CHAPTER 3
TRANSPORTATION IMPACTS

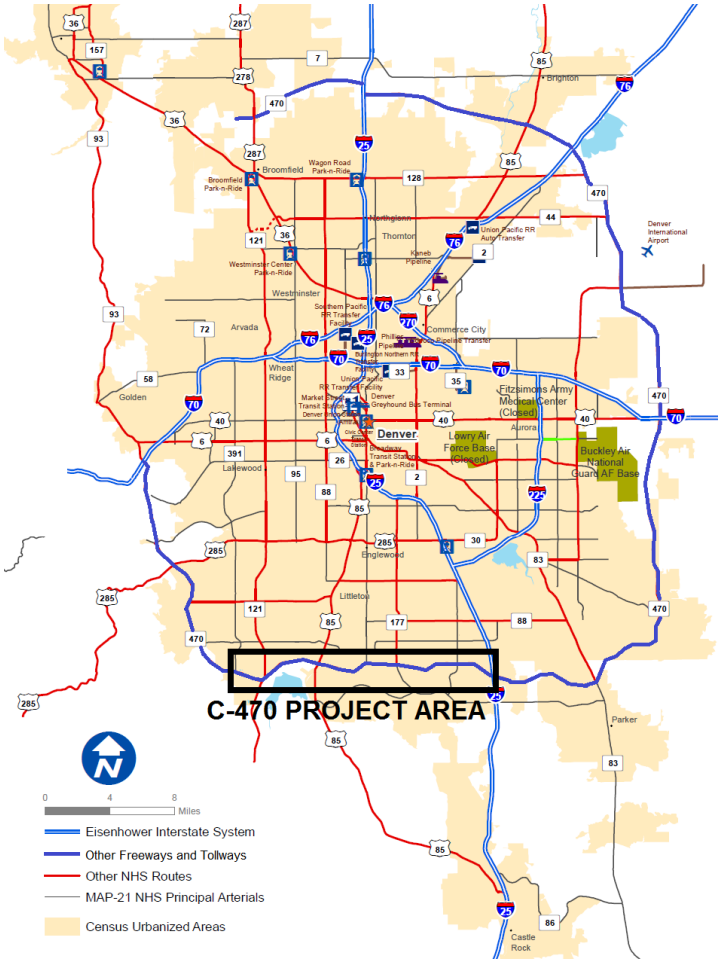
3.1 INTRODUCTION

This chapter describes C-470's current use and its role in the multimodal transportation system serving the southwest portion of the Denver metro area, followed by discussion of how the roadway would function in the future for the 2035 No-Action Alternative and Proposed Action. A discussion of project phasing is included, because a major portion of the project has funding for immediate construction, but a future project would be needed to advance the roadway from the Interim condition to the Ultimate configuration which is the Proposed Action.

3.2 TRANSPORTATION EXISTING CONDITIONS

The location of the C-470 project area in the context of the regional roadway network for the Denver metropolitan area is shown in **Figure 3-1**, a map of designated National Highway System routes. C-470 is part of this system.

Figure 3-1
National Highway System, Denver-Aurora Metro Area



Source: FHWA, 2015.

C-470 is in the southwest quadrant of the region. It was originally planned to be part of the Interstate Highway System (I-470), but was removed from that system in the late 1970s by Colorado's request. Under an arrangement called the Interstate Transfer program, Colorado received Federal funding for C-470 and various other roadway improvements in lieu of the planned Interstate highway.

Figure 3-1 reflects the importance of C-470 to the southwestern portion of the Denver region. There are significant topographical constraints south of C-470 and Highlands Ranch, as well as the Front Range of the Rocky Mountains to the west. Between C-470 in the south and I-70 in the north (approximately 19 miles apart), expressways US 285 and US 6 are alternative regional east-west routes, but the closest of these is 8 miles north of C-470. C-470 is the main east-west route serving the more than 100,000 residents south of it in the Highlands Ranch development of northern Douglas County.

Figure 3-2 displays the functional classification of the highways and arterial roadways within the C-470 project area. This figure was compiled from the municipal and county plans in the project vicinity. Most of the roadways shown are four to six lanes wide, typically with left and right turn lanes at signalized intersections. Congestion and/or crashes sometimes result in C-470 traffic diverting to County Line Road (to the north) or the Highlands Ranch Parkway/ University/Lincoln Avenue arterial system (to the south) in Highlands Ranch. To do so, this traffic also uses the various north-south arterials connecting C-470 with these alternative routes.

Access to C-470 from the surrounding roadway system is provided as detailed in **Table 3-1**. In the 13.75-mile Project Area, full access is available at seven locations, partial access is provided for two intersecting roadways, and three roads that cross C-470 have no access to the freeway.

3.2.1 Freeway Typical Sections

Currently, C-470 has two through-lanes in each direction. From Quebec Street to I-25, the freeway also has auxiliary lanes that connect the on-ramp to the subsequent off-ramp, to provide maximum possible distance for merge and diverge movements to/from the through lanes. Four-foot shoulders are typical to the left of the inside ("fast") lane, and ten-foot breakdown

Figure 3-2
Functional Classification of Highways and Arterial Roads in the C-470 Project Area

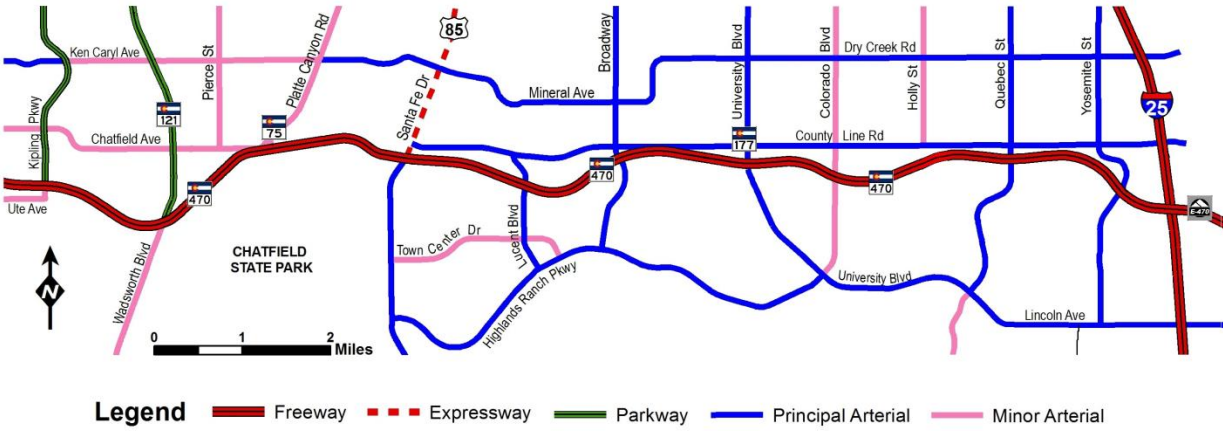


Table 3-1
Description of C-470 Existing Access Conditions

North-South Route	Access	Description (locations ordered from west to east)
Kipling Parkway	Full	Grade-separated interchange with signalized ramp terminal intersections.* Kipling Parkway crosses over C-470.
Wadsworth Boulevard	Full	Grade-separated interchange with signalized ramp terminal intersections. Crosses over C-470.
Platte Canyon Road	Partial	At-grade right-in, right out for westbound C-470 only. Platte Canyon Road does not cross C-470.
South Santa Fe Drive (US 85)	Full	Grade-separated interchange with signalized ramp terminal intersections, plus a flyover ramp from southbound Santa Fe to eastbound C-470. Santa Fe Drive crosses over C-470.
Erickson Road, not shown in Figure 3-2.	None	This collector street crosses under C-470 about one-third mile east of Santa Fe Drive.
Lucent Boulevard	None	Lucent Boulevard crosses over C-470.
Broadway	Full	Grade-separated interchange with signalized ramp terminal intersections. Crosses over C-470.
University Boulevard	Full	Grade-separated interchange with signalized ramp terminal intersections. Crosses over C-470.
Colorado Boulevard	None	No access. Colorado Boulevard crosses over C-470.
Quebec Street	Full	Grade-separated interchange with signalized ramp terminal intersections. Quebec Street crosses over C-470.
Acres Green Drive, not shown in Figure 3-2.	None	Crosses under C-470 between Quebec Street and Yosemite Street. Acres Green Drive is classified as a collector street.
Yosemite Street	Partial	Grade-separated interchange with signalized ramp terminal intersections, with C-470 access only to and from the west. This is a half-diamond interchange. Crosses under C-470.
Interstate 25	Full	Multi-level freeway-to freeway interchange. Free-flowing with no traffic signals. I-25 crosses over C-470.

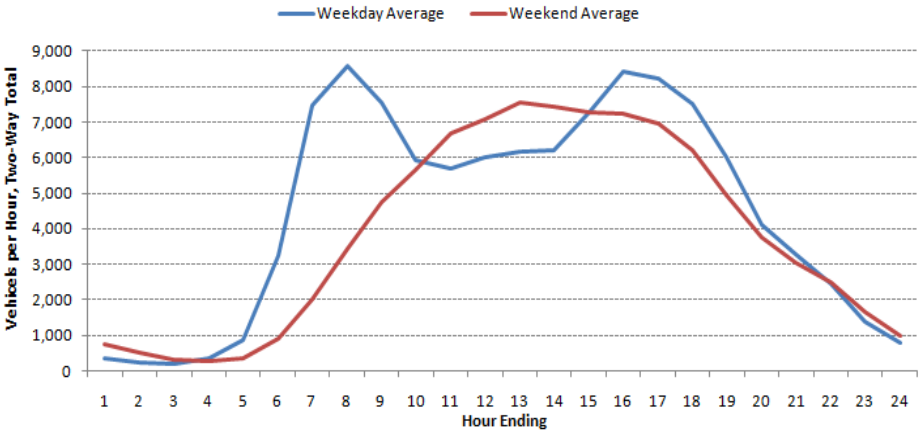
* The grade-separated intersections listed here are diamond interchanges unless otherwise noted.

shoulders are typical to the right of the outside ("slow") lane. Existing typical sections and their widths were presented previously in **Figure 2-3**.

3.2.2 Traffic Composition and Patterns

Figure 3-3 presents average weekday traffic (combined total for eastbound and westbound trips) for average weekday and weekends. Highest combined traffic

Figure 3-3
Existing C-470 Weekday versus Weekend Hourly Volumes*



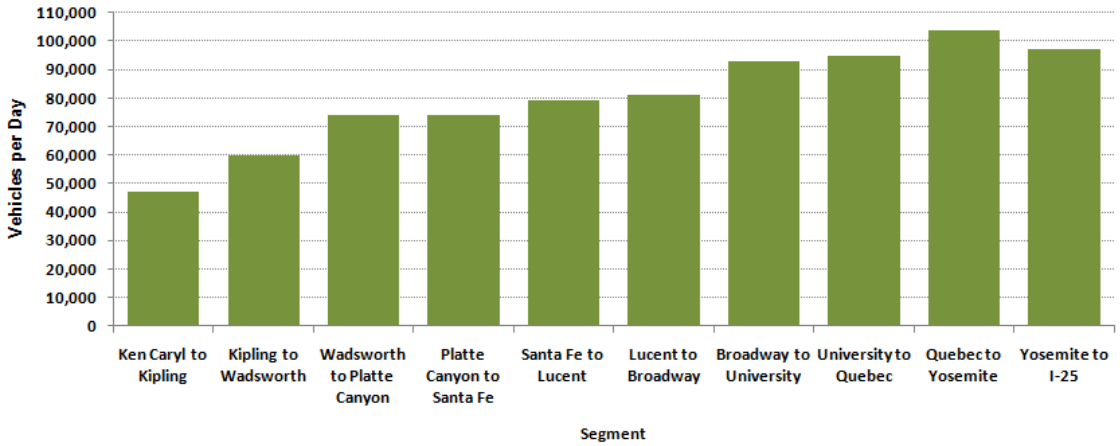
** Data shown are total, two-way traffic from CDOT's permanent, continuous counting station (#105548) located east of Quebec Street, in Lone Tree, from April 2013 (CDOT, 2013).*

volumes during the week occur on weekdays between 7:00 and 8:00 in the morning. Fridays are normally the weekday with the most traffic. These patterns are normal for a freeway in a metropolitan area.

