US Highway 16
CORRIDOR STUDY

US16/US16B/Catron Boulevard Intersection Build Option Technical Report

Pennington County, South Dakota

July 14, 2021

SD DOT

U.S. Department of Transportation Federal Highway Administration

Rapid City South Dakota

Rapid City Area Metropolitan Planning Organization

Pennington County

US16/US16B/Catron Boulevard Intersection Build Option Technical Report

Pennington County, South Dakota

July 14, 2021

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Abbreviations

AASHTO	American Association of State Highway Transportation Officials
BCA	Benefit-Cost Analysis
DLT	Displaced Left Turn
ETT	Experienced Travel Time
FHWA	Federal Highway Administration
F+I	Fatal and Injury Crashes
HCM6	6th Edition of Highway Capacity Manual
HCS	Highway Capacity Software
HSM	Highway Safety Manual
IHSDM	Interactive Highway Safety Design Module
LOS	Level of Service
MEV	Million Entering Vehicles
LT / T / RT	Left turn lane / Through lane / Right turn lane
MOT	Maintenance of Traffic
MVMT	Million Vehicle Miles Traveled
NEPA	National Environmental Policy Act
NB/SB/EB/WB	Northbound / Southbound / Eastbound / Westbound
PDO	Property Damage Only Crash
RCAMPO	Rapid City Area Metropolitan Planning Organization
RCI	Reduced Conflict Intersection
RIRO	Right-in right-out
ROW	Right of Way
SDDOT	South Dakota Department of Transportation
SPI	Single Point Interchange
STIP	Statewide Transportation Improvement Program
US16	US Highway 16

1.0 Executive Summary

The US16/US16B/Catron Boulevard intersection is located in the southern portion of the Rapid City urban area and is a crossroad of two key routes serving regional and local traffic demand. Volumes peak throughout the tourist-season summer months as the intersection is along the primary route between I-90, Rapid City, and the Black Hills/Mount Rushmore area. Recent and anticipated development on the south side of Rapid City has created the need for future intersection improvements as volumes are expected to continue to grow.

At the onset of the US16 Corridor Study, three overarching needs related to the US16/US16B/Catron Boulevard intersection were identified to be addressed by a future project:

- Poor traffic operations
- High crash rates
- Rapidly urbanizing land use

The purpose of a future Project recommended in this report is to improve traffic operations and safety at the US16/US16B/Catron Boulevard intersection, and with the goal of supporting the planned mix use urban development that is occurring in the area.

The US16/US16B/Catron Boulevard intersection analysis is a sub-area analysis to a much larger US16 Corridor Study. The US16/US16B/Catron Boulevard Intersection Build Options Report provides a technical analysis of the operational feasibility related to the proposed changes to the existing US16/US16B/Catron Boulevard intersection and nearby access points.

Previous studies completed by the SDDOT established the foundation for recommendations presented in this report. A 2004 study recommended an interchange at the US16/US16B/Catron Boulevard intersection. A 2016 study evaluated several different interchange and intersection types, ultimately recommending a Single Point Interchange (SPI) and Displaced Left Turn (DLT) at-grade intersection concept to be carried forward to this study for further analysis and refinement.

The recommended technically feasible alternative that best meets established transportation needs for the intersection study area is as follows:

- Build Option 1.1a: SPI with separated, free northbound and southbound right turn lanes
    - Reconstruct the existing US16/US16B/Catron Boulevard intersection to a SPI.
    - Incorporate the following elements from SPI 1.1b and 1.2:
        - Grade for off-ramp dual right turn lanes shown in SPI 1.2
        - Eastbound US16B/Catron Boulevard right turn lane shown in SPI 1.1b
    - Close or modify the following US16 intersections due to the location of the SPI ramps:
        - Tucker Street – closed. Access accommodated by a new Promise Road alignment on east side of US16
        - Addison Avenue – closed. Access accommodated via existing US16 service road connections to Healing Way and existing US16 service road intersection at the section line

- US16 service road (at section line) – Shift US16/Section Line Road intersection south outside of interchange functional area and incorporate right-in right-out (stop-control from side-street approaches). Maintain US16 mainline pavement through intersection.
- Promise Road – Shift intersection north out of interchange functional area and prepare for future signalization (anticipated around opening year). Reconstruct US16 service road to provide 250-foot intersection spacing from US16 mainline.
- Tablerock Road – Shift intersection north to increase separation from Promise Road, align with Fox Road, and incorporate ¾ access (stop-control from side-street approaches).

Other US16 corridor elements to include:

- US16 corridor design speed
  - 60 mph north of US16B/Catron Boulevard
  - 65 mph south of US16B/Catron Boulevard
- US16 corridor typical section
  - 4-Lane Divided with 40-foot Raised Median (Suburban) – Shifted East
- Minor road access and local network connectivity
  - Construct rearage road to connect parcels impacted by Tucker Street closure to US16/Promise Road intersection
- Bicycle and pedestrian accommodations
  - Shared-use path on east side of US16
  - Sidewalk on west side of US16

The operations and safety analysis contained within this report shows the recommended alternative is expected to improve traffic operations and safety along US16 within the study area. It also prepares the intersection for the rapidly urbanizing land use and associated impacts through the planning horizon year 2050. SDDOT has identified a project at the US16/US16B/Catron Boulevard intersection in the 8-year developmental Statewide Transportation Improvement Program (STIP) (PCN 6874 in 2026-2029 developmental STIP).

An environmental scan for the proposed changes has been developed concurrently with this report. Recommendations carried forward from this analysis will feed into the NEPA process for a future US16/US16B/Catron Boulevard intersection project.

US16/US16B/Catron Boulevard Intersection Recommendation

Intersection Project: Single Point Interchange (SPI)

Corridor: 4-Lane Divided with 40-foot Raised Median (Suburban) - Shifted East

Scale in Feet

0 250 500

Legend

- Proposed Roadway
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

US16/Addison Avenue Intersection
- Close due to conflict with SPI ramps
- Maintain existing US16 service road connections to:
  - Les Hollers Way (via Energy Park Drive) and
  - Section Line Road
- Maintain existing east connection to Healing Way

US16/Promise Road Intersection
- Shift intersection north
- Prepare for signalization (need anticipated around opening year)
- Reconstruct US16 service road to provide 250-foot intersection spacing from US16 mainline

US16/Tucker Street Intersection
- Close due to conflict with SPI ramps
- Construct rearage road to Promise Road intersection

US16/Section Line Road
- Shift intersection south
- RIRO access
- Construct Section Line Road/US16 service road intersection
- Maintain existing US16 mainline pavement through intersection

NOTE:
US16 Design Speed (North of US-16B) = 60 MPH
US16 Design Speed (South of US-16B) = 65 MPH
NB Entrance Ramp Design Speed = 45 MPH
SB Ramps and NB Exit Ramp Design Speed = 50 MPH

US16/Tablerock Road Intersection
- Shift intersection north
- Align with Fox Road
- 3/4 access

US16/Wellington Drive Intersections
- West: maintain RIRO access
- East: 3/4 access
- Extend EB LT lane back to RIRO access to provide direct movement into LT lane for downstream U-turn

Catron Blvd
Les Hollers Way
Energy Park Dr
Promise Road
Existing
Prepare for signalization at opening
Signalized upon opening
See Inset A
Rearage Road
Inset A
US 16 West Frontage Road
Fox Road
Tablerock Road
Section Line Road
Addision Ave
Healing Way
Existing
Catron Blvd
16
STOP

Build Option:

SPI 1.1a

US Highway 16 CORRIDOR STUDY

US16/US16B/Catron Boulevard Intersection Recommended Build Option
Single Point Interchange (SPI) Build Option 1.1a

US16 Corridor Study — Rapid City, SD

Figure

ES-1

2.0 Introduction

2.1 Background

In 2019, the South Dakota Department of Transportation (SDDOT) initiated a study of the US16 corridor between the Keystone Wye and Fairmont Boulevard/Cathedral Drive. The study includes an overarching, long-range planning study for corridor needs through year 2050 as well as sub-area studies at the US16/US16B/Catron Boulevard intersection and US16/Neck Yoke Road intersection in anticipation of future construction projects. The SDDOT currently has US16/US16B/Catron Boulevard intersection improvements programmed for construction in year 2026.

The purpose of this report is to document concept development, Build Option refinement, analysis, and evaluation process to support recommendations for a future project at the US16/US16B/Catron Boulevard intersection. Recommendations carried forward from this analysis will feed into the NEPA process for a future US16/US16B/Catron Boulevard intersection project.

The US16/US16B/Catron Boulevard intersection is located in the southern portion of the Rapid City urban area. The intersection is a crossroad of two key routes serving regional and local traffic demand. Volumes peak throughout the tourist-season summer months as the intersection is along the primary route between I-90, Rapid City, and the Black Hills/Mount Rushmore area.

Recent and anticipated development on the south side of Rapid City has created the need for future intersection improvements as volumes are expected to continue to grow. Further, the intersection has experienced a history of congestion-related crashes and exhibits the highest crash rate of any of the intersections along the study corridor.

2.2 Study Area

The US16/US16B/Catron Boulevard intersection study area is shown in **Figure 1** and includes the following segments and intersections.

- Study segments
    - US16 corridor between Moon Meadows Road and Enchantment Road
    - US16B/Catron Boulevard corridor between Les Hollers Way and Wellington Drive (east)
    - US16 service road, where present, on west side of US16 between Moon Meadows Road and Enchantment Road
- Study intersections:
    - US16/Moon Meadows Drive
    - US16/Addison Avenue
    - US16/US16B/Catron Boulevard
    - US16/Tucker Street
    - US16/Promise Road
    - US16/Tablerock Road

- US16/Enchantment Road
- Catron Boulevard/Les Hollers Way
- US16B/Catron Boulevard/Healing Way
- US16B/Catron Boulevard/Wellington Drive (west)
- US16B/Catron Boulevard/Wellington Drive (east)

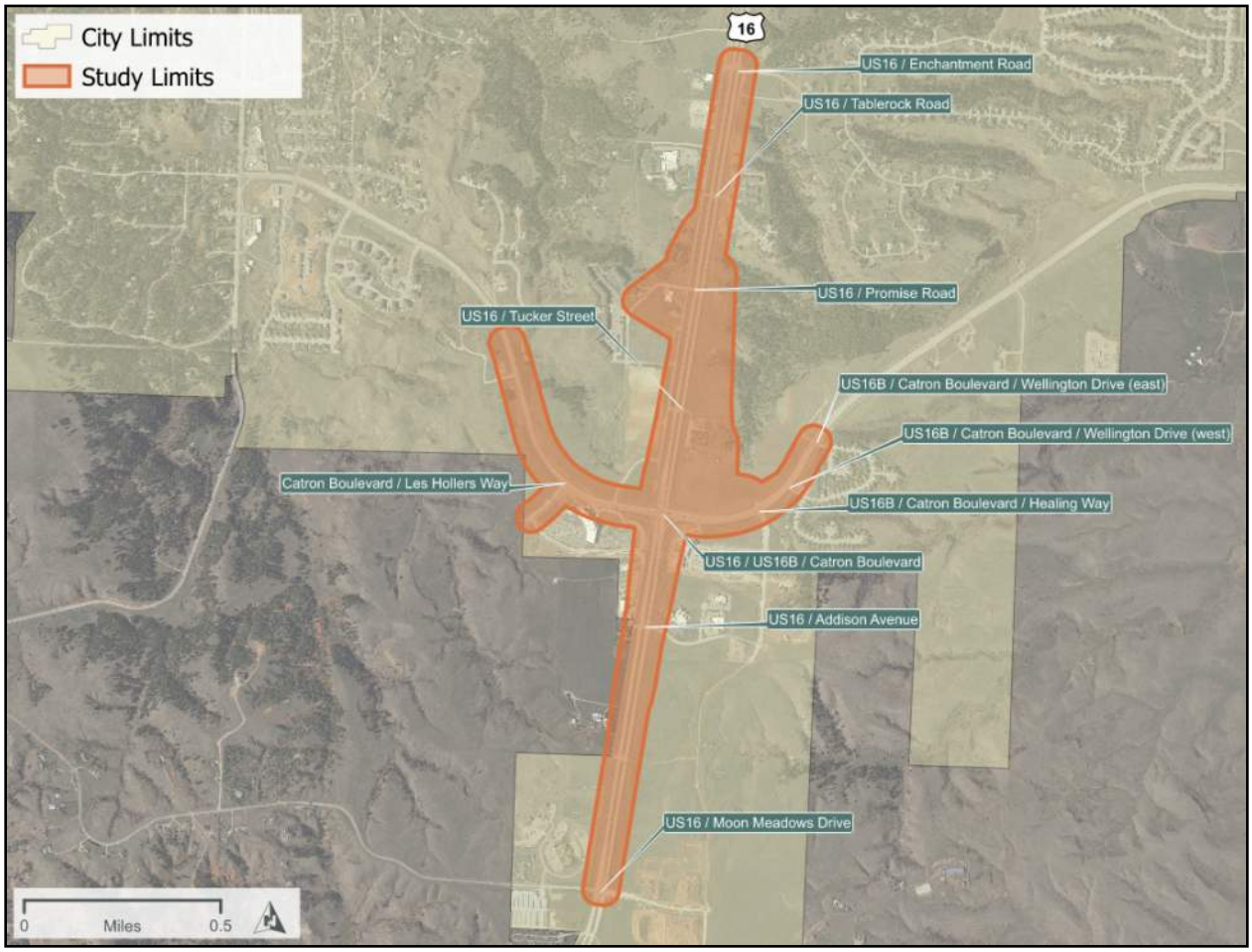


Figure 1: US16/US16B/Catron Blvd Intersection Study Area

The US16/US16B/Catron Boulevard intersection study area is a sub-area of the overall US16 Corridor Study. The US16 Corridor Study area extends approximately 16.3 miles along US16 between the US16 Alternate (Keystone Wye) and Cathedral Drive/Fairmont Boulevard in Rapid City, shown in **Figure 2.**

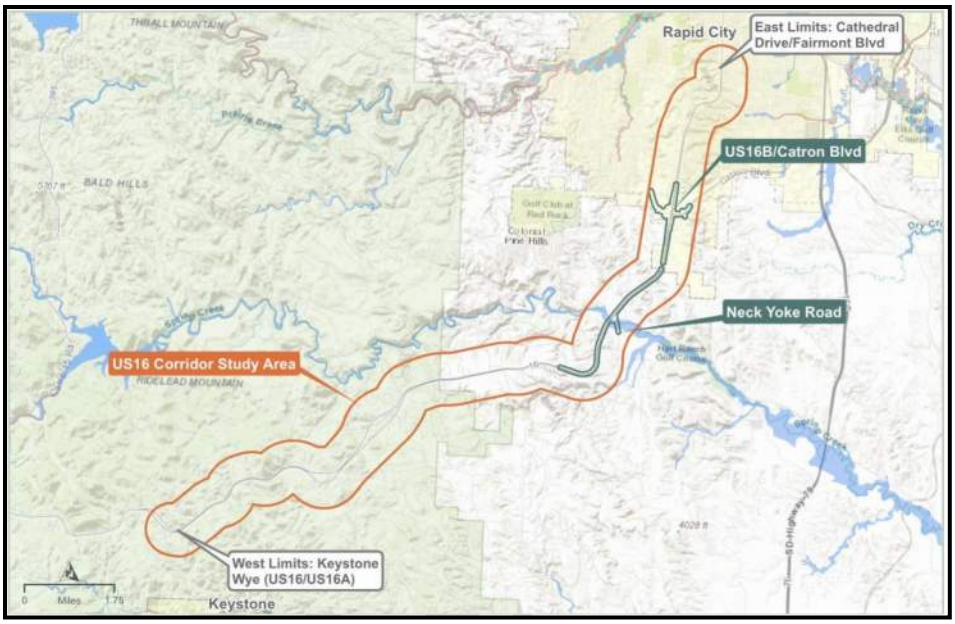
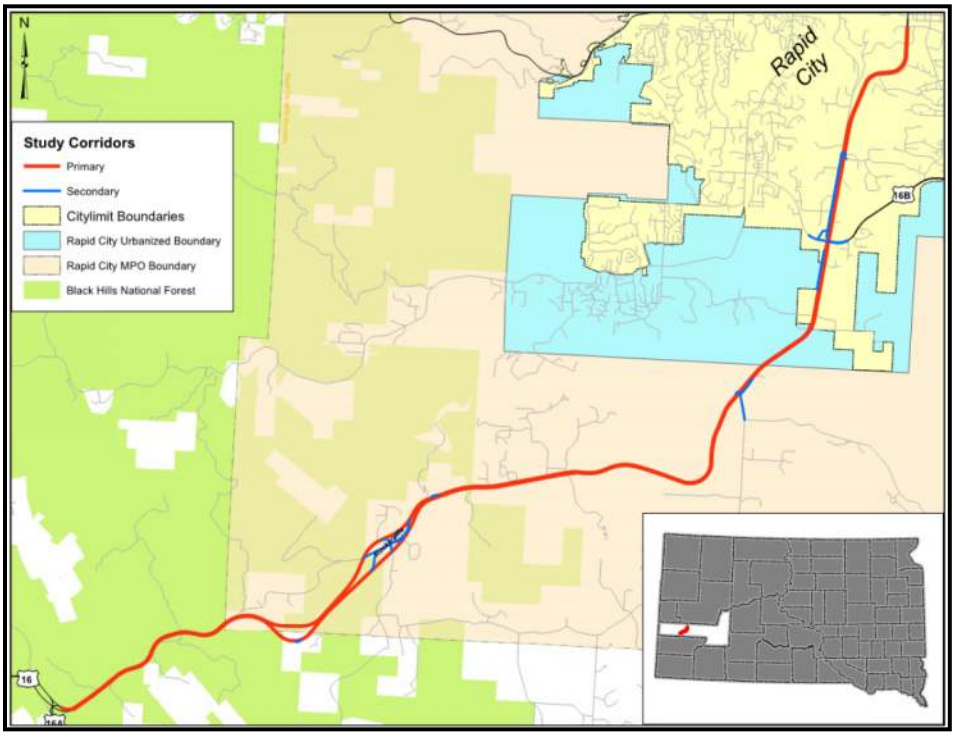


Figure 2: US16 Corridor Study Area

The entirety of this intersection sub-area is within the Federal Highway Administration (FHWA) approved urban boundary for Rapid City and Rapid City Area Metropolitan Planning Organization (RCAMPO) planning boundary. Both areas are shown in **Figure 3**.



Source: SDDOT figure

Figure 3: Rapid City Urbanized Boundary and Rapid City Area MPO Boundary

2.3 Methods and Assumptions

A methods and assumptions document (M&A document) was prepared at the onset of this study to serve as a historical record of the study process and methodologies, dates, and decisions made by the study team representatives for the US16 Corridor Study. Section 9 in the M&A document identifies the study limits for the US16/US16B/Catron Boulevard intersection sub-area analysis. A copy of the most recent, amended version of the M&A document to the date of this report is provided in **Appendix A**.

2.4 Planning and Prior Studies

The SDDOT has completed two studies encompassing the US16/US16B/Catron Boulevard intersection since 2004. A third study was initiated, but never completed.

A 2004 *US16 Corridor Study* reviewed US16 from a corridor-level perspective to develop long-range conceptual improvements. That study recommended an interchange at the US16/US16B/Catron Boulevard intersection.

A 2007 study was initiated in response to a large, proposed development in the area. However, it was abruptly terminated when the development decided to build at a different location.

The second completed study, the 2016 *US16/US16B/Catron Boulevard Intersection Alternatives Study*, refined and developed specific US16/US16B/Catron Boulevard intersection at-grade and grade separated concepts for analysis and evaluation. It recommended a Displaced Left Turn (DLT) intersection and Single Point Interchange (SPI) be carried forward into this study for further refinement and detailed analysis.

The SDDOT has identified a project at the US16/US16B/Catron Boulevard intersection in the 8-year developmental program (PCN 6874 in 2026-2029 developmental STIP). The SDDOT also has a US16 corridor improvements project identified for US16 between Catron Boulevard and Tower Road (PCN 078D) in the 2026-2029 developmental STIP to implement recommendations from the overall US16 Corridor Study.

2.5 Relationship to the US16 Corridor Study

At the onset of the study, it was determined that addressing long-term capacity and safety needs at the US16/US16B/Catron Boulevard intersection was crucial to the success of the overall US16 corridor. The SDDOT designated this intersection as a sub-study to not only plan for the programmed project, but also to serve as the framework for the long-range vision of the overarching urban area US16 corridor. The sub-study tracked ahead of the US16 Corridor Study corridor scenario to determine the option that best addresses intersection needs, the causal benefits/impacts at adjacent intersections, and begin a detailed environmental analysis.

Ultimately, findings and recommendations from this sub-study guide overarching US16 Corridor Study recommendations within the urban area to represent a complete, long-range vision with specific future projects, concepts, and strategies to address corridor needs through year 2050.

3.0 Existing Conditions

3.1 Existing Road Conditions

Table 1 summarizes existing conditions of US16 and US16B/Catron Boulevard corridors.

The US16 corridor through the intersection study area was originally constructed in the 1950's/1960's with a 70 mph design speed.

Table 1: US16/US16B/Catron Boulevard Intersection Study Area Road Summary

	US16	Catron Blvd (west leg)	US16B/Catron Blvd (east leg)
Owner	SDDOT	City of Rapid City	SDDOT
Surfacing	Bituminous	Bituminous	Concrete
Cross-Section	4-lane divided rural highway with depressed turf median	5-lane rural section with center turn lane or striped median.	4-lane divided urban highway with raised median
Roadway Widths	34 ft in both directions 24 ft surface width 3 ft inside shoulder 7 ft outside shoulder	64 ft roadway width	36 ft roadway width in both directions 26 ft surface width 2 ft inside shoulder 8 ft outside shoulder
Median Width	60 ft	Varies in study area.	Varies in study area.
Functional Classification	Urban Other Principal Arterial (north leg) Urban Other Freeways and Expressways (south leg)	Urban Minor Arterial	Urban Other Freeway or Expressway
Right-of-Way Width	150 ft	Varies, 165-200 ft	100 ft
SDDOT Access Classification	Free Flow Urban (north leg) Expressway (south leg)	-	Expressway

Existing US16 grade through the intersection area follows a rolling terrain. The US16/US16B/Catron Boulevard intersection sits in a bowl with an approximate 5.2 percent grade to the south and a 2.2 percent grade to the north. The *US16 Corridor Study Horizontal and Vertical Curve Review* memo, included as **Appendix B**, noted the crest vertical curve south of the US16/US16B/Catron Boulevard intersection meets a design speed of 60 mph.

All existing sub-area analysis intersections are full access, except one. The Wellington Drive (west) intersection is right-in right-out for eastbound traffic with a downstream U-turn opportunity at the Wellington Drive (east) intersection.

A 2018 project widened the US16B/Catron Boulevard approaches to provide dual eastbound and westbound left turn lanes and signal upgrades. The new dual left turn lanes were restricted to protected-only phasing and a westbound right turn lane overlap was added.

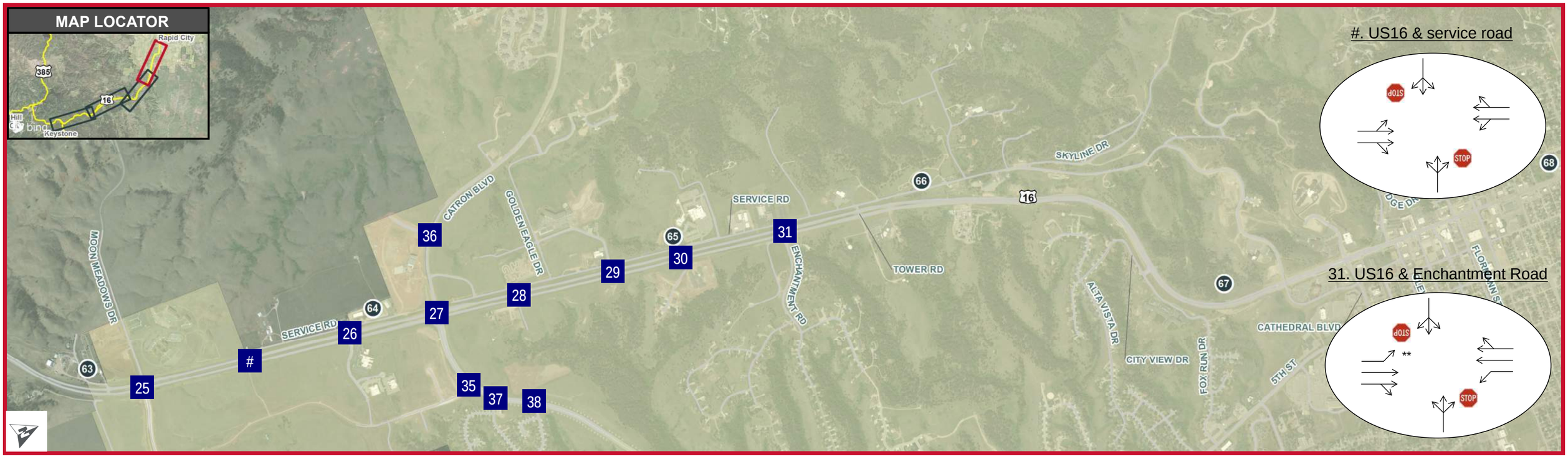
In addition to the turn lanes already constructed at many study area intersections, shown in **Figure 4**, a 2020 project is adding left turn lanes at the following locations:

- Enchantment Road: NB/SB left turn lanes
- Promise Road: NB left turn lane

- Tablerock Road: NB/SB left turn lanes

Traffic signals are provided at the following intersections:

- Catron Boulevard/Les Hollers Way
- US16/US16B/Catron Boulevard
- US16B/Catron Boulevard/Healing Way (installed 2020)
- US16/Promise Road (pre-emptive, emergency signal for fire station)



#. US16 & service road

31. US16 & Enchantment Road

25. US16 & Moon Meadows Rd

26. US16 & Addison Avenue

27. US16 & US16B/Catron Blvd

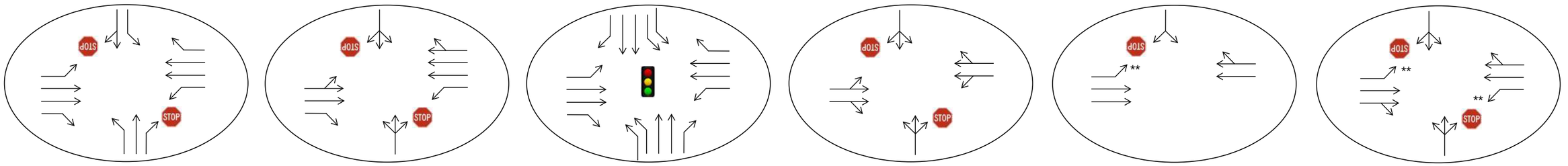
28. US16 & Tucker Street

29. US16 & Promise Road

30. US16 & Table Rock Road

US16 Corridor

S N



36. Catron Blvd & Les Hollers Way

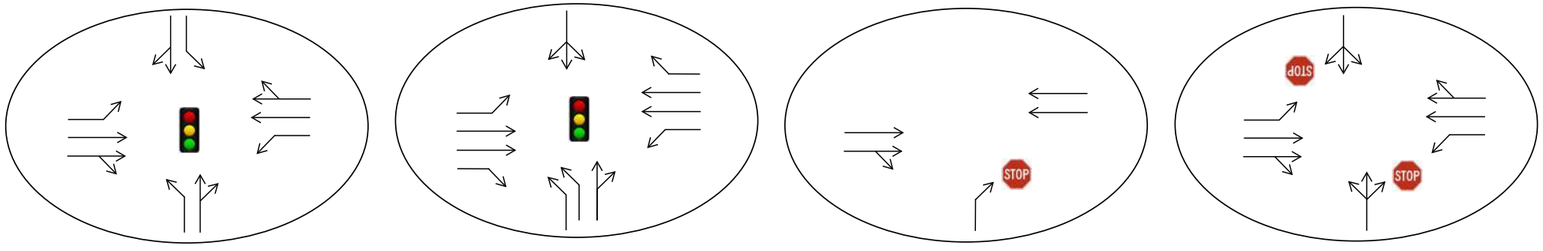
35. US16B & Healing Way

37. US16B & Wellington Dr (W)

38. US16B & Wellington Drive (E)

US16B / Catron Blvd Corridor

W E



Legend

54 Mileage Reference Marker (MRM)

1 Study Intersection

Notes

Intersection numbering is consistent with the overall US16 Corridor Study.

Turn lanes constructed as part of 2020 intersection improvements project noted with an **.

3.2 Existing US16 Structures

There are currently no structures on US16 or US16B/Catron Boulevard within the intersection study area.

