Table 4-13
Existing (2003) Intersection Level of Service

Intersection	Delay (sec/veh) AM/PM	LOS AM/PM
Chambers Road/Smith Road	45/36	D/C[1]
Mid-Block Crossing	**Link Speed (mph) AM/PM**	**LOS AM/PM**
Clayton Street	32/29	B/B
Steele Street	29/27	B/C
40th Avenue	20/21	D/D
48th Avenue	15/16	E/E
56th Avenue	27/26	C/C
Tower Road	19/21	D/D
New Castle Street[4]	28/29	B/B

1. Intersection controlled by a traffic signal.
2. Intersection is two-way or all-way stop controlled.
3. Intersection is uncontrolled.
4. Data are for New Castle Street just north of 78th Avenue.

4.3.2 No-Action Alternative Conditions

This subsection summarizes the analyses performed as part of Step 2 of the traffic analysis. Changes in future traffic operations for the No-Action Alternative are still expected without the implementation of the Preferred Alternative.

As discussed in Chapter 2, Alternatives Considered, Subsection 2.2.1, the No-Action Alternative assumes transportation improvements identified in the DRCOG *2030 Metro Vision Regional Transportation Plan*. This includes all of the elements of the FasTracks system except for the East Corridor. Future (2030) traffic volumes were developed based on information from the DRCOG 2030 regional travel demand model. In general, most traffic volumes would double between 2003 and 2030, with some locations experiencing even larger growth. The number of freight rail movements along the UPRR corridor would remain the same as the existing condition.

4.3.2.1 Grade Separation Analysis

Each existing roadway crossing and new roadway identified as planned transportation improvements were evaluated to determine if any locations would be candidates for grade separation. An extension of Central Park Boulevard is planned from Martin Luther King Boulevard to 56th Avenue. Adding Central Park Boulevard to the 19 existing crossings, the No-Action Alternative would include a total of 20 at-grade crossings requiring analysis to determine if future grade separation is appropriate.

Each of the 20 crossings was evaluated to determine if it could remain at grade with the roadway or if it should be considered for a grade separation. Grade separation methodology is based on UPRR policy and the *Grade Crossing Evaluation Methodology Report* (GCEMR) (URS Corporation, 2004a).

UPRR policy does not allow new at-grade crossings along the existing UPRR corridor. This policy requires Central Park Boulevard to be grade separated from the freight rail tracks. Central Park Boulevard was therefore eliminated from further traffic operational analysis.

The remaining 19 crossings were evaluated using GCEMR methodology. The GCEMR methodology was developed to determine when grade separations at rail crossings should be considered. It is a phased approach with each phase focusing on a key factor for determining the need to consider grade separation. The three phases were:

- Phase I - Safety of the crossing
- Phase II - Impacts to traffic operations near the crossing
- Phase III - Overall crossing feasibility

An analysis was conducted using traffic volumes obtained from the DRCOG 2030 travel demand model.

Phase I Results: Safety Analysis
The safety of roadway and rail crossings is related to roadway geometrics, traffic volumes, train volumes, and the type of crossing control. The anticipated future accident rate of each crossing was projected using the GradeDec.NET software that is maintained by the Federal Railroad Administration (FRA).

An annual accident rate threshold of fewer than 0.04 accidents per year indicates acceptable safe operation at a crossing. Results of the analysis indicated none of the crossings required grade separation based on the safety analysis. All crossings passed the safety analysis and were carried forward into Phase II of the GCEMR analysis.

Phase II Results: Traffic Operations Analysis
The impact of rail operations on roadway traffic at each crossing was evaluated with an analysis similar to the analysis determining vehicle delay at a signalized intersection. Each crossing location was analyzed to determine delay for vehicles due to rail operations. Once total delay was computed, the crossing was assigned an LOS based on GCEMR guidelines.

Based on the results, three locations were recommended for additional analysis: Peoria Street, 48th Avenue, and 56th Avenue. All other analyzed crossings passed the Phase I and Phase II analyses and were eliminated from further consideration for grade separation.

Per GCEMR guidance, possible changes to the existing roadway network should be analyzed to resolve poor operations. This includes looking at the potential for adding capacity to the roadway. This type of analysis was performed at Peoria Street, 48th Avenue, and 56th Avenue and is discussed in the following subsections.

Peoria Street Crossing
The extension of the third southbound lane beyond the Smith Road intersection and the addition of a third northbound lane would result in LOS D due to freight rail impacts. A fourth lane would need to be added to each direction on Peoria Street to reduce these impacts. Peoria Street, however, is located in an area with limited right of way (ROW), which may prohibit additional lanes. Traffic operations at the Peoria Street crossing would have significant levels of delay and LOS F in the No-Action Alternative and would require significant improvements to mitigate poor operations. The Peoria Street crossing was carried forward into Phase III for a more detailed feasibility analysis.

48th Avenue Crossing

The *2030 Metro Vision Regional Transportation Plan* identifies that 48th Avenue will be a two-lane roadway (one lane in each direction) in 2030; however, according to the 2030 DRCOG regional travel demand model, 48th Avenue is projected to carry approximately 1,400 vehicles per lane in the peak hour. For an urban arterial, this volume is at or over capacity for a two-lane road. It is likely that 48th Avenue would operate at LOS E or worse and would require improvements. If 48th Avenue were widened to four lanes (two lanes in each direction), then LOS would most likely improve to LOS C or better. The assumed addition (by others) of a second lane in each direction of 48th Avenue to solve capacity limitations eliminates this crossing from further consideration for grade separation.

56th Avenue Crossing

An addition of one lane in each direction would improve operations on 56th Avenue to LOS C; however, this would make 56th Avenue an eight-lane roadway, which is wider than the standard arterial street six-lane cross section (CCD Department of Public Works, 2005). The 56th Avenue crossing was carried forward into Phase III for a more detailed feasibility analysis.

Phase III Results: Feasibility Analysis

Based on Phase I and Phase II analyses, all crossings that are not eliminated from further consideration for grade separation warrant a feasibility analysis. The crossings at Peoria Street and 56th Avenue were carried forward for evaluation in Phase III. This analysis considers physical impacts, environmental and social impacts, overall public acceptance, and funding.

