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4.0 TRANSPORTATION IMPACTS

This chapter compares the transportation impacts of the three alternatives considered for analysis in the environmental impact statement (EIS):

- No Action
- Enhanced Bus
- Light Rail Transit (LRT)

This chapter evaluates and compares the impact of these improvements to transit service, roadway traffic, parking, bicycle and pedestrian operations, freight and rail operations, and system linkages.

A variety of data and analysis is used to evaluate and compare the alternatives' transportation impacts. Many of the data are derived from the Denver Regional Council of Governments (DRCOG) *Regional Travel Demand Model*. The analysis uses DRCOG's BA25 model, which is the most recent model developed by DRCOG to represent the *Fiscally Constrained 2025 Interim Regional Transportation Plan* (DRCOG 2002e) incorporating regionally adopted population and employment forecasts, and highway and transit networks. The Regional Transportation District (RTD) used the BA25 model to create the WC25c No Action, WE25d Enhanced Bus and WF25h LRT models. These three models each incorporate the proposed transportation system changes for their respective alternative. All of these models evaluate impacts for the year 2025.

4.1 COMPATIBILITY WITH TRANSPORTATION PLANS AND POLICIES

The No Action, Enhanced Bus and LRT alternatives have been evaluated for their compatibility with regional and local transportation plans and polices. **Table 4-1** presents a summary of each alternative's compatibility with local and regional transportation plans and policies.

The No Action Alternative would provide no transit improvements beyond what is currently programmed for future service. It is, therefore, incompatible with local and regional transportation plans, which call for significant transit improvements in response to increased population and congestion.

The Enhanced Bus Alternative would only partially meet the goals and objectives of these local and regional transportation plans. While the Enhanced Bus Alternative marginally improves transit service, it does not provide the rapid transit connections necessary for meeting transportation and economic development objectives.

The LRT Alternative will be compatible with all local and regional transportation plans and policies reviewed for development of the environmental impact statement. These plans all describe providing rapid transit in the West Corridor to improve transit service and encourage economic development. Many of these plans specifically involve implementing LRT in the West Corridor to improve connections between neighborhoods, employment and activity centers in the corridor and region. The LRT Alternative will provide the transportation improvements necessary to fulfill the goals and objectives of these plans. It effectively links the corridor with the regional rapid transit system and to the state's two largest employment centers: the Denver central business district and the Denver Technological Center.

Table 4-1: Local and Regional Plan Compatibility

Plan Name	No Action	Enhanced Bus	LRT Build
DRCOG MetroVision 2020 Plan (2000)	No	No	Yes
DRCOG Fiscally Constrained 2020 Regional Transportation Plan (2002)	No	No	Yes
DRCOG Fiscally Constrained 2025 Interim Regional Transportation Plan (2002)	No	No	Yes

Plan Name	No Action	Enhanced Bus	LRT Build
DRCOG *2003-2008 Transportation Improvement Program* (2002)	No	No	Yes
The City of Lakewood's *Lakewood Industrial Park Action Plan*	No	No	Yes
The Jefferson County Countywide Transportation Plan (1998)	No	No	Yes
Denver Federal Center Master Site Plan (1997)	No	No	Yes
Blueprint Denver, an Integrated Land Use and Transportation Plan (2002)	No	No	Yes
Lakewood *Framework Plan for the West Corridor Light Rail Line* (2002)	No	No	Yes
Draft City of Golden *Vision 2010 Comprehensive Plan* (2002)	No	Yes	Yes
Alameda Avenue Cornerstone Plan (2002)	No	No	Yes
Westside Intermodal Center Study (2002)	No	No	Yes
Northwest Quadrant Feasibility Study (2000)	No	No	Yes

4.2 TRAVEL DEMAND

Travel demand in the West Corridor and the region has grown substantially over the past decade. Increases in population and employment have partially caused the increase in travel demand. However, data have also shown that the number of trips and the miles traveled are outpacing the growth in population and employment. If travel demand continues to increase as forecast, the West Corridor's existing transportation system will not provide acceptable levels of mobility and service. By 2025, many roadways in the corridor and the region will become severely congested. The current bus transit system, dependent on the existing roadways, will be seriously impacted by the increased roadway congestion. As a result, bus transit service will be restricted in its ability to effectively meet travel demand.

The **No Action Alternative** would not provide any improvements to the existing transportation system beyond what is currently funded as part of regional and local plans. As shown in Chapter 1 and Chapter 3, the West Corridor's roadway and transit system will exhibit very poor levels of service if no action is assumed for the year 2025. Therefore, the No Action Alternative would not adequately meet travel demand for the corridor or the region.

The **Enhanced Bus Alternative** would not adequately improve transit travel times, comfort, operations or capacity to effectively meet the forecasted travel demand in the West Corridor and the region. Because the transit service improvements included as part of the Enhanced Bus Alternative would be dependent on congested roadways for operations, they would not adequately improve mobility or effectively meet the growing corridor and regional travel demand.

The **LRT Alternative** will provide an option to meet some of the travel demand in the West Corridor and will result in improved transit service and capacity. The alternative will provide rapid transit service independent of the roadway network. LRT will operate effectively even when roadway congestion limits the effectiveness of the current and future bus transit system. Moreover, LRT will offer improved transit service levels and comfort, will not be significantly impacted by adverse weather conditions, and will provide greater transportation capacity than equivalent bus or roadway improvements.

4.3 TRANSIT OPERATIONS AND IMPACTS

An alternative's impact on transit operations and service is an important component of its ability to meet travel demand. This section describes each alternative's impacts on transit operations and service. Impacts on forecasted transit service levels and ridership, station access and parking, and travel times are examined in detail. Together these measures demonstrate an alternative's overall impact related to the future transit system.

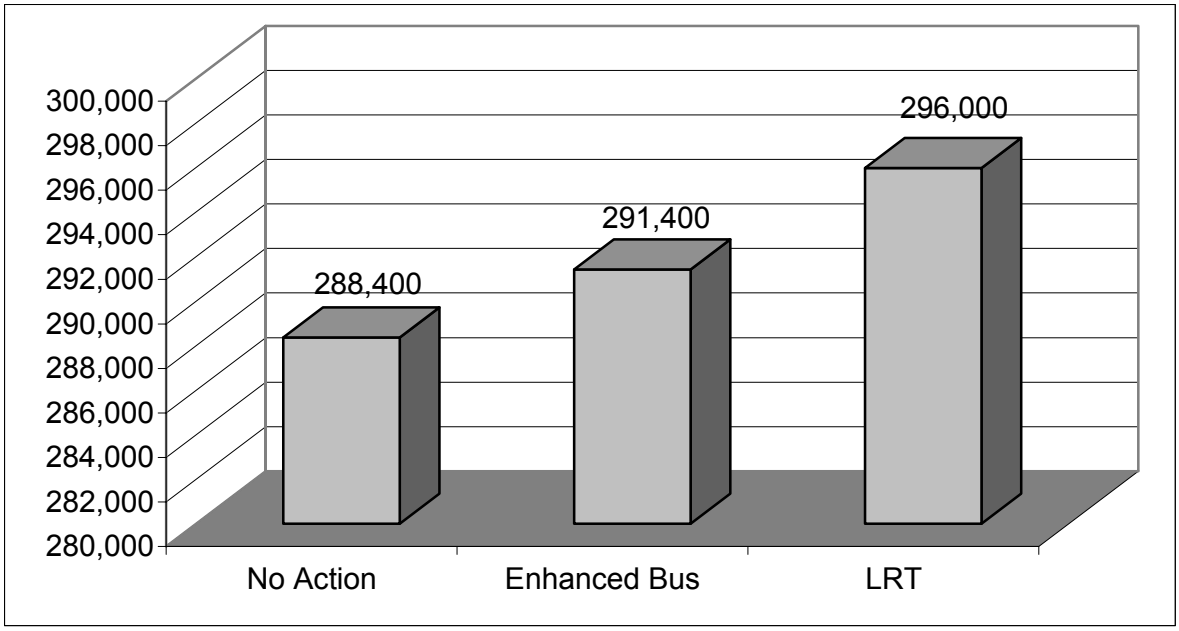
4.3.1 Transit Service and Ridership

The West Corridor LRT line will attract a significant level of ridership. Average weekday light-rail ridership in 2025 is projected to be 31,100 for the 12.1-mile West Corridor alignment. By comparison, RTD's existing 8.7-mile Southwest LRT line has observed daily ridership of 17,900, equating to 2,050 riders per mile of track. Thus, the West Corridor is forecast to carry 13,200 more daily riders and 500 more riders per mile than the Southwest LRT line is currently experiencing.

LRT ridership is only one measure of the alternative's impact. The system-wide linked transit trips generated by each alternative can provide a direct comparison of transit ridership impact. A linked transit trip is defined as a transit trip from an origin to a destination including transfers and mode changes. This measure includes both bus and rail transit trips.

Figure 4-1 shows the system-wide linked transit trips forecast for the No Action, Enhanced Bus, and LRT alternatives on an average weekday. Implementing the LRT Alternative will result in 296,000 average weekday system-wide linked transit trips. This is over 7,500 more than the No Action Alternative and 4,500 more than the Enhanced Bus Alternative.

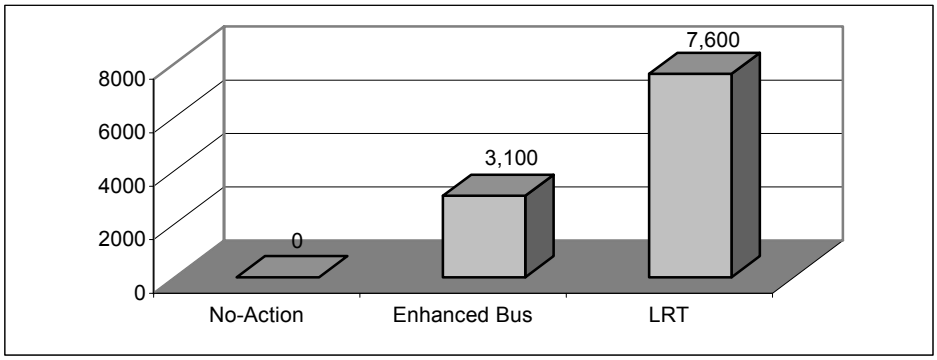
Figure 4-1: 2025 Average Weekday System-Wide Linked Transit Trips



Source: RTD WC25c, WE25d and WF25h model runs

The difference in the number of average weekday transit trips directly equates to the number of new daily transit riders. New transit riders would not normally use transit for their trip without the transit improvements associated with an alternative. Therefore, this comparison offers the best measure of an alternative's impact on transit ridership. **Figure 4-2** compares the number of new daily transit riders for each alternative. The No Action Alternative represents the status quo and would result in no new transit riders. The Enhanced Bus and LRT alternatives' new riders represent the additional number of transit trips generated beyond the No Action Alternative. As Figure 4-2 shows, the LRT Alternative will result in 7,600 new daily transit riders. This is more than twice the number of new riders generated by the Enhanced Bus Alternative. If these new LRT riders instead made their trips driving alone in personal automobiles, it would result in 7,600 more vehicles on the roadway system on an average weekday. Even with an average occupancy of 1.38 persons as shown in the 1997 DRCOG *Travel Behavior Inventory Survey*, the result would be more than 5,500 daily automobile trips.

