

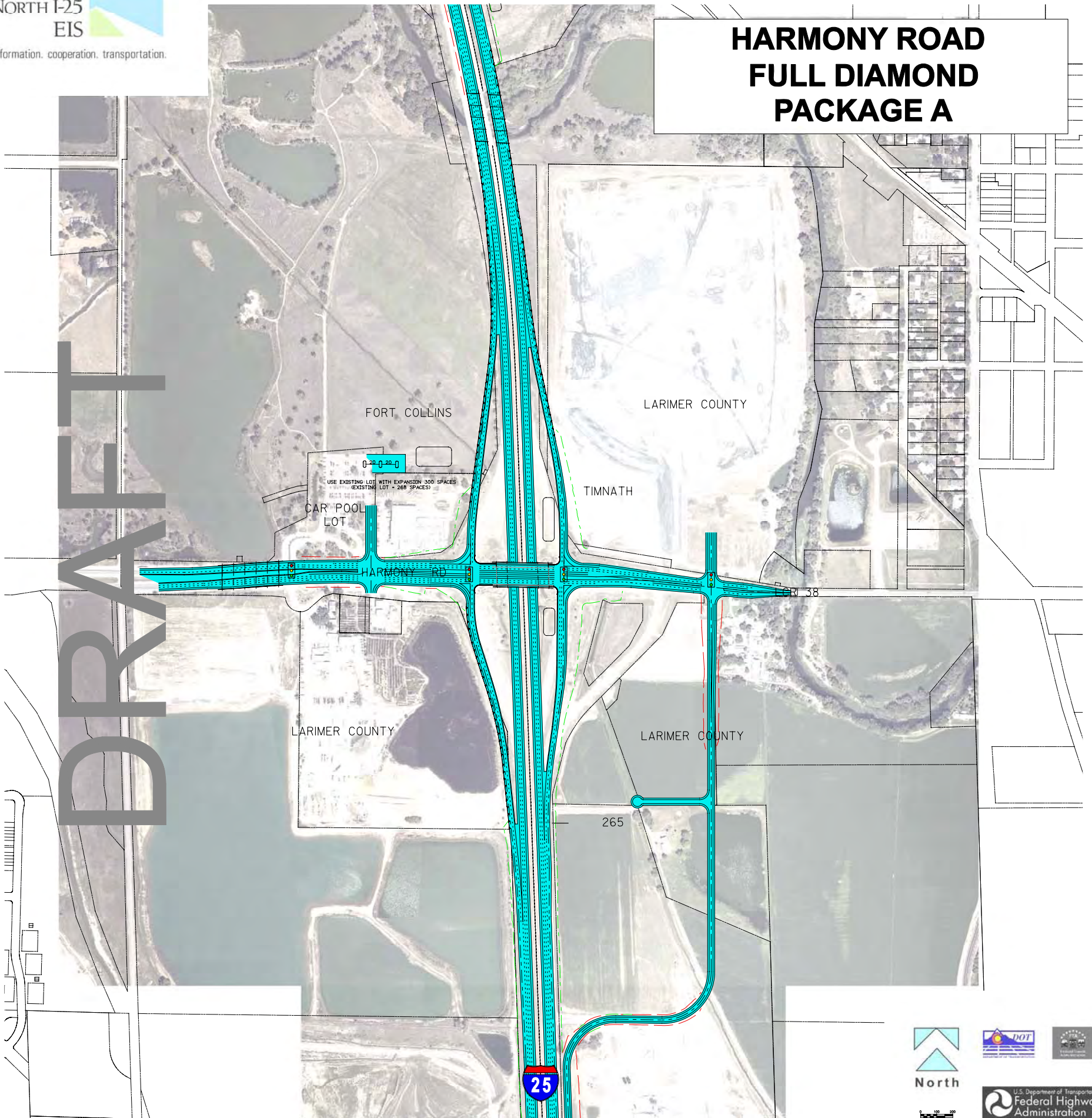
NORTH I-25  
EIS



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# HARMONY ROAD FULL DIAMOND PACKAGE A

