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CROSSROADS BLVD FULL DIAMOND PACKAGE A

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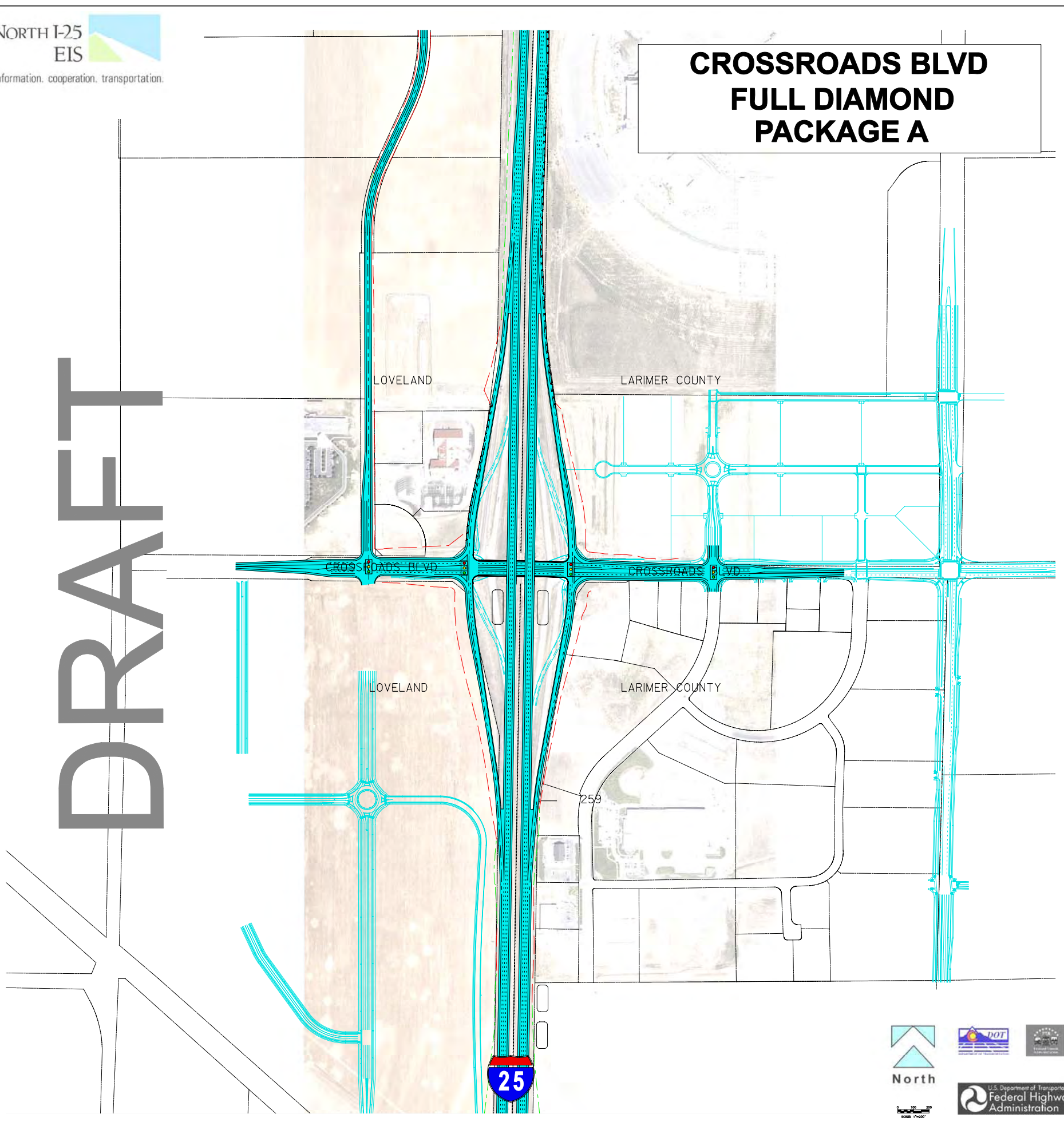

North

SCALE: 1"=200'

October 1, 2007

U.S. Department of Transportation Federal Highway Administration

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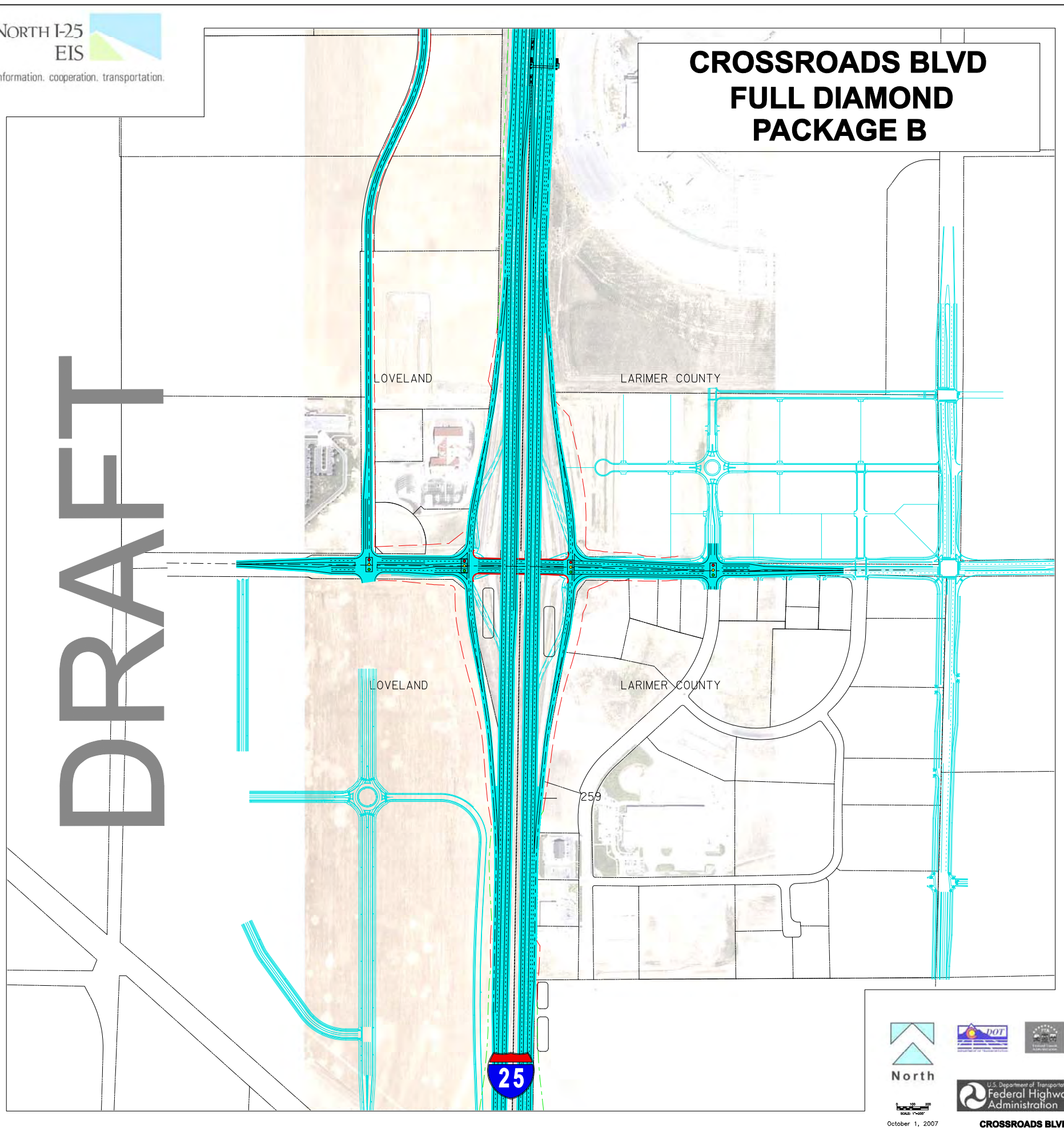
CROSSROADS BLVD FULL DIAMOND PACKAGE B