3.3 Existing Access

The current SDDOT access classification of US16 south of US16B/Catron Boulevard and US16B/Catron Boulevard east of US16 is Expressway. The SDDOT Road Design Manual defines this classification as 'high-speed divided highways serving interstate and regional travel needs.' US16 north of US16B/Catron Boulevard is classified as Free Flow Urban, which is defined as 'higher speed facilities with access to subordinate to through traffic movement.'

Current SDDOT access classification criteria is summarized in the following table.

Table 2: SDDOT Access Classification Criteria

Access Classification	Signal Spacing Distance (mile)	Median Opening Spacing (mile)	Minimum Unsignalized Access Spacing (feet)	Access Density	Denial of Direct Access When Other Available
Interstate	N/A	N/A	N/A	N/A	Yes
Expressway	1/2	1/2 F, 1/2 D	2640	at half-mile increments	Yes
Free Flow Urban	1/2	1/2 F, 1/4 D	1320	at quarter-mile increments	Yes
Intermediate Urban	1/2	1/2 F, 1/4 D	660	1 access/block face, right in/right out preferred	Yes
Urban Developed	1/4	1/4	100	2 accesses/block face	Yes
Urban Fringe	1/4	1/4	1000	5 accesses/side/mile	Yes
Rural	N/A	N/A	1000	5 accesses/side/mile	Yes

Notes:

1. Access to the Interstate system is governed by SDDOT interchange policy. No access shall be provided on non-interstate routes within the following distance of interstate ramp terminals: 1/8 mile directional access, 1/4 mile full access
2. N/A = Not Applicable, F = Full Movement – all turns and through movements provided, D = Directional Only – certain turning and through movements not provided.
3. SDDOT may defer to stricter local standards.
4. SDDOT will seek opportunities to reduce access density wherever possible.
5. Rural class minimum unsignalized access spacing may be reduced to 660' by the Area Engineer, based on results of an engineering study as described in 70:09:01:02
6. Unsignalized access spacing also is subject to corner clearance analysis.

Source: Figure 17-4, SDDOT Road Design Manual (accessed 1/20/2020)

Existing access points along the expressway segments do not directly align with access spacing outlined in the SDDOT access classification criteria. However, many of these were already established before the access criteria was developed.

Additional information regarding existing access spacing along US16 is provided in the *US16 Corridor Study Urban Area Access* report in **Appendix C**.

3.4 Existing Traffic Volumes and Traffic Patterns

3.4.1 Existing Traffic Volumes

The 2019 Existing Conditions volume set was developed for the existing study area using daily and peak hour segment counts collected in 2019 as part of the overall US16 Corridor Study:

- Peak hour (morning and afternoon/evening) intersection turning movement counts

  - Collected on Thursday, May 30, 2019
  - Counts provided peak hour intersection turning movement volumes, peak hour factors, and heavy vehicle percentages broken out by trucks, RVs, and lights pulling boats/campers/trailers over 12 continuous hours
- 24-hour roadway segment counts
  - Collected on Thursday, May 30, 2019
  - Counts provided daily segment volumes, heavy vehicle percentages, and speeds

Seasonal adjustment factors were applied to the counts to reflect a June 'peak season', accounting for the summer tourist season traffic.

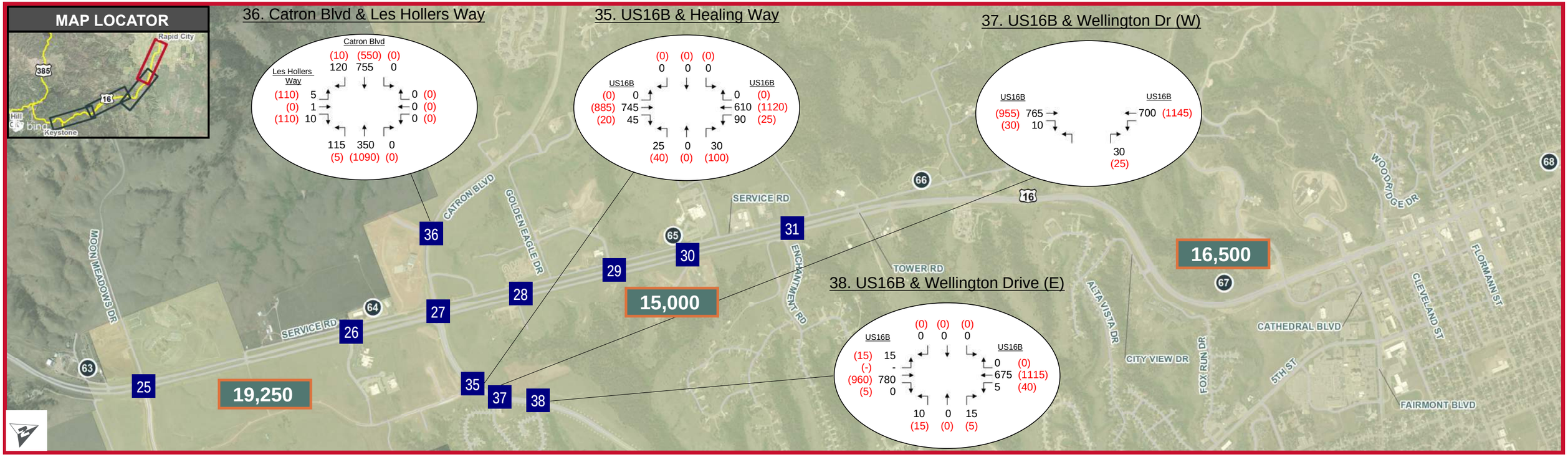
A summary of 2019 Existing Conditions volumes is shown in **Figure 5**. Further information regarding the traffic data collection and development of the 2019 Existing Conditions volume set is can be found in the *2019 Existing Conditions Traffic Operations* technical memo in **Appendix D**.

3.4.2 Traffic Patterns

Historically, the US16/US16B/Catron Boulevard intersection has primarily served regional traffic, with key origin-destination centers between Rapid City, I-90, Mount Rushmore, and communities and tourist destinations in the greater Black Hills. Due to the directness of US16 to popular Black Hills destinations and lack of alternative routes in the area, US16 is the primary tourist route heading south out of Rapid City to Mount Rushmore, Keystone, Hill City, etc. Intersection traffic volumes are highly seasonal, with the peak tourist season months of June, July, and August exhibiting notably higher volumes than what occurs in the winter months.

Local commuter traffic is directional with morning commute traffic heading north into Rapid City and afternoon commute traffic heading back to the south. During the tourist season, these volumes become more balanced with a reverse commute from Rapid City to the Black Hills in the morning and back in the evening. Volumes are also much more sustained throughout the day in the peak season with high tourist volumes beginning in mid-morning.

Future development in the area is expected to bring a changing dynamic to traffic patterns within the US16/US16B/Catron Boulevard intersection, particularly with anticipated employment center development in the area. The recent completion of Black Hills Energy Corporation headquarters is an example as it brings employees out of Rapid City on US16 from the north. This results in a more balanced flow in commute traffic and adds to the complexity in providing adequate, long-term capacity at the US16/US16B/Catron Boulevard intersection.



US16 Corridor

25. US16 & Moon Meadows Rd

(20) (1) (75)
30 0 160
(30) 10 70 (145)
(720) 575 445 (715)
(5) 1 20 (10)
0 1 15
(5) (0) (15)

26. US16 & Addison Avenue

(10) (0) (70)
1 1 10
(0) 10 75 (10)
(800) 715 530 (850)
(10) 25 90 (20)
5 0 25
(10) (0) (85)

27. US16 & US16B/Catron Blvd

(95) (390) (175)
105 375 285
(180) 75 135 (310)
(375) 330 305 (350)
(400) 345 70 (115)
285 255 95
(435) (605) (120)

28. US16 & Tucker Street

(0) (0) (0)
0 0 0
(0) 0 0 (0)
(670) 710 510 (775)
(0) 0 0 (0)
0 0 0
(0) (0) (0)

29. US16 & Promise Road

(60) (50)
50 65
(80) 45 15 (50)
(590) 665 460 (715)

30. US16 & Table Rock Road

(40) (1) (0)
10 1 0
(10) 35 0 (1)
(610) 680 455 (715)
(20) 15 15 (25)
10 0 10
(10) (0) (10)

US16 Corridor

31. US16 & Enchantment Road

(5) (10) (15)
5 5 5
(5) 2 15 (1)
(595) 680 445 (720)
(20) 10 5 (40)
20 10 55
(15) (5) (25)

Notes
Traffic volumes obtained from the US16 Corridor Study ***Existing Conditions Traffic Operations*** technical memorandum.

Intersection numbering is consistent with the overall US16 Corridor Study.

Legend

- Mileage Reference Marker (MRM)
- 1 — Study Intersection
- 14,000 — 2019 Daily Traffic Volumes*
- AM (PM) — 2019 Peak Hour Traffic Volumes*

Notes:
**** Volumes reflect June design season***

2019 EXISTING CONDITIONS TRAFFIC VOLUMES

US16 CORRIDOR STUDY - US16/US16B/CATRON BLVD INTERSECTION AREA

PATH: \\SXF-SRV01\ENG\GIS\PROJECTS\SDDOT\US16_CORRIDORSTDY\MAP_DOCS\DRAFT\PUBLIC_MEETING\US16_TRAFFIC_INTERSECTION_TEMUS

3.5 Crash History Review

Crash data for years 2014 through 2018 was provided by the SDDOT through a GIS geodatabase. Crashes were reviewed throughout the entire US16 Corridor Study area to identify any historical crash trends or high frequency areas to help develop potential crash mitigation measures for consideration in design. All crashes were sorted by corridor intersection or roadway segment. Low-volume crossroads and private driveways were typically not considered a primary analysis intersection.

Crash rates and critical crash rates were calculated for both intersections and roadway segments. Intersection crash rates were calculated in terms of crashes per million entering vehicles (crashes/MEV). Roadway segment crash rates were calculated in terms of million vehicle miles traveled (crashes/MVMT).

Critical crash rates were calculated based on the statistical populations for each crash location (intersection or segment), using methods presented in the Highway Safety Manual (HSM, American Association of State Highway and Transportation Officials (AASHTO), 2010). A critical crash rate accounts for a desired level of confidence, vehicle exposure, and similar facility types. Intersections and segments where the crash rate exceeds the critical rate should be investigated further.

Weighted crash rates were also calculated for corridor segments by weighting each crash in accordance with its severity: fatal crash (12), injury crash (3), and property damage crash (1). Weights were assigned to each crash in accordance with methodology used by the SDDOT in determining statewide average crash rates. This method differs from the calculation of an average crash rate in that the weighted crash rate accounts for injury and fatal crashes through the weighting process. An average crash rate calculation reflects total crash frequency, regardless of injury severity.

Intersection and segment crash rates were calculated with available daily traffic count data provided by the SDDOT or collected as part of this study.

Additional details regarding the crash history review can be found in the *US16 Corridor Study Crash History Review* report located in **Appendix E**.

3.5.1 US16 Corridor Segments Summary

Table 3 and **Table 4** summarize US16 corridor segment crashes by severity and crash rate for locations within the US16/US16B/Catron Boulevard intersection study area. Critical crash rate calculations incorporate all segments within the overall US16 Corridor Study.

Table 3: US16 Study Area Segments – Crash Severity (2014-2018)

US16 Segment		Fatal	Injury			PDO		Total
From	To		A	B	C	Vehicle Only	Animal	
Tablerock Road	Enchantment Road	0	0	1	0	0	2	**3**
Promise Road	Tablerock Road	0	0	0	0	1	6	**7**
US16B/Catron Blvd	Promise Road	0	0	0	1	1	8	**10**
Addison Avenue	US16B/Catron Blvd	0	0	0	1	1	6	**8**
Moon Meadows Drive	Addison Avenue	0	0	1	0	3	9	**13**

Injury severity categories:
A: Incapacitating injury B: Non-incapacitating injury C: Possible injury
PDO: Property damage only (no reported injury) crashes

Table 4: US16 Study Area Segments – Crash Rates (2014-2018)

US16 Segment		Weighted Crash Rates (crashes per MVMT)			Critical Crash Rates (crashes per MVMT)		
From	To	Weighted Crash Rate	State Rate	Ratio	Crash Rate	Critical Rate	Ratio
Tablerock Road	Enchantment Road	0.64	2	0.32	0.40	2.31	0.17
Promise Road	Tablerock Road	1.25	2	0.62	1.2	2.47	0.49
US16B/Catron Blvd	Promise Road	1.09	2	0.55	0.90	2.18	0.41
Addison Avenue	US16B/Catron Blvd	1.93	1.71	**1.13**	1.50	2.51	0.60
Moon Meadows Drive	Addison Avenue	0.97	1.71	0.56	0.80	2.07	0.39

Ratios that exceed 1.0 noted in **Orange Bold** text.
Functional Classification and statewide weighted average crash rate (weighted rate crashes/MVMT)
Urban Principal Arterial: 2 weighted crashes/MVMT
Urban Freeway & Expressway: 1.71 weighted crashes/MVMT
Critical crash rate calculations based on all segments within overall US16 Corridor Study.

3.5.2 US16 Study Area Intersection Summary

A summary of US16 Corridor Study intersection-related crashes occurring within the US16/US16B/Catron Boulevard intersection study area is presented in **Table 5** and **Table 6**. Study area intersections with zero reported crashes within the 5-year review period are not shown. The crash rate rank and critical crash rates are based on all analyzed US16 two-way stop-control intersections within the overall US16 Corridor Study.

Table 5: Study Area Intersections – Crash Severity (2014-2018)

Intersection	Intersection Control	Fatal	Injury			PDO	Total
			A	B	C	Vehicle Only	
US16 & Enchantment Road	Two-Way Stop-Control	0	0	0	0	4	**4**
US16 & Table Rock Road	Two-Way Stop-Control	0	0	1	0	0	**1**
US16 & Promise Road	Two-Way Stop-Control	0	1	0	1	2	**4**
US16 & Tucker Street	Two-Way Stop-Control	0	0	0	1	0	**1**
US16 & Addison Avenue	Two-Way Stop-Control	0	1	0	0	0	**1**
US16 & Moon Meadows Drive	Two-Way Stop-Control	0	1	1	1	5	**8**
US16 & Cathedral Drive/Fairmont Blvd	Signal	0	0	3	5	15	**23**
US16 & US16B/Catron Blvd	Signal	0	2	14	18	54	**88**
Catron Blvd/Les Hollers Way	Signal	0	0	0	0	0	**0**
US16B/Catron Blvd & Healing Way	Two-Way Stop-Control	1	0	0	0	0	**1**
US16B/Catron Blvd & Wellington Drive (west)	Two-Way Stop-Control	0	0	0	0	0	**0**
US16B/Catron Blvd & Wellington Drive (east)	Two-Way Stop-Control	0	0	0	0	1	**1**

Injury severity categories:
A: Incapacitating injury B: Non-incapacitating injury C: Possible injury
PDO: Property damage only (no reported injury) crashes

Table 6: Study Area Intersections – Crash Rates (2014-2018)

Intersection	Intersection Control	Weighted Crash Rates (crashes per MVMT)		Critical Crash Rates (crashes per MVMT)		
		Weighted Crash Rate	Rank	Crash Rate	Critical Rate	Ratio
US16 & Enchantment Road	Two-Way Stop-Control	0.17	6	0.17	0.28	0.61
US16 & Table Rock Road	Two-Way Stop-Control	0.12	7	0.04	0.28	0.15
US16 & Promise Road	Two-Way Stop-Control	0.31	5	0.15	0.27	0.55
US16 & Tucker Street	Two-Way Stop-Control	0.12	8	0.04	0.28	0.14
US16 & Addison Avenue	Two-Way Stop-Control	0.09	9	0.03	0.25	0.12
US16 & Moon Meadows Drive	Two-Way Stop-Control	0.41	4	0.23	0.25	0.91
US16 & Cathedral Drive/Fairmont Blvd	Signal	1.12	2	0.66	**	**
US16 & US16B/Catron Blvd	Signal	2.96	1	1.67	**	**
US16B/Catron Blvd & Healing Way	Two-Way Stop-Control	0.45	3	0.04	0.27	0.15
US16B/Catron Blvd & Wellington Drive (east)	Two-Way Stop-Control	0.04	10	0.04	0.28	0.14

Ratios that exceed 1.0 noted in Orange Bold text.
No statewide average available for intersections. Intersections ranked from highest to lowest weighted crash rate.
** Critical rate not calculated due to low signalized intersection sample size.
Critical crash rate calculations based on all analyzed intersections within overall US16 Corridor Study

3.5.3 Crash Review Findings

Corridor Segment Summary

The majority of segment-related crashes along US16 were vehicle-animal crashes. The US16 segment between Addison Avenue and US16B/Catron Boulevard was the lone segment to exhibit a weighted crash rate greater than the statewide average. However, six of the eight crashes were vehicle-animal related. The other two resulted in one possible injury crash and one property damage only crash. No segments exhibited a crash rate greater than the critical crash rate when considering the overall US16 corridor.

Intersection Summary

All intersections exhibit a crash rate lower than the critical crash rate. However, critical rates were not calculated for signalized intersections due to the low sample size. The US16/US16B/Catron Boulevard intersection did show a weighted crash rate that was notably greater than the other study area intersections.

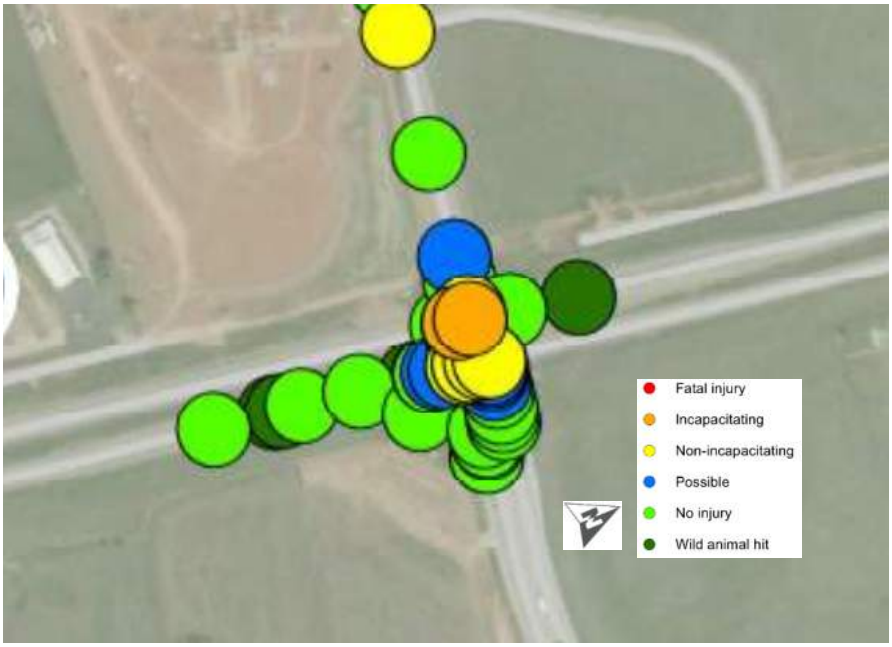
There was one fatal intersection crash reported at the US16B/Catron Boulevard/Healing Way intersection involving an angle collision between northbound and eastbound vehicles. The driver contributing circumstance was noted as disregarding traffic signs or signals. This crash

occurred prior to a traffic signal being installed at the intersection in early 2020. Other severe injury crashes occurred at US16 intersections with Promise Road, Addison Avenue, Moon Meadows Drive, and US16B/Catron Boulevard.

US16/US16B/Catron Boulevard Intersection Summary

The majority of study area crashes occurred at the US16/US16B/Catron Boulevard intersection, which are summarized in **Table 7**. As an intersection of major, regional crossroads for both commuter and tourist traffic in one of the fastest-growing areas of the Rapid City metropolitan area, it also experiences much greater traffic demand compared to the other intersections within the study area.

Table 7: US16/US16B/Catron Boulevard Intersection Crash Summary (2014 – 2018)

Total Crashes: 88 Crash Rate: 1.67 crashes/MEV Weighted Crash Rate: 2.96 crashes/MEV Intersection Control: Traffic signal <u>Injury Crash Summary</u> Fatal: 0 Incapacitating: 2 Non-incapacitating: 14 Possible: 18 <u>Manner of Collision Summary</u> Angle: 48 Rear-end: 32 Head-on: 1 Sideswipe: 1 Roadway departure: 6 <u>Weather-Related</u> Fog: 7 Snow/ice road conditions: 9	

Current posted speed limits through the intersection are 60 mph on US16 and 45 mph on US16B/Catron Boulevard. Turn lanes are included on all approaches. All left-turn movement signal phasing is currently protected-only. However, the US16B/Catron Boulevard left-turn phasing included protected-permissive phasing and single left-turn lanes during much of the crash history review period. There is a free northbound to eastbound right-turn movement.

Angle crashes were the most common manner of collision at the intersection, comprising 48 of the 88 total crashes. Further, 20 of the 34 injury crashes occurring at this intersection were angle crashes. The majority of angle crashes are between eastbound and westbound vehicles (totals below include both through and turning vehicles):

- 40 crashes involved an eastbound vehicle.
- 39 involved a westbound vehicle.
- 11 involved a northbound US16 vehicle.
- 5 involved a southbound US16 vehicle.

Rear-end crashes were the second most-frequent crash type, comprising 32 of the 88 total crashes. Rear-end crashes resulted in 13 injury crashes, 7 of which occurred on the westbound US16B approach. Crash distribution by approach is as follows:

- Eastbound approach: 9
- Westbound approach: 14
- Northbound US16 approach: 7
- Southbound US16 approach: 2

Weather-related impacts were also reviewed, including winter road conditions and fog. Nine crashes involved snow or ice road conditions, resulting in 5 rear-end crashes, 3 angle crashes, and 1 roadway departure crash. All five rear-end crashes occurred on US16B/Catron Boulevard (eastbound or westbound directions of travel). The angle and roadway departure crashes involved a variety of directions of travel. Fog was noted in seven crashes, 5 resulting in rear-end crashes and two resulting in angle crashes. Four of the 5 rear-end crashes involved a northbound vehicle.

A review of crash rates, type, and location of crashes suggests some impact of congestion, unexpected queue lengths, unexpected signal location, and weather on intersection safety.

4.0 Future Land Use and Supporting Roadway Network Planning

The future land use in the US16/US16B/Catron Boulevard intersection study area was reviewed to aid in the development and assignment of traffic forecasts. The Rapid City Comprehensive Plan (April 2014) includes a Future Land Use Plan to guide future zoning changes, development, infrastructure improvements, investment, and reinvestment. This future land use is identified within the City of Rapid City's 3-mile platting jurisdiction and looks out over the next 10 to 20 years. The Future Land Use Plan supports the City's Urban Services Boundary and Major Street Plan, for 'a more compact, efficient, and inter-connected pattern of development (Rapid City Comprehensive Plan page 87).

Figure 6 presents the Rapid City Comprehensive Plan Future Land Use Map, which includes both the Urban Services Boundary and Major Street Plan.

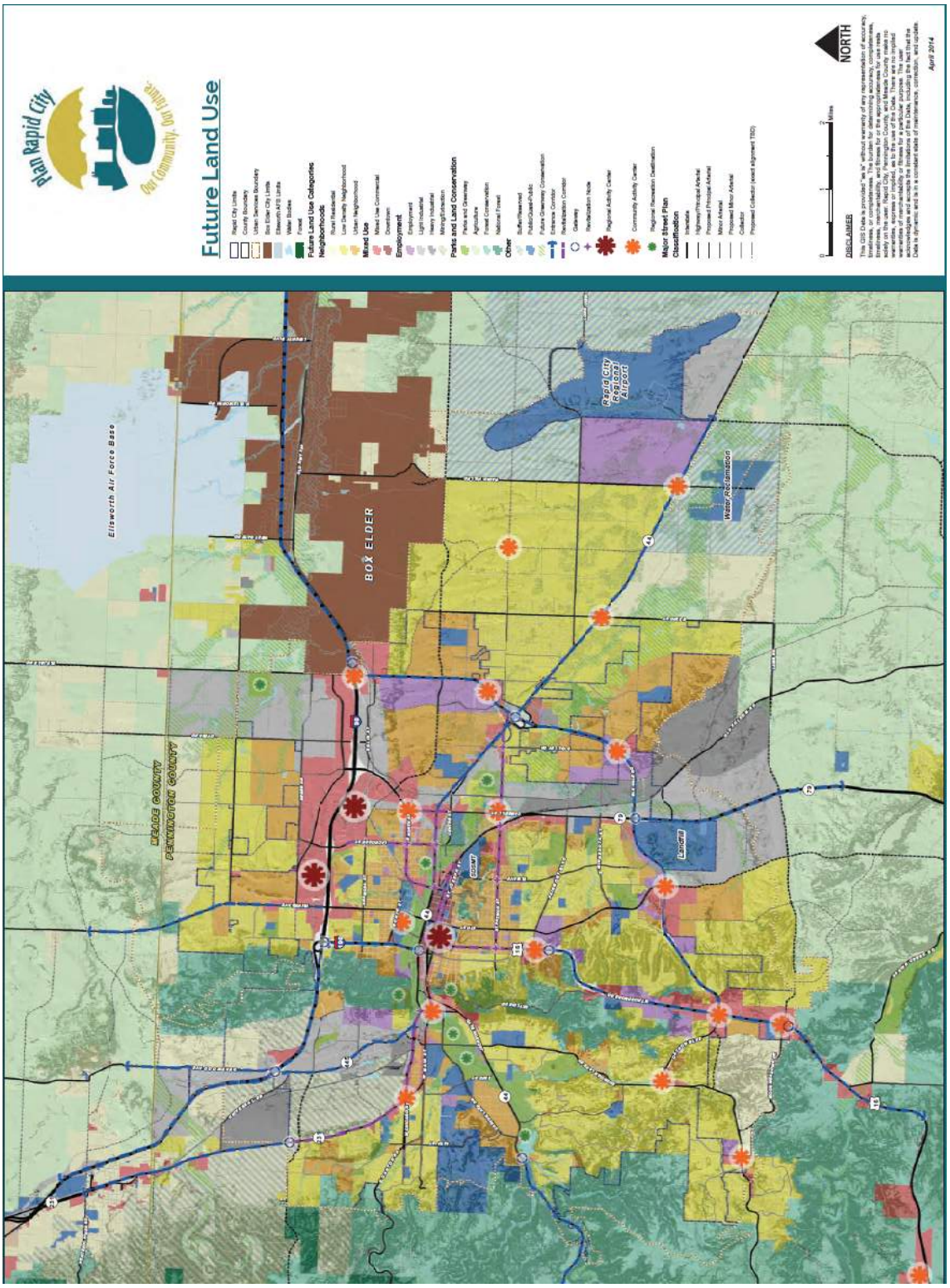
The Rapid City Comprehensive Plan subdivides Rapid City's planning area into 16 'neighborhoods'. The 'US Hwy 16' neighborhood encompasses the US16/US16B/Catron Boulevard intersection area as shown in **Figure 7**. The current urban boundary extends through this neighborhood along the section line south of Moon Meadows Drive (yellow dashed line added to **Figure 7**). The Rapid City Comprehensive Plan identifies areas north of the Urban Services Boundary as the primary growth areas within the US Hwy 16 neighborhood through year 2040.

The US Hwy 16 neighborhood, particularly north of Moon Meadows Drive, encompasses one of the fastest growing areas in Rapid City and an extensive amount of developable land. Future land use along US16 is primarily identified as mixed use commercial and employment, with pockets of urban neighborhood and public/quasi-public. Low density neighborhood is planned farther beyond the higher density development adjacent to the corridor. Two community activity center locations are noted at the US16 intersections with US16B/Catron Boulevard and Moon Meadows Drive.

