Attachment C

Traffic and Safety Technical Report

April 2020

I-25 Central PEL

Table of Contents

List of Figures

List of Tables

List of Appendixes

List of Acronyms and Abbreviations

AADT	Average Annual Daily Traffic
AT	All Types
CD	Collector/distributor
CDOT	Colorado Department of Transportation
CMF	Crash Modification Factor
Denver	City and County of Denver
DRCOG	Denver Regional Council of Governments
ELMP	Express Lanes Master Plan
EIS	Environmental Impact Statement
FHWA	Federal Highway Administration
FI	Fatal/Injury
HSM	Highway Safety Manual
HPTE	High-Performance Transportation Enterprise
I-25	Interstate 25
I-270	Interstate 270
I-70	Interstate 70
MV	Multiple Vehicle
PDO	Property Damage Only
PEL	Planning and Environmental Linkages
SPF	Safety Performance Function
SV	Single Vehicle
TDM	Travel Demand Model
US 36	U.S. Highway 36
US 6	U.S. Highway 6
US 85	U.S. Highway 85
VHT	Vehicle Hours Traveled
VMT	Vehicle Miles Traveled

1. Introduction

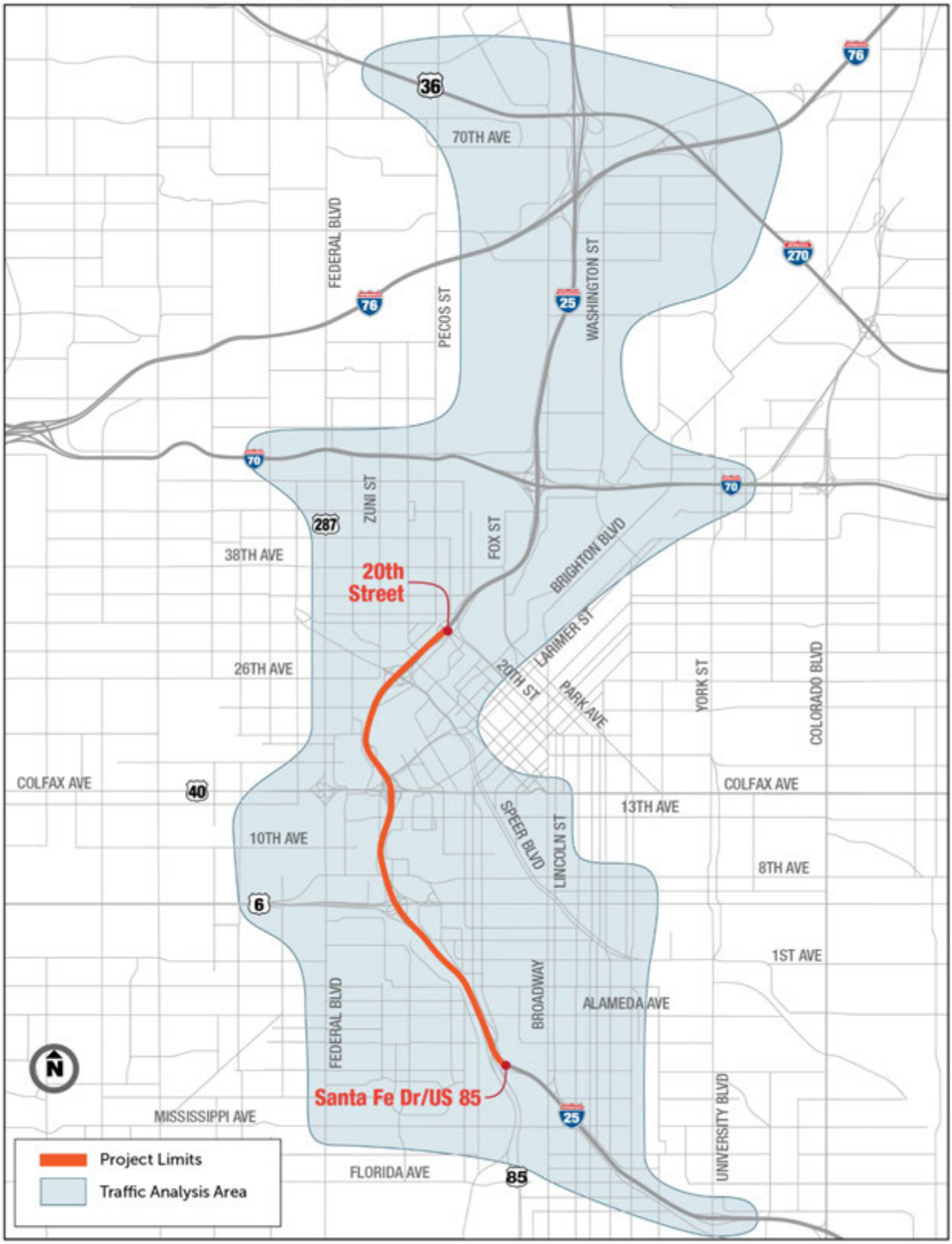
The purpose of this memorandum is to document the traffic and safety evaluation process and outcomes for the Interstate 25 (I-25) Central Planning and Environmental Linkages (PEL) Study. This memorandum presents the outcomes of the Level 3 alternatives analysis process and builds from the data, discussion, and conclusions of previous traffic and safety documentation for the I-25 Central PEL. Data and analysis presented in previous I-25 Central PEL documents will be provided/referenced within this memorandum only as needed. Previous I-25 Central PEL traffic documents are listed below and can be found in Attachment A, Existing Conditions Assessment Report, of the I-25 Central PEL Study Report.

- Central 25 PEL Traffic Data Collection and Modeling Methodology Memorandum (October 2017)
- I-25 Central Traffic Data Collection Technical Memorandum (February 2018)
- I-25 Central Traffic Safety Technical Memorandum (July 2018)
- I-25 Central Traffic Forecasting Technical Memorandum (November 2018)
- I-25 Central Origin-Destination Analysis Technical Memorandum (November 2018)
- I-25 Central Microscopic Traffic Model Calibration Results Technical Memorandum (May 2019)

1.1. Traffic Analysis Area

The project limits for the I-25 Central PEL study encompass I-25 from Santa Fe Drive/U.S. Highway 85 (US 85) to 20th Street in Denver, Colorado. Due to the highly congested nature of this corridor, drivers often choose parallel routes on the local roadway network to avoid congestion on the freeway. To capture this behavior, the area modeled in the traffic analysis microsimulation model was expanded to include parallel facilities that provide the most commonly used alternate routes when I-25 is congested. The final microsimulation model includes the roadway network generally bounded by Federal Boulevard to the west, U.S. Highway 36 (US 36) and Interstate 270 (I-270) to the north, Washington Street/Speer Boulevard/Downing Street/University Boulevard to the east, and Mississippi Avenue to the south. Figure 1 shows the project limits and the traffic analysis area.

Figure 1: Traffic Analysis Area



1.2. Traffic Analysis Methodology

The traffic analysis for the I-25 Central PEL was conducted using a combination of travel demand modeling and microsimulation traffic analysis. Travel demand modeling was completed using the Denver Regional Council of Government (DRCOG) regional travel demand model (TDM), also known as FOCUS. This model was calibrated to the existing conditions of the I-25 Central PEL traffic analysis area and used to forecast future travel demand for the PEL's planning horizon year of 2040. Additional information about the TDM calibration and forecasting methodology and results can be found in the *I-25 Central Traffic Forecasting Technical Memorandum* (November 2018), which is included in Attachment A, *Existing Conditions Assessment Report*, of the I-25 Central PEL Study Report.

Using the outputs from the TDM, a microsimulation traffic model was created using TransModeler Version 5 software. This microsimulation traffic model was calibrated to the existing year (2017) traffic conditions and then used to model future conditions. Additional information about the creation and calibration of the microsimulation model can be found in the *I-25 Central Microscopic Traffic Model Calibration Results Technical Memorandum* (May 2019), which is included in Attachment A, *Existing Conditions Assessment Report*, of the I-25 Central PEL Study Report.

1.3. Safety Analysis Methodology

The safety analysis for the I-25 Central PEL was conducted using the Federal Highway Administration (FHWA) *Highway Safety Manual* (HSM) methodology. More information about this methodology and the inputs used to determine the baseline/existing conditions is available in the *I-25 Central Traffic Safety Technical Memorandum* (July 2018), which is included in Attachment A, *Existing Conditions Assessment Report*, of the I-25 Central PEL Study Report.

1.4. Organization of the Technical Report

The remainder of this technical report is organized into the following chapters:

- Overview of the alternatives analyzed
- Comparison of traffic operational changes between the 2017 Existing Conditions and 2030 No Action Alternative
- Comparison of traffic operational changes between the 2030 No Action Alternative and the build alternatives (Bring the Corridor to Standard Alternative, Collector/Distributor Roads and Braided Ramps Alternative, and Managed Lanes Alternative)
- Safety results

2. Overview of Alternatives Analyzed

Through the I-25 Central PEL Study, numerous concepts to improve traffic operations were considered and evaluated through a multi-stepped evaluation process. This process resulted in the identification of standalone alternatives that then were analyzed using the microsimulation traffic model. These alternatives, which are further discussed throughout this technical report, include:

- No Action Alternative
- Bring the Corridor to Standard Alternative
- Collector/Distributor Roads and Braided Ramps Alternative
- Managed Lanes Alternative

From a traffic operations perspective, the alternatives were developed/informed by the identified issues observed on the corridor in the existing conditions analysis. A major component in the identification of the existing issues was the use of origin-destination data. This data identified the portion of vehicles entering and exiting at each ramp within the I-25 Central corridor to help inform the layout of improvements, such as CD roads and braided ramps. Information about the origin-destination information that was used to identify traffic patterns in the existing corridor is documented in *I-25 Central Origin-Destination Analysis Technical Memorandum* (November 2018) in Attachment A, *Existing Conditions Assessment Report*, of the I-25 Central PEL Study Report. Details about other information, beyond traffic, used to identify these standalone alternatives is provided in Attachment B, *Alternatives Evaluation Technical Report*, of the I-25 Central PEL Study Report.

2.1. Core Concepts of Each Alternative

The four alternatives were evaluated through the detailed traffic and safety analysis because they represent a range of different options to improve traffic and safety operations of I-25. The core concept behind each alternative is discussed below. Detailed descriptions of each alternative are provided in Attachment B, *Alternatives Evaluation Technical Report,* of the I-25 Central PEL Study Report.

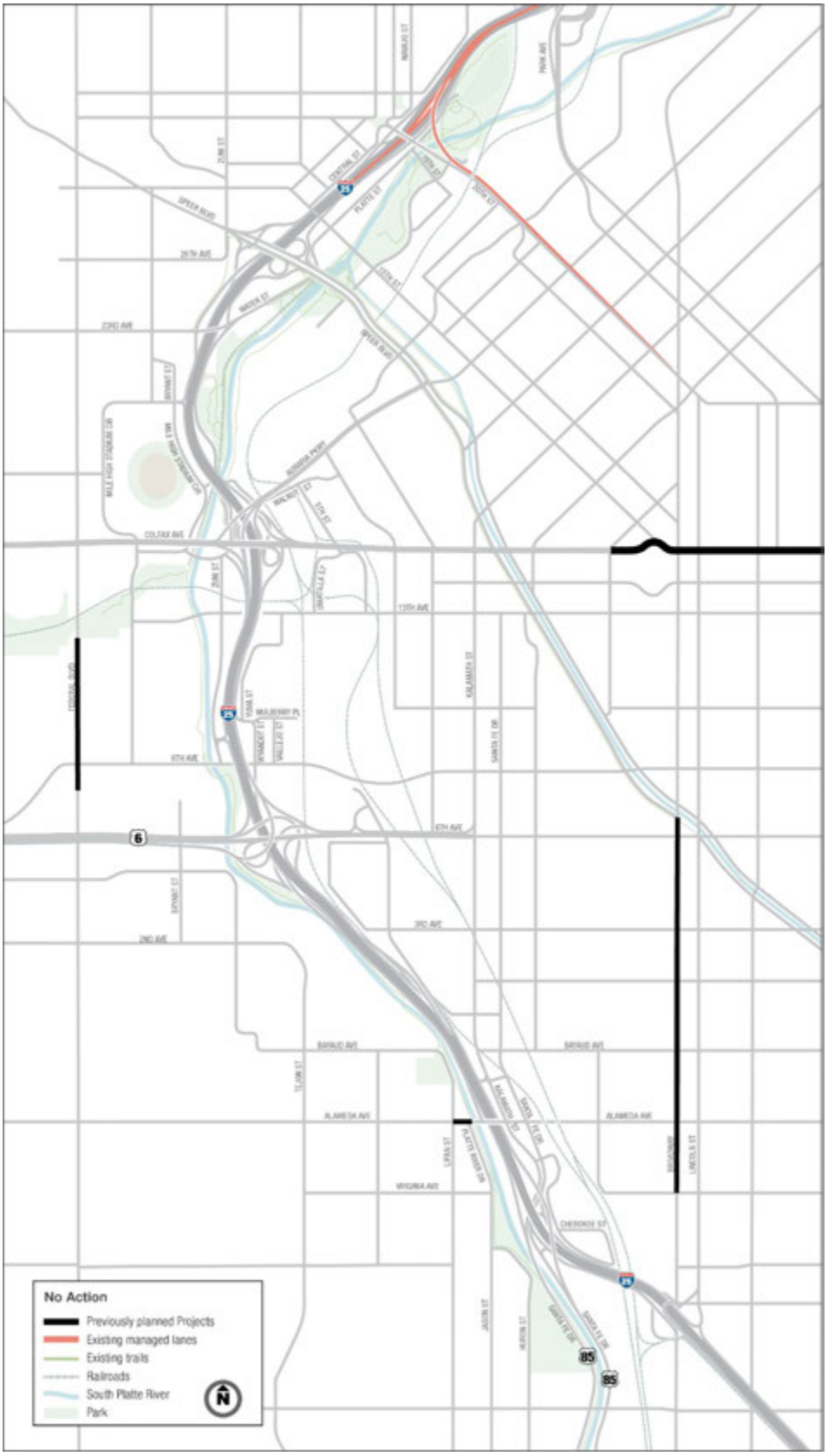
2.1.1. No Action Alternative

The No Action Alternative represents what would happen if no improvements were made to I-25 Central. This alternative represents the baseline conditions against which the other alternatives are compared. Note that the No Action Alternative evaluated and discussed in the I-25 Central PEL excludes previously planned future improvements that are scheduled to be implemented on the corridor from the Preferred Alternative described in the Valley Highway Environmental Impact Statement (EIS), which was finalized in 2006. A detailed discussion explaining this decision is provided in Attachment B, *Alternatives Evaluation Technical Report*, of the I-25 Central PEL Study Report. Figure 2 provides an overview of the layout of the No Action Alternative.

While the No Action Alternative excludes the yet to be completed Valley Highway EIS improvements, it does include the following improvements from the Fiscally Constrained Regional Transportation Plan:

- **Colfax Bus Rapid Transit:** Remove one eastbound general-purpose travel lane on East Colfax Avenue between Glenarm Place and the eastern edge (approximately Grant Street) of the I-25 Central traffic model and remove one westbound general-purpose travel lane on East Colfax Avenue between the eastern edge of the I-25 Central traffic model and 15th Street to allow for the implementation of exclusive, center-running transit lanes. Retime affected signals on Colfax Avenue to have protected left turns across the transit lanes. In all cases, maintain the existing signal cycle lengths and offsets.
- **Broadway Multi-Modal Corridor Improvements:** Remove one vehicle travel lane from Broadway between Cherry Creek and Virginia Avenue to accommodate a two-way protected bicycle track on the east side of the street. In addition to removing the travel lane, retime signals along Broadway to implement protected left turns across the bicycle track. Base signal timing assumptions and the geometric configuration of the revised roadway on the existing two-way protected bicycle track pilot currently implemented on Broadway between Bayaud Avenue and Virginia Avenue. In all cases, maintain the existing signal cycle lengths and offsets.
- **Broadway & I-25 Interchange:** Reconfigure the Broadway and I-25 interchange to implement a “wedge-ramp” design. Optimize traffic signals at the ramp terminals based on the new interchange configuration.

Figure 2: No Action Alternative Overview Map



- **Federal Boulevard:** Add one general-purpose travel lane in each direction between 7th Avenue and Holden Place.
- **Alameda Avenue:** Remove the traffic signal at Alameda Avenue and South Platte River Drive. Remove the north leg of South Platte River Drive. Convert the south leg of the intersection into a right-in/right-out configuration. Implement intersection improvements at Alameda Avenue and Lipan Street to accommodate additional northbound and southbound turn lanes. This is part of the Phase 2 improvements identified in the Valley Highway EIS.
- **Central 70:** Reconfigure Interstate 70 (I-70) east of I-25 to match the new configuration of the Central 70 project. Add one managed lane in each direction east of I-25 and modify interchanges along I-70 at Washington Street and Brighton Boulevard.
- **I-270:** Add one additional general-purpose travel lane in each direction east of I-25.
- **Washington Street:** Add one additional general-purpose travel lane in each direction between 47th Avenue and 58th Avenue.

In addition to the improvements identified in the Fiscally Constrained Regional Transportation Plan, some additional modifications were made to the No Action Alternative model based on existing management practices and future needs. These included:

- Additional Ramp Meters: Based on current Colorado Department of Transportation (CDOT) management policies, ramp meters are being added to all on-ramp facilities from local roadways where feasible. Based on this policy, on-ramp meters were added to on-ramps within the I-25 Central corridor at the following locations:
    - 8th Avenue to northbound I-25
    - Eastbound Speer Boulevard to northbound I-25
    - Eastbound Colfax Avenue to southbound I-25
    - Westbound Colfax Avenue to southbound I-25
    - Auraria Parkway to southbound I-25
    - Lower Colfax Avenue to southbound I-25
    - 8th Avenue to southbound I-25

  These ramp meters were timed to be consistent with the existing ramp meters already in place on I-25 Central. As needed, these timings were further refined to ensure that they did not result in extensive ramp spillback queues onto the local roadway network.
- Intersection Modifications: Due to the increasing travel demand between the existing conditions and the 2030 No Action Alternative, some intersections were modified to better accommodate future traffic volumes. These modifications included optimizing lane assignments, optimizing signal timings, and, if necessary, adding protected left-turn phases. In all cases, an effort was made to minimize the number of these types of changes within the model to maintain as much consistency between the existing conditions and the No Action Alternative models as possible. To this end, the following assumptions were used to guide any of these minor modifications:
    - When optimizing lane assignments at intersections—such as converting a through/right lane into a dedicated right-turn only lane—no new lanes of traffic were added, including no new turn storage bays.
    - When modifying signal timings or adding in new protected left-turn phases, all existing signal parameters were maintained, including the cycle length, minimum green time, yellow time, all red time, and minimum pedestrian crossing times.

2.1.2. Bring the Corridor to Standard Alternative

As described in the I-25 Central Roadway Geometric Technical Memorandum (July 2018)—which is included in Attachment A, Existing Conditions Assessment Report, of the I-25 Central PEL Study Report—much of the existing I-25 corridor has substandard infrastructure, including shoulder widths, sharpness of curves, and ramp spacing. The Bring the Corridor to Standard Alternative was created to determine the benefits and impacts of bringing the highway up to current engineering design standards. Major improvements provided in this alternative are listed below and shown in Figure 3 and Figure 4.

- All improvements included in the No Action Alternative
- Full-width (10-foot) inside and outside shoulders throughout the corridor
- Standard-width travel lanes (12-foot) from Santa Fe Drive/US 85 to U.S. Highway 6 (US 6)/6th Avenue
- Improved acceleration and deceleration lanes added to:
    - Northbound
        - Alameda Avenue on-ramp to northbound I-25
        - US 6/6th Avenue on-ramp to northbound I-25
        - Northbound I-25 off-ramp to Colfax Avenue
        - Northbound I-25 off-ramp to Speer Boulevard
    - Southbound
        - Speer Boulevard on-ramp to southbound I-25
        - 23rd Avenue on-ramp to southbound I-25
- Reduced sharpness of curves throughout the corridor
- Increased space between interstate access locations to meet ramp spacing requirements. This was achieved by closing the 8th Avenue and 17th Avenue interchanges. Additional information about access closures and how they were identified is provided in Section 2.2 of this Technical Memorandum.
- A southbound collector/distributor (CD) road from 20th Street to Speer Boulevard

The purpose of this alternative was to identify the benefits of addressing the identified geometric deficiencies on I-25. Therefore, improvements included in this alternative are limited to those that address an identified geometric deficiency. For example, there are some locations that meet current engineering design standards but are known to cause operational concerns, such as the minimal weaving distance between the westbound Speer Boulevard on-ramp to northbound I-25 and the northbound I-25 off-ramp to 20th Street. Because this weave distance meets existing standards, it was not changed as part of this alternative.

Figure 3: Bring the Corridor to Standard Alternative Overview Map

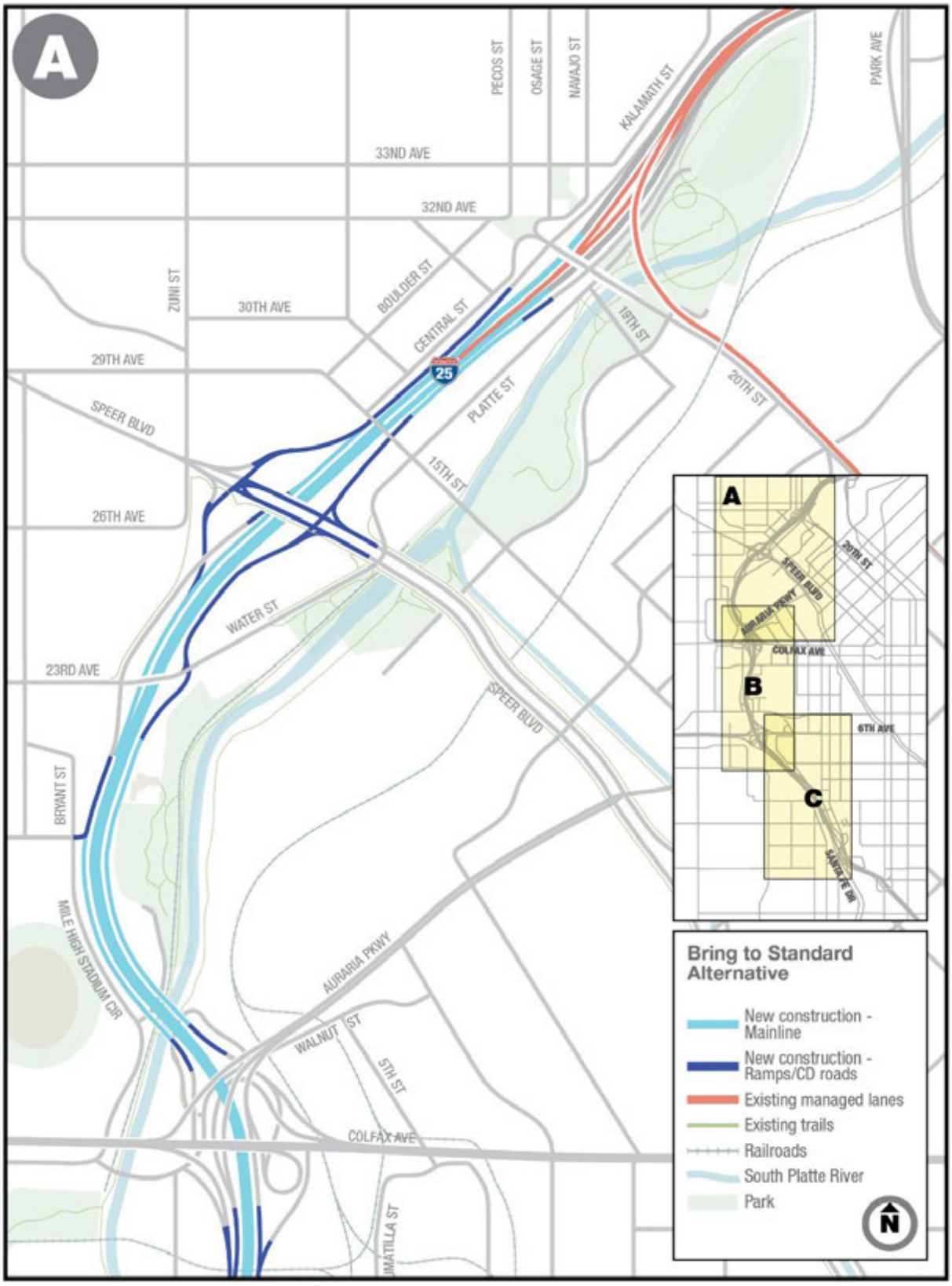
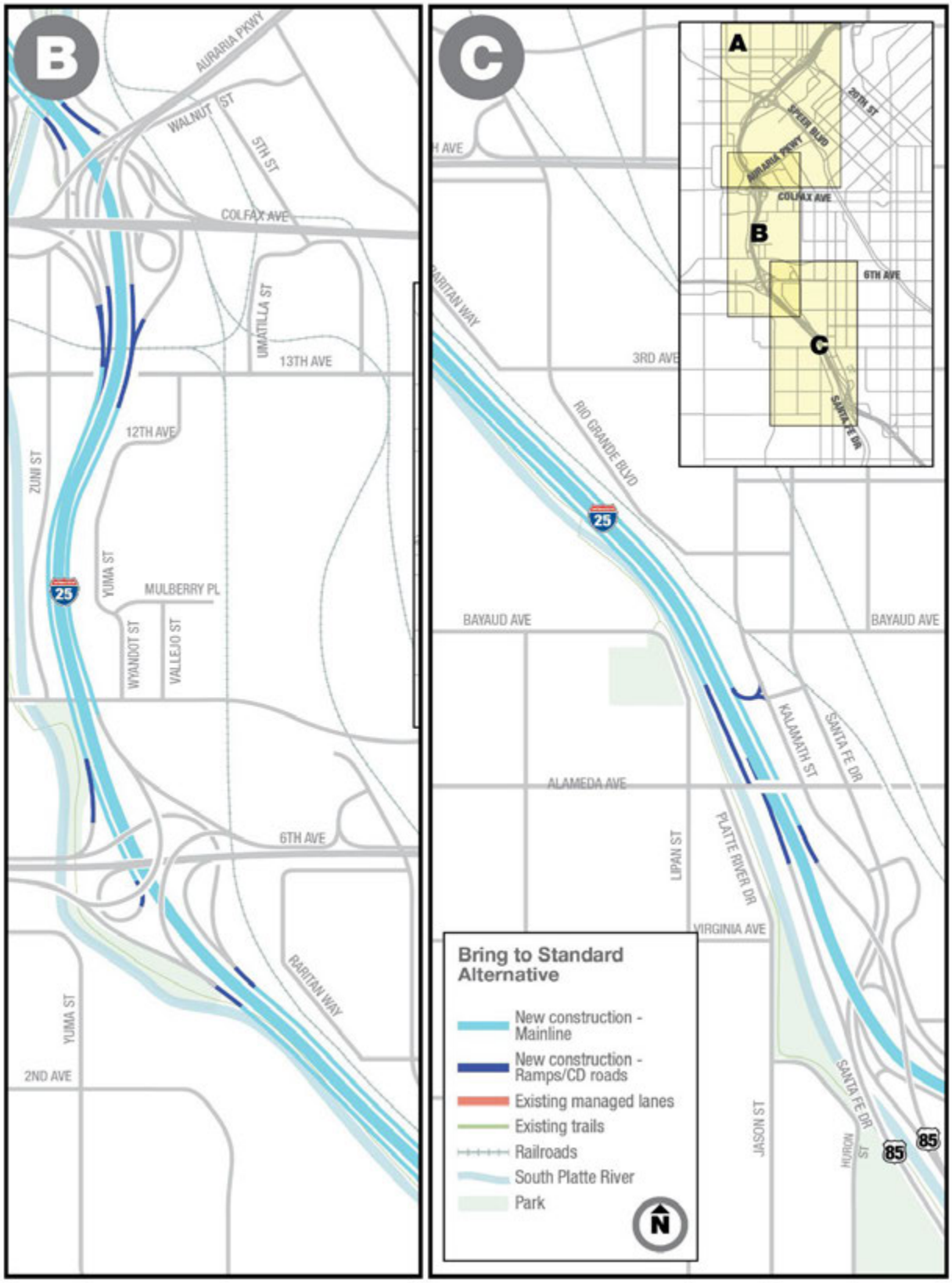


Figure 4: Bring the Corridor to Standard Alternative Overview Map (Continued)



2.1.3. Collector/Distributor Roads and Braided Ramps Alternative

Through the study area, I-25 has numerous closely spaced ramps. Many of these ramps have high traffic volumes that create congestion and safety issues throughout the corridor. The Collector/Distributor Roads and Braided Ramps Alternative was created to eliminate merging, diverging, and weaving movements in the corridor to improve the safety and operations of I-25. Braided ramps and CD roads were identified by isolating high-demand lane-changing locations to prioritize where braids or CD roads might be beneficial. Major improvements included in this alternative are listed below and shown in Figure 5 and Figure 6.

- All improvements included in the No Action Alternative
- All geometric improvements provided in the Bring the Corridor to Standard Alternative. This does not include the access changes from the Bring the Corridor to Standard Alternative. Access modifications in the Collector/Distributor Roads and Braided Ramps Alternative are handled through the implementation of CD roads and braided ramps. Additional discussion about access provided in this alternative can be found in Section 2.2 of this Technical Report.
- CD roads
    - Northbound
        - Santa Fe Drive/US 85 to US 6/6th Avenue
        - US 6/6th Avenue to Colfax Avenue/Auraria Parkway
        - 23rd Avenue to 20th Street
    - Southbound
        - 20th Street to 17th Avenue
        - Colfax Avenue/Auraria Parkway/Lower Colfax Avenue to US 6/6th Avenue
        - US 6/6th Avenue to Santa Fe Drive/US 85
- Braided Ramps
    - Northbound
        - Between the Santa Fe Drive/US 85 to US 6/6th Avenue CD road on-ramp to northbound I-25 and the northbound I-25 off-ramp to US 6/6th Avenue
        - Between the northbound I-25 off-ramp to the US 6/6th Avenue to Colfax Avenue/Auraria Parkway CD road and the US 6/6th Avenue on-ramp to northbound I-25
        - Between the Colfax Avenue on-ramp to northbound I-25 and the northbound I-25 off-ramp to the 23rd Avenue to 20th Street CD road
        - Between the Speer Boulevard on-ramp to northbound I-25 and the 23rd Avenue to 20th Street CD road
    - Southbound
        - Between the Speer Boulevard on-ramp to the southbound 20th Street to 17th Avenue CD road and the 20th Street to 17th Avenue CD road off-ramp to 23rd Avenue
        - Between the 23rd Avenue to 17th Avenue CD road on-ramp to southbound I-25 and the southbound I-25 off-ramp to the Colfax Avenue to US 6/6th Avenue CD road

- Between the Colfax Avenue, Auraria Parkway, and Lower Colfax Avenue on-ramps to southbound I-25 and the Colfax Avenue to US 6/6th Avenue CD road
- Between the US 6/6th Avenue on-ramp to southbound I-25 and the southbound I-25 off-ramp to the US 6/6th Avenue to Santa Fe Drive/US 85 CD road

Figure 5: Collector/Distributor Roads and Braided Ramps Alternative Overview Map

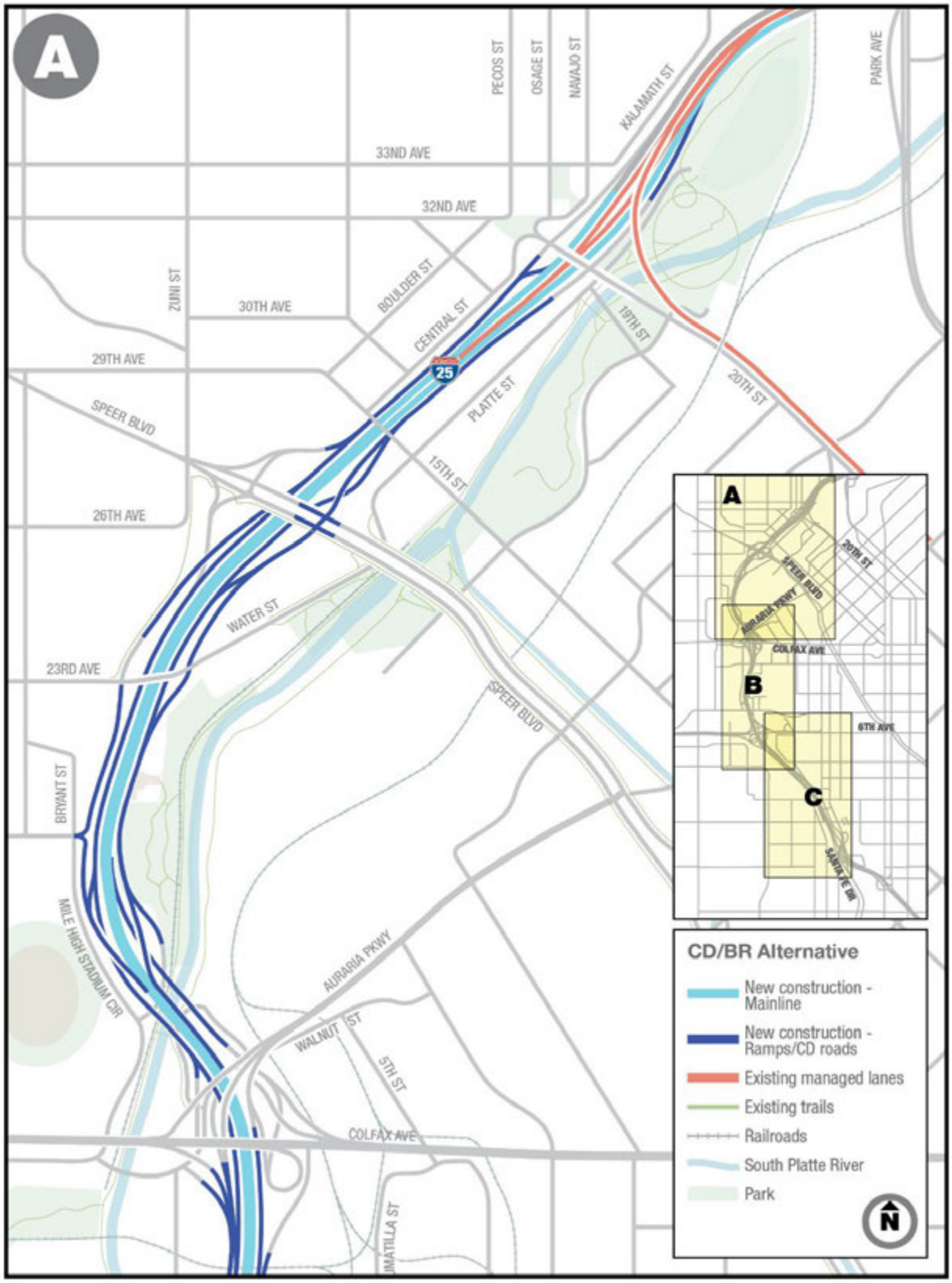
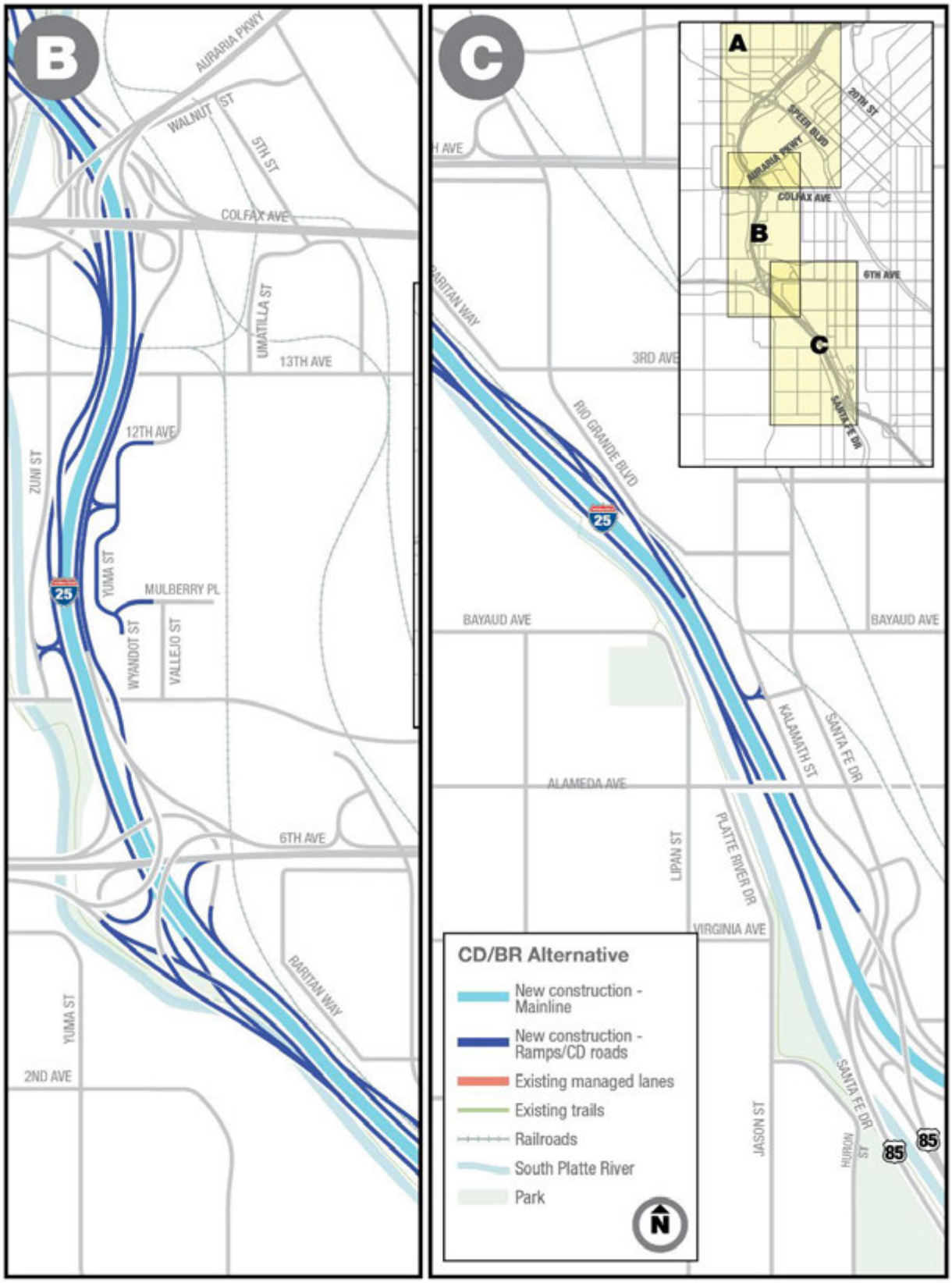


Figure 6: Collector/Distributor Roads and Braided Ramps Alternative Overview Map



2.1.4. Managed Lanes Alternative

Because of the existing congested conditions and the forecasted growth of the Denver metropolitan region and the state of Colorado, additional lanes on I-25 may be needed. Based on the findings and recommendations in the Colorado High Performance Transportation Enterprise (HPTE) *Express Lanes Master Plan* (ELMP), it is likely that any additional lanes on the corridor will be in the form of managed lanes. Because of this requirement, the Managed Lanes Alternative was created to examine the potential benefits that managed lanes throughout the corridor, from approximately Santa Fe Drive/US 85 to 20th Street, could have. Major improvements provided in this alternative are listed below and shown in Figure 7 and Figure 8. The layout of managed lanes and the direct connection ramps to/from the managed lanes were all based on the layout envisioned in the ELMP.

- All improvements included in the No Action Alternative
- All geometric and access closures provided in the Bring the Corridor to Standard Alternative. Additional discussion about access provided in this alternative can be found in Section 2.2 of this Technical Report.
- One new managed lane in both the northbound and southbound directions from the existing managed lanes near 20th Street to approximately Santa Fe Drive/US 85.
- Direct connection ramps from the managed lanes to crossing roadway facilities at the following locations:
    - Northbound
        - Eastbound and westbound US 6/6th Avenue on-ramp to the northbound I-25 managed lane
        - Northbound I-25 managed lane off-ramp to Colfax Avenue and Auraria Parkway
    - Southbound
        - Auraria Parkway on-ramp to the southbound I-25 managed lane
        - Speer Boulevard on-/off-ramp to/from the managed lanes to the north. This ramp was modeled as a reversible ramp serving southbound I-25 managed lane off-ramp traffic to Speer Boulevard during the AM peak period and then serving Speer Boulevard on-ramp traffic to the northbound I-25 managed lane during the PM peak period.
- Northbound CD road from 23rd Avenue to 20th Street
- Southbound CD road from 20th Street to Speer Boulevard

The Managed Lanes Alternative is the only alternative evaluated in detail that adds additional travel lanes to the I-25 mainline. Additional TDM modeling was completed in the Level 2 evaluation process to understand the potential impacts of adding one or two additional general-purpose lanes to the corridor in each direction. Information about this analysis and its findings are included in the *I-25 Central Traffic Forecasting Technical Memorandum* (November 2018) which is included in Attachment A, *Existing Conditions Assessment Report*, of the PEL Study Report.

Figure 7: Managed Lanes Alternative Overview Map

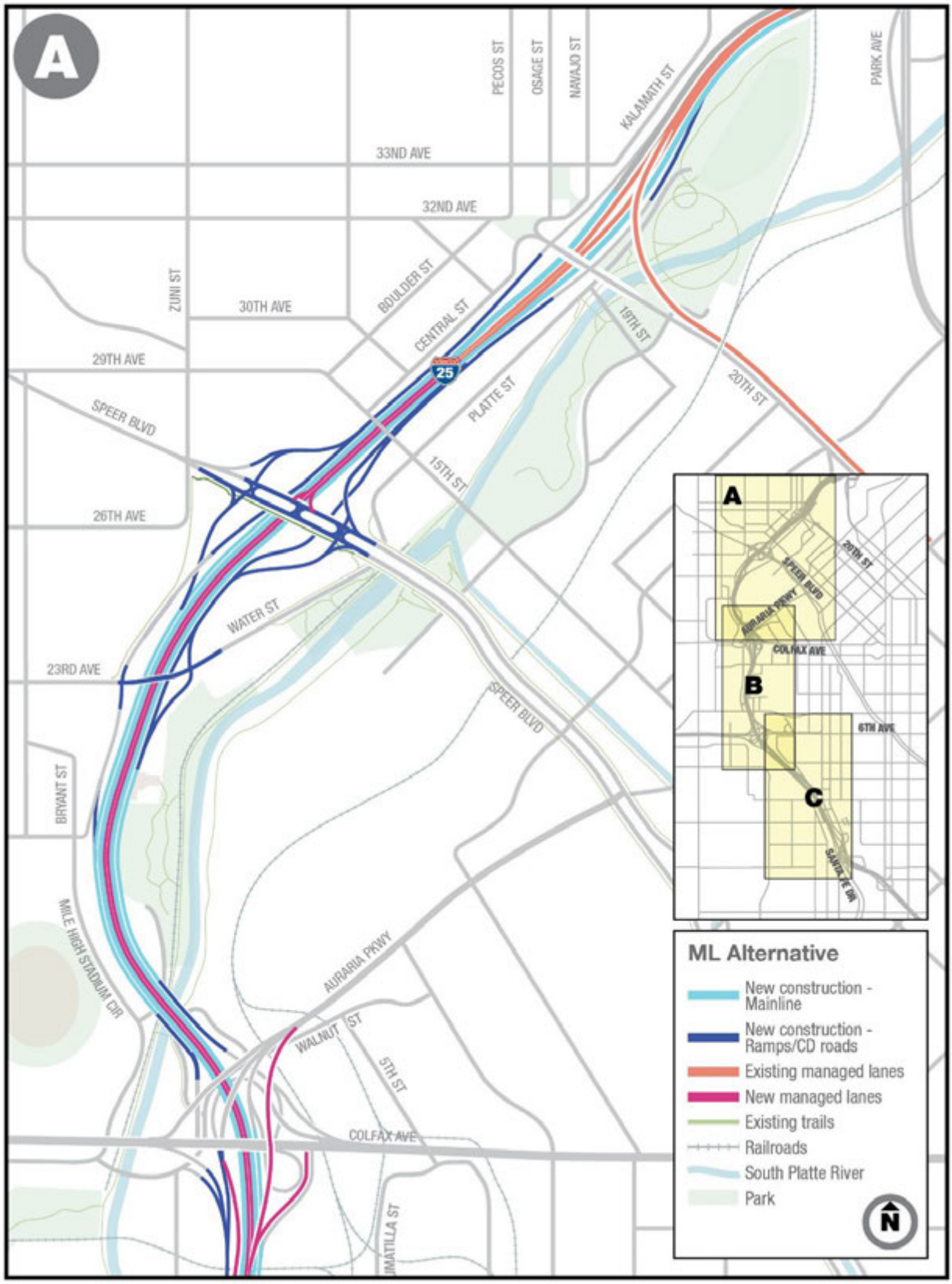
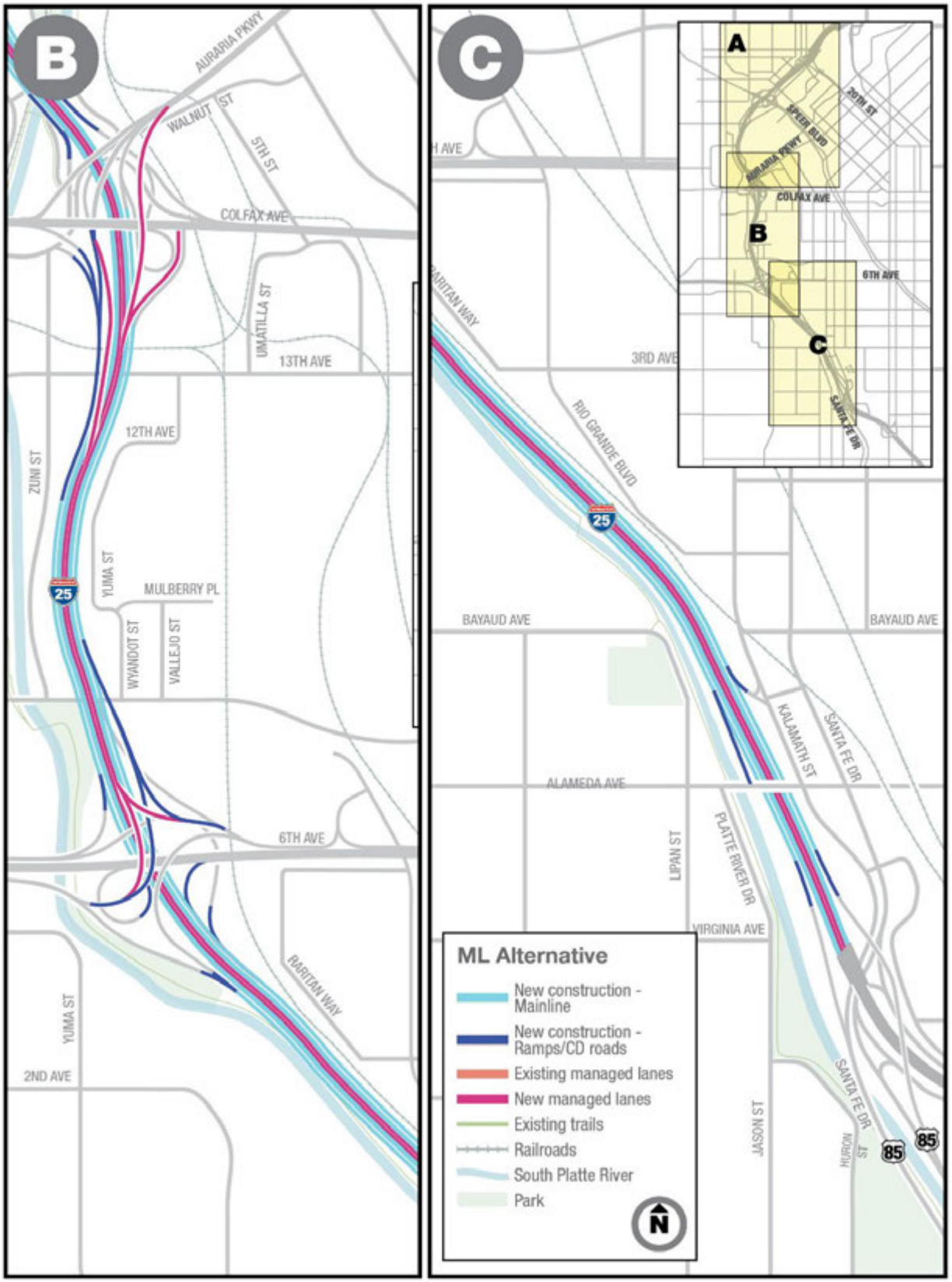


Figure 8: Managed Lanes Alternative Overview Map (Continued)



2.2. Access To/From I-25

Access to and from I-25 Central has a major effect on the operations and safety of the mainline freeway and influences drivers' route choices along the local roadway network. Many of the congestion and safety issues along I-25 Central are related to the existing geometric conditions and amount of access currently provided. To improve congestion and safety, build alternatives (the three alternatives that exclude the No Action Alternative) examined options to better manage access to/from the mainline freeway. This section discusses how access was evaluated within each alternative.

2.2.1. Existing Access Assessment

To understand the current access needs for I-25, the following characteristics were examined: (1) the existing level of demand at each interchange, (2) the cross-street's roadway classification, and (3) overall network considerations of the cross-street. These characteristics were used to categorize the existing access locations as either high-, moderate-, or low-priority access locations. High-priority access locations are those most appropriately served via direct access between the cross-street facility and the I-25 mainline. Moderate-priority access locations are those most appropriately served by some level of access to/from I-25, but not necessarily direct access. Low-priority access locations may not need access to/from I-25. Table 1 summarizes the access evaluation results for the existing interchanges.

The following definitions are used in Table 1:

- "Access Location"—For the purposes of this evaluation, "access location" is an interchange facility between the I-25 mainline and a cross-connecting facility. Although there may be multiple ramps at any given interchange, it was considered as one access location.
- "High-Priority Access Location"—The location is most appropriately served by direct access to/from the I-25 mainline.
- "Moderate-Priority Access Location"—The location is appropriately served by either direct access to/from the I-25 mainline or through a high-quality connection to a different I-25 mainline access location.
- "Low-Priority Access Location"—The location is most appropriately served by providing local connections to other I-25 mainline access locations.

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Table 1: Access Evaluation

Access Location	Level of Demand	Roadway Classification	Network Considerations	Classification	Comments	Additional Notes	
	What is the existing level of daily traffic demand for the facility?	Is the location appropriate given the hierarchy of movements?[1]	Does the connecting cross facility service many, some, or limited areas?			Other Identified Issues	Other Considerations
Santa Fe Drive/US 85	High 78,600 vehicles per day (3rd highest volume out of 9)	High Santa Fe Drive/US 85 is designated as a U.S. highway and is classified as a principal highway.	High Santa Fe Drive/US 85 serves a large area extending between downtown Denver and Castle Rock.	High Priority	Access at I-25 and Santa Fe Drive/US 85 is a high-priority location because of high traffic volumes, the roadway's classification, and the large area served by Santa Fe Drive/US 85.	Ramp Spacing: Northbound I-25 between the northbound Santa Fe Drive/US 85 on-ramp and the Cedar Avenue (Alameda Avenue) on-ramp	77% of traffic to/from the north 23% of traffic to/from the south
Alameda Avenue	Low 18,700 vehicles per day (8th highest volume out of 9)	Moderate Alameda Avenue is designated as a state highway (SH 26) and is classified as a principal arterial.	High Alameda Avenue serves a large area extending from Lakewood to Aurora.	Moderate Priority	Although the traffic volumes using this access location are relatively low compared to other access locations within the study area, access at Alameda Avenue is a medium priority because of Alameda Avenue's roadway classification and the large area it serves.	Ramp Spacing: Northbound I-25 between the northbound Santa Fe Drive/US 85 on-ramp and the Cedar Avenue (Alameda Avenue) on-ramp	100% of traffic to/from the north
US 6/6th Avenue	High 118,000 vehicles per day (Highest volume)	High US 6/6th Avenue is designated as a U.S. highway and is classified as a freeway.	High This portion of US 6/6th Avenue serves a large area extending from Golden to Aurora.	High Priority	Access at US 6/6th Avenue is a high-priority location because of the high traffic volumes, the roadway's classification, and the large-scale regional connections created by US 6/6th Avenue.	Ramp Spacing: Northbound I-25 between the US 6/6th Avenue on-ramp and the 8th Avenue ramps Southbound I-25 between the 8th Avenue ramps and the off-ramp to westbound US 6/6th Avenue	56% of traffic to/from the north 44% of traffic to/from the south
8th Avenue	Low 19,800 vehicles per day (7th highest volume out of 9)	Moderate 8th Avenue is designated as an arterial.	Moderate/Low 8th Avenue serves a moderate area starting from Federal Boulevard and extending to approximately Quebec Street. However, most traffic destined for I-25 from the east accesses the freeway via US 6. Therefore, the 8th Avenue interchange itself serves a relatively small geographic area.	Moderate Priority	Although this access location serves a relatively low traffic volume as compared to other access locations, its designation as an arterial and the continuous connections it creates across Denver makes it a moderate priority location.	Ramp Spacing: Northbound I-25 between the US 6/6th Avenue on-ramp and the 8th Avenue ramps Southbound I-25 between the 8th Avenue ramps and the off-ramp to westbound US 6/6th Avenue	64% of traffic to/from the north 36% of traffic to/from the south

[1] The concept of the "hierarchy of movements" is obtained from FHWA's *Interstate System Access Information Guide* (2010) page 23. This hierarchy notes that a roadway's classification should guide the types of facilities to which it connects. For example, interstates should connect to regional arterials which, in turn, connect to collector roads which, in turn, connect to local roads. This document can be found at: https://www.fhwa.dot.gov/design/interstate/pubs/access/access.pdf

Table 1: Access Evaluation

Access Location	Level of Demand	Roadway Classification	Network Considerations	Classification	Comments	Additional Notes	
	What is the existing level of daily traffic demand for the facility?	Is the location appropriate given the hierarchy of movements?[1]	Does the connecting cross facility service many, some, or limited areas?			Other Identified Issues	Other Considerations
Colfax Avenue/Auraria Parkway/Walnut Street	High 79,400 vehicles per day (2nd highest volume out of 9)	High Colfax Avenue is designated as both a U.S. highway and business loop for I-70 and is classified as a principal arterial. Auraria Parkway is classified as an arterial. Walnut Street is classified as a local street.	High Colfax Avenue serves a large area extending from Golden to Aurora. Auraria Parkway serves a moderate area that includes the Auraria Campus and downtown Denver. Walnut Street serves a comparatively small area, primarily including the Sun Valley Neighborhood and Empower Field at Mile High Stadium.	High Priority	Access at Colfax Avenue/Auraria Parkway/Walnut Street is a high-priority location because of the high traffic volumes, the high-level classification of Colfax Avenue and Auraria Parkway, and the regional connections created by Colfax Avenue.	Ramp Spacing: Northbound I-25 between the Colfax Avenue/Auraria Parkway/Walnut Street on-ramps and the 17th Avenue off-ramp Southbound I-25 between the 17th Avenue on-ramp and the Colfax Avenue off-ramp	34% of traffic to/from the north 66% of traffic to/from the south
17th Avenue	Low 3,500 vehicles per day (Lowest volume out of 9)	Low Mile High Circle (the roadway that connects to the 17th Avenue ramps) is classified primarily as a local street with the portion between the I-25 ramps and Federal Boulevard being classified as a collector road.	Low This access location serves a relatively small area as compared to other access locations. Areas primarily served by this location include Empower Field at Mile High Stadium, the Sun Valley Neighborhood, and portions of the Sloan's Lake Neighborhood.	Low Priority	Access at 17th Avenue is a low priority as compared to other access locations within the study area because it serves a comparatively lower traffic volume than other access locations, is classified as a low-level facility, and does not serve a large geographic area.	Ramp Spacing: Northbound I-25 between the Colfax Avenue/Auraria Parkway/Walnut Street on-ramps and the 17th Avenue off-ramp Northbound between the 17th Avenue on-ramp and the 23rd Avenue off-ramp Southbound I-25 between the 17th Avenue on-ramp and the Colfax Avenue off-ramp	This location serves as a primary access to Empower Field at Mile High Stadium and is more heavily used during events. 75% of traffic to/from the north 25% of traffic to/from the south
23rd Avenue	Moderate 22,200 vehicles per day (6th highest volume out of 9)	Low 23rd Avenue is classified as a collector road.	Low This access location serves a small area, including portions of the Sloan's Lake Neighborhood, Jefferson Park Neighborhood, and cultural attractions and businesses along Water Street and Platte Street.	Low Priority	Although traffic volumes at this location are moderate as compared to other locations in the study area, 23rd Avenue is classified as a collector road and serves a relatively small area Therefore, this location is a low priority to have direct access to the I-25 mainline.	Ramp Spacing: Northbound I-25 between the 17th Avenue on-ramp and the 23rd Avenue off-ramp Northbound I-25 between the 23rd Avenue on-ramp and the eastbound Speer Boulevard off-ramp	44% of traffic to/from the north 56% of traffic to/from the south

Table 1: Access Evaluation

Access Location	Level of Demand	Roadway Classification	Network Considerations	Classification	Comments	Additional Notes	
	What is the existing level of daily traffic demand for the facility?	Is the location appropriate given the hierarchy of movements?[1]	Does the connecting cross facility service many, some, or limited areas?			Other Identified Issues	Other Considerations
Speer Boulevard	Moderate 53,400 vehicles per day (4th highest volume out of 9)	Moderate Speer Boulevard is classified as an arterial.	High Speer Boulevard extends from just west of Federal Boulevard to Downing Street. It provides a major connection across the South Platte River to downtown Denver.	High Priority	Speer Boulevard is on the higher end of traffic volumes for the moderate category and provides a major connection into/out of downtown Denver. Therefore, even though it is classified as an arterial, it is a high-priority access location.	Ramp Spacing: Northbound I-25 between the 23rd Avenue on-ramp and the eastbound Speer Boulevard off-ramp Northbound I-25 between the westbound Speer Boulevard on-ramp and the 20th Street off-ramp Southbound I-25 between the 20th Street on-ramp and the Speer Boulevard off-ramp	71% of traffic to/from the north 29% of traffic to/from the south
20th Street	Moderate 37,800 vehicles per day (5th highest volume out of 9)	Moderate 20th Street is classified as an arterial.	Moderate 20th Street south of I-25 is a primary entrance into and out of downtown Denver and extends to Broadway. North of I-25, 20th Street provides local access to the Lower Highlands and Highlands Neighborhoods.	Moderate Priority	20th Street is a moderate-priority access location because it serves a moderate amount of traffic as compared to other access locations along the corridor, is classified as an arterial roadway, and it acts as a main entrance into downtown Denver.	Ramp Spacing: Northbound I-25 between the westbound Speer Boulevard on-ramp and the 20th Street off-ramp Southbound I-25 between the 20th Street on-ramp and the Speer Boulevard off-ramp	This location serves as a primary access to Coors Field and is more heavily used during events. 59% of traffic to/from the north 41% of traffic to/from the south

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2.2.2. Access Provided in Each Alternative

Because some of the build alternatives require access changes to meet the core intent of the alternative, the existing access assessment was utilized to inform access changes. Table 2 summarizes the access provided in each alternative. Illustrations summarizing the access provided within each alternative are provided in Figure 9.

For organization purposes, access to/from a specific interchange was categorized into one of four groups in Table 2. These included:

- Full Access: The interchange has both on and off-ramps between the I-25 mainline and the crossing facility in both the northbound and southbound directions.
- Modified Access: All movements between the I-25 mainline and the crossing facility are provided; however, one or more of the movements may require the usage of a CD road or connecting ramp.
- Restricted Access: Some movements between the I-25 mainline and the crossing facility are not possible using a freeway facility (mainline freeway, CD road, or ramp). Drivers wanting to make these movements will need to use a different I-25 access location and the local roadway network to access their destination.
- No Access: No connection between the I-25 mainline and the crossing facility is provided. Drivers wanting to make any movements between I-25 and the crossing facility will need to use a different access location and the local roadway network to access their destination.

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Table 2: Alternatives' Access Summary Table

Interchange	Movement	No Action Alternative	Bring the Corridor to Standard Alternative	Collector/ Distributor Roads and Braided Ramps Alternative	Managed Lanes Alternative
20th Street	Northbound Off-Ramp	Full Access	Full Access	Restricted Access • In this alternative, the Speer Boulevard on-ramp to northbound I-25 and the northbound I-25 off-ramp to 20th Street are braided. Because of this braid, traffic coming onto I-25 from Speer Boulevard and 23rd Avenue cannot exit to 20th Street. • In this alternative, this traffic exiting to this ramp is routed through a CD road starting near 17th Avenue. The entrance to this CD road is braided with the Colfax Avenue on-ramp to northbound I-25. Because of this braid, traffic coming from Colfax Avenue cannot exit to 20th Street.	Restricted Access • In this alternative, the Speer Boulevard on-ramp to northbound I-25 and the northbound I-25 off-ramp to 20th Street are braided. Because of this braid, traffic coming onto I-25 from Speer Boulevard and 23rd Avenue cannot exit to 20th Street.
	Northbound On-Ramp	Full Access	Full Access	Full Access	Full Access
	Southbound Off-Ramp	Full Access	Full Access	Full Access	Full Access
	Southbound On-Ramp	Full Access	Restricted Access • In this alternative, traffic from 20th Street going to southbound I-25 would be routed along a new CD road between 20th Street and Speer Boulevard. This CD road would connect with the southbound off-ramp to Speer Boulevard and the 20th Street traffic would be routed through the Speer Boulevard ramp terminal. On-ramp traffic from 20th Street would then use the Speer Boulevard on-ramp to access southbound I-25. Because the Speer Boulevard on-ramp to southbound I-25 is braided with the southbound I-25 off-ramp to 23rd Avenue, traffic coming from 20th Street would not be able to exit to 23rd Avenue in this alternative's configuration.	Modified Access • In this alternative, southbound I-25 on-ramp traffic from 20th Street is routed into a CD road. This CD road provides access to all downstream interchanges and, eventually, to the I-25 mainline.	Modified Access • In this alternative, southbound I-25 on-ramp traffic from 20th Street is routed into a CD road. This CD road provides access to all downstream interchanges and, eventually, to the I-25 mainline.

Table 2: Alternatives' Access Summary Table

Interchange	Movement	No Action Alternative	Bring the Corridor to Standard Alternative	Collector/ Distributor Roads and Braided Ramps Alternative	Managed Lanes Alternative
Speer Boulevard	Northbound Off-Ramp	Full Access	Full Access	Restricted Access • In this alternative, traffic exiting to this ramp is routed through a CD road starting near 17th Avenue. The entrance to this CD road is braided with the Colfax Avenue on-ramp to northbound I-25. Because of this braid, traffic coming from Colfax Avenue cannot exit to Speer Boulevard.	Modified Access • In this alternative, northbound I-25 off-ramp traffic to Speer Boulevard is routed into a CD. This CD road provides access from all upstream entrance ramps and the I-25 mainline to Speer Boulevard.
	Northbound On-Ramp	Full Access	Full Access	Restricted Access • In this alternative, the Speer Boulevard on-ramp to northbound I-25 and the northbound I-25 off-ramp to 20th Street are braided. Because of this braid, traffic coming onto I-25 from Speer Boulevard and 23rd Avenue cannot exit to 20th Street.	Restricted Access • In this alternative, the Speer Boulevard on-ramp to northbound I-25 and the northbound I-25 off-ramp to 20th Street are braided. Because of this braid, traffic coming onto I-25 from Speer Boulevard and 23rd Avenue cannot exit to 20th Street. • This alternative also includes a reversible direct-connection ramp between the managed lane and Speer Boulevard. This ramp would service southbound off-ramp traffic during the AM peak period, and then reverse to serve northbound on-ramp traffic during the PM peak period.
	Southbound Off-Ramp	Full Access	Full Access	Modified Access • In this alternative, southbound I-25 off-ramp traffic to Speer Boulevard is routed into a CD. This CD road provides access from all upstream entrance ramps and the I-25 mainline to Speer Boulevard.	Modified Access • In this alternative, southbound I-25 off-ramp traffic to Speer Boulevard is routed into a CD. This CD road provides access from all upstream entrance ramps and the I-25 mainline to Speer Boulevard. • This alternative also includes a reversible direct-connection ramp between the managed lane and Speer Boulevard. This ramp would service southbound off-ramp traffic during the AM peak period, and then reverse to serve northbound on-ramp traffic during the PM peak period.
	Southbound On-Ramp	Restricted Access • In this alternative, the Speer Boulevard on-ramp to southbound I-25 is braided with the southbound I-25 off-ramp to 23rd Avenue. Because of this braid, traffic coming from Speer Boulevard cannot exit to 23rd Avenue.	Restricted Access • In this alternative, the Speer Boulevard on-ramp to southbound I-25 is braided with the southbound I-25 off-ramp to 23rd Avenue. Because of this braid, traffic coming from Speer Boulevard cannot exit to 23rd Avenue.	Restricted Access • In this alternative, the Speer Boulevard on-ramp to southbound I-25 is braided with the southbound I-25 off-ramp to 23rd Avenue. Because of this braid, traffic coming from Speer Boulevard cannot exit to 23rd Avenue.	Restricted Access • In this alternative, the Speer Boulevard on-ramp to southbound I-25 is braided with the southbound I-25 off-ramp to 23rd Avenue. Because of this braid, traffic coming from Speer Boulevard cannot exit to 23rd Avenue.

Table 2: Alternatives' Access Summary Table

Interchange	Movement	No Action Alternative	Bring the Corridor to Standard Alternative	Collector/ Distributor Roads and Braided Ramps Alternative	Managed Lanes Alternative
23rd Avenue	Northbound Off-Ramp	Full Access	Full Access	Restricted Access • In this alternative, the traffic exiting to this ramp is routed through a CD road starting near 17th Avenue. The entrance to this CD road is braided with the Colfax Avenue on-ramp to northbound I-25. Because of this braid, traffic coming from Colfax Avenue cannot exit to 23rd Avenue.	Full Access
	Northbound On-Ramp	Full Access	Modified Access • In this alternative, traffic coming from 23rd Avenue going to northbound I-25 would be routed through the Speer Boulevard interchange through a CD road connection between 23rd Avenue and Speer Boulevard. This traffic would pass through the I-25 and Speer Boulevard interchange and then use the Speer Boulevard on-ramp to northbound I-25 to access the freeway.	Restricted Access • In this alternative, traffic coming from 23rd Avenue going to northbound I-25 would be routed through the Speer Boulevard interchange through a CD road connection between 23rd Avenue and Speer Boulevard. This traffic would pass through the I-25 and Speer Boulevard interchange and then use the Speer Boulevard on-ramp to northbound I-25 to access the freeway. Because the Speer Boulevard on-ramp to northbound I-25 would be braided with the northbound I-25 off-ramp to 20th Street, traffic coming from 23rd Avenue would not be able to exit to 20th Street.	Restricted Access • In this alternative, traffic coming from 23rd Avenue going to northbound I-25 would be routed through the Speer Boulevard interchange through a CD road connection between 23rd Avenue and Speer Boulevard. This traffic would pass through the I-25 and Speer Boulevard interchange and then use the Speer Boulevard on-ramp to northbound I-25 to access the freeway. Because the Speer Boulevard on-ramp to northbound I-25 would be braided with the northbound I-25 off-ramp to 20th Street, traffic coming from 23rd Avenue would not be able to exit to 20th Street.
	Southbound Off-Ramp	Restricted Access • In this alternative, the Speer Boulevard on-ramp to southbound I-25 is braided with the southbound I-25 off-ramp to 23rd Avenue. Because of this braid, traffic coming from Speer Boulevard cannot exit to 23rd Avenue.	Restricted Access • In this alternative, the Speer Boulevard on-ramp to southbound I-25 is braided with the southbound I-25 off-ramp to 23rd Avenue. Because of this braid, traffic coming from Speer Boulevard cannot exit to 23rd Avenue.	Restricted Access • In this alternative, southbound I-25 off-ramp traffic to 23rd Avenue would be routed into a CD. The exit from this CD road to 23rd Avenue would be braided with the on-ramp from Speer Boulevard. Because of this braid, traffic coming from Speer Boulevard would not be able to exit to 23rd Avenue.	Restricted Access • In this alternative, southbound I-25 off-ramp traffic to 23rd Avenue would be routed into a CD. The exit from this CD road to 23rd Avenue would be braided with the on-ramp from Speer Boulevard. Because of this braid, traffic coming from Speer Boulevard would not be able to exit to 23rd Avenue.
	Southbound On-Ramp	Full Access	Full Access	Modified Access • In this alternative, southbound I-25 on-ramp traffic from 23rd Avenue would be routed into a CD road. This CD road would provide access to all downstream exit ramps and the I-25 mainline.	Full Access

Table 2: Alternatives' Access Summary Table

Interchange	Movement	No Action Alternative	Bring the Corridor to Standard Alternative	Collector/ Distributor Roads and Braided Ramps Alternative	Managed Lanes Alternative
17th Avenue	Northbound Off-Ramp	Full Access	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.
	Northbound On-Ramp	Full Access	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.	Modified Access • In this alternative, on-ramp traffic from 17th Avenue to northbound I-25 would be routed into a CD road. This traffic would have to travel in the CD road and exit to Speer Boulevard. Using the Speer Boulevard off-ramp, this traffic would pass through the Speer Boulevard ramp terminal and then use the Speer Boulevard on-ramp to northbound I-25 to access the freeway.	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.
	Southbound Off-Ramp	Modified Access • Traffic exiting to 17th Avenue is routed through the 23rd Avenue interchange. This traffic passes through the 23rd Avenue interchange and uses a CD road connection to access 17th Avenue.	Modified Access • Traffic exiting to 17th Avenue is routed through the 23rd Avenue interchange. This traffic passes through the 23rd Avenue interchange and uses a CD road connection to access 17th Avenue.	Modified Access • Traffic exiting to 17th Avenue is routed through the 23rd Avenue interchange. This traffic passes through the 23rd Avenue interchange and uses a CD road connection to access 17th Avenue.	Modified Access • Traffic exiting to 17th Avenue is routed through the 23rd Avenue interchange. This traffic passes through the 23rd Avenue interchange and uses a CD road connection to access 17th Avenue.
	Southbound On-Ramp	Full Access	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.	Restricted Access • The on-ramp from 17th Avenue to southbound I-25 would be braided over the southbound I-25 off-ramp to the Colfax Avenue/8th Avenue/US 6/6th Avenue CD road. Because of this braid, traffic coming from 17th Avenue would not be able to exit to Colfax Avenue, 8th Avenue, or US 6/6th Avenue.	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.

Table 2: Alternatives' Access Summary Table

Interchange	Movement	No Action Alternative	Bring the Corridor to Standard Alternative	Collector/ Distributor Roads and Braided Ramps Alternative	Managed Lanes Alternative
Auraria Parkway	Northbound Off-Ramp	Full Access	Full Access	Modified Access • In this alternative, northbound I-25 off-ramp traffic to Auraria Parkway would be routed through a CD road. This CD road would provide access to Auraria Parkway from all upstream entrance ramps and the I-25 mainline.	Full Access • This alternative also includes a direct-connection off-ramp between the northbound managed lane and Auraria Parkway.
	Southbound On-Ramp	Full Access	Full Access	Modified Access • In this alternative, southbound I-25 on-ramp traffic from Auraria Parkway would be routed through a CD road. This CD road would provide access from Auraria Parkway to all downstream exit ramps and the I-25 mainline.	Full Access • This alternative also includes a direct-connection on-ramp between Auraria Parkway and the southbound managed lane.

Table 2: Alternatives' Access Summary Table

Interchange	Movement	No Action Alternative	Bring the Corridor to Standard Alternative	Collector/ Distributor Roads and Braided Ramps Alternative	Managed Lanes Alternative
Colfax Avenue	Northbound Off-Ramp	Full Access	Full Access	Modified Access • In this alternative, northbound I-25 off-ramp traffic to Colfax Avenue would be routed through a CD road. This CD road would provide access to Colfax Avenue from all upstream entrance ramps and the I-25 mainline.	Full Access • This alternative also includes a direct-connection off-ramp between the northbound managed lane and Colfax Avenue.
	Northbound On-Ramp	Full Access	Full Access	Modified Access • In this alternative, the northbound I-25 on-ramp to I-25 would be braided over the northbound I-25 off-ramp to the 23rd Avenue/Speer Boulevard/20th Street CD road. Because of this braid, traffic coming from Colfax Avenue would not be able to exit to 23rd Avenue, Speer Boulevard, or 20th Street.	Full Access
	Southbound Off-Ramp	Full Access	Full Access	Restricted Access • The on-ramp from 17th Avenue to southbound I-25 would be braided over the southbound I-25 off-ramp to the Colfax Avenue/8th Avenue/US 6/6th Avenue CD road. Because of this braid, traffic coming from 17th Avenue would not be able to exit to Colfax Avenue.	Full Access
	Southbound On-Ramp	Full Access	Full Access	Restricted Access • Traffic coming from Colfax Avenue to southbound I-25 would merge with traffic coming from Auraria Parkway and Lower Colfax Avenue before connecting to the southbound CD road and I-25. Traffic coming from Auraria Parkway and westbound Colfax Avenue would have the option to connect to the I-25 mainline or the southbound CD road to 8th Avenue and US 6/6th Avenue. However, due to geometric constraints, traffic coming from eastbound Colfax Avenue and Lower Colfax Avenue would only have access to the I-25 mainline. Therefore, traffic coming eastbound from Colfax Avenue or from Lower Colfax Avenue would not be able to access 8th Avenue or US 6/6th Avenue.	Full Access

Table 2: Alternatives' Access Summary Table

Interchange	Movement	No Action Alternative	Bring the Corridor to Standard Alternative	Collector/ Distributor Roads and Braided Ramps Alternative	Managed Lanes Alternative
8th Avenue	Northbound Off-Ramp	Restricted • The northbound I-25 off-ramp to 8th Avenue is braided with the US 6/6th Avenue on-ramp to northbound I-25. Because of this braid, traffic coming from US 6/6th Avenue cannot exit to 8th Avenue.	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.	Modified Access • In this alternative, northbound I-25 off-ramp traffic to 8th Avenue would be routed through a CD road. This CD road would provide access to 8th Avenue from all upstream entrance ramps and the I-25 mainline.	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.
	Northbound On-Ramp	Full Access	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.	Modified Access • In this alternative, northbound I-25 on-ramp traffic from 8th Avenue would be routed through a CD road. This CD road would provide access from 8th Avenue to all downstream exit ramps and the I-25 mainline.	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.
	Southbound Off-Ramp	Full Access	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.	Restricted Access • In this alternative, traffic coming from eastbound Colfax Avenue and Lower Colfax Avenue would only have access to the I-25 mainline and would not be able to access 8th Avenue. • The on-ramp from 17th Avenue to southbound I-25 would be braided over the southbound I-25 off-ramp to the Colfax Avenue/8th Avenue/US 6/6th Avenue CD road. Because of this braid, traffic coming from 17th Avenue would not be able to exit to 8th Avenue.	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.
	Southbound On-Ramp	Full Access	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.	Restricted/No Access • In this alternative, traffic coming from 8th Avenue would be routed into the Colfax Avenue/8th Avenue/US 6/6th Avenue CD road. However due to geometric constraints, this CD road does not connect back into the I-25 mainline. Therefore, traffic coming from 8th Avenue would only have access to US 6/6th Avenue and would not be able to access the I-25 mainline or any ramps downstream of US 6/6th Avenue.	No Access • In this alternative, this ramp is removed. Traffic which currently uses this ramp would need to use the local roadway network to access I-25 from a different interchange.

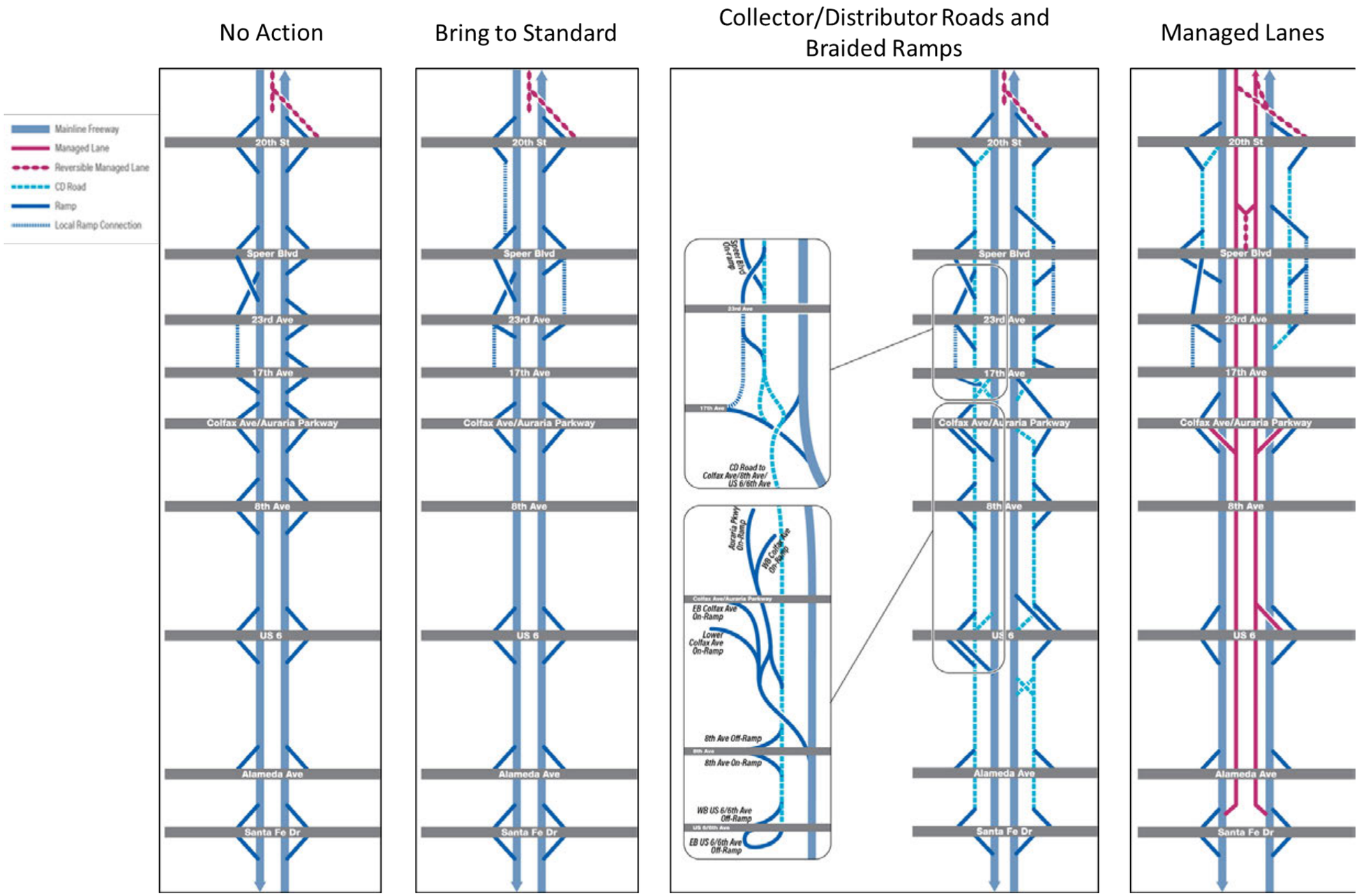
Table 2: Alternatives' Access Summary Table

Interchange	Movement	No Action Alternative	Bring the Corridor to Standard Alternative	Collector/ Distributor Roads and Braided Ramps Alternative	Managed Lanes Alternative
US 6/6th Avenue	Northbound Off-Ramp	Full Access	Full Access	Modified Access • In this alternative, northbound I-25 off-ramp traffic to US 6/6th Avenue would be routed through a CD road. This CD road would provide access to US 6/6th Avenue from all downstream entrance ramps and the I-25 mainline.	Full Access
	Northbound On-Ramp	Restricted • The northbound I-25 off-ramp to 8th Avenue is braided with the US 6/6th Avenue on-ramp to northbound I-25. Because of this braid, traffic coming from US 6/6th Avenue cannot exit to 8th Avenue.	Restricted • The northbound I-25 off-ramp to 8th Avenue is braided with the US 6/6th Avenue on-ramp to northbound I-25. Because of this braid, traffic coming from US 6/6th Avenue cannot exit to 8th Avenue.	Full Access	Restricted • The northbound I-25 off-ramp to 8th Avenue is braided with the US 6/6th Avenue on-ramp to northbound I-25. Because of this braid, traffic coming from US 6/6th Avenue cannot exit to 8th Avenue. • This alternative also includes a direct-connection on-ramp between US 6/6th Avenue and the northbound managed lane.
	Southbound Off-Ramp	Full Access	Full Access	Restricted Access • In this alternative, traffic coming from eastbound Colfax Avenue and Lower Colfax Avenue would only have access to the I-25 mainline and would not be able to access US 6/6th Avenue. • The on-ramp from 17th Avenue to southbound I-25 would be braided over the southbound I-25 off-ramp to the Colfax Avenue/8th Avenue/US 6/6th Avenue CD road. Because of this braid, traffic coming from 17th Avenue would not be able to exit to US 6/6th Avenue.	Full Access
	Southbound On-Ramp	Full Access	Full Access	Full Access	Full Access

Table 2: Alternatives' Access Summary Table

Interchange	Movement	No Action Alternative	Bring the Corridor to Standard Alternative	Collector/ Distributor Roads and Braided Ramps Alternative	Managed Lanes Alternative
Alameda Avenue	Northbound Off-ramp	No Access • This ramp does not currently exist. This alternative would not add a ramp at this location.	No Access • This ramp does not currently exist. This alternative would not add a ramp at this location.	No Access • This ramp does not currently exist. This alternative would not add a ramp at this location.	No Access • This ramp does not currently exist. This alternative would not add a ramp at this location.
	Northbound On-Ramp	Full Access	Full Access	Modified Access • In this alternative, northbound I-25 on-ramp traffic from Alameda Avenue would be routed through a CD road. This CD road would provide access from Alameda Avenue to all downstream exit ramps and the I-25 mainline.	Full Access
	Southbound Off-Ramp	Full Access	Full Access	Modified Access • In this alternative, southbound I-25 off-ramp traffic to Alameda Avenue would be routed through a CD road. This CD road would provide access to Alameda Avenue from all upstream entrance ramps and the I-25 mainline.	Full Access
	Southbound On-Ramp	No Access • This ramp does not currently exist. This alternative would not add a ramp at this location.	No Access • This ramp does not currently exist. This alternative would not add a ramp at this location.	No Access • This ramp does not currently exist. This alternative would not add a ramp at this location.	No Access • This ramp does not currently exist. This alternative would not add a ramp at this location.
Santa Fe Drive/US 85	Northbound Off-Ramp	Full Access	Full Access	Full Access	Full Access
	Northbound On-Ramp	Full Access	Full Access	Modified Access • In this alternative, northbound I-25 on-ramp traffic from Santa Fe Drive/US 85 would be routed through a CD road. This CD road would provide access from Santa Fe Drive/US 85 to all downstream exit ramps and the I-25 mainline.	Full Access
	Southbound Off-Ramp	Full Access	Full Access	Modified Access • In this alternative, southbound I-25 off-ramp traffic to Santa Fe Drive/US 85 would be routed through a CD road. This CD road would provide access to Santa Fe Drive/US 85 from all upstream entrance ramps and the I-25 mainline.	Full Access
	Southbound On-Ramp	Full Access	Full Access	Full Access	Full Access

Figure 9: Alternatives' Access Diagrams



3. Alternatives' Traffic-Related Evaluation Methodology

To compare the traffic operations of the build alternatives, four measures of effectiveness were analyzed, including:

- Vehicle miles traveled (VMT) and vehicle hours traveled (VHT) within the traffic analysis area
- Travel times on I-25
- Speeds on I-25
- Traffic volumes on the I-25 mainline, the I-25 ramps, and on adjacent local roadways

These measures are discussed in more detail in the following sections. It is important to note that the I-25 Central corridor represents a complex, highly congested transportation network. This network influences and is influenced by a variety of factors, all of which interact to produce the travel patterns and congestion experienced by its users. Because of this complexity, no single measure of effectiveness should be used to determine one alternative's performance. Instead, all measures of effectiveness should be examined side by side to gain an understanding of the relative trade-offs of each alternative.

