

Technical Memo

Date: Tuesday, August 06, 2019

Project: US16 Corridor Study

To: Study Advisory Team

From: HDR

Subject: 2050 Traffic Forecasts

Introduction

The purpose of this technical memorandum is to document the methodology and process used to develop the 2050 traffic forecasts for the US16 Corridor Study. As part of this memorandum, the following traffic volumes sets are presented:

- 2019 Existing Conditions
- 2050 Planning Horizon No-Build Conditions

The US16 Corridor Study limits are as follows:

- US16 corridor: from just north of the Keystone Wye through the Cathedral Drive/Fairmont Boulevard intersection
- Catron Boulevard/US16 Bypass (US16B) corridor: between and including the intersections with Les Hollers Way and Wellington Drive (east)

Sources of Data

The following data was obtained for the development of the corridor study volume sets:

- Peak hour (morning and afternoon/evening) intersection turning movement counts
 - Collected by consultant team on Thursday, May 30, 2019.
 - Continuous 12-hour counts, from 7 a.m. to 7 p.m., binned in 15-minute increments.
 - Peak hour intersection turning movement volumes, peak hour factors, and heavy vehicle percentages (trucks, RVs, and lights pulling boats/campers/trailers).
- 24-hour roadway segment counts
 - Collected by SDDOT on Thursday, May 30, 2019, and through the weekend.
 - Continuous counts with individual vehicle records.
 - Daily segment volumes, heavy vehicle percentages, and speeds.

The following seasonal adjustment factors were applied to the raw traffic counts to develop a 'peak season' traffic count reflective of a June design season volume:

- May: 0.93 (when counts were collected)
- June: 0.84 (design season)



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

Table 1: Study Area Intersection Turning Movement Count Locations

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

See traffic forecast figures for map.



Table 2: US16 Segment Count Locations

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

See traffic forecast figures for map.

Traffic data collected in eastbound and westbound directions at all locations.

Traffic forecasts were based on output from the Rapid City Area Metropolitan Planning Organization (RCAMPO) travel demand model. The following model versions were used to develop forecasts for this study:

- 2013 – base year
- 2040 – planning horizon

Other sources of data that were used to support or validate forecasts include:

- Historical traffic counts provided by the SDDOT – SDDOT GIS database provided for this project
- SDDOT county-wide growth factors for Pennington County
 - 30 year: 1.690
 - 35 year: 1.805

Because of the significant development in progress or planned for the areas around the US16/US16 Bypass/Catron Boulevard intersection, there are a number of historical corridor studies and traffic impact studies (TIS) available for review. Studies found pertinent to developing forecasts for this study included the following:

- *US16/US16B/Catron Boulevard Intersection Study, 2016*
- *Sheridan Lake Road Corridor Study, ongoing (City of Rapid City)*
- *Buffalo Crossing West Traffic Impact Study, 2018 (TIS)*
- *Buffalo Crossing Traffic Impact Analysis, 3rd Edition, 2015 (TIS)*
- *Riseup Sports Complex Traffic Impact Analysis, 2017 (TIS)*
- *Traffic Impact Analysis for the Black Hills Corporation Office Complex (TIS)*

Other available studies not listed above were reviewed prior to developing study-area forecasts. Many of these studies are 5+ years old and their projected traffic volumes are no longer current, reflected in existing traffic volumes due to development, and/or incorporated into more recent studies.

Existing Volumes

2019 Existing Conditions traffic data is the basis for both an assessment of current conditions and the development of segment and intersection turning movement forecasts. Daily (24-hour) traffic volumes were developed for segments reflective of the segment count locations. Peak hour volumes were developed for both the AM (morning) and PM (afternoon or evening) peak hours.

Daily segment and peak hour turning movement counts were post-processed to develop the 2019 Existing Conditions volume data set presented in this memorandum. All existing counts were factored to a design season (June) to account for seasonal fluctuations in traffic along the corridor.

In general, the intersection peak hour volumes are reflective of the following peak hours:

- AM (morning)
 - At and North of Moon Meadows Drive: 7:15 a.m. – 8:15 a.m.
 - South of Moon Meadows Drive: 9:30 a.m. – 10:30 a.m.
- PM (afternoon/evening)
 - Corridor: 4:30 p.m. – 5:30 p.m.

Through a review of the collected traffic volumes, it was found that the AM peak hour south of Moon Meadows Drive differed from the AM peak hour north of Moon Meadows Drive. Because traffic characteristics in terms of directionality and overall magnitude of volumes differed between the two AM peak periods, it was determined that separate volume data sets be developed for each segment. For intersections north of Moon Meadows Drive, the AM peak hour reflected the early morning commute northbound towards Rapid City. For segments south of Moon Meadows Drive, the AM peak hour reflected a more directional traffic southbound towards the Black Hills area in the mid-morning timeframe. The early morning commute period through these segments exhibited a directional traffic flow northward towards Rapid City, but the overall magnitude of segment volumes were notably less than the mid-morning peak period (generally 20-30 percent less).

It is anticipated that residential development will continue southward from Rapid City in the future. Thus, AM peak hour volume sets reflective of both the early morning commute and mid-morning peak time periods were developed for the Neck Yoke Road and Sammis Trail intersections to provide overlap and capture volume characteristics and patterns of both peak periods for future the analysis.

In the PM peak period, a cohesive corridor-wide volume set was developed reflective of traffic volumes in the approximate 4:30 p.m. to 5:30 p.m. timeframe.