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October 1, 2007

U.S. Department of Transportation Federal Highway Administration

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Crossroads Boulevard at I-25
DEIS Interchange and Parking Evaluation

NORTH I-25 EIS
information. cooperation. transportation.

August 20, 2007

Introduction

This report describes the existing traffic volumes at this interchange and the adjacent intersections, as well as future traffic conditions with an improved interchange.

Existing Conditions

The Crossroads Boulevard interchange at I-25 was constructed in 1965. The interchange has a diamond configuration and is similar to several older diamond interchanges (i.e. SH 392, SH 402) in the corridor. The interchange ramps are one-lane with separate turn lanes at the ramp terminals.

The interchange area includes the following roadways:

Crossroads Boulevard. Crossroads Boulevard is an east-west two lane arterial roadway that connects I-25 to the rural areas north of Loveland to the west and to the Budweiser Event Center and SH 257 to the east. A number of developments have recently opened along Crossroads Boulevard. These include Harley Davidson and a large car lot. The speed limit is 40 mph in the vicinity of the interchange, and there are no turn lanes on Crossroads in the interchange area with the exception of the westbound to northbound right turn movement onto the I-25 northbound on ramp. Both ramp intersections are stop sign-controlled.

East Frontage Road. A frontage road is located on the east side of the interchange, approximately 150 feet east of the northbound ramp intersection. There are no turn lanes at the intersection with Crossroads Boulevard. The intersection is stop-sign controlled and the posted speed limit on the frontage road in the vicinity of the interchange is 40 mph.

West Frontage Road. A frontage road is located on the west side of the interchange, approximately 150 feet west of the southbound ramp intersection. There are no turn lanes at the intersection with Crossroads Boulevard. The intersection is stop-sign controlled, and the speed limit on the frontage road in the vicinity of the interchange is 40 mph.

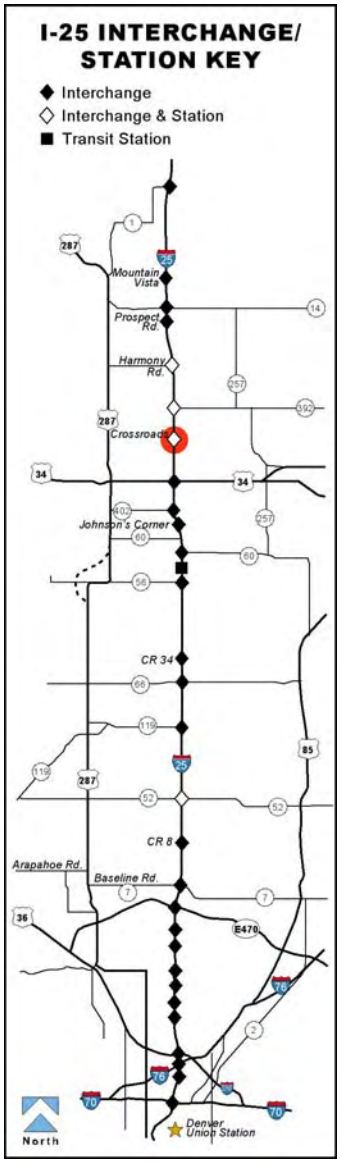

Figure 1. Vicinity Map

Figure 2 summarizes the traffic counts collected in August 2004 at this interchange. As shown, average daily traffic on Crossroads Boulevard is around 5,700 vehicles per day (vpd) west of the interchange and 14,600 vpd east of the interchange. The east and west side frontage roads have daily traffic volumes of approximately 500 vehicles and 5,600 vehicles north of Crossroads Boulevard, respectively. Daily ramp volumes are about 5,000 to and from the south and approximately 2,000 vehicles to and from north of Crossroads Boulevard.

At the interchange, each turning movements to/from the ramps is less than 300 vehicles per hour during the peak periods, with the westbound to southbound movement representing the highest traffic volumes in the morning and the opposing northbound to eastbound movement representing the highest volumes in the afternoon.

Traffic Operations

An operational analysis of the interchange was conducted based on methodology developed in the Highway Capacity Manual (Transportation Research Board, 2000). The result of such analysis is a level of service (LOS) rating. Level of service is a qualitative assessment of the traffic flow based on the average stopped delay per vehicles at controlled intersections (i.e. traffic signal, stop-sign).

Levels of service are described by a letter designation ranging from “A” to “F”, with LOS A representing essentially uninterrupted flow, and LOS F representing a breakdown of traffic flow with excessive congestion and delay. Signalized intersection analyses result in a level of service rating for each movement and for the entire intersection but typically only the level of service for the entire intersection is reported. For unsignalized intersections a level of service rating is determined for each turn movement that must yield to another turn movement but an overall level of service rating is not determined for the entire intersection. The following table shows how average stopped delay at controlled intersections equates to levels of service.

Table 1. Equivalent Level of Service to Average Stopped Delay and Density

Level of Service	Average Delay at Signalized Intersections in (sec./veh.)	Average Delay at Stop-Controlled intersections in (sec./veh.)
A	0 to <=10	0 to <=10
B	> 10 to <= 20	> 10 to <= 15
C	> 20 to <= 35	> 15 to <= 25
D	> 35 to <= 55	> 25 to <= 35
E	> 55 to <= 80	> 35 to <= 50
F	> 80	> 50

Figure 2 illustrates existing peak period levels of service at the ramp terminals, adjacent intersections and ramp junctions with I-25. Currently, the northbound left turn movement at the northbound I-25 ramp junction operates at LOS F during the PM peak period, but the remaining movements in the vicinity of the interchange operate at LOS D or better.

