US 34 and 83rd Avenue BRT Station DEIS Evaluation

August 20, 2007

Introduction

The North I-25 DEIS Package B alternative considers three bus-rapid-transit (BRT) routes: one that would extend from the Denver Union Station (DUS) and terminate in Fort Collins at the proposed Fort Collins South Transit Center; a second that would extend from the Denver International Airport (DIA) and also terminate in Fort Collins; and a third route from DUS to downtown Greeley. Stations would be located at various interchanges along I-25, as well as along both US 34 east of I-25 and Harmony Road west of I-25.

This report documents the potential traffic impacts of the proposed BRT station in the vicinity of Two Rivers Parkway (near US 34/83rd Avenue) and provides technical documentation of the traffic data analysis. The other proposed BRT stations are addressed in separate reports.

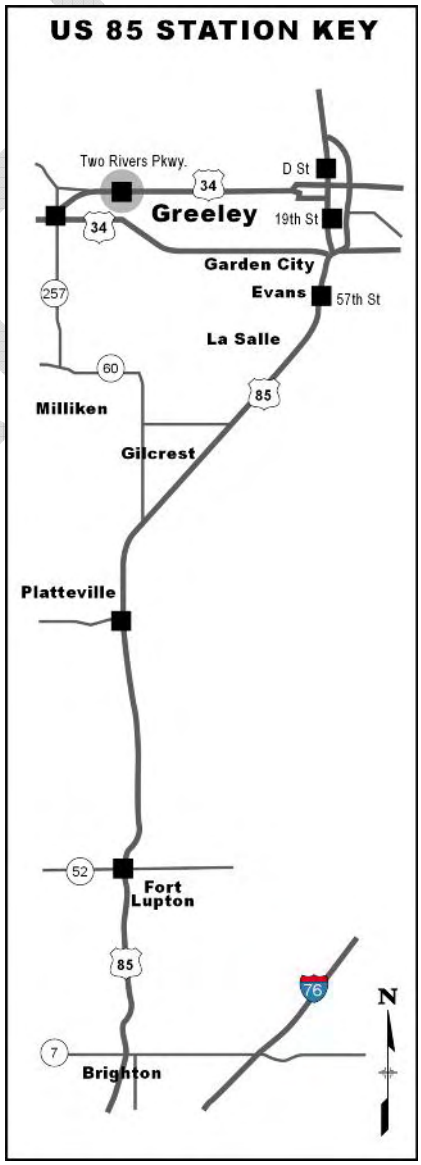

Figure 1. Vicinity Map

Existing Conditions

The proposed BRT station is located southeast of the US 34/83rd Avenue intersection. The surrounding area includes several land use types including residential, commercial, retail development, and small offices. The following major roadways and intersections are in the vicinity of the proposed site.

United States Highway 34 (US 34)

US 34 in the vicinity of the proposed BRT station is a two lane arterial with a posted speed limit of 50 mph. Six miles east of I-25, Exit 257, US 34 is split into two different routes, US 34 and US 34 Bypass. Eastbound, US 34 cuts off to the right as a two lane exit, and then takes a flyover off to the northeast, then continues due east towards Greeley. The BRT station is proposed on this route.

US 34/83rd Avenue intersection

The US 34/83rd Avenue intersection is unsignalized. The posted speed limit near the intersection is 30 mph. The intersection geometry on all the four approach legs includes a single shared through/left/right turn lane. 83rd Avenue travels north south and carries residential traffic from/to the neighborhoods while US 34 travels east-west and is a major arterial that carries moderate amount of through traffic between Loveland and Greeley.

As shown in Figure 2, the average daily traffic on US 34 east of the intersection is around 11,900 vehicles per day (vpd) and around 12,500 vpd west of the intersection. The average daily traffic on 83rd Avenue south of the intersection is around 250 vpd and around 850 vpd north of the intersection.

US 34/77th Avenue intersection

The US 34/77th Avenue intersection is unsignalized tee-intersection. The posted speed limit near the intersection on 77th Avenue is 25 mph. The intersection geometry on the northbound 77th Avenue consists of a shared through/left/right turn lane. The eastbound approach consists of a through lane and a separate right turn lane. The westbound approach consists of a through lane and an exclusive left turn lane. At the intersection, 77th Avenue is a local street that carries residential traffic from/to the neighborhoods while US 34 is a major arterial that carries moderate amount of through traffic between Loveland and Greeley.

As shown in Figure 2, the average daily traffic on US 34 east and west of the intersection is around 11,900 vehicles per day (vpd). The average daily traffic on northbound 77th Avenue is around 100 vpd.

