Record of Decision 4: Appendix A

Traffic and Transportation Technical Memorandum

April 2017

EXPRESS LANES | NORTH I-25

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1 INTRODUCTION

1.1 Purpose of Document

Transportation analysis, impacts, and improvements were previously identified within the *North I-25 Final Environmental Impact Statement* (FEIS) dated August 2011 for existing and 2035 conditions. The purpose of this technical memorandum is to update the analysis to 2040 traffic forecasts and to conduct safety assessment in support of the Reevaluation and Record of Decision (ROD) Number 4, or ROD4.

1.2 Summary of 2011 FEIS Conditions

The existing data for the 2011 FEIS were collected in two parts by Felsburg Holt & Ullevig (FHU). In 2005 and 2006:

- Ramp volume data were collected for all interchanges between the 84th Street interchange and SH 1 interchange.
- Volumes on the mainline were collected using three CDOT Automatic Traffic Recorders (ATRs) and two radar counters. These five counters were set up in 2006 on I-25 north of SH 7, south of US 34, south of SH 1, north of 84th Avenue, and north of 136th Avenue. All other mainline volumes were then calculated by distributing volumes from the furthest upstream counter using on-ramp and off-ramp volumes. The ramp volumes were then adjusted in order to bring the mainline volumes to within one standard deviation of the average weekday traffic volumes originally measured by the five counters.

Overall, the study area for the 2011 FEIS reported volumes and operational statistics for the I-25 mainline and ramps between the SH 1 interchange in northern Colorado and the 20th Street interchange in downtown Denver.

Traffic volumes on North I-25 reflect typical patterns that are easy to recognize. The highest volumes of traffic on the mainline and on interchanges are nearest to Denver, and volumes reduce further away from Denver before increasing between Loveland/Greeley and Fort Collins. The high volumes on I-25 create congestion that breaks down operations frequently. Between Loveland/Greeley (US 34) and Fort Collins traffic breaks down during the AM and PM peak periods and on weekends, when traffic volumes are high in both directions.

1.3 Changes in Existing Conditions since the 2011 FEIS

The existing condition year established by the 2011 FEIS was 2006. This data is nine years old and changes in socio-economic conditions and traffic patterns have occurred in the ensuing years. For this ROD4 update, traffic data collected by others in 2012 have been used to establish a new existing conditions assessment.

The following geometric changes have taken place within the study corridor:

- In 2011 safety improvements were completed at the I-25 and US 34 interchange. These improvements changed the interchange from a full clover leaf to a partial cloverleaf with two lane off-ramps to ramp terminal signals. The existing on-ramps remained unchanged.

- In 2012 improvements to the I-25 and Crossroads interchange were completed. These improvements consisted of replacing the existing stop controlled ramp terminals to two-lane roundabout terminals with associated ramp approach improvements. No improvements were constructed on I-25.
- In 2014 a full reconstruction of the I-25 and SH 392 interchange was completed. The new tight diamond interchange with signalized ramp terminals included a full reconstruction and widening of SH 392, relocation of the west frontage road further west, and new ramps that tie into existing I-25.

1.4 Travel Demand Modeling

Traffic forecasts for this analysis are based on the latest available "off-the-shelf" North Front Range Metropolitan Planning Organization (NFRMPO) 2040 model sets. The FEIS 2035 traffic forecast model was an amalgam of contemporaneous Denver Regional Council of Governments (DRCOG) and North Front Range Council of Governments (NFRCOG) 2035 traffic models supplemented with updated socio-economic assumptions for the North I-25 Corridor. As the FEIS analysis area overlapped the planning areas and their common boundary, an aggregation was needed to examine a wide-ranging set of alternatives.

NFRMPO models reflect NFRMPO-derived scenarios and are not specific to the ROD4 action. This memo's findings are intended to support environmental analyses needed in the initial stage of assessments. A parallel forecasting effort to develop custom ROD4 forecasts is currently being conducted at the time of writing. These later, more detailed, forecasts will provide better resolution of transportation impacts but will also take longer to finish. Therefore, the results of this memo should be considered preliminary, developed to support early ROD4 evaluations.

Two NFRMPO models were used in this analysis:

- 2040 No-Build. The NFRMPO 2040 No-Build model includes two general purpose (GP) lanes in each direction with one express lane (EL) north of SH 14 to south of Harmony (limits of ROD 1). From the end of the EL lanes at this point there are 2 GP lanes in each direction through SH 60. The inclusion of EL lanes in the No-Build Analysis in this memo is due to their presence in the corresponding NFRMPO model.
- 2040 2 Plus One. This NFRMPO model has 2 GP lanes and one EL lane throughout the corridor.

The manner of modeling EL's in the NFRMPO models is to have the entrances and exits to and from the EL occurring at nearly the same location as the ramp movements to and from the GP lanes. In the operations analyses presented later in this memo, these demands are applied to discreet locations either down or upstream of the ramp terminal based on locations previously identified in the FEIS. The operational analysis for freeway segments before and after ramp locations where EL movements are traversing the GP lanes reflect the actual total demand of combined EL and GP traffic and associated weaving.

Forecasts presented in tabular form are cited south of a given interchange, a point where all reported movements between EL and GP ramps are assumed to be feasible.

Due to this feature of the NFRMPO models, total ramp demand is the sum of EL and GP demands. Table demands reported south of an interchange do reflect the actual segment demand south of all EL and GP ramp activity associated with the interchange in question.

2 TRAFFIC OPERATIONS ANALYSIS

2.1 General Study Area Roadway Features

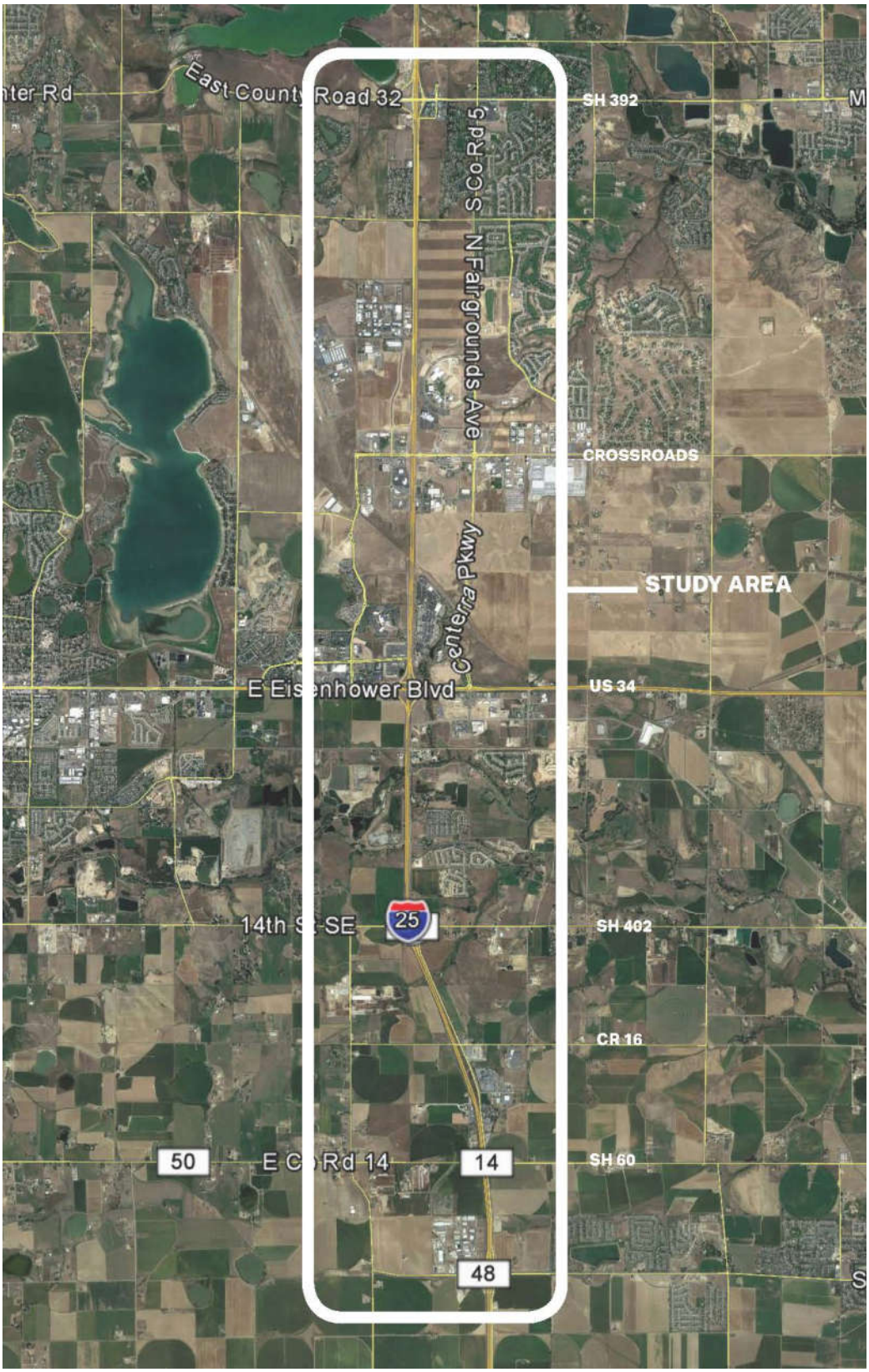
The study area is located north of Denver, Colorado, on Interstate 25 (I-25) between SH 60 and SH 392. Figure 1 shows the traffic analysis study area. The study area has numerous roadway facilities that provide access throughout the area including numerous arterial corridors and frontage roads. Major roadways within the study area include:

