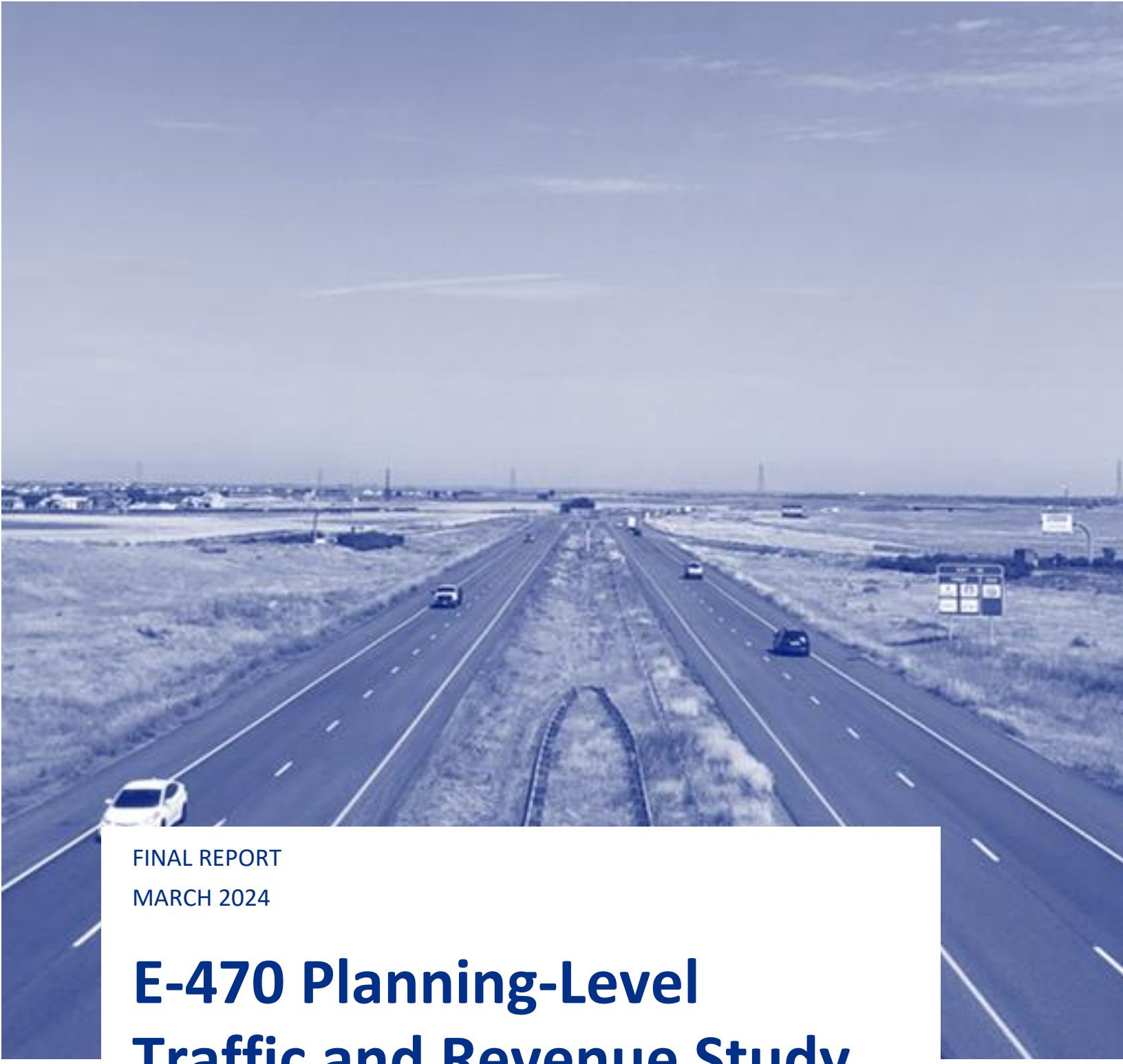

FINAL REPORT

MARCH 2024

E-470 Planning-Level Traffic and Revenue Study

Prepared for:

E-470 PUBLIC HIGHWAY AUTHORITY

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1.0 Introduction

CDM Smith was tasked by the E-470 Public Highway Authority (Authority) to perform a planning-level Traffic and Revenue (T&R) study for E-470 in the Denver Metro Area. The Authority's last investment grade traffic and revenue (T&R) study was prepared in 2019. The 2019 forecast was updated in the December 2021 Traffic and Toll Revenue "Bring-Down" Letter.

The current study provides revised traffic and revenue estimates under the current E-470 toll rate structure based on updated socioeconomic, capital planning, and customer travel pattern assumptions. The traffic and toll revenue estimates are developed for a 30-year forecast period.

The objectives of this study included the following:

- Incorporate the latest actual traffic and performance data available at the time of the study;
- Evaluate the recent trends in the socioeconomic data and update the underlying socioeconomic forecasts at a high-level for the greater Denver Metro region, specifically along the E-470 influence area;
- Incorporate the latest assumptions related to the background regional transportation network and capacity improvements anticipated along the E-470 facility; and
- Use the updated regional travel demand model to develop traffic and toll revenue forecasts for E-470 over a 30-year period.

The scope of services covered in the study included the following tasks:

- **Recent traffic trends on E-470**: As part of a separate task order performed in 2023, CDM Smith conducted a detailed review of E-470's customer travel patterns from 2019 to 2022. The analysis focused on highlighting differences in customer travel and traffic patterns before and after the COVID-19 Pandemic. In the context of the forecast update, this review of E-470 traffic trends was supplemented by incorporating the most recent available transaction data (through September 2023).
- **Socioeconomic update**: Study team member Economic & Planning Systems (EPS) evaluated the latest economic and demographic conditions and provided updated forecasts of the socioeconomic variables primarily at an aggregate level (county) underlying the Denver Regional Council of Governments (DRCOG) travel demand model. This task first produced updated county-level forecasts of population, households, and employment within the Denver region that reflect the latest U.S. Census data, Bureau of Labor Statistics trends, national and local economic outlooks, growth patterns, and relevant policies. Some select socioeconomic data adjustments were then made at the TAZ (Transportation Analysis Zone) level to account for updates on major development projects that could impact traffic conditions in the E-470 influence area via a desktop study
- **Highway network update**: CDM Smith obtained travel demand model files from DRCOG, including traffic networks and trip tables for 2020, 2023, 2030, 2040, and 2050. A 2022 base-

year highway network was developed using the 2023 DRCOG model network. This task included a review and update to the existing roadway configuration using satellite imagery and/or route reconnaissance. Future year networks were reviewed and updated in light of the most recent Metro Vision 2050 Regional Transportation Plan (RTP), adopted in 2021, and the most recent Capital Improvement Plan developed by the Authority. This review focused on E-470 improvements and other projects of major significance within the E-470 corridor. When necessary, changes to capacity and roadway configuration were made in the relevant year model networks.

- **Traffic model update and calibration**: CDM Smith used the updated trip tables and networks developed under Tasks 1 and 2 to perform traffic assignments at 2022 levels (base year for this study). The updated model incorporates values of time derived from the previously conducted stated preference surveys and available U.S. Census data adjusted to the current year. Additionally, the model incorporates the latest toll rates for E-470 and other regional toll facilities. The 2022 base year model was validated using the latest traffic count data, including traffic volumes along E-470 and several model "screenlines" by time of day, method of payment, and vehicle class.
- **Traffic and revenue analysis**: CDM Smith performed a toll sensitivity analysis and developed 30-year traffic and revenue forecasts. The forecasts are based on traffic assignments for model years 2022, 2030, 2040, and 2050. Leakage and violation assumptions were used to derive estimates of net toll revenue in addition to forecasts of annual toll transactions and gross toll revenue. These forecasts were developed at a planning-level and are therefore not intended to be used in support for financing.

The report generally follows this task breakdown and covers the following:

- Section 1: Introduction
- Section 2: Recent Traffic Trends
- Section 3: Socioeconomic Update
- Section 4: Highway Network Update
- Section 5: Traffic Model Update and Calibration
- Section 6: Traffic and Revenue Forecasts
- Disclaimer

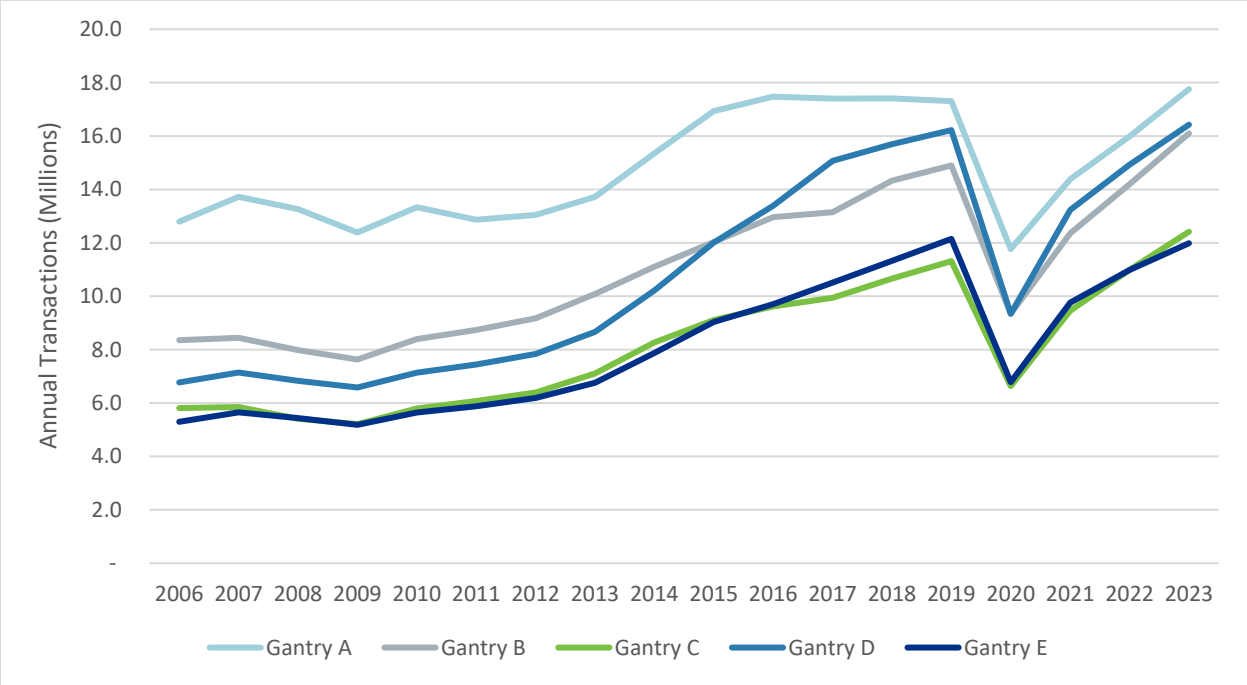
2.0 Recent Traffic Trends on E-740

As part of a separate task order performed in 2023, CDM Smith conducted a detailed review of E-470's customer travel patterns from 2019 to 2022. The analysis focused on highlighting differences in customer travel and traffic patterns before and after the COVID-19 Pandemic. The findings were documented in a report dated October 3, 2023, entitled "2023 E-470 Customer Travel and Traffic Analysis".

In the context of the forecast update, this review of E-470 traffic trends was supplemented by incorporating the most recent available transaction data (through December 2023).

Figure 2-1 and **Table 2-1** present annual toll transactions at E-470 mainline gantries and systemwide for the period 2006 through 2023.

Before the COVID-19 Pandemic, during the period 2006 through 2019, annual systemwide growth averaged 4.7 percent, with higher growth rates in the northern part of the facility. Gantries D and E averaged annual growth rates of 7.0 percent and 6.6 percent, respectively.



Actual data through December 2023.

