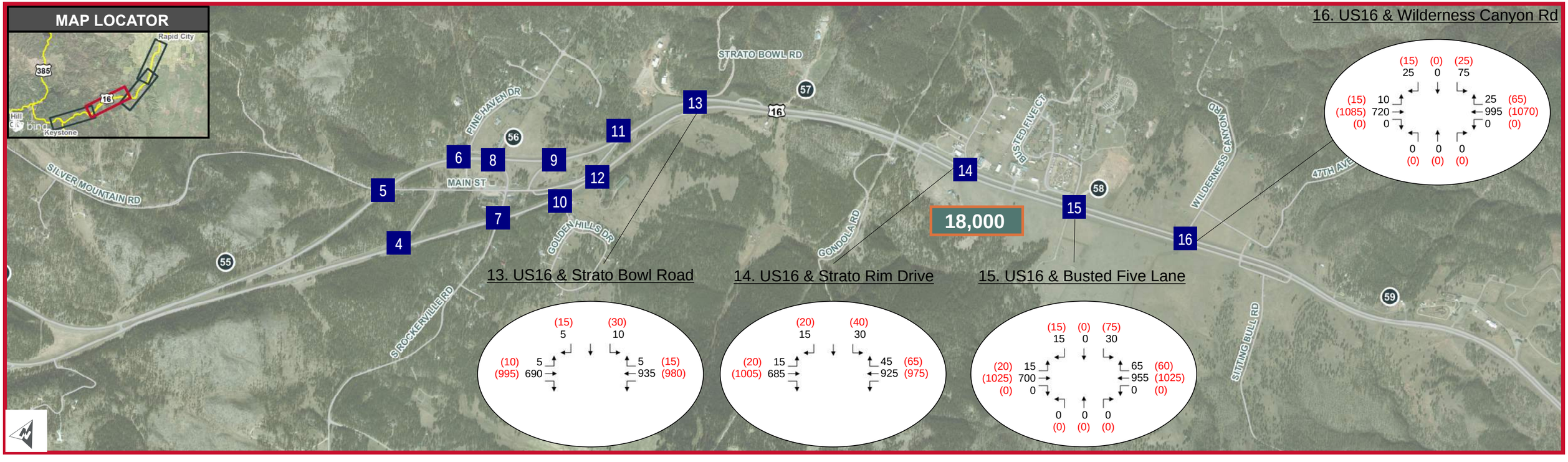
3. US16 & Silver Mountain Road



Legend

- (54) Mileage Reference Marker (MRM)
- 1 Study Intersection
- 14,000 2050 Daily Traffic Volumes*
- AM (PM) 2050 Peak Hour Traffic Volumes*

Notes:
**** Volumes reflect June design season***
Stop-controlled intersections are two-way stop-control unless noted.



US16 W Corridor

5. US16 W & Silver Mountain Rd

(15) (5)
15 5
5 (15)
890 (855)
5 (10)
10 5
(5) (5)

6. US16 W & Pine Haven Drive

(10) (15)
5 15
5 (20)
890 (865)
5 (5)
5 10
(5) (10)

8. US16 W & 16 W2 55.67

875 (875)
25
(15)

9. US16 W & 16 W1 56.16

875 (875)
5 (10)

11. US16 W & Main Street

880 (885)
60 (110)

US16 E Corridor

4. US16 E & 16 E1 55.42

(10) 5
(960) 675

7. US16 E & Rockerville Road

(75) (20)
50 5
(5) 5
(935) 660
(20) 10
15 25
(10) (40)

10. US16 E & Golden Hills Dr

(15) (5)
10 5
(0) 0
(990) 685
(5) 5
5 5
(5) (5)

12. US16 E & 16 E2 56.09

(0) (5)
0 0
(0) 0
(995) 690
(5) 5
0 5
(0) (5)

US Highway 16 CORRIDOR STUDY

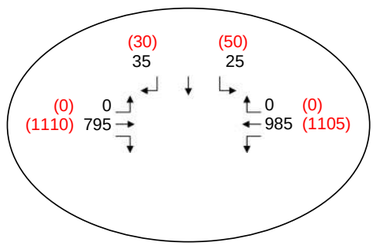
2050 NO-BUILD CONDITIONS TRAFFIC VOLUMES

US16 CORRIDOR STUDY

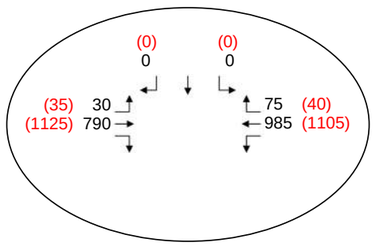
FIGURE 1, PAGE 2 OF 4

17. US16 & Bear Country Exit

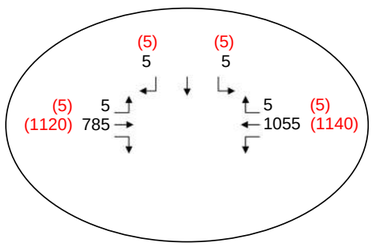
US16 Corridor



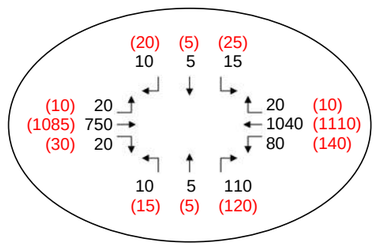
18. US16 & Bear Country Ent.



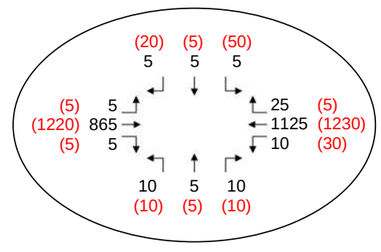
19. US16 & Croell Pit West Ent.



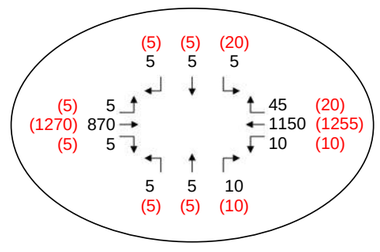
20. US16 & Neck Yoke Road



21. US16 & Reptile Gardens Cent.

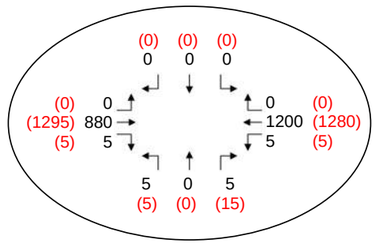


22. US16 & Reptile Gardens (N)

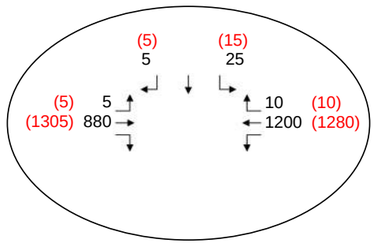


US16 Corridor

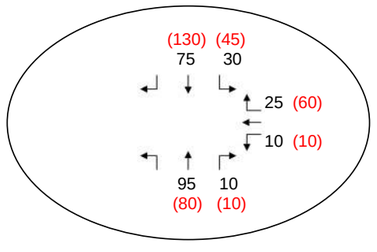
23. US16 & Unknown Road



24. US16 & Sammis Tr

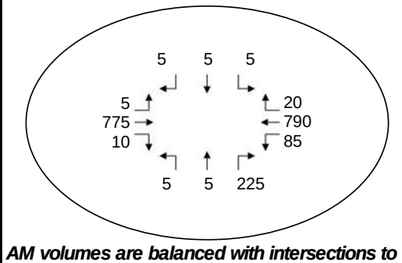


39. Neck Yoke Rd & Spring Creek Rd

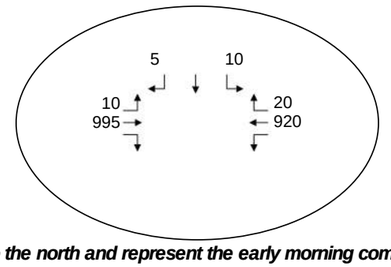


AM - Early Morning Commute (Directional to Rapid City)