In addition to reviewing the measures of effectiveness in context, it is also important to consider the natural variations in results that are inherent when performing microsimulation traffic analysis at such a large scale. The purpose of the I-25 Central PEL traffic modeling was to gain an understanding of the effect of improvements to I-25, not only on freeway operations, but also on the larger transportation network. Therefore, the microsimulation models were built to reflect the overall travel patterns and key operational characteristics needed to achieve these patterns. For the purposes of this study, the microsimulation models were not intended to capture every fine detail within the traffic analysis area. Therefore, results obtained from the models should be interpreted within that context. Small variations in results between alternative measures of effectiveness, typically within ±5 percent, are considered not to be meaningfully different.

4. Changes Between Existing Conditions and No Action

This chapter discusses the expected changes that will occur between the Existing Conditions scenario and the 2030 No Action Alternative. This information will form the basis of comparison for alternatives, which is discussed in Chapter xx.

For the purposes of modeling the Existing Conditions scenario and comparing it to the 2030 No Action Alternative, the AM peak period is defined to be from 6:00 a.m. to 9:00 a.m. and the PM peak period is defined to be from 2:00 p.m. to 7:00 p.m.

4.1. Future Travel Demand Growth

Travel demand on I-25 Central and the surrounding transportation network is expected to continue to increase between the existing conditions and 2040 planning horizon year. Based on the most current DRCOG TDM forecasts, total trips within the traffic analysis area are anticipated to increase by approximately 20 percent as compared to existing conditions (Table 3). This trend is expected to be mirrored on I-25 through the central corridor, with demand for the freeway increasing from approximately 250,000 vehicles per day in 2017 to approximately 300,000 vehicles per day in 2040.

Additional information about how future travel demands were estimated can be found in the *I-25 Central Traffic Forecasting Technical Memorandum* (November 2018), which is in Attachment A, *Existing Conditions Assessment Report*, of the I-25 Central PEL Study Report.

Table 3: Total Trips Within the Traffic Analysis Area

Scenario	AM Peak Period (6:00 a.m. to 9:00 a.m.)	PM Peak Period (2:00 p.m. to 7:00 p.m.)
Existing Conditions	334,000	653,000
2040 No Action	401,000	790,000
Change from Existing Conditions to 2040 No Action (percent change)	+67,000 (+20%)	+137,000 (+21%)

4.1.1. Planning Horizon Year Alterations

I-25 is part of a larger roadway network that includes many facilities including the interstate, arterials, and local roadways. Because this is a highly integrated network, drivers often choose a web of different routes to go from their origin to their destination. These route choices are further influenced by congestion, which results in drivers using different routes depending on current travel conditions. As part of the I-25 Central PEL's traffic analysis process, it was decided early on that one of the primary areas of focus for the microsimulation modeling effort would be to try and capture these different route choices to better understand the impact different alternatives could have on the larger roadway network, not just the freeway.

The need to capture alternate route choices resulted in the selection of TransModeler software due to its capabilities for dynamic traffic assignment. Dynamic traffic assignment allows drivers to choose routes based on congestion and travel time, which mimics the current behavior of drivers within the I-25 corridor.

By 2040, the travel demand for the I-25 Central traffic analysis area is projected to increase by approximately 20 percent. When the 2040 travel demand was analyzed within the microsimulation model, severe congestion was observed throughout the traffic analysis area. This led to extensive queueing on freeway ramps and, most significantly, on the local roadway network. The extensive congestion led to new route choices for drivers, which in many cases pushed more people onto the local network. The most impactful queues in the model were at left-turns where queues would spill back into the general-purpose through lanes and block traffic. These queues would then extend back to adjacent intersection and, over time, result in the model grid-locking.

To maintain the regional roadway network focus of the traffic analysis while analyzing the potential benefits of the build alternatives, it was decided—with input and concurrence from FHWA and City and County of Denver (Denver) staff—that overall travel demand should be reduced to a point at which the microsimulation traffic model could produce reasonable results without grid-locking. This decision ensures that the trends and future congestion conditions can be evaluated while still analyzing the interactions of I-25 and the larger roadway network—which was the original desire of the project team, agency partners, and stakeholders. Based on an iterative testing process, a global 10 percent travel demand reduction was applied to the entire microsimulation model.

With this demand reduction, the No Action Alternative reflects a planning horizon year of approximately 2030. Table 4 shows the total traffic analysis area travel demand for the existing conditions, the 2040 No Action conditions, and the modified (2030) conditions that ultimately were used for the future

condition microsimulation traffic analysis and the future condition safety analysis. This revised planning horizon year was used to analyze the No Action Alternative, as well as the build alternatives. For clarity, the remainder of this technical report will refer to the No Action Alternative results as the 2030 No Action Alternative results to reflect this reduction in overall travel demand.

Table 4: Modified 2040 Travel Demand

Condition	Total AM Peak Period Trips (6:00 a.m. – 9:00 a.m.) (percent difference from Existing Conditions)	Total PM Peak Period Trips (2:00 p.m. – 7:00 p.m.) (percent difference from Existing Conditions)
Existing Conditions	334,000	653,000
2040 No Action Conditions	401,000 (+20%)	790,000 (+21%)
Modified (2030) Conditions	360,600 (+8%)	711,300 (+9%)

4.1.2. Potential Changes to Travel Choices

The future travel demand growth is based on the DRCOG forecasts. These forecasts account for planned land use growth and change, anticipated transportation network changes—such as roadway capacity projects and major transit projects—and other travel choice influencers, such as people's choices to walk and bicycle. Major projects included in the DRCOG regional TDM models are listed in DRCOG's *2040 Fiscally Constrained Regional Transportation Plan* (February 2015).

Because the timing of improvements analyzed in this PEL Study is not known currently, it is important to understand that the DRCOG models forecast future travel demand based on the most likely current projections. Should major changes occur to the base assumptions made within the current DRCOG models or if an updated version of the DRCOG models is released, then the analysis of the I-25 Central alternatives should be re-evaluated to reflect these changes.

A sensitivity analysis was conducted to determine the potential impacts large-scale transit investments near the I-25 Central corridor could have on overall travel demand for the highway. This analysis found that, even with large-scale transit investment in bus rapid transit and additional light rail service, there still would be a need for improvements to I-25 Central to meet this study's purpose, needs, goals, and objectives. More details about this sensitivity analysis can be found in Appendix B, *I-25 Central Transit Sensitivity Analysis Technical Memorandum* (April 2019), of this Technical Report.

4.1.3. Potential Additional Growth Beyond DRCOG Forecasts

The DRCOG travel demand forecasts are based on planned development data from around the Denver metropolitan region and represent a "most likely" scenario of future growth. However, Denver is currently working on plans for additional, large-scale growth areas that are not captured currently in the DRCOG forecasts because they are still in early development stages. Because they are missing from the forecasts, the potential travel demand generated by these large-scale development areas is not captured in the analysis of alternatives completed as part of this PEL Study. To account for this lack of data and gain an understanding of the potential impacts these large-scale developments could have on I-25, a land use sensitivity analysis was completed.

This land use sensitivity analysis found that there is a potential for an additional 116,000 trips on I-25 if all the currently envisioned development were to come to fruition by 2040. These trips would be in addition to the growth already included in the DRCOG forecasts, as shown in Table 3. Additional information and discussion about the land use sensitivity analysis is included in Appendix D, *I-25 Central Land Use Sensitivity Analysis Technical Memorandum*, of this Technical Report.

4.2. Impacts of Travel Demand Growth on VMT and VHT

As travel demand increases, it will have a variety of impacts to roadway operations within the traffic analysis area. At a high level, these impacts can be captured by analyzing the total vehicle miles traveled (VMT) and vehicle hours traveled (VHT) within the traffic analysis area. Changes in VMT within a given area generally reflect the overall changes in travel demand with a rise or fall in VMT usually indicating a rise or fall in the overall desire/need for people to travel. VHT generally reflects overall congestion within an area and represents how much time people spend traveling from one place to another. Comparing the changes in VMT to the changes in VHT provides a high-level overview of travel conditions in an area. The following sections discuss the anticipated changes in VMT and VHT between the Existing Conditions scenario and the 2030 No Action Alternative.

It is important to note that the data presented within this section are based on the microsimulation traffic analysis, which examined the AM (6:00 a.m. to 9:00 a.m.) and PM (2:00 p.m. to 7:00 p.m.) peak travel periods. Additional VMT and VHT growth is likely to occur outside of these peak travel periods as drivers change their travel patterns in response to increasing congestion—for example, choosing to go to work earlier in the day before 6:00 a.m. to avoid traffic. These travel choice changes were captured in the travel demand modeling exercise completed as part of the I-25 Central PEL Study and are discussed in the *I-25 Central Traffic Forecasting Technical Memorandum* (November 2018), which is in Attachment A, *Existing Conditions Assessment Report*, of the I-25 Central PEL Study Report.

4.2.1. Changes in AM Peak Period VMT and VHT between Existing Conditions Scenario and 2030 No Action Alternative

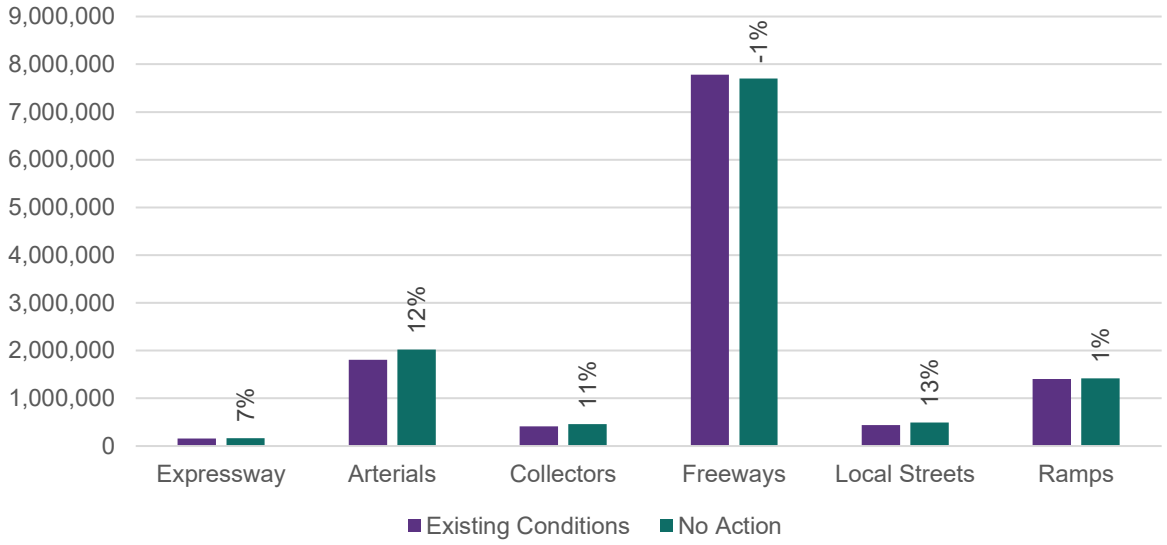
During the AM peak period, VMT and VHT are expected to increase by 2 percent and 9 percent, respectively, between the Existing Conditions scenario and the 2030 No Action Alternative. This growth, however, is not experienced evenly across the roadway network. For VMT, almost all the growth between the Existing Conditions scenario and the 2030 No Action Alternative is anticipated to be on non-freeway facilities—all facilities excluding freeways, expressways, and ramps. VMT on these non-freeway facilities is expected to increase by approximately 313,000 VMT (+12 percent) during the AM peak period. Comparatively, freeway facility VMT—including freeways, expressways, and ramps—is anticipated to remain relatively constant, with a modest decrease of approximately 52,000 VMT (-1 percent) during the AM peak period. Table 5 and Figure 10 summarize the anticipated changes in total VMT for the AM peak period.

Table 5: AM Peak Period VMT

	Existing Conditions	2030 No Action
Total VMT	11,999,000	12,260,000
Percent Difference from Existing Conditions	N/A	+2%

Source: I-25 Central PEL microsimulation traffic models

Figure 10: AM Peak Period VMT by Facility Type (Existing Conditions vs. 2030 No Action)



Percentages shown represent the percent difference from the Existing Conditions.
Source: I-25 Central PEL microsimulation traffic models

This VMT growth pattern—with almost all VMT growth occurring on non-freeway facilities—indicates that the existing and future freeway networks are at capacity and are unable to process additional vehicles during the AM peak period. This capacity constraint results in drivers using alternate routes with extra capacity to make their trips. The only available alternate routes for these drivers are the non-freeway facilities, which is why VMT on those facilities is expected to increase.

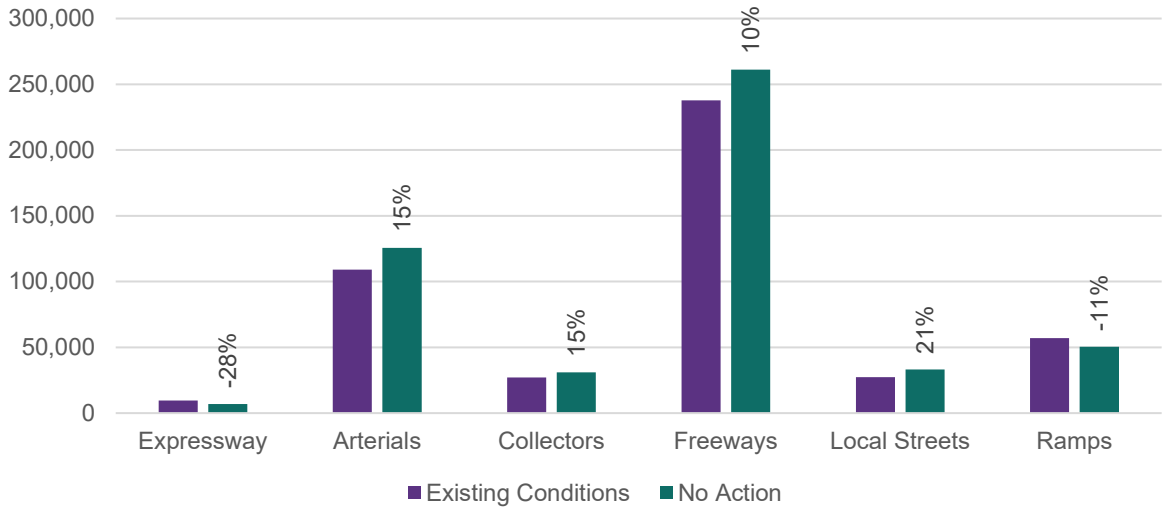
Although overall VMT during the AM peak period is expected to increase by approximately 2 percent between the Existing Conditions scenario and the 2030 No Action Alternative, VHT is anticipated to increase by approximately 9 percent. Similar to VMT, non-freeway facilities are expected to experience the most growth in VHT, with an approximate increase of 27,000 VHT (+17 percent) between the Existing Conditions scenario and the 2030 No Action Alternative. Furthermore, although freeway facilities are not expected to experience a notable increase in VMT, they are anticipated to experience an approximate increase in VHT of 14,000 hours (+5 percent). This increase in VHT without an increase in VMT further indicates an increase in the level of congestion anticipated on freeway facilities in the future. Table 6 and Figure 11 summarize the VHT by facility type.

Table 6: AM Peak Period VHT

	Existing Conditions	2030 No Action
Total VHT	468,000	509,000
Percent Difference from Existing Conditions	N/A	+9%

Source: I-25 Central PEL microsimulation traffic models

Figure 11: AM Peak Period VHT by Facility Type (Existing Conditions vs. 2030 No Action)



Percentages shown represent the percent difference from the Existing Conditions.
Source: I-25 Central PEL microsimulation traffic models

4.2.2. Changes in PM Peak Period VMT and VHT between Existing Conditions Scenario and 2030 No Action Alternative

Overall, PM peak period VMT and VHT are expected to increase by about 10 percent and 21 percent, respectively, between the Existing Conditions scenario and the 2030 No Action Alternative. The majority of this increase is anticipated to occur on non-freeway facilities—specifically, on local streets that are estimated to experience an increase of 2,285,000 VMT (+183 percent) during the PM peak period between the Existing Conditions scenario and the 2030 No Action Alternative. This is a result of the extreme congestion on I-25 expected to occur during the PM peak period. In the existing conditions, much of the roadway network is already at or exceeding its capacity during the PM peak period. Therefore, much of the travel demand growth likely will be accommodated by more local streets as drivers find alternate routes, not only to freeways but to major arterials as well.

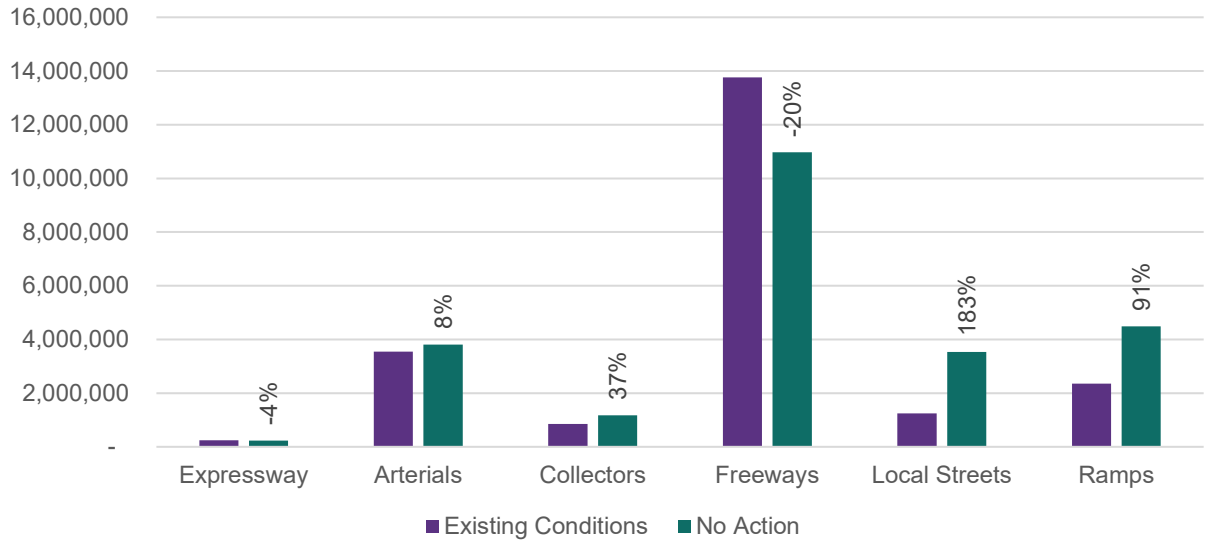
The high level of congestion anticipated during the PM peak period in the 2030 No Action Alternative is likely to result in a shift in travel behavior and driver route choice on the freeway network and its associated ramps. Based on the microsimulation modeling, VMT on freeway facilities is anticipated to decrease by approximately 2,795,000 VMT (-20 percent) between the Existing Conditions scenario and the 2030 No Action Alternative. However, VMT on ramp facilities is expected to increase by 2,144,000 VMT (+91 percent) in that same period. This decrease on freeway facilities and increase on ramp facilities indicates a change in travel patterns as more drivers choose to use the freeway facilities for shorter trips. Table 7 and Figure 12 summarize the PM peak period VMT for the Existing Conditions scenario and the 2030 No Action Alternative.

Table 7: PM Peak Period VMT

	Existing Conditions	2030 No Action
Total VMT	21,993,000	24,206,000
Percent Difference from Existing Conditions	N/A	+10%

Source: I-25 Central PEL microsimulation traffic models

Figure 12: PM Peak Period VMT by Facility Type (Existing Conditions vs. 2030 No Action)



Percentages shown represent the percent difference from the Existing Conditions.
Source: I-25 Central PEL microsimulation traffic models

VHT is expected to increase approximately 21 percent between the Existing Conditions scenario and the 2030 No Action Alternative. A majority of this VHT increase is expected to occur on local streets and ramps, with each increasing by 121 percent and 138 percent, respectively. The increase on local roadways is a result of the increasing congestion throughout the roadway network. As discussed previously, as other roadway facilities—such as freeways and arterial roadways—reach and exceed their capacity, drivers will begin to use more local streets to avoid congestion. Similarly, high levels of congestion on both the freeways and local network result in many freeway on-ramps and off-ramps experiencing more queueing and, therefore, more VHT. This is further exacerbated by freeway on-ramp meters, which also will increase the delay on ramps.

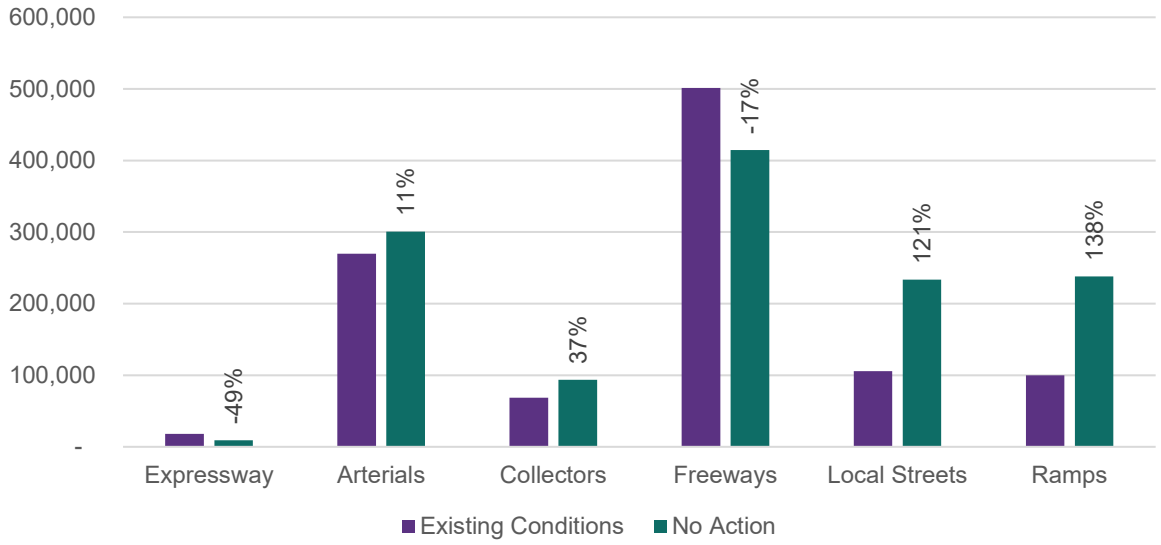
Note that the VHT on freeway and expressway facilities is anticipated to decrease approximately 17 percent between the Existing Conditions scenario and the 2030 No Action Alternative. This decrease in VHT is a result of the high level of congestion throughout the roadway network, which prevents vehicles from even being able to reach the freeway facilities. This is exemplified by the increase in VHT on ramp facilities, which offsets the reduction in VHT on freeway facilities. This shows that overall delay is being shifted from the freeway to the ramps and local roadway network and not actually being reduced. Table 8 and Figure 13 summarize the PM peak period VHT for the Existing Conditions scenario and the 2030 No Action Alternative.

Table 8: PM Peak Period VHT by Facility Type

	Existing Conditions	2030 No Action
Total VHT	1,063,000	1,289,000
Percent Difference from Existing Conditions	N/A	+21%

Source: I-25 Central PEL microsimulation traffic models

Figure 13: PM Peak Period VHT by Facility Type (Existing Conditions vs. 2030 No Action)



Percentages shown represent the percent difference from the Existing Conditions.
Source: I-25 Central PEL microsimulation traffic models

4.3. Impacts of Travel Demand Growth on Congestion

Congestion is expected to increase between the Existing Conditions scenario and the 2030 No Action Alternative. For the purposes of this PEL Study, congestion was measured using both travel times and average speeds. The following sections document the expected changes in both travel times and speeds between the Existing Conditions scenario and the 2030 No Action Alternative. Note that all results presented below are from the I-25 Central PEL's microsimulation models.

4.3.1. Changes in Travel Times Between Existing conditions and 2030 No Action

During both peak periods and in both directions, travel times on I-25 exceed the free-flow travel times in the corridor—which is approximately seven minutes between Broadway and Park Avenue. In general, the average and peak travel times in the I-25 Central corridor—between Broadway and Park Avenue—are expected to increase between the Existing Conditions scenario and the 2030 No Action Alternative. This increase reflects the growing travel demand for I-25 Central. The exception to this increase is in the northbound direction during the PM peak period. The microsimulation modeling results show that

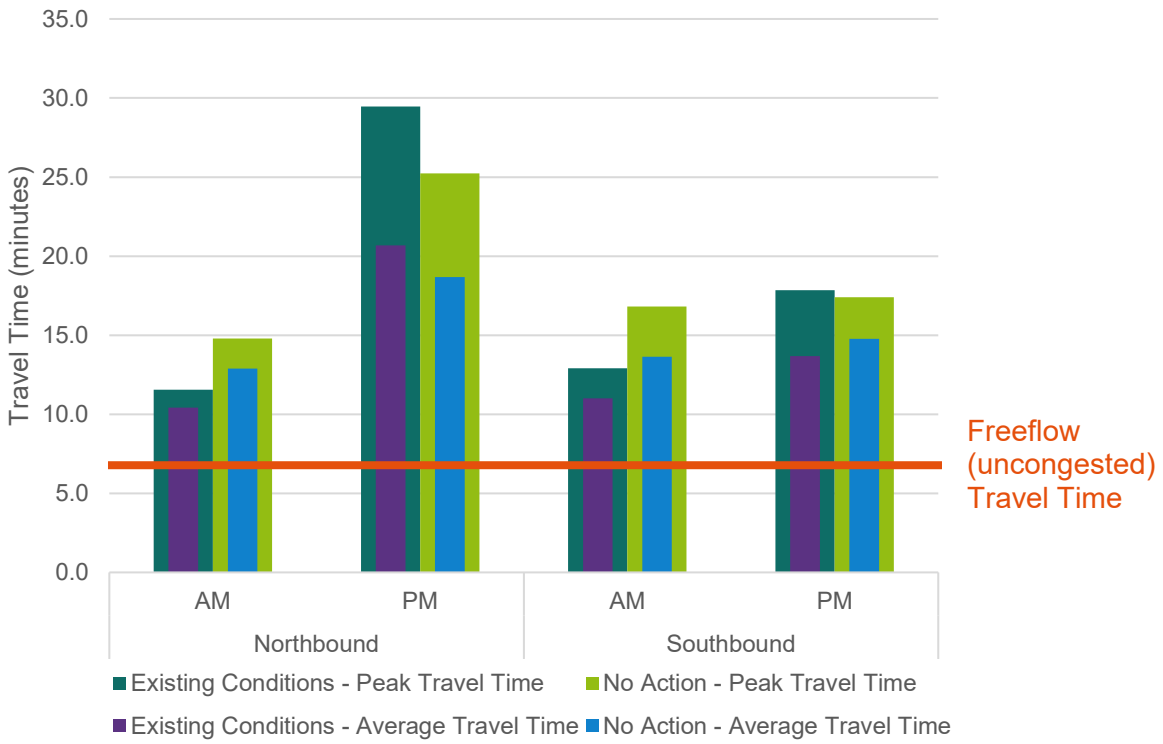
both the average and peak period travel times decrease between the Existing Conditions scenario and the 2030 No Action Alternative.

The decrease in travel times on northbound I-25 primarily result from two factors. First, existing capacity constraints on I-25 to the south of the I-25 Central study area—between approximately University Boulevard and Downing Street—limits/meters the number of vehicles that can reach I-25 Central. Even though travel demand increases by 2030, the number of northbound vehicles able to reach I-25 Central remains approximately the same as in the existing conditions.

Second, due to the increasing volumes attempting to enter and exit the freeway, vehicles on the mainline freeway often enter stop-and-go conditions around interchanges. This condition is most prevalent in the right-most lanes of the freeway, where vehicles are merging and weaving with off-ramp traffic. These slower conditions in the right lanes on the freeway act as a barrier to traffic attempting to merge onto the mainline since changing lanes in stop-and-go conditions is very difficult. Because of this barrier effect, traffic in the left lanes of the freeway is able to flow by with less interference from ramp traffic. Both the metering effect from the existing capacity constraints on I-25 south of the I-25 Central study area and the barrier effect throughout the study area result in end-to-end travel times being slightly reduced. Figure 14 summarizes the travel time changes for I-25 Central between the Existing Conditions scenario and the 2030 No Action Alternative.

It is important to note that although northbound PM peak end-to-end travel times are slightly reduced, this should not be interpreted as an overall reduction in congestion in the 2030 No Action Alternative. Rather, this reflects extreme congestion that negatively impacts freeway operations to such a degree that traditional traffic analysis and modeling efforts have difficulty quantifying it.

Figure 14: Average and Peak Travel Times – Broadway to Park Avenue (Existing Conditions vs. 2030 No Action)

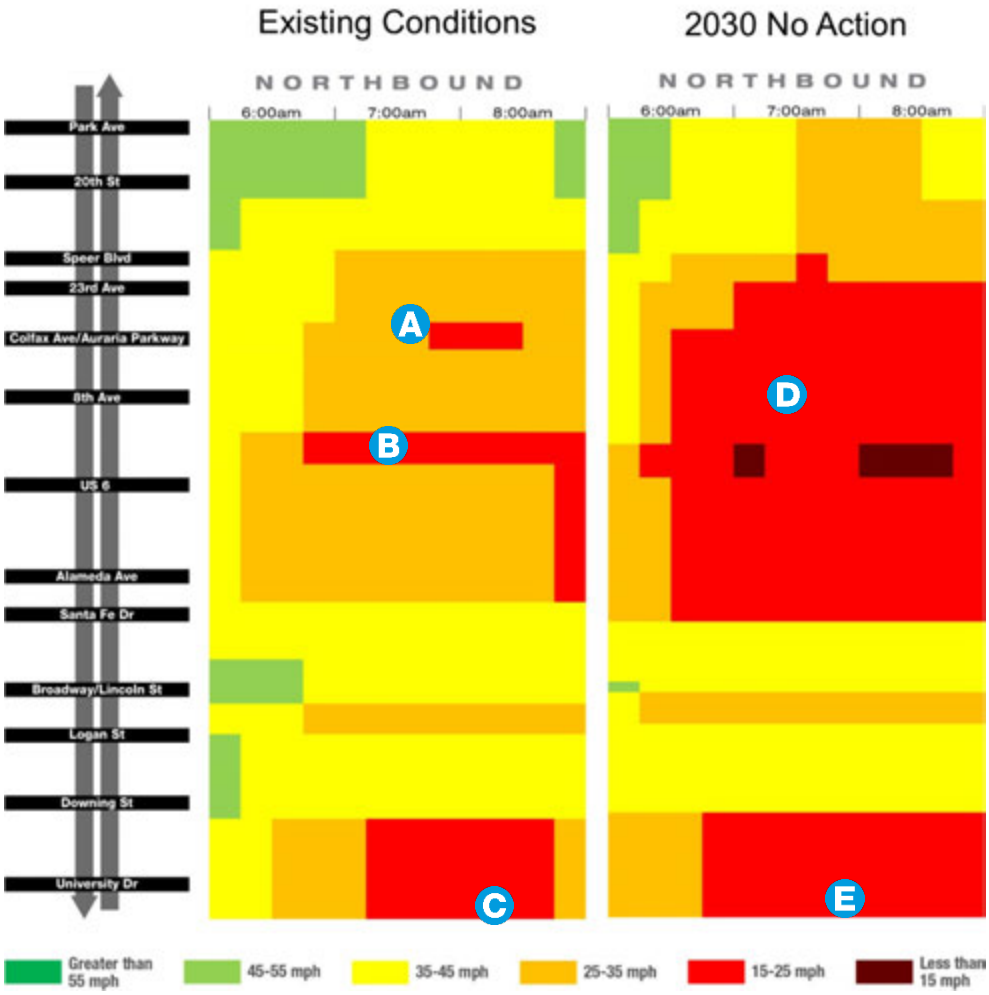


4.3.2. Changes in Speeds Between Existing Conditions and 2030 No Action

The increasing travel demand between the Existing Conditions scenario and the 2030 No Action Alternative will result in slower speeds on I-25 Central. Figure 15 through Figure 18 summarize the changes in speeds between the Existing Conditions scenario and the 2030 No Action Alternative for each direction of travel—between University Boulevard and Park Avenue—and each peak period. Additional annotations are provided with each figure to highlight the key differences/changes.

In general, traffic congestion on I-25 Central is expected to continue to be primarily influenced by the travel demand into and out of the downtown Denver area. This traffic pattern is observed in the existing conditions origin-destination data—documented in the *I-25 Central Origin-Destination Analysis Technical Memorandum* (November 2018) available in Attachment A, *Existing Conditions Assessment Report*, of the I-25 Central PEL Study Report—and is reflected in both the existing conditions and the 2030 No Action Alternative microsimulation models.

Figure 15: Average, Northbound, AM Peak Period Speeds on I-25 – University Boulevard to Park Avenue (Existing Conditions vs 2030 No Action)



A On-ramp traffic from Colfax Avenue creates localized slowing due to the short distance between the Colfax Avenue on-ramp and the 17th Avenue off-ramp.

B On-ramp traffic from US 6/6th Avenue must merge into I-25 traffic and weave across traffic exiting to Colfax Avenue and Auraria Parkway. This heavy merging and weaving movements slow traffic to stop-and-go conditions.

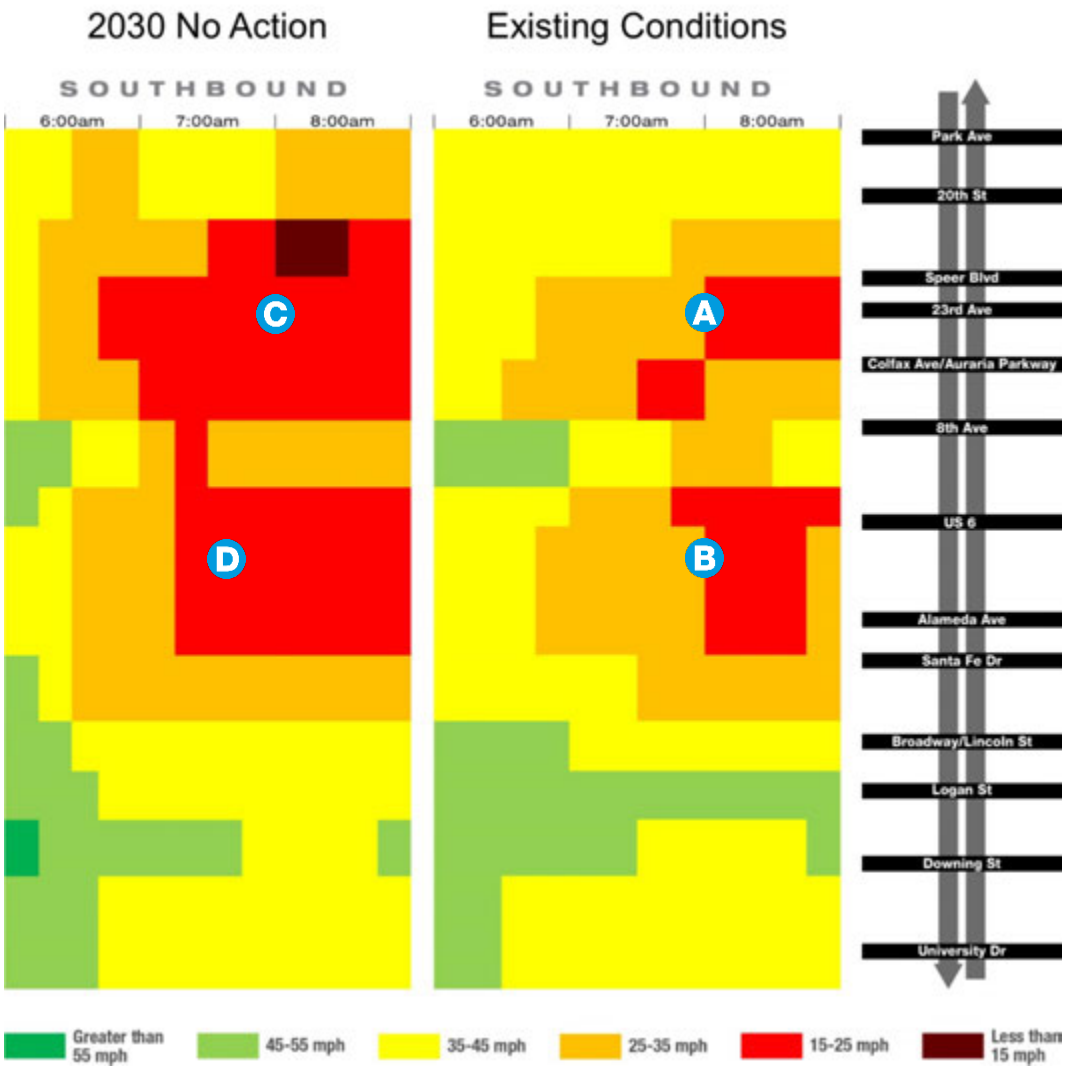
C During the worst times of the AM peak period, traffic on I-25 south of the I-25 Central corridor is very congested. This limits/meters the amount of traffic that can reach the I-25 Central corridor.

D Due to increasing travel demand, congestion is expected to worsen in the 2030 No Action Alternative. Where traffic was slow with only pockets of stop-and-go conditions in the existing conditions, it is anticipated to turn into a continuous segment of stop-and-go traffic beginning at Santa Fe Drive/US 85 and continuing to approximately Speer Boulevard.

E During the worst times of the AM peak period, traffic on I-25 south of the I-25 Central corridor is very congested. This limits/meters the amount of traffic that can reach the I-25 Central corridor. This metering effect is expected to intensify in the 2030 No Action Alternative.

Source: Speed data was obtained from the I-25 Central PEL microsimulation traffic models.

Figure 16: Average, Southbound, AM Peak Period Speeds on I-25 – University Boulevard to Park Avenue (Existing Conditions vs. 2030 No Action)



A Double lane drops to Speer Boulevard and 23rd Avenue creates a bottleneck as southbound I-25 traffic must merge into four through lanes. This—combined with on-ramp traffic from 20th Street, Speer Boulevard, and 23rd Avenue—creates slowing.

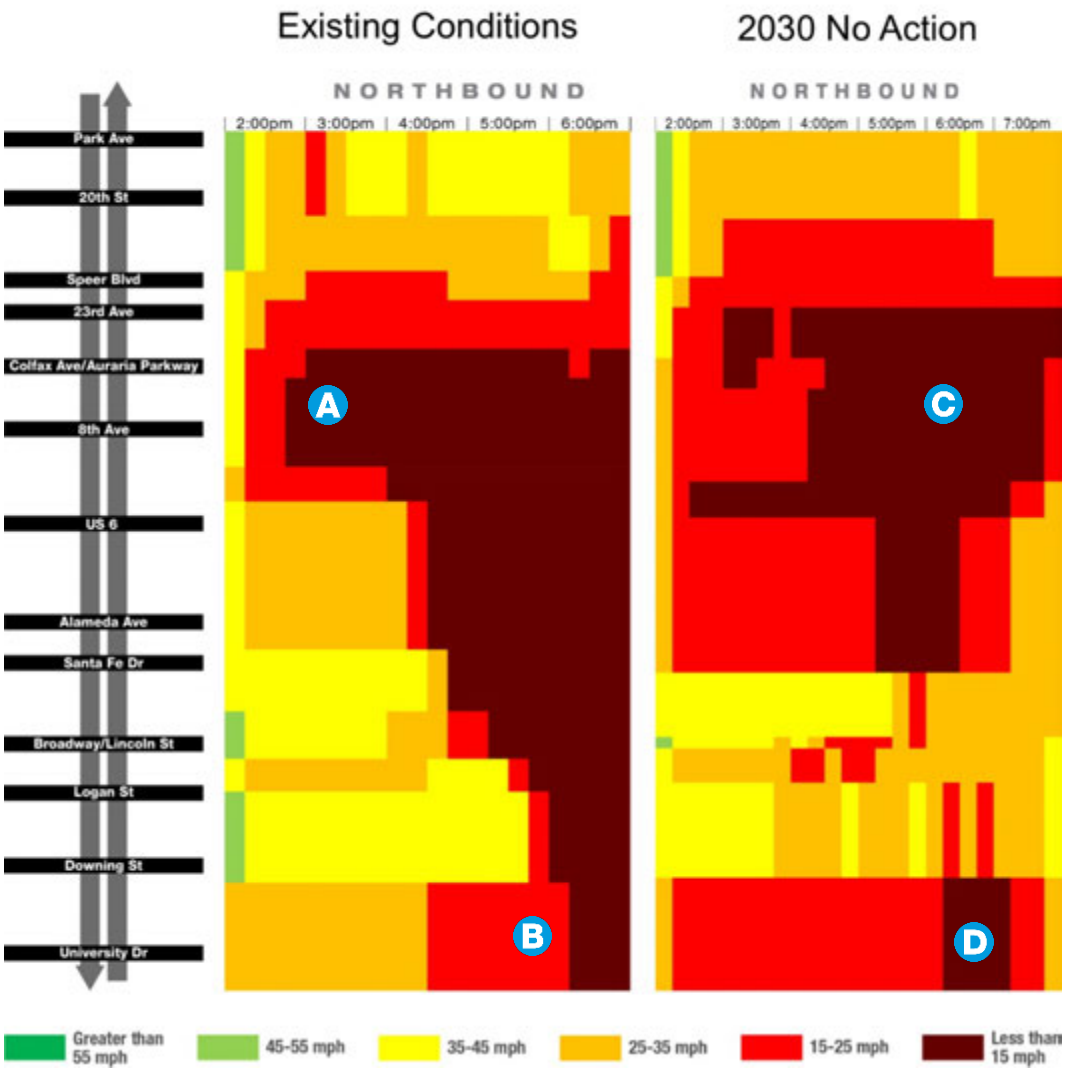
B Weaving between on-ramp traffic from US 6/6th Avenue and off-ramp traffic to Alameda Avenue and Santa Fe Drive/US 85, combined with substandard geometry, creates slowing in this area.

C Increasing volumes on southbound I-25 between the Existing Conditions scenario and the 2030 No Action Alternative are expected to make the existing bottleneck at 23rd Avenue worse.

D Increasing volumes on both I-25 and the on- and off-ramps are expected to make the existing weaving and geometric issues worse in the 2030 No Action Alternative.

Source: Speed data was obtained from the I-25 Central PEL microsimulation traffic models.

Figure 17: Average, Northbound, PM Peak Period Speeds on I-25 – University Boulevard to Park Avenue (Existing Conditions vs. 2030 No Action)



A Heavy weaving traffic between US 6/6th Avenue and Colfax Avenue/Auraria Parkway slows traffic. This results in queues forming on the freeway that extend back past Santa Fe Drive/US 85.

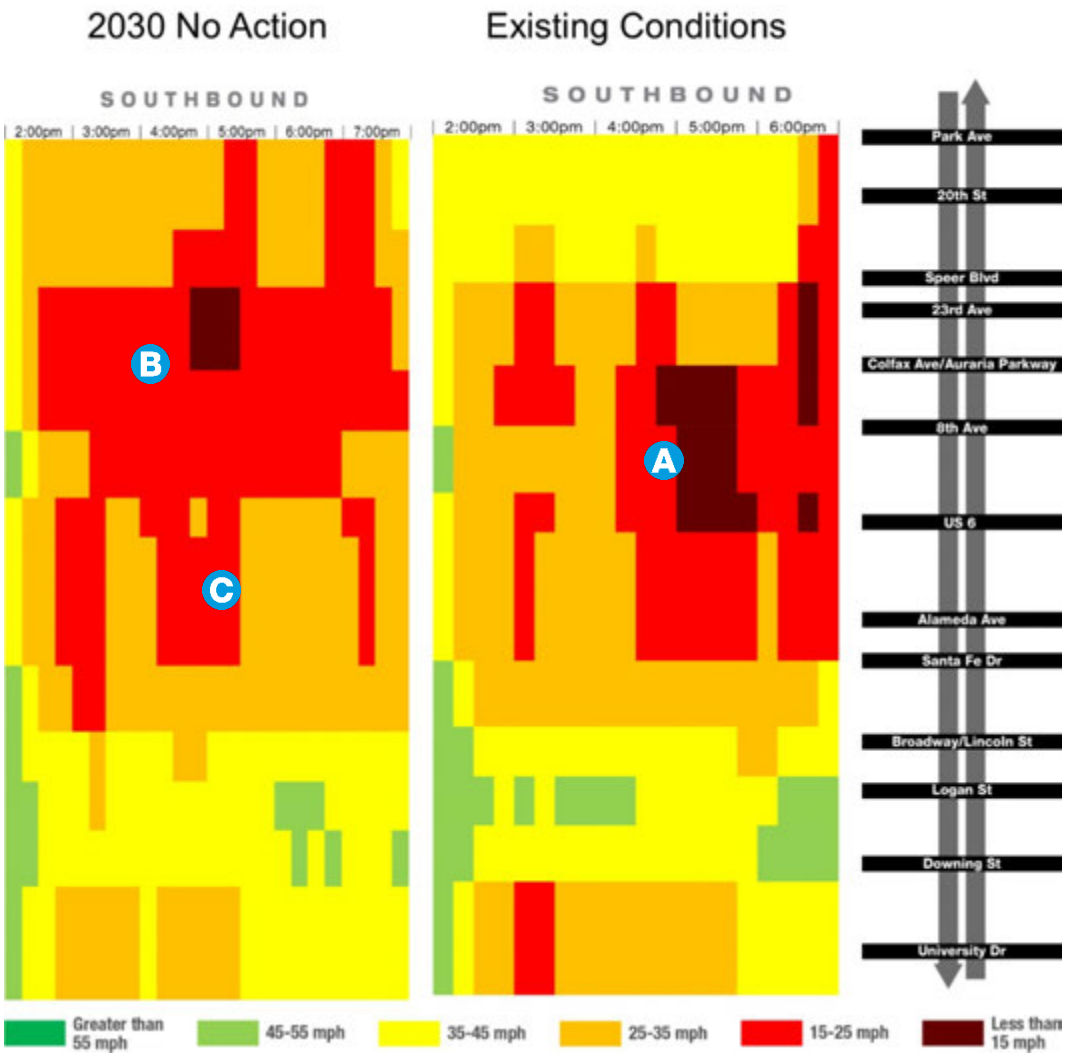
B Existing capacity constraints on I-25 to the south limits/meters the amount of traffic that can come into the I-25 Central corridor.

C The existing weaving issues between US 6/6th Avenue and Colfax Avenue/Auraria Parkway remain in the 2030 No Action Alternative; however, they are further exacerbated by the continued travel demand growth from Santa Fe Drive/US 85. This extends the weaving issues to include the area from Santa Fe Drive/US 85 to Colfax Avenue/Auraria Parkway.

D Spillback queues from the area between Santa Fe Drive/US 85 to Colfax Avenue/Auraria Parkway are limited due to the metering effects south of the I-25 Central study area. Capacity limitations on northbound I-25 near University Boulevard result in fewer vehicles being able to reach the I-25 Central corridor.

Source: Speed data was obtained from the I-25 Central PEL microsimulation traffic models.

Figure 18: Average, Southbound, PM Peak Period Speeds on I-25 – University Boulevard to Park Avenue (Existing Conditions vs. 2030 No Action)



A Heavy weaving movements between the Colfax Avenue/Auraria Parkway/Lower Colfax Avenue on-ramps and the US 6/6th Avenue off-ramps results in slowing. This slowing persists through Santa Fe Drive/US 85 due to the continued weaving movements from US 6/6th Avenue on-ramp traffic and Santa Fe Drive/US 85 off-ramp traffic.

B As volumes increase in the 2030 No Action Alternative, the southbound PM peak period congestion patterns are expected to shift and begin to better reflect the southbound AM peak period congestion patterns. This is observed near 23rd Avenue, where the double-lane drop to Speer Boulevard and 23rd Avenue results in a bottleneck on the freeway. This bottleneck results in slowing and begins to meter traffic south. This metering of traffic reduces the weaving friction between the Colfax Avenue/Auraria Parkway/Lower Colfax Avenue on-ramps and the US 6/6th Avenue off-ramps.

C Existing weaving issues between the US 6/6th Avenue on-ramps and the Santa Fe Drive/US 85 off-ramps are expected to get worse as traffic volumes increase in the 2030 No Action Alternative.

Source: Speed data was obtained from the I-25 Central PEL microsimulation traffic models.

4.4. Impacts of Travel Demand Growth on Roadway Volumes

In general, roadway volumes are expected to increase between the Existing Conditions scenario and the 2030 No Action Alternative. This section documents and discusses the anticipated changes to roadway volumes within the I-25 traffic analysis area, specifically in and around the I-25 Central PEL study area. For clarity, the subsections are divided into a discussion about the mainline freeway, the on- and off-ramps, and, finally, the local roadway network.

Throughout this chapter, much of the discussion involves understanding the large roadway network congestion patterns and how they affect people's route choices. In general, a driver's route choice behavior can be summarized into three scenarios. For the purpose of this discussion, these scenarios are referred to as a driver's route choice given moderate congestion, high congestion, and extreme congestion. Each of these scenarios is described in greater detail below.

In general, as volumes and travel demand continue to increase in the 2030 No Action Alternative, I-25 Central is anticipated to experience more hours of the day within the extreme congestion scenario and fewer hours of the day in the moderately congested scenario. Each of these scenarios is reflected in the following discussions about changes in roadway volumes.

4.4.1. Moderate-Congestion Scenario

In a moderate-congestion scenario, drivers usually will have one primary route that they take every day to make the same trip. This trip may take longer during congested periods of the day, but in general drivers always use this same route because the congestion is not bad enough to search for an alternate route. Within the I-25 Central model, this scenario exists during the shoulder periods of the existing conditions AM peak period when most people choose to use I-25 if possible.

4.4.2. Highly Congested Scenario

In a highly congested scenario, drivers may have a few different routes they choose from to make the same trip. The route they choose depends on the level of congestion, but in general each route is distinct and uses one of a few major routes. An example of this may be the choice to use the freeway for a trip or, if the freeway is congested, then use a parallel major arterial as an alternate route. In either route, the driver is following one primary roadway throughout the trip. An example of this scenario within the I-25 Central study area would be the existing conditions AM peak period or the existing conditions shoulder periods of the PM peak period when some people use I-25 and some people begin to use parallel local facilities such as Broadway/Lincoln Street or Federal Boulevard.

4.4.3. Extreme Congestion Scenario

In an extreme congestion scenario, drivers route choices become more variable because a majority of the primary roadway network—the major facilities such as the freeway and local arterial network by which most trips are made—is equally congested. This means that the roadway network has slowed down to the point at which local roadways and circuitous paths have equal travel time as compared to the major facilities. In this situation, drivers going between the same origin/destination pair may use very different paths. An example of this scenario within the I-25 Central study area is the existing PM peak period, in which drivers skip between the freeway, arterials, and local roadways—often zig-zagging through the gridded roadway network—in an effort to avoid congestion.

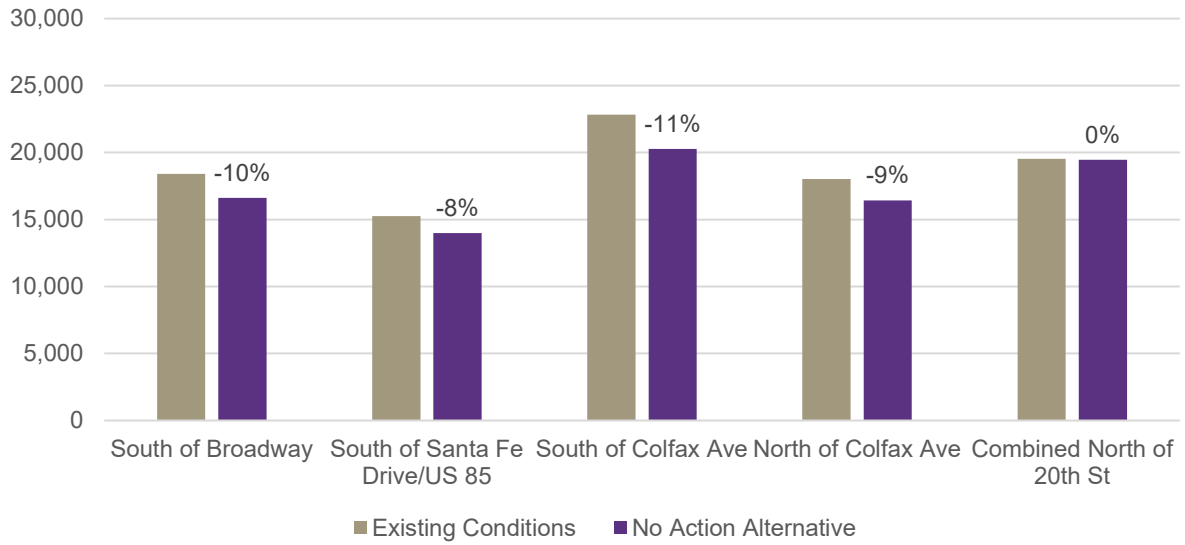
4.4.4. Changes in I-25 Mainline Freeway Volumes between Existing Conditions and 2030 No Action

Although overall travel demand is anticipated to increase between the Existing Conditions scenario and the 2030 No Action Alternative, volumes on I-25 through the central corridor are expected to remain relatively similar to the existing conditions or even decrease slightly. This will happen because I-25 is already operating at or over capacity during the peak periods. Without any improvements to the freeway, it will be unable to process any more vehicles in the future. Furthermore, an increasing number of vehicles entering and exiting the highway in the future will increase the turbulence on the roadway and further reduce the overall safety and capacity of the freeway. This scenario is reflected by a decrease in overall volumes being processed on the freeway during the peak periods. The following subsections discuss the mainline freeway volumes during the peak periods.

4.4.4.1. I-25 AM Peak Period Freeway Volumes

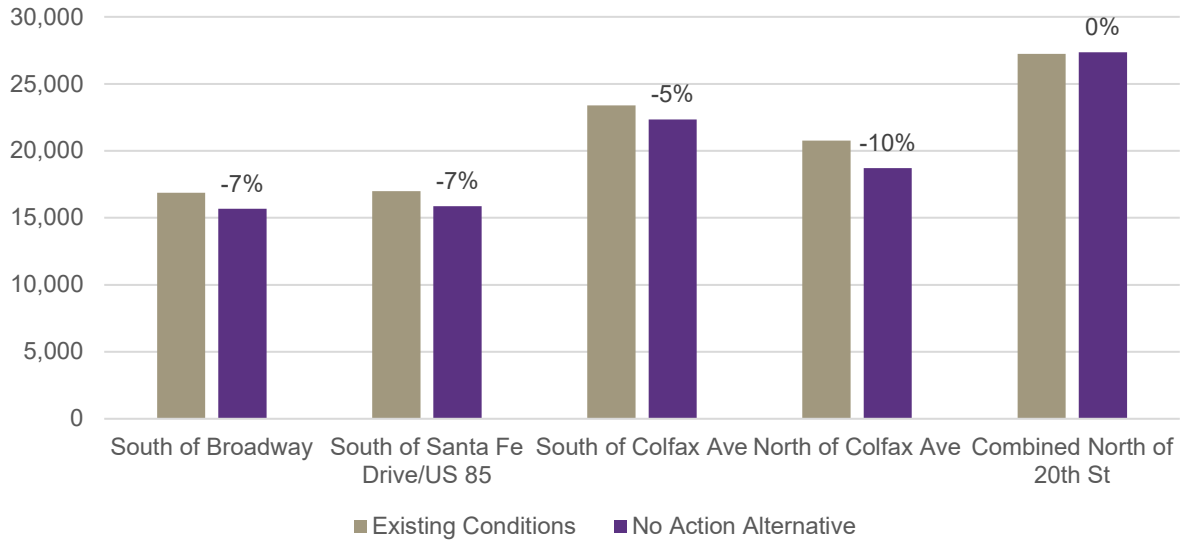
In the 2030 No Action AM peak period scenario, existing congestion will be exacerbated by an increase in travel demand, thereby increasing the duration and intensity of congestion. This will result in segments of the I-25 mainline freeway processing between 5 percent and 10 percent less volume than in the existing conditions. In the AM peak period, the largest reductions in volume are anticipated around the Colfax Avenue/Auraria Parkway interchange. This interchange represents the primary entrance point into and out of the downtown area and experiences some of the highest merging and weaving volumes as vehicles traveling northbound navigate the weave between the US 6/6th Avenue on-ramp and Colfax Avenue/Auraria Parkway off-ramp. Likewise, vehicles traveling southbound navigate the series of on-ramps from Speer Boulevard, 23rd Avenue, Colfax Avenue/Auraria Parkway/Lower Colfax Avenue, and the US 6/6th Avenue off-ramps. Increasing ramp volumes in the 2030 No Action Alternative result in more merging and weaving in these areas, thus reducing the overall capacity of the freeway. This means the freeway will process fewer vehicles than it does in the existing conditions. Figure 19 and Figure 20 summarize the mainline freeway volumes during the AM peak period for the Existing Conditions scenario and the 2030 No Action Alternative.

Figure 19: Northbound, AM Peak Period Mainline Freeway Volumes (Existing Conditions vs. 2030 No Action)



Percentages shown represent the percent difference from the Existing Conditions.

Figure 20: Southbound, AM Peak Period Mainline Freeway Volumes (Existing Conditions vs. 2030 No Action)

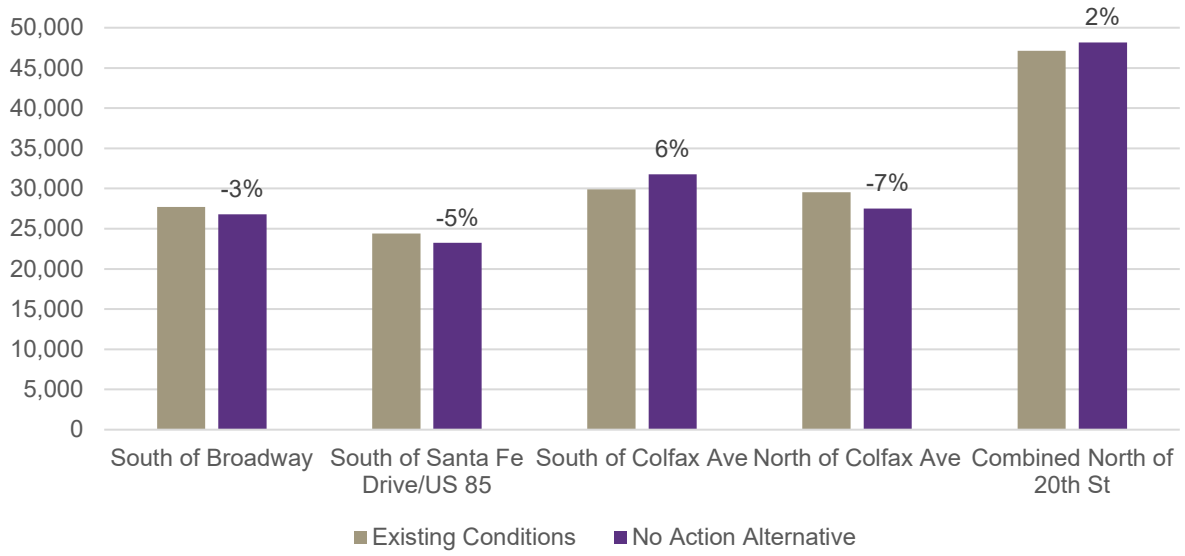


Percentages shown represent the percent difference from the Existing Conditions.

4.4.4.2. I-25 PM Peak Period Freeway Volumes

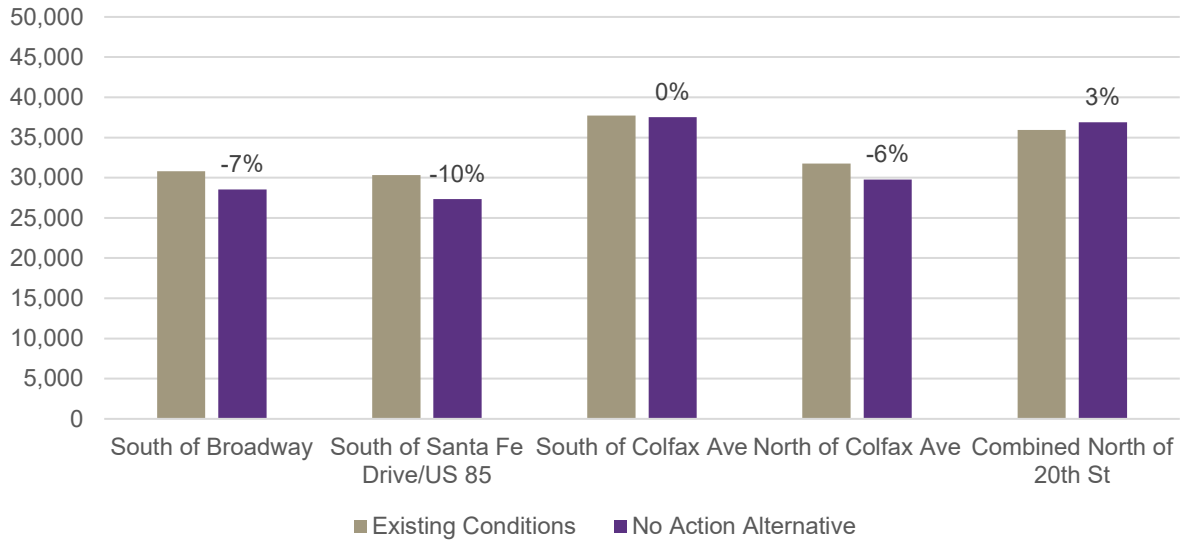
During the PM Peak period, I-25 is expected to process about the same number of vehicles (± 5 percent) as the existing conditions. Similar to the AM peak period, while some locations are anticipated to process fewer vehicles due to an increase in merging and weaving, this effect is expected to be smaller in the PM peak period since it already experiences extreme merging and weaving turbulence in the existing conditions. Although the overall travel demand will increase, the existing capacity constraints experienced today on both the mainline freeway and the ramps limit the increase in volume much beyond what is experienced today. Figure 21 and Figure 22 summarize the I-25 mainline freeway volumes for the PM peak period for the Existing Conditions scenario and the 2030 No Action Alternative.

Figure 21: Northbound, PM Peak Period Mainline Freeway Volumes (Existing Conditions vs. 2030 No Action)



Percentages shown represent the percent difference from the Existing Conditions.

Figure 22: Southbound, PM Peak Period Mainline Freeway Volumes (Existing Conditions vs. 2030 No Action)



Percentages shown represent the percent difference from the Existing Conditions.

4.4.5. Changes in I-25 Ramp Volumes between Existing Conditions and 2030 No Action

In general, ramp volumes are expected to increase between the Existing Conditions scenario and the 2030 No Action Alternative. This is a result of increasing travel demand for I-25. However, in select locations, ramp volumes are expected to decrease. This is in response to increasing congestion on the freeway. As congestion increases, some drivers will choose to use alternate routes to reach their

destinations. This results in lower ramp volumes in some of the highly congested areas of I-25 Central. Figure 23 and Figure 24 summarize the I-25 ramp volumes for the AM peak period and PM peak period for the Existing Conditions scenario and 2030 No Action Alternative.

Figure 23: AM Peak Period Ramp Volume Changes (Existing Conditions to 2030 No Action)

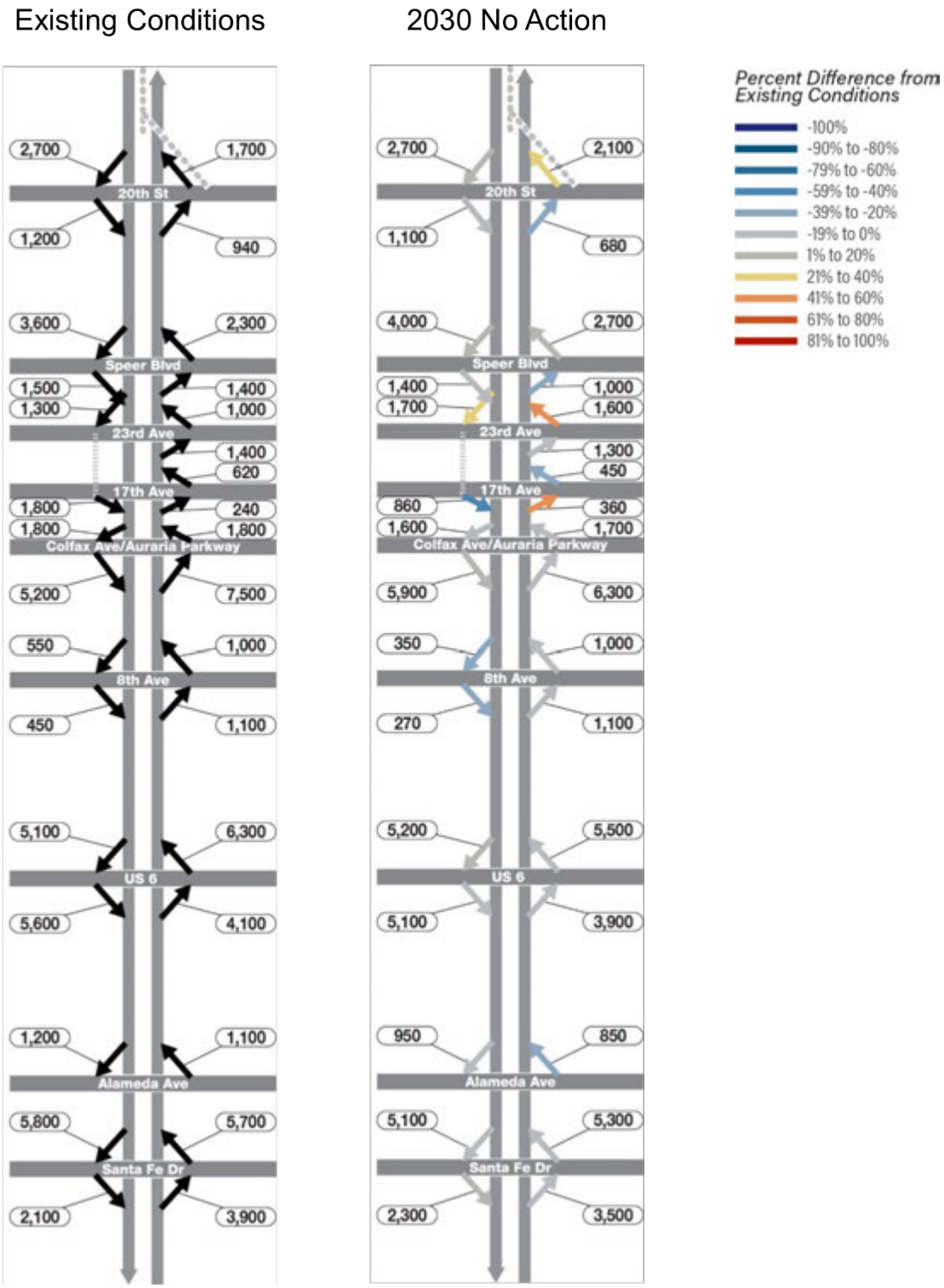
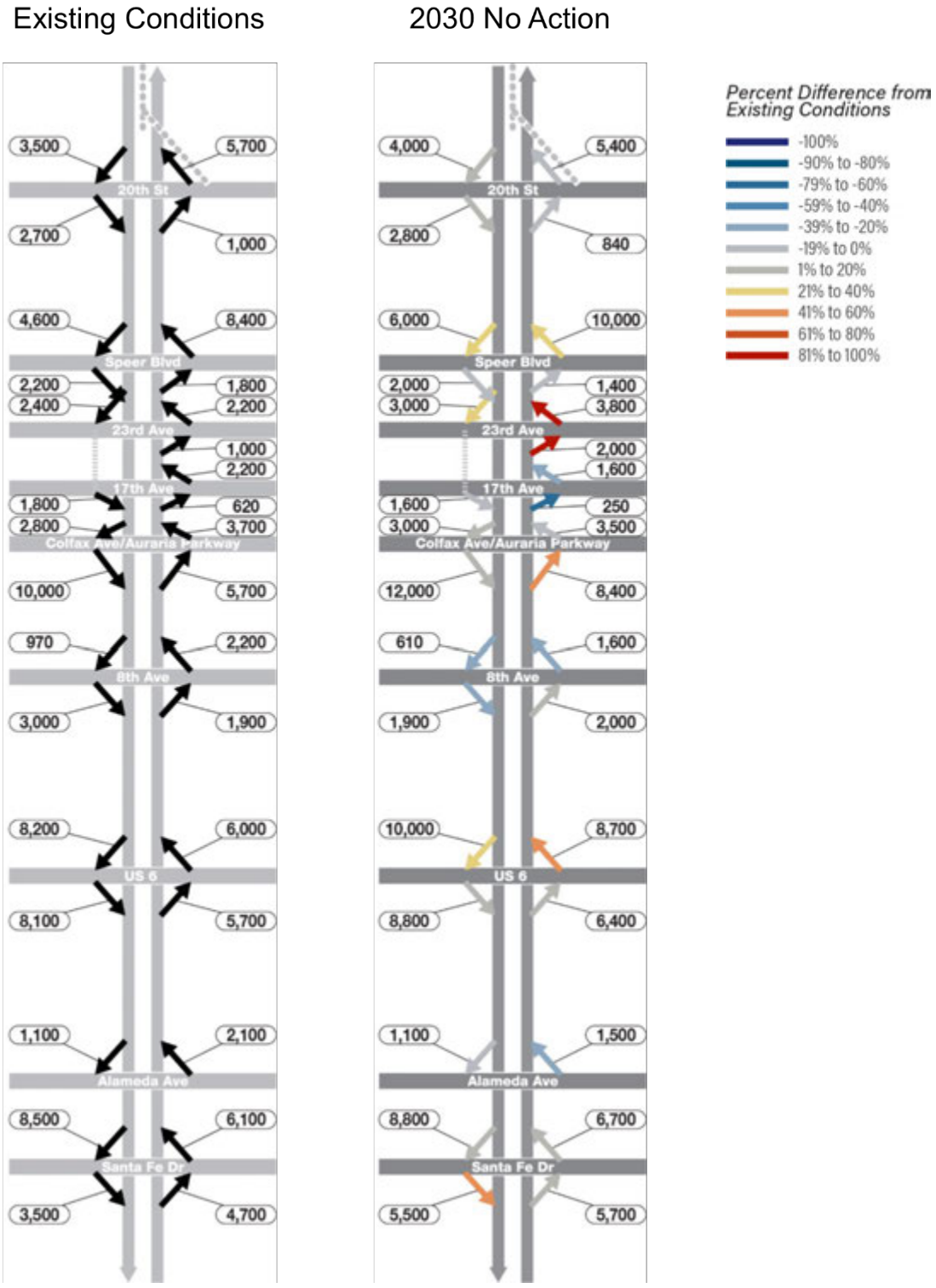


Figure 24: PM Peak Period Ramp Volume Changes (Existing Conditions to 2030 No Action)



4.4.6. Changes in Local Roadway Volumes between Existing Conditions and 2030 No Action

As travel demand increases between the Existing Conditions scenario and the 2030 No Action Alternative, volumes on the local network will increase. As discussed in the VMT and VHT section of this report, traffic on the local network will increase faster than on the freeway network due to capacity constraints on I-25. This increase is most notable in the areas closest to downtown Denver and for roadway facilities that are closer to I-25.

Figure 25 through Figure 28 compare the screenline volumes between the Existing Conditions scenario and the 2030 No Action Alternative. Additional discussion about specific volumes and locations is included in Appendix E, *Detailed Screenline Volumes*, of this Technical Report.