Figure 4-2: 2025 Average Weekday New Riders



Source: RTD WC25c, WE25d and WF25h model runs

In addition to systemwide ridership, it is important to examine transit activity and associated impacts at each station. Station activity is important for determining service demand and impacts along the alignment. It measures the relative impact on overall LRT usage. Station activity is equal to the total number of average weekday boardings and alightings at each station. Station location, surrounding land uses, bus connections, and roadway access all affect a station's activity level. Stations with high station activity serve a large number of transit trips and often act as major transportation hubs and include park-n-Ride and bus transfer facilities. Low activity stations are usually designed to serve local areas, neighborhoods or special activity centers. Normally, these smaller stations do not include bus transfer activity, park-n-Rides or other major facilities. Although station activity is an important measure of a station's usage, it does not directly translate to ridership. This is because station activity may double-count intracorridor trips. These intracorridor trips must be subtracted from the total station activity in order to provide and accurate ridership measure. **Table 4-2** shows station activity for the West Corridor stations. The Auraria West Station was not considered in station activity or ridership because it is part of an existing LRT line.

Table 4-2: 2025 Average Weekday Light Rail Station Activity

Station	Station Activity (Boardings and Alightings)
Federal/Decatur	9,900
Knox	1,200
Perry	700
Sheridan	3,800
Lamar	300
Wadsworth	7,000
Garrison	1,100
Oak	3,000
Denver Federal Center	5,200
Red Rocks Community College	2,800
Jefferson County Government Center	1,100
Total Activity	**36,100**
Intracorridor Trips	**5,000***
Total Ridership	**31,100**

Source: RTD WF25h model run

* Intracorridor trips represent riders who board and alight within the same corridor; they are counted twice in the activity counts. Auraria West Station is not included because it is an existing station.

Table 4-2 shows the Federal/Decatur, Sheridan, Wadsworth and Federal Center Stations are forecast to have the highest levels of station activity. Each of these four stations will have well over 3,000 boardings and alightings per day. These four stations will function as major transportation hubs for the West Corridor with parking, bus transfer facilities and connections to higher density business and residential land uses. The other seven lower-activity stations are designed to serve local neighborhoods or smaller activity and employment centers.

Station activity is forecast to be highest at the Federal/Decatur Station. The Federal/Decatur Station is located near major roadways, low- to medium-density land uses, important transit routes and special events. This station will function as an important transportation hub for park-n-Ride commuters, bus transfers, and the many residents and workers from nearby neighborhoods and businesses. Also, this station will provide the last park-n-Ride opportunity for West Corridor commuters destined for the Denver central business district; it is therefore expected to attract a large number of park-n-Ride users.

Farther west, the Sheridan and Wadsworth Stations will have high activity levels because of their locations on major north-south arterial streets and access to West 6th Avenue and West Colfax Avenue. Important bus routes with high ridership and service levels will connect with these stations providing a large number of bus transfers. These stations will include bus transfer and park-n-Ride facilities to accommodate the high levels of activity. RTD has planned for a possible future station at West 8Th Avenue. It is not included as part of this initial project, but sufficient right-of-way exists to accommodate the station.

Roadway and bus access to the Denver Federal Center, the station's proximity to high-density employment and residential land uses, and north-south traffic access from heavily traveled Simms Street/Union Boulevard are factors in its high utilization. This station will function as a major transportation hub and incorporate the bus transfer and park-n-Ride facilities of the proposed RTD Westside Intermodal Center.

The lowest levels of station activity will occur at the Perry and Lamar stations. Both stations are neighborhood stations without park-n-Rides and major bus transit connections. Although these stations will experience relatively low levels of activity, they would provide transit to area residents who do not have access to automobiles and are transit-dependent. In addition, these stations will fulfill an important function from an environmental justice perspective, providing walk-up transit access to low income and minority neighborhoods.

4.3.2 Station Access and Parking Impacts

The No Action Alternative has no substantial station access and parking impacts. It requires no new fixed transit stations or park-n-Rides beyond what is currently programmed in the *2003-2008 Transit Development Program* (RTD 2000b).

The Enhanced Bus Alternative would include the addition of a new park-n-Ride near the Jefferson County Government Center with approximately 700 spaces and the expansion of the existing Cold Spring park-n-Ride to approximately 1,000 spaces. Traffic impacts from these park-n-Rides would be comparable to those for LRT park-n-Rides at these same locations. These impacts are discussed in Section 4.4.2.

Access to LRT stations will primarily be by automobiles, buses and walking. **Table 4-3** shows the percentage of average weekday trips to stations by automobile, bus and walking.

Mode of access varies significantly by station. As expected, neighborhood stations, including Knox, Perry, Lamar, and Garrison as well as the Red Rocks Community College Station will experience very high walk access percentages. Because these stations will be located within walking distance of many residences and small businesses, they will rely heavily on walk trips for riders. These stations will have no parking, and limited automobile and bus access.

Table 4-3: 2025 Average Weekday Proposed Station Mode of Access

Station	Park-n-Ride	Mode of Access		
		Auto	Bus	Walk
Federal/Decatur	Yes	24%	70%	6%
Knox	No	N/A*	11%	89%
Perry	No	N/A*	0%	100%
Sheridan	Yes	25%	62%	13%
Lamar	No	N/A*	22%	78%
Wadsworth	Yes	17%	70%	13%
Garrison	No	N/A*	0%	100%
Oak	Yes	6%	92%	2%
Denver Federal Center	Yes	23%	58%	19%
Red Rocks Community College	No	N/A*	20%	80%
Jefferson County Government Center	Yes	79%	18%	3%
Total		**20%**	**60%**	**20%**

Source: RTD WF25h model run
*No parking is provided at these stations and therefore the model forecasts no auto access.
Although not forecast by the model, travel surveys at existing RTD park-n-Rides indicate that approximately 7.5 % of trips at stations without parking will be drop-offs/pickups.

The Federal/Decatur, Sheridan, Wadsworth and Denver Federal Center Stations are expected to receive a majority of their access from connecting bus routes. Because these stations will have excellent automobile access from major arterial streets they will receive a significant daily number of drive access trips.

Oak Station will receive nearly all its access trips from connecting bus routes. Oak Station will be located near several major bus routes providing good bus transfer access. This station will receive only a small percentage of its access from automobiles and walk trips.

The Jefferson County Government Center is the only station forecast to have the majority of its access trips come from automobiles. This is largely because the Jefferson County Government Center is not located near major bus routes and lacks significant residential and commercial development within walking distance of the station.

Overall, the majority of riders, approximately 60 percent, are forecast to access LRT by bus. Equal percentages are expected to walk to LRT (20 percent) or arrive by car (20 percent).

DRCOG's regional travel demand model was used as a tool in estimating the overall demand for parking at LRT stations in the West Corridor. Because the regional model does not precisely account for factors related to access characteristics at each station location, the model results were modified as described below.

The regional travel demand model was first used to define overall parking demand for the drive access to LRT stations. The model results were refined to reflect RTD's previous experience in planning park-n-Ride facilities, demand from areas external to the modeling area and demand from special generators not fully accounted for in the model.

The parking supply based on the refined model results was increased to provide for an anticipated parking demand and to provide for an improved perception of parking availability. The proposed parking supply for the full West Corridor is 5,700 spaces. The parking demand was then allocated among the station locations based on the following factors:

- Initial travel model allocation
- Existing and future transit ridership accumulation throughout the corridor
- Overlap/proximity of station capture areas
- Opportunities and constraints of the physical site for the station (i.e., availability of land area for the development of parking spaces)
- Access characteristics of the station (directness of access from freeway or major arterials and peak traffic congestion)
- Feeder bus system serving the location
- Opportunities for transit oriented development, which could encourage bus, walk, and bicycle access.

The station access information was used to help determine parking requirements at each of the stations. **Table 4-4** shows the recommended number of parking spaces to ensure adequate parking. Based on previous experience with other LRT lines, RTD intends to provide a greater number of spaces than the required number forecast by the DRCOG travel demand model to ensure sufficient parking and thereby minimize parking impacts or surrounding neighborhoods and businesses.

Table 4-4: Proposed Station Parking

Station	Recommended Number of Spaces (RTD)
Federal/Decatur	2,000
Knox	0
Perry	0
Sheridan	800
Lamar	0
Station	**Recommended Number of Spaces (RTD)**
Wadsworth	1,000
Garrison	0
Oak	200
Denver Federal Center	1,000
Red Rocks Community College	0
Jefferson County Government Center	700
Total	5,700

*Source: RTD WF25h model run

As the table shows, the Federal/Decatur Station will have the largest park-n-Ride. The reasons are twofold: the Federal/Decatur Station is forecast to have the highest number of boarding riders of any station on the West Corridor LRT line and the Federal/Decatur Station has a relatively high drive access percentage. This reflects the station's location and excellent automobile access from major arterials including Federal Boulevard, West Colfax Avenue and West 6th Avenue. Furthermore, as noted previously, the Federal/Decatur Station will be the last opportunity for West Corridor commuters to park and ride LRT to avoid Denver central business district parking costs and congestion.

The other stations with large park-n-Rides will be Sheridan, Wadsworth and the Denver Federal Center. These stations have excellent automobile access. All three stations are located on major north-south arterials with interchange access from West 6th Avenue. This allows convenient access for commuters using north-south arterials to reach West Colfax Avenue or West 6th Avenue. The station locations will

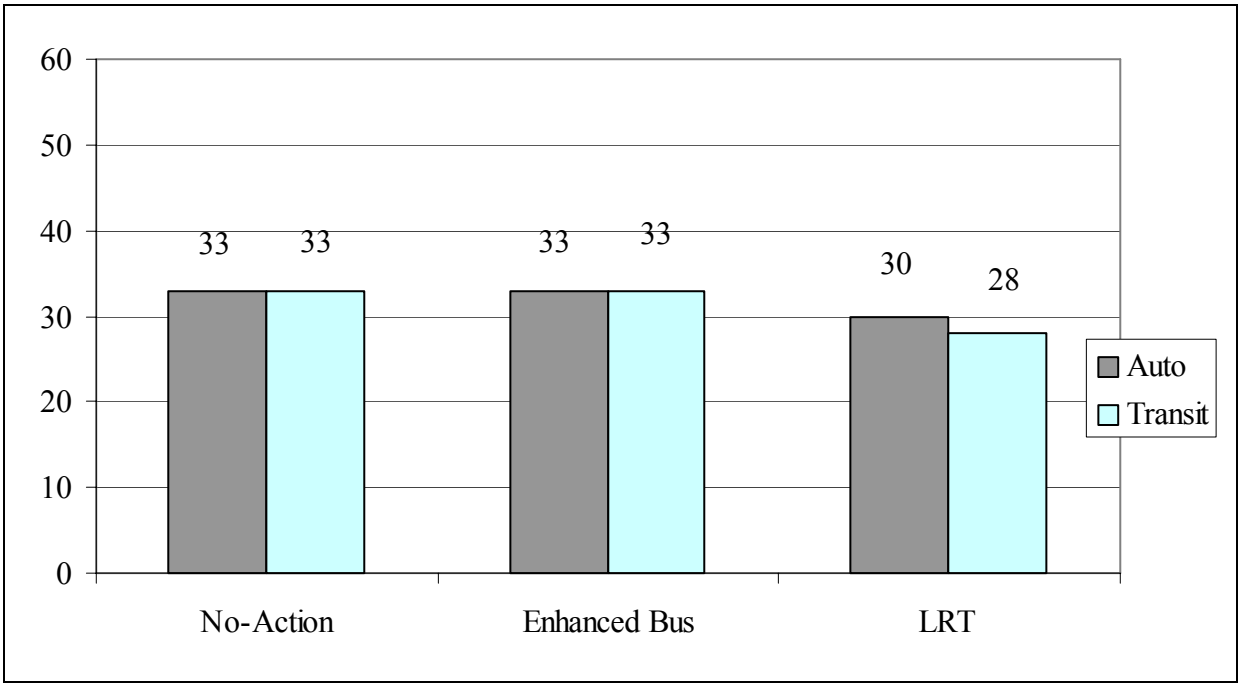
also allow commuters using West 6th Avenue to conveniently exit the freeway and board LRT to avoid freeway congestion farther east.