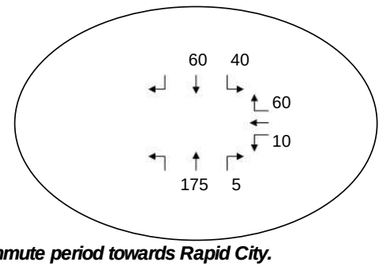
20. US16 & Neck Yoke Road



24. US16 & Sammis Tr



39. Neck Yoke Rd & Spring Creek Rd

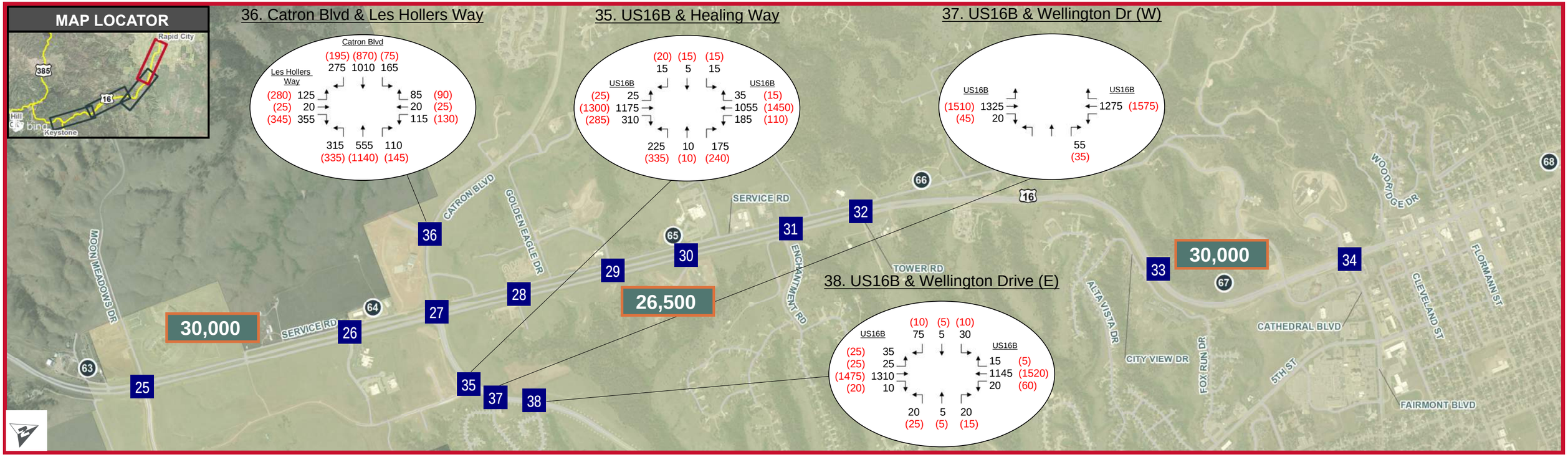


AM volumes are balanced with intersections to the north and represent the early morning commute period towards Rapid City.

2050 NO-BUILD CONDITIONS TRAFFIC VOLUMES

US16 CORRIDOR STUDY

PATH: \\SXF-SRV01\ENG\GIS\PROJECTS\SDDOT\US16_CORRIDORSTDY\MAP_DOCS\DRAFT\PUBLIC_MEETING\US16_TRAFFIC_INTERSECTION_TEMPLATE_ANSID.MXD - USER: KVANDEKA - DATE: 7/16/2019



US16 Corridor

25. US16 & Moon Meadows Rd

(80) (40) (110)
105 55 195
(85) 45
(1095) 875
(140) 85
185 (220)
770 (1120)
105 (290)
65 65 235
(90) (55) (295)

26. US16 & Addison Avenue

(75) (5) (125)
25 5 50
(40) 20
(1325) 1180
(135) 85
115 (20)
1000 (1450)
125 (65)
35 5 55
(105) (5) (130)

27. US16 & US16B/Catron Blvd

(250) (770) (325)
195 745 540
(270) 185
(715) 555
(595) 535
255 (510)
525 (630)
230 (245)
520 540 235
(655) (840) (310)

28. US16 & Tucker Street

(5) (5) (5)
5 5 5
(5) 5
(1340) 1320
(5) 5
5 (5)
1000 (1375)
5 (5)
5 5 5
(5) (5) (5)

29. US16 & Promise Road

(80) (15) (70)
60 10 105
(125) 55
(1195) 1245
(30) 30
30 (90)
915 (1285)
20 (30)
35 5 35
(20) (15) (30)

30. US16 & Table Rock Road

(50) (5) (5)
45 5 15
(20) 45
(1220) 1305
(55) 35
10 (10)
900 (1330)
25 (35)
25 5 20
(25) (5) (15)

US16 Corridor

31. US16 & Enchantment Road

(25) (25) (35)
25 25 65
(55) 15
(1135) 1290
(50) 35
25 (85)
865 (1305)
10 (80)
45 15 80
(45) (10) (50)

32. US16 & School Entrances

(40) (5) (15)
20 5 10
(25) 35
(1185) 1370
(10) 30
25 (20)
860 (1410)
15 (15)
20 5 20
(20) (5) (25)

33. US16 & Echo Ridge Drive

(1190) 1360
(35) 40
900 (1445)
35 (50)
90
(85)

34. US16 & Cathedral Drive/ Fairmont Blvd

(55) (45) (55)
20 20 25
(55) 40
(1025) 1055
(195) 355
75 (100)
750 (1145)
525 (650)
165 35 405
(295) (55) (580)

US Highway 16 CORRIDOR STUDY

2050 NO-BUILD CONDITIONS TRAFFIC VOLUMES

US16 CORRIDOR STUDY

PATH: \\SXF-SRV01\ENG\GIS\PROJECTS\SDDOT\US16_CORRIDORSTDY\MAP_DOCS\DRAFT\PUBLIC_MEETING\US16_TRAFFIC_INTERSECTION_TEMPLATE_ANSID.MXD - USER: KVANDEKA - DATE: 7/16/2019

Traffic Operations Analysis Methodology

Peak hour level of service (LOS) was calculated for study area intersections and roadway segments using Highway Capacity Software, Version 7 (HCS7) and methodology described in the 6th Edition of the Highway Capacity Manual (HCM6).

Intersection LOS

HCM6 analysis methodology measures intersection average control delay in terms of seconds of delay per vehicle (sec/veh) and applies a LOS value in accordance with thresholds presented in **Table 3**.

Table 3: Intersection Level of Service Thresholds

LOS	Intersection Delay per Vehicle (sec/veh)	
	Signalized Intersections	**Two-Way Stop-Control*, All-Way Stop-Control, and Roundabouts**
A	≤ 10	≤ 10
B	> 10 – 20	> 10 – 15
C	> 20 - 35	> 15 - 25
D	> 35 – 55	> 25 – 35
E	> 55 – 80	> 35 – 50
F	Demand exceeds capacity; > 80	Demand exceeds capacity; > 50

Source: Transportation Research Board, HCM6.
* Two-way stop-control LOS reflects worst-case stop-controlled approach.

Overall, or 'weighted', intersection delay was also calculated to present a second average delay measure at two-way stop-control intersections. This method accounts for the operational benefits afforded to the major, high volume through movements that are not stop or signal-controlled at intersections. HCM6 reporting in HCS7 provides an average intersection delay value that reflects the weighted average delay of all vehicles entering the intersection. A LOS measure is applied to this overall intersection delay value using HCM6 All-Way Stop-Control LOS thresholds.

Multilane Highway Segment LOS

HCM6 methodology was used to analyze multilane highway segments. HCM6 analysis methods measure lane density in terms of passenger cars per mile per lane (pc/mi/ln) and applies a LOS value in accordance with thresholds presented in **Table 4**.

Table 4: Multilane Highway Segment Level of Service Thresholds

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 – 18
C	> 18 – 26
D	> 26 – 35
E	> 35 – 45
F	Demand exceeds capacity OR Density > 45

Merge and Diverge Segment LOS

For merge and diverge locations around the Rockerville area, HCM6 methodology for freeway merge and diverge segments was used to analyze similar locations around the Rockerville area. HCM analysis methods measure merge and diverge segment density in terms of passenger cars per mile per lane (pc/mi/ln) and applies a LOS value in accordance with thresholds presented in **Table 5**.

Table 5: Freeway Merge and Diverge Segment Level of Service Thresholds

LOS	Density (pc/mi/ln)
A	≤ 10
B	> 10 – 20
C	> 20 – 28
D	> 28 – 35
E	> 35
F	Demand exceeds capacity

Level of Service Goals

The following minimum allowable LOS thresholds in **Table 6** have been established for this study, applicable to the existing conditions.