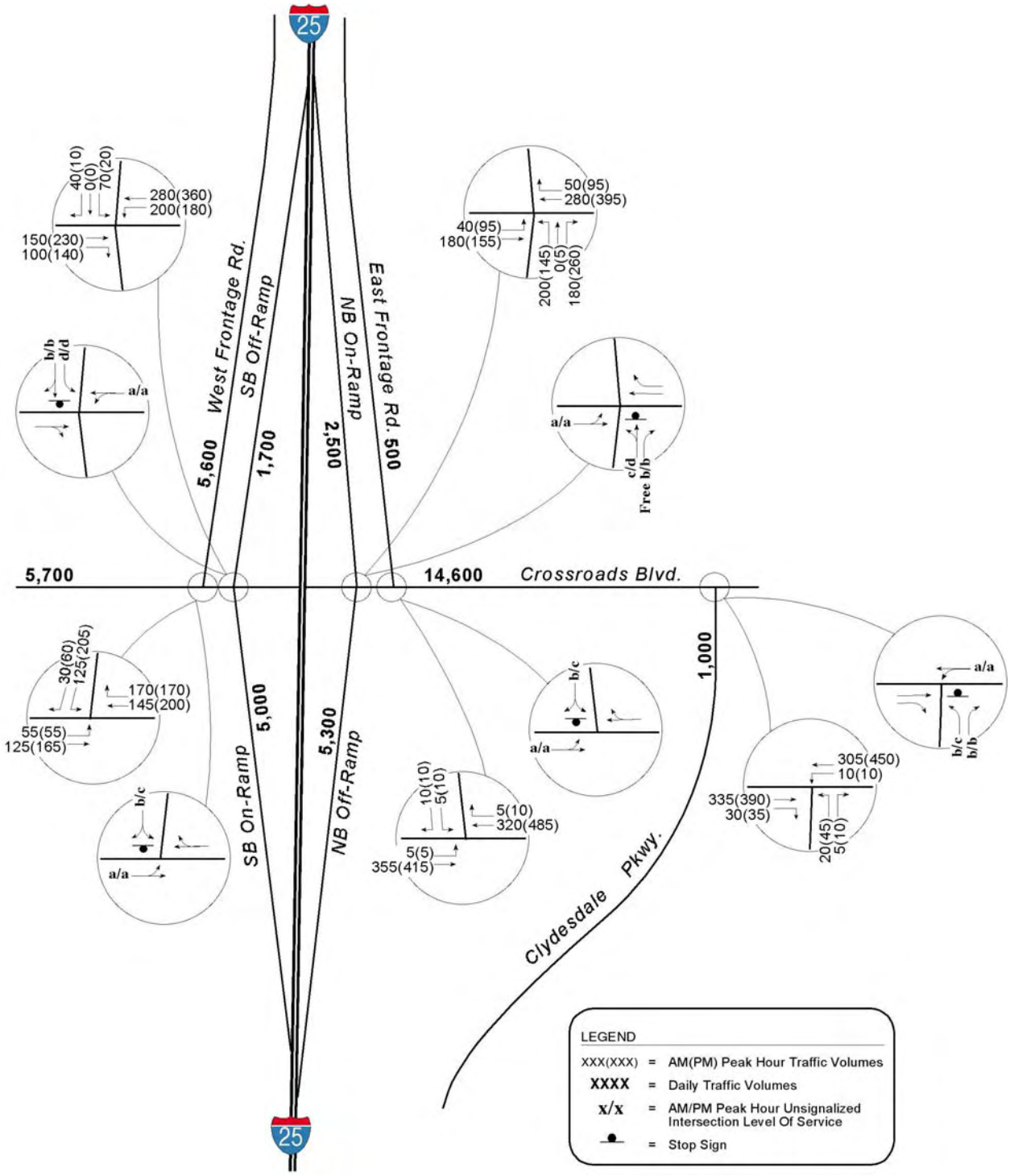

Figure 2. Existing Conditions

In addition to the intersection level of service shown in the figure, Table 2 provides additional information for key movements at each intersection to provide further insight into existing operations at the interchange. Key movements are those movements that could have an impact on adjacent intersections or an impact to I-25. For example, east-west movements along Crossroads Boulevard can queue into adjacent intersections and impede traffic flow at those locations, while vehicles on the ramps could queue back onto the interstate. North-south movements at the east frontage road intersection have not been included in the table because they would not impede traffic flow on Crossroads Boulevard. As shown in the table, the 95th percentile queue lengths for all movements were not greater than the distance between intersections or did not exceed the current storage length provided on the ramps.

Table 2. Existing Level of Service and Queue Lengths for Key Movements

Intersection / Movement	Level of Service		Estimated 95th Percentile Queue[1]		Intersection Spacing and Storage Length Provisions
	AM	PM	AM	PM	
West Frontage Road Intersection					
WB Approach	A	A	10’	20’	Distance to Adjacent Intersection – 100’
Southbound Ramp Terminal					
WB Approach	A	A	100’	120’	Distance to Adjacent Intersection – 360’
SB Left	D	D	70’	40’	Ramp Length – 900’
SB Right	B	B	50’	30’	Ramp Length – 900’
Northbound Ramp Terminal					
EB Approach	A	A	40’	80’	Distance to Adjacent Intersection – 360’
NB Left	C	D	100’	90’	Ramp Length – 900’
NB Right	Free	Free	N/A	N/A	Ramp Length – 900’
East Frontage Road Intersection					
EB Approach	A	A	10’	10’	Distance to Adjacent Intersection – 100’

[1] The queue lengths given in this table primarily come from SimTraffic with some engineering judgment. SimTraffic gives a queue length for each lane. For example, with dual left-turn lanes SimTraffic estimates a queue for each lane. In the table, for thru movements the queue length is the longest queue observed in any through lane. For multiple turn lanes (i.e. dual lefts), the queue length is the sum of the queues in each lane. For a single turn lane (i.e. right turn), the queue is just the queue for that lane.

2030 Conditions

2030 traffic projections were developed for the three alternatives being considered:

1) No-Action Alternative
2) Package A: GPL + CR + CB 85
3) Package B: TEL + BRT.

These three packages are illustrated in Figures 3 through 5. In developing peak hour turning movements at the ramp terminals and the nearest adjacent intersections, model results were calibrated against existing traffic counts to derive an adjusted model forecast. These adjusted forecasts along with existing turning movement data were used in the NCHRP 255 balancing procedure to develop 2030 peak hour turning movement forecasts. These forecasts were further adjusted, as necessary, to balance between intersections and for reasonableness.

2030 No Action Traffic Volumes

Figure 6 depicts 2030 daily and peak hour No Action traffic projections for the Crossroads Boulevard interchange and adjacent intersections. As shown, daily volume projections on Crossroads Boulevard range from 21,700 vpd east of the interchange to 29,500 vpd west of the interchange, and ramp volumes range from approximately 8,000 to 13,000 vehicles per day. These volumes show a large increase on the west side of the interchange. Ramp volumes continue to be higher to and from the south.