Weekend traffic is steady and moderately heavy during the early afternoon. The source data indicate that traffic is higher on Saturdays than Sundays. Shopping trips to the Park Meadows Mall at the project area's eastern end and recreation trips to parks and open space at the western end (as well as mountain destinations further west) contribute to midday weekend traffic on this particular corridor.

Traffic congestion on weekdays, not weekends, is the focus of this EA. The base year for the analysis is 2013. Average weekday traffic volumes by C-470 segment for 2013 are presented in **Figure 3-4**, from west to east. C-470 traffic volumes are lowest (60,000 vehicles per day) at the western end of the project area and highest near the eastern end (105,000 vpd).

Figure 3-4
C-470 Average Annual Daily Traffic (AADT) by Segment, 2013



(CDOT, 2013)

The average volume west of Kipling Parkway was 47,000 vpd. The volume on tolled E-470, immediately east of the project area, was 37,000 vpd. Both of these numbers are well below the project area minimum, found east of Kipling Parkway.

The number of regional through-trips using all of C-470 from I-25 to I-70 is less than or equal to the lowest volume shown in **Figure 3-4**, which is at the western end of the project area. This demonstrates that the majority of C-470 trips are not through-trips but instead have an origin or destination that is along the corridor.

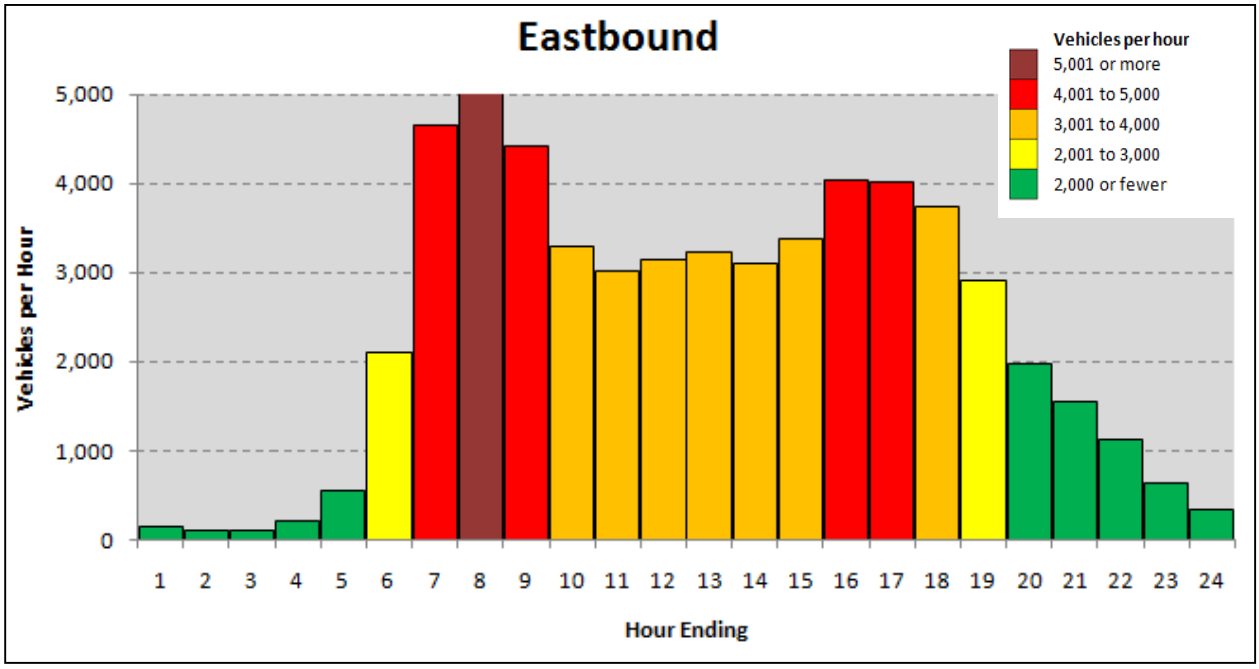
Multiplying the length of each segment by the traffic volume on it yields a corridor total of 1.16 million vehicle miles traveled (VMT) per average weekday.

Figures 3-5 and 3-6 illustrate hourly weekday traffic volumes by direction. The hours with the highest volumes experience the heaviest traffic congestion. The single highest hourly volume in either direction is an average just over 5,000 vehicles per hour (vph) in the eastbound direction for the 7:00 to 8:00 a.m. rush hour.

During the evening peak hours, traffic in each direction is approximately the same, at 4,000 vph, or 2,000 vph per lane. This general balance of traffic in each direction is not well-suited for capacity improvement strategies that include reversible lanes.

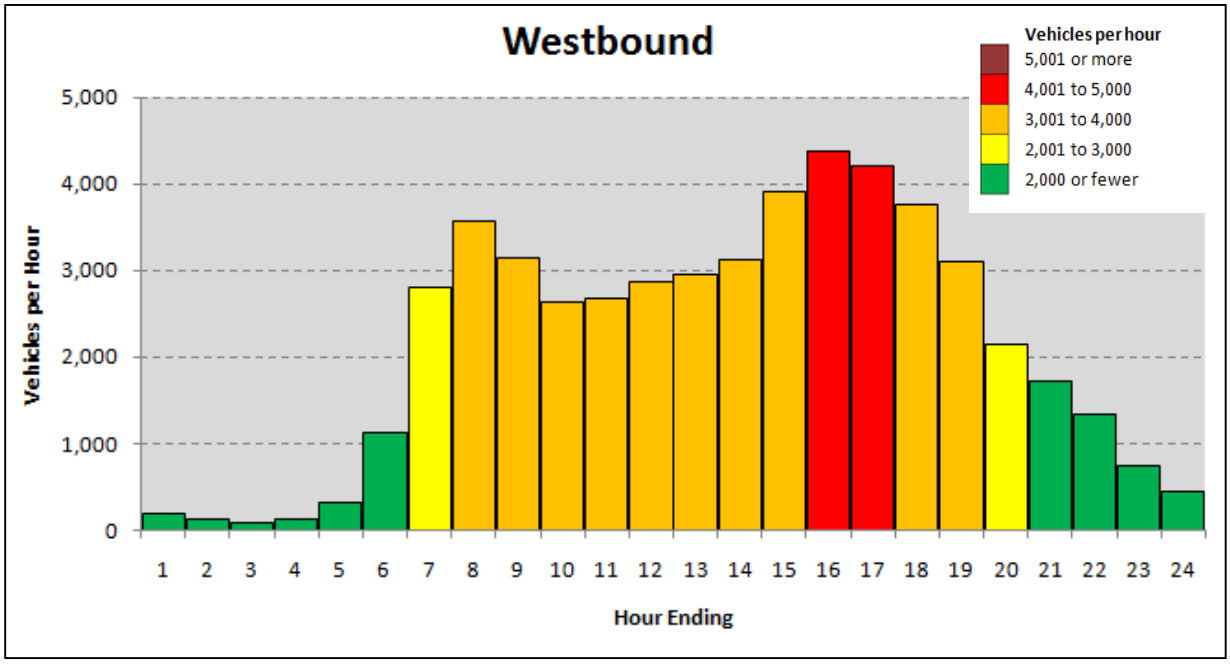
The posted speed limit on all of C-470 is 65 miles per hour (mph). Travel speed observations in May 2013 found traffic flowing at 60 mph westbound in the morning with 3,500 vehicles per hour (vph), 50 mph eastbound in the evening with 4,000 vph, and 25 mph or less during peak hours in the peak directions, with traffic volumes of 4,100 to 5,000 vph. This is consistent with standard traffic engineering models that show travel speed deteriorates rapidly when the volume increases above 4,000 vph.

Figure 3-5
C-470 Hourly Average Weekday Traffic Volumes, Eastbound



(CDOT, 2013)

Figure 3-6
C-470 Hourly Average Weekday Traffic Volumes, Westbound



(CDOT, 2013)

Table 3-2 presents congestion information for the full 26-mile C-470 corridor as found in Appendix 1 (Corridor Visions) of the DRCOG *2035 Metro Vision Regional Transportation Plan.*

The DRCOG estimates in **Table 3-2** can be updated to 2013 and narrowed down to just the 13.75-mile C-470 project area. Calculations based on free-flow speeds, 2013 CDOT traffic volumes, and interpolation of the above DRCOG estimates suggest that total vehicle hours of travel (VHT) on C-470 in the project area were slightly over 23,000 VHT for an average weekday in 2013. This includes 17,847 VHT for free-flow travel, with the remainder being delay due to congestion.

3.2.3 Freeway Volumes and LOS

Traffic volumes on C-470 are shown in **Figure 3-7.** This portion of the analysis was updated to 2014 since new traffic counts became available.

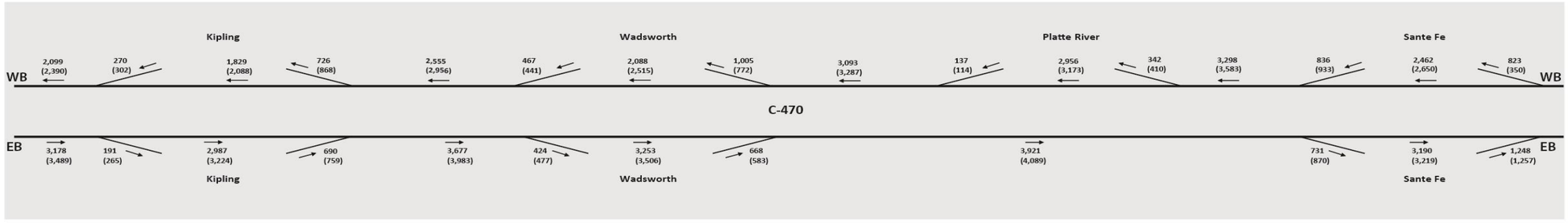
Freeway traffic operations are expressed in terms of LOS, as defined by the *2000 Highway Capacity Manual* (HCM).