- Freeways: Freeways provide for interregional travel and carry the greatest proportion of regional trips. The freeway within the study area includes I-25 from Milepost (MP) 250.5 through MP 262.5 which serves north – south traffic throughout Colorado. The freeway provides six full or partial interchanges at SH 60, CR 16, SH 402, US 34, Crossroads Boulevard, and SH 392.
- Principal Arterials: Principal arterials carry regional trips while serving local access. Principal arterial within the study area include SH 60, CR 16, SH 402, US 34, Crossroads Boulevard, and SH 392.

This technical memorandum included the following traffic operations analysis:

- Existing conditions updated to 2016 traffic
- 2040 No-Action as reflected in the NFRCOG 2040 No-Build Traffic Model
- 2040 Selected Alternative with two general purpose lanes and one express lane traffic operations.

Figure 1. Study Area



2.2 Traffic Analysis Methodology

Operational analysis is generally performed following three methodologies:

- **HCM 2010 Capacity Analysis:** Freeway facility, merge and diverge analysis is performed using the Highway Capacity Manual (HCM) 2010 methodology. The FREEVAL (FREeway EVALuation) 2010 tool was used for the analysis. The software outputs LOS as a measure of effectiveness and is a recognized approach to evaluating highway performance. In FREEVAL analysis, the segment evaluations are divided into undersaturated (when demand on one or more freeway segment is below its capacity) and oversaturated (when demand on one or more freeway segments exceed its capacity). If no oversaturated segments are encountered, the segment performance measures are aggregated over the length of the directional freeway facility and over the time duration of the study interval. Once oversaturation is encountered, the methodology changes its temporal and spatial units of analysis that focus on the computation of segment average flows and densities in each time interval and are aggregated to produce facility wide estimates.
- **Synchro Intersection Analysis:** Intersection analysis is performed using the Synchro software. The software uses volume and geometric data, as well as signal timing parameters, to optimize the capacity of the signalized intersections. Synchro generates delay calculations for different signal phasing and signal offset schemes, and selects the one with the least overall network delay.
- **Rodel Roundabout Analysis:** Rodel software, version 1.88, was used for roundabout traffic analysis that is based upon the HCM 2010 methods. Rodel is an empirically based software package for the analysis and design of roundabouts. Roundabouts are used to control traffic flow at intersections without the use of stop signs or traffic signals. The Rodel software uses volume and geometric data to analyze the capacity of the roundabout. The roundabout capacity is influenced by the entering, circulating, and exiting traffic flows. Rodel adjusts roundabout capacity to reflect geometric details such as effective flare length, entry radius, circulating width, inscribed circle diameter, etc.

The freeway LOS is determined by the density (in passenger car per mile per lane or pc/mi/ln) of a segment of the facility where LOS A indicates a free-flow operation and LOS F indicates breakdown, with volume exceeding capacity. Density is the number of vehicles occupying a given length of a roadway per lane at a specific time period. Density measures the proximity of vehicles to one another, and reflects the freedom to maneuver within the traffic stream. The LOS criteria varies by segment type (freeway facility; freeway segment; weave, merge, diverge segment) and is shown in Table 1.

Table 2 presents the relationship between LOS and delay for signalized intersections and roundabouts.

Table 1. LOS Criteria by Facility/Segment Type

LOS	Density (pc/mi/In)	
	Freeway Facility[1]	Merge/Diverge Segment
A	≤ 11	≤ 10
B	> 11–18	> 10–20
C	> 18–26	> 20–28
D	> 26–35	> 28–35
E	> 35–45	> 35
F	> 45 or v/c > 1.00	v/c > 1.00

Notes: v/c: volume/capacity

Source: *Highway Capacity Manual 2010*, Transportation Research Board

[1]Freeway Facility composed of continuously connected basic freeway, weave merge, and diverge segments

Table 2. LOS Criteria for Signalized Intersections and Roundabouts

LOS	Control Delay (sec/veh)	
	Signalized Intersection	Roundabout/Unsignalized
A	≤ 10	0–10
B	> 10–20	> 10–15
C	> 20–35	> 15–25
D	> 35–55	> 25–35
E	> 55–80	> 35–50
F	> 80	> 50

Source: *Highway Capacity Manual 2010,* Transportation Research Board

The following parameters were assumed in the freeway analysis:

- Truck demand: 10-percent average trucks (single unit and combination) based on CDOT's *Online Transportation Information System* (OTIS) for general purpose lanes. It was assumed that no trucks would use the express lanes.
- Speed limit: 70 mph (GP Lanes and EL) based on 2013 speed data collected by CDM-Smith during low volume conditions
- Freeway mainline corridor terrain: Rolling based on CDOT OTIS
- Morning peak period analyses were assumed between 7:00AM – 8:00AM and between 5:00PM – 6:00PM analyses for the afternoon peak period. The analysis for both periods was converted to 15-minute time steps using the assumed peak hour factor (PHF) of 0.95
- For express lane, the access and egress areas were assumed to be 1,000 feet long and located a minimum of 2,500 feet from the nearest interchange on-ramp (in the case of access points) or off-ramp (in the case of egress points) based on 2011 FEIS assumption.

The following signal timing parameters were assumed in the cross-street analysis:

- Peak hour factor (PHF): 0.92 (existing) and 0.95 (2040 future year)

- Speed limit: between 30 mph and 45 mph depending on the locations.
- Signal controller: actuated-coordinated
- Yellow (Y) plus all red (AR) time, equal to five seconds (Y=3, AR=2)
- Cycle length (C): between 90 and 120 seconds depending on the locations and scenarios.

2.3 Assessment of Existing Conditions

2.3.1 Existing Roadway Conditions

Existing North I-25 corridor provides of two travel lanes each direction. Figure 2 shows the existing mainline, ramp merge/diverge, lane configuration and typical cross section. Current conditions are identical to Existing in the 2011 FEIS.

2.3.2 Existing Traffic Volumes

The existing traffic counts were documented in 2005 and 2006 for the FEIS. This data is ten years old and traffic patterns have changed over the years. For this updated traffic analysis (ROD4), the existing traffic volumes were compiled, adjusted, and balanced based on traffic counts at SH 392 (All Traffic Data (ATD), 2016), Crossroads Boulevard (ATD, 2013), and US 34 (ATD, 2013), Interchange selection report at SH 402 (FHU, 2014), and Synchro reports at CR 16 and SH 60 (Muller Engineering, 2014).