2030 Package A Traffic Volumes

Figure 7 depicts 2030 daily and peak hour Package A traffic projections for the Crossroads Boulevard interchange and adjacent intersections. The volumes in the figure are generally the same or higher than those presented in the No Action Alternative. Daily volume projections on Crossroads Boulevard range from 24,500 vpd east of the interchange to 32,000 vpd west of the interchange, and ramp volumes range from approximately 8,000 to 18,000 vehicles per day. The volumes patterns show higher volume on the northbound off ramp. The change in this particular volume may be high as a result of the modeling and balancing process; however, in order to account for the worst case scenario, this volume was retained and evaluated for Package A.

2030 Package B Volumes

Figure 8 depicts 2030 daily and peak hour Package B traffic projections for the Crossroads Boulevard interchange and adjacent intersections. The volumes in the figure generally depict patterns and volumes in the same order of magnitude as those in Package A.

2030 No Action Traffic Operations

Figure 6 shows the projected levels of service at the frontage road and ramp intersections on Crossroads Boulevard under the No Action Alternative. Note that the two ramp intersections were assumed to have roundabouts as traffic control, per the short-term improvement plans for the interchange. The roundabouts would provide additional traffic capacity through the interchange area in the near-term without having to widen the I-25 overpass over Crossroads Boulevard.

