NORTH I-25 EIS
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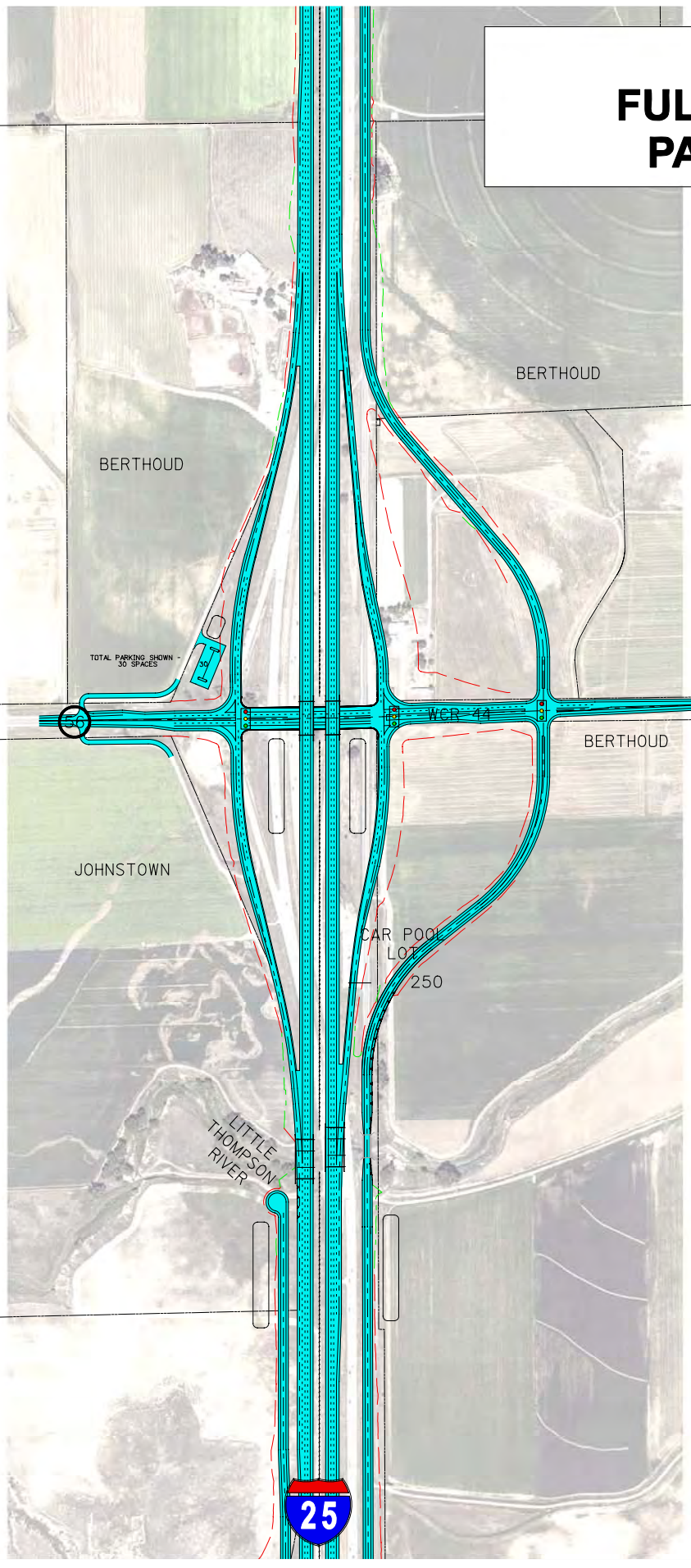
SH 56
FULL DIAMOND
PACKAGE A



North

SCALE: 1"=200'