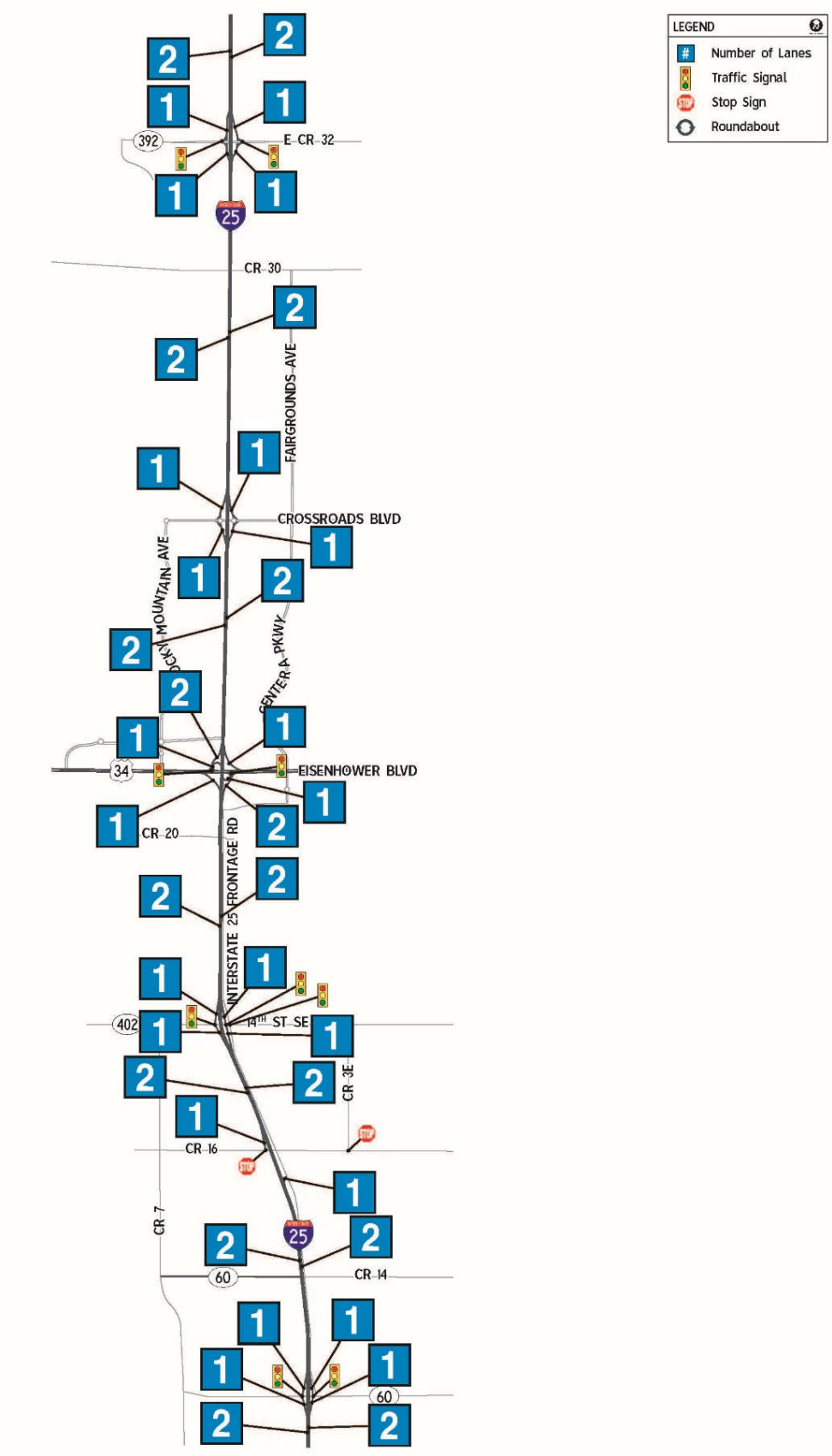
Table 3 shows estimated existing 2016 daily traffic. The mainline I-25 daily traffic is relatively balanced by direction within the study area. As shown, average daily traffic (ADT) along I-25 is between 84,800 vehicles per day (vpd) and 91,400 vpd. The highest daily volumes occurred south of US 34 interchange followed by south of Crossroads Boulevard interchange and south of SH 402 interchange. All ramp ADTs are less than 10,000 vpd, with the exception of US 34 off-ramps (northbound and southbound) and US 34 on-ramp (southbound).

Table 3. Existing 2016 Daily Traffic

I-25 Location – South of Interchange	Existing 2016 Daily Traffic Adjusted[1] (vehicles per day)						
	Northbound (NB)			Southbound (SB)			Mainline Daily Total
	Off-Ramp	On-Ramp	South of Interchange	Off-Ramp	On-Ramp	South of Interchange	
SH 392	7,000	6,600	42,400	6,400	7,200	42,400	84,800
Crossroads Blvd.	4,500	3,400	43,500	4,600	5,700	43,500	87,000
US 34	11,100	8,900	45,700	12,800	15,000	45,700	91,400
n/s to EB		4,600			6,800		
n/s to WB		4,300			8,200		
SH 402	6,800	8,500	44,000	5,700	4,000	44,000	88,000
CR 16	2,500		46,500	4,100		39,900	86,400
SH 60	2,500	5,500	43,500	1,400	3,400	41,900	85,400

[1]Existing 2016 ADT were estimated from various counts between 2013 and 2016.

Figure 2. Existing Roadway Conditions



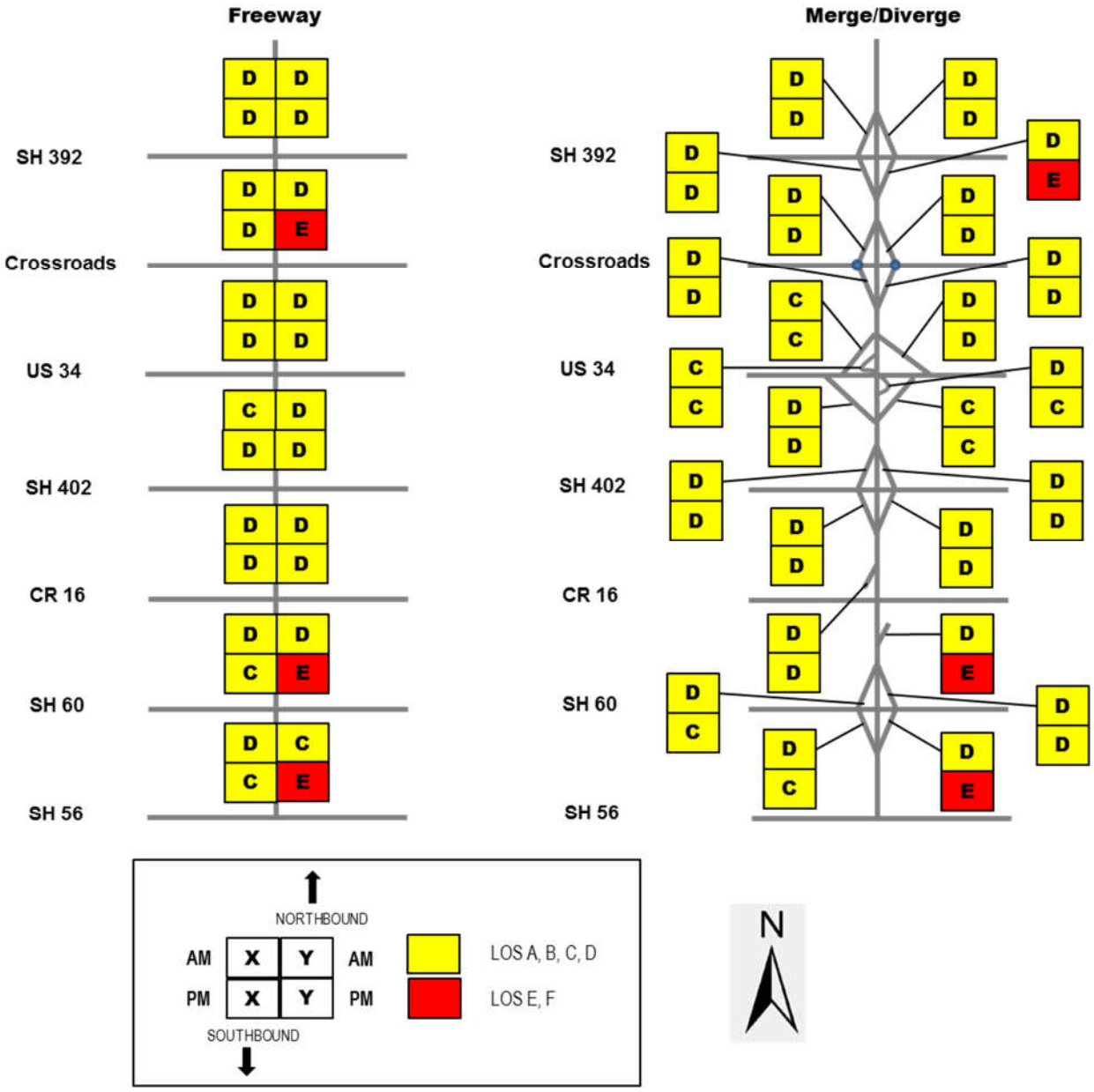
2.3.3 Existing Conditions Capacity Analysis

A traffic operations analysis of the existing traffic volumes was completed for the study area freeway facilities and cross street intersections as described in Section 2.2.

2.3.3.1 Freeway Sections

The analysis of I-25 interchanges within the study area includes an assessment of mainline and ramps merge/diverge sections. Figure 3 shows the mainline freeway LOS and merge/diverge LOS. As shown, the mainline and ramps merge/diverge levels of service operate at an acceptable LOS (LOS D or better) during both the AM and PM peak hours. These LOS estimates are similar to the results documented in the I-*25 Managed Lanes Traffic Operations Analysis* (Muller Engineering, 2014). Most locations drop from LOS C to LOS D in comparison to the existing 2011 in 2011 FEIS (FHU, 2011).