To support the planned development in the area and lay out a framework for future local roadway network connections, the 2016 *US16/US16B/Catron Boulevard Intersection*

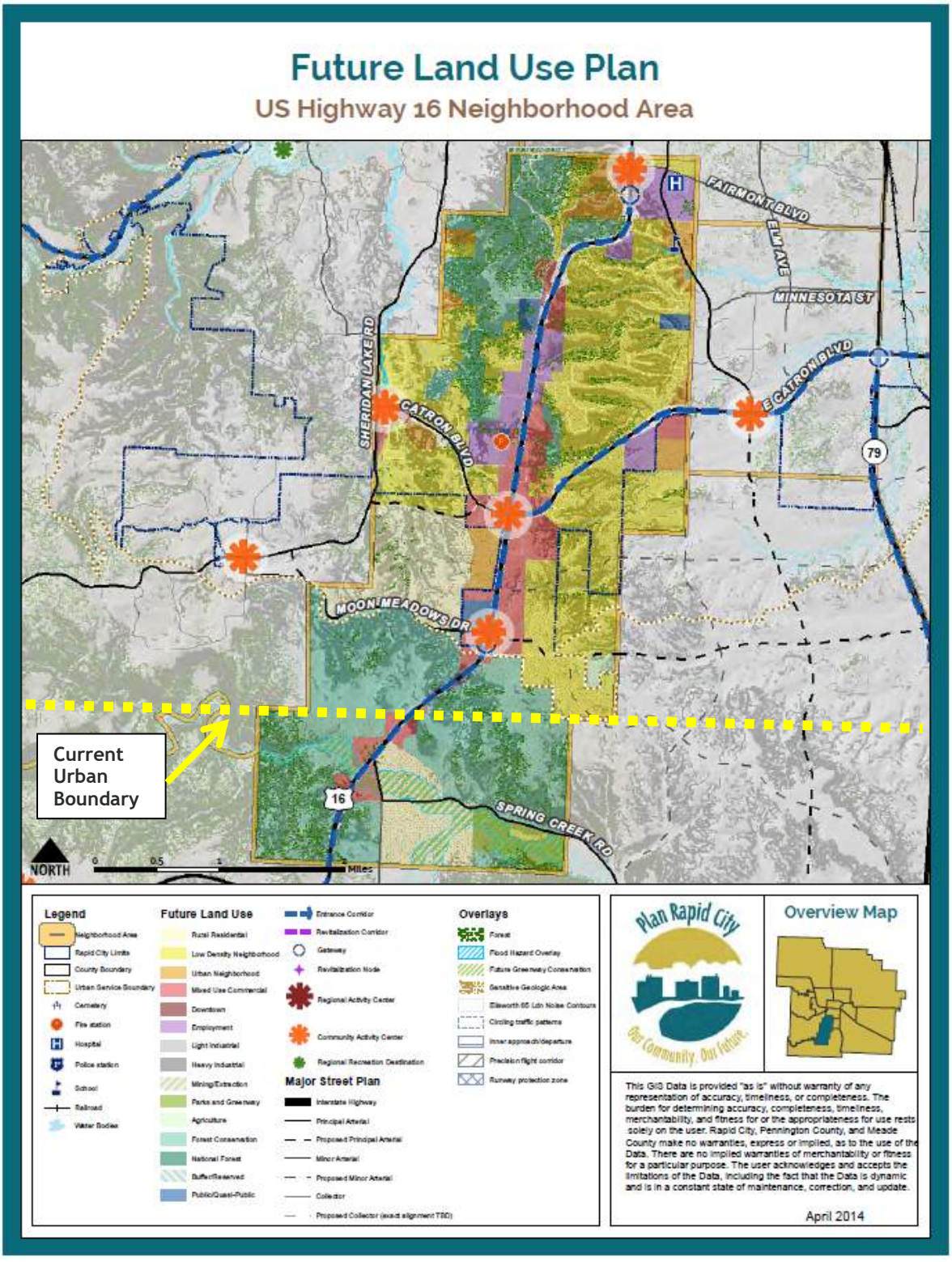
Alternatives Report presented two local network concepts. Both were initially presented to the public as part of that study. While not officially adopted by the City of Rapid City, the options serve as a guide for developers and fills in local network connectivity gaps beyond what is presented in the City of Rapid City *Major Street Plan*.

The Option 1 layout, shown in **Figure 8**, best reflects roadways constructed to date and anticipated future development roadways. This option has served as a guide for preliminary analysis in this study to maintain consistency with planning effort completed to date. As shown, an unnamed future rearage road and Healing Way would provide north/south connectivity for development east and west of US16 between US16B/Catron Boulevard and Moon Meadows Drive.



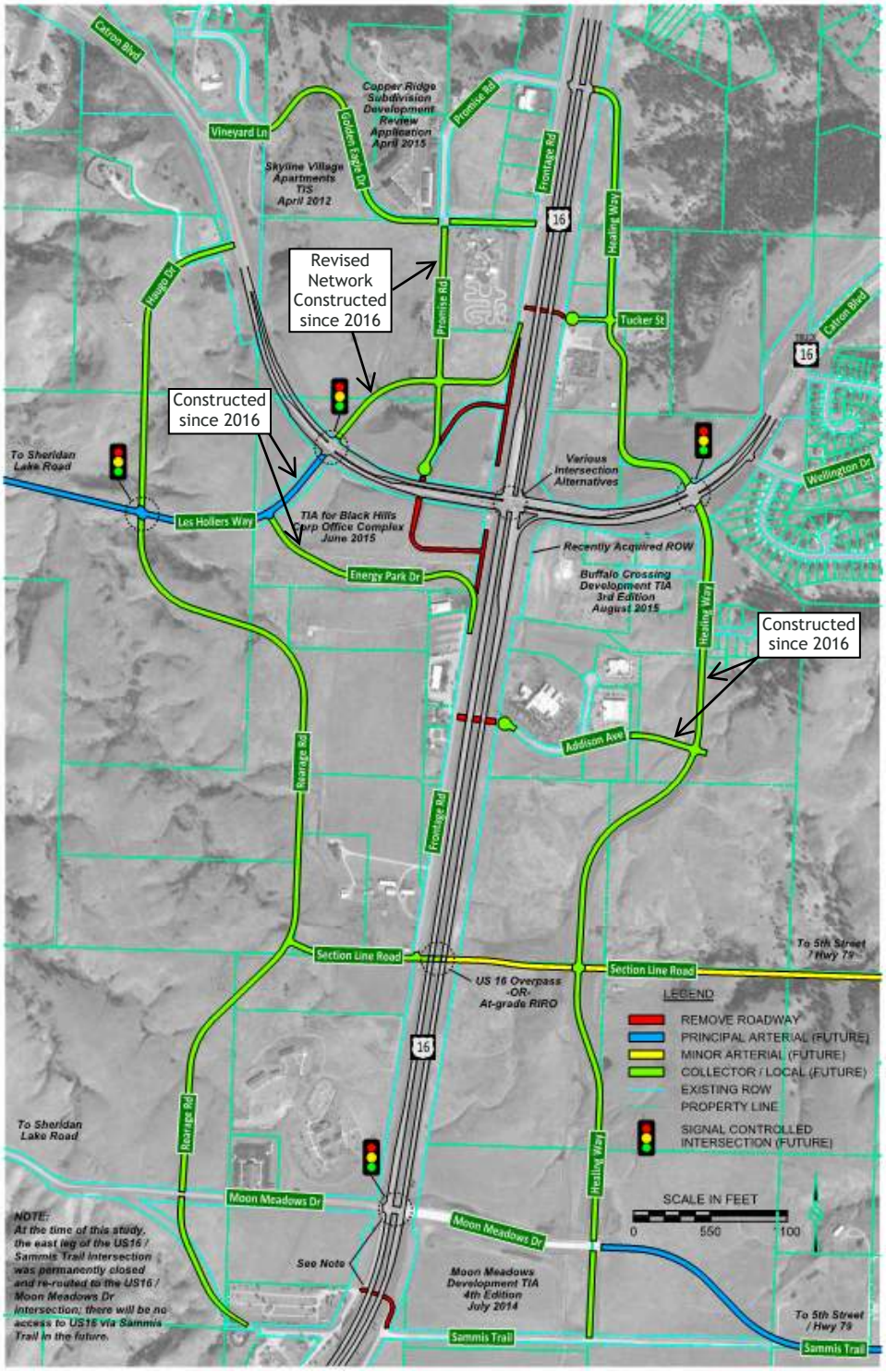
Source: Rapid City Comprehensive Plan, April 2014. Page 89.

Figure 6: Rapid City Comprehensive Plan Future Land Use



Source: Rapid City Comprehensive Plan, April 2014. Page 173.

Figure 7: Rapid City Comprehensive Plan – US Hwy 16 Neighborhood Area



Source: US16/US16B/Catron Boulevard Intersection Alternatives Report, December 2016. Figure 3. Segments constructed since 2016 noted. Updated map from this study provided at end of report.

Figure 8: US16/US16B/Catron Boulevard Intersection Alternatives Report Peripheral Street Network Option 1

5.0 Traffic Forecasts

Traffic forecasts help assess future-year capacity and operational needs throughout the study area due to growth in traffic demand and/or changes in traffic patterns and were developed as part of the overall US16 Corridor Study. The study's forecast years include:

- Year 2026 – First Possible Year of Project Completion
- Year 2050 – Planning Horizon Year

The basis for the traffic forecasts included traffic counts collected by the SDDOT and HDR in 2019 and the RCAMPO travel demand model. Future land use presented in the previous section was a key element used to develop future-year trips incorporated into the model. The following model versions were used to develop forecasts for this study:

- 2013 – travel demand model base year
- 2040 – travel demand model planning horizon

The following process was used to develop daily and peak hour intersection turning movement forecasts throughout the study area for the 2050 Planning Horizon No Build conditions:

1. The 2040 travel demand model scenario was evaluated for reasonableness, whether it met study goals, consistency in planned future roadway network, and any gaps in future development.
2. 2040 model output was post-processed consistent with travel demand model forecast methodologies presented in *NCHRP 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design*.
    a. 2050 daily segment and peak hour intersection forecasts were developed using:
        i. Seasonally adjusted existing volumes (June 2019)
        ii. 2050 growth factors were calculated from a comparison of 2013 base model and 2040 planning horizon model output
        iii. The iterative directional volume estimation method as outlined in *NCHRP 765* (intersection peak hour forecasts)

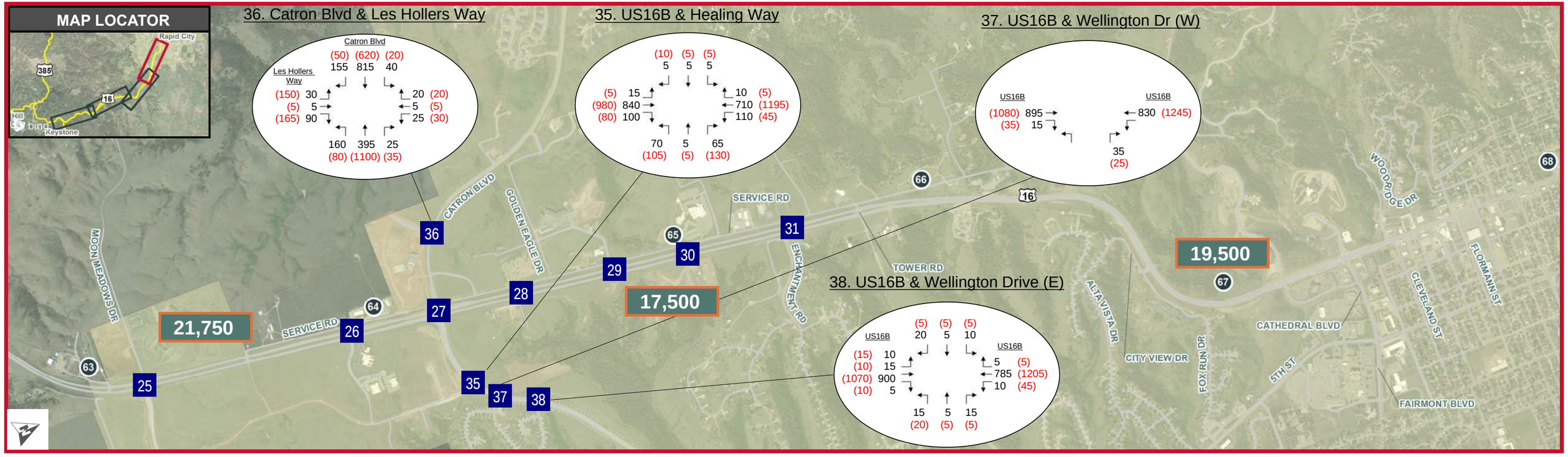
Where there were gaps in the model's estimation of future development, development-generated traffic was assigned to the network based on an estimation of future development occurring within the planning horizon.

Peak hour intersection turning movement volumes were smoothed and balanced throughout the study corridor.

Year 2026 No Build condition traffic volumes were developed from a straight-line interpolation between the 2019 Existing conditions volume set and the 2050 No Build conditions volume set.

An overview of Year 2026 and Year 2050 No Build condition traffic volumes are provided in **Figure 9** and **Figure 10**, respectively. These volumes are also applicable to Build conditions where there are no changes in access within the study area.

Additional information regarding the overall traffic forecasting process, a project-level review of the travel demand model, and considerations of previous studies completed to date in the area is provided in the *US16 Corridor Study Traffic Forecasts* technical memo provided in **Appendix F**.



Notes

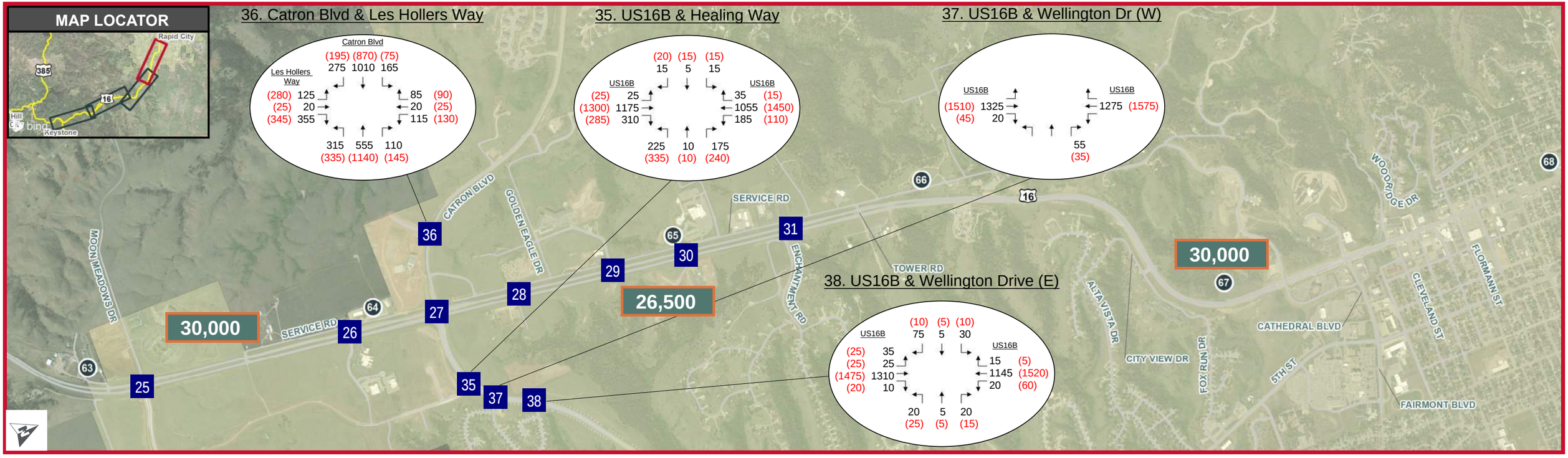
Traffic volumes obtained from the US16 Corridor Study ***2026 No-Build Conditions Traffic Operations*** technical memorandum.

Intersection numbering is consistent with the overall US16 Corridor Study.

2026 NO BUILD CONDITIONS TRAFFIC VOLUMES

US16 CORRIDOR STUDY - US16/US16B/CATRON BLVD INTERSECTION AREA

FIGURE 9, PAGE 1 OF 1



25. US16 & Moon Meadows Rd

US16 Corridor

(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)
25 (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)

31. US16 & Enchantment Road

US16 Corridor

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

Notes
Traffic volumes obtained from the US16 Corridor Study ***Traffic Forecasts*** technical memorandum.

Intersection numbering is consistent with the overall US16 Corridor Study.

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***

2050 NO BUILD CONDITIONS TRAFFIC VOLUMES

US16 CORRIDOR STUDY - US16/US16B/CATRON BLVD INTERSECTION AREA

US Highway 16 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

6.0 Traffic Operations Analysis Methodology

Peak hour level of service (LOS) was calculated for study area intersections and roadway segments using Highway Capacity Software (HCS), Version 7, Vissim microsimulation software (Vissim), and methodology described in the 6th Edition of the Highway Capacity Manual (HCM6). The following operational measures and applicable analysis tools were used in this study:

- Intersection delay and LOS (HCS and Vissim)
    - Measured in terms of total (overall) intersection delay to account for all vehicles entering the intersection
    - Two-way stop-control delay noted as both worst-case stop-control delay and total intersection delay
- Ramp terminal (interchange) and alternative intersection delay and LOS (HCS and Vissim)
    - Measured in terms of experienced travel time (ETT) to account for total origin-destination travel path delay across multiple intersections in HCS.
    - Vissim measures follow similar origin-destination travel path delay methodology as ETT in HCS
    - HCM6 LOS thresholds slightly different between interchanges and alternative intersections
- Urban street LOS (HCS)
    - Measured in terms of travel speed as a percentage of base free flow speed.
    - Travel time is a second measure obtained from this analysis of corridor operations (HCS and Vissim)
- Multilane highway segment LOS (HCS)
    - Measured in terms of vehicle density
    - Only applicable to No Build conditions (US16/Moon Meadows Drive and US16/Promise Road unsignalized)
- Freeway segment and facility LOS
    - Measured in terms of vehicle density for merge, diverge, and basic freeway segments and for overall freeway facility

To provide a level comparison of traffic benefits and drawbacks afforded to each Build Option, overall intersection/interchange delay was determined to account for all entering vehicles. This methodology follows the HCM6-based ETT calculations of delay at interchanges and alternative intersections.

Current limitations to DLT intersection analysis with HCM6 methodology and HCS software should also be noted. The Vissim analysis, which is an HCM6-recommended alternative method for analysis of DLT intersections, overcomes these limitations to provide a comparable, overall measure of interchange and intersection operations. Output from Vissim was also used to supplement the HCS analysis with regard to incorporating measured delay for free movements.

The Vissim analysis represents a 'proof of concept' level of analysis without calibration of existing traffic conditions. This type of analysis provides a beneficial comparison of Build Options, or 'concept', with consistent traffic parameters. However, the lack of calibration to local conditions which is done in HCS analyses may lead to misleading overall LOS results. Therefore, it is not recommended that HCS results be compared to Vissim results (and vice versa) and results from each tool are generally presented separately in this report.

HCM6-based LOS thresholds specific to each measure and additional information regarding HCM6 and HCS limitations are provided in **Appendix G**.

6.1 Level of Service Goals

The US16/US16B/Catron Boulevard intersection has been identified as an urban intersection for the US16 Corridor Study. The entire intersection study area is located within the current Rapid City urban boundary as documented in City of Rapid City and RCAMPO plans.

The following minimum allowable LOS thresholds in **Table 8** have been established for this study.

Table 8: Minimum Allowable Level of Service by Facility

Facility Type	Minimum Allowable LOS	Notes
	Rural Area	
Signalized Intersections	LOS C	Individual movements allowed to operate at LOS D.
Two-Way Stop-Controlled Intersections	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.
Freeway Segments and Multilane Highways	LOS C	LOS B is desirable.

7.0 Existing and Future No Build Conditions Traffic Operations

An existing and future No Build condition traffic analysis was conducted to aid in the identification of long range traffic operational needs within the intersection. Locations that do not meet LOS goals outlined for this study area are noted in Bold Orange text in the table. Additional information for these analyses can be found in the following reports included in the **Appendix**:

- *2019 Existing Conditions Traffic Operations* technical memo (**Appendix D**)
- *2026 No Build Conditions Traffic Operations* technical memo (**Appendix H**)
- *2050 No Build Conditions Traffic Operations* technical memo (**Appendix I**)

7.1 Intersections

A summary of intersection operations for the Existing, 2026 No Build and 2050 No Build conditions is provided in the following tables. The LOS C goal for this study at two-way stop-controlled intersections is applied to the overall, or weighted, delay measure.

Table 9: TWSC Intersection Operations – Existing Conditions (HCS)

Intersection	Measure	AM			PM		
		Control Delay (sec/veh)	LOS	95% Queue (veh)	Control Delay (sec/veh)	LOS	95% Queue (veh)
US16 & Enchantment Road	**Overall**	**1.0**	**A**	-	**1.1**	**A**	-
	TWSC	*14.8*	*B*	*0.1*	*19.5*	*C*	*0.4*
US16 & Table Rock Road	**Overall**	**0.9**	**A**	-	**0.9**	**A**	-
	TWSC	*13.7*	*B*	*0.2*	*12.2*	*B*	*0.1*
US16 & Promise Road	**Overall**	**1.7**	**A**	-	**1.9**	**A**	-
	TWSC	*14.2*	*B*	*1.0*	*14.9*	*B*	*1.0*
US16 & Tucker Street	**Overall**	**0.0**	**A**	-	**0.0**	**A**	-
	TWSC	*0.0*	*A*	*0.0*	*0.0*	*A*	*0.0*
US16 & Addison Avenue	**Overall**	**1.2**	**A**	-	**2.1**	**A**	-
	TWSC	*25.8*	*D*	*0.2*	*33.3*	*D*	*1.8*
US16 & Moon Meadows Drive	**Overall**	**4.0**	**A**	-	**1.7**	**A**	-
	TWSC	*25.8*	*D*	*3.2*	*23.3*	*C*	*1.3*
US16B/Catron Blvd & Healing Way	**Overall**	**1.5**	**A**	-	**1.9**	**A**	-
	TWSC	*25.9*	*B*	*0.8*	*27.7*	*D*	*1.7*
US16B/Catron Blvd & Wellington Dr (W)	**Overall**	**0.2**	**A**	-	**0.1**	**A**	-
	TWSC	*11.4*	*B*	*0.2*	*12.5*	*B*	*0.2*
US16B/Catron Blvd & Wellington Dr (E)	**Overall**	**0.4**	**A**	-	**0.9**	**A**	-
	TWSC	*19.6*	*C*	*0.3*	*62.9*	*F*	*0.9*

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.

Table 10: Signalized Intersection Operations – Existing Conditions (HCS)

Intersection	Measure	AM		PM	
		Control Delay (sec/veh)	LOS	Control Delay (sec/veh)	LOS
Catron Blvd & Les Hollers Way	Signal	6.0	A	8.2	A
US16 & US16B/Catron Blvd	Signal	**37.8**	**D**	**46.1**	**D**

Overall intersection delay greater than LOS C noted in **Bold Orange**.
A signal was constructed at the US16/Healing Way intersection in early 2020. See 2026 No Build analysis for an estimate of current operations.

Table 11: TWSC Intersection Operations – 2026 No Build Conditions (HCS)

Intersection	Measure	AM			PM		
		Control Delay (sec/veh)	LOS	95% Queue (veh)	Control Delay (sec/veh)	LOS	95% Queue (veh)
US16 & Enchantment Road	**Overall**	**1.2**	**A**	-	**1.5**	**A**	-
	TWSC	*15.2*	*C*	*0.6*	*24.0*	*C*	*0.6*
US16 & Table Rock Road	**Overall**	**1.4**	**A**	-	**1.3**	**A**	-
	TWSC	*17.7*	*C*	*0.4*	*19.4*	*C*	*0.5*
US16 & Promise Road	**Overall**	**3.1**	**A**	-	**4.0**	**A**	-
	TWSC	*25.6*	*D*	*2.3*	*39.4*	*E*	*3.3*
US16 & Tucker Street	**Overall**	**0.4**	**A**	-	**0.4**	**A**	-
	TWSC	*15.7*	*C*	*0.1*	*17.8*	*C*	*0.2*
US16 & Addison Avenue	**Overall**	**2.0**	**A**	-	**6.1**	**A**	-
	TWSC	*31.4*	*D*	*0.8*	*100.5*	*F*	*5.6*
US16 & Moon Meadows Drive	**Overall**	**6.8**	**A**	-	**5.3**	**A**	-
	TWSC	*40.4*	*E*	*5.3*	*57.9*	*F*	*4.1*
US16B/Catron Blvd & Wellington Dr (W)	**Overall**	**0.2**	**A**	-	**0.1**	**A**	-
	TWSC	*12.5*	*B*	*0.2*	*13.8*	*B*	*0.2*
US16B/Catron Blvd & Wellington Dr (E)	**Overall**	**1.7**	**A**	-	**7.3**	**A**	-
	TWSC	*39.2*	*E*	*1.0*	*425.9*	*F*	*3.8*

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.

Table 12: Signalized Intersection Operations – 2026 No Build Conditions (HCS)

Intersection	Measure	AM		PM	
		Control Delay (sec/veh)	LOS	Control Delay (sec/veh)	LOS
Catron Blvd & Les Hollers Way	Signal	13.6	B	15.7	B
US16B/Catron Blvd & Healing Way	Signal	17.8	B	19.4	B
US16 & US16B/Catron Blvd	Signal	43.2	D	58.7	E

Overall intersection delay greater than LOS C noted in Bold Orange.

Table 13: TWSC Intersection Operations – 2050 No Build Conditions (HCS)

Intersection	Measure	AM			PM		
		Control Delay (sec/veh)	LOS	95% Queue (veh)	Control Delay (sec/veh)	LOS	95% Queue (veh)
US16 & Enchantment Road	**Overall**	**11.0**	**B**	**-**	**98.0**	**F**	**-**
	TWSC	*135.3*	*F*	*6.7*	*2716.4*	*F*	*12.6*
US16 & Table Rock Road	**Overall**	**4.6**	**A**	**-**	**4.7**	**A**	**-**
	TWSC	*93.6*	*F*	*2.9*	*102.6*	*F*	*2.8*
US16 & Promise Road	**Overall**	**33.4**	**D**	**-**	**~**	**F**	**-**
	TWSC	*401.3*	*F*	*14.7*	*~*	*F*	*~*
US16 & Tucker Street	**Overall**	**0.6**	**A**	**-**	**0.9**	**A**	**-**
	TWSC	*27.3*	*D*	*0.3*	*34.5*	*D*	*0.4*
US16 & Addison Avenue	**Overall**	**32.9**	**D**	**-**	**~**	**F**	**-**
	TWSC	*960.6*	*F*	*10.1*	*~*	*F*	*~*
US16 & Moon Meadows Drive	**Overall**	**220.4**	**F**	**-**	**~**	**F**	**-**
	TWSC	*1664.1*	*F*	*26.3*	*~*	*F*	*~*
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*	*~*

Overall intersection delay greater than LOS C noted in **Bold Orange**.
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 14: Signalized Intersection Operations – 2050 No Build Conditions (HCS)

Intersection	Measure	AM		PM	
		Control Delay (sec/veh)	LOS	Control Delay (sec/veh)	LOS
Catron Blvd & Les Hollers Way	Signal	79.6	E	55.0	D
US16B/Catron Blvd & Healing Way	Signal	23.9	C	33.9	C
US16 & US16B/Catron Blvd	Signal	75.4	E	136.6	F

Overall intersection delay greater than LOS C noted in **Bold Orange**.

7.2 Multilane Highway Segments

Multilane highway segment analysis measures along US16 through the study area are shown in the following tables for Existing, 2026 No Build and 2050 No Build conditions. The segment numbering corresponds with the overall US16 Corridor Study multilane highway segmentation, with segments 35-37 occurring in this intersection sub-area as follows:

- Segment 35: MRM 63.00 (just south of Moon Meadows Drive) to Addison Avenue
- Segment 36: Addison Avenue to US16B/Catron Boulevard
- Segments 37: US16B/Catron Boulevard to MRM 66.0 (approximately 0.25 miles north of Enchantment Road)

A reference map for these locations is included in the respective traffic operations analysis technical memos in the **Appendix**.

Table 15: US16 Multilane Highway Operations – Existing Conditions (HCS)

Seg. #	Mainline	Approximate Limits		Approx. Length (miles)	Analysis Grade (%)**	AM LOS		PM LOS	
		From	To			NB	SB	NB	SB
35	US 16	MRM 63.00	Addison Ave	0.8	Rolling	A	A	A	A
36	US 16	Addison Ave	US16B/ Catron Blvd	0.3	5.2	A	A	A	A
37	US 16	US16B/ Catron Blvd	MRM 66.00	1.5	Rolling	A	A	A	A

Segment number corresponds with overall US16 Corridor Study segmentation.
** Analysis grade reflects level, rolling or specific grade.
Existing profile information obtained from SDDOT profile GIS layer (current spring 2019).
Limits and length are approximate, and thus may not align due to rounding and approximation of MRM locations.

Table 16: US16 Multilane Highway Operations – 2026 No Build Conditions (HCS)

Seg. #	Mainline	Approximate Limits		Approx. Length (miles)	Analysis Grade (%)**	AM LOS		PM LOS	
		From	To			NB	SB	NB	SB
35	US 16	MRM 63.00	Addison Ave	0.8	Rolling	A	A	A	A
36	US 16	Addison Ave	US16B/ Catron Blvd	0.3	5.2	A	A	B	A
37	US 16	US16B/ Catron Blvd	MRM 66.00	1.5	Rolling	A	A	A	A

Segment number corresponds with overall US16 Corridor Study segmentation.
** Analysis grade reflects level, rolling or specific grade.
Existing profile information obtained from SDDOT profile GIS layer (current spring 2019).
Limits and length are approximate, and thus may not align due to rounding and approximation of MRM locations.

