APPENDIX B PURPOSE AND NEED

STATE HIGHWAY 9 AND U.S HIGHWAY 6 IMPROVEMENT PROJECT
AT THE INTERSTATE 70 SILVERTHORNE/DILLON INTERCHANGE

PURPOSE AND NEED

July 9, 2012

1. Background

The Towns of Silverthorne and Dillon, in coordination with the Colorado Department of Transportation (CDOT) and the Federal Highway Administration (FHWA) have identified the need for improved safety, capacity and multimodal connectivity on State Highway 9 (SH 9) and U.S. Highway 6 (US 6) at the Interstate 70 (I-70) Silverthorne/Dillon interchange (Exit 205: I-70 Milepost 205.4). Based on the identified needs, the project study area includes portions of SH 9, US 6 and I-70, including public and private land within the boundaries of the Town of Silverthorne, the Town of Dillon, and Summit County. The study area perimeter is presented in Figure 1. Figure 2 presents a detailed map of SH 9, US 6, the I-70 Silverthorne/Dillon interchange and the local street network.

Figure 1 Project Study Area

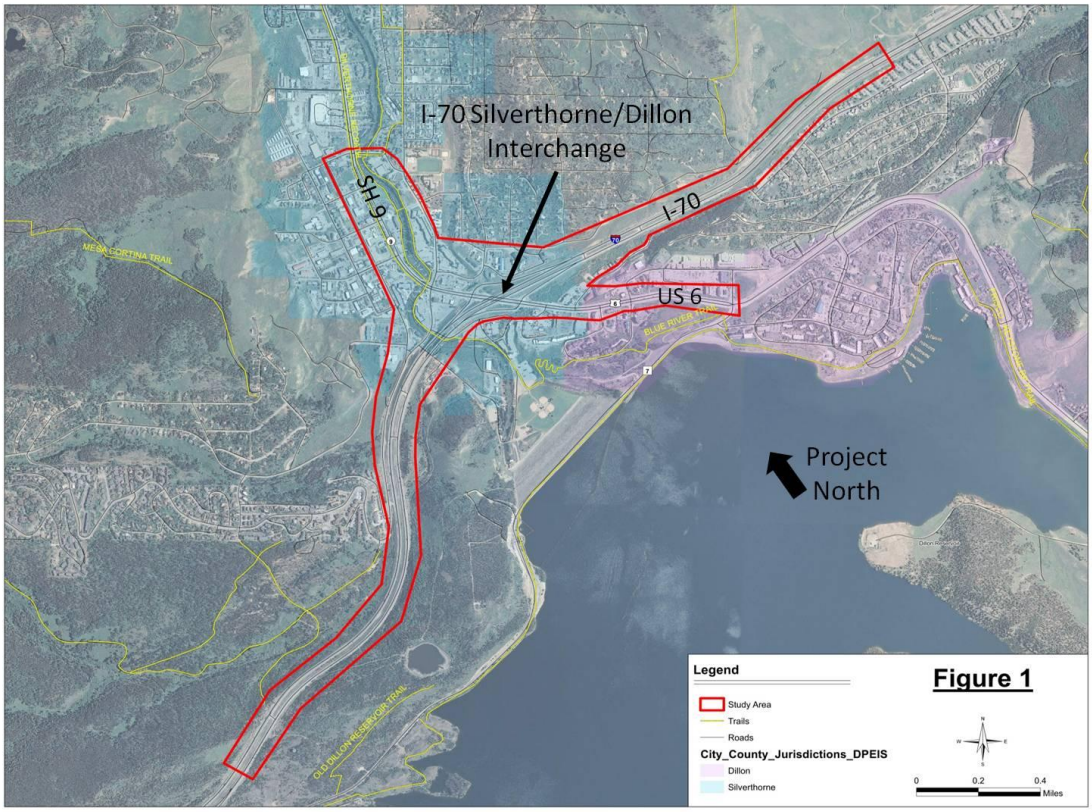


Figure 2 Detailed Map of the Interchange Area

Note:

References to north, east, south and west within the study area differ from actual compass directions. The direction references are applied to conform to the general understanding that I-70 passes through Colorado in an east/west manner with westbound and eastbound traffic and that State Highway 9 and US 6 generally pass through the area in a north/south manner with northbound and eastbound traffic. This approach provides for northwest, northeast, southwest and southeast quadrant references in project documents.

2. Transportation Planning

The need for safety, capacity and multimodal connectivity improvements where SH 9 and US 6 meet at the I-70 Silverthorne/Dillon interchange is described within the I-70 Mountain Corridor Final Programmatic Environmental Impact Statement (PEIS). An improvement at the interchange is defined as early action project and priority of the "Consensus Recommendation" or Preferred Alternative defined in the I-70 Mountain Corridor Record of Decision (ROD).

The PEIS also describes “continuous eastbound auxiliary lanes” from Frisco to Silverthorne (Mileposts 202.7 to 205.1) as part of the Consensus Recommendation. Auxiliary lanes are defined as part of the “Minimal Action Alternative” in the PEIS. An auxiliary lane typically extends between a freeway on ramp and off ramp. In the I-70 corridor between Frisco and Silverthorne/Dillon, phased construction is considered with the first phase being from the scenic overlook to the Silverthorne/Dillon interchange. Auxiliary lanes are added to reduce impacts of heavy on ramp traffic merging with a freeway through lane. Auxiliary lanes help accommodate slow moving vehicles, are primarily located in areas of steep grades along I-70, and increase capacity of the highway along their length.

These improvements are not identified in the CDOT 2012-2017 *Statewide Transportation Improvement Program* (STIP), but are referenced in the *Intermountain Transportation Planning Region 2030 Regional Transportation Plan* (RTP) as “Silverthorne Interchange Reconstruction.”

The SH 9 and US 6 improvements at the I-70 interchange and the auxiliary lane improvement primarily focus on local and regional travel needs rather than major east/west movement issues on I-70. For this reason, because they can be constructed without the primary components of the Tiered improvements to I-70, and because they do not preclude alternatives that would be associated with those improvements, local and regional improvements at this location are considered independent of future I-70 improvements.