Figure 3. Existing Mainline and Ramp LOS



2.3.3.2 Arterial Street Intersections

The signalized intersections, two-way stop controlled intersection, and roundabouts are forecast to operate at LOS D or better with the exception of the SH 402/East Frontage Road during both peak hours, and SB Ramp/SH 402 and NB ramp/SH 402 intersections during the PM peak hour as shown in Table 4.

Table 4. CDOT Noise Abatement Criteria

No.	Intersection	Control	Existing	
			AM Peak LOS	PM Peak LOS
1	SH 60/SB Ramp	Signal	B	B
2	SH 60/NB Ramp	Signal	A	A
3	SH 60/East Frontage Road	Signal	C	C
4	CR 16/SB Ramp	TWSC	A	B
5	CR 16/NB Ramp	Signal	NA	NA
6	CR 16/East Frontage Road	TWSC	B	C
7	SH 402/SB Ramp	Signal	C	E
8	SH 402/NB Ramp	Signal	D	E
9	SH 402/East Frontage Road	Signal	F	F
10	US 34/SB Ramp	Signal	B	B
11	US 34/NB Ramp	Signal	B	B
12	Crossroads Blvd/SB Ramp	Roundabout	A	A
13	Crossroads Blvd/NB Ramp	Roundabout	A	A
14	SH 392/SB Ramp	Signal	B	B
15	SH 392/NB Ramp	Signal	B	B

2.4 2040 No-Action

2.4.1 2040 No-Action Roadway Conditions

There are no changes of roadway condition for 2040 No-Action.

2.4.2 2040 No-Action Traffic Forecasts

The 2040 NFRMPO model forecasts consisted of two types:

- Unadjusted forecasts consisting of values directly out of the model assignment procedure.
- Adjusted forecasts using adjustments outlined in *Analytical Travel Forecasting Approaches for Project-Level Planning and Design* better known simply as "NCHRP 765" reflecting the NCHRP report number. This report is a tool box of techniques for directly creating project-level forecasts or for post-processing travel demand model results for use in the planning and design of highway projects.

Unadjusted and Adjusted forecast sets were provided by NFRMPO. A feature of some of the adjusted forecasts is that they often do not balance in and out of a particular node. For example, an on-ramp demand of 500 vehicles per hour (vph) and an upstream freeway demand of 1000 vph should sum to a total of 1500 vph downstream. With the adjustments made by NFRMPO, balancing of this type rarely occurs where adjustments are made. As a result, some additional balancing of demands was needed.

The procedure in this effort was to start with the total daily two-way adjusted demand across a section of I-25 and then to balance that daily total with the upstream and downstream totals at adjacent interchanges. With the exception of one location, that being south of Prospect, the balance of daily demands could be made by assuming that the daily differences were there result of net demands north and south of an interchange.

With the daily forecasts set, the unadjusted GP ramp demands were then adjusted such that the ramp demands matched the percentage change north and south of an interchange. Unadjusted peak hour demands were adjusted by similar amounts to reflect the daily totals on both sides of the interchange. This adjustment was made to GP demands only as the EL demands were assumed to be balanced and not in need of further adjustments.

One thing to note is that the combined peak hour demands (AM and PM) out of the models were approximately 21% of the daily totals. This was consistent throughout the GP demands and also was the result from the EL demands as well.

Previous FEIS 2035 forecasts reflect much higher volumes than the 2040 NFRMPO volumes. The 2035 FEIS model was a combined model of the NFRMPO and DRCOG models built from original 2030 versions of these travel demand models. Previous documentation has indicated that in addition to overall changes in land use and socioeconomic data the 2034 FEIS model likely over assigned trips to I-25. The volumes from the 2040 NFRMPO model still show a need for both the selected alternative described in this analysis and the overall I-25 Preferred Alternative of 3-general purpose lanes and 1-express lane in each direction.

Table 5 shows the 2040 No-Action daily traffic. As shown, average daily traffic along I-25 is forecast at between 100,500 vpd and 111,300 vpd. The ramps were forecast to be approaching 18,000 vpd for the US 34 ramps, and around 10,000 vpd for all other interchanges.

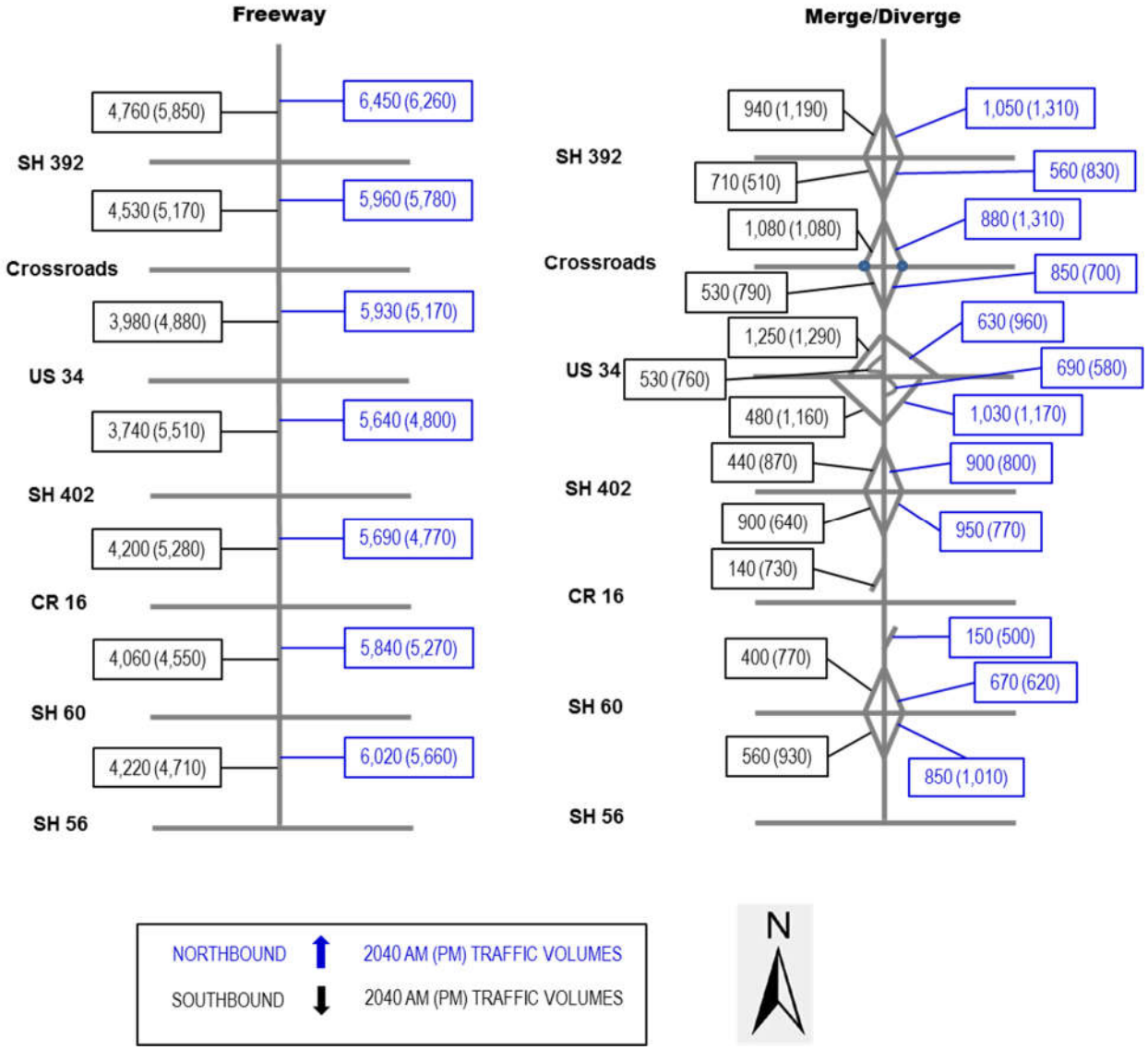
Figure 4 illustrates the 2040 No-Action AM and PM peak hour traffic volumes.