Table 17: US16 Multilane Highway Operations – 2050 No Build Conditions (HCS)

Seg. #	Mainline	Approximate Limits		Approx. Length (miles)	Analysis Grade (%)**	AM LOS		PM LOS	
		From	To			NB	SB	NB	SB
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

Segment number corresponds with overall US16 Corridor Study segmentation.
** Analysis grade reflects level, rolling or specific grade.
Existing profile information obtained from SDDOT profile GIS layer (current spring 2019).
Limits and length are approximate, and thus may not align due to rounding and approximation of MRM locations.

7.3 Existing and Future No Build Conditions Traffic Operations Conclusions

It was found that the following intersections did not meet the overall intersection delay LOS C goal for this study in the existing, 2026, or 2050 No Build conditions.

- US16/US16B/Catron Boulevard Intersection (existing, 2026, and 2050)
- US16/Moon Meadows Drive (2050)
- US16/Addison Avenue (2050)
- US16/Promise Road (2050)
- US16/Enchantment Road (2050)
- Catron Boulevard/Les Hollers Way (2050)
- US16B/Catron Boulevard/Wellington Drive (east) (2050)

Many of these needs are traffic control-related (stop-control vs. signalization) and assume no route diversion to adjacent signalized intersections. The primary intersection need is associated with the US16/US16B/Catron Boulevard which demonstrates notable congestion as traffic volumes continue to grow.

All US16 multilane segments through the study area were measured at LOS B or better, and thus meet LOS goals for this study.

8.0 Summary of US16/US16B/Catron Boulevard Intersection Transportation Needs

The purpose of a future Project recommended in this report is to improve traffic operations and safety at the US16/US16B/Catron Boulevard intersection, and with the goal of supporting the planned mix use urban development that is occurring in the area. The following summarizes transportation needs that support the purpose for a future project at the US16/US16B/Catron Boulevard intersection. Additional information regarding the project purpose and need can be found in the **Appendix J**.

Traffic Operations

The US16 and US16B/Catron Boulevard corridors are important to both the regional and local roadway networks. Traffic volumes fluctuate throughout the day as a key commuter route between Rapid City and the Black Hills area. Seasonally, US16 and US16B are makes up the main route between I-90/Rapid City and the Black Hills, Mount Rushmore, and other tourist destinations to the south.

Recent improvements to the US16/US16B/Catron Boulevard intersection are expected to extend the operational acceptability for a few more years. However, tourist-season congestion is noted with 2019 traffic volumes in the existing conditions analysis. This congestion is expected to continue to grow and reach conditions where volumes exceed capacity (LOS F) without further modification by year 2050. Modifications are needed to this intersection to provide safe and reliable travel for the locally and regionally important corridors of US16 and US16B/Catron Boulevard.

High crash rate

There were 88 reported crashes occurring at the intersection between 2014 and 2018, leading to the highest weighted crash rate of all study area intersections. The weighted crash rate, 2.96, was nearly 2.5 times the next highest intersection weighted crash rate within the sub-stud area.

Thirty-four of the 88 crashes resulted in an injury. The injury severity tended to be lower than some of the other intersections as there were no fatalities and two incapacitating injuries. The remaining 32 injury crashes were less-severe non-incapacitating injury or possible injury crashes.

Of the 88 crashes, 48 were angle crashes and 32 were rear-end crashes. Weather played a notable role in many of these crashes. Fog contributed to seven crashes, with four of those occurring in the northbound direction. Nine other crashes involved snow or ice road conditions, with most involving a vehicle traveling on US16B/Catron Boulevard.

Overall, the US16/US16B/Catron Boulevard intersection crash rate, types, and locations are consistent with intersection congestion, unexpected queue lengths, and road conditions affected by weather.

Rapidly Urbanizing Land Use

The US16 corridor within the study area is one of the fastest growing areas within the Rapid City MPO area. Mixed-use development is the predominant planned land use, with spot locations of employment, residential, and public/quasi-public. This development is expected to generate a considerable amount of traffic that will add to the future traffic demand entering the US16/US16B/Catron Boulevard intersection. Further, this development will alter traffic patterns that have historically been reflective of more regional travel passing through the area.

9.0 US16/US16B/Catron Boulevard Intersection Preliminary Concept Summary

The 2016 *US16/US16B/Catron Boulevard Alternatives Report* documented the development and evaluation of eight intersection Build alternatives, noted below:

1. Tight Diamond Urban Interchange (TDUI)
2. Single Point Urban Interchange (SPUI) (also known as a Single Point Interchange, or SPI)
3. Diverging Diamond Interchange (DDI)
4. At-Grade Intersection
5. Continuous Flow Intersection (CFI) (also known as a DLT intersection)
6. SPUI with Flyover
7. Echelon Interchange
8. At-Grade Intersection with Flyover

The recommended alternatives of 2 (SPI) and 5 (CFI, or DLT intersection) were carried forward into this study for additional refinement and analysis.

The report also presented two local roadway network options in the vicinity of the intersection that were carried forward to the US16 Corridor Study (Option 1 shown previously in **Figure 8**).

10.0 US16/US16B/Catron Boulevard Intersection Build Options

This study developed eight different Build Options, three variations of a Single Point Interchange (SPI) and five variations of a Displaced Left Turn (DLT) intersection (referred to as a CFI in the 2016 study). The primary differences across the variations focused on turn lane type and traffic control at the US16/US16B/Catron Boulevard intersection.

Build Options, shown in **Figure 11** through **Figure 18,** are as follows:

- 1.1a: SPI – Free NB/SB Right Turn Lanes
- 1.1b: SPI – Free NB/SB Right Turn Lanes
    - With eastbound right turn lane at Healing Way
- 1.2: SPI – Signalized NB/SB Dual Right Turn Lanes
- 2.1a: DLT – Free NB/SB Right Turn Lanes
- 2.1b: DLT – Free Right Turn Lanes (all Quadrants)
- 2.2a: DLT – Signalized Right Turn Lanes (all quadrants)
    - NB/SB signalized at crossover intersections
- 2.2b: DLT – Signalized NB/SB Right Turn Lanes
    - NB/SB signalized at crossover intersections
- 2.3: DLT – Unseparated, Signalized Right Turn Lanes at Main Intersection

The SPI Build Options require closure of US16/Addison Avenue and US16/Tucker Street intersections due to the access being located within the interchange ramps. For the DLT Build Options, analysis scenarios were developed to evaluate different access treatments at the US16/Addison Avenue and US16/Tucker Street intersections. It is assumed for this analysis that all traffic impacted by potential modified access points would still be accommodated by future local network connections within the intersection study area.

Design-related considerations incorporated into the Build Options include:

- Due to the required closure of US16/Tucker Street access in the SPI Build Options, an extension of Promise Road is required to either:
    - US16/Promise Road intersection and/or
    - US16B/Catron Boulevard/Healing Way intersection.
- All Build Options include reconstruction of US16 between Catron Boulevard and Addison Avenue to flatten a vertical curve that does not meet current design speed.
- US16 intersections with Moon Meadows Drive and Promise Road were assumed signalized in the Build Condition analysis.

Several corridor elements were being developed and analyzed concurrently as part of the overarching US16 Corridor Study. As many of these involved an iterative process between the corridor study and this sub-study, the following are reflected in the recommended Build Option layout at the end of the report:

- US16 corridor design speed
- US16 corridor typical section
- Promise Road/Tablerock Road intersection location/access type
- Promise Road intersection signalization needs and planning-level anticipated timeframe for meeting traffic signal warrants
- Minor road access and local network connectivity
- Bicycle and pedestrian accommodations

Additional information regarding the concept development, refinement, and analysis for these recommendations incorporated into the Build Options is documented in the overarching *US16 Corridor Study* report. Additional discussion regarding each Build Option is provided in the *US16/US16B/Catron Boulevard Intersection Build Option Evaluation* report provided in **Appendix K**.

N

Scale in Feet

0 250 500

Legend

- Proposed Roadway
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

Ramp Design Notes:
Layout reflects two design speed options considered as part of the intersection study and the relationship design speed has with ramp geometrics.

North of Catron Boulevard:
US16 design speed: 55 MPH
NB Entrance ramp design speed: 45 MPH
SB Exit ramp design speed: 50 MPH

South of Catron Boulevard:
US16 design speed: 65 MPH
NB Exit ramp design speed: 50 MPH
SB Entrance ramp design speed: 50 MPH

Catron Blvd
Golden Eagle Dr
Promise Road
16
Rearage Road
Tucker St
Catron Blvd
Promise Road
TRUCK 16
Les Hollers Way
Unsignalized/Free Right Turn Lane
Shared Thru/Right Turn Lane
Energy Park Dr
Healing Way
Addision Ave
16

	Drawn By: Date: Chked By: Date: Revision:		US Highway 16 CORRIDOR STUDY	Alternative 1.1a SPI with Separated, Free NB and SB Right Turn Lanes US16 Corridor Study — Rapid City, SD	Figure 11

N

Scale in Feet
0 250 500

Legend
- Proposed Roadway
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

Ramp Design Notes:
Layout reflects two design speed options considered as part of the intersection study and the relationship design speed has with ramp geometrics.

North of Catron Boulevard:
US16 design speed: 55 MPH
NB Entrance ramp design speed: 45 MPH
SB Exit ramp design speed: 50 MPH

South of Catron Boulevard:
US16 design speed: 65 MPH
NB Exit ramp design speed: 50 MPH
SB Entrance ramp design speed: 50 MPH

Catron Blvd
Golden Eagle Dr
Promise Road
16
Rearage Road
Tucker St
Catron Blvd
TRUCK 16
Promise Road
Les Hollers Way
Right Turn Lane
Unsignalized/Free Right Turn Lane
Energy Park Dr
Healing Way
Addision Ave
16

	Drawn By: Date: Chked By: Date: Revision:	US Highway 16 CORRIDOR STUDY	Alternative 1.1b SPI with Separated, Free NB and SB Right Turn Lanes with EB Right Turn Lane at Healing Way US16 Corridor Study — Rapid City, SD	Figure 12

N

Scale in Feet
0 250 500

Legend
- Proposed Roadway
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

Ramp Design Notes:
Layout reflects two design speed options considered as part of the intersection study and the relationship design speed has with ramp geometrics.

North of Catron Boulevard:
US16 design speed: 55 MPH
NB Entrance ramp design speed: 45 MPH
SB Exit ramp design speed: 50 MPH

South of Catron Boulevard:
US16 design speed: 65 MPH
NB Exit ramp design speed: 50 MPH
SB Entrance ramp design speed: 50 MPH

Catron Blvd
Golden Eagle Dr
Promise Road
16
Rearage Road
Tucker St
Catron Blvd
TRUCK 16
Promise Road
Signalized SB to WB Dual Right Turn Lane
Les Hollers Way
Energy Park Dr
Signalized NB to EB Dual Right Turn Lane
Healing Way
Addision Ave
16

	Drawn By: Date: Chked By: Date: Revision:	US Highway 16 CORRIDOR STUDY	Alternative Scenario 1.2 SPI with Signalized NB and SB Dual Right Turn Lanes and EB Right Turn Lane at Healing Way US16 Corridor Study — Rapid City, SD	Figure 13

N

Scale in Feet
0 250 500

Legend
- Proposed Roadway
- Displaced Left
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

Catron Blvd
Golden Eagle Dr
Promise Road
16
Rearage Road
Tucker St
Catron Blvd
TRUCK 16
Promise Road
Les Hollers Way
Energy Park Dr
Unsignalized/Free Right Turn Lane
Healing Way
Addision Ave
16

	Drawn By: Date: Chked By: Date: Revision:	US Highway 16 CORRIDOR STUDY	Alternative 2.1a DLT with Separated, Free NB and SB Right Turn Lanes US16 Corridor Study — Rapid City, SD	Figure 14

N

Scale in Feet

0 250 500

Legend

- Proposed Roadway
- Displaced Left
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

Catron Blvd
Golden Eagle Dr
Promise Road
16
Rearage Road
Tucker St
Catron Blvd
TRUCK 16
Promise Road
Les Hollers Way
Unsignalized/Free Right Turn Lane with Acceleration Lane (All Quadrants)
Energy Park Dr
Healing Way
Addision Ave
16

	Drawn By: Date: Chked By: Date: Revision:		US Highway 16 CORRIDOR STUDY	Alternative 2.1b DLT with Separated, Free Right Turn Lanes at Main Intersection (all Quadrants) US16 Corridor Study Rapid City, SD	Figure 15

N

Scale in Feet

0 250 500

Legend

- Proposed Roadway
- Displaced Left
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

Catron Blvd

Golden Eagle Dr

Promise Road

16

Rearage Road

Tucker St

Catron Blvd

TRUCK 16

Promise Road

SB to WB Dual Right Turn Lane Signalized at Crossover Intersection

Les Hollers Way

Energy Park Dr

NB to EB Dual Right Turn Lane Signalized at Crossover Intersection

Healing Way

Addision Ave

16

	Drawn By: Date: Chked By: Date: Revision:	US Highway 16 CORRIDOR STUDY	Alternative 2.2a DLT with Signalized Right Turn Lanes at Main Intersection (all Quadrants) US16 Corridor Study — Rapid City, SD	Figure 16

N

Scale in Feet

0 250 500

Legend

- Proposed Roadway
- Displaced Left
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

Catron Blvd

Golden Eagle Dr

Promise Road

16

Rearage Road

Tucker St

Catron Blvd

TRUCK 16

Promise Road

SB to WB Dual Right Turn Lane Signalized at Crossover Intersection

Unsignalized / Free Right Turn Lane with Acceleration Lane

Les Hollers Way

Unsignalized / Free Right Turn Lane with Acceleration Lane

Energy Park Dr

NB to EB Dual Right Turn Lane Signalized at Crossover Intersection

Healing Way

Addision Ave

16

	Drawn By: Date: Chked By: Date: Revision:		US Highway 16 CORRIDOR STUDY	Alternative 2.2b DLT with NB and SB Signalized Right Turn Lanes, Free EB and WB Right Turn Lanes US16 Corridor Study Rapid City, SD	Figure 17

N

Scale in Feet

0 250 500

Legend

- Proposed Roadway
- Displaced Left
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

Catron Blvd

Golden Eagle Dr

Promise Road

16

Rearage Road

Tucker St

Catron Blvd

TRUCK 16

Promise Road

Signalized SB to WB Dual Right Turn Lane Crosses in Front of Displaced Left Turn Lane

Les Hollers Way

Energy Park Dr

Signalized NB to EB Dual Right Turn Lanes Crosses in Front of Displaced Left Turn Lane

Healing Way

Addision Ave

16

	Drawn By: Date: Chked By: Date: Revision:		US Highway 16 CORRIDOR STUDY	Alternative 2.3a DLT with Unseparated, Signalized Right Turn Lanes at Main Intersection US16 Corridor Study Rapid City, SD	Figure 18

11.0 US16/US16B/Catron Boulevard Intersection Build Option Analysis

11.1 Build Condition Traffic Volume Development

This study assumes that all traffic volumes entering and exiting the US16/US16B/Catron Boulevard intersection sub-area in the No Build conditions will also enter the sub-area in the Build conditions. Where access is not modified at any study intersections, the previously presented No Build condition volume is applicable. For scenarios where an access is modified, impacted traffic is redistributed, or assigned, to access points within the sub-area. The 2050 and 2026 Build condition volume scenarios where access is modified at US16/Addison Avenue and US16/Tucker Street are shown in **Figure 19** and **Figure 20**.

11.2 2050 Build Condition Traffic Operations Analysis

The following sections present the traffic operations analysis of Build Options with 2050 Build condition traffic volumes. Analysis measures are noted as being HCS or Vissim in the respective table heading. US16 access with Addison Avenue and Tucker Street is analyzed as closed in all SPI Build Options and as noted in the respective table for DLT intersection Build Options.

The operations analysis primarily focuses on the US16 corridor between Moon Meadows Drive and Promise Road and US16B/Catron Boulevard corridor between Les Hollers Way and Healing Way. Intersection operations beyond these limits are expected to exhibit minimal deviation between Build Options and are further analyzed in the overall US16 Corridor Study concept analysis.

Technical memos with additional analysis, discussion, and output to support this section are as follows:

- *US16/US16B/Catron Boulevard Intersection Sub-Area Build Option Highway Capacity Software Analysis* report (**Appendix L**)
- *US16 Traffic Simulation Results* technical memo (**Appendix M**)
- *US16 Corridor Study Urban Area Access* report (**Appendix C**)

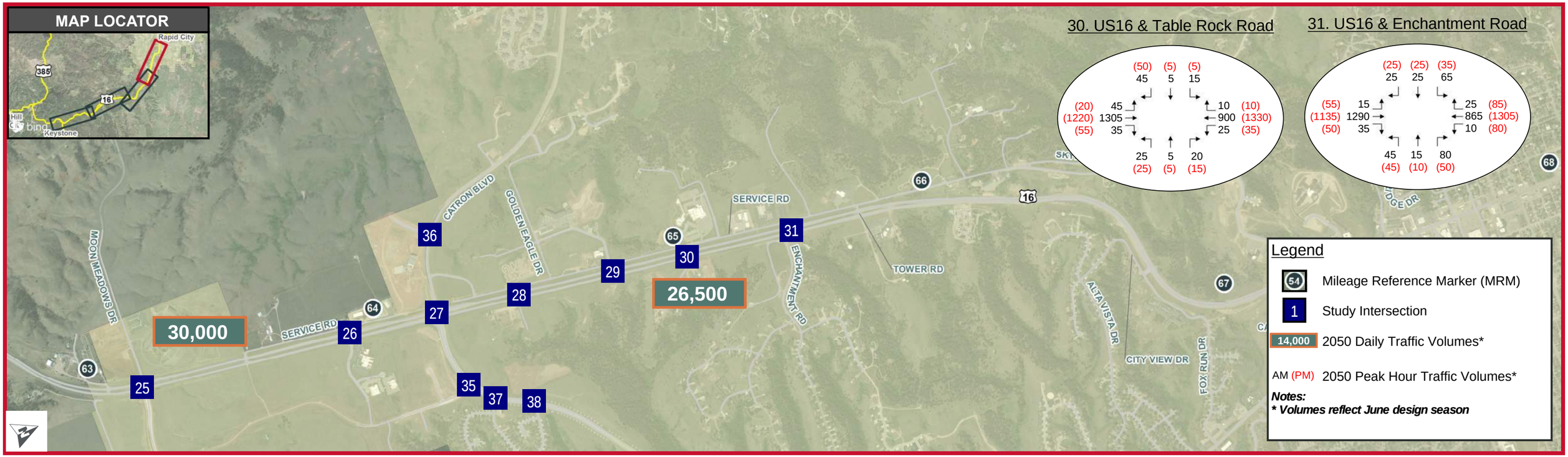
Addison Avenue and Tucker Street Full Closure Scenario

Scenario Notes
US16/US16B/Catron Boulevard subarea traffic volumes are based on No-Build Conditions forecasts presented in the US16 Corridor Study ***Traffic Forecasts*** technical memorandum.

Intersection numbering is consistent with the overall US16 Corridor Study.

This scenario closes US16 access to Addison Avenue (26) and Tucker Street (28). Affected volumes have been redistributed throughout the network.

There is no change to overall volumes entering/exiting this subarea from the 2050 No-Build Conditions forecasts.



US16 Corridor
S N

US16B / Catron Blvd Corridor
W E

25. US16 & Moon Meadows Rd
(155) (45) (145)
130 60 200
(125) 85 270 (240)
(920) 750 710 (940)
(275) 170 195 (330)
100 70 250
(195) (60) (340)

26. US16 & Addison Avenue
(1405) 1200 1175 (1510)

27. US16 & US16B/Catron Blvd
(250) (805) (365)
195 755 555
(235) 165 285 (510)
(640) 520 460 (605)
(530) 515 265 (270)
520 550 255
(655) (860) (345)

28. US16 & Tucker Street
(1350) 1330 1010 (1385)

29. US16 & Promise Road
(85) (20) (75)
65 15 110
(130) 60 35 (95)
(1185) 1235 905 (1275)
(35) 35 25 (35)
40 10 40
(25) (20) (35)

36. Catron Blvd & Les Hollers Way
(90) (25) (130)
85 20 115
(75) 165 110 (145)
(870) 1010 545 (1125)
(195) 275 345 (335)
135 20 380
(295) (25) (420)

35. US16B & Healing Way
(20) (15) (15)
15 5 15
(25) 25 35 (15)
(1270) 1165 1055 (1450)
(310) 345 185 (110)
255 10 185
(390) (10) (270)

37. US16B & Wellington Dr (W)
(1510) 1345 1275 (1575)
(45) 20 55
(35)

38. US16B & Wellington Drive (E)
(10) (5) (10)
75 5 30
(25) 35 15 (5)
(25) 25 1145 (1520)
(1475) 1330 20 (60)
(20) 10 20
20 5 20
(20) (5) (15)

Addison Avenue and Tucker Street 3/4 Access Scenario

Scenario Notes

US16/US16B/Catron Boulevard subarea traffic volumes are based on No-Build Conditions forecasts presented in the US16 Corridor Study ***Traffic Forecasts*** technical memorandum.

Intersection numbering is consistent with the overall US16 Corridor Study.

This scenario provides 3/4 access at the US16 intersections of Addison Avenue (26) and Tucker Street (28). Affected volumes have been redistributed throughout the network.

There is no change to overall volumes entering/exiting this subarea from the 2050 No-Build Conditions forecasts.

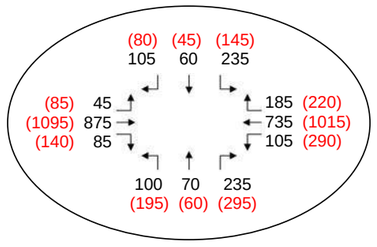
30. US16 & Table Rock Road

31. US16 & Enchantment Road

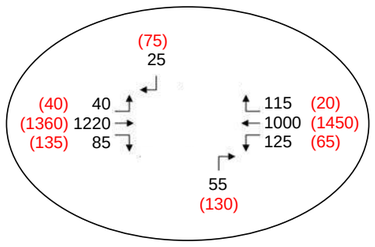
US16 Corridor

S N

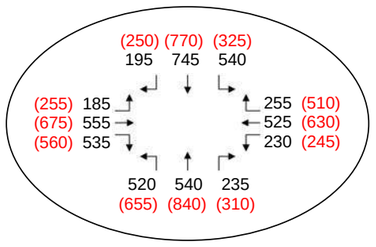
25. US16 & Moon Meadows Rd



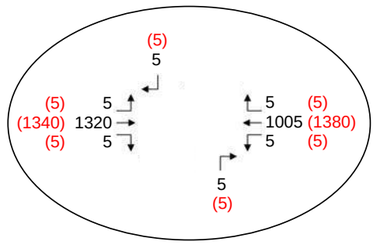
26. US16 & Addison Avenue



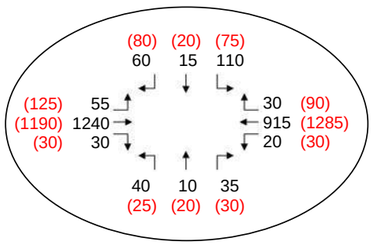
27. US16 & US16B/Catron Blvd



28. US16 & Tucker Street



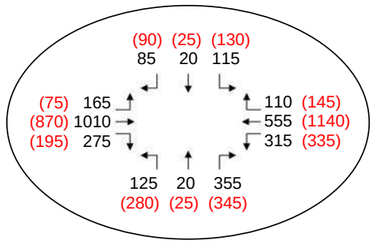
29. US16 & Promise Road



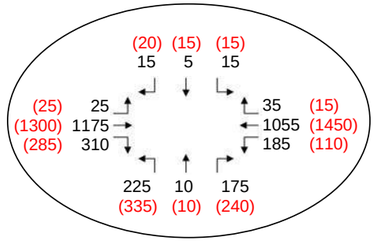
US16B / Catron Blvd Corridor

W E

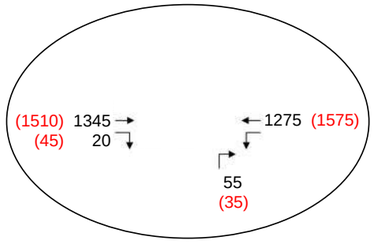
36. Catron Blvd & Les Hollers Way



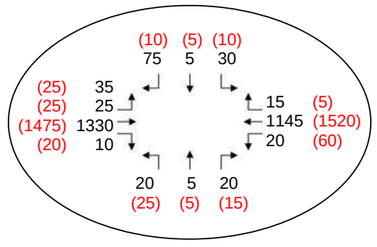
35. US16B & Healing Way



37. US16B & Wellington Dr (W)



38. US16B & Wellington Drive (E)



Addison Avenue and Tucker Street Right-in Right-out Access Scenario

30. US16 & Table Rock Road

31. US16 & Enchantment Road

Scenario Notes
US16/US16B/Catron Boulevard subarea traffic volumes are based on No-Build Conditions forecasts presented in the US16 Corridor Study ***Traffic Forecasts*** technical memorandum.

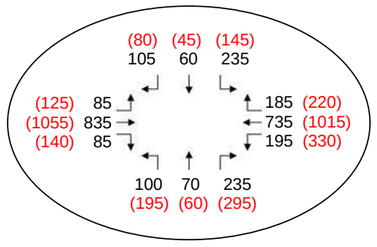
Intersection numbering is consistent with the overall US16 Corridor Study.

This scenario provides right-in right-out access at the US16 intersections of Addison Avenue (26) and Tucker Street (28). Affected volumes have been redistributed throughout the network.

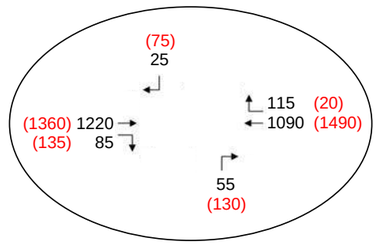
There is no change to overall volumes entering/exiting this subarea from the 2050 No-Build Conditions forecasts.

US16 Corridor
S N

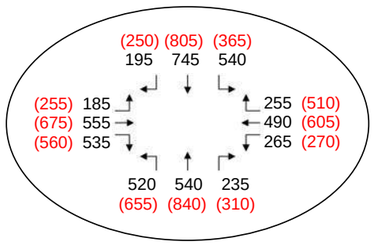
25. US16 & Moon Meadows Rd



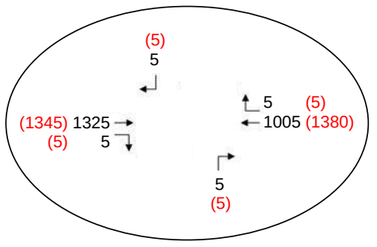
26. US16 & Addison Avenue



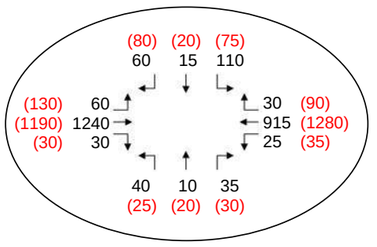
27. US16 & US16B/Catron Blvd



28. US16 & Tucker Street

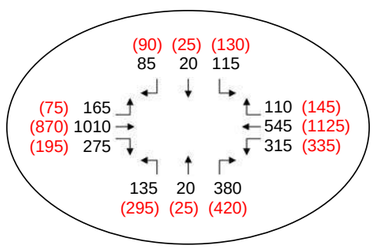


29. US16 & Promise Road

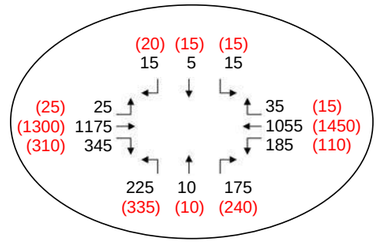


US16B / Catron Blvd Corridor
W E

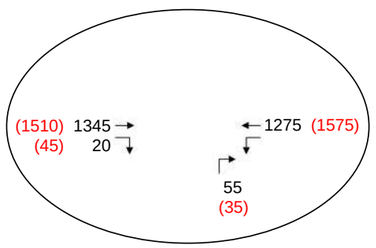
36. Catron Blvd & Les Hollers Way



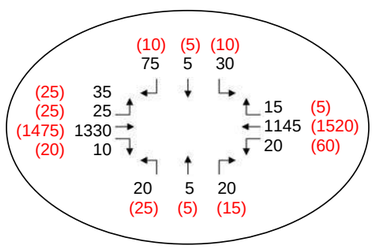
35. US16B & Healing Way



37. US16B & Wellington Dr (W)



38. US16B & Wellington Drive (E)



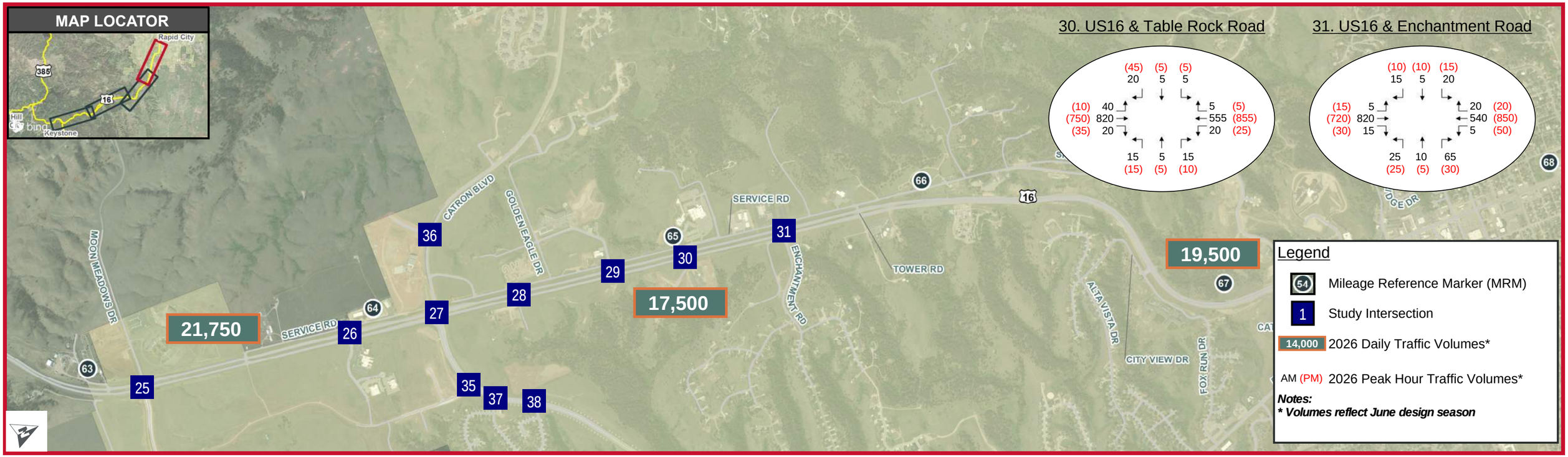
Addison Avenue and Tucker Street Full Closure Scenario

Scenario Notes
US16/US16B/Catron Boulevard subarea traffic volumes are based on No-Build Conditions forecasts presented in the US16 Corridor Study ***Traffic Forecasts*** technical memorandum.