Traffic Operations Evaluation

Operational analyses of each key intersection were 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 controlled 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 (sec./veh.)	Average Delay at Stop-Controlled intersections (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

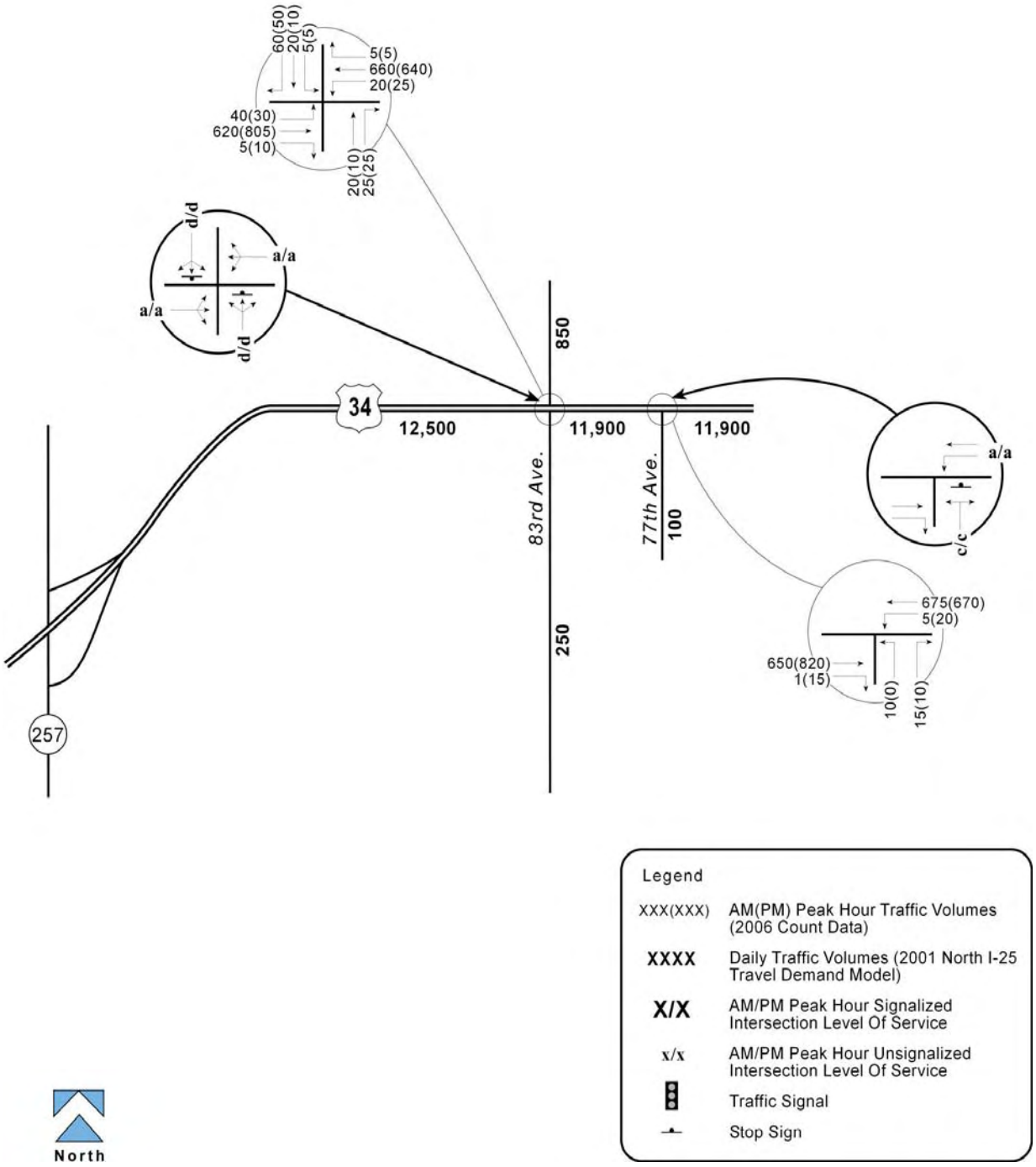

Figure 2. Existing Conditions

Peak hour traffic counts were conducted in August 2006 at the study area intersections. Other background parameters are documented in the *DEIS Traffic Evaluation – Methodology Summary*.

Figure 2 and Table 2 illustrate the existing peak hour levels of service at the unsignalized intersections within the study area. Currently, both the southbound and northbound approaches of the US 34/83rd Avenue intersection operate at Level of Service (LOS) D during both the AM and PM peak hours. The northbound approach of the US 34/77th Avenue intersection operates at LOS C during both the AM and PM peak hours.

Table 2 Existing Intersection LOS and Delay

Intersection / Movement	Level of Service		Delay (seconds)	
	AM	PM	AM	PM
US 34/83rd Ave (unsignalized)				
Southbound Approach	D	D	30	27
Northbound Approach	D	D	31	32
US 34/77th Ave (unsignalized)				
Northbound Approach	C	C	20	19

2030 Conditions

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

1) No Action Alternative
2) Package B: TEL + BRT

These packages are illustrated in Figure 3 and 4. Since there are no project elements in the 83rd Avenue area in Package A, the No Action results are representative of Package A conditions. In developing peak hour turning movements at the study area intersections, the North I-25 Travel Demand Model – 2001 base year, 2030 No Action, and 2030 Package B results were utilized to calculate the growth factors over a 29 year period. Since the actual traffic counts were conducted in year 2006, the growth factors were adjusted to reflect a 24 year growth rate. These growth factors 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 checked for balancing between intersections and reasonableness.