Figure 25: AM Peak Period Existing Conditions Scenario Screenline Volumes

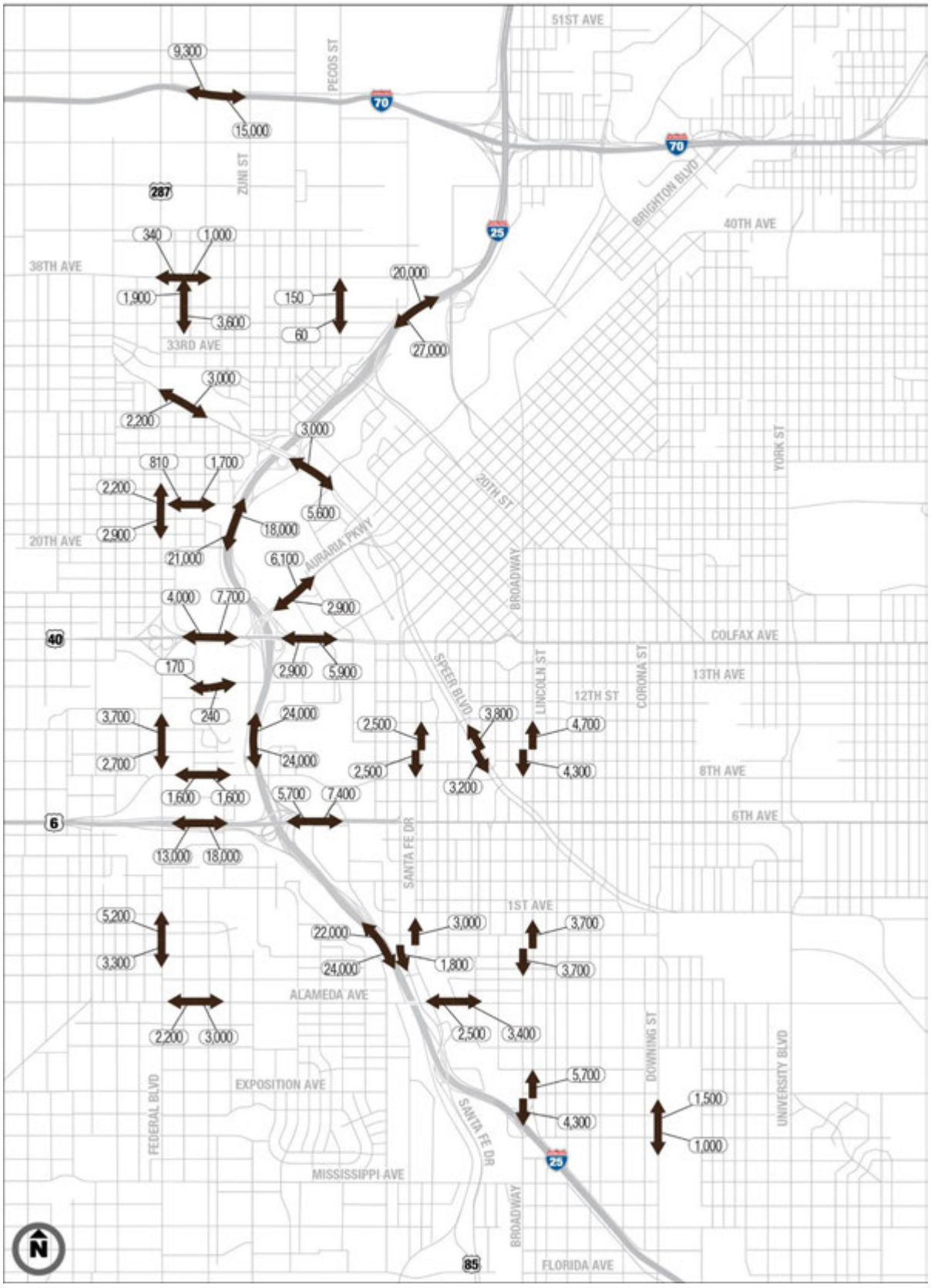


Figure 26: AM Peak Period 2030 No Action Alternative Screenline Volumes

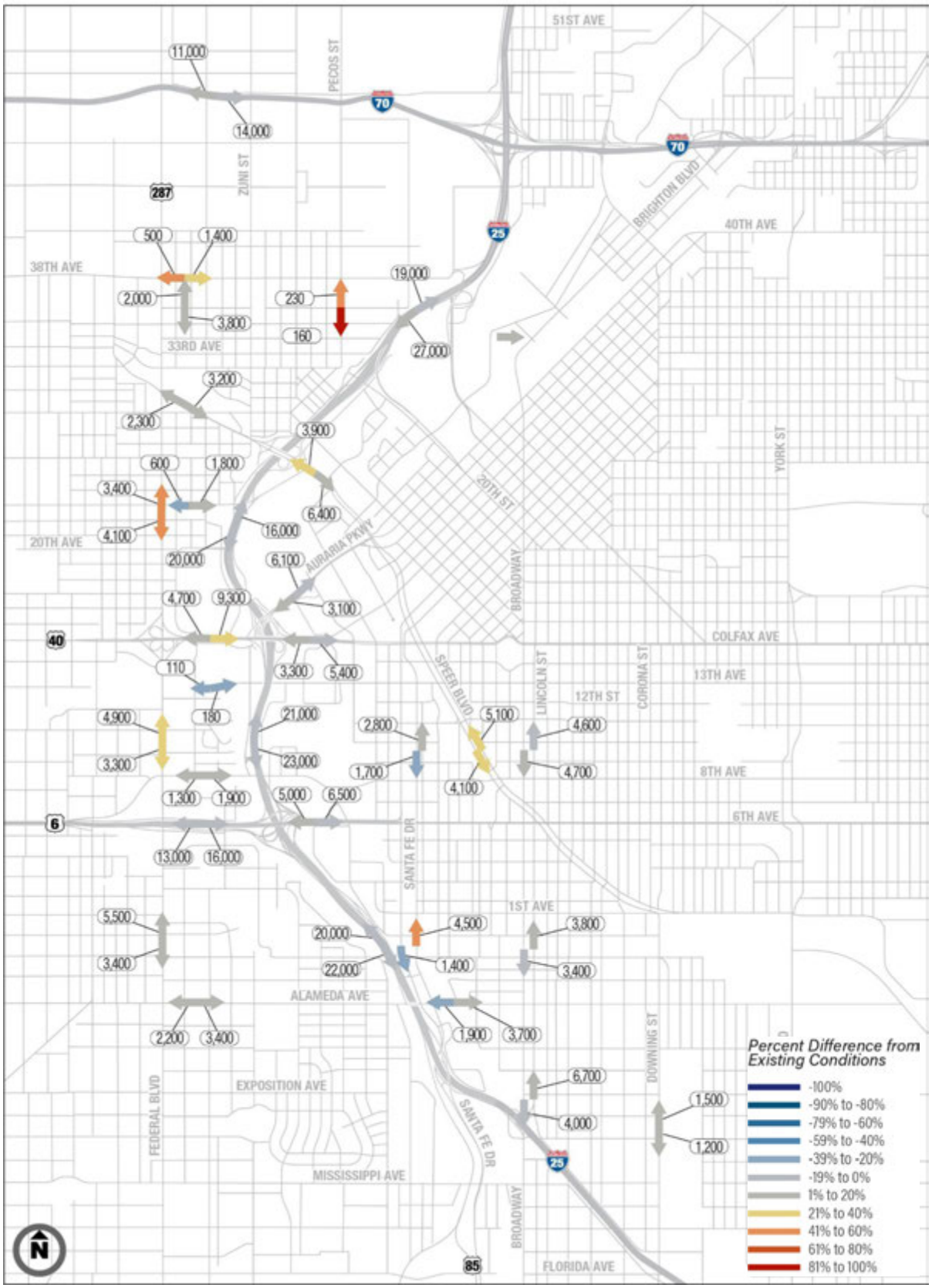


Figure 27: PM Peak Period Existing Conditions Scenario Screenline Volumes

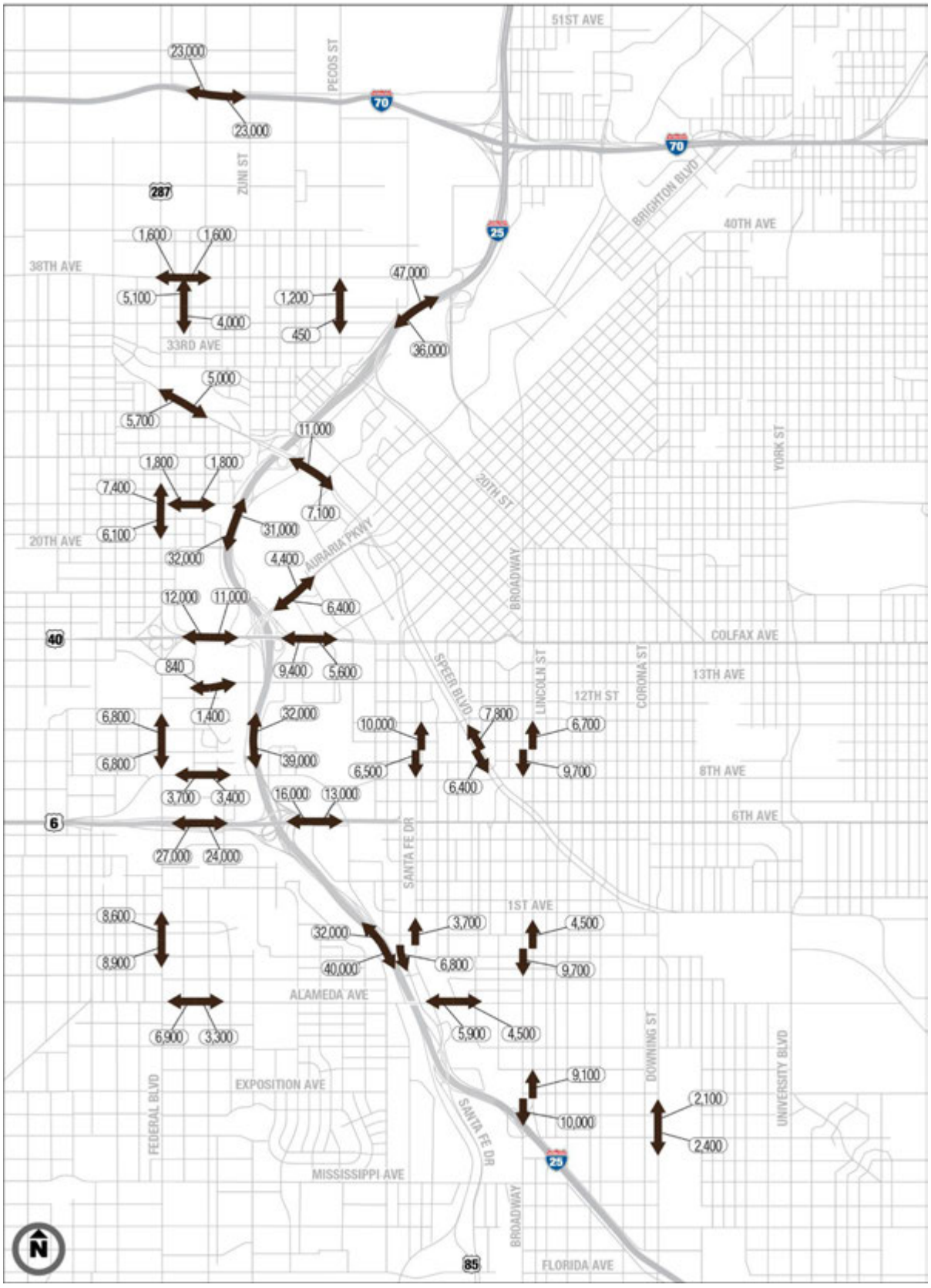
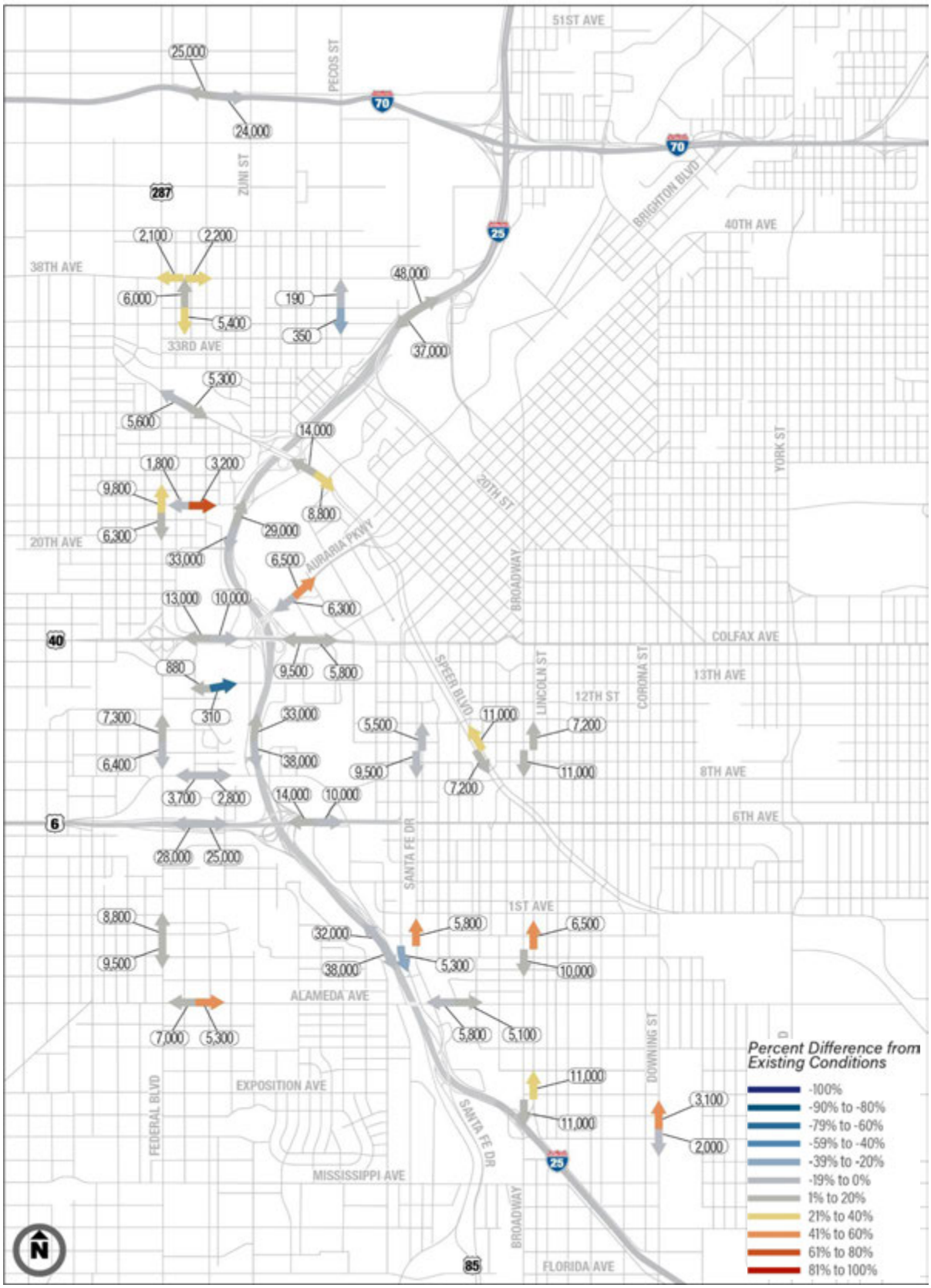


Figure 28: PM Peak Period 2030 No Action Alternative Screenline Volumes



5. Alternatives Analysis Traffic Results

This section documents the traffic analysis results for the I-25 Central alternatives. Discussion within the subsections below are grouped together by topic area with results of each alternative being discussed within each topic area. The comparative results between alternatives are discussed at the end of this chapter.

5.1. Alternatives Modeling Methodology

When modeling the alternatives, every effort was made to maintain the same assumptions that were used for the calibrated existing conditions modeling. However, because the alternatives introduced new situations that do not exist in the existing conditions, some modifications to the modeling methodology were made. Based on new elements introduced as part of the alternatives analysis, changes and/or assumptions that were made for the purposes of modeling the alternatives included:

- The PM peak period modeling time was extended by one hour.
- Drivers were banned from using CD roads to circumvent the mainline freeway.
- New or modified managed lane facilities were assumed to be dynamically priced.
- The existing reversible managed lanes between 20th Street and US 36 were converted into bidirectional travel.
- New or modified traffic signals were timed and optimized to be consistent with existing signal timings.
- The 2030 No Action origin/destination tables were used for all build alternatives.

A discussion of these changes in assumptions is included in the following subsections.

5.1.1. Extended PM Peak Period Modeling Duration

In the existing conditions, the PM peak period was analyzed from 2:00 p.m. to 7:00 p.m. The 2030 No Action PM peak period model results analyzed the time period between 2:00 p.m. and 8:00 p.m. The outputs from these model runs were then truncated to compare them to the Existing Conditions which only had modeling results for the period between 2:00 p.m. and 7:00 p.m. This was done to match the PM peak period out of the DRCOG TDM. However, due to the increasing duration of congestion in the 2030 No Action Alternative, the build alternatives were analyzed using a longer PM peak period. For the purposes of analyzing alternatives, the PM peak period was analyzed from 2:00 p.m. to 8:00 p.m. This allowed the microsimulation traffic models to better capture the peak of congestion as well as the shoulder periods. To provide the best side-by-side comparison, all PM peak period results presented within this chapter are aggregated results for the duration from 2:00 p.m. to 8:00 p.m. The numbers for the 2030 No Action Alternative presented within this chapter include the additional hour and are therefore slightly different than those discussed in the previous chapter.

5.1.2. Bypass Routes on the CD Roads

Depending on the configuration of CD roads, they can sometimes provide a parallel route to the mainline freeway. This occurs when a CD road exits the mainline freeway, passes one or more interchanges, and then reconnects to the mainline freeway. When this configuration occurs, some drivers will choose to exit the freeway to the CD road, travel in the CD road, and then re-enter the mainline freeway farther downstream. Drivers most often choose to use CD roads in this way when congestion is present on the mainline freeway.

This type of behavior is already observed on portions of I-25 in the Denver metropolitan region, where CD roads with a similar configuration currently exist. Although not illegal or explicitly prohibited, CD roads are not intended to be used in this manner. Doing so can reduce the effectiveness of CD roads.

When attempting to replicate this behavior in the I-25 Central microsimulation traffic model, a perfect travel time equilibrium could never be reached between the mainline freeway and the adjacent CD road. This resulted in an all-or-nothing route assignment within the traffic model, which eventually grid-locked the model. To avoid the breakdown of the model, bypass routes within the model were banned. This means that drivers were not allowed to exit to a CD road and then re-enter the mainline freeway.

5.1.3. New or Modified Managed Lane Facilities

In the existing conditions, there is only one managed lane facility within the traffic analysis area—the reversible express lanes between 20th Street and US 36. These lanes currently have set time-of-day toll rates. These rates were used in the existing conditions model and slightly raised within the 2030 No Action Alternative model to maintain congestion-free conditions within the managed lanes.

Based on the vision identified in the ELMP, the Managed Lanes Build Alternative includes adding a managed lane in each direction between approximately Santa Fe Drive/US 85 and 20th Street. Furthermore, it also assumes that the existing reversible express lanes between 20th Street and US 36 are converted to bidirectional travel all day.

It was assumed that these facilities, like all existing managed lane facilities within Colorado, will be managed using variable toll rates that ensure congestion free travel within the managed lane. To achieve this, all new or modified managed lane facilities within the build alternatives were modeled using TransModeler's dynamic pricing capabilities, which were set to ensure a *Highway Capacity Manual* Version 6 (HCM 6) Level of Service of LOS C or better within the managed lanes.

Note that—unlike the existing time-of-day toll rates, which are optimized only to historical average conditions taken over a period of time—the continually variable toll rates used within the microsimulation traffic models use real-time conditions within the model to update the toll rates every few minutes. Using this continually updating tolling scheme likely results in a higher level of optimization and, therefore, more maximized utilization of the managed lanes than would occur in the field.

In addition, in all cases involving managed lanes and tolling, it was assumed that the current high-occupancy vehicle (HOV) policy remains the same. This policy allows vehicles traveling with three or more passengers to use the managed lane facilities for free.

5.1.4. Conversion of the Existing Managed Lanes into a Bidirectional Facility

As mentioned previously, for the purposes of the Managed Lanes Alternative, it was assumed that the existing reversible managed lanes between 20th Street and US 36 are modified to accommodate bidirectional travel throughout the day. Within the I-25 Central microsimulation traffic model, this conversion was achieved by assuming that an additional third managed lane is added to the two existing lanes. These three lanes would operate in a "zipper" fashion with two lanes serving the peak direction—southbound during the AM peak period and northbound during the PM peak period—and one lane serving the off-peak direction. This reconfiguration of the existing managed lanes was only done within the Managed Lanes Alternative.

This modification to the existing managed lanes was based on the managed lanes system envisioned in the ELMP. It was applied to the Managed Lanes Alternative to allow the managed lanes through the I-25 Central corridor to operate at their peak efficiency. Without the conversation of the existing

managed lanes between 20th Street and US 36, the volumes being processed through the proposed new managed lanes from 20th Street to Santa Fe Drive/US 85 likely would be lower.

5.1.5. New or Modified Traffic Signals

In general, all traffic signal timings from the 2030 No Action Alternative were maintained in all build alternatives. However, due to the configuration of some build alternatives, certain traffic signals had to be retimed. This occurred at ramp terminals where the interchange was reconfigured. When this occurred, the traffic signals were retimed using the following assumptions:

- The cycle length, minimum green, yellow time, all red time, and other parameters were maintained from the original traffic signal. If a new signal had to be added, then its parameters were set to match the parameters of other traffic signals on the same facility.
- Signal timing offsets were calculated and optimized manually in an effort to maintain a similar progression pattern to the 2030 No Action Alternative.

5.1.6. 2030 Origin/Destination Tables

All build alternatives were modeled using the same origin/destination tables that were used in the 2030 No Action Alternative. This allows individual improvements to be compared side-by-side across the different build alternatives.

It is understood that improvements which substantially enhance operations on I-25 are likely to have a regional effect on route choice. This scenario is most likely to occur in the Managed Lanes Alternative because it adds an additional lane of traffic in each direction through the entire corridor. New origin/destination tables were not used for the Managed Lanes Alternative due to limitations within the most current DRCOG TDM. These limitations currently prevent the TDM from being able to produce accurate origin/destination tables for networks with extensive managed lanes systems.

5.2. Alternatives' Impacts to VMT and VHT

To gain an understanding of the network-wide effects of alternatives on congestion and travel, VMT and VHT for the build alternatives were compared to those of the 2030 No Action Alternative. For organizational purposes, the AM and PM peak periods are discussed separately.

5.2.1. Build Alternatives AM Peak Period VMT and VHT

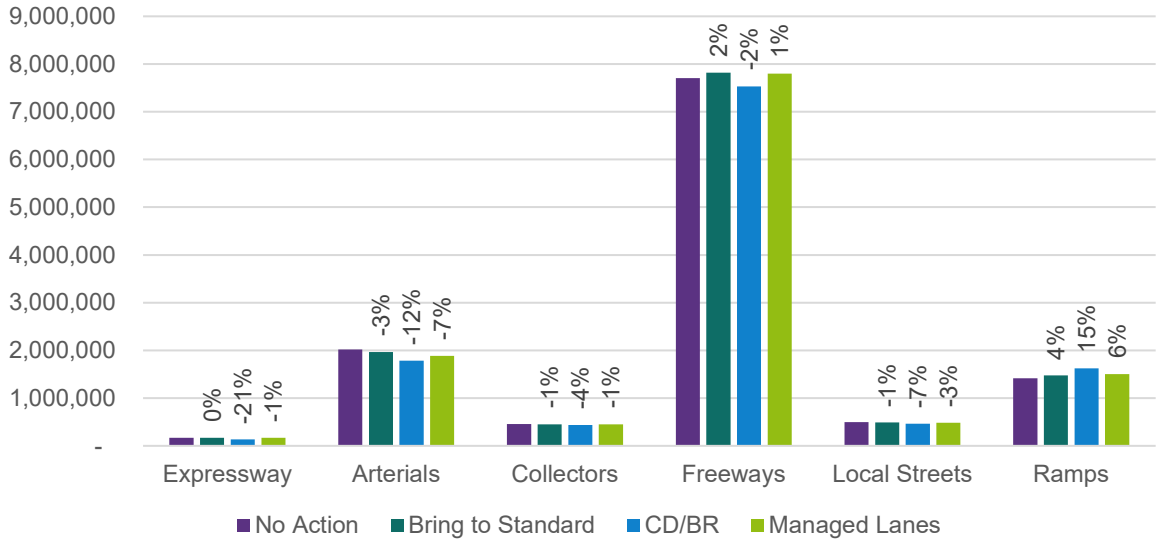
During the AM peak period, total VMT is expected to remain similar in the build alternatives as compared to the 2030 No Action Alternative; however, its distribution across facility types is expected to change. In general, the build alternatives are expected to shift some VMT from non-freeway facilities to freeway facilities. This shift is a result of the build alternatives improvements reducing congestion on the freeway, which then encourages more vehicles to use the freeway instead of diverting onto the local roadway network.

Also note that VMT on the ramps leading to and from freeway facilities increases. This is partially due to more people using the freeways because of reduced congestion, and also partially due to the modifications made to the on- and off-ramps within the build alternatives. In general, ramps in the build alternatives become slightly longer due to the addition of CD roads. This increase in length leads to an increase in VMT. Table 9 summarizes the overall change in VMT for the AM peak period and Figure 29 shows the changes by facility type.

Table 9: Changes to 2030, AM Peak Period, Network VMT by Alternative

	2030 No Action	Bring the Corridor to Standard	Collector/ Distributor Roads and Braided Ramps	Managed Lanes
Total VMT	12,260,000	12,369,000	11,975,000	12,285,000
Percent Difference from No Action	N/A	+1%	-2%	+0%

Figure 29: Build Alternatives 2030 AM Peak Period VMT by Facility Type



Percentages shown represent the percent difference from the No Action Alternative.

VHT during the AM peak period is expected to remain similar to the 2030 No Action Alternative, with the modeling result for all build alternatives being within the natural variation of the traffic model (± 5 percent). In general, the build alternatives reduce VHT on the freeway facilities, but increase it on ramps and arterials. This shift occurs as a result of the reduced congestion on the freeway facilities provided by the build alternatives' improvements. These improvements reduce congestion on the freeway facilities and, therefore, reduce the total VHT on freeway facilities.

However, in the 2030 No Action Alternative, the congestion on the freeway meters the number of vehicles that can reach their exit ramp at any given time. Reducing congestion on the freeway results in a reduction in this metering effect. This results in more vehicles choosing to take the freeway to reach their destinations instead of local roadway facilities. This shift in pattern has two affects.

First, the total VMT on local facilities decreases because fewer people are using them as an alternate route to the highway. Instead, drivers are remaining on the highway longer and exiting closer to their destination.

Second, in the 2030 No Action Alternative, because some drivers choose to exit the freeway and take parallel local facilities, the exit ramp volumes are more distributed across multiple off-ramps and local facilities. However, in the build alternatives, most vehicles remain on the freeway and exit at only a few ramps close to downtown, where many vehicle destinations are located. This concentration of volumes

at only a few off-ramps and only a few local roadway facilities results in very high congestion on these facilities, which results in an increase in VHT. This is why—even though build alternatives reduce VMT on local roadway facilities—VHT on these facilities increase. Table 10 summarizes the overall change in VHT for the AM peak period and Figure 30 shows the changes by facility type.

Table 10: Changes to 2030, AM Peak Period, Network VHT by Alternative

	2030 No Action	Bring the Corridor to Standard	Collector/ Distributor Roads and Braided Ramps	Managed Lanes
Total VHT	508,000	521,000	531,000	486,000
Percent Difference from No Action	N/A	+2%	+4%	-4%

Figure 30: Build Alternatives 2030, AM Peak Period VHT by Facility Type

Percentages shown represent the percent difference from the No Action Alternative.

5.2.2. Build Alternatives PM Peak Period VMT and VHT

Overall VMT in the build alternatives is expected to increase as compared to the 2030 No Action Alternative. This increase is a result of more vehicles being processed in the build alternatives as compared to the 2030 No Action Alternative. Extensive queueing and congestion within the microsimulation model resulted in many vehicles being queued outside of the model in the 2030 No Action Alternative. If these vehicles never have the opportunity to load into the model, then their VMT is considered to be zero. Because the build alternatives reduce congestion within the model, they can load more trips into the model and, therefore, have a higher total VMT. Table 11 documents the magnitude of change of serviced trips within the PM peak period by alternative and Table 12 summarizes the total PM peak period VMT by alternative.

Table 11: PM Peak Period Trips Queued Outside of the Model

	2030 No Action	Bring the Corridor to Standard	Collector/ Distributor Roads and Braided Ramps	Managed Lanes
Number of trips queued outside of the model at the end of the PM Peak Period	44,900	37,200	37,000	35,400
Percent difference from No Action	N/A	-17%	-18%	-21%

Table 12: Changes to 2030, PM Peak Period, Network VMT by Alternative

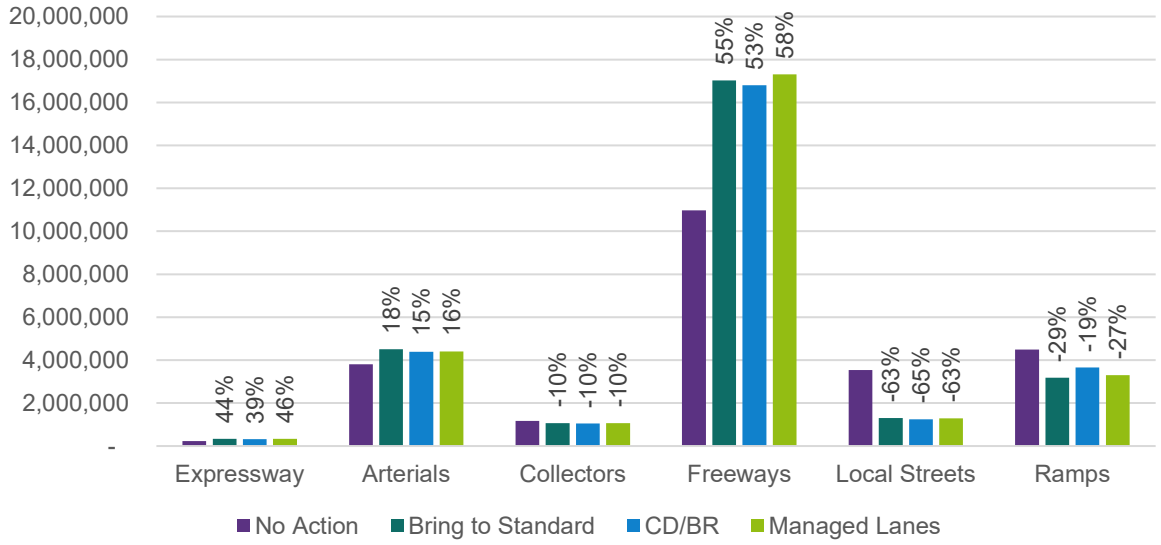
	2030 No Action	Bring the Corridor to Standard	Collector/ Distributor Roads and Braided Ramps	Managed Lanes
Total VMT	24,206,000	27,398,000	27,454,000	27,696,000
Percent Difference from No Action	N/A	+13%	+13%	+14%

Improvements from the build alternatives result in a large increase in VMT on freeway facilities and a large reduction in VMT on local roadway facilities as compared to the 2030 No Action Alternative. These changes are a result of reduced congestion on the freeway facilities, which then encourages more vehicles to use the freeway instead of the local roadway network.

Note that, during the PM peak period, the build alternatives are expected to reduce VMT on ramp facilities and increase VMT on arterials as compared to the 2030 No Action Alternative. This results from many vehicles make short trips on I-25 Central—entering the freeway at one ramp and exiting the freeway at one of the next one, two, or three consecutive off-ramps—in an effort to avoid congestion. In the build alternatives, many of the most common short ramp-to-ramp movements are restricted either due to ramp closures or the implementation of braided ramps. Eliminating these short trips results in these drivers using the arterial network to access their destinations rather than using the freeway.

One example of this behavior occurs in the Collector/Distributor Roads and Braided Ramps Alternative. The Colfax Avenue on-ramp to northbound I-25 is braided with the 23rd Avenue to 20th Street CD road in this alternative. This results in traffic coming from Colfax Avenue not being able to exit to 17th Avenue, 23rd Avenue, Speer Boulevard, or 20th Street. Vehicles that originally used these routes must instead use the local roadway network to reach their destinations. This shift in volumes results in reduced VMT on the ramps and an increase on the arterial network. Figure 31 summarizes the PM peak period VMT by build alternative.

Figure 31: Build Alternatives 2030, PM Peak Period VMT by Facility Type



Percentages shown represent the percent difference from the No Action Alternative.

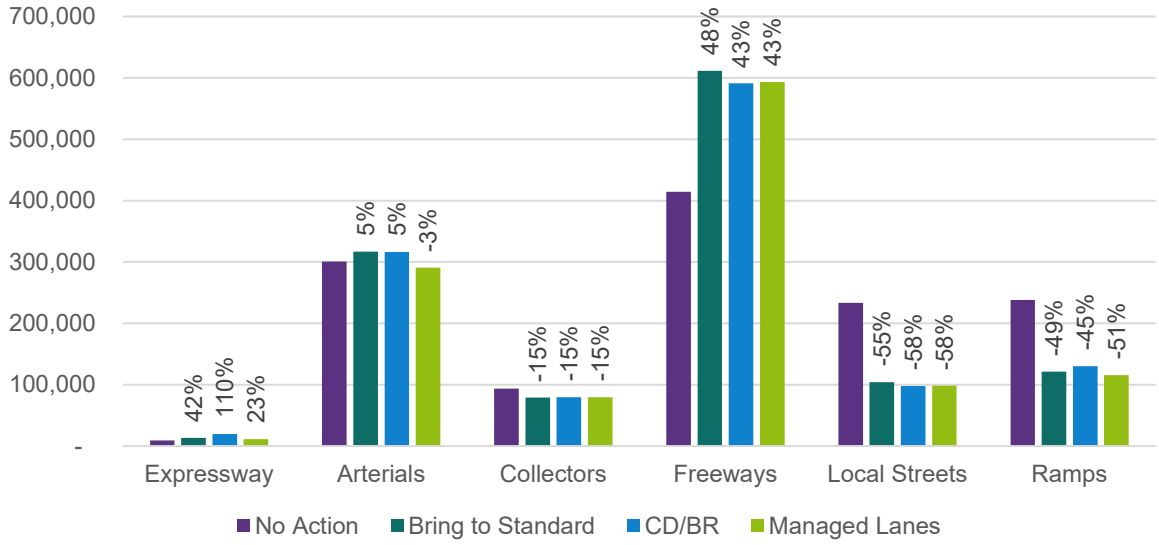
Although the build alternatives are expected to increase VMT during the PM peak period, they also are expected to provide an overall reduction in VHT as compared to the 2030 No Action Alternative. Table 13 summarizes the expected PM peak period VHT by alternative.

Table 13: Changes to 2030, PM Peak Period, Network VHT by Alternative

	2030 No Action	Bring the Corridor to Standard	Collector/ Distributor Roads and Braided Ramps	Managed Lanes
Total VHT	1,289,000	1,246,000	1,235,000	1,189,000
Percent Difference from No Action	N/A	-3%	-4%	-8%

VHT on freeway facilities is expected to increase in the build alternatives, with VHT on local streets and ramps showing the largest reduction as compared to the 2030 No Action Alternative. These results reflect the alternatives' abilities to process more vehicles on the freeway facility. This increase in capacity encourages more drivers to use the freeway instead of local roadway facilities. Furthermore, improving the flow of the freeway reduces the queues on ramps. Figure 32 illustrates the PM peak period VHT by facility type for the 2030 build alternatives.

Figure 32: Build Alternatives 2030, PM Peak Period VHT by Facility Type



Percentages shown represent the percent difference from the No Action Alternative.

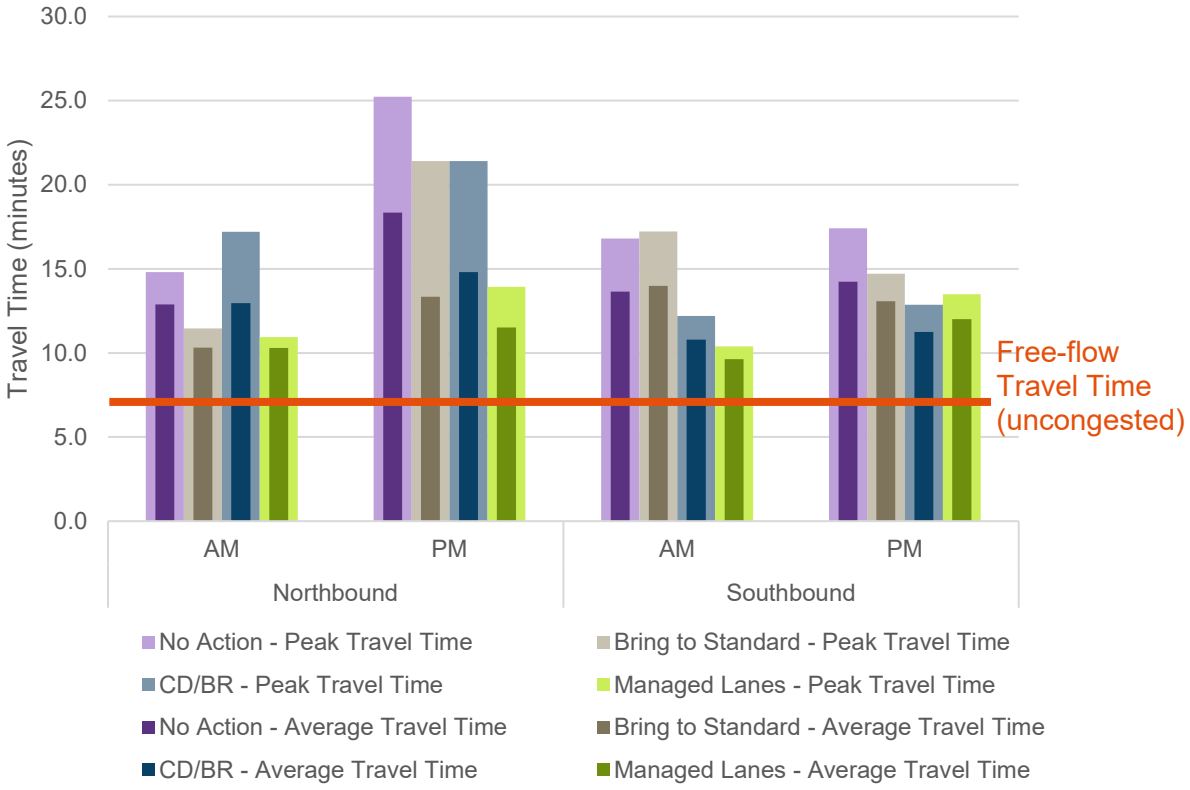
5.3. I-25 Travel Times

For the purposes of comparing alternatives, both the average peak period travel time and the maximum peak period travel time were examined for each alternative. Considering both the average and the maximum peak travel times is important because the peak period average travel time captures the duration of congestion while the maximum travel time reflects the single most intense period of congestion. Comparing the peak period average travel time to the maximum travel time provides an indication of the character of congestion experienced within that particular alternative. An average travel time that is close to the maximum travel time indicates that congestion likely is steady throughout the peak period. If the average travel time is very different than the maximum travel time, then the alternative likely experiences short but intense periods of congestion.

In general, all build alternatives reduce end-to-end travel times on I-25 Central in both directions and in both peak periods. Figure 33 summarizes the modeled travel times for the 2030 No Action Alternative and the build alternatives.

The travel times shown in Figure 33 represent the modeled travel times on I-25 from Broadway to Park Avenue. The travel times presented for the Managed Lanes Alternative are for the general-purpose lanes only. Travel times within the managed lanes remain approximately 6 minutes long, generally reflecting free-flow conditions within the managed lanes.

Figure 33: Alternatives' Travel Times (2030)



5.4. I-25 Speeds

By examining speed data by location along the corridor, the locations of bottlenecks can be identified. This section presents the speeds by location for each alternative in the form of heat diagrams. These heat diagrams show the average 15-minute speeds along segments of the I-25 Central corridor.

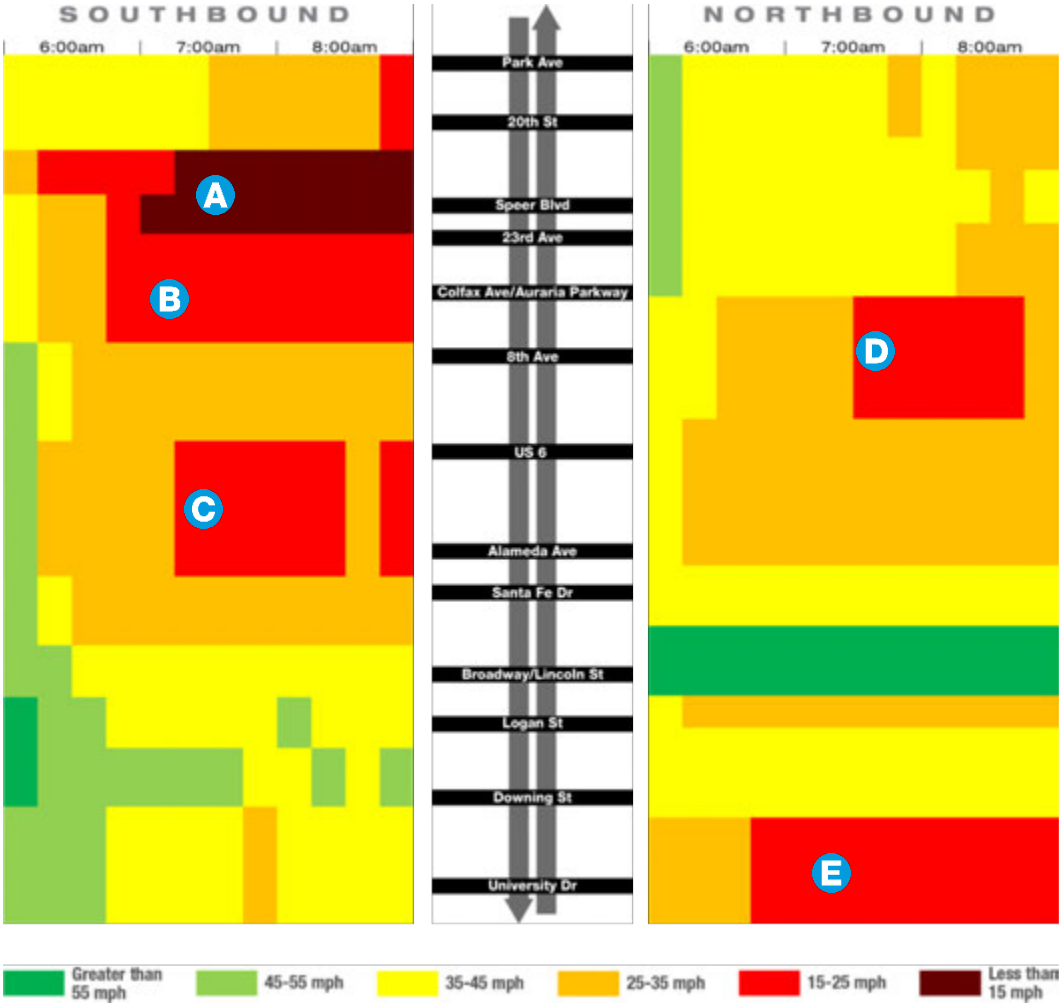
For organizational purposes, speeds are discussed alternative by alternative. At the end of this section, a side-by-side comparison of speeds between alternatives is presented.

5.4.1. Bring the Corridor to Standard Alternative Speeds

Improvements provided in the Bring the Corridor to Standard Alternative enhance speeds on the corridor as compared to the 2030 No Action Alternative; however, some bottlenecks are still anticipated. Figure 34 shows the AM peak period speeds on I-25 for the Bring the Corridor to Standard Alternative. Additional annotations are provided below the figure to highlight key results.

During the PM peak period, congestion is anticipated to be worse than in the AM peak period. Figure 35 shows the PM peak period speeds on I-25 for the Bring the Corridor to Standard Alternative. Additional annotations are provided below the figure to highlight key results.

Figure 34: 2030 AM Peak Period Speeds on I-25 for the Bring the Corridor to Standard Alternative



A Combining the 20th Street and Speer Boulevard on-ramps results in higher volumes entering southbound I-25 at one location. This results in a slowing of southbound traffic.

B High southbound I-25 volumes are limited by the four lanes of traffic over the South Platte River. This congestion is reduced after the Colfax Avenue and Auraria Parkway on-ramps merge into the mainline to add extra auxiliary lanes through to US 6/6th Avenue.

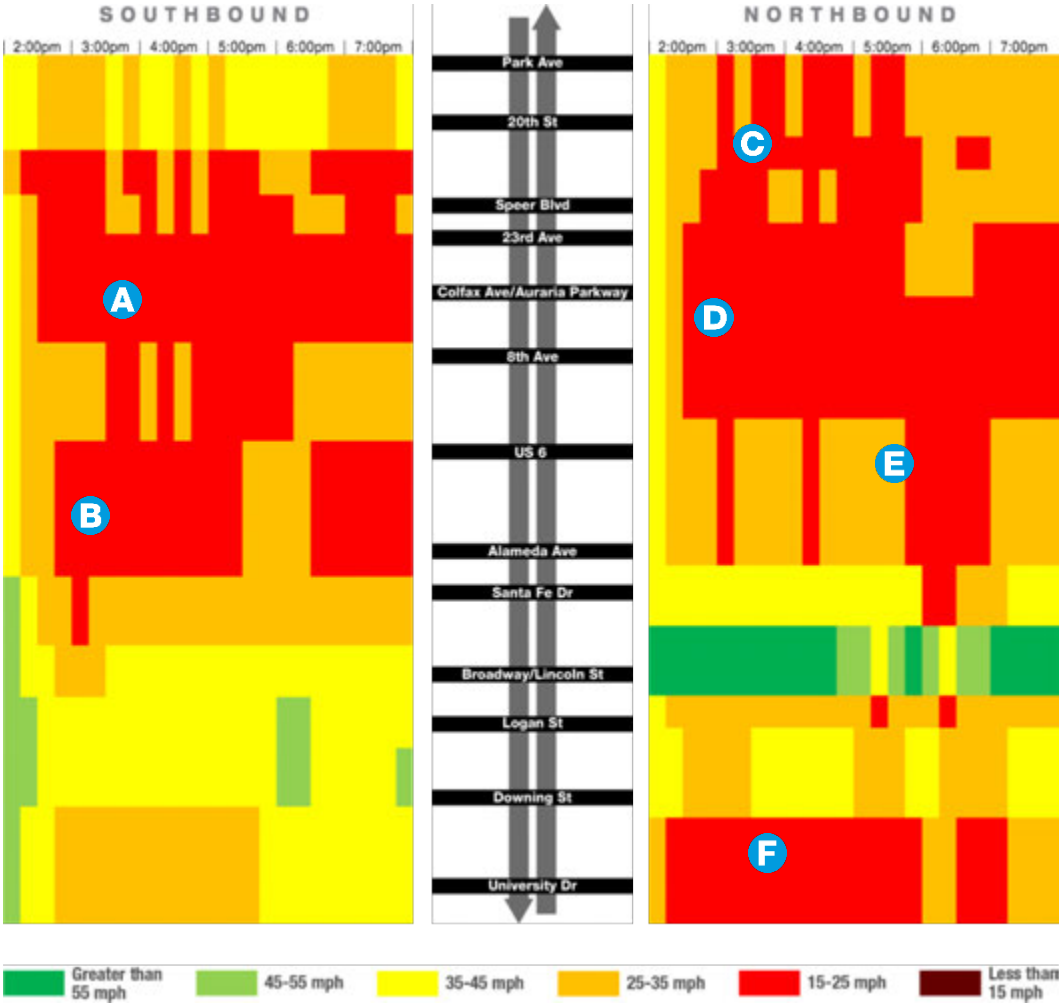
C Heavy weaving movements between the traffic entering southbound I-25 from US 6/6th Avenue and exiting I-25 to Santa Fe Drive/US 85 cause traffic to slow.

D Heavy weaving movements between on-ramp traffic from US 6/6th Avenue and off-ramp traffic to Colfax Avenue/Auraria Parkway cause northbound traffic to slow.

E Traffic coming northbound on I-25 into the I-25 Central corridor from south of the I-25 Central study area is metered/constrained due to existing capacity limitations between University Boulevard and Downing Street.

Source: Speed data was obtained from the I-25 Central PEL microsimulation traffic models.

Figure 35: 2030 PM Peak Period Speeds on I-25 for the Bring the Corridor to Standard Alternative



A — High southbound I-25 volumes are limited by the four lanes of traffic over the South Platte River. This congestion is reduced after the Colfax Avenue and Auraria Parkway on-ramps merge into the mainline to add extra auxiliary lanes through to US 6/6th Avenue.

B — Heavy weaving movements between the traffic entering southbound I-25 from US 6/6th Avenue and exiting I-25 to Santa Fe Drive/US 85 cause traffic to slow.

C — Improving the flow through the I-25 Central corridor pushes more vehicles into the I-70 and I-25 interchange. This results in a slowdown to the north of the I-25 Central study area.

D — High northbound on-ramp volumes from Colfax Avenue and the combined 23rd Avenue and Speer Boulevard result in slowing of the mainline.

E — Heavy weaving movements between on-ramp traffic from US 6/6th Avenue and 8th Avenue and off-ramp traffic to Colfax Avenue/Auraria Parkway cause northbound traffic to slow.

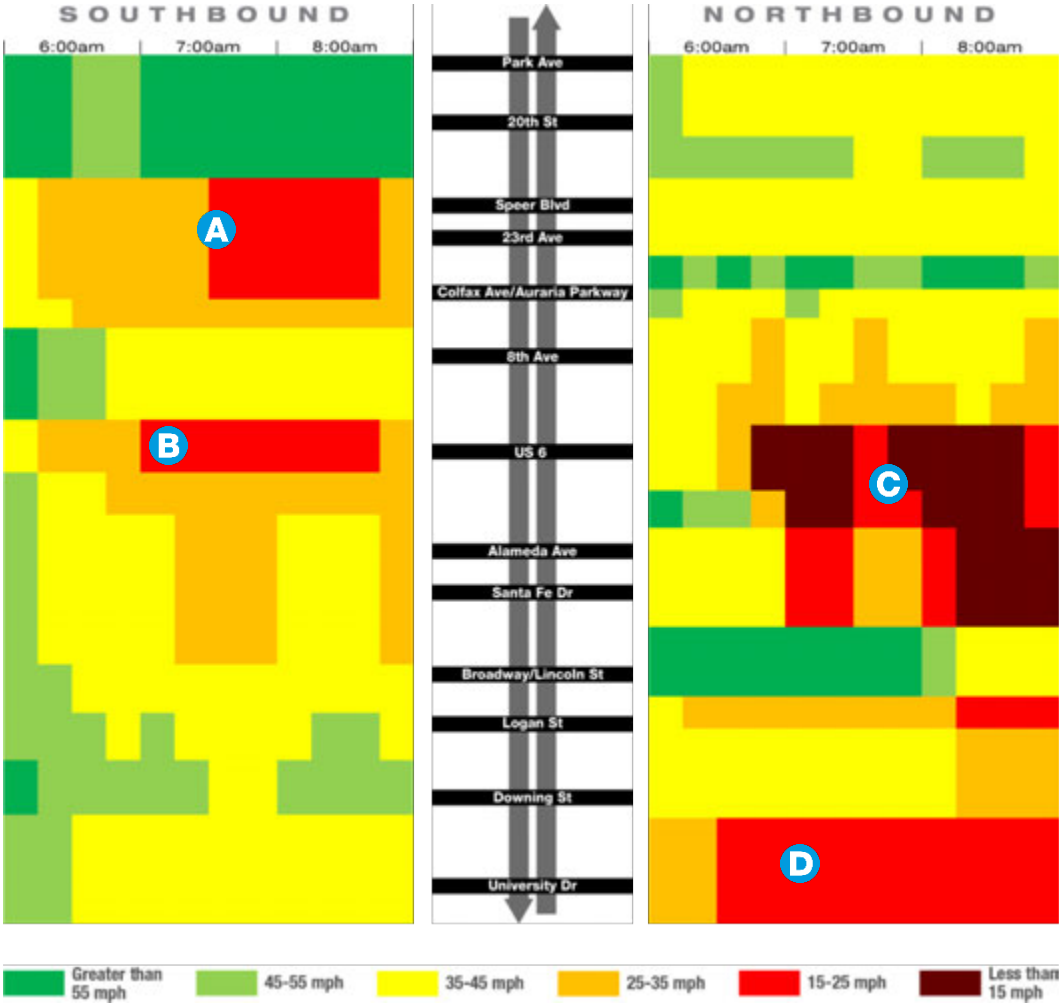
F — Traffic coming northbound on I-25 into the I-25 Central corridor from south of the I-25 Central study area is metered/constrained due to existing capacity limitations between University Boulevard and Downing Street.

Source: Speed data was obtained from the I-25 Central PEL microsimulation traffic models.

5.4.2. Collector/Distributor Roads and Braided Ramps Alternative Speeds

In general, the Collector/Distributor Roads and Braided Ramps Alternative improves speeds throughout the corridor during both peak periods as compared to the 2030 No Action Alternative by removing vehicle turbulence. However, some slowdowns still are expected to occur, particularly in the northbound direction between US 6/6th Avenue and Colfax Avenue/Auraria Parkway. Figure 36 and Figure 37 show the AM and PM peak period speeds on I-25, respectively, for the Collector/Distributor Roads and Braided Ramps Alternative. Additional annotations are provided below the figures to highlight key results.

Figure 36: 2030 AM Peak Period Speeds on I-25 for the Collector/Distributor Roads and Braided Ramps Alternative



A The large volume of southbound I-25 traffic exiting to Colfax Avenue, 8th Avenue, and US 6/6th Avenue must merge to the right to access the CD road. Shortly after the CD road exit, on-ramp traffic from 20th Street, Speer Boulevard, 23rd Avenue, and 17th Avenue must merge into the mainline. These two movements result in a slowdown in southbound traffic.

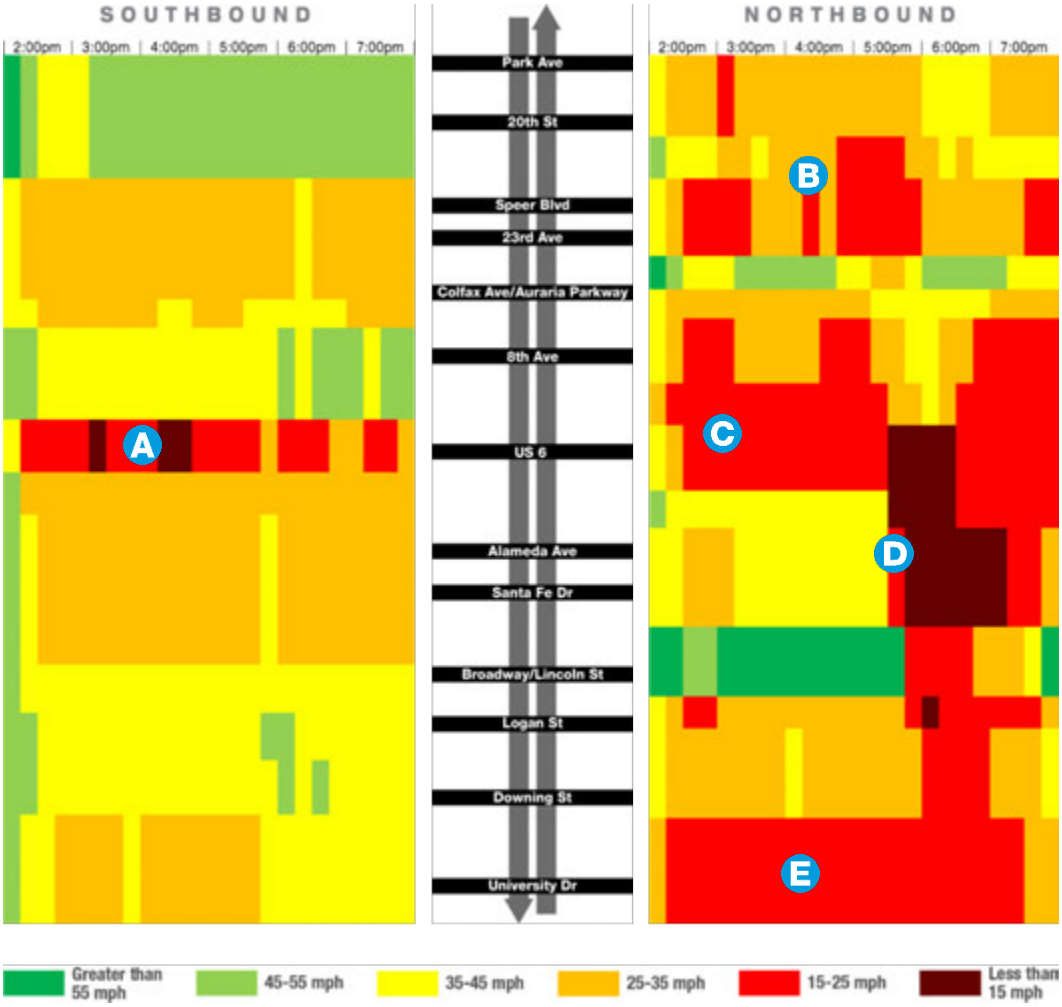
B Slowing is caused by the high volumes entering from Colfax Avenue and Auraria Parkway weaving with southbound mainline traffic exiting to the Alameda Avenue and Santa Fe Drive/US 85 CD road.

C One lane of traffic exits to the 8th Avenue, Colfax Avenue, and Auraria Parkway CD road, resulting in three lanes of traffic on the mainline freeway for a short section until the US 6/6th Avenue on-ramp comes on as an additional lane. This three-lane cross section creates a bottleneck and results in the slowing of traffic.

D Congestion between University Boulevard and Downing Street meters northbound I-25 traffic entering the study area.

Source: Speed data was obtained from the I-25 Central PEL microsimulation traffic models.

Figure 37: 2030 PM Peak Period Speeds on I-25 for the Collector/Distributor Roads and Braided Ramps Alternative



A Slowing is caused by the high volumes entering from Colfax Avenue and Auraria Parkway weaving with southbound mainline traffic exiting to the Alameda Avenue and Santa Fe Drive/US 85 collector/distributor road.

B High on-ramp volumes from Speer Boulevard merging with high mainline volumes meet and/or exceed the capacity of the mainline freeway, resulting in vehicle slowing.

C Heavy on-ramp volumes from US 6/6th Avenue cause the freeway to slow.

D One lane of traffic exits to the 8th Avenue, Colfax Avenue, and Auraria Parkway CD road, resulting in three lanes of traffic on the mainline freeway for a short section until the US 6/6th Avenue on-ramp comes on as an additional lane. This three-lane cross section creates a bottleneck and results in the slowing of traffic.

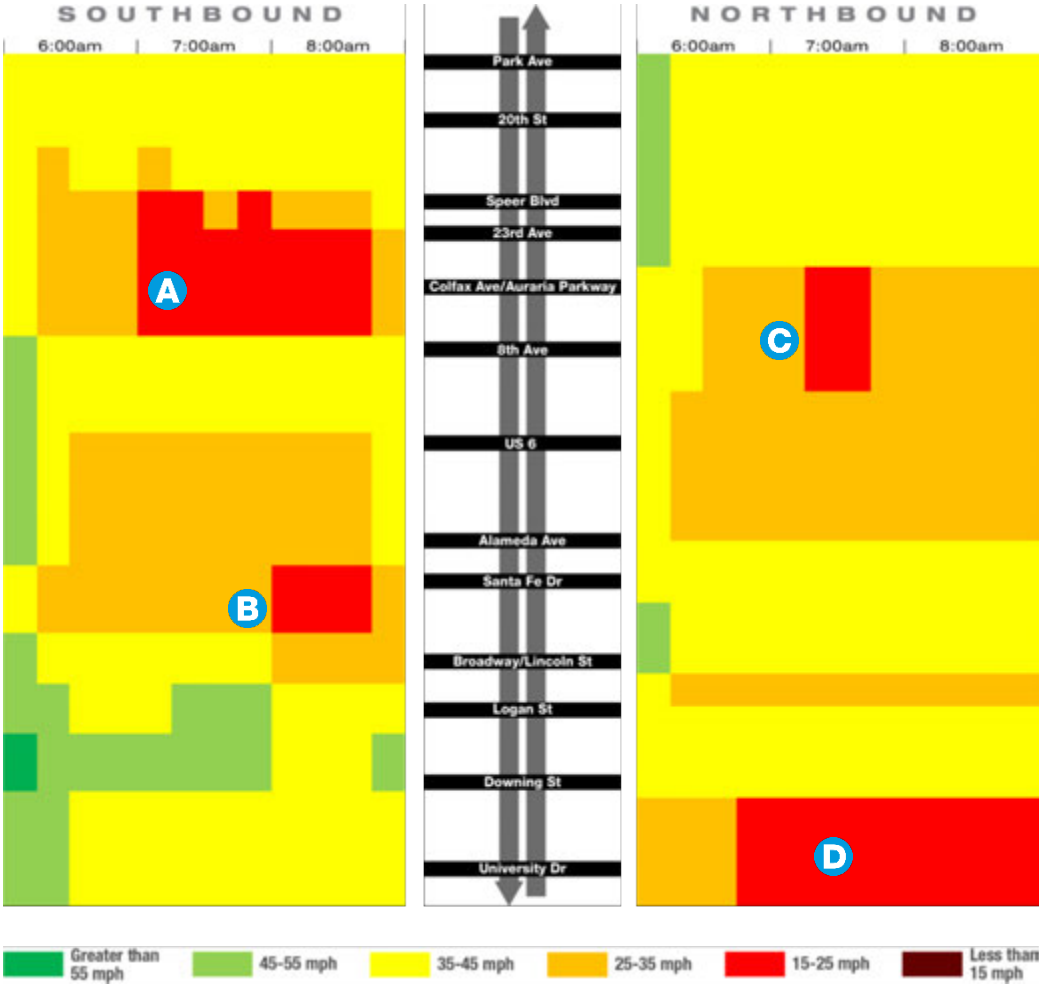
E Congestion between University Boulevard and Downing Street meters northbound I-25 traffic entering the study area.

Source: Speed data was obtained from the I-25 Central PEL microsimulation traffic models.

5.4.3. Managed Lanes Alternative Speeds

Speeds on I-25 in the Managed Lanes Alternative are expected to remain above an average of approximately 25 miles per hour during both the AM and PM peak periods, with only select locations having slower average speeds. These slowdowns typically occur near weaving or merging areas at on-/off-ramps or lane drops. Figure 38 and Figure 39 summarize the AM and PM peak period speeds, respectively, for the Managed Lanes Alternative.

Figure 38: 2030 AM Peak Period Speeds on I-25 for the Managed Lanes Alternative



A High southbound I-25 volumes are limited by the four lanes of traffic plus the managed lane over the South Platte River. This congestion is reduced after the Colfax Avenue and Auraria Parkway on-ramps merge into the mainline to add extra auxiliary lanes through to US 6/6th Avenue.

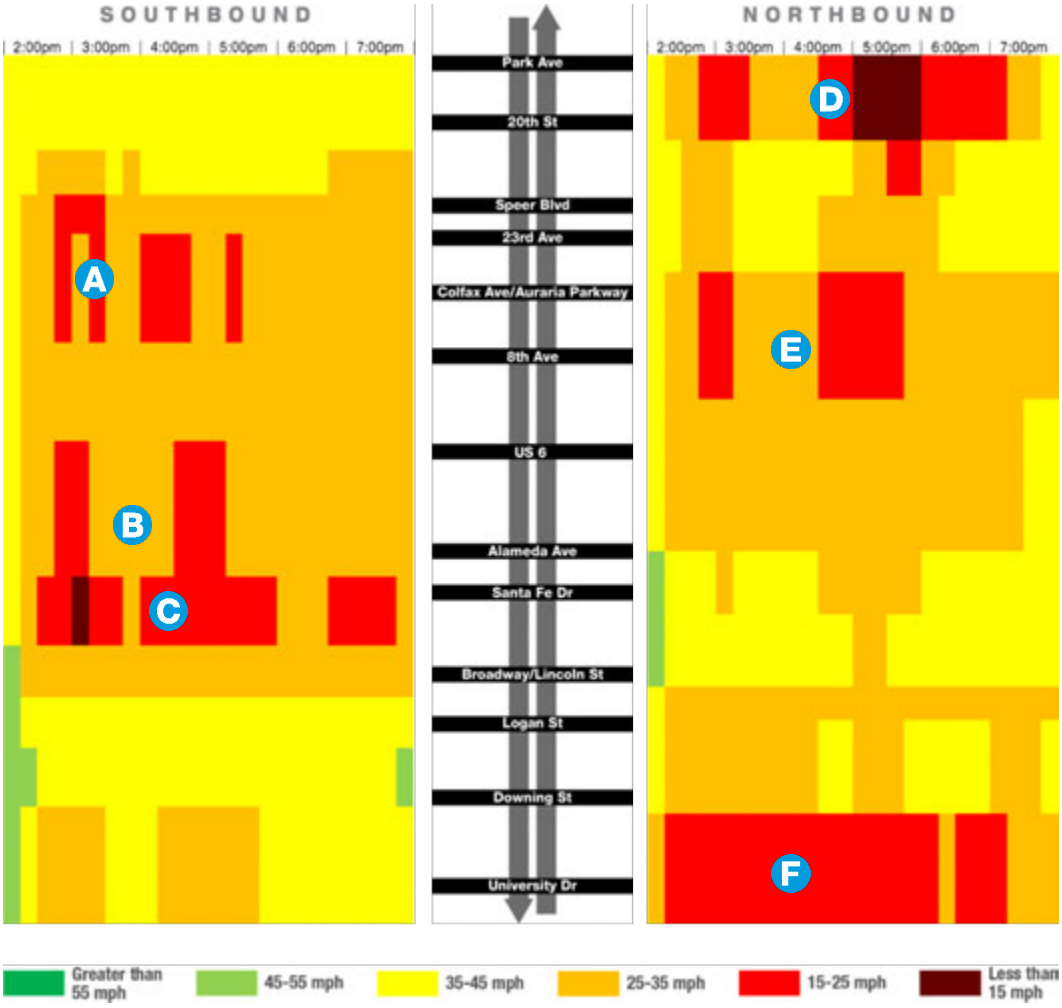
B The southbound managed lane ends near Santa Fe Drive/US 85 and the traffic in the managed lane must merge back into the four general-purpose lanes. This lane reduction causes traffic to slow.

C Heavy weaving movements between on-ramp traffic from US 6/6th Avenue and 8th Avenue and off-ramp traffic to Colfax Avenue/Auraria Parkway cause northbound traffic to slow.

D Congestion between University Boulevard and Downing Street meters northbound I-25 traffic entering the study area.

Source: Speed data was obtained from the I-25 Central PEL microsimulation traffic models.

Figure 39: 2030 PM Peak Period Speeds on I-25 for the Managed Lanes Alternative



A — High southbound I-25 volumes are limited by the four lanes of traffic plus the managed lane over the South Platte River. This congestion is reduced after the Colfax Avenue and Auraria Parkway on-ramps merge into the mainline to add extra auxiliary lanes through to US 6/6th Avenue.

B — Heavy weaving movements between the traffic entering southbound I-25 from US 6/6th Avenue and exiting I-25 to Santa Fe Drive/US 85 cause traffic to slow.

C — Where the southbound managed lane ends near Santa Fe Drive/US 85, the traffic in the managed lane must merge back into the four general-purpose lanes. This lane reduction causes traffic to slow.

D — Improving the flow through the I-25 Central corridor pushes more vehicles into the I-70 and I-25 interchange. This results in a slowdown to the north of the I-25 Central study area.

E — Heavy weaving movements between on-ramp traffic from US 6/6th Avenue and off-ramp traffic to Colfax Avenue/Auraria Parkway cause northbound traffic to slow.

F — Traffic coming northbound on I-25 into the I-25 Central corridor from south of the I-25 Central study area is metered/constrained due to existing capacity limitations between University Boulevard and Downing Street.

Source: Speed data was obtained from the I-25 Central PEL microsimulation traffic models.

5.4.4. Comparison of Speeds Between Alternatives

In general, build alternatives increase the average speed as compared to the 2030 No Action Alternative. However, in select instances, speeds are reduced in the build alternatives. This is a result of the build alternatives improving the highway to such a degree that traffic is pulled off the local roadway network and onto the freeway. This increase in freeway volumes in turn slows the freeway down. This phenomenon is discussed in greater detail in the following sections, which present the roadway volumes for each alternative. Figure 40 and Figure 41 show side-by-side comparisons of the average speeds for each build alternative and the 2030 No Action Alternative.

In the northbound direction, the build alternatives generally improve conditions as compared to the 2030 No Action Alternative. However, the area between US 6/6th Avenue and approximately 23rd Avenue remains a challenge in all alternatives. In the southbound direction, two areas of congestion remain in all alternatives, albeit to differing degrees. These areas include southbound I-25 around the 23rd Avenue and Colfax Avenue interchanges and the area between US 6/6th Avenue and Santa Fe Drive/US 85. Figure 40 through Figure 43 show a side-by-side comparison of speeds between the different alternatives.

Figure 40: Northbound, 2030, AM Peak Period Average Speed by Build Alternative

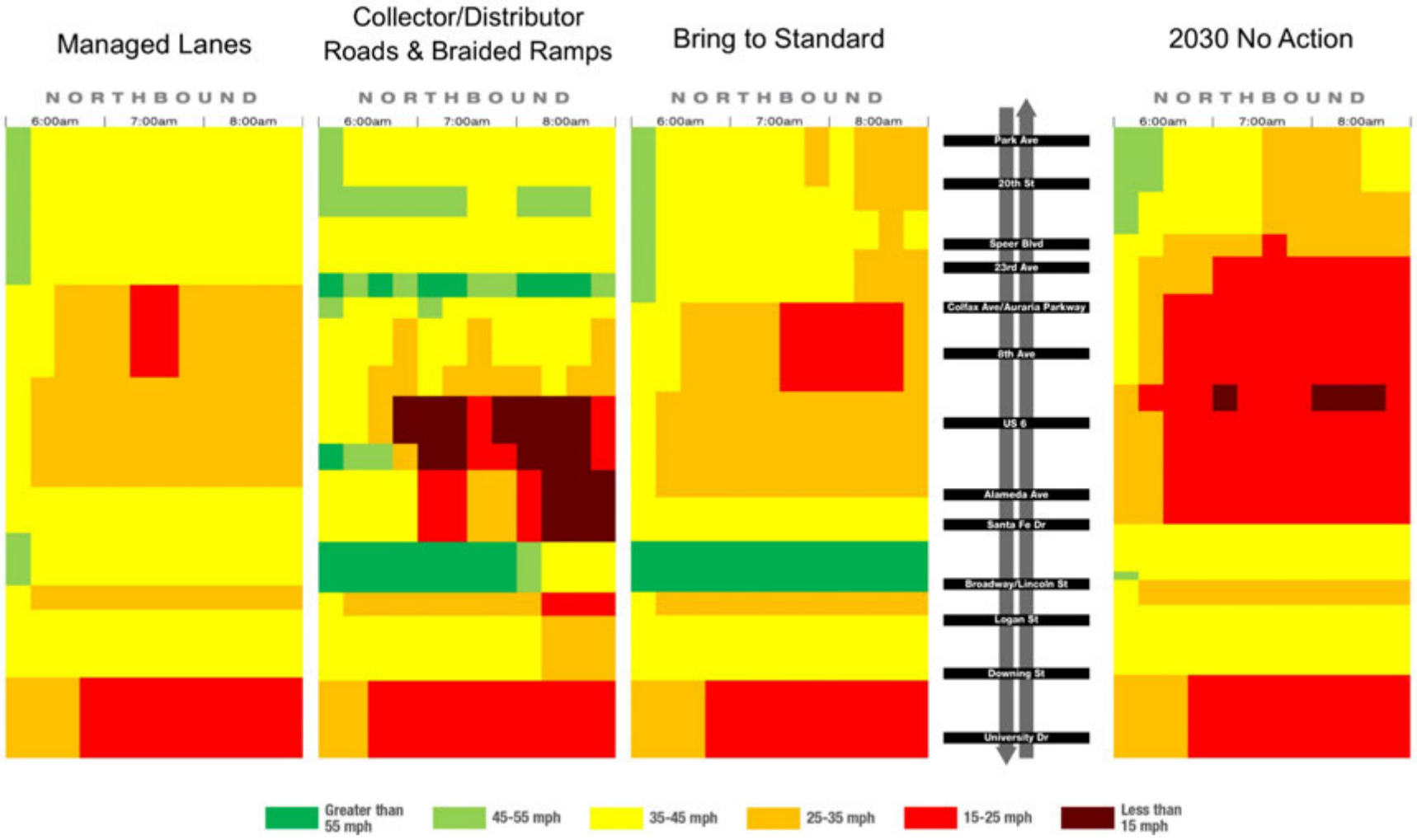


Figure 41: Southbound, 2030, AM Peak Period Average Speed by Build Alternative

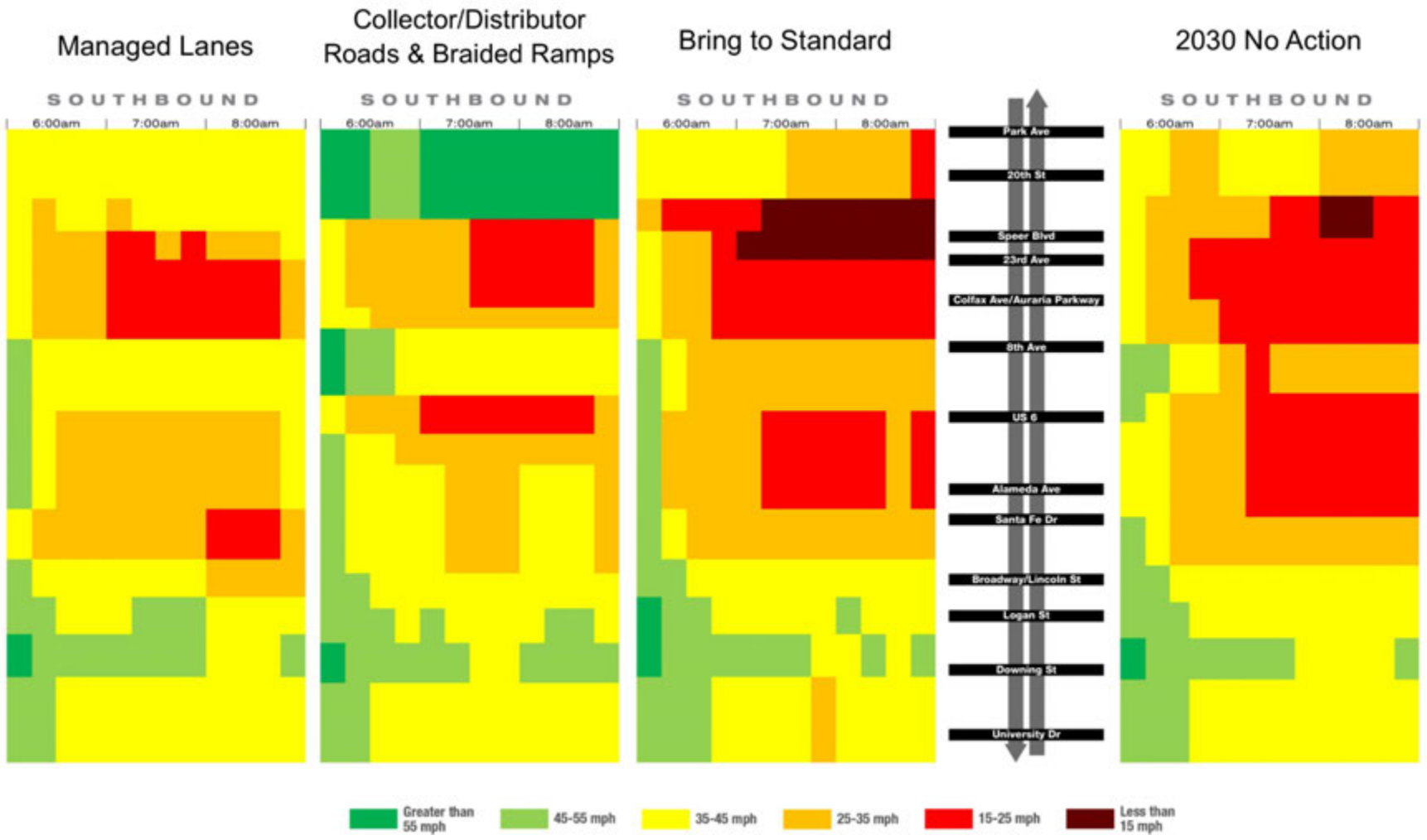


Figure 42: Northbound, 2030, PM Peak Period Average Speed by Build Alternative

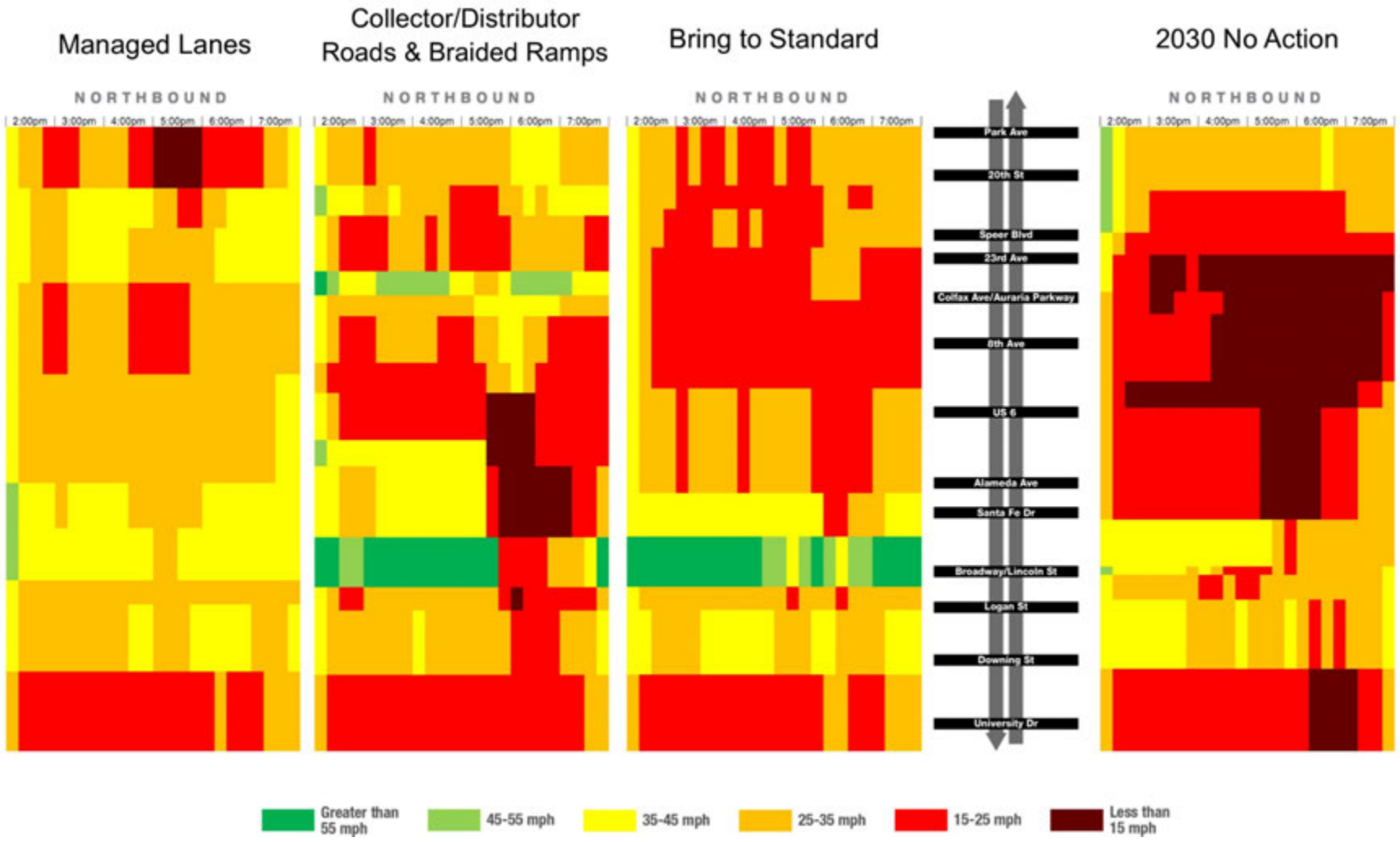
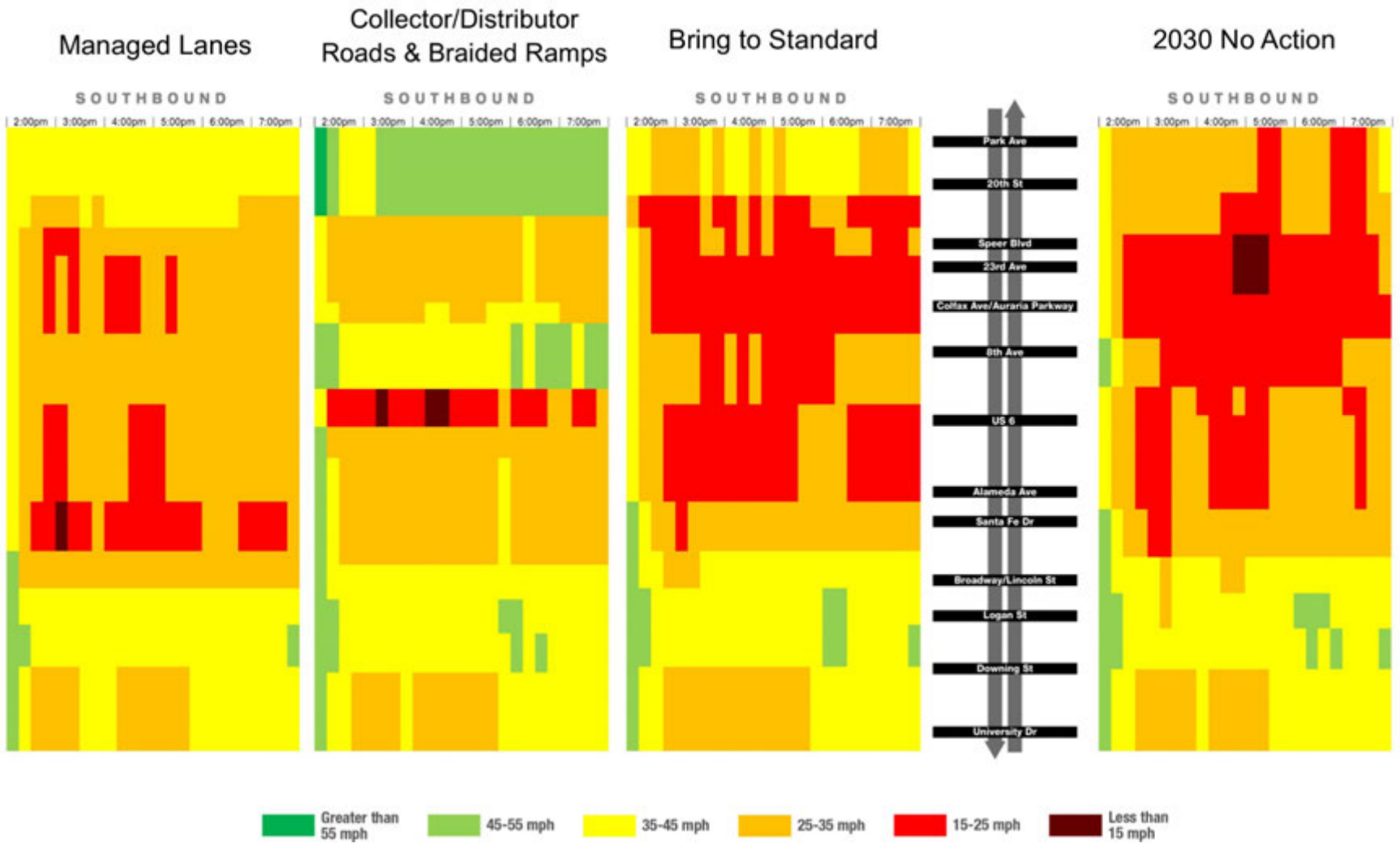


Figure 43: Southbound, 2030, PM Peak Period Average Speed by Build Alternative



5.5. Traffic Volumes

Based on the microsimulation modeling, reducing congestion on I-25 is anticipated to increase the volume of vehicles on I-25 and reduce the volume of vehicles on the local roadway network. The following sections document the volumes on I-25 Central, the on- and off-ramps, and the surrounding local roadways for each alternative.

5.5.1. I-25 Mainline Volumes

Freeway volumes through the I-25 Central corridor are expected to increase between the 2030 No Action Alternative and all the build alternatives. This results from the build alternatives reducing congestion on the freeway, thus making it a more attractive route. For clarity, the AM peak period and PM peak period volume results for the mainline freeway are discussed separately.

Note that, for the purpose of this analysis, mainline freeway volumes include volumes in all general-purpose lanes and, if applicable, volumes in auxiliary lanes, on CD roads, and in managed lanes.