Intersection numbering is consistent with the overall US16 Corridor Study.

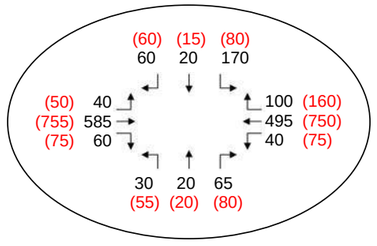
This scenario closes US16 access to Addison Avenue (26) and Tucker Street (28). Affected volumes have been redistributed throughout the network.

There is no change to overall volumes entering/exiting this subarea from the 2026 No-Build Conditions forecasts.

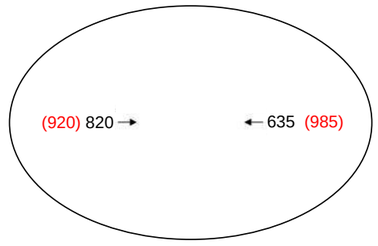


US16 Corridor
S N

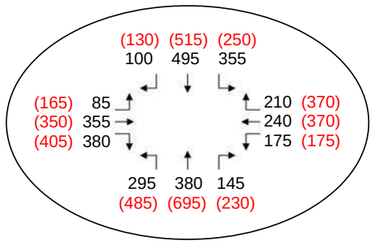
25. US16 & Moon Meadows Rd



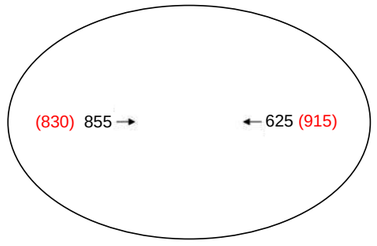
26. US16 & Addison Avenue



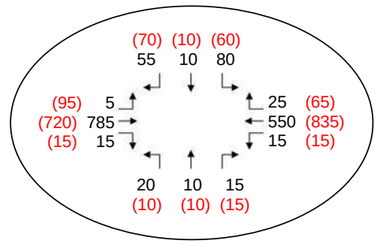
27. US16 & US16B/Catron Blvd



28. US16 & Tucker Street

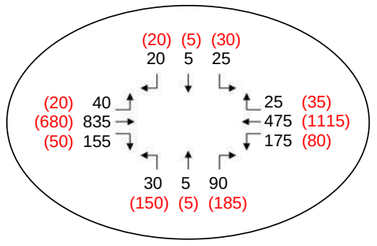


29. US16 & Promise Road

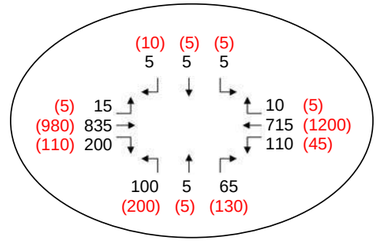


US16B / Catron Blvd Corridor
W E

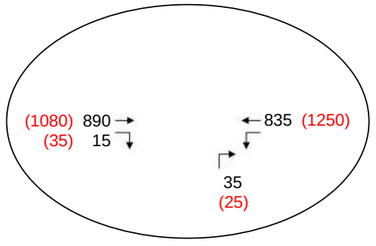
36. Catron Blvd & Les Hollers Way



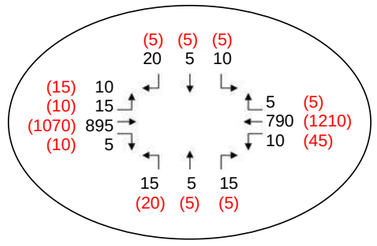
35. US16B & Healing Way



37. US16B & Wellington Dr (W)



38. US16B & Wellington Drive (E)



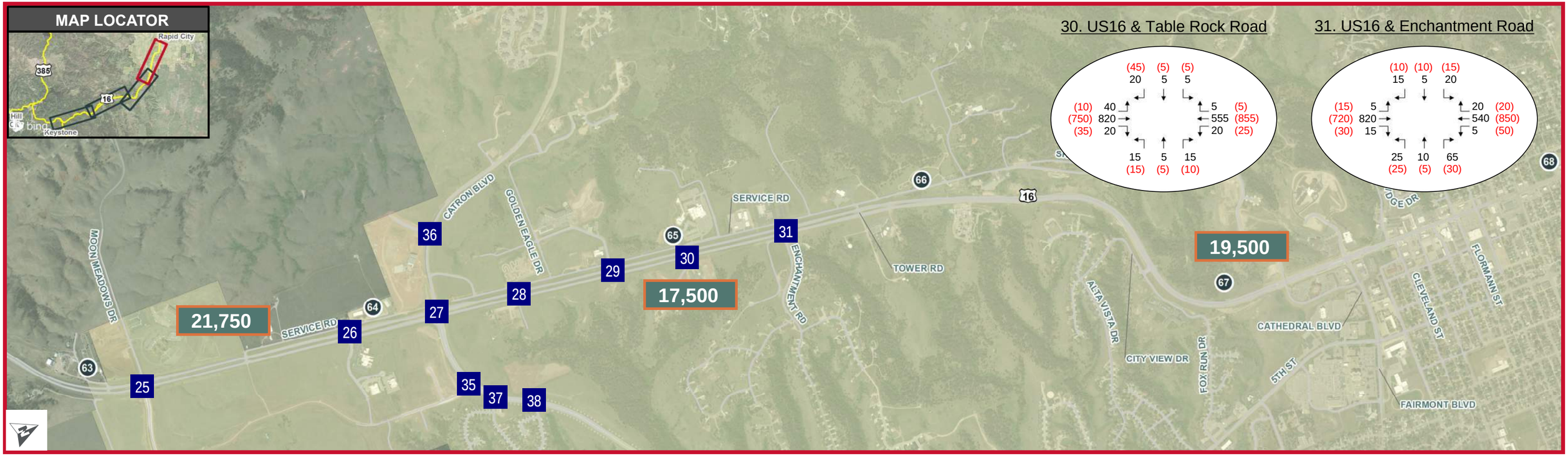
Addison Avenue and Tucker Street 3/4 Access Scenario

Scenario Notes
US16/US16B/Catron Boulevard subarea traffic volumes are based on No-Build Conditions forecasts presented in the US16 Corridor Study ***Traffic Forecasts*** technical memorandum.

Intersection numbering is consistent with the overall US16 Corridor Study.

This scenario provides 3/4 access at the US16 intersections of Addison Avenue (26) and Tucker Street (28). Affected volumes have been redistributed throughout the network.

There is no change to overall volumes entering/exiting this subarea from the 2026 No-Build Conditions forecasts.

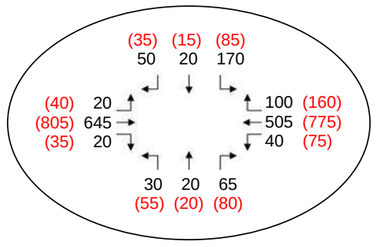


30. US16 & Table Rock Road

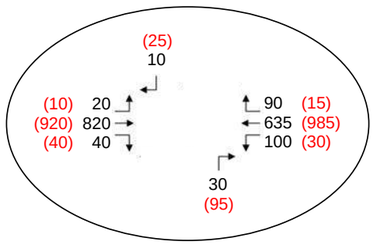
31. US16 & Enchantment Road

US16 Corridor
S N

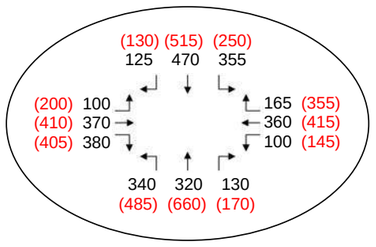
25. US16 & Moon Meadows Rd



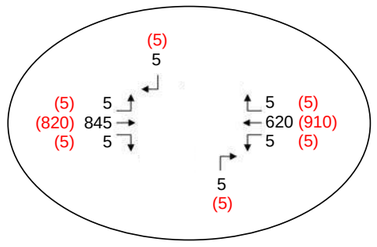
26. US16 & Addison Avenue



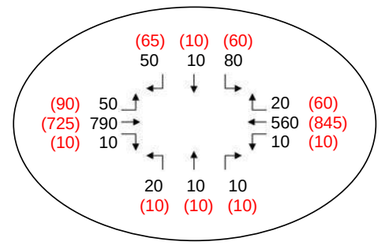
27. US16 & US16B/Catron Blvd



28. US16 & Tucker Street

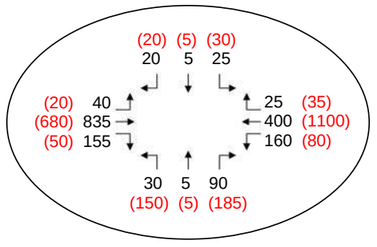


29. US16 & Promise Road

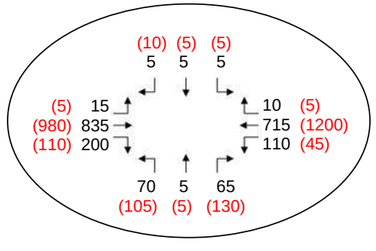


US16B / Catron Blvd Corridor
W E

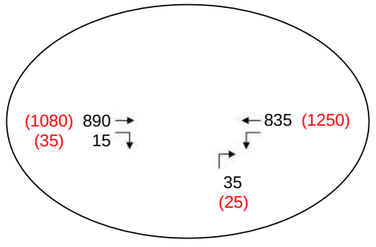
36. Catron Blvd & Les Hollers Way



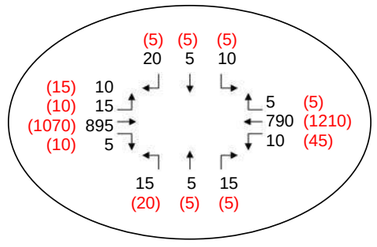
35. US16B & Healing Way



37. US16B & Wellington Dr (W)



38. US16B & Wellington Drive (E)



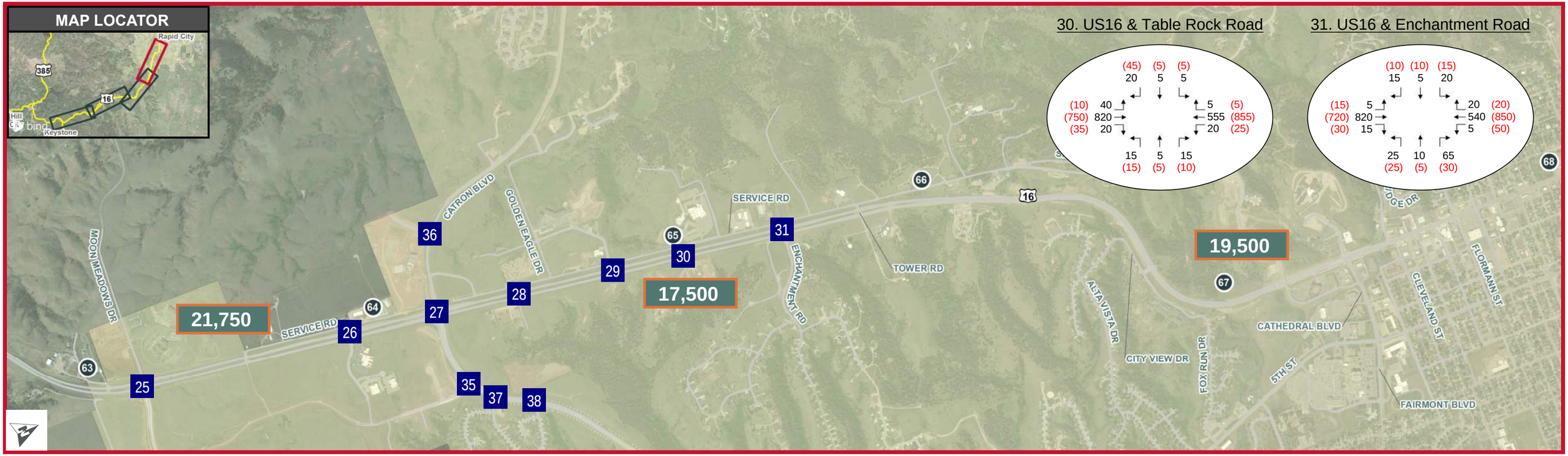
Addison Avenue and Tucker Street Right-in Right-out Access Scenario

Scenario Notes
US16/US16B/Catron Boulevard subarea traffic volumes are based on No-Build Conditions forecasts presented in the US16 Corridor Study ***Traffic Forecasts*** technical memorandum.

Intersection numbering is consistent with the overall US16 Corridor Study.

This scenario provides right-in right-out access at the US16 intersections of Addison Avenue (26) and Tucker Street (28). Affected volumes have been redistributed throughout the network.

There is no change to overall volumes entering/exiting this subarea from the 2026 No-Build Conditions forecasts.



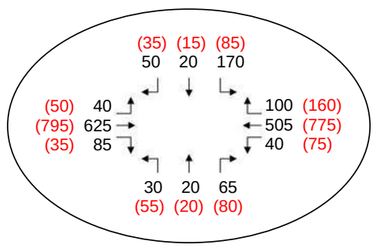
US16 Corridor
S N

US16B / Catron Blvd Corridor
W E

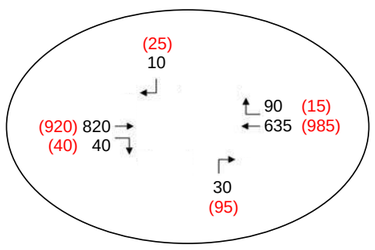
30. US16 & Table Rock Road

31. US16 & Enchantment Road

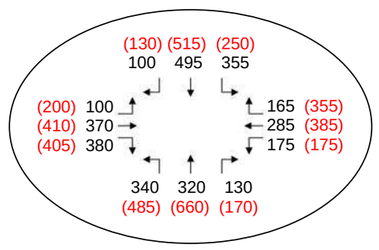
25. US16 & Moon Meadows Rd



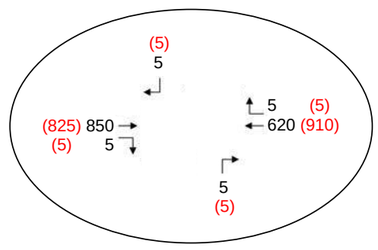
26. US16 & Addison Avenue



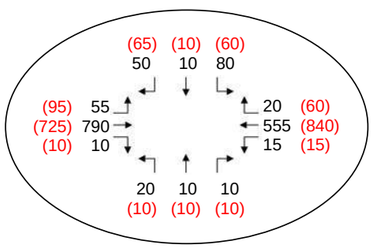
27. US16 & US16B/Catron Blvd



28. US16 & Tucker Street

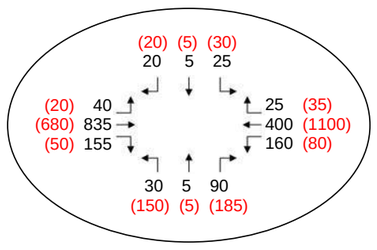


29. US16 & Promise Road

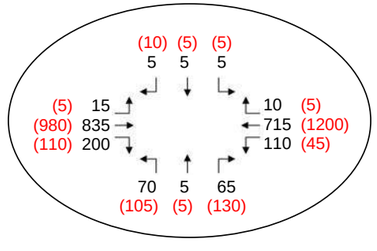


US16B / Catron Blvd Corridor
W E

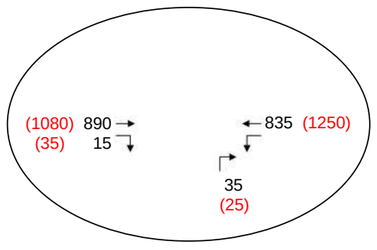
36. Catron Blvd & Les Hollers Way



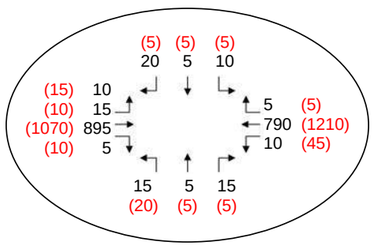
35. US16B & Healing Way



37. US16B & Wellington Dr (W)



38. US16B & Wellington Drive (E)



11.2.1 US16/US16B/Catron Boulevard Interchange/Intersection Delay

The following tables present LOS representative of measured overall intersection delay for each Build Option. This measure accounts for all traffic entering the interchange or intersection, including the northbound/southbound US16 free movements in the SPI Build Options. For DLT intersection Build Options, the alternative intersection ETT accounts for delay a vehicle would experience traversing through any/all three DLT intersections.

HCS results are provided in **Table 18** and Vissim results are provided in **Table 19**.

Table 18: US16/US16B/Catron Blvd Intersection Operations – 2050 Build Conditions (HCS)

Build Option	Description	HCS LOS Measure	LOS AM / PM
SPI 1.1a SPI 1.1b	SPI – Free NB/SB RT Lanes	Weighted Interchange ETT	B / B
SPI 1.2	SPI – Signalized, Dual NB/SB RT Lanes	Weighted Interchange ETT	B / B
DLT 2.1a DLT 2.1b	DLT – Free NB/SB RT Lanes	Alternative Intersection ETT	C / C
DLT 2.2a DLT 2.2b	DLT – Signalized, Dual NB/SB RT Lanes	Alternative Intersection ETT	C / D
DLT 2.3	DLT – Unseparated, Signalized RT Lanes at Main Intersection	Alternative Intersection ETT	D / D

LOS greater than C and queue impacts are noted in Bold Orange.
Weighted Interchange ETT: ETT of all traffic entering the SPI interchange.
Alternative Intersection ETT: ETT of all traffic entering any/all three DLT signalized intersections.

Table 19: US16/US16B/Catron Blvd Intersection Operations – 2050 Build Conditions (Vissim)

Build Option	Description	Vissim LOS Measure	LOS AM / PM
SPI 1.1a SPI 1.1b	SPI – Free NB/SB RT Lanes	Weighted Interchange Delay	B / B
SPI 1.2	SPI – Signalized, Dual NB/SB RT Lanes	Weighted Interchange Delay	B / C
DLT 2.1a DLT 2.1b	DLT – Free NB/SB RT Lanes	Weighted Intersection Delay	C / C
DLT 2.2a DLT 2.2b	DLT – Signalized, Dual NB/SB RT Lanes	Weighted Intersection Delay	C / C
DLT 2.3	DLT – Unseparated, Signalized RT Lanes at Main Intersection	Weighted Intersection Delay	Not analyzed

Weighted Interchange delay: average delay of all traffic entering the SPI interchange.
Alternative Intersection delay: average delay of all traffic entering any/all three DLT signalized intersections.

SPI 1.1 exhibits the least overall delay for vehicles entering the US16/US16B/Catron Boulevard intersection area. Both the HCS and Vissim analysis results show LOS B in the AM and PM peak hours and represent a full one or two LOS grades better than the DLT intersection Build Options.

These results highlight operational benefits an SPI Build Option provides to overall intersection operations, most notably:

- Provides free movements for US16 northbound/southbound through traffic, resulting in zero delay for a high-volume movement
- Best addresses traffic operations in the highest volume PM peak hour
- Provides greatest separation between US16 and Les Hollers Way and Healing Way, resulting in less delay for the high volume US16 northbound/southbound right turn movements
- SPI 1.1 provides the least overall delay of all Build Options, approximately 5 to 6 seconds less delay per vehicle than SPI 1.2.
- DLT 2.1 delay is approximately 7 to 13 seconds greater than SPI 1.1. The most notable 13-second difference occurs in the high-volume PM peak period.
- DLT 2.2 fails to meet LOS C goals in the PM peak period due to the inclusion of US16 northbound/southbound right turn delay. DLT 2.1, with free right turns, is already approaching LOS C/D threshold and the inclusion of right turn delay in DLT 2.2 causes it to reach LOS D.
- DLT 2.3 provides the worst operations of all Build Options with both AM and PM peak hours at LOS D.

11.2.2 US16 Corridor Travel Times

The measurement of US16 travel times provides a holistic view of corridor operations as it incorporates delay from all signalized intersections within a given corridor. Both HCS and Vissim models were developed to incorporate US16 signalized intersections with Promise Road and Moon Meadows Drive. However, the actual limits from a travel distance perspective were slightly different, as noted below, and thus the travel times show considerable difference between the two analysis tools.

- HCS limits: Promise Road and Moon Meadows Drive intersections
- Vissim limits: approximately 4,000 feet north of Promise Road and 4,000 feet south of Moon Meadows Drive intersections

HCS and Vissim facility LOS and travel time results are provided in **Table 20** and **Table 21**, respectively.

Table 20: US16 Corridor Segment Operations – 2050 Build Options (HCS)

US16 Segment	SPI 1.1a, 1.1b & 1.2		DLT 2.1a & 2.2a		DLT 2.1b, 2.2b, & 2.3	
	AM NB / SB	PM NB / SB	AM NB / SB	PM NB / SB	AM NB / SB	PM NB / SB
Facility LOS	A / A	A / A	B / B	B / B	B / B	B / B
Facility Travel Time (sec)	122 / 130	120 / 133	155 / 152	158 / 155	142 / 139	148 / 146
Addison Ave & Tucker St access	*Closed*		*¾ access*		*Closed*	

Table 21: US16 Corridor Segment Operations – 2050 Build Options (Vissim)

US16 Segment	SPI 1.1a, 1.1b & 1.2		DLT 2.1a & 2.2a		DLT 2.1b, 2.2b, & 2.3	
	AM NB / SB	PM NB / SB	AM NB / SB	PM NB / SB	AM NB / SB	PM NB / SB
Facility Travel Time (sec)	235 / 230	241 / 240	235 / 244	263 / 262	235 / 244	263 / 262
Addison Ave & Tucker St access	*Closed*		*¾ access*		*Closed*	

The SPI Build Options provide notable operational benefits to northbound/southbound US16 corridor traffic by removing the high volume movements from the US16/US16B/Catron Boulevard signalized intersection. Thus, the difference in corridor travel times between the SPI and DLT Build Options is primarily a function of intersection delay (deceleration, stop, and startup time) associated with whether US16 corridor traffic needs to stop at a signal. Overall, the SPI Build Options are expected to provide upwards of 25 to 35 seconds (depending on analysis tool, time of day, and direction of travel) in travel time savings compared to the DLT Build Options.

Specific to the DLT Build Options variations, the HCS analysis notes the benefit of free US16B/Catron Boulevard eastbound/westbound right turn movements into a US16 add-lane (DLT 2.1b and 2.2b) compared to signalized right turns shown in 2.1a and 2.2a. US16 travel times are approximately 10-12 seconds less for DLT 2.1b and 2.2b because greater green time is available for northbound/southbound US16 through movements. This results in less delay and fewer stops for US16 traffic. In DLT 2.1a and 2.2a, the conflicting signalization of eastbound/westbound left turn and right turn movements requires additional green time to meet the turning traffic demand of both phases successively, and thus shortens available green time for the high-priority US16 traffic. Due to Vissim signal timing assumptions at the proof of concept level, this difference is less pronounced in the Vissim analysis.

11.2.3 US16B/Catron Boulevard Corridor Travel Times

The US16B/Catron Boulevard corridor traffic operations were reviewed using similar methodology as the US16 corridor. However, limitations to HCM6 methodology and HCS software does not allow for a direct comparison of travel times or operational impacts of signalized intersections in close proximity to a DLT intersection. Therefore, the Vissim analysis provides the best, most comprehensive comparison of Build Option type US16B/Catron Boulevard corridor travel times. Results are provided in **Table 22**.

Table 22: US16B/Catron Blvd Corridor Segment Operations – 2050 Build Options (Vissim)

US16 Segment	SPI 1.1a, 1.1b & 1.2		DLT 2.1a & 2.2a		DLT 2.1b, 2.2b, & 2.3	
	AM EB / WB	PM EB / WB	AM EB / WB	PM EB / WB	AM EB / WB	PM EB / WB
Facility Travel Time (sec)	146 / 140	140 / 153	155 / 140	141 / 156	155 / 140	141 / 157
Addison Ave & Tucker St access	*Closed*		*¾ access*		*Closed*	

Similar to the US16 corridor travel times, the SPI Build Options demonstrate the lowest overall travel times along the US16B/Catron Boulevard corridor. The differences are most pronounced in the peak direction within the given peak hour (AM – EB, PM – WB).

While HCS does not provide for a comprehensive Build Option comparison, it does provide for comparison of variations within a specific intersection type. For the SPI Build Option variations, the following table shows HCS-based travel time differences when traversing between Les Hollers Way and Healing Way. SPI 1.1 provides upwards of 15 seconds less travel time than 1.2. This is primarily due to the signalized treatment of high US16 northbound/southbound right turn traffic and arrival to downstream signalized intersections during a red signal phase. With a free movement, the US16 northbound/southbound right turns are a free movement into an add-lane and a notable proportion of that turning traffic will arrive at the downstream signal during a green phase.

Table 23: US16B/Catron Blvd Corridor Segment Operations – 2050 SPI Build Options (HCS)

US16B/Catron Blvd Segment	SPI 1.1		SPI 1.2	
	AM EB / WB	PM EB / WB	AM EB / WB	PM EB / WB
Les Hollers Way to US16	D / C	E / D	E / C	D / D
US16 to Healing Way	C / D	C / D	C / D	D / E
Facility LOS	**D / D**	**D / D**	**D / D**	**D / E**
Facility Travel Time (sec)	**86 / 83**	**84 / 94**	**89 / 83**	**99 / 102**

Note: HCS travel time limits extend between Les Hollers Way and Healing Way intersections, total facility length does not match with SPI Build Option facility measures.

For the DLT Build Options, HCS is only able to measure travel time between the two DLT signalized crossover intersections. As shown in **Table 24**, the signalization of US16B/Catron Boulevard eastbound/westbound right turn movements (DLT 2.1b, 2.2b, and 2.3) has a notable effect on travel time and results in upwards of 15 more seconds of travel time between the two DLT crossover intersections.

Table 24: US16B/Catron Blvd Corridor Segment Operations – 2050 DLT Build Options (HCS)

US16B/Catron Blvd Segment	DLT 2.1a & 2.2a		DLT 2.1b, 2.2b, & 2.3	
	AM NB / SB	PM NB / SB	AM NB / SB	PM NB / SB
Facility (LOS)	**E / C**	**F / E**	**F / E**	**F / F**
Facility Travel Time (sec)	**51 / 48**	**61 / 51**	**66 / 59**	**71 / 63**
Addison Ave & Tucker St access	*¾ access*		*Closed*	

HCS travel time limits extend between DLT crossover signalized intersections, total facility length does not match with SPI Build Option facility measures.