The importance of addressing local and regional travel needs within Summit County and the Towns of Silverthorne and Dillon cannot be overstated. The interchange area is a critical transportation facility and provides access to and from the Town Center of Silverthorne and Dillon. In addition, I-70 serves as the primary connection within Summit County between Silverthorne and Dillon and Frisco to the west.

The I-70 Mountain Corridor EIS states that Summit County is characterized as having 40 percent or more of its jobs related to tourism and representing almost 25 percent of the 9-county region's gross regional product in 2035. The development that exists near the I-70 Silverthorne/Dillon interchange is a key part of that employment and economic statement. Clearly, the existing and planned development along SH 9 and US 6 within a mile of the interchange is vital to the economic health of Summit County, the Town of Dillon and the Town of Silverthorne making the interchange area a gateway to the region. Existing development, community investments in infrastructure and amenities; future land use plans calling for new development and redevelopment, and; the potential for future regional transit service with a station in the interchange area, make efficient operation of SH 9, US 6, the local roadway network and the interchange vital both now and in the future.

3. Anticipated Growth in the Region

Summit County, the Town of Silverthorne and the Town of Dillon have experienced considerable population and employment growth in the last 10 years. Although growth rates in the past few years have not been as high as previous years, substantial growth is anticipated along with tourism activity and associated traffic. Figure 3 presents population, employment, and daily trip growth rates between 2000 and 2035 for areas around the interchange. Table 1 presents expected growth for those same areas in traffic between 2010 and 2035. This growth information, combined with higher vehicle travel increases on SH 9 and US 6 relative to increases on I-70, reflects the importance of local and regional growth as an important factor defining the need for improvements along SH 9 and US 6 in Silverthorne and Dillon.

Figure 3 Population and Daily Trip Forecasts (Saturday, August) 2000 - 2035

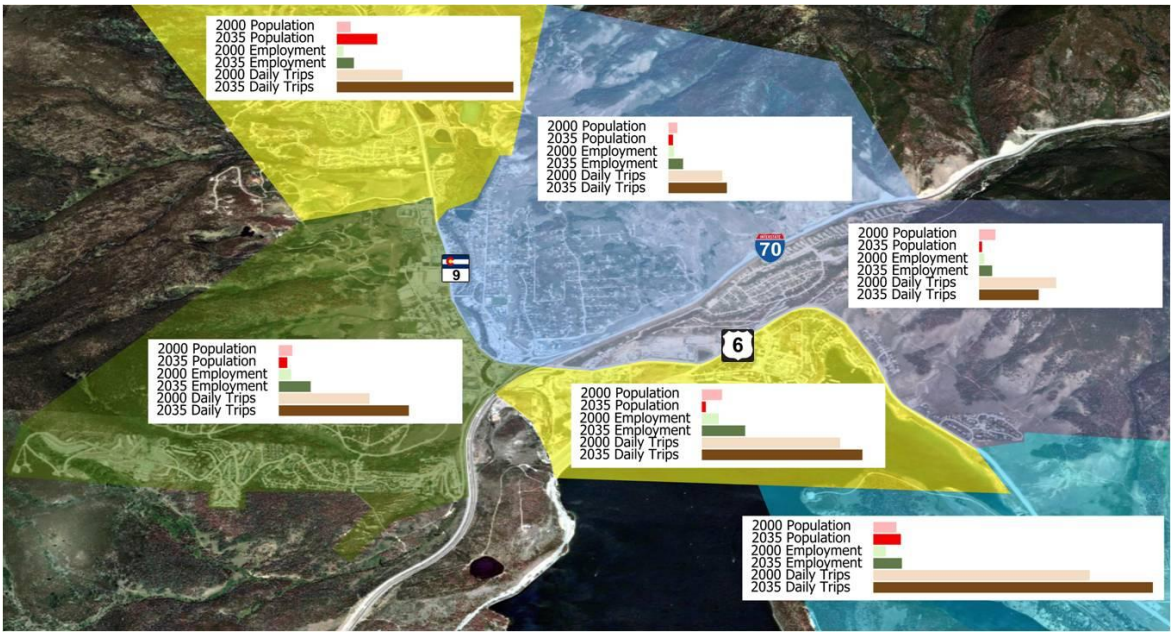


Table 1 Traffic Growth Summary, 2010 Existing Conditions to 2035 Forecast Levels

Traffic Area	2010-2035 Growth in Traffic
North of Silverthorne along SH 9	74%
Silverthorne, east of SH 9	22%
Silverthorne, west of SH 9	53%
Dillon, east of US 6	37%
Dillon, west of US 6	15%
South of Dillon along US 6	4%
I-70, east of the interchange	37%
I-70, west of the interchange	34%

4. Project Purpose

The overall purpose of this project is to develop transportation improvements that increase safety for motorists, pedestrians, and bicyclists; address anticipated traffic and congestion increases; address private property access needs; provide for future multimodal transit options and connectivity; and improve pedestrian and bicycle mobility.

Specific transportation needs are described in Section 5. The project outcome is expected to address these needs and be consistent with the I-70 Mountain Corridor PEIS and ROD and the RTP, STIP, and local plans.

5. Project Need

Specific needs or problem statements are presented in the following discussions under these headings: Safety, Capacity, and Multimodal Connectivity

5.1 Safety

Safety issues in the Study Area involve motor vehicle crash rates and causes on SH 9, US 6, the interchange ramps, and on I-70. Other safety issues involve the adequacy of facilities for pedestrians and cyclists along SH 9 and US 6.

On US 6, crash risks at intersections are relatively high because of limited turn-lane storage, limited sight distance and relatively steep approach grades at start/stop areas near intersections. Other contributing factors conflicts associated with right turn only lanes, frequent and late lane changes, close intersection spacing, and signal phasing. On SH 9, crash risks at intersections and driveways are relatively high with a high percentage of crashes occurring at driveways involving broadside and turning crashes. Access control, sight distance and weaving between closely spaced intersections are contributing factors.

Adverse weather is a significant issue. Adverse weather conditions contributed to 44 percent of crashes on US 6 and 34 percent of crashes on SH 9. The potential for accidents is substantially increased in the winter when snow and/or ice are often present and when incident conditions back up traffic. These

incidents are caused by local and regional weather conditions. Regional weather conditions (or weather related accidents) can close I-70 near the interchange, which leads to high congestion levels on SH 9 and US 6 when weather related risks are elevated.