October 1, 2007

U.S. Department of Transportation
Federal Highway Administration

SH 56 FULL DIAMOND

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NORTH I-25 EIS
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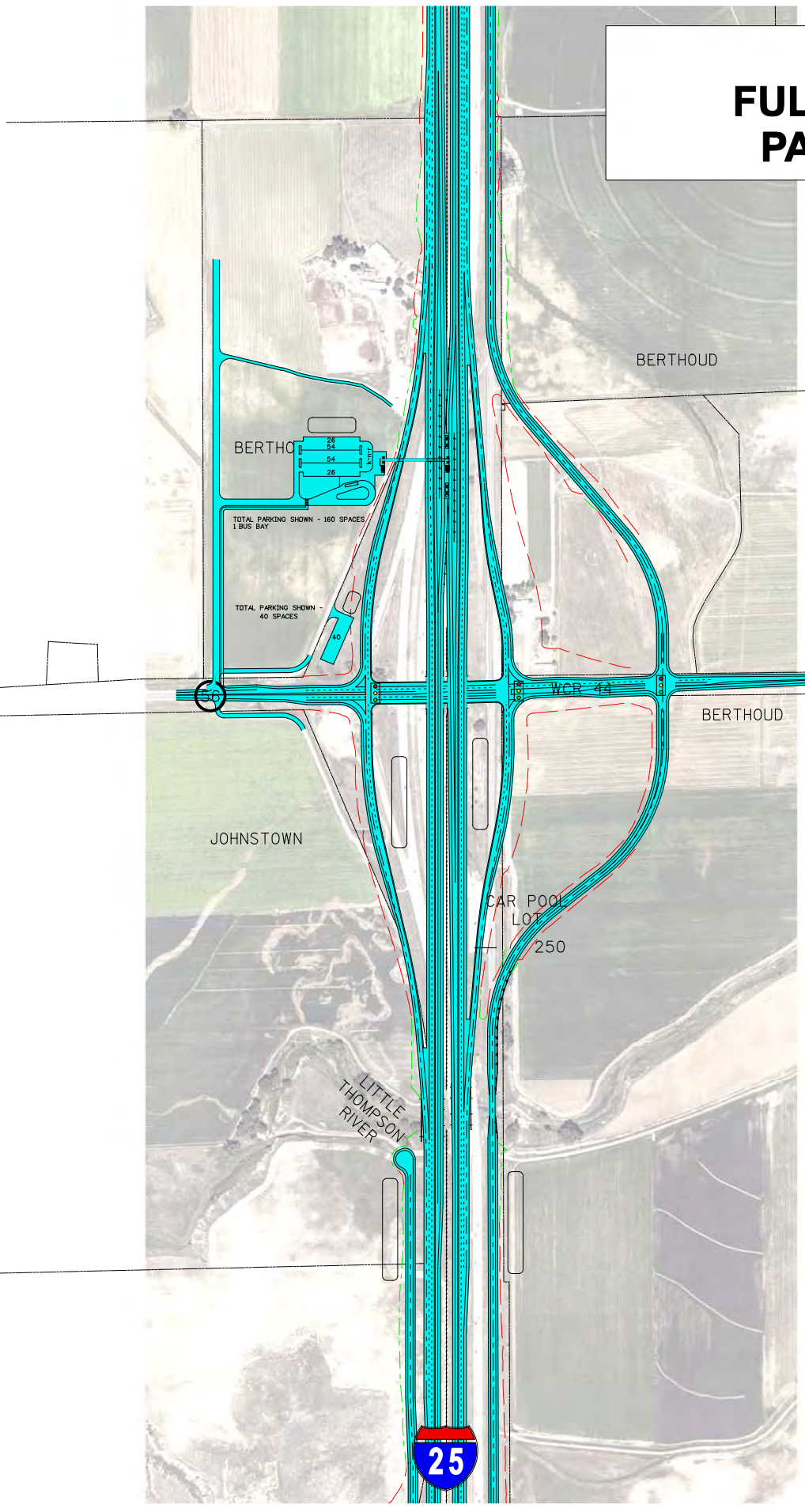
SH 56
FULL DIAMOND
PACKAGE B

DRAFT



North

SCALE: 1"=200'

October 1, 2007

U.S. Department of Transportation
Federal Highway Administration

SH 56 FULL DIAMOND

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SH 56 at I-25
Interchange and Parking Traffic Evaluation

August 20, 2007

Introduction

This report describes the existing traffic volumes at the I-25 SH 56 interchange and the adjacent intersections, as well as future traffic conditions with an improved interchange.

Existing Conditions

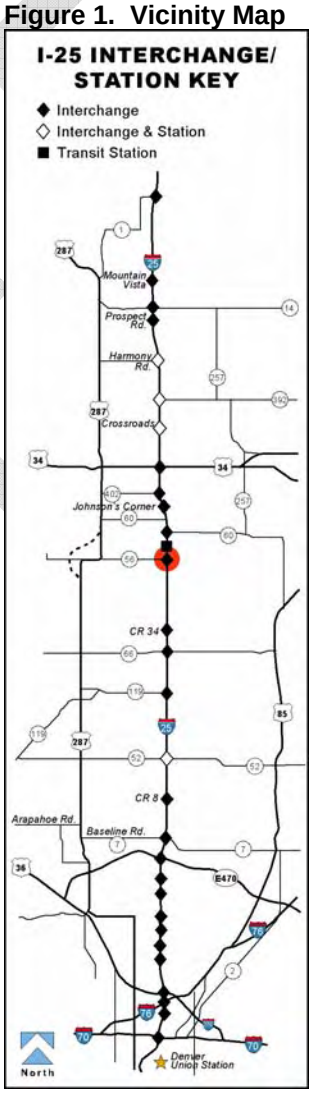
The SH 56 interchange at I-25 was constructed in 1961. The interchange has a diamond configuration and is similar to several older diamond interchanges (i.e. SH 392, SH 402) in the corridor. The interchange area includes the following roadways:

SH 56. SH 56 is an east-west two lane arterial roadway that connects I-25 to the Town of Berthoud to the west and the WCR 13 and rural Weld County to the east. Figure 2 summarizes the traffic counts collected in August 2004 at this interchange. As shown, average daily traffic on SH 56 is around 6,600 vehicles per day (vpd) west of the interchange and 1,500 vpd east of the interchange, illustrating the higher travel demand to and from Berthoud, west of I-25. There are no turn lanes at the stop-sign controlled ramp terminals.

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 SH 56. The east frontage road carried less than 2,000 vpd both north and south of SH 56. The intersection is stop-sign controlled.

I-25 Ramp Terminals. All four ramps carry less than 2,000 vpd; evenly split between north and southbound travel. The eastbound to southbound right turn experiences the highest turning-movement demand during the AM peak hour; the opposing northbound to westbound left turn experiences the highest turning-movement demand in the PM peak hour.

Figure 1. Vicinity Map



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

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.