5.5.1.1. I-25 AM Peak Period

In the northbound direction during the AM peak period (6:00 a.m. to 9:00 a.m.), the Managed Lanes Alternative processes the largest volume of vehicles on I-25 as compared to the other build alternatives and the 2030 No Action Alternative. Because the Managed Lanes Alternative is the only alternative to add an additional lane to the freeway, it has the most geometric capacity.

The Bring the Corridor to Standard Alternative processes the second largest volume of vehicles in the northbound direction during the AM peak period. The increase in the number of vehicles being processed in this alternative is primarily due to the closure of the 8th Avenue on- and off-ramps. Removing these ramps not only allows for two continuous auxiliary lanes between US 6/6th Avenue and Colfax Avenue/Auraria Parkway, but it also reduces the turbulence in this area because vehicles no longer have to weave across traffic to enter or exit at 8th Avenue.

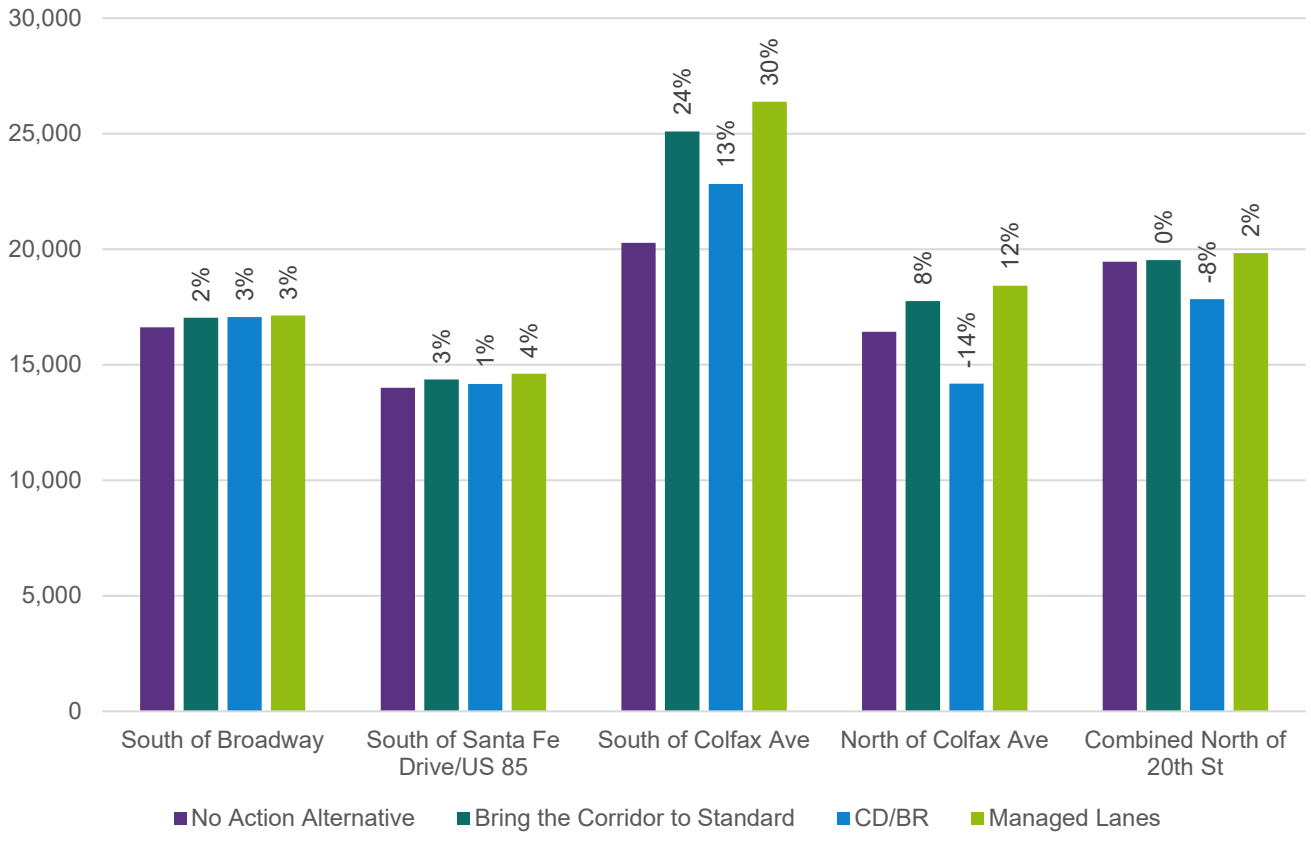
The Collector/Distributor Roads and Braided Ramps Alternative processes the lowest number of vehicles in the northbound direction during the AM peak period. This is primarily due to the configuration of the freeway between US 6/6th Avenue and Colfax Avenue/Auraria Parkway. In the Collector/Distributor Roads and Braided Ramps Alternative, one of the four northbound lanes of traffic drops at the exit to the 8th Avenue/Colfax Avenue/Auraria Parkway CD road. This means that the mainline freeway only has three general-purpose lanes for a short segment, so fewer cars are processed by this alternative as compared to the alternatives that maintain four general-purpose lanes all the way through the corridor.

Note that the configuration of the Collector/Distributor Roads and Braided Ramps Alternative was intentionally set to have a lane drop to the 8th Avenue/Colfax Avenue/Auraria Parkway CD road. This was done because of the high volume of off-ramp traffic that exits to Colfax Avenue and Auraria Parkway during the AM peak period, as well as the high volume of traffic entering I-25 northbound from US 6/6th Avenue. Having a lane drop to the CD road not only promotes the off-ramp movement from the freeway, but it also allows the US 6/6th Avenue traffic to enter I-25 in its own lane. This prevents the on-ramp traffic from US 6/6th Avenue from having to change lanes when it enters I-25.

During the AM peak period, the lane-drop configuration of the Collector/Distributor Roads and Braided Ramps Alternative is expected to process approximately the same number of vehicles as the Bring the Corridor to Standard Alternative. Colfax Avenue is unable to process all of the vehicles using the exit ramp and traffic becomes queued on the off-ramp. This queue spills back to the CD road and reduces

the number of vehicles being processed in the drop lane. Although similar queueing is experienced in the other two build alternatives, it is notably worse in the Collector/Distributor Roads and Braided Ramps Alternative because of this lane-drop configuration, which heavily promotes the exiting movement. Figure 44 summarizes the northbound AM peak period volumes on I-25 by alternative.

Figure 44: Northbound, 2030, AM Peak Period Volumes on I-25



Percentages shown represent the percent difference from the No Action Alternative.

In the southbound direction during the AM peak period, the Managed Lanes Alternative and Collector/Distributor Roads and Braided Ramps Alternative process about the same volume of vehicles, with the Bring the Corridor to Standard Alternative processing the lowest volume out of the build alternatives. The Managed Lanes and Collector/Distributor Roads and Braided Ramps Alternative process a similar number of vehicles because both add capacity to the highway. In the Managed Lanes Alternative, this capacity is in the form of an added managed lane. In the Collector/Distributor Roads and Braided Ramps Alternative, the capacity is added through the addition of a nearly continuous CD road throughout the entire I-25 Central corridor.

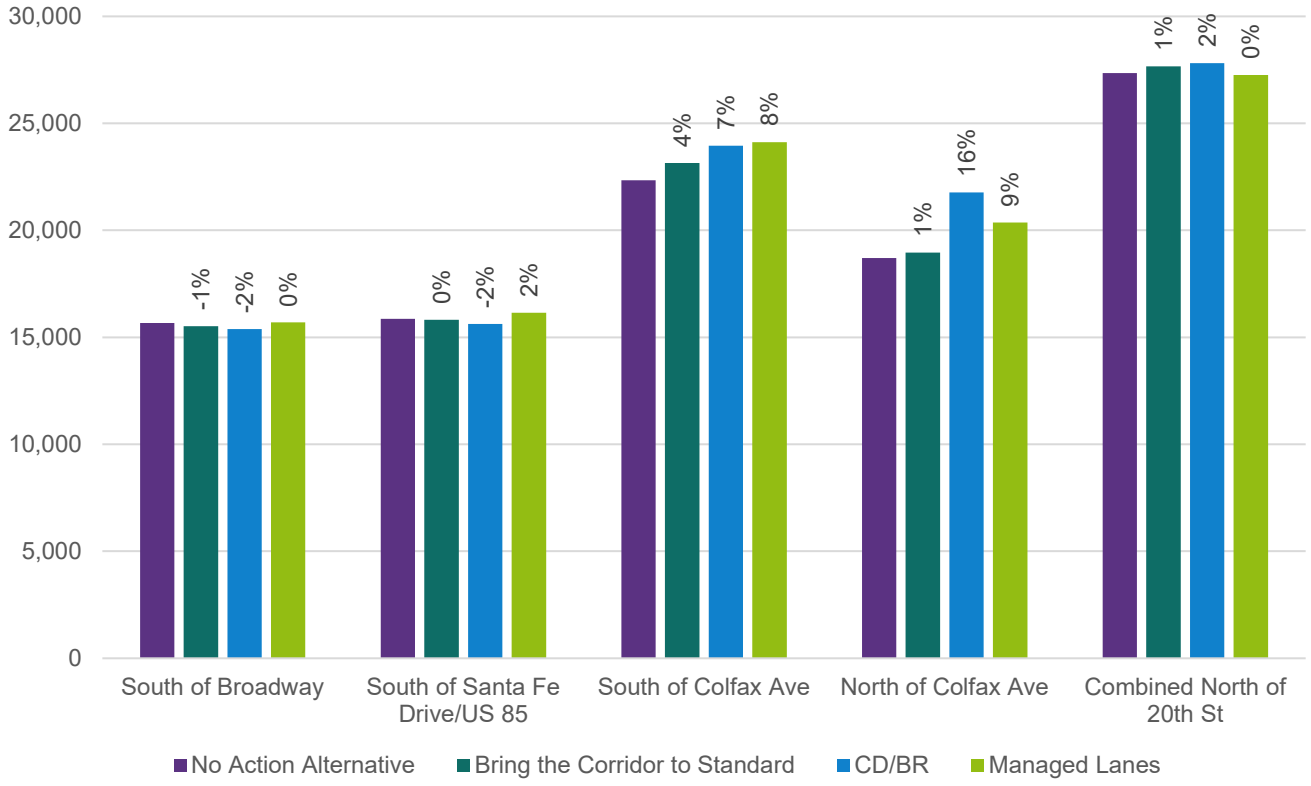
For the Collector/Distributor Roads and Braided Ramps Alternative, the CD road configuration in the southbound direction has two key differences that improve the volume throughput as compared to the CD roads in the northbound direction. These differences are the additional slip ramp connections between consecutive CD roads and the reduced off-ramp queueing.

In both the northbound and southbound directions, three sets of CD roads are planned: (1) Santa Fe Drive/US 85 to US 6/6th Avenue, (2) US 6/6th Avenue to Colfax Avenue/Auraria Parkway, and (3) Colfax Avenue to 20th Street. In the northbound direction, each CD road is separate from the other.

This means that traffic within the CD road must re-enter the mainline for a period of time before the next CD road begins. However, in the southbound direction, there is a slip ramp connection between the 20th Street/Speer Boulevard/23rd Avenue CD road and the Colfax Avenue/8th Avenue/US 6/6th Avenue CD road. Traffic coming onto I-25 from 20th Street, Speer Boulevard, and 23rd Avenue that wants to exit to Colfax Avenue, 8th Avenue, or US 6/6th Avenue never has to enter the mainline freeway. Because of this configuration, the CD road in the southbound direction operates more as an additional highway lane compared to the configuration used in the northbound direction.

The second key difference between the northbound and southbound configuration of the CD roads in the Collector/Distributor Roads and Braided Ramps Alternative is the reduced off-ramp queueing. As discussed previously, the northbound off-ramp to Colfax Avenue experiences long queues in the AM peak period. These queues spill back onto the CD road and block traffic. This kind of extensive queueing does not occur in the southbound direction during the AM peak period and the southbound CD roads are able to process more vehicles. Figure 45 summarizes the I-25 mainline volumes for the southbound AM peak period by alternative.

Figure 45: Southbound, 2030, AM Peak Period Volumes on I-25



Percentages shown represent the percent difference from the No Action Alternative.

5.5.1.2. I-25 PM Peak Period

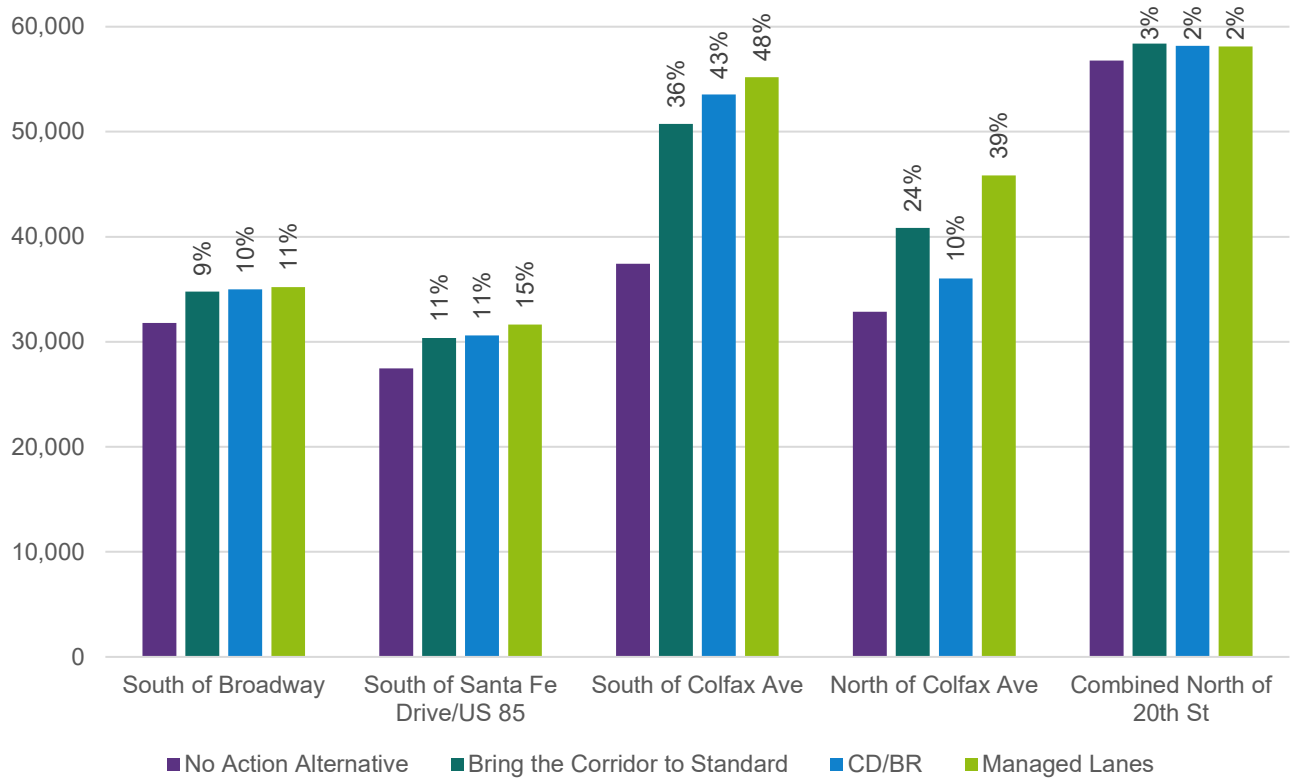
In the northbound direction during the PM Peak period (2:00 p.m. to 8:00 p.m.), all build alternatives process more volume than the 2030 No Action Alternative, with the Managed Lanes Alternative expected to process the largest volume of vehicles out of all the build alternatives because of the addition of a managed lane.

Following the Managed Lanes Alternative, the Collector/Distributor Roads and Braided Ramps Alternative processes the next largest volume of vehicles in the northbound PM peak period. The CD roads add additional lanes and, therefore, additional capacity to the highway. The only exception is north of Colfax Avenue, where the Bring the Corridor to Standard Alternative is shown to process more vehicles than the Collector/Distributor Roads and Braided Ramps Alternative. This result reflects a difference in reporting and not a bottleneck or limitation of the Collector/Distributor Roads and Braided Ramps Alternative.

The reason volumes are lower at this location for this alternative is because of the Colfax Avenue on-ramp configuration. In the Managed Lanes Alternative and the Bring the Corridor to Standard Alternative, the Colfax Avenue on-ramp merges into the mainline freeway before the count location. However, in the Collector/Distributor Roads and Braided Ramps Alternative, the Colfax Avenue on-ramp is braided with the 23rd Avenue/Speer Boulevard/20th Street CD road off-ramp and does not merge into the mainline freeway until north of the count location. Therefore, the Colfax Avenue on-ramp traffic is not included in the mainline freeway volumes reported north of Colfax Avenue for the Collector/Distributor Roads and Braided Ramps Alternative. This results in the reported volumes at this location appearing lower for this alternative than for the Bring the Corridor to Standard Alternative.

The Bring the Corridor to Standard Alternative is expected to process the lowest volume of vehicles on I-25 as compared to the other build alternatives; however, this alternative still is expected to process more vehicles than the 2030 No Action Alternative. The increase in volume for the Bring the Corridor to Standard Alternative over the 2030 No Action Alternative is primarily a result of the elimination of access at 8th Avenue and 17th Avenue. Figure 46 summarizes the northbound PM peak period volumes on I-25 for each alternative.

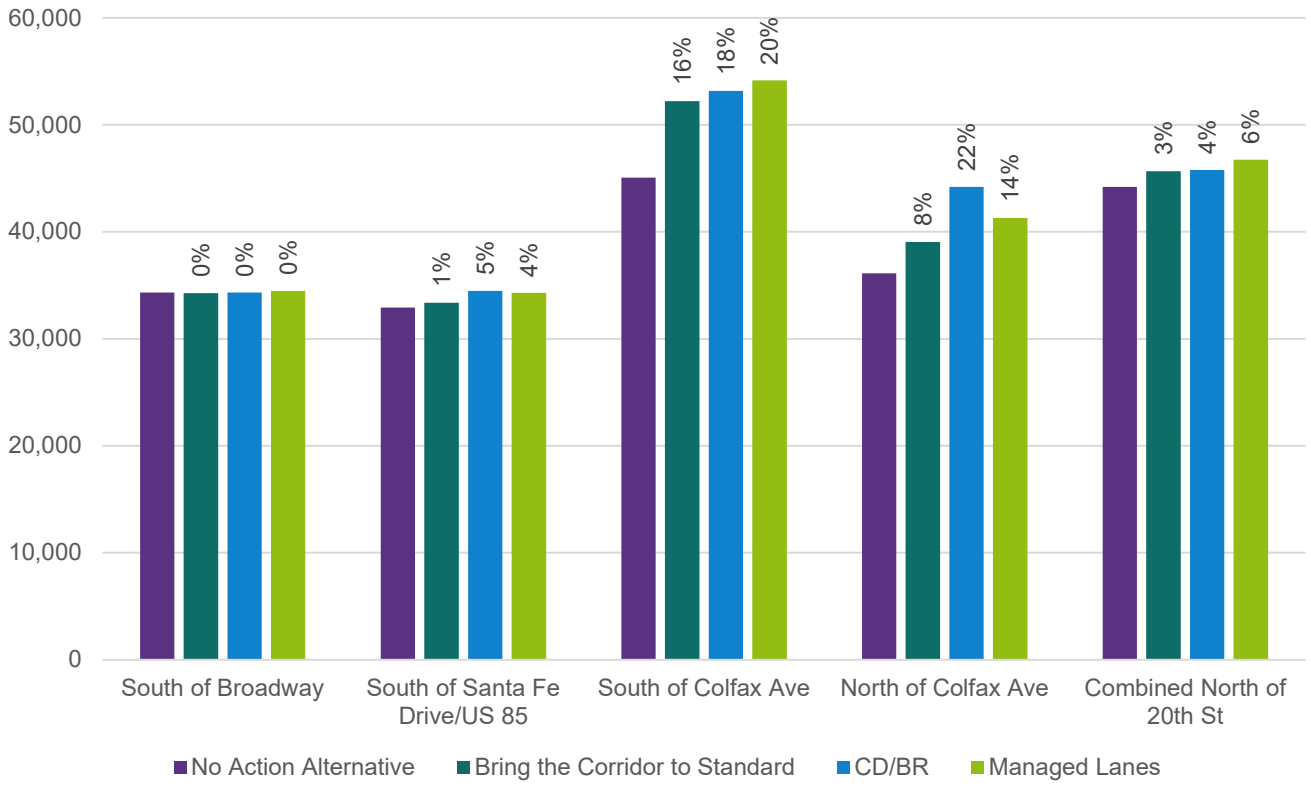
Figure 46: Northbound, 2030, PM Peak Period Volumes on I-25



Percentages shown represent the percent difference from the No Action Alternative.

In the southbound direction during the PM peak period, all alternatives are expected to process more volume than the 2030 No Action Alternative, with the Managed Lanes Alternative and the Collector/Distributor Roads and Braided Ramps Alternative expected to process the largest volumes. The Bring the Corridor to Standard Alternative is expected to process the lowest volume of vehicles. The reasoning behind this result is the same as discussed in the southbound AM peak period section; namely, both the Managed Lanes Alternative and the Collector/Distributor Roads and Braided Ramps Alternative add capacity to the freeway. Figure 47 summarizes the southbound PM peak period volumes on I-25 for each alternative.

Figure 47: Southbound, 2030, PM Peak Period (2:00 p.m. – 8:00 p.m.) Volumes on I-25



Percentages shown represent the percent difference from the No Action Alternative.

5.5.2. I-25 Ramp Volumes

This section documents the on-ramp and off-ramp volumes on I-25 Central between Broadway and Park Avenue. For reporting purposes, volumes shown in this section are summarized by interchange. If an interchange has multiple ramps serving the same movement, then the volumes on those ramps have been added together and reported as a singular volume. The Colfax Avenue and Auraria Parkway interchange is an example of this. Here, the on-ramp volumes from Auraria Parkway, eastbound and westbound Colfax Avenue, and Lower Colfax Avenue to southbound I-25 have been combined and reported as a single southbound on-ramp volume.

In general, ramp volumes change between the 2030 No Action Alternative and the build alternatives for two key reasons: shifting congestion patterns and access changes. Shifting congestion patterns affect ramp volumes because people choose to use a different route in response to congestion. As freeway congestion increases, more people choose to exit the freeway and use the local roadway network to

reach their destinations. In general, the more congestion relief an alternative provides on I-25, the higher the ramp volumes on ramps near the downtown area (US 6/6th Avenue, Colfax Avenue/Auraria Parkway, 23rd Avenue, and Speer Boulevard) will be. Conversely, if an alternative has a high amount of freeway congestion as compared to other alternatives, then higher ramp volumes are observed on ramps further away from downtown—such as Broadway and Santa Fe Drive/US 85.

The second factor affecting ramp volumes is access changes. In some build alternatives, specific ramps are either closed—such as the 17th Avenue ramps in the Bring the Corridor to Standard Alternative—or they have restricted movements—such as the 8th Avenue on-ramps going southbound, which can only go to US 6/6th Avenue and cannot access southbound I-25. In general, if a build alternative's ramp access is restricted as compared to the 2030 No Action Alternative's configuration, then its volume decreases. Furthermore, if multiple ramps are combined—such as the northbound 23rd Avenue and Speer Boulevard ramps—then the resulting volume of the combined ramps is higher than in the 2030 No Action Alternative.

Figure 48 and Figure 49 show the ramp volumes for each alternative, as well as the ramp's percentage difference from the 2030 No Action Alternative for the AM and PM peak periods, respectively. Additional information about changes at specific ramps, as well as more detailed discussion about changes at specific ramps, is included in Appendix A, Detailed Ramp Volumes, of this Technical Report.

Figure 48: 2030, AM Peak Period Ramp Volumes for No Action and Build Alternatives

Figure 49: 2030, PM Peak Period Ramp Volumes for No Action and Build Alternatives

5.5.3. Local Roadway Volumes

As conditions on I-25 Central continue to deteriorate in the 2030 No Action Alternative, drivers will increasingly search for alternate routes to the highway to avoid congestion. By improving conditions on the freeway, more vehicles will choose to use the freeway instead of diverting to local roadways. In general, this means that the build alternatives will reduce traffic volumes on the local roadway network. This section documents the changes in volume expected to occur on the local roadway network under each build alternative.

Figure 50 through Figure 57 show the expected volume changes on the local roadway network for each alternative. Additional, more-detailed discussion of the screenline results are provided in Appendix E, Detailed Screenline Volumes, of this Technical Report.

Figure 50: AM Peak Period 2030 No Action Alternative Screenline Volumes

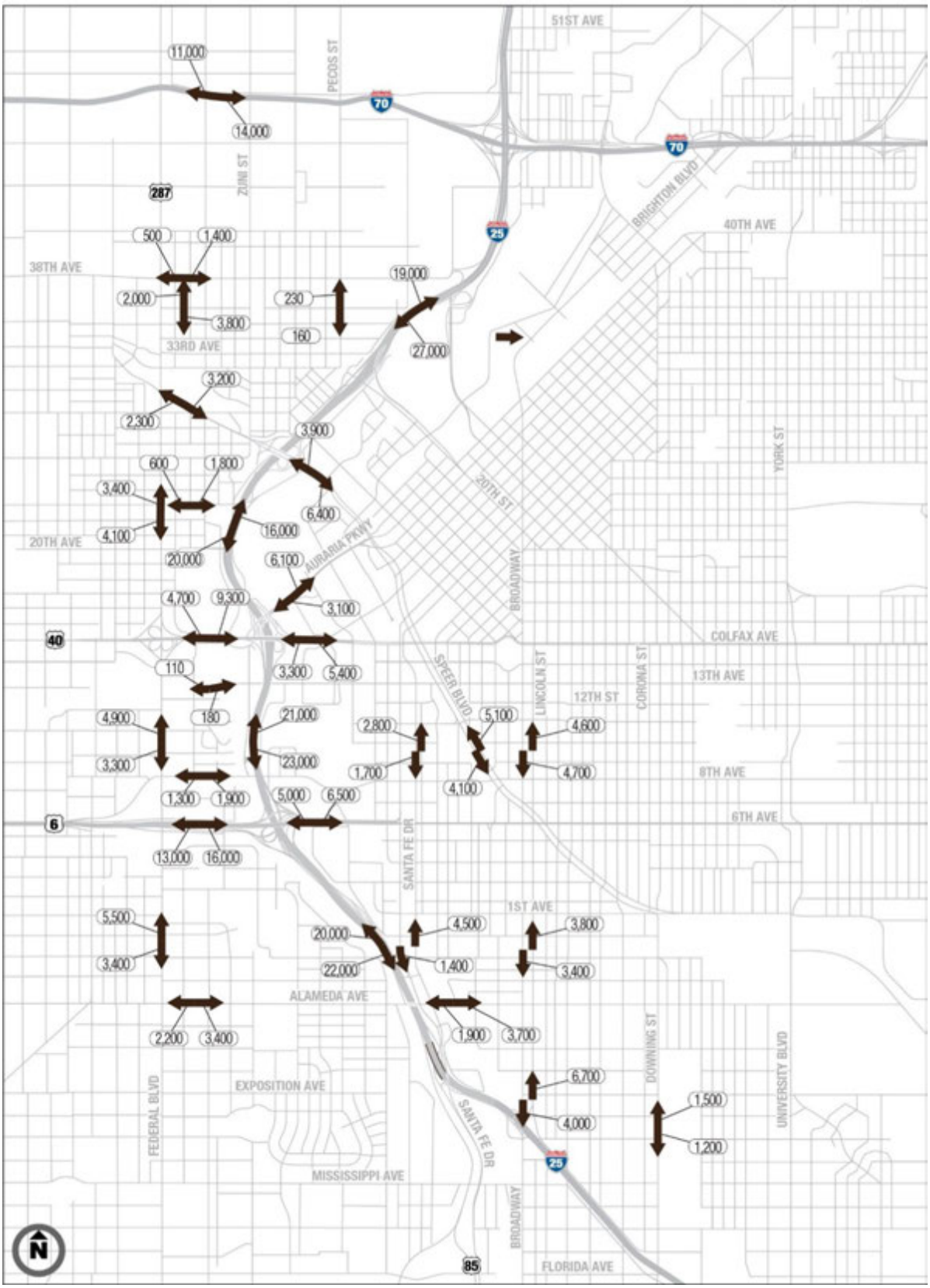


Figure 51: AM Peak Period Bring the Corridor to Standard Alternative Screenline Volumes

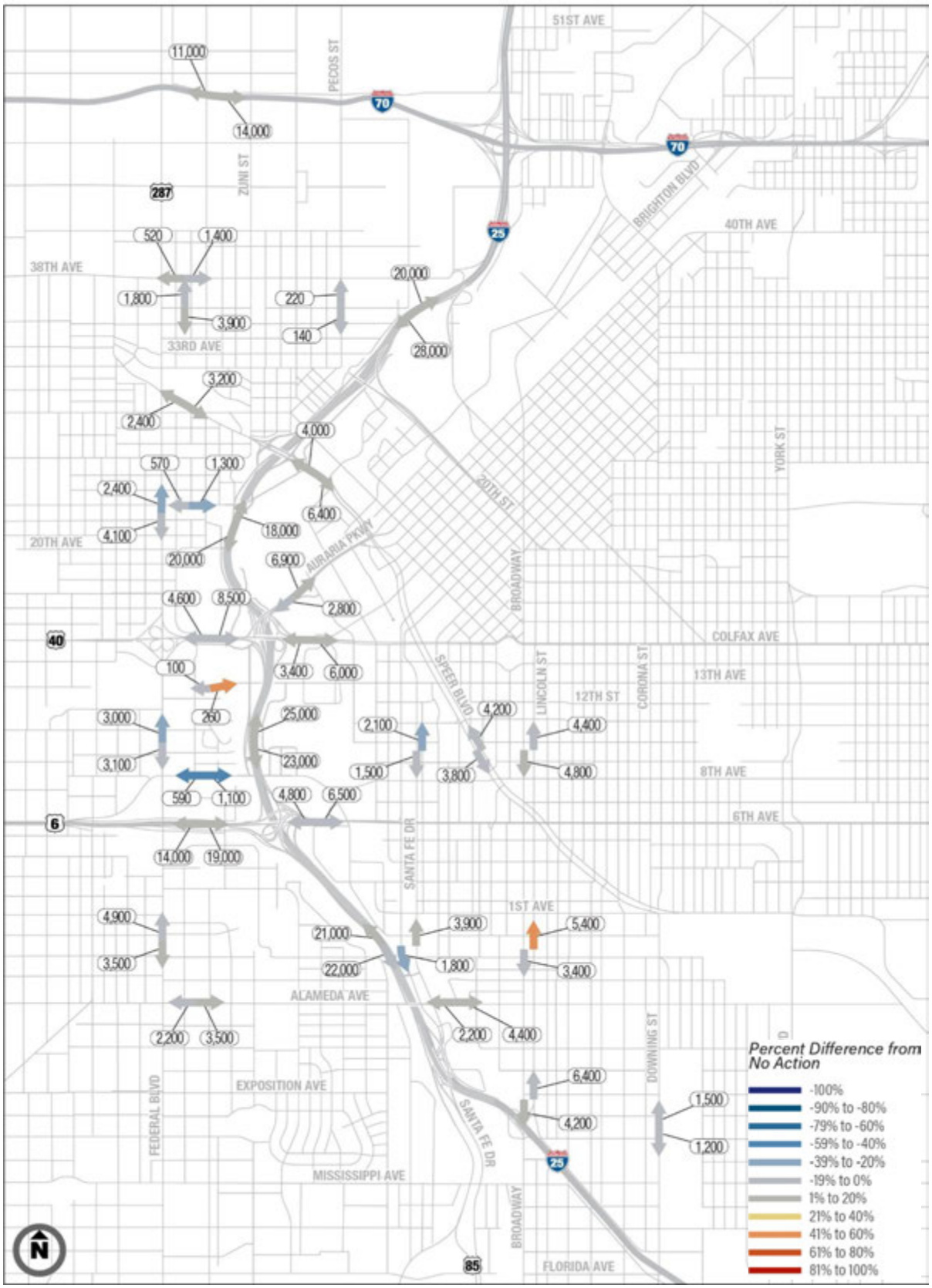


Figure 52: AM Peak Period Collector/Distributor Roads and Braided Ramps Alternative Screenline Volumes

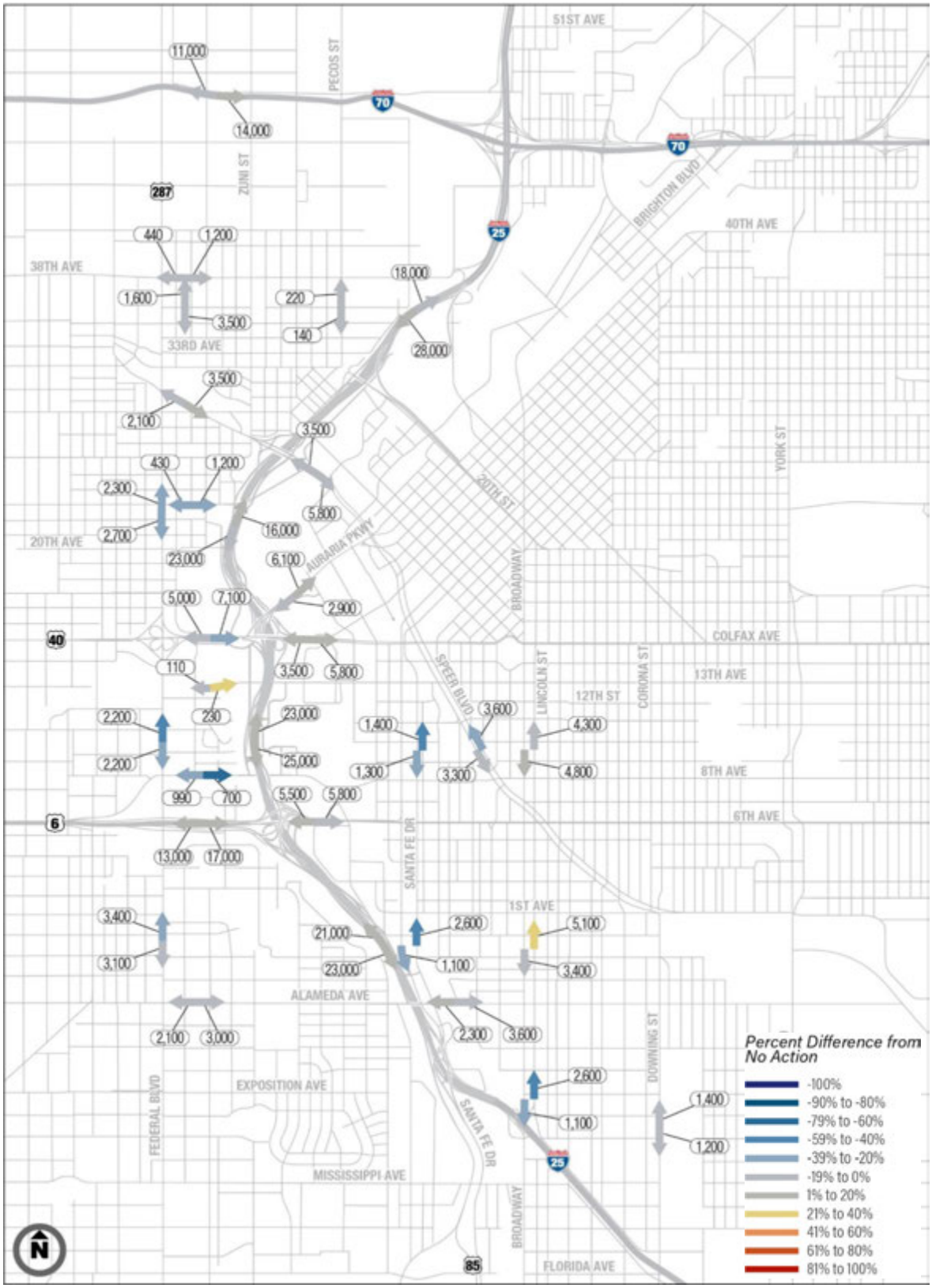


Figure 53: AM Peak Period Managed Lanes Alternative Screenline Volumes

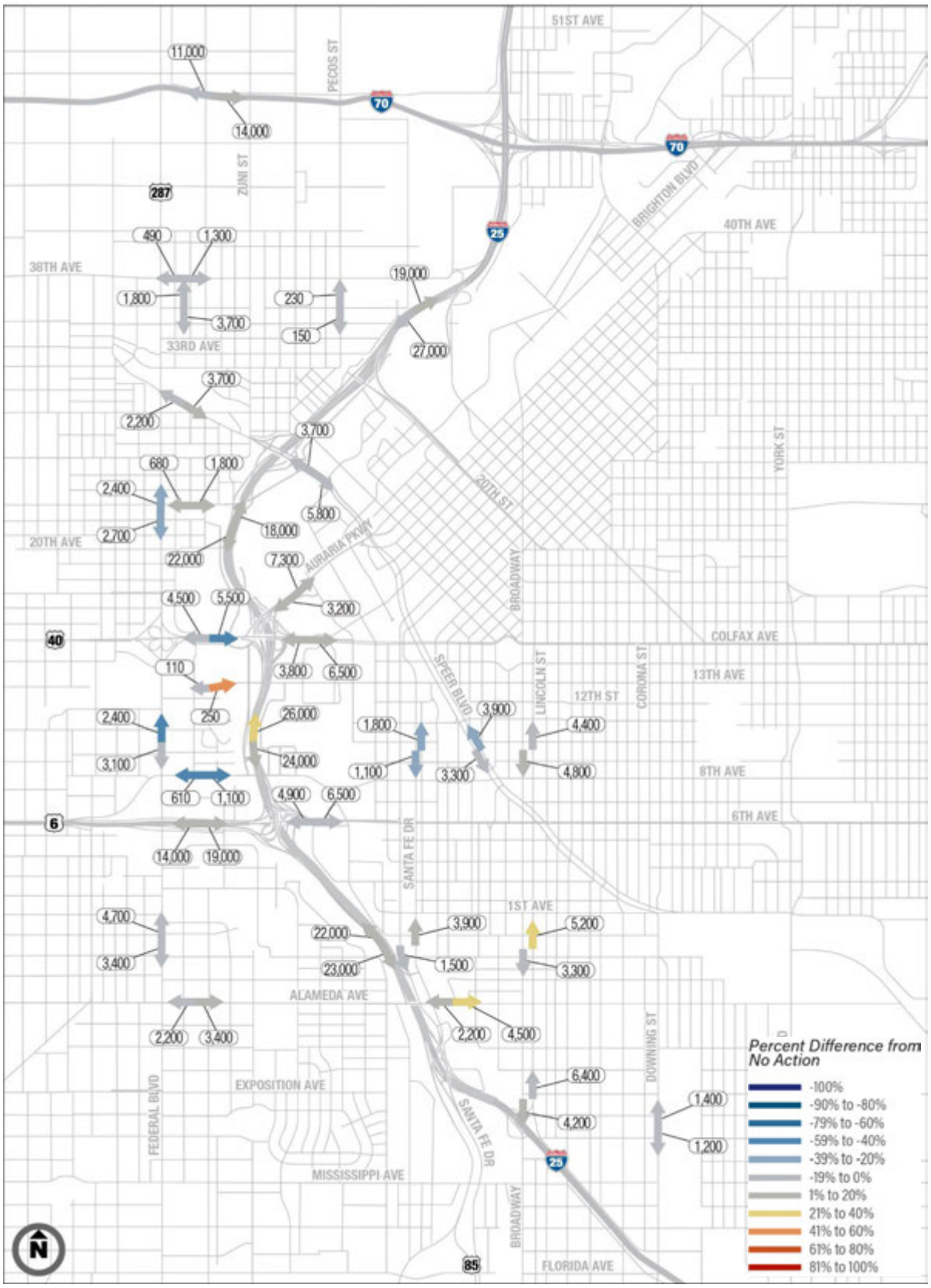


Figure 54: PM Peak Period 2030 No Action Alternative Screenline Volumes

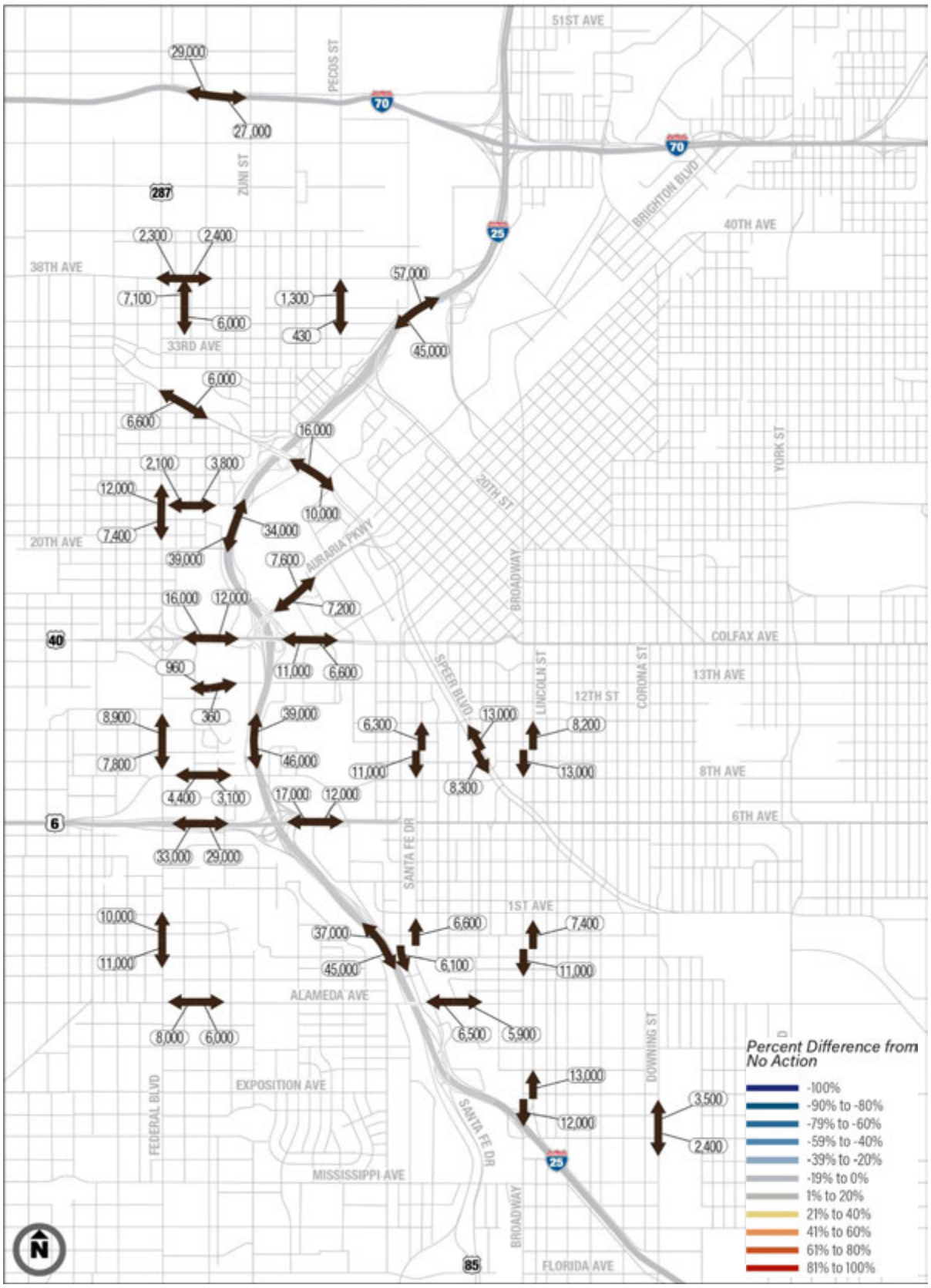


Figure 55: PM Peak Period Bring the Corridor to Standard Alternative Screenline Volumes

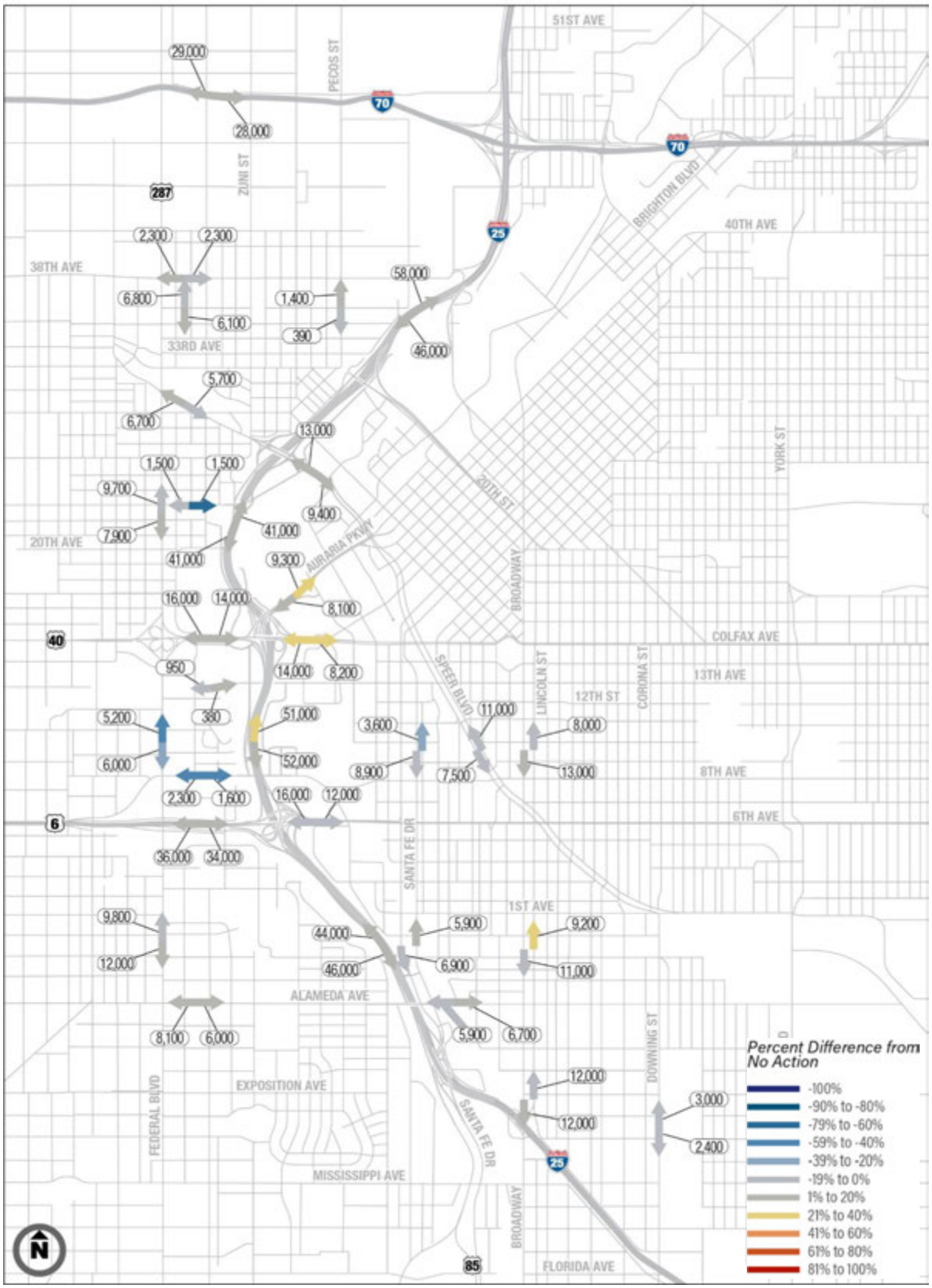


Figure 56: PM Peak Period Collector/Distributor Roads and Braided Ramps Alternative Screenline Volumes

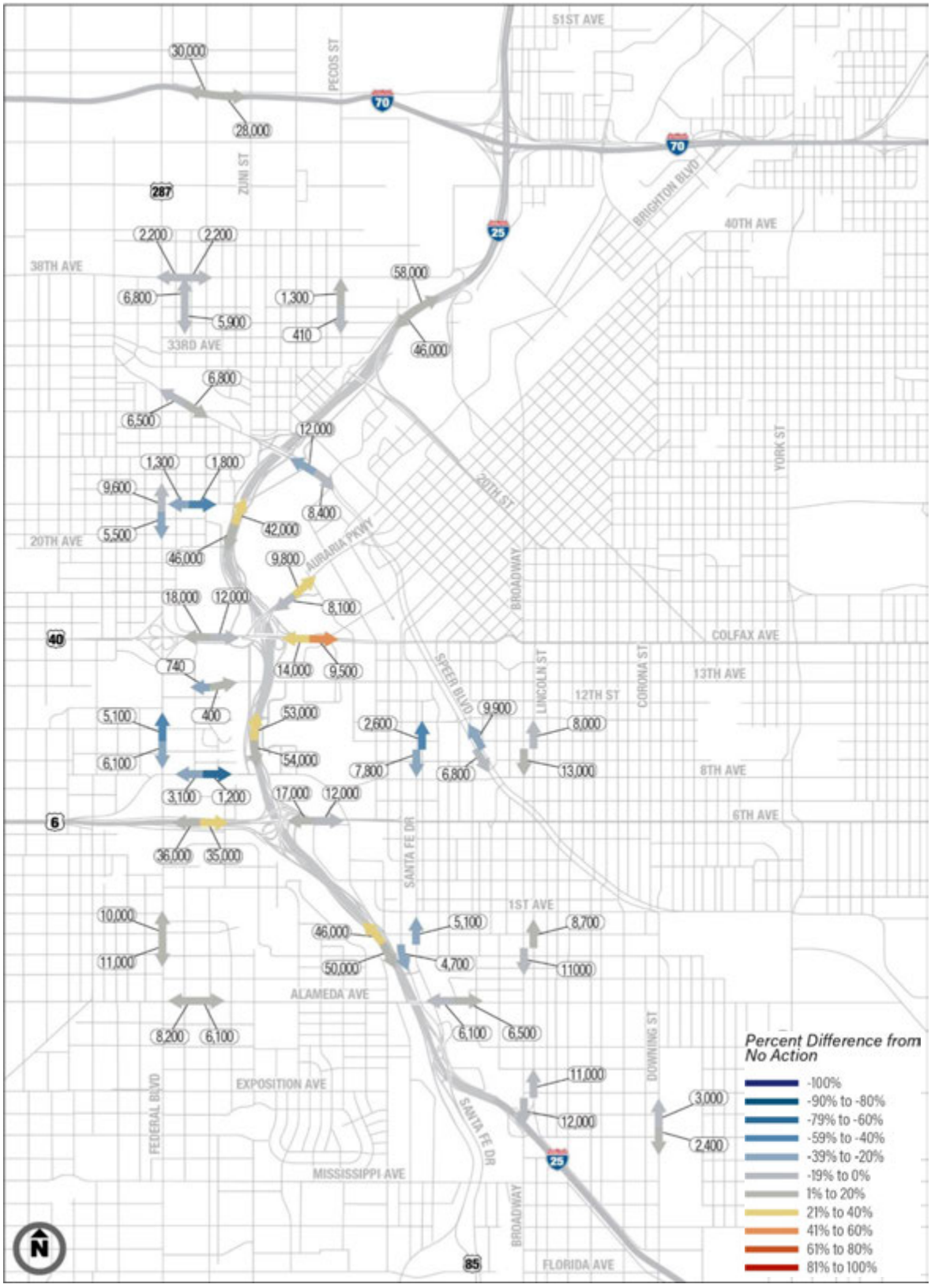
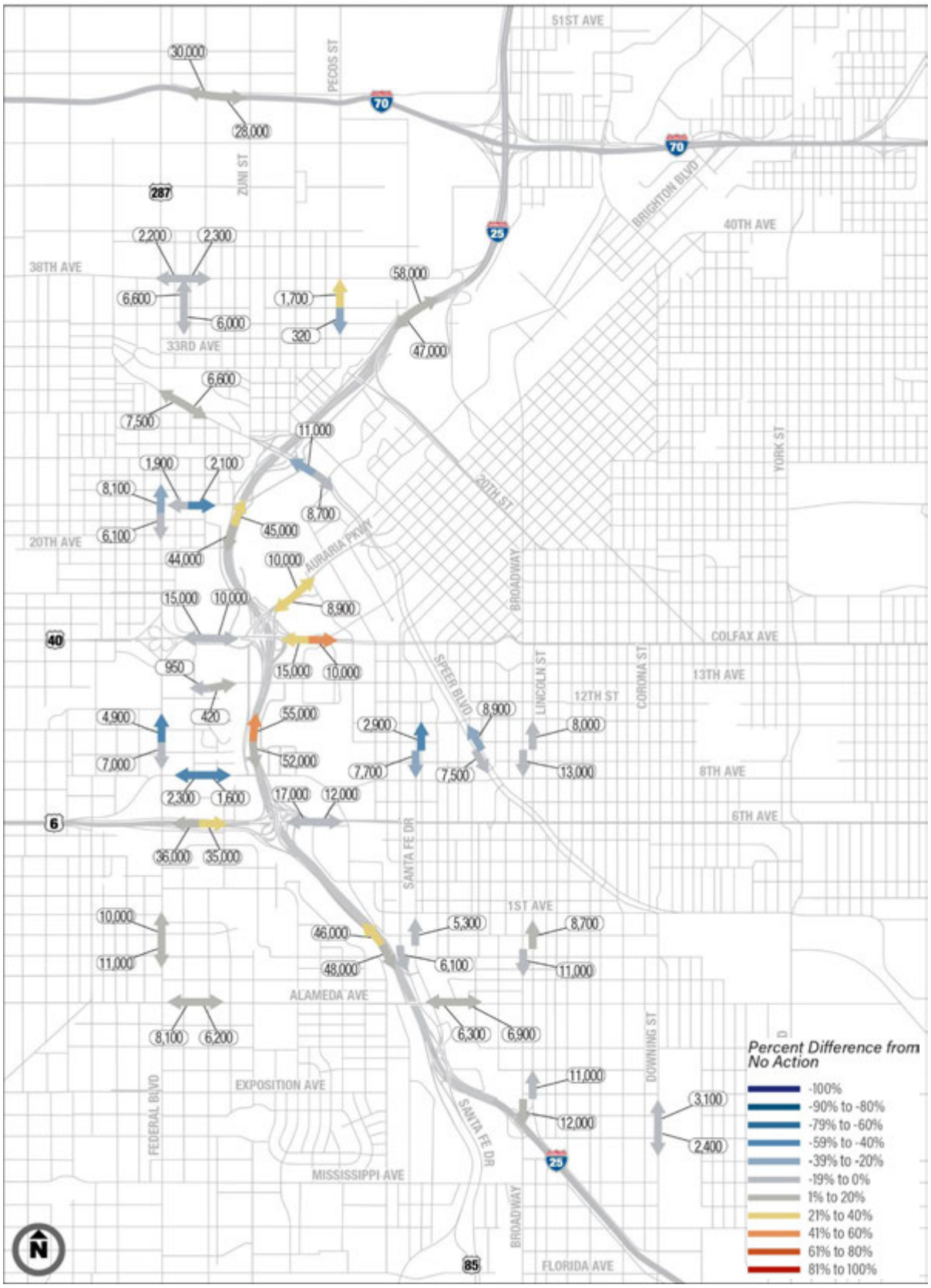


Figure 57: PM Peak Period Managed Lanes Alternative Screenline Volumes



6. Safety Analysis Results

A safety analysis was conducted using the HSM methodology to calculate the number of predicted crashes for each alternative. Crashes are predicted using Safety Performance Functions (SPFs) and Crash Modification Factors (CMFs). SPFs are formulas used to estimate the potential frequency of crashes at a given location. The estimated crash frequency calculated using SPFs then is modified using CMFs to estimate the impact of safety treatments on the predicted number of crashes. This methodology was used to predict the safety performance of each of the four alternatives: 2030 No Action Alternative, Bring the Corridor to Standard Alternative, Collector/Distributor Roads and Braided Ramps Alternative, and Managed Lanes Alternative.

HSM methodology calculates the predicted number of crashes per year on individual freeway segments. Freeway facilities are split into segments based on geometric characteristics, ramp locations, and curvature. Segments are selected such that geometry and volume are consistent throughout each individual segment; segment breaks occur at changes in freeway geometry and at ramps. Predicted crashes in each segment are characterized by type and severity. Predicted crashes for mainline freeway segments, CD roads, and ramps are categorized into single vehicle (SV), multiple vehicles (MV), and all types (AT). In addition to crash types, two crash severities are predicted by the HSM methodology: property damage only (PDO) and fatal/injury (FI).

The safety performance of a facility is determined by summing the predicted crashes on each segment. The predicted number of crashes per year on a facility can be useful in comparing the safety performance between two facilities, but the total number of predicted crashes does not account for changing conditions between two alternatives. Normalizing the total number of predicted crashes provides a more equitable comparison between alternatives that accounts for changing conditions between them. HSM analysis results presented in this document have been normalized by million vehicle miles traveled to provide a better comparison between the alternatives. Additional detail on the HSM methodology used to predict crashes is provided in the *I-25 Central Traffic Safety Technical Memorandum* (July 2018), which is included in Attachment A, *I-25 Central Existing Conditions Assessment*, of the I-25 Central PEL Study Report.

6.1. HSM Methodology Limitations

While HSM methodology is useful in predicting safety performance of facilities, there are some limitations to the analysis that must be considered. Each of these considerations are listed below and discussed in further detail in the following sections.

- Lack of locally available SPFs
- High vehicle volumes on I-25 Central
- Presence of managed lanes

6.1.1. Lack of Locally Available SPFs

SPFs work best when they are calibrated to local roadway conditions. CDOT maintains Colorado-specific SPFs for ramp facilities; however, similarly calibrated SPFs are not available for mainline freeway segments. To provide consistency in the safety analysis, default SPF values provided by the HSM were used for the I-25 Central analysis.

Using default SPF values instead of locally calibrated SPF values was used to provide a consistent methodology across all facilities and alternatives to determine a relative comparison between alternatives.

6.1.2. High Vehicle Volumes on I-25

One of the most critical inputs into the HSM analysis is the predicted average annual daily traffic (AADT) on each analyzed roadway segment. Because this input impacts so much of the analysis, the HSM provides boundaries on the range of values that should be used. Volumes that exceed a certain threshold results in unrealistic and unreliable outputs from the HSM analysis.

Within the Collector/Distributor and Braided Ramps Alternative, some CD road segments exceeded the acceptable volume limits and therefore could not be analyzed as CD roads. To allow for some level of comparison between alternatives, CD road segments that exceeded the acceptable volume threshold were instead analyzed as mainline freeway segments.

6.1.3. Presence of Managed Lanes

Managed lanes on freeway facilities do not currently have HSM-approved SPFs for predicting safety performance. For this analysis, SPFs for freeway facilities with managed lanes were used from a 2015 peer-reviewed paper written by researchers at the University of Florida (Srinivasan et al., 2015). The study developed SPFs for freeway facilities with HOV and high-occupancy toll (HOT) lanes using crash data from freeway facilities in California, Florida, and Washington. Because a different methodology was used to evaluate the Managed Lanes Alternative than was used for the evaluation of other alternatives, the results should be interpreted cautiously.

6.2. HSM Results

The results of the HSM analysis predict that the Bring the Corridor to Standard Alternative and the Collector/Distributor Roads and Braided Ramps Alternative will both have fewer crashes than the 2030 No Action Alternative. The reductions in crashes is a result of improved ramp spacing and roadway geometrics.

The results also indicate that the Managed Lanes Alternative will have more crashes than the No Action Alternative. This increase in crashes is the result of the addition of buffer-separated managed lanes in both directions. These managed lanes create speed differentials between themselves and the adjacent general-purpose lanes which result in more crashes. Table 14 summarizes the results of the HSM analysis for each alternative.

It should be noted that although the HSM results do show an increase in crashes between the 2030 No Action Alternative and the Managed Lanes Alternative, these results are based on an experimental methodology that differs from the traditional HSM methodology used to evaluate the other alternatives.

Table 14: HSM Results

Alternative	Total Number of Predicted Crashes	Crash Rate (crashes per million vehicle miles travelled)
2030 No Action Alternative	995	2.24
Bring the Corridor to Standard Alternative	784	1.88
Collector/Distributor Roads and Braided Ramps Alternative	719	1.65
Managed Lanes Alternative[1]	1,708[1]	3.92[1]

[1]Due to limitations of the HSM, the Managed Lanes Alternative was evaluated using an experimental methodology developed by FDOT (Srinivasan et al., 2015). Therefore, comparing the results of the Managed Lane Alterative to other alternatives should be done cautiously.

6.3. Discussion of Safety Analysis Results

The HSM methodology was originally developed for use during the design phase of projects to help decision makers understand the specific safety benefits/tradeoffs of detailed design elements, such as safety tradeoffs for different shoulder widths in space constrained areas. The HSM was intended to help designers decide, from a safety perspective, if decisions made during the design process would impact safety of a roadway. This detailed tradeoff analysis, although very useful in the design phase of a project, does not perfectly reflect the high-level planning nature of the alternatives evaluated in the PEL Study. The alternatives evaluated at this level of study are conceptual in nature and, therefore, most of the details that the HSM analyzes are neither well defined nor differentiated within or between different alternatives.

To best evaluate alternatives in the PEL study, a blended approach was used in which the quantitative HSM results guided and informed a qualitative evaluation. The outcome of this approach, presented below, was a discussion about the potential benefits and considerations of the key elements of each alternative.

6.3.1. No Action Alternative

Without improvements, the conditions on I-25 Central are expected to continue to deteriorate between now and 2030. As traffic volumes increase, the total number of crashes are expected to also increase between the existing conditions and future 2030 No Action Alternative conditions.

6.3.2. Bring the Corridor to Standard Alternative

The Bring the Corridor to Standard Alternative is predicted to provide an overall reduction in the total number of crashes on I-25 as compared to the No Action Alternative. Key improvements provided in this alternative which contribute to improved safety include:

- Improved roadway geometrics—including more gentle curves and full width travel lanes—will give drivers more time and space to react to changing roadway conditions
- Improved ramp spacing will reduce the turbulence on the freeway from vehicles merging and weaving, allowing for a more predictable and constant flow of traffic
- Improved and added full-width shoulders will provide space for disabled vehicles to be removed from traffic and allow first responders to assist drivers outside of the active travel lanes

6.3.3. Collector/Distributor Roads and Braided Ramps Alternative

The Collector/Distributor Roads and Braided Ramps Alternative is expected to further reduce the number of crashes as compared to the Bring the Corridor to Standard Alternative. Key improvements provided in this alternative which contribute to improved safety include:

- Improved roadway geometrics—including more gentle curves and full width travel lanes—will give drivers more time and space to react to changing roadway conditions
- Collector/distributor roads substantially remove the turbulence on the mainline freeway from vehicles merging and weaving, allowing for a more predictable and constant flow of traffic
- Collector/distributor roads will provide space away from the mainline freeway to hold off-ramp queues. This will prevent these queues from spilling back onto the mainline freeway and posing an unexpected hazard to through-traffic
- Braided ramps will remove the need for vehicles to weave. This significantly reduces conflict points on the highway and makes the flow of traffic safer and more predictable
- Improved and added full-width shoulders will provide space for disabled vehicles to be removed from traffic and allow first responders to assist drivers outside of the active travel lanes

6.3.4. Managed Lanes Alternative

The Managed Lanes Alternative is expected to provide some safety benefits to the corridor, while also introducing new safety elements to consider. Key elements provided in this alternative that contribute to improved safety include:

- Improved roadway geometrics—including more gentle curves and full width travel lanes—will give drivers more time and space to react to changing roadway conditions
- Improved ramp spacing will reduce the turbulence on the freeway from vehicles merging and weaving, allowing for a more predictable and constant flow of traffic
- Improved and added full-width shoulders will provide space for disabled vehicles to be removed from traffic and allow first responders to assist drivers outside of the active travel lanes

In addition to providing benefits to safety, the addition of managed lanes in this alternative may also introduce new safety concerns. These concerns primarily extend from the differential in speeds expected to occur between the general-purpose lanes and the managed lanes. Because the managed lanes are expected to only be separated from the general-purpose lanes via painted stripes, these speed differentials have the potential to result in additional crashes as some drivers attempt to merge into or out of the managed lanes. Based on observations made about other managed lane facilities already in operation across Colorado, this merging behavior is likely to occur both at designated managed lane ingress and egress locations and, due to lane-changing violations, at locations where ingress and egress is prohibited.

At this time, there is limited historical safety information available about managed lane facilities. Furthermore, the safety calculations are based on assumptions of detailed design considerations—

such as the width of the buffer space provided between the general-purpose lanes and the managed lanes, or the design of managed lane ingress and egress locations. Because of these factors, the impact of managed lanes on the overall safety of the corridor is not well known. Future studies should reassess the safety of the managed lanes once more detailed design information is available.

6.4. Recommendations for Future Studies

The safety analysis presented can be further refined as more information and improved methodology becomes available.

Ramp terminal intersections were not included in this safety analysis. As more-detailed design is completed at those intersections, the safety performance of ramp terminals can be included in the comparative safety analysis as well.

In the absence of HSM-approved methodology for analyzing safety performance of freeway facilities with managed lanes, the SPFs used to analyze safety performance of the Managed Lanes Alternative were experimentally derived by a research study. For consistency and accuracy, HSM-approved SPFs should be used to analyze safety performance of the Managed Lanes Alternative as they become available. In the absence of HSM methodology, SPFs for freeway facilities with managed lanes may be refined as data are collected in more locations outside of the three states included in the research study used for this analysis.

7. References

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FHWA. 2012. Interstate System Access Information Guide. Pg. 23. Available at: https://www.fhwa.dot.gov/design/interstate/pubs/access/access.pdf

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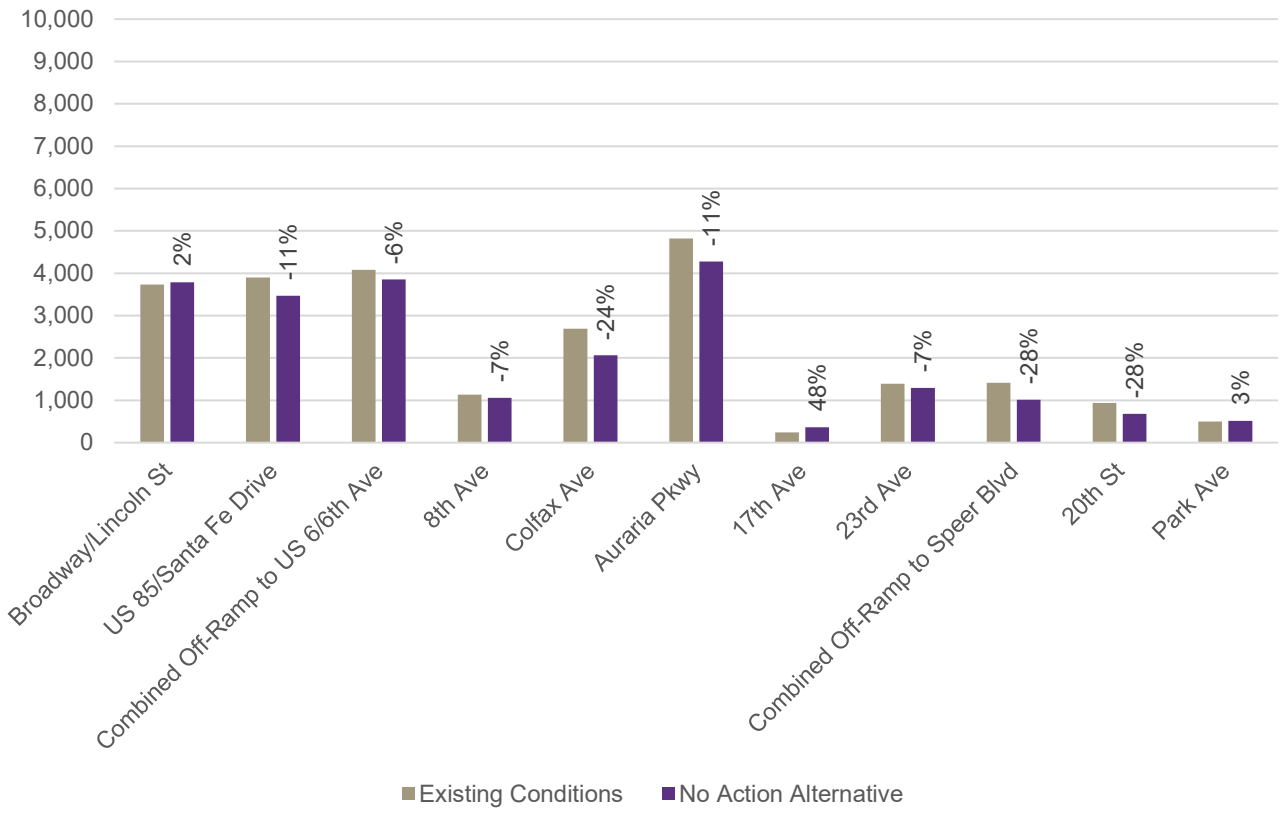
Appendix A
Detailed Ramp Volumes

1. Introduction

This appendix documents the on-ramp and off-ramp volumes on I-25 Central between Broadway and Park Avenue. Volumes presented within this section reflect the volumes entering or exiting the mainline freeway or CD road. If a ramp is removed or consolidated with another ramp before or after merging with/diverging from the mainline freeway or CD road, then its volumes are not reported in this section. Furthermore, if an interchange has multiple ramps serving the same direction on I-25—for example, the multiple northbound ramps serving both directions of Speer Boulevard in the 2030 No Action Alternative or the additional direct connection ramps to/from the managed lanes in the Managed Lanes Alternative—then the volumes on these ramps have been combined and reported as the total volumes per interchange.

Figure 1 through Figure 8 present the changes in ramp volumes between the Existing Conditions scenario and the 2030 No Action Alternative, with discussion in a table following each bar chart. Figure 9 through Figure 16 present the changes to ramp volumes between the 2030 No Action Alternative and the build alternatives.

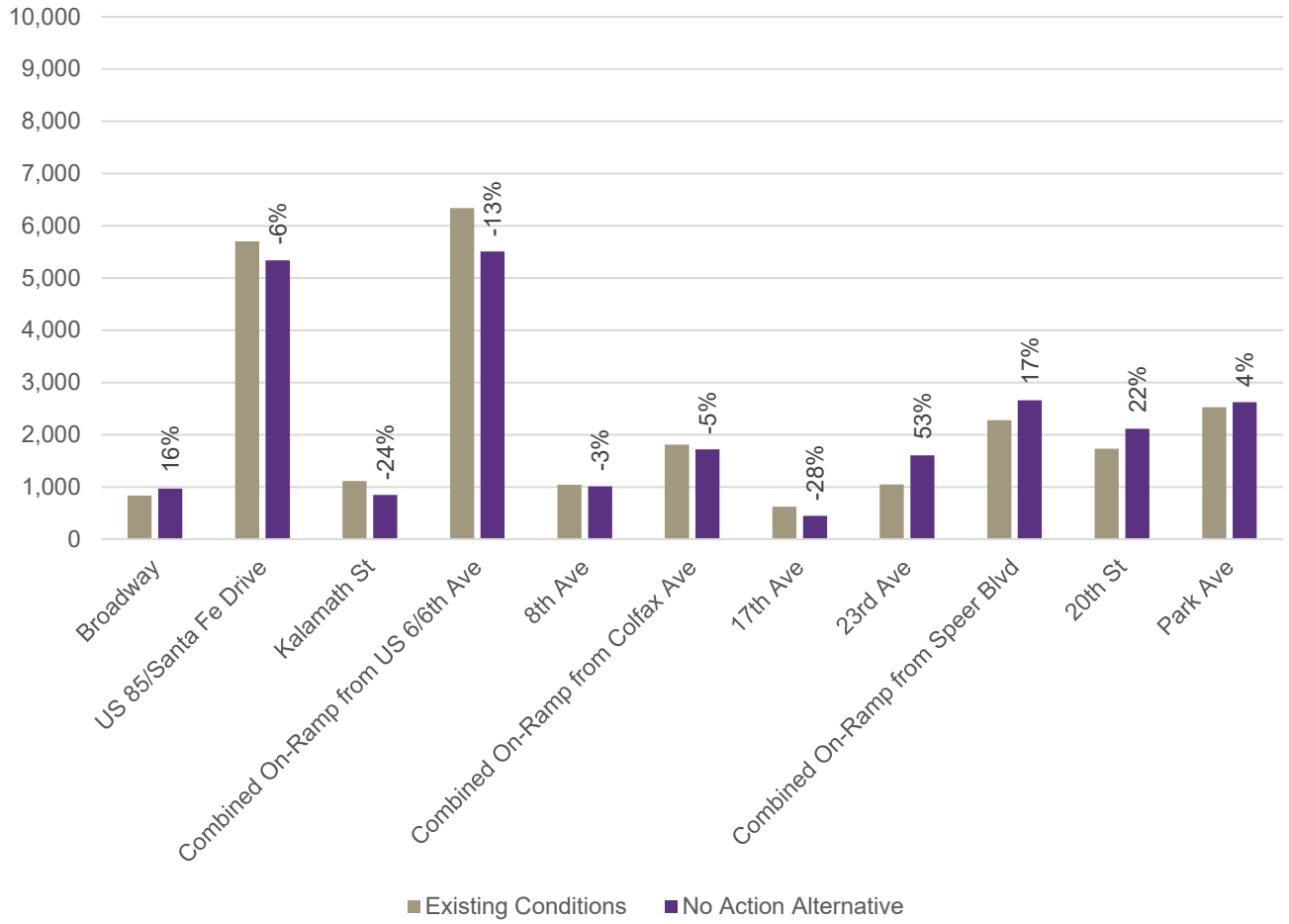
Figure 1: Northbound, AM Peak Period Off-Ramp Volumes (Existing Conditions vs. 2030 No Action)



Percentages shown represent the percent difference from the Existing Conditions.

Northbound Off-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
Broadway/Lincoln St	+2%	This change is within the natural variation of the model (± 5%) and is not considered significant.
Santa Fe Dr/US 85	-11%	Congestion on the freeway blocks vehicles from being able to access these ramps. The reductions match the overall reduction in serviced vehicles on the freeway.
US 6/6th Ave	-6%	
8th Ave	-7%	
Colfax Ave	-24%	Colfax Avenue is very congested during the AM peak period, with eastbound queues (going into downtown) extending from Speer Boulevard to approximately I-25/ Federal Boulevard. This queue blocks traffic on the northbound I-25 off-ramp and reduces the total number of vehicles being serviced by this ramp.
Auraria Pkwy	-11%	Congestion on the freeway blocks vehicles from being able to access these ramps. The reductions match the overall reduction in serviced vehicles on the freeway.
17th Ave	+48%	This is a low-volume ramp. This increase in traffic corresponds to a total ramp volume increase of approximately 120 vehicles during the AM peak period. This low number of vehicles is not considered significant.
23rd Ave	-7%	Congestion on the freeway blocks vehicles from being able to access these ramps. The reductions match the overall reduction in serviced vehicles on the freeway.
Speer Blvd	-28%	Severe northbound freeway congestion near the Colfax Avenue interchange spills back to approximately Santa Fe Drive/US 85. For drivers attempting to go to Speer Boulevard or 20th Street, it is likely faster for them to take an alternate route rather than wait in the freeway congestion. Therefore, off-ramp volumes decrease.
20th St	-28%	
Park Ave	+3%	This change is within the natural variation of the model and is not considered significant.

Figure 2: Northbound, AM Peak Period On-Ramp Volumes (Existing Conditions vs. 2030 No Action)

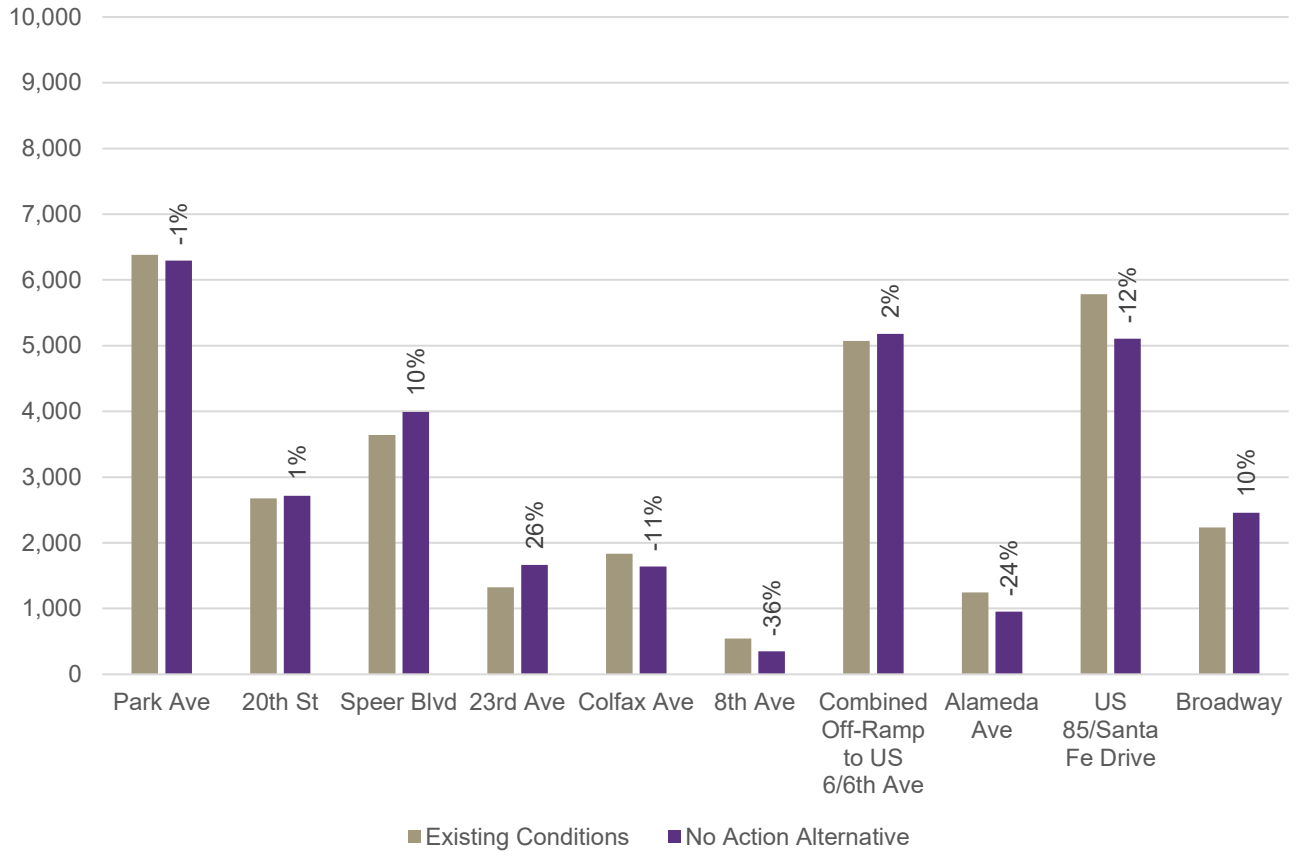


Percentages shown represent the percent difference from the Existing Conditions.

Northbound On-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
Broadway	+16%	This increase is due to forecasted travel demand growth.
Santa Fe Dr/US 85	-6%	Congestion on the freeway blocks vehicles from being able to enter I-25 from this ramp. This results in vehicles queueing on this ramp. These queues extend from I-25 to past Mississippi Avenue.
Kalamath St	-24%	A majority of northbound on-ramp traffic at this location is coming from Alameda Avenue and northbound Santa Fe Drive/US 85. Congestion on the mainline freeway encourages drivers going into downtown to remain on northbound Santa Fe Drive/US 85 instead of entering the freeway. This results in fewer vehicles coming onto I-25 from this location.

Northbound On-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
US 6/6th Ave	-13%	Congestion on the freeway blocks vehicles from being able to enter I-25 from this ramp. This results in vehicles queueing on this ramp from I-25 to past Federal Boulevard.
8th Ave	-3%	These changes are within the natural variation of the model and are not considered significant.
Colfax Ave	-5%	
17th Ave	-28%	In the existing conditions, northbound AM peak period congestion diminishes after Colfax Avenue. Therefore, drivers stay on Federal Boulevard to bypass the congestion, then get back onto the freeway at 17th Avenue. However, in the 2030 No Action Alternative, congestion does not diminish until 23rd Avenue. Therefore, people avoiding congestion continue farther north on the local network before entering the freeway. This results in lower volumes at 17th Avenue and higher volumes at ramps farther to the north.
23rd Ave	+53%	
Speer Blvd	+17%	
20th St	+22%	
Park Ave	+4%	This change is within the natural variation of the model and is not considered significant.