2030 No Action Traffic Volumes

The 2030 No Action daily and peak hour projections for the study area intersections are shown in Figure 5. As shown, the average daily traffic projection on US 34, west of the US 34/83rd Avenue intersection, is around 33,900 vehicles per day (vpd) and around 32,000 vpd east of the intersection. The average daily traffic projection on 83rd Avenue, north of the intersection is around 4,700 vpd and around 4,600 vpd south of the intersection. The average daily traffic projection on US 34, west of the US 34/77th Avenue intersection, is around 32,000 vpd and around 34,000 vpd east of the intersection. The average daily traffic projection on 77th Street, south of the intersection is around 1,900 vehicles per day. However, it should be noted that the

Figure 3. No Action Alternative

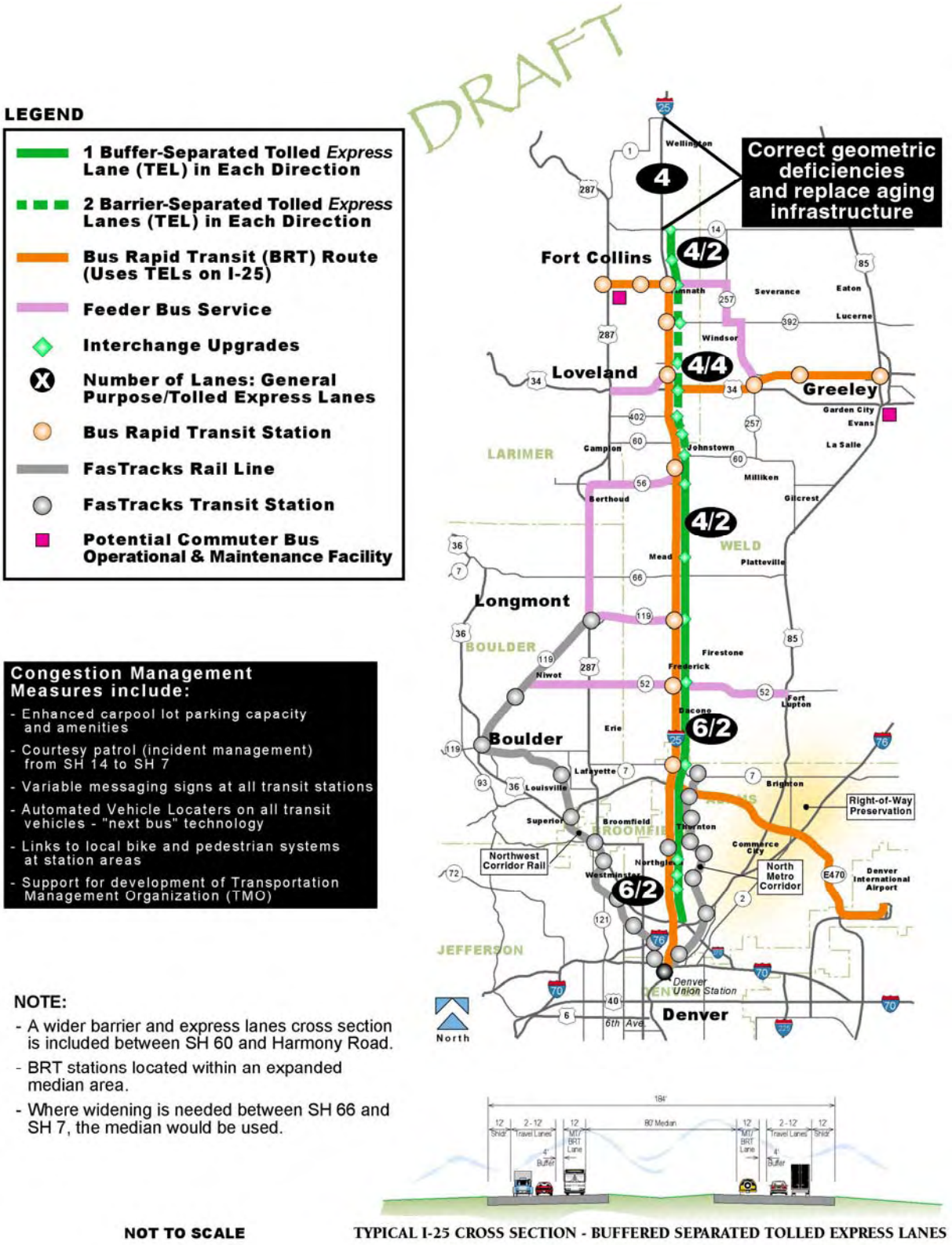

Figure 4. Package B Alternative

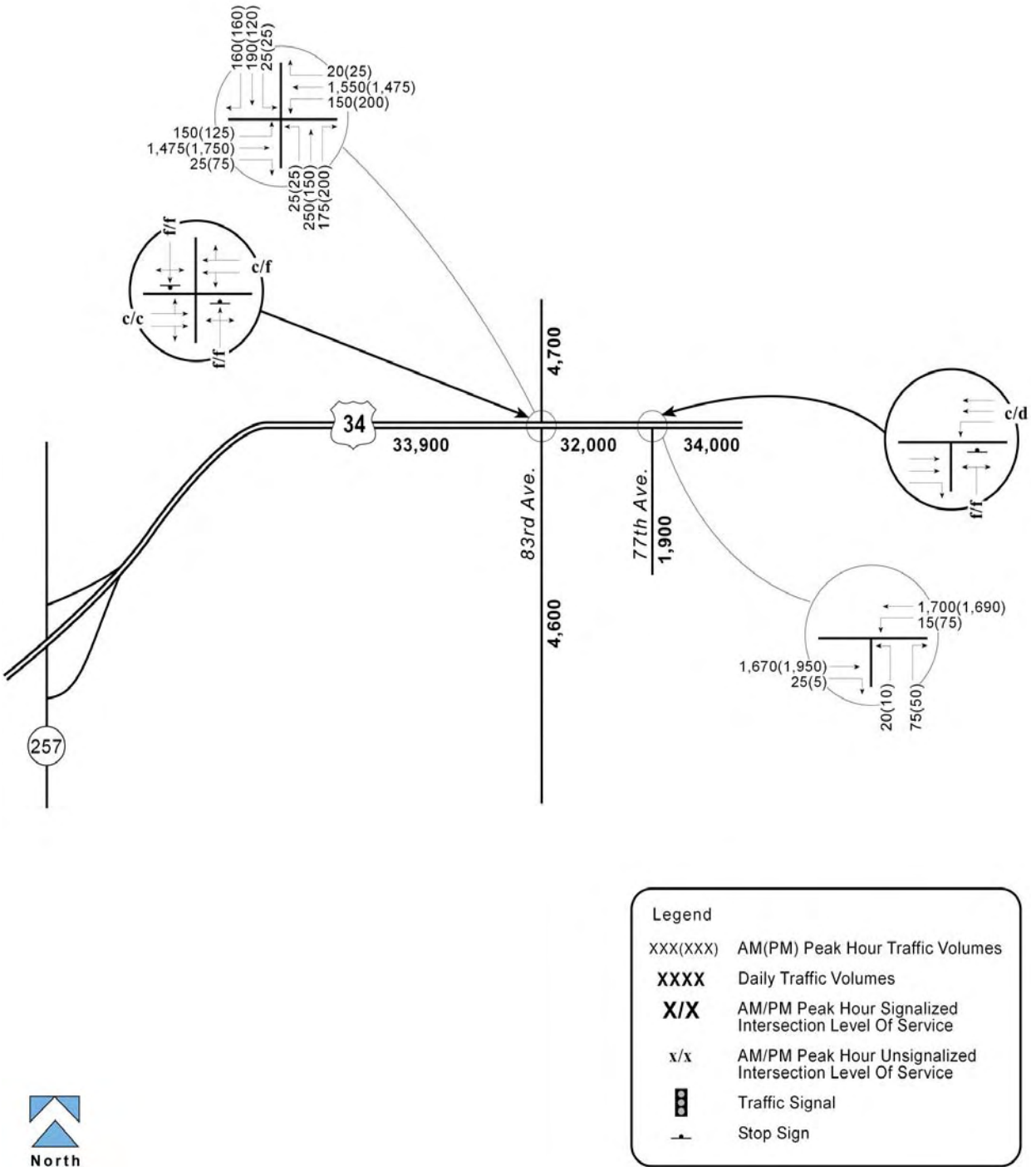

Figure 5. 2030 No Action Forecasts and Levels of Service

2030 No Action alternative assumes US 34 as a four-lane expressway instead of existing two-lane expressway in the vicinity of the proposed BRT station, based on the North Front Range MPO fiscally constrained 2030 transportation plan.

2030 Package B Traffic Volumes

The same methodology used to develop the 2030 No Action volumes was applied to estimate 2030 background traffic volumes for the Package B alternative. The North I-25 Travel Demand Model does not include park-and-ride patrons in its traffic assignment procedure. Therefore, in addition to these background forecasts – which are shown in Figure 6 – peak hour site traffic associated with the development of the commuter bus station and park-and-ride lot was estimated and assigned to the local road network according to the methodology outlined in the *Park-and-Ride Trip Generation and Distribution Methodology* report. A summary of this methodology and its application for this park-and-ride is provided below.