Peoria Street Crossing

At Peoria Street, conceptual design plans for a grade separation that would accommodate traffic movements, pedestrian movements, access to local properties, and rail operations were developed. These conceptual plans accommodate both freight and commuter rail. Four grade separation concepts were considered:

- Concept 1: Raise both Peoria Street and Smith Road over freight and commuter rail
- Concept 2: Lower both Peoria Street and Smith Road under freight and commuter rail
- Concept 3: Raise/lower freight and commuter rail over/under only Peoria Street
- Concept 4: Raise commuter rail over Peoria Street

Concept 2 was eliminated due to the need for deeper structures under freight rail that may result in longer approaches and impacts to properties on Peoria Street and Smith Road. Concept 3 was eliminated due to the length of freight track that would need to be relocated and the impact of relocating local freight leads. Concept 4 was eliminated due to sight distance issues for the freight rail crossing and the Smith Road and Peoria Street intersection. Leaving the freight rail at grade under Concept 4 would also still result in traffic impacts and would likely preclude the ability to grade separate Peoria Street over the freight tracks in the future.

A conceptual level design for Concept 1 was developed to determine impacts and costs. Grade separating Peoria Street and Smith Road over the commuter and freight tracks would require 17 full and 7 partial property acquisitions. The conceptual design of the bridge structure on Peoria Street was lengthened to span over 37th Avenue (north of the freight rail) in order to maintain access to the four adjacent parcels on 37th Avenue.

Based on the conceptual level design, the cost to construct the grade separation was estimated between $50 and $60 million (in current year dollars when the analysis was conducted). Traffic analysis compared a grade-separated Smith Road and Peoria Street intersection with an at-grade intersection with localized improvements. The analysis showed that the grade separation

from freight and commuter rail still resulted in an intersection with poor operations (LOS F). By grade separating Peoria Street from the freight and commuter rail and maintaining an intersection of Smith Road and Peoria Street, delays decreased slightly, but due to the lack of additional capacity, the intersection would still operate at LOS F. A complicating factor associated with the grade separation is that it would preclude future roadway capacity improvements as growth occurs in the area.

In order to improve the 2030 conditions to a point that an elevated Smith Road and Peoria Street intersection would function at LOS D or better, Peoria Street would need to be nine lanes wide and Smith Road would need to be six lanes wide through the intersection. A traffic operational analysis was completed to compare the No-Action Alternative to a conceptual grade separation at Peoria Street and Smith Road. The grade-separated concept did reduce some delay at the intersection, but the intersection still operated similarly to the No-Action Alternative during the peaks.

Based on the feasibility analysis, the Peoria Street crossing was determined unfeasible to grade separate based on property impacts, financial constraints, and the lack of benefits for the associated high costs. Although the grade separation of Peoria Street would not be required due to the East Corridor, it should be noted that the local jurisdictions have expressed interest in a grade separation; therefore, the Preferred Alternative would not preclude a future grade separation by others.

56th Avenue Crossing

Fifty-Sixth Avenue is located close to the Peña Boulevard interchange, and First Creek is located just north of 56th Avenue. Although the analysis conducted as part of the GCEMR indicated adding another lane to 56th Avenue would reduce the commuter rail impact, the addition of another lane could have significant impacts to the Peña Boulevard interchange west of the crossing location. Because the Preferred Alternative is elevated over First Creek just north of 56th Avenue, it is not likely the commuter rail would be able to remain at grade across 56th Avenue and then climb to the elevation necessary to cross First Creek without having the vertical alignment of the track exceed design standards. Based on the feasibility analysis, the commuter rail is proposed to be grade separated over 56th Avenue.

4.3.2.2 Summary of Grade Separation Analysis

The results of the grade separation analysis are shown in Table 4-14. Based on the analysis, it is assumed that 56th Avenue would be grade separated; therefore, a comparison of LOS between the No-Action Alternative and Preferred Alternative was not required.

Table 4-14
Grade Separation Recommendations

Crossing	UPRR Policy	GCEMR Analysis
York Street	No	No
Josephine Street	No	No
Clayton Street	No	No
Steele Street	No	No
Dahlia Street	No	No
Holly Street	No	No
Monaco Street	No	No
Quebec Street Frontage (southbound)	No	No

Table 4-14
Grade Separation Recommendations

Crossing	UPRR Policy	GCEMR Analysis
Quebec Street Frontage (northbound)	No	No
Central Park Boulevard	Yes	No
Ulster Street	No	No
Havana Street	No	No
Peoria Street	No	No
Sable Road	No	No
Chambers Road	No	No
40th Avenue	N/A	No
48th Avenue	N/A	No
56th Avenue	N/A	Yes
Tower Road	N/A	No
New Castle Street	N/A	No

N/A = not applicable or not available

As part of the coordination efforts with local agencies and other stakeholders following the release of the DEIS, grade-separated design options at both New Castle Street and 40th Avenue were added for consideration in the FEIS.

At 40th Avenue just north of the 40th/Airport station, the two design options include an at-grade alternative (Design Option 1) and a grade separated alternative (Design Option 2). Details of the two design options are provided in Chapter 2, Alternatives Considered. Design Option 1 is part of the Preferred Alternative.

At New Castle Street, the two design options include an at-grade alternative (Design Option 1) and a grade separated alternative (Design Option 2). Details of the two design options are provided in Chapter 2, Alternatives Considered. Design Option 2 is part of the Preferred Alternative.

4.3.2.3 Detailed Traffic Operational Analysis

The operational analysis completed as part of the GCEMR three-phase analysis was a planning-level analysis intended to identify crossings that warrant grade separation. For crossings that do not warrant grade separation, a more detailed traffic operation analysis was completed. This analysis was completed using a micro-simulation model (AIMSUN). It determined benchmark operational conditions at the 18 crossings for comparison purposes between the No-Action Alternative and the Preferred Alternative. The results of the traffic operations analysis are shown in Table 4-15.