Figure 3. No Action Alternative

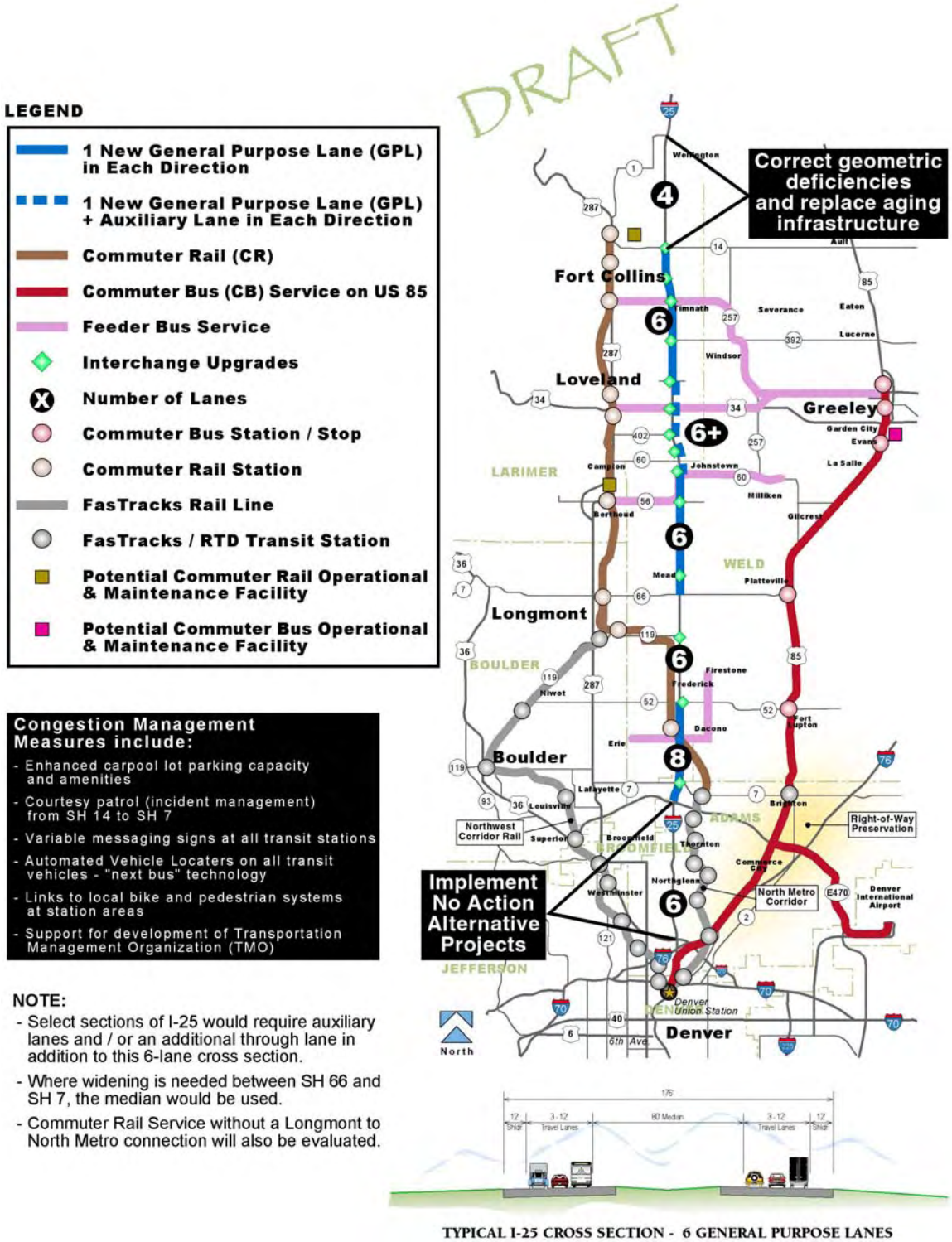

Figure 4. Package A: GPL + CR + CB 85

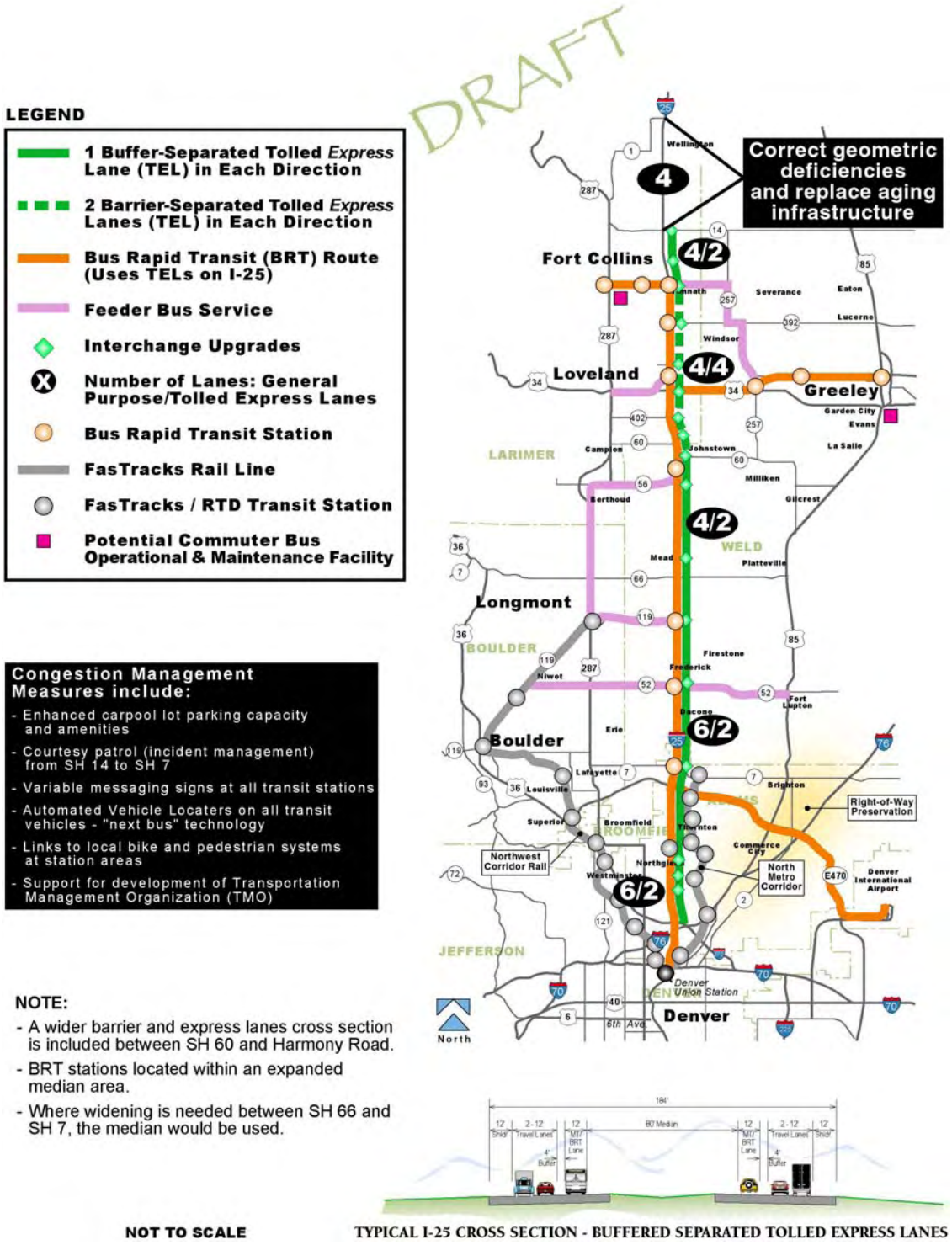

Figure 5. Package B: TEL + BRT

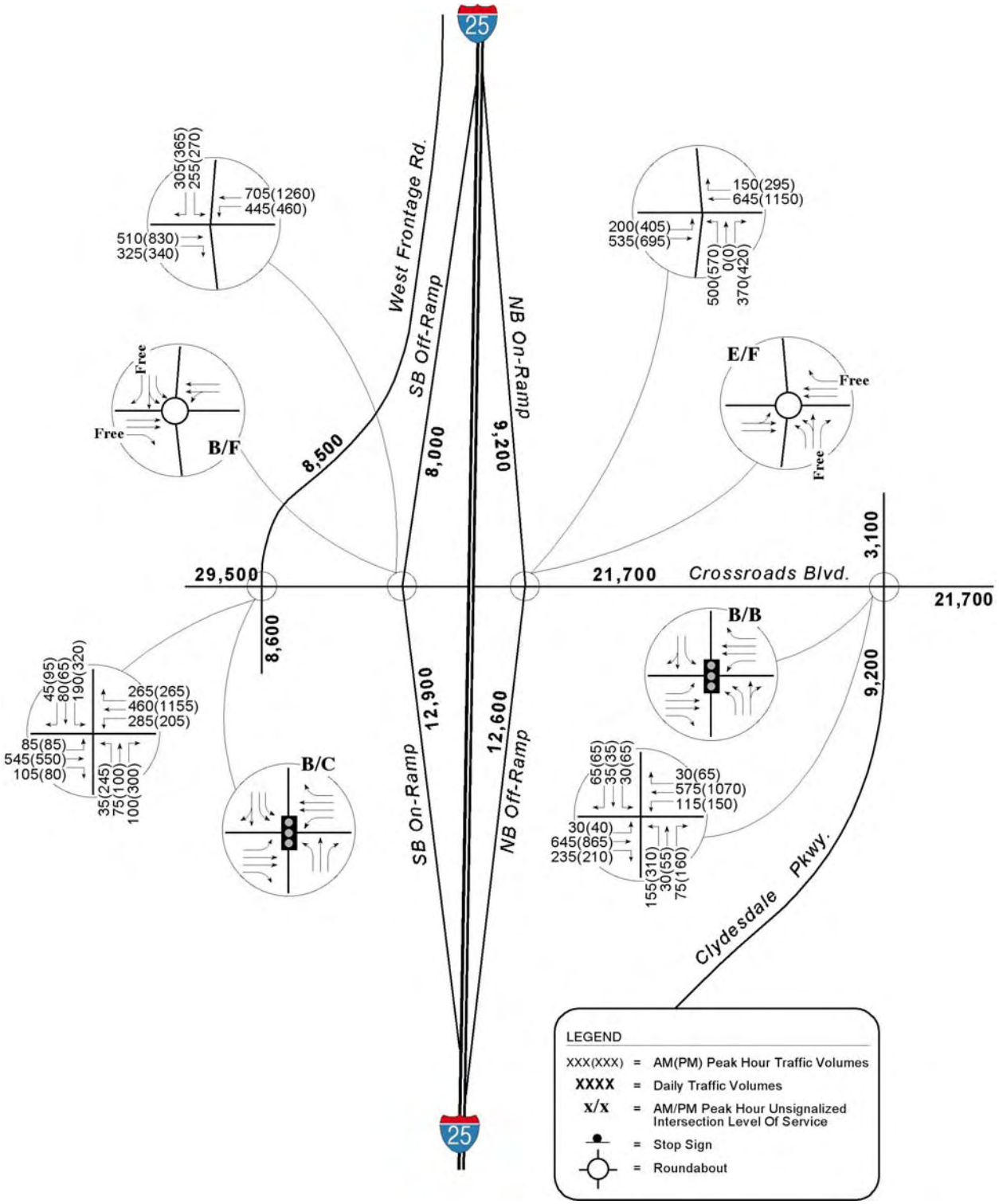

Figure 6. No Action Forecasts and Levels of Service

However as the figure indicates, by 2030 traffic volumes would be such that the roundabouts would be over capacity and operate at LOS F in the afternoon peak period. The side street movements at the frontage road intersections would operate at LOS or E or F in both peak hours, as well. Table 3 shows the projected queuing for key movements at the interchange and further underscores that the interchange (with roundabout) would be significantly over capacity with the projected traffic volumes.