Table 6: Minimum Allowable Level of Service by Facility and Area Type

Facility Type	Minimum Allowable LOS		Notes
	Rural Area	Urban Area	
Signalized Intersections	LOS B	LOS C	Individual movements allowed to operate at LOS D.
Two-Way Stop-Controlled Intersections	LOS B	LOS C	TWSC intersection LOS will be based on weighted average intersection delay. The worst-cast stop-controlled approach delay and LOS may be lower than the minimum allowable LOS.
Multilane Highways	LOS B	LOS C	LOS B desirable in urban area.

Different LOS goals are identified for rural and urban areas. Currently, the urban-rural classification boundary is as follows:

- Urban – north of section line between Sammis Trail and Neck Yoke Road
- Rural – south of section line between Sammis Trail and Neck Yoke Road

Study LOS goals will be used to identify areas of operational needs along the corridor. Later in the study, these thresholds will be used to guide the development of potential improvements and subsequent evaluation of concepts.

2050 No-Build Conditions Traffic Operations Analysis

The 2050 No-Build Conditions traffic operations analysis reflects a scenario that analyzes forecasted 2050 volumes and existing roadway conditions, such as number of lanes, intersection traffic control, speed limits, etc. It is assumed that signal timings will be updated on a recurring basis in the future and thus this analysis reflects re-optimized timings.

Changes to the 2019 Existing Conditions roadway network typically center on development-related modifications to accommodate this future development. Additional intersection legs to serve this development have been incorporated, per recommendations from traffic impact studies (TISs) to date, to help understand future-year needs from this development. The 2050 No-Build Conditions also assumes no redistribution or re-assignment of traffic due to congestion or existing traffic control, regardless of how unrealistic the resulting delay is at an intersection.

The other modification is at the intersection of US16B/Healing Way as both the existing stop-controlled intersection and a future, planned signalized intersection is analyzed.

The 2050 No-Build Conditions intersection and highway segment operations are summarized in the following tables. HCS7 analysis reports are provided in the **Appendix**.

Intersections

The intersections are grouped by urban and rural classifications, based on whether they are north or south of the section line between Sammis Trail and Neck Yoke Road. A graphical summary of intersection operations is presented in **Figure 1.**

Urban Area Intersections

Table 7 through **Table 10**, provide operational results for the urban area TWSC and signalized intersections.

Because a traffic signal is currently planned for construction in 2019 at the US16B/Healing Way intersection, both the TWSC and signalized operations are shown in the tables.

Table 7: US16 Corridor Two-Way Stop-Control Intersection Traffic Operations – Urban Area

US16 Corridor Intersection	Measure*	AM			PM		
		Control Delay (sec/veh)	LOS	95% Queue (veh)	Control Delay (sec/veh)	LOS	95% Queue (veh)
Echo Ridge Drive	**Overall**	**0.9**	**A**	-	**0.7**	**A**	-
	TWSC	*19.1*	*C*	*1.1*	*16.4*	*C*	*0.9*
Service Road / school entrances	**Overall**	**1.5**	**A**	-	**1.9**	**A**	-
	TWSC	*49.7*	*E*	*6.0*	*44.3*	*E*	*1.8*
Enchantment Road	**Overall**	**11.0**	**B**	-	**98.0**	**F**	-
	TWSC	*135.3*	*F*	*6.7*	*2716.4*	*F*	*12.6*
Table Rock Road	**Overall**	**4.6**	**A**	-	**4.7**	**A**	-
	TWSC	*93.6*	*F*	*2.9*	*102.6*	*F*	*2.8*
Promise Road	**Overall**	**33.4**	**D**	-	**~**	**F**	-
	TWSC	*401.3*	*F*	*14.7*	*~*	*F*	*~*
Tucker Street	**Overall**	**0.6**	**A**	-	**0.9**	**A**	-
	TWSC	*27.3*	*D*	*0.3*	*34.5*	*D*	*0.4*
Addison Avenue	**Overall**	**32.9**	**D**	-	**~**	**F**	-
	TWSC	*960.6*	*F*	*10.1*	*~*	*F*	*~*
Moon Meadows Drive	**Overall**	**220.4**	**F**	-	**~**	**F**	-
	TWSC	*1664.1*	*F*	*26.3*	*~*	*F*	*~*
Sammis Trail	**Overall**	**0.2**	**A**	-	**0.2**	**A**	-
	TWSC	*18.4*	*C*	*0.2*	*27.4*	*D*	*0.4*

** Measure notes: Overall intersection control delay represents the weighted average of each approach.*
TWSC control delay represents the worst-cast stop-controlled approach delay and the associated 95th% queue.
~ Volume exceeds capacity on minor approaches and computation not defined.

Table 8: Other Study Area Two-Way Stop-Control Intersection Traffic Operations – Urban Area

Intersection	Measure*	AM			PM		
		Control Delay (sec/veh)	LOS	95% Queue (veh)	Control Delay (sec/veh)	LOS	95% Queue (veh)
US16B/Catron Blvd & Healing Way *(signal planned 2019)*	**Overall**	**98.6**	**F**	-	**211.4**	**F**	-
	TWSC	*5664.8*	*F*	*3.6*	*3324.9*	*F*	*27.6*
US16B/Catron Blvd & Wellington Dr (W)	**Overall**	**0.4**	**A**	-	**0.2**	**A**	-
	TWSC	*17.0*	*C*	*0.6*	*18.7*	*C*	*0.4*
US16B/Catron Blvd & Wellington Dr (E)	**Overall**	**75.2**	**F**	-	**~**	**F**	-
	TWSC	*1443.9*	*F*	*14.3*	*~*	*F*	*~*

** Measure notes: Overall intersection control delay represents the weighted average of each approach.*
TWSC control delay represents the worst-cast stop-controlled approach delay and the associated 95th% queue.
~ Volume exceeds capacity on minor approaches and computation not defined.

Table 9: US16 Corridor Signalized Intersection Traffic Operations – Urban Area

US16 Corridor Intersection	Measure	AM		PM		Notes
		Control Delay (sec/veh)	LOS	Control Delay (sec/veh)	LOS	
Fairmont Blvd / Cathedral Drive	Signal	24.3	C	34.7	C	*Measured queues exceed available storage: SBL (AM & PM) and WBL (PM).*
US16B / Catron Blvd	Signal	75.4	E	136.6	F	*Multiple movements LOS F in AM and PM peak hours. Intersection demand exceeds capacity.*

Table 10: Other Signalized Intersection Traffic Operations – Urban Area

Intersection	Measure	AM		PM		Notes
		Control Delay (sec/veh)	LOS	Control Delay (sec/veh)	LOS	
Catron Blvd & Les Hollers Way	Signal	79.6	E	55.0	D	*Measured queues exceed available storage: NBL (AM) and WBL (AM & PM). Multiple LOS E or F approaches.*
US16B & Healing Way *(signal planned 2019)*	Signal	23.9	C	33.9	C	

US16B and Healing Way signal planned for 2019 installation.

There were five US16 corridor and US16B corridor TWSC intersections where the overall intersection LOS degraded to LOS D or worse:

- US16 & Promise Road (AM and PM peak periods)
- US16 & Addison Avenue (AM and PM peak periods)
- US16 & Moon Meadows Drive (AM and PM peak periods)
- US16B/Catron Boulevard & Healing Way (AM and PM peak periods)
- US16B/Catron Boulevard & Wellington Drive (east) (AM and PM peak periods)

Each of these intersections are expected to see notable traffic demand from future development and have been studied extensively through recent traffic impact studies. Recommendations from those studies will be reviewed for consideration in the overall plan for the US16 corridor.

There are several other intersections throughout the study area that show LOS F on the stop-controlled approach, but have an overall intersection LOS of A or B. These approaches demonstrate the increasing difficulty vehicles may have completing a turn onto or crossing US16 or US16B in the future. Collectively, the future-year demand at potentially signalized intersections is likely greater than what is shown in the 2050 No-Build Conditions forecasts. A signalized access point will attract traffic from adjacent stop-controlled intersections due to the difficulty in completing a turning or crossing movement.

At signalized intersections, the US16/US16B/Catron Boulevard intersection experiences LOS F in both the AM and PM peak periods as demand far exceeds capacity.

The Catron Boulevard and Les Hollers Way also shows degrading operations with LOS E and D in the AM and PM peak periods, respectively. Multiple approaches measure LOS E or F. Right-turn lanes would provide the greatest benefit at this intersection, particularly in the northbound direction, where a right-turn overlap could be used to improve capacity and lengthen green time for high-volume through movements. Traffic signal coordination of high volume through movements, in this case the westbound direction from US16/US16B/Catron Boulevard, would also benefit the intersection.