Figure 3: Southbound, AM Peak Period Off-Ramp Volumes (Existing Conditions vs. 2030 No Action)

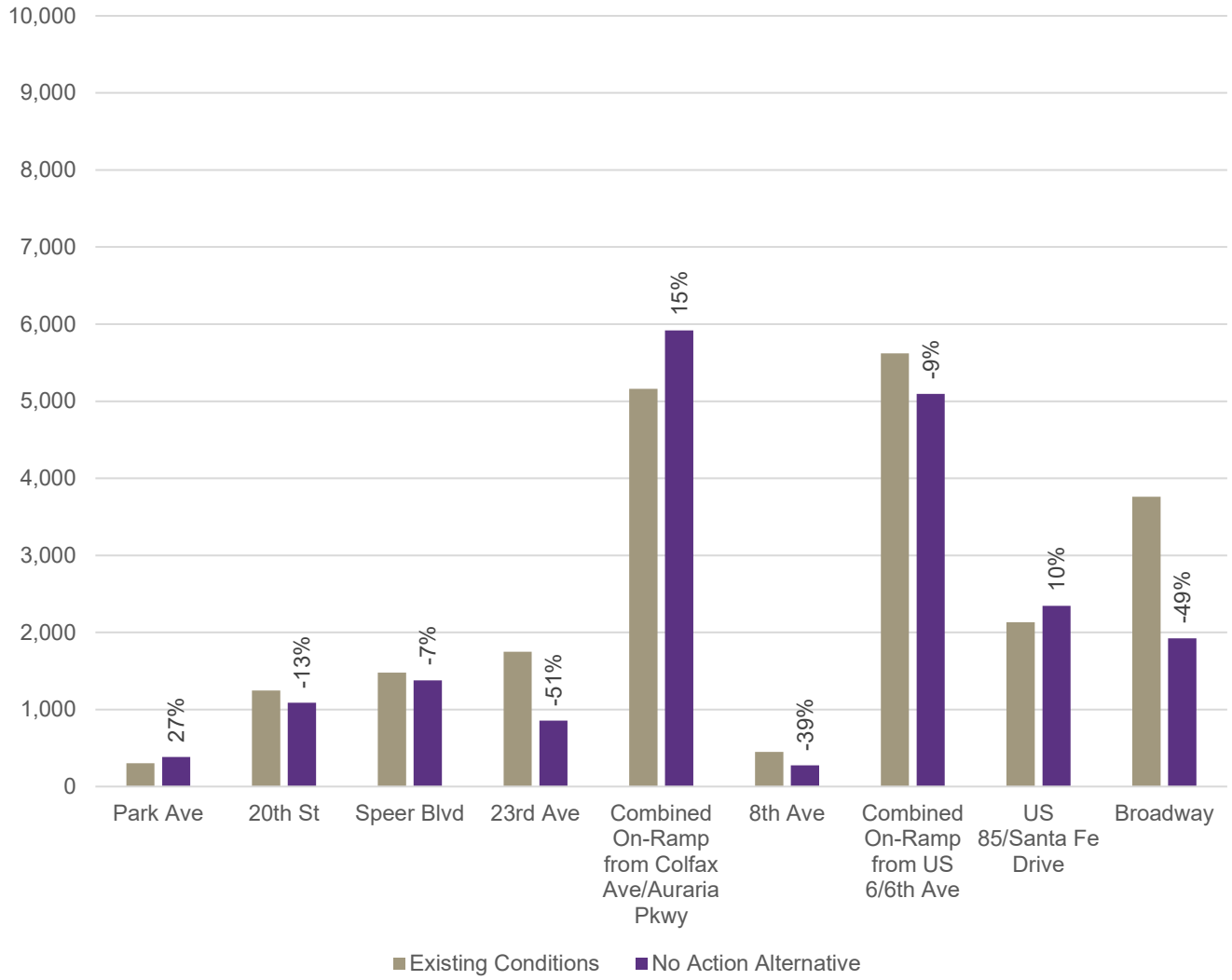


Percentages shown represent the percent difference from the Existing Conditions.

Southbound Off-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
Park Ave	-1%	These changes are within the natural variation of the model and are not considered significant.
20th St	+1%	
Speer Blvd	+10%	Both of these off-ramps are configured as drop lanes from the mainline freeway. Due to increasing congestion between the Existing Conditions scenario and the 2030 No Action Alternative, more drivers choose to avoid downstream congestion on the highway and exit to these ramps. For drivers attempting to go into downtown or southeast Denver, it is faster to exit at Speer Boulevard and use eastbound Speer Boulevard to bypass I-25. For drivers going to southwest Denver, it is faster to exit I-25 at 23rd Avenue and use Federal Boulevard to avoid I-25.
23rd Ave	+26%	
Colfax Ave	-11%	In the existing conditions, some drivers exit at Colfax Avenue to get to southbound Federal Boulevard. However, due to increasing congestion in the 2030 No Action Alternative,

Southbound Off-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
		drivers wanting to go to southbound Federal Boulevard instead exit earlier at 23rd Avenue to avoid congestion on the freeway.
8th Ave	-36%	This is a low-volume ramp. This decrease in traffic corresponds to a total ramp volume decrease of approximately 200 vehicles during the AM peak period. This low number of vehicles is not considered significant.
US 6/6th Ave	+2%	This change is within the natural variation of the model and is not considered significant.
Alameda Ave	-24%	Increasing congestion between the Existing Conditions scenario and 2030 No Action Alternative results in slower speeds on the freeway, especially between US 6/6th Avenue and Alameda Avenue. Therefore, drivers that currently exit southbound to Alameda Avenue or Santa Fe Drive/US 85 to go to places in southwest Denver will instead exit at US 6/6th Avenue and take southbound Federal Boulevard to avoid congestion.
Santa Fe Dr/US 85	-12%	
Broadway	+10%	This increase is due to forecasted travel demand growth.

Figure 4: Southbound, AM Peak Period On-Ramp Volumes (Existing Conditions vs. 2030 No Action)

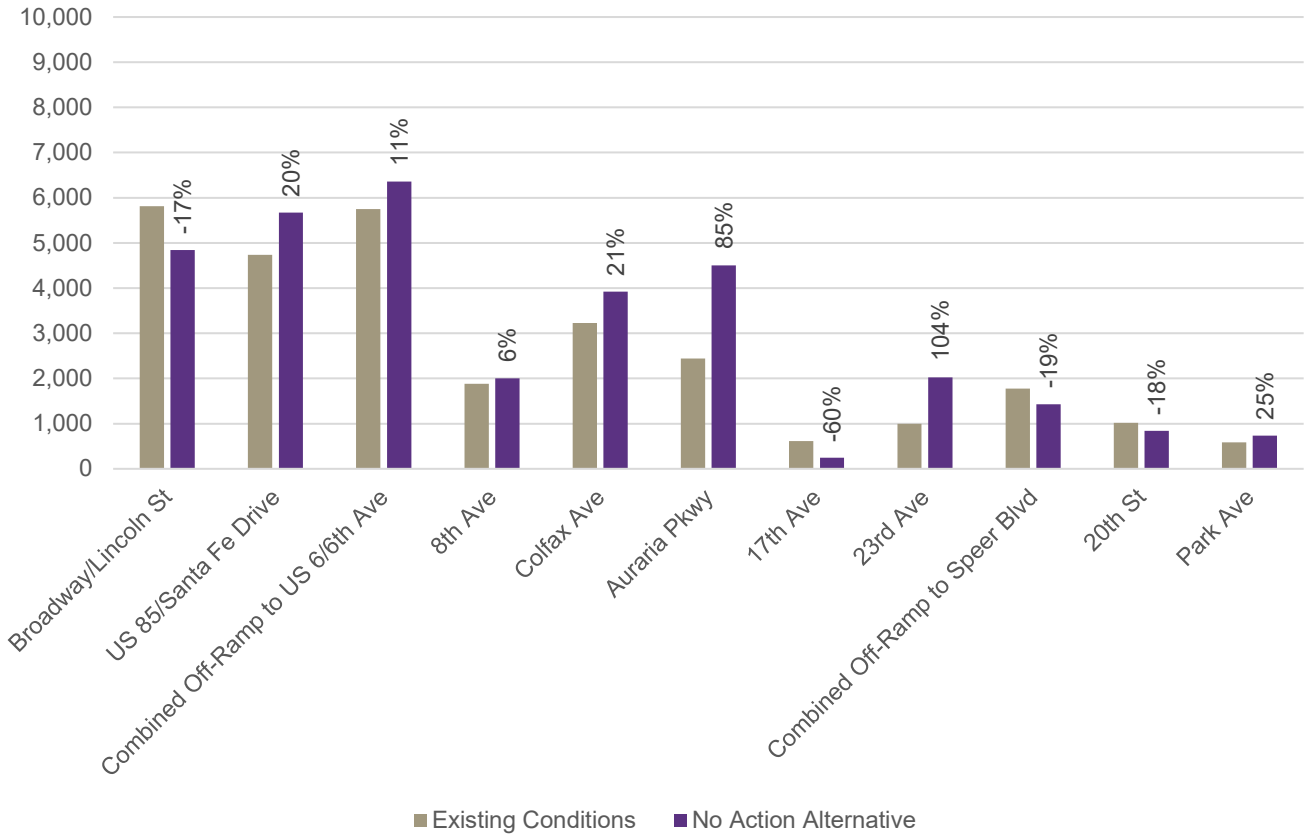


Percentages shown represent the percent difference from the Existing Conditions.

Southbound On-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
Park Ave	+27%	This is a low-volume ramp. This decrease in traffic corresponds to a total ramp volume decrease of approximately 80 vehicles during the AM peak period. This low number of vehicles is not considered significant.
20th St	-13%	In the Existing Conditions scenario, 10 percent, 7 percent, and 26 percent of traffic entering I-25 southbound from 20th Street, Speer Boulevard, and 23rd Avenue, respectively, is exiting the freeway a short time later at Colfax Avenue, 8th Avenue, or US 6/6th Avenue[1]. In the 2030 No Action Alternative, congestion on southbound I-25 in this area increases. This results in some of these drivers making these short trips to either access I-25 south of the congestion—at Colfax Avenue—or use the local roadway network to access these facilities to avoid growing congestion on I-25.
Speer Blvd	-7%	
23rd Ave	-51%	
Colfax Ave/Auraria Pkwy/Lower Colfax Ave	+15%	
8th Ave	-39%	This is a low-volume ramp. This decrease in traffic corresponds to a total ramp volume decrease of approximately 175 vehicles during the AM peak period. This low number of vehicles is not considered significant.
US 6/6th Ave	-9%	Congestion on the freeway blocks vehicles from being able to enter I-25 from this ramp. This results in vehicles queueing on this ramp from I-25 to past Federal Boulevard.
Santa Fe Dr/US 85	+10%	This increase is due to forecasted travel demand growth.
Broadway	-49%	In the 2030 No Action Alternative, the southbound on-ramp from Broadway is reconfigured into a wedge ramp configuration. This shifts the on-ramp to be on the north side of the highway and results in drivers coming northbound on Broadway to pass through two additional traffic signals (including a left-turn signal) to access the on-ramp. Due to this additional delay, it becomes faster for drivers coming northbound on Broadway to access southbound I-25 via Mississippi Avenue and Buchtel Boulevard as opposed to using the reconfigured Broadway on-ramp.

[1]Additional origin/destination information and discussion about short trips on I-25 can be found in the *I-25 Central Origin-Destination Analysis Technical Memorandum* located in Appendix A, *Existing Conditions Assessment Report*, of the I-25 Central PEL Study Report.

Figure 5: Northbound, PM Peak Period Off-Ramp Volumes (Existing Conditions vs. 2030 No Action)

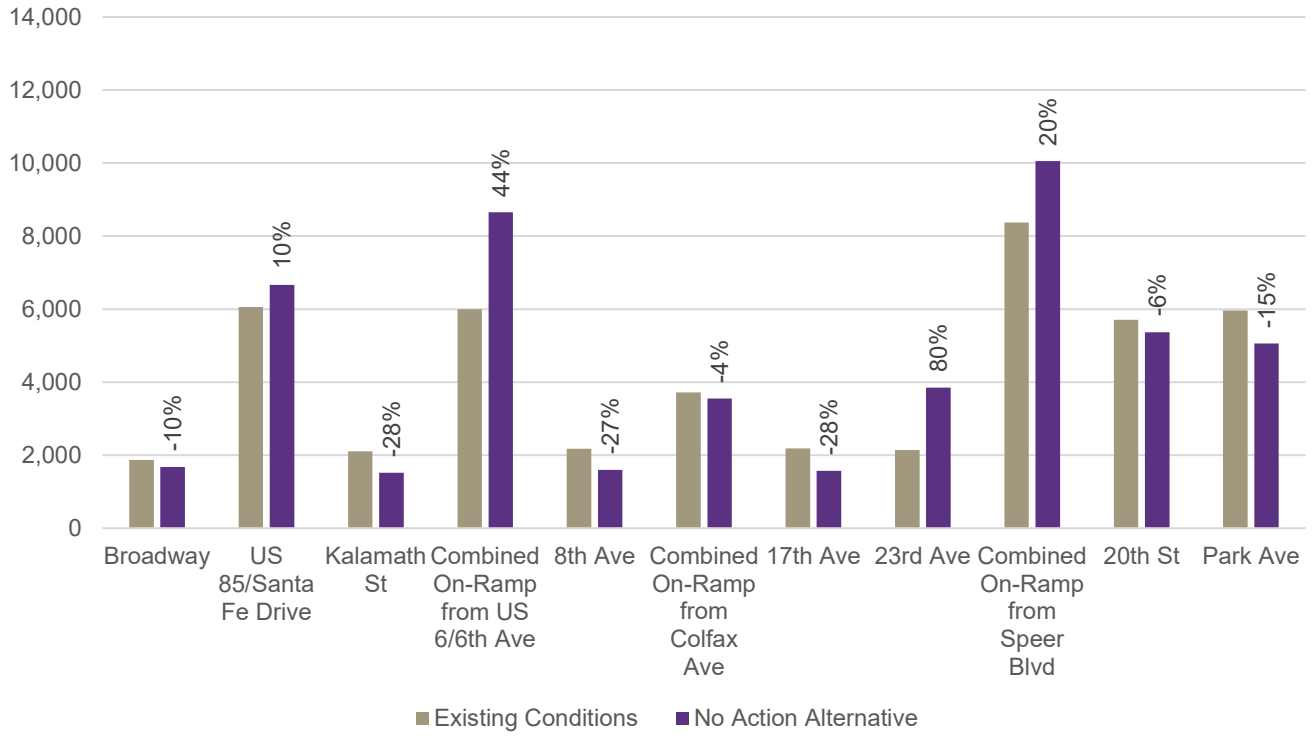


Percentages shown represent the percent difference from the Existing Conditions.

Northbound Off-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
Broadway/Lincoln St	-17%	In the existing conditions, drivers use northbound Lincoln Street as the primary alternate route to I-25 to access downtown. However, in the 2030 No Action Alternative, Lincoln Street is at or over capacity during the PM peak period. Therefore, some drivers on I-25 change their choice and instead use Santa Fe Drive as an alternate route to northbound I-25 and Lincoln Street.
Santa Fe Dr/US 85	+20%	
US 6/6th Ave	+11%	This increase is due to forecasted travel demand growth.
8th Ave	+6%	This is a low-volume ramp. This increase in traffic corresponds to a total ramp volume increase of approximately 120 vehicles during the PM peak period. This low number of vehicles is not considered significant.

Northbound Off-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
Colfax Ave	+21%	In the existing conditions, traffic into and out of downtown—which makes up a majority of traffic using the Colfax Avenue and Auraria Parkway ramps—is very directional, with traffic entering into downtown in the morning and exiting out of downtown in the evening. However, in the 2030 No Action Alternative, this highly directional flow changes as travel demand in the downtown area is increasingly influenced by factors other than traditional office jobs—for example, as more people choose to live downtown or travel there for entertainment purposes. This change in travel demand patterns results in more people exiting to Colfax Avenue and Auraria Parkway during the PM peak period.
Auraria Pkwy	+85%	
17th Ave	-60%	Due to congestion on I-25 northbound, many drivers use alternate routes. The primary northbound alternate route is Federal Boulevard. In the existing conditions, many drivers choose to exit I-25 at US 6/6th Avenue or Colfax Avenue, travel to Federal Boulevard, and then travel northbound on Federal Boulevard to avoid congestion on the highway. In the 2030 No Action Alternative, however, Federal Boulevard is very congested, especially between Colfax Avenue and 23rd Avenue as the roadway narrows from three lanes to two. Therefore, in the 2030 No Action Alternative, many drivers choose to remain on I-25 and exit at 23rd Avenue to access Federal Boulevard. This route avoids the congestion on Federal Boulevard, as well as some of the congestion on I-25 between 23rd Avenue and I-70.
23rd Ave	+104%	
Speer Blvd	-19%	As discussed above, northbound PM peak period congestion on I-25 is expected to extend to about Speer Boulevard. To avoid this congestion, drivers who in the existing conditions take I-25 northbound to Speer Boulevard or 20th Street instead choose to exit the highway at Colfax Avenue and Auraria Parkway and use those routes to reach Speer Boulevard and 20th Street to avoid prolonged congestion on the freeway.
20th St	-18%	
Park Ave	+25%	This is a low-volume ramp. This increase in traffic corresponds to a total ramp volume increase of approximately 150 vehicles during the PM peak period. This low number of vehicles is not considered significant.

Figure 6: Northbound, PM Peak Period On-Ramp Volumes (Existing Conditions vs. 2030 No Action)



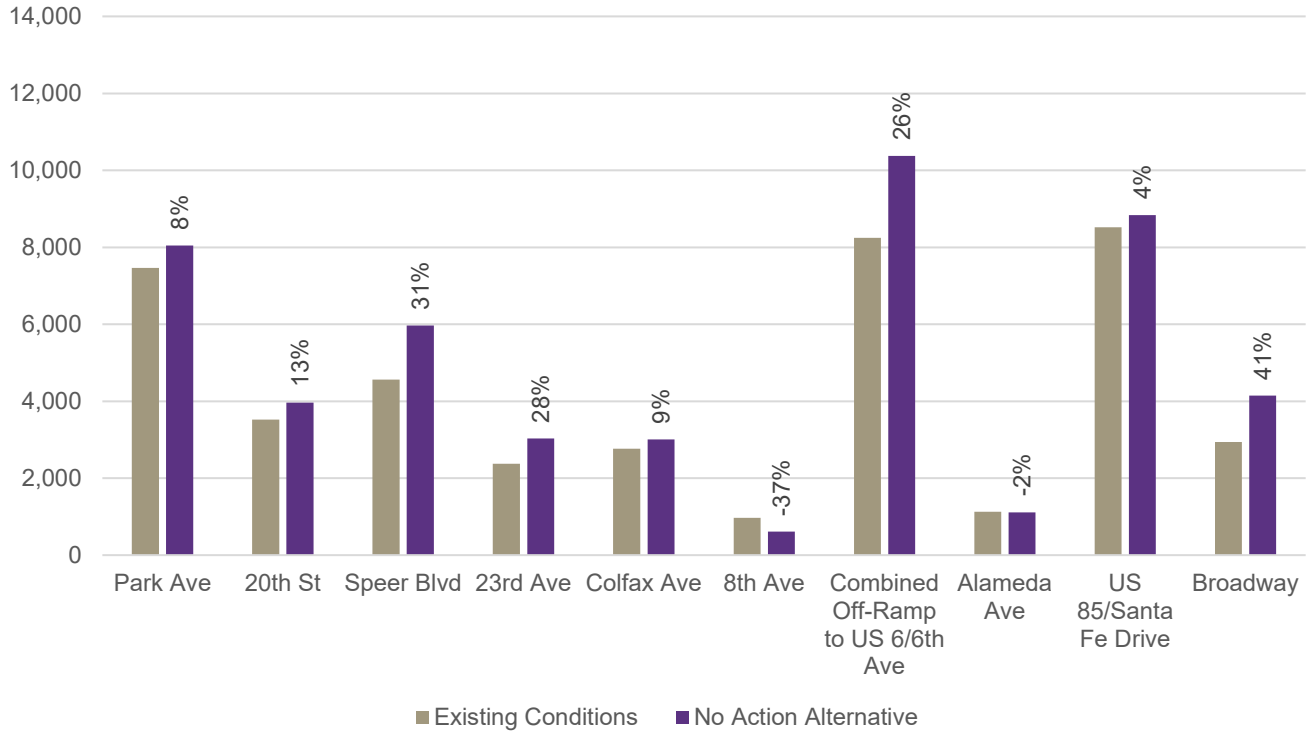
Percentages shown represent the percent difference from the Existing Conditions.

Northbound On-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
Broadway	-10%	Increasing congestion on northbound I-25 between the existing conditions and the 2030 No Action Alternative results in more people choosing to stay on Broadway/Lincoln Street to travel northbound. This reduces the number of vehicles using this on-ramp.
Santa Fe Dr/US 85	+10%	This increase is due to forecasted travel demand growth.
Kalamath St	-28%	A majority of northbound on-ramp traffic at this location is coming from Alameda Avenue and northbound Santa Fe Drive/US 85. Congestion on the mainline freeway encourages drivers going into downtown to remain on northbound Santa Fe Drive/US 85 instead of entering the freeway. This results in fewer vehicles coming onto I-25 from this location.
US 6/6th Ave	+44%	In the existing conditions, traffic into and out of downtown—which makes up a large portion of traffic on US 6/6th Avenue—is very directional, with traffic entering into downtown in the morning and exiting out of downtown in the evening. However, in the 2030 No Action Alternative, this

Northbound On-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
		highly directional flow changes as travel demand in the downtown area is increasingly influenced by factors other than traditional office jobs—for example, as more people choose to live downtown or travel there for entertainment purposes. This change in travel demand patterns results in more people coming from US 6/6th Avenue during the PM peak period.
8th Ave	-27%	In the Existing Conditions scenario, a portion of the on-ramp traffic at 8th Avenue is vehicles coming from northbound Federal Boulevard. These drivers choose to access northbound I-25 via 8th Avenue to avoid congestion on the US 6/6th Avenue on-ramp to I-25. However, in the 2030 No Action Alternative, congestion on northbound I-25 worsens. This results in drivers remaining on northbound Federal Boulevard and accessing I-25 farther to the north at 23rd Avenue to avoid congestion on the freeway.
Colfax Ave	-4%	This change is within the natural variation of the model and is not considered significant.
17th Ave	-28%	In the existing conditions, a portion of the on-ramp traffic at 17th Avenue is vehicles coming from northbound Federal Boulevard. These drivers choose to access northbound I-25 via 17th Avenue to avoid congestion on the US 6/6th Avenue on-ramp to I-25. However, in the 2030 No Action Alternative, congestion on northbound I-25 worsens. This results in drivers remaining on northbound Federal Boulevard and accessing I-25 farther to the north at 23rd Avenue to avoid congestion on the freeway.
23rd Ave	+80%	Due to increasing congestion between the existing conditions and the 2030 No Action Alternative, more drivers choose to use Federal Boulevard as an alternate route to I-25. 23rd Avenue represents the last connection between Federal Boulevard and I-25 before I-25 turns to the northwest and begins to move away from Federal Boulevard. Therefore, the volumes at the 23rd Avenue on-ramp increase as more people divert to Federal Boulevard to avoid congestion on the freeway.
Speer Blvd	+20%	Speer Boulevard represents one of the primary alternate routes to I-25 on the east side of the freeway. As congestion increases on I-25, more people choose to use Speer Boulevard to avoid traffic. These drivers then access I-25 at the Speer Boulevard interchange.

Northbound On-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
20th St	-6%	Congestion on the freeway blocks vehicles entering I-25 from these ramps. This results in vehicles queueing on these ramps and fewer vehicles being served during the peak periods.
Park Ave	-15%	

Figure 7: Southbound, PM Peak Period Off-Ramp Volumes (Existing Conditions vs. 2030 No Action)

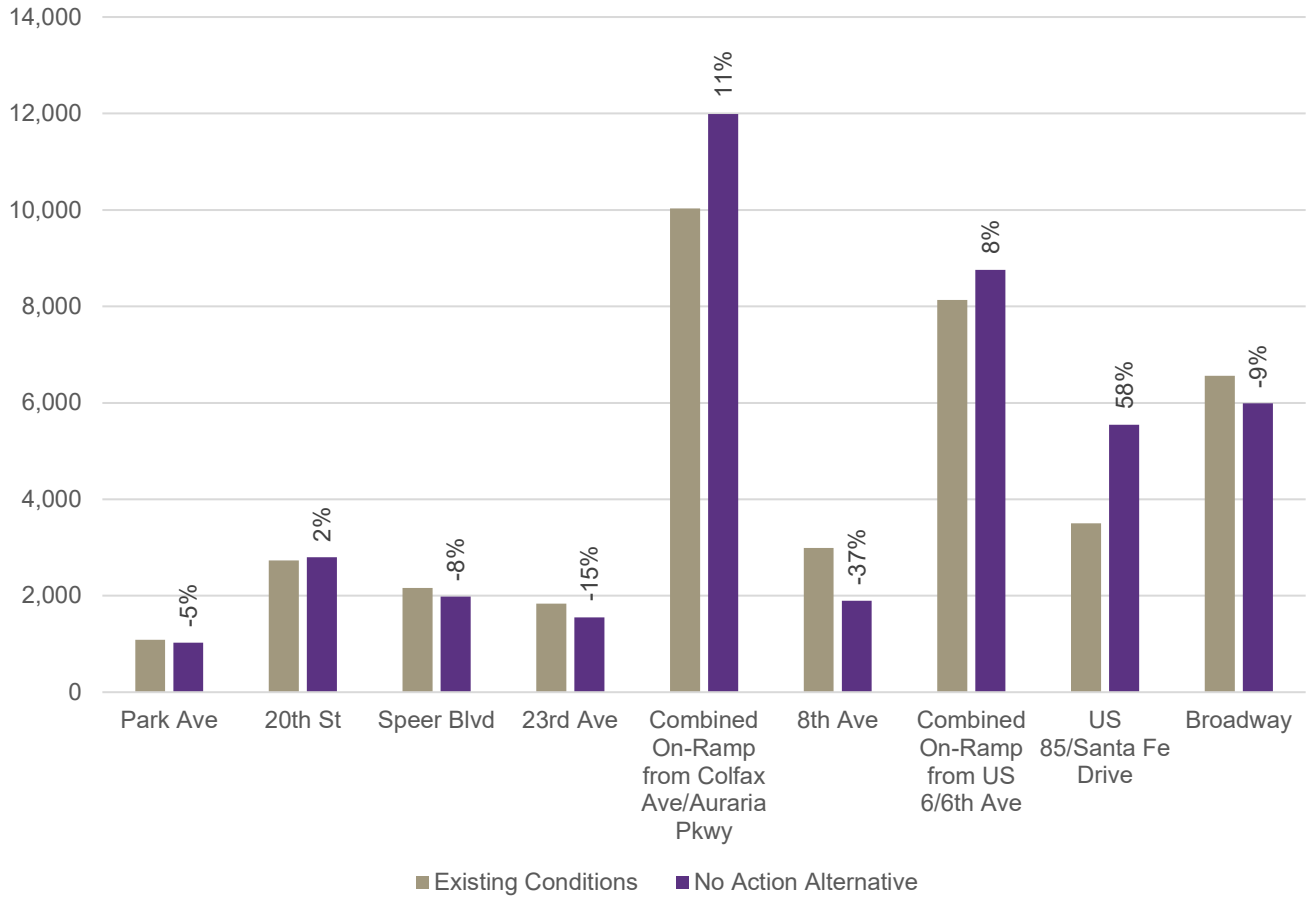


Percentages shown represent the percent difference from the Existing Conditions.

Southbound Off-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
Park Ave	+8%	In the existing conditions, traffic into and out of downtown—which makes up a majority of traffic using the Park Avenue, 20th Street, and Speer Boulevard ramps—is very directional, with traffic entering into downtown in the morning and exiting out of downtown in the evening. However, in the 2030 No Action Alternative, this highly directional flow changes as travel demand in the downtown area is increasingly influenced by factors other than traditional office jobs—for example, as more people choose to live downtown or travel there for entertainment purposes. This change in travel
20th St	+13%	
Speer Blvd	+31%	

Southbound Off-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
		demand patterns results in more people exiting to Park Avenue, 20th Street, and Speer Boulevard during the PM peak period.
23rd Ave	+28%	Southbound I-25 congestion during the PM peak period begins near Speer Boulevard and extends south to approximately Santa Fe Drive/US 85. This congestion is expected to increase between the Existing Conditions scenario and the 2030 No Action Alternative. Because of this increase in congestion, some drivers will choose to use Federal Boulevard as an alternate route to I-25. To access Federal Boulevard, drivers exit I-25 at 23rd Avenue and Colfax Avenue. Therefore, off-ramp volumes at these locations increase in the 2030 No Action Alternative.
Colfax Ave	+9%	
8th Ave	-37%	Due to increasing congestion on I-25 in the 2030 No Action Alternative, some drivers choose to exit the highway earlier, such as at 23rd Avenue and Colfax Avenue, and use parallel routes, such as Federal Boulevard, to avoid prolonged congestion on the freeway. This is why volumes at the 8th Avenue ramp decrease between the Existing Conditions scenario and the 2030 No Action Alternative.
US 6/6th Ave	+26%	The increase in volumes at this ramp between the Existing Conditions scenario and the 2030 No Action Alternative are a result of two factors. First, there is natural travel demand growth to/from US 6/6th Avenue as population and employment continues to grow on the west side of the Denver metropolitan area. Second, because of the congestion on southbound I-25, some drivers choose to use southbound Federal Boulevard as an alternate route. The most congested portion of southbound Federal Boulevard is between Colfax Avenue and US 6/6th Avenue; therefore, some drivers choose to use southbound I-25 to US 6/6th Avenue and then exit to southbound Federal Boulevard. This avoids congestion on Federal Boulevard while also avoiding some congestion on I-25.
Alameda Ave	-2%	These changes are within the natural variation of the model and are not considered significant.
US 85/Santa Fe Dr	+4%	
Broadway	+41%	Population growth to the south of I-25 (in the Platte Park Neighborhood, as well as cities south of Denver, such as Englewood and Littleton) results in more vehicles using Broadway. This, in turn, results in more vehicles exiting I-25 to Broadway.

Figure 8: Southbound, PM Peak Period On-Ramp Volumes (Existing Conditions vs. 2030 No Action)

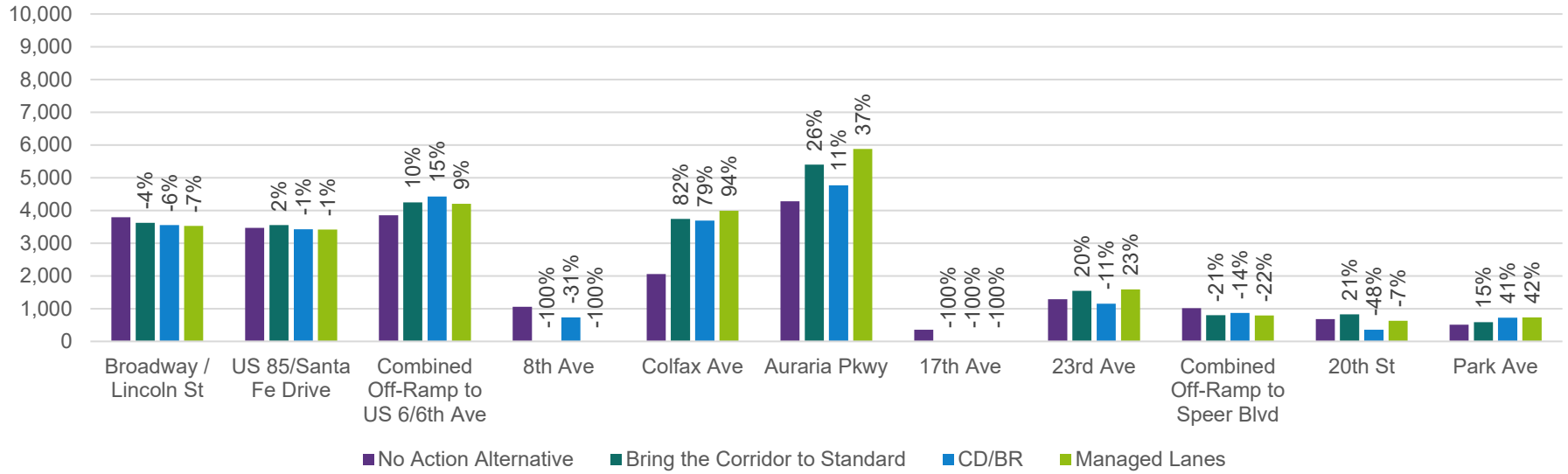


Percentages shown represent the percent difference from the Existing Conditions.

Southbound On-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
Park Ave	-5%	These changes are within the natural variation of the model and are not considered significant.
20th St	+2%	
Speer Blvd	-8%	A large portion of southbound on-ramp traffic at Speer Boulevard and 23rd Avenue is coming from southbound Federal Boulevard. Because southbound congestion increases between the Existing Conditions scenario and the 2030 No Action Alternative, many of these drivers choose to avoid the freeway congestion by remaining on Federal Boulevard and traveling farther south before entering I-25. This, in turn, reduces the volumes coming onto the freeway at Speer Boulevard and 23rd Avenue.
23rd Ave	-15%	
Colfax Ave/Auraria Pkwy/Lower Colfax Ave	+11%	This increase is due to forecasted travel demand growth.

Southbound On-Ramp	Percent Change from Existing Conditions to 2030 No Action	Primary Cause(s)
8th Ave	-37%	A large portion of southbound on-ramp traffic at 8th Avenue comes from the local land uses around the interchange. This travel demand pattern remains true in the 2030 No Action Alternative. However, due to increasing congestion on I-25, it becomes faster for some of these trips to use parallel routes, such as Federal Boulevard and Kalamath Street, instead of traveling on I-25. This reduces the total volume at this ramp.
US 6/6th Ave	+8%	This increase is due to forecasted travel demand growth.
US 85/Santa Fe Dr	+58%	Due to the congestion on southbound I-25 in the 2030 No Action Alternative, many drivers choose to use Kalamath Street as an alternate route to avoid traffic. These drivers then enter I-25 at this Santa Fe Drive on-ramp resulting in an increase in volumes at this ramp as compared to the Existing Conditions scenario.
Broadway	-9%	In the 2030 No Action Alternative, the southbound on-ramp from Broadway is reconfigured into a wedge ramp configuration. This shifts the on-ramp to be on the north side of I-25 and results in drivers coming northbound on Broadway to pass through two additional traffic signals (including a left-turn signal) to access the on-ramp. Due to this additional delay, it becomes faster for drivers coming northbound on Broadway to access southbound I-25 via Mississippi Avenue and Buchtel Boulevard as opposed to using the reconfigured Broadway on-ramp.

Figure 9: Northbound, AM Peak Period Off-Ramp Volumes (2030 No Action vs. Build Alternatives)



Percentages shown represent the percent difference from the No Action Alternative.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Broadway/Lincoln St	-4% Improvements on I-25 reduce the number of vehicles using Lincoln St as an alternate route into downtown.	-6% Improvements on I-25 reduce the number of vehicles using Lincoln St as an alternate route into downtown.	-7% Improvements on I-25 reduce the number of vehicles using Lincoln St as an alternate route into downtown.
US 85/Santa Fe Dr	+2% This change is within the natural variation of the model and is not considered significant.	-1% This change is within the natural variation of the model and is not considered significant.	-1% This change is within the natural variation of the model and is not considered significant.

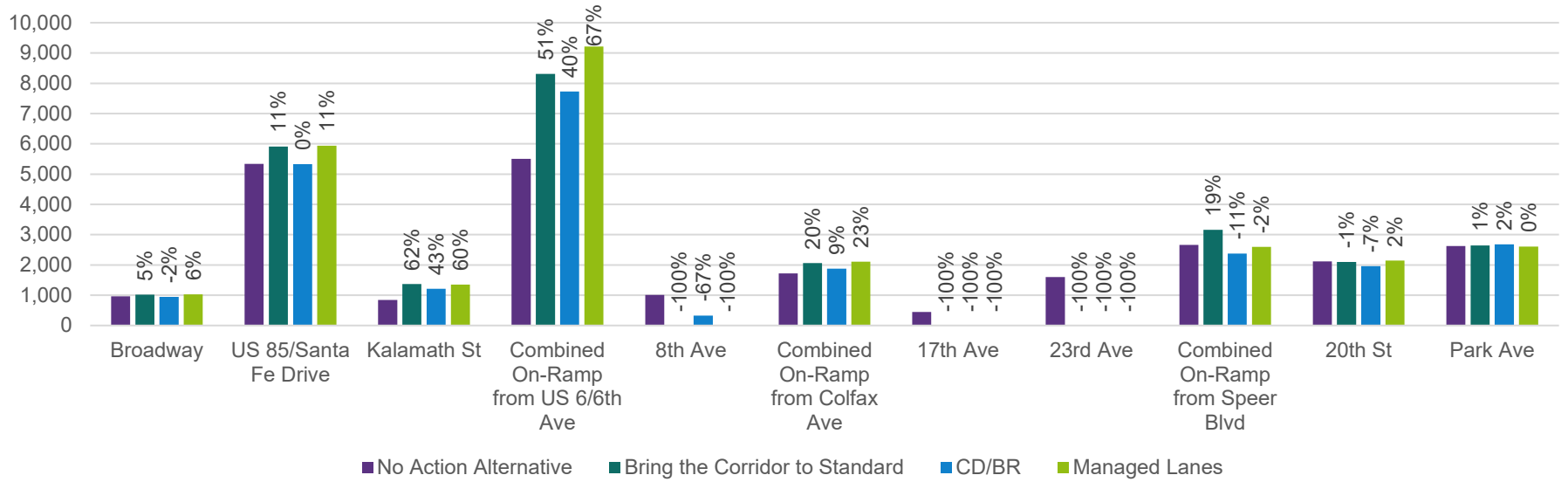
Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
US 6/6th Ave	+10% Improving the roadway geometrics between Santa Fe Dr/US 85 and US 6/6th Ave and reducing the spillback congestion from the weaving area between US 6/6th Ave and Colfax Ave/Auraria Pkwy improves the flow on the freeway and encourages drivers to use I-25 to access US 6/6th Ave as opposed to parallel local routes, such as Santa Fe Dr/US 85 and Broadway.	+15% This alternative provides a separated CD road from Santa Fe Dr/US 85 north to US 6/6th Ave. This allows traffic going to US 6/6th Ave to bypass congestion on I-25 northbound, thus making this a faster route as compared to the parallel local side streets.	+9% Improving the roadway geometrics between Santa Fe Dr/US 85 and US 6/6th Ave and reducing the spillback congestion from the weaving area between US 6/6th Ave and Colfax Ave/Auraria Pkwy improves the flow on the freeway and encourages drivers to use I-25 to access US 6/6th Ave as opposed to parallel local routes, such as Santa Fe Dr/US 85 and Broadway.
8th Ave	-100% This ramp is closed in this alternative.	-31% In both the Existing Conditions scenario and the 2030 No Action Alternative, a large portion of traffic exits to 8th Ave to avoid congestion on northbound I-25. The most common routes for these drivers include exiting I-25 at 8th Ave and then using Federal Boulevard, Zuni Street, or Santa Fe Dr/US 85 to continue northbound. In this alternative, the 8th Ave off-ramp is moved farther to the north, near 11th Ave. This results in some out-of-direction travel (along Yuma St/Mulberry Pl/Wyandot St) for drivers who want to access 8th Ave. This out-of-direction travel makes it a less-appealing alternate route to I-25. Furthermore, this alternative reduces congestion on I-25, which further dis-incentivizes drivers to use alternate routes.	-100% This ramp is closed in this alternative.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Colfax Ave	+82% Reducing northbound congestion on I-25 encourages drivers destined for downtown to remain on the highway as opposed to using parallel local facilities.	+79% Reducing northbound congestion on I-25 encourages drivers destined for downtown to remain on the highway as opposed to using parallel local facilities.	+94% Reducing northbound congestion on I-25 encourages drivers destined for downtown to remain on the highway as opposed to using parallel local facilities. The additional volumes being processed as compared to the other two build alternatives is a result of the direct connection ramps from the northbound managed lanes to Colfax Ave.
Auraria Pkwy	+26% Reducing northbound congestion on I-25 encourages drivers destined for downtown to remain on the highway as opposed to using parallel local facilities. This alternative has a larger increase in volumes at this off-ramp as compared to the Collector/Distributor Roads and Braided Ramps Alternative because, without CD roads, drivers exiting to Auraria Pkwy can remain on I-25 to bypass the spillback queues from Colfax Ave. This reduces the delay to exit at Auraria Pkwy as compared to the Collector/Distributor Roads and Braided Ramps Alternative.	+11% Reducing northbound congestion on I-25 encourages drivers destined for downtown to remain on the highway as opposed to using parallel local facilities. This alternative has a smaller increase in volumes at this off-ramp as compared to the Bring the Corridor to Standard Alternative due to queueing at the Colfax Ave off-ramp. In this alternative's configuration, the spillback queues from the Colfax Ave off-ramp are held within the CD road. These queues then block vehicles attempting to exit at Auraria Pkwy and thus encourage drivers to exit I-25 at other ramps.	+37% Reducing northbound congestion on I-25 encourages drivers destined for downtown to remain on the highway as opposed to using parallel local facilities. The additional volumes being processed as compared to the Bring the Corridor to Standard Alternative—with which this alternative shares the same general-purpose lane configuration—is a result of the direct connection ramps from the northbound managed lanes to Auraria Pkwy.
17th Ave	-100% This ramp is closed in this alternative.	-100% This ramp is closed in this alternative.	-100% This ramp is closed in this alternative.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
23rd Ave	+20% Reducing northbound congestion on I-25 encourages drivers destined for downtown to remain on the highway as opposed to using parallel local facilities.	-11% In this alternative, the on-ramp from Colfax Ave to northbound I-25 is braided with the off-ramp to the 23rd Ave/Speer Blvd/20th St CD road. Traffic coming onto northbound I-25 from Colfax Ave cannot exit to 23rd Ave, which reduces the volumes exiting at 23rd Ave.	+23% Reducing northbound congestion on I-25 encourages drivers destined for downtown to remain on the highway as opposed to using parallel local facilities.
Speer Blvd	-21% The Speer Blvd interchange is reconfigured such that off-ramp traffic must pass through a traffic signal at the ramp-terminal as opposed to being able to freely flow onto Speer Blvd as it does in the Existing Conditions scenario and the 2030 No Action Alternative. This new traffic signal adds delay to this route and encourages some drivers to choose a different route.	-14% The Speer Blvd interchange is reconfigured such that off-ramp traffic must pass through a traffic signal at the ramp-terminal as opposed to being able to freely flow onto Speer Blvd as it does in the Existing Conditions scenario and the 2030 No Action Alternative. This new traffic signal adds delay to this route and encourages some drivers to choose a different route.	-22% The Speer Blvd interchange is reconfigured such that off-ramp traffic must pass through a traffic signal at the ramp-terminal as opposed to being able to freely flow onto Speer Blvd as it does in the Existing Conditions scenario and the 2030 No Action Alternative. This new traffic signal adds delay to this route and encourages some drivers to choose a different route.
20th St	+21% This is a low volume off-ramp. This percent difference represents a total change of approximately 140 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.	-48% The volume at this off-ramp in this alternative is lower than the Bring the Corridor to Standard Alternative because the I-25 northbound on-ramp from Speer Blvd is braided with the I-25 northbound off-ramp to 20th St. Traffic from Speer Blvd cannot exit to 20th St, reducing the off-ramp volumes at 20th St.	-7% The volume at this off-ramp in this alternative is lower than the Bring the Corridor to Standard Alternative because the I-25 northbound on-ramp from Speer Blvd is braided with the I-25 northbound off-ramp to 20th St. Traffic from Speer Blvd cannot exit to 20th St, reducing the off-ramp volumes at 20th St.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Park Ave	+15% This is a low volume off-ramp. This percent difference represents a total change of approximately 80 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.	+41% This is a low volume off-ramp. This percent difference represents a total change of approximately 210 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.	+42% This is a low volume off-ramp. This percent difference represents a total change of approximately 220 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.

Figure 10: Northbound, AM Peak Period On-Ramp Volumes (2030 No Action vs. Build Alternatives)



Percentages shown represent the percent difference from the No Action Alternative.

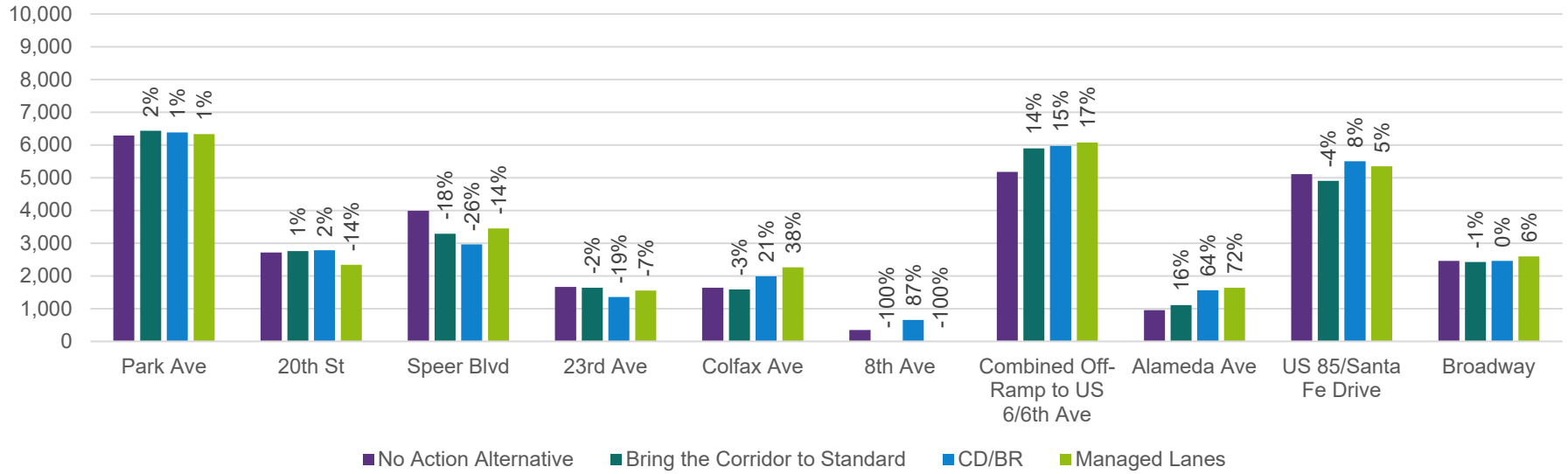
Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Broadway/Lincoln St	+5% This is a low volume on-ramp. This percent difference represents a total change of approximately 50 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.	-2% This change is within the typical variation of the traffic model.	+6% This is a low volume on-ramp. This percent difference represents a total change of approximately 60 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Santa Fe Dr/US 85	+11% Improving the flow on northbound I-25 allows more vehicles to flow onto the freeway from this on-ramp.	+0% The lane drop to the 8th Ave/Colfax Ave/Auraria Pkwy CD road results in three general-purpose lanes on I-25 for a short duration. Queueing from this bottleneck extends back on the freeway at the Santa Fe Drive/US 85 on-ramp and thus reduces the amount of traffic that the ramp can process.	+11% Improving the flow on northbound I-25 allows more vehicles to flow onto the freeway from this on-ramp.
US 6/6th Ave	+51% Closing the 8th Ave interchange allows for continuous auxiliary lanes between US 6/6th Ave and Colfax Ave/Auraria Pkwy. This improves the flow of traffic coming on from US 6/6th Ave and allows the ramps to process more vehicles during the peak period.	+40% In this alternative, US 6/6th Ave traffic comes onto I-25 as an additional lane (as opposed to an acceleration or auxiliary lane). This, coupled with the braided CD road, which eliminates the weaving of US 6/6th Ave on-ramp traffic with Colfax Ave/Auraria Pkwy off-ramp traffic, results in improved on-ramp flow from US 6/6th Ave.	+67% Closing the 8th Ave interchange allows for continuous auxiliary lanes between US 6/6th Ave and Colfax Ave/Auraria Pkwy. This improves the flow of traffic coming on from US 6/6th Ave and allows the ramps to process more vehicles during the peak period. Furthermore, the addition of direct connections to the managed lanes increases the capacity of this interchange.
8th Ave	-100% This ramp is closed in this alternative.	-67% In the 2030 No Action Alternative, a high number of vehicles using the northbound 8th Ave on-ramp do so to avoid the US 6/6th Ave interchange. Because this alternative improves the flow of traffic from the US 6/6th Ave on-ramp, more drivers choose to use that interchange as opposed to using the 8th Ave on-ramp.	-100% This ramp is closed in this alternative.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Colfax Ave	+20% Reducing congestion on I-25 encourages more people to use the freeway instead of parallel local roadway facilities.	+9% Reducing congestion on I-25 encourages more people to use the freeway instead of parallel local roadway facilities. Volumes in this alternative increase less than the other build alternatives because the Colfax Ave on-ramp to northbound I-25 is braided with the northbound I-25 off-ramp to the 23rd Ave/Speer Blvd/20th St CD road. Vehicles coming onto I-25 from Colfax Ave cannot exit to 23rd Ave, Speer Blvd, or 20th St. Therefore, traffic that wants to make this movement must find an alternate route.	+23% Reducing congestion on I-25 encourages more people to use the freeway instead of parallel local roadway facilities.
17th Ave	-100% This ramp is closed in this alternative.	-100% This ramp is closed in this alternative.	-100% This ramp is closed in this alternative.
23rd Ave	-100% In this alternative, there is no direct on-ramp from 23rd Ave to I-25 northbound. Traffic wanting to make this movement must use a CD road from 23rd Ave to Speer Blvd, then pass through the Speer Blvd intersection and use the Speer Blvd on-ramp to northbound I-25.	-100% In this alternative, there is no direct on-ramp from 23rd Ave to I-25 northbound. Traffic wanting to make this movement must use a CD road from 23rd Ave to Speer Blvd, then pass through the Speer Blvd intersection and use the Speer Blvd on-ramp to northbound I-25.	-100% In this alternative, there is no direct on-ramp from 23rd Ave to I-25 northbound. Traffic wanting to make this movement must use a CD road from 23rd Ave to Speer Blvd, then pass through the Speer Blvd intersection and use the Speer Blvd on-ramp to northbound I-25.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Speer Blvd	+19% Reducing congestion on I-25 encourages more people to use the freeway instead of parallel local roadway facilities.	-11% In this alternative, the Speer Blvd on-ramp to northbound I-25 is braided with the 20th St off-ramp. This means vehicles coming onto northbound I-25 from Speer Blvd cannot exit to 20th St. Limiting this movement reduces volumes on this ramp.	-2% In this alternative, the Speer Blvd on-ramp to northbound I-25 is braided with the 20th St off-ramp. This means vehicles coming onto northbound I-25 from Speer Blvd cannot exit to 20th St. Limiting this movement reduces volumes on this ramp.
20th St	-1% This change is within the typical variation of the traffic model.	-7% This is a low volume on-ramp. This percent difference represents a total change of approximately 150 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.	2% This change is within the typical variation of the traffic model.
Park Ave	+1% This change is within the typical variation of the traffic model.	+2% This change is within the typical variation of the traffic model.	+0% This change is within the typical variation of the traffic model.

Figure 11: Southbound, AM Peak Period Off-Ramp Volumes (2030 No Action vs. Build Alternatives)



Percentages shown represent the percent difference from the No Action Alternative.

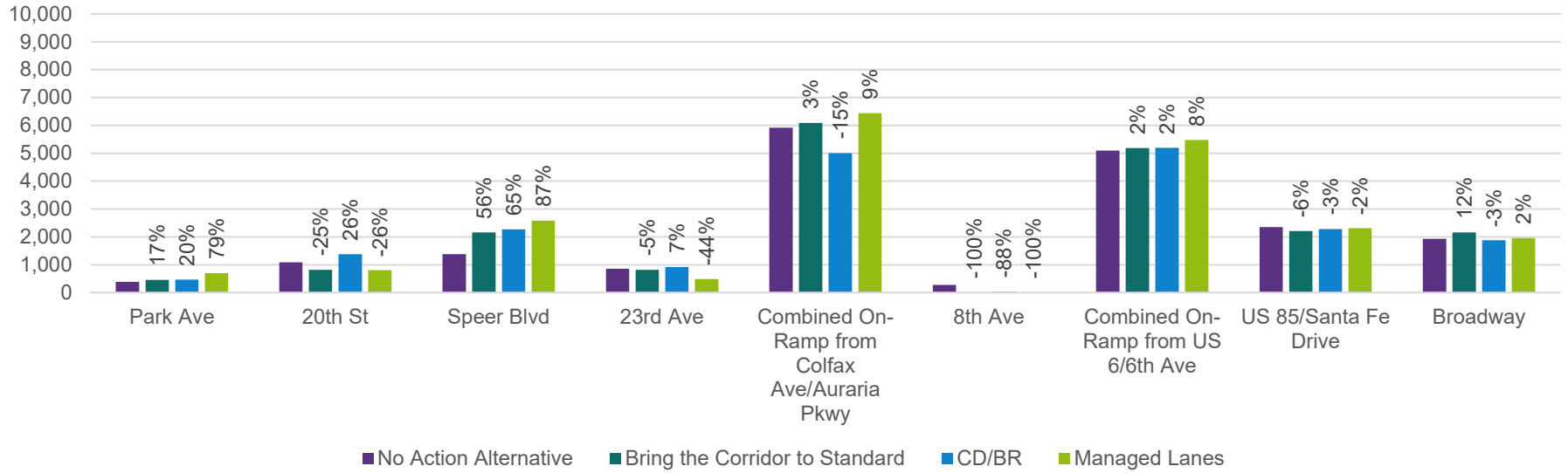
Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Park Ave	+2% This change is within the natural variation of the model.	+1% This change is within the natural variation of the model.	+1% This change is within the natural variation of the model.
20th St	+1% This change is within the natural variation of the model.	+2% This change is within the natural variation of the model.	-14% In this alternative, congestion on southbound I-25 is reduced, encouraging drivers to remain on the freeway rather than using an alternate route. This results in lower volumes at this ramp.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Speer Blvd	-18% The volume reduction at this ramp is less in this alternative as compared to the Collector/ Distributor Roads and Braided Ramps Alternative because of the configuration of the southbound 20th St on-ramp. In this alternative, the southbound 20th St on-ramp traffic must use a CD road to Speer Blvd, exit at Speer Blvd and pass through the Speer Blvd ramp terminal intersection, and then use the Speer Blvd on-ramp to access southbound I-25. Because the 20th St traffic is routed to the Speer Blvd off-ramp, there are higher off-ramp volumes in this alternative as compared to the Collector/ Distributor Roads and Braided Ramps Alternative.	-26% In the 2030 No Action Alternative, congestion on southbound I-25 begins near 20th St and extends throughout the I-25 Central corridor. Because of this, some drivers choose to exit I-25 at Speer Blvd and use the local roadway network instead of remaining on the freeway. In this alternative, congestion on southbound I-25 is reduced. This encourages drivers to remain on the freeway rather than using an alternate route. This results in lower volumes at this ramp.	-14% The volume reduction at this ramp is less in this alternative as compared to the Bring the Corridor to Standard Alternative because of the additional direct connect ramp from the southbound managed lane.
23rd Ave	-2% This change is within the natural variation of the model.	-19% In the 2030 No Action Alternative, congestion on southbound I-25 begins near 20th St and extends throughout the I-25 Central corridor. Because of this, some drivers choose to exit I-25 at 23rd Ave and use the local roadway network instead of remaining on the freeway. In this alternative, congestion on southbound I-25 is reduced. This encourages drivers to remain on the freeway rather than using an alternate route. This results in lower volumes at this ramp.	-7% In the 2030 No Action Alternative, congestion on southbound I-25 begins near 20th St and extends throughout the I-25 Central corridor. Because of this, some drivers choose to exit I-25 at 23rd Ave and use the local roadway network instead of remaining on the freeway. In this alternative, congestion on southbound I-25 is reduced. This encourages drivers to remain on the freeway rather than using an alternate route. This results in lower volumes at this ramp.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Colfax Ave	-3% This change is within the natural variation of the model.	+21% In the 2030 No Action Alternative, congestion on southbound I-25 begins near 20th St, resulting in some drivers exiting I-25 to the north and then using the local roadway network instead of remaining on the freeway. In this alternative, congestion on southbound I-25 is reduced, which encourages drivers to remain on the freeway rather than using an alternate route. This results in higher volumes at this ramp.	+38% In the 2030 No Action Alternative, congestion on southbound I-25 begins near 20th St, resulting in some drivers exiting I-25 to the north and then using the local roadway network instead of remaining on the freeway. In this alternative, congestion on southbound I-25 is reduced, which encourages drivers to remain on the freeway rather than using an alternate route. This results in higher volumes at this ramp.
8th Ave	-100% This ramp is closed in this alternative.	+87% In this alternative, there is a continuous southbound CD road starting from 20th St and extending to US 6/6th Ave. This CD road configuration allows traffic going to the 8th Ave exit to bypass the congestion on the mainline freeway and encourages more people to exit at this ramp as compared to the 2030 No Action Alternative.	-100% This ramp is closed in this alternative.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
US 6/6th Ave	+14% In the 2030 No Action Alternative, congestion on southbound I-25 begins near 20th St, resulting in some drivers exiting I-25 to the north and then using the local roadway network instead of remaining on the freeway. In this alternative, congestion on southbound I-25 is reduced, which encourages drivers to remain on the freeway rather than using an alternate route. This results in higher volumes at this ramp.	+15% In the 2030 No Action Alternative, congestion on southbound I-25 begins near 20th St, resulting in some drivers exiting I-25 to the north and then using the local roadway network instead of remaining on the freeway. In this alternative, congestion on southbound I-25 is reduced, which encourages drivers to remain on the freeway rather than using an alternate route. This results in higher volumes at this ramp.	+17% In the 2030 No Action Alternative, congestion on southbound I-25 begins near 20th St, resulting in some drivers exiting I-25 to the north and then using the local roadway network instead of remaining on the freeway. In this alternative, congestion on southbound I-25 is reduced, which encourages drivers to remain on the freeway rather than using an alternate route. This results in higher volumes at this ramp.
Alameda Ave	+16% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+64% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+72% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.
Santa Fe Dr/US 85	-4% This change is within the natural variation of the model.	+8% The continuous CD road from US 6/6th Ave to Santa Fe Dr/US 85 allows traffic exiting to Santa Fe Dr/US 85 to avoid the mainline freeway congestion that occurs between US 6/6th Ave and Santa Fe Dr/US 85. This encourages more vehicles to use this route instead of parallel local roadway facilities.	+5% This change is within the natural variation of the model.
Broadway	-1% This change is within the natural variation of the model.	+0% This change is within the natural variation of the model.	+6% In this alternative, the managed lane ends south of Santa Fe Dr/US 85. The Broadway off-ramp is where vehicles in the managed lanes can exit I-25. Because of this, the volumes at this off-ramp increase.

Figure 12: Southbound, AM Peak Period On-Ramp Volumes (2030 No Action vs. Build Alternatives)



Percentages shown represent the percent difference from the No Action Alternative.

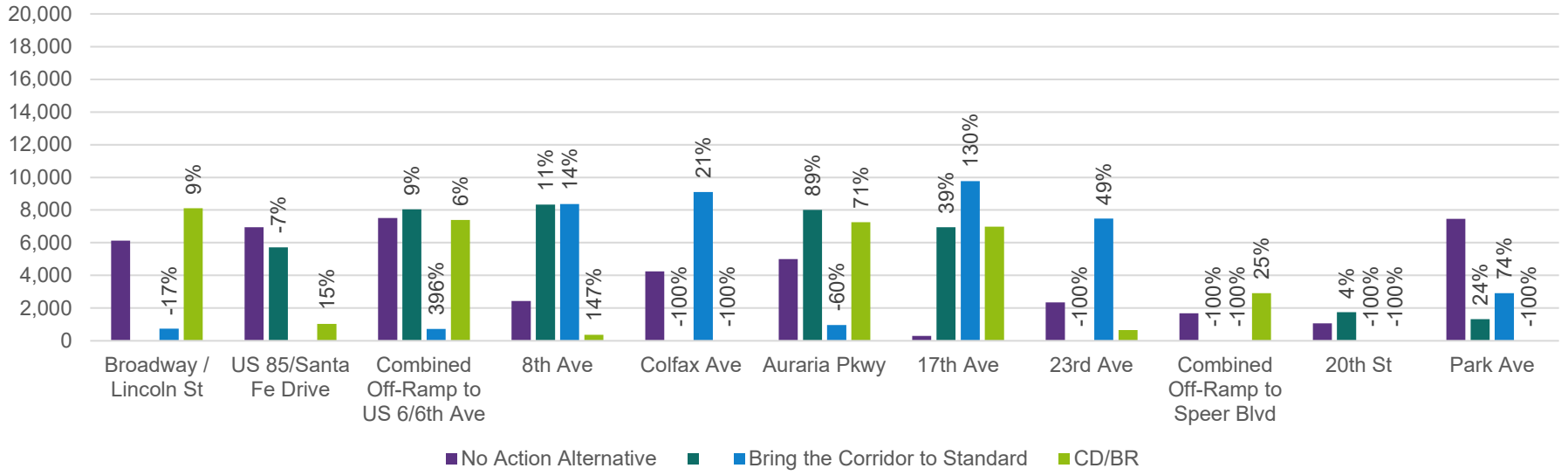
Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Park Ave	+17% This is a low volume on-ramp. This percent difference represents a total change of approximately 60 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.	+20% This is a low volume on-ramp. This percent difference represents a total change of approximately 80 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.	+79% Adding in a continuous managed lane through the I-25 Central corridor reduces congestion and increases speeds on the freeway. This encourages more drivers to use I-25 instead of parallel local roadway facilities.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
20th St	-25% In this alternative, there is no direct access from 20th St to southbound I-25. Drivers wanting to make this movement must use a CD road to Speer Blvd, then pass through the Speer Blvd intersection and use the Speer Blvd on-ramp to access southbound I-25. This adds some delay to this route, and precludes drivers coming from 20th St to exit to 23rd Ave. Both factors cause some drivers to choose an alternate route, thereby reducing volumes on this ramp.	+26% The most southbound congestion on I-25 during the AM peak period occurs between approximately 20th St and Colfax Ave. In this alternative, there is a continuous CD road from 20th St to Colfax Ave. This allows traffic coming onto southbound I-25 from 20th St to bypass most of the southbound freeway congestion. This reduces the travel time for these users and encourages more drivers to choose this route.	-26% In this alternative, there is no direct access from 20th St to southbound I-25. Drivers wanting to make this movement must use a CD road to Speer Blvd, then pass through the Speer Blvd intersection and use the Speer Blvd on-ramp to access southbound I-25. This adds some delay to this route, and precludes drivers coming from 20th St to exit to 23rd Ave. Both factors cause some drivers to choose an alternate route, thereby reducing volumes on this ramp.
Speer Blvd	+56% Reducing congestion on southbound I-25 south of Speer Blvd encourages more drivers to use the freeway instead of parallel local roadway facilities. This increases the volumes at this on-ramp.	+65% Reducing congestion on southbound I-25 south of Speer Blvd encourages more drivers to use the freeway instead of parallel local roadway facilities. This increases the volumes at this on-ramp.	+87% Reducing congestion on southbound I-25 south of Speer Blvd encourages more drivers to use the freeway instead of parallel local roadway facilities. This increases the volumes at this on-ramp.
23rd Ave	-5% This is a low volume on-ramp. This percent difference represents a total change of approximately 50 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.	+7% This is a low volume on-ramp. This percent difference represents a total change of approximately 60 vehicles during the entire AM peak period. This low number of vehicles is not considered significant.	-44% This alternative provides the most benefit to southbound I-25 from I-70 to Colfax Avenue. Reducing congestion in this area encourages drivers to enter I-25 farther to the north, such as at Park Avenue and Speer Boulevard, instead of using Federal Boulevard as an alternate route and then cutting over to the freeway using 23rd Avenue. Because fewer trips are using alternate routes, there are fewer vehicles entering I-25 from 23rd Avenue.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Colfax Ave/Auraria Pkwy/Lower Colfax Ave	+3% This change is within the natural variation of the model.	-15% Due to the configuration of the CD roads in this alternative, vehicles entering southbound I-25 from eastbound Colfax Ave or Lower Colfax Ave cannot exit to 8th Ave or US 6/6th Ave. Because of this limitation, some traffic chooses to use an alternate route, reducing volumes on this ramp.	+9% Reduced congestion on southbound I-25, especially between US 6/6th Ave and Santa Fe Dr/US 85, encourages drivers to use I-25 instead of parallel alternate facilities. This increases traffic at this on-ramp.
8th Ave	-100% This ramp is closed in this alternative.	-88% Due to the configuration of the CD roads in this alternative, vehicles using the southbound 8th Ave on-ramp must exit to US 6/6th Ave. Because of this access restriction, many drivers choose to use an alternate route, reducing volumes at this ramp.	-100% This ramp is closed in this alternative.
US 6/6th Ave	+2% This change is within the natural variation of the model.	+2% This change is within the natural variation of the model.	+8% Reduced congestion on southbound I-25 encourages drivers to use I-25 instead of parallel alternate facilities, increasing traffic at this on-ramp.
Santa Fe Dr/US 85	-6% This change is within the natural variation of the model.	-3% This change is within the natural variation of the model.	-2% This change is within the natural variation of the model.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Broadway	+12% This change is primarily a result of vehicles choosing to travel southbound on Broadway instead of Santa Fe Dr/US 85. This effect is most pronounced in this alternative because there is more congestion on I-25 in this alternative than in the other two build alternatives. This causes more people to use alternate routes, such as Santa Fe Dr/US 85 and Broadway.	-3% This change is within the natural variation of the model.	+2% This change is within the natural variation of the model.

Figure 13: Northbound, PM Peak Period Off-Ramp Volumes (2030 No Action vs. Build Alternatives)



Percentages shown represent the percent difference from the No Action Alternative.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Broadway/Lincoln St	-7% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This reduces volumes at this off-ramp.	-7% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This reduces volumes at this off-ramp.	-10% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This reduces volumes at this off-ramp.
Santa Fe Dr/US 85	+10% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases volumes at this off-ramp.	+7% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases volumes at this off-ramp.	+6% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases volumes at this off-ramp.
US 6/6th Ave	+11% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp. Additionally, the closure of the 8th Avenue ramps results in some additional traffic exiting to US 6/6th Avenue.	+21% This alternative provides a separated CD road from Santa Fe Dr/US 85 north to US 6/6th Ave. This allows traffic going to US 6/6th Ave to bypass congestion on I-25 northbound and thus makes this a faster route as compared to the parallel local side streets.	+12% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp. Additionally, the closure of the 8th Avenue ramps results in some additional traffic exiting to US 6/6th Avenue.

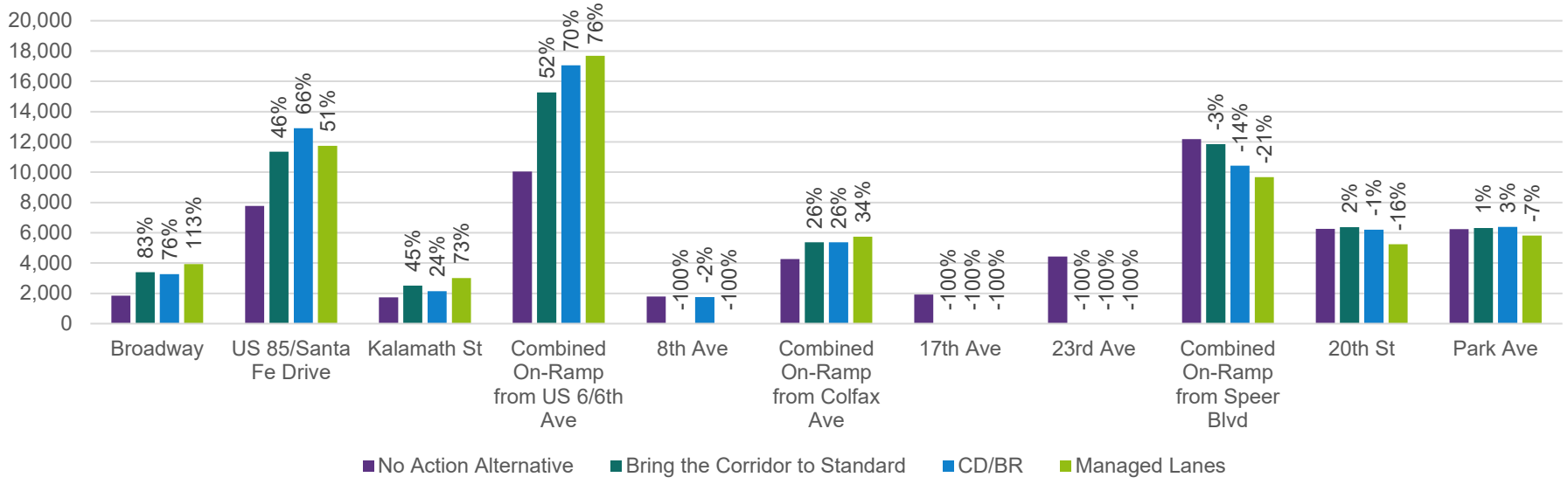
Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
8th Ave	-100% This ramp is closed in this alternative.	-60% In both the Existing Conditions scenario and the 2030 No Action Alternative, a large portion of traffic exits to 8th Ave to avoid congestion on northbound I-25. The most common route for these drivers is to exit at 8th Ave and use either Federal Boulevard, Zuni Street, or Santa Fe Dr/US 85 to continue northbound. In this alternative, the 8th Ave off-ramp is moved farther to the north, near 11th Ave. This results in some out-of-direction travel (along Yuma St/Mulberry Pl/Wyandot St) for drivers who want to access 8th Ave. This out-of-direction travel makes it a less-appealing alternate route to I-25. Furthermore, this alternative reduces congestion on I-25, which further dis-incentivizes drivers to use alternate routes.	-100% This ramp is closed in this alternative.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Colfax Ave	+89% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+130% Off-ramp volumes in this alternative increase more than in the other two build alternatives due to the configuration of the CD road. In this alternative, one of the general-purpose lanes on northbound I-25 drops at the exit to the northbound 8th Ave/Colfax Ave/Auraria Pkwy CD road. This creates a bottleneck on northbound I-25. To avoid this bottleneck, drivers destined for downtown exit I-25 at Colfax Ave to take advantage of the drop lane rather than remaining on I-25 and exiting farther north.	+71% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.
Auraria Pkwy	+39% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+49% Off-ramp volumes in this alternative increase more than in the Bring the Corridor to Standard Alternative due to the configuration of the CD road. In this alternative, one of the general-purpose lanes on northbound I-25 drops at the exit to the northbound 8th Ave/Colfax Ave/ Auraria Pkwy CD road. This creates a bottleneck on northbound I-25. To avoid this bottleneck, drivers destined for downtown exit I-25 at Auraria Pkwy to take advantage of the drop lane rather than remaining on I-25 and exiting farther north.	+53% Off-ramp volumes in this alternative increase more than in the Bring the Corridor to Standard Alternative because of the direct connection ramp from the northbound managed lane.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
17th Ave	-100% This ramp is closed in this alternative.	-100% This ramp is closed in this alternative.	-100% This ramp is closed in this alternative.
23rd Ave	+36% Off-ramp volumes in this alternative increase more than in the Managed Lanes Alternative because of the congestion on northbound I-25 between 23rd Ave and 20th St. In this alternative, there is greater congestion on the freeway, which results in some drivers choosing to exit earlier and use parallel local roadway facilities rather than remaining on I-25.	-20% Due to the congestion on northbound I-25 as a result of the lane drop to the 8th Ave/Colfax Ave/Auraria Pkwy CD road, some drivers choose to exit at Colfax Ave and use parallel local facilities, such as Federal Boulevard, rather than remaining on I-25 and exiting at 23rd Ave. This results in a decrease in volumes at this off-ramp.	+25% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.
Speer Blvd	+4% This change is within the natural variation of the model.	+74% In this alternative, this off-ramp is accessed via a CD road that starts just north of Colfax Avenue. This CD road allows traffic going to Speer Boulevard to bypass congestion on the mainline freeway. This encourages more people to use this exit rather than exiting I-25 earlier and using the local roadway network.	+80% In this alternative, this off-ramp is accessed via a CD road that starts just north of Colfax Avenue. This CD road allows traffic going to Speer Boulevard to bypass congestion on the mainline freeway. This encourages more people to use this exit rather than exiting I-25 earlier and using the local roadway network.
20th St	+24% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+19% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+35% Reducing congestion on I-25 northbound encourages drivers to remain on the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Park Ave	-17% This is a low volume on-ramp. This percent difference represents a total change of approximately 150 vehicles during the entire PM peak period. This low number of vehicles is not considered significant.	+15% This is a low volume on-ramp. This percent difference represents a total change of approximately 130 vehicles during the entire PM peak period. This low number of vehicles is not considered significant.	-9% This is a low volume on-ramp. This percent difference represents a total change of approximately 80 vehicles during the entire PM peak period. This low number of vehicles is not considered significant.

Figure 14: Northbound, PM Peak Period On-Ramp Volumes (2030 No Action vs. Build Alternatives)



Percentages shown represent the percent difference from the No Action Alternative.

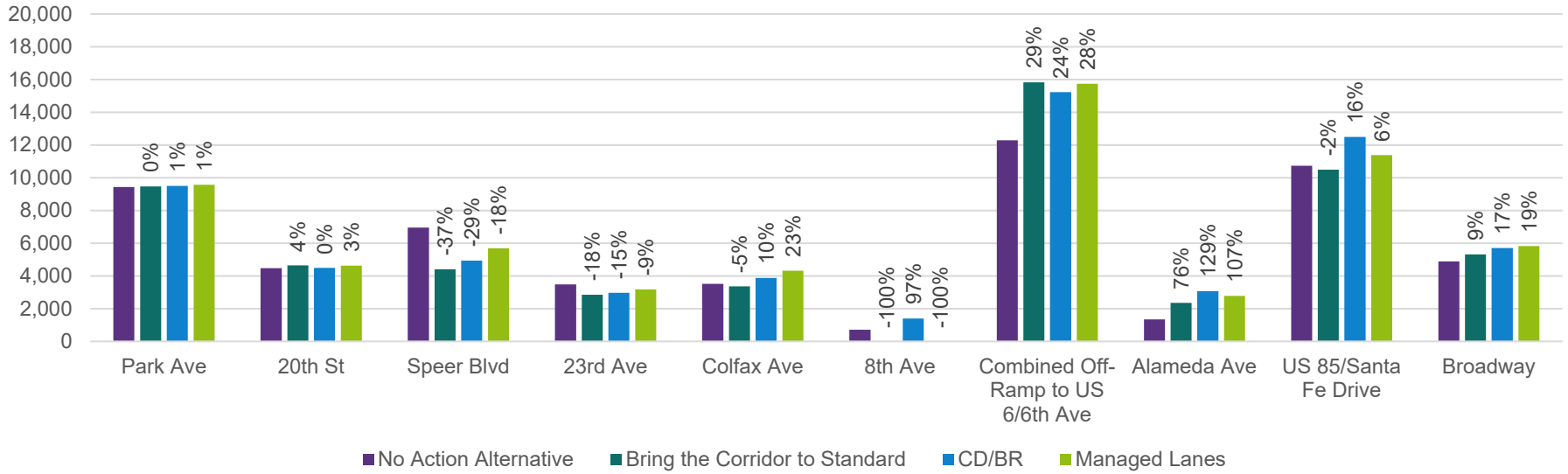
Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Broadway/Lincoln St	+83% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	+76% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	+113% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.
Santa Fe Dr/US 85	+46% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	+66% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	+51% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.
Kalamath St	+45% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	+24% Volumes at this on-ramp increase less than in the other two build alternatives due to the congestion on I-25 near US 6/6th Ave. This congestion creates a spillback queue onto the CD road, which causes an increase in delays for vehicles entering northbound I-25 from the Kalamath St on-ramp. This makes this route less attractive in this alternative as compared to the other two build alternatives.	+73% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
US 6/6th Ave	+52% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	+70% Volumes at this on-ramp increase more than in the Bring the Corridor to Standard Alternative due to the configuration of the on-ramp. In this alternative, the US 6/6th Ave on-ramp enters I-25 as an additional lane, whereas in the Bring the Corridor to Standard Alternative, the US 6/ 6th Ave on-ramp enters I-25 as an auxiliary lane. This means that, in the Collector/ Distributor Roads and Braided Ramps Alternative, vehicles coming onto I-25 from the US 6/6th Ave on-ramp do not need to change lanes to remain on I-25 northbound. This improves the flow of this on-ramp and encourages more drivers to use this route.	+76% Volumes at this on-ramp increase more than in the Bring the Corridor to Standard Alternative due to the additional direct connection ramp to the northbound managed lane.
8th Ave	-100% This ramp is closed in this alternative.	-2% This change is within the natural variation of the model.	-100% This ramp is closed in this alternative.
Colfax Ave	+26% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	+26% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	+34% Reducing congestion on I-25 northbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.
17th Ave	-100% This ramp is closed in this alternative.	-100% This ramp is closed in this alternative.	-100% This ramp is closed in this alternative.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
23rd Ave	-100% In this alternative, there is no direct on-ramp from 23rd Ave to I-25 northbound. Drivers wanting to make this movement must use a CD road from 23rd Ave to Speer Blvd, then pass through the Speer Blvd intersection and use the Speer Blvd on-ramp to northbound I-25.	-100% In this alternative, there is no direct on-ramp from 23rd Ave to I-25 northbound. Drivers wanting to make this movement must use a CD road from 23rd Ave to Speer Blvd, then pass through the Speer Blvd intersection and use the Speer Blvd on-ramp to northbound I-25.	-100% In this alternative, there is no direct on-ramp from 23rd Ave to I-25 northbound. Drivers wanting to make this movement must use a CD road from 23rd Ave to Speer Blvd, then pass through the Speer Blvd intersection and use the Speer Blvd on-ramp to northbound I-25.
Speer Blvd	-3% This change is within the natural variation of the model.	-14% In the 2030 No Action Alternative, northbound congestion on I-25 is heavy until approximately Speer Blvd. Because of this, many drivers choose to use parallel local roadway facilities, then access northbound I-25 from the Speer Blvd on-ramp to avoid freeway congestion. Because this alternative reduces the congestion on I-25, some drivers choose to access the freeway at other locations south of Speer Blvd, such as US 6/6th Ave or Colfax Ave, instead of using parallel local roadway facilities to get to Speer Blvd. Therefore, the volumes at this on-ramp decrease.	-21% In the 2030 No Action Alternative, northbound congestion on I-25 is heavy until approximately Speer Blvd. Because of this, many drivers choose to use parallel local roadway facilities, then access northbound I-25 from the Speer Blvd on-ramp to avoid freeway congestion. Because this alternative reduces the congestion on I-25, some drivers choose to access the freeway at other locations south of Speer Blvd, such as US 6/6th Ave or Colfax Ave, instead of using parallel local roadway facilities to get to Speer Blvd. Therefore, the volumes at this on-ramp decrease.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
20th St	+2% This change is within the natural variation of the model.	-1% This change is within the natural variation of the model.	-16% This alternative can process more vehicles through the I-25 Central corridor as compared to the other two build alternatives. This results in more congestion north of the study area near the I-70 and I-25 interchange. This congestion extends back to 20th Street and blocks traffic coming on from the 20th Street on-ramp. This results in fewer vehicles being processed on this ramp during the peak period.
Park Ave	+1% This change is within the natural variation of the model.	+3% This change is within the natural variation of the model.	-7% This alternative can process more vehicles through the I-25 Central corridor as compared to the other two build alternatives. This results in more congestion north of the study area near the I-70 and I-25 interchange. This congestion extends back to Park Avenue and blocks traffic coming on from the Park Avenue on-ramp. This results in fewer vehicles being processed on this ramp during the peak period.

Figure 15: Southbound, PM Peak Period Off-Ramp Volumes (2030 No Action vs. Build Alternatives)



Percentages shown represent the percent difference from the No Action Alternative.