Park-and-Ride Trip Generation

The number of proposed spaces at the US 34/83rd Avenue BRT station 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 in Table 3.

Table 3 – Peak Hour Trip Generation for North I-25 EIS Park-and-Ride Lots

	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%

The US 34/83rd Avenue BRT station would be located at the southeast corner of the US 34/83rd Avenue intersection and would have 105 parking spaces. The future peak hour traffic from the proposed BRT station is shown in Table 4 below.

Table 5 – Future Peak Hour Traffic from the BRT station

Location	Daily Trips	AM Peak			PM Peak		
		In	Out	Total	In	Out	Total
US 34/83rd Avenue BRT Station	220	60	10	70	10	40	50

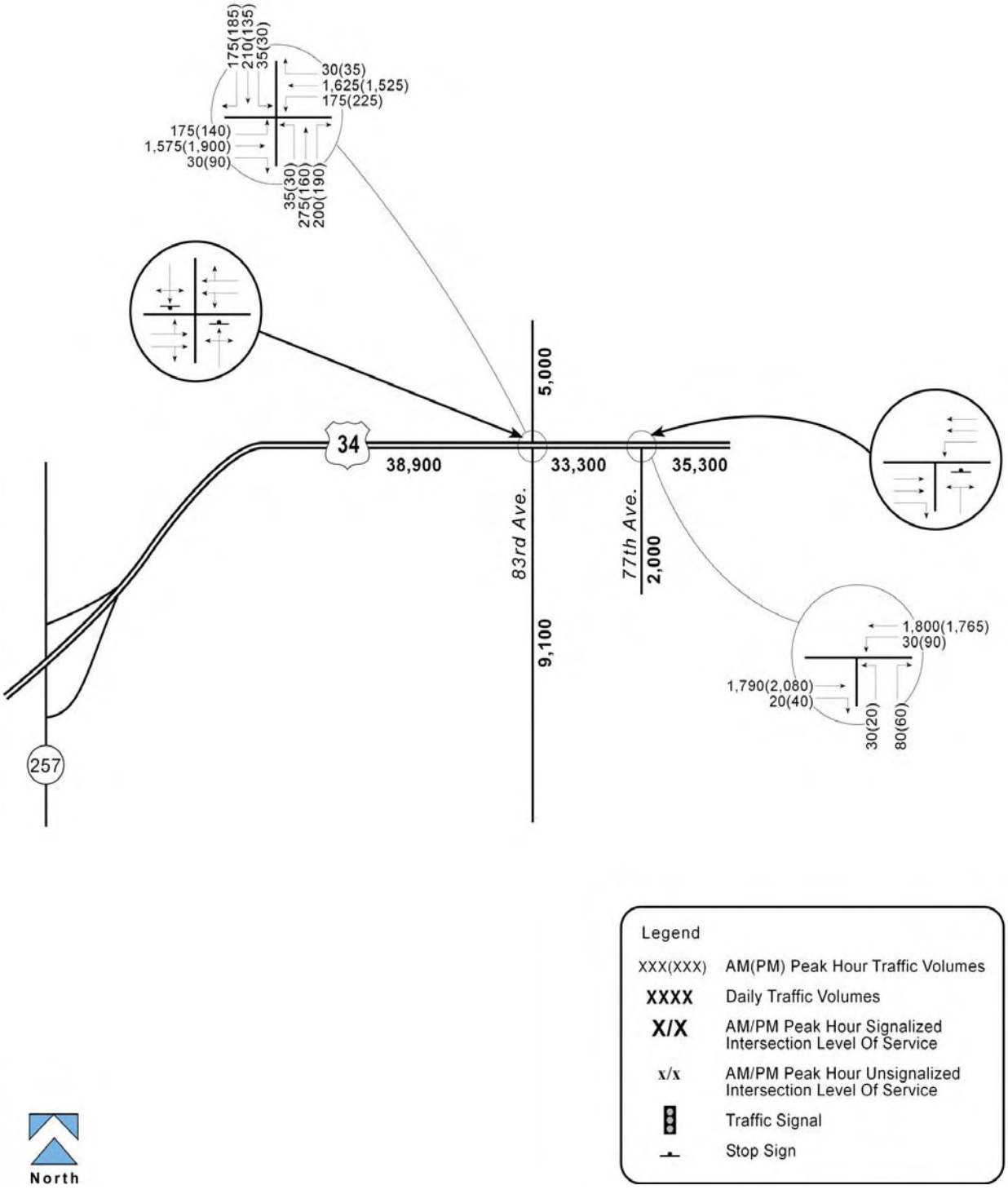

Figure 6. 2030 Package B Background Traffic Forecasts

Trip Distribution and Assignment

The trip distribution and assignment for the BRT station was determined based on existing and future residential land use patterns in the vicinity of the site. It was assumed that the access to the BRT station would be provided from 83rd Avenue. The peak hour trip generation and distribution estimates for the proposed park-and-ride lot are shown in Figure 7. These peak hour trip generation estimates were combined with the background traffic projections to arrive at the total 2030 Package B peak hour projections in Figure 8.