The US16 and Cathedral Drive/Fairmont Boulevard met LOS goals for this study, but queue spillback was noted on the dual southbound left-turn lanes and the westbound left-turn lane.

Rural Area Intersections

The following tables, **Table 11** through **Table 13**, provide operational results for the rural area TWSC intersections.

It was found that all rural area TWSC intersections meet study operational goals of weighted average intersection of LOS B or better. There are several locations, however, that exhibit worst-case stop-controlled approach LOS D, E or F, and are most prominent in the Neck Yoke Road area, Busted Five Lane area, and other common tourist-related exits.

Table 11: US16 Corridor Two-Way Stop-Control Intersection Traffic Operations – Rural Area (Neck Yoke Road Area to Strato Bowl Road)

US16 Corridor Intersection	Measure*	AM			PM		
		Control Delay (sec/veh)	LOS	95% Queue (veh)	Control Delay (sec/veh)	LOS	95% Queue (veh)
Unknown Road	**Overall**	**0.6**	**A**	-	**1.9**	**A**	-
	TWSC	*42.5*	*E*	*0.4*	*78.0*	*F*	*1.3*
Reptile Gardens North	**Overall**	**3.1**	**A**	-	**64.0**	**F**	-
	TWSC	*204.6*	*F*	*1.9*	*4539.5*	*F*	*6.3*
Reptile Gardens Center	**Overall**	**11.2**	**B**	-	**134.9**	**F**	-
	TWSC	*577.9*	*F*	*4.0*	*4259.0*	*F*	*13.1*
Neck Yoke Road / Reptile Gardens S	**Overall**	**22.8**	**C**	-	**590.7**	**F**	-
	TWSC	*525.4*	*F*	*10.1*	*12975.8*	*F*	*23.1*
Croell Pit West / Main Entrance	**Overall**	**0.3**	**A**	-	**0.5**	**A**	-
	TWSC	*39.3*	*E*	*0.3*	*63.4*	*F*	*0.6*
Bear Country Entrance	**Overall**	**0.3**	**A**	-	**0.3**	**A**	-
	TWSC	*121.9*	*F*	*~*	*288.3*	*F*	*~*
Bear Country Exit	**Overall**	**1.3**	**A**	-	**12.8**	**B**	-
	TWSC	*40.6*	*E*	*2.0*	*368.1*	*F*	*8.4*
Wilderness Canyon Road	**Overall**	**2.5**	**A**	-	**1.0**	**A**	-
	TWSC	*42.9*	*E*	*3.3*	*26.2*	*D*	*0.9*
Busted Five Lane	**Overall**	**0.8**	**A**	-	**3.6**	**A**	-
	TWSC	*21.5*	*C*	*0.8*	*66.2*	*F*	*4.1*
Strato Rim Drive	**Overall**	**0.6**	**A**	-	**1.4**	**A**	-
	TWSC	*12.3*	*B*	*0.3*	*31.7*	*D*	*1.5*
Strato Bowl Road	**Overall**	**0.3**	**A**	-	**1.1**	**A**	-
	TWSC	*20.7*	*C*	*0.2*	*25.3*	*D*	*0.9*

** Measure notes: Overall intersection control delay represents the weighted average of each approach.*
TWSC control delay represents the worst-cast stop-controlled approach delay and the associated 95th% queue.
~ Volume exceeds capacity on minor approaches and computation not defined.

Table 12: US16 Corridor Two-Way Stop-Control Intersection Traffic Operations – Rural Area (Rockerville Area to Keystone Wye)

US16 Corridor Intersection	Measure*	AM			PM		
		Control Delay (sec/veh)	LOS	95% Queue (veh)	Control Delay (sec/veh)	LOS	95% Queue (veh)
US16 E & Golden Hills Drive	**Overall**	**0.6**	**A**	-	**0.6**	**A**	-
	TWSC	17.7	C	0.2	25.4	D	0.4
US16 E & Rockerville Road	**Overall**	**2.3**	**A**	-	**5.0**	**A**	-
	TWSC	20.0	C	0.8	48.1	E	3.4
US16 W & Pine Haven Drive	**Overall**	**0.8**	**A**	-	**0.8**	**A**	-
	TWSC	21.4	C	0.3	21.1	C	0.3
US16 W & Silver Mountain Road / Main Street	**Overall**	**0.7**	**A**	-	**0.7**	**A**	-
	TWSC	20.2	C	0.2	19.1	C	0.2
Silver Mountain Road	**Overall**	**0.4**	**A**	-	**0.4**	**A**	-
	TWSC	25.2	D	0.4	30.7	D	0.5
Beretta Road	**Overall**	**1.1**	**A**	-	**4.8**	**A**	-
	TWSC	57.8	F	0.8	212.0	F	3.6
Cosmos Road	**Overall**	**1.8**	**A**	-	**2.4**	**A**	-
	TWSC	64.4	F	1.1	87.3	F	2.2

** Measure notes: Overall intersection control delay represents the weighted average of each approach.*
TWSC control delay represents the worst-cast stop-controlled approach delay and the associated 95th% queue.
~ Volume exceeds capacity on minor approaches and computation not defined.

Table 13: Other Study Area Two-Way Stop-Control Intersection Traffic Operations – Rural Area

Intersection	Measure*	AM			PM		
		Control Delay (sec/veh)	LOS	95% Queue (veh)	Control Delay (sec/veh)	LOS	95% Queue (veh)
Neck Yoke Road & Spring Creek Road	**Overall**	**2.1**	**A**	-	**2.9**	**A**	-
	TWSC	7.9	A	0.1	8.5	A	0.3

** Measure notes: Overall intersection control delay represents the weighted average of each approach.*
TWSC control delay represents the worst-cast stop-controlled approach delay and the associated 95th% queue.
~ Volume exceeds capacity on minor approaches and computation not defined.

Multilane Highway Segments

The US16 corridor was segmented in accordance with HCM6 methodology, with segment break points typically reflective of changes in grade. The respective segment was then analyzed based on 'level' or 'rolling' terrain or a specific grade for segments areas where long, steep grades were present (typically for segments longer than 0.25 miles and with grades of 3 percent or greater).

The US16 multilane highway segments are grouped by urban and rural classifications, based on whether they are north or south of the section line between Sammis Trail and Neck Yoke Road, in the following tables. A key that shows approximate limits of each segment is provided in the **Appendix**.

Overall, all US16 corridor multilane highway segments were measured to operate at LOS A or B with 2050 No-Build Conditions traffic volumes.

Table 14: US16 Corridor Multilane Highway Traffic Operations – Urban Area

Seg. #	Mainline	Approximate Limits		Approx. Length (miles)*	Analysis Grade (%)**	AM LOS		PM LOS	
		From	To			EB	WB	EB	WB
35	US 16	MRM 63.00	Addison Ave	0.8	Rolling	B	B	B	B
36	US 16	Addison Ave	US16B/ Catron Blvd	0.3	5.2	B	A	B	B
37	US 16	US16B/ Catron Blvd	MRM 66.00	1.5	Rolling	B	A	B	B
38 - 39	US 16	MRM 66.00	Cathedral Dr/ Fairmont Blvd	1.4	5.9	B	B	B	C

** Where multiple grades are shown, first length reflects eastbound direction and second length reflects westbound direction.*
*** Analysis grade reflects level, rolling or specific grade (segment upgrade typically shown for segments representing two directions of travel; grade may be shown as negative when US16 EB or WB analyzed as a downgrade when only one direction is analyzed due to alignment split), per HCM6 methodology.*
Existing profile information obtained from SDDOT profile GIS layer (current spring 2019).
Note: limits and length are approximate, and thus may not align due to rounding and approximation of MRM locations.