Figure 2-1 E-470 Annual Toll Transactions at Mainline Gantries (2006-2023)

Table 2-1 E-470 Annual Transactions at Mainline Gantries and Systemwide (2006-2023)

Year	Gantry A	Gantry B	Gantry C	Gantry D	Gantry E	Systemwide
2006	12,794,085	8,355,461	5,813,536	6,772,738	5,298,278	**49,929,186**
2007	13,722,616	8,445,238	5,847,335	7,142,900	5,652,806	**52,232,372**
2008	13,259,670	7,982,402	5,409,639	6,830,368	5,432,996	**50,111,693**
2009	12,383,793	7,631,036	5,209,157	6,582,180	5,182,739	**47,443,379**
2010	13,331,374	8,394,057	5,797,063	7,136,412	5,644,401	**51,297,941**
2011	12,863,902	8,738,007	6,075,209	7,440,510	5,878,725	**52,080,386**
2012	13,048,995	9,176,916	6,395,155	7,838,432	6,188,263	**53,965,816**
2013	//13,722,771	10,084,744	7,104,817	8,665,141	6,759,547	**58,402,732**
2014	15,355,232	11,105,675	8,266,721	10,218,284	7,873,978	**66,365,038**
2015	16,935,141	12,034,972	9,109,646	12,007,555	9,039,236	**74,609,047**
2016	17,475,732	12,964,435	9,618,852	13,384,776	9,704,115	**79,975,235**
2017	17,401,797	13,147,947	9,941,687	15,071,870	10,512,371	**83,175,170**
2018	17,407,286	14,329,661	10,659,821	15,694,590	11,324,130	**87,338,800**
2019	17,304,686	14,898,208	11,311,613	16,224,973	12,149,520	**90,279,570**
2020	11,765,259	9,340,333	6,633,756	9,339,304	6,786,061	**58,070,189**
2021	14,382,316	12,356,070	9,455,843	13,228,955	9,761,292	**76,189,807**
2022	15,989,483	14,198,985	10,991,439	14,926,776	10,987,245	**86,183,539**
2023*	17,757,446	16,099,651	12,415,864	16,425,721	11,984,184	**95,531,831**
2006-2019 CAGR	2.4%	4.5%	5.3%	7.0%	6.6%	**4.7%**
2020 vs 2019	-32.0%	-37.3%	-41.4%	-42.4%	-44.1%	**-35.7%**
2023 vs 2019	2.6%	8.1%	9.8%	1.2%	-1.4%	**5.8%**

* Actuals through December 2023.

The impacts of the COVID-19 Pandemic generally occurred between March 2020 and June 2022. At the height of the Pandemic (April 2020), traffic on E-470 was down by 68.5 percent compared to the prior year. By comparison, other regional expressways only experienced about a 40 percent reduction. This is due to the reduction in the time savings offered by E-470 as well as the impacts to DEN and the reduction of air travel.

In 2023, systemwide traffic exceeded 2019 (pre-Pandemic) level by 5.8 percent. Gantries A, B, C and D all exceeded 2019 traffic levels; and Gantry E was below by 1.4 percent.

In addition to the updated transaction data noted, CDM Smith utilized additional time of day distributions, interchange-to-interchange movements, trip length and other data obtained from the prior travel and traffic pattern analysis in the model development process. These data were documented in the report dated October 3, 2023, entitled “2023 E-470 Customer Travel and Traffic Analysis”.

3.0 Socioeconomic Update

Economic & Planning Systems (EPS) conducted an evaluation of the recent trends in socioeconomic data and updated the socioeconomic forecasts for the greater Denver Metro region, specifically along E-470. EPS reviewed and recalibrated DRCOG's population, household, and employment forecasts for base year 2022 and forecast year 2050.

EPS utilized a variety of local, state, and national sources to recalibrate the DRCOG socioeconomic data at the county level. These sources include the Home Builders Association (HBA) of Colorado, the Colorado Legislative Council, the Denver Economic Development Corporation (Metro EDC), the Colorado-based Business and Economic Research (CBER), the Colorado Department of Local Affairs (DOLA), the U.S. Census Bureau American Community Survey (ACS), the U.S. Census Bureau Quarterly Census of the Economy & Wages (QCEW), the U.S. Bureau of Labor Statistics (BLS) Current Employment Statistics (CES), and the U.S. Gross Domestic Product (GDP).

The updated socioeconomic forecasts produced under this task were utilized to adjust the underlying travel demand model trip tables used in forecasting the traffic and toll revenue potential for E-470.

3.1 Review of DRCOG's Forecast

The Denver Regional Council of Governments (DRCOG) maintains the regional travel demand model for metro Denver. The current model, Focus 2.3.1, includes regional growth projects for 11-counties within their planning area boundary: Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Elbert, Gilpin, Jefferson counties, and part of Weld County. While EPS reviewed all eleven counties, additional attention was given to the 8-county subset that excludes Clear Creek, Elbert, and Gilpin counties. Additionally, as part of a prior analysis, EPS identified the E-470 influence area, shown on **Figure 3-1**. This area was the primary focus of the TAZ-level adjustments, in which the detailed review of socioeconomic conditions and major developments were performed. The regional growth projections within DRCOG's planning area are shown in **Table 3-1** at the 11-county and 8-county areas, and the E-470 influence area.

The population forecast for the 11-county area shows an increase of 961,200 people between 2022 and 2050, an increase of 27 percent, averaging approximately 34,300 people per year. The 2050 population is projected to increase by 27 percent over the 2022 base for the 8-county area and by 45 percent in the E-470 influence area.

In terms of households, the 11-county area shows an increase of approximately 474,500 households, 34 percent higher than the 2022 base, which is an average of approximately 16,900 households per year. The 2050 number of households is projected to increase by 34 percent over the 2022 base for the 8-county area, and by 55 percent in the E-470 influence area.

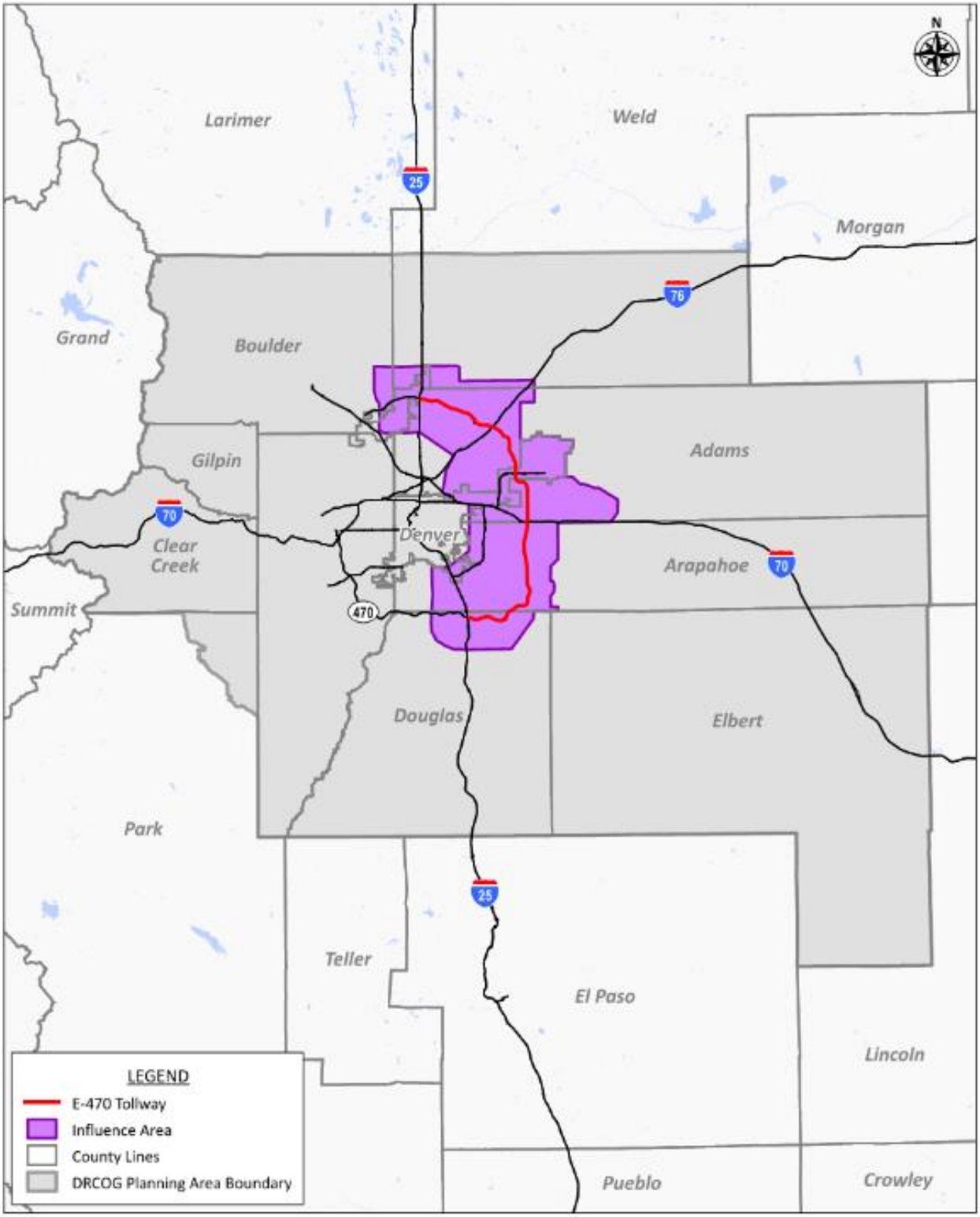


Figure 3-1 DRCOG Planning Area Boundary

Table 3-1 Summary of DRCOG Regional Growth Projections

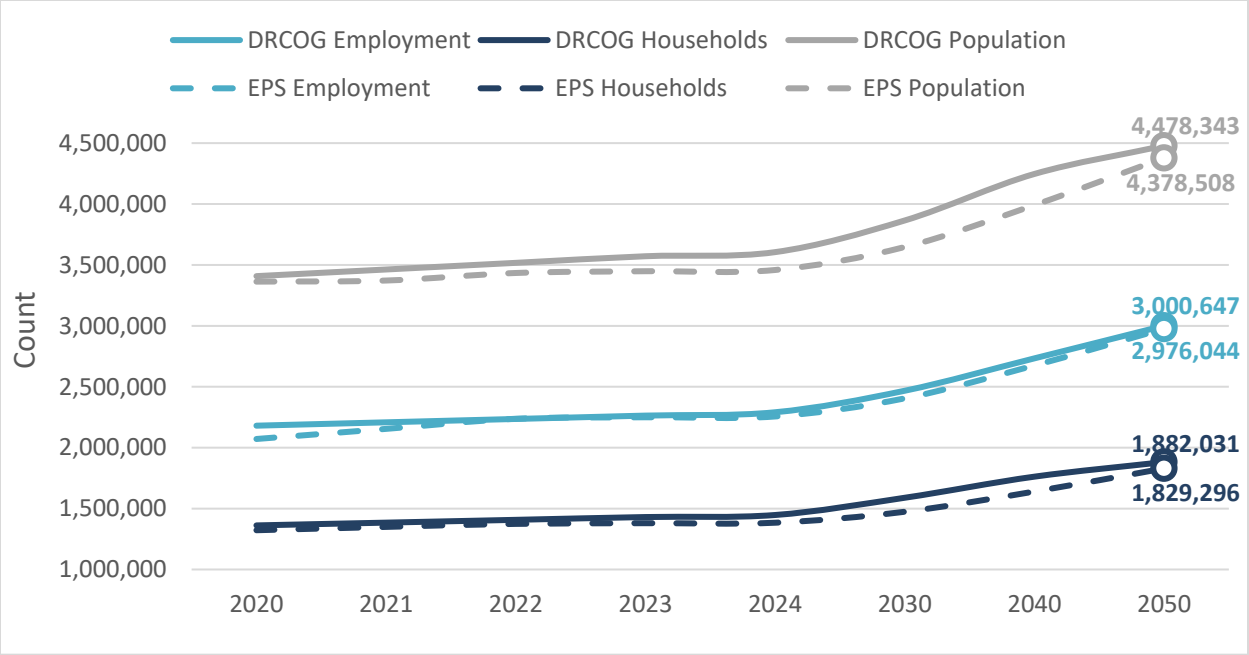
	2020	2022*	2030	2040	2050	2022-2050 Growth Total	2022-2050 Growth %	2022-2050 Annual Average	2022-2050 Annual %	Annual Percentage 2022-2030	Annual Percentage 2030-2040	Annual Percentage 2040-2050
11-county region												
Population	3,408,152	3,517,103	3,865,007	4,246,892	4,478,343	961,240	27.3%	34,330	0.87%	1.19%	0.95%	0.53%
Households	1,361,781	1,407,577	1,588,770	1,761,979	1,882,031	474,454	33.7%	16,945	1.04%	1.53%	1.04%	0.66%
Employment	2,180,587	2,235,707	2,467,274	2,733,136	3,000,647	764,940	34.2%	27,319	1.06%	1.24%	1.03%	0.94%
8-county region												
Population	3,369,829	3,477,833	3,818,335	4,193,703	4,419,780	941,947	27.1%	33,641	0.86%	1.17%	0.94%	0.53%
Households	1,346,506	1,391,711	1,570,812	1,741,777	1,859,536	467,825	33.6%	16,708	1.04%	1.52%	1.04%	0.66%
Employment	2,162,262	2,216,608	2,445,455	2,709,159	2,974,557	757,949	34.2%	27,070	1.06%	1.24%	1.03%	0.94%
E-470 influence area												
Population	1,155,817	1,204,532	1,356,768	1,545,372	1,673,124	468,592	38.9%	16,735	1.18%	1.50%	1.31%	0.80%
Households	428,464	446,545	520,767	602,606	664,537	217,992	48.8%	7,785	1.43%	1.94%	1.47%	0.98%
Employment	713,211	731,962	809,945	904,955	1,003,254	271,292	37.1%	9,689	1.13%	1.27%	1.12%	1.04%