11.2.4 US16 Corridor Periphery Intersection Operations

Promise Road and Moon Meadows Drive Intersections

The bookend intersections of Promise Road and Moon Meadows Drive met LOS C goals for this study regardless of Build Option variation. Both intersections assume future signalization in the analyzed scenarios.

The goal of this sub-section is to present a validation of acceptable LOS C operations as well as highlight reasons for the slight deviations in measured intersection delay across the Build Options. From a Build Option comparison perspective, the US16 corridor travel time measures presented in a previous sub-section provide a more holistic view of corridor operations than an intersection spot analysis.

A summary of HCS and Vissim-measured intersection delay at Promise Road and Moon Meadows Drive intersections is provided in **Table 25** and **Table 26**, respectively.

Table 25: US16 Major Intersection Operations – 2050 Build Options (HCS)

US16 Intersection	SPI 1.1 & 1.2		DLT 2.1a & 2.2a		DLT 2.1b, 2.2b, and 2.3	
	AM LOS / Delay	PM LOS / Delay	AM LOS / Delay	PM LOS / Delay	AM LOS / Delay	PM LOS / Delay
Promise Road	B 18.0	B 18.8	B 15.8	B 15.1	B 16.1	B 17.1
Moon Meadows Drive	C 26.5	C 31.6	C 25.3	C 27.5	C 22.3	C 27.7
Addison Ave & Tucker St access	*Closed*		*¾ access*		*Closed*	

Table 26: US16 Major Intersection Operations – 2050 Build Options (Vissim)

US16 Intersection	SPI 1.1 & 1.2		DLT 2.1a & 2.2a		DLT 2.1b, 2.2b, and 2.3	
	AM LOS / Delay	PM LOS / Delay	AM LOS / Delay	PM LOS / Delay	AM LOS / Delay	PM LOS / Delay
Promise Road	B 12.7	B 14.6	A 9.0	A 8.8	A 9.0	A 8.8
Moon Meadows Drive	B 18.9	C 21.8	B 14.7	C 20.7	B 14.7	C 20.7
Addison Ave & Tucker St access	*Closed*		*¾ access*		*Closed*	

Overall, differences across the Build Options were generally negligible from an overall study area operations standpoint. While minor, the primary reasons for these deviations include:

- Addison Avenue and Tucker Street closure traffic redistribution exhibits negligible impact to intersection delay
    - All Build Options exhibited ample available capacity to accommodate shifts in traffic demand due to intersection closures
- Traffic signal coordination is better in the DLT Build Options with a mid-segment DLT signalized intersection to maintain platoon progression
    - Moon Meadows Drive and Promise Road signals more likely to operate uncoordinated (free) in the SPI Build Option conditions

Tucker Street and Addison Avenue Intersections

Traffic operations were reviewed for US16 intersections with Addison Avenue and Tucker Street in relation to the proposed Build Options. The purpose of this review is to identify what level of access is feasible long-term with regard to intersection delay, vehicle queues, and proximity to US16 service road.

Four US16/Addison Avenue and US16/Tucker Street access scenarios were analyzed with HCS and/or Vissim:

- **Full Access**: intersection accommodates all movements between US16 and minor road, similar to No Build condition
    - Applicability: DLT intersection Build Options
- **¾ Access**: intersection accommodates all movements between US16 and minor road except left-turn and through movement from the minor road approach. All movements are permitted to turn onto the minor road from US16.
    - Applicability: DLT intersection Build Options
- **Right-in Right-out (RIRO)**: right turns are the only movements permitted between US16 and the minor road
    - Applicability: DLT intersection Build Options
- **Access Closure**: closes access between US16 and minor road. US16 mainline through movements are maintained
    - Applicability: SPI and DLT intersection Build Options

Minor road approach traffic queues were reviewed to identify any potential impacts from queues blocking turns to US16 service road. This is of particular concern on the west side of US16 where the US16 service road is approximately 85 feet west of US16 (measured from outside of outer southbound US16 through lane to outside of northbound US16 service road lane). Queues extending beyond 85 feet could block turning traffic destined for the US16 service road, leading to potential queue spillback onto US16 and safety conflicts. From an access evaluation standpoint, queues exceeding 85 feet at these locations are considered drawbacks to the option.

US16/Addison Avenue and US16/Tucker Street intersection traffic operations are shown in **Table 27** and **Table 29**, respectively. Drawbacks to traffic operations (LOS goals) and measured queue lengths (85 feet at US16 service road connected approach) are noted in **Bold Orange**.

Table 27: US16/Addison Ave Intersection Traffic Operations – 2050 Build Conditions (HCS)

Intersection Access	Intersection Control	AM		PM		Meet study LOS C goal?	Manage Queues?
		LOS / Delay (sec/veh)	95% Queues (ft)	LOS / Delay (sec/veh)	95% Queues (ft)		
Full Access	TWSC	A 6.5	**EB LT: 108** WB: 48	**F ~**	**EB LT: ~** WB: 288	**No**	**No**
Full Access	Traffic Signal	A 5.7	EB LT: 63 WB: 62	B 11.4	**EB LT: 124** WB RT: 136	Yes	**No**
¾ Access	TWSC	A 1.4	EB RT: 13 WB RT: 5	A 1.8	EB RT: 48 WB RT: 25	Yes	Yes
RIRO Access	TWSC	A 0.5	EB RT: 13 WB RT: 5	A 1.4	EB RT: 48 WB RT: 25	Yes	Yes
Access Closure	No access	A 0.0	EB: n/a WB: n/a	A 0.0	EB: n/a WB: n/a	Yes	Yes

LOS greater than C and queue impacts are noted in **Bold Orange**.
Overall intersection control delay represents the weighted average of each approach.

Table 28: US16/Addison Ave Intersection Traffic Operations – 2050 Build Conditions (Vissim)

Intersection Access	Intersection Control	AM		PM		Meet study LOS C goal?	Manage Queues?
		LOS / Delay (sec/veh)	95% Queues (ft)	LOS / Delay (sec/veh)	95% Queues (ft)		
Full Access	TWSC	A 1.9	**EB LT: 99** WB: 108	A 4.5	**EB LT: 237** WB: 287	Yes	**No**
Full Access	Traffic Signal	Not analyzed	Not analyzed	Not analyzed	Not analyzed	-	-
¾ Access	TWSC	A 1.3	EB RT: 54 WB RT: 82	A 2.3	**EB RT: 89** WB RT: 153	Yes	**No**
RIRO Access	TWSC	Not analyzed	Not analyzed	Not analyzed	Not analyzed	-	-
Access Closure	No access	A 0.4	EB: n/a WB: n/a	A 0.4	EB: n/a WB: n/a	Yes	Yes

LOS greater than C and queue impacts are noted in **Bold Orange**.
Overall intersection control delay represents the weighted average of each approach.

Table 29: US16/Tucker Street Intersection Traffic Operations – 2050 Build Conditions (HCS)

Intersection Access	Intersection Control	AM		PM		Meet study LOS C goal?	Manage Queues?
		LOS / Delay (sec/veh)	95% Queues (ft)	LOS / Delay (sec/veh)	95% Queues (ft)		
Full Access	TWSC	A 0.6	EB: 8 WB: 8	A 0.9	EB: 10 WB: 10	Yes*	Yes*
¾ Access	TWSC	0.1	EB: 0 WB: 0	0.1	EB: 0 WB: 0	Yes*	Yes*
RIRO Access	TWSC	0.1	EB: 0 WB: 0	0.1	EB: 0 WB: 0	Yes*	Yes*
Access Closure	No access	A 0.0	EB: n/a WB: n/a	A 0.0	EB: n/a WB: n/a	Yes	Yes

Overall intersection control delay represents the weighted average of each approach.

Table 30: US16/Tucker Street Intersection Traffic Operations – 2050 Build Conditions (Vissim)

Intersection Access	Intersection Control	AM		PM		Meet study LOS goal?	Manage Queues?
		LOS / Delay (sec/veh)	95% Queues (ft)	LOS / Delay (sec/veh)	95% Queues (ft)		
Full Access	TWSC	A 1.0	EB: 32 WB: 54	A 1.3	EB: 37 WB: 57	Yes*	Yes*
¾ Access	TWSC	A 0.8	EB: 33 WB: 35	A 1.2	EB: 33 WB: 35	Yes*	Yes*
RIRO Access	TWSC	Not analyzed	Not analyzed	Not analyzed	Not analyzed	-	-
Access Closure	No access	A 1.0	EB: n/a WB: n/a	A 1.3	EB: n/a WB: n/a	Yes	Yes

Overall intersection control delay represents the weighted average of each approach.
* See discussion for more information on forecasting assumptions. Analysis results and conclusions subject to change based on intensity of development on east side of US16.

Findings from the analysis of US16/Addison Avenue and US16/Tucker Street traffic operations are summarized as follows:

- US16/Addison Avenue Intersection
    - ¾, RIRO, and no access scenarios meet LOS goals and manage queues in the HCS and Vissim analyses.
    - Full access scenarios do not meet LOS goals and/or manage queues in the HCS and Vissim analyses.
        - TWSC full access intersection neither meets LOS goals nor manages eastbound left turn queues.
        - Signalized full access does not adequately manage eastbound left turn queues with the existing intersection location and would require reconstruction to increase separation.
- US16/Tucker Street Intersection
    - Due to the low volumes forecasted for this intersection, all scenarios meet LOS goals and adequately manage queues.
    - If access is maintained and the development density is greater than assumed in this analysis, traffic impact studies will be important to fully assess the impact future development will be expected to have at this access.

11.2.5 US16B/Catron Boulevard Corridor Periphery Intersection Operations

Les Hollers Way and Healing Way Intersections

The US16B/Catron Boulevard intersections with Les Hollers Way and Healing Way served as the primary, signalized bookend intersections for US16B/Catron Boulevard corridor analysis. Similar to the US16 corridor periphery intersection delay sub-section, the goal here is to present a validation of acceptable LOS C operations with the respective Build Option.

A summary of HCS and Vissim-measured intersection delay at Les Hollers Way and Healing Way intersections is provided in **Table 31** and **Table 32**, respectively.

Table 31: US16B/Catron Blvd Intersection Operations – 2050 Build Options (HCS)

US16 Intersection	SPI 1.1		SPI 1.2		DLT 2.1a & 2.2a		DLT 2.1b, 2.2b, & 2.3	
	AM LOS/Delay	PM LOS/Delay	AM LOS/Delay	PM LOS/Delay	AM LOS/Delay	PM LOS/Delay	AM LOS/Delay	PM LOS/Delay
Les Hollers Way	C 23.6	C 31.3	C 26.8	C 33.3	C 26.4	C 31.7	C 26.4	C 31.7
Healing Way	C 20.3	C 22.7	B 19.6	C 32.2	C 22.5	C 27.5	C 22.5	C 27.5
Addison Ave & Tucker St access	*Closed*		*Closed*		*¾ access*		*Closed*	

Table 32: US16B/Catron Blvd Intersection Operations – 2050 Build Options (Vissim)

US16 Intersection	SPI 1.1		SPI 1.2		DLT 2.1a & 2.1b		DLT 2.2a, 2.2b, & 2.3	
	AM LOS/Delay	PM LOS/Delay	AM LOS/Delay	PM LOS/Delay	AM LOS/Delay	PM LOS/Delay	AM LOS/Delay	PM LOS/Delay
Les Hollers Way	C 25.0	C 32.2	C 25.2	C 31.1	C 21.8	C 28.2	C 22.0	C 26.1
Healing Way	B 12.7	B 15.3	B 12.1	B 15.7	B 12.4	B 15.4	B 11.5	B 14.2
Addison Ave & Tucker St access	*Closed*		*Closed*		*¾ access*		*Closed*	

It was found that traffic operations at Catron Boulevard/Les Hollers Way and US16B/Catron Boulevard/Healing Way intersections were similar across the different Build Options and all meet LOS goals.

Wellington Drive Intersections

While inside the intersection sub-study area, the US16B/Catron Boulevard/Wellington Drive (east and west) intersection traffic operations are not affected by the SPI or DLT intersections. Potential modifications to these two intersections will be developed as part of the overall US16 Corridor Study and incorporated separately from this project.

11.2.6 Closely Spaced Intersection Movement Analyses

The relationship between closely spaced intersections and traffic operations was further reviewed along the US16B/Catron Boulevard corridor using Vissim simulation and measured output. Two areas for further analysis included:

- US16 free right turn weave to Les Hollers Way/Healing Way left turn
- US16B/Catron Boulevard mainline queues

US16 Free Right Turn Weave to Les Hollers Way/Healing Way Left Turn

A primary impetus for Build Option variations is the treatment of US16 northbound and southbound right turn lanes at US16B/Catron Boulevard. The weave movement between a US16 right turn lane and the respective downstream left turn (Les Hollers Way or Healing Way) required additional review to determine whether the right turn lanes needed to be signalized to provide adequate gaps in traffic. Typically, drivers on a free flow right turn destined to a closely-spaced downstream left turn will treat the free flow right turn as a yield and wait for a gap in traffic. Examples are shown in **Figure 21** and

Figure 22.

Vissim was used to analyze these movements in terms of right turn lane queues, number of stops, and delay. Table 33 and **Table 34** summarize these findings for SPI and DLT Build Options, respectively. Because this comparison does not take into account bigger picture operational measures, the intent of these tables is to focus on differences between variations of the same intersection/interchange type.

The Vissim analysis only included 2050 traffic operations and thus an approximation of off-peak and non-tourist peak hour operations could be interpreted from the 'average' conditions in the table. The 'max' conditions reflects a worst-case condition in a typical tourist season year 2050 peak hour.

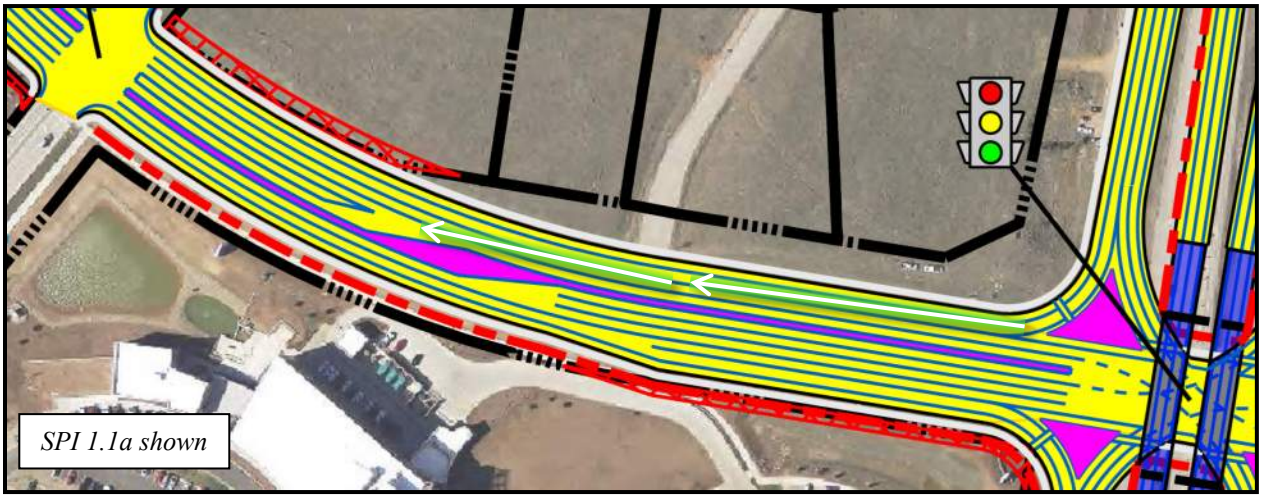


Figure 21: US16 SB Right Turn Weave to WB Catron Boulevard Left Turn

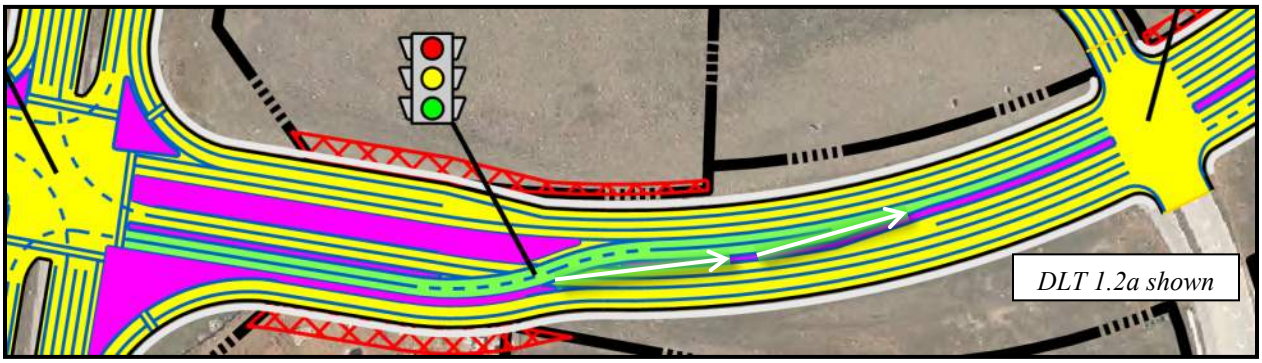


Figure 22: US16 NB Right Turn Weave to EB US16B/Catron Boulevard Left Turn

Table 33: US16 NB/SB Right Turn Operations – 2050 SPI Build Options (Vissim)

Build Option	Right Turn Lane Treatment	Northbound Right Turn				Southbound Right Turn			
		Average Queue (ft) AM / PM	Max Queue (ft) AM / PM	Average Stops (#/veh) AM / PM	Average Delay (sec/veh) AM / PM	Average Queue (ft) AM / PM	Max Queue (ft) AM / PM	Average Stops (#/veh) AM / PM	Average Delay (sec/veh) AM / PM
SPI 1.1	Free, single right turn lane	0 / 0	166 / 188	0.5 / 0.5	3 / 3	2 / 8	215 / 467	0.5 / 1.3	5 / 10
SPI 1.2	Signalized, dual right turn lanes	55 / 72	242 / 301	0.9 / 0.8	29 / 36	33 / 74	194 / 333	0.8 / 0.9	27 / 36

Table 34: US16 NB/SB Right Turn Operations – 2050 DLT Build Options (Vissim)

Build Option	Right Turn Lane Treatment	Northbound Right Turn				Southbound Right Turn			
		Average Queue (ft) AM / PM	Max Queue (ft) AM / PM	Average Stops (#/veh) AM / PM	Average Delay (sec/veh) AM / PM	Average Queue (ft) AM / PM	Max Queue (ft) AM / PM	Average Stops (#/veh) AM / PM	Average Delay (sec/veh) AM / PM
DLT 2.1	**Free, single right turn lane**	0 / 0	86 / 155	0.7 / 0.4	3 / 2	1 / 4	128 / 356	0.5 / 1.5	4 / 9
DLT 2.2	**Signalized, dual right turn lanes**	40 / 72	243 / 301	0.7 / 0.8	22 / 36	22 / 53	164 / 290	0.8 / 0.8	22 / 29

A free right turn configuration would be expected to adequately manage traffic operations through much of the planning horizon. Low average vehicle delay, average queue, and number of stops indicate adequate gaps in traffic are generally available for a right turning vehicle to weave across US16B/Catron Boulevard travel lanes to a downstream left turn lane.

In addition to managing peak hour volume conditions, an underlying benefit of a free movement is the efficiency it provides during the off-peak conditions (non-commute hours, non-tourist season, etc.). Gaps in traffic are more available during these times and vehicles would not need to stop unnecessarily due to a traffic signal.

One area of note is the southbound right turn lane in the PM peak hour. The maximum measured queue was over 350 feet and each vehicle making this turn stopped an average of 1.5 times. However, the average queue during that same analysis period was only eight feet and overall average delay was 10 seconds. This indicates the movement is expected to operate efficiently through a typical peak hour.

Providing dual, signalized right turn lanes was found to reduce southbound right turn maximum queue and number of stops. However, it increases average queues, maximum queues and average stops (outside of southbound PM peak hour), and average delay.

US16B/Catron Boulevard Queues between Closely Spaced Intersections

US16B/Catron Boulevard intersection queues were reviewed to assess potential queue spillback impacts to upstream traffic operations. This is of particular interest for the DLT Build Options with the signalized crossover intersections east and west of US16 where signalized intersection spacing is nearly half of what it is in the SPI Build Options. Separation between the crossover intersections and adjacent signalized intersection is shown in **Figure 23**. Separation of signalized intersections in the SPI Build Options is much greater at approximately 1,100 feet.

Vissim-measured maximum queues between the subject closely spaced intersections are summarized in **Table 35** and **Table 36**.

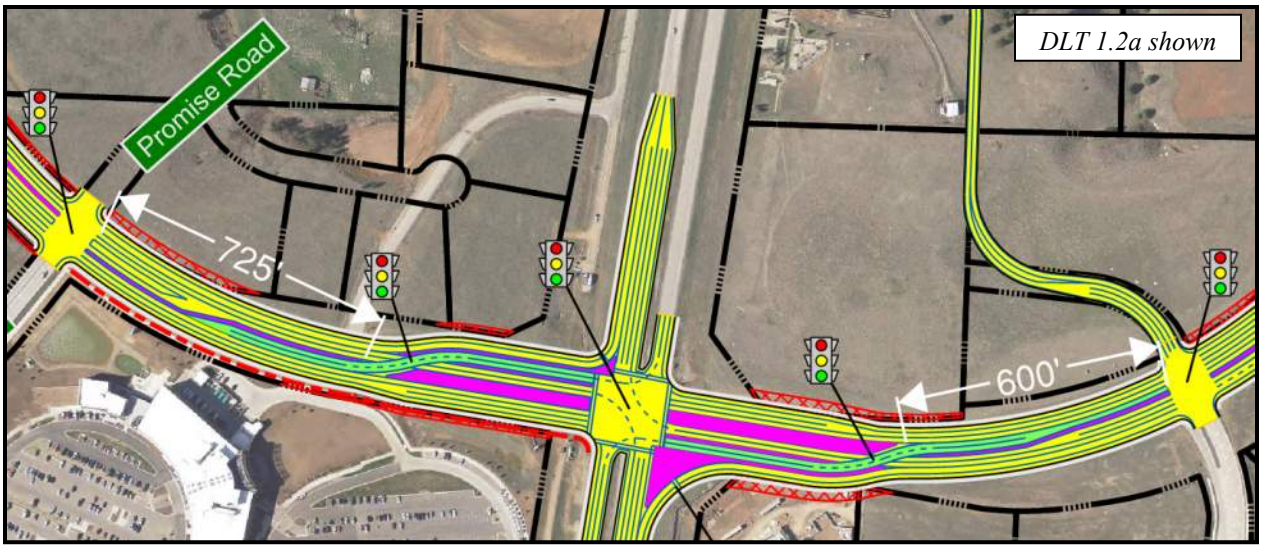


Figure 23: Spacing between DLT Crossover Intersections and Les Hollers Way/Healing Way

Table 35: US16B/Catron Blvd Queues – 2050 SPI Build Options (Vissim)

Intersection Movement	Distance to Upstream Intersection (ft)	SPI 1.1		SPI 1.2	
		Maximum Queue (ft)	Peak Hour	Maximum Queue (ft)	Peak Hour
Westbound at Les Hollers Way	1,100	513	PM	537	PM
Eastbound at Healing Way	1,100	317	PM	429	PM

Note: Available distance measured from stop bar upstream to opposite direction stop bar or right turn entry point.

Table 36: US16B/Catron Blvd Queues – 2050 DLT Build Options (Vissim)

Intersection Movement	Distance to Upstream Intersection (ft)	DLT 2.1		DLT 2.2	
		Maximum Queue (ft)	Peak Hour	Maximum Queue (ft)	Peak Hour
Westbound at Les Hollers Way	725	516	PM	516	PM
Eastbound LT at West Crossover	725	284	AM	262	AM
Westbound LT at East Crossover	600	549	PM	512	PM
Eastbound at Healing Way	600	321	PM	395	PM

Note: Available distance measured from stop bar upstream to opposite direction stop bar or right turn entry point.

Maximum queues between US16B/Catron Boulevard signalized intersections were maintained within the available intersection spacing for both the SPI and DLT Build Options. However,

maximum westbound left-turn queues measured nearly 550 feet and utilize nearly all available space (600 feet) between the westbound crossover and Healing Way intersection. This could potentially be problematic from an operations standpoint due to:

- Queue spillback impacts affecting operations at Healing Way
- Queue spillback extending beyond the location of guide signage (placed between westbound crossover and Healing Way intersections)
- Traffic impacts to US16B/Catron Boulevard through lanes due to slow or stopped vehicles trying to access the left turn lane

It would be expected that average and maximum queues across a typical day, particularly during the tourist off-peak winter months, would be well managed within the proposed DLT configurations.

11.2.7 Build Option Reliability Analysis

The *US16/US16B/Catron Boulevard Intersection Sub-Area Build Option Highway Capacity Software Analysis* report, provided in **Appendix L**, presents an HCM6-based reliability analysis for the US16 corridor. HCM6 reliability methodology replicates sensitivities to traffic variability and travel time unreliability, such as temporal variability in traffic demand (time of day, day of week, seasonal, etc.), incidents blocking travel lanes, weather events, work zones, and special events. Five Build Option scenarios were developed to analyze potential sources of travel time unreliability along the US16 and US16B/Catron Boulevard corridors.

Findings include:

- **US16 corridor**: SPI Build Options provide greatest reliability benefits due to the free, unsignalized northbound/southbound movements through the US16/US16B/Catron Boulevard intersection.
- **US16B/Catron Boulevard corridor**: SPI Build Options and DLT Build Option 2.1a provide similar reliability benefits.

11.2.8 SPI Build Option Supplemental Analyses

Two supplemental analyses were completed for the SPI Build Options to further evaluate a change in conditions representative of constructing a grade-separated interchange in place of the existing at-grade intersection:

- US16 freeway facility analysis
- SPI structure sensitivity analysis

US16 Freeway Facility Analysis

A freeway segment analysis was conducted to verify if the proposed SPI Build Option would meet study LOS goals for basic freeway segments, ramp merge and diverge segments, for the overall corridor (freeway facility) through the interchange. Because the different SPI Build Option variations are all focused on intersection treatments along US16B/Catron Boulevard, only one scenario is analyzed that can be applied to all SPI Build Options. 2050 SPI Build Option freeway analysis results are shown in **Table 37**.

Overall, the interchange configuration provides ample freeway segment capacity for 2050 Build condition traffic volumes.

Table 37: SPI Build Option Freeway Segment Traffic Operations – 2050 Build Conditions

US16 Southbound			US16 Northbound		
Traveling Southbound	AM LOS Density (pc/mi/ln)	PM LOS Density (pc/mi/ln)	Traveling Northbound	AM LOS Density (pc/mi/ln)	PM LOS Density (pc/mi/ln)
Basic *(from Promise Rd)*	A 9.3	B 12.7	Basic *(to Promise Rd)*	B 12.7	B 13.6
Diverge *(freeway / ramp)*	A 11.1 (f) 5.1 (r)	A 15.3 (f) 8.8 (r)	Merge *(freeway / ramp)*	B 13.5 (f) 10.7 (r)	A 16.4 (f) 9.8 (r)
Basic *(Includes structures)*	A 4.2	A 5.6	Basic *(Includes structures)*	A 4.9	A 6.0
Merge *(freeway / ramp)*	A 11.7 (f) 9.4 (r)	B 15.4 (f) 12.3 (r)	Diverge *(freeway / ramp)*	A 14.0 (f) 7.6 (r)	B 13.7 (f) 11.0 (r)
Basic *(to Moon Meadows Dr)*	B 11.7	B 15.0	Basic *(from Moon Meadows Dr)*	B 11.7	B 9.8
Facility	**A 9.1**	**B 12.0**	**Facility**	**A 10.7**	**B 11.9**

SPI US16 Structure Sensitivity Analysis

A sensitivity analysis was conducted for the US16 structure(s) associated with the SPI Build Options to determine if more than two lanes in each direction would be needed within the structures' 75-year design life. Build condition traffic volumes were extrapolated to 75 and 100-year design horizon timeframes based on straight-line growth between 2026 and 2050 volumes developed for this study. The study's LOS C goal was applied to this analysis. A summary of findings is shown in **Table 38**.