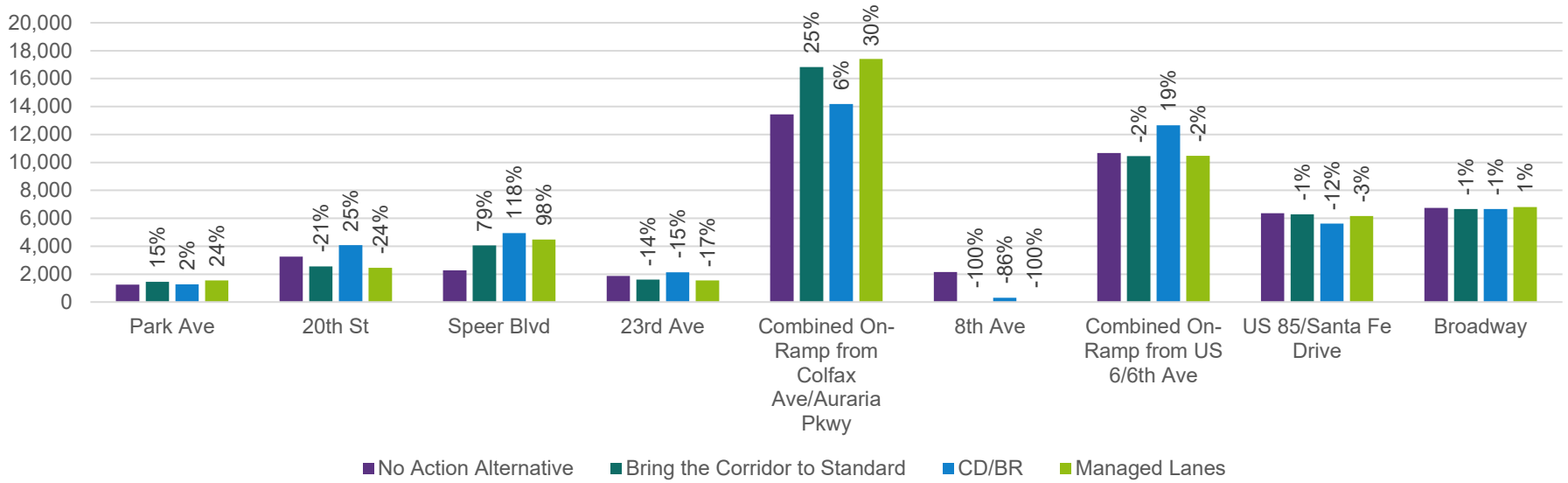
Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Park Ave	+0% This change is within the natural variation of the model.	+1% This change is within the natural variation of the model.	+1% This change is within the natural variation of the model.
20th St	+4% This change is within the natural variation of the model.	+0% This change is within the natural variation of the model.	+3% This change is within the natural variation of the model.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Speer Blvd	-37% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	-29% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	-18% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.
23rd Ave	-18% In the 2030 No Action Alternative, some drivers choose to exit southbound I-25 at 23rd Ave to then use southbound Federal Boulevard to avoid congestion on the freeway. Because this build alternative reduces congestion, fewer drivers choose to divert off the freeway. This reduces the volumes on this off-ramp.	-15% In the 2030 No Action Alternative, some drivers choose to exit southbound I-25 at 23rd Ave to then use southbound Federal Boulevard to avoid congestion on the freeway. Because this build alternative reduces congestion, fewer drivers choose to divert off the freeway. This reduces the volumes on this off-ramp.	-9% In the 2030 No Action Alternative, some drivers choose to exit southbound I-25 at 23rd Ave to then use southbound Federal Boulevard to avoid congestion on the freeway. Because this build alternative reduces congestion, fewer drivers choose to divert off the freeway. This reduces the volumes on this off-ramp.
Colfax Ave	-5% This change is within the natural variation of the model.	+10% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+23% Volumes on this ramp increase more in this alternative as compared to the Collector/Distributor Roads and Braided Ramps Alternative because the 8th Ave ramps are closed. Traffic that used to use the 8th Ave ramps now chooses to use the Colfax Ave off-ramp to access its destinations. This increases the volumes at this ramp.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
8th Ave	-100% This ramp is closed in this alternative.	+97% In this alternative, there is a continuous southbound CD road starting from 20th St and extending to US 6/6th Ave. This CD road configuration allows traffic going to the 8th Ave exit to bypass the congestion on the mainline freeway and encourages more people to exit at this ramp as compared to the 2030 No Action Alternative.	-100% This ramp is closed in this alternative.
US 6/6th Ave	+29% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+24% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+28% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.
Alameda Ave	+76% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+129% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+107% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.
US 85/Santa Fe Dr	-2% This change is within the natural variation of the model.	+16% In this alternative, there is a continuous CD road from US 6/6th Ave to Santa Fe Dr/US 85. Because of this, traffic exiting to Santa Fe Dr/US 85 is able to avoid the mainline freeway congestion that occurs between US 6/6th Ave and Santa Fe Dr/US 85. This encourages more vehicles to use this route instead of parallel local roadway facilities.	+6% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Broadway	+9% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+17% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this off-ramp.	+19% Volumes increase more in this alternative as compared to the other two build alternatives since the managed lane ends south of Santa Fe Dr/US 85. The Broadway off-ramp is the ramp at which vehicles in the managed lanes can exit I-25. Because of this, the volumes at this off-ramp increase.

Figure 16: Southbound, PM Peak Period On-Ramp Volumes (2030 No Action vs. Build Alternatives)



Percentages shown represent the percent difference from the No Action Alternative.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Park Ave	+15% In this alternative there is no direct access from 20th St to southbound I-25. Instead, vehicles wanting to make this movement must use a collector/distributor road from 20th St to Speer Blvd, pass through the Speer Blvd ramp terminal intersection, then use the Speer Blvd on-ramp to access southbound I-25. Because of this added delay, some drivers choose to use the southbound Park Ave on-ramp to I-25 instead.	+2% This change is within the natural variation of the model.	+24% In this alternative there is no direct access from 20th St to southbound I-25. Instead, vehicles wanting to make this movement must use a collector/distributor road from 20th St to Speer Blvd, pass through the Speer Blvd ramp terminal intersection, then use the Speer Blvd on-ramp to access southbound I-25. Because of this added delay, some drivers choose to use the southbound Park Ave on-ramp to I-25 instead.
20th St	-21% In this alternative, there is no direct access from 20th St to southbound I-25. Instead, vehicles wanting to make this movement must use a CD road from 20th St to Speer Blvd, pass through the Speer Blvd ramp terminal intersection, then use the Speer Blvd on-ramp to access southbound I-25. Because of this added delay, some drivers choose to use other on-ramps to I-25 instead, thus reducing the volumes at this ramp.	+25% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	-24% In this alternative, there is no direct access from 20th St to southbound I-25. Instead, vehicles wanting to make this movement must use a CD road from 20th St to Speer Blvd, pass through the Speer Blvd ramp terminal intersection, then use the Speer Blvd on-ramp to access southbound I-25. Because of this added delay, some drivers choose to use other on-ramps to I-25 instead, thus reducing the volumes at this ramp.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Speer Blvd	+79% Volumes on this ramp increase due to reduced congestion on I-25—which encourages more drivers to use the freeway instead of the parallel local roadway network—and because of the configuration of the 20th Street on-ramp to southbound I-25. In this alternative, traffic from 20th Street is forced to exit at Speer Boulevard, pass through the ramp terminal intersection, and then enter I-25 from the Speer Boulevard ramp. This results in increased volumes at this on-ramp.	+118% Ramp volumes in this alternative increase more than the other build alternatives due to the configuration of the CD road. The CD road allows southbound vehicles entering from Speer Blvd to go all the way to US 6/6th Ave without having to enter the mainline freeway. This allows these vehicles to avoid the congestion on the freeway and makes this route more attractive. This increases the volumes on this ramp.	+98% Volumes on this ramp increase due to reduced congestion on I-25—which encourages more drivers to use the freeway instead of the parallel local roadway network—and because of the configuration of the 20th Street on-ramp to southbound I-25. In this alternative, traffic from 20th Street is forced to exit at Speer Boulevard, pass through the ramp terminal intersection, and then enter I-25 from the Speer Boulevard ramp. This results in increased volumes at this on-ramp.
23rd Ave	-14% In the 2030 No Action Alternative, some drivers choose to use southbound Federal Blvd as an alternate route to southbound I-25. These drivers then access southbound I-25 at 23rd Ave. In this build alternative, congestion on I-25 is reduced; therefore, drivers using Federal Blvd instead choose to access I-25 farther to the north, such as at Speer Blvd. This results in lower volumes at this ramp.	-15% In the 2030 No Action Alternative, some drivers choose to use southbound Federal Blvd as an alternate route to southbound I-25. These drivers then access southbound I-25 at 23rd Ave. In this build alternative, congestion on I-25 is reduced; therefore, drivers using Federal Blvd instead choose to access I-25 farther to the north, such as at Speer Blvd. This results in lower volumes at this ramp.	-17% In the 2030 No Action Alternative, some drivers choose to use southbound Federal Blvd as an alternate route to southbound I-25. These drivers then access southbound I-25 at 23rd Ave. In this build alternative, congestion on I-25 is reduced; therefore, drivers using Federal Blvd instead choose to access I-25 farther to the north, such as at Speer Blvd. This results in lower volumes at this ramp.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
Colfax Ave/Auraria Pkwy/Lower Colfax Ave	+25% Reducing congestion on I-25 southbound encourages drivers to use the freeway rather than taking parallel local roadway facilities. This increases the volumes at this on-ramp.	+6% Volumes at this ramp increase less in this alternative as compared to the other two build alternatives due to the configuration of the CD roads. In this alternative, vehicles coming from eastbound Colfax Ave or Lower Colfax Ave cannot exit to 8th Ave or US 6/6th Ave. Because of this access restriction, vehicles wanting to make that movement must find an alternate route. This reduces the number of vehicles using this ramp.	+30% Volumes at this ramp increase more in this alternative as compared to the Bring the Corridor to Standard alternative due to the additional direct connect ramp from Auraria Pkwy to the southbound managed lane.
8th Ave	-100% This ramp is closed in this alternative.	-86% Due to the configuration of the CD roads in this alternative, vehicles using the southbound 8th Ave on-ramp must exit to US 6/6th Ave. They cannot enter southbound I-25. Because of this access restriction, many drivers choose to use an alternate route and, therefore, the volumes at this ramp decrease.	-100% This ramp is closed in this alternative.

Ramp	Bring the Corridor to Standard Alternative	Collector/Distributor Roads & Braided Ramps Alternative	Managed Lanes Alternative
	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results	Percent Volume Change from No Action Discussion of Results
US 6/6th Ave	-2% This change is within the natural variation of the model.	+19% In this alternative, the on-ramps from US 6/6th Ave to southbound I-25 are braided with the off-ramps to Alameda Ave and Santa Fe Dr/US 85. Braiding these ramps and providing a continuous CD road from US 6/6th Ave to Santa Fe Dr/US 85 reduces congestion and makes this a faster route than the parallel local roadway facilities. This encourages more drivers to use this route and, therefore, increases the volumes at this ramp.	-2% This change is within the natural variation of the model.
US 85/Santa Fe Dr	-1% This change is within the natural variation of the model.	-12% Reducing congestion on I-25 southbound encourages drivers to use southbound I-25 instead of southbound Kalamath St as an alternate route. This reduces the volumes at this on-ramp.	-3% This change is within the natural variation of the model.
Broadway	-1% This change is within the natural variation of the model.	-1% This change is within the natural variation of the model.	+1% This change is within the natural variation of the model.

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Appendix B

Order-of-Magnitude Transit Ridership Development Process Technical Memorandum

Order–of-Magnitude Transit Ridership Development Process

Order-of-magnitude ridership estimates and the associated effect on vehicle trip reduction on I-25 were developed for the Level 2 alternatives. A travel demand model was not used due to resource constraints, but instead the estimation method used professional judgment.

The estimates were prepared for the two Level 2 alternatives with specific transit components:

- New Transit Facilities
    - High capacity transit on Broadway/Lincoln Street
    - High capacity transit on Federal Boulevard
    - Two new light-rail (LRT) tracks for the Regional Transportation District (RTD) between the Broadway & I-25 Station and Central Platte Valley Junction at Colfax Avenue

  The high capacity arterial transit was assumed to be bus rapid transit (BRT)-like service with frequent headways and improved travel times, due to queue jumps and transit-only lanes at least at intersections.

  With twice the track capacity, it was assumed that LRT service could be doubled over current levels. It was noted that constraints for riders to access the rail lines exist, namely park-and-ride capacity and feeder service levels. However, for the purposes of this exercise these constraints were not taken into account. The scenario of increased LRT service without new tracks was also considered.

- Realign Adjacent to RTD
    - Two new LRT tracks for RTD between the Broadway & I-25 Station and Central Platte Valley Junction at Colfax Avenue

  Same track capacity assumptions as above.

For each transit element in the alternatives, the following steps were applied to produce the estimates:

1. Assemble Reference Data (Table 1)
    a. Route-level existing and 2040 daily ridership
        i. Broadway/Lincoln Street buses
        ii. Federal Boulevard buses
        iii. CDEFH LRT lines
        iv. W LRT line
    b. The 2040 numbers included adjustments using 2015 model to 2015 observed route-level comparisons.

   c. It was noted the 2040 numbers in the model reflect the 2040 Regional Transportation Plan, and therefore do not assume any RTD service expansion in the study area.

2. Estimate the increase in 2040 ridership due to the new service introduced
   a. Note this is the amount over and above the effect of transit service assumed in the travel demand modeling for the I-25 Central PEL.
   b. Estimate both a low and a high percentage increase, to provide a bracket for the estimates.
   c. Calculate the low and high numbers of new daily riders.
3. Estimate the portion of riders traveling within the Central I-25 study area (Santa Fe Drive/U.S. Highway 85 (US 85) to 20th Street).
4. Estimate the portion of these new riders who were diverted from a vehicle trip on I-25.
5. The result is a low and high estimate of person trips diverted from I-25 to transit. Auto-occupancy was not included at this point in time.

Note the estimates were based on professional experience including observed increases of ridership after various service increases or expansions over several years, awareness of origin and destination travel markets for the route corridors; and other derived observations.

Table 2 contains the results. In summary, it is estimated the maximum effect of new transit services and facilities would remove between 8,000 and 16,000 person trips per day from I-25. The vast majority of these trips removed from I-25 would be south of Speer Boulevard. I-25 volumes north of Speer Boulevard would largely not be affected. The number of trips removed is mostly due to the scenario of doubling LRT service allowed by the doubling the number of tracks between I-25 & Broadway Station and Colfax Avenue.

Table 1: Average Weekday Transit Ridership of Routes Traversing Corridor

Route	Jan. 2015 Observed	2015 Modeled	2015 Difference	2015 % Difference	Sep. 2018 Observed	2040 Modeled	2040 Adjusted	2015-2040 Growth	2015-2040 % Growth
CDEFH Lines	69,237	63,990	-5,247	-8%	62,044	73,886	79,539	10,302	15%
W Line	12,436	12,329	-107	-1%	13,868	20,885	21,030	8,594	69%
Broadway/Lincoln buses	9,455	9,095	-360	-4%	9,458	11,869	12,284	2,829	30%
Federal buses	8,741	7,368	-1,373	-16%	8,760	10,004	11,623	2,882	33%
Total	99,869	92,781	-7,088	-7%	94,130	116,645	124,476	24,607	25%

Source: RTD

Table 2: Effect on Ridership and Trips Removed From I-25

Route	Estimated Ridership Increase		New 2040 Daily Riders		Total 2040 Daily Riders		Person Trips Removed From I-25			
	Low	High	Low	High	Low	High	% of New Riders in Area	% Used to Use I-25	Low	High
CDEFH Lines (Additional Service only)	10%	10%	8,000	8,000	87,500	87,500	70%	60%	3,300	3,300
W Line	20%	40%	4,200	8,400	25,200	29,400	80%	30%	1,000	2,000
CDEFH Lines (Two Additional Tracks)	20%	40%	15,900	31,800	95,400	111,300	70%	60%	6,700	13,400
Broadway/Lincoln buses	5%	25%	600	3,100	12,900	15,400	65%	20%	100	400
Federal buses	10%	30%	1,200	3,500	12,800	15,100	60%	10%	100	200
Maximum Effect (Arterial BRT & New Tracks)									7,900	16,000

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Appendix C

Vissim Connected and Automated Vehicle Sensitivity Analysis Technical Memorandum

Vissim Connected and Automated Vehicle (CAV) Sensitivity Analysis Technical Memorandum

1. Introduction

A Vissim simulation analysis was completed for Interstate 25 (I-25) between Santa Fe Drive/US 85 and 20th Street in Denver to support the I-25 Central Planning and Environmental Linkages (PEL) Study. The sensitivity analysis evaluates the potential impacts on the transportation system given different rates of connected and automated vehicle (CAV) adoption.

CAV operational assumptions were based on the Colorado Department of Transportation's (CDOT's) Framework for CAV Modeling in Vissim[1]. This framework assumes that CAVs operate with full autonomy requiring no human driver and that they are fully connected with one another. The framework does not include CAV connectivity to infrastructure elements, such as traffic signals or dynamic speed messaging. The framework assumes that CAVs operate with a common driving behavior without stochastic (random) car following. While CAVs may be connected on all facilities, the framework includes platooning of CAVs only on facilities with uninterrupted flow and only within the same lane. Platoon size was limited to three cars and two trucks based on suggested platoon size from the CDOT framework.

The following sections summarize the methodology and results from the Vissim CAV sensitivity analysis. Referenced exhibits are at the end of this document. Key results from the analysis are located on page 20, Key Results.

2. Methodology

Vissim microsimulation traffic analysis was completed with the level of demand to match the corridor TransModeler microsimulation analysis used for alternative evaluation. The volumes used for TransModeler were factored down 10% from the 2040 DRCOG TransCAD macro model origin and destination tables to achieve TransModeler operability. These volumes are labelled year 2030.

The Vissim CAV microsimulation effort analyzed the year 2030 PM peak hour No Action Alternative and the Managed Lane Alternative build condition for three adoption rates of CAVs (0%, 25% and 75%). These adoption rates were determined through discussion with the I-25 Central PEL's Project Management Team. The intent was to evaluate conditions for a wide range of adoption given the current uncertainty surrounding CAV adoption. The following summarizes the model assumptions:

- The Vissim model area included all freeway mainline and ramps along I-25 between Santa Fe Drive and 20th Street. Additionally, ramp terminal intersections that have the potential to queue traffic near the freeway or meter traffic entering the freeway were

[1] Framework for CAV Modeling in Vissim, Colorado DOT, June 2019.

included. To illustrate the model limits, screen captures of the No Action Vissim model are shown in **Exhibits 1 and 2**.

- The No Action model geometry and traffic control matched existing conditions, with adjustments to signal timings and ramp meter rates, as needed, to accommodate future traffic demands.
- Simulated volume throughput from TransModeler for year 2030 PM peak hour No Action conditions was provided.
- The No Action Vissim model included adjustments to software default driving behavior parameter values so volume throughput from Vissim would better match the volume throughput from the TransModeler 2030 PM No Action model. Essentially, driving behavior parameters were adjusted to reduce the roadway capacity and limit the amount of demand served based on the calibration adjustments made for the TransModeler model. Specifically, the items in the table were adjusted from Vissim defaults.

Parameter	Vissim Default Value	Updated Value
Freeway car following gap time	0.9 seconds	1.3 seconds
Freeway lane change safety distance reduction factor	0.6	0.7
Freeway car following gap time (for higher-capacity freeway segments, such as weaving and merge areas with high demand)	0.9 seconds	1.2 seconds
Freeway lane change safety distance reduction factor (for higher capacity freeway segments, such as weaving and merge areas with high demand)	0.6	0.55
Lane change distance	656.2 feet	Varied between 1,000 and 4,300 depending on location

Exhibit 1

Vissim No Action Model Screen Capture - North Half

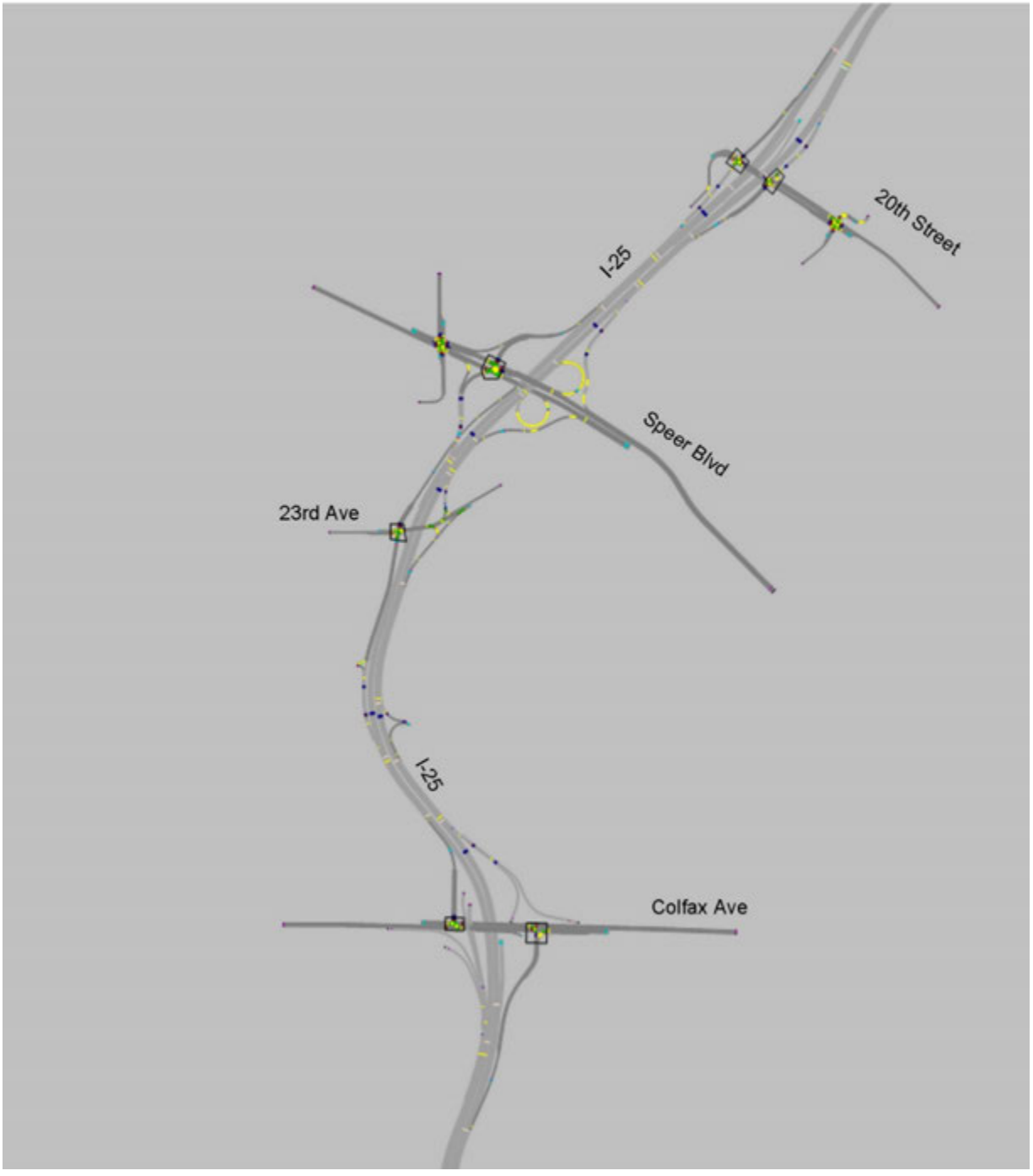
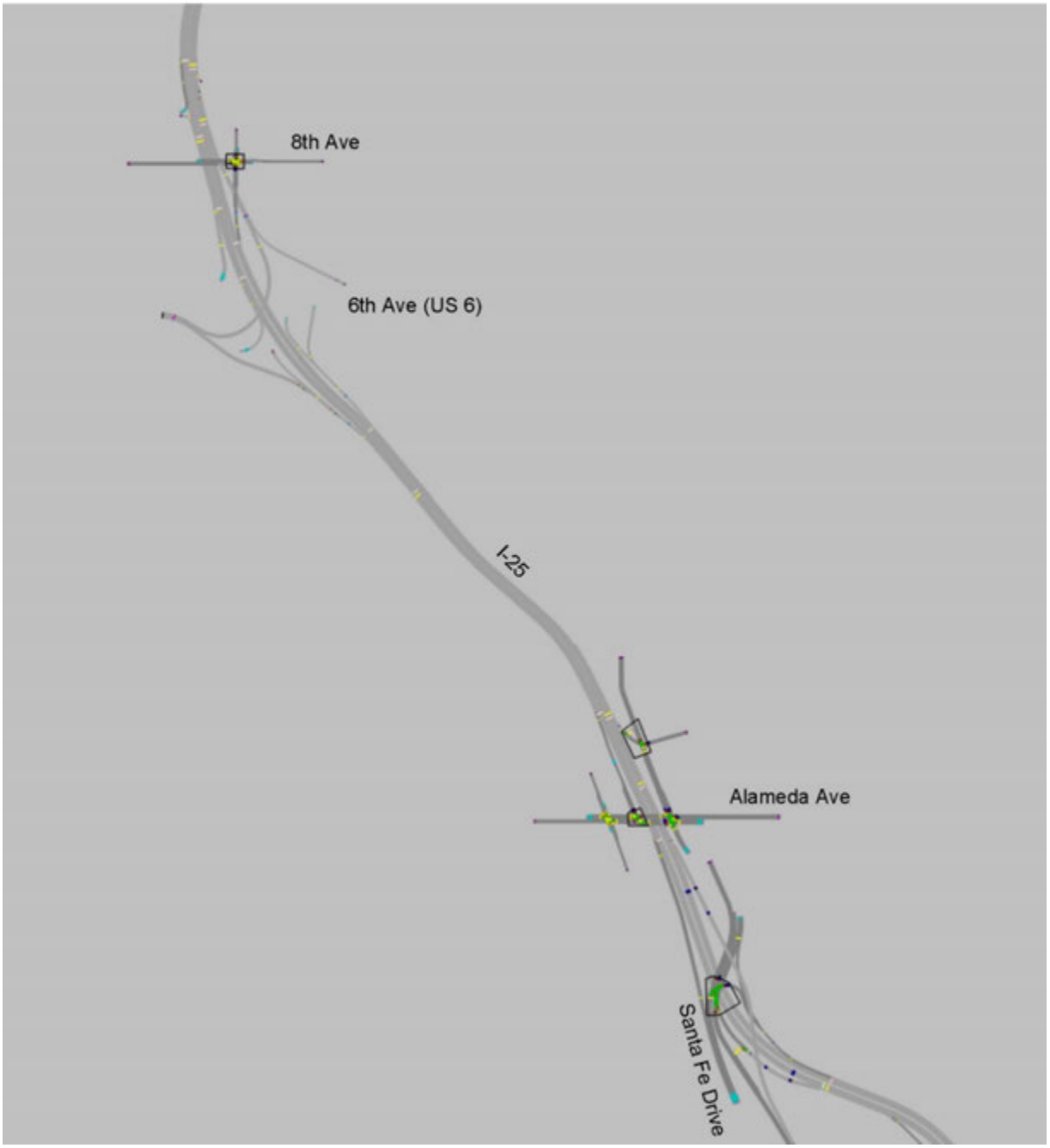


Exhibit 2

Vissim No Action Model Screen Capture - South Half



- The CDOT Framework for CAV Modeling in Vissim was applied to the No Action Vissim model, and scenarios were created for the adoption of CAVs at 25% and 75%. The CDOT Framework for CAV Modeling in Vissim includes steps to edit Vissim

models to add CAVs into the model, mimic suggested CAV driving behavior, and interface with external software scripts to platoon CAVs.

- A Build Vissim model was developed from the No-Action Vissim model for build improvements provided by the study team. Build improvements included those to bring the corridor to standard (flatter curves, 12-foot lanes, 10-foot shoulders, lower ramp density, etc.) and to add managed lanes in both directions with direct connections at select locations.
- The 2030 PM peak hour demand modeled for the No Action condition was used for the Build condition.
- Ramp volumes were redistributed to adjacent locations for ramps removed or consolidated with Build improvements.
- Managed lanes were assumed to operate with non-CAV and CAV mixed traffic for 0% and 25% CAV adoption scenarios. Managed lanes were assumed to operate as CAV-only lanes for 75% CAV adoption.
    - The managed lanes were assumed with a maximum demand of 1,400 vehicles per hour for 0% and 25% CAV scenarios. The demand for traffic exiting northbound I-25 into the managed lane under 20th Street was estimated from the supplied TransModeler throughput. When balancing traffic volumes along northbound I-25 for use in Vissim, there was a large drop in traffic volumes at 20th Street that was determined to be traffic exiting into the managed lane. The imbalance of traffic at 20th Street resulted in an estimate of 1,400 vehicles entering the managed lane.
    - The managed lanes were assumed with a maximum demand of 1,800 vehicles per hour for 75% CAVs based on an expected increase of managed lane capacity when they are CAV-only lanes.
    - Demand in the managed lanes was assigned such that the maximum demand threshold was met in the northbound direction north of the direct connection from Speer Boulevard and in the southbound direction south of the direct connection from Auraria Parkway.

3. Results

This section contains the detailed results of the analysis for the No Action and Build conditions with references to relevant exhibits.

3.1. No Action

- Northbound I-25 volume throughput is similar between all CAV adoption rates (0%, 25% and 75%) (see **Exhibit 3**). Northbound throughput is not limited because of available mainline capacity but is limited because entering traffic cannot be processed through entrance ramps. Northbound throughput does not match the demand because of over-capacity entrance ramps at Santa Fe and 6th Avenue. In **Exhibits 3 and 4**, the throughput from the previously completed No Action TransModeler simulation with 0% CAV (green line/bars) is shown for comparison with the Vissim 0% CAV Throughput (gray line/bars) to illustrate the relative match of throughput at spot locations after

making adjustments to driving behavior in Vissim. Note that TransModeler throughput values were not available at all locations.

- Northbound I-25 entrance ramp volume throughput from Santa Fe and 6th Avenue are significantly less than the demand, and CAV adoption does not improve throughput on these ramps (**see Exhibit 4**).
- Northbound I-25 speeds and travel times are slightly improved with 25% CAV adoption and more improved with 75% CAV adoption (see **Exhibits 5 and 23**).
- Southbound I-25 volume throughput is increased with CAV adoption, and the demand is able to be served at 75% CAV adoption (see **Exhibits 6 and 7**). Southbound throughput with 75% CAV adoption is roughly 10-15% higher than throughput with 0% CAV adoption. In **Exhibits 6 and 7**, the throughput from the previously completed No Action TransModeler simulation with 0% CAV (green line/bars) are shown for comparison with the Vissim 0% CAV Throughput (gray line/bars) to illustrate the relative match of throughput at spot locations after making adjustments to driving behavior in Vissim. Note that TransModeler throughput values were not available at all locations.
- Southbound I-25 speeds and travel times are slightly improved with 75% CAV adoption (see **Exhibits 8 and 23**). Slower speeds and longer travel times are noted with 25% CAV adoption between Colfax Avenue and 6th Avenue. This is largely due to:
    - Slightly more traffic (roughly 4%) on southbound I-25 entering this segment with 25% CAV adoption compared to 0% CAV adoption because of the slight increase to capacity with 25% CAV adoption.
    - Less space for weaving at 25% CAV adoption because there are relatively few platoons at the lower adoption to create additional space on the segment. Additionally, the CAVs in the network have slightly reduced car following spacing than non-CAVs.

Exhibit 3

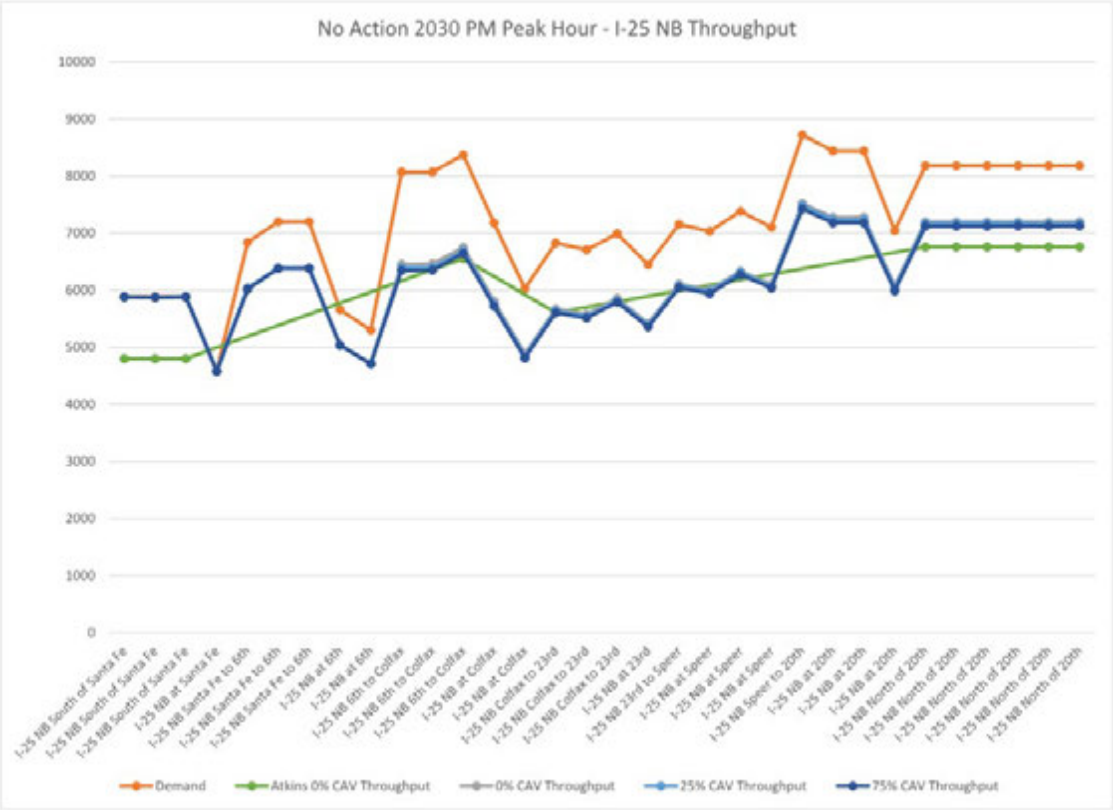


Exhibit 4

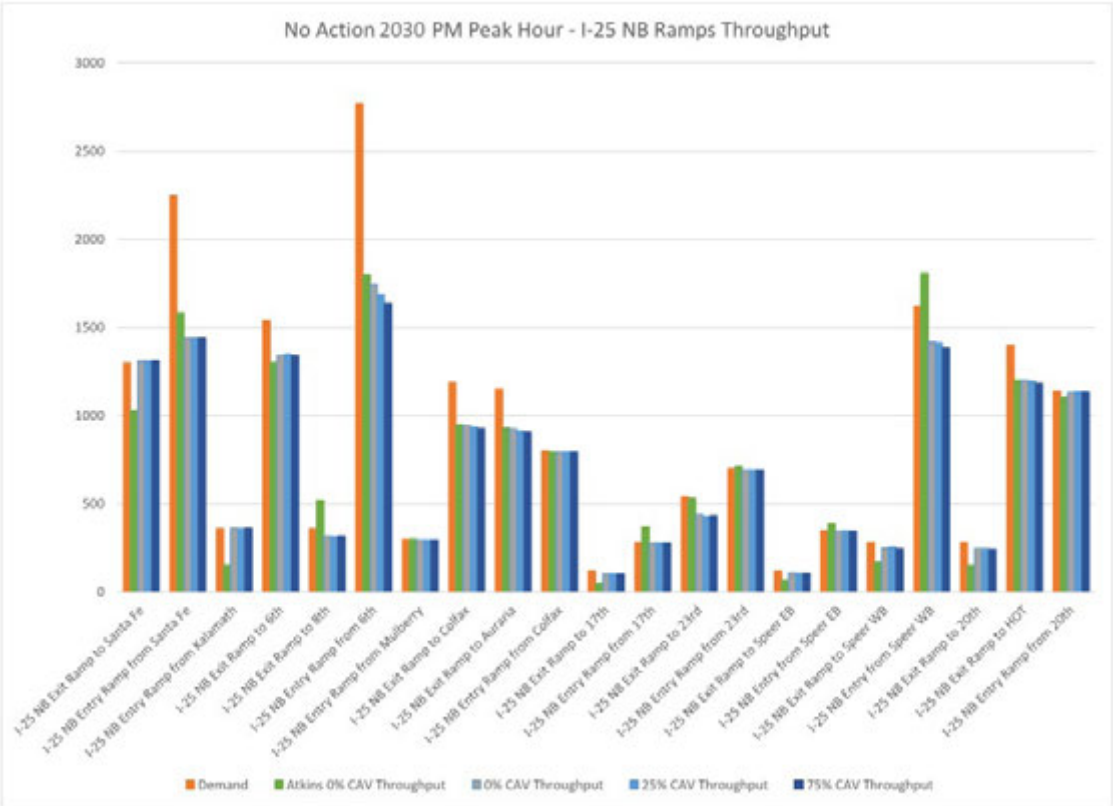


Exhibit 5

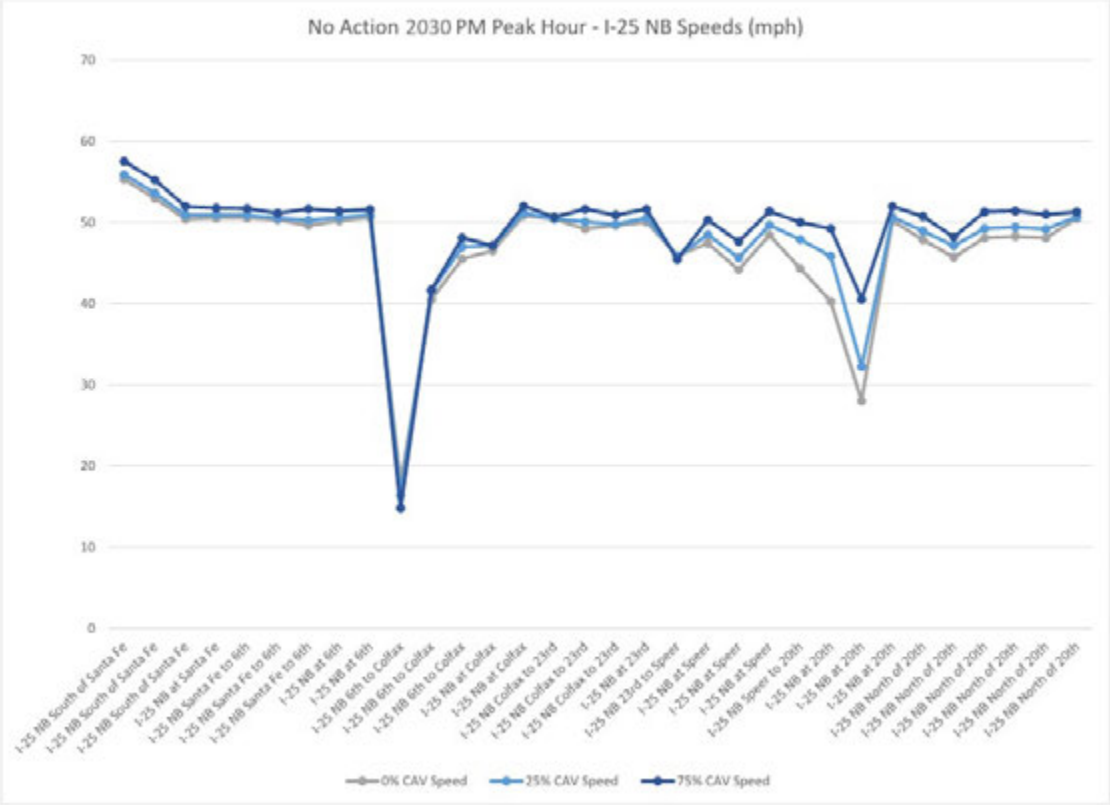


Exhibit 6

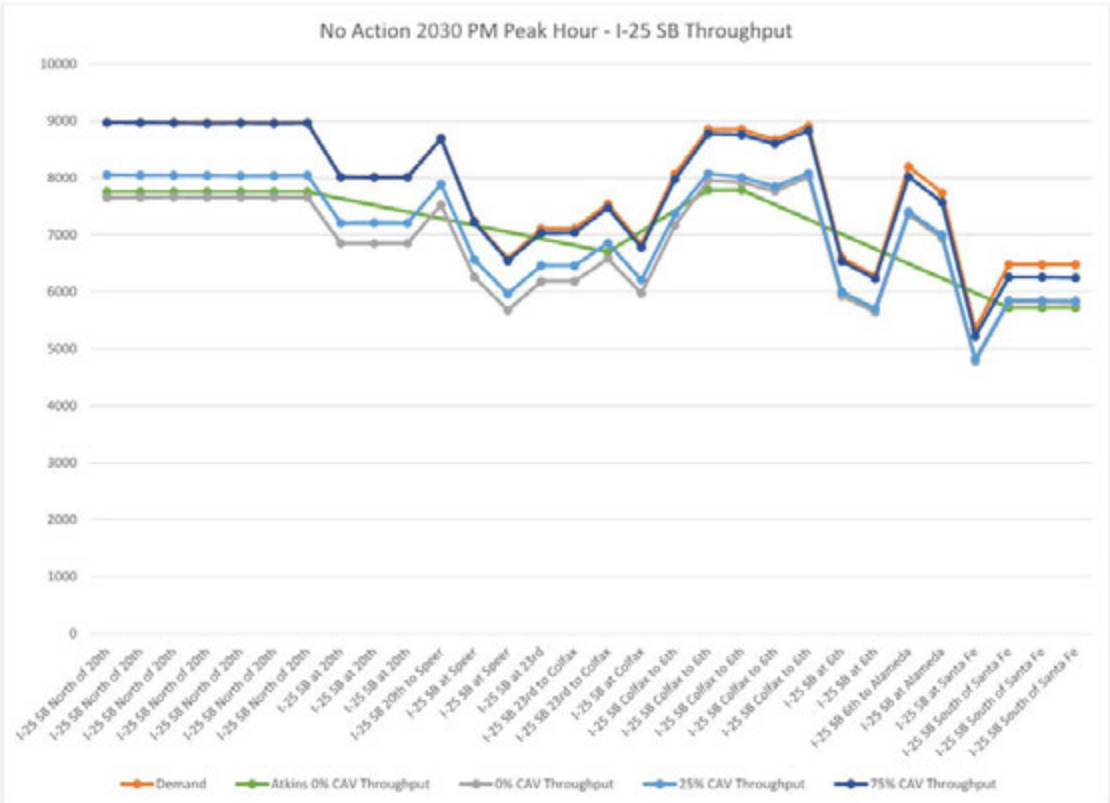


Exhibit 7

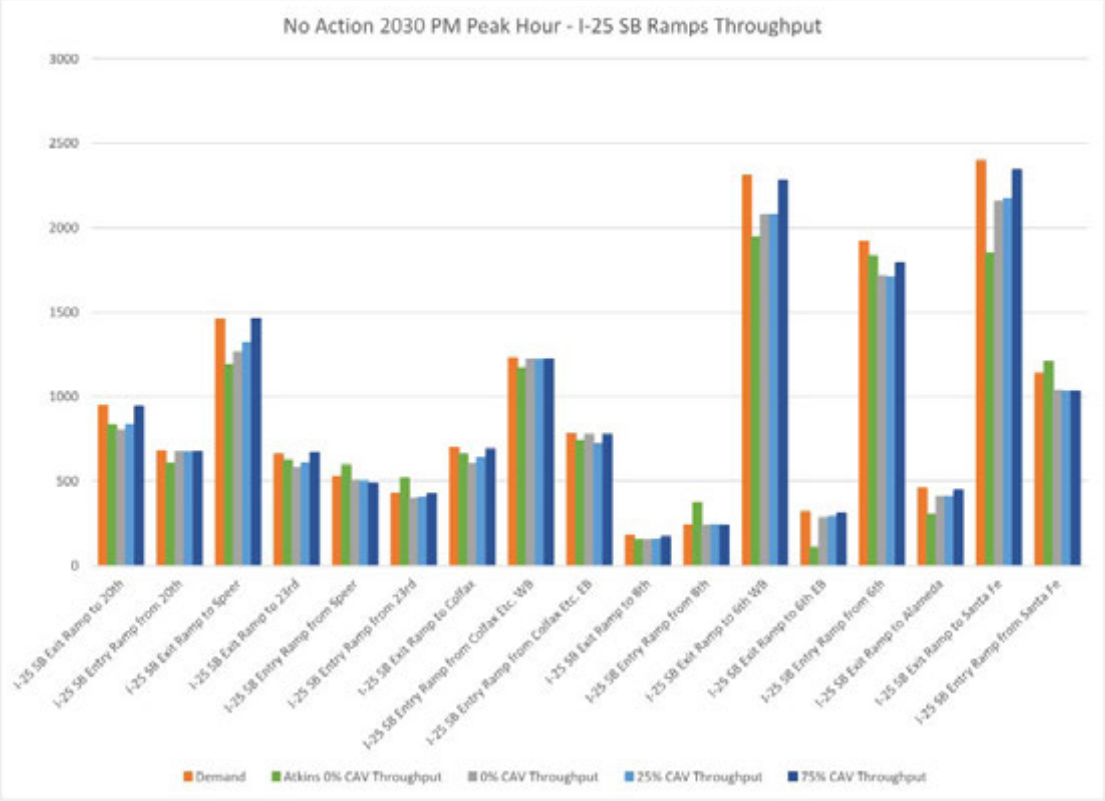
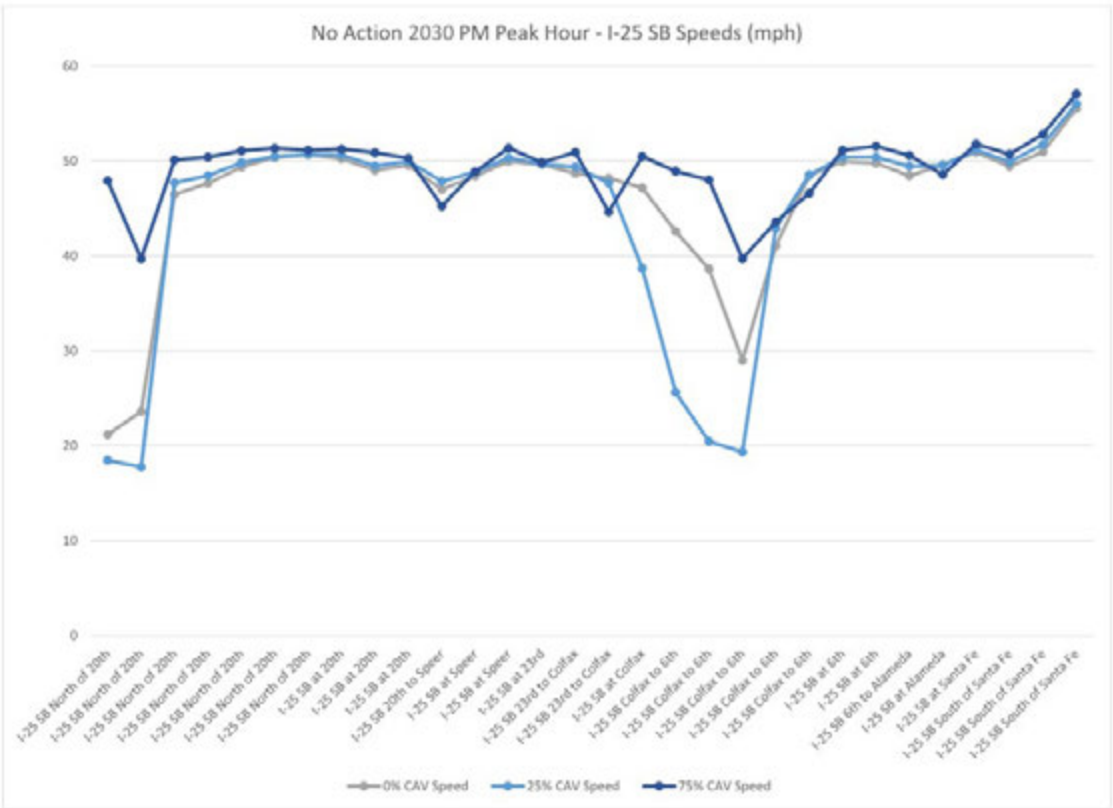


Exhibit 8



3.2. Build

- Northbound I-25 volume throughput is similar between all CAV adoption rates (0%, 25% and 75%) (see **Exhibits 9, 10, and 11**). Northbound throughput is not limited because of available mainline capacity but is limited because entering traffic cannot be processed through entrance ramps. Northbound throughput does not match the demand because of an over-capacity entrance ramp at Santa Fe.
- Northbound I-25 entrance ramp volume throughput from Santa Fe is significantly less than the demand, and CAV adoption does not improve throughput on this ramp (see **Exhibit 12**).
- Northbound I-25 speeds and travel times are slightly improved with 25% CAV adoption and more improved with 75% CAV adoption (see **Exhibits 13 and 23**).
- Southbound I-25 volume throughput is improved with CAV adoption, and the demand is able to be served at 75% CAV adoption (see **Exhibits 14, 15, 16, and 17**). Southbound throughput with 75% CAV adoption is roughly 5-10% higher than throughput with 0% CAV adoption.
- Southbound I-25 speeds and travel times are similar between all CAV adoption rates (0%, 25% and 75%) (see **Exhibits 18 and 23**).
- Managed lane volume throughput is able to accommodate roughly 30% more vehicles with 75% CAV adoption and conversion to CAV-only lanes (1,800 vehicles assigned into managed lane with 75% CAV adoption compared to 1,400 assigned with 0% and 25% adoption) (see **Exhibits 10 and 15**).
- Speeds in the northbound and southbound managed lanes drop at direct access merge locations (see **Exhibits 13 and 18**). These locations are at 6th Avenue and Speer Boulevard in the northbound direction and at Auraria Pkwy in the southbound direction.
- Speeds in the northbound and southbound managed lanes are below speeds in the general-purpose lanes at some locations with 0% and 25% CAV adoption (see **Exhibits 13 and 18**). Slower speeds in the managed lane are caused by non-CAVs with a lower desired speed that slow all vehicles behind them.

Exhibit 9

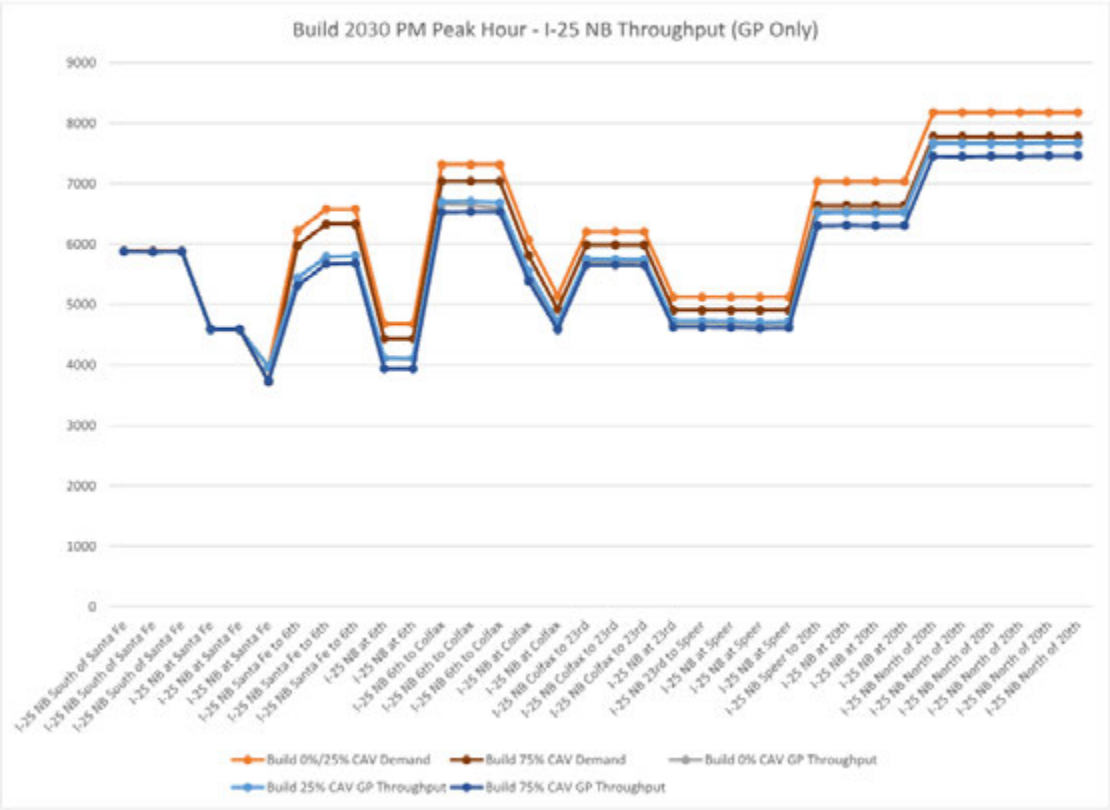
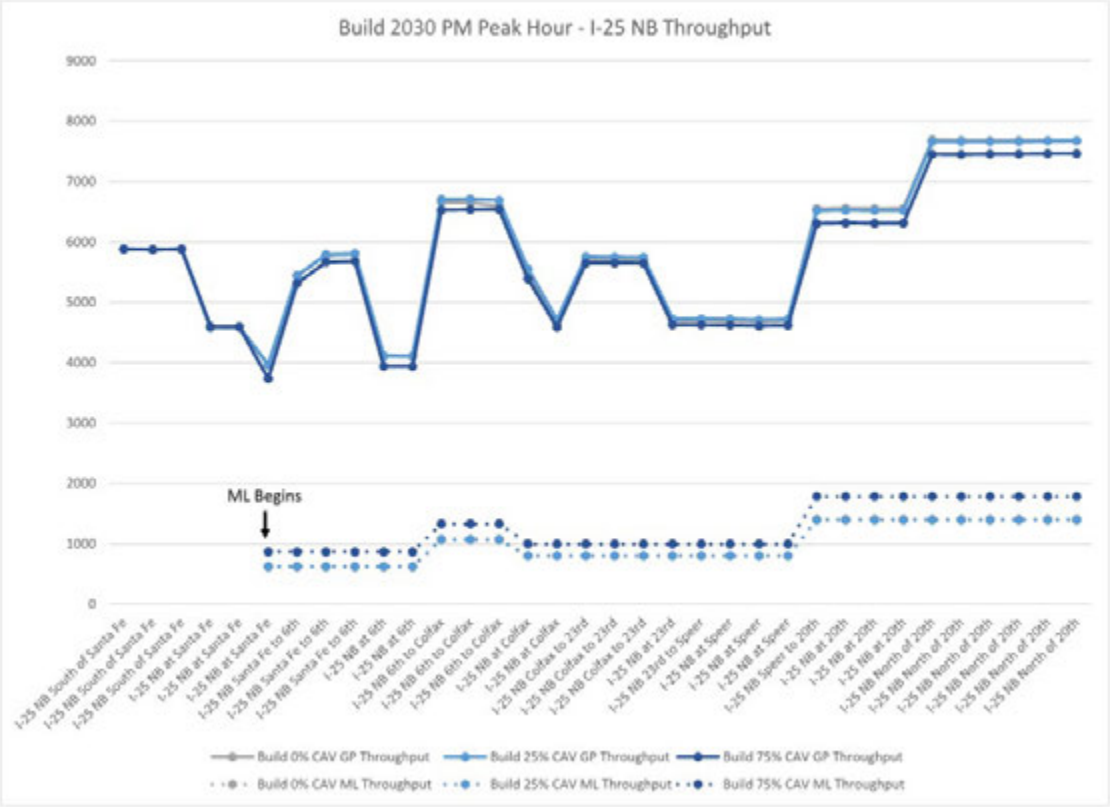

Build 2030 PM Peak Hour - I-25 NB Throughput (GP Only)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
I-25 NB South of Santa Fe
I-25 NB South of Santa Fe
I-25 NB South of Santa Fe
I-25 NB at Santa Fe
I-25 NB at Santa Fe
I-25 NB at Santa Fe
I-25 NB Santa Fe to 6th
I-25 NB Santa Fe to 6th
I-25 NB Santa Fe to 6th
I-25 NB at 6th
I-25 NB at 6th
I-25 NB at 6th
I-25 NB 6th to Colfax
I-25 NB 6th to Colfax
I-25 NB 6th to Colfax
I-25 NB at Colfax
I-25 NB at Colfax
I-25 NB at Colfax
I-25 NB Colfax to 23rd
I-25 NB Colfax to 23rd
I-25 NB Colfax to 23rd
I-25 NB at 23rd
I-25 NB at 23rd
I-25 NB 23rd to Speer
I-25 NB at Speer
I-25 NB at Speer
I-25 NB at Speer
I-25 NB Speer to 20th
I-25 NB at 20th
I-25 NB at 20th
I-25 NB at 20th
I-25 NB North of 20th
I-25 NB North of 20th
I-25 NB North of 20th
I-25 NB North of 20th
I-25 NB North of 20th
I-25 NB North of 20th
Build 0%/25% CAV Demand
Build 75% CAV Demand
Build 0% CAV GP Throughput
Build 25% CAV GP Throughput
Build 75% CAV GP Throughput

Exhibit 10



Note: Managed Lane (ML) throughput for 0% and 25% CAV are nearly identical, as the demand for the ML was not modified between these scenarios. It is expected that there would be limited opportunity to platoon CAVs at 25% adoption in a single lane because of the significantly greater number of non-CAVs, and the efficiency goal of the ML may not allow additional demand at 25% CAV adoption.

Exhibit 11

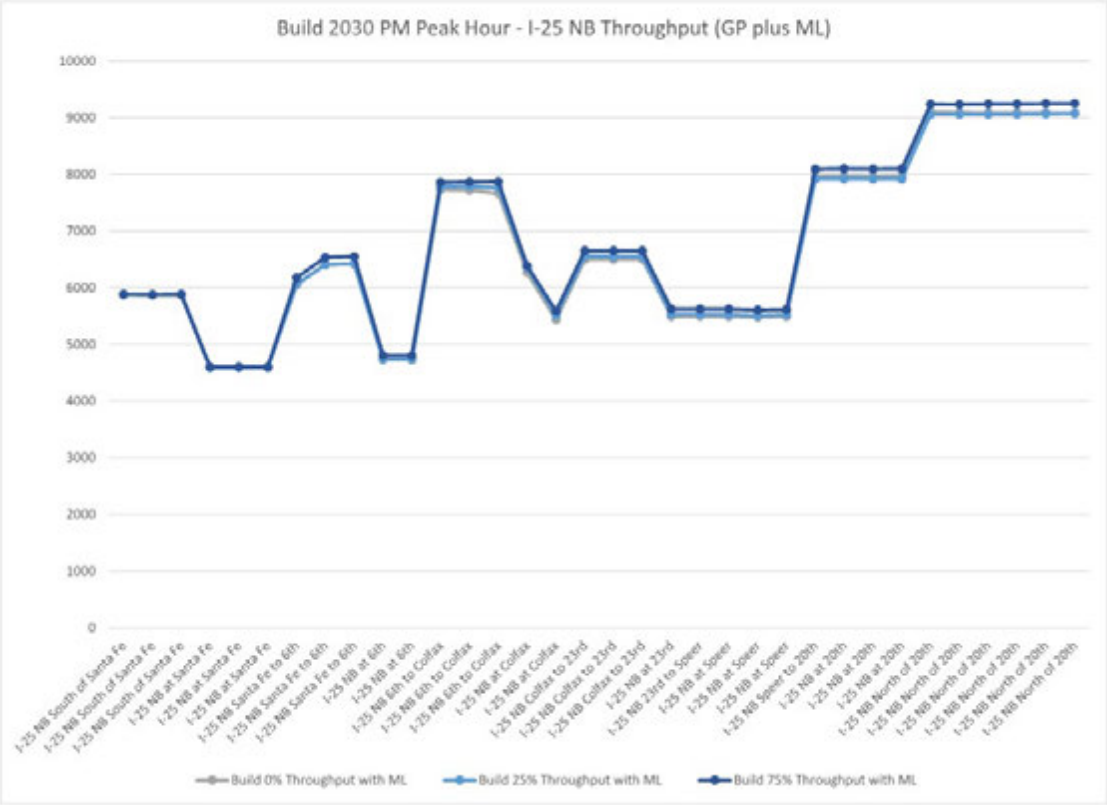


Exhibit 12

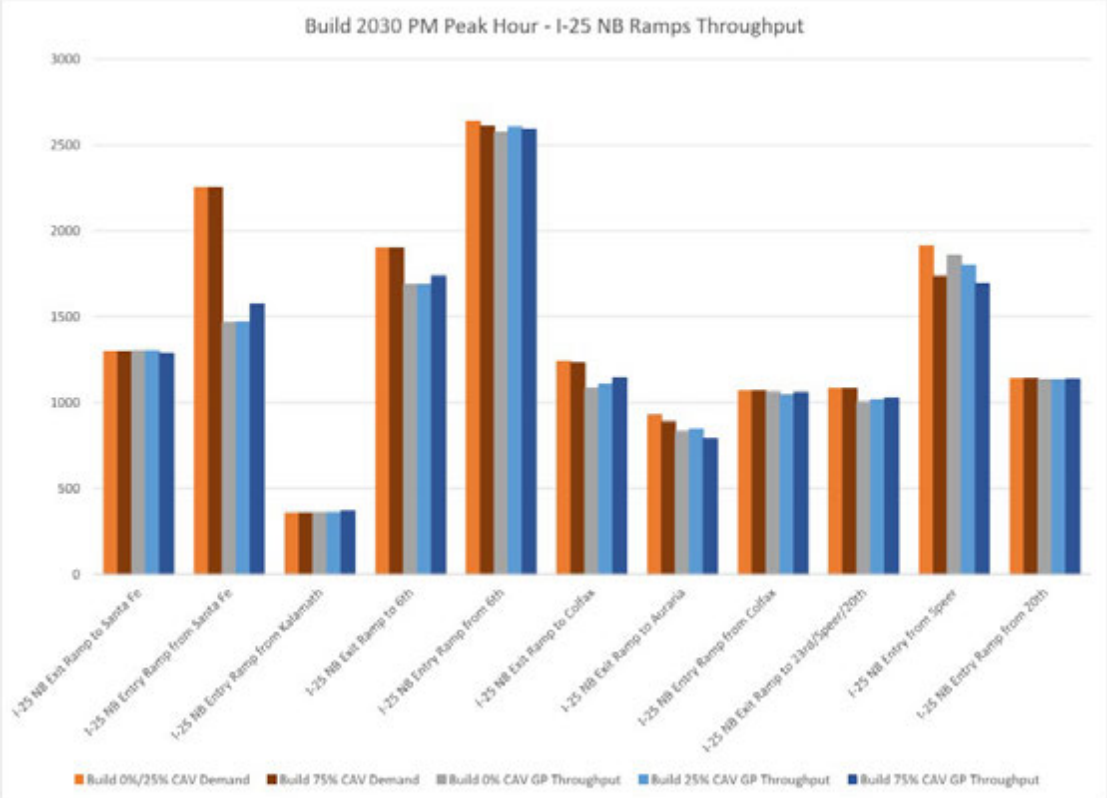


Exhibit 13

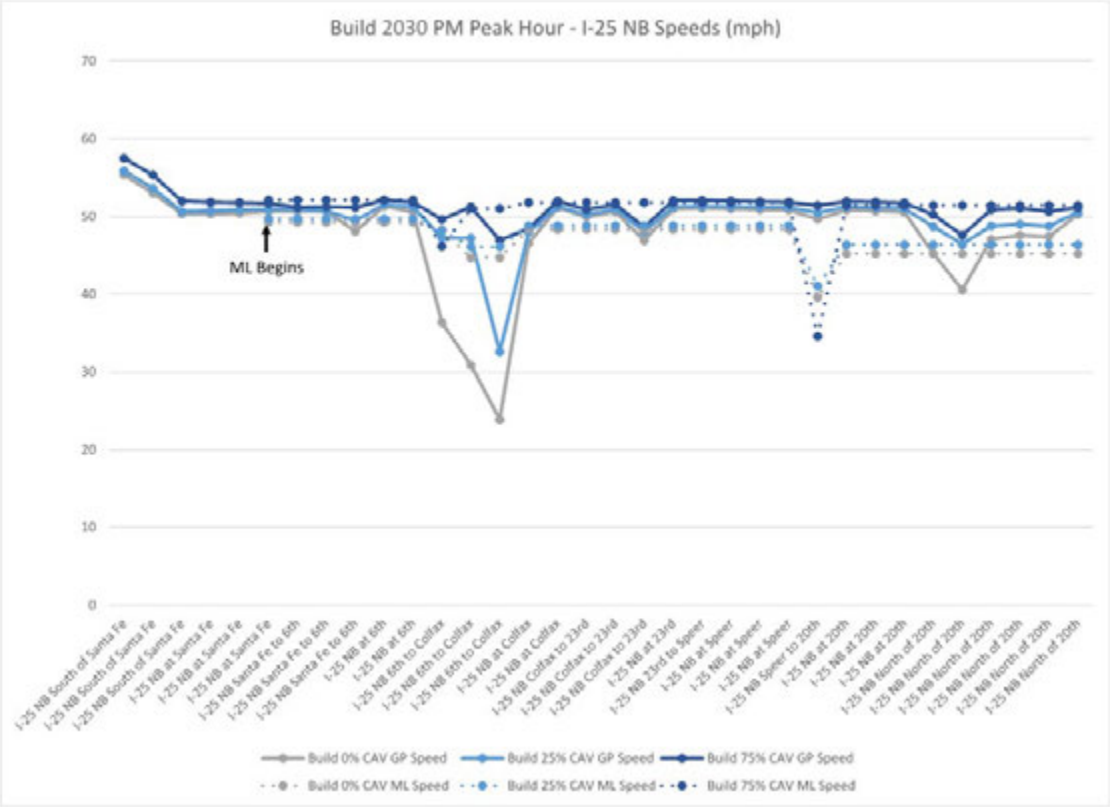


Exhibit 14

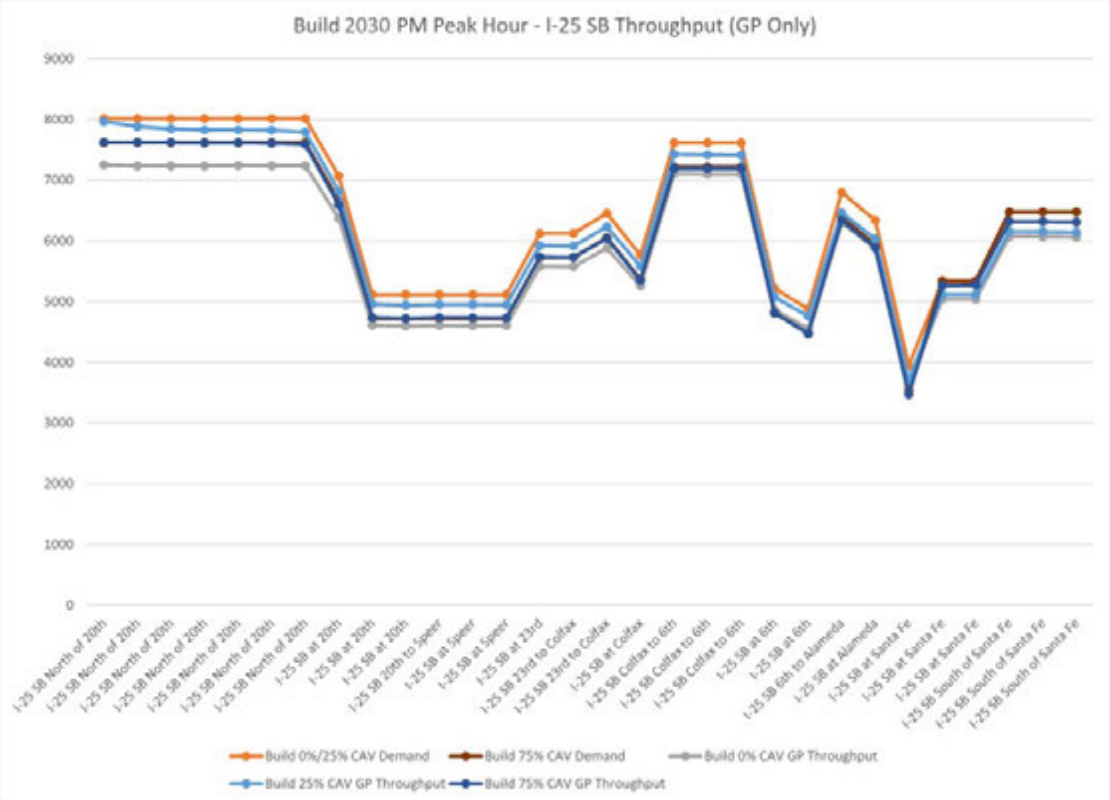
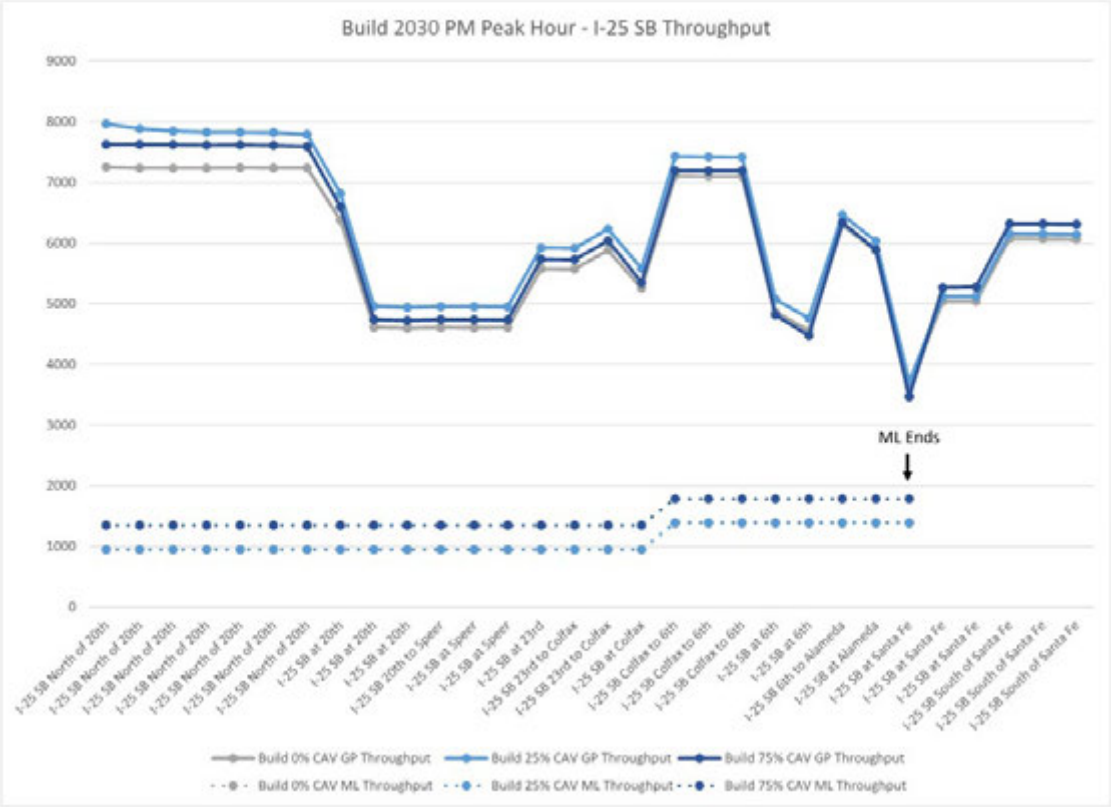


Exhibit 15



Note: Managed Lane (ML) throughput for 0% and 25% CAV are nearly identical, as the demand for the ML was not modified between these scenarios. It is expected that there would be limited opportunity to platoon CAVs at 25% adoption in a single lane because of the significantly greater number of non-CAVs, and the efficiency goal of the ML may not allow additional demand at 25% CAV adoption.

Exhibit 16

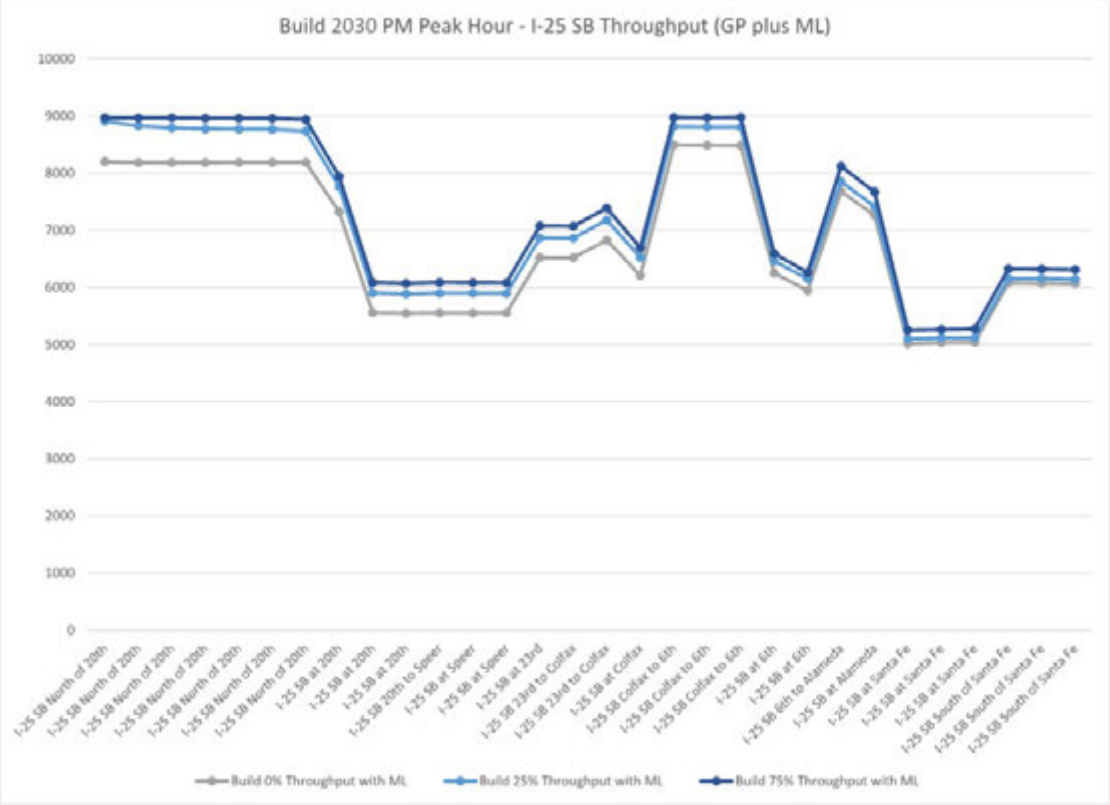


Exhibit 17

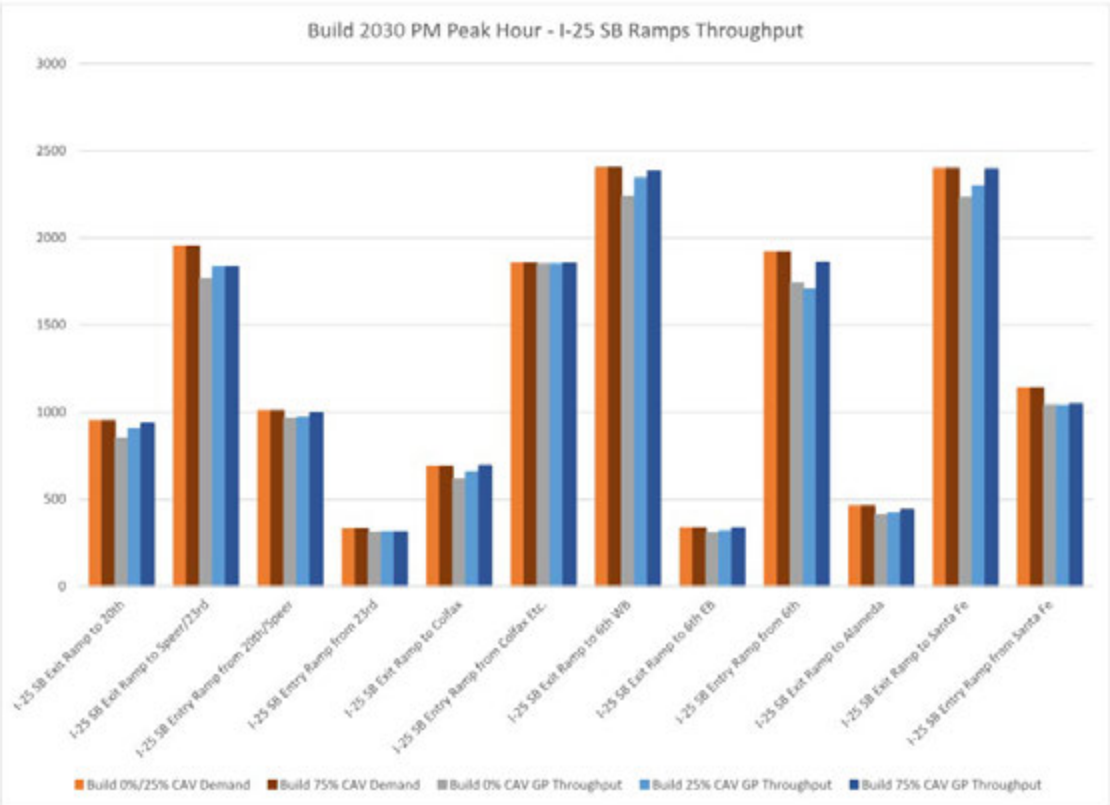
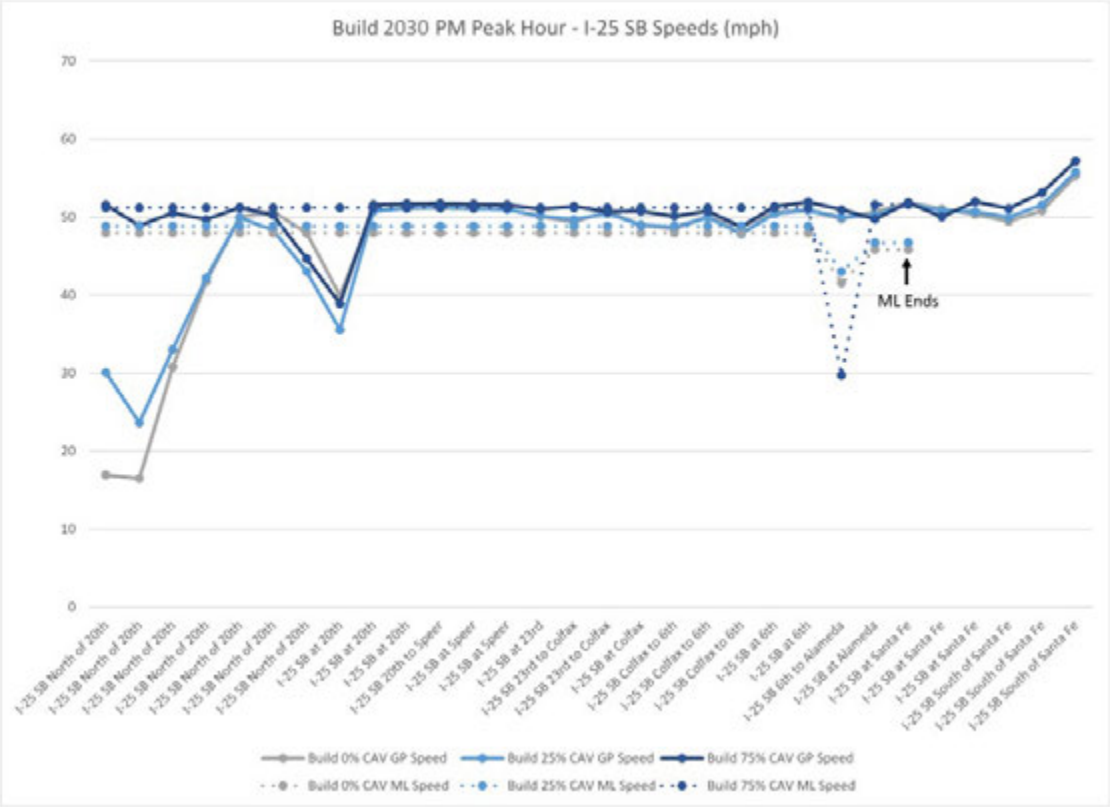


Exhibit 18



3.3. No Action vs. Build

- Volume throughput is increased with the Build improvements for all CAV adoption rates (see **Exhibits 19 and 21**).
    - Throughput in the northbound direction is roughly 10% greater for much of the corridor with the Build improvements (0% CAVs).
    - Throughput in the southbound direction with 0% and 25% CAV adoption is roughly 5-10% greater with the Build improvements. Throughput in the southbound direction with 75% CAV adoption is only slightly greater than the No Action with the Build improvements because the 75% adoption in No Action was able to mostly serve the demand.
- Speeds around 50 mph are maintained for much of the corridor with the Build conditions, while speeds with No Action are more volatile (see **Exhibits 20 and 22**).