Forecast Methodology

This study's forecast year is 2050 and reflects the planning horizon for traffic operations analysis and conceptual design. 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.

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 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.
 - b. 2050 peak hour intersection turning movement 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 described in *NCHRP 765*.

Where there were gaps in the model's estimation of future development surrounding the US16/US16B/Catron Boulevard intersection, development-generated traffic was assigned to affected intersections 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.

Travel Demand Model Review

This section summarizes findings from a review of the RCAMPO travel demand model, future land use, traffic studies within the study area completed to date, and historical counts.



FHWA Model Requirements

The Federal Highway Administration (FHWA) requires documentation of the following items for use of the travel demand model:

- A. Assemble continuous daily, directional traffic count information for comparison with base year model information.
- B. Compare base year model estimated volumes to observed counts within the project study area.
- C. Discuss impacted travel markets where path diversion is most likely to occur.
- D. Compare model estimated and observed travel speeds on the project main line and directly impacted facilities.

These requirements will be discussed in the following sections.

Base Model Volumes vs. Observed Counts

This section summarizes a comparison of travel demand model base year 'model' volumes and observed counts from May 30, 2019. Sources of this data are as follows:

- Base year 'model' volumes: 2013 RCAMPO base year model.
- Observed volumes: Segment counts collected by the SDDOT on May 30, 2019. Volumes were adjusted to reflect average annual daily traffic (AADT) using the SDDOT-provided seasonal adjustment factor for May.

A summary of 2019 observed count and 2013 base model volumes for corresponding segments reflective of those counted by the SDDOT is shown in **Table 3**

Table 3: Base Travel Demand Model and Observed US16 Segment Count Summary

Ref #	MRM	Location	2019 Count* (vpd)	2013 Base Model Volume (vpd)	Difference (vpd)
A	55.00	2.5 miles east of US16/US16A junction (Keystone Wye)	9,482	5,409	+ 4,073
B	58.25	Between Busted Five Ln and Wilderness Canyon Rd	11,034	8,457	+ 2,577
C	63.00	South of Moon Meadows Dr.	14,403	10,849	+ 3,554
D	63.89	Between Moon Meadows Dr. and US16B/Catron Blvd	16,209	14,709	+ 1,500
E	64.00	Between Promise Rd and Tablerock Rd	12,602	9,391	+ 3,211
F	64.90	Between Tower Rd and Echo Ridge Dr.	13,955	12,810	+ 1,145

* Reflects May count adjusted to an AADT volume for comparison to travel demand model volumes.



The existing counts all show an increase in volume compared to the 2013 travel demand model volumes throughout the US16 corridor. This was expected based on two considerations:

- Timeframe: approximately six year difference between the 2013 model base year and 2019 counts.
- Historical US16 traffic counts at several locations within the corridor show notable increases in traffic volumes from 2012 and 2013.

To account for these differences, *NCHRP 765* provides methodology for adjusting the travel demand model output based on observed counts. This post-processing procedure compares the base model volumes and observed traffic counts through five different adjustment methodologies. The selected adjustment is based on set criteria that compares the adjusted volumes back to the base year model volume.

Table 4 presents a summary of 2019 observed counts, 2013 base model volumes, 2040 planning horizon model volumes, and the resulting 2050 Planning Horizon daily traffic volume for a June design season for the six segments where volumes were collected by the SDDOT.

Table 4: US16 Corridor 2050 Planning Horizon Design Season Forecasts

Ref #	MRM	Location	2019 Count* (vpd)	2013 Base Model Volume (vpd)	2040 Planning Horizon Model Volume (vpd)	2050 Adjusted Design Season Volume** (vpd)
A	55.00	2.5 miles east of US16/US16A junction (Keystone Wye)	9,482	5,409	8,940	15,341
B	58.25	Between Busted Five Ln and Wilderness Canyon Rd	11,034	8,457	11,800	17,065
C	63.00	South of Moon Meadows Dr.	14,403	10,849	15,706	22,723
D	63.89	Between Moon Meadows Dr. and US16B/Catron Blvd	16,209	14,709	22,337	28,622
E	64.00	Between Promise Rd and Tablerock Rd	12,602	9,391	17,972	24,854
F	64.90	Between Tower Rd and Echo Ridge Dr.	13,955	12,810	25,586	28,907

* Reflects May count adjusted to an AADT volume for comparison to travel demand model volumes.

** 2050 Planning Horizon Volume adjusted to the June Design Season.

Impacted Travel Markets

There are several alternative routes to travel north/south (or east/west) between Rapid City and the Black Hills area. However, the US16 corridor provides the quickest, most direct route between Rapid City and central hills communities and tourist attractions.

The following alternative routes wind through the Black Hills west of Rapid City and would result in notably longer travel times:

- Sheridan Lake Road – 2-lane local roadway that parallels US16 to the north
- SD44 – east/west 2-lane State highway nearly 10 miles north of US16 that heads west out of Rapid City and connects to US385
- Rockerville Road – 2-lane local roadway between Neck Yoke Road and SD40

SD79 to SD40, through Hermosa, also provides an alternate route to US16, but requires notable out-of-the-way travel.

It can be concluded that there would be minimal path diversion due to constraints on US16. All other routes are 2-lane highways, many of them local, that wind through the Black Hills at low speeds and result in notably longer travel times. The US16 corridor is a primary thoroughfare linking Rapid City and the Black Hills areas south of Rapid City and SD44.