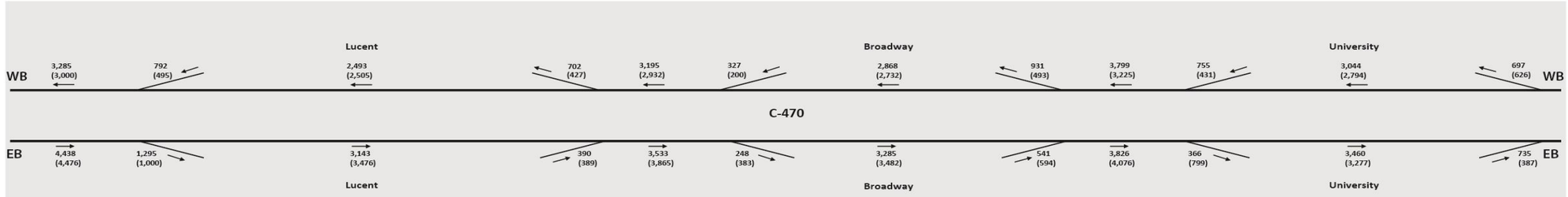
Table 3-2
DRCOG Assessment of Congestion on the 26-mile C-470 Corridor

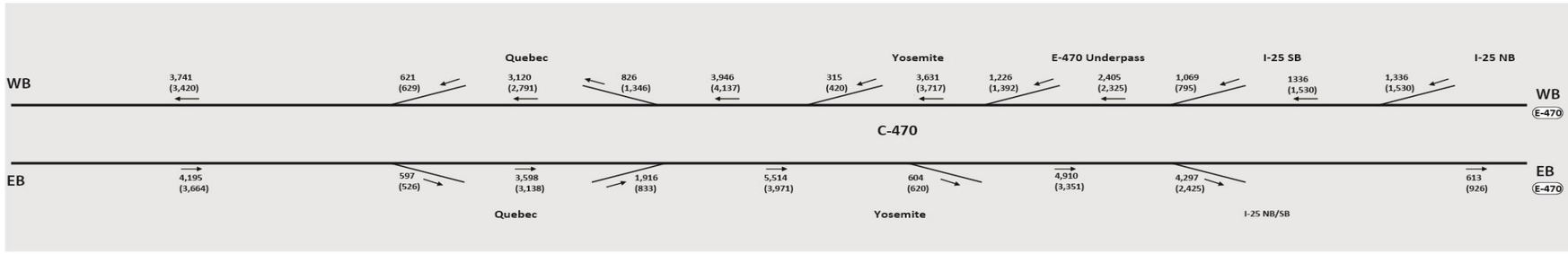
Component	Congestion Measure	2006	2035
Reliability	Travel Time Variation (ratio of peak hour to non-peak hour travel time)	1.44	2.93
Duration	Daily Congestion (hours per day)	1-2	3-4
Severity	Percent of Peak Travel Time in Delay	21%	49%
Delay	Vehicle Delay (hours per day)	6,650	41,940

(DRCOG, 2011a)

Figure 3-7







2014 Existing C-470 Freeway Traffic Volumes

Legend

AM Peak Hour
(#) PM Peak Hour
General Purpose Lanes/Ramps
N

Operational LOS is a congestion measure used to describe service quality and is related to the density of the traffic stream. Free-flow conditions with no restrictions are described as LOS A. LOS B through D conditions demonstrate progressively worse traffic conditions. LOS F represents a breakdown in traffic flow, characterized by the familiar traffic jam.

The entire section of westbound C-470 between Kipling and I-25 generally operates at LOS D or better during the AM and PM peak hours with the exception between I-25 and Yosemite Street where LOS E freeway weave operations were reported.

Eastbound, LOS E/F congested conditions occur for the entire section from Kipling to I-25 for both (AM and PM) peak periods. The existing corridor has traffic operational problems due to high traffic volumes, interchange access points spaced close together, tight weaving and short merging and diverging areas.

The Traffic Technical Report in the Appendix E of this Revised EA provides a comprehensive evaluation and summary of freeway traffic operations for existing conditions and for future conditions with the No-Action Alternative and the Proposed Action.

3.2.4 Interchanges and Arterial Intersections

Interchange ramp terminals and arterial intersection operations in the project area were evaluated using existing signal timing and current intersection geometry. Results of the existing intersection operational analysis are presented in **Table 3-3**.

Table 3-3
Existing (2013) Peak Hour Intersection LOS and Delay

Location (Cross-streets listed from west to east, intersections listed from north to south)	AM Peak Hour		PM Peak Hour	
	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS
Kipling & C-470 Eastbound (EB)	9.6	A	34.8	C
Kipling & C-470 Westbound (WB)	18.0	B	28.3	C
Wadsworth & C-470 EB	12.7	B	12.5	B
Wadsworth & C-470 WB	20.9	C	17.8	B
Santa Fe & C-470 EB	14.1	B	15.3	B
Santa Fe & C-470 WB	21.0	C	28.5	C
Lucent & C-470 EB	26.1	C	12.8	B
Lucent & C-470 WB	36.4	D	36.1	D
Broadway & C-470 EB	9.1	A	9.9	A
Broadway & C-470 WB	18.4	B	23.2	C
University & C-470 EB	12.5	B	30.8	C
University & C-470 WB	11.9	B	14.4	B
Quebec & C-470 EB	115.7	F	14.5	B
Quebec & C-470 WB	15.1	B	186.9	F
Yosemite & C-470 EB	23.1	C	12.7	B
Yosemite & C-470 WB	7.7	A	30.3	C

In the table above, red-shaded cells denote congestion at LOS E or F.

The results show that all of the project area intersections currently operate at an acceptable LOS (LOS D or better for urban conditions) during the peak hours,

The northbound I-25 to westbound C-470 ramp is a left-hand side merge that ends in a lane drop, which leads to slower operating speeds and safety concerns on C-470. In addition, traffic must weave onto I-25 between C-470 and Lincoln in the northbound and southbound directions due to lane drops at the Lincoln and C-470/E-470 interchanges, which lead to slower operating speeds and reduced safety on I-25.

3.2.5 Freeway Travel Times

Travel time data were collected in 2013 to determine current weekday peak and off-peak travel times on C-470. **Table 3-4** summarizes these findings.

3.2.6 C-470/I-25 Traffic Operations

The existing C-470/I-25 interchange area has traffic operational problems due to interchange access points spaced close together, tight weaving areas, and short merging and diverging areas.

Undesirable weaving areas and/or diverge areas were reported along northbound and southbound I-25 between C-470 and Lincoln Avenue. These operational problems will spill back along each of the freeway corridors impacting freeway operations upstream of these locations.

The northbound I-25 to westbound C-470 ramp is a left-hand side merge that ends in a lane drop, which leads to slower operating speeds and safety concerns on C-470. In addition, traffic must weave onto I-25 between C-470 and Lincoln in the northbound and southbound directions due to lane drops at the Lincoln and C-470/E-470 interchanges, which lead to slower operating speeds and reduced safety on I-25.

CDOT has prepared a separate, detailed analysis of operations at the C-470/I-25 interchange. See Section 3.3.2 for more discussion of this analysis called an Interstate Access Request (IAR).

3.2.7 C-470 Crash Data

The Purpose and Need for C-470 improvements is based on the need for congestion relief and improved travel time reliability. However, there is reason to expect that relieving traffic congestion may also have traffic safety benefits.

The *Roadway Safety Technical Report* that is included in **Appendix D** analyzed 1,465 C-470 crashes over a five-year period (2008-2012) and found that rear-end collisions accounted for approximately half (711) of the total. About 75 percent of the rear-end collisions occurred during morning and evening peak hours, during the most congested times of the day. CDOT's Office of Transportation Safety has concluded that most rear-end collisions on C-470 are the direct result of one or more vehicles either.

Table 3-4
Existing (2013) Weekday Average Travel Time and Delay on C-470*

Time Period	Free-Flow Time at 65 mph (Minutes)	Delay (Minutes)		Total Travel Time (minutes)	
		Eastbound	Westbound	Eastbound	Westbound
AM Peak	13	7	1.5	18	14.5
PM Peak	13	0	14.5	13	27.5
Off-Peak	13	N/A	N/A	13	13

** Between I-25 and Kipling Parkway, mileposts 12.449 to 26.195 (13.75 miles)*

unexpectedly slowing or stopping, due to congestion, on the high-speed roadway

Another important finding was that more than half (773 out of 1,465) of the C-470 crashes over five years involved an identifiable driver behavior or condition including: distracted driving, driver inexperience, driver impaired, driver fatigue, aggressive driving, or driver medical condition. Regardless of how safe a roadway design may be, these types of drivers will have crashes.

In the analysis, adverse weather and slick pavement conditions did not appear to be a major cause of crashes. On average, about 300 crashes per year occur on the C-470 mainline, and about 90 percent of them occur when the weather and roads are dry.

The analysis did not identify any locations of high crash frequency for any type of crash that would suggest specific roadway deficiencies. On a mile-by-mile basis, the Broadway interchange vicinity had C-470's highest number of rear-end collisions (average 91 per year, or one every four days) and the most crashes involving cable rail (23 per year).

Only 2.5 percent of the crashes in the C-470 safety database involved heavy trucks. This is approximately proportional to the reported prevalence of heavy trucks on this highway. The corridor does not appear to have design issues causing difficulty for larger, less maneuverable vehicles.

3.2.8 Freight on C-470

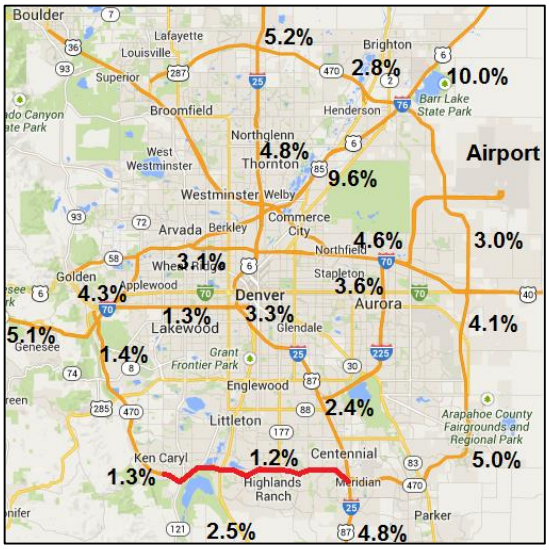
C-470 carries minimal freight trucking in comparison with the other freeways and state highways in the Denver region. High truck volumes occur on east-west I-70, on I-76 bringing freight to and from I-80 in Nebraska, and also delivering freight to and from Denver International Airport (DIA), which is a major hub for many types of cargo including mail and overnight shipping services. DIA is located northeast of downtown Denver, some 30 miles away from the C-470 project area.

Figure 3-8 presents average weekday combination truck (3 or more axles) percentages reported at ten-mile intervals for freeways and other major highways in the Denver region. The 1.2 percent heavy trucks seen on C-470 in the project area (milepost 20) is the lowest percentage noted in the region. Per CDOT's statewide map of bridges with height restrictions, no bridge over C-470 has substandard clearance for trucks.

There are no intermodal freight transfer facilities along the corridor, according to the DRCOG 2035 *Metro Vision Regional Transportation Plan*. The nearest multimodal facility is the Centennial Airport, east of I-25 at County Line Road, which handles some air cargo operations.

Freight railroad tracks cross over C-470 on bridges immediately east of the Santa Fe Drive interchange, but are not found anywhere else in the project area.

Figure 3-8
Heavy Truck Prevalence on C-470 and Other Denver Region Highways



(CDOT, 2103)

C-470 is a designated truck route and a designated hazardous materials route, but not a designated route for transport of nuclear materials.

3.2.9 TDM/TSM

Transportation Demand Management (TDM) and Transportation System Management (TSM) infrastructure or programs that exist within the project area include the following:

- Variable message signs (one each direction) on C-470 approaching Quebec Street
- Ramp metering signals on all C-470 on-ramps (except Kipling Parkway
- DRCOG regional "Way to Go" rideshare matching service and employer outreach program

No congestion management pricing system exists currently on the C-470 corridor. If toll lanes are added, tolls would vary by time interval, with the highest tolls being charged during peak periods. This would encourage off-peak travel for discretionary trips.