Exhibit 19

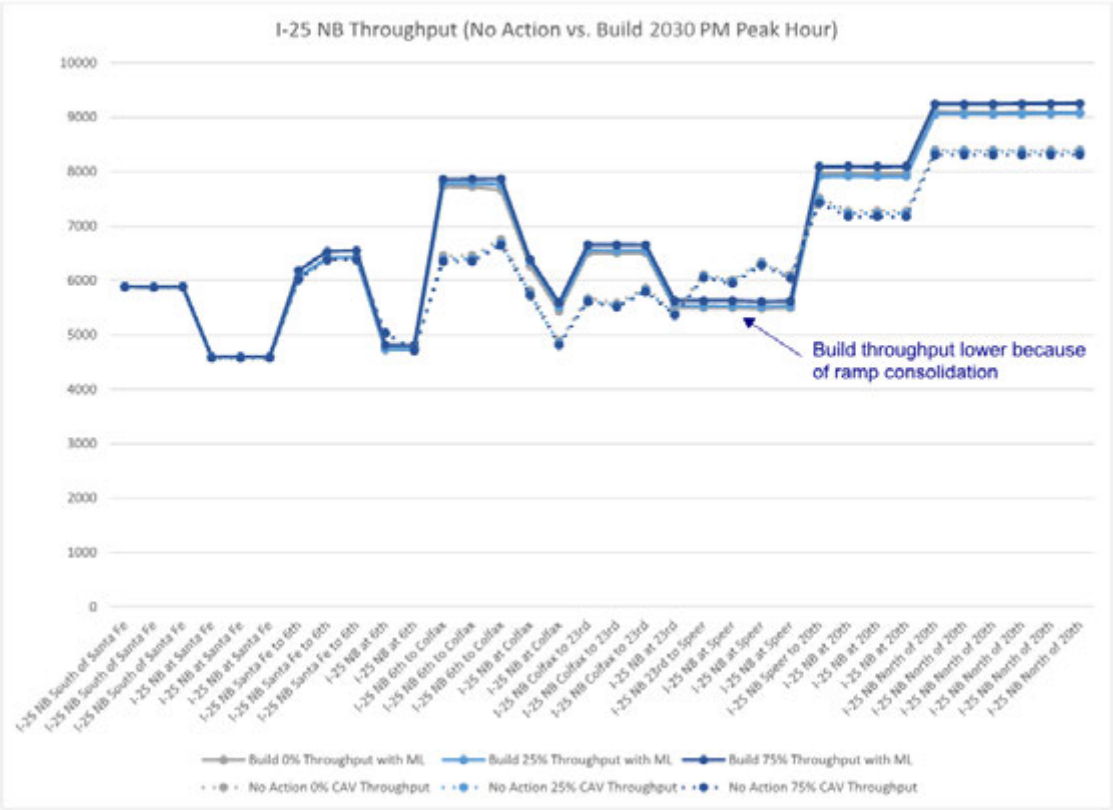


Exhibit 20

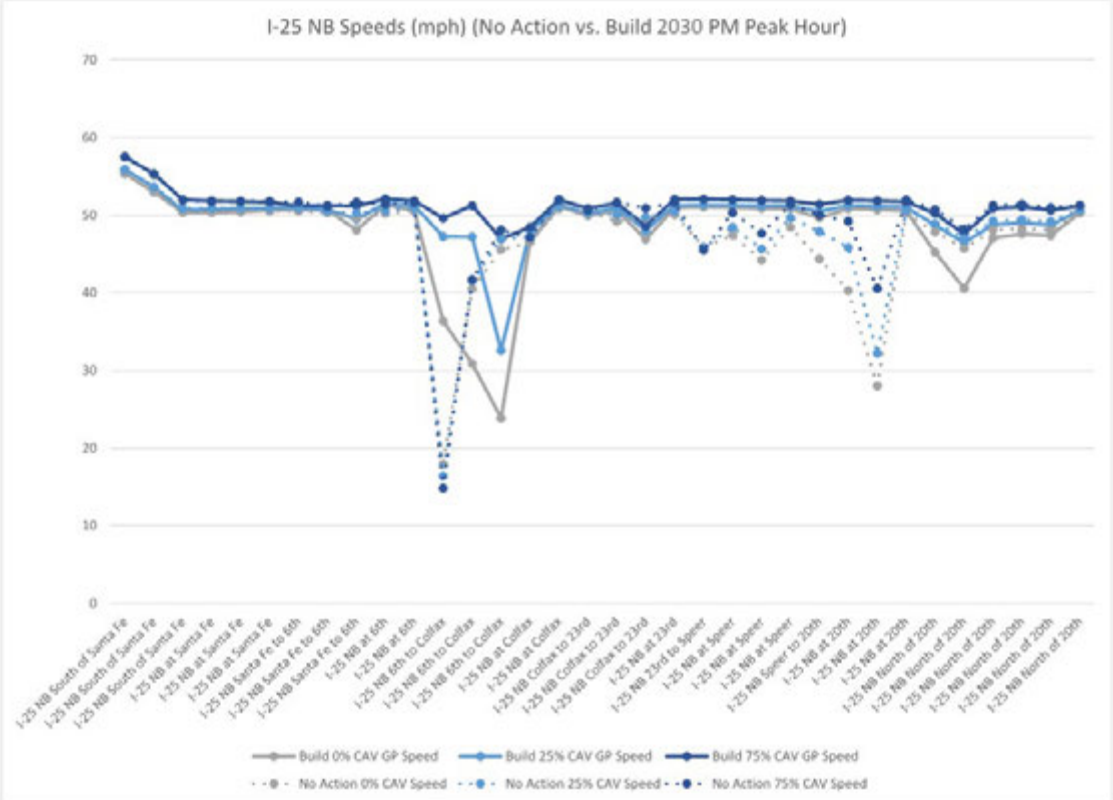


Exhibit 21

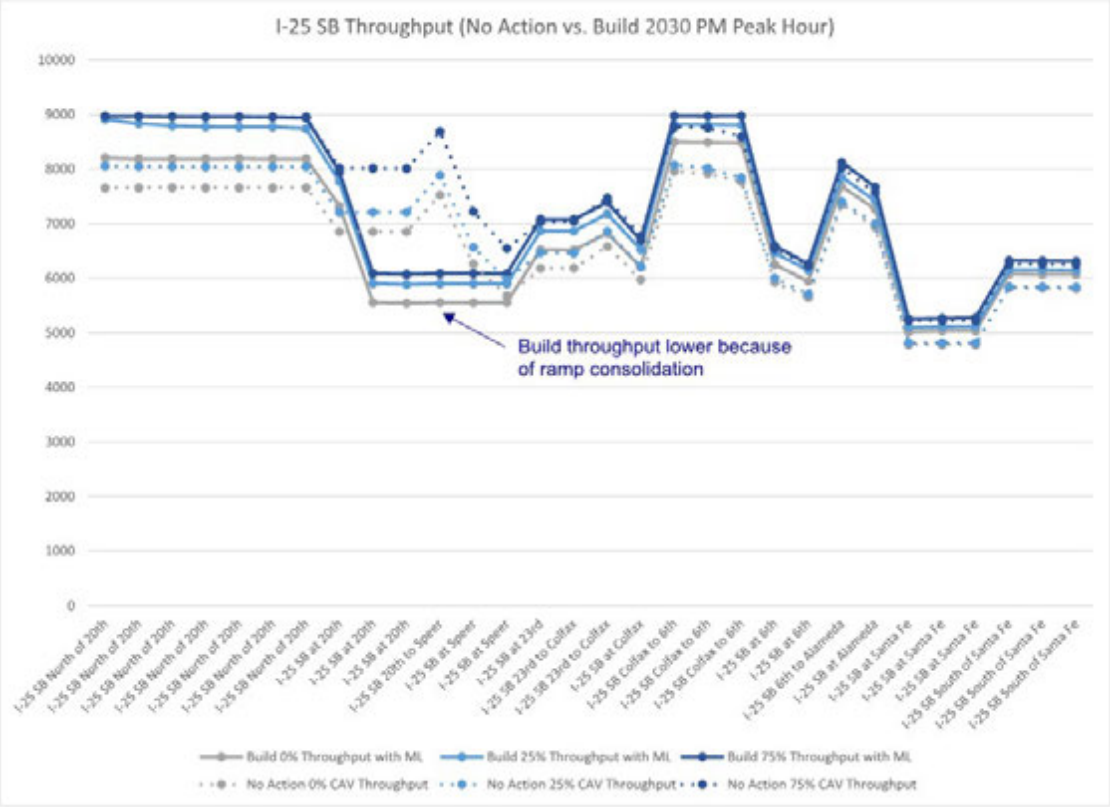
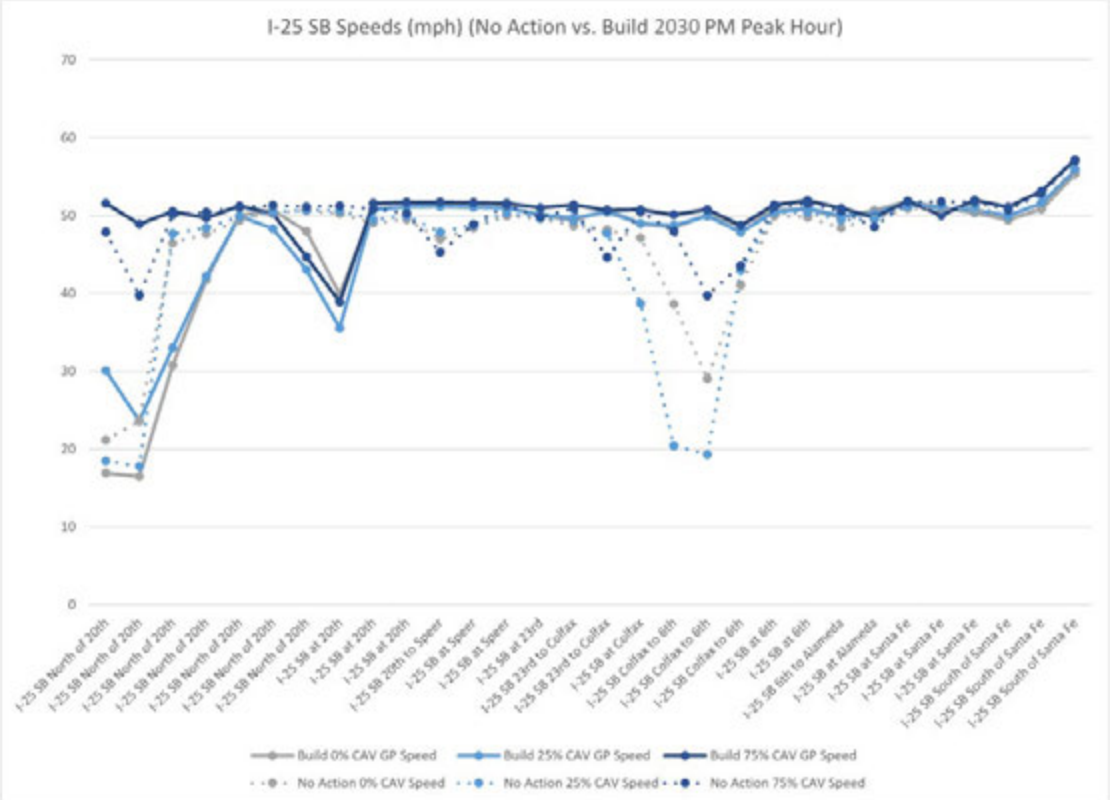


Exhibit 22



4. Key Results

Key results of the Vissim CAV simulation analysis include:

- Northbound I-25 volume throughput is similar between all CAV adoption rates (0%, 25% and 75%) for No Action and Build conditions (see **Exhibits 3, 9 and 11)**. Northbound throughput is not limited because of available mainline capacity, but is limited because entering traffic cannot be processed through entrance ramps. Northbound throughput does not match the demand because of over-capacity entrance ramps at Santa Fe (No Action and Build conditions) and 6th Avenue (No Action conditions).
- Southbound I-25 volume throughput is increased with CAV adoption, and the 2040 No Action demand is able to be served at 75% CAV adoption for No Action and Build conditions (see **Exhibits 6, 14 and 16**). In the No Action condition, southbound throughput with 75% CAV adoption is roughly 10-15% higher than throughput with 0% CAV adoption. In the Build condition, southbound throughput with 75% CAV adoption is roughly 5-10% higher than throughput with 0% CAV adoption.
- In the Build condition with 75% CAV adoption and conversion of the managed lane to CAV-only, the managed lane is able to serve roughly 30% more vehicles, and average speeds in the managed lane are higher (see **Exhibits 10, 13, 15, and 18**).
- At 75% CAV adoption, speeds are generally higher and less volatile for No Action and Build conditions (see **Exhibits 5, 8, 13, and 18**).
- In the Build condition, speeds around 50 mph are maintained for much of the corridor, while speeds with No Action are more volatile (see **Exhibits 20 and 22**).

Exhibit 23 contains the detailed peak hour travel times for the tested CAV scenarios.

Exhibit 23

2030 PM Peak Hour Travel Times - Comparison between CAV Adoption

		No Action					Build				
TT No.	TT Name	0% CAV (sec)	25% CAV (sec)	Change (%)	75% CAV (sec)	Change (%)	0% CAV (sec)	25% CAV (sec)	Change (%)	75% CAV (sec)	Change (%)
100	NB Full - Santa Fe Off to 20th On	366.6	359.4	-2.0%	350.4	-4.4%	357.7	349.5	-2.3%	344.3	-3.7%
101	NB - Santa Fe Off to Santa Fe On	49.4	49.1	-0.7%	48.2	-2.4%	49.3	49.0	-0.6%	48.2	-2.2%
102	NB - Santa Fe On to Kalamath On	10.4	10.3	-0.7%	10.2	-2.0%	10.3	10.3	-0.6%	10.2	-1.7%
103	NB - Kalamath On to 6th Off	51.4	51.0	-0.9%	50.0	-2.7%	51.1	50.5	-1.1%	49.8	-2.4%
104	NB - 6th Off to 8th Off	31.8	31.5	-0.8%	31.1	-2.2%	31.2	31.1	-0.3%	30.8	-1.4%
105	NB - 8th Off to 6th On	16.7	16.6	-0.7%	16.4	-1.9%	16.9	16.3	-3.7%	16.1	-4.9%
106	NB - 6th On to Yuma On	7.6	7.6	-0.5%	7.6	-0.1%	12.5	8.0	-35.8%	7.5	-40.1%
107	NB - Yuma On to Colfax Off	16.0	15.5	-2.8%	15.2	-4.9%	39.0	25.5	-34.5%	15.5	-60.1%
108	NB - Colfax Off to Auraria Off	19.1	18.8	-1.6%	18.8	-1.7%	20.1	19.1	-4.5%	18.5	-7.6%
109	NB - Auraria Off to Colfax On	26.5	26.3	-0.6%	25.9	-2.2%	26.5	26.4	-0.3%	26.1	-1.6%
110	NB - Colfax On to Mile High Off	10.1	10.0	-0.4%	9.9	-1.4%	10.3	10.3	-0.5%	10.1	-1.9%
111	NB - Mile High Off to Mile High On	8.5	8.3	-1.8%	8.1	-4.9%	8.1	8.0	-0.7%	7.9	-1.8%
112	NB - Mile High On to 23rd Off	16.9	16.8	-0.6%	16.4	-3.0%	17.0	16.7	-1.6%	16.4	-3.3%
113	NB - 23rd Off to 23rd On	16.3	16.1	-1.0%	15.8	-3.1%	15.7	15.6	-0.5%	15.4	-2.0%
114	NB - 23rd On to EB Speer Off	6.0	6.0	-0.6%	5.9	-1.2%	5.7	5.7	-0.5%	5.6	-2.0%
115	NB - EB Speer Off to EB Speer On	9.3	9.1	-2.2%	8.8	-5.8%	8.6	8.5	-0.6%	8.4	-2.0%
116	NB - EB Speer On to WB Speer Off	6.8	6.6	-3.0%	6.4	-6.8%	6.4	6.4	-0.6%	6.3	-2.0%
117	NB - WB Speer Off to WB Speer On	15.8	15.4	-2.4%	14.9	-5.7%	14.9	14.8	-0.9%	14.6	-2.2%
118	NB - WB Speer On to 20th Off	11.6	10.5	-9.5%	10.0	-13.5%	10.1	10.0	-1.0%	9.8	-2.4%
119	NB - 20th Off to NB HOT	19.6	16.9	-13.5%	14.3	-26.9%	12.8	12.7	-0.8%	12.5	-2.1%
120	NB - NB HOT to 20th On	18.1	18.0	-0.8%	17.5	-3.2%	18.1	17.9	-0.9%	17.6	-2.3%
200	SB Full - 20th Off to Santa Fe On	370.0	383.9	3.8%	358.2	-3.2%	371.8	376.9	1.4%	375.6	1.0%
201	SB - 20th Off to SB HOT	23.5	23.3	-0.8%	23.0	-2.0%	23.7	25.0	5.6%	23.8	0.6%
202	SB - SB HOT to 20th On	13.8	13.7	-0.9%	13.4	-3.2%	13.3	13.3	0.1%	13.1	-1.3%
203	SB - 20th On to Speer Off	10.6	10.5	-0.6%	11.0	3.9%	10.1	10.2	0.1%	10.0	-1.0%
204	SB - Speer Off to 23rd Off	16.4	16.3	-1.0%	16.2	-1.5%	15.6	15.6	0.1%	15.4	-1.1%
206	SB - Speer On to 23rd On	44.3	43.8	-1.2%	42.6	-3.7%	43.4	43.3	-0.3%	42.4	-2.5%
207	SB - 23rd On to Colfax Off	10.1	10.1	0.6%	10.7	6.0%	9.8	9.8	0.6%	9.8	0.3%
208	SB - Colfax Off to Colfax/Auraria On	35.4	46.3	31.0%	32.9	-6.8%	33.4	33.4	0.0%	32.5	-2.8%
209	SB - Colfax/Auraria On to Zuni Off	37.9	51.4	35.4%	29.7	-21.6%	27.1	27.1	0.0%	26.3	-3.1%
210	SB - Zuni Off to Zuni On	13.3	12.7	-4.5%	12.5	-6.3%	10.7	10.8	0.2%	10.6	-1.5%
211	SB - Zuni On to WB 6th Off	10.3	10.3	-0.2%	10.5	1.8%	10.4	10.6	1.6%	10.4	-0.4%
212	SB - WB 6th Off to EB 6th Off	10.1	9.9	-1.1%	9.8	-2.9%	10.1	10.2	0.6%	9.9	-2.1%
213	SB - EB 6th Off to 6th On	38.3	37.8	-1.2%	37.0	-3.4%	37.6	37.5	-0.1%	36.8	-2.1%
214	SB - 6th On to Alameda Off	40.9	40.2	-1.8%	39.3	-3.9%	40.0	39.8	-0.5%	39.0	-2.3%
215	SB - Alameda Off to Santa Fe Off	19.3	19.4	0.3%	19.8	2.5%	19.0	19.2	0.9%	19.4	1.9%
216	SB - Santa Fe Off to Santa Fe On	41.6	41.4	-0.6%	40.9	-1.7%	41.5	41.3	-0.4%	40.8	-1.5%
1001	NB GP - ML Start to 6th Bridge						96.5	96.0	-0.6%	95.0	-1.5%
1002	NB GP - 6th Bridge to Colfax Bridge						84.2	76.7	-9.0%	74.2	-11.9%
1003	NB GP - Colfax Bridge to Speer Bridge						83.0	82.4	-0.8%	81.3	-2.1%
1004	NB GP - Speer Bridge to ML End						51.1	50.6	-0.9%	50.0	-2.2%
1005	NB GP - ML Start to ML End						312.7	304.7	-2.6%	300.0	-4.1%
1101	NB ML - ML Start to 6th Bridge						100.2	99.4	-0.8%	94.8	-5.4%
1102	NB ML - 6th Bridge to Colfax Bridge						79.2	78.2	-1.2%	74.3	-6.2%
1103	NB ML - Colfax Bridge to Speer Bridge						88.1	87.1	-1.1%	81.6	-7.4%
1104	NB ML - Speer Bridge to ML End						57.8	56.4	-2.4%	55.4	-4.1%
1105	NB ML - ML Start to ML End						326.0	321.9	-1.3%	306.2	-6.1%
2001	SB GP - ML Start to Speer Bridge						50.4	50.9	1.0%	49.9	-0.9%
2002	SB GP - Speer Bridge to Colfax Bridge						84.3	84.4	0.1%	82.9	-1.7%
2003	SB GP - Colfax Bridge to 6th Bridge						76.3	76.5	0.3%	74.6	-2.3%
2004	SB GP - 6th Bridge to ML End						98.5	98.5	0.0%	97.7	-0.9%
2005	SB GP - ML Start to ML End						324.1	328.3	1.3%	327.6	1.1%
2101	SB ML - ML Start to Speer Bridge						50.9	50.3	-1.2%	48.1	-5.5%
2102	SB ML - Speer Bridge to Colfax Bridge						87.5	85.9	-1.8%	81.1	-7.3%
2103	SB ML - Colfax Bridge to 6th Bridge						83.1	80.9	-2.6%	82.2	-1.1%
2104	SB ML - 6th Bridge to ML End						108.9	107.3	-1.4%	97.2	-10.7%
2105	SB ML - ML Start to ML End						330.7	325.1	-1.7%	308.8	-6.6%

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Appendix D

Land Use Sensitivity Analysis Technical Memorandum

I-25 Central Land Use Sensitivity Analysis Technical Memorandum

1. Introduction

This memorandum documents the land use sensitivity analysis methodology and results for the I-25 Central Planning and Environmental Linkages (PEL) study. The City and County of Denver (CCD) has developed year 2040 socioeconomic forecasts for major future development areas within close proximity to the I-25 Central project corridor. This analysis was performed to provide an understanding of the potential impact to traffic volumes along the I-25 corridor from CCD's greater population and employment estimates, as compared to estimates from the Denver Regional Council of Government's (DRCOG's) 2040 Regional Travel Demand Model, known as Focus.

This memorandum describes the methodology used to estimate the trips generated by these development sites, their distribution to the roadway network, and estimated trip assignment to the I-25 corridor in addition to trips already estimated from the Focus model.

2. Methodology

The following steps were used to develop the sensitivity analysis forecasts:

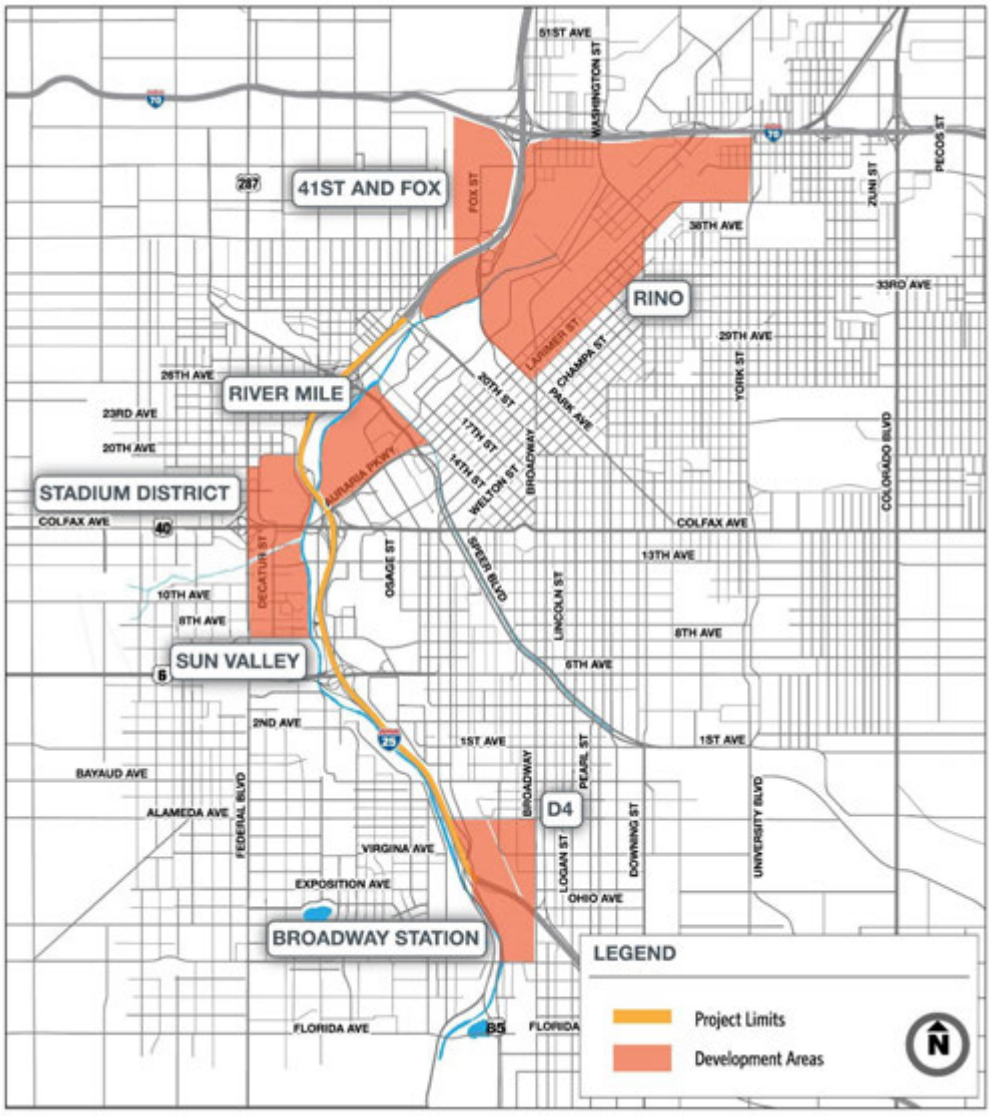
1. Identified development areas and defined boundary areas to correspond with the DRCOG model traffic analysis zone (TAZ) boundaries
2. Defined CCD socioeconomic projections compared to DRCOG projections, including household and employment estimates
3. Estimated vehicle trip generation associated with the variation between the CCD and DRCOG socioeconomic projections
4. Identified trip distribution and routing patterns by performing a select zone analysis for each development in TransCAD using the I-25 Central 2040 No Action (2040 No Action) model
5. Estimated the additional CCD vehicle trip distribution and assignment based on the select zone results

Further details regarding the methodology and the results are described below.

3. CCD Development Areas

A total of seven critical development areas along the I-25 Central corridor were considered for this analysis. This includes development areas at Fox and 41st, River North (RINO), River Mile, Stadium District, Sun Valley, Broadway Station, and at Alameda and South Broadway (D4 Urban). City and County of Denver provided future development projections for these development areas. The development areas are illustrated in Figure 1.

Figure 1: CCD Development Areas


41ST AND FOX
RIVER MILE
STADIUM DISTRICT
SUN VALLEY
RINO
D4
BROADWAY STATION
51ST AVE
WASHINGTON ST
FOX ST
38TH AVE
33RD AVE
29TH AVE
LARIMER ST
CHAMPA ST
PARK AVE
YORK ST
ZUNI ST
PECOS ST
COLORADO BLVD
26TH AVE
23RD AVE
20TH AVE
20TH ST
17TH ST
14TH ST
WELTON ST
BROADWAY
AURARIA PKWY
COLFAX AVE
DECATUR ST
OSAGE ST
SPEER BLVD
LINCOLN ST
13TH AVE
10TH AVE
8TH AVE
6TH AVE
2ND AVE
1ST AVE
PEARL ST
BAYAUD AVE
ALAMEDA AVE
FEDERAL BLVD
VIRGINIA AVE
EXPOSITION AVE
LOGAN ST
DOWNING ST
OHIO AVE
UNIVERSITY BLVD
FLORIDA AVE
LEGEND
Project Limits
Development Areas
N

3.1. Socioeconomic Inputs

The socioeconomic inputs for the development zones are illustrated in Table 1. These values were provided by DRCOG and CCD. CCD estimates were reviewed and approved by the project team. The Focus model's 2040 projections include nearly 14,700 households and 27,500 jobs within the seven development areas. The CCD estimates include nearly 27,900 households and 117,100 jobs within the seven development areas, an increase of 90% (approximately 13,200 households) and over 325% (approximately 89,600 jobs), respectively.

Table 1: 2040 Socio-Economic Totals for Development Areas

Development Area	2040 DRCOG		2040 CCD		+/- CCD v DRCOG	
	Households	Jobs	Households	Jobs	Households	Jobs
41st & Fox	705	1,575	1,500	3,500	795	1,925
Broadway Station	1180	1,450	3,000	17,500	1,820	16,050
D4	2173	2,234	1,400	11,500	-773	9,266
RINO	9758	10,967	14,660	21,350	4,902	10,383
River Mile	106	4,353	4,600	45,250	4,494	40,897
Stadium District	0	3,733	700	12,000	700	8,267
Sun Valley	747	3,146	2,000	6,000	1,253	2,854
Sum	**14,669**	**27,458**	**27,860**	**117,100**	**13,191**	**89,642**

Source: City and County of Denver and DRCOG Focus Model, 2018

3.2. Vehicle Trip Generation

The methodology for estimating vehicle trip generation was developed in coordination with DRCOG, CCD, and I-25 Central project team members. DRCOG model statistics illustrating household/population totals, person trips, and vehicle trips by Area Type (AT) in the model were used in development of the methodology. The development areas under consideration for this analysis are all considered to be AT 1 (Central Business District) or AT 2 (Downtown "Fringe").

DRCOG model statistics show that person trips per household/job within the Focus model for AT 1 and AT 2 are 4.00 and 5.35 daily trip ends, respectively. So, for AT 1, there are essentially two person trips inbound and two outbound per household/job. In addition, DRCOG recommends that commercial vehicles (CVs) and external trips be set to 1.0 daily trips per job/household. Thus, the total person trips per household/job within the Focus model for AT 1 and AT 2 are 5.00 (4.00 + 1.0) and 6.35 (5.35 + 1.0) daily trip ends, respectively.

For this effort, only vehicle trips are of concern as we attempt to estimate the number of vehicles entering, exiting, and crossing I-25 from the developments. DRCOG statistics show

the vehicle trips per household/job within the Focus model for AT 1 and AT2 are 1.24 and 2.82, respectively. The working group agreed that this represented a fair portion of the person trips considering the high multi-modal nature of the area types. Commercial vehicles (CVs) and external trips would remain unchanged and set to 1.0 daily trips per job/household. Assuming these rates, the total vehicle trips per household/job recommended for the development areas for AT 1 and AT 2 are 2.24 (1.24 + 1.0) and 3.82 (2.82 + 1.0) daily trip ends, respectively.

The project team agreed to the recommended vehicle trip rates above. AT 1 was applied to the River Mile development area. All other development areas were considered AT 2. Table 2 illustrates the final trip generation assumptions.

Table 2: Daily Trip Generation Factors

Area Type	Person Trips (Daily Trips per HH/Job)			Vehicle Trips (Daily Trips per HH/Job)		
	Personal	Commercial Vehicles / External Trips	Total	Personal	Commercial Vehicles / External Trips	Total
AT 1	4.00	1.0	5.00	1.24	1.0	2.24
AT2	5.35	1.0	6.35	2.82	1.0	3.82

Source: DRCOG Focus Model, 2018

3.3. Trip Distribution and Routing Patterns

Select zone analyses were performed to determine trip distribution routing patterns to/from the zones within the various development areas. The purpose is to gain an understanding of the vehicle trips from the new developments that would use I-25.

The process utilized the 2040 No Action Model to identify trip distribution and assignment patterns. The TAZs within each development were flagged (selected) for the analysis. Traffic assignment was performed in the model for the AM2, PM2, and OP3 time periods, for both personal and commercial vehicles. These three time periods represent the busiest travel times during the AM and PM peak periods and the off-peak periods, respectively. Results from each of the time periods were factored to represent the full 24-hour period.

In analyzing the results, vehicle trips with a trip end in the development areas that utilize an I-25 on- or off-ramp along the I-25 Central project area were tabulated and identified as one of the following:

- Entering I-25 NB from the zone
- Entering I-25 SB from the zone
- Exiting I-25 SB destined for the zone
- Exiting I-25 NB destined for the zone

Additionally, trips that cross I-25 to/from a given development area were also tabulated. These trips may travel directly across I-25 or may travel along I-25 before exiting to cross to the other side of I-25 to/from the development.

The results from the select zone analysis were converted to percentages of trips. These trip distribution percentages were then applied to the CCD development trip generation to provide an estimate of trips utilizing or crossing I-25.

4. Results

Table 3 illustrates the vehicle trip generation and distribution results due to the CCD projections of the development areas in year 2040. Specifically, the additional vehicle trip activity over and above the original DRCOG Focus model is presented in the table.

Table 3: CCD Development Additional Vehicle Trips Generated

Development Area	Additional Vehicle Trips vs DRCOG Model	Additional Vehicle Trips Utilizing I-25	Additional Vehicle Trips Crossing I-25
41st & Fox	10,390	4,010	5,675
Broadway Station	68,265	25,520	34,400
D4	32,445	11,115	9,940
RINO	58,390	7,300	2,095
River Mile	101,675	49,540	24,070
Stadium District	34,255	11,640	7,650
Sun Valley	15,690	6,510	2,115

Source: HDR, 2018

The final total estimates for vehicle trips entering, exiting, and crossing I-25 to/from the development areas are illustrated in Figure 2 through Figure 8. The figures include the estimated trips from the 2040 Focus model, the additional trips projected from the CCD socioeconomic estimates, and the final total (DRCOG plus CCD vehicle trips). The figures convey the vehicle trip activity inbound and outbound from each development area, by direction to/from I-25. The vehicle trips crossing I-25 from each development area are also depicted.

Figure 2: 41st & Fox Area Vehicle Trip Distribution Estimates

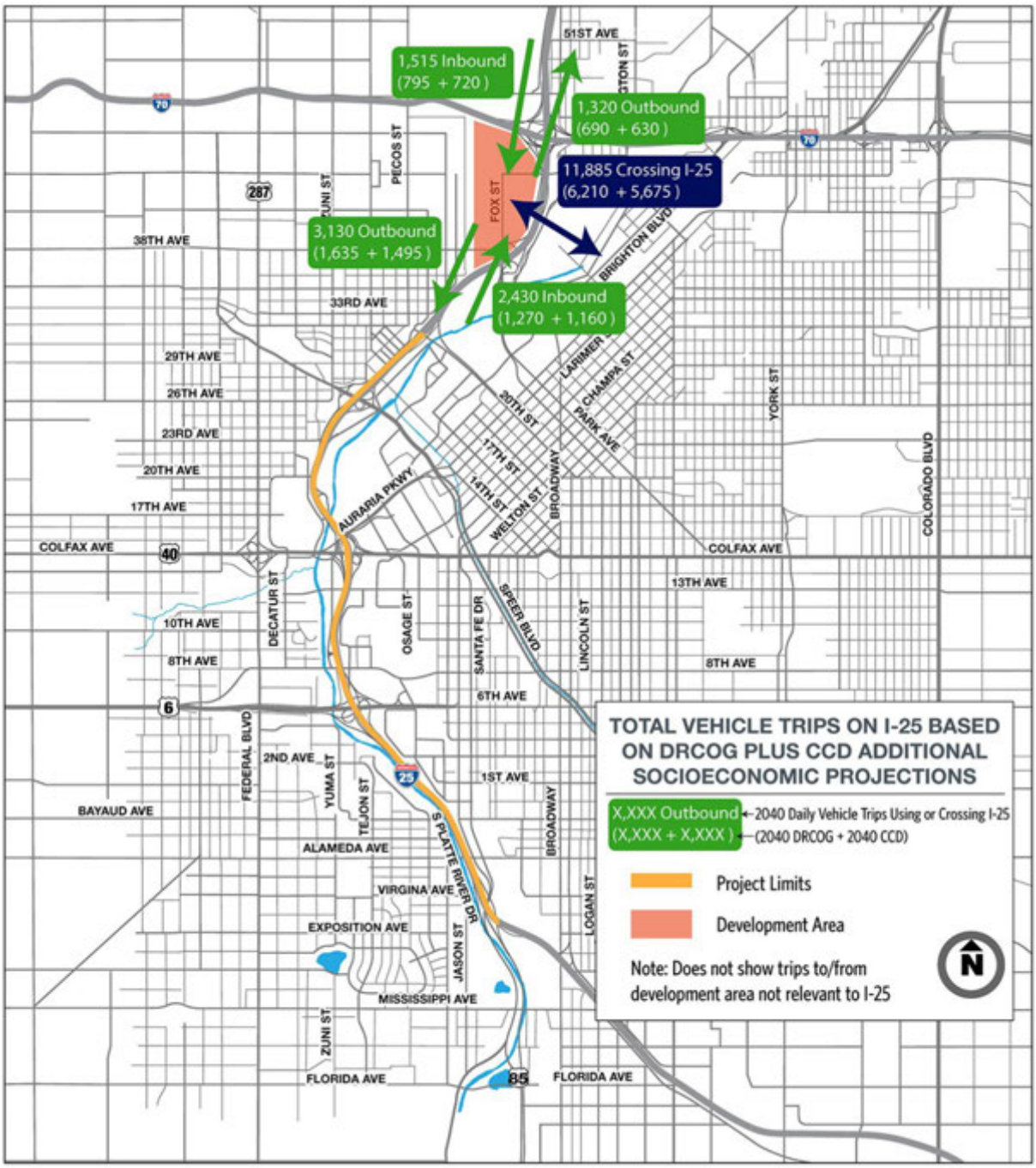


Figure 3: Broadway Station Area Vehicle Trip Distribution Estimates

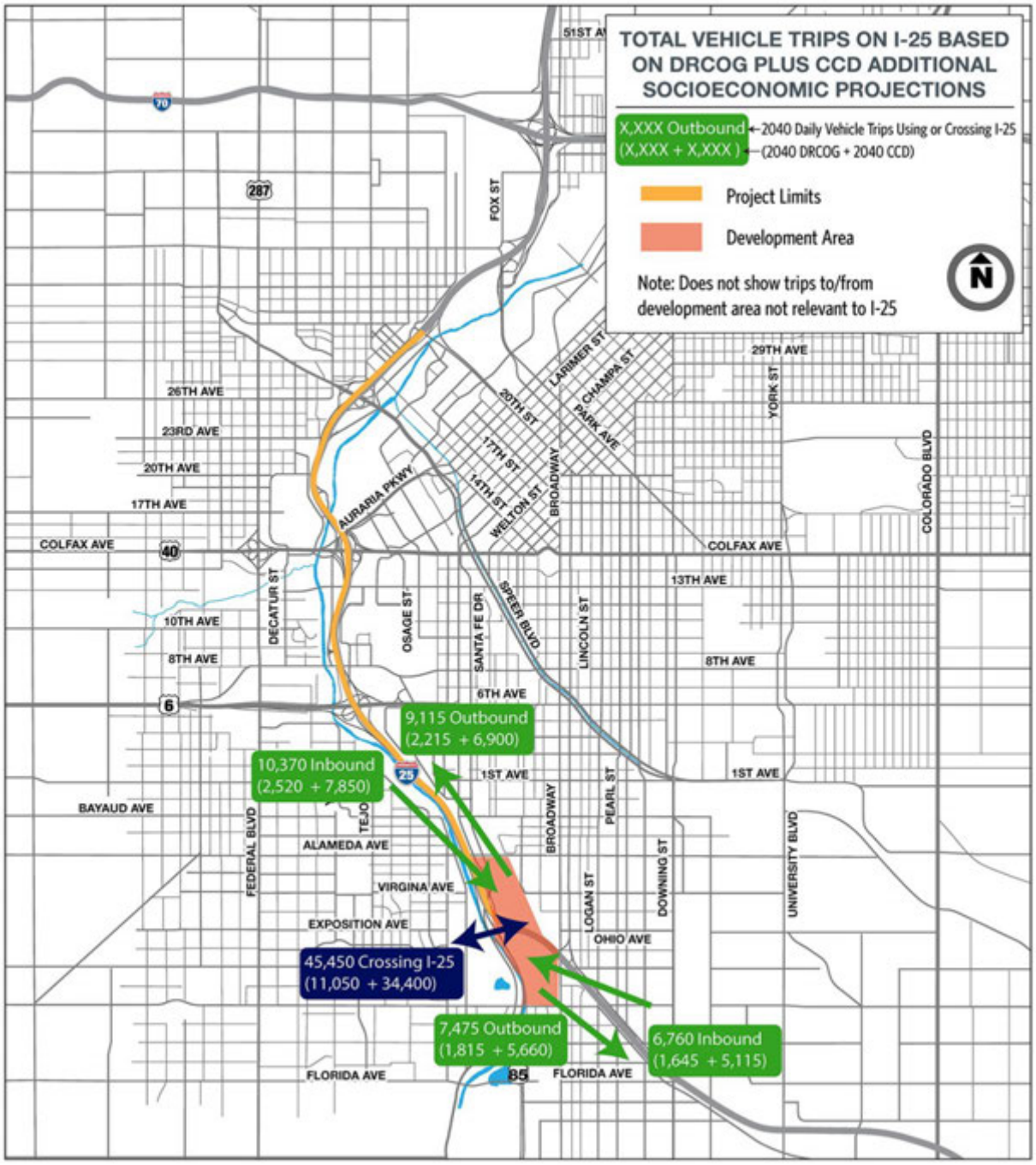


Figure 4: D4 Area Vehicle Trip Distribution Estimates

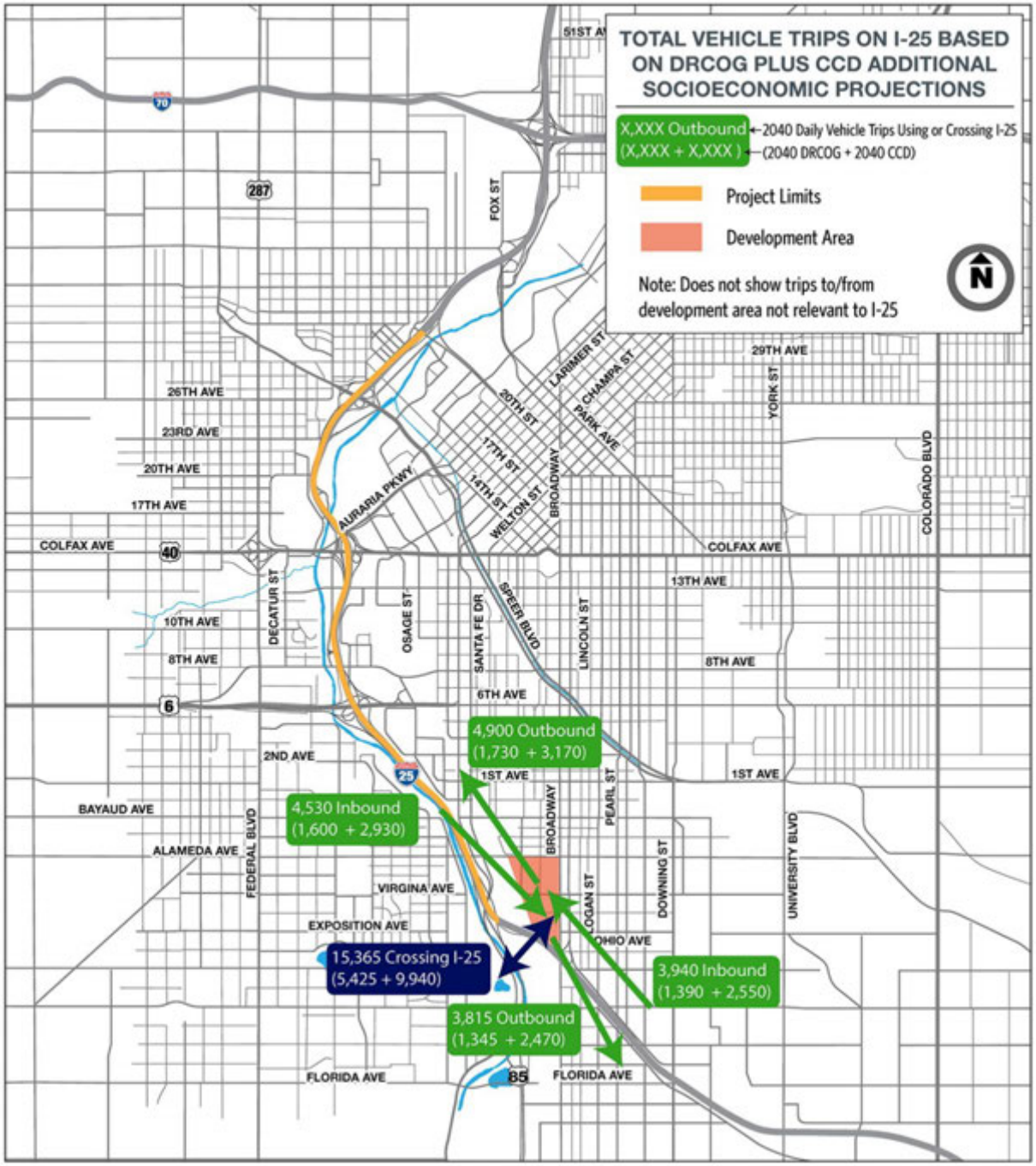


Figure 5: RINO Area Vehicle Trip Distribution Estimates

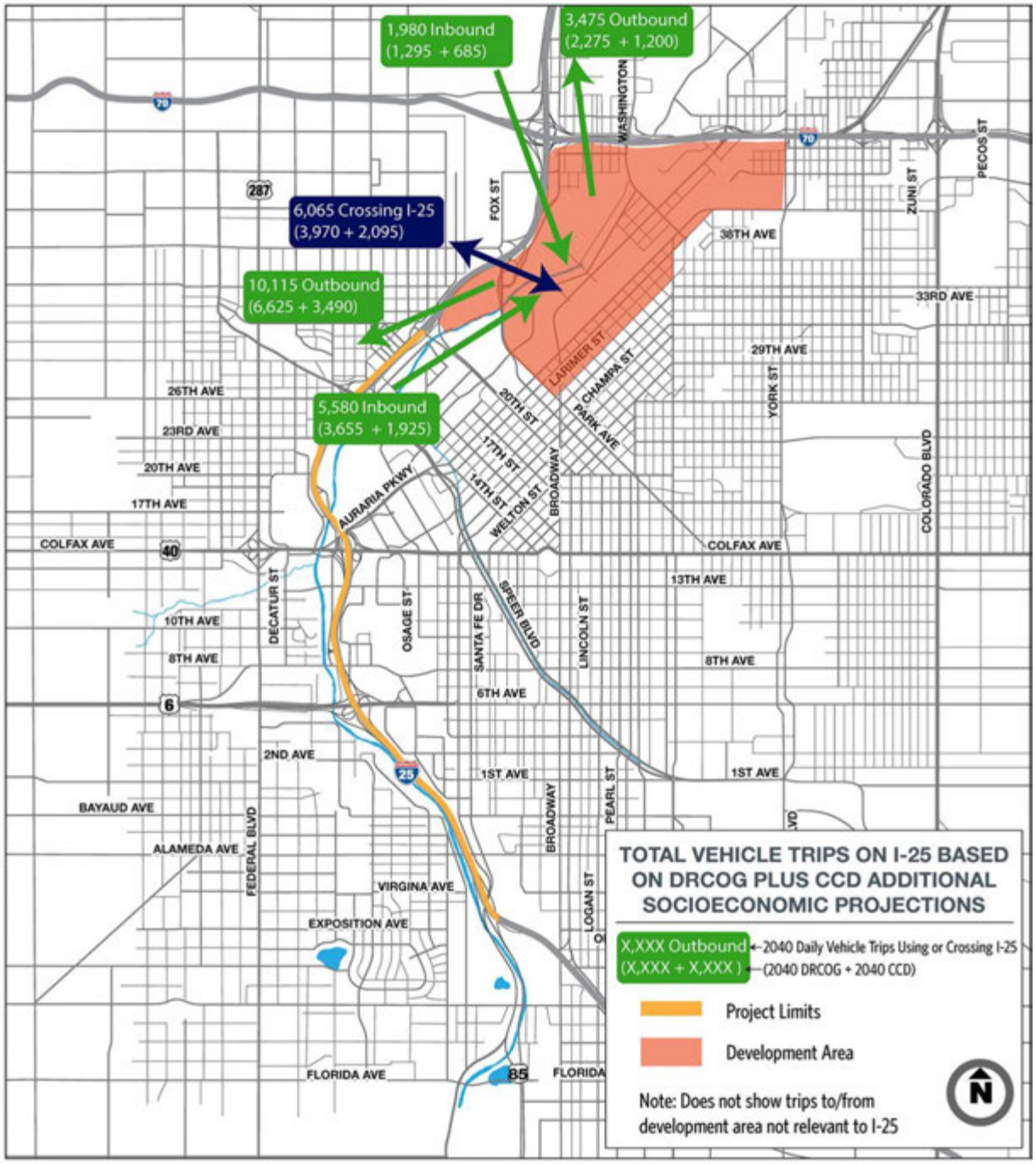


Figure 6: River Mile Area Vehicle Trip Distribution Estimates

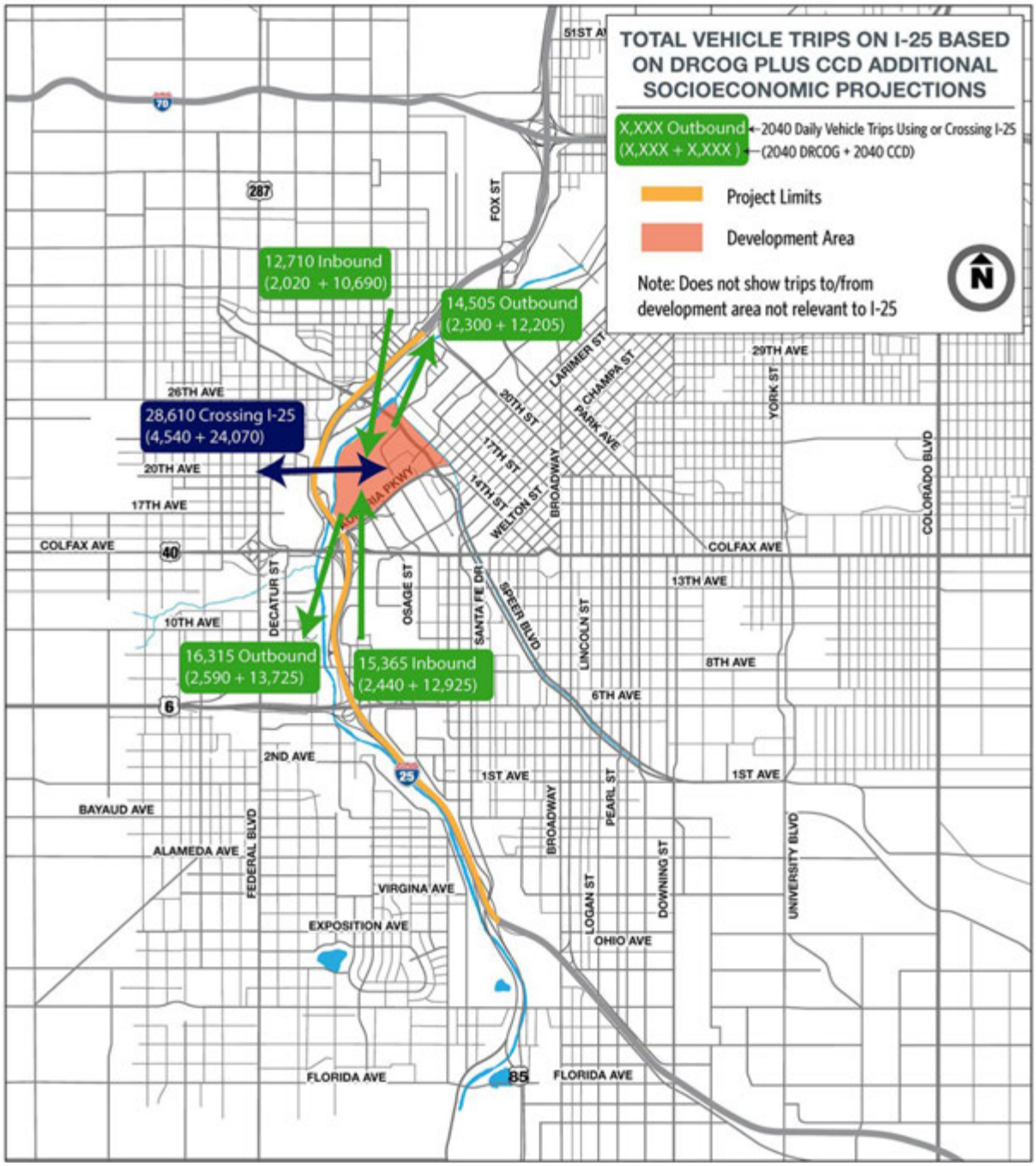


Figure 7: Stadium District Vehicle Trip Distribution Estimates

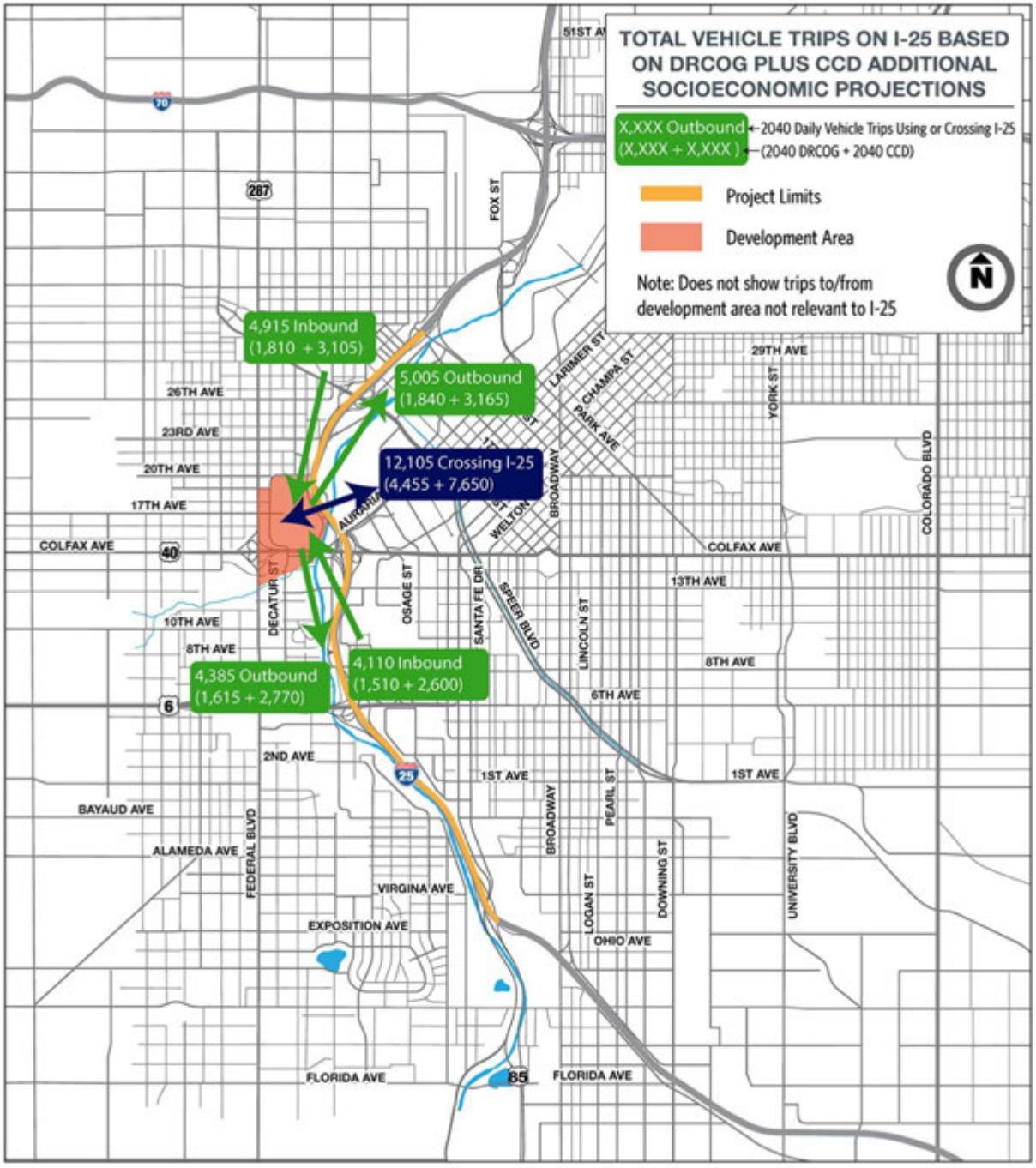
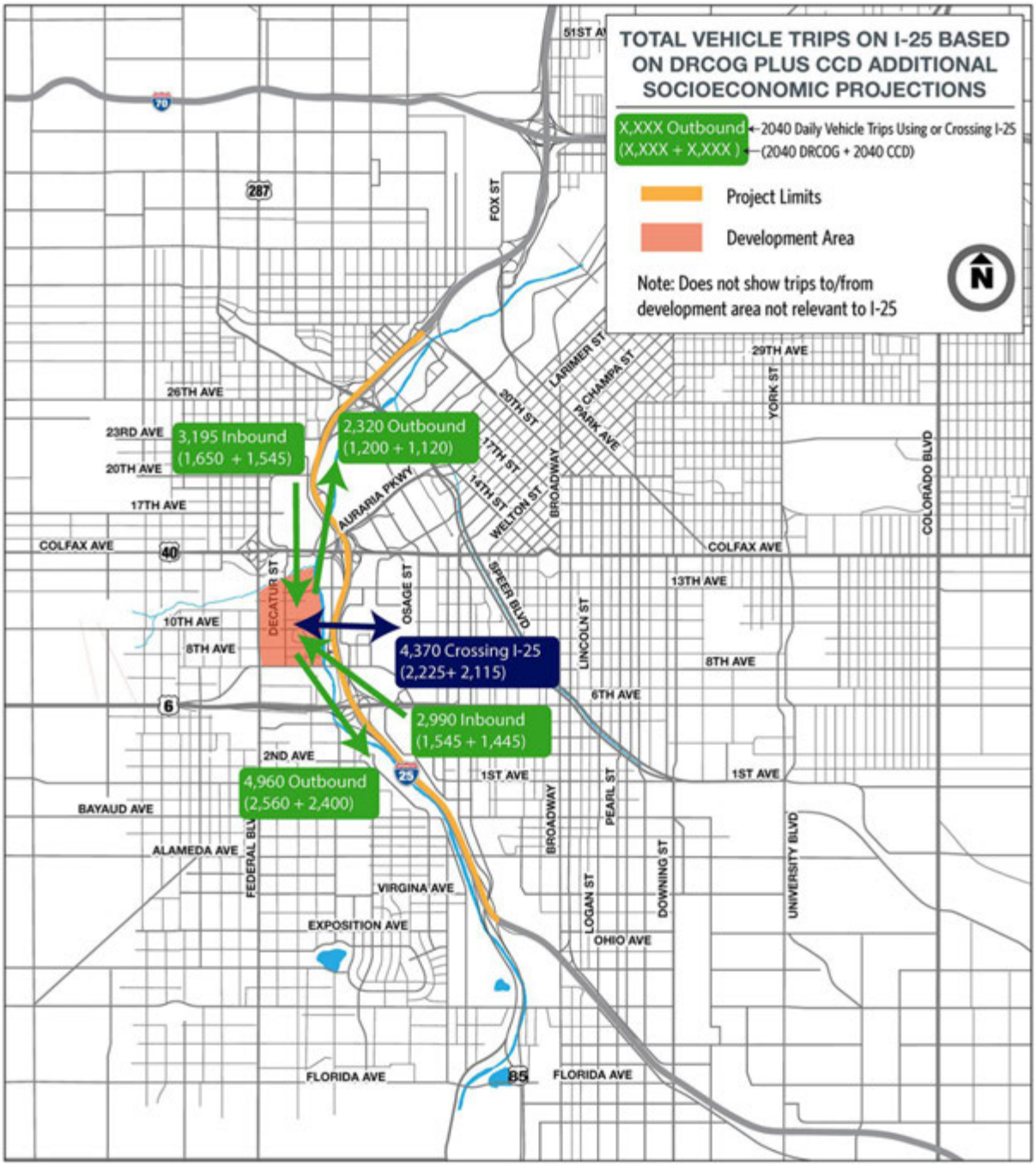


Figure 8: Sun Valley Area Vehicle Trip Distribution Estimates



The CCD projections typically double or triple the original amount of DRCOG 2040 model vehicle trips emanating from the development areas, although it varies by site. The greatest variation is the River Mile development, where the number of vehicle trips is six times the original DRCOG projections. Land use distribution and densities are the critical driver for the trip generation and distribution within the DRCOG model. The travel forecasts developed from the model should be considered as a single point within a much broader potential range as future development location and intensity is uncertain in the future. Though detailed traffic analysis of the alternatives with these additional traffic volumes will not be performed, the results from this sensitivity analysis will be used as a reference during the development of alternatives and evaluation process.

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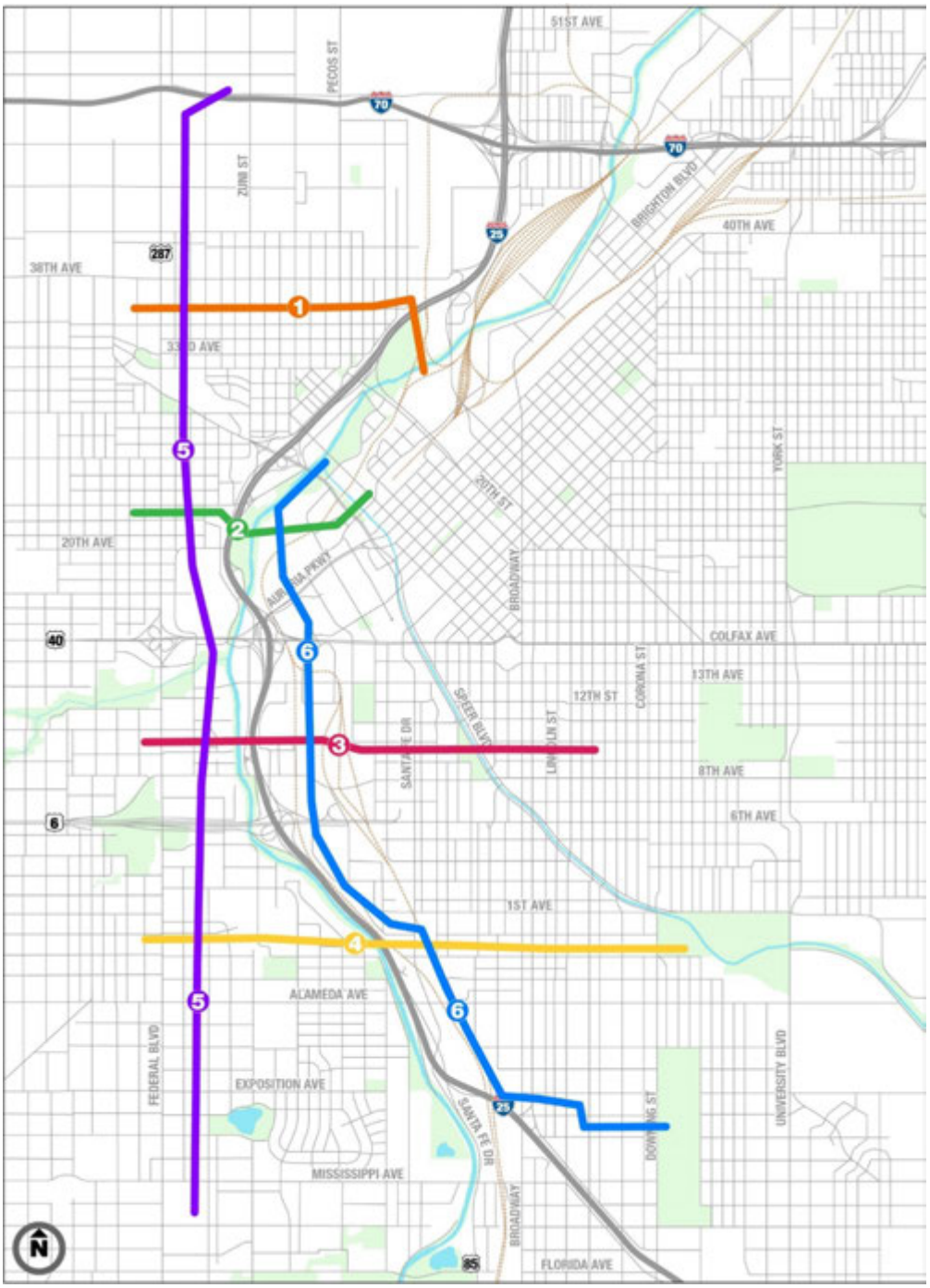
Appendix E
Detailed Screenline Volumes

1. Introduction

This appendix documents the screenline volumes on I-25 Central within the traffic analysis area. Volumes are reported for major facilities crossing any of the six identified screenlines, shown in Figure 1. For clarity, the comparison of the Existing Conditions scenario to the 2030 No Action Alternative is presented first. After this discussion, the comparison of the 2030 No Action Alternative to the build alternatives is presented.

Figure 1: I-25 Central Screenlines

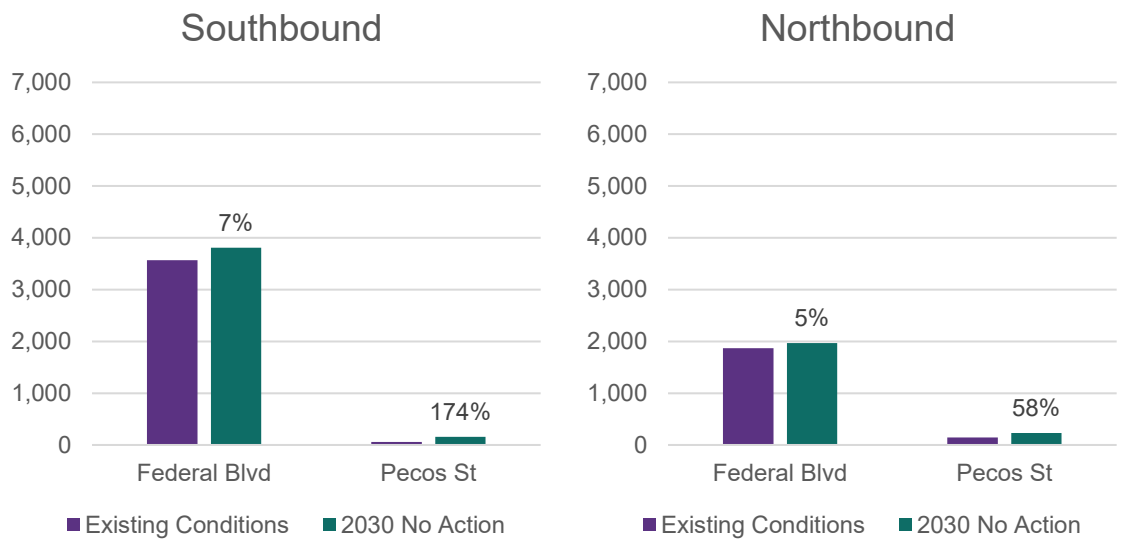


1.1. Existing Conditions Scenario Compared to 2030 No Action Alternative AM Peak Period Screenline Volumes

During the AM peak period (6:00 a.m. – 9:00 a.m.), volumes on the local roadways are anticipated generally to increase between the Existing Conditions scenario and the 2030 No Action Alternative. This increase is most notable in the areas closest to downtown Denver and for roadway facilities that are closer to I-25.

At Screenline 1, volumes on Federal Boulevard and Pecos Street are expected to increase a moderate amount as compared to the existing conditions, which would be in line with expected overall travel demand growth. Figure 2 summarizes the volumes at this screenline.

Figure 2: Screenline 1: Between 35th Avenue and 38th Avenue—AM Peak Period

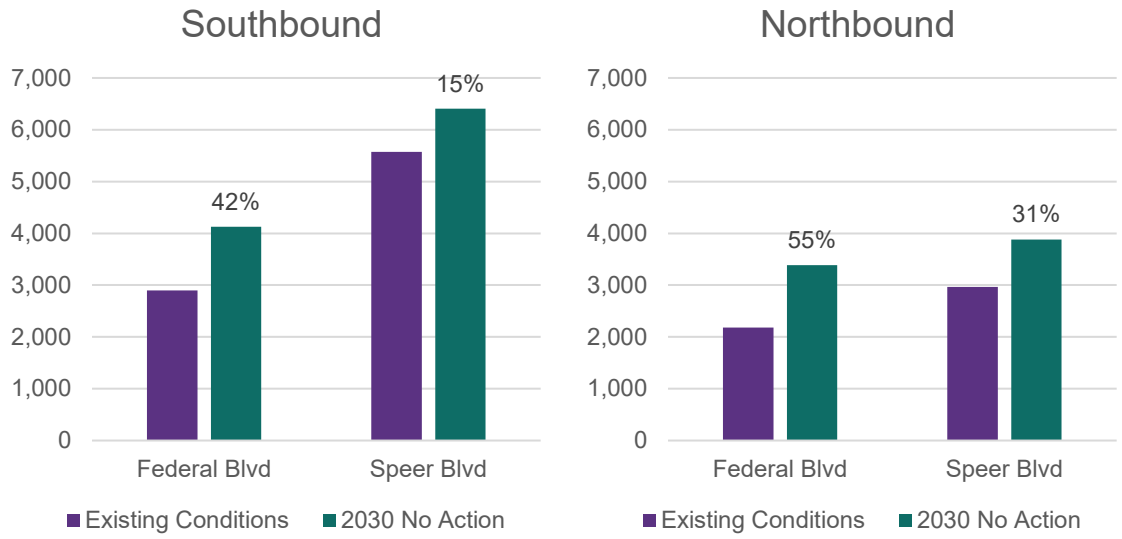


Percentages shown represent the percent difference from the Existing Conditions.

At Screenline 2, volumes on Federal Boulevard and Speer Boulevard are anticipated to increase between 15 percent and 55 percent. The largest increase is expected on Federal Boulevard in both the northbound and southbound directions. This increase is being caused not only by the natural growth in traffic due to population and employment changes, but also in response to increasing congestion on I-25. As discussed previously, the most severe congestion on I-25 Central in the 2030 No Action Alternative is expected to occur between approximately 23rd Avenue and US 6/6th Avenue. Because of this, many drivers begin to use alternate routes to bypass this congestion.

In this area, the most convenient alternate route is Federal Boulevard. This congestion response is especially true for drivers who were using I-25 for short trips—those entering southbound I-25 at 20th Street, Speer Boulevard, or 23rd Avenue and exiting at Colfax Avenue, 8th Avenue, or US 6/6th Avenue. For these drivers, growing congestion on I-25 results in them simply using the local roadway network to get between their origin and destination without ever getting onto I-25. Figure 3 summarizes the volumes at this screenline.

Figure 3: Screenline 2: Between 22nd Avenue and 23rd Avenue—AM Peak Period



Percentages shown represent the percent difference from the Existing Conditions.

At Screenline 3, volumes on local roadway facilities generally increase proportionately to the increasing congestion on I-25. Exceptions to this are southbound on Kalamath Street and northbound on Lincoln Street.

Volumes on Kalamath Street at this location are expected to decrease between the Existing Conditions scenario and the 2030 No Action Alternative due to signal timing changes at the Kalamath Street and Alameda Avenue intersections and as a result of larger shifts in origin/destination patterns.

One reason for decreasing volumes on Kalamath Street is the changing origin/destination patterns. This shift in patterns is reflective of high growth in the area generally bounded by Lincoln Street, Mississippi Avenue, Kalamath Street, and 8th Avenue. During the AM peak period, this area experiences the largest internal travel demand growth south of Colfax Avenue. Because of this growth, the local roadway network will become more congested. In the existing conditions, a notable portion of traffic traveling southbound in this area is coming from the downtown area north of 8th Avenue and heading toward southbound I-25, southbound Santa Fe Drive/US 85, and southbound Federal Boulevard. Because of increasing local roadway congestion south of 8th Avenue, these drivers change routes and instead of traveling directly south to reach these other facilities—using Kalamath Street or Broadway to cut east on US 6/6th Avenue or Alameda Avenue—they travel east, then south—using Speer Boulevard, Colfax Avenue, or Auraria Parkway to cut south on Federal Boulevard or I-25.

Further influencing route choice, the intersection between Alameda Avenue and Santa Fe Drive/Kalamath Street was one of the areas where the largest changes to signal timings were required to reasonably accommodate additional travel demand. In the existing conditions, one of the largest movements at this intersection is the northbound left-turn from Santa Fe Drive/ US 85 to westbound Alameda Avenue. Volumes for this movement increase in the 2030 No Action Alternative. In the current signal timing configuration, vehicles make this left turn and then stop immediately at the Alameda Avenue and Kalamath Street signal. This causes the northbound left-turning vehicles to queue on westbound Alameda Avenue between the Kalamath Street and Santa Fe Drive/US 85 signals. Due to increasing volumes in the 2030 No Action Alternative, this queue exceeds the storage capacity of this

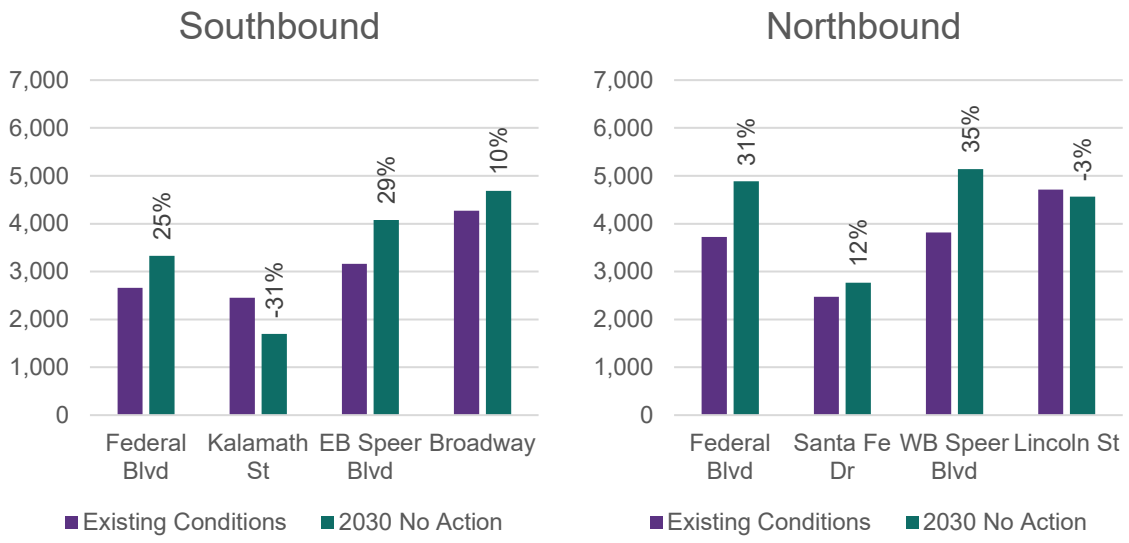
space and results in a large spillback queue forming on northbound Santa Fe Drive/US 85. Before signal timing adjustments were made, this queue regularly spilled back to I-25 and blocked the northbound I-25 off-ramp to Santa Fe Drive/US 85. This queue then would block I-25 and result in the model grid-locking.

To avoid this condition from forming, an overlap period was added to the Alameda Avenue and Kalamath Street signal to allow, for a short time, the northbound left-turning vehicles from Santa Fe Drive/US 85 to pass through the Alameda Avenue and Kalamath Street signal without stopping. This change allows the space between the southbound I-25 and Alameda Avenue ramp terminal signal and the Alameda Avenue and Kalamath Street signal to be used as additional storage space. This minimizes the spillback queues on northbound Santa Fe Drive/US 85 at Alameda Avenue and prevents them from blocking I-25. However, because all cycle lengths were held the same, this additional overlap phase was created by taking green time away from the southbound Kalamath Street movement. This resulted in some new/ additional queueing forming on Kalamath Street at Alameda Avenue. Although the new/ extended queues on Kalamath Street did not spill back to notably affect other roadways, the additional delay incurred resulted in some drivers choosing to take a different route. In most cases, this resulted in drivers using westbound US 6/6th Avenue to southbound I-25.

The impacts of the combined origin/destination and traffic signal timing changes are observable in Screenlines 3, 4, and 6 during both the AM and PM peak periods.

In addition to Kalamath Street, volumes on Lincoln Street also are expected to decrease slightly. This is because Lincoln Street is already at capacity in the existing conditions. This facility cannot process any more vehicles. Figure 4 summarizes the volumes at this screenline.

Figure 4: Screenline 3: Between 9th Avenue and 10th Avenue—AM Peak Period

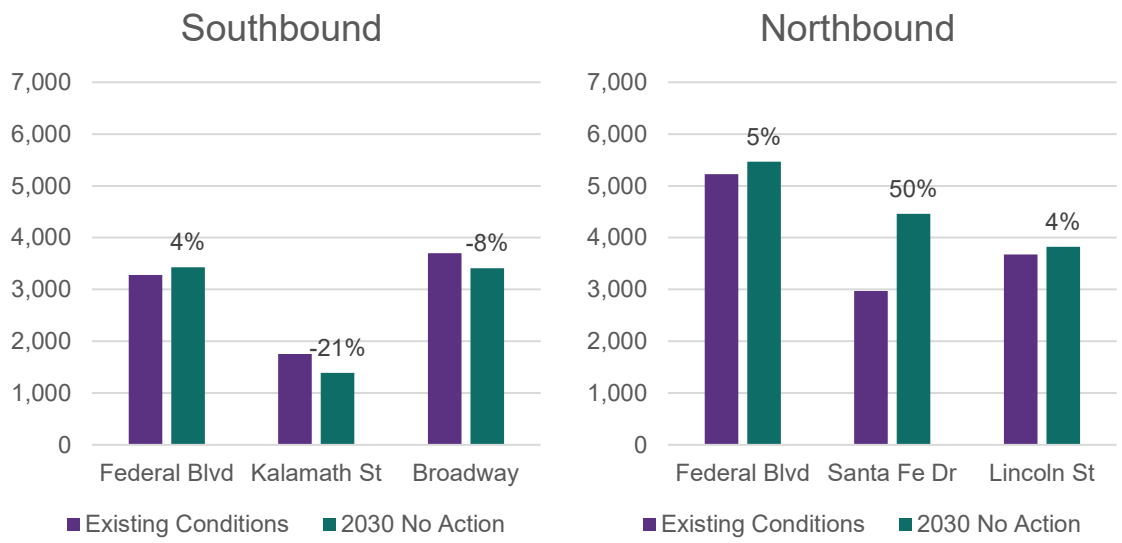


Percentages shown represent the percent difference from the Existing Conditions.

The most notable change in volume at Screenline 4 is expected to occur on northbound Santa Fe Drive/US 85. Volumes on this facility are expected to increase as a result of increasing congestion on I-25. At this location, Santa Fe Drive/US 85 provides the best alternate route to I-25—especially given the fact that Lincoln Street is already at capacity. Figure 5 summarizes the volumes at this screenline.

The only other facility that is expected to experience a meaningful change in volumes is Kalamath Street. As documented in the Screenline 3 discussion, this volume reduction is due to the combination of shifting origin/destination patterns and traffic signal timing adjustments.