DRAFT



North



October 1, 2007



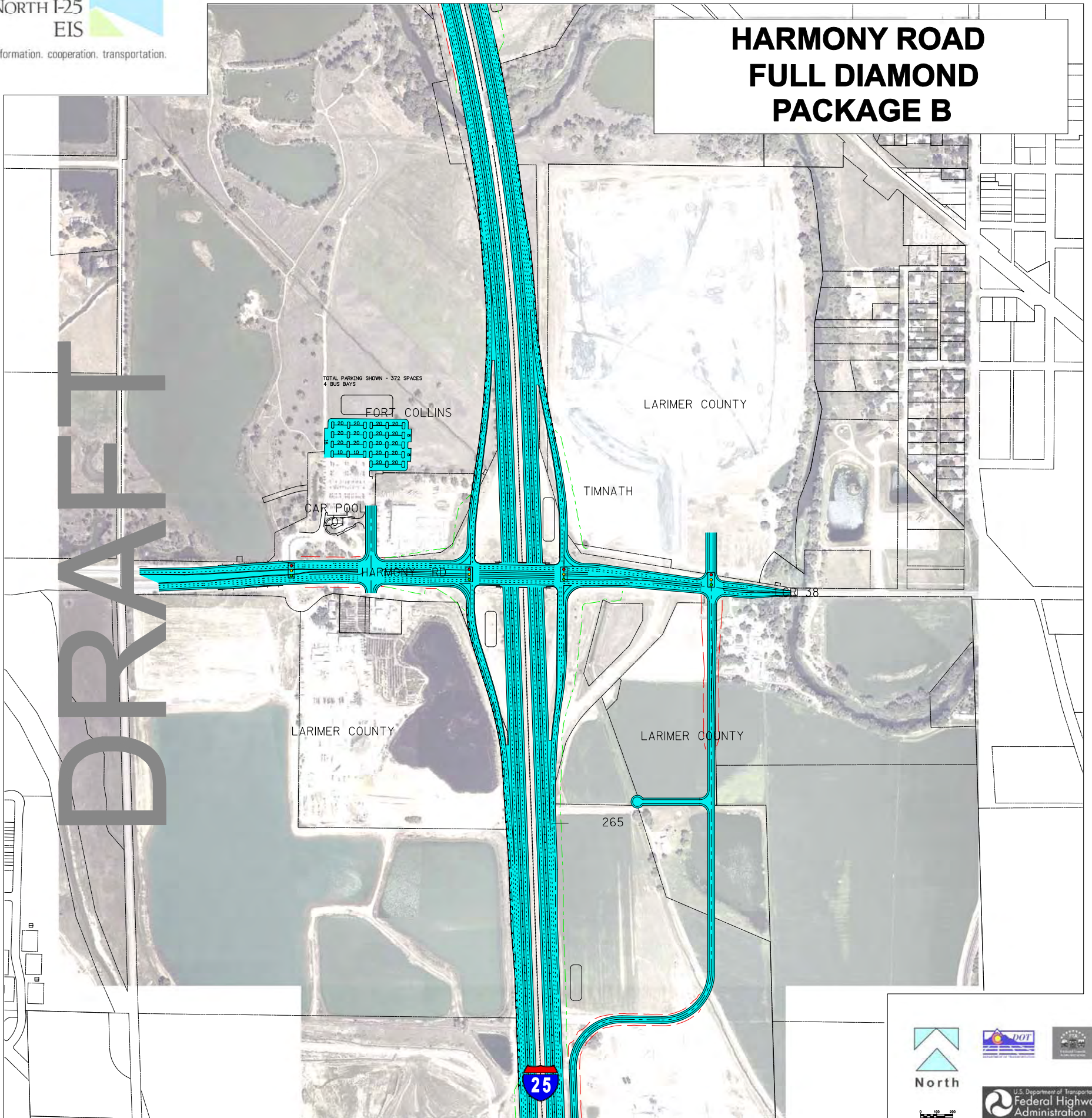
HARMONY RD FULL DIAMOND





# HARMONY ROAD FULL DIAMOND PACKAGE B

**DRAFT**



North



October 1, 2007



U.S. Department of Transportation  
Federal Highway  
Administration

HARMONY RD FULL DIAMOND

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

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 interchange of Harmony Road with I-25 (milepost 265) was built in 1999 and connects I-25 to south Fort Collins to the west and the Town of Timnath to the east. It has a diamond configuration and is one of the newer interchanges in the I-25 corridor. The interchange ramps are one-lane with turn lanes at the ramp terminals and are controlled by traffic signals. The bridge over I-25 consists of two through lanes plus a bike lane in each direction, dual eastbound left turn lanes at the northbound ramp terminal and a single left turn lane at the southbound ramp terminal.

The interchange area includes the following roadways:

**Harmony Road (LCR 38).** Harmony Road serves as a major point to access for the City of Fort Collins and therefore is a four-lane facility with a high level of access control, traffic signals at major intersections, and turn lanes at intersections and at access points. The land along Harmony immediately west of the interchange is relatively undeveloped, although a park-and-ride facility is located in the northwest quadrant of the interchange. Harmony Road to the east of the interchange, technically known as LCR 38, continues as a four-lane facility to the frontage road intersection. East of the frontage road intersection, LCR 38 continues as a two-lane roadway providing access to rural areas of Larimer County. Land along LCR 38 is primarily undeveloped, but the Town of Timnath has development plans for both the northeast and southeast quadrants. The speed limit in the vicinity of the interchange is 45 mph.

**West Frontage Road.** The west frontage road provides to the City of Fort Collins Harmony Road Multi-Modal Transfer Center, and intersects Harmony Road approximately 990 feet west of the southbound ramp terminal. The intersection also provides access to the south side of Harmony Road. A traffic signal controls the intersection. The speed limit on the west frontage road is 30 mph.

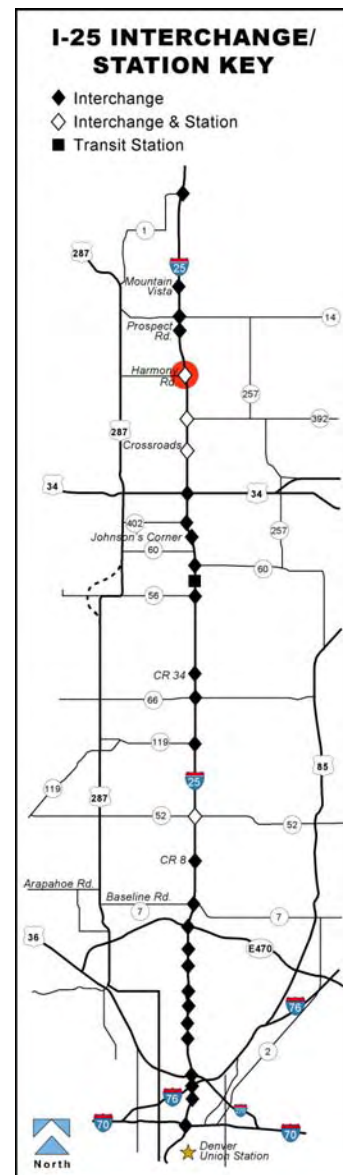


Figure 1. Vicinity Map



# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

**East Frontage Road.** The I-25 east side frontage road intersects Harmony Road approximately 600 feet east of the northbound ramp terminal. The intersection was relocated to its present location in 1999 as part of the interchange reconstruction and now provides adequate spacing from the northbound ramp terminal. The speed limit on the frontage road is 30 mph, and it has stop-sign control on the northbound approach at Harmony Road.

Figure 2 shows the existing traffic counts collected in August 2004 at the Harmony Road interchange. The counts show that a majority of the traffic at this intersection is oriented to and from the west; average daily traffic is around 36,000 vehicles per day (vpd) west of the interchange but is only about 13,000 vpd east of the interchange. Daily ramp volumes range between 4,800 and 12,900 vehicles per day, with the higher ramp volumes on the southern oriented ramps. At the interchange, there are several peak hour turn movements over 350 vehicles per hour, all oriented to and from the Fort Collins area. The highest peak hour volumes occur for the northbound to westbound left-turn movement at nearly 800 vehicles in the AM peak and over 1,000 vehicles in the PM peak. In fact, these are some of the highest existing peak hour turning movement volumes observed in the I-25 corridor.