Table 5. 2040 No-Action Daily Traffic

Interchange	2040 No-Action Daily Traffic[1] (vehicles per day)						
	Northbound (NB)			Southbound (SB)			Mainline Daily Total
	Off-Ramp	On-Ramp	South of Interchange	Off-Ramp	On-Ramp	South of Interchange	
SH 392	7,200	11,900	54,200	13,600	8,900	54,200	108,400
Crossroads Blvd.	9,100	12,100	51,200	13,200	10,100	51,100	102,300
US 34	16,500	17,400	50,300	18,700	17,800	50,200	100,500
n/s to EB		7,700			9,900		
n/s to WB		9,700			7,900		
SH 402	10,300	9,400	51,200	7,700	11,400	53,900	105,100
CR 16	3,900		55,100	4,400		49,500	104,600
SH 60	11,100	10,300	55,600	4,500	10,700	55,700	111,300

[1]2040 No-Action ADT developed by AECOM from various data using 2040 NFRMPO travel demand model data as a basis.

Figure 4. 2040 No-Action Traffic Volumes



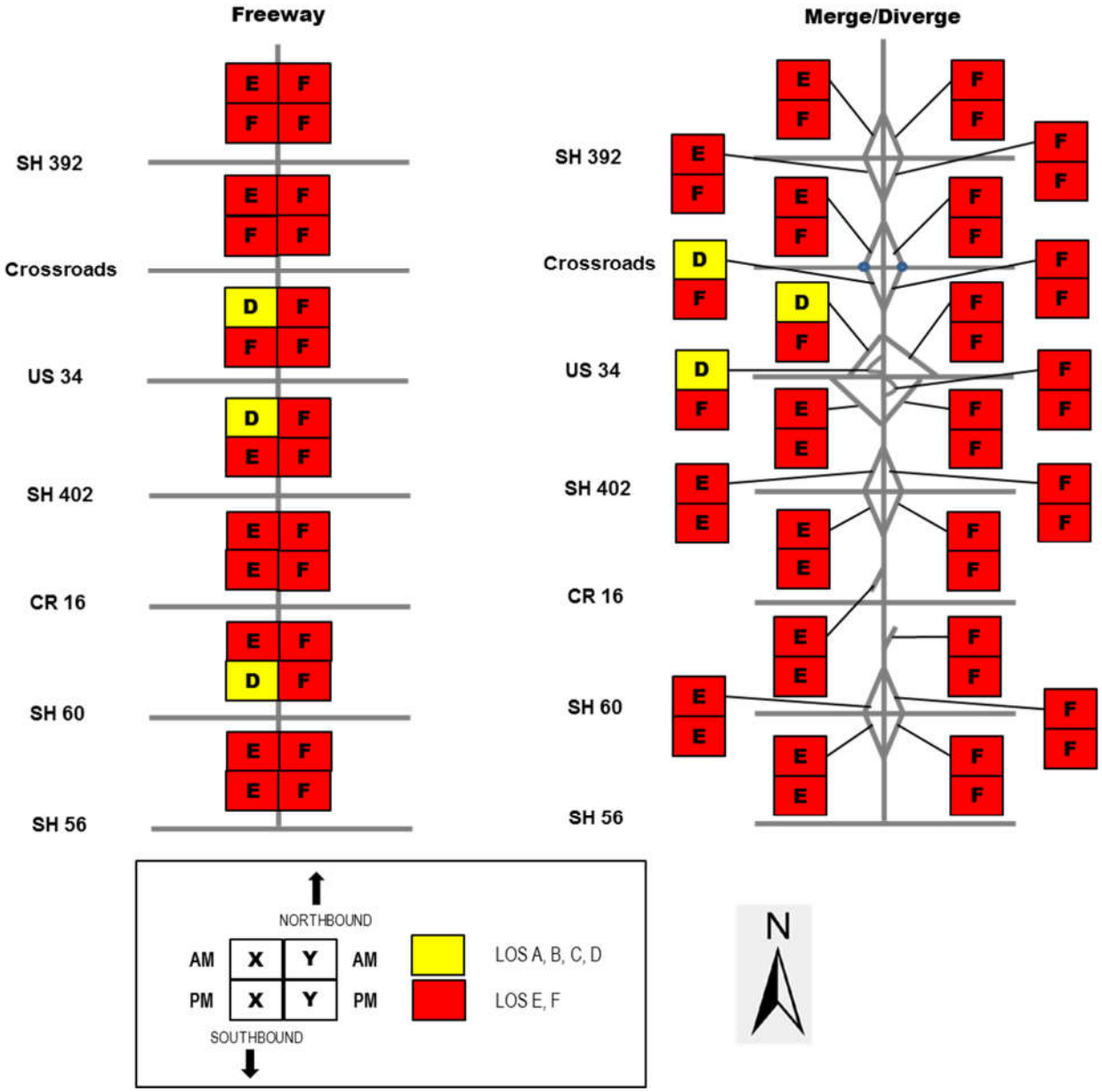
2.4.3 2040 No-Action Capacity Analysis

A traffic operations analysis of the 2040 No-Action traffic volumes was completed, for the study area freeway facilities and cross street intersections as described in Section 2.2.

2.4.3.1 Freeway Sections

The analysis of I-25 interchanges within the study area includes mainline and ramps merge/diverge sections. Figure 5 shows the mainline freeway LOS and merge/diverge LOS. As shown, the mainline and ramps merge/diverge levels of service are forecasted to operate between LOS B and LOS F for both the northbound and southbound directions during the AM and PM peak hours.

Figure 5. 2040 No-Action Mainline and Ramp LOS



2.4.3.2 Arterial Street Intersections

In the No-Action Alternative analysis, it was assumed that the existing ramp terminal intersections (where the on and off ramps meet the intersecting roads) would remain in the same configurations as the existing conditions.

As shown in Table 6, many of the intersections are forecast to operate at poor LOS F during both peak hours, particularly at the SH 60, LCR 16, SH 402 and Crossroads interchanges. The SH 392 interchange operates acceptably in the AM peak period, and the US 34 interchanges continue to operate acceptably in both the AM and PM peak periods.

Table 6. 2040 No-Action Intersections Level of Service

No.	Intersection	Control	Existing	
			AM Peak LOS	PM Peak LOS
1	SH 60/SB Ramp	Signal	C	F
2	SH 60/NB Ramp	Signal	F	F
3	SH 60/East Frontage Road	Signal	F	F
4	CR 16/SB Ramp	TWSC	D	F
5	CR 16/NB Ramp	Signal	NA	NA
6	CR 16/East Frontage Road	TWSC	F	F
7	SH 402/SB Ramp	Signal	F	F
8	SH 402/NB Ramp	Signal	F	F
9	SH 402/East Frontage Road	Signal	F	F
10	US 34/SB Ramp	Signal	C	D
11	US 34/NB Ramp	Signal	B	C
12	Crossroads Blvd/SB Ramp	Roundabout	F	F
13	Crossroads Blvd/NB Ramp	Roundabout	F	F
14	SH 392/SB Ramp	Signal	C	F
15	SH 392/NB Ramp	Signal	D	F

2.5 2040 Selected Alternative

2.5.1 2040 Selected Alternative Roadway Conditions

The 2011 FEIS defined the proposed improvements along the study corridor: additional lane for express lanes in each direction and upgraded interchanges at SH 60, CR 16, SH 402, US 34, and Crossroads Boulevard. Figure 6 shows the Selected Alternative interchange configurations assumed in this analysis.

2.5.2 2040 Selected Alternative Traffic Forecasts

Similar to the 2040 No-Action traffic forecasting methods, year 2040 Preferred Alternatives traffic volumes were forecasted. These included the balancing hourly demands in proportion to changes in daily totals, the adjustment upward of south of Prospect forecasts, and use of unadjusted EL forecasts.

Table 7 shows the 2040 Selected Alternative daily traffic for the general purpose lanes. As shown, average daily traffic along I-25 in the general purpose lanes is between 107,100 vpd and 118,600 vpd. The highest daily volumes occurred between SH 392 and US 34. The ramps ADTs were forecast to be approaching 18,000 vpd at US 34.

Table 7. 2040 Selected Alternative Daily Traffic for GP Lanes

I-25 Location – South of Interchange	2040 Selected Alternative Daily Traffic[1] (vehicles per day) – GP Lanes						
	Northbound (NB)			Southbound (SB)			Mainline Daily Total
	Off-Ramp	On-Ramp	South of Interchange	Off-Ramp	On-Ramp	South of Interchange	
SH 392	8,200	7,300	57,300	7,300	8,100	61,300	118,600
Crossroads Blvd.	9,300	10,700	55,300	10,700	9,400	60,000	115,300
US 34	13,600	14,100	55,300	17,100	14,000	56,500	112,000
n/s to EB		5,100			9,000		
n/s to WB		9,000			5,000		
SH 402	9,100	9,100	55,700	9,600	9,600	57,500	113,200
CR 16	2,900	2,900	56,900	3,100	2,700	58,000	114,400
SH 60	11,300	15,900	52,600	9,200	4,600	54,500	107,100

[1]2040 Selected Alternative ADT developed by AECOM from various data using 2040 NRFMPO travel demand model data as a basis.