Higher than expected crash rates occur in relation to the interchange ramps. Ramp intersection and on ramp lane capacity limitations combine to create ramp backups onto I-70 during peak periods and during incident conditions. Backups onto I-70, particularly from the eastbound off ramp, substantially increase I-70 safety risks. The eastbound I-70 off ramp includes a sharp curve combined with lane choices for motorists heading toward the signalized intersection. Accident data suggests that sight distance and driver confusion may contribute to accidents at this location.

There have been a substantial number of crashes on I-70 at and near the interchange in both directions. Adverse weather conditions contributed to 57% of crashes on I-70. Figure 4 presents the number of eastbound and westbound crashes on I-70 by mile marker between 2002 and 2006. Figure 5 compares crash totals with similar roadways elsewhere in Colorado.

The data for eastbound travel shows that a high proportion of crashes on I-70 in this direction occur just west of the interchange between mile markers 204.0 and 205.5. The center of the interchange is located at mile marker 205.4. The greatest number of crashes occurred within one mile west of the I-70 Silverthorne/Dillon interchange. This situation, combined with the fact that the total number of accidents is substantial, highlights safety issues associated with the eastbound off-ramp facilities.

Other causes of crashes on the steep grades of I-70 east and west of the interchange result from:

- High speeds and the speed differential between interchange traffic and through traffic on I-70, particularly in association with the eastbound off ramp and westbound on ramp.
- On ramp traffic merging into through lanes in combination with lane changes, particularly in association with the westbound on-ramp
- Horizontal and vertical curves
- Narrow shoulders on the Blue River Bridge

Crashes west of the interchange may also be caused by scenic overlook traffic movements on both sides of I-70. The rest stops are located between the Frisco interchange and the Silverthorne/ Dillon interchange.

One important difference between the eastbound and westbound off ramp conditions is that the eastbound off ramp is served by an exit only deceleration lane that begins and splits into two lanes just west of the Blue River Bridge (about 750 feet). The westbound off ramp is served by an exit only lane that begins miles from the interchange. This ramp is a termination of the westbound auxiliary lane from the Eisenhower-Johnson Tunnel, which drops or merges from two lanes into one lane.

Figure 4 **Westbound and Eastbound I-70 Crash Locations** (January 2002 – December 2006)

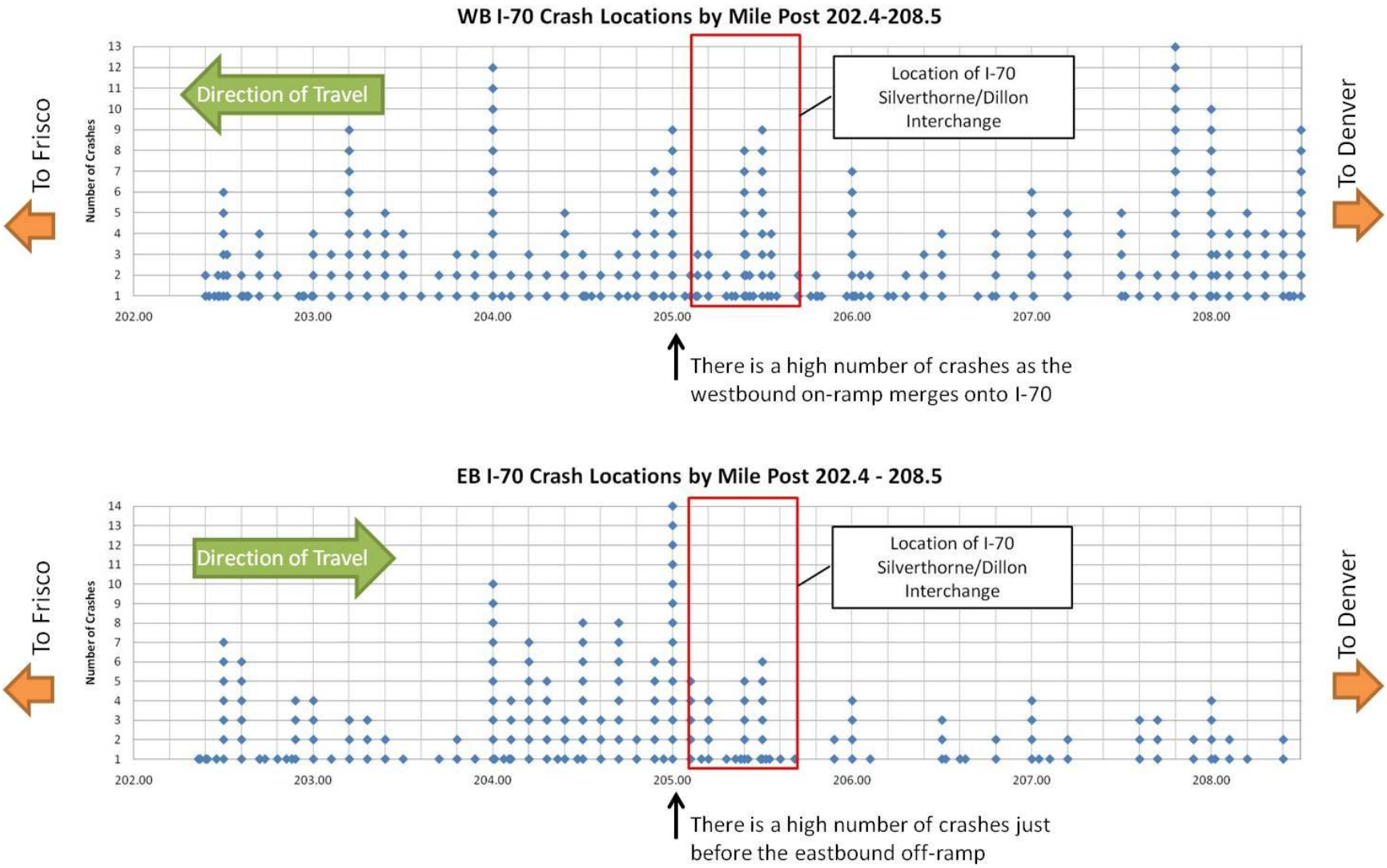
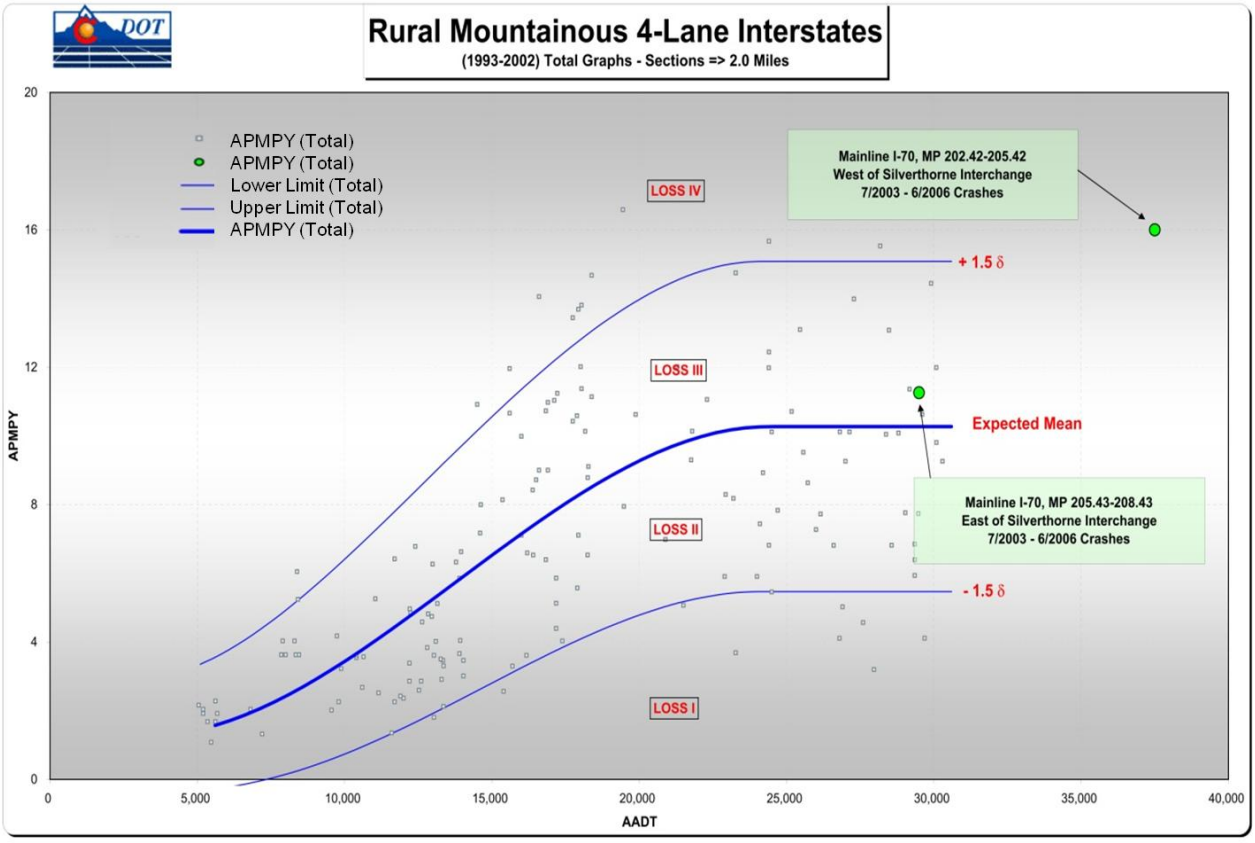