Table 15: US16 Corridor Multilane Highway Traffic Operations – Rural Area (Keystone Wye to Busted Five Lane Area)

Seg. #	Mainline	Approximate Limits		Approx. Length (miles)*		Analysis Grade (%)**	AM LOS		PM LOS	
		From	To				EB	WB	EB	WB
1 - 2	US 16	Project Beginning MRM 50.75	Cosmos Road	0.5		4.5	A	A	A	A
3	US 16	Cosmos Road	MRM 52.00	0.6		Rolling	A	B	B	A
4	US 16	MRM 52.00	MRM 52.50	0.5		4.0	A	A	B	A
5	US 16	MRM 52.50	MRM 52.75	0.25		3.9	A	A	A	A
6	US 16	MRM 52.75	MRM 53.00	0.2		Level	A	A	A	A
7	US 16	MRM 53.00	Silver Mountain Rd	0.3		5.0	A	A	A	A
8	US 16	Silver Mountain Rd	MRM 54.00 (EB) / MRM 53.75 (WB)	0.7	0.6	3.1	A	A	A	A
9	US 16 (EB)	MRM 54.00	MRM 54.25	0.54		Rolling	A	-	B	-
10	US 16 (WB)	MRM 53.75	MRM 54.00	0.4		-3.5	-	A	-	A
11	US 16 (EB)	MRM 54.00	MRM 54.25	0.25		4.8	-	A	-	A
12	US 16	MRM 54.25	MRM 54.50	0.3		6.0	A	A	B	A
13	US 16	MRM 54.50	MRM 55.00	0.3		6.0	A	A	A	A
14	US 16 (EB)	MRM 55.00	MRM 55.25	0.25		Level	A	-	A	-
15	US 16 (WB)	MRM 55.00	MRM 55.25	0.25		4.0	-	A	-	A
16	US 16	MRM 55.25	MRM 55.75 (EB) / Silver Mtn Rd (WB)	0.4	0.3	6.0	A	A	A	A
17	US 16	Silver Mountain Rd	Pine Haven Dr	0.2		3.2	-	A	-	A
18	US 16	MRM 55.75 (EB)/ Pine Haven Rd (WB)	Golden Hills Dr (EB) / MRM 56.00 (WB)	0.3	0.2	Level	A	A	A	A
19	US 16 (EB)	Golden Hills Dr	MRM 56.50	0.3		-5.7	A	-	A	-
20	US 16 (WB)	MRM 56.00	Strato Bowl Rd	0.5		3.0	-	A	-	B

** Where multiple grades are shown, first length reflects eastbound direction and second length reflects westbound direction.*
*** Analysis grade reflects level, rolling or specific grade (segment upgrade typically shown for segments representing two directions of travel; grade may be shown as negative when US16 EB or WB analyzed as a downgrade when only one direction is analyzed due to alignment split), per HCM6 methodology.*
Existing profile information obtained from SDDOT profile GIS layer (current spring 2019).
Note: limits and length are approximate, and thus may not align due to rounding and approximation of MRM locations.

Table 16: US16 Corridor Multilane Highway Traffic Operations – Rural Area (Busted Five Lane Area to Urban Area Boundary)

Seg. #	Mainline	Approximate Limits		Approx. Length (miles)*		Analysis Grade (%)**	AM LOS		PM LOS	
		From	To				EB	WB	EB	WB
21	US 16	MRM 56.50 (EB) / Strato Bowl Rd (WB)	MRM 57.00	0.5	0.3	Rolling	A	B	B	A
22	US 16	MRM 57.00	MRM 57.25	0.25		4.6	A	A	B	B
23	US 16	MRM 57.25	MRM 57.50	0.25		6.0	A	B	B	B
24	US 16	MRM 57.50	MRM 58.75	1.2		Level	A	B	B	B
25	US 16	MRM 58.75	MRM 59.25	0.7		6.0	A	B	B	B
26	US 16	MRM 59.25	Croell Pit West Entrance	0.35		Level	A	B	B	B
27 - 31	US 16	Croell Pit West Entrance	MRM 61.50	1.8		6.0	A	B	B	B
32	US 16	MRM 61.50	MRM 62.00	0.4		Level	A	B	B	B
33 - 34	US 16	MRM 62.00	MRM 63.00	1.0		6.5	A	B	B	B

** Where multiple grades are shown, first length reflects eastbound direction and second length reflects westbound direction.*

*** Analysis grade reflects level, rolling or specific grade (segment upgrade typically shown for segments representing two directions of travel; grade may be shown as negative when US16 EB or WB analyzed as a downgrade when only one direction is analyzed due to alignment split), per HCM6 methodology.*

Existing profile information obtained from SDDOT profile GIS layer (current spring 2019).

Note: limits and length are approximate, and thus may not align due to rounding and approximation of MRM locations.

Merge and Diverge Segments

US16 merge and diverge locations around the Rockerville area were analyzed as freeway merge and diverge segments to give an indication to how these locations are operating in terms of vehicle density. **Table 17** presents a summary of merge and diverge segment density. All locations were measured at LOS A or B.

Table 17: US16 Corridor Merge/Diverge Segment Traffic Operations – Rural Area (Rockerville Area)

Merge/ Diverge Location	Segment Type	AM			PM		
		LOS	Average Density (pc/mi/ln)	Ramp Influence Area Density (pc/mi/ln)	LOS	Average Density (pc/mi/ln)	Ramp Influence Area Density (pc/mi/ln)
US16 E & 16 E1 55.42 *Off-ramp to Rockerville*	Diverge	A	7.9	7.1	B	11.2	10.4
US16 W & 16 W2 55.67 *On-ramp to Rockerville*	Merge	B	10.7	11.9	B	10.3	11.6
US16 W & WB 55.70/Main Street *Off-ramp to Rockerville*	Diverge	B	10.9	10.9	B	10.7	10.7
US16 E & 16 E2 56.09 *On-ramp to Rockerville*	Merge	A	8.2	7.7	B	11.9	11.1
US16 W & 16 W1 56.15 *Off-ramp to Rockerville*	Diverge	B	10.9	10.9	B	10.9	10.9

Conclusions

The 2050 No-Build Conditions analysis incorporates future development and build-out of the local network throughout the US16 corridor as identified in the 2050 Rapid City Area MPO travel demand model and TISs completed to date. The greatest impact of future development is around the US16/US16B/Catron Boulevard intersection where flat, developable land is available on all four intersection quadrants. Future build-out of the local network and new connections outside of the study area via Les Hollers Way (extended to Sheridan Lake Road) and Moon Meadows (possible extension to SD79) also contribute to increased demand along these routes.

The resulting 2050 No-Build Conditions traffic operations reflects the turning movement demand on various US16 and US16B intersections with the local roadway network and the need to accommodate these movements via safe and reliable access at some location along the corridor. TWSC intersections that resulted in an overall intersection LOS that does not meet study goals includes:

- Moon Meadows Drive
- Addison Avenue
- Promise Road
- Healing Way (traffic signal construction planned 2019)
- Wellington Drive (east)

Throughout the corridor, it is not unusual for TWSC intersections to operate at LOS F from the stop-controlled approach during peak hours. This typically does not necessitate a modification to traffic control or the intersection geometrics. However, LOS F from a TWSC does illustrate additional considerations that aid in the corridor study, such as:

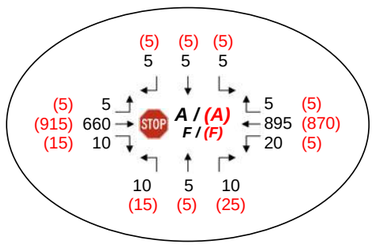
- Provides an overall understanding of demand into/out of development or local network access locations.
- Helps guide an access management plan for the development of safe and operationally beneficial access locations.
- Provides an understanding of available gaps in traffic during a peak hour.
- Highlights the need and/or availability of alternate means of access to complete desired turning movements, such as the location of signalized intersections, local network connectivity to get to signalized intersections, and localized turning restrictions.

With regard to signalized intersections, the Catron Boulevard and Les Hollers Way intersection shows degrading operations with continued development and an extension of Les Hollers Way to Sheridan Lake Road. The inclusion of right-turn lanes, particularly for the northbound to eastbound right-turn movement, would help address capacity constraints at this intersection.

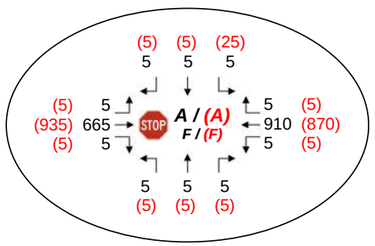
The combination of growing through traffic on both US16 and US16B continues to degrade operations at the US16/US16B/Catron Boulevard intersection. Demand in year 2050 is expected to exceed capacity with average vehicle delays around three minutes.