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 SH 56 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 SH 56. 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.

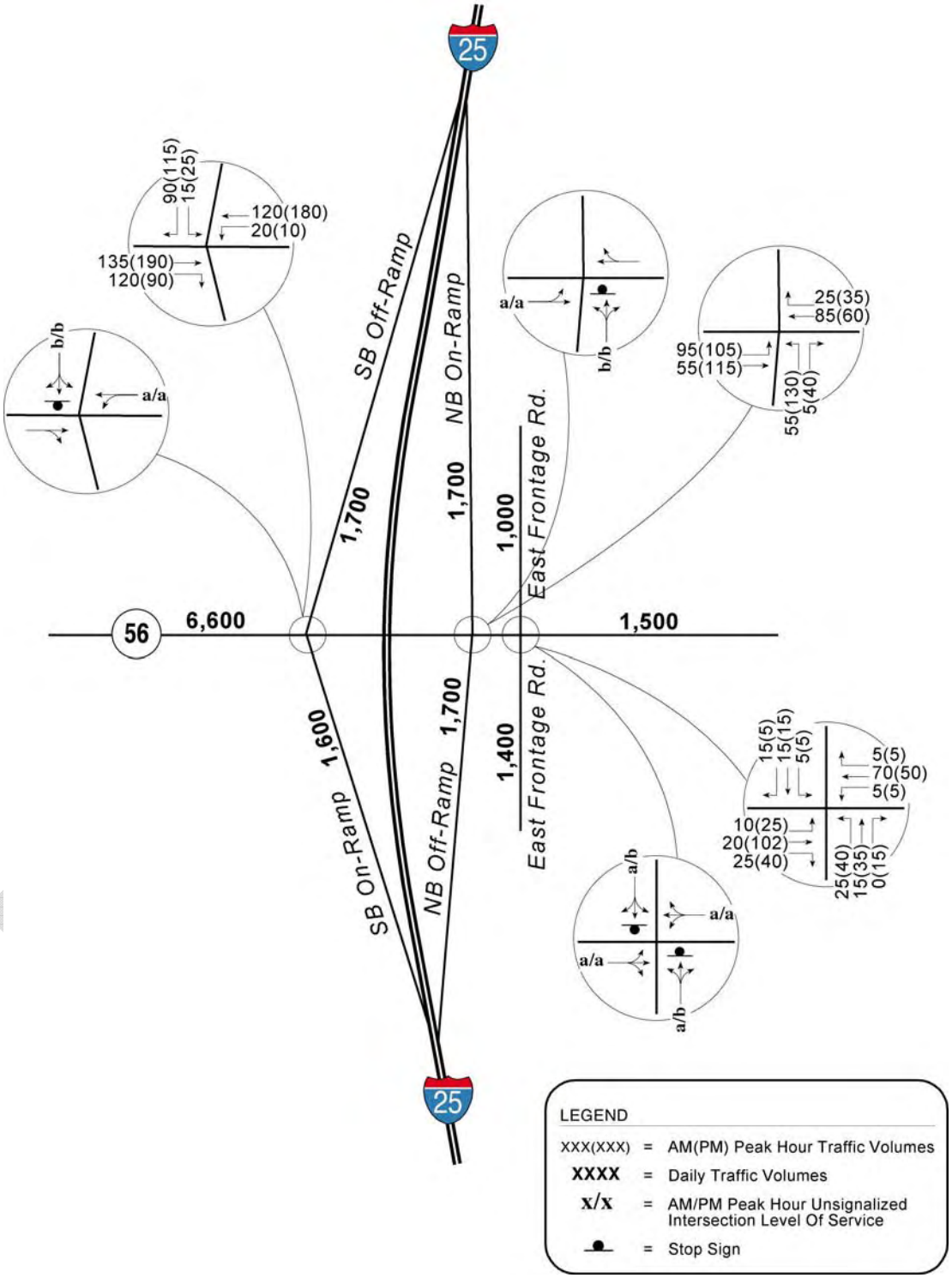


Figure 2. Existing Conditions

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	
Southbound Ramp Terminal					
WB Approach	A	A	30'	30'	Distance to Adjacent Intersection – 430'
SB Approach	B	B	60'	70'	Ramp Length – 900'
Northbound Ramp Terminal					
EB Approach	A	A	40'	30'	Distance to Adjacent Intersection – 430'
NB Approach	B	C	50'	80'	Ramp Length – 900'
East Frontage Road Intersection					
EB Approach	A	A	10'	20'	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.