Table 4-15
No-Action (2030) Rail Crossing/Intersection Level of Service

Intersection	Existing		No-Action	
	Delay (sec/veh) **AM/PM**	**LOS AM/PM**	**Delay** (sec/veh) **AM/PM**	**LOS AM/PM**
York Street/40th Avenue	15/16	B/B[1]	79/44	E/D[1]
Josephine Street/40th Avenue	4/9	A/A[3]	350/415	F/F[1]
Dahlia Street/Smith Road	40/26	D/C[1]	237/220	F/F[1]
Holly Street/Smith Road	29/27	C/C[1]	138/177	F/F[1]
Monaco Street/Smith Road	34/33	C/C[1]	177/309	F/F[1]
Quebec Street Frontage Road (southbound)/ Smith Road	38/38	D/D[1]	109/85	F/F[1]
Quebec Street Frontage Road (northbound)/ Smith Road	23/20	C/C[1]	107/83	F/F[1]
Ulster Street/Smith Road	24/22	C/C[2]	37/72	D/E[1]
Havana Street/Smith Road	27/26	C/C[2]	115/81	F/F[1]
Peoria Street/Smith Road	46/56	D/E[1]	184/166	F/F[1]
Sable Road/Smith Road	24/32	C/C[1]	206/231	F/F[1]
Chambers Road/Smith Road	45/36	D/C[1]	85/130	F/F[1]
Mid-Block Crossing	**Link Speed** (mph) **AM/PM**	**LOS AM/PM**	**Link Speed** (mph) **AM/PM**	**LOS AM/PM**
Clayton Street	32/29	B/B	24/21	C/D
Steele Street	29/27	B/C	19/20	D/D
40th Avenue[5]	20/21	D/D	17/18	D/D
48th Avenue	15/16	E/E	14/16	E/E
Tower Road	19/21	D/D	17/18	D/D
New Castle Street[4 & 5]	28/29	B/B	20/18	D/D

1. Intersection controlled by a traffic signal.
2. Intersection is two-way or all-way stop controlled.
3. Intersection is uncontrolled.
4. Data are for New Castle Street just north of 78th Avenue.
5. For the grade separation design options, the No-Action Alternative would be the same

Due to the projected traffic growth between 2003 and 2030, all of the intersections would warrant signalization and are assumed to be signalized by the local jurisdictions for the No-Action Alternative. Changes to the number of roadway lanes were not assumed to occur at the intersections unless there were planned projects in the *2030 Metro Vision Regional Transportation Plan*. The majority of signalized intersections would operate at LOS E or F during both peak periods. The primary reason for LOS E or F is that most of the intersections along the two-lane Smith Road currently lack turn lanes, and none are planned. The LOS E or F indicates that in 2030 the analyzed intersections would need improvements even without the addition of commuter rail service.

The majority of the mid-block crossings would continue to operate at LOS D or better during the peaks. This is an indication that the addition of traffic to these roadways would have no

significant impact to the traffic operations at the crossings. Forty-Eighth Avenue continues to operate at LOS E, but this is due to reasons identified in the existing conditions analysis.

4.3.3 Preferred Alternative (2030) Conditions

This subsection summarizes the analyses performed as part of Step 3 of the traffic analysis. The Preferred Alternative assumes all of the planned and committed improvements from the No-Action Alternative, with the addition of commuter rail service from DUS to DIA and associated stations. Eighteen at-grade roadway crossings are proposed along the corridor. Two of these (40th Avenue and New Castle Street) also have a grade separation design option evaluated in the FEIS.

Additional analysis was performed to determine other roadway impacts from the Preferred Alternative, including:

- Evaluation of potential arterial roadway improvements
- Evaluation of potential crossing relocations
- Evaluation of at-grade crossing/intersection operations
- Identification of potential roadway improvements due to station circulation analysis

4.3.3.1 Arterial Improvement Analysis

Future (2030) traffic volumes for the Preferred Alternative were developed based on information from the DRCOG regional travel demand model including the addition of the East Corridor commuter rail. Table 4-16 lists the results of the link volume comparisons between the No-Action Alternative and Preferred Alternative. The table shows that most of the roadway link volumes for the Preferred Alternative would be slightly lower than the No-Action Alternative. Because the Preferred Alternative would not result in any significant changes in roadway link volumes near the commuter rail alignment, no major arterial improvements are required for global changes in traffic patterns due to the addition of the Preferred Alternative.

Table 4-16
Future (2030) Roadway Average Daily Traffic Comparison

Roadway	No-Action Alternative	Preferred Alternative	Difference (%)
Peña Boulevard east of E-470	148,600	144,900	-2.5
Peña Boulevard west of E-470	131,000	127,500	-2.7
Peña Boulevard north of I-70	124,300	123,900	-0.3
Tower Road between 48th Avenue and 56th Avenue	30,100	29,900	-0.7
Tower Road between 40th Avenue and 48th Avenue	36,800	36,700	-0.3
56th Avenue east of Peña Boulevard	66,700	66,700	0.0
48th Avenue east of Peña Boulevard	28,100	28,200	0.4
I-70 between I-225 and Peña Boulevard	234,600	232,700	-0.8
I-70 between Monaco Street and Quebec Street	200,700	199,700	-0.5
I-70 between Steele Street and Dahlia Street	162,500	162,800	0.2
Tower Road south of I-70	48,000	48,000	0.0
Airport Boulevard south of I-70	51,500	51,600	0.2
Chambers Road south of I-70	41,000	40,100	-2.0
I-225 south of I-70	173,200	172,800	-0.2

Table 4-16
Future (2030) Roadway Average Daily Traffic Comparison

Roadway	No-Action Alternative	Preferred Alternative	Difference (%)
Havana Street south of I-70	37,800	37,700	-0.3
Central Park Boulevard south of I-70	30,800	30,500	-1.0
Quebec Street south of I-70	63,600	63,600	0.0
Monaco Street south of I-70	36,700	36,600	-0.3
Holly Street south of I-70	7,600	7,500	-1.3
Dahlia Street south of I-70	10,600	10,600	0.0
Steele Street south of I-70	25,900	25,600	-1.2
Clayton Street south of I-70	10,100	9,900	-2.0
Josephine Street south of I-70	11,000	10,900	-0.9
York Street south of I-70	17,300	17,300	0.0
Airport Boulevard south of Smith Road	48,100	48,100	0.0
Chambers Road south of Smith Road	30,100	29,800	-1.0
Peoria Street south of Smith Road	53,100	53,300	0.4
Havana Street south of Smith Road	21,900	21,600	-1.4
Central Park Boulevard south of Smith Road	30,800	30,500	-1.0
Quebec Street south of Smith Road	50,400	50,300	-0.2
Monaco Street south of Smith Road	37,200	37,000	-0.5
Holly Street south of Smith Road	1,100	1,000	-9.0
Dahlia Street south of Smith Road	800	800	0.0
Steele Street south of 40th Avenue	4,100	4,000	-2.4
York Street south of 40th Avenue	17,600	17,600	0.0
40th Avenue between Clayton Street and Steele Street	34,900	34,600	-0.9
40th Avenue between Steele Street and Colorado Boulevard	14,900	14,500	-2.7
Smith Road between Holly Street and Monaco Street	19,000	18,900	-0.5
Smith Road between Quebec Street and Central Park Boulevard	23,500	23,400	-0.4
Smith Road between Central Park Boulevard and Havana Street	23,300	23,200	-0.4
Smith Road between Peoria Street and I-225	15,100	15,100	0.0
Smith Road between I-225 and Chambers Road	16,400	16,300	-0.6
Smith Road between Airport Boulevard and Tower Road	12,800	12,800	0.0

Source: 2030 DRCOG travel model for No-Action and Preferred alternatives (rounded to the nearest hundred vehicles).