Table 3. 2030 No Action Level of Service and Queue Lengths for Key Movements

Intersection / Movement	Level of Service		Estimated 95th Percentile Queue[1]		Intersection Spacing and Storage Length Provisions
	AM	PM	AM	PM	
West Frontage Road Intersection					
WB Left	A	A	160’	120’	Storage Provided – 250’
WB Thru	B	B	120’	150’	Distance to Adjacent Intersection – 500’
WB Right	B	B	60’	60’	Distance to Adjacent Intersection – 500’
Southbound Ramp Terminal					
WB Approach	F	F	0’	>400’	Distance to Adjacent Intersection – 400’
SB Approach	F	F	230’	>900’	Ramp Length – 900’
Northbound Ramp Terminal					
EB Thru/Left	A	F	0’	0’	Distance to Adjacent Intersection – 400’
NB Thru/Left	F	F	580’	>900’	Ramp Length – 900’
Clydesdale Frontage Road Intersection					
EB Left	B	B	60’	60’	Distance to Adjacent Intersection – 740’
EB Thru	C	C	190’	150’	Distance to Adjacent Intersection – 740’
EB Right	B	B	100’	70’	Distance to Adjacent Intersection – 740’

[1] For stop-sign controlled intersections the 95th percentile queues come from SimTraffic. For the two roundabout intersections SIDRA was used with some engineering judgment. SIDRA provides a longest quest output. SimTraffic gives a queue length for each lane. For example, with dual left-turn lanes SimTraffic estimates a queue for each lane. In the table, for thru movements the queue length is the longest queue observed in any through lane. For multiple turn lanes (i.e. dual lefts), the queue length is the sum of the queues in each lane. For a single turn lane (i.e. right turn), the queue is just the queue for that lane.

2030 Package A Traffic Operations

Interchange Configuration

The proposed Package A configuration for the Crossroads Boulevard interchange evaluation is a diamond configuration (Figure 7). The new interchange would increase the distance between the ramps to 600 feet, and shift the east frontage road intersection so that it is approximately 900 feet from the northbound ramp terminal and aligns with Clydesdale Parkway. The west frontage road would be shifted west to provide approximately 700 feet between the frontage road and the southbound ramps. At the interchange Crossroads Boulevard would be widened to seven lanes to accommodate dual left-turn lanes and two through lanes in both directions (one of the left turn lanes in each direction would be built back to back). The northbound and southbound off ramps would be constructed with two left turn lanes (one would be shared with a through movement) and a right turn lane. All four intersections would be signalized.

Interchange Operations

Figure 7 also shows the levels of service for the ramps and frontage road intersections, along with recommendations for laneage and storage at each location. As shown, all four intersections in the vicinity of the ramp are anticipated to operate at LOS C or better with the forecasted traffic volumes and the enhancements identified.

Table 4 summarizes the levels of service, queue lengths, intersection spacing and designed storage lengths for key movements at the interchange. As shown in the table, specific movement levels of service at this interchange range from LOS A to LOS D. No single movement operates with a substandard level of service; thus, the improvements identified at this interchange appear to provide good operations at both ramp terminals and at the frontage road intersection.

Table 4 also compares SimTraffic estimates of the 95th percentile queue length for key movements to the storage distance available for each. For turning movements, the distance listed is the planned turn lane storage length, while for through movements the length listed is the distance between intersections. The queuing analysis shows that in all cases the estimated 95th percentile queues would be contained within the turn bays or within the space between adjacent intersections. On both the northbound and southbound ramp terminals, the left and right turn queues would be accommodated well within the storage length and would not extend into the I-25 main lanes.