* 2022 was interpolated

DRCOG's employment projections show an increase of 794,900 jobs in the 11-county area and 757,900 jobs in the 8-county area between 2022 and 2050, an increase of 34 percent over both the 11- and 8-county areas 2022 bases, which average approximately 27,300 jobs and 27,100 jobs per year, respectively. The 2050 number of jobs is projected to increase by 41 percent over the 2022 base in the E-470 influence area.

3.2 EPS Base Year Adjustments and Projections

EPS performed a high-level review of the DRCOG population, households, and employment estimates at the county level and made revisions for 2020 through 2024, 2030, 2040, and 2050 by aligning them with several different sources at the local, state, and national levels. **Figure 3-2** summarizes the adjustments by EPS.



Source: EPS

Figure 3-2 EPS Adjustments Summary

3.2.1 Population and Households

The first step was to adjust the DRCOG 2020 and 2021 population and household estimates to tie to the U.S. Census ACS 1-year estimates. To reach the base year of 2022, HBA building permit data was used to estimate the number of new housing units in each county. These units were multiplied by a housing vacancy factor from the 2021 Census to get a total number of households. The total number of households was then multiplied by a population to household ratio that was calculated from the 2021 Census data to get population. The 2022 EPS estimates were then used to adjust interpolated 2022 DRCOG estimates, which were derived from older model year vintage forecasts. For 2023, EPS performed the same steps.

To project 2024 households and population, a 2022-2023 growth rate factor derived for employment was used and then factored down using an adjustment factor derived from economic forecasts by Metro EDC, CBER, the Colorado Legislative Council, and the U.S. GDP. This adjustment rate lowered 2023-2024 growth rate by 46.3 percent compared to 2022-2023 growth rate. For future years 2030, 2040, and 2050, the DRCOG rates by county were used from the year 2024 onward. EPS did not see any justification for modifying the long-term growth rates in the model.

Further socioeconomic data adjustments were also made at the Transportation Analysis Zone (TAZ) level to account for the most recent updates on major development projects that could impact traffic conditions in the E-470 influence area.

Table 3-2 illustrates the original and adjusted population forecasts, as well as the differences between the two.

Table 3-2 Summary of EPS County-Level Population Projections

	2020	2022*	2030	2040	2050	2022-2050 Growth Total	%	2022-2050 Annual Average	%	Annual Percentage 2022-2030	2030-2040	2040-2050
11-county region												
Original DRCOG	3,408,152	3,517,103	3,865,007	4,246,892	4,478,343	961,240	27.3%	34,330	0.87%	1.19%	0.95%	0.53%
EPS Adjusted**	3,363,157	3,434,343	3,646,991	3,991,293	4,378,508	944,165	27.5%	33,720	0.87%	0.75%	0.91%	0.93%
Difference	-44,995	-82,760	-218,016	-255,599	-99,835	-17,075	0.2%	-610	0.00%	-0.43%	-0.04%	0.40%
As % of DRCOG	-1.3%	-2.4%	-5.6%	-6.0%	-2.2%							
8-county region												
Original DRCOG	3,369,829	3,477,833	3,818,335	4,193,703	4,419,780	941,947	27.1%	33,641	0.86%	1.17%	0.94%	0.53%
EPS Adjusted**	3,326,016	3,396,627	3,605,624	3,943,708	4,323,511	926,884	27.3%	33,103	0.87%	0.75%	0.90%	0.92%
Difference	-43,813	-81,206	-212,711	-249,995	-96,269	-15,063	0.2%	-538	0.01%	-0.43%	-0.04%	0.40%
As % of DRCOG	-1.3%	-2.3%	-5.6%	-6.0%	-2.2%							
E-470 influence area												
Original DRCOG	1,155,817	1,204,532	1,356,768	1,545,372	1,673,124	468,592	38.9%	16,735	1.18%	1.50%	1.31%	0.80%
EPS Adjusted**		1,175,646	1,278,472	1,451,659	1,633,791	458,145	39.0%	16,362	1.18%	1.05%	1.28%	1.19%
Difference		-28,886	-78,296	-93,713	-39,333	-10,448	0.1%	-373	0.00%	-0.45%	-0.03%	0.39%
As % of DRCOG		-2.4%	-5.8%	-6.1%	-2.4%							

* 2022 was interpolated
** Before TAZ level adjustments

At the 11-county level, DRCOG projects a population of 4.48 million by 2050, an increase of 27.3 percent over its 2022 base, which averages approximately 34,300 more persons per year. For the same geography, EPS projects a population of 4.38 million by 2050, a 27.5 percent increase over 2022, which averages approximately 33,700 more persons per year. Overall, EPS' population forecast for 2050 at the 11-county level is 2.2 percent lower than DRCOG's.

For the 8-county area, EPS projects a population of 4.32 million by 2050, a 27.3 percent increase over the 2022 base, which averages approximately 33,100 more persons per year. Overall, EPS' population forecast for 2050 at the 8-county level is also 2.2 percent lower than DRCOG's.

Within the E-470 influence area, EPS projects a population of 1.63 million by 2050, a 38.9 percent increase over 2022 which averages approximately 16,400 more persons per year. Overall, EPS' population forecast for 2050 in the influence area is 2.4 percent lower than DRCOG's.

Table 3-3 illustrates the original and adjusted household forecasts, as well as the differences between the two.

Table 3-3 Summary of EPS County-Level Household Projections

	2020	2022*	2030	2040	2050	2022-2050 Growth Total	2022-2050 Growth %	2022-2050 Annual Average	2022-2050 Annual %	Annual Percentage 2022-2030	Annual Percentage 2030-2040	Annual Percentage 2040-2050
11-county region												
Original DRCOG	1,361,781	1,407,577	1,588,770	1,761,979	1,882,031	474,454	33.7%	16,945	1.04%	1.53%	1.04%	0.66%
EPS Adjusted**	1,322,176	1,374,344	1,473,791	1,639,896	1,829,296	454,952	33.1%	16,248	1.03%	0.88%	1.07%	1.10%
Difference	-39,605	-33,233	-114,979	-122,083	-52,735	-19,502	-0.6%	-697	-0.02%	-0.65%	0.03%	0.44%
As % of DRCOG	-2.9%	-2.4%	-7.2%	-6.9%	-2.8%							
8-county region												
Original DRCOG	1,346,506	1,391,711	1,570,812	1,741,777	1,859,536	467,825	33.6%	16,708	1.04%	1.52%	1.04%	0.66%
EPS Adjusted**	1,307,009	1,358,734	1,456,838	1,620,699	1,807,416	448,682	33.0%	16,024	1.02%	0.88%	1.07%	1.10%
Difference	-39,497	-32,977	-113,974	-121,078	-52,120	-19,143	-0.6%	-684	-0.02%	-0.65%	0.03%	0.44%
As % of DRCOG	-2.9%	-2.4%	-7.3%	-7.0%	-2.8%							
E-470 influence area												
Original DRCOG	428,464	446,545	520,767	602,606	664,537	217,992	48.8%	7,785	1.43%	1.94%	1.47%	0.98%
EPS Adjusted**		431,704	476,346	554,093	637,536	205,832	47.7%	7,351	1.40%	1.24%	1.52%	1.41%
Difference		-14,841	-44,421	-48,513	-27,001	-12,160	-1.1%	-434	-0.03%	-0.70%	0.05%	0.43%
As % of DRCOG		-3.3%	-8.5%	-8.1%	-4.1%							

* 2022 was interpolated
** Before TAZ level adjustments

At the 11-county level, DRCOG projects 1.88 million households by 2050, an increase of 33.7 percent over its 2022 base, which averages approximately 16,900 more households per year. For the same geography, EPS projects 1.83 million households by 2050, a 33.1 percent increase over 2022, which averages to approximately 16,200 more households per year. Overall, EPS' household forecast for 2050 at the 11-county level is 2.8 percent lower than DRCOG's.

For the 8-county area, EPS projects 1.81 million households by 2050, a 33.0 percent increase over the 2022 base, which averages approximately 16,000 more households per year. Overall, EPS' household forecast for 2050 at the 8-county level is also 2.8 percent lower than DRCOG's.

Within the E-470 influence area, EPS projects 637,500 households by 2050, a 47.7 percent increase over 2022 which averages approximately 7,400 more households per year. Overall, EPS' household forecast for 2050 in the influence area is 4.1 percent lower than DRCOG's.

3.2.2 Employment

Table 3-4 illustrates the original and adjusted employment forecasts, as well as differences between the two.

Table 3-4 Summary of EPS County-Level Employment Projections

	2020	2022*	2030	2040	2050	2022-2050 Growth Total	2022-2050 Growth %	2022-2050 Annual Average	2022-2050 Annual %	Annual Percentage 2022-2030	Annual Percentage 2030-2040	Annual Percentage 2040-2050
11-county region												
Original DRCOG	2,180,587	2,235,707	2,467,274	2,733,136	3,000,647	764,940	34.2%	27,319	1.06%	1.24%	1.03%	0.94%
EPS Adjusted**	2,071,228	2,237,240	2,404,686	2,674,965	2,976,044	738,804	33.0%	26,386	1.02%	0.91%	1.07%	1.07%
Difference	-109,359	1,533	-62,588	-58,171	-24,603	-26,136	-1.2%	-933	-0.03%	-0.33%	0.04%	0.13%
As % of DRCOG	-5.0%	0.1%	-2.5%	-2.1%	-0.8%							
8-county region												
Original DRCOG	2,162,262	2,216,608	2,445,455	2,709,159	2,974,557	757,949	34.2%	27,070	1.06%	1.24%	1.03%	0.94%
EPS Adjusted**	2,055,992	2,219,096	2,384,895	2,652,613	2,950,664	731,568	33.0%	26,127	1.02%	0.90%	1.07%	1.07%
Difference	-106,270	2,488	-60,560	-56,546	-23,893	-26,381	-1.2%	-942	-0.03%	-0.33%	0.04%	0.13%
As % of DRCOG	-4.9%	0.1%	-2.5%	-2.1%	-0.8%							
E-470 influence area												
Original DRCOG	713,211	731,962	809,945	904,955	1,003,254	271,292	37.1%	9,689	1.13%	1.27%	1.12%	1.04%
EPS Adjusted**		737,957	794,888	891,395	1,000,592	262,635	35.6%	9,380	1.09%	0.93%	1.15%	1.16%
Difference		5,995	-15,057	-13,560	-2,662	-8,657	-1.5%	-309	-0.04%	-0.34%	0.04%	0.13%
As % of DRCOG		0.8%	-1.9%	-1.5%	-0.3%							

* 2022 was interpolated
** Before TAZ level adjustments

At the 11-county level, DRCOG projects 3.00 million jobs by 2050, an increase of 34 percent over its 2022 base, which averages to approximately 27,300 more jobs per year. For the same geography, EPS projects 2.98 million jobs by 2050, a 33 percent increase over 2022, which averages to approximately 26,400 more jobs per year. Overall, EPS' household forecast for 2050 at the 11-county level is 0.8 percent lower than DRCOG's.