No parking demand was forecast at neighborhood stations without park-n-Ride facilities. It is anticipated that the ample parking, excellent automobile access, and spacing of the major park-n-Ride stations throughout the corridor will attract park-n-Ride commuters to the designated park-n-Ride stations and, thereby, prevent spillover parking demand at the neighborhood stations. In addition, the limited automobile access and lack of off-street parking facilities at neighborhood stations are expected to deter drive access commuters. Although the possibility exists for some users, especially neighborhood residents, to drive to nearby neighborhood stations to find street parking, RTD's current experience on the Southwest LRT line does not demonstrate significant parking impacts at nonpark-n-Ride stations. If LRT related parking impacts do create parking issues for a neighborhood, mitigation measures including, but not limited to, resident parking permit programs (as a last resort option), aggressive parking enforcement, and additional park-n-Ride facilities will be considered through cooperation between the neighborhood, the jurisdictional city or county, and RTD.

4.3.3 Travel Times

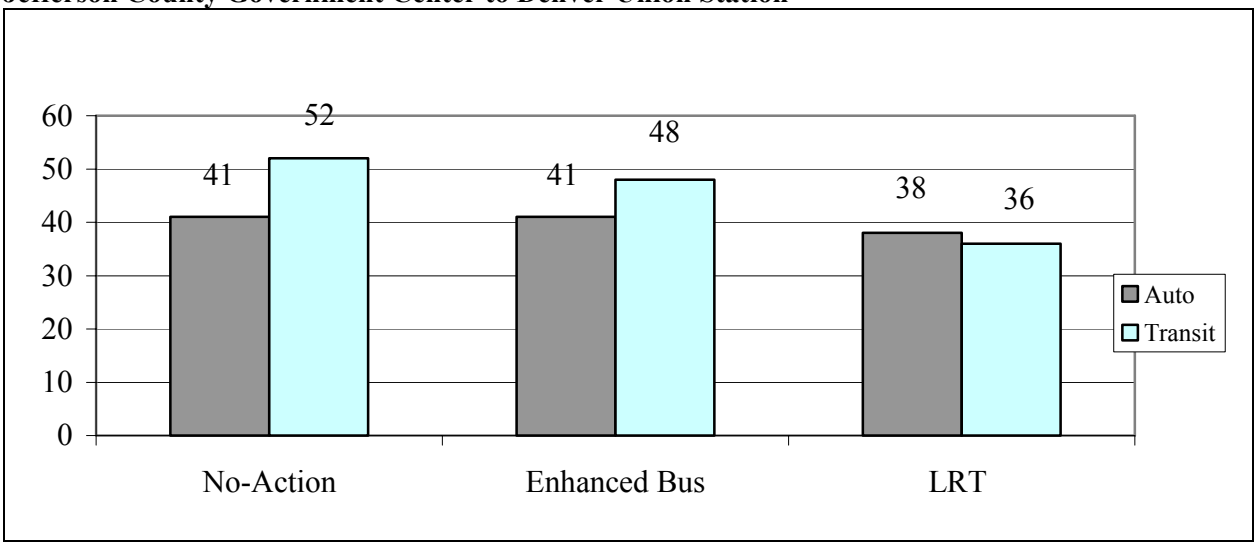
Figure 4-3 and Figure 4-4 present a comparison of the in-vehicle travel times under the No Action, Enhanced Bus, and LRT alternatives. Figure 4-3 compares the auto and transit travel times between the Denver Federal Center and Denver Union Station in the morning peak hour. Table 4-4 compares the auto and transit travel times between the Jefferson County Government Center and Denver Union Station in the morning peak hour. This analysis used 2002 observed travel times to adjust the results of DRCOG's model results.

Figure 4-3: 2025 Auto and Transit Morning Peak Hour Peak Direction Travel Time in Minutes: Denver Federal Center to Denver Union Station



Source: DRCOG FA01 model run, and RTD WC25c, WE25d and WF25h model runs

Figure 4-4: 2025 Auto and Transit Morning Peak Hour Peak Direction Travel Time in Minutes: Jefferson County Government Center to Denver Union Station



Source: DRCOG FA01 model run, and RTD WC25c, WE25d and WF25h model runs

Both figures show an improvement in transit travel times with the LRT Alternative over the No Action and Enhanced Bus alternatives. As the figures show, the LRT Alternative is forecast to improve transit travel time between the Denver Federal Center and Denver Union Station by 5 minutes. Furthermore, the LRT Alternative will improve transit travel time between the Jefferson County Government Center and Denver Union Station by 12 minutes over the Enhanced Bus Alternative and 16 minutes over the No Action Alternative. As discussed in *Chapter 1: Purpose and Need* and *Chapter 3: Affected Environment,* travel times are expected to increase for both auto and transit between 2002 and 2025. However, with the LRT Alternative, travel times will improve for both auto and transit users in 2025 over the No Action Alternative.

The LRT Alternative's improvement in transit travel times over the No Action and Enhanced Bus alternatives is attributable to LRT's exclusive right-of-way in the West Corridor. Unlike bus transit, which is dependent on congested roadways to provide service, LRT will not be affected by roadway congestion.

4.4 ROADWAY OPERATIONS AND IMPACTS

This section examines the No Action, Enhanced Bus, and LRT alternatives' impacts to roadway operations in the West Corridor. Impacts to regional congestion, as reflected in vehicle miles traveled (VMT) and vehicle hours of travel (VHT), are examined first. Then traffic operations and impacts in the West Corridor are discussed in detail.

4.4.1 Roadway Congestion

Vehicle miles traveled and vehicle hours of travel are important measures of travel demand and congestion. Increasing VMT indicate the number of miles driven on roadways is increasing, potentially resulting in increased traffic levels and pollution. VMT is impacted by several factors including changes in land use, population, employment, travel demand management, and transit service. Transit service improvements make transit more attractive and thereby reduce the number of miles driven in personal automobiles.

Vehicle hours of travel is a similar measure of roadway impacts. VHT measures the hours of travel making it a better measure of roadway congestion than the number of miles driven. Usually, vehicle

hours of travel increase as VMT increase. If roadways are congested, speeds slow and people spend more time in traffic. However, VHT can be reduced through transportation systems management, transportation demand management and adding transportation capacity.

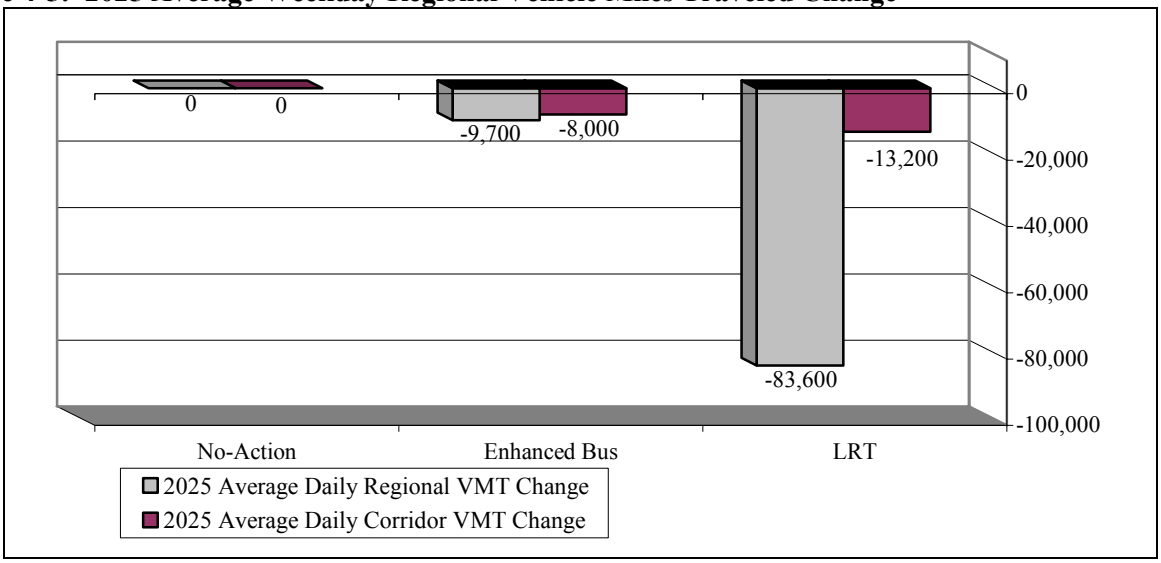
Table 4-5, **Figure 4-5** and **Figure 4-6** show the impact of each alternative on the West Corridor and regional VMT and VHT. The region is defined as the entire Denver metropolitan area. The No Action Alternative provides a benchmark for comparison to the Enhanced Bus and LRT alternatives. As shown in **Table 4-5**, **Figure 4-5** and **Figure 4-6**, differences in VMT and VHT between the three alternatives are expected to be minor. Regionally, the impact will be less than a 1 percent difference. However, the LRT Alternative demonstrates an absolute improvement in VMT over the Enhanced Bus and No Action alternatives for both the corridor and the region. Moreover, the LRT Alternative is expected to slightly reduce regional VHT and roadway congestion. In contrast, the Enhanced Bus Alternative is expected to slightly increase regional VHT despite a slight decrease in VMT, possibly resulting from changing travel patterns. **Figure 4-5** and **Figure 4-6** illustrate these comparisons.