US16 Corridor

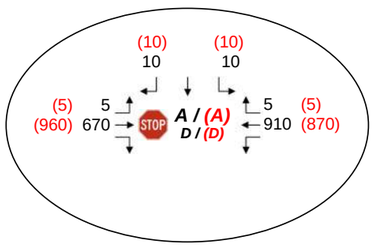
1. US16 & Cosmos Road



2. US16 & Beretta Road



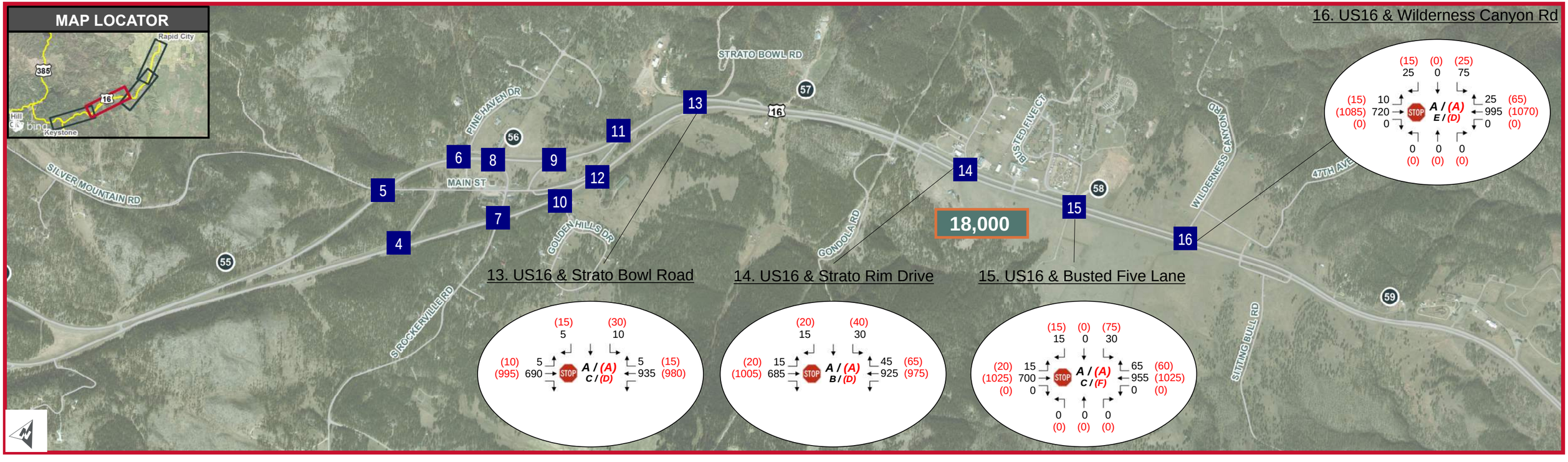
3. US16 & Silver Mountain Road



Legend

- (54) Mileage Reference Marker (MRM)
- 1 Study Intersection
- 14,000 2050 Daily Traffic Volumes*
- AM (PM) 2050 Peak Hour Traffic Volumes*
- Intersection Traffic Control and AM / (PM) Level of Service (LOS)
- A / (B) Signalized Intersection
- Two-way Stop Control Intersection
  - STOP A / (B) — Overall Intersection
  - A / (B) — *Worst-case Stop-Controlled Approach*

Notes:
**** Volumes reflect June design season***
Stop-controlled intersections are two-way stop-control unless noted.



US16 W Corridor

5. US16 W & Silver Mountain Rd

(15) (5)
15 5
5 (15)
A / (A) 890 (855)
C / (C) 5 (10)
10 5
(5) (5)

6. US16 W & Pine Haven Drive

(10) (15)
5 15
5 (20)
A / (A) 890 (865)
C / (C) 5 (5)
5 10
(5) (10)

8. US16 W & 16 W2 55.67

Merge
B / (B) 875 (875)
25
(15)

9. US16 W & 16 W1 56.16

Diverge
B / (B) 875 (875)
5 (10)

11. US16 W & Main Street

Diverge
B / (B) 880 (885)
60 (110)

US16 E Corridor

4. US16 E & 16 E1 55.42

(10) 5 Diverge
(960) 675 A / (B)

7. US16 E & Rockerville Road

(75) (20)
50 5
(5) 5 A / (A)
(935) 660 C / (E)
(20) 10
15 25
(10) (40)

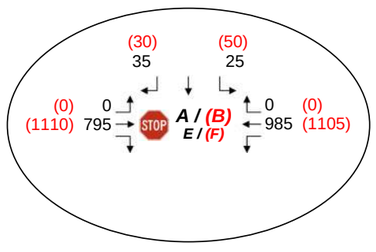
10. US16 E & Golden Hills Dr

(15) (5)
10 5
(0) 0 A / (A)
(990) 685 C / (D)
(5) 5
5 5
(5) (5)

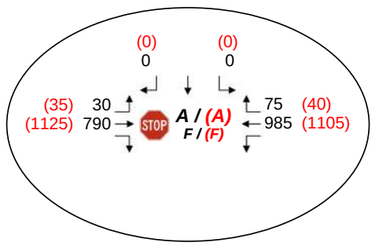
12. US16 E & 16 E2 56.09

(0) (5)
0 0
(0) 0 Merge
(995) 690 A / (B)
(5) 5
0 5
(0) (5)

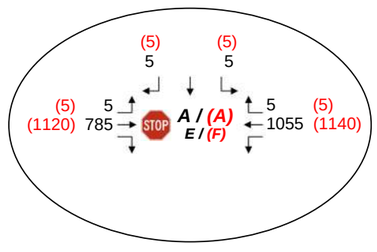
17. US16 & Bear Country Exit



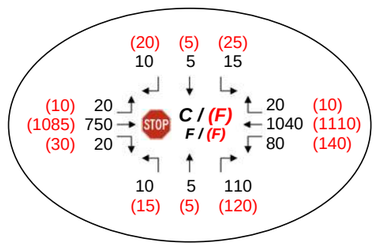
18. US16 & Bear Country Ent.



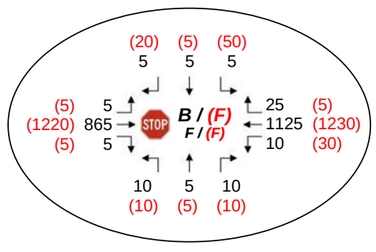
19. US16 & Croell Pit West Ent.



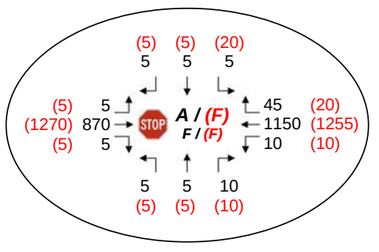
20. US16 & Neck Yoke Road



21. US16 & Reptile Gardens Cent.

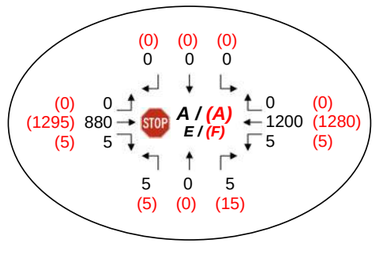


22. US16 & Reptile Gardens (N)

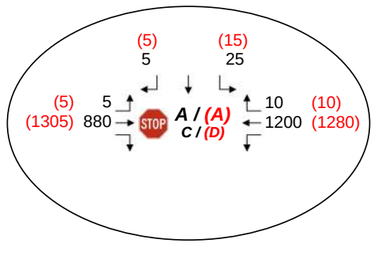


US16 Corridor

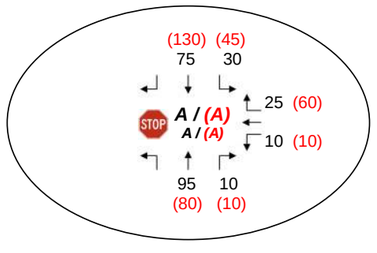
23. US16 & Unknown Road



24. US16 & Sammis Tr

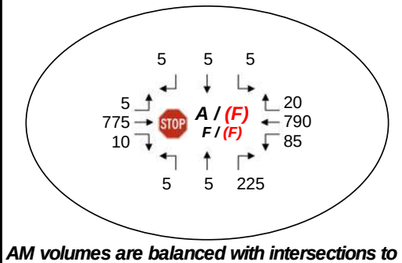


39. Neck Yoke Rd & Spring Creek Rd

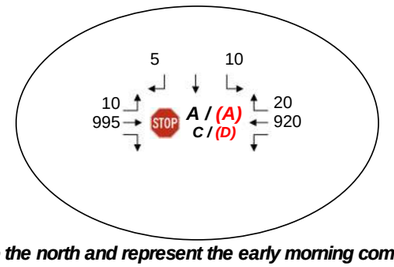


AM - Early Morning Commute (Directional to Rapid City)