Figure 3. No Action Alternative

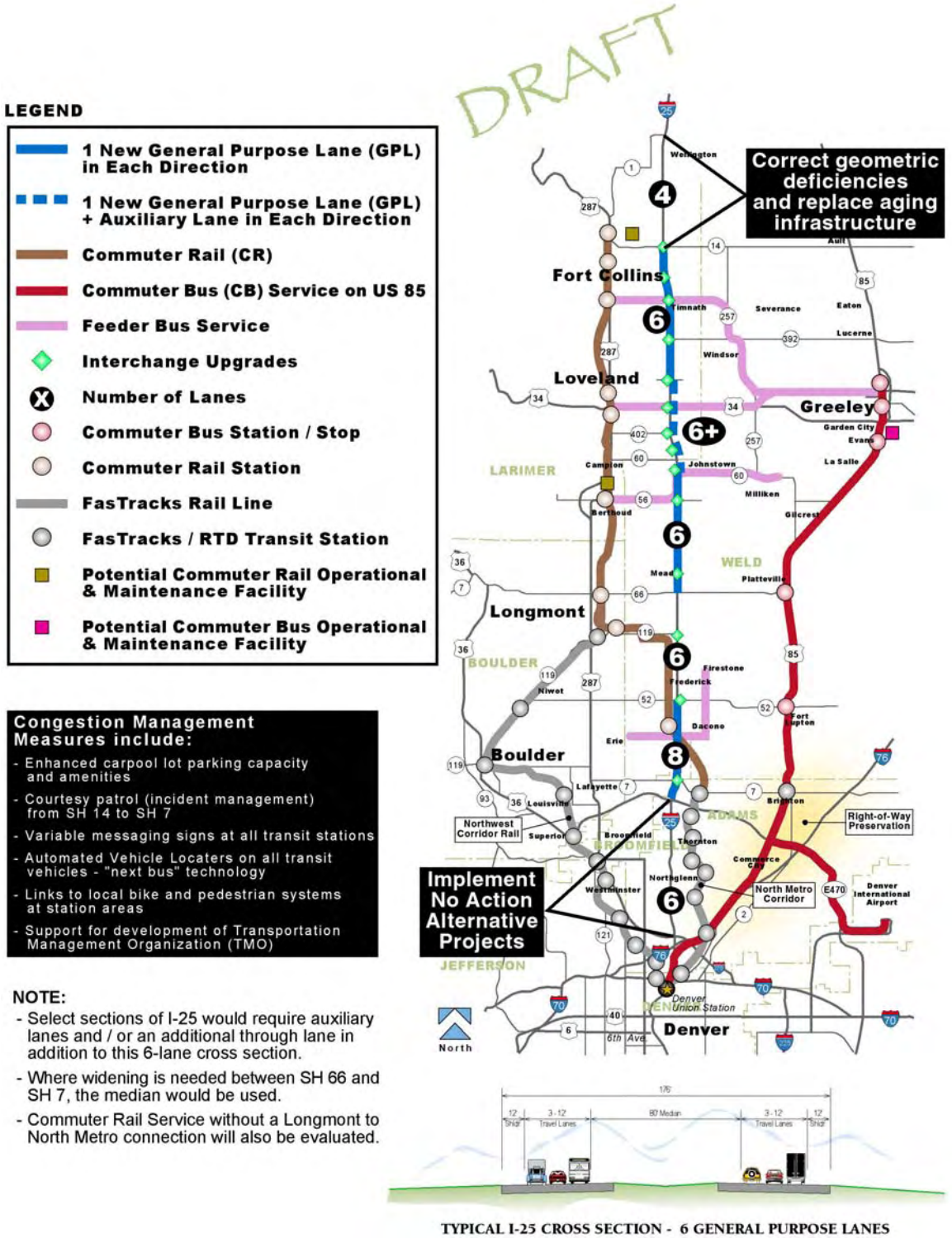


Figure 4. Package A: GPL + CR + CB 85

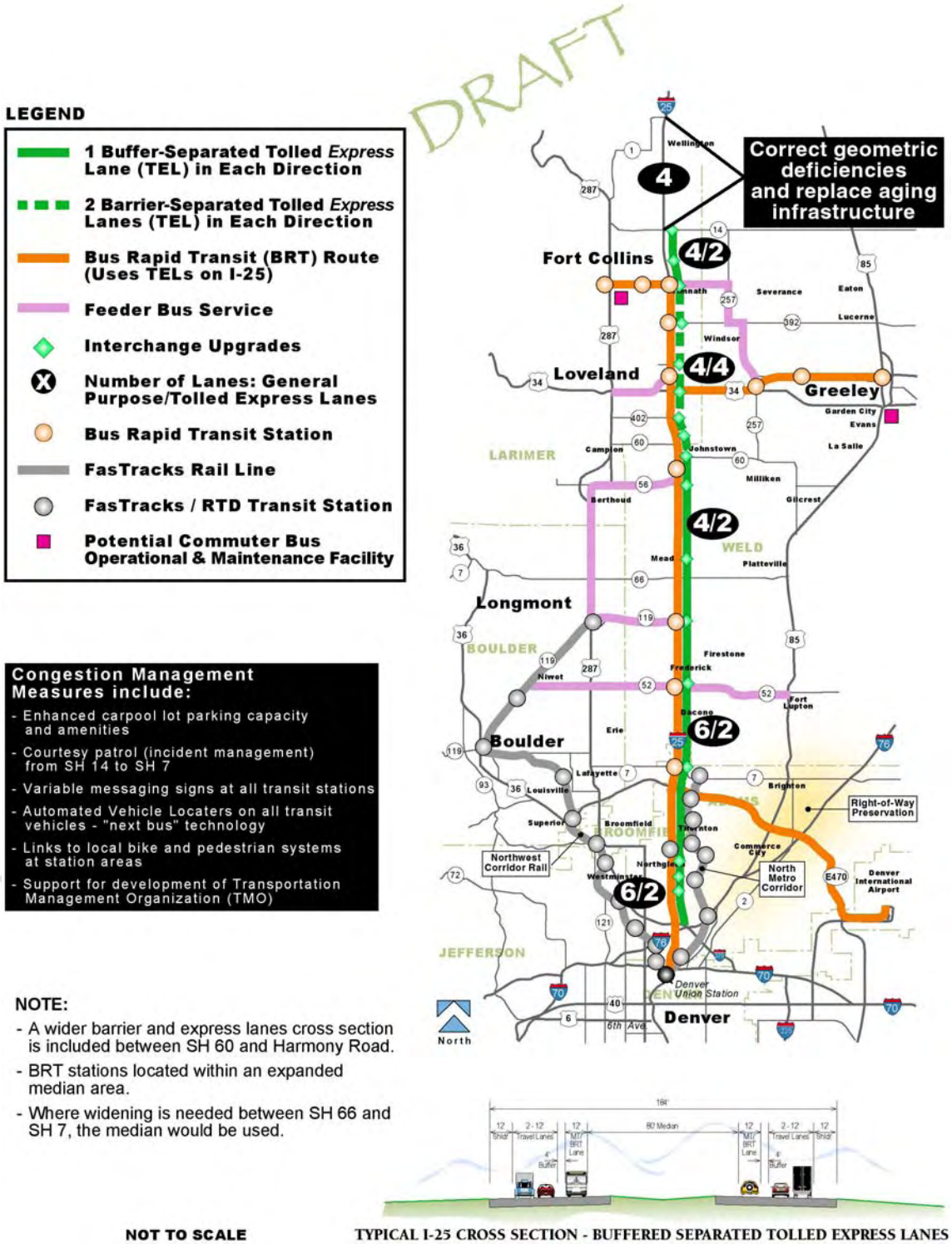


Figure 5. Package B: TEL + BRT

2030 No Action Traffic Volumes

Figure 6 depicts 2030 daily and peak hour No Action traffic projections for the SH 56 interchange and adjacent intersections. As shown, daily volume projections on SH 56 range from 14,200 vpd west of the interchange to 6,000 vpd east of the interchange, and ramp volumes range from approximately 3,400 to 5,500 vehicles per day. Travel to and from Berthoud west of I-25 continues to be the dominant movement.

2030 Package A Traffic Volumes

Figure 7 depicts 2030 daily and peak hour Package A traffic projections for the SH 56 interchange and adjacent intersections. As shown, Package A would relocate the east frontage road east to provide better spacing between the frontage road and the northbound ramp terminal. Daily volume projections on SH 56 are higher than those in the No Action Alternative; west of the interchange SH 56 would carry 17,200 vehicles and east of the interchange SH 56 would carry 8,300 vehicles daily. The interchange and the ramp terminals are also higher than those in the No Action Alternative, with higher travel demand to and from the north and west.

2030 Package B Volumes

Figure 8 depicts 2030 daily and peak hour Package B traffic projections for the SH 56 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 SH 56 under the No Action Alternative. As the figure indicates, the ramp terminal approach movements operate at LOS F in both peak hours. Table 3 shows the projected queuing for key movements at the interchange and further underscores that the existing interchange would be significantly over capacity with the projected traffic volumes.

It should be noted that signalizing the three intersections without any widening improvements would improve operation but would still result in over-capacity operations at the ramps and the east frontage road, especially during the PM peak hour.