Table 4-5: 2025 Average Weekday Corridor and Regional VMT and VHT

	Region			West Corridor		
	No Action	**Enhanced Bus**	**LRT**	**No Action**	**Enhanced Bus**	**LRT**
VMT	92,353,200	92,343,500	92,269,600	4,873,800	4,865,800	4,860,600
Reduction or Increase in VMT over No Action	N/A	-9,700	-83,600	N/A	-8,000	-13,200
VHT	2,836,000	2,838,800	2,828,800	159,600	159,200	157,700
Reduction or Increase in VHT over No Action	N/A	+2,800	-7,200	N/A	-400	-1,900

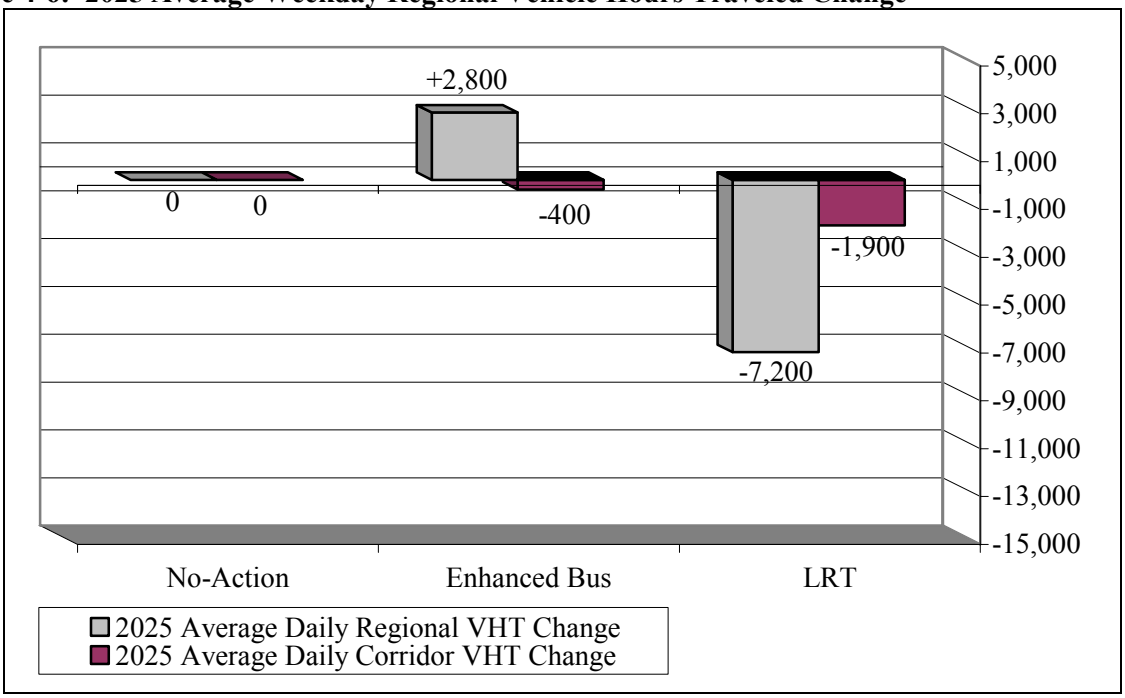
Source: RTD WC25c, WE25d and WF25h model runs

Figure 4-5: 2025 Average Weekday Regional Vehicle Miles Traveled Change



Source: RTD WC25c, WE25d and WF25h model runs

Figure 4-6: 2025 Average Weekday Regional Vehicle Hours Traveled Change



Source: RTD WC25c, WE25d and WF25h model runs

4.4.2 Traffic Operations and Impacts

Grade Crossing Treatments

The West Corridor LRT alignment crosses a number of roadways in the Denver metropolitan area ranging in importance from major freeways (Interstate Highway 25 [I-25], West 6th Avenue, Interstate Highway 70 [I-70]) to minor local streets and a handful of private driveways. Because of safety and mobility concerns, the alignment will be grade separated from all of the major roadways identified in the *West Corridor Major Investment Study* (RTD 1997). These roadways include I-25, Federal Boulevard, Sheridan Boulevard, Wadsworth Boulevard, Kipling Street, West 6th Avenue, West Colfax Avenue, and I-70. This analysis recommends additional grade separations. RTD will consult with the Colorado Public Utilities Commission during final design regarding the ultimate design, treatment and warning devices to be used at all grade crossings.

The initial criteria used to determine where grade separations are required along the West Corridor LRT alignment were average daily traffic and LRT peak headway, which is the average frequency between LRT arrivals during peak periods. These criteria are typically used because as traffic volumes increase, and LRT headways decrease (trains become more frequent), traffic flow worsens. Eventually, a point is reached where the combination of high traffic volumes and short headways result in unacceptable congestion on a crossing street and significant hazards for motorists.

The Institute of Transportation Engineers' *Light Rail Transit Grade Separation Guidelines* (ITE 1993) provides guidance on the appropriateness of various types of grade crossing strategies based upon cross-street volume and LRT headway thresholds. The study reported thresholds that were based upon a six-lane cross-section for varying LRT headways. These threshold values were also adjusted to apply to either four-lane or six-lane cross-sections for a LRT headway of 5 minutes. The following summarizes the resulting thresholds.

Two-lane crossing roadway and LRT headways of 5 minutes:

- An at-grade LRT crossing with full preemption (no LRT delay) is appropriate for an average daily traffic of less than 6,700 vehicles per day.
- An at-grade LRT crossing with full preemption might be appropriate for an average daily traffic between 6,700 and 13,300 vehicles per day.
- An at-grade crossing with conditional preemption (LRT crossing delay of up to 15 seconds) is appropriate for an average daily traffic between 13,300 and 16,700 vehicles per day.
- An at-grade LRT crossing is not appropriate for an average daily traffic exceeding 16,700 vehicles per day.

Four-lane crossing roadway and LRT headways of 5 minutes:

- An at-grade LRT crossing with full preemption (no LRT delay) is appropriate for an average daily traffic of less than 13,300 vehicles per day.
- An at-grade LRT crossing with full preemption might be appropriate for an average daily traffic between 13,300 and 26,000 vehicles per day.
- An at-grade LRT crossing with conditional preemption (LRT crossing delay of up to 15 seconds) is appropriate for an average daily traffic between 26,000 and 37,500 vehicles per day.
- An at-grade LRT crossing is not appropriate for an average daily traffic exceeding 37,500 vehicles per day.

Six-lane crossing roadway and LRT headways of 5 minutes:

- An at-grade LRT crossing with full preemption (no LRT delay) is appropriate for an average daily traffic of less than 20,000 vehicles per day.
- An at-grade LRT crossing with full preemption might be appropriate for an average daily traffic between 20,000 and 40,000 vehicles per day.
- An at-grade LRT crossing with conditional preemption (LRT crossing delay of up to 15 seconds) is appropriate for an average daily traffic between 40,000 and 50,000 vehicles per day.
- An at-grade LRT crossing is not appropriate for an average daily traffic exceeding 50,000 vehicles per day.

For the above criteria, “full preemption” is defined as an at-grade crossing where automated gates lower in advance of LRT so it can cross without slowing or stopping. “Conditional preemption” is defined as an at-grade crossing where, in order to minimize disruption to traffic on the intersecting street, LRT may be required to slow or stop for a short period of time before crossing.

Other criteria may also dictate where grade separations are required. Safety, for example, requires that LRT be grade separated over the Consolidated Mainline. Although Umatilla Street is low-volume, its proximity to the Consolidated Mainline is too close for LRT to return to grade and therefore Umatilla Street will also be grade separated.

Roadways that do not meet criteria requiring a grade separation were evaluated on a case-by-case basis. Two fundamental options exist for roadways that are not candidates for grade separation: either an at-grade crossing is permitted or the roadway is closed at the point where it crosses the track.

Roadways with moderate traffic volumes are often good candidates for at-grade intersections. Generally, these roadways need to remain open to provide adequate emergency vehicle access and to maintain vehicle mobility across greater distances. Minor arterial streets and collectors with some continuity fall into this category. Some collector and local streets also provide important local property access, network consistency and access for multiple modes.

Pedestrian and bicycle crossings are only allowed at protected LRT-street grade crossings in order to provide them with adequate protection. This will limit pedestrian activity to areas where the LRT operator is expecting potential conflicts. A number of measures will be implemented to enhance safety

for pedestrians and bicyclists at LRT street-grade crossings. Pedestrian warning signs will be provided at all crossings. Manual gates that open toward the pedestrian will be provided at all at-grade crossings within residential areas. Because of its proximity to Eiber Elementary School, RTD will fund a crossing guard before and after school at the pedestrian crossing at Independence Street.

In order to improve safety and LRT operations to the maximum extent possible, roadways of lesser importance may be closed rather than permitting an at-grade crossing with LRT, because they tend to have low traffic volumes, route discontinuities, and local character (generally serving local access needs only). Benefits of road closures include enhanced safety, potential noise reductions, traffic volume reductions through sensitive neighborhoods (provided traffic is not diverted into other nearby neighborhoods), improved LRT operations and reduced maintenance.

The West Corridor LRT alignment crosses 42 roadways between its connection to the Central Platte Valley LRT Spur and the Jefferson County Government Center. Based upon the criteria described above, the preliminary engineering for the West Corridor LRT Alternative, and coordination with local jurisdictions and emergency response agencies, the proposed crossing treatment for each location is provided in **Table 4-6** and shown on **Figure 4-7**. Of these 42 roadway crossings, 20 will remain as at-grade crossings, eight will be closed, and 13 will be grade separated from the LRT line.

Crossing protection for at-grade intersections is typically provided through a high level of warning devices. A range of active devices can identify an oncoming train by flashing lights, bells, and lowering gates across the intersection. Use of gates has the advantage of providing the train with exclusive right-of-way, thereby eliminating potential conflicts and the need for the light rail vehicle to slow at the crossing. Passive devices such as signs and pavement markings are also used at all crossings. The *Manual on Uniform Traffic Control Devices, Millennium Edition* (MUTCD 2002) does not require use of audible bells or warning devices at at-grade crossings.

Table 4-6: Summary of West Corridor Grade Crossing Recommendations

Street/Feature	Community	EIS Recommendation
5th Street	Denver	At-grade intersection
Old West Colfax Avenue	Denver	At-grade intersection
Cottonwood Street (14th)	Denver	Closure
Burnham Lead/Shoshone Street	Denver	Grade separation
Consolidated Main Line	Denver	Grade separation
Umatilla Street	Denver	Grade separation
I-25	Denver	Grade separation
Zuni Street	Denver	At-grade intersection
Decatur Street	Denver	At-grade intersection
Federal Boulevard	Denver	Grade separation
Knox Court	Denver	At-grade intersection
Perry Street	Denver	At-grade intersection
Sheridan Boulevard	Denver/Lakewood	Grade separation
Harlan Street	Lakewood	At-grade intersection
Lamar Street	Lakewood	At-grade intersection
Marshall Street	Lakewood	Closure

Street/Feature	Community	EIS Recommendation
Otis Street	Lakewood	Closure
Pierce Street	Lakewood	At-grade intersection
Reed Street	Lakewood	Not applicable (closed)
Teller Street	Lakewood	At-grade intersection
Vance Street	Lakewood	Closure
Wadsworth Boulevard	Lakewood	Grade separation
Allison Street	Lakewood	Closure
Brentwood Street	Lakewood	Closure
Carr Street	Lakewood	At-grade intersection
Estes Street	Lakewood	At-grade intersection
Garrison Street	Lakewood	At-grade intersection
Holland Street	Lakewood	Closure
Independence Street	Lakewood	At-grade intersection
Kipling Street	Lakewood	Grade Separation
Nelson Street	Lakewood	Closure
Oak Street	Lakewood	At-grade intersection
Quail Street	Lakewood	At-grade intersection
Collins Avenue	Lakewood	At-grade intersection
West 8th Avenue	Lakewood	At-grade intersection
West 6th Avenue & Frontage Road	Lakewood	Grade separation
North Avenue	Lakewood	At-grade intersection
Union Street	Lakewood	Grade separation
West 6th Avenue	Lakewood	Grade separation
Indiana Street	Lakewood	Grade separation
I-70	Jefferson County	Grade separation
West Colfax Avenue	Jefferson County	Grade separation
Ulysses Street	Jefferson County	At-grade intersection
Earl Johnson Road	Jefferson County/Golden	At-grade intersection

Two types of gated crossings are recommended for the West Corridor LRT project. "Dual gates" are a traditional type of crossing protection that provides automated gates for all traffic approaching the intersection. "Quad gates" have application at locations with more complex traffic movements and include automated gates around the entire intersection, including the lanes departing from the intersection. **Table 4-7** lists the proposed crossing protection for the 20 at-grade intersections along the West Corridor alignment.