Locally to the US16 corridor, many of the intersecting roadways branch off of US16, with US16 being their only access into/out of the development. Path diversion is not an option to these motorists.

The primary local diversion to be considered in the development of traffic forecasts is between the Catron Boulevard, Les Hollers Way, and Moon Meadows Drive roadways. A potential future extension of Les Hollers Way to Sheridan Lake Road and a project at the Sheridan Lake Road/Catron Boulevard intersection provides a notable increase in capacity for east/west traffic between Sheridan Lake Road and US16. This additional capacity also has the potential to attract future-year traffic away from Moon Meadows Drive that was diverted away from Catron Boulevard due to congestion. This is discussed further in a subsequent section.

Observed Travel Speeds

A review of travel speeds was conducted as part of the 2019 Existing Conditions traffic operations analysis. Free flow speeds were determined using SDDOT-collected segment count data and Highway Capacity Manual methodologies. It was found that observed travel speeds were in line with or slightly higher than the posted speed limits, which were coded into the RCAMPO travel demand model.

Recent and Future Development

A number of traffic studies have been conducted around the US16/US16B/Catron Boulevard intersection over the last ten years, many of which focus on the significant planned future development in the area. Many of these studies have used different assumptions, model years, and land use plans. Thus, there are notable discrepancies in magnitude of traffic volumes and subsequent traffic patterns throughout the study area.

To supplement the travel demand model-driven traffic forecasts described in the Forecast Methodology section, this study used the most recent, larger TISs and US16/US16B/Catron

Boulevard intersection study as supporting information for estimating development traffic and traffic patterns.

The most recent SDDOT-led study of US16 through the US16/US16B/Catron Boulevard intersection was the US16/US16B/Catron Boulevard Intersection Study completed in 2016. It should be noted, only limited site-generated traffic from planned development surrounding the US16/US16B/Catron Boulevard intersection was included in that study's forecast at the following intersections:

- US16 intersections with: Moon Meadows Drive and Addison Avenue
- Catron Boulevard intersection with: Les Hollers Way
- US16B/Catron Boulevard intersection with: Healing Way

Buffalo Crossing TISs (2015 *Buffalo Crossing TIS, 3rd Edition*, and 2018 *Buffalo Crossing West TIS*) provide more estimates for site-generated traffic in the southeast and northwest quadrants of the intersection. Generally, TISs assume 100 percent build-out of the proposed development by the planning horizon and provide a long-range estimate of site-generated traffic assuming 100 percent build-out of the proposed development. When assigning traffic to access points surrounding these developing areas for this study, it was assumed that approximately 70 to 85 percent of the TISs' ultimate build-out conditions would come to fruition within this study's planning horizon.

The *Buffalo Crossing West TIS, 2018*, was the primary source for site-generated traffic around the US16/US16B/Catron Boulevard intersection as it encompasses and updates findings from previous TISs throughout the area (including the *Buffalo Crossing TIS, 3rd Edition*, in 2015 and the *Traffic Impact Analysis for the Black Hills Corporation Office Complex*).

Traffic was assigned to the study area based on the current roadway and intersection configurations. Traffic affected by proposed access modifications as part of this study, or carried forward from previous studies, will be redistributed in a Build conditions volume set. Daily model volumes presented in **Table 4** were further adjusted to account for this development traffic assignment and maintain similar peak hour to daily volume percentages (often referred to as a K value, the percentage of the daily volume occurring in a peak hour).

Les Hollers Way Extension

As part of the analysis for the City of Rapid City's Sheridan Lake Road corridor study, it was found that the Sheridan Lake Road and Catron Boulevard intersection limited capacity along the Catron Boulevard corridor extending west from US16. Thus, this corridor was not serving the area's future-year east/west demand between Sheridan Lake Road and US16.

A supplemental travel demand model run was developed by the RCAMPO to analyze the impact of a Les Hollers Way extension to Sheridan Lake Road as part of the Sheridan Lake Road corridor study. It was found that the combination of an improved Catron Boulevard and new Les Hollers Way extension attracted nearly 40 percent more model volume in the year 2040 supplemental model run. The effect of the Les Hollers Way extension on surrounding

roadways was as follows (increase or decrease in 2040 supplemental model run volumes compared to 2040 base model):

- US16 north of US16B/Catron Boulevard: increase in model volumes
- US16B/Catron Boulevard east of US16: increase in model volumes
- US16 south of US16B/Catron Boulevard: decrease in model volumes

Based on these findings, the 2050 forecast growth factors and subsequent traffic patterns in the proximity of the US16/US16B/Catron Boulevard and Moon Meadows Drive intersections account for the Les Hollers Way extension.