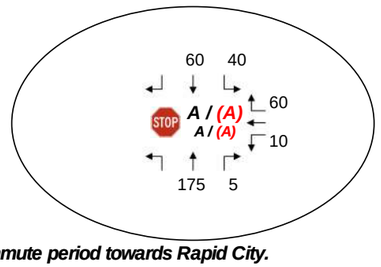
20. US16 & Neck Yoke Road



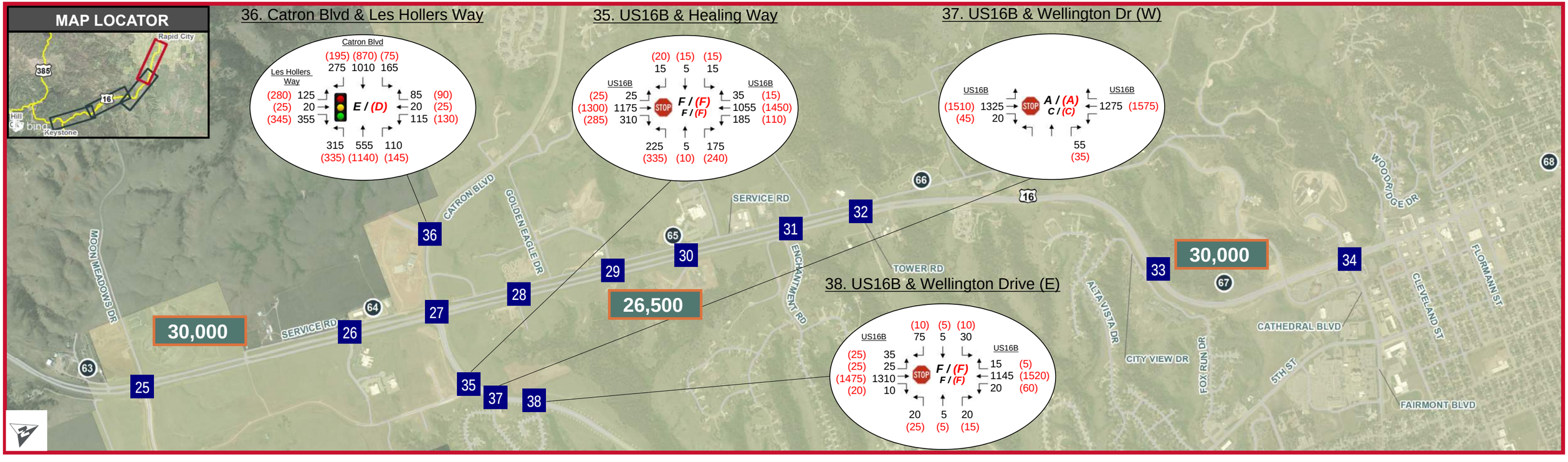
24. US16 & Sammis Tr



39. Neck Yoke Rd & Spring Creek Rd

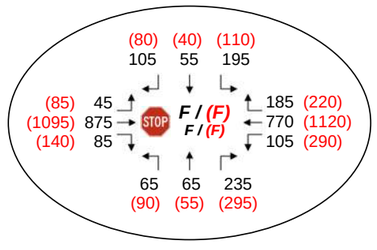


AM volumes are balanced with intersections to the north and represent the early morning commute period towards Rapid City.

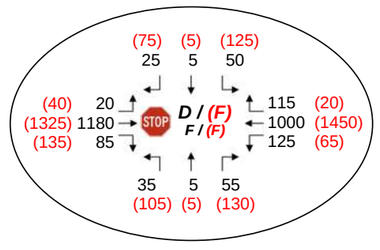


US16 Corridor

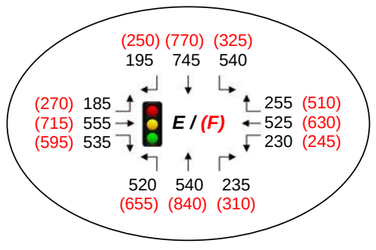
25. US16 & Moon Meadows Rd



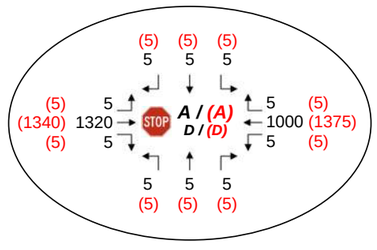
26. US16 & Addison Avenue



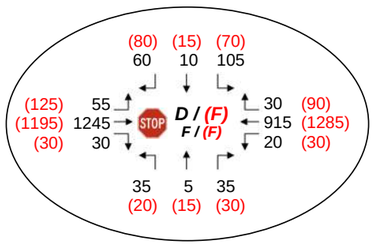
27. US16 & US16B/Catron Blvd



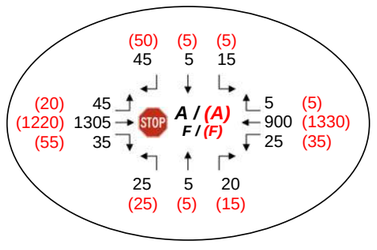
28. US16 & Tucker Street



29. US16 & Promise Road

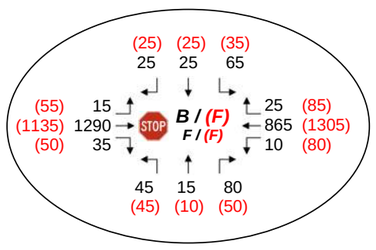


30. US16 & Table Rock Road

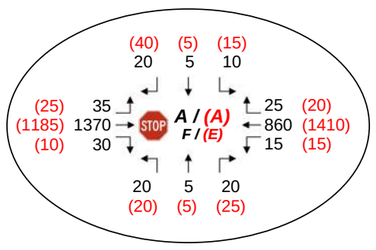


US16 Corridor

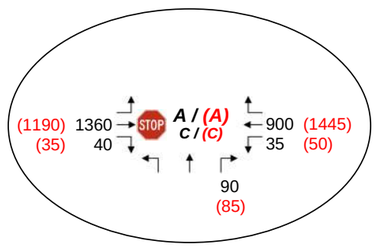
31. US16 & Enchantment Road



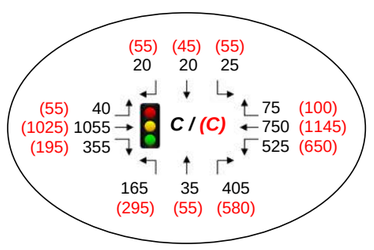
32. US16 & School Entrances



33. US16 & Echo Ridge Drive



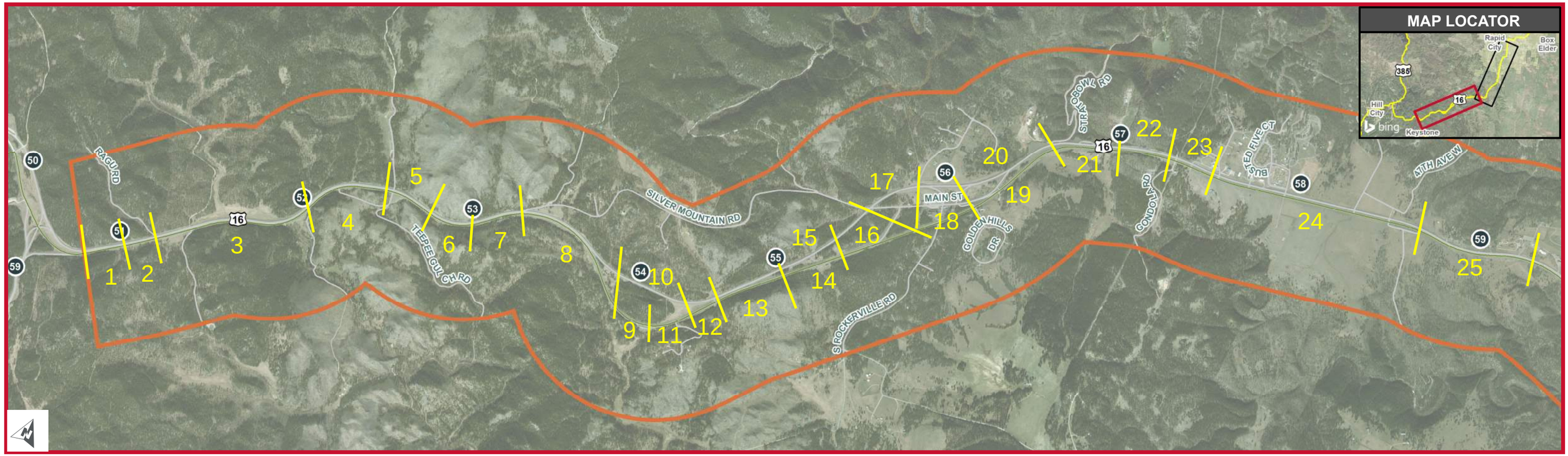
34. US16 & Cathedral Drive/ Fairmont Blvd