4.3.3.2 Crossing Relocation Analysis

In the No-Action Alternative analysis, Josephine Street was observed to operate with large delays and LOS F during the peak periods. Josephine Street is a one-way northbound roadway where it would cross the Preferred Alternative. It forms a one-way pair with southbound York Street, as shown in Figure 4-8. South of 40th Avenue, York Street is a two-way arterial. Northbound traffic on York Street must turn east on 40th Avenue, travel one block, and then turn

left onto Josephine Street to continue northbound through the area. The intersection at Josephine Street has no traffic control devices, requiring drivers making the eastbound to northbound left-turn movement to wait for gaps in traffic. Fortieth Avenue is a four-lane roadway between York Street and Josephine Street and a three-lane roadway west of York Street and east of Josephine Street.

Several concepts were considered at this location to improve safety and operations. Due to its close proximity to York Street, the addition of a traffic signal at Josephine Street was not identified as a desired solution. The angle that the commuter rail alignment would cross Josephine Street was also a problem. In order for the commuter rail to transition from 40th Avenue to the UPRR corridor, the crossing at Josephine Street would need to be a skewed crossing, as shown in Figure 4-8. A perpendicular crossing is preferred.

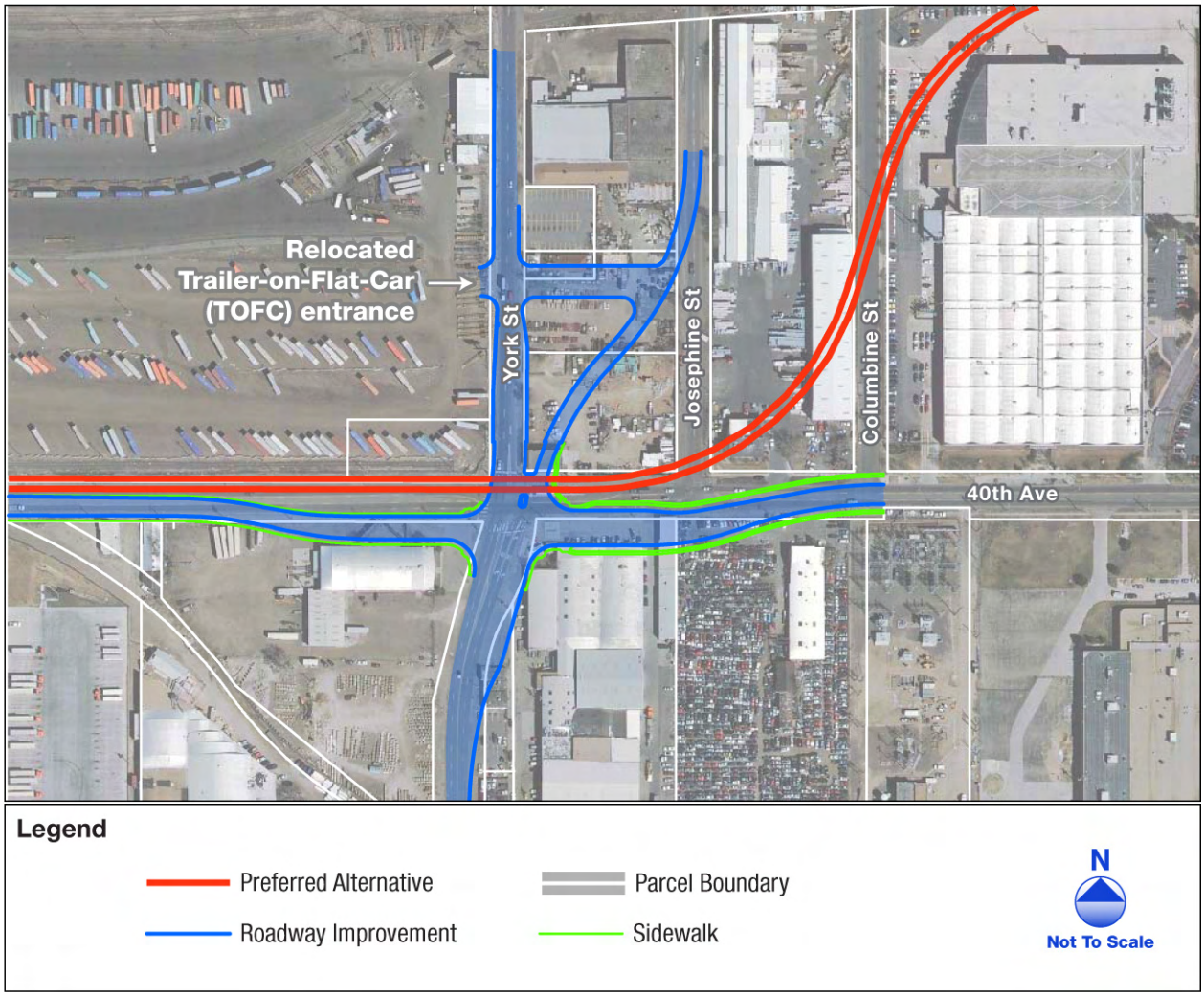
The recommended design for this intersection includes realigning the north leg of Josephine Street at 40th Avenue so it shares the existing York Street and 40th Avenue intersection, as shown in Figure 4-8. This design would create a four-legged intersection with the commuter rail tracks crossing perpendicular on the north side of the intersection, and eliminate the skewed crossing of Josephine Street. This would also create a single commuter rail crossing at York Street and Josephine Street, which is safer than two separate crossings.

Analysis of the single York Street, Josephine Street, and 40th Avenue intersection identified that the single intersection operated at a better LOS and lower delay compared to the two separate intersections. A single intersection would operate with LOS F/F (111/122 sec/veh) compared to LOS E/D (79/44 sec/veh) at York Street and 40th Avenue, and LOS F/F (350/415 sec/veh) at Josephine Street and 40th Avenue for the two individual intersections or LOS F/F (429/459 sec/veh) if the two intersections are combined. ROW constraints due to the presence of a nearby electrical substation prohibit the addition of more lanes to further improve operations at this intersection. Although the intersection operates at LOS F/F, it does service more vehicles during the peak periods with lower overall delay than the existing configuration of two separate intersections.