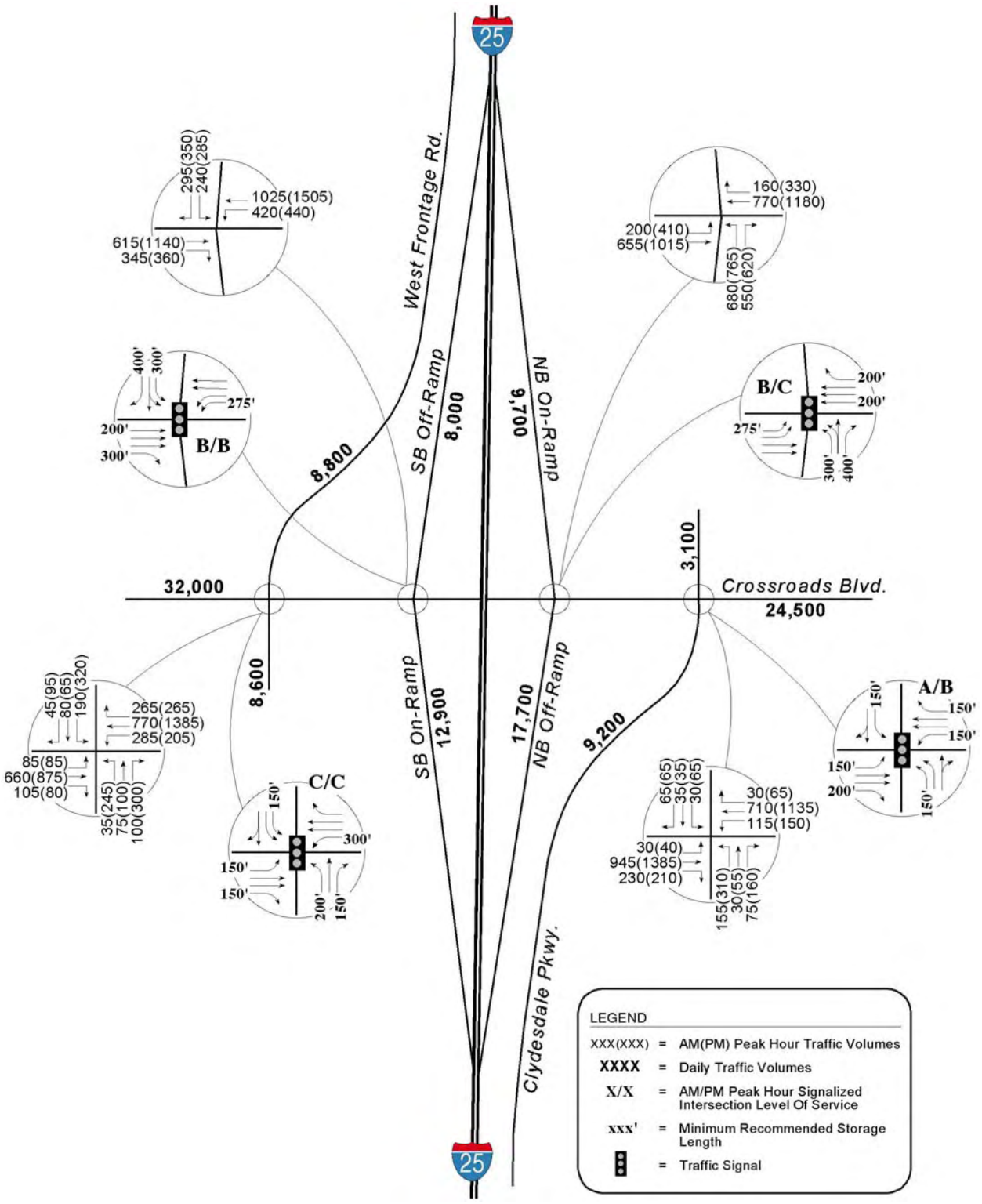

Figure 7. Package A Forecasts and Levels of Service

Table 4. 2030 Package A Level of Service and Queue Lengths for Key Movements

Intersection / Movement	Level of Service		Estimated 95th Percentile Queue[2]		Distance Between Intersections and Storage Length Provisions
	AM	PM	AM	PM	
West Frontage Road Intersection					
WB Left	B	B	210’	150’	Storage Provided in Design – 300’
WB Thru	B	B	160’	220’	Distance to Adjacent Intersection – 550’
WB Right	B	A	70’	110’	Storage Provided in Design – 300’
Southbound Ramp Terminal					
EB Thru	A	C	90’	210’	Distance to Adjacent Intersection – 550’
EB Right	A	B	140’	150’	Storage Provided in Design – 300’
WB Left	A	A	260’	430’	Storage Provided in Design – 1,000’
WB Thru	A	A	100’	130’	Distance to Adjacent Intersection – 610’
SB Left/Thru	C	C	200’	280’	Storage Provided in Design – 700’
SB Right	C	D	140’	210’	Storage Provided in Design – 400’
Northbound Ramp Terminal					
EB Left	C	C	170’	350’	Storage Provided in Design – 1,060’
EB Thru	A	B	150’	240’	Distance to Adjacent Intersection – 610’
WB Thru	B	C	230’	740’	Distance to Adjacent Intersection – 830’
WB Right	A	B	60’	260’	Storage Provided in Design – 200’
NB Left/Thru	B	C	320’	370’	Storage Provided in Design – 700’
NB Right	C	D	140’	230’	Storage Provided in Design – 400’
Clydesdale Frontage Road Intersection					
EB Left	A	A	40’	90’	Storage Provided in Design – 150’
EB Thru	A	B	130’	280’	Distance to Adjacent Intersection – 830’
EB Right	A	A	70’	140’	Distance to Adjacent Intersection – 200’
Note: The queue lengths given in this table primarily come from SimTraffic with some engineering judgment. SimTraffic gives a queue length for each lane. For example, with dual left-turn lanes SimTraffic estimates a queue each lane. In the table, for thru movements the queue length is the longest queue observed in any through lane. For multiple turn lanes (i.e. dual lefts), the queue length is the sum of the queues in each lane. For a single turn lane (i.e. right turn), the queue is just the queue for that lane.					

2030 Package B Traffic Operations

Interchange Configuration

The proposed configuration for the Package B Crossroads Boulevard DEIS interchange evaluation is a diamond configuration, with similar enhancements and lane configuration to that included in Package A.

BRT Park and Ride Lot Location Options

The Package B proposed BRT service would include a station near Crossroads Boulevard interchange with I-25. Two potential sites (M and O) for the Bus Rapid Transit station were identified.

Site M is located northeast of the Crossroads Boulevard interchange adjacent to Budweiser Event Center. This site would utilize the existing fairgrounds parking which can be accessed via the I-25 East Frontage Road and two locations along Fairground Avenue. Access to and from the Frontage Road is Stop-sign controlled does not provide any accel or decal lanes. Both accesses off Fairground Avenue are Stop-sign controlled and provide left and right turn deceleration lanes and separate exiting left and right turn lanes.

Site O is located approximately one mile south of Crossroads Boulevard on the west side of I-25. This site would include constructing 90 new parking spaces that would be accessed via CR 24. Loveland's plan for CR 24 includes building a grade-separated connection to connect it to four-lane Cordova Pass on the east side of I-25. Access to the station parking would be stop-sign controlled. Based on a previous study conducted in the area, it is estimated that CR 24 currently carries approximately 2,000 vehicles per day.

Park-and-Ride Trip Generation

The number of proposed spaces at the Crossroads park-and-ride lot was determined using the methodology outlined in the *North I-25 DEIS Parking Results* report (Carter & Burgess, November 2006). Using the results of this report, trip generation is estimated at each site, by applying the following factors.

- First, a conservative estimate of maximum utilized spaces is determined by multiplying the number of spaces provided by 90 percent (or 0.9). This is referred to as the number of occupied spaces.

- Then, the number of occupied spaces is multiplied by the factors shown below.

	Trip Rate	Entering	Exiting
AM Peak Hour			
Trips per occupied space	0.75	87%	13%
PM Peak Hour			
Trips per occupied space	0.50	20%	80%

A 90-space park-and-ride station would be expected to generate approximately 180 trips daily.

Location	Daily Trips	AM Peak			PM Peak		
		In	Out	Total	In	Out	Total
Crossroads PNR Lot	180	53	8	61	8	32	40

Station Trip Distribution

The trip distribution and assignment for the station was determined based on existing and future residential land use patterns in the vicinity of the site.

Site M. Because another BRT station is located north of this area at SH 392 and the primary destination of travel is to the south, the majority of trips are expected to arrive from east and west of the site along Crossroads Boulevard.

Site O. Similar to Site M, the majority of trips are expected to arrive from east and west of the site, however, these trip are more likely to utilize both US 34 and Crossroads Boulevard. Trips generated by Site O are included in the Package B traffic volumes illustrated below.

Interchange Operations

Figure 8 also shows the levels of service for the ramps and frontage road intersections, along with recommendations for laneage and storage at each location. As shown, all four intersections in the vicinity of the ramp are anticipated to operate at LOS C or better with the forecasted traffic volumes and the enhancements identified.

Table 5 summarizes the levels of service, queue lengths, intersection spacing and designed storage lengths for key movements at the interchange. As shown in the table, specific movement levels of service at this interchange range from LOS A to LOS D. No single movement operates with a substandard level of service; thus, the improvements identified at this interchange appear to provide good operations at both ramp terminals and at the frontage road intersection.