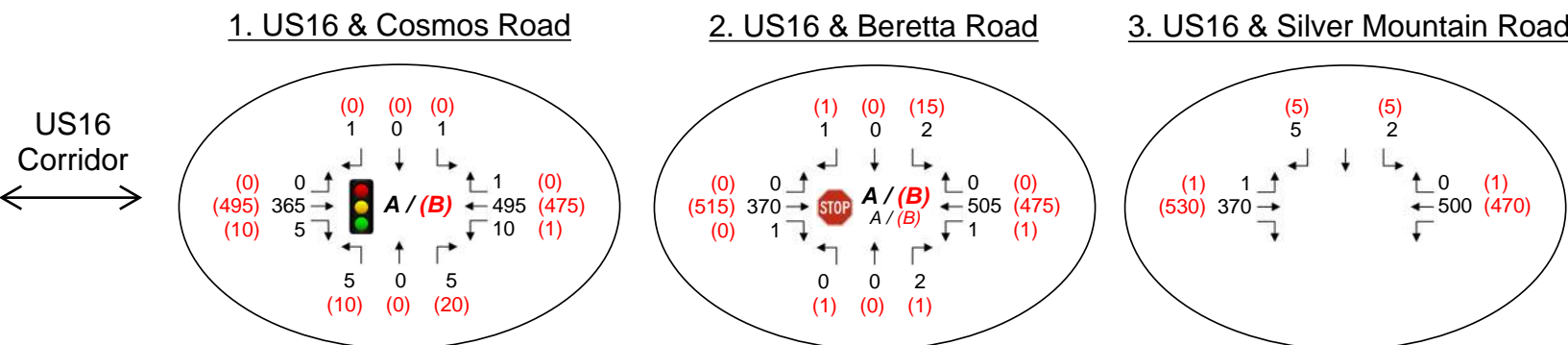
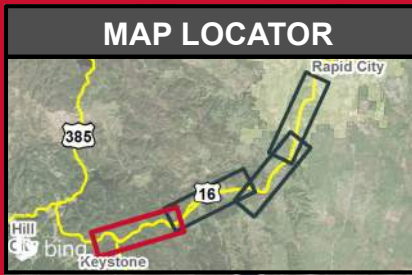
Traffic Volumes

Traffic volumes are summarized in the following figures:

- **Figure 1: 2019 Existing Conditions Traffic Volumes**
- **Figure 2: 2050 Planning Horizon Traffic Volumes (No-Build Conditions)**

The resulting growth factors between the balanced 2019 Existing Conditions and 2050 Planning Horizon No-Build Conditions traffic volume sets range from approximately 1.75 to 2.1 along the US16 corridor. North of and including the intersection of US16 and Moon Meadows Drive, growth factors were typically between 1.85 and 1.95. South of Moon Meadows Drive, growth is projected to be slightly less and typical intersection growth factors ranged between 1.75 and 1.85.