The Preferred Alternative would include relocating the entrance of the existing trailer-on-flat-car (TOFC) facility to York Street. Data obtained from the TOFC property operator indicated this facility west of York Street would generate approximately 30 incoming and outgoing trips during the peak hours. All 30 trips are projected to be heavy trucks and were modeled as commercial vehicles in the analysis. Results of the analysis indicate that the link connection between York Street and Josephine Street would experience an average queue of approximately one commercial vehicle (80 feet) and a maximum queue of approximately two commercial vehicles (160 feet) during the peak hours. Based on preliminary design work at this location the connecting roadway would be in excess of 200 feet in length, providing sufficient storage length for the expected queues.

This recommended approach for the Josephine Street crossing eliminates the need to analyze Josephine Street as a separate crossing. This reduces the number of at-grade crossings requiring traffic operational analysis to 17 along the Preferred Alternative alignment.

Figure 4-8
Preferred Alternative Roadway Modifications at Josephine Street and York Street



4.3.3.3 At-Grade Crossing/Intersection Operational Analysis

A detailed traffic operations analysis was completed for each at-grade crossing. The analysis of the at-grade crossings and intersections was separated into two phases: a non-mitigated analysis and a mitigated analysis. The first phase (non-mitigated) of the operational analysis evaluated each location based upon future (2030) traffic volumes projected due to the addition of park-n-Rides at stations, and the addition of commuter rail movements without making any changes to the roadways, such as adding turn lanes or lengthening existing turn lanes. The results of the analysis provide a way to quantify the traffic impacts due to the addition of commuter rail service.

The second phase (mitigated) investigated mitigation measures at crossings and intersections that operate at unacceptable LOS, in an effort to return operations back to the LOS of the No-Action Alternative or to LOS D if the no-action operations were LOS C or better. The analysis focused on identifying mitigation for the impacts associated with the introduction of commuter rail service.

Assumptions for commuter and freight operations were developed for the analysis of traffic impacts. The Preferred Alternative would provide commuter rail service with 15-minute headways between DUS and DIA for most of the day, including the AM and PM peak travel times. With commuter rail vehicles completing roundtrips between DUS and DIA, each crossing location would generally experience one commuter rail train (either inbound or outbound) crossing an average of every 7.5 minutes.

During the crossing of a commuter rail train, traffic flow would be interrupted. Interruption time varies depending on whether the crossing would be located directly adjacent to a signalized intersection or at a mid-block location. Procedures outlined by the U.S. Department of Transportation (USDOT) for railroad-highway grade crossings were used to estimate interruption time. The associated calculations were based on train lengths of 400 feet (four-car trains) and crossing speeds that ranged from 35 mph to 79 mph.

At intersections or mid-block locations, the interruption time includes the time from when the traffic signals would first be notified of an approaching train until the time when normal signal operations would resume after the train passed. At intersections the interruption time was estimated to range from 55 to 80 seconds for each train passing. At mid-block locations the interruption time was estimated to range from 40 to 50 seconds for each train passing. It should be noted that some of the commuter rail crossings at intersections would coincide with a red signal for crossing traffic, and therefore would not contribute any additional delay.

The Preferred Alternative would include the relocation or replacement of the same total length of freight track in the corridor. Capacity would neither be increased nor decreased; therefore, the crossing analysis includes one freight movement during each peak period, which is assumed to result in six minutes of blockage time per peak hour at each roadway crossing, just as in the no-action analysis.

4.3.3.3.1 Non-Mitigated Analysis Results

The results of the non-mitigated traffic operations analysis are shown in Table 4-17. A majority of the signalized intersections would operate at LOS F with higher delay compared to the No-Action Alternative. Not all vehicle movements are completely blocked at intersections during either a freight or commuter rail movement. Because these intersections are controlled by traffic signals, some traffic movements can occur at the same time as freight or commuter rail movements.

The combined impact of freight and commuter rail movements reduces the amount of green time for northbound and southbound vehicle movements, but increases the amount of green time provided for eastbound through, eastbound right-turn, westbound through, and westbound left-turn traffic. Presence of congestion on the intersecting north-south roadway does not influence availability of capacity for the east-west roadway since commuter rail pre-emption impacts northbound and southbound through movements.

A majority of the mid-block crossings would continue to operate at LOS D during the peak periods. An exception is 48th Avenue, which would operate at LOS E in both the No-Action Alternative and the Preferred Alternative. The grade separation design options for 40th Avenue and New Castle Street would have no impact on the link speeds and LOS.

Table 4-17
Preferred Alternative (2030) Non-Mitigated Rail Crossing/Intersection LOS

Signalized Intersection		No-Action Alternative		Preferred Alternative (Non-Mitigated)	
		Delay (sec/veh) AM/PM	LOS AM/PM	Delay (sec/veh) AM/PM	LOS AM/PM
York Street/Josephine Street/40th Avenue		429/459[2]	N/A[2]	111/122	F/F
Dahlia Street/Smith Road		237/220	F/F	260/228	F/F
Holly Street/Smith Road		138/177	F/F	158/194	F/F
Monaco Street/Smith Road		177/309	F/F	211/375	F/F
Quebec Street Frontage Road (southbound)/ Smith Road		109/85	F/F	111/95	F/F
Quebec Street Frontage Road (northbound)/ Smith Road		107/83	F/F	119/88	F/F
Ulster Street/Smith Road		37/72	D/E	62/91	E/F
Havana Street/Smith Road		115/81	F/F	135/87	F/F
Peoria Street/Smith Road[3]		184/166	F/F	81/132	F/F
Sable Road/Smith Road		206/231	F/F	268/316	F/F
Chambers Road/Smith Road		85/130	F/F	94/144	F/F
Mid-Block Crossing		**Link Speed (mph) AM/PM**	**LOS AM/PM**	**Link Speed (mph) AM/PM**	**LOS AM/PM**
Clayton Street		24/21	C/D	21/18	D/D
Steele Street		19/20	D/D	17/18	D/D
40th Avenue	Design Option 1 - at grade (Preferred Alternative)	17/18	D/D	17/18	D/D
	Design Option 2 - grade separated	17/18	D/D	17/18	D/D
48th Avenue[1]		14/16	E/E	14/16	E/E
Tower Road		17/18	D/D	17/18	D/D
New Castle Street[4]	Design Option 1 - at grade	20/18	D/D	18/18	D/D
	Design Option 2 - grade separated (Preferred Alternative)	20/18	D/D	20/18	D/D

1. Assumes capacity is improved to four lanes by others; see grade separation evaluation section.
2. Location was two separate intersections in No-Action Alternative. Values shown are the sum of the results for the two individual intersections.
3. Includes closure of Smith Road between Moline Street and Peoria Street.
4. Data are for New Castle Street just north of 78th Avenue.