3.2.10 Transit Service

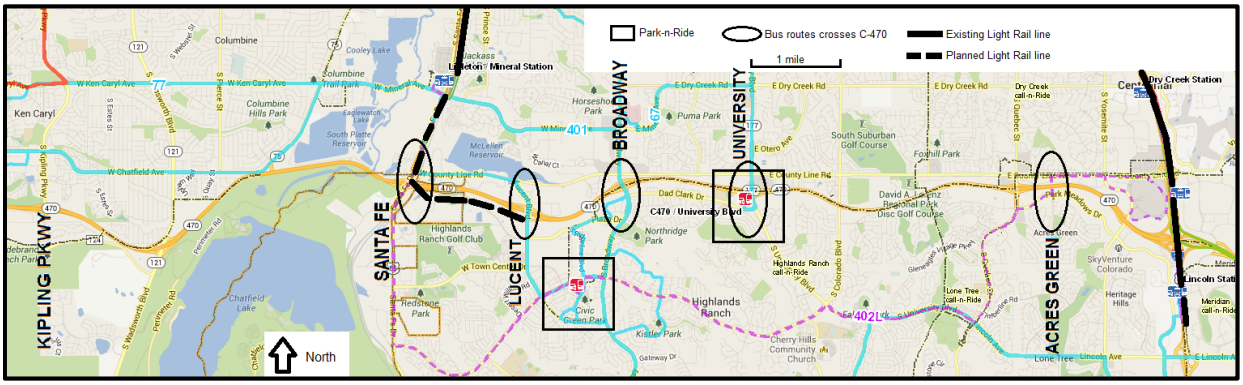
Public transit service in the C-470 project area and throughout the Denver metro area is provided by the Regional Transportation District (RTD). The C-470 project area is at the southern, suburban outskirts of the RTD transit system, with fewer bus routes than in denser, more central parts of the metropolitan area. **Figure 3-9** is an excerpt from RTD's online system map as of early 2014, with local bus routes depicted with various colored lines. The map has been annotated to highlight three transit system features: locations where bus routes cross C-470; Park-n-Ride lots; and light rail lines (existing and planned).

Bus Routes: Currently, no RTD bus routes use C-470. C-470 is not suitable for local bus service as it has no access to adjacent land uses, and is not well suited for express bus routes because crashes and traffic congestion make peak-period travel times highly inconsistent and unreliable.

As of early 2014, bus routes cross C-470 at five locations in the project area, at Santa Fe Drive (US 85), Lucent Boulevard, Broadway, University Boulevard, and Acres Green Drive. Two of these locations (Lucent and Acres Green) do not have freeway interchanges, while the other three pass through interchange ramp intersections. An express route to the town of Parker (east of the project area) uses I-25 and toll highway E-470 but does not use or cross C-470.

Light Rail: Two light rail lines from downtown Denver reach the C-470 project area. The Southeast Corridor follows I-25, with stations at the Park Meadows Mall

Figure 3-9
RTD Transit System Elements in the C-470 Project Area



(RTD, 2014)

north of C-470 and Lincoln Avenue south of C-470. The Southwest Corridor extends southward down Santa Fe Drive to the Mineral Station, and is planned to extend southward across C-470 then turn eastward to a planned new station at Lucent Boulevard. The DRCOG *2035 Metro Vision Regional Transportation Plan* indicates that implementation of this 2.8-mile, $142.5 million extension is anticipated in the 2015-2024 timeframe.

Park-n-Ride Lots: Two RTD Park-n-Ride lots are located within the project area. A 440-space lot is located immediately south of C-470 and west of University Boulevard. Deeper into the interior of the Highlands Ranch development, a 177-space lot is located at the intersection of Highlands Ranch Parkway and Ridgeline Boulevard.

3.2.11 Bicycle and Pedestrian Facilities

C-470 is a freeway, so it does not have adjacent sidewalks or bike lanes. According to the CDOT Colorado Bicycle Map, bicycling on the C-470 shoulder is prohibited on the busiest section of the highway, from I-25 to Quebec Street. However, there is a separate, paved multiuse trail called the Centennial Trail (or C-470 Trail) that parallels the highway for its entire length. See photo in **Figure 3-10**.

The C-470 Trail serves the very important transportation purpose of providing east-west mobility and offering cyclists a safe route that is not on the busy, high-speed freeway.

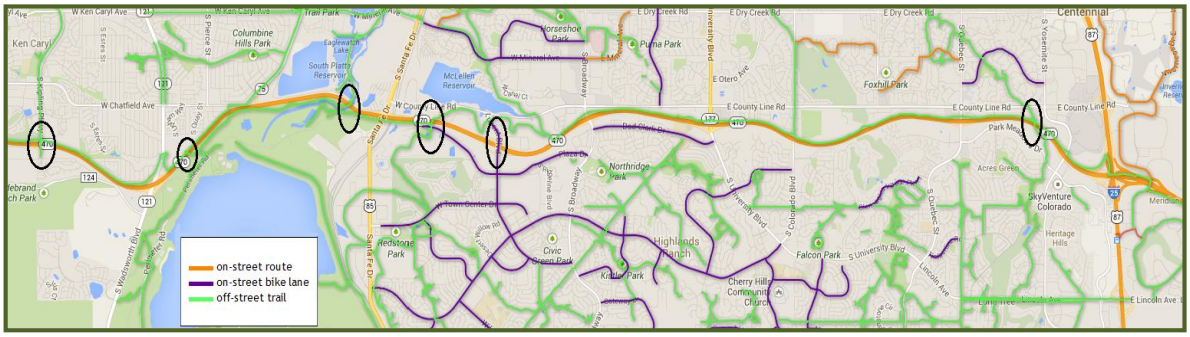
Most of the C-470 Trail is located north of C-470. From I-25 to the High Line Canal, west of Lucent Boulevard, it is north of C-470. It crosses under C-470 with the High Line Canal Trail and remains on the south side of C-470 through Chatfield State Park, then crosses under C-470 at the Massey Draw drainage, east of Wadsworth Boulevard, and remains on the north side of the highway thereafter to the west.

Figure 3-11 is an excerpt of the DRCOG Regional Bicycle Map, depicting on-street routes, on-street bike lanes, and off-street trails. Off-street trails and on-street bike lanes are relatively plentiful south of C-470 between the Chatfield Reservoir and I-25, in the Highlands Ranch development of Douglas County. Black ovals on the figure indicate the six locations where bicycle facilities cross C-470.

Figure 3-10
View of C-470 Trail Next to the Freeway

Facing west, approaching the Colorado Boulevard overpass. In this location, the trail is on the north side of the freeway.

Figure 3-11
Bicycle Facilities in the C-470 Project Area



(DRCOG, 2011a) Note: crossings of C-470 are highlighted with a black oval.

From west to east along the corridor, these are: Kipling Parkway, Massey Draw, South Platte River (Mary Carter Greenway Trail), High Line Canal (east of Erickson Road), Lucent Boulevard, and Willow Creek (west of Yosemite Street). These crossings are heavily concentrated in the western half of the project area, with three of the six occurring in the vicinity of Chatfield State Park.

In addition to crossing the freeway twice, the C-470 Trail makes east-west crossings of the various north-south highways and arterial streets that cross the freeway. Unlike the two C-470 Trail crossings of the freeway, some of the trail's crossings of arterials are at-grade, meaning that cyclists must cross the street in traffic. Over time, these at-grade crossings are being replaced with safer, grade-separated crossings.

3.3 FUTURE TRANSPORTATION CONDITIONS

This section discusses the anticipated impacts of the Proposed Action and No-Action Alternative on the transportation resources and conditions that have been discussed above. As there are only two alternatives under consideration, their effects are discussed simultaneously, in comparison to each other, rather than sequentially (i.e., first discussing all aspects of one alternative and then repeating the discussion for the second alternative).

Traffic modeling for this Revised EA used 2013/2014 baseline conditions and DRCOG model assumptions from the DRCOG *2035 Metro Vision Regional Transportation Plan (RTP).* The DRCOG 2035 plan anticipated several improvements to the roadway network in the vicinity of the C-470 project area within the next two decades. These are:

- County Line Road, widening to add two lanes between University Boulevard and Phillips Avenue (east of Broadway), in the 2015-2024 timeframe.
- E-470 widening to add two lanes between I-25 and Parker Road, in the 2025-2035 timeframe.

Additionally, there are ongoing efforts to widen U.S. 85 (Santa Fe Drive) south of the project area to Castle Rock. This was the subject of an approved and still active *South I-25 Corridor and US 85 Corridor Final Environmental Impacts Statement* (2001) and its subsequent Record of Decision (2002).

In February 2015, DRCOG adopted a 2040 Fiscally Constrained RTP. This new plan specifies some of the upcoming US 85 improvements from the EIS noted above. It

indicates that funding is programmed for widening U.S. 85 from four through lanes to six through lanes as follows:

- 2015 to 2014 - Highlands Ranch Parkway to Blakeland Drive
- 2025 to 2034 – Blakeland Drive to County Line Road
- 2025 to 2034 – Titan Parkway to Highlands Ranch Parkway

These widening efforts have been anticipated since the 2002 ROD, and C-470 improvements in the vicinity of U.S. 85 are compatible with these future needs.

The 2040 RTP also indicates that approximately $50 million is programmed for capacity improvements at the I-25/Lincoln Avenue interchange. This project will be designed to be compatible with the C-470 Proposed Action as well.

3.3.1 Transit Resources

There are no special lanes or other accommodations for buses or High Occupancy Vehicles on C-470. Poor travel time reliability makes C-470 unattractive for bus service. This would continue to be true under the No-Action Alternative, but with the Proposed Action, new toll lanes would be managed through time-of-day pricing to offer improved travel time reliability. Thus, the express lanes would be more attractive for RTD bus use than C-470 is today. Given the limited number of locations where ingress and egress between the express lanes and the adjacent free lanes would be allowed, the new lanes would be better suited for express bus services than for local service routes.

3.3.2 Freeway Volumes and Operations

Year 2035 No-Action and Proposed Action traffic forecasts for the study were developed utilizing the DRCOG 2035 FOCUS travel demand model and the VISSIM traffic micro-simulation models prepared for this study. Model data for 2040 was not available from DRCOG at the time of the analysis.

The calibration of the travel demands was an iterative process that involved refining the demands in the static equilibrium assignment procedure within the FOCUS model and then testing the operations of these demands within the simulation models. The No-Action Alternative AM and PM peak hour volumes on C-470 are shown in **Figure 3-12.** The Proposed Action traffic volumes are shown in **Figure 3-13**.

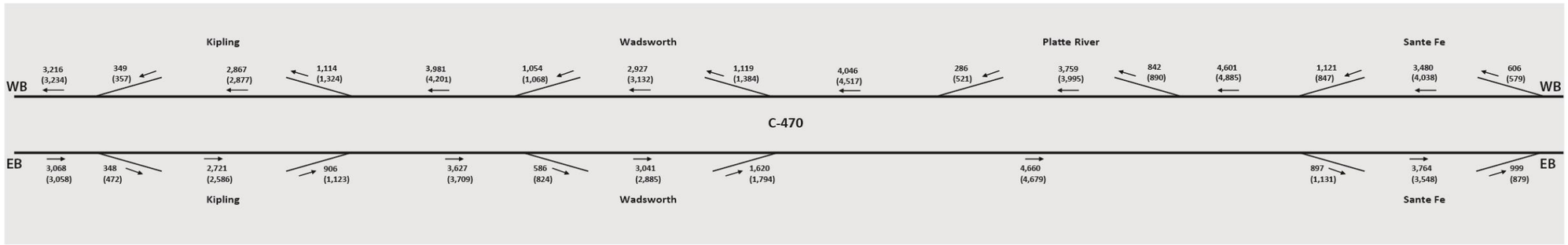
No-Action Alternative

Freeway Traffic Operations: The AM and PM freeway levels of service for the 2035 No-Action Alternative are summarized in **Table 3-5**. The analysis indicates that many of the mainline freeway segments along the C-470 corridor would operate at an unsatisfactory LOS (LOS E or F) for the No-Action Alternative during each of the peak hours. These operational problems will spill back along the C-470 corridor impacting freeway operations upstream of the congested locations.