Table 38: SPI Build Option Freeway Segment Traffic Operations – Bridge Structure Design Horizon Sensitivity Analysis

US16 Southbound			US16 Northbound		
Traveling Southbound	75-Year LOS Density (pc/mi/ln)	100-Year LOS Density (pc/mi/ln)	Traveling Northbound	75-Year LOS Density (pc/mi/ln)	100-Year LOS Density (pc/mi/ln)
Basic *(from Promise Rd)*	C 22.0	D 27.3	Basic *(to Promise Rd)*	C 23.5	D 29.8
Diverge	B 27.0 (f) 18.7 (r)	C 32.9 (f) 23.4 (r)	Merge	C 25.4 (f) 20.6 (r)	C 31.6 (f) 25.3 (r)
Basic *(Includes structures)*	A 10.2	B 12.4	Basic *(Includes structures)*	B 11.8	B 14.6
Merge	C 27.4 (f) 22.1 (r)	C 33.9 (f) 26.7 (r)	Diverge	C 29.2 (f) 20.5 (r)	C 35.4 (f) 25.7 (r)
Basic *(to Moon Meadows Dr)*	D 26.5	D 34.7	Basic *(from Moon Meadows Dr)*	C 23.9	D 30.4

Facility	C 20.6	D 26.7	Facility	C 21.7	D 26.5

The upstream and/or downstream basic freeway segments are the first to reach LOS D. Because of high turning volumes within the interchange, volumes are considerably less on US16 mainline within the interchange. The basic freeway segment, between interchange ramp terminals, encompassing the structure(s), is shown as LOS A or B with ample capacity for additional traffic demand.

With the projected traffic patterns in this interchange, additional lanes needed beyond the interchange could be added/dropped at the on/off ramps and two lanes carried through the interchange. With the southbound downstream basic freeway segment being the only one measuring LOS D in the 75-year design horizon, a third southbound lane could be added from the SPI southbound on-ramp. The 100-year design horizon points towards additional through lane needs south and north of the interchange, but not through the interchange.

11.2.9 2050 Build Condition Traffic Operations Key Findings

The following key traffic operations findings were identified for the Build Options:

- Level of service
    - All SPI Build Options measure LOS B
    - DLT 2.1 measures LOS C
    - DLT 2.2 and 2.3 measures LOS D in one or both peak hours
- Travel time
    - SPI Build Options demonstrate the shortest US16 corridor travel times.
        - Approximately 20 to 30 seconds less per vehicle compared to DLT Build Options.
    - SPI and DLT Build Option US16B/Catron Boulevard travel times were similar in the AM peak hour, but SPI better managed travel times in the higher volume PM peak hour.
- DLT Build Options demonstrate a more limited intersection capacity than the SPI Build Options, as the measured DLT intersection delay approaches or exceeds the LOS C/D threshold.
- Free US16 northbound/southbound right turn lanes result in less intersection/ interchange delay than the signalized dual right turn lanes.
- The closure of Addison Avenue and Tucker Street access points has negligible effect on signalized intersection operations throughout the study area.
- Periphery intersections on US16 and US16B/Catron Boulevard are expected to meet operational goals with potential modifications presented in this analysis.

11.3 2026 Build Condition Traffic Operations

The HCS 2026 Build condition operational measures are summarized in the *US16/US16B/Catron Boulevard Intersection Sub-Area Build Option Highway Capacity Software Analysis* report provided in **Appendix L**. This analysis reflects expected traffic operations at

the year of opening for each Build Option. All Build Options are expected to meet LOS goals with 2020 Build condition traffic volumes.

11.4 Predictive Safety Analysis

A predictive safety analysis was completed for the No Build and Build Option conditions using the American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual (HSM) method to evaluate the expected safety of proposed intersection and roadway modifications. As stated in the HSM, "*The predictive method provides a quantitative measure of expected crash frequency under both existing conditions and conditions which have not yet occurred. This allows proposed roadway conditions to be quantitatively assessed…*" (HSM, 2010 version).

FHWA's Interactive Highway Safety Design Model (IHSDM) was the tool used to evaluate safety in the No Build and Build Option conditions. Output from this tool includes the predicted average annual crash frequency and total crashes over the analyzed timeframe (2026 – 2050). Crashes are categorized as fatal and injury crashes (F+I) and property damage only (PDO) crashes for both intersections and roadway segments.

The potential access treatments at US16/Addison Road, US16/Tucker Street, and US16/section line road intersections have a notable impact on overall predicted safety within the sub-study area. A summary of Build Options evaluated are listed in **Table 39**.

Table 39: Predictive Safety Build Option Analysis Groups

US16/US16B/Catron Blvd Intersection Type	Section Line Road Access	Addison Avenue Access	Tucker Street Access	Applicable Build Option
SPI	Closure	Closure	Closure	1.1a, 1.1b, 1.2
SPI	Full	Closure	Closure	
DLT	Closure	Closure	Closure	All DLT
DLT	Full	Closure	Closure	All DLT
DLT	Full	¾ Access	¾ Access	DLT 2.1a, 2.2a, 2.3
DLT	Closed	Full, Signalized	¾ Access	DLT 2.1a, 2.2a, 2.3
DLT	Full	Full	Full	DLT 2.1a, 2.2a, 2.3

It was found that all Build Options demonstrate safety improvements to the US16/US16B/Catron Boulevard intersection area when compared to the No Build condition. A summary of predicted average annual crash frequencies between years 2026 and 2050 is shown in **Figure 24**. A quantitative ranking of Build Options in terms of total number of predicted crashes between 2026 and 2050 is shown in **Table 40**.

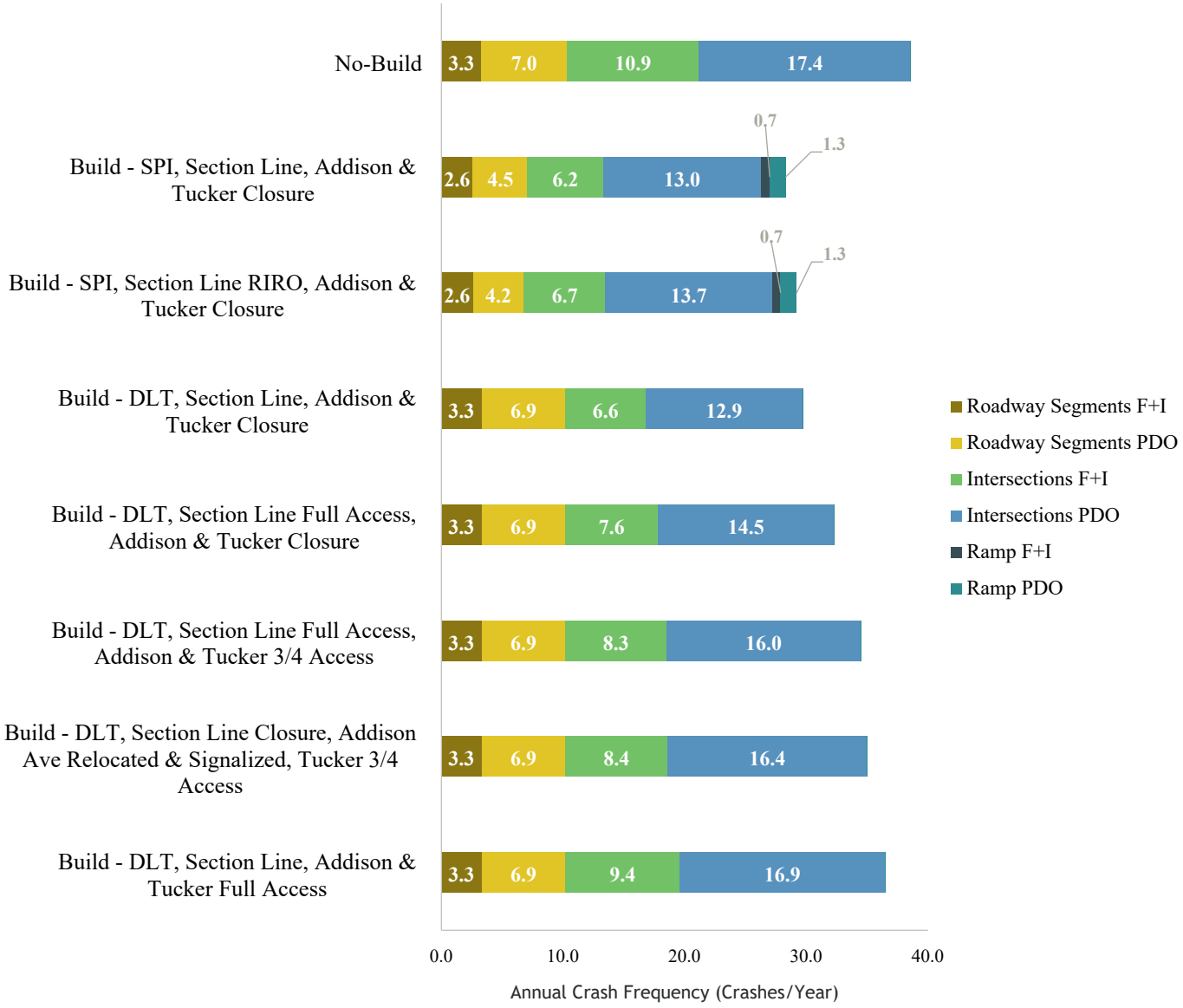


Figure 24: Predicted Average Annual Crash Frequencies (2026-2050)

Table 40: Predicted Build Option Crash Reduction (2026-2050)

Build Option	Minor Road Access Scenario Description	Total Crashes	Fatal and Injury Crashes
		- decrease in # of crashes from No Build (%)	- decrease in # of crashes from No Build (%)
SPI 1.1a SPI 1.1b SPI 1.2	Section line road: Closed Addison Ave: Closed Tucker St: Closed	-257 (-27%)	-117 (-33%)
SPI 1.1a SPI 1.1b SPI 1.2	Section line road: RIRO Addison Ave: Closed Tucker St: Closed	-235 (-24%)	-105 (-30%)
DLT 2.1a DLT 2.2a	Section line road: Open Addison Ave: Closed Tucker St: Closed	-157 (-16%)	-82 (-23%)
DLT 2.1a DLT 2.2a	Section line road: Open Addison Ave: ¾ Access Tucker St: ¾ Access	-102 (-11%)	-65 (-18%)
DLT 2.1a DLT 2.2a	Section line road: Closed Addison Ave: Relocated and signalized Tucker St: ¾ Access	-87 (-9%)	-62 (-18%)
No Build	No Build	965 (baseline, total crashes)	355 (baseline, total crashes)

Predicted reduction in crashes from 2026 to 2050.

The SPI Build Options are expected to provide the greatest safety benefit and predicted reduction in crashes for the study area. The SPI Build Option's greatest benefit is the predicted reduction of nearly five F+I crashes annually when compared to the No Build conditions (33 percent reduction).

Overall, the findings demonstrate the relationship between access and predicted safety within this study area. Scenarios with fewer access points and more restrictive access at section line road, Addison Avenue, and Tucker Street exhibited the greatest reduction in crashes. As more access points are incorporated and turn movements less restrictive, the predicted reduction in crashes decreases (and crashes increase). DLT scenarios that maintain this access result in a greater number of crashes and equates to nearly two additional F+I crashes occurring annually when compared to the SPI Build Options.

It was also found that signalizing a US16/Addison Avenue intersection would be expected to degrade safety when compared to a ¾ access. The primary impact is related to stopping a portion of US16 mainline traffic and introducing rear-end conflicts, whereas the ¾ access maintains a free movement for the high volume US16 mainline.

The *Predictive Safety Analysis for US16/US16B/Catron Boulevard Intersection Study Area* technical memo in **Appendix N** provides additional details regarding the predictive safety evaluation methodology and discussion of findings.

11.5 Bicycle and Pedestrian Accommodations

The review of bicycle and pedestrian accommodations was a collaborative effort between the intersection sub-area analysis and the overall US16 Corridor Study process. As part of this sub-area analysis, the focus centered on bicycle and pedestrian routes through the intersection and along the US16 and US16B/Catron Boulevard corridors. The *Pedestrian and Bicycle Access Considerations* technical memo provided in **Appendix O** evaluated the following items:

- Pedestrian route and estimated travel time to cross the US16/US16B/Catron Boulevard intersection
- US16 northbound/southbound right turns and pedestrian crossing delay
    - Free single right turn lanes
    - Signalized dual right turn lanes
- DLT intersection signalization impacts on traffic

Conclusions from this review include:

- **East/west crossing of US16/US16B/Catron Boulevard intersection:** SPI Build Options require crossing of up to two additional crosswalks and thus can potentially increase overall crossing time, but the actual crossing distance being exposed to traffic is similar to the DLT Build Options.
- **Diagonal crossing or north/south crossing of US16/US16B/Catron Boulevard intersection:** SPI Build Options do not facilitate north/south crossings at the single point intersection. This pedestrian crossing would be facilitated at Les Hollers Way and Healing Way.
- **North/south US16 corridor travel:** SPI requires an extra 2,300 feet of out of the way travel (to/from US16 shared-use path and Les Hollers Way or Healing Way signalized intersections) for someone traversing north/south on the US16 corridor.
- **US16 northbound/southbound right turns:** differences between a free, single right turn lane and signalized, dual right turn lanes include:
    - Free, single right turn lanes exhibited least amount of delay for pedestrians. Year 2050 PM peak hour delay approaches signalized intersection delay and would represent a condition to be monitored towards the latter years of the study planning horizon.
    - Signalized, dual right turn lanes provided signal-controlled gaps in traffic, but also represented the greatest pedestrian delay and longest crosswalk distances.
- **DLT intersection signalization impacts on traffic:** due to the long crosswalk distances, it is anticipated that each pedestrian-actuated WALK phase will force the traffic signal out of coordination with adjacent traffic signals. This can significantly reduce the DLT intersection's operational efficiency for several minutes while the signal progresses through multiple cycles to return to coordinated patterns.

11.6 Constructability Review

The Build Options were reviewed to assess whether they were biddable and buildable as a future project and if there are any key differentiators from a constructability standpoint.

Sources of information for this review include the *Constructability Review* report, **Appendix P**, and the *US16/US16B/Catron Boulevard Intersection Build Option Design Considerations* memo, **Appendix Q**.

11.6.1 Maintenance of Traffic Goals

For this review, it was assumed that traffic must be maintained along US16 corridor during construction due to the importance of this route for daily commuter traffic and summer tourist season traffic. Maintenance of traffic (MOT) goals are as follows:

- Maintain two lanes of US16 in each direction
- Maintain all movements through US16/US16B/Catron Boulevard intersection
- Use temporary pavement as needed to maintain travel lanes
- Short-term shoulder closures are possible
- Limit high volume turning movements onto frontage or local roads
- Phase construction to minimize traffic constraints during the summer months (tourist season) due to the influx of traffic and tourists

11.6.2 SPI Construction Phasing and MOT

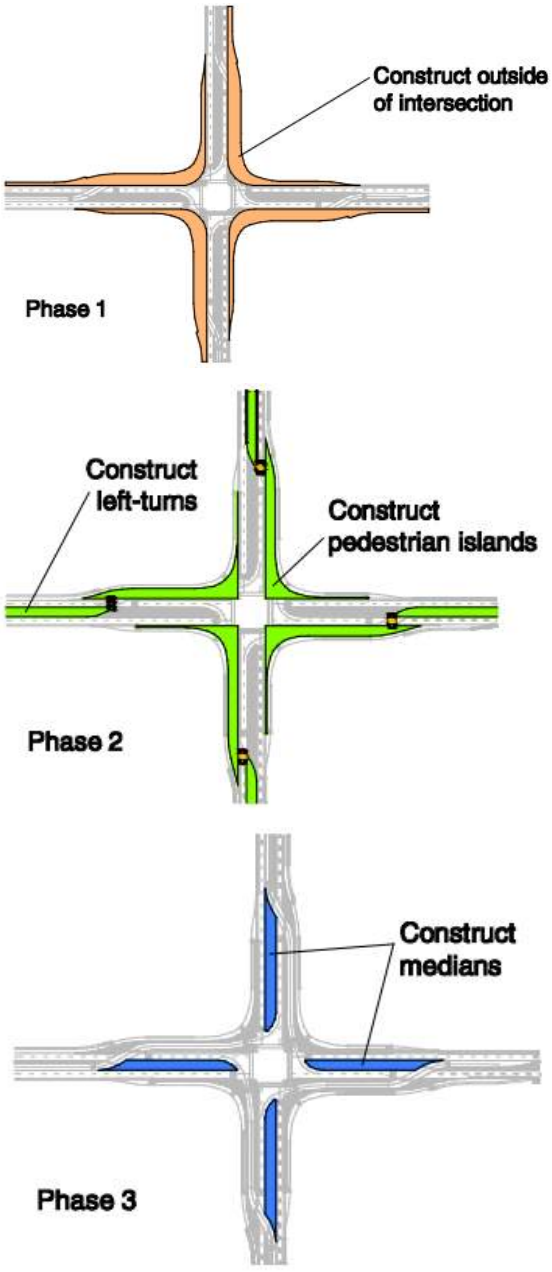
Proposed SPI construction phasing and MOT is based on methods frequently used in constrained, urban areas to maintain high levels of mobility for traffic and constructability for contractors. Three primary phases, as shown below, are proposed for the SPI Build Options.

1. Construct NB and SB US16 ramps
    a. Construct NB and SB US16 ramps and tie to US16B/Catron Blvd
        i. Maximizes work outside of existing traveled way
        ii. Design ramps to appropriate design speed for maintaining through traffic during construction.
    b. Maintain traffic on US16 mainline
    c. Temporary pavement as needed
2. Construct NB and SB US16 mainline and single point intersection geometry
    a. Construct NB and SB US16 bridges and mainline
    b. Maintain traffic on ramps.
    c. Signalize both intersections and operate similar to a ‘tight diamond’ configuration
    d. Temporary pavement as needed
3. Construct EB & WB Catron Blvd
    a. May be completed during either US16 corridor phase
    b. Construct EB and WB US16B/Catron Blvd in halves
    c. Temporary pavement as needed

11.6.3 DLT Intersection Construction Phasing and MOT

The proposed DLT intersection construction phasing and MOT is based on recent HDR DLT design experience and national guidance, where work begins to the outside of the intersection and works inward. The process is similar to a traditional intersection widening project and consists of three primary phases:

1. Construct NB to EB RT lanes and SB to WB RT lanes (outside of intersection)
    a. Traditional left turn lanes maintained within main intersection
    b. Similar to 'Phase 1' in **Figure 25**
2. Construct EB and WB crossover left turns
    a. Includes crossover left turn lanes at the crossover intersections and the crossed-over left turn lanes at the main intersection
    b. Traditional left-turn lanes maintained for traffic within main intersection
    c. Similar to 'Phase 2' in **Figure 25**
3. Reconstruct inside as typical intersection
    a. Shift traffic to new, outer pavement and reconstruct existing mainline and intersection area (traditional left turn lanes and raised medians)
    b. Similar to 'Phase 3' in **Figure 25**



Source: FHWA Displaced Left Turn Informational Guide, August 2014

Figure 25: Proposed DLT Construction Phasing and MOT

11.6.4 US16 Bridges (SPI Build Options)

Two structure options for construction, shown in **Figure 26**, were reviewed and include:

Option 1: Consists of two 44'-8" wide, 208' long, single span bridges with 5 steel I plate girders. Each bridge has standard SDDOT Jersey barriers along each edge of the 8" deck. The bridges are zero skew bridges adjacent to each other. If future widening to the center is a possibility, sufficient separation between the two structures must be incorporated into the design.

Option 2: Consists of a single 84'-8" wide, 208' long, single span bridge with 9 steel I girders. The bridge has standard SDDOT Jersey barriers along

each edge of the 8” deck along with either 7’ shoulders with center barrier (shown in figure below) or a 14’ wide by 6” deep median running along the center of the bridge. This bridge is a zero skew structure. Widening for additional lanes would need to occur to the outside of the structure.

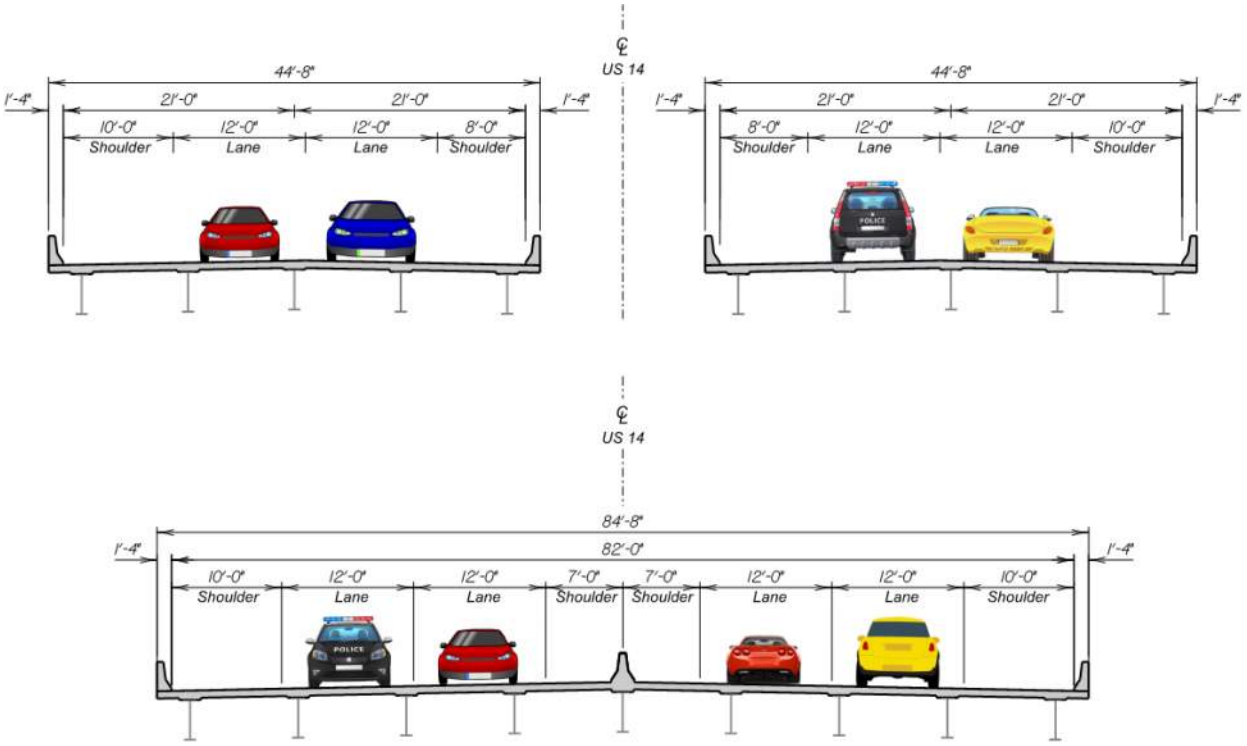


Figure 26: SPI Build Option Structure Options for US16 Mainline

11.6.5 Build Option Constructability Conclusions

The constructability review concluded that each Build Option presents unique benefits and challenges specific to the interchange or intersection type. For both, it is anticipated that construction techniques, phasing, and maintenance will follow familiar methods. However, it is anticipated that local contractors will likely be unfamiliar with DLT intersections. Key differentiators from the constructability review are as follows:

- SPI advantages:
    - Local contractor familiarity
    - Maintains high levels of mobility for traffic during construction
        - New ramps can be constructed outside of US16 mainline to maximize work outside of existing travel way and serve as detours during bridge construction.
    - Fewer traffic signals; less complex signal timings and infrastructure needs
    - Less right of way (ROW) required
    - Less complex staging to maintain traffic, median length (and fewer medians on each approach)

  - More of US16 mainline is reconstructed now as opposed to in a future project (however, this increases costs for this project)

- DLT intersection advantages:
  - Less borrow, embankment, and retaining wall needed
  - No new bridge structures needed
  - Less pavement removal and new pavement (however, this increases removal and new pavement needs as part of a subsequent corridor project)

11.7 Maintenance and Operations

Throughout the study, discussions were held with HDR staff involved in previous SPI and DLT intersection designs in Salt Lake City and Kansas City, Utah DOT staff, and SDDOT staff to gauge maintenance and operations benefits and drawbacks for each Build Option. A summary of these discussions is as follows:

- Winter maintenance
  - The *Manual of Best Practices and Techniques for Clearing Intersection Layouts* (www.clearroads.org) illustrates recommended methods for clearing snow from alternative intersections and interchanges. Using recommended plowing patterns, Benefit-Cost Analysis (BCA) scenarios were developed for the SPI and DLT intersection Build Options to measure time and mileage to plow each configuration. It was found that while it took more time to plow a DLT intersection, the overall vehicle miles traveled was greater for the SPI.
  - **SPI:** SDDOT and City of Rapid City maintenance staff are familiar with SPI configurations which leads to more efficient operations.
  - **DLT:** Utah DOT winter maintenance staff estimated that plowing a DLT intersection is highly dependent on signal timing, ranging from just slightly longer than a traditional intersection to twice as long.
- Traffic signal infrastructure
  - **SPI:** requires one cabinet/controller for the main single point intersection
  - **DLT:** requires two cabinets/controllers, with the main controller for the DLT main intersection and a secondary controller for the crossover intersections
  - In both instances, the periphery signalized intersections would all operate with their own cabinet/controller
- Traffic signal timing maintenance
  - **SPI:** SDDOT and City of Rapid City have experience with developing, implementing, and maintaining SPI signal timing plans. Greater spacing between signals improves signal timing flexibility and fewer signals to incorporate into coordinated timing plans. Significantly less effort to provide a variety of timing plans based on time of day and time of year (i.e. tourist and non-tourist seasons).
  - **DLT:** timing plans are a significant effort and complex due to the need to maintain tight progression through the five US16B/Catron Boulevard signalized intersections. Development and implementation of a variety of timing plans

based on time of day and time of year would require considerably more time than an SPI. Maintaining timings at alternative intersections also requires significant effort. It was found that many agencies with these types of intersections have dedicated staff for these types of intersections. SDDOT and City of Rapid City noted they do not currently have the resources or staff to maintain signal timings at this type of complex intersection.

- Roadway maintenance and SDDOT/City of Rapid City/contractor familiarity
    - **SPI:** familiar interchange type for SDDOT, City of Rapid City, and local contractors
    - **DLT:** new intersection type for SDDOT, City of Rapid City, and local contractors. There is concern about route reliability and maintenance of traffic during future lane closures for routine maintenance and other closure needs.
- Roadway maintenance costs
    - SPI likely to exhibit higher maintenance costs due to additional pavement (ramps) and bridge structures (US16 over single point intersection). However, as shown in the BCA, the difference in maintenance costs were negligible in relation to benefits associated with traffic operations and safety benefits in the benefit-cost calculations.
- Ability to sign
    - **SPI:** US16B/Catron Boulevard signalized intersection spacing allows for guide signage placement between signalized intersections (i.e. Les Hollers Way and Healing Way). This guide signage can be placed in advance of the SPI queues to provide ample maneuver distance in response to the signage.
    - **DLT:** closely spaced intersections along US16B/Catron Boulevard requires guide signs to either be placed with little advance notification of a required turn at the DLT crossover intersections or located at least one signalized intersection prior to the turn. This may create issues with queue blockages extending through the area where guide signage is located, necessitating lane change maneuvers well upstream of the guide sign location.
    - Conceptual signing plans for each Build Option type are provided in **Appendix R**.

11.8 Cost Summary

Comparative ROW impacts and construction cost summary is provided in **Table 41**. ROW impacts account for both acquisition and easement needs. The total cost includes construction costs, ROW costs, and a 30 percent contingency.

Table 41: Total Right of Way Impacts and Costs

Build Option	Description	Right of Way Impacts (acres)	Total Costs ($mil)
1.1a	SPI – Free NB/SB RT Lanes	3.3	32.4
1.1b	SPI – Free NB/SB RT Lanes; EB RT lane at H. Way	3.3	32.4
1.2	SPI – Signalized NB/SB Dual RT Lanes	2.8	31.1
2.1a	DLT – Free NB/SB RT Lanes	3.5	18.5
2.1b	DLT – Free RT Lanes (all Quadrants)	3.6	20.3
2.2a	DLT – Signalized RT Lanes (all quadrants); NB/SB signalized at crossover intersections	3.6	18.3
2.2b	DLT – NB/SB Signalized RT Lanes; NB/SB signalized at crossover intersections	3.7	20.3
2.3	DLT – Unseparated, Signalized RT Lanes at Main Intersection	3.2	17.3

11.9 Benefit Cost Analysis Summary

A BCA was performed to compare expected benefits associated with the proposed improvements against the project costs over a 30-year analysis period. The BCA evaluated SPI 1.1, SPI 1.2, DLT 2.1, and DLT 2.2 to account for variations in intersection type, local network access modifications, and northbound/southbound US16 right turn treatment.

It should be noted that the BCA attempts to monetize benefits to the greatest extent possible. However, it is not always possible to assign a dollar value to the benefit. Quantitative and qualitative analysis are also important components to an evaluation of Build Options and thus the BCA should be viewed as one of many considerations in the overall evaluation process.