4.3.3.3.2 Mitigated Analysis Results

An analysis was completed at the crossings and intersections where the addition of commuter rail service would result in increased traffic delay. The purpose of the additional analysis was to identify mitigation measures that could reduce or eliminate delay associated with the addition of commuter rail service where the Preferred Alternative was operating at LOS D or worse. No mitigation was identified at crossings and intersections where the Preferred Alternative would already operate at LOS D or better. The goal of this analysis was not to improve the Preferred

Alternative operations to LOS D or better, but to mitigate for the amount of delay associated with the addition of commuter rail. Nearly all of the intersections or crossings operated below LOS D for the No-Action Alternative conditions, meaning these locations would be in need of mitigation by the local agencies prior to the addition of commuter rail service.

For the mitigated analysis, each location was evaluated independently to identify changes to roadway laneage and/or changes to signal timing to reduce the delay to No-Action Alternative levels. Some of the potential mitigation measures that were evaluated included adding turn lanes on approaches where they do not currently exist, increasing the length of existing turn lanes, and adjusting signal timing. In addition, efforts were made to ensure recommended intersection laneage was consistent with long range visions of the local agencies and guidelines for preferred maximum storage lengths of turn lanes. For example, at the Smith Road and Chambers Road intersection, the analysis was completed to ensure adequate ROW was available to accommodate two through lanes in each direction on Smith Road and shorter dual left-turn lanes on Smith Road.

This subsection describes the mitigation measures at individual crossings and intersections that are not located near planned commuter rail stations. Intersections that are located close to a planned commuter rail station are discussed separately. Table 4-18 briefly describes the mitigation measures designed to eliminate or reduce the delay associated with the addition of commuter rail to the corridor. Where additional turn lanes are a recommended mitigation measure, the length of the turn bays were designed to accommodate the expected average queues during the peaks based on the traffic analysis model. The results of the No-Action Alternative (non-mitigated) and Preferred Alternative (non-mitigated and mitigated) analyses are shown in Table 4-19.

Table 4-18
Crossing/Intersection Mitigation Measures

Roadway	Type of Crossing	Proposed Mitigation
York Street/Josephine Street	Adjacent to intersection with 40th Avenue	• No mitigation required; the proposed intersection results in improved operations over the No-Action Alternative.
Clayton Street	Mid-block	• None; the crossing operates at LOS D or better during the peaks without mitigation measures.
Steele Street	Mid-block	• None; the crossing operates at LOS D or better during the peaks without mitigation measures.
Dahlia Street	Adjacent to intersection with Smith Road	• Add an eastbound left-turn lane on Smith Road. • Add a westbound left-turn lane on Smith Road.

Table 4-18
Crossing/Intersection Mitigation Measures

Roadway	Type of Crossing	Proposed Mitigation
Holly Street	Adjacent to intersection with Smith Road	• Add an eastbound left-turn lane on Smith Road. • Add a westbound left-turn lane on Smith Road. • Add a northbound left-turn lane on Holly Street. • Add a southbound left-turn lane on Holly Street. • Add an eastbound right-turn lane on Smith Road. • Add a westbound right-turn lane on Smith Road.
Monaco Street	Adjacent to intersection with Smith Road	• Add an eastbound left-turn lane on Smith Road. • Add a westbound left-turn lane on Smith Road. • Add a southbound right-turn lane on Monaco Street.
Quebec Street Southbound Frontage Road	Adjacent to intersection with Smith Road	• Add an eastbound through lane on Smith Road.
Quebec Street Northbound Frontage Road	Adjacent to intersection with Smith Road	• This intersection is discussed further as part of the station circulation analysis.
Ulster Street	Adjacent to intersection with Smith Road	• This intersection is discussed further as part of the station circulation analysis.
Havana Street	Adjacent to intersection with Smith Road	• Add an eastbound left-turn lane on Smith Road. • Add a westbound left-turn lane on Smith Road. • Add a northbound left-turn lane on Havana Street. • Add a southbound left-turn lane on Havana Street. • Add an eastbound right-turn lane on Smith Road. • Add a westbound right-turn lane on Smith Road. • Add a southbound right-turn lane on Havana Street.

Table 4-18
Crossing/Intersection Mitigation Measures

Roadway		Type of Crossing	Proposed Mitigation
Peoria Street		Adjacent to intersection with Smith Road	• This intersection is discussed further as part of the station circulation analysis.
Sable Road		Adjacent to intersection with Smith Road	• Add a westbound right-turn lane on Smith Road.
Chambers Road		Adjacent to intersection with Smith Road	• Add a second westbound through lane on Smith Road. • Add an eastbound shared through/right-turn lane on Smith Road. • Add a second eastbound left-turn lane on Smith Road. • Add length to the remaining turn bays at the intersection.
40th Avenue	Design Option 1 - at grade (Preferred Alternative)	Mid-block	• This mitigation is discussed further as part of the station circulation analysis.
	Design Option 2 - grade separated	N/A – grade separated	• This mitigation is discussed further as part of the station circulation analysis.
48th Avenue		Mid-block	• None; the crossing experiences only minimal degradation in operations.
Tower Road		Mid-block	• None; the crossing operates at LOS D or better during the peaks without mitigation measures.
New Castle Street	Design Option 1 - at grade	Mid-block	• None; the crossing experiences only minimal degradation in operations.
	Design Option 2 - grade separated (Preferred Alternative)	N/A – grade separated	• None; the crossing experiences no degradation in operations.