Figure 5 **Safety Performance Function Analysis: Number of Crashes on I-70 vs. Rural Mountainous Four-Lane Interstates in Colorado (1993-2002)**



Colorado Department of Transportation
HQ Safety Engineering and Analysis Group

The gray points reflect actual accident data for a particular roadway with a given a traffic volume

AADT Annual Average Daily Traffic

APMPY Accidents Per Mile Per Year

Expected Mean Line: Average number of accidents per mile per year for a given annual average daily volume of traffic on a roadway

Upper Limit and Lower Limit Lines: These lines are measures of statistical dispersion for the data points plotted in the diagram. The likely range in the number of accidents for a given traffic volume is clarified by these lines. The span between the upper and lower limit lines is referred to as the "midspread" or middle 50. A total of 25 percent of the data points are above and below the Expected Mean Line.

LOSS Level of Service of Safety

LOSS I Indicates a Low Potential for Accident Reduction
LOSS II Indicates a Better than Expected Safety Performance
LOSS III Indicates a Less than Expected Safety Performance
LOSS IV Indicates a High Potential for Accident Reduction

Based on local observations, pedestrian crossings of SH 9 and US 6 within crosswalks often result in rushed trips across oncoming traffic. This suggests that pedestrian crossing times are low due to signal phasing constraints and/or pedestrian compliance is low. Cycling on 6 foot local sidewalks and under I-70 along SH 9 and US 6 also creates safety issues despite the presence of the Blue River Trail. Land use planning documents encourage pedestrian travel within the interchange study area, so more activities of this type, as well as the related safety problems that accompany them, are anticipated. Pedestrian short cuts across I-70 east of the interchange and across the westbound off ramp present substantial safety hazards. Three primary short cuts routes visible from aerial photography are parallel to the arrows in Figure 6. These short cuts strongly suggest the need to improve the pedestrian safety and the need for guided pedestrian access under I-70.

Figure 6 Pedestrian Short Cuts Across I-70 and the I-70 Westbound Off Ramp

5.2 Capacity

There are various capacity issues associated with operational problems and traffic volumes within the Study Area. The following discussion highlights and describes the capacity issues.

SH 9 and US 6 have unusual peak period volume conditions relative to typical AM/PM urban commute patterns. Due to the seasonal nature of I-70 travel (winter and summer) and the high level of tourism in the area, peak period volumes occur on weekends and the peak period involves weekends in August. Other peak periods occur in the winter on Friday, Saturday and Sunday. Figure 7 illustrates the peaking pattern during the year and during the day on I-70 east of SH 9 and US 6. The August weekend peak period is visible in Figure 7, and a similar peaking pattern is found for traffic volumes on SH 9 and US 6. Based on this information a Saturday afternoon during August was chosen as the peak period for capacity analysis.