In general, daily traffic is projected to be about the same along US 34 in the Package B alternative.

2030 No Action Traffic Operations

Figure 5 shows the projected levels of service at the study area intersections under no action scenario. For the purpose of the No Action analysis it was assumed that the US 34 in the vicinity of the study area would be a four lane expressway, based on the North Front Range MPO fiscally constrained 2030 transportation plan.

As Figure 5 and Table 6 indicate, the southbound and northbound approaches of the US 34/83rd Avenue intersection would operate at Level of Service (LOS) F during both the AM and PM peak hours. The northbound approach of the US 34/77th Avenue intersection would also operate at LOS F during both the AM and PM peak hours.

Table 6 2030 No Action Intersection LOS and Delay

Intersection / Movement	Level of Service		Delay (seconds)	
	AM	PM	AM	PM
US 34/83rd Ave (unsignalized)				
Southbound Approach	F	F	>100	>100
Northbound Approach	F	F	>100	>100
US 34/77th Ave (unsignalized)				
Northbound Approach	F	F	>100	>100

Thus, the side street movements at the unsignalized intersections are projected to operate at LOS F in both the peak hours. It is not uncommon for movements from driveways and side streets along higher volume roadways to experience poor levels of service, however, as noted in Chapter 17 (Unsignalized Intersections) of the Highway Capacity Manual (2000):

> *In evaluating the overall performance of two-way stop control intersections, it is important to consider measures of effectiveness in addition to delay, such as v/c ratios for individual movements, average queue lengths, and 95th percentile queue lengths. By focusing on a single measure of effectiveness for the worst movement only, such as delay for the minor street left turn, users may make less effective traffic control decisions.*