Table 4-19
Preferred Alternative (2030) Mitigated Rail Crossing/Intersection LOS Results

Signalized Intersection		No-Action Alternative		Preferred Alternative (Non-Mitigated)		Preferred Alternative (Mitigated)	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
		AM/PM	AM/PM	AM/PM	AM/PM	AM/PM	AM/PM
York Street/Josephine Street/40th Avenue		429/459[2]	N/A[2]	111/122	F/F	111/122	F/F
Dahlia Street/Smith Road[4]		237/220	F/F	260/228	F/F	108/55	F/D
Holly Street/Smith Road[4]		138/177	F/F	158/194	F/F	93/54	F/D
Monaco Street/Smith Road[4]		177/309	F/F	211/375	F/F	81/85	F/F
Quebec Street Frontage Road (southbound)/Smith Road[4]		109/85	F/F	111/95	F/F	45/43	D/D
Quebec Street Frontage Road (northbound)/ Smith Road		107/83	F/F	119/88	F/F	38/40	D/D
Ulster Street/Smith Road		37/72	D/E	62/91	E/F	38/55	D/D
Havana Street/Smith Road[4]		115/81	F/F	135/87	F/F	49/64	D/F
Peoria Street/Smith Road[3]		184/166	F/F	81/132	F/F	81/132	F/F
Sable Road/Smith Road[4]		206/231	F/F	268/316	F/F	37/105	D/F
Chambers Road/Smith Road[4]		85/130	F/F	94/144	F/F	66/92	E/F
Mid-Block Crossing		**No-Action Alternative**		**Preferred Alternative** (Non-Mitigated)		**Preferred Alternative** (Mitigated)	
		Link Speed (mph)	LOS	Link Speed (mph)	LOS	Link Speed (mph)	LOS
		AM/PM	AM/PM	AM/PM	AM/PM	AM/PM	AM/PM
Clayton Street		24/21	C/D	21/18	D/D	21/18	D/D
Steele Street		19/20	D/D	17/18	D/D	17/18	D/D
40th Avenue	Design Option 1 - at grade (Preferred Alternative)	17/18	D/D	17/18	D/D	17/18	D/D
	Design Option 2 - grade separated	17/18	D/D	17/18	D/D	17/18	D/D
48th Avenue[1]		14/16	E/E	14/16	E/E	14/16	E/E
Tower Road		17/18	D/D	17/18	D/D	17/18	D/D
New Castle Street[5]	Design Option 1 - at grade	20/18	D/D	18/18	D/D	18/18	D/E
	Design Option 2 - grade separated (Preferred Alternative)	20/18	D/D	20/18	D/D	20/18	D/D

[1] Assumes capacity is improved to four lanes by others; see grade separation evaluation section.
[2] Location was two separate intersections in No-Action Alternative. Values shown are the sum of the results for the two individual intersections.
[3] Includes closure of Smith Road between Moline Street and Peoria Street.
[4] Intersection with proposed mitigation measure(s).
[5] Data are for New Castle Street just north of 78th Avenue.
[6] Assumes grade separation of this crossing by others in the future.

The mitigated crossing locations were improved to operate with less delay than the non-mitigated conditions. In many cases, mitigated conditions have less delay than the No-Action Alternative conditions. In most instances, the recommended mitigation measures resulted in improved LOS (LOS D in many cases). Based on the analysis, mitigation measures can be successfully implemented that would reduce or eliminate the delay associated with the addition of commuter rail to the corridor.

4.3.3.4 The Preferred Alternative Station Circulation Analysis

Introduction of the Preferred Alternative will result in the addition of several commuter rail stations. In addition to DUS and DIA, recommended stations include:

- 38th/Blake (formerly called 40th/40th)
- Colorado
- Central Park
- Peoria
- 40th/Airport

Local traffic circulation changes around the station sites were analyzed. Station site analysis addressed existing traffic operations and projected future (2030) traffic volumes to identify impacts to the local roadway network due to station area traffic and potential mitigation measures. Potential stations at 64th/Peña and 72nd/Himalaya (Dunkirk) are not part of the Preferred Alternative, but the current design plans for the East Corridor do not precluded the addition of these stations in the future. The addition of these stations may require additional environmental analysis/clearances that would need to be performed by others before construction of the stations. RTD has and will continue to participate in discussions about these possible future station locations.

38th/Blake Station Circulation Analysis Results

The 38th/Blake station would have two parking locations. One would be northwest of the UPRR corridor and bordered by 38th Street on the southwest, Wynkoop Street on the northeast, and the UPRR corridor on the southeast. The other location would be southeast of the UPRR corridor and bordered by the UPRR corridor on the northwest, Blake Street on the southeast, and 38th Street on the southwest. The platform would be located between the UPRR corridor and Blake Street just southwest of 38th Street. A pedestrian bridge would provide access between the two parking sites and the platform. Figure 4-9 shows the location of the station along with the intersections near the station.

This site would serve two bus routes and provide 200 parking spaces opening day (2015) and an additional 300 spaces by 2030. The parking distribution on opening day is 100 spaces at the park-n-Ride northwest of the UPRR corridor and 100 spaces at the park-n-Ride southeast of the UPRR corridor. The parking and associated roadway improvements would be phased, as necessary, between opening day and 2030.

Vehicle access to the northwest park-n-Ride would be provided at 39th Street and Wynkoop Street. Access to the southeast park-n-Ride would be provided as a right in and left in from Blake Street and a right-only exit to Blake Street, with one way flow through the parking lot. Approximately 1,250 daily vehicle trips to and from the station are projected in 2030. Table 4-20 summarizes the projected traffic operations at impacted intersections for the No-Action and Preferred alternatives with and without traffic mitigation. Proposed mitigation measures include:

- Add a northbound right-turn lane on 38th Street at Brighton Boulevard.
- Add a second southbound left-turn lane on 38th Street at Brighton Boulevard.

- Signalize 40th Street at Brighton Boulevard. The traffic signal would likely be added as the parking expands to a point where station generated traffic volumes warrant the need for a traffic signal.
- Add a westbound left-turn lane on Brighton Boulevard at 40th Street.
- Add an eastbound right-turn lane on Brighton Boulevard at 40th Street.
- Convert the intersection of Brighton Boulevard and 39th Street to a right-in, right-out intersection where left turns would not be allowed from Brighton Boulevard onto 39th Street. (It should be noted that the intersection could be converted to a ¾-movement in the future if Brighton Boulevard is converted to a 5-lane roadway by others without adverse impacts to the operations at this intersection.)
- Add an eastbound right-turn lane on Brighton Boulevard at 39th Street.
- Optimize signal timing at the Walnut Street and Marion Street and Walnut Street and Downing Street intersections.
- Convert the Wynkoop Street and 38th Street intersection to right-in, right-out.