## Traffic Operations

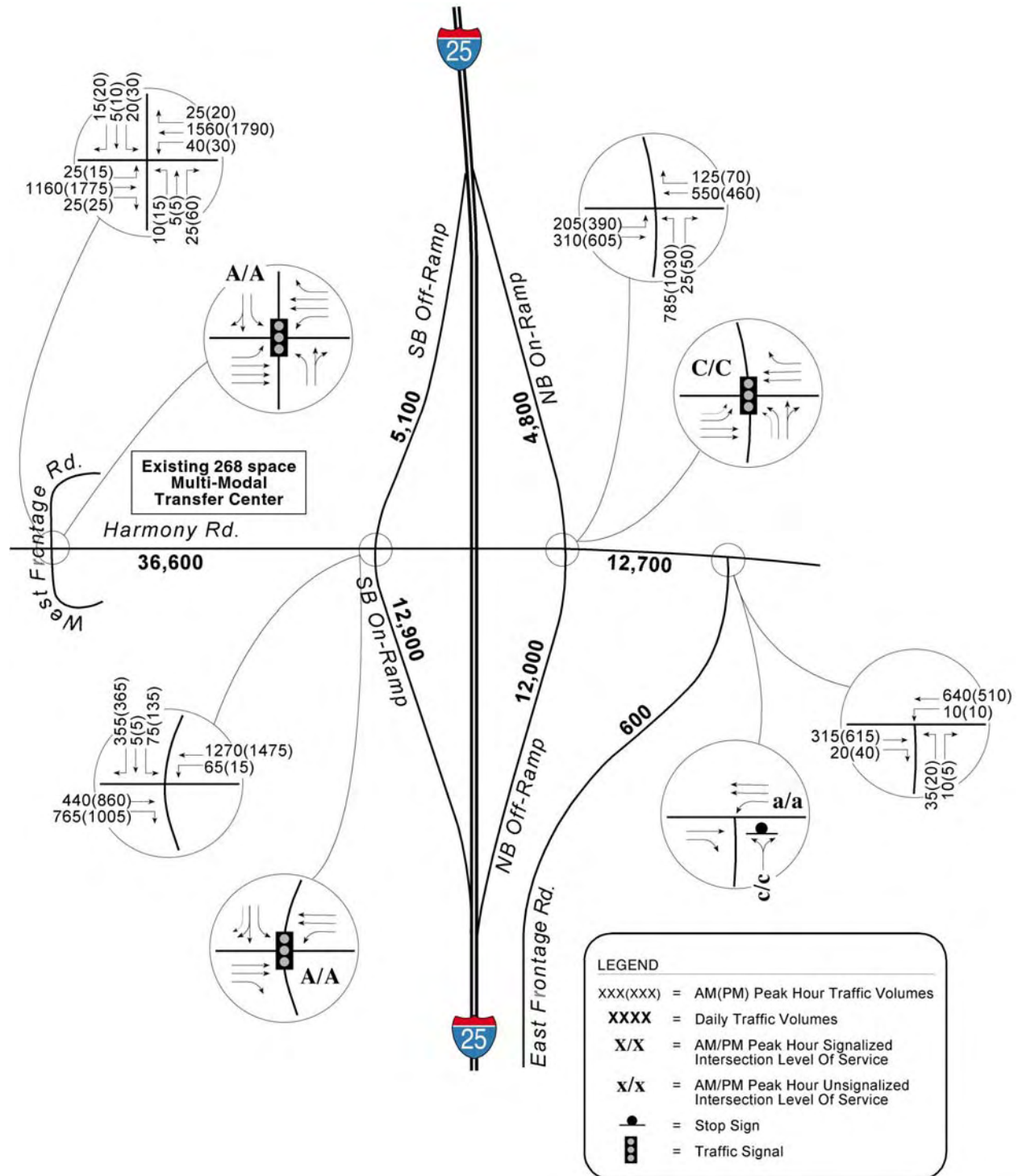
An operational analysis of the interchange was conducted based on methodology developed in the Highway Capacity Manual (Transportation Research Board, 2000). The result of such analysis is a level of service (LOS) rating. Level of service is a qualitative assessment of the traffic flow based on the average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

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

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation



**Figure 2. Existing Conditions**

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

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Figure 2 also illustrates existing peak period levels of service at the ramp terminals and adjacent intersections. Currently, all three signalized intersections operate at LOS C or better during both peak periods, while the northbound approach at the east frontage road intersection also operates at LOS C.

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 Harmony 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 west and east frontage road intersections have not been included in the table because they would not impede traffic flow on Harmony Road. As shown in the table, most of the turn movements currently operate at a LOS D or better. Only the eastbound left-turn movement at the northbound ramp terminal had a level of service worse than LOS D. In all cases, the 95<sup>th</sup> percentile queue lengths were not less than the distance between intersections or did not exceed the current storage length provided at the interchange.

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

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

Intersection / Movement	Level of Service		Estimated 95 <sup>th</sup> Percentile Queue <sup>3</sup>		Intersection Spacing and Storage Length Provisions
	AM	PM	AM	PM	
<b>West Frontage Road Intersection</b>					
<b>WB Left</b>	A	A	50'	40'	Current Storage Provided – 390'
<b>WB Thru</b>	A	A	140'	180'	Distance to Adjacent Intersection – 990'
<b>WB Right</b>	A	A	10'	10'	Storage Provided <sup>2</sup> – 990'
<b>Southbound Ramp Terminal</b>					
<b>EB Thru</b>	C	B	190'	250'	Distance to Adjacent Intersection – 990'
<b>EB Right</b>	Free	Free	N/A <sup>1</sup>	N/A <sup>1</sup>	N/A <sup>1</sup>
<b>WB Left</b>	A	B	100'	70'	Current Storage Provided – 100'
<b>WB Thru</b>	B	A	320'	440'	Distance to Adjacent Intersection – 420'
<b>SB Left</b>	D	D	100'	130'	Current Storage Provided – 300'
<b>SB Right</b>	Free	Free	N/A	N/A	Current Storage Provided – 430'
<b>Northbound Ramp Terminal</b>					
<b>EB Left</b>	E	E	210'	340'	Current Storage Provided – 520'
<b>EB Thru</b>	A	A	120'	170'	Distance to Adjacent Intersection – 420'
<b>WB Thru</b>	C	C	240'	210'	Distance to Adjacent Intersection – 500'
<b>WB Right</b>	B	C	50'	50'	Current Storage Provided – 125'
<b>NB Left</b>	C	C	640'	780'	Current Storage Provided – 900'
<b>NB Right</b>	A	A	40'	40'	Current Storage Provided – 150'
<sup>1</sup> The outside eastbound through lane on Harmony Road becomes the EB right-turn lane at the SB ramp terminal. <sup>2</sup> Continuous accel. / decel. lane is provided between southbound ramps and park-n-ride intersection. <sup>3</sup> 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 Conditions

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

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

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

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 Harmony Road interchange and adjacent intersections. As shown, daily volume projections on Harmony Road range from 33,900 vpd east of the interchange to 73,500 vpd west of the interchange, and ramp volumes range from 14,000 to 19,700 vehicles per day. These volumes show the same patterns as existing counts; the highest traffic flows are westerly to and from Fort Collins and southerly on the ramps.

## 2030 Package A Traffic Volumes

Figure 7 depicts 2030 daily and peak hour Package A traffic projections for the Harmony Road interchange and adjacent intersections. The volumes in the figure are generally similar to those presented in the No Action Alternative, differing slightly due to the change in capacity on I-25. Daily volume projections on Harmony Road range from 32,200 vpd east of the interchange to 83,200 vpd west of the interchange, and ramp volumes range from 15,100 to 24,000 vehicles per day. The traffic patterns are generally the same as existing conditions and No Action conditions; the highest traffic flow is westerly to and from Fort Collins and southerly on the ramps.