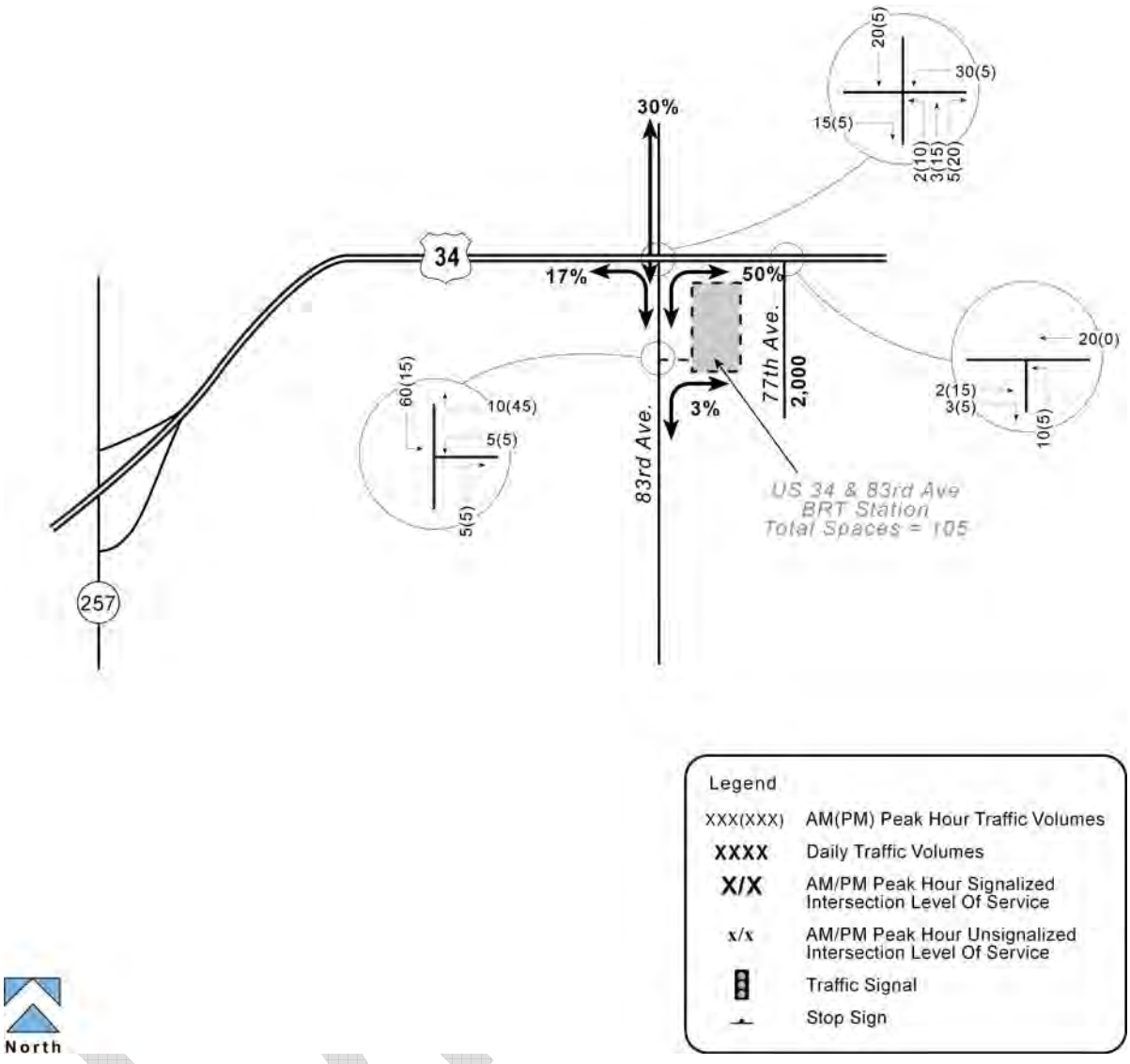

Figure 7. BRT Station Lot Trip Distribution and Assignment

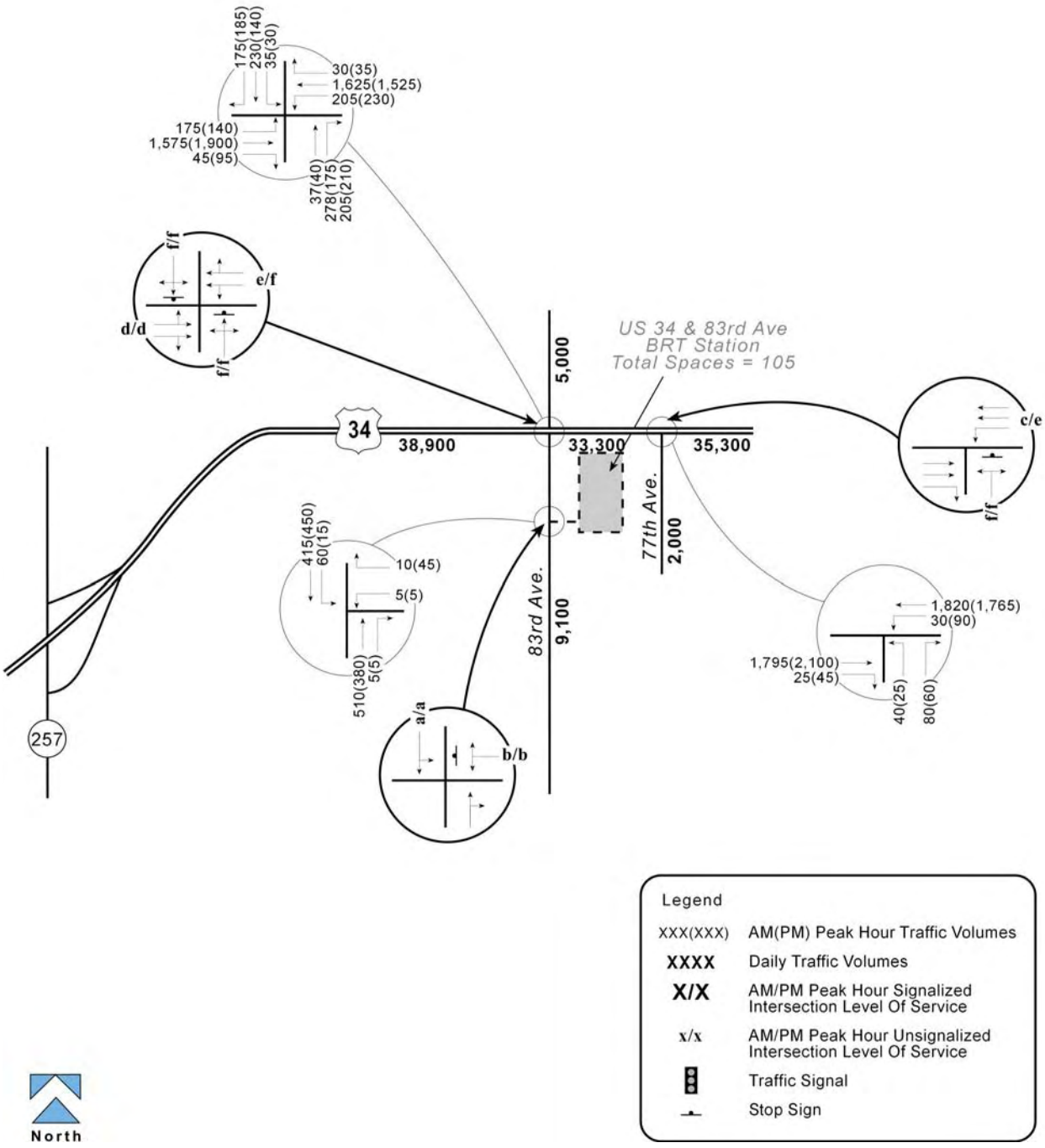

Figure 8. 2030 Package B Total Traffic Forecasts and Levels of Service

Table 7 indicates a more detailed traffic analysis at the study area intersections. The v/c ratio for the side street movements was exceeding 1.00 and the 95th percentile queue length was more than 300 feet at both of the unsignalized intersections, which indicated that improvements are necessary at these intersections.