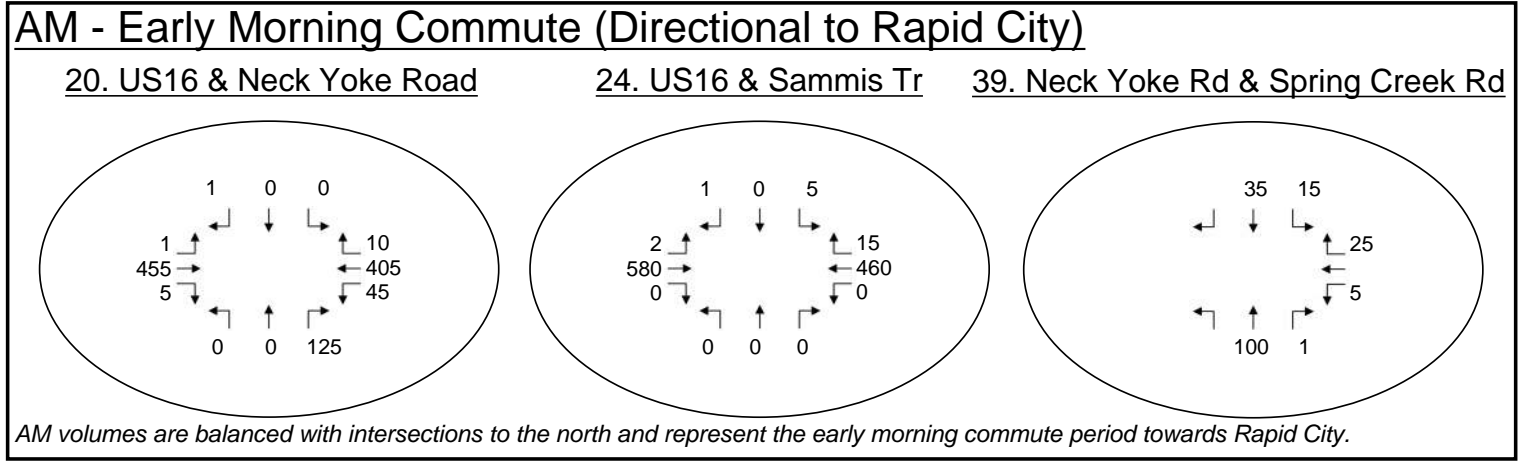
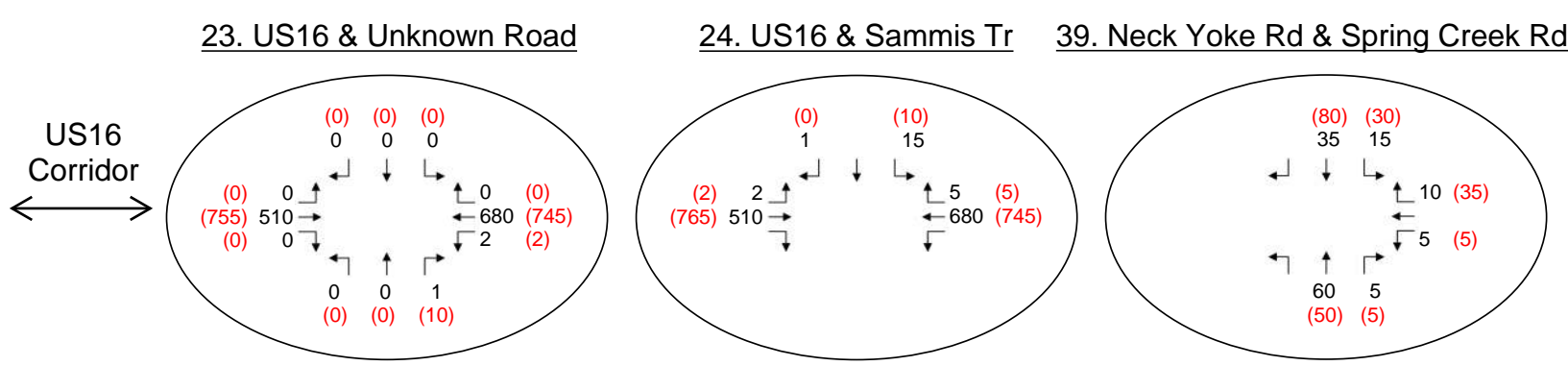
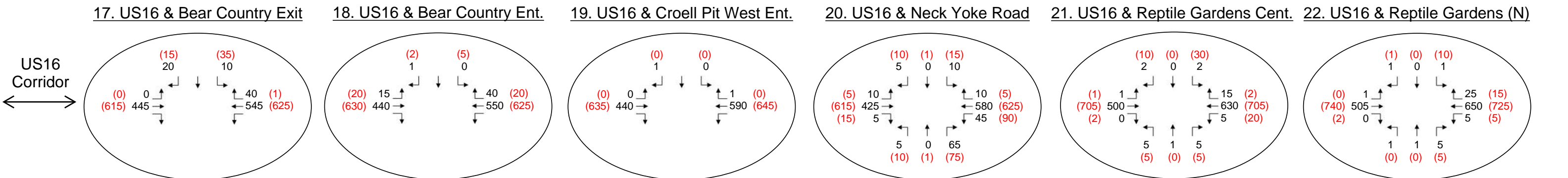
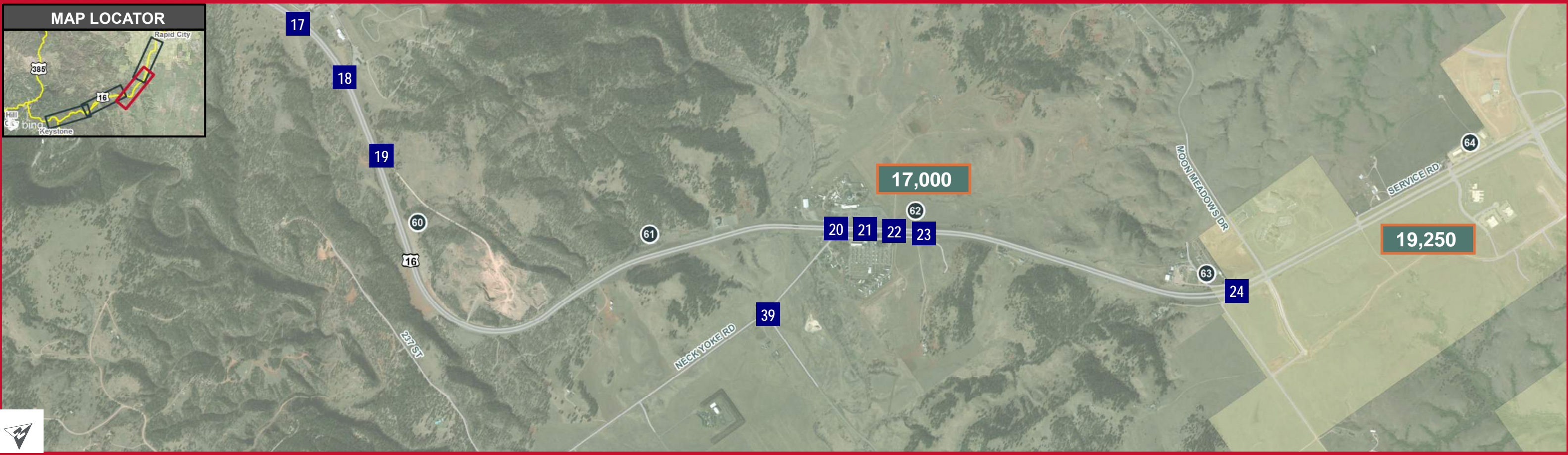
Growth factors towards the upper end of the range were located at intersections providing access to/from future development, such as the Catron Boulevard/Les Hollers Way, US16B/Catron Boulevard/Healing Way, and US16/Moon Meadows Drive intersections. The Catron Boulevard/Les Hollers Way volume growth is also affected by the potential Les Hollers Way extension to Sheridan Lake Road.