Appendix

A. Multilane Highway Segmentation Key
B. HCS7 Reports

Appendix A – Multilane Highway Segmentation Key



Seg. #	Mainline	Approximate Limits		Approx. Length (miles)*		Specific Grade (%)	
		From	To			EB	WB
1	US 16	Project Beginning MRM 50.75	MRM 51.00	0.3		-4.1	4.1
2	US 16	MRM 51.00	Cosmos Rd	0.2		-4.5	4.5
3	US 16	Cosmos Road	MRM 52.00	0.6		Rolling	Rolling
4	US 16	MRM 52.00	MRM 52.50	0.5		4.0	-4.0
5	US 16	MRM 52.50	MRM 52.75	0.25		-3.9	3.9
6	US 16	MRM 52.75	MRM 53.00	0.2		Level	Level
7	US 16	MRM 53.00	Silver Mountain Rd	0.3		-5.0	5.0
8	US 16	Silver Mountain Rd	MRM 54.00 (EB) / MRM 53.75 (WB)	0.7	0.6	-3.2	3.1
9	US 16 (EB)	MRM 54.00	MRM 54.25	0.54		Rolling	-
10	US 16 (WB)	MRM 53.75	MRM 54.25	0.4		-	-3.5
11	US 16 (EB)	MRM 54.00	MRM 54.25	0.25		-	4.8
12	US 16	MRM 54.25	MRM 54.50	0.3		6	-4.5
13	US 16	MRM 54.50	MRM 55.00	0.3		-7	6
14	US 16 (EB)	MRM 55.00	MRM 55.25	0.25		Level	-
15	US 16 (WB)	MRM 55.00	MRM 55.25	0.25		-	3.8
16	US 16	MRM 55.25	MRM 55.75 (EB) / Silver Mtn Rd (WB)	0.4	0.3	-6	6
17	US 16 (WB)	Silver Mountain Rd	Pine Haven Dr	0.2		-	3.2
18	US 16	MRM 55.75 (EB)/ Pine Haven Rd (WB)	Golden Hills Dr (EB) / MRM 56.00 (WB)	0.3	0.2	Level	Level
19	US 16 (EB)	Golden Hills Dr	MRM 56.50	0.3		-5.7	-
20	US 16 (WB)	MRM 56.00	Strato Bowl Rd	0.5		-	3.0
21	US 16	MRM 56.50 (EB) / Strato Bowl Rd (WB)	MRM 57.00	0.5	0.3	Rolling	Rolling
22	US 16	MRM 57.00	MRM 57.25	0.25		4.6	-4.6
23	US 16	MRM 57.25	MRM 57.50	0.25		-6	6
24	US 16	MRM 57.50	MRM 58.75	1.2		Level	Level
25	US 16	MRM 58.75	MRM 59.25	0.7		-6	6

*** Analysis grade reflects level, rolling or specific grade (segment upgrade typically shown for segments representing two directions of travel), per HCM6 methodology.*

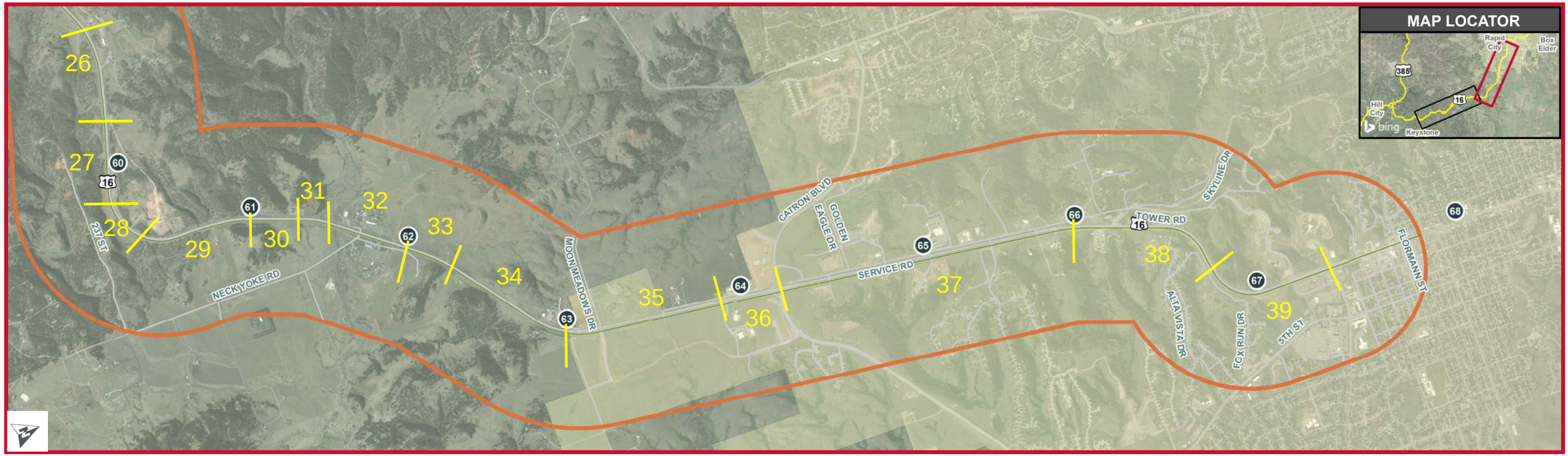
Existing profile information obtained from SDDOT profile GIS layer (current spring 2019).

Note: limits and length are approximate, and thus may not align due to rounding and approximation of MRM locations.

Legend

\ Segment Boundary

35 Segment Number



Seg. #	Mainline	Approximate Limits		Approx. Length (miles)*	Analysis Grade (%)**	Specific Grade (%)	
		From	To			EB	WB
26	US 16	MRM 59.25	Croell Pit West Entrance	0.35	Level	Level	Level
27	US 16	Croell Pit West Entrance	MRM 60.25	0.5	6.0	-6	6
28	US 16	MRM 60.25	MRM 60.50	0.2	4.7	-4.7	4.7
29	US 16	MRM 60.50	MRM 61.00	0.7	6.0	-6	6
30	US 16	MRM 61.00	MRM 61.25	0.2	5.0	-5	5
31	US 16	MRM 61.25	MRM 61.50	0.2	5.8	-5.8	5.8
32	US 16	MRM 61.50	MRM 62.00	0.4	Level	Level	Level
33	US 16	MRM 62.00	MRM 62.25	0.4	6.5	6.5	-6.5
34	US 16	MRM 62.25	MRM 63.00	0.6	4.3	4.3	-4.3

Seg. #	Mainline	Approximate Limits		Approx. Length (miles)*	Specific Grade (%)	
		From	To		EB	WB
35	US 16	MRM 63.00	Addison Ave	0.8	Rolling	Rolling
36	US 16	Addison Ave	US16B/ Catron Blvd	0.3	-5.2	5.2
37	US 16	US16B/ Catron Blvd	MRM 66.00	1.5	Rolling	Rolling
38	US 16	MRM 66.00	Echo Ridge Dr	0.8	-5.9	5.9
39	US 16	Echo Ridge Dr	Cathedral Dr/ Fairmont Blvd	0.6	-5.3	5.3

*** Analysis grade reflects level, rolling or specific grade (segment upgrade typically shown for segments representing two directions of travel), per HCM6 methodology.*

Existing profile information obtained from SDDOT profile GIS layer (current spring 2019).

Note: limits and length are approximate, and thus may not align due to rounding and approximation of MRM locations.

Legend

\ Segment Boundary

35 Segment Number

PATH: H:\GIS\PROJECTS\SDDOT\US16_CORRIDORSTDY\MAP_DOCS\DRAFT\PUBLIC_MEETING\US16_TRAFFIC_2-PAGE_TEMPLATE_ANSID.MXD - USER: KVANDEKA - DATE: 7/16/2019

Appendix B – HCS7 Reports