For the 8-county area, EPS projects 2.95 million jobs by 2050, a 33 percent increase over the 2022 base, which averages to approximately 26,100 more households per year. Overall, EPS' household forecast for 2050 at the 8-county level is also 0.8 percent lower than DRCOG's.

Within the E-470 influence area, EPS projects 1.00 million jobs by 2050, a 36 percent increase over 2022 which averages to approximately 9,400 more jobs per year. Overall, EPS' employment forecast for 2050 in the influence area is 0.3 percent lower than DRCOG's.

3.3 Review of Major Development Projects

The final element of the socioeconomic forecast update consisted of reviewing major development plans along the E-470 corridor to identify if any further adjustments to the socioeconomic dataset were necessary at the TAZ level. The analysis leveraged area-, site-, and development-specific research, along with future land use plans and land availability. A "major development plan" is defined as a residential, non-residential, or mixed-use development that is in the process of being built, in the final plan approval process, early stage of platting, or even in the conceptual planning phase. Specific developments were identified based on a review of municipal development plans, local reconnaissance, and experience from prior analyses. This was conducted at a desktop level, and further validation through site visits and meetings would be required.

Figure 3-3 illustrates the location of the 23 major developments evaluated in this process. The research focused on documenting uses, magnitudes, timing, status, risk, and likelihood of these major development plans.

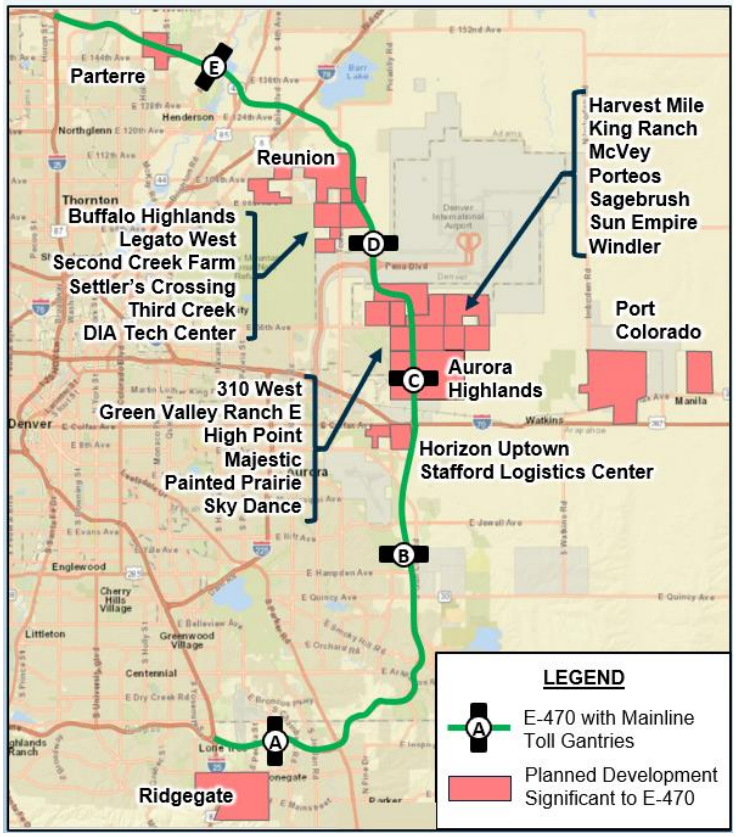


Figure 3-3 Planned Developments Significant to E-470

Projections at the TAZ level produce results with a generally high degree of specificity and uncertainty. Moreover, DRCOG has often cautioned users against placing great reliance on TAZ level totals, as forecasting growth in such small geographic areas is difficult. As such, the approach to adjusting at the TAZ level is to do so only when market information and research provide a clear basis for such adjustments. In general, the TAZ-level data were adjusted when the difference between what was likely to materialize in terms of land use developments and what was reported at the TAZ level was significantly different from each other. Any adjustments made at the TAZ level were made on top of the county-level forecast adjustments described in the previous section.

The adjustments made to the DRCOG forecasts to account for the identified major development projects are summarized in **Table 3-5**. The adjustments assume an increase in population and household over the underlying DRCOG forecasts, given additional development information obtained by EPS. However, the adjustments also included a reduction in estimated employment. This was based on prior experience, where retail and employment within major developments tended to lag the original plans.

Table 3-5 Summary of TAZ-level Adjustments Related to Major Developments

	2030	2040	2050
Population	6,597	14,665	16,230
Households	3,470	6,830	7,558
Employment	-1,790	-2,063	-3,433

3.4 Trip Table Adjustments

The updated socioeconomics data were used to update the DRCOG model origin-destination trip tables applied to estimate future traffic on E-470.

The process that was followed to adjust the trip tables involved the following steps:

- Start with the socioeconomics data and trip tables from the DRCOG model for 2020 and 2023;
- Interpolate DRCOG socioeconomics data and trip tables for 2022;
- Compare the change in DRCOG socioeconomics (population + employment) against the change in number of trips (2023-2022) at the county level;
- Compute the rate of change in trips per change in socioeconomics (population + employment) at the county level;
- Apply these county-level change factors to the 2022 EPS-adjusted socioeconomics to develop 2022 trip table adjustments;
- Apply trip table adjustments to develop 2022 EPS-adjusted trip tables.

Overall, the socioeconomics adjustments produce a 1.1 percent reduction in the 2022 number of trips compared to the original DRCOG trip table (9,770 trips vs. 9,874), as shown in **Table 3-6**. CDM Smith then utilized the county-level change factors to adjust the future year trip tables at 2030, 2040, and 2050 levels, including the TAZ-level adjustments provided by EPS for the identified major developments. For years 2030, 2040, and 2050, the reduction in the number of trips resulting from the EPS adjustments is respectively 4.4 percent, 4.0 percent, and 1.1 percent.

Table 3-6 Trip Table Adjustment Factors (2022)

County	DRCOG Population + Employment (000s)				DRCOG Trips (000s)				Change in Trips per Change in Pop+Emp	EPS Population + Employment (000s)			EPS Trips (000s)		
	2022	2023	Diff.	% Diff.	2022	2023	Diff.	% Diff.		2022	Diff.	% Diff.	2022	Diff.	% Diff.
Adams	829	844	15	1.9%	1,444	1,465	21	1.5%	1.39	824	-5	-0.6%	1,437	-7	-0.5%
Arapahoe	1,118	1,130	12	1.1%	2,084	2,101	17	0.8%	1.41	1,091	-27	-2.4%	2,045	-39	-1.8%
Boulder	587	591	4	0.6%	998	1,003	5	0.5%	1.28	587	0	0.1%	999	1	0.1%
Broomfield	128	131	4	2.8%	236	240	4	1.7%	1.22	130	2	1.6%	238	2	0.9%
Denver	1,412	1,428	16	1.1%	2,216	2,235	19	0.9%	1.19	1,371	-41	-2.9%	2,167	-49	-2.2%
Douglas	565	582	18	3.1%	986	1,009	23	2.3%	1.27	575	10	1.8%	999	13	1.3%
Jefferson	917	925	8	0.9%	1,688	1,699	11	0.7%	1.38	903	-14	-1.5%	1,669	-19	-1.1%
Weld	139	144	4	3.2%	222	228	6	2.7%	1.46	135	-5	-3.3%	215	-7	-3.1%
Total	**5,694**	**5,776**	**81**	**1.4%**	**9,874**	**9,980**	**106**	**1.1%**	**1.32**	**5,616**	**-79**	**-1.4%**	**9,770**	**-104**	**-1.1%**

4.0 Highway Network Update

For this study, CDM Smith obtained DRCOG's regional travel demand model files including traffic networks and trip tables for 2020, 2023, 2030, 2040, and 2050. A 2022 base-year highway network was developed using the 2023 DRCOG model network. Future year networks were reviewed and updated to reflect the relevant planned highway improvements. When necessary, changes to capacity and roadway configuration were made in the relevant year model networks.

4.1 Existing Network Review and Update

The 2022 base-year highway network was developed utilizing the 2023 DRCOG model network. The base roadway network was compared with existing facilities using satellite imagery and route reconnaissance. Where necessary, adjustments were made to the existing network to reflect 2022 geometry configuration: number of lanes, capacities, and speeds.

4.2 Review and Update Future Networks

The future year networks developed by DRCOG for 2030, 2040, and 2050 were reviewed in light of the most recent Metro Vision 2050 Regional Transportation Plan (RTP), adopted in 2021, and the most recent Capital Improvement Plan developed by the Authority. This review focused on E-470 improvements planned by the Authority and those projects of major significance within the E-470 corridor planned by state and local agencies. Where necessary, changes to capacity and roadway confirmation were made.

4.3 Regional Transportation Plan Projects

The forecast year networks included in the DRCOG models were reviewed and compared to the DRCOG 2050 Metro Vision Regional Transportation Plan (RTP).[1] A list of the regional Metro Vision projects within the E-470 corridor area and included in the CDM Smith updated E-470 toll model is shown in **Table 4-1**, **Table 4-2**,**Table 4-3** (respectively for 2030, 2040, and 2050) and presented graphically in **Figure 4-1**. Note that the E-470 improvement projects are excluded from these tables and are covered separately in section 4.4.

The project dates indicated in these tables represent the year by which the projects are anticipated to be completed, aligned with the DRCOG model three future year highway networks. Specific projects may be completed earlier based on local plans. Given the process for developing interim year forecasts through interpolation, as described later in this report, CDM Smith does not believe any difference between the "complete by" date assumed by DRCOG and the completion date programmed by local municipalities would trigger any significant adjustments to the ultimate E-470 transaction and revenue forecasts.

[1] DRCOG 2050 Metro Vision Regional Transportation Plan. Adopted Sept. 21, 2022. https://drcog.org/sites/default/files/resources/2050_RTP_22_11_4.pdf