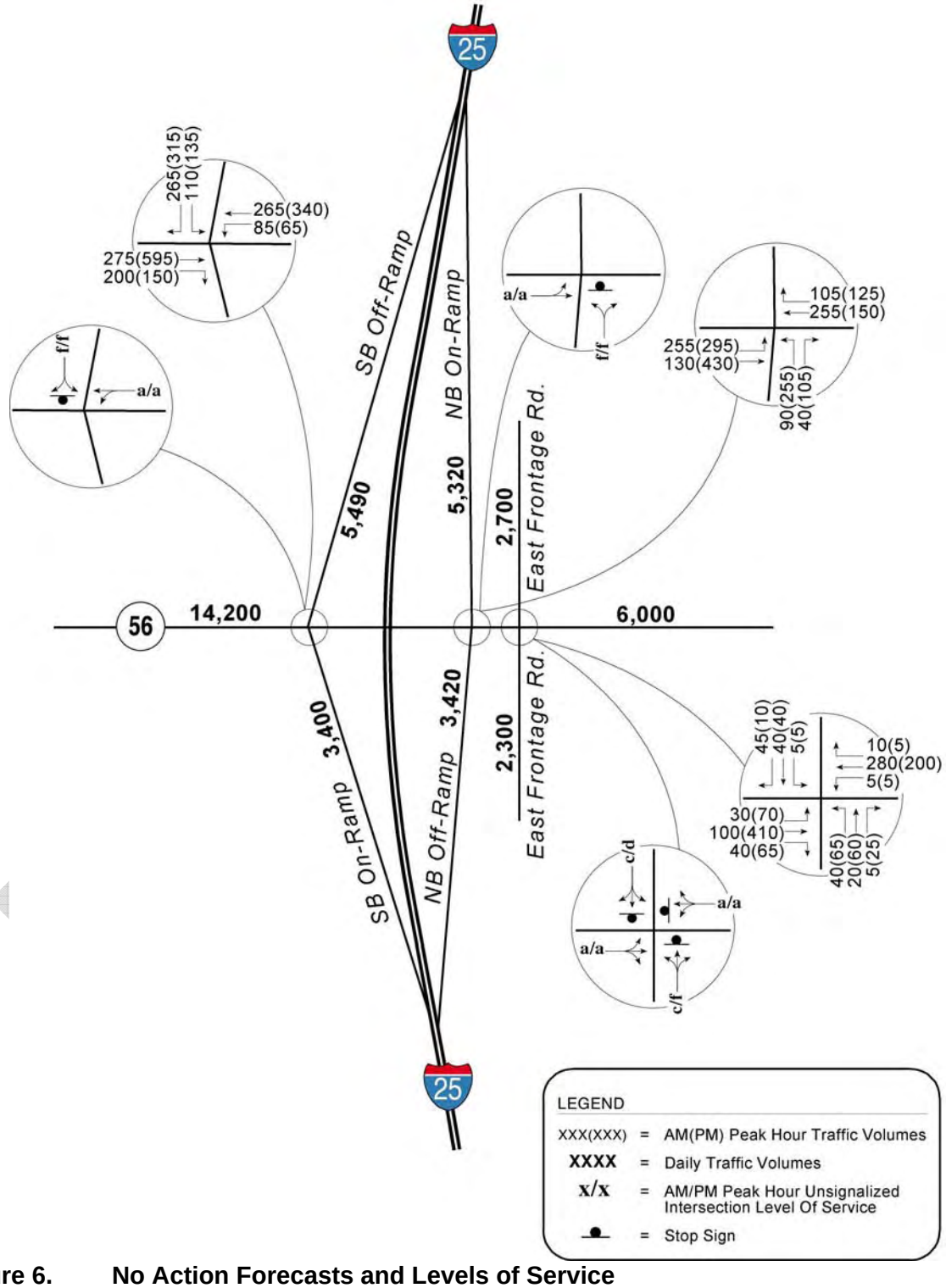


Figure 6. No Action Forecasts and Levels of Service

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	
Southbound Ramp Terminal					
WB Approach	A	A	390'	160'	Distance to Adjacent Intersection – 430'
SB Approach	F	F	250'	520'	Ramp Length – 900'
Northbound Ramp Terminal					
EB Approach	A	A	430'	460'	Distance to Adjacent Intersection – 430'
NB Approach	F	F	200'	680'	Ramp Length – 900'
East Frontage Road Intersection					
EB Approach	A	A	110'	110'	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 Package A Traffic Operations

Interchange Configuration

The proposed configuration for the SH 56 DEIS interchange evaluation is a diamond configuration (Figure 7). The new interchange would increase the distance between the ramps to more than 600 feet, and shift the east frontage road intersection to provide nearly 600 feet of spacing from the northbound ramp terminal. SH 56 would be widened at the interchange to five lanes to accommodate dual left-turn lanes and a single through lane eastbound and a single left and two through lanes westbound. 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 three intersections would be signalized.

Carpool Lot Location

Package A also includes a 30-space carpool lot located in the northwest quadrant of the interchange. Access to the lot would be provided off an existing local street approximately 600 feet west of the southbound ramps.