The traffic forecasts for Harmony west of the interchange are significantly higher than the generally accepted capacity of a six lane major arterial (48,000 vpd) under both No Action and Package A, but have been used in the analysis here to present a conservative analysis, ensuring that the turn lane designs at the interchange would accommodate higher traffic volumes. This was done because there are enough examples of other arterial roadways in Colorado carrying significantly more traffic than their generally accepted capacity (Table 3) to suggest it would be prudent to design for the higher forecasts.

**Table 3. Arterial Roadways where Current Actual Traffic Volumes Significantly Exceed the Generally Accepted Roadway Capacity**

Facility	Location	Roadway Type	Capacity	Actual Volume
Colorado Blvd.	at I-25	6-lane Major	48,000 vpd	70,000 vpd
Wadsworth Blvd.	n/o I-70	6-lane Major	48,000 vpd	62,500 vpd
Federal Blvd.	s/o 6 <sup>th</sup> Avenue	5-lane Major	40,000 vpd	51,200 vpd
Hampden Blvd.	w/o I-25	4-lane Major	32,000 vpd	53,400 vpd
US 287	at US 36	4-lane Major	32,000 vpd	51,300 vpd
Sheridan Blvd.	s/o 6 <sup>th</sup> Avenue	4-lane Major	32,000 vpd	45,100 vpd



# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation



Figure 3. No Action Alternative

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

**LEGEND**

	<b>1 New General Purpose Lane (GPL) in Each Direction</b>
	<b>1 New General Purpose Lane (GPL) + Auxiliary Lane in Each Direction</b>
	<b>Commuter Rail (CR)</b>
	<b>Commuter Bus (CB) Service on US 85</b>
	<b>Feeder Bus Service</b>
	<b>Interchange Upgrades</b>
	<b>Number of Lanes</b>
	<b>Commuter Bus Station / Stop</b>
	<b>Commuter Rail Station</b>
	<b>FasTracks Rail Line</b>
	<b>FasTracks / RTD Transit Station</b>
	<b>Potential Commuter Rail Operational &amp; Maintenance Facility</b>
	<b>Potential Commuter Bus Operational &amp; Maintenance Facility</b>

**Congestion Management Measures include:**

- Enhanced carpool lot parking capacity and amenities
- Courtesy patrol (incident management) from SH 14 to SH 7
- Variable messaging signs at all transit stations
- Automated Vehicle Locaters on all transit vehicles - "next bus" technology
- Links to local bike and pedestrian systems at station areas
- Support for development of Transportation Management Organization (TMO)

**NOTE:**

- Select sections of I-25 would require auxiliary lanes and / or an additional through lane in addition to this 6-lane cross section.
- Where widening is needed between SH 66 and SH 7, the median would be used.
- Commuter Rail Service without a Longmont to North Metro connection will also be evaluated.



**Figure 4. Package A: GPL + CR + CB85**



# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

**LEGEND**

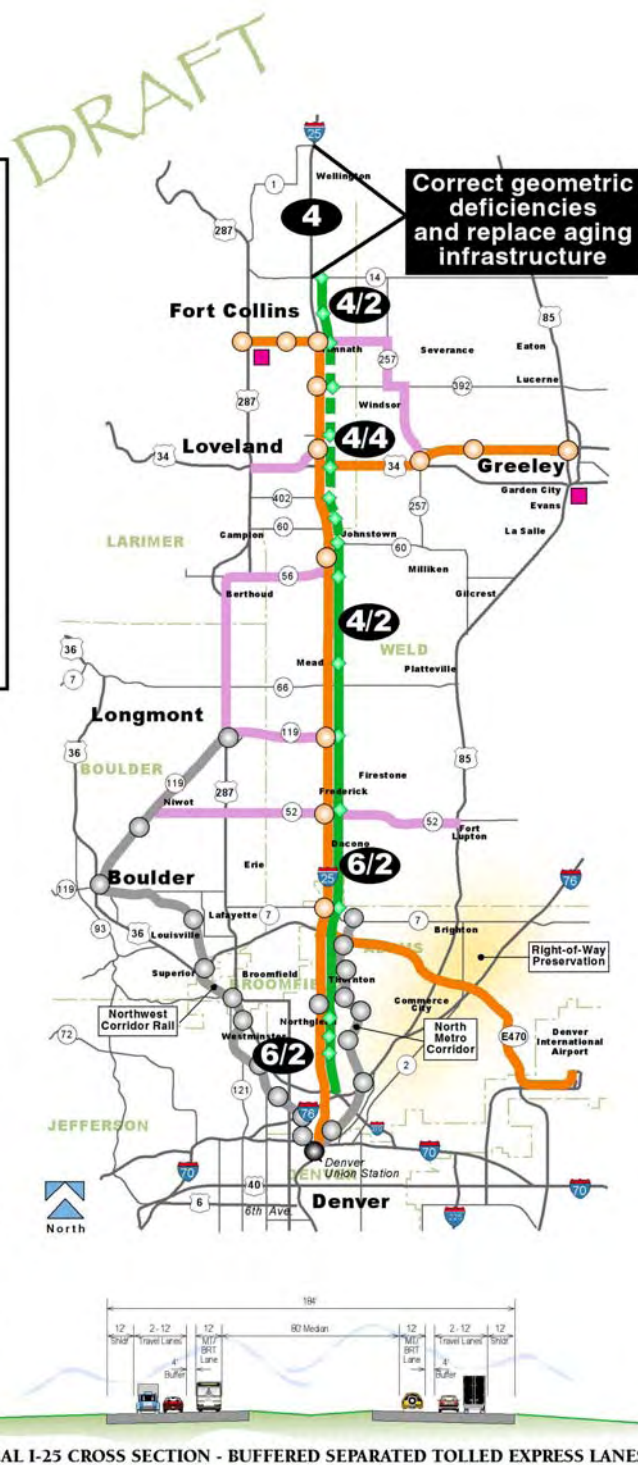
- 1 Buffer-Separated Tolloed Express Lane (TEL) in Each Direction
- ■ 2 Barrier-Separated Tolloed Express Lanes (TEL) in Each Direction
- Bus Rapid Transit (BRT) Route (Uses TELs on I-25)
- Feeder Bus Service
- ◆ Interchange Upgrades
- X Number of Lanes: General Purpose/Tolloed Express Lanes
- Bus Rapid Transit Station
- FasTracks Rail Line
- FasTracks / RTD Transit Station
- Potential Commuter Bus Operational & Maintenance Facility

**Congestion Management Measures include:**

- Enhanced carpool lot parking capacity and amenities
- Courtesy patrol (incident management) from SH 14 to SH 7
- Variable messaging signs at all transit stations
- Automated Vehicle Locaters on all transit vehicles - "next bus" technology
- Links to local bike and pedestrian systems at station areas
- Support for development of Transportation Management Organization (TMO)

**NOTE:**

- A wider barrier and express lanes cross section is included between SH 60 and Harmony Road.
- BRT stations located within an expanded median area.
- Where widening is needed between SH 66 and SH 7, the median would be used.