Figure 7 Peak Travel Periods on I-70 East of the Silverthorne/Dillon Interchange

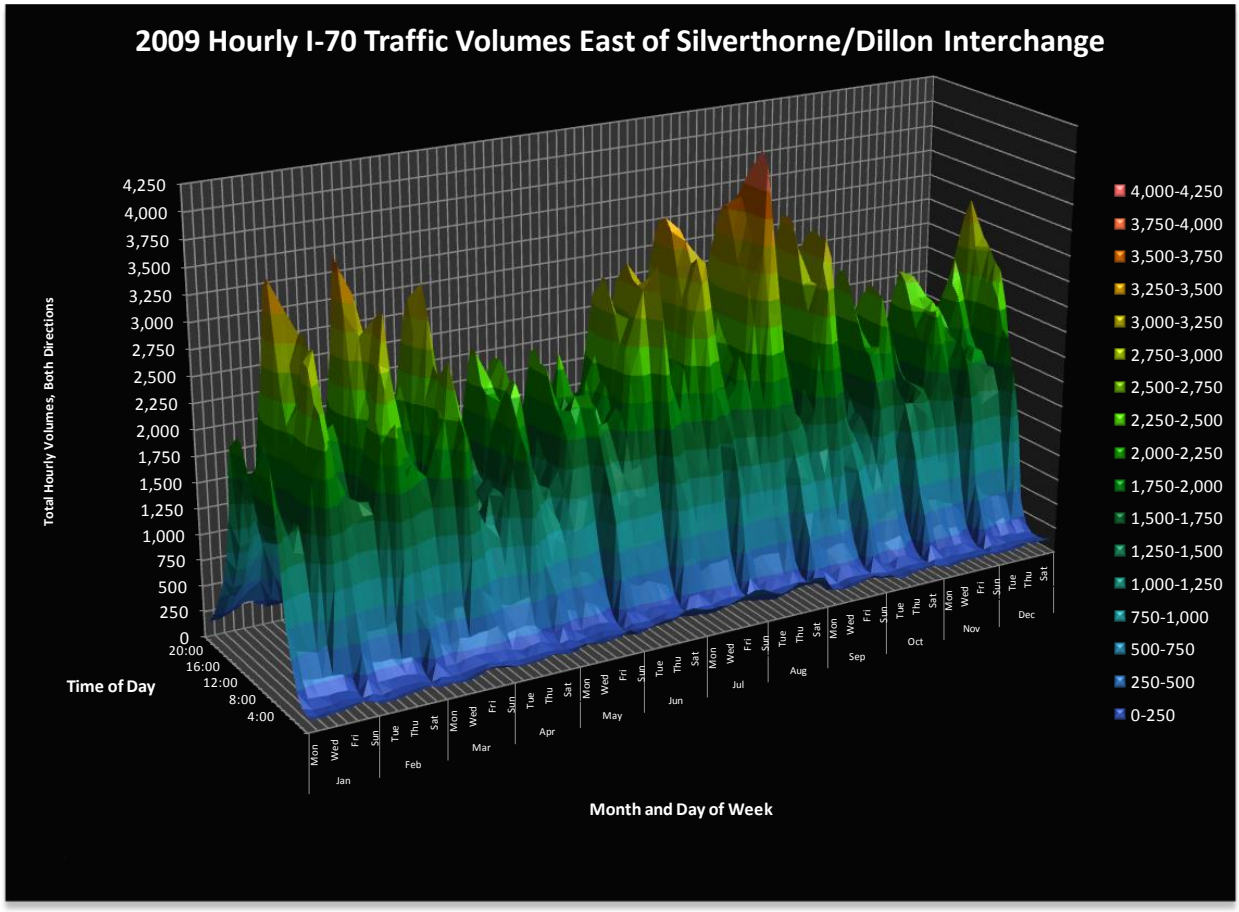


Figure 8 identifies the top five critical movements. The relative ranks were based on traffic demand and congestion levels. Table 2 clarifies the systemic and localized operational issues for these critical movements. Details are provided in the following discussion.