Table 8 shows the 2040 Selected Alternative daily traffic in the express lanes. The 2040 NFRMPO volumes were reviewed and capped in locations where the volumes would degrade express lane operations below LOS C in peak hours. These volumes are much lower than the 2035 FEIS full preferred alternative volumes. Similar to the comparisons of the 2040 NFRMPO model output and the 2035 FEIS volumes it was noted that the previous EIS model was much higher than current projections. Actual volumes in the express lanes are being studied in an update to the corridor tolling and revenue study.

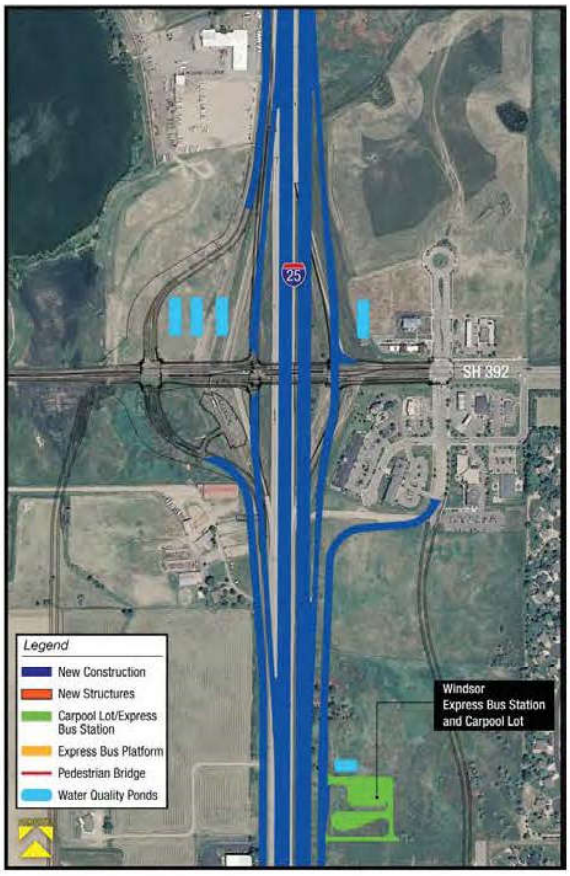
Table 8. 2040 Selected Alternative Daily Traffic for TEL

Interchange	2040 No-Build Daily Traffic[1] (vehicles per day) – EL		
	Northbound (NB)	Southbound (SB)	Mainline Daily Total
	South of Interchange	South of Interchange	
SH 392	7,700	4,000	11,700
Crossroads Blvd.	8,300	4,000	12,300
US 34	7,600	4,400	12,000
SH 402	7,400	3,400	10,800
CR 16	6,200	2,500	8,700
SH 60	5,900	1,400	7,300

[1]2040 Selected Alternative ADT developed by AECOM from various data using 2040 NFRMPO travel demand model data as a basis.

Figure 6. 2040 Selected Alternative Interchange Configurations

SH 392 Interchange (No-Action Improvement)



Crossroad Interchange
(Existing Roundaboutts to Remain)

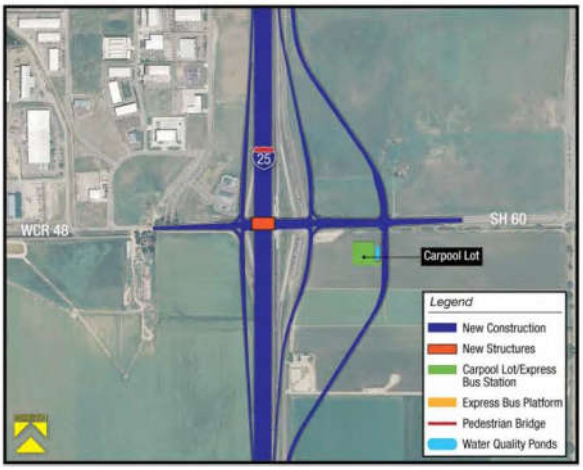
US 34 Interchange
(Note Only Diamond Interchange at I-25/US 34 and SB I-25 to EB US 34 and WB US 34 to SB I-25 Direct Connect Ramps included in ROD4)

SH 402 Interchange

Figure 6. 2040 Selected Alternative Interchange Configurations (*continued*)

LCR 16 Interchange

SH 60 Interchange



I-25 Typical Cross Section

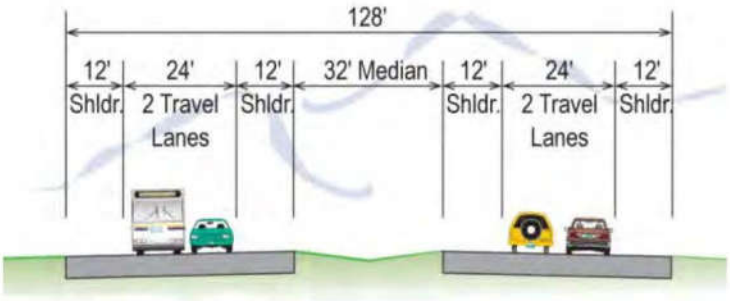
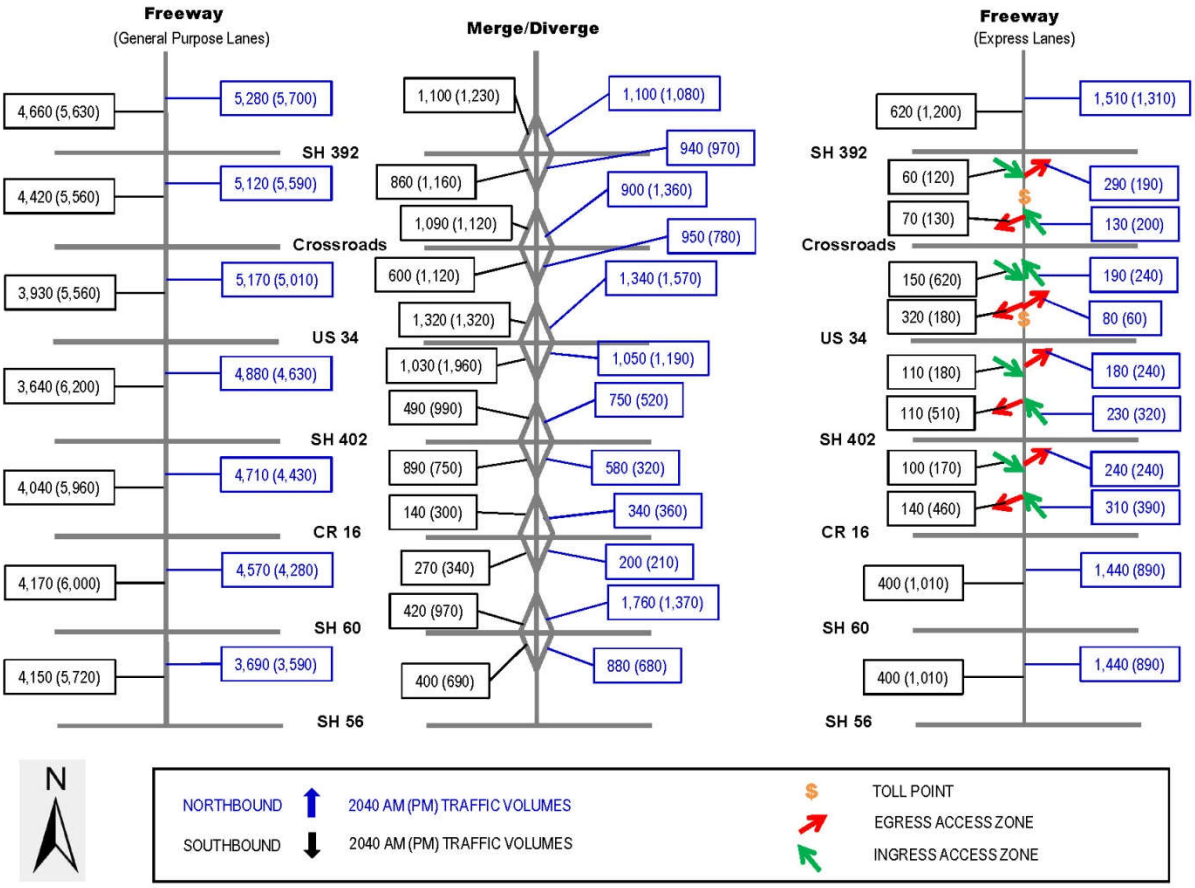