Along I-25 congested operations are projected in both the northbound and southbound directions between County Line Road and Lincoln Avenue during each of the peak hours. Examination of traffic impacts at the C-470/I-25 interchange was an important element of the overall corridor traffic analysis.

Interchange Traffic Operations: Peak hour traffic operations for 16 signalized intersections were analyzed for the 2035 No-Action Alternative and the results are summarized in **Table 3-6**. Out of the 20 total intersections evaluated, seven intersections exhibited capacity deficiencies.

Figure 3-12



2035 No Action C-470 Freeway Traffic Volumes

Legend

AM Peak Hour
(#) PM Peak Hour
General Purpose Lanes/Ramps

N

Figure 3-13

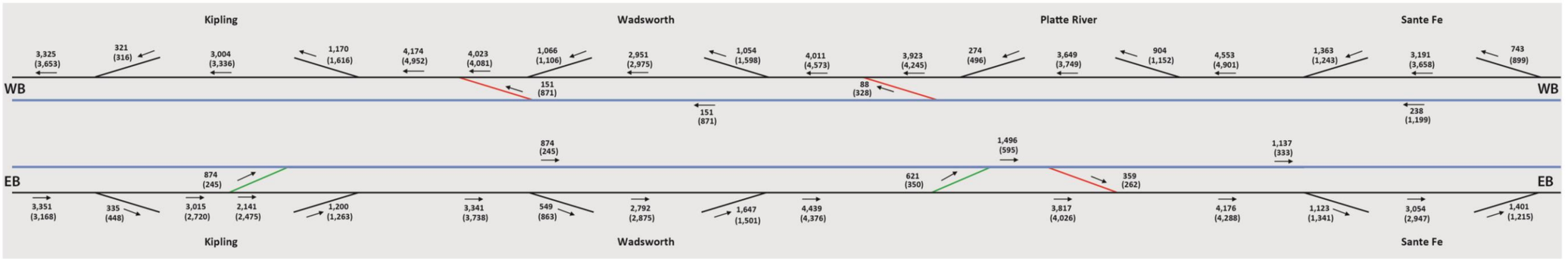

Kipling
Wadsworth
Platte River
Sante Fe
WB
EB
3,325 (3,653)
321 (316)
3,004 (3,336)
1,170 (1,616)
4,174 (4,952)
4,023 (4,081)
1,066 (1,106)
2,951 (2,975)
1,054 (1,598)
4,011 (4,573)
3,923 (4,245)
274 (496)
3,649 (3,749)
904 (1,152)
4,553 (4,901)
1,363 (1,243)
3,191 (3,658)
743 (899)
151 (871)
88 (328)
151 (871)
238 (1,199)
874 (245)
1,496 (595)
1,137 (333)
874 (245)
621 (350)
359 (262)
3,351 (3,168)
335 (448)
3,015 (2,720)
2,141 (2,475)
1,200 (1,263)
3,341 (3,738)
549 (863)
2,792 (2,875)
1,647 (1,501)
4,439 (4,376)
3,817 (4,026)
4,176 (4,288)
1,123 (1,341)
3,054 (2,947)
1,401 (1,215)
Kipling
Wadsworth
Sante Fe
Lucent
Broadway
University
WB
EB
3,933 (4,557)
1,079 (873)
2,854 (3,684)
2,631 (3,286)
933 (1,485)
3,564 (4,771)
424 (750)
3,140 (4,020)
3,306 (4,446)
1,214 (920)
4,520 (5,366)
1,049 (1,166)
3,472 (4,200)
3,269 (3,648)
782 (832)
223 398
166 (426)
203 (552)
238 (1,199)
461 (1,597)
461 (1,597)
295 (1,171)
295 (1,171)
498 (1,723)
796 (153)
1,487 (474)
1,709 (676)
341 (180)
691 (321)
222 (202)
4,455 (4,162)
1,102 (1,202)
3,352 (2,959)
3,693 (3,139)
1,554 (872)
5,248 (4,011)
639 (441)
4,609 (3,570)
3,918 (3,248)
1,243 (1,160)
5,160 (4,408)
722 (1,041)
4,438 (3,368)
4,216 (3,166)
1,045 (869)
Lucent
Broadway
University
Quebec
Yosemite
E-470 Underpass
I-25 SB
I-25 NB
WB
EB
E-470
4,051 (4,480)
3,644 (3,767)
3,860 (4,099)
1,132 (1,436)
2,728 (2,663)
1,177 (2,162)
3,905 (4,825)
436 (1,417)
3,468 (3,408)
2,344 (1,317)
1,124 (2,091)
395 (1,243)
729 (848)
729 (848)
407 (713)
215 (333)
905 (2,436)
689 (2,104)
I-25 NB
I-25 SB
9 (101)
108 (441)
572 (1,562)
689 (2,104)
1,709 (676)
1,453 (683)
1,453 (683)
1,453 (683)
334 (321)
-256 (-7)
1,119 (362)
334 (321)
5,261 (4,035)
5,517 (4,027)
1,398 (945)
4,118 (3,083)
2,168 (1,707)
6,286 (4,790)
7,405 (5,152)
1,242 (639)
6,162 (4,513)
4,181 (1,769)
1,981 (2,744)
2,316 (3,065)
I-25 NB/SB
Quebec
Yosemite
C-470 Proposed Action Freeway Traffic Volumes
Legend
AM Peak Hour
(#) PM Peak Hour
General Purpose Lanes/Ramps
Toll Managed Lanes
Tolled Managed Lane Egress
Tolled Manged Lane Ingress
N

Table 3-5
2035 Freeway Peak Hour Level of Service
for the No-Action Alternative

	Basic Freeway Segements		2035 No-Build					
			AM peak			PM peak		
	From	To	Volume	Density	LOS	Volume	Density	LOS
Westbound C-470	E of C-470	I-25 Off ramp	4,255	23.4	C	4,475	24.7	C
	E-470	I-25 N/S Ramp Split	1,887	19.4	C	2,030	20.9	C
	I-25 Off ramp	I-25 On ramp	2,369	19.5	C	2,445	20.1	C
	I-25 Ramps	C470	1,464	12.0	B	2,289	18.8	C
	I-25 On ramp	Yosemite On ramp	3,832	21.0	C	4,734	26.4	D
	Yosemite On ramp	Quebec Off ramp	4,261	23.4	C	6,141	38.9	E
	Quebec Off ramp	Quebec On ramp	2,932	24.2	C	3,959	36.6	E
	Quebec On ramp	University On ramp	3,822	34.5	D	4,702	52.9	F
	University Off ramp	University On ramp	3,316	28.1	D	3,892	35.6	E
	University On	Broadway Off	4,329	43.5	E	4,778	55.3	F
	Broadway Off ramp	Broadway On ramp	3,402	29.1	D	4,065	38.4	E
	Broadway On ramp	Lucent Off ramp	3,903	35.7	E	4,880	58.8	F
	Lucent Off ramp	Lucent On ramp	3,163	26.5	D	3,712	33.0	D
	Lucent On ramp	Santa Fe Off ramp	4,086	38.8	E	4,617	50.4	F
	Santa Fe Off ramp	Santa Fe On ramp	3,480	30.0	D	4,038	37.9	E
	Santa Fe On ramp	lane drop	4,601	50.0	F	4,885	59.0	F
	Lane drop	Platte Canyon Off ramp	4,601	25.5	C	4,885	27.5	D
	Platte Canyon Off ramp	Platte Canyon On ramp	3,759	33.6	D	3,995	37.2	E
	Platte Canyon On ramp	Wadworth Off ramp	4,046	38.1	E	4,517	47.8	F
	Wadworth Off ramp	Wadworth On ramp	2,927	24.2	C	3,132	26.2	D
	Wadworth On ramp	Kipling Off ramp	3,981	37.0	E	4,201	40.9	E
	Kipling Off ramp	Kipling On ramp	2,867	23.7	C	2,877	23.7	C
	Kipling On ramp	W of Kipling	3,216	27.0	D	3,234	27.2	D
	Kipling Off ramp	W of Kipling	3,068	25.5	C	3,058	25.4	C
	Kipling Off ramp	Kipling On ramp	2,721	22.4	C	2,586	21.2	C
Eastbound C-470	Kipling On ramp	Wadworth Off ramp	3,627	31.8	D	3,709	32.9	D
	Wadworth Off ramp	Wadworth On ramp	3,041	25.3	C	2,885	23.8	C
	Wadworth On ramp	Santa Fe Off ramp	4,660	51.7	F	4,679	52.3	F
	Santa Fe Off ramp	Santa Fe On ramp	3,764	33.7	D	3,548	30.8	D
	Santa Fe On ramp	Lucent Off ramp	4,763	26.6	D	4,427	24.4	C
	Lucent Off ramp	Lucent On ramp	3,567	31.1	D	3,363	28.6	D
	Lucent On ramp	Broadway Off ramp	4,783	55.4	F	4,034	37.9	E
	Broadway Off ramp	Broadway On ramp	4,013	37.5	E	3,313	28.1	D
	Broadway On ramp	University Off ramp	4,949	61.4	F	4,415	45.4	F
	University Off ramp	University On ramp	4,066	38.4	E	3,384	28.9	D
	University On ramp	Quebec Off ramp	5,017	64.2	F	4,110	39.2	E
	Quebec Off ramp	Quebec On ramp	4,335	43.6	E	3,495	30.2	D
	Quebec On ramp	Yosemite Off ramp	6,675	46.2	F	5,154	29.5	D
	Yosemite Off ramp	I-25 Off ramp	5,796	35.1	E	4,500	24.9	C
	I-25 Off ramp	I-25 On Ramp	1,975	16.2	B	2,819	23.2	C
	C470	I-25 N/S Ramp Split	3,821	33.0	D	1,680	12.8	B
	I-25 N/S On ramp Merge	E-470	1,221	9.3	A	2,231	17.0	B
	I-25 On ramp	E of C-470	3,196	17.5	B	5,050	28.7	D

Table cells with red shading denote congested conditions with LOS E or F.

Table 3-6
2035 Peak Hour Intersection LOS and Delay
for the No-Action Alternative

Location (Cross-streets listed from west to east, intersections listed from north to south)	AM Peak Hour		PM Peak Hour	
	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS
Kipling & C-470 EB	13.3	B	19.5	B
Kipling & C-470 WB	28.1	C	81.1	F
Wadsworth & C-470 EB	73.8	E	74.5	E
Wadsworth & C-470 WB	33.8	C	42.0	D
Santa Fe & C-470 EB	52.7	D	>120	F
Santa Fe & C-470 WB	23.5	C	22.8	C
Lucent & C-470 EB	24.0	C	26.0	C
Lucent & C-470 WB	36.7	D	108.2	F
Broadway & C-470 EB	51.5	D	15.6	B
Broadway & C-470 WB	16.0	B	20.4	C
University & C-470 EB	43.4	D	28.5	C
University & C-470 WB	29.0	C	68.5	E
Quebec & C-470 EB	79.9	E	14.1	B
Quebec & C-470 WB	26.2	C	>120	F
Yosemite & C-470 EB	39.1	D	14.6	B
Yosemite & C-470 WB	14.7	B	47.4	D

Table cells with red shading denote congested conditions with LOS E or F.