Figure 8 Top Five Critical Movements

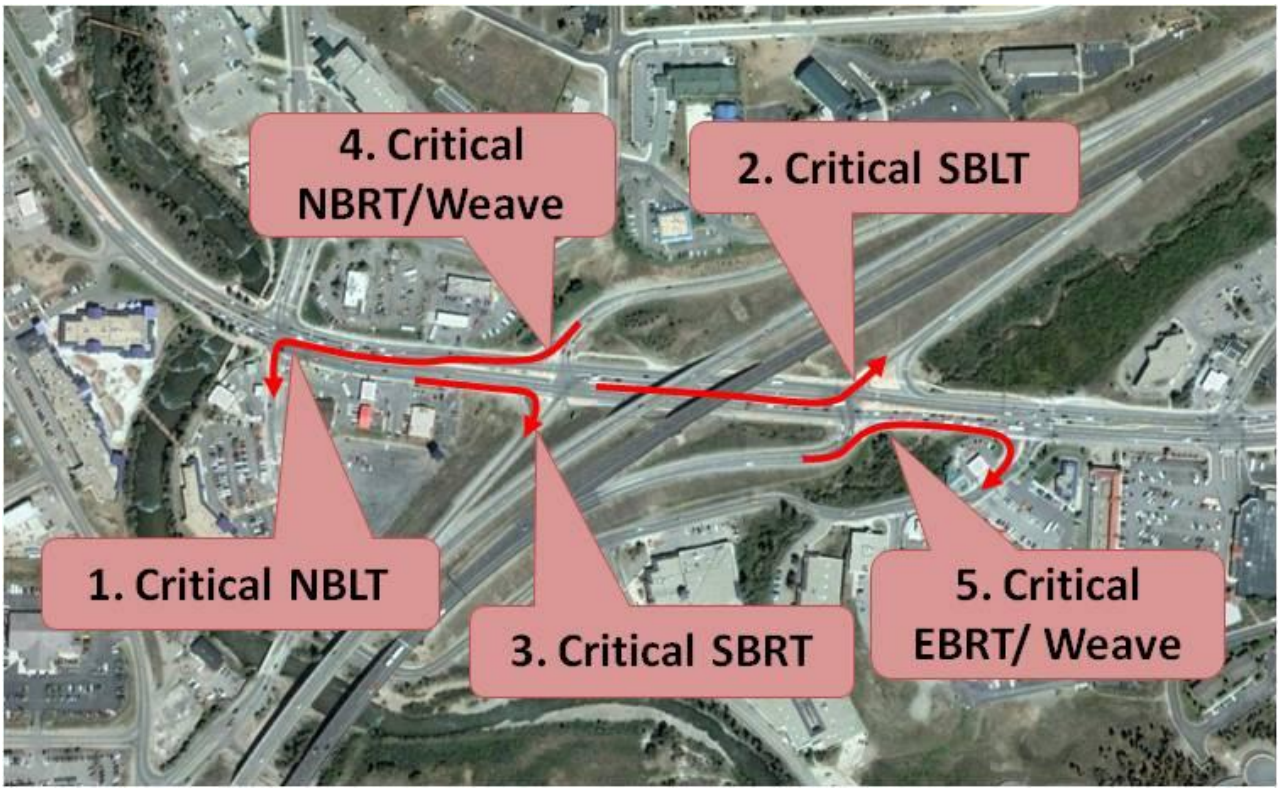
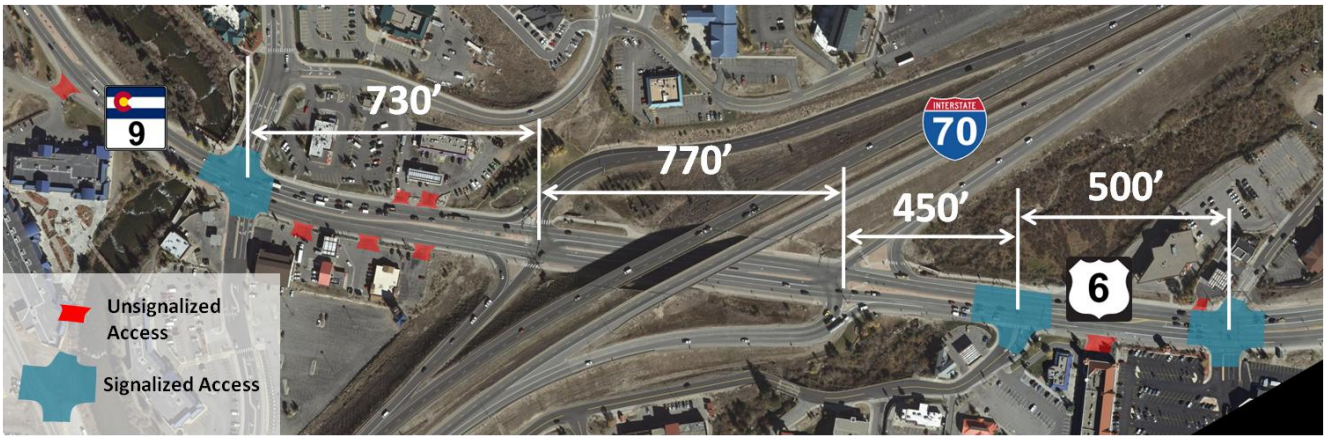


Table 2 Critical Movements and Issues

RANK	CRITICAL MOVEMENTS	ISSUES
1	**SH 9/Wildernest:** Northbound Left Turn (NBLT)	The left turn movement fails and backs up to the south through the westbound off-ramp. Poor levels of service and queue backups result. Split phasing at this intersection contributes to inadequate left turn capacity in all four directions.
2	**US 6/I-70 Eastbound On Ramp**: Southbound Left Turn (SBLT) (Steamboat to Denver)	The left turn movement fails and backs up to the north through the westbound off-ramp. Poor levels of service and queue backups result.
3	**SH 9/I-70 Westbound On Ramp**: Southbound Right Turn (SBRT) (Steamboat to Frisco)	Ramp capacity is constrained by lane widths, merge distances and the steep ramp grade. The grade results in slow moving trucks that delay other vehicles. Merge delays and delays caused by slow moving vehicles generate overall ramp speeds that are too low for the I-70 merge.
4	**SH 9/I-70 Westbound Off Ramp**: Northbound Right Turn (NBRT) (Denver to Steamboat) and Weave to SH 9/Wildernest Left Turn	The merge distance from the SH/I-70 westbound off ramp to the SH 9/Wildernest intersection is too short causing vehicles to cross up to three lanes of SH 9. This weave delays the ramp intersection movement backing up traffic onto westbound I-70, and constrains SH 9 northbound traffic.
5	**US 6/I-70 Eastbound Off Ramp:** Eastbound Right Turn (EBRT) and Weave involving Stephens Way (Frisco to Keystone)	Southbound vehicles on US 6 and vehicles exiting I-70 from Frisco southbound onto US 6 must merge and weave as they proceed from the ramp intersection to the US 6/Stephens Way intersection. The lack of merging and weaving capacity and right turn storage into Stevens Way causes poor levels of service including backups on US 6 and onto eastbound I-70.

SH 9 and US 6 Intersections: Numerous and closely spaced traffic signals, isolated areas without access control, and turning movements at intersections near the interchange limit through movement capacity on SH 9 and US 6. Conflicts between existing business access points and through movements on SH 9 and US 6 exist. These conflicts are expected to increase as new development and redevelopment occurs in this area. Existing access controls (medians) are in place on SH 9 and US 6 and guide traffic movement, but driveways serving specific businesses still exist in some areas. This access is important for existing business owners, but is disruptive to through traffic (See Figure 9).

Figure 9 Existing Driveways along SH 9 and US 6



The number and density of signalized and unsignalized local access points within close proximity to the I-70 interchange ramps causes much of the congestion along SH 9 and US 6 as well as difficulty accessing I-70. This congestion would be expected to increase as the Towns of Silverthorne and Dillon develop in this area.

The Wildernest/SH 9 skewed intersection's split phase signal timing and necessary green time for pedestrian activated movements limit through and left turn movement green times, resulting in reduced traffic capacity. The northbound left turn movement is a major impediment overall to efficient corridor operations.

The split phase signal operation cannot be eliminated without intersection expansion because of geometric lane balance through the intersection. For example, typical intersection approaches in each direction for the side streets provide a dedicated left turn lane, shared left turn/through lane, and a dedicated right turn lane. Because of the dual left offsets through the intersection, and the offset accepting lanes on the other side of the intersection, the signal phasing is restricted to split/phase operation. This allows each of the approaches to the intersection to run on its own protected signal phase, but reduces overall green time to SH9/US6 through movements. A signal timing change and other minor improvements could increase capacity, but a complete fix would require rebuilding the intersection and side street approaches along SH9/US6.