Interchange Operations

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

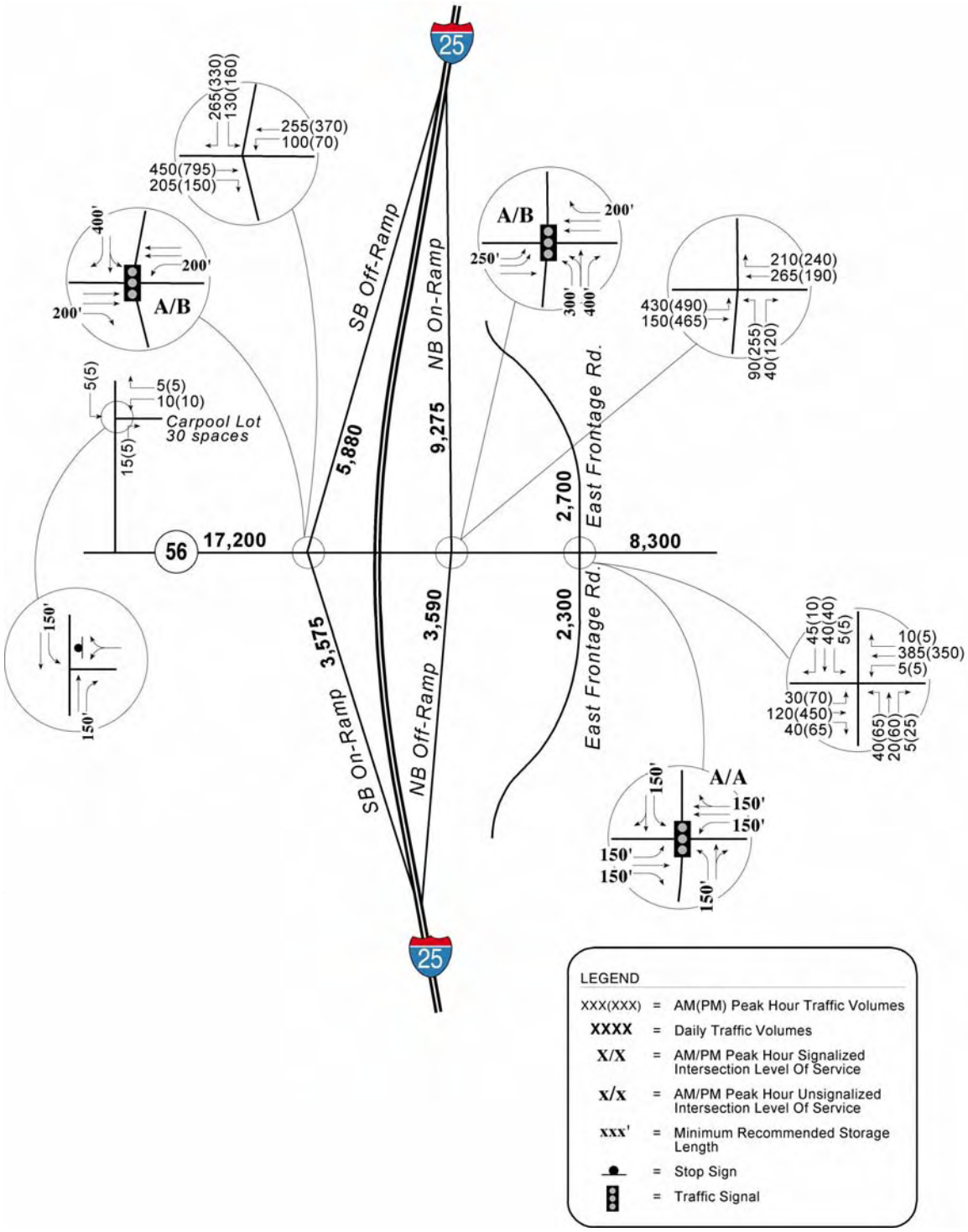


Figure 7. Package A Forecasts and Levels of Service

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.

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

Intersection / Movement	Level of Service		Estimated 95th Percentile Queue[1]		Distance Between Intersections and Storage Length Provisions
	AM	PM	AM	PM	
Southbound Ramp Terminal					
EB Thru	A	A	60’	180’	Distance to Adjacent Intersection – 520’
EB Right	A	A	50’	40’	Storage Provided in Design – 200’
WB Left	B	B	110’	90’	Storage Provided in Design – 200’
WB Thru	A	A	40’	50’	Distance to Adjacent Intersection – 610’
SB Left	C	C	140’	160’	Storage Provided in Design – 700’
SB Right	C	C	80’	100’	Storage Provided in Design – 400’
Northbound Ramp Terminal					
EB Left	C	B	440’	630’	Storage Provided in Design – 1380’
EB Thru	A	A	30’	120’	Distance to Adjacent Intersection – 610’
WB Thru	A	B	80’	70’	Distance to Adjacent Intersection – 570’
WB Right	A	A	90’	120’	Storage Provided in Design – 200’
NB Left	C	C	160’	210’	Storage Provided in Design – 700’
NB Right	C	C	50’	60’	Storage Provided in Design – 400’
East Frontage Road Intersection					
EB Left	A	A	40’	60’	Storage Provided in Design – 150’
EB Thru	A	A	40’	90’	Distance to Adjacent Intersection – 570’
EB Right	A	A	30’	40’	Storage Provided in Design – 150’

[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 Package B Traffic Operations

Interchange Configuration

The proposed configuration for the Package B SH 56 DEIS interchange evaluation is a diamond configuration, with similar enhancements and lane configuration to that included in Package A.

BRT Park and Ride/Carpool Lot Location

Package B includes a 160-space BRT park and ride/carpool lot located approximately 1000 feet north of SH 56 on the west side of I-25. Access to the lot would be provided off an existing local street approximately 600 feet west of the southbound ramps. The lot is expected to generate approximately 100 AM peak hour and 72 PM peak hour vehicle trips.

Interchange Operations

Figure 8 also shows the levels of service for the ramps and frontage road intersections, along with recommendations for laneage at each location. As shown, all three intersections in the vicinity of the ramp are anticipated to operate at LOS B 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 operation at both ramp terminals and at the frontage road intersection.

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.