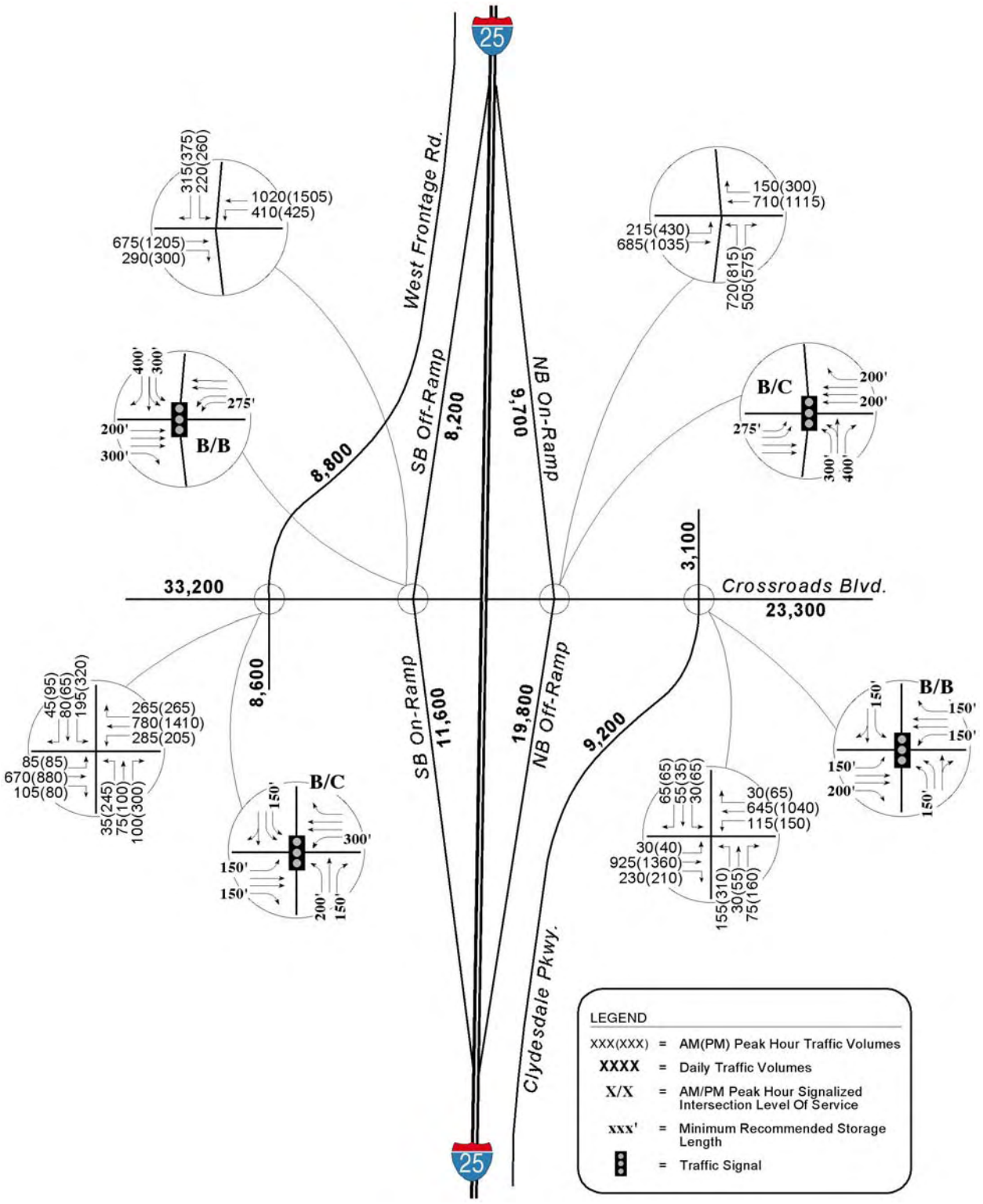

Figure 8. Package B Forecasts and Levels of Service

Table 5 also compares SimTraffic estimates of the 95th percentile queue length for key movements to the storage distance available for each. For turning movements, the distance listed is the planned turn lane storage length, while for through movements the length listed is the distance between intersections. The queuing analysis shows that in all cases the estimated 95th percentile queues would be contained within the turn bays or within the space between adjacent intersections. On both the northbound and southbound ramp terminals, the left and right turn queues would be accommodated well within the storage length and would not extend into the I-25 main lanes.

Table 5. 2030 Package B Level of Service and Queue Lengths for Key Movements

Intersection / Movement	Level of Service		Estimated 95th Percentile Queue[2]		Distance Between Intersections and Storage Length Provisions
	AM	PM	AM	PM	
West Frontage Road Intersection					
WB Left	B	B	150'	150'	Storage Provided in Design – 300'
WB Thru	B	B	140'	310'	Distance to Adjacent Intersection – 550'
WB Right	A	A	70'	140'	Storage Provided in Design – 300'
Southbound Ramp Terminal					
EB Thru	A	C	100'	300'	Distance to Adjacent Intersection – 550'
EB Right	A	B	130'	170'	Storage Provided in Design – 300'
WB Left	C	A	290'	360'	Storage Provided in Design – 1,000'
WB Thru	A	A	190'	130'	Distance to Adjacent Intersection – 610'
SB Left/Thru	C	C	180'	220'	Storage Provided in Design – 700'
SB Right	C	D	160'	250'	Storage Provided in Design – 400'
Northbound Ramp Terminal					
EB Left	C	C	100'	410'	Storage Provided in Design – 1,060'
EB Thru	A	B	160'	260'	Distance to Adjacent Intersection – 610'
WB Thru	B	C	200'	420'	Distance to Adjacent Intersection – 830'
WB Right	B	B	60'	200'	Storage Provided in Design – 200'
NB Left/Thru	B	C	320'	440'	Storage Provided in Design – 700'
NB Right	C	D	130'	220'	Storage Provided in Design – 400'
Clydesdale Frontage Road Intersection					
EB Left	B	A	50'	70'	Storage Provided in Design – 150'
EB Thru	B	B	210'	280'	Distance to Adjacent Intersection – 830'
EB Right	A	A	120'	120'	Distance to Adjacent Intersection – 200'

Note: The queue lengths given in this table primarily come from SimTraffic with some engineering judgment. SimTraffic gives a queue length for each lane. For example, with dual left-turn lanes SimTraffic estimates a queue each lane. In the table, for thru movements the queue length is the longest queue observed in any through lane. For multiple turn lanes (i.e. dual lefts), the queue length is the sum of the queues in each lane. For a single turn lane (i.e. right turn), the queue is just the queue for that lane.

Station Traffic Mitigation

Access to Site M via Fairground Avenue already provides left and right turn deceleration lanes, so no additional traffic mitigation is recommended at this location. Left and right turn deceleration lanes along CR 24 into Site O access would be included in the design of the station if this site were selected.

Alternatives Evaluation Comparison

Traffic Operational Analysis

Table 6 compares the levels of service and delay at the Crossroads Boulevard interchange for the three packages. As the table indicates, delay at the interchange complex would be reduced substantially with the lane widening and capacity improvements included in packages A and B. The levels of service and delays at each intersection are virtually the same for both alternatives, so it would appear that either package would result in adequate operations at this interchange.

Table 6. Intersection Level of Service and Delay

Intersection	No Action[1]		Package A		Package B	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
West Frontage Road	LOS B (15 sec.)	LOS C (24 sec.)	LOS C (22 sec.)	LOS C (23 sec.)	LOS B (19 sec.)	LOS C (23 sec.)
Southbound Ramp Intersection	LOS B (19 sec.)	LOS F (>80 sec.)	LOS B (10 sec.)	LOS B (15 sec.)	LOS B (14 sec.)	LOS B (16 sec.)
Northbound Ramp Intersection	LOS E (75 sec.)	LOS F (>80 sec.)	LOS B (17 sec.)	LOS C (27 sec.)	LOS B (17 sec.)	LOS C (24 sec.)
East Frontage Road	LOS B (20 sec.)	LOS B (19 sec.)	LOS A (10 sec.)	LOS B (16 sec.)	LOS B (14 sec.)	LOS B (16 sec.)

1. No Action 2030 volumes with signals at frontage road intersections and roundabouts at ramp terminals.
LOS X – Level of service
##.# - Average delay in seconds per vehicle