Table 4-1 Programmed 2030 Regional Highway Improvements

Facility Name	From	To	Improvement
6th Ave.	Airport Blvd.	Tower Rd.	Widen from 2 to 6 lanes
6th Ave.	Tower Rd.	6th Pkwy.	Widen from 2 to 6 lanes
6th Ave.	6th Pkwy.	Harvest Rd.	Widen from 2 to 6 lanes
17th Ave.	Alpine St.	Ute Creek Dr.	Widen from 2 to 4 lanes
48th Ave.	Picadilly Rd.	Powhaton Rd.	New 6-lane road
48th Ave.	Powhaton Rd.	Monaghan Rd.	New 2-lane road
58th Ave.	Washington St.	York St.	Widen from 2 to 4 lanes
56th Ave.	Peoria St.	Peña Blvd.	Widen from 2 to 4 lanes
56th Ave.	Peña Blvd.	Tower Rd.	Widen from 4 to 6 lanes
56th Ave.	Genoa St.	Picadilly Rd.	Widen from 5 to 6 lanes
56th Ave.	Picadilly Rd.	E-470	Widen from 2 to 6 lanes
56th Ave.	E-470	Powhaton Rd.	Widen from 2 to 6 lanes
64th Ave.	Tower Rd.	Denver/Aurora City Limits	Widen from 2 to 4 lanes
64th Ave.	Denver/Aurora City Limits	Himalaya St.	Widen from 2 to 6 lanes
64th Ave.	Harvest Mile Rd.	Powhaton Rd.	New 2-lane road
64th Ave.	Harvest Mile Rd.	Powhaton Rd.	Widen from 2 to 4 lanes
64th Ave.	Powhaton Rd.	Monaghan Rd.	New 4-lane road
88th Ave.	I-76 northbound ramps	State Hwy. 2	Widen from 2 to 4 lanes
104th Ave.	Marion St.	Colorado Blvd.	Widen from 4 to 6 lanes
104th Ave.	Colorado Blvd.	McKay Rd.	Widen from 2 to 4 lanes
104th Ave.	McKay Rd.	U.S. Route 85	Widen from 2 to 4 lanes
120th Ave.	U.S. Route 85	E-470	Widen to 4 lanes
144th Ave.	U.S. Route 287	Zuni St.	Widen from 2 to 4 lanes
144th Ave.	Washington St.	York St.	Widen from 2 to 4 lanes
144th Ave.	York St.	Colorado Blvd.	Widen from 2 to 4 lanes
160th Ave.	Lowell Blvd.	Sheridan Pkwy.	New 2-lane road
Arapahoe Rd.	Waco St.	Himalaya St.	Widen from 2 to 6 lanes
Arapahoe Rd.	Himalaya Way	Liverpool St.	Widen from 4 to 6 lanes
Broncos Pkwy.	Havana St.	Peoria St.	Widen from 4 to 6 lanes
Broncos Pkwy.	Jordan Rd.	Parker Rd.	Widen from 4 to 6 lanes
Buckley Rd.	136th Ave.	Bromley Rd.	Widen from 2 to 4 lanes
Buckley Rd.	118th Ave.	Cameron Dr.	Widen from 2 to 6 lanes
C-470 EB	S. Kipling Pkwy.	I-25	Add 1 high-occupancy toll lane
C-470 WB	S. Kipling Pkwy.	I-25	Add 1 high-occupancy toll lane
Chambers Rd.	Crowfoot Valley Rd.	Hess Rd.	New 2-lane road
Chambers Rd.	Vistancia Dr.	South Boundary	New 2-lane road
Chambers Rd.	Crowfoot Valley Rd.	Parker South Town Limit	New 2-lane road
County Line Rd.	Phillips St.	University Blvd.	Widen from 2 to 4 lanes
E. Bromley Ln.	U.S. Route 85	Sable Blvd.	Widen from 4 to 6 lanes
E. Bromley Ln.	Tower Rd.	I-76	Widen from 4 to 6 lanes
Federal Blvd.	6th Ave.	Howard Pl.	Widen from 5 to 6 lanes
Green Valley Ranch Blvd.	Chambers Rd.	Peña Blvd.	Widen from 4 to 6 lanes
Green Valley Ranch Blvd.	Peña Blvd.	Tower Rd.	Widen from 4 to 6 lanes
Gun Club Rd.	State Hwy. 30	6th Ave.	Widen from 2 to 4 lanes
Gun Club Rd.	Quincy Ave.	Aurora Pkwy.	Widen from 2 to 4 lanes
Gun Club Rd.	Quincy Ave.	1.5 mi S of Quincy Ave.	Widen from 2 to 6 lanes
Hampden Ave.	Picadilly Rd.	Gun Club Rd.	Widen from 2 to 4 lanes

Facility Name	From	To	Improvement
Harvest Rd.	56th Ave.	64th Ave.	New 3-lane road
Harvest Rd.	6th Ave.	I-70	New 6-lane road
Harvest Rd.	I-70	26th Ave.	New 4-lane road
Harvest Rd.	Mississippi Ave.	Alameda Ave.	New 6-lane road
Harvest Rd.	Alameda Ave.	1st Ave.	Widen from 4 to 6 lanes
Hilltop Rd.	Canterberry Pkwy.	Singing Hills Rd.	Widen from 2 to 4 lanes
Huron St.	150th Ave.	160th Ave.	Widen from 2 to 4 lanes
Huron St.	160th Ave.	State Hwy. 7	Widen from 2 to 4 lanes
I-225/Yosemite St.	DTC Blvd.	I-25 on-ramp	Interchange and ramp reconstruction
I-25	El Paso County Line	N of Crystal Valley Pkwy.	Add 1 toll/managed-lane each direction
"I-25 (Segment 5)"	State Hwy. 66	Weld County Rd. 38	Add 1 toll/managed lane each direction
I-25	Crystal Valley Pkwy.		New interchange
I-70	I-70	Picadilly Rd.	New interchange
I-70	I-70	Harvest Rd.	New interchange
I-70	Twin Tunnels	U.S. Route 40	Add 1 WB peak period managed lane
I-70	I-25	Chambers Rd.	Add 2 new managed lanes
I-70	Picadilly Rd.		Add new interchange
I-70	Harvest Mile Rd.		Add new interchange
I-70/Floyd Hill WB	Floyd Hill Way	Veterans Memorial Tunnel	New express travel lane
I-76	Bridge St.		New interchange
Interlocken Loop	96th St.	State Hwy. 128	Add 2 toll lanes
Jefferson Pkwy.	State Hwy. 128/96th St.	State Hwy. 93	New 4-lane road
Jefferson Pkwy.	Indiana St./State Hwy. 128		New interchange
Jefferson Pkwy.	Candelas Pkwy.		New interchange
Jefferson Pkwy.	State Hwy. 72		New interchange
Jewell Ave.	Himalaya St.	E-470	Widen from 3 to 6 lanes
Jewell Ave.	E-470	Gun Club Rd.	Widen from 2 to 6 lanes
Jewell Ave.	Gun Club Rd.	Harvest Mile Rd.	Widen from 2 to 6 lanes
Lincoln Ave.	Keystone Blvd.	Parker Rd.	Widen from 4 to 6 lanes
Martin Luther King Jr. Blvd.	Havana St./Lola St.	Peoria St.	Widen 2 to 4 lanes; new 4-lane road
McIntyre St.	52nd Ave.	60th Ave.	Widen from 2 to 4 lanes
Nelson Rd.	75th St.	Affolter Dr.	Widen from 2 to 4 lanes
Pace St.	5th Ave.	17th Ave.	Widen from 2 to 4 lanes
Pecos St.	52nd Ave.	0.72 miles north of 52nd Ave.	Widen from 2 to 4 lanes
Peña Blvd.	E-470	Jackson Gap St.	Widen from 6 to 8 lanes
Peña Blvd.	Gun Club Rd.		Interchange capacity
Peña Blvd.	Jackson Gap St.	W ramps to DEN terminal	Widen from 6 to 8 lanes
Picadilly Rd.	Smith Rd.	48th Ave.	Widen from 2 to 6 lanes
Picadilly Rd.	48th Ave.	56th Ave.	Widen from 2 to 6 lanes
Picadilly Rd.	56th Ave.	70th Ave.	New 6-lane road
Picadilly Rd.	70th Ave.	82nd Ave.	New 6-lane road

Facility Name	From	To	Improvement
Picadilly Rd.	State Hwy. 30	6th Pkwy.	New 4-lane road
Picadilly Rd.	6th Pkwy.	Colfax Ave.	Widen from 2 to 6 lanes
Picadilly Rd.	Colfax Ave.	I-70	New 6-lane road
Picadilly Rd.	I-70	Smith Rd.	Widen from 2 to 6 lanes
Plum Creek Pkwy.	Wolfensberger Rd.	I-25	Widen from 2 to 4 lanes
Plum Creek Pkwy.	Gilbert St.	Ridge Rd.	Widen from 2 to 4 lanes
Powhaton Rd.	26th Ave.	48th Ave.	New 6-lane road
Quebec St.	120th Ave.	128th Ave.	Widen from 2 to 4 lanes
Quebec St.	132nd Ave.	160th Ave.	Widen from 2 to 4 lanes
Quincy Ave.	Simms St.	Kipling Pkwy.	Widen from 2 to 4 lanes
Quincy Ave.	Irving St.	Federal Blvd.	New 2-lane road
Quincy Ave.	Plains Pkwy.	Gun Club Rd.	Widen from 2 to 6 lanes
Ridgegate Pkwy.	Havana St.	Lone Tree E. City Limit	Widen from 2 to 4 lanes
Ridgegate Pkwy.	Havana St.	Lone Tree E. City Limit	Widen from 2 to 4 lanes
Ridge Rd.	Plum Creek Pkwy.	State Hwy. 86	Widen from 2 to 4 lanes
Sheridan Pkwy.	Lowell Blvd.	Northwest Pkwy.	Widen from 2 to 4 lanes
Sheridan Pkwy.	Northwest Pkwy.	Preble Creek	Widen from 2 to 4 lanes
State Hwy. 2	72nd Ave.	I-76	Widen from 2 to 4 Lanes
State Hwy. 7	164th Ave.	Dahlia St.	Widen from 2 to 4 lanes
State Hwy. 7	Boulder County Line	Sheridan Pkwy.	Widen from 2 to 4 lanes
State Hwy. 7	Sheridan Pkwy.	I-25	Widen from 2 to 6 lanes
State Hwy. 30	Stephen D. Hogan Pkwy. (6th Pkwy.)	Mississippi Ave.	Widen from 2 to 4 lanes
State Hwy. 58	Cabela St.		New interchange
State Hwy. 66	Hover St.	Main St.	Widen from 2 to 4 lanes
Stephen D. Hogan Pkwy.	E-470	Gun Club Rd.	Widen from 2 to 6 lanes
Stroh Rd.	Chambers Rd.	Crowfoot Valley Rd.	New 4-lane road
Stroh Rd.	Crowfoot Valley Rd.	J. Morgan Blvd.	Widen from 2 to 4 lanes
Tower Rd.	6th Ave.	Colfax Ave.	New 2-lane road
Tower Rd.	Colfax Ave.	Smith Rd.	Widen from 2 to 6 lanes
Tower Rd.	45th Ave.	Green Valley Ranch Blvd.	Widen from 4 to 6 lanes
Tower Rd.	48th Ave.	56th Ave.	Widen from 4 to 6 lanes
Tower Rd.	56th Ave.	Peña Blvd.	Widen from 4 to 6 lanes
Tower Rd.	Peña Blvd.	105th Ave.	Widen from 4 to 6 lanes
Buckley Rd.	105th Ave.	118th Ave.	New 4-lane road
U.S. Route 6	Wadsworth Blvd.		Interchange capacity
U.S. Route 6	Heritage Rd.		New interchange
U.S. Route 36	South Boulder Rd.	I-25	Add 1 managed-lane each direction
U.S. Route 85	104th Ave.		New interchange
U.S. Route 85	120th Ave.		New interchange

Note: This list excludes E-470 improvement projects presented in Table 4-4.