**Figure 5. Package B: TEL + BRT**



# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

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## **2030 Package B Traffic Volumes**

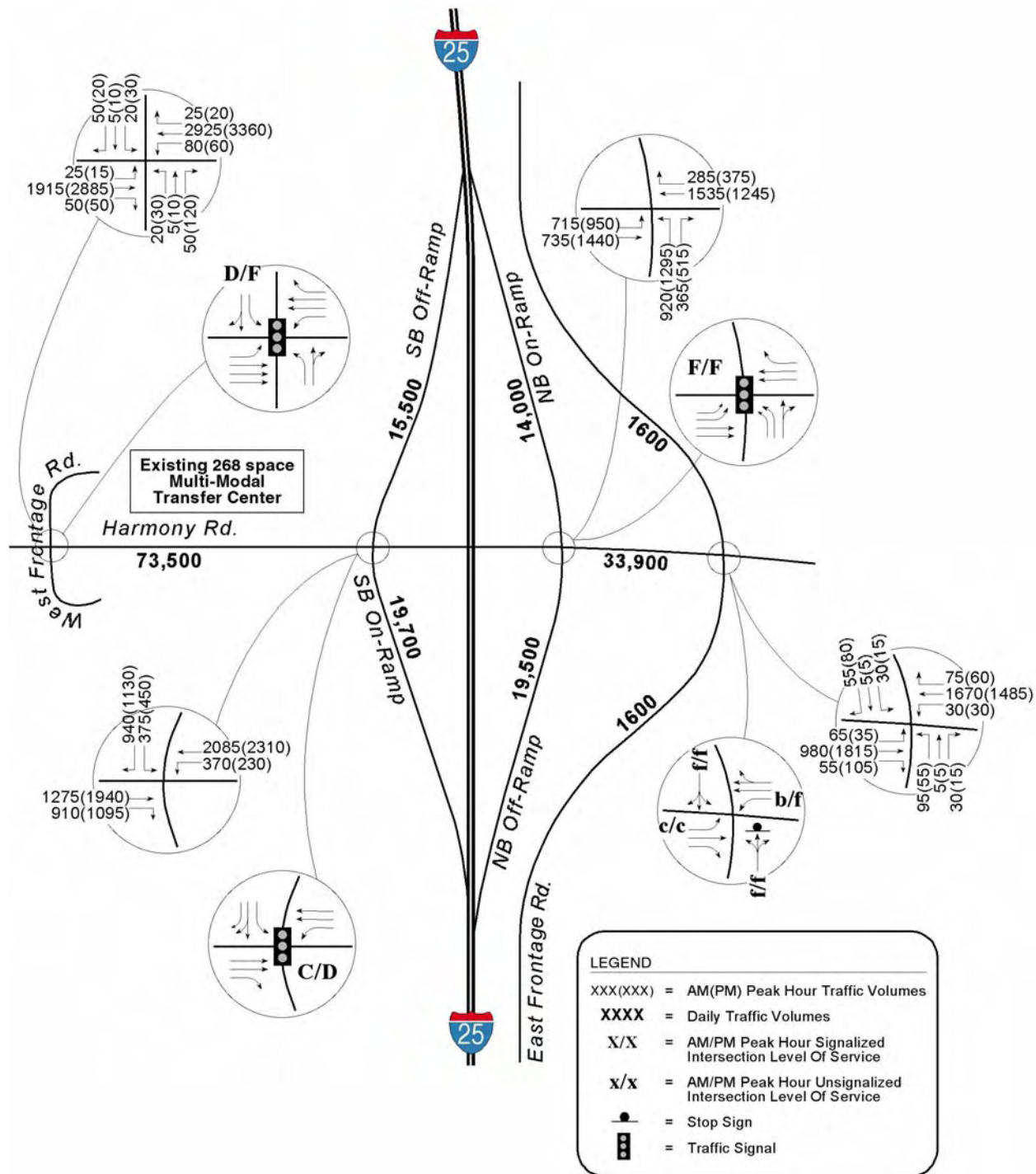
Figure 8 depicts 2030 daily and peak hour Package B traffic projections for the Harmony Road interchange and adjacent intersections. The volumes in the figure are generally similar to those presented in the No Action and Package A scenarios, differing slightly due to the change in capacity on I-25. Daily volume projections on Harmony Road range from 33,900 vpd east of the interchange to 77,400 vpd west of the interchange, and ramp volumes range from 16,500 to 21,500 vehicles per day. While the traffic patterns in Package B are generally similar to both No Action and Package A (the highest flows are to and from the west and south), the flow to and from the north in this alternative is higher than in either of the other alternatives.

## **2030 No Action Traffic Operations**

Figure 6 shows the projected levels of service at the frontage road and ramp intersections on Harmony under the No Action Alternative. As the figure indicates, all three of the signalized intersections would operate at LOS E or worse in at least one of the peak periods, while both side streets and the westbound main street left turn movement at the unsignalized east frontage road intersection would operate at LOS F in at least one of the peak periods. Table 4 shows the projected queuing for key movements at the interchange and further underscores that the existing interchange would be in need of capacity improvements with the projected traffic volumes.

It should be noted that signalizing the east frontage road intersection would improve operations to LOS B in the morning, but only LOS E in the afternoon.

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation



**Figure 6. No Action Forecasts and Levels of Service**

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

**Table 4. 2030 No Action Level of Service and Queue Lengths for Key Movements**

Intersection / Movement	Level of Service		Estimated 95 <sup>th</sup> Percentile Queue <sup>3</sup>		Intersection Spacing and Storage Length Provisions
	AM	PM	AM	PM	
<b>West Frontage Road Intersection</b>					
<b>WB Left</b>	B	D	70'	70'	Current Storage Provided – 390'
<b>WB Thru</b>	F	F	1340'	1400'	Distance to Adjacent Intersection – 990'
<b>WB Right</b>	A	A	10'	220'	Storage Provided <sup>2</sup> – 990'
<b>Southbound Ramp Terminal</b>					
<b>EB Thru</b>	B	E	1300'	1,390'	Distance to Adjacent Intersection – 990'
<b>EB Right</b>	Free	Free	N/A <sup>1</sup>	N/A <sup>1</sup>	N/A <sup>1</sup>
<b>WB Left</b>	E	F	140'	150'	Current Storage Provided – 100'
<b>WB Thru</b>	C	D	560'	570'	Distance to Adjacent Intersection – 420'
<b>SB Left</b>	F	F	460'	500'	Current Storage Provided – 300'
<b>SB Right</b>	Free	Free	N/A	N/A	Current Storage Provided – 430'
<b>Northbound Ramp Terminal</b>					
<b>EB Left</b>	F	F	690'	610'	Current Storage Provided – 520'
<b>EB Thru</b>	A	B	490'	560'	Distance to Adjacent Intersection – 420'
<b>WB Thru</b>	F	F	580'	570'	Distance to Adjacent Intersection – 500'
<b>WB Right</b>	C	C	190'	200'	Current Storage Provided – 125'
<b>NB Left</b>	F	F	1,220'	1,140'	Current Storage Provided – 900'
<b>NB Right</b>	C	F	240'	240'	Current Storage Provided – 150'
<b>East Frontage Road Intersection</b>					
<b>EB Left</b>	C	C	60'	40'	Current Storage Provided – 200'
<sup>1</sup> The outside eastbound through lane on Harmony Road becomes the EB right-turn lane at the SB ramp terminal. <sup>2</sup> Continuous accel. / decel. lane is provided between southbound ramps and park-n-ride intersection. <sup>3</sup> 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.					



# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

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## **2030 Package A Traffic Operations**

### **Interchange Configuration**

The proposed configuration for the Harmony Road DEIS interchange evaluation is a diamond configuration (Figure 7). This diamond configuration maintains the current terminal spacing but has several lane enhancements over the existing interchange. Specifically, the overpass bridge has been widened to ten lanes to accommodate dual left-turn lanes and three through lanes in both directions. The northbound I-25 off ramp would be constructed with two left turn lanes, a shared left-through lane and a right turn lane while the southbound off ramp would be constructed with a left turn lane, a shared left-through lane and a right turn lane. Harmony Road itself would be widened to six lanes (plus auxiliary lanes) both east and west of the interchange, dropping to four lanes east of the east frontage road intersection.

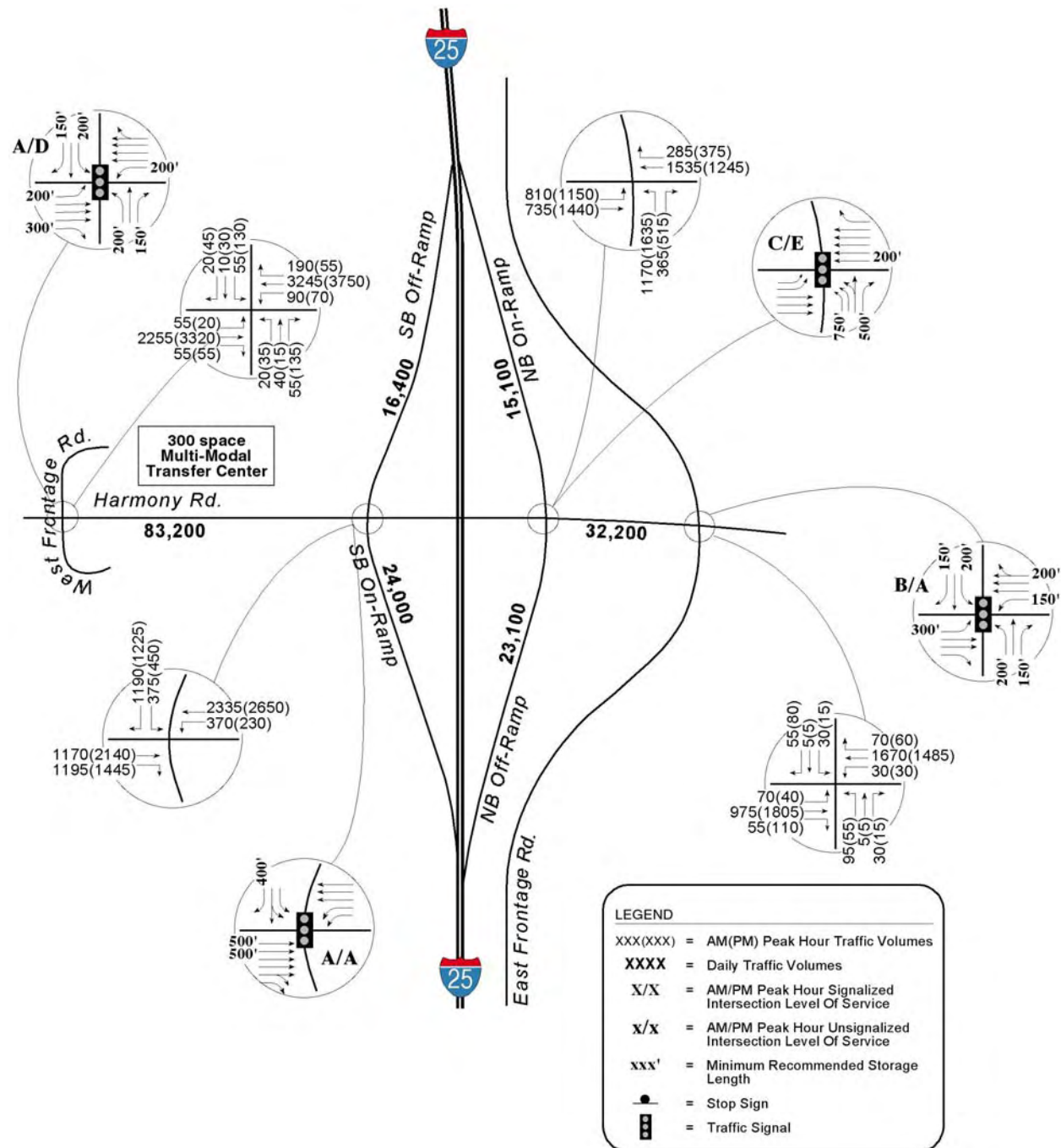
A 268-space park-and-ride lot is currently located on the north side of Harmony west of the interchange and is accessed via the west frontage road intersection. Under Package A that park-and-ride would be expanded to 300 spaces.

### **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, the southbound ramp and the east and west frontage road intersections would operate at LOS D or better with the forecasted traffic volumes and the enhancements identified, but the northbound ramp intersection would operate at LOS E during the afternoon peak. The poor levels of service are a result of the high through traffic volume forecasts along Harmony Road. As noted previously, Colorado Boulevard is the highest volume six lane major arterial in the state and currently carries approximately 70,000 vpd in the vicinity of I-25, or about 15 percent less traffic than the Package A forecast for Harmony. If the PM peak hour through traffic on Harmony is reduced an equivalent level, the northbound ramp would operate at LOS D.

Table 5 summarizes levels of service for key individual turning movements and compares SimTraffic estimates of the 95<sup>th</sup> percentile queue length for those 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 the morning the estimated 95<sup>th</sup> percentile queues would be contained well within the turn bays or within the space between adjacent intersections. On both the northbound and southbound ramp terminals, left and right turn queues would be accommodated well within the storage length and would not extend into the I-25 main lanes.