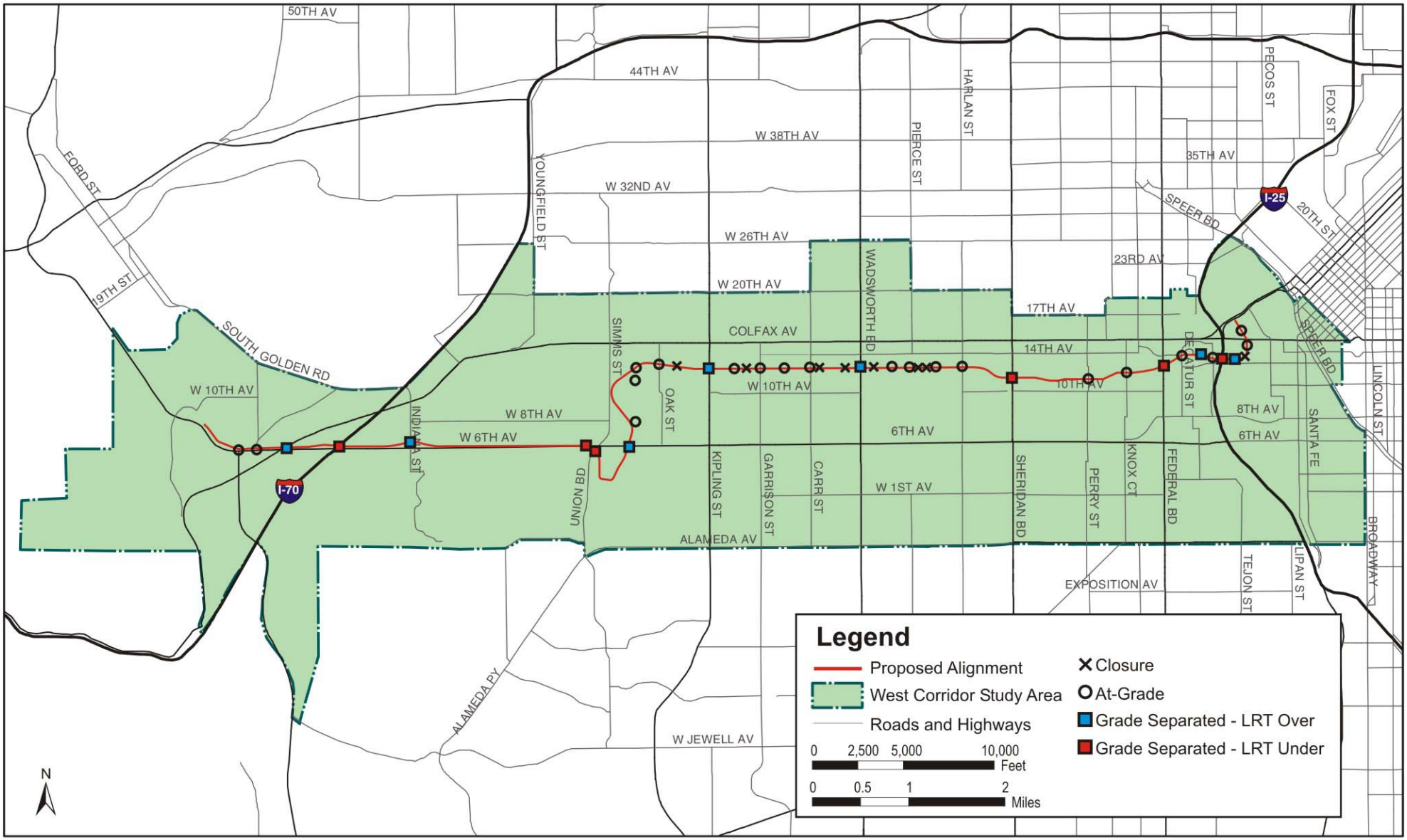


Figure 4-7
Crossing Treatment

Table 4-7: West Corridor EIS At-grade Crossing Protection

Street	Average Daily Traffic	Jurisdiction	Preferred Treatment[1]
5th Street	N/A	Denver	Dual gates
Old West Colfax	N/A	Denver	Dual gates
Zuni Street	2,700	Denver	Dual gates
Decatur Street	3,800	Denver	Dual gates
Knox Court	6,000	Denver	Dual gates
Perry Street	6,000	Denver	Dual gates
Harlan Street	3,100	Lakewood	Quad gates
Lamar Street	2,400	Lakewood	Quad gates
Pierce Street	3,400	Lakewood	Quad gates
Teller Street	500	Lakewood	Quad gates
Carr Street	4,200	Lakewood	Quad gates
Estes Street	1,020	Lakewood	Quad gates
Garrison Street	10,000	Lakewood	Quad gates
Independence	1,200	Lakewood	Quad gates
Oak Street	4,500	Lakewood	Quad gates
Quail Street	5,500	Lakewood	Dual gates
Collins Avenue	2,200	Lakewood	Dual gates
West 8th Avenue	6,100	Lakewood	Dual gates
Ulysses Street	N/A	Jefferson County	Dual gates
Earl Johnson Road	14,000	Jefferson County/Golden	Dual gates

[1] Other treatments may be available
N/A = Not Available

Station Traffic Analysis

Six of the LRT Alternative stations feature park-n-Ride facilities. Stations with park-n-Rides are proposed at Federal/Decatur, Sheridan, Wadsworth, Oak, Denver Federal Center, and the Jefferson County Government Center. The remaining stations are located in either residential areas, areas of employment, or institutional land uses where parking lots are unnecessary or undesirable.

In addition to generating automobile traffic related to park-n-Ride facilities, many of the park-n-Ride stations will have bus traffic resulting from feeder bus service. **Table 4-8** summarizes the amount of parking that will be provided as well as the proposed number of bus routes and bus bays serving each station.

Each station has the potential for traffic impacts to the surrounding area depending on the configuration of the park-n-Ride and bus facilities in relationship to the transportation system. The layout and traffic impacts of each station are described below. The impacts are based on a comparison of intersection operations in the No Action Alternative with those in the LRT Alternative for the year 2025.

Table 4-8: Parking and Bus Facilities at Stations

Station	Parking Spaces	Bus Bays*	Bus Routes*	Maximum Buses per Hour*
Federal/Decatur	2,000	7 on-street	16 - West Colfax 30/31 – Federal 49 – North Lowell 30L – South Federal Limited 36L – Littleton via Ft. Logan	25
Knox	0	2 on-street	1 – West 1st 49 – North Lowell	10
Perry	0	2 on-street	0	0
Sheridan	800	2 on-street	51 – Sheridan Crosstown	10
Lamar	0	2 on-street	9 – West 10th	4
Wadsworth	1,000	2 on-street	76 – Wadsworth Crosstown 17L - Wadsworth Limited 93f – Green Mtn Express	16
Garrison	0	0	0	0
Oak	200	4 off-street	16 – West Colfax 76L – Wadsworth Limited 100 – Kipling Crosstown	16
Denver Federal Center	1,000	15 off-street	3 - Alameda Crosstown 9 - West 10th 14 - West Florida 17 – JCGC 17L – Wadsworth Limited 18 – Simms/Union 21 – Evans Crosstown 125 – Denver West Crosstown Mills/Federal Center Circulator 2f – Federal Center Feeder 6x – DTC Express 93f – Green Mtn Express 116x – South Simms Express C – Conifer/Denver G – Golden/Boulder E – Evergreen/Denver	95
Red Rocks Community College	0	2 on-street	125 – Denver West Crosstown Mills/Federal Center Circulator	2
Jefferson County Government Center	700	2 off-street	17 – JCGC	4

DTC – Denver Technological Center
JCGC – Jefferson County Government Center
*Source: Padron 2003

All analysis was conducted according to procedures outlined in the *Highway Capacity Manual 2000* (TRB 2000). Level of service (LOS) is the term used to describe the operational conditions of a roadway. It is the principal means of evaluating traffic congestion and is typically derived from analyzing factors such as speed and travel time, freedom to maneuver, traffic interruptions, convenience and comfort, and safety. **Table 4-9** illustrates level of service criteria for signalized intersections.

Table 4-9: Level of Service Criteria for Signalized Intersections

Level of Service (LOS)	Average Delay (Seconds Per Vehicle)	Description
A	<= 10	Very low delay; most vehicles do not stop at all.
B	> 10 and <= 20	More vehicles stop than with LOS A, increasing the average delay.
C	>20 and <= 35	The number of vehicles stopping is significant; however, many still pass through the intersection without stopping.
D	>35 and <= 55	Congestion is readily apparent with many vehicles stopping and individual cycle failures are noticeable (i.e., not all vehicles waiting at the intersection are able to get through on the first green indication).
E	>55 and <=80	Frequent cycle failures occur
F	>80	Unacceptable operations, which include many cycle failures caused by arrival flow rates exceeding intersection capacity.

Federal/Decatur Station

The Federal/Decatur Station will be an at-grade station located southeast of the Federal Boulevard/West Colfax Avenue interchange. At this location, parking will be shared between Invesco Field at Mile High and RTD. Approximately 2,000 parking spaces will be available for RTD use.

Automobile access to the station will be provided via Howard Place. The majority of bus service to the station will occur via stops along Federal Boulevard in the vicinity of the station. Selected bus routes will also utilize stops along eastbound Howard Place.

Impacts

Based upon the traffic analysis, current and year 2025 No Action traffic conditions are expected to be satisfactory in the vicinity of the station (LOS C or better). With the LRT Alternative, traffic conditions would deteriorate to LOS F during the year 2025 evening peak hour at the Federal Boulevard/Howard Place intersection without mitigation. Although the overall level of service at the intersection of Irving Street/West 14th Avenue would operate at an acceptable LOS C, the westbound approach would operate at a LOS F without mitigation. Without improvements, the access to the parking area from Howard Place would also operate poorly.

Mitigation

The analysis indicates that the widening of Howard Place between Federal Boulevard and Decatur Street, combined with improvements at the intersections of Federal Boulevard/Howard Place and the park-n-Ride access would alleviate the impacts associated with the LRT Alternative. It indicates that the intersection of Irving Street/West 14th Avenue should be striped to provide turn lanes and converted to all-way stop control.

Knox Station

The Knox Station will be a neighborhood station without parking. Neighborhood residents specifically stated that they did not want a parking facility at this location. Knox Station will be located on the west side of Knox Court, south of West 13th Avenue at the northern edge of Lakewood Dry Gulch Park. Because there will be no parking, the potential for traffic impact will be limited to the at-grade crossing. Based upon existing and projected traffic volumes, the light rail vehicle crossings, and the duration that the crossing gates would be down, no significant traffic problems are anticipated.

Impacts

No traffic impacts are anticipated. Vehicle delays at the LRT crossing will average less than 7 seconds per vehicle (LOS A). Because there will be no parking provided at this station, LRT riders could use local streets, tying up spaces all day. Due to the steep hill approaching the Knox Station from the north, drivers at higher speeds will have limited sight distance to the LRT alignment.

Mitigation

It is RTD's intent to provide bus pullouts along either side of Knox Court in the vicinity of the station. RTD would coordinate with the City and County of Denver on a LRT parking management program if informal parking demand materializes as a result of the West Corridor LRT project. RTD will provide a train warning device at the top of the hill.

Perry Station

The Perry Station will be a neighborhood station without parking. Neighborhood residents specifically stated that they did not want a parking facility at this location. Perry Station will be located on the west side of Perry Street, south of West 12th Avenue at the northern edge of Lakewood/Dry Gulch Park. Because there will not be parking, the potential for traffic impact will be limited to the at-grade crossing. Existing Bus Route 1 will serve Perry Station. Based upon existing and projected traffic volumes, the frequency of light rail vehicle crossings, and the duration that the crossing gates will be down, no significant traffic problems are anticipated.