The spacing of intersections near the interchange results in acceleration/deceleration and weaving operational issues near the interchange ramp intersections. Motorists from Wildernest trying to reach the eastbound on ramp must weave across three through lanes to reach the left turn lane to get onto EB I-70.

The capacity of the SH 9 and US 6 intersections and relatively steep westbound on ramp substantially decrease when local roads are covered with snow or ice, which occurs frequently in the winter.

Evaluation of traffic operations, including operations at intersections, is based on level of service (LOS) calculations conducted in accordance with the *Highway Capacity Manual* 2010. LOS is a term used to describe the operating performance of an intersection or roadway. The operation is described by a letter designation from "A" to "F," with LOS A representing essentially uninterrupted flow with minimal delays, and LOS F representing a breakdown of traffic flow with excessive congestion and delay. Table 3 shows a comparison LOS between 2010 and 2035 conditions under No Action Conditions. Figure 10 presents anticipated peak period 2035 LOS under No Action conditions.

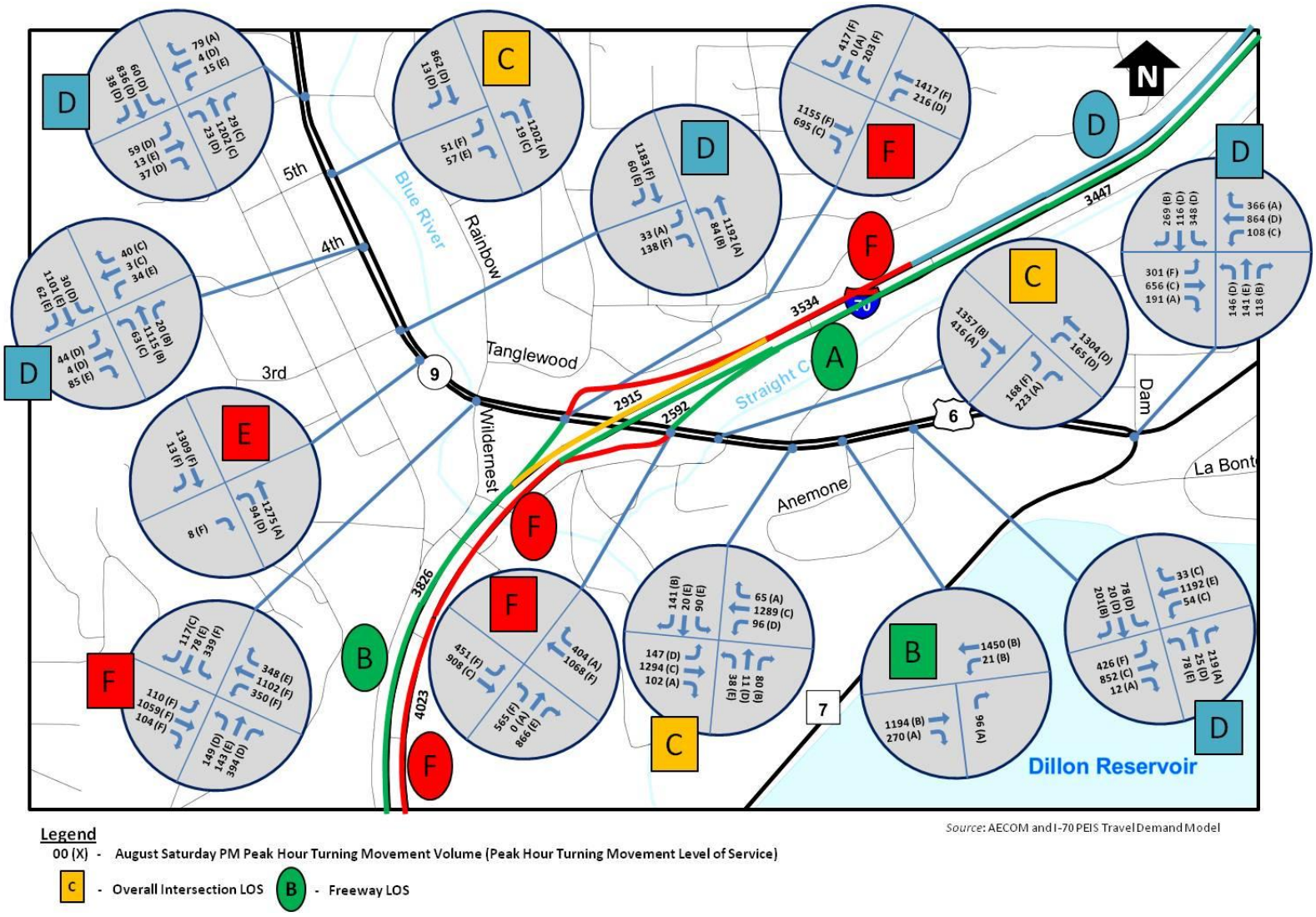
Table 3 No Action Level of Service (LOS) Comparison between 2010 and 2035 Conditions

Location	2010 LOS	2035 LOS
WB I-70 On Ramp	**A**	**B***
EB I-70 Off Ramp	**C**	**F**
WB I-70 Off Ramp	**B**	**F**
EB I-70 On Ramp	**B**	**A***
WB I-70 and SH 9 Ramp Intersection	**B**	**F**
EB I-70 and US 6 Ramp Intersection	**C**	**F**
6th and SH 9 Intersection	**B**	**D**
5th and SH 9 Intersection	A	C
4th and SH 9 Intersection	B	**D**
3rd and SH 9 Intersection	A	**D**
Nike Driveway and SH 9 Intersection	**A**	**E**
Wildernest and SH 9 Intersection	**D**	**F**
Stephens and US 6 Intersection	**A**	**C**
Little Beaver Trail and US 6 Intersection	**B**	**C**
Anenome Trail and US 6 Intersection	**A**	**B**
Dillon Ridge Road and US 6 Intersection	**C**	**D**
Dillon Dam Road and US 6 Intersection	**C**	**D**

*These levels of service are good only because of heavy upstream traffic bottlenecks.