Proposed Action

Freeway Traffic Operations: Under the Proposed Action, the tolled express lanes are predicted to operate at LOS C or better in the peak direction and at LOS A in the off-peak direction. The general purpose lanes are generally projected to operate at LOS D or better in both the peak and off peak directions during the AM and PM peak hours. There are sections that are projected to operate at congested levels (LOS E/F), but the number of sections projected to operate at congested levels are less compared to the No-Action Alternative. **Table 3-7** summarizes the AM and PM freeway levels of service for the 2035 Proposed Action.

Along I-25, the laneage on I-25 and ramp laneage and connections to and from I-25 are consistent between the No-Action Alternative and Proposed Action. In addition, peak hour traffic volumes along the I-25 corridor are relatively consistent between these two alternatives, therefore, the traffic operations along the freeway corridor are also consistent. Congested freeway operations (LOS E/F) were reported along I-25 in both directions during each of the peak hours, from County Line Road to Lincoln Avenue.

Express lanes introduce a weave movement at ingress/egress locations, which was analyzed in the Traffic Technical Report (see **Appendix E**). Westbound, weaves with LOS E would occur at two locations. The first of these begins with the westbound Quebec on-ramp, for motorists wishing to cross the general purpose lanes to the next available express lanes ingress location.

Table 3-7
2035 C-470 Peak Hour LOS for the Proposed Action

	Basic Freeway Segements		2035 Ultimate Build					
			AM peak			PM peak		
	From	To	Volume	Density	LOS	Volume	Density	LOS
Westbound C-470 GPL	I-25 On ramp	Yosemite On ramp	3,468	19.0	C	3,408	18.7	C
	Yosemite On ramp	Quebec Off ramp	3,905	21.4	C	4,825	27.0	D
	Quebec Off ramp	Quebec On ramp	2,728	22.4	C	2,663	21.9	C
	Quebec On ramp	ML ingress	3,860	35.1	E	4,099	39.0	E
	ML ingress	ML egress	3,644	32.0	D	3,767	33.7	D
	ML egress	University Off ramp	4,051	38.2	E	4,480	46.9	F
	University Off ramp	ML egress	3,269	27.6	D	3,648	32.1	D
	ML egress	University On ramp	3,472	29.9	D	4,200	40.9	E
	University On ramp	Broadway Off ramp	4,520	25.0	C	5,366	31.2	D
	Broadway Off ramp	ML ingress	3,306	28.0	D	4,446	46.1	F
	ML ingress	Broadway On ramp	3,140	26.2	D	4,020	37.6	E
	Broadway On ramp	Lucent Off ramp	3,564	19.5	C	4,771	26.7	D
	Lucent Off ramp	ML combo	2,631	21.6	C	3,286	27.8	D
	ML combo	Lucent On ramp	2,854	11.7	B	3,684	15.1	B
	Lucent On ramp	Santa Fe Off ramp	3,933	21.6	C	4,557	25.2	C
	Santa Fe Off ramp	Santa Fe On ramp	3,191	26.8	D	3,658	32.2	D
	Santa Fe On ramp	Platte Canyon Off ramp	4,553	25.2	C	4,901	27.6	D
	Platte Canyon Off ramp	Platte Canyon On ramp	3,649	32.1	D	3,749	33.5	D
	Platte Canyon Off ramp	ML egress	3,923	36.1	E	4,245	41.8	E
	ML egress	Wadworth Off ramp	4,011	22.0	C	4,573	25.4	C
	Wadworth Off ramp	Wadworth On ramp	2,957	24.5	C	2,975	24.6	C
	Wadworth On ramp	ML egress	4,023	22.1	C	4,081	22.4	C
	ML egress	Kipling off ramp	4,174	17.2	B	4,952	20.4	C
	Kipling Off ramp	Kipling On ramp	3,004	24.9	C	3,336	28.3	D
	Kipling On ramp	W of C-470	3,325	28.2	D	3,653	32.1	D
	Kipling Off ramp	W of C-470	3,351	28.5	D	3,168	26.5	D
	Kipling Off ramp	ML ingress	3,015	25.0	C	2,720	22.4	C
Eastbound C-470 GPL	ML ingress	Kipling on Ramp	2,141	11.7	B	2,475	13.6	B
	Kipling On ramp	Wadworth Off ramp	3,341	18.3	C	3,738	20.5	C
	Wadworth Off ramp	Wadworth On ramp	2,792	23.0	C	2,875	23.7	C
	Wadworth On ramp	ML ingress	4,439	45.9	F	4,376	44.5	E
	ML ingress	ML egress	3,817	34.4	D	4,026	37.7	E
	ML egress	Santa Fe Off ramp	4,176	40.4	E	4,288	42.6	E
	Santa Fe Off ramp	Santa Fe On ramp	3,054	25.4	C	2,947	24.4	C
	Santa Fe On ramp	Lucent Off ramp	4,455	24.6	C	4,162	22.8	C
	Lucent Off ramp	ML egress	3,352	28.5	D	2,959	24.5	C
	ML egress	Lucent On ramp	3,693	32.7	D	3,139	26.2	D
	Lucent On ramp	Broadway Off ramp	5,248	30.2	D	4,011	22.0	C
	Broadway Off ramp	ML ingress	4,609	50.2	F	3,570	31.1	D
	ML ingress	Broadway On ramp	3,918	36.0	E	3,248	27.4	D
	Broadway On ramp	University Off ramp	5,160	29.5	D	4,408	24.3	C
	University Off ramp	ML ingress	4,438	45.9	F	3,368	28.7	D
	ML ingress	University On ramp	4,216	41.2	E	3,166	26.5	D
	University On ramp	ML Combo	5,261	76.3	F	4,035	37.9	E
	ML Combo	Quebec Off ramp	5,517	32.5	D	4,027	22.1	C
	Quebec Off ramp	Quebec On ramp	4,118	39.3	E	3,083	25.7	C
	Quebec On ramp	ML egress	6,286	40.7	E	4,790	26.8	D
	ML egress	Yosemite Off ramp	7,405	32.8	D	5,152	21.2	C
	Yosemite Off ramp	I-25 Off ramp	6,162	39.2	E	4,513	25.0	C
	C470	I-25 N/S Split	4,181	22.9	C	1,769	9.7	A
	I-25 Off ramp	ML egress	1,981	NA	NA	2,744	NA	NA
	ML egress	I-25 On ramp	2,316	19.0	C	3,065	25.5	C
	I-25 N/S Ramp Merge	I-25 On ramp	1,162	10.4	A	2,072	18.5	C
	I-25 On ramp	E of I-25	3,477	19.0	C	5,137	29.3	D

Table cells with red shading denote congested conditions with LOS E or F.

The second involves traffic from the express lanes egress location working across the general purpose lanes to exit at University Boulevard.

For eastbound traffic, LOS E weaves would occur at three locations: first, for between the Wadsworth Boulevard on-ramp and the next available express lane ingress; second, between the express lane egress and the Santa Fe Drive off-ramp; and finally, between the express lane egress and the Yosemite Street off-ramp (morning peak only).

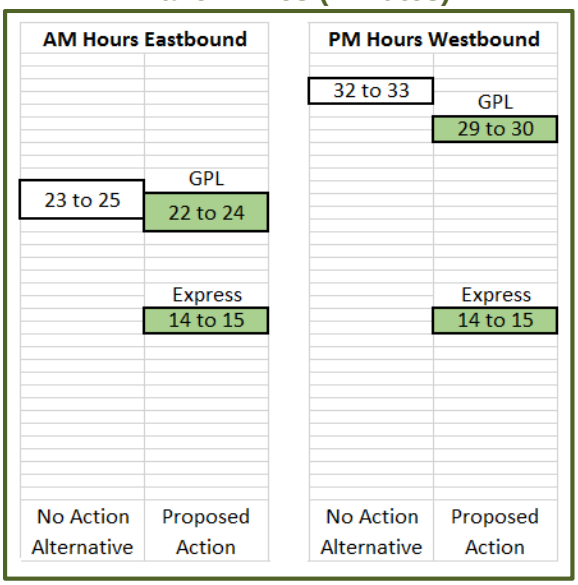
The proposed addition of direct-connect ramps at the C-470 interchange with I-25 requires preparation of a detailed operational analysis in support of an Interstate Access Request (IAR). CDOT has submitted an IAR to FHWA for consideration. Once the IAR is approved, copies will be available upon request to the CDOT Project Engineer. See the contact information at the front of this Revised EA.

Freeway Travel Times: C-470 corridor peak hour, peak direction travel times from I-25 to Kipling were estimated for the No-Action Alternatives and the Proposed Action for the AM and PM peak hours. During the morning the peak direction of travel is in the eastbound direction and during the evening the westbound direction is the peak travel direction.

Travel times for the general purpose lanes and tolled express lanes associated with each alternative were estimated. For the general purpose lanes the peak hour, peak direction travel times were estimated based on current C-470 peak hour, peak direction corridor travel times and travel speed results reported from the HCS analyses for each of the alternatives.

As discussed previously CDOT, will manage the tolled express lanes such that traffic flows freely. LOS C can be considered a reasonable maximum LOS for the tolled express lanes which would reflect a corridor travel speed of approximately 55 mph. The estimated C-470 peak hour, peak direction 13.75-mile corridor travel times are summarized in **Figure 3-14**.

Figure 3-14
2035 Peak Hour Peak Direction C-470 Travel Times (minutes)



As shown, travel time in the express lanes for the C-470 section between Kipling Parkway and I-25 would be approximately 14 to 15 minutes during of each of the peak hours. Peak direction travel times in the general purpose lanes of the Proposed Action would one to three minutes lower than the No-Action Alternative.

The reliability of travel with the No-Action Alternative would continue to worsen, resulting in substantial effects to corridor mobility, affecting economic viability of businesses in the corridor area and quality of life for corridor residents.

The Proposed Action would provide reliable travel times in the tolled express lanes while maintaining consistent and/or better travel times in the general purpose lanes compared to the No-Action Alternative.

System VMT/VHT: The following is contained in the *C-470 Express Toll Lanes Traffic Operations Analysis Report*,

prepared for Douglas County (Cambridge Systematics, 2015).

The two major measures of effectiveness for understanding the overall changes in network-wide performance that were used are the Vehicle Miles Traveled (VMT) and the Vehicle Hours Traveled (VHT). The VMT can show increases in vehicle throughput or be used to analyze changes in routing, where the VHT can be used as an overall statistic to show increases or decreases in congestion and/or delay along the roadway. The future VMT and VHT for both the AM and PM peak periods can be seen below in **Table 3-8**.

It can be seen in **Table 3-8** that the Proposed Action has a beneficial impact on congestion. In 2035, an eight percent reduction in VHT is predicted for the morning, and a 24 percent VHT reduction is predicted for the afternoon and evening.

Another impact that can be seen in the network-wide statistics is that an increase in VMT is achieved with the Proposed Action. This VMT is the result of increase of vehicle throughput along the C-470 mainline as a result of the reduction of congestion and addition of toll lanes to avoid the congestion. The combination of increased VMT decreased VHT clearly indicates that the Proposed Action is improving the operational conditions of the entire network, which includes the general purpose lanes, auxiliary lanes, express lanes, ramps, and the arterials up to the nearest adjacent intersections.

Interchange Traffic Operations for the Proposed Action: Intersection delays were evaluated to determine the LOS for arterial intersections for 2035 volumes. There is some rerouting of traffic through these interchange intersections but overall intersection LOS remains relatively the same between the No-Action Alternative and the Proposed Action. The results are shown in **Table 3-9**.