Table 4-2 Programmed 2040 Regional Highway Improvements

Facility Name	From	To	Improvement
48th Ave.	Powhaton Rd.	Monaghan Rd.	Widen from 2 to 4 lanes
48th Ave.	Imboden Rd.	Manila Rd.	Widen from 2 to 4 lanes
56th Ave.	Havana St.	Peña Blvd.	Widen from 4 to 6 lanes
56th Ave.	Powhaton Rd.	Imboden Rd.	Widen from 2 to 4 lanes
64th Ave.	Himalaya Rd.	Harvest Mile Rd.	Widen from 2 to 4 lanes
64th Ave.	Himalaya Rd.	Harvest Mile Rd.	Widen from 4 to 6 lanes
72nd Ave.	Simms St.	Kipling St.	Widen from 2 to 4 lanes
96th Ave.	State Hwy. 2	Tower Rd.	Widen from 2 to 4 lanes
96th Ave.	Tower Rd.	Picadilly Rd.	Widen from 2 to 6 lanes
120th Ave.	Sable Blvd.	E-470	Widen from 2 to 6 lanes
120th Ave.	E-470	Picadilly Rd.	Widen from 2 to 6 lanes
152nd Ave./152nd Pkwy.	Washington St.	York St.	Widen from 2 to 4 lanes
Aurora Airport Rd.	N. Picadilly Rd.	Powhaton Rd.	Widen from 2 to 4 lanes
Aurora Pkwy.	Parker Rd.	S. Ireland Way.	New 4 lane road
E. Alameda Ave.	S. Powhaton Rd.	S. Watkins Rd.	New 4 lane road
C-470 EB	Broadway	I-25	Add 1 high-occupancy toll lane
C-470 WB	Colorado Blvd.	Lucent Blvd.	Add 1 high-occupancy toll lane
Canyonside Blvd.	Crowfoot Valley Rd.	Hess Rd.	New 4-lane road
Chambers Rd.	Crowfoot Valley Rd.	Hess Rd.	Widen from 2 to 4 lanes
Chambers Rd.	Crowfoot Valley Rd.	Parker S Town Limit	Widen from 2 to 4 lanes
Colorado Blvd.	E. Dry Creek Rd.	E. County Line Rd.	Widen from 2 to 4 lanes
Colorado Blvd.	144th Ave.	156th Ave.	Widen from 2 to 4 lanes
Colorado Blvd.	156th Ave.	South of 168th Ave.	New 4-lane road
Colorado Blvd.	South of 168th Ave.	168th Ave.	New 4-lane road
Crowfoot Valley Rd.	Founders Pkwy.	Macanta Rd./Canyonside Blvd.	Widen from 2 to 4 lanes
Crowfoot Valley Rd.	Macanta Rd./Canyonside Blvd.	Chambers Rd.	Widen from 2 to 4 lanes
Crowfoot Valley Rd.	Chambers Rd.	Stroh Rd.	Widen from 2 to 4 lanes
E. County Line Rd.	9th Ave.	State Hwy. 66	Widen from 2 to 4 lanes
Gun Club Rd.	Aurora Airport Rd.	Mississippi Ave.	Widen from 2 to 4 lanes
Gun Club Rd.	Yale Ave.	Mississippi Ave.	Widen from 2 to 4 lanes
Gun Club Rd.	Yale Ave.	Mississippi Ave.	Widen from 4 to 6 lanes
Hampden Ave/Harvest Rd.	Florence St	Yale Ave.	Widen from 5 to 6 lanes
Harvest Rd.	48th Ave.	56th Ave.	New 6-lane road
Harvest Rd.	56th Ave.	64th Ave.	Widen from 3 to 6 lanes
Harvest Rd.	Jewell Ave.	Mississippi Ave.	Widen from 2 to 6 lanes
Harvest Rd./Powhaton Rd.	I-70	26th Ave.	Widen from 4 to 6 lanes
Hess Rd.	Canyonside Blvd.	Chamber Rd.	Widen from 2 to 4 lanes
20th Ave.	Picadilly Rd.	N. Watkins Rd.	Widen from 2 to 4 lanes
38th Ave.	Himalaya Rd.	Picadilly Rd.	Widen from 2 to 4 lanes
88th Ave.	Tower Rd.	Picadilly Rd.	Widen from 2 to 4 lanes
104th Ave.	E-470	Quency Way	Widen from 2 to 4 lanes
112th Ave.	Sable Blvd.	Quency Way	Widen from 2 to 4 lanes

Facility Name	From	To	Improvement
I-25	E-470	State Hwy. 7	Managed lanes, State Hwy. 7 interchange reconstruction and State Hwy. 7 mobility hub
I-25	State Hwy. 7	State Hwy. 66	Managed lanes, State Hwy. 119 mobility hub (Firestone-Longmont Mobility Hub), intelligent transportation systems, bicycle and pedestrian trail connections
I-270	I-25/U.S. Route 36	I-70	New freeway "direct connects" at ends of I-270
I-270	I-25/U.S. Route 36	I-70	New managed lanes
Harvest Rd.	E. Jewell Ave.	E. Yale Ave.	New 2 lane road
Hayesmount Rd.	E. 26th Ave.	I-70	New 4 lane road
Hayesmount Rd.	I-70	E. Alameda Ave.	Widen from 2 to 4 lanes
Himalaya St.	E. 64th Ave.	E. 58th Ave.	Widen from 2 to 4 lanes
Hudson Rd.	E. Quincy Ave.	E. Yale Ave.	New 4 lane road
Imboden Rd.	48th Ave.	56th Ave.	Widen from 2 to 4 lanes
Jewell Ave.	Harvest Rd.	Monaghan Rd.	Widen from 2 to 6 lanes
Jewell Ave.	Monaghan Rd.	Watkins Rd.	Widen from 2 to 4 lanes
Lincoln Ave.	Peoria St.	1st Ave.	Widen from 4 to 6 lanes
Lincoln Ave.	1st St.	Keystone Blvd.	Widen from 4 to 6 lanes
Manila Rd.	Alameda Ave.	I-70	New 4-lane road
Manila Rd.	I-70	48th Ave.	Widen from 2 to 4 lanes
Mississippi Ave.	S. Harvest Rd.	N. Monaghan Rd.	New 4 lane road
Mississippi Ave.	N. Monaghan Rd.	N. Hayesmount Rd.	New 2 lane road
Monaghan Rd.	E. 6th Ave.	E. Jewell Ave.	Widen from 2 to 4 lanes
Monaghan Rd.	I-70	26th Ave.	New 4-lane road
Monaghan Rd.	26th Ave.	56th Ave.	Widen from 2 to 4 lanes
Monaghan Rd.	56th Ave.	64th Ave.	New 4-lane road
Monaghan Rd.	Quincy Ave.	Yale Ave.	New 6-lane road
Peña Blvd.	I-70	64th Ave.	Add 1 managed lane in each direction
Peña Blvd.	64th Ave.	E-470	Add 1 managed lane in each direction
Peoria St.	E-470	0.75 mi S of Lincoln Ave.	Widen from 2 to 4 lanes
Peoria St.	0.75 mi S of Lincoln Ave.	Mainstreet/Ridge Gate Pkwy.	Widen from 2 to 4 lanes
Picadilly Rd.	82nd Ave.	96th Ave.	New 6-lane road
Picadilly Rd.	96th Ave.	120th Ave.	New 6-lane road
Powhaton Rd.	Smoky Hill Rd.	County Line Rd.	Widen from 2 to 6 lanes
Quail Run Rd./ Imboden Rd.	I-70	48th Ave.	New 4-lane road
Quincy Ave.	Monaghan Rd.	Hayesmount Rd.	Widen from 2 to 6 lanes
Quincy Ave.	Hayesmount Rd.	Watkins Rd.	Widen from 2 to 6 lanes
Rampart Range Rd.	Waterton Rd.	Titan Rd.	Widen from 2 to 4 lanes
Smith Rd.	Picadilly Rd.	Powhaton Rd.	Widen from 2 to 4 lanes
Smith Rd.	Powhaton Rd.	N. Monaghan Rd.	New 2 lane road
State Hwy. 7	Riverdale Rd.	U.S. Route 85	Widen from 2 to 4 lanes
State Hwy. 30	Airport Blvd.	Quincy Ave.	Widen from 2 to 4 lanes

Facility Name	From	To	Improvement
State Hwy. 72	W. 80th Ave.	W. 86th Pkwy.	Widen to 4 lanes
State Hwy. 93	State Hwy. 58	State Hwy. 170	Widen to 4 lanes
Stephen D. Hogan Pkwy.	State Hwy. 30	E-470	Widen from 2 to 6 lanes
Titan Rd.	Rampart Range Rd.	Santa Fe Dr.	Widen from 2 to 4 lanes
Tower Rd.	6th Ave.	Colfax Ave.	Widen from 2 to 6 lanes
Tower Rd.	E. 160th Ave.	152nd Ave.	Widen from 2 to 4 lanes
U.S. Route 85	Titan Rd.	Highlands Ranch Pkwy.	Widen from 4 to 6 lanes
U.S. Route 285	Parker Ave.		New interchange
U.S. Route 285	Pine Valley Rd.	Mt. Evans Blvd.	New interchange
Waterton Rd.	State Hwy. 121	Campfire St.	Widen from 2 to 4 lanes
Watkins Rd.	Quincy Ave.	I-70	Widen from 2 to 6 lanes
Wolfensberger Rd.	Coachline Rd.	Prairie Hawk Dr.	Widen from 2 to 4 lanes
Yale Ave.	S. Gun Club Rd.	S. Harvest Rd.	New 4 lane road
Yale Ave.	Monaghan Rd.	Hayesmount Rd.	Widen from 2 to 6 lanes
York St.	152nd Ave.	E-470	Widen from 2 to 4 lanes

Note: This list excludes E-470 improvement projects presented in Table 4-4.

Table 4-3 Programmed 2050 Regional Highway Improvements

Facility Name	From	To	Improvement
6th Ave.	Harvest Mile Rd.	Watkins Rd.	New 6-lane road
6th Ave.	Watkins Rd.	Manila Rd.	New 4-lane road
6th Ave.	Manila Rd.	Schumaker Rd.	New 2-lane road
32nd Pkwy.	Himalaya Rd.	Picadilly Rd.	Widen from 2 to 4 lanes
56th Ave.	Imboden Rd.	Schumaker Rd.	New 2-lane road
Chambers Rd.	E-470	Arapahoe/Douglas County Line	Widen from 4 to 6 lanes
Chambers Rd.	Crowfoot Valley Rd.	Hess Rd.	Widen from 4 to 6 lanes
Chambers Rd.	Hess Rd.	Mainstreet	Widen from 4 to 6 lanes
Chambers Rd.	Mainstreet	Lincoln Ave.	Widen from 4 to 6 lanes
Chambers Rd./Bayou Gulch Rd.	Parker Rd.	Vistancia Dr.	Widen from 2 to 4 lanes
Chambers Rd./Bayou Gulch Rd.	Vistancia Dr.	South boundary	Widen from 2 to 4 lanes
Mainstreet	Canterberry Pkwy.	Delbert Rd.	Widen from 2 to 4 lanes
Powhaton Rd.	Jewell Ave.	26th Ave.	Widen from 2 to 4 lanes
Quail Run Rd.	6th Ave.	I-70	New 4-lane road
State Hwy. 66	E. County Line Rd.	Weld County Rd. 19	Widen 2 to 4 lanes

Note: This list excludes E-470 improvement projects presented in Table 4-4.

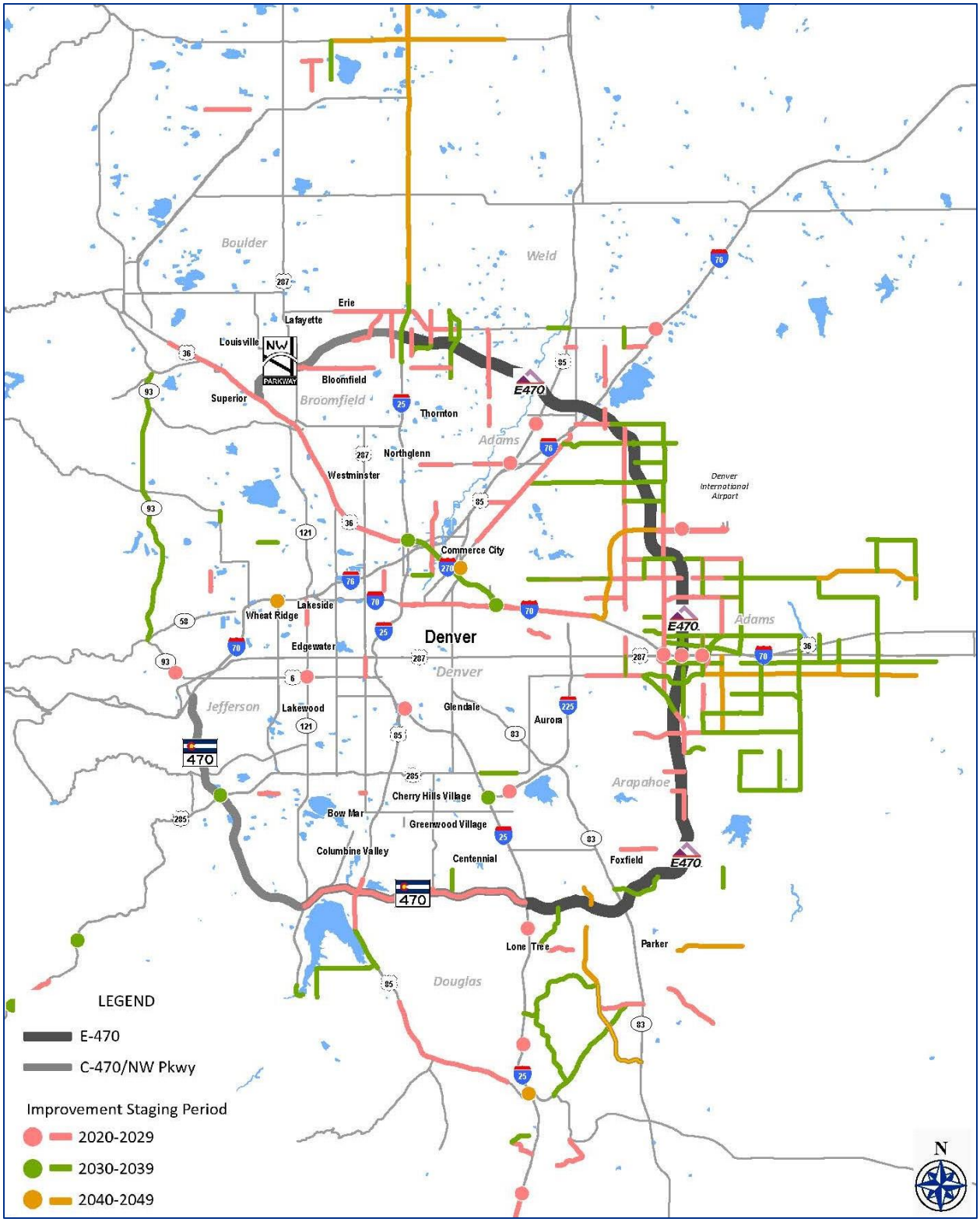


Figure 4-1 DRCOG 2050 Metro Vision Regional Transportation Projects

Three significant regional improvements were explored based on their relation to the RTP project list.