Legend

- Mileage Reference Marker (MRM)
- Study Intersection
- 2019 Daily Traffic Volumes*
- 2019 Peak Hour Traffic Volumes*
- A / (B)** Signalized Intersection
- A / (B)** Two-way Stop Control Intersection
- A / (B)** Overall Intersection
- A / (B)** Worst-case Stop-Controlled Approach

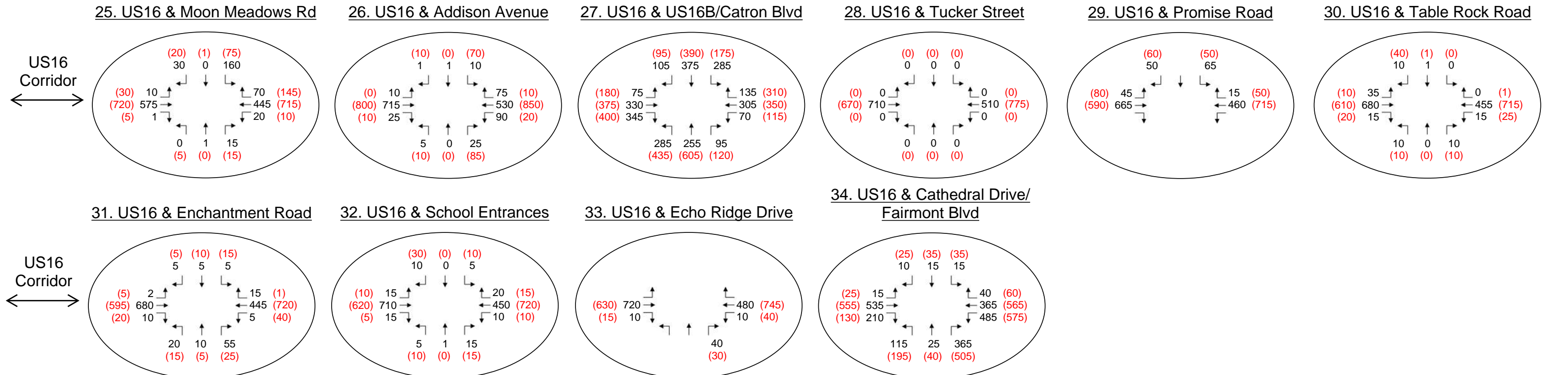
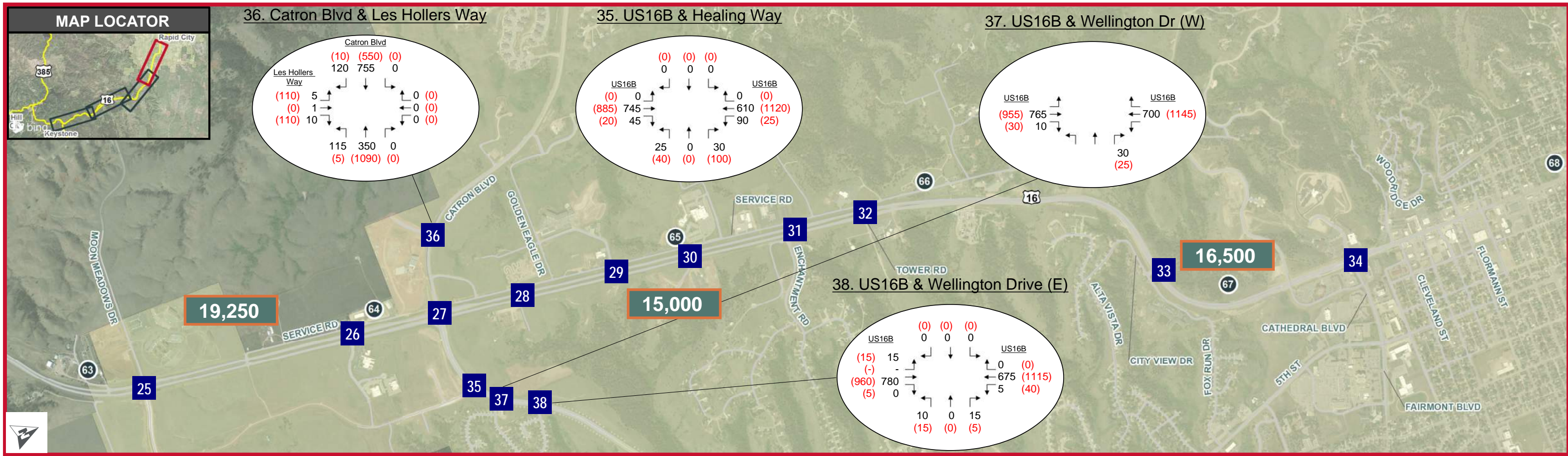
Notes:
 * Volumes reflect June design season
 Stop-controlled intersections are two-way stop-control unless noted.