Figure 4-9
38th/Blake Station

Table 4-20
Comparison of Traffic Operations at Intersections near 38th/Blake Station

Intersection	Peak Hour	No-Action Alternative		Preferred Alternative without Mitigation		Preferred Alternative with Mitigation	
		Delay	LOS	Delay	LOS	Delay	LOS
Walnut Street/Marion Street[2]	AM	70	E	84	F	59	E
	PM	72	E	84	F	42	D
Brighton Boulevard/38th Street[2]	AM	66	E	71	E	62	E
	PM	98	E	108	F	89	E
Walnut Street/Downing Street[2]	AM	58	E	83	F	47	D
	PM	43	D	57	E	48	D
Lawrence Street/Downing Street	AM	9	A	19	B	19	B
	PM	12	B	16	B	16	B
Downing Street/Blake Street	AM	19	C	21	C	21	C
	PM	13	B	13	B	13	B
Blake Street/park-n-Ride exit[1]	AM	N/A	N/A	12	B	12	B
	PM	N/A	N/A	17	C	17	C
Blake Street/park-n-Ride entrance[1]	AM	N/A	N/A	20	C	20	C
	PM	N/A	N/A	20	C	20	C
40th Street/Brighton Boulevard[2]	AM	20	C	83	F	12	B
	PM	24	C	600	F	17	B
26th Avenue/Downing Street	AM	26	C	26	C	26	C
	PM	28	C	28	C	28	C
39th Street/Brighton Boulevard	AM	16	C	11	B	11	B
	PM	19	C	11	B	11	B

Note: Delay is reported in seconds per vehicle.
1. This intersection does not exist in existing conditions.
2. This intersection includes proposed improvements.

Colorado Station Circulation Analysis Results

The Colorado station is proposed to be located north of 41st Avenue and west of Jackson Street and Smith Road. Figure 4-10 shows the location of the proposed station along with the intersections in the vicinity. Under existing conditions, Jackson Street continues north across 40th Avenue, 41st Avenue, and 42nd Avenue before terminating at the south edge of the existing UPRR corridor. Smith Road begins midway between 41st Avenue and 42nd Avenue and angles northeast from Jackson Street turning due east and passing under Colorado Boulevard.

The site would serve four bus routes and contain 200 parking spaces on opening day (2015) and 1,800 parking spaces (in a parking structure) in 2030. Vehicles would be able to access the site from the 40th Avenue and Jackson Street intersection and then via Garfield Street or Monroe Street and 41st Avenue or 42nd Avenue. The parking and associated roadway improvements would be phased as necessary between opening day and 2030.

Smith Road Realignment Design Options

The Preferred Alternative requires modification to Smith Road in the vicinity of the Colorado station due to insufficient ROW under the existing Colorado Boulevard overpass to accommodate Smith Road, existing freight tracks, and proposed commuter rail tracks.

The Preferred Alternative will close Smith Road between 41st Avenue and the northbound Colorado Boulevard off ramp. Two design options to realign Smith Road between Colorado Boulevard and Dahlia Street to maintain the connectivity of Smith Road are included in this FEIS. Both Smith Road realignment design options were designed with curves that minimize the impacts to the adjacent properties while providing a minimum design speed of 25 mph.

Study intersections would experience increased volumes due to the construction of the Colorado station and would experience a change in volume patterns due to the realignment of Smith Road. Traffic analysis for the No-Action Alternative assumes that Smith Road would remain on its current alignment. Traffic analysis for build conditions includes changes in volumes due to construction of the Colorado station and the realignment of Smith Road. The Colorado station is projected to generate approximately 4,520 daily trips to and from the station in 2030. Table 4-21 summarizes the projected traffic operations at impacted intersections for the No-Action Alternative and the Preferred Alternative with and without traffic mitigation.

Smith Road Realignment Preferred Option (Design Option 2)

As shown in Figure 4-10, the Preferred Alternative includes a realignment of Smith Road from the east leg of the intersection of 40th Avenue and Colorado Boulevard east to Albion Street, north along Albion Street, and then east approximately along the existing Smith Road alignment. This option includes the elimination of the northbound slip ramp from Colorado Boulevard to Smith Road. This movement would access Smith Road via the intersection of 40th Avenue and Colorado Boulevard. The connection of Albion Street to 40th Avenue and to Smith Road would be modified as shown in Figure 4-10.

Proposed mitigation measures are:

- Add a northbound left-turn lane on Colorado Boulevard at 40th Avenue.
- Add one eastbound and one westbound lane to 40th Avenue between Jackson Street and Colorado Boulevard.
- Re-stripe the westbound 40th Avenue approach to Colorado Boulevard to have two left-turn lanes, one through lane, and one shared through-right lane.
- Convert the southbound Colorado Boulevard at 40th Avenue right-turn movement to a free right turn, which would include the addition of a westbound lane on 40th Avenue to receive the turning vehicles.
- Convert the eastbound 40th Avenue at Colorado Boulevard right-turn movement to a free right turn, which would include the addition of a southbound acceleration lane on Colorado Boulevard to receive the turning vehicles.
- Add a northbound right-turn pocket on Colorado Boulevard at 40th Avenue
- Convert the west leg of 41st Avenue at Colorado Boulevard to a right-in, right-out access, which would result in a free right-turn for southbound Colorado Boulevard at 41st Avenue. Add an eastbound left-turn lane on 40th Avenue at Jackson Street.
- Add an eastbound left-turn lane on 40th Avenue at Jackson Street.
- Add a westbound right-turn lane on 40th Avenue at Jackson Street.
- Add a second southbound left-turn lane on Jackson Street at 40th Avenue.

- Signalize the intersection of Jackson Street and 40th Avenue. The traffic signal would likely be added as the parking expands to a point where station generated traffic volumes warrant the need for a traffic signal.
- Add a second northbound left-turn lane on Jackson Street at 41st Avenue.
- Add a southbound right-turn (through-right) and a southbound left-turn lane on Jackson Street at 41st Avenue.
- Signalize the intersection of Jackson Street and 41st Avenue. The traffic signal would likely be added as the parking expands to a point where station generated traffic volumes warrant the need for a traffic signal.
- Add a northbound right-turn lane on Colorado Boulevard at 40th Avenue.

Based on traffic volume projections, a traffic signal at the intersection of 40th Avenue and Jackson Street would need to be installed prior to 2030 for the No-Action Alternative. Because Smith Road would be relocated as part of the Preferred Alternative, the majority of traffic on Jackson Street would be traffic going to/from the station and would warrant installation as part of the station construction. Jackson Street would be improved to provide direct access to the station, busbay areas, and 42nd Avenue.

Figure 4-10
Colorado Station Area Preferred Alternative
Smith Road Realignment Design Option 2