Figure 7. 2040 Selected Alternative Traffic Volumes



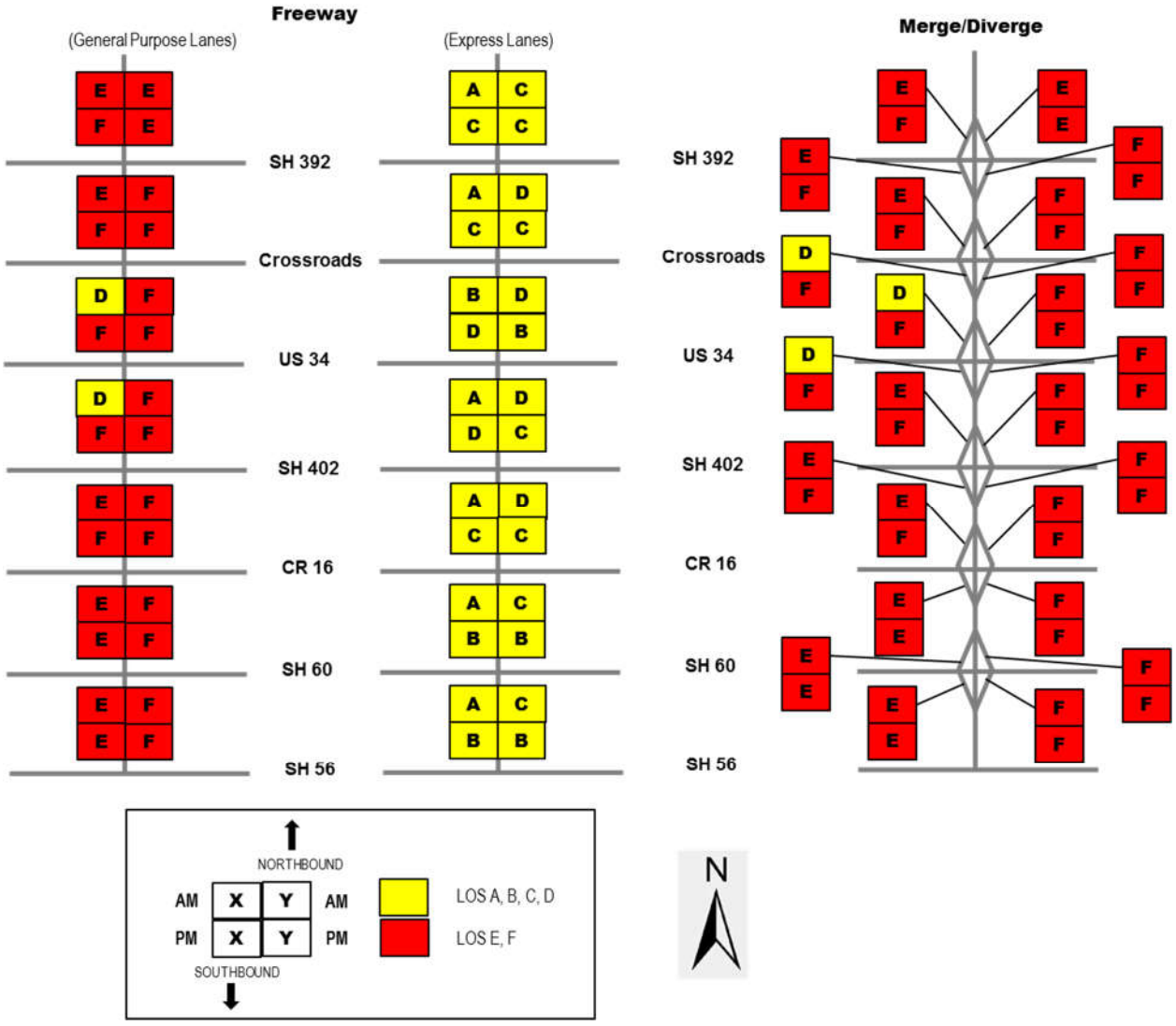
2.5.2.1 2040 Selected Alternative Capacity Analysis

A traffic operations analysis of the 2040 Selected Alternative traffic volumes was completed for the study area freeway facilities and cross street intersections as described in Section 2.2.

2.5.2.2 Freeway Sections

The analysis of I-25 interchanges within the study area includes an assessment of mainline and ramps merge/diverge sections. Figure 8 shows the mainline freeway and ramp LOS. As shown, the mainline and ramp merge/diverge levels of service are forecast between LOS B and LOS F in each direction during both the AM and PM peak hours. As shown, express lane levels of service are forecast to consistently operate better than the general purpose lane levels of service. Similar findings on 2011 FEIS that the 1,600 vehicles per lane is the maximum service volume in the toll lane, when the volume reaches more than the maximum, the LOS drops from acceptable LOS to poor LOS.

Figure 8. 2040 Selected Alternative Mainline and Ramp LOS



2.5.2.3 Arterial Street Intersections

In the 2040 Selected Alternative analysis, it was assumed that the existing ramp terminal intersections (where the on and off ramps meet the intersecting roads) would be signalized in the future 2040 Build, with the exception of Crossroads which would remain roundabout ramp terminals.

As shown in Table 9, the signalized intersections are forecast to operate at LOS D or better during the AM peak hour with the exception of Crossroads, where no improvements are planned beyond the No Action existing conditions.

Table 9. 2040 Selected Alternative Intersections Level of Service

No.	Intersection	Control	2040 Build	
			AM Peak LOS	PM Peak LOS
1	SH 60/SB Ramp	Signal	C	D
2	SH 60/NB Ramp	Signal	D	B
3	SH 60/East Frontage Road	Signal	C	C
4	CR 16/SB Ramp	TWSC	A	B
5	CR 16/NB Ramp	Signal	A	A
6	CR 16/East Frontage Road	TWSC	C	C
7	SH 402/SB Ramp	Signal	C	D
8	SH 402/NB Ramp	Signal	C	D
9	SH 402/East Frontage Road	Signal	A	E
10	US 34/SB Ramp	Signal	C	C
11	US 34/NB Ramp	Signal	B	B
12	Crossroads Blvd/SB Ramp	Roundabout	F	F
13	Crossroads Blvd/NB Ramp	Roundabout	F	F
14	SH 392/SB Ramp	Signal	C	B
15	SH 392/NB Ramp	Signal	B	B

3 TRAFFIC SAFETY HISTORY

3.1 Site Location

This study addresses a segment of Interstate 25 beginning at MP 250.00, just north of SH 56 interchange and extending to MP 269.00 which is at SH 14 interchange. The direction of increasing milepost (primary direction) for this section of I-25 is northbound. This section of I-25 is classified as an urban flat rolling mountainous 4-lane divided freeway. Figure 9 shows the safety assessment site location.

3.2 Crash History

Crash history for the five-year period, January 1, 2010 through December 31, 2014, was examined to locate crash clusters and identify safety problems. Table 10 summarizes the number of crashes for I-25. These totals include both mainline and ramp crashes along this segment. As shown in this table, the total number of crashes increased from year to year over the five-year study period, with the exception of year 2012.

During the five-year study period there were 2713 reported crashes within the study limits including mainline I-25 crashes, ramp crashes and ramp terminal intersection crashes. There were 1928 property damage only (PDO) crashes, 777 injury crashes, and 8 fatal crashes.

Table 10. Crash History SH 25A: MP 250.00 – MP 269.00

Period	Number of Crashes			
	PDO	Injury	Fatality	Total
2010	340	93	1	434
2011	361	165	2	528
2012	332	122	1	455
2013	399	177	1	577
2014	496	220	3	719
Total (5-year)	**1928**	**777**	**8**	**2713**
Overall 5-Year Average per Year	**385.6**	**155.4**	**1.6**	**542.6**

Source: CDOT Crash Data (2010-2014) compiled by AECOM

Figure 10 presents a graphical representation of crash types for this area. Rear end crashes (46%) were the predominant crash type followed by fixed object crashes (26%) and side swipe same direction crashes (13%). The data indicates there are higher than expected crashes than expected in the study area because of congestion, in particular the high number of rear end crashes.