Table 7 2030 No Action Intersection V/c Ratio and Queue lengths

Intersection / Movement	V/c Ratio		Queue Length (ft)	
	AM	PM	AM	PM
US 34/83rd Ave (unsignalized)				
Southbound Approach	>2.00	>2.00	>300	>300
Northbound Approach	>2.00	>2.00	>300	>300
US 34/77th Ave (unsignalized)				
Northbound Approach	1.80	2.50	250	300

2030 Package B Traffic Operations

Total Traffic LOS

As Figure 8 and Table 8 indicate, the southbound and northbound approaches of the US 34/83rd Avenue intersection would operate at Level of Service (LOS) F during both the AM and PM peak hours. The northbound approach of the US 34/77th Avenue intersection would also operate at LOS F during both the AM and PM peak hours. These are the same levels of service as in the No Action scenario except for the BRT Station Access/83rd Avenue unsignalized intersection. The BRT Station Access/83rd Avenue intersection would operate at acceptable LOS without any improvements to 83rd Street.

Access to the park-and-ride will be provided from 83rd Street south of US 34. As shown in Figure 8 and Table 7, this access would be a single lane with stop-control on the station approach, and would operate at acceptable levels of service without any need for laneage improvements to 83rd Street.

Table 8 2030 Package B Intersection LOS and Delay

Intersection / Movement	Level of Service		Delay (seconds)	
	AM	PM	AM	PM
US 34/83rd Ave (unsignalized)				
Southbound Approach	F	F	>100	>100
Northbound Approach	F	F	>100	>100
US 34/77th Ave (unsignalized)				
Northbound Approach	F	F	>100	>100
Station Access/83rd Ave (unsignalized)				
Westbound Approach	B	B	13	13

Proposed Mitigation

The Package B alternative includes toll/express lanes on I-25 in addition to the proposed bus rapid transit routes. This would result in more trip attractions towards I-25 increasing the average daily traffic and peak hour traffic volumes on US 34. However, the results of the traffic analysis indicate that major improvements would be needed at the study area intersections in the vicinity of the proposed site regardless of the Package B consideration. The proposed mitigation is discussed below:

US 34/83rd Avenue Intersection

- The 2030 No Action Travel Demand model assumes US 34 in the vicinity of the proposed site as a four-lane expressway instead of existing two-lane, based on the North Front Range MPO fiscally constrained 2030 transportation plan; hence, it is assumed that US 34 would be improved to four lanes by year 2030

- Provision of signal control, with protected-permitted left turn phasing on all approaches. When signalized, provide exclusive left turn lanes with 250-foot pocket length and separate right-turn lanes with 250-foot pocket length on all approaches.

These improvements would result in LOS C during both the AM and PM peak hours.

US 34/77th Avenue Intersection

- The 2030 No Action Travel Demand model assumes US 34 in the vicinity of the proposed site as a four-lane expressway instead of existing two-lane, based on the North Front Range MPO fiscally constrained 2030 transportation plan; hence, it is assumed that US 34 would be improved to four lanes by year 2030.

- Provision of signal control, with protected-permitted left turn phasing on westbound approach of US-34. When signalized, provide exclusive left turn lane with 100-foot pocket length and separate right-turn lane with 100-foot pocket length on the northbound approach.

These improvements would result in LOS C during both the AM and PM peak hours.

Alternatives Evaluation Comparison

Traffic Operational Analysis

Table 9 compares the levels of service and delay at the study area intersections for the two packages. As the table indicates, major improvements to the intersections in the vicinity of the BRT station would be required to address the LOS and delay issues. The proposed mitigation measures mentioned above would cause these intersections to operate at an acceptable LOS under both the No Action and Package A alternatives.

Table 9. Intersection Level of Service and Delay

Intersection	No Action		Package B	
	AM Peak	PM Peak	AM Peak	PM Peak
US 34/83rd Ave. (unsignalized)				
Southbound Approach	LOS F (>100 sec.)	LOS F (>100 sec.)	LOS F (>100 sec.)	LOS F (>100 sec.)
Northbound Approach	LOS F (>100 sec.)	LOS F (>100 sec.)	LOS F (>100 sec.)	LOS F (>100 sec.)
US 34/77th Ave. (unsignalized)				
Northbound Approach	LOS F (>100 sec.)	LOS F (>100 sec.)	LOS F (>100 sec.)	LOS F (>100 sec.)
Station Access/83rd Ave. (unsignalized)				
Westbound Approach	N/A	N/A	LOS B (13 sec.)	LOS B (13 sec.)

LOS X – Level of service
##.# - Average delay in seconds per vehicle

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