The Traffic Technical Report for this Revised EA also examined arterial intersections beyond the C-470 interchanges to see how traffic would differ between the No-Action Alternative and Proposed Action. See the report for additional details.

Table 3-8
2035 Forecast WMT and VHT

Alternative	VMT (Millions)		VHT (Thousands)	
	AM*	PM**	AM	PM
No Action	1.67	1.62	53.4	69.1
Proposed Action	1.77	1.90	49.1	52.3
Percent Change	6%	17%	-8%	-24%

**6:00 am to 1:00 pm* ***1:00 pm to 8:00 pm* Source: Cambridge Systematics, Inc.

Table 3-9
Proposed Action (2035) Peak Hour Intersection LOS and Delay

Location (Streets listed from west to east, intersections listed from north to south)	AM Peak Hour		PM Peak Hour	
	Average Delay (seconds)	LOS	Average Delay (seconds)	LOS
Kipling & C-470 EB	15.0	B	21.7	C
Kipling & C-470 WB	25.7	C	110.2	F
Wadsworth & C-470 EB	79.6	E	42.0	D
Wadsworth & C-470 WB	27.0	C	53.3	D
Santa Fe & C-470 EB	95.7	F	72.3	E
Santa Fe & C-470 WB	30.6	C	63.2	E
Lucent & C-470 EB	31.7	C	39.1	D
Lucent & C-470 WB	62.1	E	>120	F
Broadway & C-470 EB	>120	F	11.6	B
Broadway & C-470 WB	23.9	C	25.8	C
University & C-470 EB	49.0	D	51.7	D
University & C-470 WB	39.3	D	64.3	E
Quebec & C-470 EB	159.5	F	35.1	D
Quebec & C-470 WB	26.3	C	>120	F
Yosemite & C-470 EB	54.1	D	12.9	B
Yosemite & C-470 WB	7.0	A	38.2	D

Table cells with red shading denote congested conditions with LOS E or F.

3.3.3 Summary of Proposed Action Traffic Impacts

Figure 3-16 indicated that the Express Lanes would provide a travel time of 14 to 15 minutes for the 13.75-mile corridor. Comparing the mainline LOS for the Proposed Action (**Table 3-7**) and No-Action Alternative (**Table 3-5**), reduced peak period congestion is evident on many portions of the corridor. Finally, as an indicator of overall delay, **Table 3-8** reported substantially reduced VHT on the corridor for the 14 most heavily traveled hours of the day with the Proposed Action, compared with the No-Action Alternative. It is concluded that the Proposed Action would meet the project's Purpose and Need by providing reliable trip times, reducing congestion, and reducing C-470 congestion.

3.4 HIGH OCCUPANCY VEHICLE USE OF EXPRESS LANES

CDOT is considering whether or not to permit high occupancy vehicles (HOVs) with three or more occupants (HOV3+) to use the express lanes in the Proposed Action without paying a toll, as will be the case on other express lane corridors in the Denver region by 2017. This section discusses the factors that are being considered with regard to this issue.

Additional study currently underway, and therefore not included in this Revised EA section, will assist CDOT in making this decision. This will include both C-470 corridor specific HOV financial information via the Level III Traffic and Revenue (T&R) Team and solicitation of public comment on the topic during the public review period following completion of the Revised EA.

All of the information available will be considered by CDOT in making a final decision on whether or not to permit HOV3+ use in the express lanes as part of the Proposed Action. The final decision will be included in the Decision Document for this Revised EA.

3.4.1 Results of Alternatives Analysis

A key consideration in approaching the HOV3+ exempt question is understanding the purpose for taking action to improve C-470. The project's Purpose and Need are detailed in Chapter 1 of this Revised EA. The project purpose is to address existing and future C-470 congestion, reduce traveler delay, and improve travel time reliability for corridor users. Any proposed corridor improvements must be financially feasible based on reasonably foreseeable available funding.

The 2006 EA considered a large number of alternatives, including two that would have provided lanes with HOV use. Both alternatives considered would have widened the existing four–lane highway from two general purpose lanes (GPL) in each direction to and eight-lane highway with three GPL plus one HOV lane in each direction. The second of the two alternatives included the addition of auxiliary lanes at select locations. Both alternatives were eliminated in the 2006 EA because they were projected not to provide appropriate levels of congestion and delay relief.

The updated 2015 alternatives assessment identified no new information to change these conclusions. However, this does not preclude the option of considering HOV3+ exempt use within the Proposed Action. Targeted toll exemptions do not necessarily represent a new "alternative" but instead may be considered as operational options for the Proposed Action.

3.4.2 Traffic and Revenue Studies Are Pertinent to Toll Exemption Issues

The C-470 Express Lanes project has been the subject of a series of traffic and revenue ("T&R") studies to determine how much toll revenue would be generated, as this key information is important in deciding what can be built and when. Near-term "Interim" improvements of the Proposed Action are expected to cost $269 million. CDOT currently has $100 million in approved RAMP funds plus $10 million committed by Douglas County. The remaining $159 million will likely come from debt financing paid back through collection of user tolls.

The C-470 Level I T&R study was conducted to provide gross assurances that toll revenue would be sufficient to make the project financially feasible. The Level II T&R study completed in September 2014 was developed with more detailed information, including specific modeling-based traffic assumptions, and represents the best information currently available.

To support the anticipated $159 million in debt financing, an investment-grade Level III T& R study is currently underway for the purpose of demonstrating to the investment community that future toll revenues would be adequate to repay debt obligations arising from the sale of bonds to finance the project. The Level III T&R study findings will be available prior to the NEPA Decision Document.

The Level II T&R study showed that any toll exemptions would reduce the amount of future revenue as compared to projections with no toll exemptions. This study also indicated that for the busiest 14 hours of the day in 2018 (opening day for the Proposed Action), an estimated 1.7% of C-470 traffic would be carrying 3+ occupants, declining to 1.4% by 2035. This is the base-case condition, without an HOV3+ exemption.

As the result of toll exemption, much of the future traffic carrying 3+ occupants would use the express lanes, thus reducing projected revenue. Also, over time, HOV3+ use would be expected to increase, thereby further reducing toll revenues.

The results of the Level II T&R study suggest that in terms of 2013 dollars, the 30-year accumulated impact of an HOV3+ exemption could result in a revenue reduction of $15 million for the corridor. The full financial impact to the project that would result from HOV3+ exemption is being studied in greater detail by the Level III T&R Team, using newer and more detailed data and assumptions. The Level III T&R study will help to determine how much money CDOT can borrow from the investment community to finance the project. This is a key factor, as almost 60% of the near-term "Interim" project is estimated to be financed.

3.4.3 Other Factors for Consideration Regarding HOV3+ Policy

Some other factors with a bearing on CDOT's decision regarding HOV3+ exemption for C-470 express lanes may potentially include (but are not limited to) the following:

- Regional Transportation Plan calls for increased travel efficiency
- Regional Transportation Plan indicates that local communities should have input on tolling decisions
- Consistency with other CDOT express lanes
- Consistency with connecting beltway segments
- Environmental consequences

Regional Transportation Plan Calls for Increased Travel Efficiency: The adopted DRCOG *2035 Metro Vision Regional Transportation Plan* (RTP) calls for increased travel efficiency in the region, especially for peak period commuting. Consistent with increasing travel efficiency, CDOT plans to change the vehicle occupancy requirements for Denver-region HOV lanes on State Highways from two persons per vehicle (HOV2+) to a minimum of three persons per vehicle (HOV3+) by 2017. HOV3+ vehicles include RTD transit buses and vanpools, as well as carpools. This new occupancy requirement is designed to provide more reliable travel times for the most efficient vehicles and offer an incentive for two-person carpools to add another rider.

Express lanes can also improve commuter travel efficiency by pricing non-essential trips out of peak travel times. Charging higher tolls during peak periods gives motorists an incentive to drive during off-peak periods if they can, which also reduces peak period congestion compared to a system of flat hourly tolls unchanging by hour of day. Thus, express lanes with variable pricing is an energy-saving and pollution-reducing highway option, compared to simply adding general purpose lanes. "Congestion pricing" can be implemented with or without any toll exemptions.

RTP Goal for Local Community Input on Tolling Decisions: The adopted DRCOG *2035 Metro Vision Regional Transportation Plan* (RTP) also includes a specific goal indicating that local communities should have input on tolling decisions for roadways that traverse their jurisdictions. All the affected communities along C-470 in February 2011 joined together as a group called the C-470 Corridor Coalition. They examined various funding options for C-470 corridor improvements and unanimously selected tolled express lanes as their preferred option.

CDOT worked closely with this Coalition throughout development of the Revised EA, and is an affiliate, non-voting member of the group. The C-470 Corridor Coalition has specifically considered the HOV3+ exempt question and does not favor it due to

potential revenue losses that could impact project financing.

Consistency with Other CDOT Express Lanes: CDOT has stated that the decision on whether or not to allow toll exemptions will be made on a corridor-by-corridor basis. One challenge related to HOV being a corridor-by-corridor decision is related to public messaging. The concept of express lanes is already viewed as a transportation complexity by some highway users and a variable HOV policy throughout Colorado could be perceived as a further complicating factor. HOV/Express lanes exist or are currently under construction by CDOT on a number of corridors throughout the Denver region.

CDOT plans to change the vehicle occupancy requirement by 2017 so that toll exemptions are made available only for HOV3+ users, and no longer for HOV2+ users. The north I-25 and US 36 express lanes are allowing toll exemptions. The I-70 Peak Period Shoulder Lanes will not allow HOV toll exemptions.

Consistency with Connecting Beltway Segments: The only tolled facility that currently connects directly with C-470 is the private toll road E-470. E-470 provides no toll exemptions based on vehicle occupancy. E-470 and the Northwest Parkway are toll roads (i.e., with no free general purpose lanes at all) that together with C-470 form a nearly complete regional beltway system.

The busy C-470/E-470/I-25 freeway-to-freeway interchange currently connects facilities with two different pricing conditions (all free on I-25 and C-470; all-tolled on E-470). Adding an HOV3+ exemption on C-470 would introduce a third pricing system, furthering complicating motorists' decisions. This situation is not optimal and is not found elsewhere in the Denver region.

Environmental Consequences: With or without any toll exemptions, C-470would have the same roadway footprint with approximately the same total traffic levels (although shifted from the free, general purpose lane to express lane, or vice versa). Therefore, environmental consequences of the Proposed Action would be largely the same with or without the HOV3+ exempt policy.

The HOV3+ exemption could have a small beneficial impact for air quality by providing an incentive for persons in two-occupant carpools to add a third occupant, or for new carpool formation by solo drivers. In general, however, newly induced carpool formation resulting from toll exemption would be expected to be a fraction of existing HOV3+ use (1.4% in 2035) because many factors other than tolls go into the decision to carpool.

Shifting existing HOV3+ carpools from the general purpose lanes to the express lanes would reduce their emissions. However, this benefit could be partially offset if HOV3+ use results in pricing other (single-occupant) users out of the express lanes to maintain peak-period travel speeds. Level II T&R projections did not analyze air quality but did predict future Vehicle Hours of Travel (VHT) on C-470. The Level II T&R results showed no net VHT reduction within the corridor for the HOV3+ exemption scenario.

3.4.4 Summary of HOV3+ Pros and Cons for the C-470 Express Lanes Project

The considerations discussed above are summarized in **Table 3-13** as "pros" (factors that would tend to favor use of an HOV3+ exempt policy) or "cons" (factors that would favor not offering an exemption) for the Proposed Action. All of these factors can be discussed in a qualitative manner. Some are quantifiable to a degree. Importantly, all of the factors discussed here are not necessarily of equal weight.