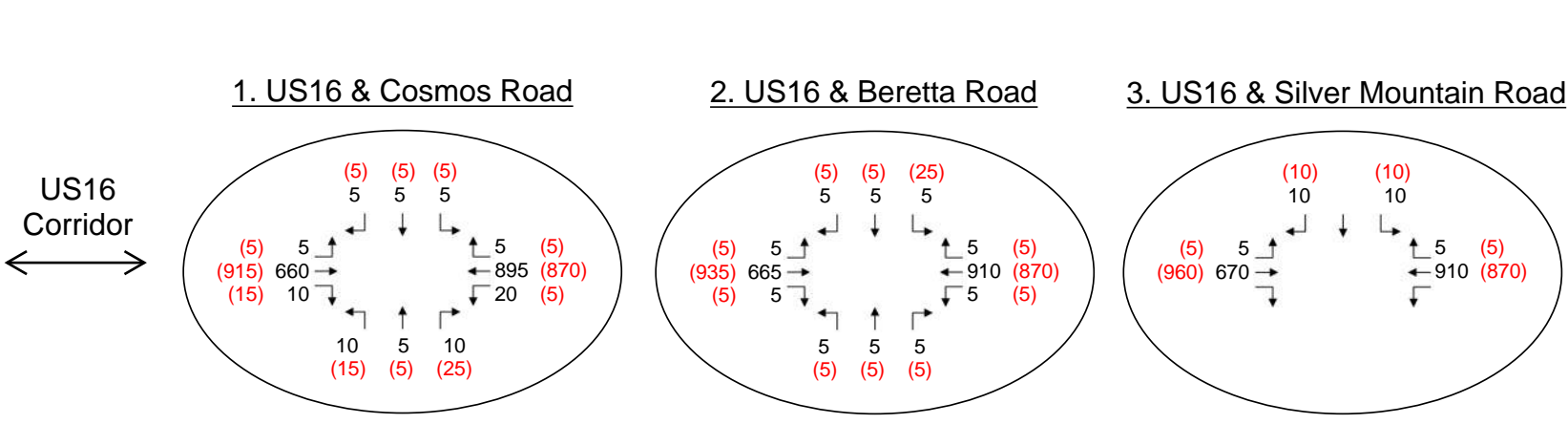


2019 EXISTING CONDITIONS TRAFFIC VOLUMES AND LEVEL OF SERVICE

US16 CORRIDOR STUDY



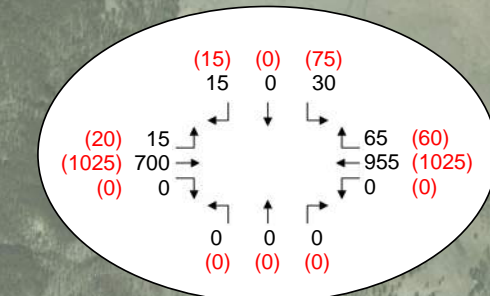
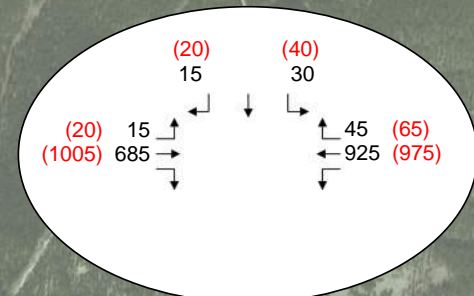
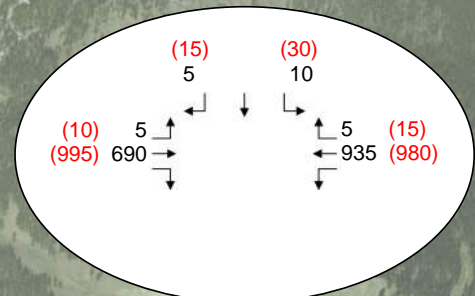
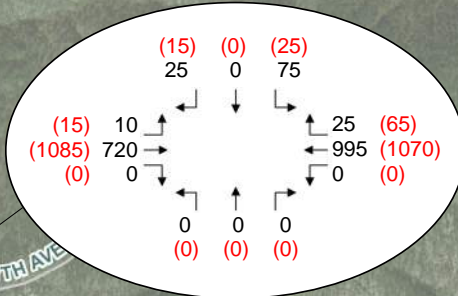
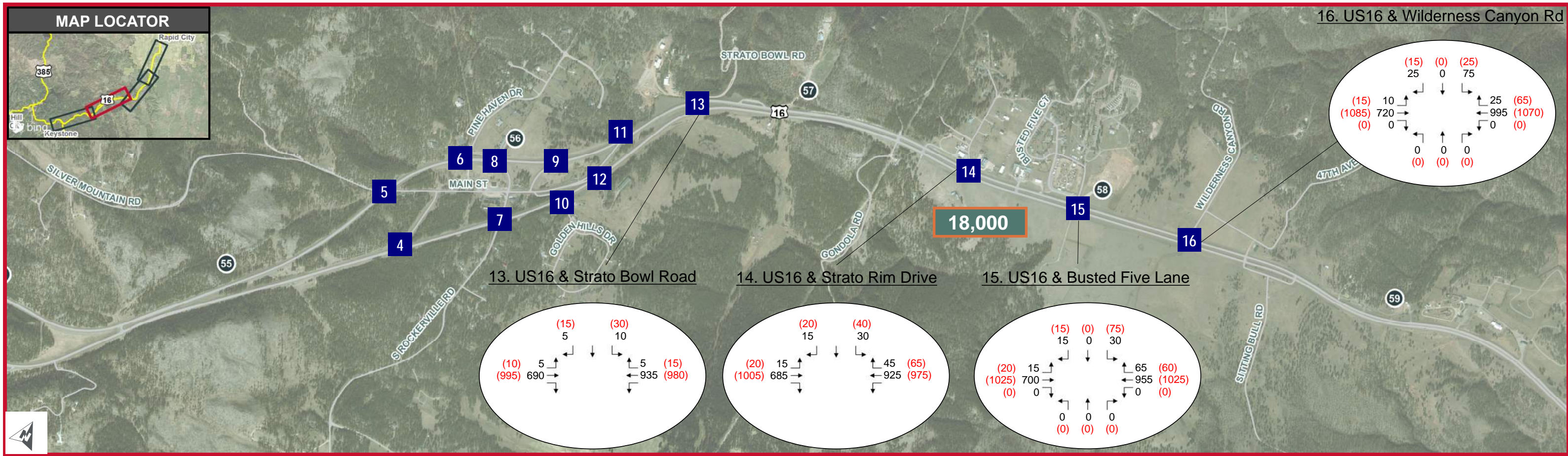