Figure 5: Screenline 4: Between Cedar Avenue and Irvington Place—AM Peak Period

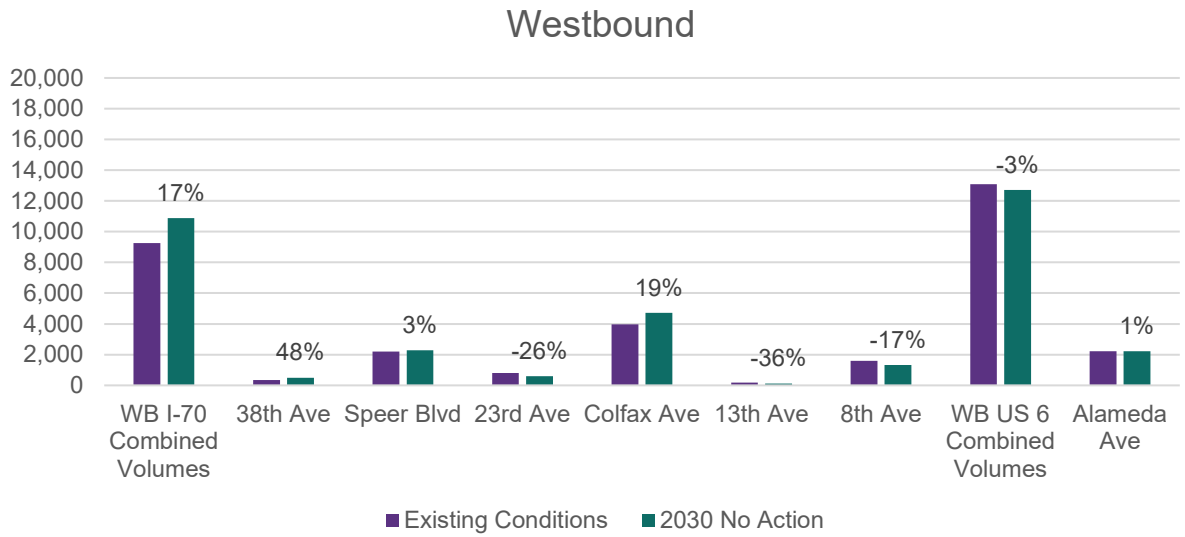


Percentages shown represent the percent difference from the Existing Conditions.

Traveling westbound at Screenline 5, the largest volume increases occur at Colfax Avenue and I-70. The increase at Colfax Avenue is likely a result of increasing congestion on southbound I-25 between Colfax Avenue and US 6/6th Avenue. Because of this increasing congestion, more drivers going westbound on Colfax Avenue headed toward westbound US 6/6th Avenue will likely choose to avoid I-25 and continue on westbound Colfax Avenue to southbound Federal Boulevard to access westbound US 6/6th Avenue. This route avoids the increasing congestion on southbound I-25, as well as the congestion on US 6/6th Avenue at the I-25 and US 6/6th Avenue Interchange.

The volume increase on westbound I-70 is likely a combination of population and employment growth on the west side of the Denver metropolitan region, as well as the effects of the changes from the Central 70 project. The Central 70 improvements to I-70 between I-25 and approximately Chambers Road will relieve the existing bottleneck on I-70 to the east of I-25 and allow more vehicles to pass over Screenline 5. Figure 6 summarizes the westbound volumes at Screenline 5.

Figure 6: Screenline 5: Westbound between Federal Boulevard and I-25—AM Peak Period

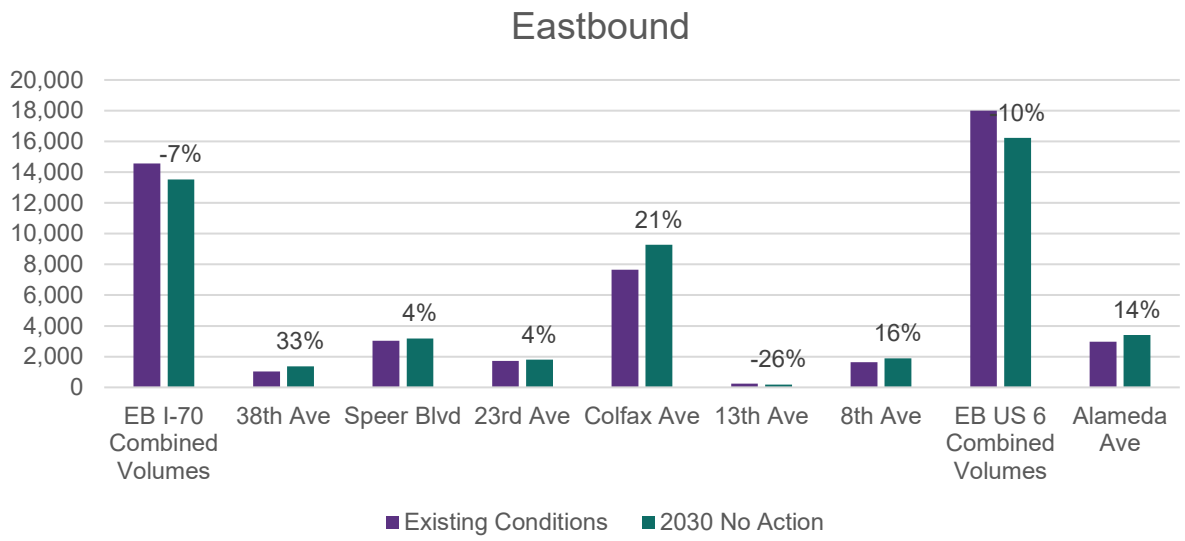


Percentages shown represent the percent difference from the Existing Conditions.

The most notable increase in eastbound volumes at Screenline 5 is at Colfax Avenue. Volumes at this location are expected to increase approximately 20 percent between the Existing Conditions scenario and the 2030 No Action Alternative. This increase is a result of drivers avoiding I-25 by using Federal Boulevard to travel north/south and then using Colfax Avenue to access downtown.

The volume decreases on eastbound I-70 and eastbound US 6/6th Avenue are a result of increasing congestion on these facilities. Because of this congestion, extensive queueing is expected on these facilities, with queues forming at I-25 and extending past Federal Boulevard. This congestion reduces the number of vehicles that these facilities can process during the peak period. It is important to note that Federal Boulevard represents the edge of the microsimulation traffic analysis area. Queues on these facilities extended beyond the edge of the modeling area but were not able to be fully captured due to the geographic limits. Figure 7 summarizes the eastbound volumes at Screenline 5.

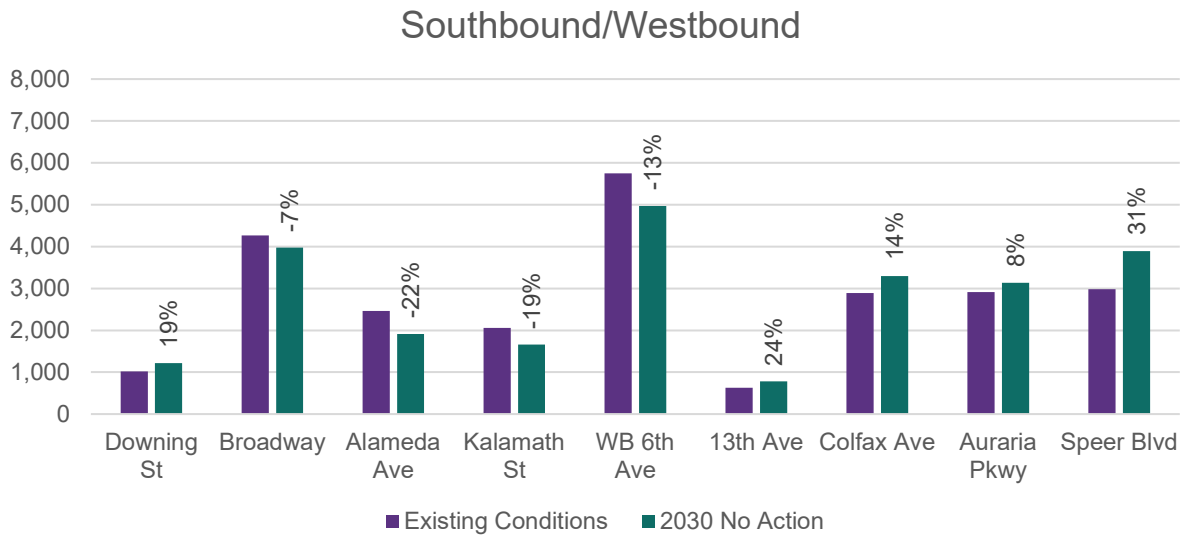
Figure 7: Screenline 5: Eastbound between Federal Boulevard and I-25—AM Peak Period



Percentages shown represent the percent difference from the Existing Conditions.

Westbound/southbound travel across Screenline 6 captures the general flow of traffic out of the downtown area toward the west and southwest part of the Denver metropolitan area. Changing volumes across this screenline generally show fewer trips crossing to the south—on Broadway, Kalamath Street, Alameda Avenue, and US 6/6th Avenue—and more trips crossing in the northern part of the traffic analysis area—around 13th Avenue, Colfax Avenue, Auraria Parkway, and Speer Boulevard. As documented in the Screenline 3 discussion, this change is a result of shifting origin/destination patterns in the area. Figure 8 summarizes the southbound/westbound volume changes at Screenline 6.

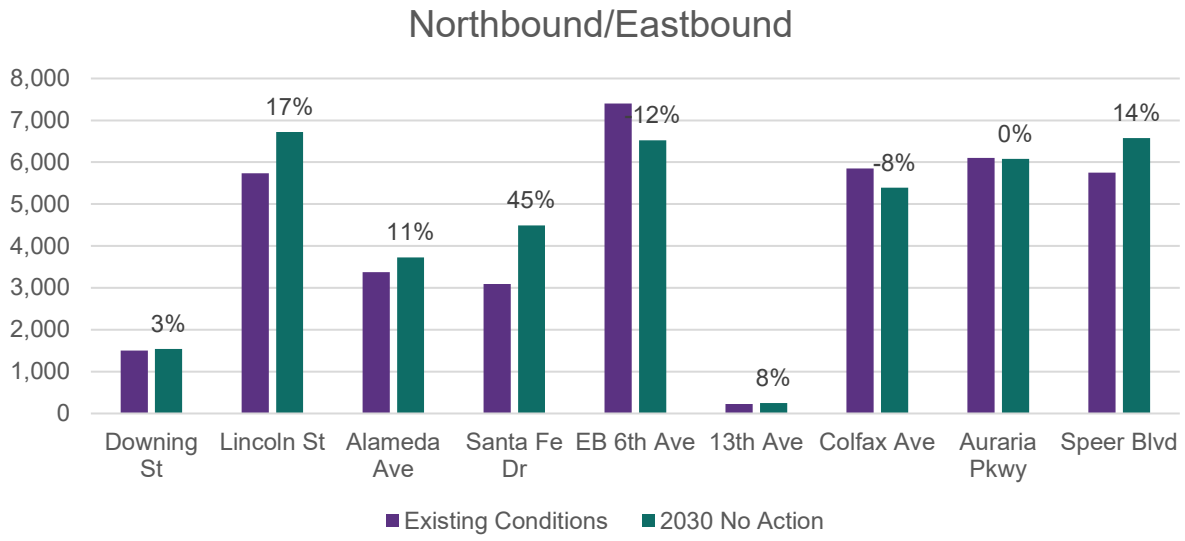
Figure 8: Screenline 6: Southbound/Westbound between I-25 and Downtown—AM Peak Period



Percentages shown represent the percent difference from the Existing Conditions.

Traveling toward the downtown area, volumes on local roadways are expected to increase. This mirrors increasing congestion on I-25 and increasing travel demand. The only exceptions to this trend are eastbound US 6/6th Avenue and eastbound Colfax Avenue. Volumes on these roadways decrease due to extensive queueing on these facilities. These queues spill back across the screenline and result in fewer vehicles being processed. Figure 9 summarizes the volumes at this screenline.

Figure 9: Screenline 6: Northbound/Eastbound between I-25 and Downtown—AM Peak Period

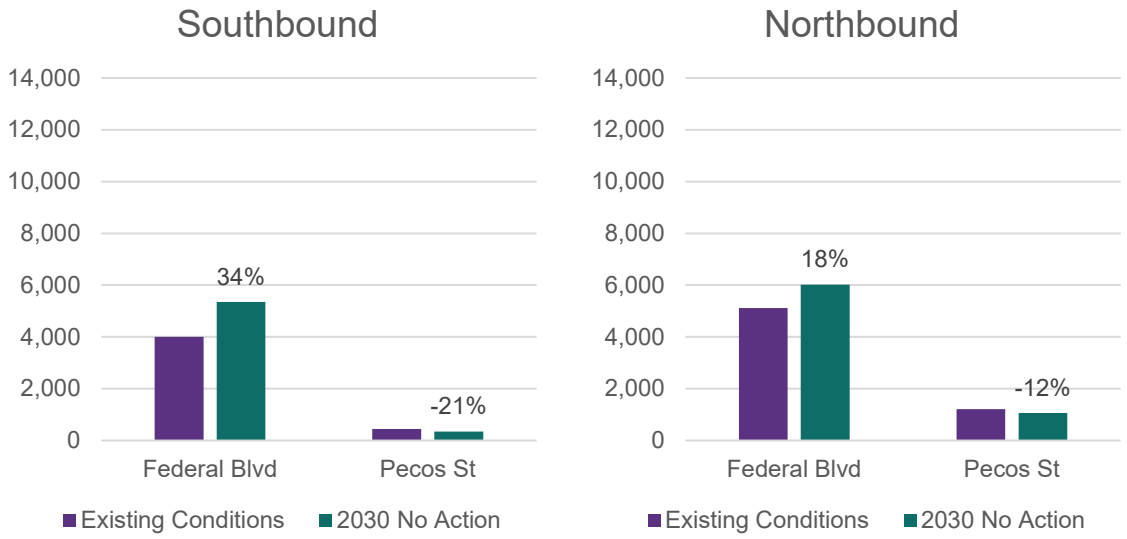


Percentages shown represent the percent difference from the Existing Conditions.

1.2. Existing Conditions Scenario Compared to 2030 No Action Alternative, PM Peak Period Screenline Volumes

Local roadway volumes during the PM peak period (2:00 p.m. to 7:00 p.m.) are expected to increase in a similar response as in the AM peak period. At Screenline 1, this results in volumes increasing on Federal Boulevard. This increase is the result of both increasing population growth in the area around Federal Boulevard, as well as some drivers choosing to use Federal Boulevard to access I-70 to avoid congestion on I-25. Volumes on Pecos Street are expected to decrease; however, this is a low-volume road that is subject to more natural variations within the traffic model; therefore, this change in volumes is not considered to be significant. Figure 10 summarizes the expected volume changes at this screenline.

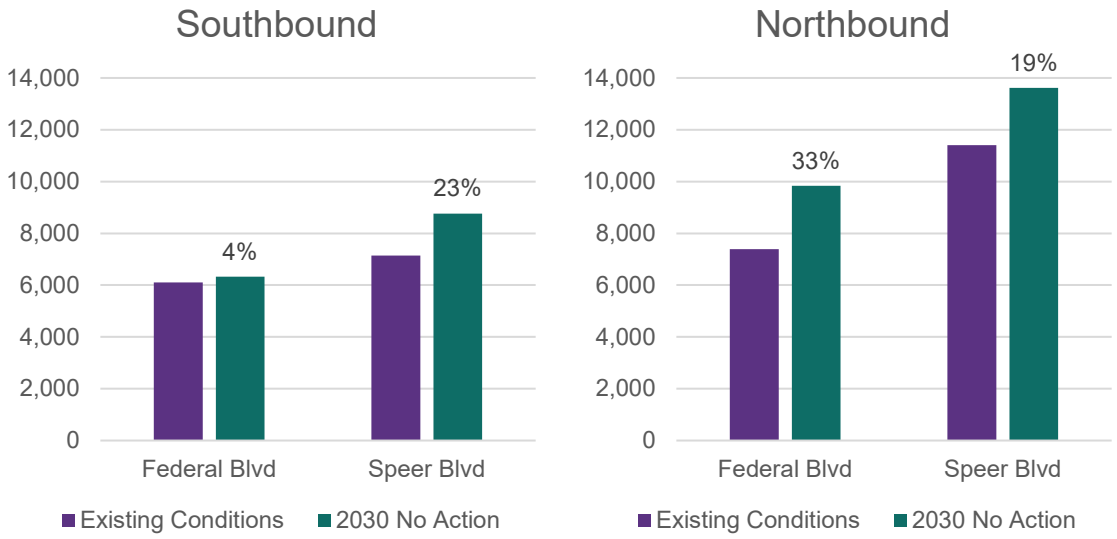
Figure 10: Screenline 1: Between 35th Avenue and 38th Avenue—PM Peak Period



Percentages shown represent the percent difference from the Existing Conditions.

Volumes at Screenline 2 are expected to increase in proportion to increasing congestion on I-25. The exception to this is southbound Federal Boulevard. At this location, volumes on southbound Federal Boulevard are anticipated to remain similar in the 2030 No Action Alternative as they are in the Existing Conditions scenario. This is because southbound I-25 traffic that wants to divert to Federal Boulevard as an alternate route must use 23rd Avenue. However, 23rd Avenue between I-25 and Federal Boulevard is already very congested in the Existing Conditions scenario. In the 2030 No Action Alternative, extensive queueing is observed on westbound 23rd Avenue beginning from Federal Boulevard and extending east to I-25. Although increasing congestion on I-25 encourages more drivers to use southbound Federal Boulevard as an alternate route, congestion on the routes connecting I-25 to Federal Boulevard prevent them from being able to do so. Figure 11 summarizes the volumes at this screenline.

Figure 11: Screenline 2: Between 22nd Avenue and 23rd Avenue—PM Peak Period

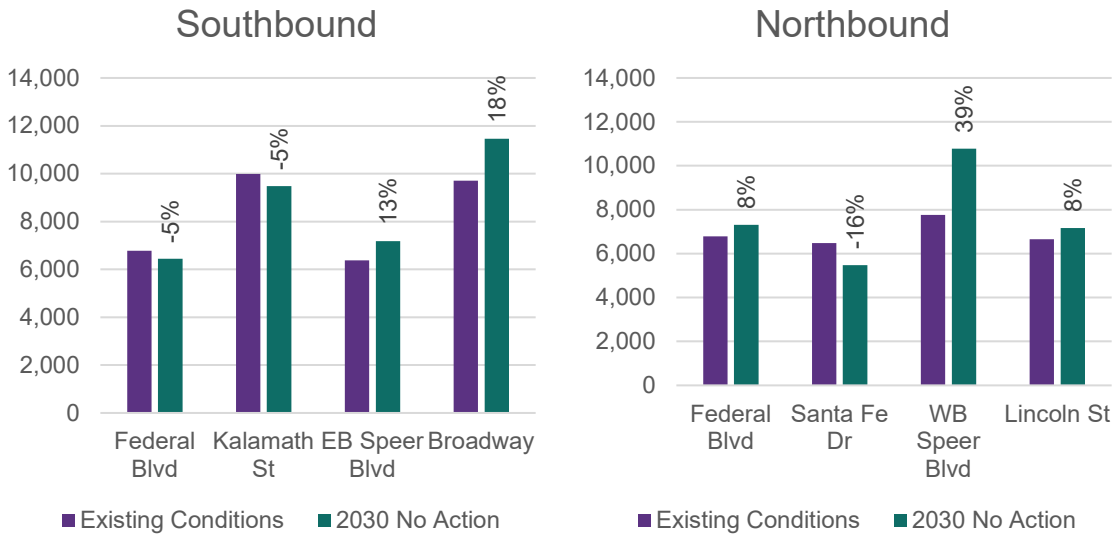


Percentages shown represent the percent difference from the Existing Conditions.

During the PM peak period, volumes at Screenline 3 are constrained due to extensive queueing and network congestion. This is why volumes on Federal Boulevard, Santa Fe Drive/US 85, Kalamath Street, and Lincoln Street all remain similar in the 2030 No Action Alternative as in the Existing Conditions scenario. On Federal Boulevard, capacity constraints at the US 6/6th Avenue and Federal Boulevard Interchange to the south limits the number of vehicles that can be processed on Federal Boulevard. Similar conditions exist on Santa Fe Drive/US 85 and Kalamath Street where they cross US 6/6th Avenue and 8th Avenue. Congestion in this area results in queueing on both Kalamath Street and Santa Fe Drive/US 85, which limits their ability to process more vehicles.

Facilities that are not as constrained by crossing traffic on US 6/6th Avenue and 8th Avenue experience larger increases in volumes. This includes Speer Boulevard and Broadway. For both of these facilities, the PM peak period signal timings favor progression on these facilities over signal progression on US 6/6th Avenue and 8th Avenue. This increases their capacity and allows them to better absorb increasing traffic demand in the 2030 No Action Alternative. Figure 12 summarizes the volume changes at this sceenline.

Figure 12: Screenline 3: Between 9th Avenue and 10th Avenue—PM Peak Period

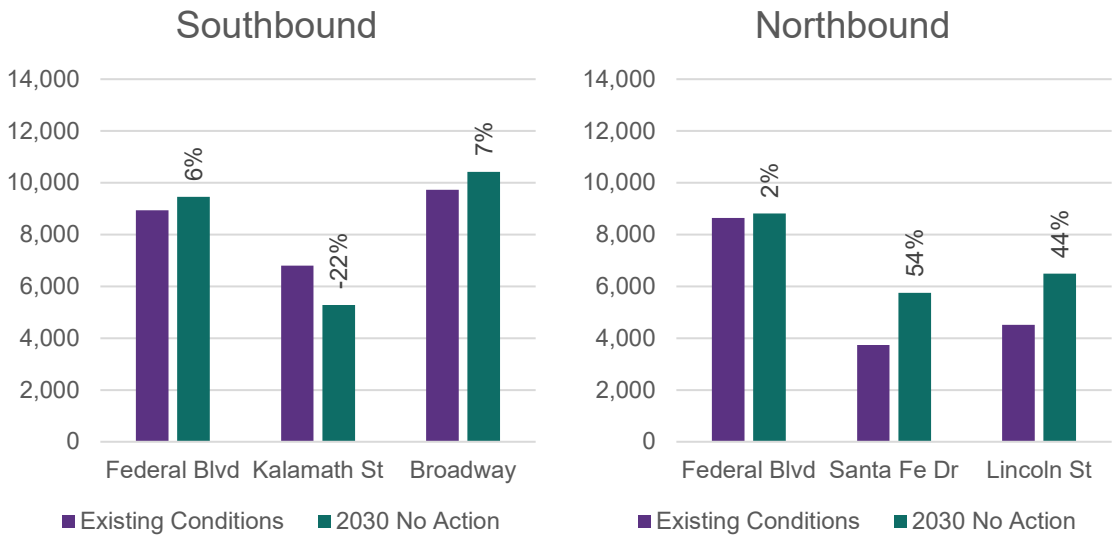


Percentages shown represent the percent difference from the Existing Conditions.

Similar to other screenlines, traffic across Screenline 4 is expected to increase in response to growing travel demand and congestion on I-25. The largest increases are expected on Santa Fe Drive/US 85 and Lincoln Street. Increasing volumes on these facilities is a result of increasing congestion on I-25. As I-25 continues to slow down, more drivers will choose to use Lincoln Street. However, because Lincoln Street does not have enough capacity to accommodate all of the excess demand, drivers then begin to choose Santa Fe Drive/US 85.

The only facility that has a decrease in volumes is Kalamath Street. This is due to the same shifting origin/destination patterns and modified signal timings as discussed for the AM Screenline 3 results. Figure 13 summarizes the volumes at this screenline.

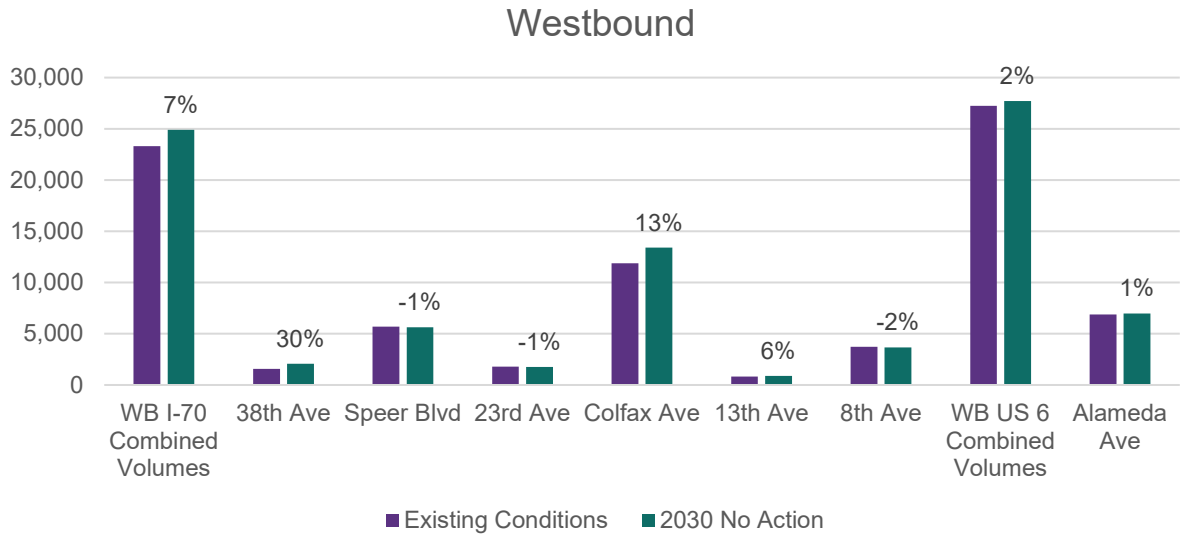
Figure 13: Screenline 4: Between Cedar Avenue and Irvington Place—PM Peak Period



Percentages shown represent the percent difference from the Existing Conditions.

Westbound volumes across Screenline 5 are expected to remain relatively similar between the Existing Conditions scenario and the 2030 No Action Alternative. In a few cases—such as on I-70, 38th Avenue, and Colfax Avenue—volumes are expected to increase in response to increasing travel demand; however, because many of these facilities are already at capacity, their volumes do not increase because they are unable to process additional vehicles. Figure 14 summarizes the volumes across this screenline.

Figure 14: Screenline 5: Westbound between Federal Boulevard and I-25—PM Peak Period



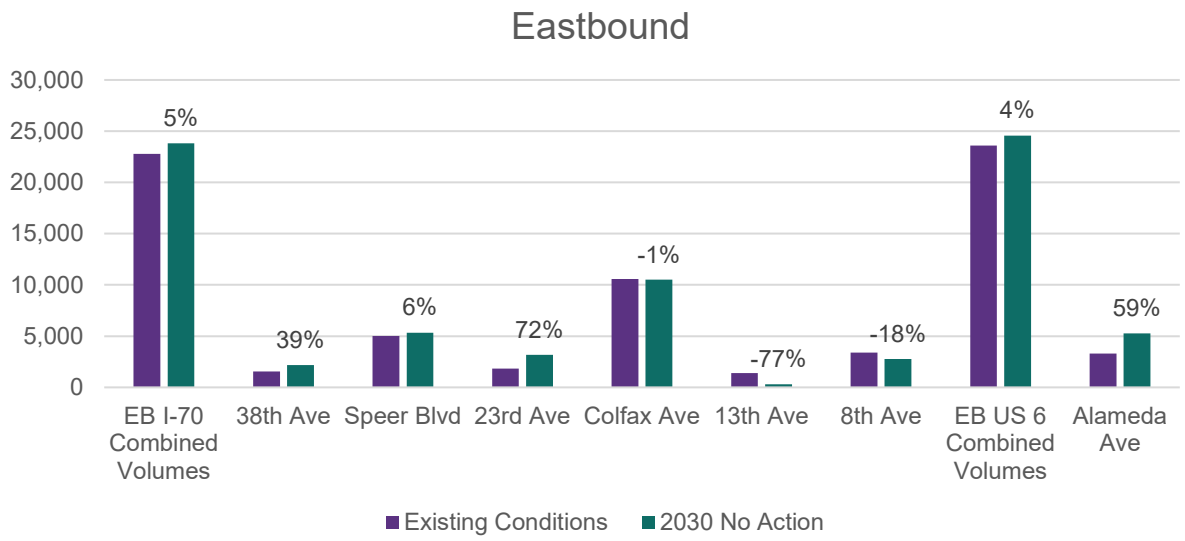
Percentages shown represent the percent difference from the Existing Conditions.

The most notable changes in eastbound volumes across Screenline 5 occur at 23rd Avenue and Alameda Avenue. Eastbound volumes increase on 23rd Avenue as a result of increasing congestion on northbound I-25. Because of this congestion, more drivers choose to use northbound Federal Boulevard to avoid traffic, then cut across on 23rd Avenue to enter the freeway.

Volumes on Alameda Avenue increase as a result of both changing origin/destination patterns and increasing congestion on US 6/6th Avenue. The increase in origins and destination along the South Broadway corridor—previously discussed in the AM Screenline 3 results—contribute to more trips crossing Alameda Avenue, which provides one of only a few east/west connections between these new origins/destinations and origins/destinations to the east.

These changing origin/destination patterns are exacerbated by the increasing congestion on US 6/6th Avenue. In the Existing Conditions scenario, drivers going northbound on Federal Boulevard often use US 6/6th Avenue to travel east. However, in the 2030 No Action Alternative, extensive queueing will exist on eastbound US 6/6th Avenue during the PM peak period between Federal Boulevard and Speer Boulevard. Because of this, some drivers choose to use Alameda Avenue as an alternate route to US 6/6th Avenue. Both of these factors contribute to an increasing volume at Alameda Avenue across Screenline 5. Figure 15 summarizes the eastbound volumes across this screenline.

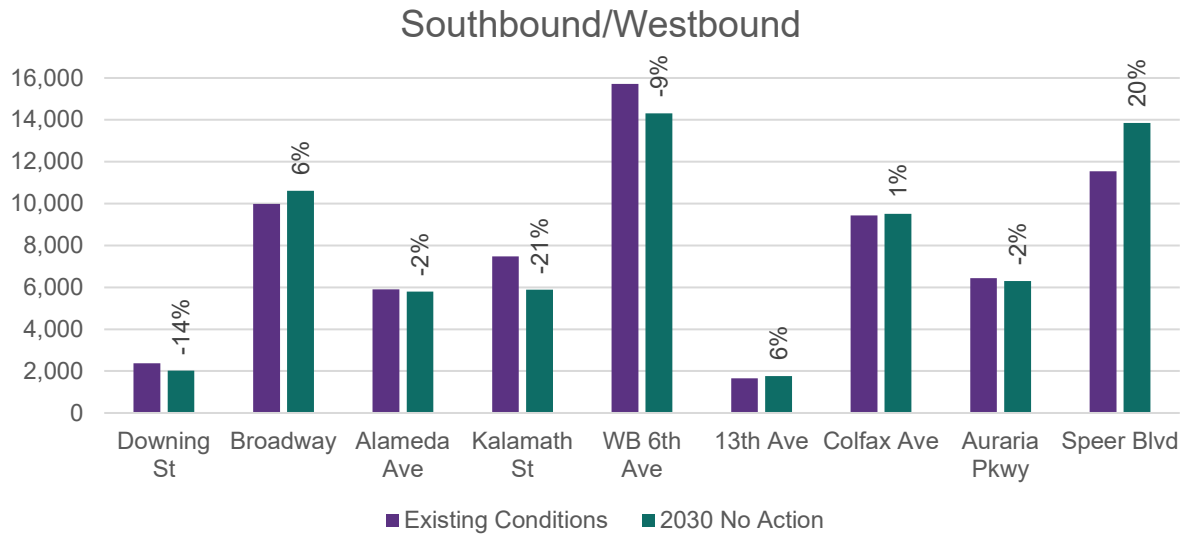
Figure 15: Screenline 5: Eastbound between Federal Boulevard and I-25—PM Peak Period



Percentages shown represent the percent difference from the Existing Conditions.

Similar to the AM peak period changes, high growth in the area between Lincoln Street, I-25, Santa Fe Drive/US 85, and 8th Avenue results in increasing local roadway network congestion, which shifts travel patterns. Screenline 6 reflects this southbound/westbound traffic on roadways in the southern portion of the study area—Alameda Avenue, Kalamath Street, and US 6/6th Avenue—having a reduction in volumes and roadways farther to the north—13th Avenue, Colfax Avenue, and Speer Boulevard—having an increase in traffic. Figure 16 summarizes the southbound/westbound volume changes across this screenline.

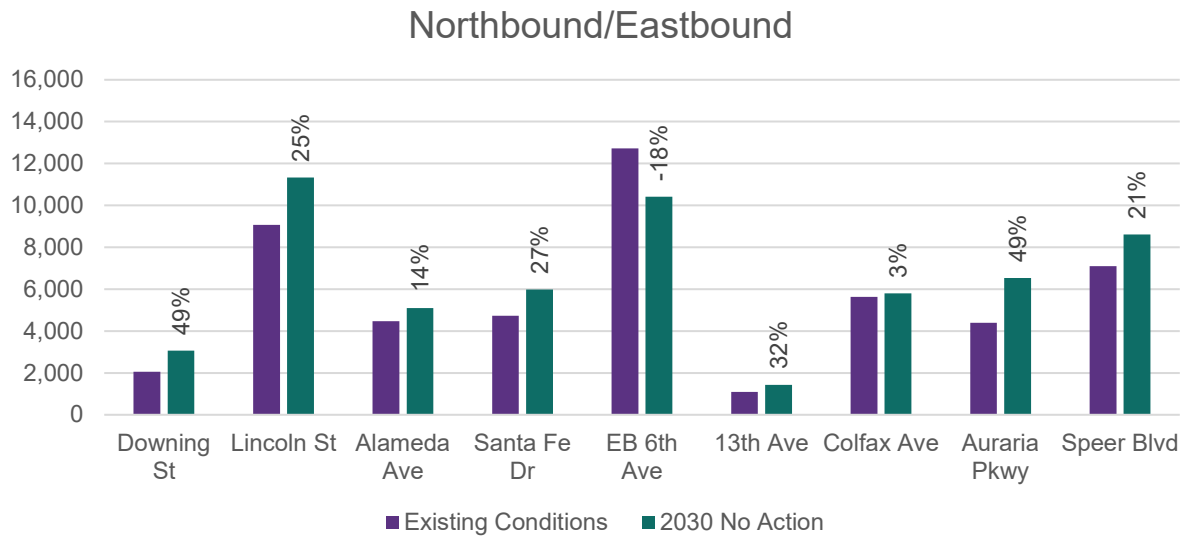
Figure 16: Screenline 6: Southbound/Westbound between I-25 and Downtown—PM Peak Period



Percentages shown represent the percent difference from the Existing Conditions.

Traveling northbound/eastbound across Screenline 6, most roadway facilities see an increase in traffic. This increase is in response to growing travel demand and increasing congestion on I-25. The exception to this growth is on eastbound US 6/6th Avenue. At this location, volumes decrease between the Existing Conditions scenario and the 2030 No Action Alternative. This decrease is a result of extensive queueing on eastbound US 6/6th Avenue starting at Speer Boulevard and extending to approximately I-25. This queueing degrades the operations along eastbound US 6/6th Avenue and reduces the number of vehicles able to be processed during the PM peak period. Figure 17 summarizes the changes in northbound/eastbound volumes at this screenline.

Figure 17: Screenline 6: Northbound/Eastbound between I-25 and Downtown—PM Peak Period



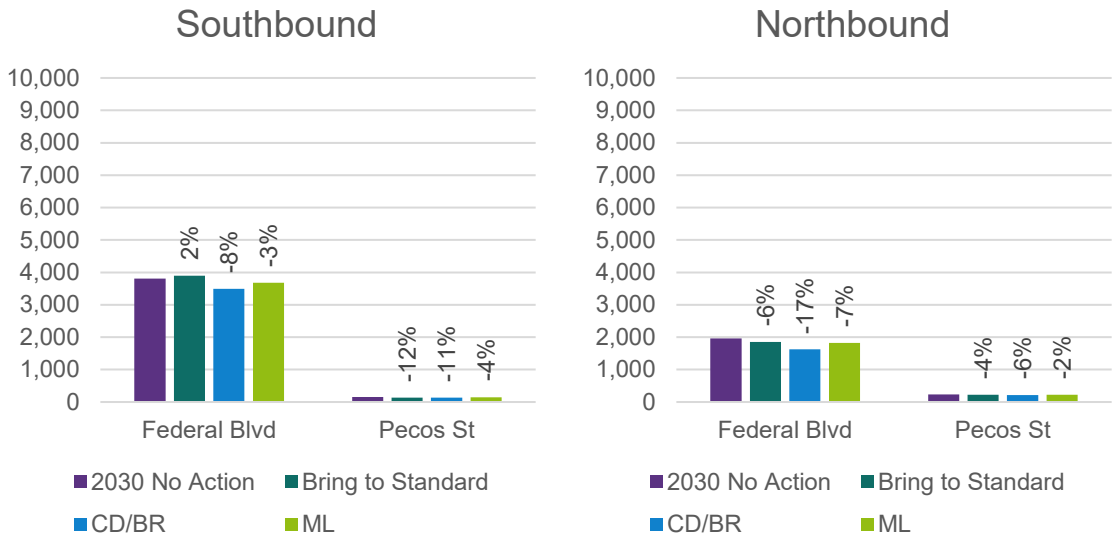
Percentages shown represent the percent difference from the Existing Conditions.

1.3. 2030 No Action Alternative Compared to Build Alternatives, AM Peak Period Screenline Volumes

During the AM peak period (6:00 a.m. to 9:00 a.m.), the local roadway volumes most affected by improvements on I-25 typically are those that lead into downtown and are geographically close to the freeway.

At Screenline 1, all build alternatives are expected to reduce volumes a similar amount on Federal Boulevard and Pecos Street. Figure 18 summarizes the local roadway volumes at this location.

Figure 18: Screenline 1: Between 35th Avenue and 38th Avenue—AM Peak Period

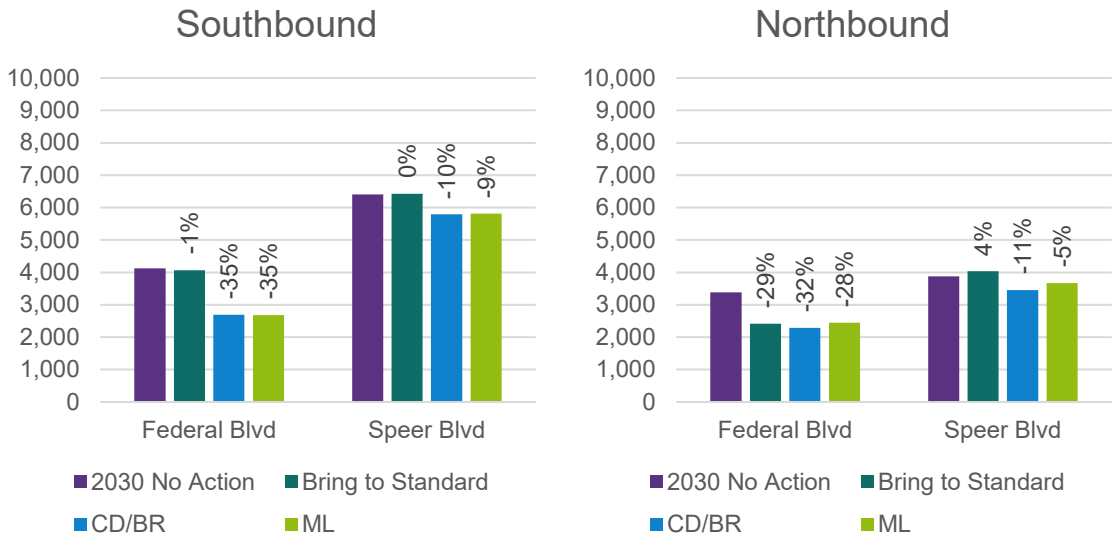


Percentages shown represent the percent difference from the 2030 No Action Alternative.

At Screenline 2, the Collector/Distributor Roads and Braided Ramps Alternative and the Managed Lanes Alternative are expected to provide the largest reduction in local roadway volumes. In the southbound direction, the largest reductions are expected on Federal Boulevard. The Collector/Distributor Roads and Braided Ramps Alternative and the Managed Lanes Alternative provide the most benefit at this location due to the reduction in southbound I-25 congestion between 20th Street and US 6/6th Avenue. Both alternatives provide more congestion relief in this area than the Bring the Corridor to Standard Alternative and encourage more vehicles to use the freeway instead of Federal Boulevard to access Colfax Avenue and US 6/6th Avenue. Similar, yet more modest, volume reductions are observed on Speer Boulevard.

In the northbound direction, all alternatives provide some reduction in volumes on local roadway facilities. These reductions are proportional to the level of congestion relief provided on I-25. Figure 19 summarizes the expected volume changes at Screenline 2 for each alternative.

Figure 19: Screenline 2: Between 22nd Avenue and 23rd Avenue—AM Peak Period



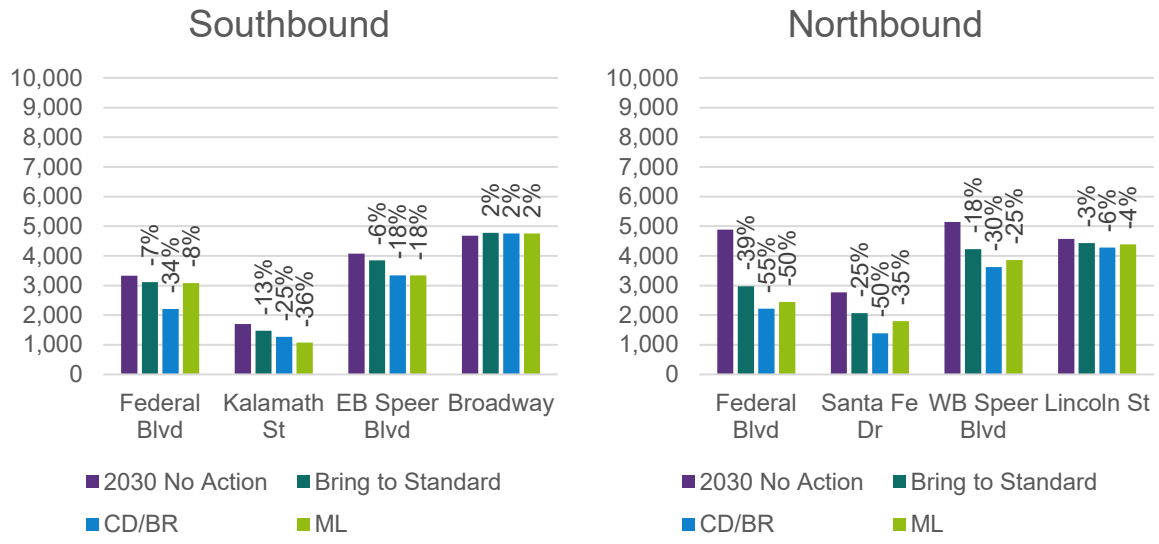
Percentages shown represent the percent difference from the 2030 No Action Alternative.

At Screenline 3, volume reduction on the local roadway facilities generally is proportional to the level of congestion reduction provided on I-25, with a few exceptions. In the southbound direction on Federal Boulevard, the Collector/Distributor Roads and Braided Ramps Alternative provides the largest volume reduction, even though the Managed Lanes Alternative provides the most congestion relief on I-25. This is because a large traffic movement using southbound Federal Boulevard at this location is traffic coming from westbound Colfax Avenue and using southbound Federal Boulevard to access US 6/6th Avenue. In the Collector/Distributor Roads and Braided Ramps Alternative, the southbound CD road configuration allows for these vehicles to use the CD road to directly connect from Colfax Avenue to US 6/6th Avenue. This route avoids congestion on both Federal Boulevard and on I-25, providing the fastest connection and the highest volume reduction.

The Collector/Distributor Roads and Braided Ramps Alternative provides a greater volume reduction to northbound Federal Boulevard, northbound Santa Fe Drive/US 85, and northbound/westbound Speer Boulevard as compared to the other build alternatives. This is because of the northbound off-ramp configuration to Colfax Avenue and Auraria Parkway in the Collector/Distributor Roads and Braided Ramps Alternative. In this alternative, one general-purpose lane on I-25 drops at the exit to the CD road. This configuration prioritizes the exit ramps and allows traffic exiting to 8th Avenue, Colfax Avenue, and Auraria Parkway to bypass congestion on I-25. This, in turn, encourages more vehicles to choose this route. Figure 20 summarizes the expected volumes changes at Screenline 3.

Note that, at Screenline 3, volume reductions on Broadway and Lincoln Street are expected to be notably less than at other parallel facilities. This is due to the distance between I-25 and these facilities. Because of this separation, the benefits of reduced travel times on I-25 do not outweigh the additional delay that would be experienced from the additional out-of-direction travel required to go from Broadway or Lincoln Street to I-25.

Figure 20: Screenline 3: Between 9th Avenue and 10th Avenue—AM Peak Period

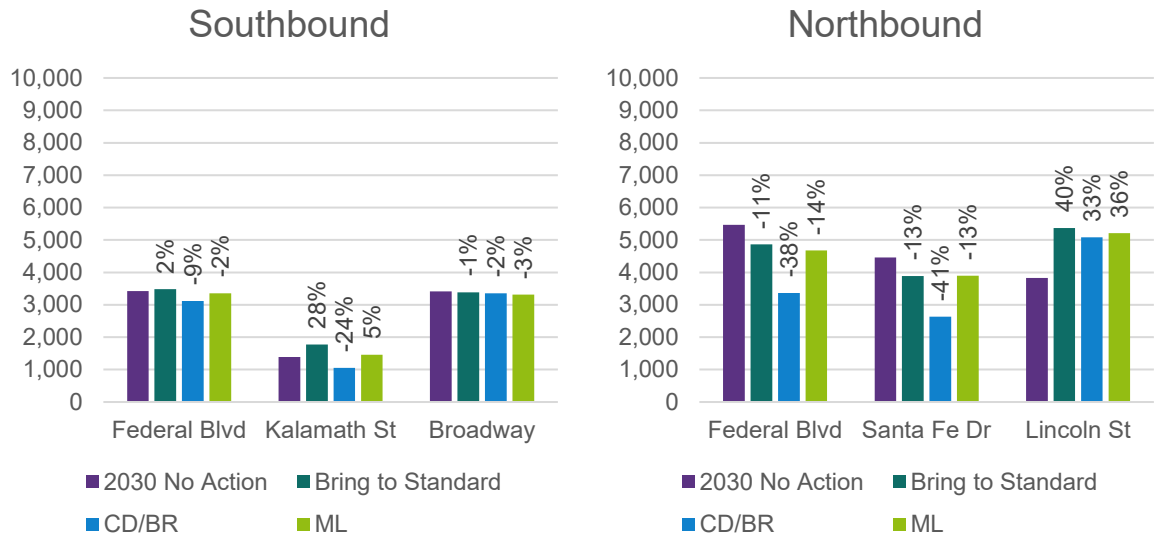


Percentages shown represent the percent difference from the 2030 No Action Alternative.

At Screenline 4, the Collector/Distributor Roads and Braided Ramps Alternative provides the largest volume reductions on local roadway facilities because this alternative provides continuous CD roads between Santa Fe Drive/US 85 and US 6/6th Avenue in both directions. These CD roads not only reduce congestion on I-25, but they also allow vehicles entering and exiting to/from these facilities to use the CD roads, avoiding congestion on the mainline freeway. This encourages more drivers to use the freeway instead of using parallel local facilities.

The only facility that is expected to see a notable increase in traffic volumes is Lincoln Street. Volumes on this facility increase in all build alternatives. This increase is the result of reduced network congestion to the north and west of this screenline location. In the 2030 No Action Alternative, there is extensive queueing on Lincoln Street and the surrounding roadway network. This queueing blocks traffic on Lincoln Street and reduces the total number of vehicles that can be processed on the facility. In all build alternatives, queueing and congestion on the local network are reduced. This allows Lincoln Street to better process the travel demand and results in an overall higher number of vehicles crossing this screenline location. Figure 21 summarizes the changes to local roadway volumes for each alternative.

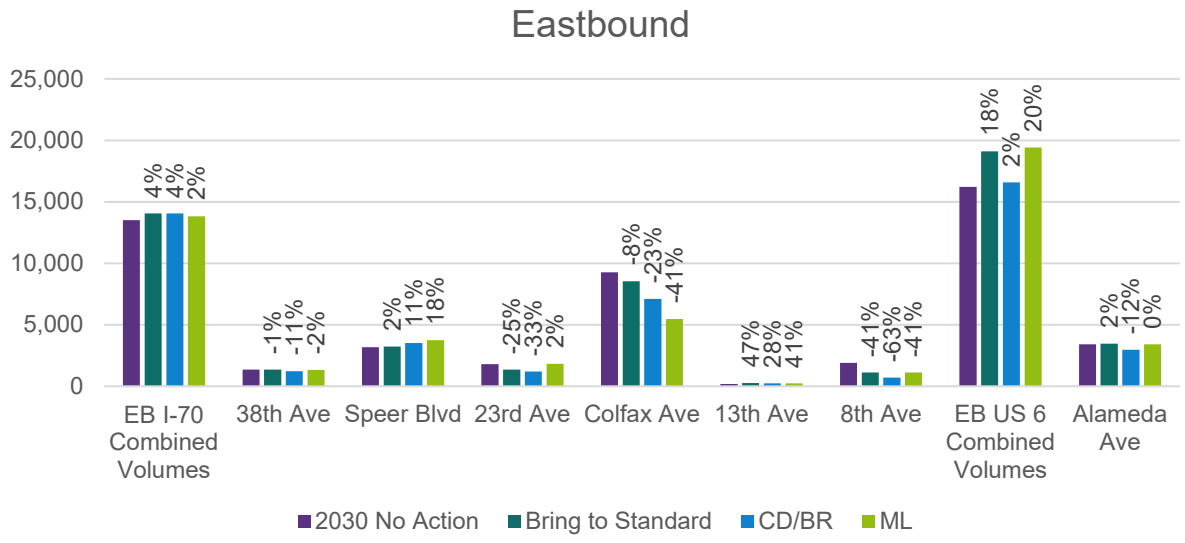
Figure 21: Screenline 4: Between Cedar Avenue and Irvington Place—AM Peak Period



Percentages shown represent the percent difference from the 2030 No Action Alternative.

At Screenline 5 traveling eastbound, the largest volume changes between the 2030 No Action Alternative and the build alternatives occur at Colfax Avenue and US 6/6th Avenue. In the build alternatives, reduced congestion on I-25—especially between US 6/6th Avenue and Colfax Avenue—results in more drivers choosing to use US 6/6th Avenue to northbound I-25 to Colfax Avenue, Auraria Parkway, and Speer Boulevard, instead of using northbound Federal Boulevard to Colfax Avenue. Figure 22 summarizes the eastbound volumes at this screenline.

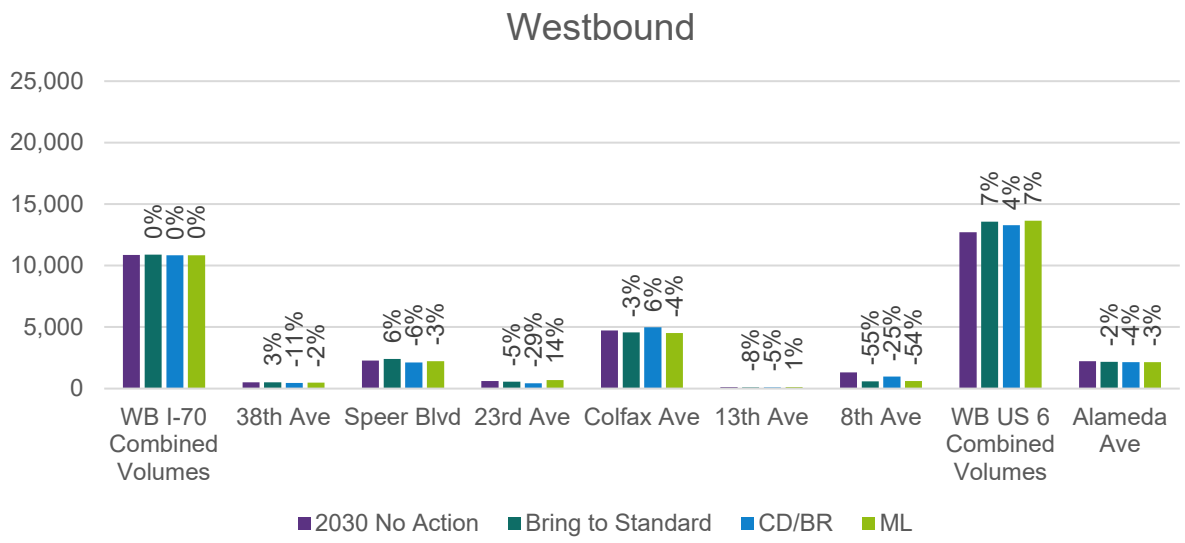
Figure 22: Screenline 5: Eastbound between Federal Boulevard and I-25—AM Peak Period



Percentages shown represent the percent difference from the No Action Alternative.

Westbound travel across Screenline 5 in the AM peak period is similar between the 2030 No Action Alternative and the build alternatives. Figure 23 summarizes the westbound volumes at this location.

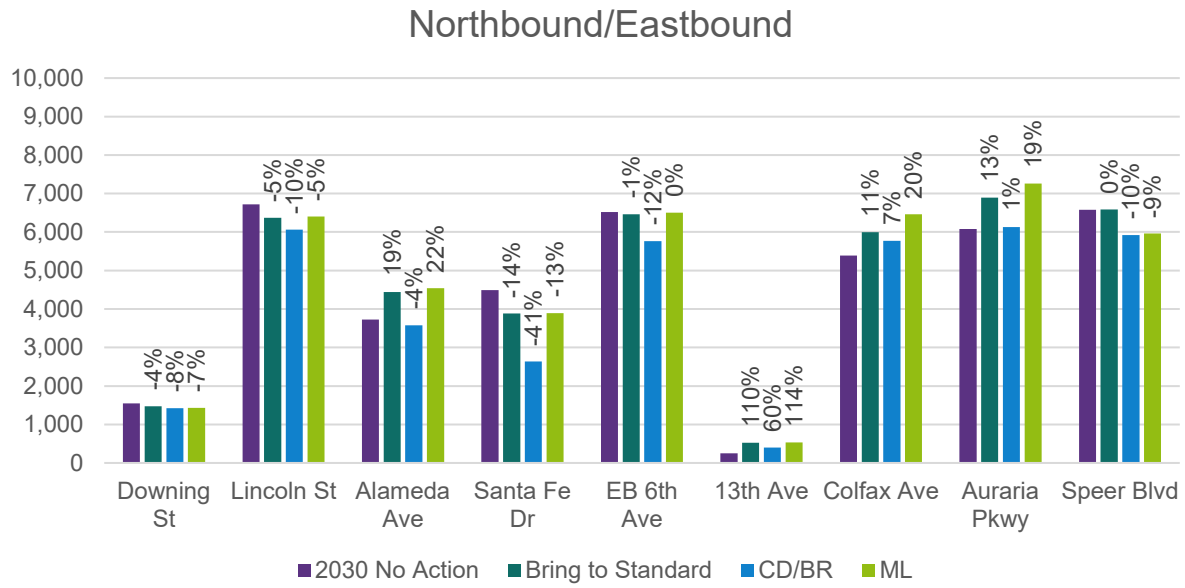
Figure 23: Screenline 5: Westbound between Federal Boulevard and I-25—AM Peak Period



Percentages shown represent the percent difference from the No Action Alternative.

At Screenline 6, traffic going northbound/eastbound generally decreases south of US 6/6th Avenue and increases north of US 6/6th Avenue. This reflects the reduced congestion on I-25 provided by the build alternatives. Reducing congestion on I-25 lowers the number of vehicles exiting I-25 south of US 6/6th Avenue and using parallel local roadways to access downtown and instead results in these vehicles traveling farther north and using exits north of US 6/6th Avenue to access downtown. Figure 24 summarizes the northbound/eastbound volumes across this screenline.

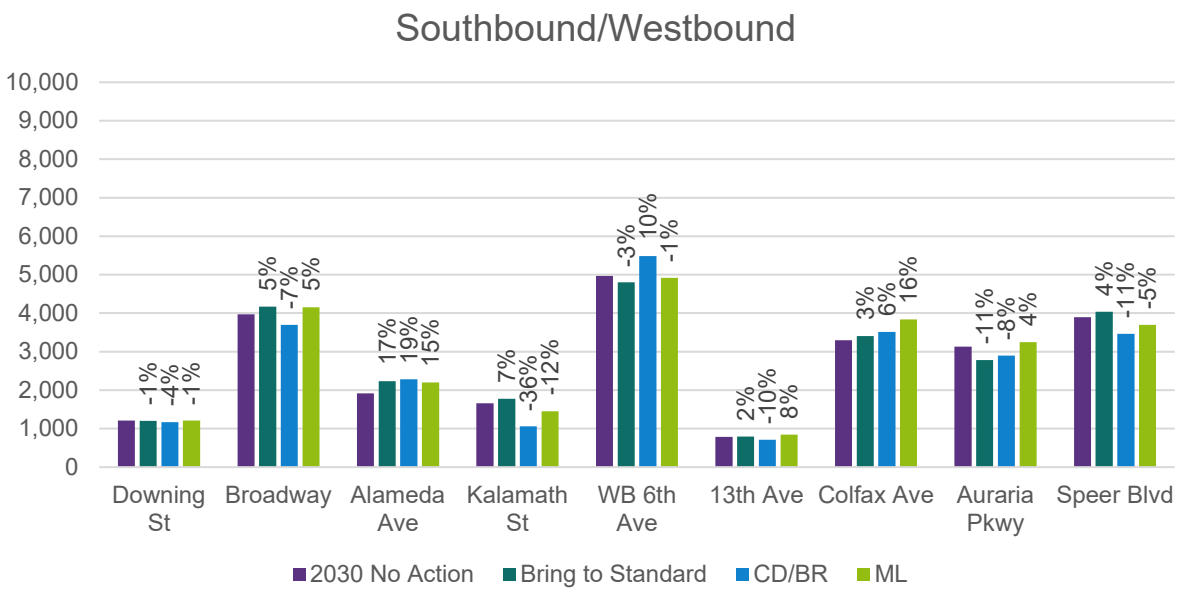
Figure 24: Screenline 6: Northbound/Eastbound between I-25 and Downtown—AM Peak Period



Percentages shown represent the percent difference from the No Action Alternative.

Southbound/westbound travel across Screenline 6 in the AM peak period is similar between the 2030 No Action alternative and the build alternatives. Figure 25 summarizes the westbound volumes at this location.

Figure 25: Screenline 6: Southbound/Westbound between I-25 and Downtown—AM Peak Period



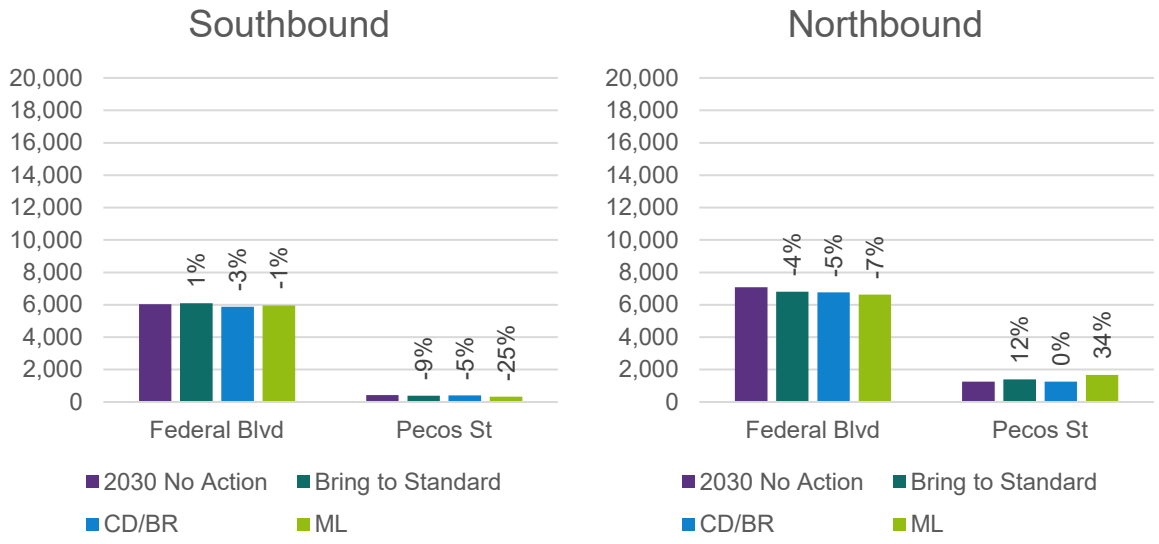
Percentages shown represent the percent difference from the No Action Alternative.

1.4. 2030 No Action Alternative Compared to Build Alternatives, PM Peak Period Screenline Volumes

During the PM peak period (2:00 p.m. to 8:00 p.m.), the local roadway volumes most affected by improvements on I-25 typically are those that lead away from downtown and are geographically close to the freeway.

At Screenline 1, the build alternatives are not expected to impact volumes a notable amount on Federal Boulevard or Pecos Street. Figure 26 summarizes the expected changes in volumes for each build alternative.

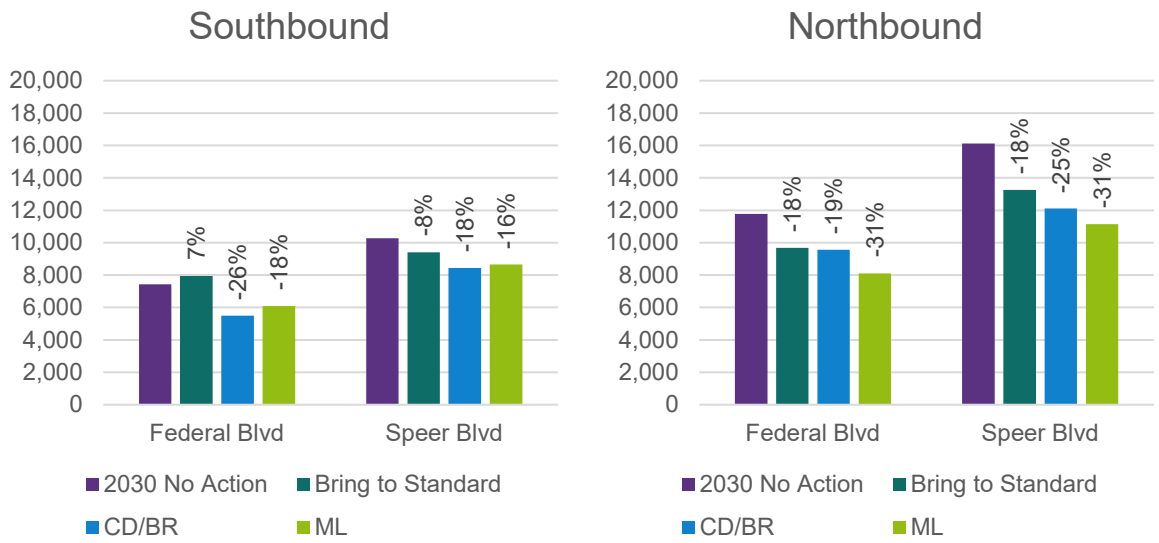
Figure 26: Screenline 1: Between 35th Avenue and 38th Avenue—PM Peak Period



Percentages shown represent the percent difference from the No Action Alternative.

PM peak period Screenline 2 volumes on local roadway facilities are expected to be reduced in all alternatives. The reduction in volumes generally is correlated to the reduction in congestion on I-25 provided by each build alternative. Figure 27 summarizes the expected volume changes for each build alternative.

Figure 27: Screenline 2: Between 22nd Avenue and 23rd Avenue—PM Peak Period

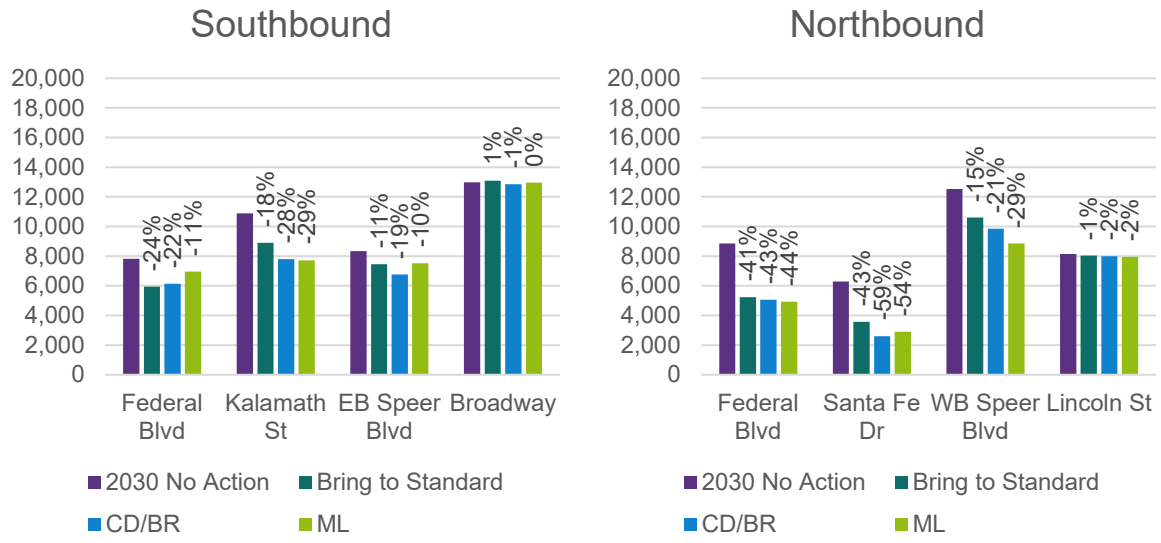


Percentages shown represent the percent difference from the No Action Alternative.

At Screenline 3, volumes in both directions are expected to be reduced relatively proportionately to the congestion reduction on I-25. The exception to this is at Broadway and Lincoln Street. These facilities do not see notable volume reductions due to the distance between them and I-25. The additional delay

that would be incurred due to the out-of-direction travel required to go from these facilities to I-25 would outweigh the travel time savings on I-25 provided by the build alternatives. Figure 28 summarizes the expected volume changes for each build alternative.

Figure 28: Screenline 3: Between 9th Avenue and 10th Avenue—PM Peak Period

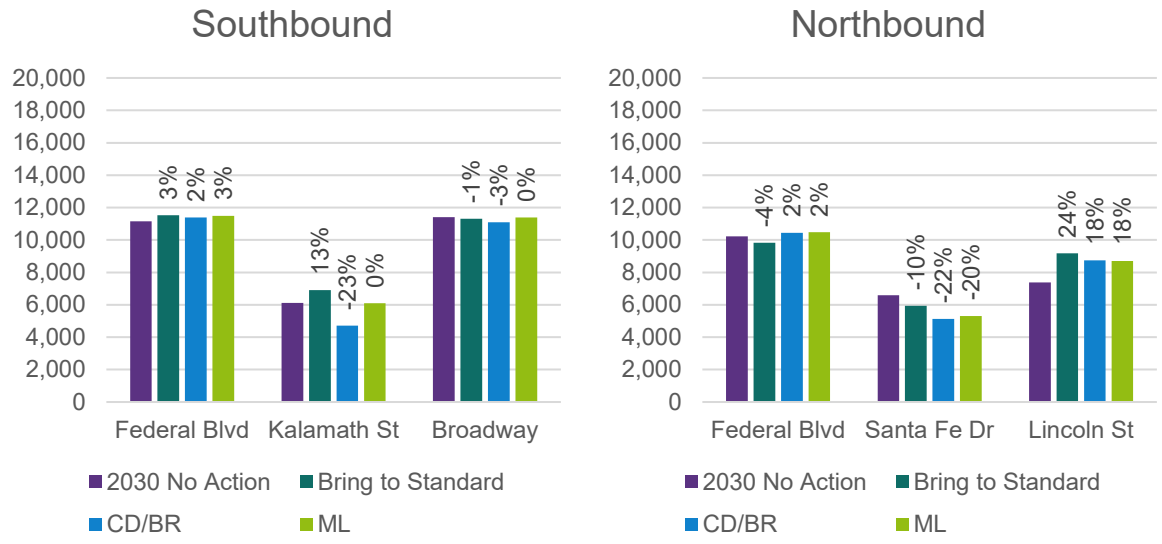


Percentages shown represent the percent difference from the No Action Alternative.

Volumes at Screenline 4 are expected to remain similar to the 2030 No Action Alternative volumes regardless of the build alternative. Exceptions to this include Kalamath Street, Santa Fe Drive/US 85, and Lincoln Street. Kalamath Street and Santa Fe Drive/US 85 are expected to have moderately reduced volumes in the build alternatives as compared to the 2030 No Action Alternative. This is a result of the roadways' proximity to I-25 and their use as an alternate route to the freeway during times of high congestion.

Volumes on Lincoln Street increase in the build alternatives as a result of reduced queueing and blockages on the roadway. In the 2030 No Action Alternative during the PM peak period, queueing on Lincoln Street occurs at Cherry Creek Boulevard/Speer Boulevard and spills back to I-25. This queueing results in fewer vehicles being processed by the facility. In the build alternatives, local network roadway congestion is reduced and, therefore, there is less queueing on Lincoln Street. This allows the facility to process more vehicles than in the 2030 No Action Alternative. Figure 29 summarizes the expected volume changes for each alternative.

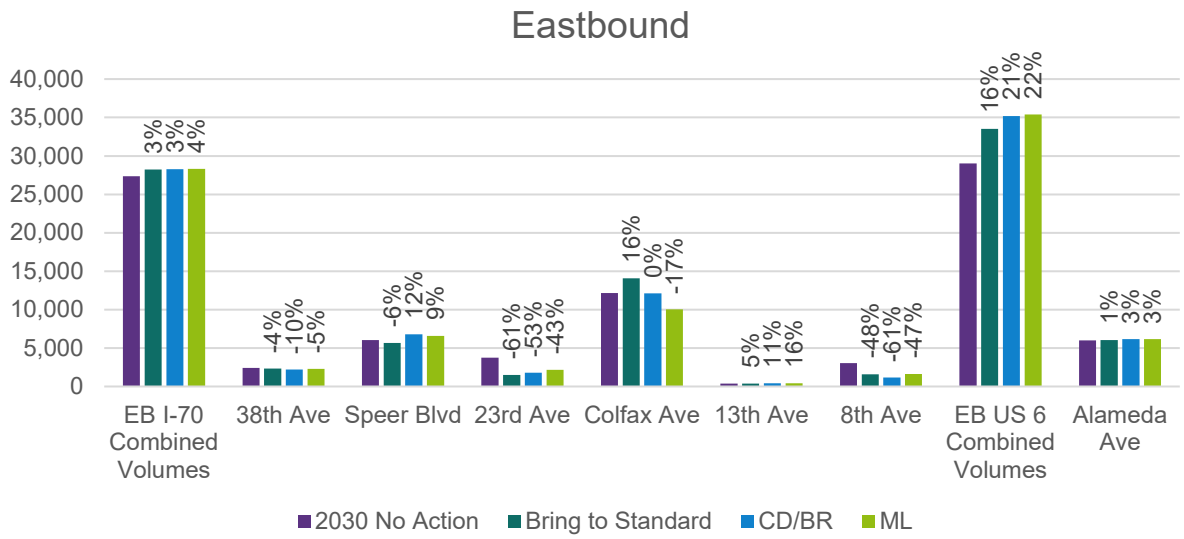
Figure 29: Screenline 4: Between Cedar Avenue and Irvington Place—PM Peak Period



Percentages shown represent the percent difference from the No Action Alternative.

At Screenline 5 during the PM peak period, the largest change in volumes between the 2030 No Action Alternative and the build alternatives occurs at US 6/6th Avenue, 23rd Avenue, and 8th Avenue. In the 2030 No Action Alternative, congestion on I-25 and US 6/6th Avenue results in some drivers choosing to travel north on Federal Boulevard and then heading east on 8th Avenue or 23rd Avenue. However, because the build alternatives improve the flow of traffic from US 6/6th Avenue to I-25, more drivers choose to use this route instead of Federal Boulevard. This results in higher volumes on US 6/6th Avenue and lower volumes on 23rd Avenue and 8th Avenue. Figure 30 summarizes the eastbound volumes across this screenline.

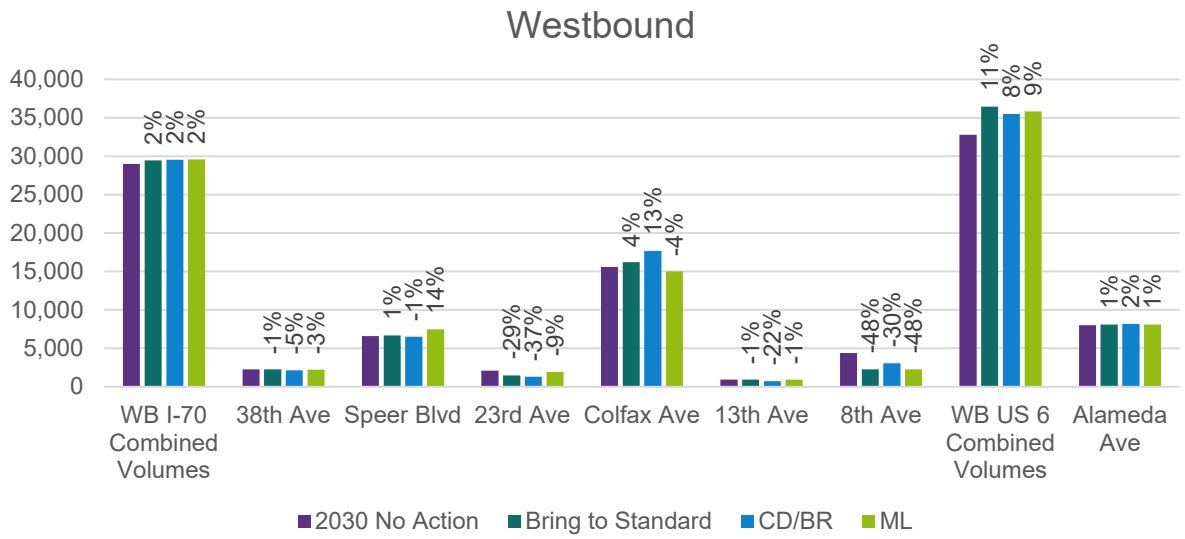
Figure 30: Screenline 5: Eastbound between Federal Boulevard and I-25—PM Peak Period



Percentages shown represent the percent difference from the No Action Alternative.

Similar to the eastbound findings, westbound build alternative volumes across Screenline 5 in the PM peak period show an increase in traffic on US 6/6th Avenue and a decrease in traffic on 23rd Avenue and 8th Avenue. This is a result of reduced congestion on I-25. Figure 31 summarizes the westbound volumes across this screenline.

Figure 31: Westbound Screenline 5: Between Federal Boulevard and I-25— PM Peak Period

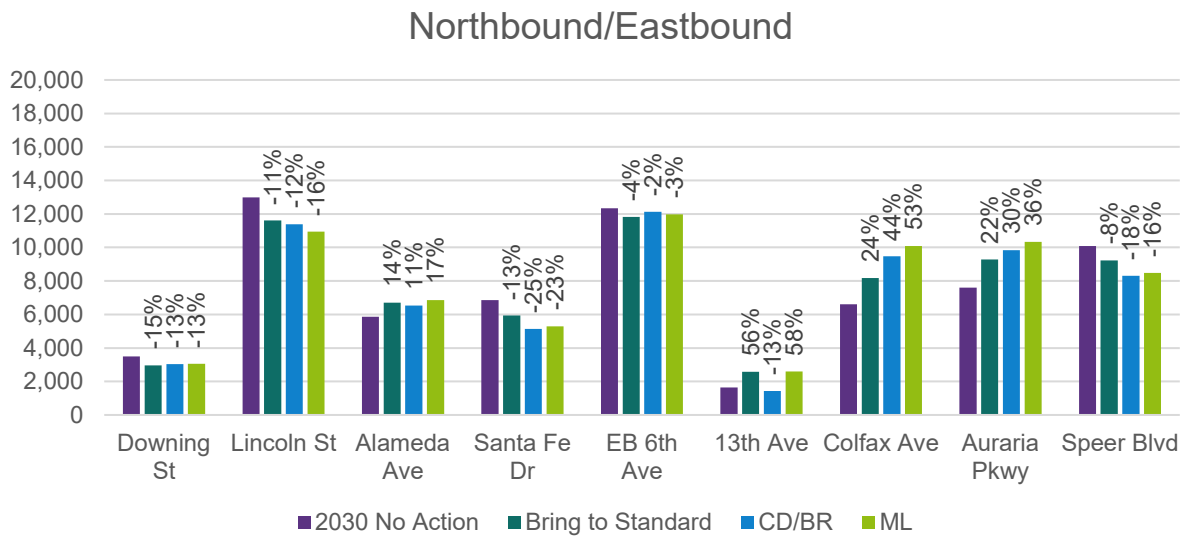


Percentages shown represent the percent difference from the No Action Alternative.

Volumes at Screenline 6 in the northbound/eastbound direction for the build alternatives are generally lower south of US 6/6th Avenue and higher north of US 6/6th Avenue as compared to the 2030 No Action Alternative volumes. This is because, in the 2030 No Action Alternative, congestion on northbound I-25 pushes more traffic to the parallel facilities—such as Downing Street, Lincoln Street, and Santa Fe Drive. Reducing congestion on I-25 encourages more people to use the highway to access downtown. This results in lower volumes on the parallel facilities and increased volumes on facilities farther to the north, such as Colfax Avenue and Auraria Parkway, which provide more direct access into downtown.

Eastbound volumes on Alameda Avenue increase in the build alternatives as a result of more vehicles trying to access I-25. Northbound volumes on Speer Boulevard decrease because fewer people are using Speer Boulevard as an alternate route to I-25. Figure 32 summarizes the northbound/eastbound volumes across this screenline.

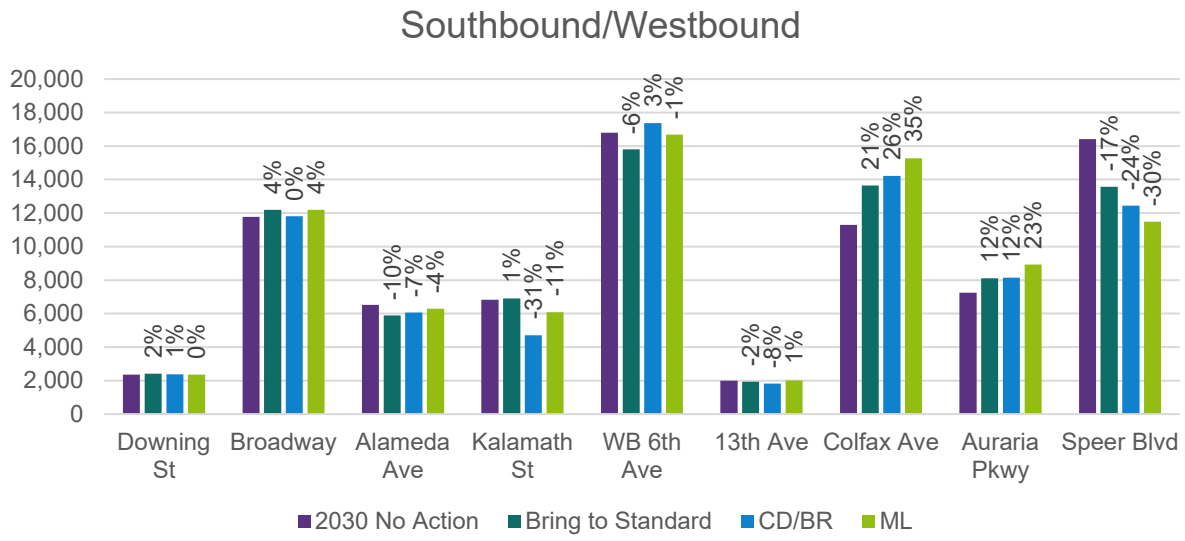
Figure 32: Screenline 6: Northbound/Eastbound between I-25 and Downtown—PM Peak Period



Percentages shown represent the percent difference from the No Action Alternative.

In the southbound/westbound direction across Screenline 6, the largest differences between the 2030 No Action Alternative and the build alternatives occur at Colfax Avenue, Auraria Parkway, and Speer Boulevard. Volumes on westbound Colfax Avenue and Auraria Parkway increase in response to improved conditions on I-25. Reducing congestion on I-25 encourages more vehicles exiting downtown to go to I-25 rather than use other parallel local facilities to travel south. Volumes on southbound Speer Boulevard decrease in response to reduced congestion on I-25 because more drivers use I-25 to travel south as opposed to using Speer Boulevard as an alternate route. Figure 33 summarizes the southbound/ westbound volumes across this screenline.

Figure 33: Screenline 6: Southbound/Westbound between I-25 and Downtown—PM Peak Period



Percentages shown represent the percent difference from the No Action Alternative.

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