Table 3-13
Pros and Cons Regarding an HOV3+ Exempt Policy for C-470*

Factor	Pro (+), Neutral, or Con (-)	Discussion
Revenue impact, per the September 2014 Level II T&R Study	-	It is estimated that HOV3+ exemption could reduce toll revenue by $15 million over a 30-year analysis period. Conceptually, this revenue reduction could impact the scope of the Proposed Action and/or be passed along to express lanes users through higher toll rates.
DRCOG Regional Transportation Plan goals call for increased travel efficiency	+	Toll exemption could slightly increase overall corridor vehicle occupancy, thus slightly reducing the number of vehicles on the roadway.
DRCOG Regional Transportation Plan indicates that local communities should have input on tolling decisions	-	The C-470 Corridor Coalition The Coalition has expressed concerns about revenue loss impacting the financially feasibility of the project.
Consistency with other CDOT express lanes	+	CDOT has stated that the decision on whether or not to allow toll exemptions will be made on a corridor-by-corridor basis. On opening day and into the future, more corridors in Colorado are projected to provide an HOV exemption than not.
Consistency with connecting beltway segments	-	The existing private toll road connected to C-470 is E-470, which provides no toll exemptions to any vehicle class.
Environmental consequences	neutral	The Proposed Action would have the same impacts on most resources (water quality, wildlife, traffic noise) regardless of whether or not an HOV3+ policy were in place. A small reduction in air quality emissions could result if toll exemption results in increased carpooling.

** Note: These factors should not all be assumed to be of equal importance, and their order of presentation also is not intended to imply their relative importance.*

The table summarizes these factors and shows a trend of more “cons” than “pros”. However, as stated previously, CDOT will not make a final decision on the HOV3+ topic until additional public input is received and the ongoing analysis by the Level III T&R Team is complete. The final decision will be included in the Decision Document for this Revised EA.

3.5 PROJECT PHASING

Implementing the Proposed Action identified in **Chapter 2** of this Revised EA will require a substantial investment of financial resources, and is expected to occur in two phases. The interim configuration can be funded in the near-term. The ultimate configuration would be completed in the future, funded by successful toll collection from the Interim phase. The second phase would complete the Proposed Action’s Ultimate configuration. **Table 3-14** provides information about the elements of each construction phase.

Traffic and revenue studies have been performed to determine that the first project phase is financially viable, and that it could generate future revenues sufficient to later build the second phase. Additional

investment-grade revenue studies will be needed to demonstrate financial capacity to satisfy bond market requirements. Revenue bonds would then be sold to finance the first phase, together with $100 million in available public funds from Colorado's Responsible Acceleration of Maintenance and Partnerships (RAMP) program.

3.5.1 Interim versus Ultimate Configuration

A diagram indicating the extent and location of the Interim project and the Ultimate configuration is provided in **Figure 3-15**. The first-phase Interim project would provide managed express lanes as follows:

- Westbound, two express lanes from I-25 to approximately Colorado Boulevard, and one lane from Colorado Boulevard to Wadsworth Boulevard
- Eastbound, one express lane from Platte Canyon Road to I-25

The Ultimate configuration would extend and add lanes to achieve two express lane in each direction between I-25 and Kipling Parkway. As noted in **Chapter 2**, the Proposed Action would maintain two (reconstructed) general purpose lanes in each direction, giving motorists the option to not pay any tolls.

The traffic and environmental analysis of this Revised EA focuses on the Ultimate configuration. As a cost-saving approach, mitigation for water quality, wetlands, traffic noise and other resource impacts would largely occur in conjunction with the near-term project, and thus would not have to be moved or reconstructed in the future.

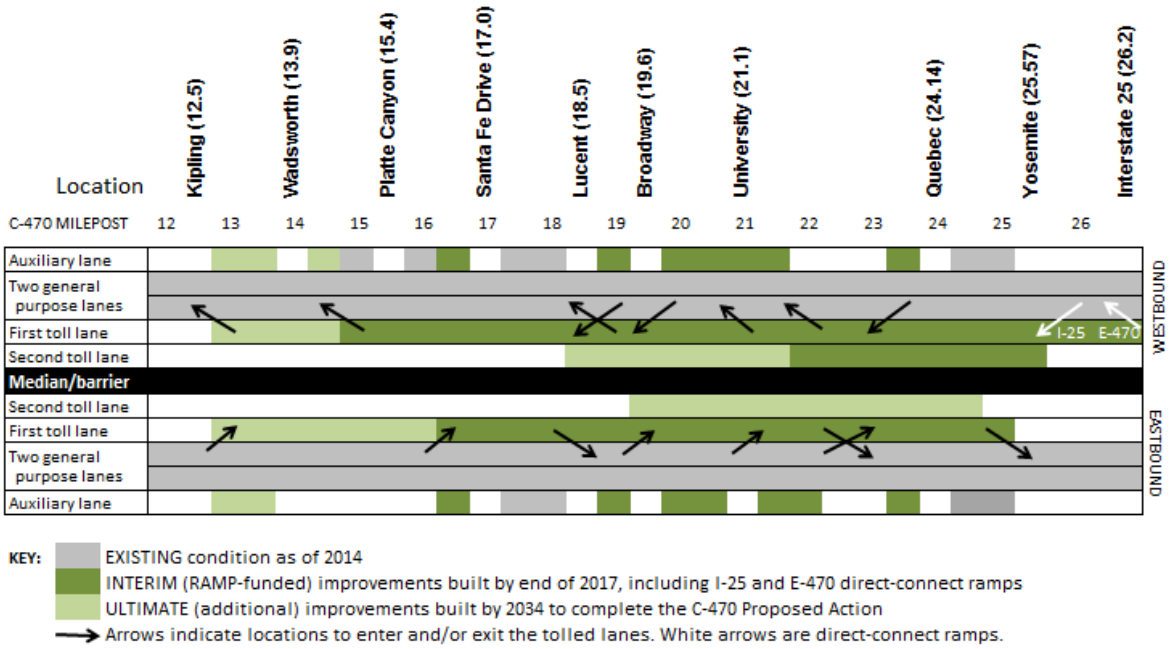
3.5.2 Meeting Current Needs Now, Future Needs Later

The Proposed Action has been developed to address foreseeable needs by the year 2035, with an expected 50 percent increase in traffic demand compared with existing conditions. The extra demand does not exist today, and the corresponding capacity is not all needed today, either. However, C-470's traffic demand already exceeds the highway's capacity and additional capacity is needed now to address today's congestion problems.

Table 3-13
Key Elements of Interim and Ultimate Configurations

Project Element	Near-Term Project to Build Interim Configuration	Future Project to Build Ultimate Configuration
Reconstruction to address existing design deficiencies (estimated cost of over $77 million)	Part of Interim project	--
Replacement of South Platte River bridges	Part of Interim project	--
I-25/C-470 Direct-Connect Ramps	Part of Interim project	--
Environmental mitigation for Ultimate Configuration	Part of Interim project	Additional if needed
Capacity needed for existing demand and near-term growth	Part of Interim project	--
Capacity needed for future Growth through the year 2035		To be provided in Future Phase
Auxiliary lanes	As needed	As needed
Estimated project cost (includes design, right-of-way, engineering and construction)	$269 million	

Figure 3-15
Diagram of Interim and Ultimate Configurations



The DRCOG Fiscally Constrained 2040 RTP includes $220 million in near term funding (including bonded toll revenues) and an additional $165 million in future toll revenues, for a project total of $385 million. These numbers will be subject to change over time. Already, the cost of the near-term $220 million phase has been adjusted upward to $269 million in response to recent construction industry cost trends.

3.5.3 Reconstruction a Key Component of the Interim Project

No part of the Proposed Action consists of "just adding lanes" to the existing C-470 facility. Instead, the conceptual design for the Proposed Action also addresses known existing conditions of suboptimal horizontal and vertical curvature as well as pavement structural needs. Thus, in conjunction with the planned new capacity, CDOT would fix existing design problems.

As noted previously, C-470 was originally planned to be Interstate 470, but it was removed from the Interstate system and Colorado received funds to build its own highway instead. The resulting C-470 highway thus was not designed or constructed in accordance with Interstate Highway standards. The Proposed Action will not be able to bring C-470 into full compliance with Interstate Highway standards, but will make strides in that direction. Providing consistent design on freeways is generally desirable for safety reasons to meet driver expectancy.

CDOT's April 2014 cost estimate for the Interim project indicated that about one-third of that cost was attributable to C-470 reconstruction rather than the addition of new capacity.

3.6 OTHER TRANSPORTATION IMPACTS

The permanent impacts of the Proposed Action are reduced delay and improved travel time reliability, which do not require mitigation. Two Proposed Action would also have two other transportation impacts discussed below.

Relocating Portions of the C-470 Trail: CDOT's C-470 Trail general parallels the entire length of the 26-mile highway, often very close to the roadway. Expansion of C-470 to add the highway to add express lanes and auxiliary lanes will in some locations result in the need to move the trail.

Based on conceptual design for the Proposed Action, approximately 5.8 miles of the C-470 Trail would be need to be moved. The trail will be shifted up to 167 feet outward from its existing course, but generally 45-50 feet.

CDOT's preferred approach to minimizing disruptions for trail users will be to construct the new trail and shift users over to it before impacting the existing trail. However, this may not be practicable in every situation. In some locations, a temporary trail surface may need to be provided as a detour around work zones. In other locations, an off-site detour may be required if sufficient room is not available to safely pass through the roadway construction zone.

In no case would the trail be closed without providing adequate detour routes. Advance signing of trail closures and detours would be required. A minimum of two weeks' notice would be provided for potential closures and detours. These detours would be posted and presented to trail user groups.

One anticipated temporary closure of the C-470 Trail would occur where it crosses under the highway in a culvert shared with the High Line Canal Trail, between Santa Fe Drive and Lucent Boulevard. Please see **Section 4.2.6, Parks and Recreation**, for a discussion of this impact.

Traffic Congestion Due to Construction Activity: Maintaining traffic flow while also constructing improvements on busy, existing highways is a challenge routinely faced on CDOT projects. Temporary speed reductions and increased congestion in construction cone zones would be experienced on C-470 by the roadway's users.

As part of the Proposed Action, considerable funding would be budgeted for maintenance of C-470 traffic flow during construction. It is anticipated that a three-phase construction sequence would be used: (1) first, shifting traffic on the existing pavement toward the outside while building a portion of the median area; (2) then, shifting traffic to the partially constructed median and constructing the outside portion; (3) and finally, shifting traffic to the outside and completing the interior sections.

Specific construction phasing and maintenance of traffic details have not been developed and would be determined by the design-build contractor. However, these details are likely to include most of the following strategies:

- Develop detailed construction phasing and traffic control plans
- Maintain two 12-foot travel lanes in each direction
- Maintain existing C-470 exit and entrance ramps open to traffic during morning and evening peak traffic periods
- Maintain a minimum of two-foot shoulders throughout the construction zone
- Provide emergency pullout areas when shoulders are less than eight feet wide

- Provide a construction zone assistance vehicle to assist motorists with vehicular problems
- Use signing to announce timing of planned road closures

In a February 2015 Request for Qualifications document issued to the construction community, CDOT clearly communicated that one of its key goals for the C-470 project is: “Minimize impacts to the traveling public during project construction and future construction.”

As discussed in Section 3.5, much of the Proposed Action would be constructed in the near term, producing the Interim configuration, and the remainder of the project would be completed in the future. The near-term improvements would be designed and constructed in a manner that would tend to minimize traffic disruption resulting from the future project.