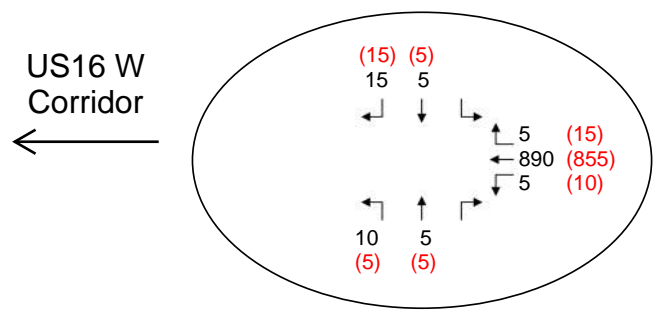
Legend

- Mileage Reference Marker (MRM)
- Study Intersection
- 2050 Daily Traffic Volumes*
- AM (PM) 2050 Peak Hour Traffic Volumes*

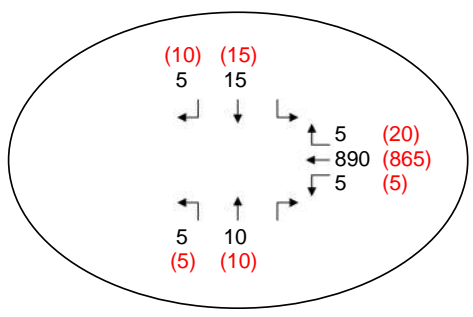
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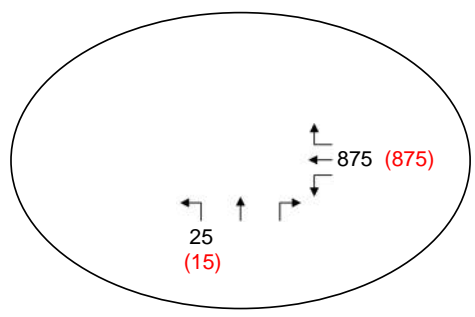
5. US16 W & Silver Mountain Rd



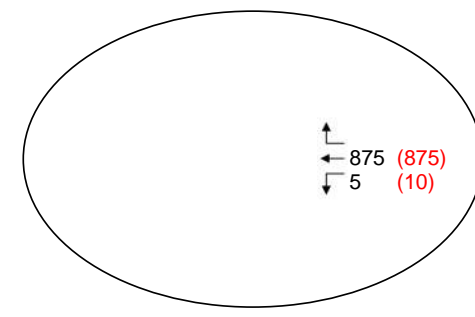
6. US16 W & Pine Haven Drive



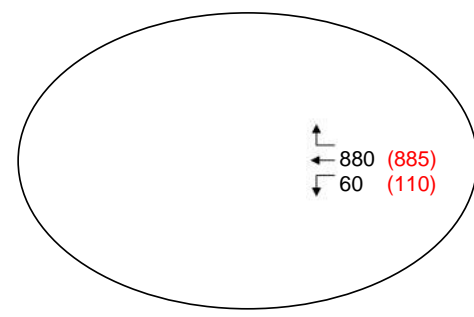
8. US16 W & 16 W2 55.67



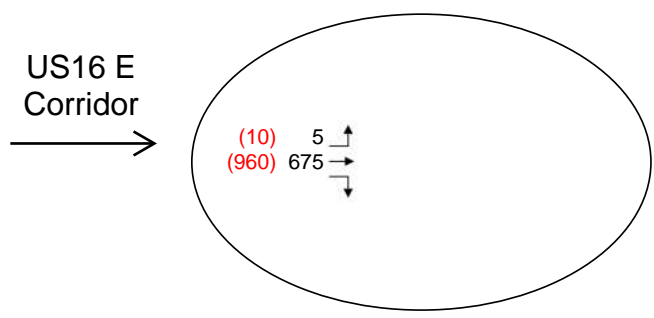
9. US16 W & 16 W1 56.16



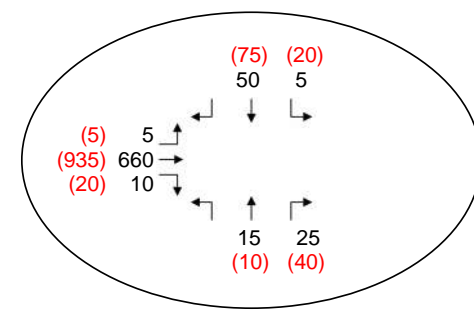
11. US16 W & Main Street



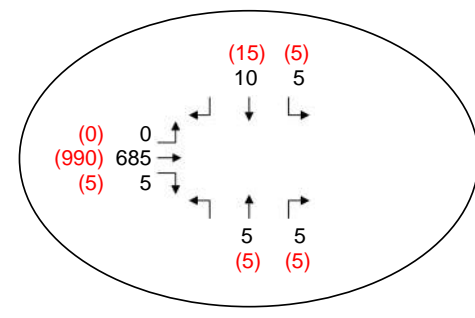
4. US16 E & 16 E1 55.42



7. US16 E & Rockerville Road



10. US16 E & Golden Hills Dr



12. US16 E & 16 E2 56.09