The need to maintain access and the alignment of LRT in this area will require that West 12th Avenue be converted to one-way operation between Newton Street and Perry Street. All approaches to the intersection of West 12th Avenue and Perry Street will be protected with gates.

Impacts

Conversion of West 12th Avenue from Newton Street to Perry Street to one-way operation may result in inconvenience to local residents. However, because of right-of-way constraints, there is not sufficient room to maintain two directions of travel on West 12th Avenue. Because there will be no parking provided at this station, LRT riders could use local streets, tying up spaces all day. Currently, there are 300 vehicles per day traveling along West 12th Avenue east of Perry Street. No significant traffic impacts are anticipated at the at-grade crossing. Vehicle delays at the LRT crossing will average less than 7 seconds per vehicle (LOS A). Due to the steep hill approaching the Perry Station from the north, drivers at higher speeds will have limited sight distance to the LRT alignment.

Mitigation

Assuming West 12th Avenue is one-way westbound, gates will be provided on this approach to the Perry Street intersection. RTD will coordinate with the City and County of Denver on a LRT parking management program if informal parking demand materializes as a result of the West Corridor project. RTD will provide a train warning device at the top of the hill.

Sheridan Station

The park-n-Ride for this station will be located northwest of the intersection of Sheridan Boulevard and West 10th Avenue. Eight hundred parking spaces will be provided. Automobile access to the station will

occur via West 10th Avenue and Sheridan Boulevard. Access will be a right in/right out from southbound Sheridan Boulevard and left in from northbound Sheridan Boulevard.

Sheridan Boulevard will be reconstructed to pass over the LRT alignment that will follow the existing grade. Therefore, the station will be below the roadway. Buses will drop off passengers along either side of Sheridan Boulevard with vertical circulation down to the station.

Impacts

Based upon the traffic analysis, current traffic conditions are satisfactory in the vicinity of the station (LOS D or better). The LRT Alternative will result in a change in level of service at the Sheridan Boulevard/West Colfax Avenue intersection from LOS D to LOS E. The LRT Alternative will also impact the level of service of the Sheridan Boulevard/West 10th Avenue intersection. This location is projected to operate at a LOS C under the No Action Alternative and LOS D under the LRT Alternative.

Mitigation

In order to mitigate the impact that the LRT Alternative would have on the Sheridan Boulevard/West 10th Avenue intersection, a southbound auxiliary lane will be constructed along Sheridan Boulevard and a right-in, right-out access be provided on the west side of Sheridan Boulevard to provide access to the park-n-Ride. A left-in turn bay will be provided north of West 10th Avenue. Left turn, through, and right-turn lanes should also be constructed on eastbound West 10th Avenue at the intersection with Sheridan Boulevard. These improvements will result in peak hour traffic conditions of LOS C or better under the LRT Alternative. RTD will provide left-turn arrow signals at the intersection of Sheridan Boulevard/West 10th Avenue.

Lamar Station

Although the major investment study recommended 100 parking spaces at this location, the EIS has determined that it is more appropriate for the Lamar Station to be a neighborhood station without parking. Lamar Station will be located north of West 13th Avenue on the east side of Lamar Street. Without a park-n-Ride, the potential for traffic impact will be limited to the at-grade crossing. According to the *Transit Operations Plans Report* (Padron 2003) no feeder bus service is proposed to serve Lamar Station. Based upon existing and projected traffic volumes, the frequency of light rail vehicle crossings, and the duration that the crossing gates will be down, no significant traffic problems are anticipated.

Impacts

No impacts are anticipated. Vehicle delays at the LRT crossing will average approximately 5 seconds per vehicle (LOS A).

Mitigation

No mitigation is necessary. RTD will coordinate with the City of Lakewood on a parking management program or other mitigation measures if informal parking demand materializes as a result of the West Corridor LRT project.

Wadsworth Station

The park-n-Ride for this station will be located northeast of the intersection of Wadsworth Boulevard and West 14th Avenue. One thousand parking spaces will be provided. Automobile access to the station will be via West 14th Avenue and a right-in, right-out access along northbound Wadsworth Boulevard between West 13th and West 14th avenues.

The LRT alignment will pass over Wadsworth Boulevard and the station will be elevated. Buses will drop off passengers along either side of Wadsworth Boulevard with vertical circulation up to the station.

A number of improvements have already been identified by the City of Lakewood and the Colorado Department of Transportation for the intersection of Wadsworth Boulevard and West Colfax Avenue. A

*2003-2008 Transportation Improvement Pro*gram project is currently under construction to provide double left-turn lanes on approaches to the intersection and an additional through lane will be provided in each direction on Wadsworth Boulevard north of West 14th Avenue.

Impacts

The need to maintain access and the alignment of LRT in this area will require restriction of the existing full-movement intersection of Wadsworth Boulevard/West 13th Avenue to right-in, right-out movements only. This configuration is consistent with the long-range plan for the Wadsworth Boulevard corridor.

Based upon the traffic analysis, current traffic conditions are marginal in the vicinity of Wadsworth Boulevard and West Colfax Avenue. The *2003-2008 Transportation Improvement Program* project that is currently under construction will result in short-term improvement at this intersection, which currently operates at LOS D during the evening peak hours. By year 2025, this intersection will return to LOS D conditions with or without the LRT project.

Although the intersection of Wadsworth Boulevard and West 14th Avenue is expected to operate at a LOS C with the West Corridor LRT project, improvements are nevertheless required to provide additional capacity for left-turns and stopped vehicles at the intersection.

Mitigation

Mitigation of the impacts of the LRT project at this location includes converting the existing full movement intersection of Wadsworth Boulevard/West 13th Avenue to right-in, right-out movements only. In addition, right-in, right-out access will be provided along northbound Wadsworth Boulevard serving the park-n-Ride. West 14th Avenue east of Wadsworth Boulevard should be improved to provide westbound double-left turn lanes. West 14th Avenue should provide auxiliary lanes at the unsignalized access to the park-n-Ride.

Garrison Station

The Garrison Station will be a neighborhood station without parking. Garrison Station will be located north of West 13th Avenue on the east side of Garrison Street. Without a park-n-Ride, the potential for traffic impact would be limited to the at-grade crossing. According to the *Transit Operations Plans Report* (Padron 2003), no feeder bus service is proposed to serve Garrison Station. Based upon existing and projected traffic volumes, the frequency of light rail vehicle crossings, and the duration that the crossing gates would be down, no significant traffic problems are anticipated. During peak hour crossings, vehicle queues may extend up to 10 vehicles in either direction when the gates are down. However, there will be sufficient time between crossings to clear the queue and return traffic flow to normal.

The need to maintain access and the alignment of LRT in this area will require that West 13th Avenue be converted to one-way westbound operation between Carr and Garrison Streets. All approaches to the intersection of West 13th Avenue and Garrison Street will be protected with gates.

Impacts

Conversion of West 13th Avenue to one-way westbound operation may result in inconvenience to local residents. However, because of right-of-way constraints, insufficient room is available to maintain two directions of travel on West 13th Avenue. In order to limit traffic intrusion into the neighborhood east of Garrison Street, West 13th Avenue will be a westbound one-way street.

Garrison Street is narrow near the station and traffic volumes exceed 10,000 vehicles per day. The potential exists for "kiss-n-Ride" traffic to stop along Garrison Street and disrupt traffic flow during peak periods. Level of service would continue to be LOS A and B.

Mitigation

Based upon the traffic analysis of this station, it is apparent that coordination of the traffic signals located at Garrison Street/West Colfax Avenue and Garrison Street/West 14th Avenue will be beneficial to traffic flow along Garrison Street under any of the alternatives.

In order to accommodate projected kiss-n-Ride traffic, RTD has initiated discussions with the Hope of Glory Church to implement a shared facility agreement.

Oak Station

The Oak Station would be an at-grade station located at the northern end of the Lakewood Industrial Park between Oak and Quail streets. At this location, 200 parking spaces will be initially provided with the potential for expansion to 500 spaces. Automobile and bus access to Oak Station would be provided via Oak Street and Quail Street. Buses would also have a bus only exit to Oak Street.

Impacts

Based upon the traffic analysis, current and year 2025 No Action traffic conditions at signalized intersections are expected to be satisfactory in the vicinity of the station (LOS D or better), with the exception of the West Colfax Avenue/Simms Street intersection, which is forecast to operate at LOS F during the evening peak hour under the No Action Alternative. The unsignalized intersection at Simms Street/West 13th Avenue currently experiences LOS F conditions during the evening peak hour and this would continue into the future. Because of the low volumes on West 13th Avenue, this location does not warrant a traffic signal. With the LRT Alternative, traffic conditions will remain at the same level of service as the No Action Alternative except the West Colfax Avenue/Quail Street intersection that will change from LOS A to B.

Mitigation

Because the LRT Alternative will not result in an unacceptable drop in level of service for any area intersection, no project-related mitigation is proposed. However, the current station design calls for a new connection between Oak Street and Quail Street adjacent to the park-n-Ride. This roadway would follow the north side of the LRT alignment.

Denver Federal Center Station

The Denver Federal Center Station will be an at-grade station located east of Union Boulevard and north of West 2nd Avenue in the Denver Federal Center. The Denver Federal Center Station will provide a multimodal transportation hub for RTD serving the Federal Center and potential redevelopment.

The Denver Federal Center Station park-n-Ride will be located north of West 2nd Avenue and consist of 1,000 total parking spaces. Vehicle and bus access to the park-n-Ride will be provided by West 2nd Avenue and a new roadway connection (Quail Street) between West Alameda Avenue and West 2nd Avenue.

Impacts

Based upon the traffic analysis, the intersection of Union Boulevard/West 4th Avenue currently operates at a LOS F during the evening peak hour. The level of service at this intersection will not improve under either the No Action Alternative or the LRT Alternative. The existing congestion at this intersection is a result of a combination of Denver Federal Center, Union Square, and Cold Spring park-n-Ride traffic. Relocation of the park-n-Ride to West 2nd Avenue would not remove enough traffic from this intersection to improve the level of service. Many of the other intersections along Union Boulevard are also either at or near capacity.

The analysis assumes that a new connection (Quail Street to Alameda) will be provided by RTD between West Alameda Avenue and Denver Federal Center Station. The extension of Quail Street north over

West 6th Avenue and into the Lakewood Industrial Park is not included in the LRT Alternative but may be constructed by others in the future to improve access to the Denver Federal Center redevelopment.

Under the LRT Alternative with 1,000 total parking spaces and the new Quail Street connection to Alameda, traffic conditions will remain at the same level of service as the No Action Alternative at all existing intersections. Mitigation will be required at the new intersection of Quail Street and West Alameda Avenue to accommodate both park-n-Ride and Denver Federal Center Station traffic.

Based upon the analysis, other improvements will be needed to address existing and projected deficiencies that are not associated with the West Corridor LRT project.

Mitigation

The LRT Alternative, when combined with the new access roadway (Quail Street to Alameda), does not result in an unacceptable drop in level of service for any of the existing area intersections. However, in addition to Quail Street, improvements will be required at the new intersection of Quail Street/West Alameda Avenue to accommodate park-n-Ride and Denver Federal Center Station traffic. These improvements include eastbound double left-turn lanes and a westbound right-turn lane along Alameda, and southbound left- and right-turn lanes on Quail Street. RTD will provide a traffic signal at this intersection.