Figure 9. Safety Assessment Site Location

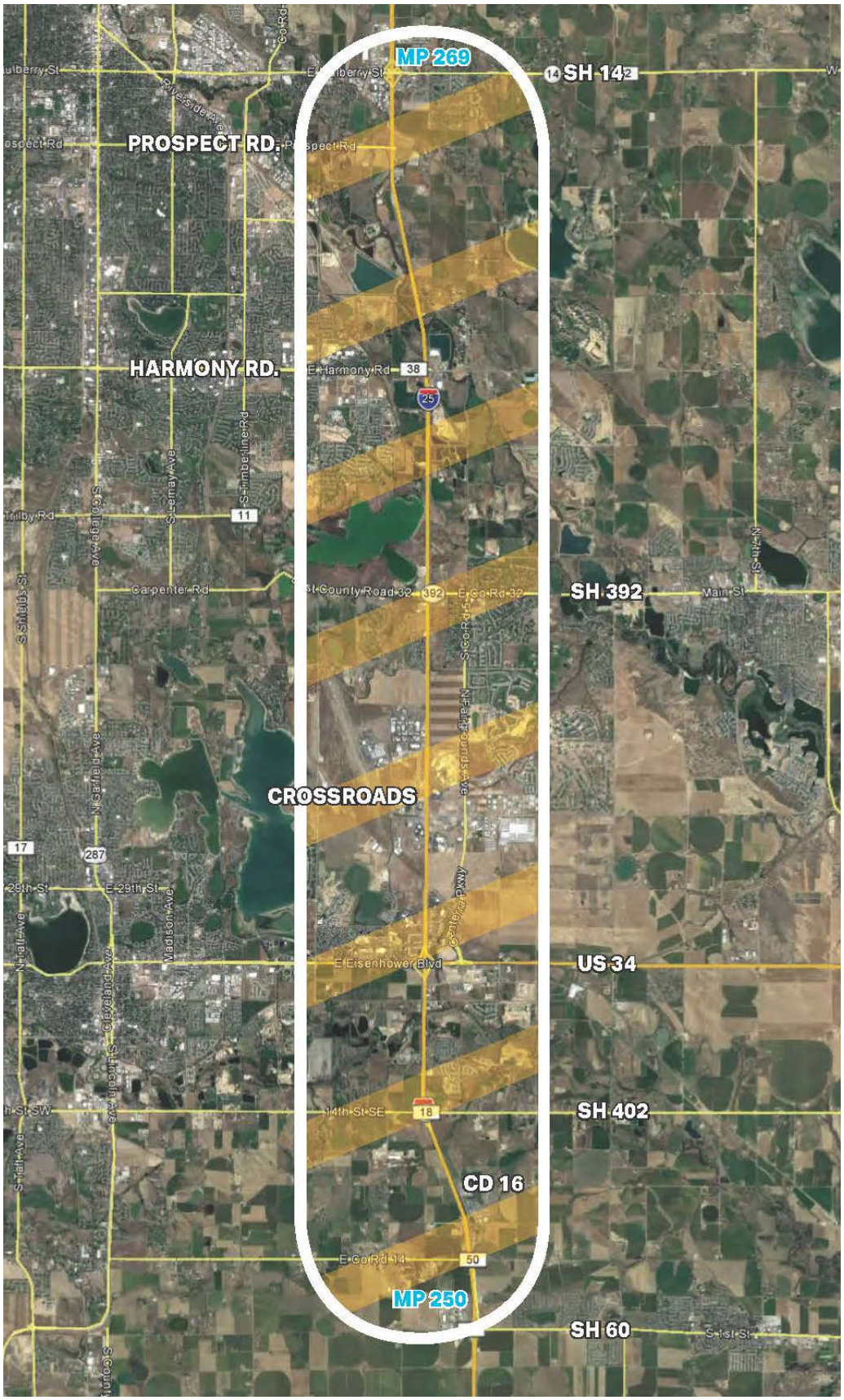
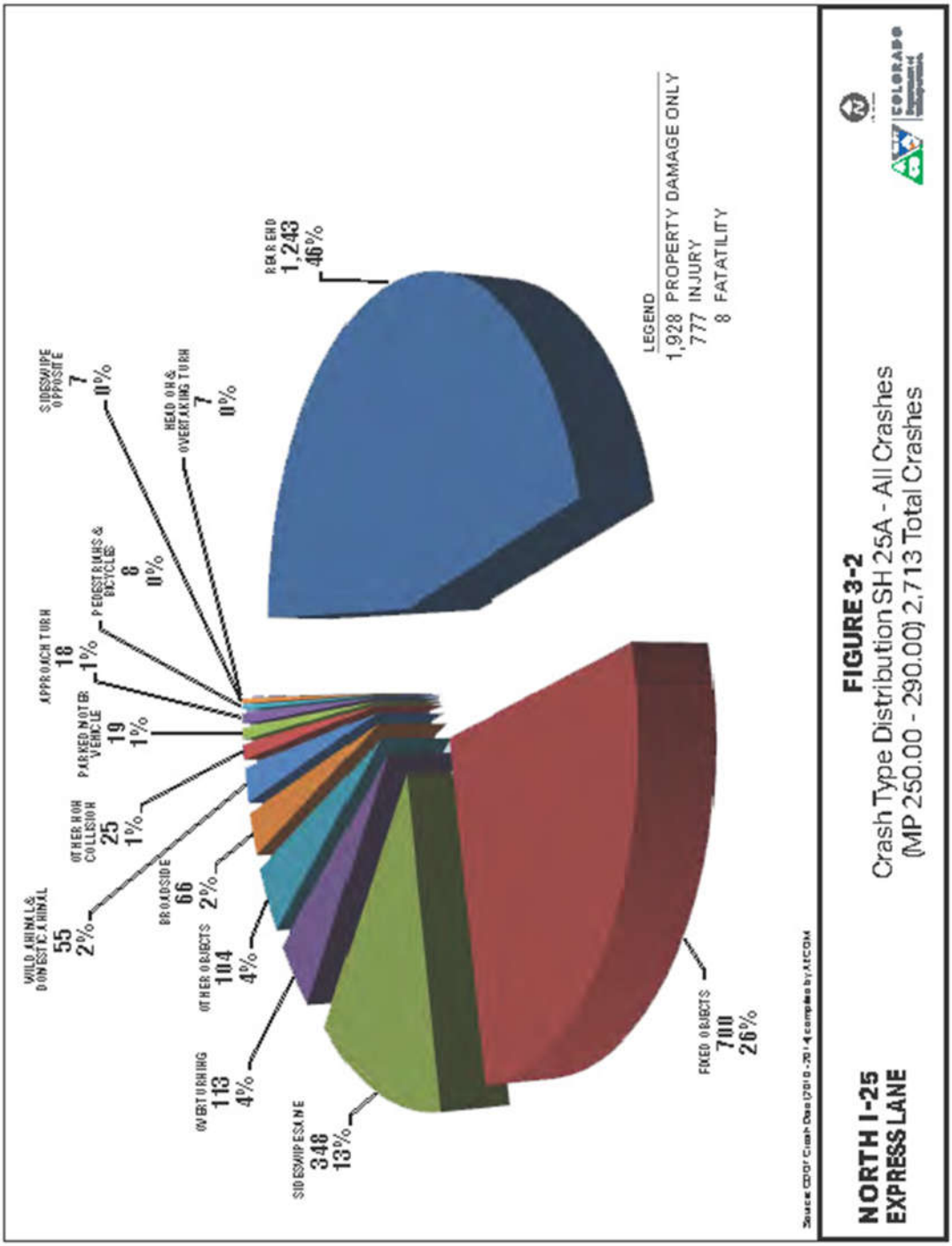


Figure 10. Crash Type Distribution



4 FINDINGS AND NEXT STEPS

The findings from the traffic analysis to support ROD4 are:

- The existing 2016 LOS operate at an acceptable LOS similar to the results documented in the *I-25 Managed Lanes Traffic Operations Analysis* (Muller Engineering, 2014).

- The 2040 No Action condition would result in continued congestion and reduced level of service on the I-25 general purpose lanes and at interchange ramp terminals.

- The Selected Alternative provides mode reliability and reduced travel times in the express lanes, and an overall travel time savings to the corridor. The general purpose lanes will continue to operate at poor levels of service similar to the No Action general purpose lanes.

- The interchanges included in the Selected Alternative would improve operations to an acceptable LOS level.

- The addition of the express lane and overall reduction and shoulder improvements included in the Selected Alternative should improve safety along the corridor, which has a high number of congestion related crashes.

5 REFERENCES

Final North I-25 EIS, Alternatives Development and Screening Report, Felsburg Holt & Ullevig, August 2011.

Final I-25 Managed Lanes Traffic Operations Analysis, Muller Engineering, July 30, 2014

Highway Capacity Manual 2010, Transportation Research Board.

Traffic and Revenue Assessment of Tolled Express Lanes Scenarios, CDM Smith, July 23, 2014.