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation



**Figure 7. Package A Forecasts and Levels of Service**

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

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

Intersection / Movement	Level of Service		Estimated 95 <sup>th</sup> Percentile Queue <sup>2</sup>		Distance Between Intersections and Storage Length Provisions
	AM	PM	AM	PM	
<b>Park-and-Ride Intersection</b>					
WB Left	C	E	100'	130' (80') <sup>4</sup>	Storage Provided in Design – 200'
WB Thru	A	B	370'	640' (430')	Distance to Adjacent Intersection – 550'
<b>Southbound Ramp Terminal</b>					
EB Thru	B	A	190'	180' (210')	Distance to Adjacent Intersection – 550'
EB Right	Free	Free	120'	90' (150')	Storage Provided in Design <sup>1</sup> – 550'
WB Left	A	D	710'	810' (560')	Storage Provided in Design – 1,240'
WB Thru	A	A	90'	280' (80')	Distance to Adjacent Intersection – 420'
SB Left	D	D	400'	1,850' (490')	Storage Provided in Design – 800'
SB Right	Free	Free	280'	1,640' (220')	Storage Provided in Design – 400'
<b>Northbound Ramp Terminal</b>					
EB Left	C	E	790'	1,190' (1,950')	Storage Provided in Design – 1,840'
EB Thru	A	B	110'	280' (520')	Distance to Adjacent Intersection – 420'
WB Thru	C	D	300'	440' (230')	Distance to Adjacent Intersection – 500'
WB Right	C	E	150'	320' (240')	Storage Provided in Design <sup>3</sup> – 500'
NB Left	D	E	910'	3,260' (1,780)	Storage Provided in Design – 2,250'
NB Right	C	E	100'	490' (420')	Storage Provided in Design – 500'
<b>East Frontage Road Intersection</b>					
EB Left	C	A	90'	50' (50')	Storage Provided in Design – 200'
EB Thru	A	A	170'	480' (410')	Distance to Adjacent Intersection – 500'
EB Right	A	A	30'	40' (110')	Distance to Adjacent Intersection <sup>3</sup> – 500'
<sup>1</sup> Storage is the continuous accel / decel. lane between SB ramp terminal and the park-n-ride access.. <sup>2</sup> 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. <sup>3</sup> Storage is the continuous accel / decel. lane between the east frontage road and NB ramp terminal. <sup>4</sup> (##') = 95 <sup>th</sup> percentile queue lengths with a 15 percent reduction in through traffic on Harmony Road.					

In the afternoon, significant queuing issues would occur at all intersections under the forecasted volumes. When through traffic on Harmony is reduced by 15 percent, the storage provided in the design would for the most part contain the queues but may on occasion exceed the available storage. This suggests that the proposed design could accommodate traffic forecasts of up to nearly 70,000 vpd on Harmony. Beyond that, however, additional through lanes are needed on Harmony to adequately service traffic volumes.



# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

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As mentioned above, northbound triple left turn lanes are recommended at this intersection due to the very high level of traffic projected for northbound to westbound movements. In the northern Colorado area there are no intersections with triple left-turn lanes. However, triple left-turn lanes are currently in operation in the Denver metro area at the I-25/Hampden interchange, Arapahoe Road/Parker Road intersection and at the Colfax Avenue/Indiana Street intersection. The analysis in Table 5 shows the proposed triple left-turn lanes operating at a LOS E with 95<sup>th</sup> percentile queue lengths of 700 to 750 feet in each lane. These queues are manageable in that they can be accommodated on the ramp and will not back up into the I-25 main lanes.

Options to the triple left turn lanes would be traditional dual-left turn lanes or a flyover. Operationally, dual left-turn lanes cause the northbound ramp intersection to operate at LOS F in both peak periods, with long queues on the ramp that would back into the I-25 main lanes. The flyover would improve overall operations at the interchange but would impact right-of-way and access along Harmony Road and would have a significantly higher cost.

## **2030 Package B Traffic Operations**

### **Interchange Configuration**

While Package B would replace the Harmony structure to accommodate the wider cross section on I-25, the proposed interchange configuration for Harmony Road is the same as in Package A (Figure 8).

Under Package B the existing 268-space park-and-ride lot would be expanded to 372 spaces.