Red Rocks Station

The Red Rocks Station will be a destination station without parking and no at-grade crossings. Red Rocks Station will be located on the north side of West 6th Avenue across from Red Rocks Community College. The West Corridor LRT alignment will be between West 6th Avenue and the frontage road. According to the *Transit Operations Plans Report* (Padron 2003), RTD bus route 125 (Denver West Crosstown) will provide feeder bus service to Red Rocks Station. There will also be a circulator bus serving the campus, Denver Federal Center, and Colorado Mills Mall from this location. RTD is currently pursuing opportunities for a kiss-n-Ride at the LDS church near Red Rocks Station.

Impacts

No impacts are anticipated.

Mitigation

No mitigation is necessary. RTD will coordinate with the City of Lakewood on a parking management program or other mitigation measures if informal parking demand materializes as a result of the West Corridor project.

Jefferson County Government Center Station

The Jefferson County Government Center Station will be an at-grade station located at the western end of the LRT alignment. The station and park-n-Ride will be located west of the Jefferson County Government Center in an area that was purchased with Jefferson County Open Space funds. There will be 700 parking spaces at this location.

Automobile access to the station will be provided via Jefferson County Parkway, which can be accessed by either Earl Johnson Road on the east end or Heritage Road on the west end. Access to the park-n-Ride will be located opposite West 10th Avenue.

Impacts

Based upon the traffic analysis, all intersections currently operate below capacity during peak periods (LOS E or better). The level of service at signalized intersections along West 6th Avenue would decline by year 2025 under both the No Action and LRT alternatives. The intersection of West 6th Avenue and Jefferson County Parkway is the most critical of all intersections. Without improvements, this intersection will operate at a LOS E during the evening peak hour under the year 2025 No Action Alternative. The

LRT Alternative will not change the level of service of area intersections when compared to the No Action Alternative.

Concerns have been expressed by Jefferson County and the Colorado Department of Transportation (CDOT) regarding the operations of the at-grade crossing of Earl Johnson Road, located east of the Jefferson County Government Center. The volumes along Earl Johnson Road by themselves do not warrant a grade separation and RTD is proposing to operate this crossing in a similar fashion to the crossing at 7th Street and West Colfax Avenue near the Auraria Campus in Denver. Trains will not have pre-emption at Earl Johnson Road, rather, light rail vehicles will be held at the station and released to conform with green phase at West 6th Avenue. Further coordination between RTD, Jefferson County, and CDOT will be required before a final decision is made on the grade crossing treatment at this location.

Mitigation

Because the LRT Alternative will not result in a change in the level of service at area intersections, no project-related mitigation is proposed

Summary of Station Area Impacts and Mitigation Measures

As described above, anticipated roadway and grade crossing impacts attributable to the new traffic generated by stations would be minor and localized and would be mitigated using standard traffic engineering strategies.

Mitigation measures were considered under the following circumstances:

- No Action LOS A, B, C, D, or E and LRT Alternative LOS F
- No Action LOS D and LRT Alternative LOS E
- No Action LOS A, B, or C and LRT Alternative LOS D, E or F
- Problems with vehicle queues are created with the LRT Alternative
- Neighborhood contingency plans
- Mitigation is needed to address other operational issues.

Provided the last three points from the above list are not observed, mitigation measures were generally not considered under the following circumstances:

- LRT Alternative LOS A, B, or C
- LRT Alternative and No Action level of service are the same.

Traffic mitigation measures for each station area are summarized in **Table 4-10** and would be further refined during the final design stage of project development. The levels of service at intersections near the stations that are described above are summarized in detail in **Table 4-11**. **Table 4-11**compares the year 2025 No Action, LRT Alternative (without mitigation), and LRT Alternative with mitigation measures in place (described in **Table 4-10**).

Table 4-10: Station Area Traffic Mitigation Measures

Station	Mitigation Measures
Federal/Decatur	Construct westbound double left turn lanes on Howard Place. Reconstruct parking access to accommodate left-in, right-in, right-out movements only. Reconstruct Howard Place from Federal Boulevard to Decatur Street to accommodate access and intersection improvements. Convert Irving Street/West 14th Avenue to all-way stop. Re-stripe Irving Street/West 14th Avenue to add turn lanes. Construct bus pullouts on eastbound Howard Place.
Knox	Provide a bus pullout on either side of Knox Court. Coordinate with the City and County of Denver on a parking management program if informal parking demand materializes as a result of the West Corridor LRT project.
Perry	Provide crossing gates at the intersection of Perry Street and West 12th Avenue. Coordinate with the City and County of Denver on a parking management program if informal parking demand materializes as a result of the West Corridor LRT project.
Sheridan	Add eastbound left-turn lane on West 10th Avenue. Add eastbound right-turn lane on West 10th Avenue. Provide left-turn arrows at the Sheridan Boulevard intersections with West 14th Avenue and West 10th Avenue. Provide a right-in, right-out intersection along southbound Sheridan Boulevard.
Lamar	Coordinate with the City of Lakewood on a parking management program or other mitigation measures if informal parking demand materializes as a result of the West Corridor project.
Wadsworth	Add on-street bus bays between West 13th and West 14th Avenues. Provide a right-in, right-out intersection along northbound Wadsworth Boulevard. Widen West 14th Avenue to provide westbound double left-turn lanes at the Wadsworth Boulevard intersection. Provide auxiliary lanes (eastbound and westbound left-turn lanes and an eastbound right turn lane) at the park-n-Ride access along West 14th Avenue. Improvements to Wadsworth Boulevard/West Colfax Avenue currently under construction: Add double left-turn lanes on all approaches. Add a third northbound and southbound through lane.
Garrison	Coordinate traffic signals at Garrison Street/West Colfax Avenue and Garrison Street/West 14th Avenue. Pursue kiss-n-Rides opportunities at the Hope of Glory church. Convert West 13th Avenue to one-way westbound. Provide a crossing gate on West 13th Avenue to prevent turns across the LRT tracks.
Oak	Provide a new roadway connecting Oak Street and Quail Street.
Red Rocks	Coordinate with the City of Lakewood on a parking management program or other mitigation measures if informal parking demand materializes as a result of the West Corridor project.
Denver Federal Center	Provide a new roadway (Quail Street) connecting West Alameda Avenue and Denver Federal Center Station at West 2nd Avenue. Construct eastbound double-left turn lanes at the new intersection of West Alameda Avenue and Quail Street. Construct a westbound right-turn lane at the new intersection of West Alameda Avenue and Quail Street. Provide a traffic signal at the new intersection of West Alameda Avenue and Quail Street.
Jefferson County Government Center	No mitigation necessary due to implementation of LRT other than access improvements at West 10th Avenue.

Table 4-11: Station Area Levels of Service

Station	Roadway	Intersection	Unsignalized Approach	Year 2025 Peak Period					
				No Action		LRT with out mitigation		LRT with mitigation	
				AM	PM	AM	PM	AM	PM
Federal/ Decatur	Federal	Howard	-	A	B	B	F	B	C
		Holden	-	A	A	A	A	-	-
		NB Ramp to West Colfax	-	A	A	A	A	-	-
	Colfax	Irving	-	B	B	B	C	-	-
	Irving	West 14th	Westbound	A	E	A	F	A	A
	Howard	Decatur	Eastbound	A	A	A	A	-	-
			Westbound	A	A	A	A	-	-
			Northbound	B	C	B	C	-	-
			Southbound	A	A	A	A	-	-
		p-n-R access	Southbound	-	-	C	F	-	-
	Decatur	LRT crossing	Northbound	-	-	A	A	-	-
			Southbound	-	-	A	A	-	-
Knox	Knox	LRT crossing	Northbound	-	-	A	A	-	-
			Southbound	-	-	A	A	-	-
Perry	Perry	LRT crossing	Northbound	-	-	A	A	-	-
			Southbound	-	-	A	A	-	-
		West 12th	Westbound	-	-	A	A	-	-
Sheridan	Sheridan	Colfax	-	D	E	E	E	-	-
		West 14th	-	C	C	C	C	-	-
		West 10th	-	B	C	D	E	B	C
Lamar	Lamar	LRT crossing	Northbound	-	-	A	A	-	-
Wadsworth	Wadsworth	Colfax	-	D	E	D	E	-	-
		West 14th	-	B	B	C	C	C	C
		West 13th	Eastbound	F	F	C	E	C	E
			Westbound	F	F	C	E	C	E
		West 10th	-	B	D	C	D	B	D
			Southbound	-	-	A	A	-	-
Garrison	Garrison	Colfax	-	B	B	B	B	B	B
		West 14th	-	A	A	A	A	A	A
		Village	Eastbound	B	C	B	C	-	-
			Westbound	B	D	B	D	-	-
		LRT crossing	Northbound	-	-	A	A	A	A
			Southbound	-	-	A	A	A	A
		West 10th	-	A	A	A	A	A	A

Station	Roadway	Intersection	Unsignalized Approach	Year 2025 Peak Period					
				No Action		LRT with out mitigation		LRT with mitigation	
				AM	PM	AM	PM	AM	PM
Oak	Colfax	Simms	-	D	F	D	F	-	-
		Quail	-	A	D	A	D	-	-
		Oak	-	A	B	A	B	-	-
	Simms	Collins	-	A	B	A	B	-	-
	Quail	West 13th	Eastbound	B	C	B	C	-	-
		Collins	Eastbound	B	A	B	A	-	-
			Westbound	A	B	A	B	-	-
			Northbound	A	C	A	C	-	-
			Southbound	B	B	B	B	-	-
		Access	Westbound	-	-	B	C	-	-
	Simms	West 13th	Eastbound	F	F	F	F	-	-
			Westbound	F	F	F	F	-	-
	Oak	Bus Exit	Eastbound	-	-	B	B	-	-
		Access	Eastbound	-	-	B	B	-	-
			Westbound	B	B	B	B	-	-
Denver Federal Center	Simms	West 8th	-	B	D	C	C	-	-
		West 6th F.R.	East/West	A	B	A	B	-	-
		North Ramp	-	D	E	D	E	-	-
		South Ramp	-	B	D	B	D	-	-
	Union	West 4th	-	E	F	D	F	-	-
		West 2nd	-	B	B	D	C	C	B
		Alameda	-	C	E	D	E	D	E
	Alameda	Quail	-	-	-	-	-	A	A
Jefferson County Government Center	West 6th	Jefferson County	-	C	E	D	E	-	-
		Johnson	-	D	D	D	D	-	-
	Heritage	Golden Ridge Road	-	A	A	A	A	-	-

- Not Applicable
NB – north bound
F.R. – frontage road
p-n-R – park-n-Ride

4.5 PEDESTRIAN AND BICYCLE FACILITIES IMPACTS

Impacts to bicycle and pedestrian facilities are not anticipated under the No Action or Enhanced Bus Alternatives. In addition, no improvements to the bicycle or pedestrian networks are expected under those alternatives.

Improvements to bicycle and pedestrian operations under the LRT Alternative would include enhancements to the bike path system along the LRT alignment, including on- and off-street bicycle paths, in order to provide better linkages to the LRT stations with surrounding neighborhoods. The LRT Alternative would also provide additional transportation options to households that heavily rely on

walking, bicycling, and transit due to limited automobile access. The proposed bicycle and pedestrian system is shown in **Figure 4-8**. As part of the EIS, a separate study was prepared detailing bicycle and pedestrian access and connection through the West Corridor titled *West Corridor Pedestrian and Bicycle Facilities Report* (Gannett Fleming 2002) as input to the PE. In addition to this study, local area plans such as the Wenk (1996) study for the City of Lakewood have been prepared examining bicycle and pedestrian issues in the corridor.