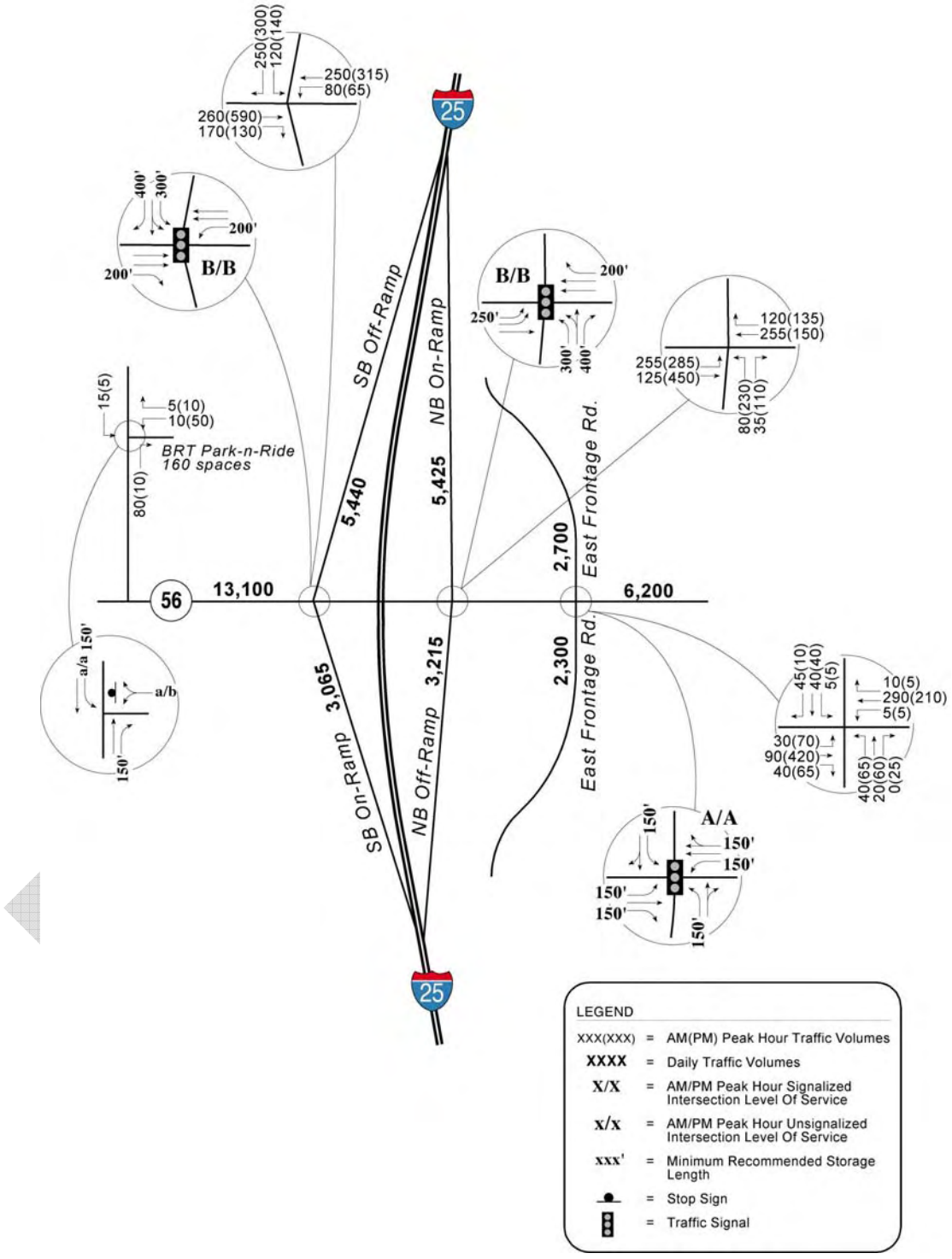


Figure 8. Package B Forecasts and Levels of Service

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

Intersection / Movement	Level of Service		Estimated 95th Percentile Queue[1]		Distance Between Intersections and Storage Length Provisions
	AM	PM	AM	PM	
Southbound Ramp Terminal					
EB Thru	A	A	50’	100’	Distance to Adjacent Intersection – 520’
EB Right	A	A	40’	40’	Storage Provided in Design – 200’
WB Left	B	B	110’	80’	Storage Provided in Design – 200’
WB Thru	A	A	40’	50’	Distance to Adjacent Intersection – 610’
SB Left	C	C	150’	160’	Storage Provided in Design – 700’
SB Right	C	C	70’	90’	Storage Provided in Design – 400’
Northbound Ramp Terminal					
EB Left	C	B	300’	380’	Storage Provided in Design – 1380’
EB Thru	A	A	20’	130’	Distance to Adjacent Intersection – 610’
WB Thru	A	A	70’	70’	Distance to Adjacent Intersection – 570’
WB Right	A	A	50’	60’	Storage Provided in Design – 200’
NB Left	C	C	120’	210’	Storage Provided in Design – 700’
NB Right	C	C	50’	60’	Storage Provided in Design – 400’
East Frontage Road Intersection					
EB Left	A	A	40’	60’	Storage Provided in Design – 150’
EB Thru	A	A	30’	80’	Distance to Adjacent Intersection – 570’
EB Right	A	A	30’	30’	Storage Provided in Design – 150’

[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.

Traffic Operational Analysis

Table 6 compares the levels of service and delay at the SH 56 interchange for the three packages. As the table indicates, without improvements at this location, the northbound ramp terminal would operate at LOS E during the PM peak hour and long queues would occur on both the northbound and southbound ramp approaches. Providing more approach lanes and signalizing these three intersections improves operation to LOS B or better and minimizes queuing at all three intersections. 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 Comparison

Intersection	No Action[1]		Package A		Package B	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Southbound Ramp Intersection	LOS B (20 sec)	LOS D (50 sec)	LOS B (14 sec)	LOS B (13 sec)	LOS B (14 sec)	LOS B (13 sec)
Northbound Ramp Intersection	LOS A (9 sec)	LOS E (77 sec)	LOS B (15 sec)	LOS B (14 sec)	LOS B (13 sec)	LOS B (14 sec)
East Frontage Road	LOS C (31 sec)	LOS B (15 sec)	LOS A (8 sec)	LOS A (7 sec)	LOS A (10 sec)	LOS A (8 sec)

1. No Action 2030 volumes with signals at all four intersections – no laneage improvements included.
LOS X – Level of service
##.# - Average delay in seconds per vehicle