- **Jefferson Parkway** – The RTP list includes the Jefferson Corridor and Interlocken Loop improvements associated with the extension of Northwest Parkway and the addition of Jefferson Parkway. However, based on discussions with E-470 staff and the latest information available, it was decided not to include these improvements in the analysis.
- **C-470 Toll Express Lanes** – The C-470 Corridor Coalition completed the environmental planning process, and improvements are included in the RTP and in the forecasting model used for this study.
- **I-25 Managed Lanes Extension** – The RTP list includes the extension of the single managed lanes in each direction along I-25 between E-470 and Weld County Road 38 and between Crystal Valley Parkway and the El Paso County Line. These projects are included in the model used in this study.

In addition to the RTP project list, several additional improvements were included in the travel demand model owing to the projects' high likelihood of occurrence and proximity to the study corridor. One of these projects is the construction of Aurora Parkway between S. Ireland Way and Parker Road. This project is development-driven and developer-built and will provide a six-lane parallel facility to E-470 running between the Parker Road and S. Ireland Way interchanges. A number of additional Aurora Highlands developer-driven and -built projects are also included in the travel demand model.

The RTP document does not provide the estimated project completion date for future highway improvements. Instead, the plan indicates whether anticipated future-year highway improvements should be included in the 2030, 2040, or 2050 model networks. Impacts were applied in 2030, 2040, or 2050, as indicated in the planning documents.

4.4 E-470 Capital Program

The programmed E-470 widenings and interchange improvements are worth special attention due to their direct impact on the use of the toll system. **Table 4-4** and **Figure 4-2** show a list of E-470 capital improvement projects focusing on mainline widenings, new interchanges and new interchange ramps. This list of major E-470 improvement projects was developed based on information provided by E-470 staff and these projects were assumed in the forecasting model used for this study.

These projects include the addition of five new tolled interchanges, new direct ramps to two major interstates, and the effective addition of at least one travel lane to the full E-470 facility. These changes represent a major upgrade to the E-470 system, expanding capacity and providing new movements, which are reflected in the transaction and toll revenue forecasts.

Table 4-4 E-470 Major Improvement Projects

Completion Year	From	To	Improvement
2024	38th Ave.		New diamond interchange
2024	48th Ave.		New diamond interchange
2025	I-70	Pena Blvd.	Widen from 4 to 6 lanes
2025	Pena Blvd.	E 104th Ave.	Widen from 4 to 6 lanes
2026	Sable Blvd.		New diamond interchange
2028	E 104th Ave.	I-76	Widen from 4 to 6 lanes
2029	88th Ave.		New diamond interchange
2029	112th Ave.		New diamond interchange
2030	I-25 South	Parker Rd.	Widen from 6 to 8 lanes
2030	I-70		Ramp C - EB I-70 to SB E-470
2033	Parker Rd.	Smoky Hill Rd.	Widen from 6 to 8 lanes
2035	Smoky Hill Rd.	I-70	Widen from 6 to 8 lanes
2035	I-76		Ramp - NB E-470 to WB I-76
2036	I-70		Fully directional interchanges at I-70
2037	I-76	US 85	Widen from 4 to 6 lanes
2038	US 85	I-25 N	Widen from 4 to 6 lanes
2039	I-76		Ramp - WB I-76 to NB E-470
2040	Pena Blvd.	I-76	Widen from 6 to 8 lanes
2040	I-76		Remaining buildout of interchange

Figure 4-2 E-470 Major Improvement Projects

5.0 Traffic Model Update and Calibration

This section describes the refinements and calibration process of the travel demand model used in developing the forecasts, as well as the assumptions underlying these forecasts, such as toll rates, values of time, vehicle operating costs, and toll revenue leakage.

5.1 Forecasting Process

The overall forecasting process is illustrated on **Figure 5-1**. The updated forecast incorporates the results of the independent review of socioeconomic forecasts (discussed in Section 3), the most recent highway improvement assumptions, and the latest traffic data and counts to update the DRCOG trip tables.

Following the development of the updated trip tables, traffic assignments were run at 2022 levels; these served as the starting point for the model calibration process. Traffic assignments used CDM Smith's proprietary tolling algorithms within a Cube Voyager travel demand model platform. These algorithms were developed specifically to estimate the "market share" of the total traffic demand willing to pay tolls for different project configurations based on the amount of time savings provided by the toll facility (versus the most likely toll-free alternative route).

The calibration involved adjusting some parameters in the highway network, and adjustments to specific movements within the trip tables to ensure that model output volumes and speeds replicated actual conditions reasonably well. The base year (2022) traffic conditions used for model validation are described in Section 5.2.

Following calibration of the model, future trip tables representative of 2030, 2040, and 2050 demand levels were developed based on the updated socioeconomic assumptions provided by the independent economist and described further in Section 3. These trip tables also incorporated the calibration adjustments made to the 2022 trip tables. Traffic assignments were generated using CDM Smith's proprietary diversion assignment technique in Cube Voyager.

Traffic assignments were run at 2030, 2040, and 2050 levels with the updated trip tables and the model outputs were compared versus the "Base Case" assignments from the prior (2021) study. The traffic growth and other impacts estimated using the updated model were then applied to the actual volumes contained in the balanced profile to develop the future year transaction and revenue forecasts. These forecasts served as the basis upon which Felsburg Holt & Ullevig (FHU) performed a Level of Service Analysis, the results of which are summarized in **Appendix A**.

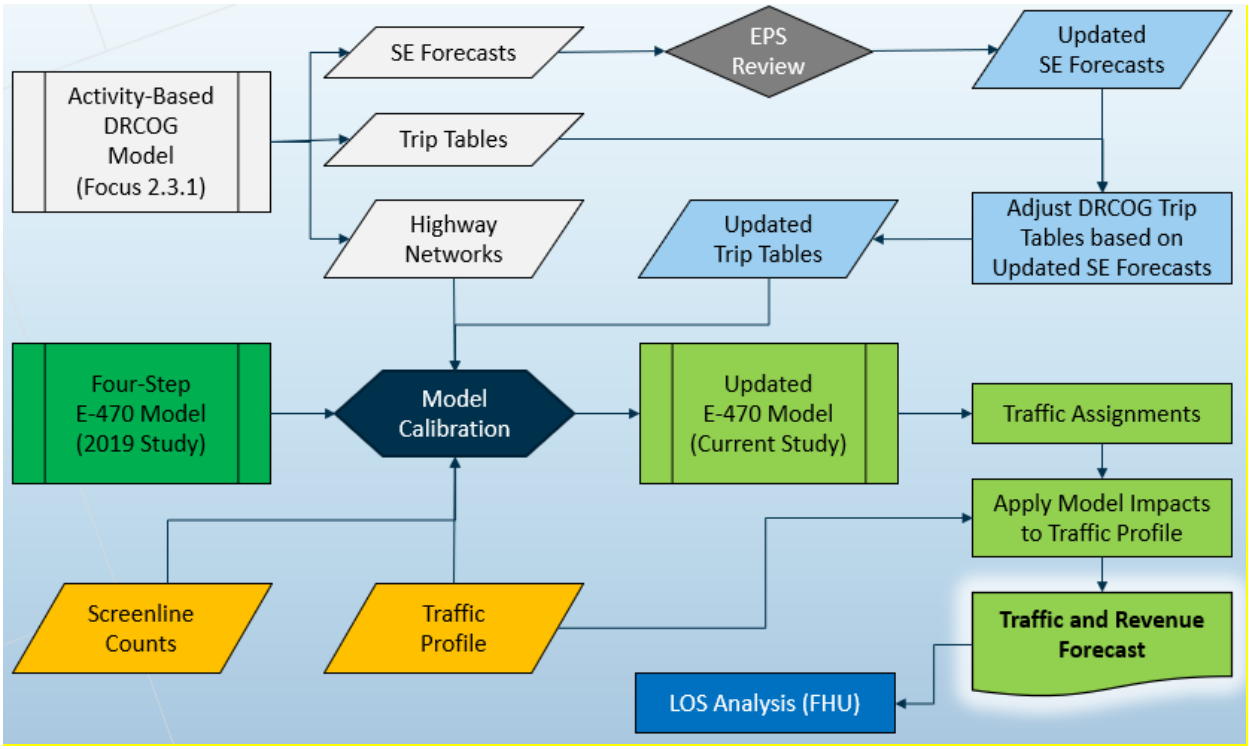


Figure 5-1 Forecasting Process

5.2 Base Year (2022) Model Calibration

The Base Year regional travel demand model used in the traffic and revenue forecasting process is based on 2022 annual average weekday traffic (AWDT) volumes. The model was validated using traffic count data and recent traffic trends. This included traffic volumes along E-470 and several model "screenlines" by time of day, method of payment, and vehicle class. Additionally, origin-destination data was used as a reference against modeled travel patterns.

5.2.1 Project Volume Screenlines

One way to test the results of the tolled traffic assignments is whether the total volume crossing a group of parallel routes called a screening, compares well with actual traffic volumes. CDM Smith developed five screenlines to assist in the calibration of the travel demand model, illustrated in **Figure 5-2**. CDM Smith obtained available traffic counts for the roadways along these screenlines from different sources, including E-470, CDOT, DRCOG, and ATD (All Traffic Data Services). These counts were previously conducted between 2017 and 2022. Based on historical traffic growth trends and monthly factors developed from the data provided by the Authority and from continuous counter information obtained from CDOT, the traffic counts were adjusted to 2022 AWDT levels. The resulting 2022 AWDT volumes along the five screenlines are provided in **Table 5-1.**

As expected, based on the available count data, the share of screenline traffic on E-470 varies by location. The share of traffic using E-470 at Screenline A is 7.3 percent. The share of traffic on E-470 at Screenlines B and C are 7.0 percent and 4.7 percent, respectively. These shares would probably be higher without the proximity of several major competing toll-free parallel roads, including I-25, I-225, Pena Boulevard, and Tower Road.

Of the five screenlines, Screenlines D and E have the greatest share of traffic using E-470, with market shares of 11.8 percent and 10.2 percent, respectively. These higher market shares reflect the smaller number of competing parallel facilities at these locations. For example, E-470 serves as one of only seven crossings of the South Platte River in the ten miles between E 160th Avenue and E 88th Avenue.