As noted in the *West Corridor Pedestrian and Bicycle Facilities Report* (Gannett Fleming 2002) and Chapter 2 of the EIS, a variety of bicycle and pedestrian improvements are proposed for the corridor as part of the LRT Alternative. These improvements include links to existing bicycle paths along the corridor with connections to LRT stations, restoration of displaced and impacted bicycle and pedestrian facilities along the corridor, sidewalk improvements at the stations, and pedestrian bridges along the corridor over the Lakewood and Dry Gulch waterways. Bike path improvements along the corridor would include a combination of on and off-street bicycle facilities, upgrades and improvements to existing bicycle facilities, and connections between currently disconnected bicycle facilities. At Wadsworth Boulevard, due to right-of-way and budget constraints, the bicycle path cannot be grade-separated. If Lakewood can identify additional funding for right-of-way acquisition and construction, RTD will work with the city to design the bike overpass. It is also important to note that all bicycle and pedestrian facilities and station linkages will be built in conformity with the *Americans with Disabilities Act,* as discussed below. These improvements are intended to both improve bicycle and pedestrian mobility in the corridor and provide efficient bicycle and pedestrian access to LRT stations.

Despite these improvements, some impacts to the continuity of bicycle and pedestrian operations in the corridor are anticipated under the LRT alternative. These impacts are related primarily to the LRT alignment and associated safety and sound barriers restricting north-south pedestrian movement along the corridor. To mitigate these impacts, bicycle and pedestrian crossings of the alignment will be provided at all LRT stations. Pedestrian bridges and underpasses are proposed for Sanchez Park west of Federal Boulevard, between Knox and Perry Streets, the vicinity of Tennyson Street and the vicinity of Wolff Street. The will be no bike bridge at Kipling Street as noted in the Lakewood Wenk (1996) study.

Under the *Americans with Disabilities Act* (ADA) Accessibility Guidelines, it is not required that accessible routes be installed with new road construction and reconstruction. ADA does require that any new or existing (if doing reconstruction) pedestrian paths or transit stops be made accessible. Grades of the path are of the greatest concern, with handrails and landings required for path grades exceeding 5 percent. ADA does not require that an entire bike path be made accessible. It is acceptable to match the gradient of the road, even if it is greater than five percent. ADA does not have any requirement for grade separation between a roadway and a pedestrian way. A paved shoulder can be considered an accessible route.

Pedestrian overpasses and underpasses present special concerns. The Public Right-of-Way Access Advisory Committee (PROWAAC) recommends an elevator if more than a five percent grade is required for greater than a five-foot rise in elevation. PROWAAC recommendations are guidelines only while the ADA is law. West Corridor facilities were designed in accordance with the ADA Accessibility Guidelines and PROWAAC guidelines.

4.6 FREIGHT AND RAIL IMPACTS

The No Action and Enhanced Bus alternatives would not impact current freight rail operations in the West Corridor. No impacts to trucking and commercial vehicle freight are expected as a result of the Enhanced Bus Alternative.

The LRT Alternative will have minimal impacts on freight rail operation in the corridor. Two rail companies operate freight rail service on lines that will be impacted by the LRT Alternative. These two rail companies are the Union Pacific Railroad and Burlington Northern Santa Fe Railroad. These

railroads operate all freight service on a north/south Consolidated Mainline track and right-of-way under a joint operating agreement. In addition, the study area includes a rail branch from the Consolidated Mainline known as the Burnham Lead. This branch is operated by the Union Pacific Railroad and connects to the Union Pacific's Burnham rail operations and storage yard near West 13th Avenue and Osage Street. These railroad lines and facilities are all located within the City and County of Denver at the eastern end of the LRT alignment.

The LRT Alternative will include grade separated crossings of the freight rail lines. This will prevent any freight rail operations impacts related to LRT. In addition, emergency egress procedures will be available in the event of a freight rail accident. Therefore, freight rail impacts are expected to be limited to construction impacts only.

In addition to freight rail service, the corridor intersects with the Platte River Trolley, a passenger trolley serving Invesco Field at Mile High, the Children's Museum, and the Ocean Journey Aquarium north of the LRT alignment. The Trolley currently operates within existing RTD right-of-way between Confluence Park and Decatur Street. The LRT Alternative will impact Platte River Trolley service by reducing the existing route to end east of Decatur Street. The LRT Alternative may allow for potential future transfers or connections with the trolley service, but trolley service along the LRT right-of-way will be discontinued. RTD will work with Platte River Trolley and City of Denver to identify opportunities to extend the trolley service to Decatur Street.

The LRT Alternative will have grade-separated crossings at highways and major arterials within approved standards to accommodate truck freight and commercial vehicle operations. Impacts to truck freight and commercial vehicles are expected to be minor. Impacts to other modes of commercial freight will be minimal or nonexistent. None of the three alternatives would impact air or waterborne freight.

4.7 CONSTRUCTION IMPACT

The No Action Alternative would have no construction impacts. The Enhanced Bus Alternative would have minor construction impacts associated with the park-n-Rides at Cold Spring and the Jefferson County Government Center.

Construction of the LRT Alternative is expected to impact both roadways and the Consolidated Mainline freight rail corridor. During final design, prior to construction, RTD will consult with CDOT, Jefferson County, Denver and Lakewood regarding the development of construction routing and detouring.

The following roadways would be impacted during LRT construction:

North-South Streets

Federal Boulevard
Knox Court
Perry Street
Sheridan Boulevard
Harlan Street
Lamar Street
Marshall Street
Otis Street
Pierce Street
Reed Street
Teller Street
Vance Street
Wadsworth Boulevard
Yarrow Street
Zephyr Street
Allison Street
Brentwood Street
Carr Street
Estes Street
Everett Court
Garrison Street
Holland Street
Independence Street
Kipling Street
Nelson Street
Oak Street
Quail Street
Simms Street
Indiana Street
Ulysses Street
Earl Johnson Road
Jefferson County Parkway
Colorado Highway 470 (C-470)

East-West Streets

West 13th Avenue
Collins Avenue
West 8th Avenue
West 6th Avenue
West 6th Avenue Frontage Road
I-70
West Colfax Avenue

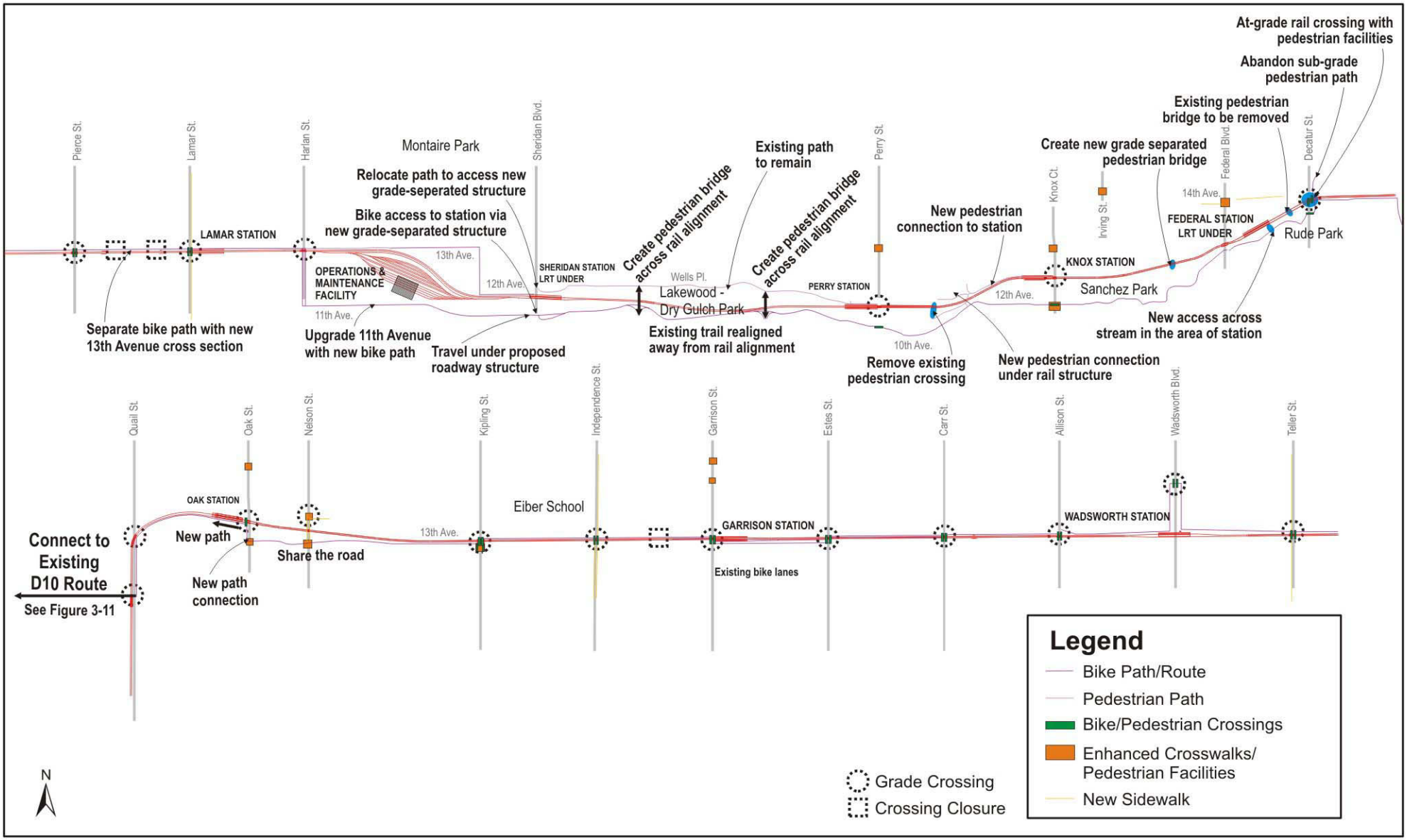


Figure 4-8
Bike Path Routes

Overall construction impacts to the abovementioned roadways are expected to be minor if mitigation measures are employed. Traffic operations on roadways will be maintained to the greatest extent possible during construction. Strategies to minimize impacts to roadways will include off-peak and night construction in nonresidential areas, construction phasing, providing detours, temporary roadways, alignment shifts, and roadway expansions in construction areas to maintain capacity, use of precast concrete members when possible, and increased use of intelligent transportation systems and travel demand management programs during construction.

4.8 SYSTEM LINKAGES

Regional transit system linkages are an important element of any West Corridor alternative. The No Action Alternative would provide no improvements to the transit system linkages. The Enhanced Bus Alternative is expected to provide only minimal improvements to regional transit system linkages. Although many bus routes currently tie into the rapid transit system, they do not provide the rapid transit corridor service necessary for a comprehensive, regional, rapid transit system.

In contrast, the LRT Alternative will provide an important link in the rapid transit system for the Denver metropolitan region serving both West Corridor and regional trips. The LRT Alternative will provide an important rapid transit link with dedicated right-of-way connecting to the existing and planned rapid transit system. Construction of a comprehensive rapid-transit system is integral to the *MetroVision* long-range regional plan. The LRT Alternative will provide transfer connections to the Southwest and Southeast light rail lines as part of the regional rapid transit system. These lines serve important suburban employment and town centers including the Denver Technological Center, Meridian Office Park, Englewood City Center and downtown Littleton. The LRT Alternative will also provide connections to future lines planned to the east, north, northwest and west of the Denver central business district. In addition, West Corridor LRT Alternative will provide metro area rapid transit riders with access to important regional activity centers in the West Corridor including Lakewood Industrial Park, the Denver Federal Center, Red Rocks Community College and the Jefferson County Government Center.