This analysis includes the anticipated signal phasing improvements that resulted from the recent study prepared by Felsburg, Holt and Ulevig in 2010.

Figure 10 **2035 No-Action/No-Build August Saturday Peak Hour Levels-of-Service and Peak Hour Turning Movements**



On and Off Ramps: The capacities of the I-70 Silverthorne/Dillon Interchange on and off ramps are limited by the capacity of the ramp intersections. The ramp stacking distances are insufficient, causing stacking to reach the through lanes on I-70. More specifically, the following operational problems exist:

- Motorists using the westbound off ramp who plan to turn left onto Wilderness at the SH 9/Wildernest intersection are required to weave across two SH 9 through lanes in a short distance.
- The left turn movement from SH 9 to eastbound I-70 has inadequate capacity/storage.
- Motorists using the eastbound off ramp turning right onto US 6 are required to negotiate southbound weaving vehicle movements on US 6 associated with turns onto Stephens Way. The Stephens Way intersection is only 450 feet away from the ramp intersection.
- Motorists using the westbound on ramp must merge into one lane over a short, non-standard, distance before merging with I-70 westbound traffic. This merge is complicated by a steep grade.

I-70: In the westbound direction, there are three lanes east of the interchange, two lanes across the interchange bridge and three west of the interchange bridge. In the eastbound direction, there are two travel lanes west of the interchange, two lanes across the interchange bridge, and three lanes east of the interchange. These lane changes are associated with on and off ramps to the SH 9/US 6 interchange. The Blue River Bridge is also a constraint in significantly widening I-70 to allow for improved acceleration and deceleration lanes as well as for improvements in through traffic capacity. In the future, through traffic volumes on the two westbound and two eastbound lanes are anticipated to increase, but widening to three lanes is not needed in 2035, and this improvement is not part of the Consensus Alternative for I-70.

In summary, areas of traffic operational concern include:

- 2035 forecasts indicate that demand involving the left turn lane from SH 9 to eastbound I-70 is approximately two times the available capacity provided by the existing single left turn lane.
- Split phasing at Wildernest (all movements) is contributing to the overall levels of congestion.
- Split phasing is also seriously constraining the quality of signal progression along US 6/SH 9. This lack of good signal progression is also contributing to congestion in 2035. A signal timing change and other minor improvements could increase capacity, but a complete fix would require rebuilding the intersection and side street approaches along SH9/US6.
- Freeway operations are significantly impacted by the lack of capacity at the ramp signals. There are significant backups onto the freeway from the ramp intersections that do not have adequate capacity. Once traffic flows past the ramp intersections with SH 9/US 6, good traffic conditions are again evident.
- The proximity of the Stephens intersection to the eastbound I-70 ramps leads to northbound traffic stacking through the Stephens intersection and the short southbound weave between I-70 and Stephens Way is also contributing to congestion.

5.3 Multimodal Connectivity

There are three primary multimodal connectivity needs.

Local Bus Service Efficiency: Important local bus service routes and stations are located within the study area. Future roadway improvements need to ensure that bus movements and bus passengers are accommodated, and that future opportunities for expanded local bus service are not limited or precluded by future improvement plans.

Accommodating Future Regional Transit Plans: Transit improvements characterized in the Revised Draft PEIS for the I-70 Mountain Corridor may involve constructing substantial facilities at or near the I-70 Silverthorne/Dillon Interchange. Opportunities for these improvements should not be limited or precluded by future improvement plans.

Bike and Pedestrian: Accommodations for pedestrians and cyclists along SH 9 and US 6 in the interchange area are needed. On road bike lanes are not present along SH 9 and US 6. Trails and sidewalks are available along, near, and under SH 9 (Blue River Trail) and sidewalks are available along portions of US 6.

The sidewalks are underutilized because they do not provide direct access between certain origins and destinations and because some sidewalks and crosswalk transitions are in poor condition. As shown in Figure 6, hazardous shortcuts are used. In the winter, the sidewalks under I-70 are often difficult to use because of accumulated snow and ice. This occurs because plows deposit snow on the sidewalks under the I-70/SH 9/US 6 bridge. This condition persists because there is no other space for this snow and because of slow melting times in shaded areas.

6. Conclusion

The following presents the key needs of the project:

SAFETY

- High crash risks exist along SH 9 and US 6, particularly at and near intersections.
- Backups onto I-70, particularly from the eastbound off ramp, substantially increase I-70 safety risks and accident rates.
- High speeds and speed differences involving merging interchange ramp traffic and through traffic on I-70 create safety issues and accidents, particularly in association with the eastbound off ramp and westbound on ramp.
- Cycling on local sidewalks along SH 9 and US 6 and evidence of shortcuts across I-70 ramps and lanes creates safety issues despite the presence of the Blue River Trail.

CAPACITY

- The number and density of signalized and unsignalized local access points and turning movements within close proximity to the I-70 interchange ramps serves existing commercial development, but causes much of the congestion along SH 9 and US 6 as well as difficulty accessing I-70.
- Skewed intersections, split phase signals and necessary green time for pedestrian movements, particularly at the SH 9/Wildernest intersection, limit through and left turn movement green times, resulting in reduced traffic capacity along SH 9 and US 6.
- Motorists using the westbound off ramp who plan to turn left onto Wilderness at the SH 9/Wildernest intersection are required to weave across two SH 9 through lanes in a short distance.
- The southbound left turn movement from SH 9 to eastbound I-70 has inadequate capacity/ storage.
- Motorists using the eastbound off ramp turning right onto US 6 are required to negotiate southbound weaving vehicle movements on US 6 associated with the close proximity of the nearest interchange and intersection immediately to the south.
- Motorists using the westbound on ramp must weave into one lane over a short distance before merging with I-70 westbound traffic. This weave and merge is complicated by a steep grade.

MULTIMODAL CONNECTIVITY

- Existing local bus service and future transit service are important and should not be limited or precluded by future improvement plans.
- Direct access for pedestrians and cyclists under I-70 is limited because some sidewalks and crosswalk transitions are in poor condition and/or are difficult to use in the winter.

With substantial anticipated growth in population, employment and traffic in the area, the need for improvements will intensify over time. To meet these needs, improvements must provide safe, efficient and reliable routes for local and regional travel, while addressing business accessibility needs, providing short-term multimodal connectivity, and not precluding future regional transportation options.