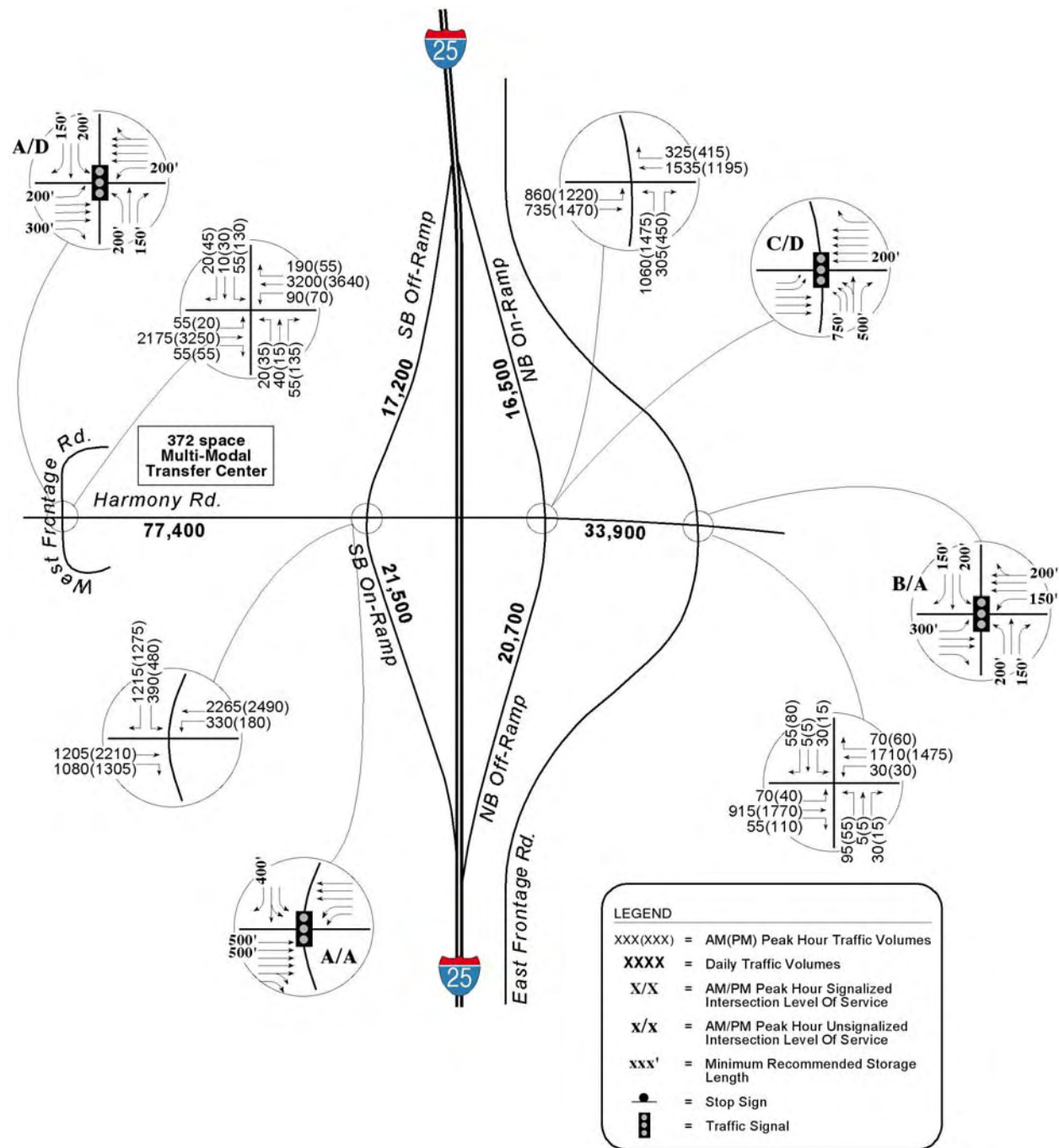
### **Interchange Operations**

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 four intersections would operate at LOS D or better with the forecasted traffic volumes and the enhancements identified.

Table 6 summarizes levels of service for key individual turning movements and compares SimTraffic estimates of the 95<sup>th</sup> percentile queue length for those key movements to the storage distance available for each. The queuing analysis shows that in the morning the estimated 95<sup>th</sup> percentile queues would be contained well within the turn bays or within the space between adjacent intersections. On both the northbound and southbound ramp terminals, left and right turn queues would be accommodated well within the storage length and would not extend into the I-25 main lanes.

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

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**Figure 8. Package B Forecasts and Levels of Service**

# Harmony Road (LCR 38) at I-25 Interchange and Parking Traffic Evaluation

**Table 6. 2030 Package B Level of Service and Queue Lengths for Key Movements**

Intersection / Movement	Level of Service		Estimated 95 <sup>th</sup> Percentile Queue <sup>2</sup>		Distance Between Intersections and Storage Length Provisions
	AM	PM	AM	PM	
<b>Park-and-Ride Intersection</b>					
WB Left	C	C	90'	110' (80') <sup>4</sup>	Storage Provided in Design – 200'
WB Thru	A	B	350'	670' (440')	Distance to Adjacent Intersection – 550'
<b>Southbound Ramp Terminal</b>					
EB Thru	B	A	120'	140' (170')	Distance to Adjacent Intersection – 550'
EB Right	Free	Free	130'	80' (90')	Storage Provided in Design <sup>1</sup> – 550'
WB Left	A	D	850'	660' (500')	Storage Provided in Design – 1,240'
WB Thru	A	A	100'	210' (70')	Distance to Adjacent Intersection – 420'
SB Left	D	D	400'	2,000' (430')	Storage Provided in Design – 800'
SB Right	Free	Free	380'	1,800' (230')	Storage Provided in Design – 400'
<b>Northbound Ramp Terminal</b>					
EB Left	B	D	890'	1,170' (1,57)	Storage Provided in Design – 1,840'
EB Thru	A	A	110'	270' (320')	Distance to Adjacent Intersection – 420'
WB Thru	C	D	500'	500' (210')	Distance to Adjacent Intersection – 500'
WB Right	C	E	210'	290' (260')	Storage Provided in Design <sup>3</sup> – 500'
NB Left	D	E	740'	2,500' (1,440')	Storage Provided in Design – 2,250'
NB Right	C	E	80'	520' (300')	Storage Provided in Design – 500'
<b>East Frontage Road Intersection</b>					
EB Left	C	A	80'	50' (50')	Storage Provided in Design – 200'
EB Thru	A	A	120'	480' (300')	Distance to Adjacent Intersection – 500'
EB Right	A	A	30'	40' (40')	Distance to Adjacent Intersection <sup>3</sup> – 500'
<sup>1</sup> Storage is the continuous accel / decel. lane between SB ramp terminal and the park-n-ride access.. <sup>2</sup> 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. <sup>3</sup> Storage is the continuous accel / decel. lane between the east frontage road and NB ramp terminal. <sup>4</sup> (##') = 95 <sup>th</sup> percentile queue lengths with a 15 percent reduction in through traffic on Harmony Road.					

In the afternoon, as with Package A, significant queuing issues would occur at all intersections under the forecasted volumes, even though the overall intersection levels of service are adequate at each location. When through traffic on Harmony is reduced by 15 percent, the storage provided in the design would adequately contain all queues, suggesting that the proposed design could accommodate traffic forecasts of up to 70,000 vpd on Harmony.



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## Alternatives Evaluation Comparison

### Traffic Operational Analysis

Table 7 compares the levels of service and delay at the Harmony Road interchange for the three packages. As the table indicates, without improvements at this location, all four intersections would operate at LOS E or F during the PM peak hour, and the west frontage road and northbound ramp intersections would operate at LOS E or F in the morning peak hour. With the improvements identified above, however, all four intersections operate at LOS D or better during both peak periods, except for the northbound ramp, which would operate at LOS E in the afternoon peak under Package A. Package B provides slightly better operations along Harmony Road in the vicinity of the interchange than Package A. However, it should be noted that significant queuing issues occur at both ramps and at the west frontage road under both scenarios, suggesting that it is not possible to accommodate the high traffic volume forecasts on Harmony with only three travel lanes in each direction. When through traffic on Harmony is reduced by 15 percent in either scenario, the queuing issues are eliminated, so it would appear that the proposed design could accommodate traffic forecasts of up to 70,000 vpd on the arterial. Beyond that, however, additional through lanes are needed to adequately service traffic volumes.

**Table 7. Intersection Level of Service and Delay**

Intersection	No Action <sup>1</sup>		Package A		Package B	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
West Frontage Road	LOS D (51 sec.)	LOS F (>80 sec.)	LOS A (9 sec.)	LOS D (49 sec.)	LOS A (9 sec.)	LOS D (42 sec.)
Southbound Ramps	LOS C (26 sec.)	LOS D (47 sec.)	LOS A (8 sec.)	LOS A (7 sec.)	LOS A (9 sec.)	LOS A (7 sec.)
Northbound Ramps	LOS F (>80 sec.)	LOS F (>80 sec.)	LOS C (26 sec.)	LOS E (56 sec.)	LOS C (25 sec.)	LOS D (48 sec.)
East Frontage Road	LOS F <sup>1</sup> (>50 sec.)	LOS F <sup>1</sup> (>50 sec.)	LOS B (14 sec.)	LOS A (9 sec.)	LOS B (14 sec.)	LOS A (9 sec.)

1. Assumes a traffic signal at the east frontage road intersection, but no turn lane revisions at any location.

LOS X – Level of service

##.# - Average delay in seconds per vehicle