Economic benefits incorporated into the analysis include:

- Travel time savings
- Emissions cost savings
- Crash cost savings
- Operations and maintenance (O&M) cost savings
- Infrastructure residual value

Project costs focused on ROW acquisition and construction costs. One thing to note with construction costs is that the DLT Build Options exhibit approximately 0.75 fewer miles of mainline US16 reconstruction than the SPI Build Options. With a potential future US16 corridor reconstruction project identified in the SDDOT's 2029 developmental STIP, the construction cost savings realized with a DLT is transferred to the US16 corridor project as an additional cost. This reduces the cost discrepancy between the DLT and SPI Build Options when corridor projects are considered as a whole.

BCA access scenarios include the following access treatments at the three US16 minor crossroad intersections within the sub-area:

- SPI Build Options:
    - Section line road, Addison Avenue, and Tucker Street: closed
- DLT Build Options:
    - Section line road: open
    - Addison Avenue and Tucker Street: ¾ access

Additional turning movements and/or access points beyond what is shown in these two analysis scenarios would reduce the BCA ratio due to increases in predicted number of crashes.

BCA results for the sensitivity scenario that accounts for daily intersection delay over a 12-hour period are summarized in **Table 42**. Additional information on the BCA methodology, sensitivity scenarios, findings, and discussion is provided in the *US16/US16B/Catron Boulevard Intersection Benefit-Cost Analysis Supplemental Documentation* report in **Appendix S**.

Table 42: Build Option BCA Results

Build Option	Benefit-Cost Ratio
SPI 1.1	1.32
SPI 1.2	1.18
DLT 2.1	1.34
DLT 2.2	1.22

Scenario accounts for 12-hours of vehicular delay

The SPI Build Option's greatest benefit is reflected in the expected crash cost savings, expected at over $20 million within the analysis period when compared to the No Build conditions. SPI 1.1 provides the greatest travel time savings of all Build Options at approximately $13 million over the same period.

The DLT intersection Build Option crash cost savings is nearly half of what was presented with the comparable SPI Build Option at approximately $11 million. Travel time savings was nearly $5.5 million less than the SPI Build Option at $7.5 million.

For both the SPI and DLT Build Options, signalizing US16 northbound/southbound right turn lanes influences the overall B-C ratios by decreasing the travel time savings.

Overall, the BCA demonstrates that benefits would be expected to outweigh costs for any of the evaluated Build Options. Thus, each is considered a feasible project for consideration.

12.0 Public Involvement Summary

Two sets of public and stakeholder meetings were held as part of the concept and Build Option development phases of this study. Each set of meetings included three stakeholder meetings during the day and an evening public meeting. Information was also uploaded to the study website for people to review at their leisure.

Invitations were sent out to adjacent businesses and property owners, interested groups, and government agencies for each stakeholder group:

- US16/US16B/Catron Boulevard intersection
- US16/Neck Yoke Road intersection
- US16 corridor south of Neck Yoke Road

The first set of public and stakeholder meetings were held on July 23, 2019. For the US16/US16B/Catron Boulevard intersection, the purpose of these meetings was to solicit and

discuss transportation-related needs in the area. Feedback from these meetings was used to refine the study purpose and need statement and intersection Build Options.

The second set of public and stakeholder meetings for the overall US16 Corridor Study focused on presenting Build Options for the US16/US16B/Catron Boulevard intersection. At these December 10, 2019, meetings, refined Build Options were presented to stakeholders and the public for their feedback with the following information:

- Build Option layouts
- Traffic operations results
- Predictive safety results
- Construction costs

Notable feedback and comments from the stakeholders and public with regard to the US16/US16B/Catron Boulevard intersection area included:

- Support for both SPI and DLT intersection Build Options. However, comments regarding benefits and drawbacks of each Build Option resulted in opposing views of the mobility and access spectrum.
- Support for SPI Build Options focused on traffic operations, safety, tourist traffic and seasonal volume fluctuations, driver familiarity, maintaining through traffic as a free movement and a high level of mobility on US16, route reliability, addressing weather-related concerns and the downgrade into a signalized intersection, and accounting for planning efforts completed to date.
- Concerns regarding the SPI Build Options focused on cost and the closure of US16 intersections with Tucker Street and Addison Avenue due to the SPI ramps.
- Support for the DLT intersection Build Options focused on the availability to maintain US16 intersections with Addison Avenue and Tucker Street, lower construction costs, and a desire to create a more urban, slower speed/greater access US16 corridor.
- Concerns for the DLT intersection focused on the inability to provide the long-term traffic operations and safety benefits afforded by the SPI Build Options.

Further information, submitted comments, and stakeholder meeting notes for these public and stakeholder meetings are provided in the respective public involvement summary reports in **Appendix T**.

13.0 Build Option Evaluation Summary

This section summarizes the Build Option evaluation process that led to the development of a future project recommendation. A more detailed discussion of the Build Option evaluation process is provided in the *US16/US16B/Catron Boulevard Intersection Build Option Evaluation* report attached in **Appendix K**.

13.1 Evaluation Methodology

The following methodology was used to compare Build Options and assess feasibility, benefits, and drawbacks of each.

13.1.1 Evaluation Categories

Meets Purpose and Need

Each Build Option was evaluated on whether it meets the US16/US16B/Catron Boulevard project Purpose and Need.

2050 Planning Horizon Traffic Operations

This category uses HCM6 traffic operations methodologies to measure traffic operations in terms of:

- Intersections: average intersection delay (seconds per vehicle) and associated LOS
    - Measures presented in terms of ETT or overall weighted delay to account for all entering vehicles of the SPI or series of DLT-related intersections
- Travel time: average travel time (seconds per vehicle) to traverse between two points along the specified corridor

Operational measures were obtained from both HCS and Vissim, where applicable.

Traffic Safety

This measure demonstrates a Build Options' predicted improvement over the No Build condition as well as establishes a comparative framework for gauging predicted safety improvements between each Build Option. IHSDM output reflecting the expected decrease or increase in crashes between years 2026 and 2050 for each Build Option is summarized in terms of:

- 'Total Crashes' consists of all crash types (property damage only, injury, and fatal)
- 'Fatal and Injury Crashes' reflects the higher severity type crashes

Traffic

The traffic category presents two measures based on engineering interpretation of the traffic models, safety models, and human factors that play a notable role in developing design standards.

Closely spaced intersection considerations:

- US16 northbound/southbound right turn to downstream (Healing Way or Les Hollers Way) left turn weave movement
    - Accounts for right turn movement delay, total stops, weave movement simulation review, and effect on overall intersection operations
- Spacing between US16 and US16 service road intersections
- US16B/Catron Boulevard corridor operations, weave movements, and intersection functional area

Driver expectancy and ability to sign considerations:

- Expected performance during inclement weather conditions common to the intersection (fog, snow, etc.)
- Ability to sign local access and differentiate between local access and regional routes

- Tourist traffic, unfamiliar drivers, and the intersection's importance to regional travel

A rating of 5 to 1 was applied to each Build Option based on these considerations, with 5 being the most favorable and 1 being the least favorable.

Right of Way Needs and Total Costs

Build Option ROW and total cost components include:

- ROW and easement acquisition (total acres)
- Total cost (construction cost + ROW cost + contingency)

Benefit-Cost Ratio

This category reflects findings from the BCA that accounts for the following:

- Travel Time Savings
- Emissions Cost Savings
- Accident Cost Savings
- Operations and Maintenance (O&M) Cost Savings
- Infrastructure Residual Value
- Capital Costs

A BCA greater than 1.0 represents a feasible project as the benefits are expected to exceed the costs within the analysis period. The BCA ratio presented in the matrix includes an estimation of daily traffic operations.

Construction, Maintenance, and Operations

This category measures the constructability, maintenance, and operations to assess the build, own, and operate aspects of each Build Option.

Constructability is measured by considerations such as:

- Overall timeline for construction and construction limits
- Maintenance of traffic along US16
- Exposure of workers to traffic
- Traffic signal infrastructure and timing plan development

Maintenance and Operations considerations include:

- Winter weather maintenance
- Signal phasing and timing plans
- Roadway maintenance and SDDOT/City/contractor familiarity
- Roadway maintenance costs (primarily accounted for in BCA)
- Traffic signal equipment maintenance costs

A rating of 5 to 1 was applied to each Build Option based on these considerations, with 5 being the most favorable and 1 being the least favorable.

Public Input

This measure accounts for input provided by the public and project stakeholders during the December 10, 2019, and February 2021 stakeholder and public meetings. Feedback in the form of written or verbal comments primarily focused on the following:

- Commuter traffic
- Tourist traffic
- Bicycle/pedestrian connectivity
- Local network access
- Planning effort to date
- Local agency support
- Whether US16 through traffic needs to stop

A rating of 5 (most favorable) to 1 (least favorable) was applied to each Build Option based on the considerations noted above.

Bicycle and Pedestrian

Considerations for bicycle and pedestrian travel though the US16/US16B/Catron Boulevard intersection area include:

- Route connectivity (along and across US16 corridor)
- Crossing delay
- Route travel time
- Signalized crossings
- Crossing impacts to vehicular traffic and traffic signal timings

A rating of 5 to 1 was applied to each Build Option based on these considerations, with 5 being the most favorable and 1 being the least favorable.

Potential Environmental Impacts

Socioeconomics and land use were used to qualitatively evaluate potential impacts.

13.1.2 Evaluation Measures

Each Build Option was evaluated on how they compare with other Build Options in a given category and/or whether they meet study goals. This evaluation is summarized through the following color coding in the evaluation matrix:

- **Bold Green** text indicates a Build Option measure was favorable compared to the other Build Options in a category
- Black text indicates a Build Option measure was in the middle compared to other Build Options in a category
- **Bold Red** text indicates a Build Option measure was unfavorable compared to the other Build Options in a category or the measure does not meet study goals.

13.2 No Build Condition

The No Build condition is carried throughout the technical and environmental analysis for consideration as an option and as a baseline comparison for the Build Options. However, as noted in the evaluation matrix, the No Build option does not:

- Meet project purpose and need
- Achieve LOS goals at the US16/US16B/Catron Boulevard intersection in the 2050 Planning Horizon
- Improve intersection safety
- Address growing traffic volumes from rapidly urbanizing land use

13.3 Build Option Evaluation

Each Build Option was evaluated and compared using the presented measures. A summary of these measures is provided in the Build Option evaluation matrix shown in **Table 43**. **Appendix U** includes a summary of considerations for each measure incorporated into the matrix. Tables in that discussion are color-coded to align with values presented in the evaluation matrix.

Table 43: US16/US16B/Catron Boulevard Intersection Build Option Evaluation Matrix

		Meets P & N		2050 Planning Horizon Traffic Operations						Safety *2026 - 2050*		Traffic		ROW & Total Costs		BCA	Construction, Maintenance, & Operations		Public Input	Bike/ Ped	Potential Environmental Impacts	
Build Option	Description	Improves Traffic Operations	Improves Safety	US16/US16B/Catron Blvd Intersection LOS	US16/US16B/Catron Blvd Intersection Weighted Delay (sec)	US16 Corridor Travel Time (sec)	US16/US16B/Catron Blvd Intersection LOS	US16 Corridor Travel Time (sec)	US16B/Catron Blvd Corridor Travel Time (sec)	Total Crashes	Fatal and Injury Crashes	Closely Spaced Intersection Operations	Driver Expectancy / Ability to Sign	ROW Acquisition	Construction + ROW Costs + Contingency	BCA Ratio Greater than 1.0?	Constructability	Maintenance and Operations	Build Option Support based on Stakeholder & Public Feedback	Bicycle and Pedestrian	Socioeconomics	Land Use
				AM/PM	AM/PM	*Range of AM & PM travel time*	AM/PM	*Range of AM & PM travel time*	*Range of AM & PM travel time*	*+ increase - decrease from No Build*	*+ increase - decrease from No Build*	*5 - Best 3 - Middle 1 - Poor*	*5 - Best 3 - Middle 1 - Poor*	Acre	$ mil	*Yes/No (ratio)*	*5 - Best 3 - Middle 1 - Poor*	*5 - Best 3 - Middle 1 - Poor*	*5 - Greatest 3 - Middle 1 - Least*	*5 - Best 3 - Middle 1 - Poor*		
1.1a	**SPI - Free NB/SB RT Lanes**	Yes	Yes	B / B	22 / 18	120 - 133	B / B	230 - 246	140 - 149	-257	-117	4	4	3.3	32.4	Yes *(1.32)*	3	4	4	3	Minor ROW for developed and undeveloped parcels on Catron Blvd and potentially Promise Road; closure of Addison Ave on US16.	Supports designated future land use.
1.1b	**SPI - Free NB/SB RT Lanes;** EB RT lane at H. Way	Yes	Yes	B / B	22 / 18	120 - 133	B / B	230 - 246	140 - 149	-257	-117	4	4	3.3	32.4	Yes *(1.32)*	3	4	4	3	Minor ROW for developed and undeveloped parcels on Catron Blvd and potentially Promise Road; closure of Addison Ave on US16.	Supports designated future land use.
1.2	**SPI - Signalized NB/SB Dual RT Lanes**	Yes	Yes	B / B	27 / 24	120 - 133	B / C	231 - 245	140 - 153	-257	-117	5	4	2.8	31.1	Yes *(1.18)*	3	4	4	4	Minor ROW for developed and undeveloped parcels on Catron Blvd and potentially Promise Road; closure of Addison Ave on US16.	Supports designated future land use.
2.1a	**DLT - Free NB/SB RT Lanes**	Yes	Yes	C / C	29 / 32	152 - 158	C / C	235 - 262	140 - 156	-102	-65	2	3	3.5	18.5	Yes *(1.34)*	3	2	3	3	Minor ROW for developed and undeveloped parcels on Catron Blvd.	Supports designated future land use.
2.1b	**DLT - Free RT Lanes (all Quadrants)**	Yes	Yes	C / C	29 / 31	139 - 142	C / C	235 - 262	140 - 157	-157	-82	2	3	3.6	20.3	Yes *(1.34)*	3	2	3	3	Minor ROW for developed and undeveloped parcels on Catron Blvd. Partial closure of Addison Ave on US16.	Supports designated future land use.
2.2a	**DLT - Signalized RT Lanes (all quadrants);** NB/SB signalized at crossover intersections	Yes	Yes	C / D	32/ 37	152 - 158	C / C	235 - 263	140 - 156	-102	-65	3	3	3.6	18.3	Yes *(1.22)*	3	2	3	3	Minor ROW for developed and undeveloped parcels on Catron Blvd.	Supports designated future land use.
2.2b	**DLT - NB/SB Signalized RT Lanes;** NB/SB signalized at crossover intersections	Yes	Yes	C / D	31/ 35	139 - 142	C / C	235 - 263	140 - 157	-157	-82	3	3	3.7	20.3	Yes *(1.22)*	3	2	3	3	Minor ROW for developed and undeveloped parcels on Catron Blvd. Partial close of Addison Ave on US16.	Supports designated future land use.
2.3	**DLT - Unseparated, Signalized RT Lanes at Main Intersection**	Yes	Yes	D / D	38/ 45	139 - 142	C / C	- - -	- - -	-102	-65	3	2	3.2	17.3	- - -	2	2	2	2	Minor ROW for developed and undeveloped parcels on Catron Blvd.	Supports designated future land use.
No Build	**No Build**	No	No	E / F	75 / 137	- / -	C / D	238 - 262	155 - 183	965	355	Base	3	0	0	Base	n/a	3	1	2	Area continues to transition into commercial activity center.	Limits designated future land use.
	Analysis Source			*HCS*	*HCS*	*HCS*	*Vissim*	*Vissim*	*Vissim*	*IHSDM*	*IHSDM*											

13.4 Build Option Screening Summary

Build Option screening followed a 3-step process to compare and eliminate Build Options from further consideration:

1. **Intersection type:** SPI Build Options vs. DLT Build Options
2. **US16 northbound/southbound right turn lane treatment at US16B/Catron Boulevard:** free, single right turn lane or signalized, dual right turn lanes
3. **Sub-option review:** to determine if any can be screened out

13.4.1 Step 1: Intersection Type

The SPI Build Options performed considerably better than the DLT Build Options with regard to traffic operations. The SPI provided the least overall intersection delay, best corridor travel times, and exhibits the greatest available capacity for traffic growth and seasonal fluctuations. The 2050 planning horizon volumes are close to or exceeding congested conditions for the DLT Build Options (LOS C or D), while the overall interchange is anticipated to perform at LOS B for the SPI Build Options.

The most notable benefit to the SPI Build Option is the predicted reduction in crashes, with a predicted reduction between 1.5 and 2 times greater than the DLT Build Options. Further, the SPI Build Option is predicted to reduce the most serious fatal and injury crashes by nearly two additional crashes per year when compared the DLT Build Option. The SPI also best addresses public and stakeholder safety concerns with fog, ice, and down-grade into the signalized intersection.

The SPI Build Options also are expected to best address challenges with closely spaced intersections, driver expectancy, ability to sign, and SDDOT/City of Rapid City operations and maintenance. The DLT analysis of closely spaced intersections (Les Hollers Way, the three DLT intersections, and Healing Way) demonstrated issues related to queue spillback affecting upstream intersections, increased traffic delay and corridor travel times, sign spacing, and driver expectancy.

The DLT's dependency of detailed traffic signal timings and uninterrupted coordination throughout all area traffic signals is a significant time commitment and expense for owner agencies. There was notable concern with the complexity of and investment into traffic signal infrastructure, timings, and required maintenance to provide a reliable corridor during typical and atypical conditions for the DLT Build Option.

The primary drawback to the SPI Build Option is cost, which includes reconstruction of nearly 1.25 miles of US16 mainline. This is approximately 0.75 miles more than what is accounted for in the DLT Build Option. With a potential future US16 corridor reconstruction on the horizon, a portion of the US16 mainline reconstruction cost savings realized with a DLT would lead to higher costs in that future reconstruction project and reduce the overall cost discrepancy when the corridor projects are considered as a whole.

US16 access was one of the primary differentiators between the two Build Option types, with the DLT Build Options being able to accommodate some level of access at Addison Avenue and Tucker Street. While additional access to surrounding development can be provided with the DLT Build Options, it comes at a large expense of degraded traffic operations, safety, and long-term performance throughout the intersection area.

While initially perceived as a benefit to the DLT intersection, bicycle and pedestrian accommodations were found to be similar between the SPI and DLT Build Options. The

primary drawback to the DLT is the notable impact pedestrian crosswalk phases are expected to have on corridor signal coordination. It is anticipated that each pedestrian actuation to receive a WALK indication will force the traffic signal out of coordination with adjacent traffic signals. This can significantly reduce the operational efficiency of the DLT intersection for several minutes while the signal progresses through multiple cycles to return to coordinated patterns.

Overall, the SPI Build Option best meets the project purpose and need. It provides the best traffic operations, greatest predicted reduction in crashes, and better accommodates urbanizing land use through providing the greatest amount of capacity to accommodate growing traffic volumes and seasonal and daily traffic fluctuations. Further, the SPI Build Option provides the greatest benefit in nearly all the remaining measures analyzed as part of this study. The primary drawback was cost; however, the BCA found that an SPI project was equally as feasible as a DLT project. Further, there are several unquantifiable measures not accounted for in the BCA that are important to the long-term operations and safety that support an SPI. Based on these findings, it is recommended that the three SPI Build Options be carried forward and all DLT Build Options be eliminated from further consideration.

13.4.2 Step 2: US16 Northbound/Southbound Right Turn Lane Treatment at US16B/Catron Boulevard Intersection

The second step of the screening process focuses on US16 northbound/southbound right turn lane treatment at US16B/Catron Boulevard single point intersection. Based on a review of traffic operations throughout the planning horizon, it was determined that:

- SPI Build Option 1.1a provides the best long-term traffic operations and was therefore the desired Build Option.
- Towards the end of the 2050 planning horizon, the PM peak hour experiences longer queues and greater number of stops on the US16 northbound/southbound right turn lanes. Therefore, it was desired that grading for dual right turn lanes shown in SPI 1.2 be incorporated to the final Build Option. This will allow for a quick conversion to signalized, dual right turn lanes at the off-ramps when volumes reach a point where it benefits overall operations and safety.

13.4.3 Step 3: Initial Sub-Option Review

The third step of the screening process focused on the eastbound US16B/Catron Boulevard right turn lane at Healing Way shown in SPI 1.1b. It was determined that the right turn lane be incorporated for the following reasons:

- Separates accelerating traffic from traffic slowing to turn right,
- Allows right turn overlap phasing within traffic signal, and
- Driver expectancy of right turn lane at major intersection and existing right turn lane.

Based on the overarching operational and safety benefits of SPI 1.1a, the recommended Build Option is: **SPI 1.1a with the following modifications:**

- **Northbound/southbound US16 off-ramp grading to accommodate future dual right turn lanes shown in SPI 1.2**
- **Eastbound US16B/Catron Boulevard right turn lane at Healing Way shown in SPI 1.1b**

14.0 Recommendations

14.1 Recommended Build Option

The recommended technically feasible alternative that best meets the established transportation needs of the US16/US16B/Catron Boulevard intersection is Build Option 1.1a, SPI with separated, free northbound and southbound right turn lanes. Key benefits and differentiators of this Build Option include:

- Lowest overall interchange/intersection delay
    - LOS B in 2050 Planning Horizon AM and PM peak hours
    - Greatest available capacity to accommodate traffic growth and fluctuations within interchange/intersection
- Shortest US16 corridor travel time
- Shortest US16B/Catron Boulevard corridor travel time
- Greatest expected reduction in crashes from the No Build condition:
    - Fatal and injury crashes: 33% reduction
    - Total crashes: 27% reduction
- Provides the greatest separation between US16 and next adjacent US16B/Catron Boulevard signalized intersections
    - Best addresses weave and queue spillback concerns without degrading overall intersection/interchange operations
- Best addresses public and stakeholder support for long-term traffic operations and safety benefits
- Provides familiarity for driver expectancy, construction, maintenance, and operation
- Areas affected by access closures will be accommodated through frontage and rearage roads, consistent with local network planning completed to date
- BCA ratio greater than 1.0 showing that benefits are expected to exceed costs

Due to the operational benefits afforded to US16 northbound/southbound right turning traffic towards the end of the Planning Horizon, it is also recommended that grading for dual right turn lanes shown in SPI 1.2 be incorporated into SPI 1.1a for an easy transition to signalized, dual right turn lanes when needed to meet operational goals for the intersection. An eastbound US16B/Catron Boulevard right turn lane, shown in SPI 1.1b, is also recommended at Healing Way to separate accelerating and slowing/turning traffic approaching the intersection.

14.2 US16 Corridor Elements

The recommended Build Option 1.1a configuration with elements incorporated from the overall US16 Corridor Study is shown in **Figure 27**. A conceptual signing plan for this configuration is presented in **Figure 28**.

US16 corridor study-specific recommendations within the US16/US16B/Catron Boulevard intersection sub-study area are as follows:

- US16 corridor design speed
    - 60 mph north of US16B/Catron Boulevard due to constraints with Promise Road
    - 65 mph south of US16B/Catron Boulevard.
- US16 corridor typical section
    - 4-Lane Divided with 40-foot Raised Median (Suburban) – Shifted East
- Section Line Road intersection location/access type
    - Shift intersection south
    - RIRO access (stop control)
    - Construct Section Line Road/US16 service road intersection improvements
    - Maintain existing US16 mainline pavement through intersection
- Promise Road intersection location/access type
    - Shift intersection north
    - Prepare for signalization (need anticipated around opening year)
    - Reconstruct US16 service road to provide 250-foot intersection spacing from US16 mainline
- Tablerock Road intersection location/access type
    - Shift intersection north to increase separation from Promise Road
    - Align with Fox Road
    - ¾ access (stop control)
- Minor road access and local network connectivity
    - Construct rearage road to connect parcels impacted by Tucker Street closure to US16/Promise Road intersection
    - Updated local network figure provided in **Figure 29**
- Bicycle and pedestrian accommodations
    - Shared-use path on east side of US16
    - Sidewalk on west side of US16

Scale in Feet
0 250 500

Legend

- Proposed Roadway
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

US16/US16B/Catron Boulevard Intersection Recommendation

Intersection Project: Single Point Interchange (SPI)

Corridor: 4-Lane Divided with 40-foot Raised Median (Suburban) - Shifted East

US16/Addison Avenue Intersection
- Close due to conflict with SPI ramps
- Maintain existing US16 service road connections to:
  - Les Hollers Way (via Energy Park Drive) and
  - Section Line Road
- Maintain existing east connection to Healing Way

US16/Promise Road Intersection
- Shift intersection north
- Prepare for signalization (need anticipated around opening year)
- Reconstruct US16 service road to provide 250-foot intersection spacing from US16 mainline

US16/Tucker Street Intersection
- Close due to conflict with SPI ramps
- Construct rearage road to Promise Road intersection

US16/Section Line Road
- Shift intersection south
- RIRO access
- Construct Section Line Road/US16 service road intersection
- Maintain existing US16 mainline pavement through intersection

NOTE:
US16 Design Speed (North of US-16B) = 60 MPH
US16 Design Speed (South of US-16B) = 65 MPH
NB Entrance Ramp Design Speed = 45 MPH
SB Ramps and NB Exit Ramp Design Speed = 50 MPH

US16/Tablerock Road Intersection
- Shift intersection north
- Align with Fox Road
- 3/4 access

US16/Wellington Drive Intersections
- West: maintain RIRO access
- East: 3/4 access
- Extend EB LT lane back to RIRO access to provide direct movement into LT lane for downstream U-turn

Catron Blvd
Les Hollers Way
Existing
Promise Road
Energy Park Dr
Promise Road
Prepare for signalization at opening
16
Section Line Road
STOP
Signalized upon opening
See Inset A
Rearage Road
Inset A
US 16 West Frontage Road
Fox Road
Addision Ave
Existing
Healing Way
Tablerock Road
Catron Blvd

Build Option:
SPI 1.1a

US Highway 16 CORRIDOR STUDY

US16/US16B/Catron Boulevard Intersection Recommended Build Option
Single Point Interchange (SPI) Build Option 1.1a

US16 Corridor Study — Rapid City, SD

Figure 27

Scale in Feet
0 250 500

Legend

- Proposed Roadway
- Depressed Median
- Raised Median
- Sidewalk
- Bridge Construction
- Remove Roadway
- Existing ROW / Property Line
- Retaining Wall
- ROW Acquisition
- Signalized Intersection
- Stop Condition Intersection

Catron Blvd
Les Hollers Way
Promise Road
Energy Park Dr
Rearage Road
Section Line Road
Addision Ave
Healing Way
Catron Blvd

Place 1 mile upstream of exit

Place 1 mile upstream of exit

See Inset A

Inset A

NOTE:
US16 Design Speed (North of US-16B) = 60 MPH
US16 Design Speed (South of US-16B) = 65 MPH
NB Entrance Ramp Design Speed = 45 MPH
SB Ramps and NB Exit Ramp Design Speed = 50 MPH

Build Option:
SPI 1.1a

US Highway 16 CORRIDOR STUDY

US16/US16B/Catron Boulevard Intersection Recommended Build Option Signing Plan
Single Point Interchange (SPI) Build Option 1.1a

US16 Corridor Study

Rapid City, SD

Figure
28

US Highway 16 CORRIDOR STUDY

Updated Local Roadway Network

US16 Corridor Study

Rapid City, SD

Figure 29

Appendix A. Methods and Assumptions Document

Appendix B. US16 Corridor Study Horizontal and Vertical Curve Review Memo

Appendix C. US16 Corridor Study Urban Area Access Report

Appendix D. 2019 Existing Conditions Traffic Operations Technical Memo

Appendix E. US16 Corridor Study Crash History Review Report

Appendix F. US16 Corridor Study Traffic Forecasts Technical Memo

Appendix G. HCM6 LOS Thresholds and HCS Limitations

Appendix H. 2026 No Build Conditions Traffic Operations Technical Memo

Appendix I. 2050 No Build Conditions Traffic Operations Technical Memo

Appendix J. US16/US16B/Catron Boulevard Intersection Purpose and Need

Appendix K. US16/US16B/Catron Boulevard Intersection Build Option Evaluation Report

Appendix L. US16/US16B/Catron Boulevard Intersection Sub-Area Build option Highway Capacity Software Analysis Report

Appendix M. US16 Traffic Simulation Results Technical Memo

Appendix N. Predictive Safety Analysis for US16/US16B/Catron Boulevard Intersection Study Area Technical Memo

Appendix O. Pedestrian and Bicycle Access Considerations Technical Memo

Appendix P. Constructability Review Report

Appendix Q. US16/US16B/Catron Boulevard Intersection Build Option Design Considerations Memo

Appendix R. Conceptual Signing Plans (Build Option Type)

Appendix S. US16/US16B/Catron Boulevard Intersection Benefit-Cost Analysis Supplemental Documentation Report

Appendix T. Public Involvement Summary Reports

Appendix U. Supporting Information for the Build Option Evaluation Matrix