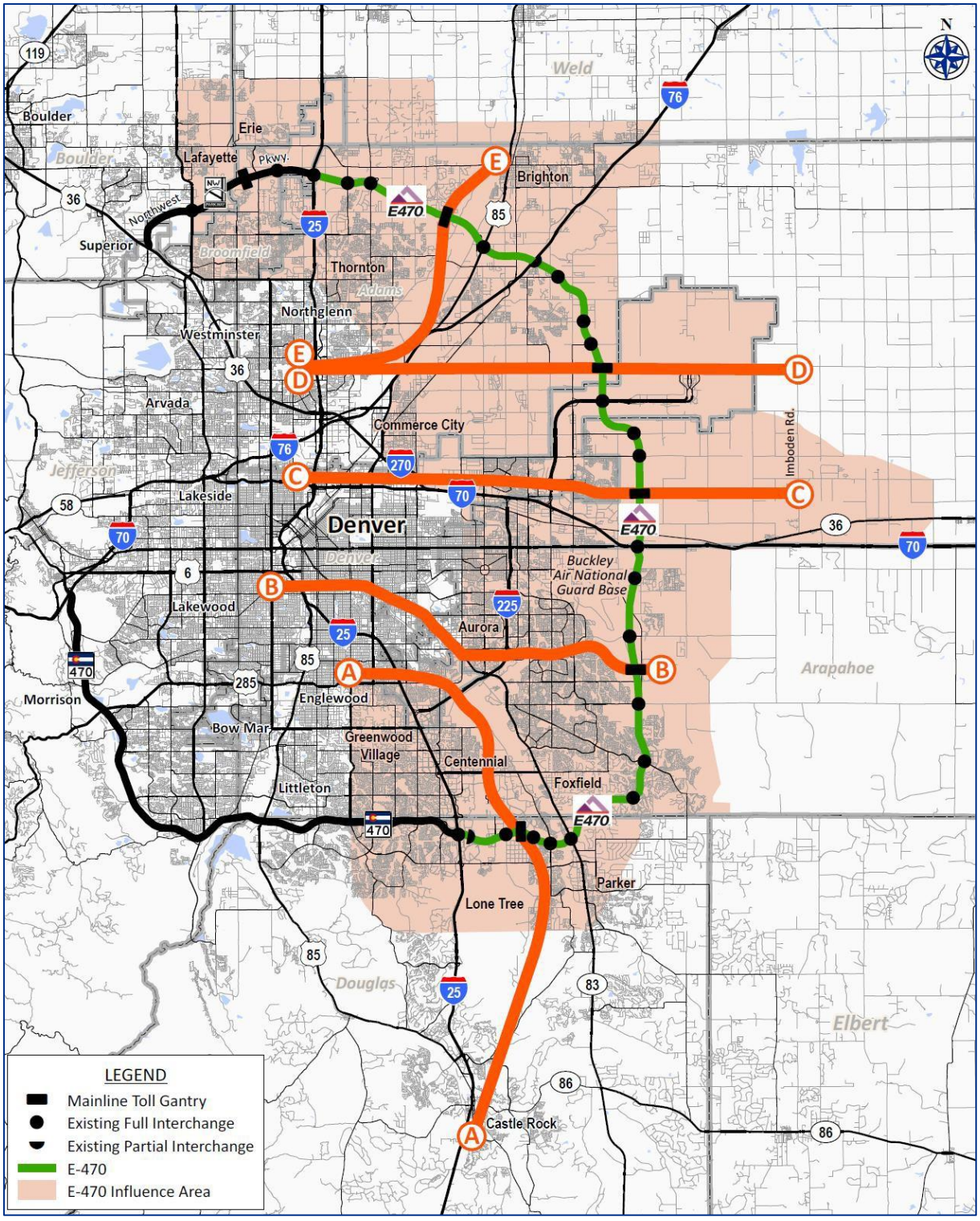


Figure 5-2 Project Screenlines

Table 5-1 2022 Annual Average Weekday Traffic Volumes at Screenline Locations

Name	Location	Annual Average Weekday Traffic (AWDT)		
		Northbound	Southbound	Total
Screenline A				
I-25	SH 30 / E Hampden Ave.	123,220	130,380	253,599
SH 30	E Dartmouth Ave.	20,318	20,981	41,300
I-225	SH 83 / Parker Rd.	83,000	81,200	164,200
Dam Rd.	SH 83 / Parker Rd.	4,123	3,325	7,448
SH 88 / E Arapahoe Rd.	S Peroia St.	30,292	28,401	58,694
E Broncos Pkwy.	S Potomac St.	8,589	8,292	16,881
E County Line Rd.	Concord Center Dr.	4,049	4,491	8,541
Compark Blvd.	Concord Center Dr.	2,928	3,046	5,974
E-470	**Toll Gantry A**	23,229	25,439	48,668
E Lincoln Ave.	S Peoria St.	19,399	18,679	38,078
Ridgegate Pkwy.	S Peoria St.	7,855	8,025	15,880
Hess Rd.	S Havana St.	3,931	3,628	7,559
Total Screenline A		**330,933**	**335,887**	**666,820**
E-470 % Market Share for Screenline A		*7.0%*	*7.6%*	*7.3%*
Screenline B				
I-25	SH 6 / 6th Ave.	96,520	121,912	218,431
SH 2 / S Colorado Blvd.	E 1st Ave.	26,799	25,101	51,900
SH 30 / S Havana St.	SH 83 / S Parker Rd.	16,922	17,320	34,242
S Peoria St.	E Iliff Ave.	11,688	11,291	22,978
I-225	SH 83 / S Parker Rd.	75,775	69,079	144,854
S Chambers Blvd.	E Iliff Ave.	15,092	16,600	31,692
S Buckley Rd.	E Iliff Ave.	11,858	11,770	23,628
S Tower Rd.	E Iliff Ave.	13,429	12,950	26,379
S Dunkirk St.	E Iliff Ave.	2,596	2,266	4,862
E-470	**Toll Gantry B**	**21,295**	**22,044**	**43,339**
SH 30 / S Gun Club Rd.	E Jewell Ave.	10,772	10,113	20,885
Total Screenline B		**302,745**	**320,445**	**623,189**
E-470 % Market Share for Screenline B		*7.0%*	*6.9%*	*7.0%*
Screenline C				
I-25	I-70	124,081	118,758	242,839
SH 265 / Brighton Blvd.	York St.	4,530	4,770	9,300
SH 6 / Vasquez Blvd.	I-70	9,320	13,606	22,926
SH 2 / Colorado Blvd.	I-70	17,364	16,186	33,550
I-270	I-70	48,907	42,318	91,224
Central Park Blvd.	I-70	16,354	13,644	29,998
Havana St.	I-70	15,716	13,747	29,463
Peoria St.	I-70	22,268	16,592	38,859

Name	Location	Annual Average Weekday Traffic (AWDT)		
		Northbound	Southbound	Total
Chambers Rd.	E 40th Ave.	17,073	19,609	36,682
Pena Blvd.	E 40th Ave.	57,103	52,848	109,951
Tower Rd.	Green Valley Ranch Blvd.	11,430	12,626	24,056
Picadilly Rd.	Green Valley Ranch Blvd.	3,070	3,325	6,396
E-470	**Toll Gantry C**	**16,743**	**16,232**	**32,975**
Mohegan Rd.	E 56th Ave	421	455	877
Total Screenline C		**364,380**	**344,714**	**709,094**
E-470 % Market Share for Screenline C		*4.6%*	*4.7%*	*4.7%*
Screenline D				
I-25	E 88th Ave.	87,798	92,966	180,765
I-76	E 88th Ave.	48,036	47,501	95,537
Brighton Rd.	E 88th Ave.	1,731	1,772	3,503
Rosemary St.	E 88th Ave.	6,580	7,405	13,985
SH 2	E 88th Ave.	600	1,027	1,626
Tower Rd.	E 88th Ave.	20,746	20,513	41,259
E-470	**Toll Gantry D**	**21,402**	**23,531**	**44,933**
Total Screenline D		**186,894**	**194,714**	**381,608**
E-470 % Market Share for Screenline D		*11.5%*	*12.1%*	*11.8%*
Screenline E				
I-25	E 88th Ave.	87,798	92,966	180,765
E 88th Ave.	South Platte River	12,901	12,205	25,106
McKay Rd.	South Platte River	8,968	9,058	18,025
SH 44 / E 104th Ave.	South Platte River	7,847	7,694	15,541
E 120th Ave.	South Platte River	7,871	8,346	16,217
Henderson Rd.	South Platte River	2,743	3,095	5,838
E-470	**Toll Gantry E**	**15,894**	**16,836**	**32,729**
SH 7 / E 160th Ave.	South Platte River	9,782	9,716	19,498
E 168th Ave.	South Platte River	2,932	2,713	5,644
Total Screenline E		**156,734**	**162,629**	**319,363**
E-470 % Market Share for Screenline E		*10.1%*	*10.4%*	*10.2%*

5.2.2 E-470 Weekday Traffic Profile (2022)

Estimated 2022 average weekday traffic (AWDT) volumes for E-470 mainline segments and ramps are provided in **Figure 5-3**. AWDT estimates are shown based on counts and as derived from the model. All volumes are presented in thousands of vehicles.

For the mainline toll gantries, the difference between modelled and actual volumes range between -3.3 percent (at toll gantries B and C) and +1.4 percent at toll gantry A. With only one exception, all mainline

locations between I-25 (north end) and I-25 (south end) show a difference below 10 percent between counts and modeled volumes.

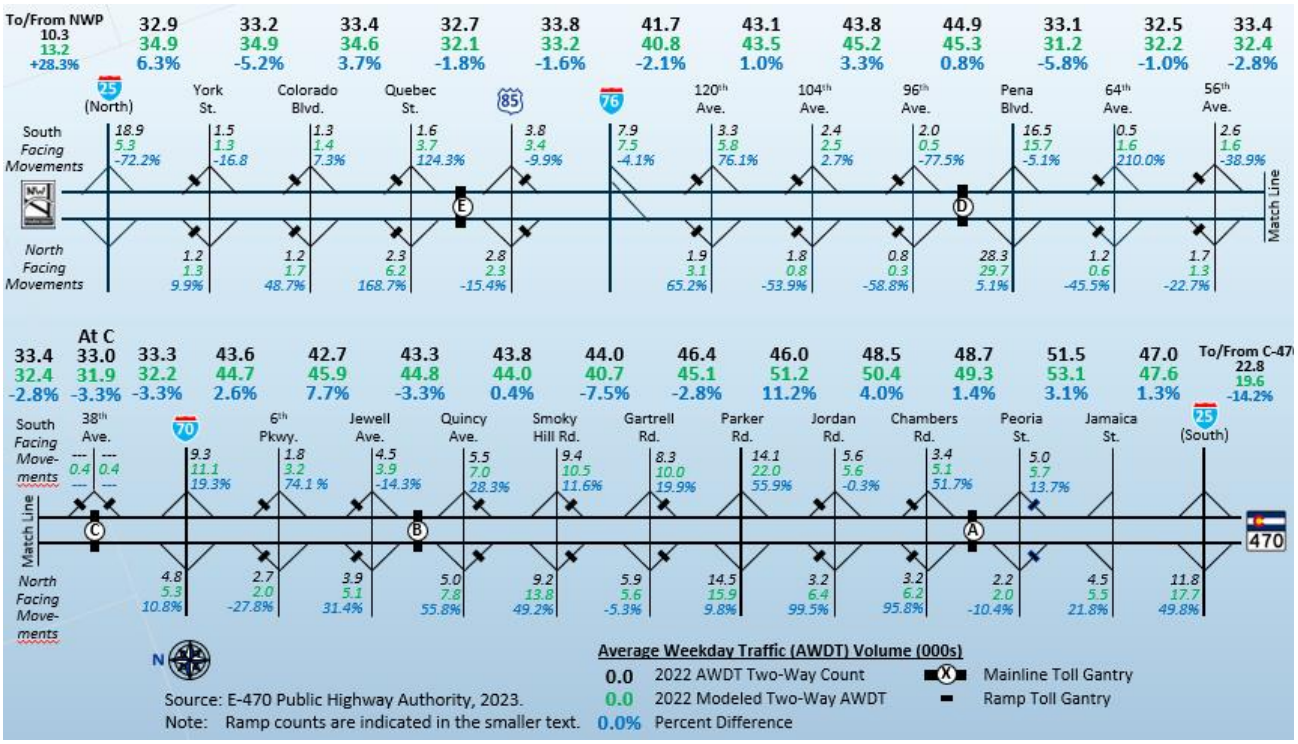


Figure 5-3 E-470 Weekday Traffic Profile (2022)

A similar comparison is shown on **Figure 5-4** by plotting mainline and ramp counts compared to model volume outputs. Overall, there is a good match between model volumes and actual traffic counts, indicating that the calibration matched or exceeded the guidelines included in the Federal Highway Administration's NCHRP 255 report.

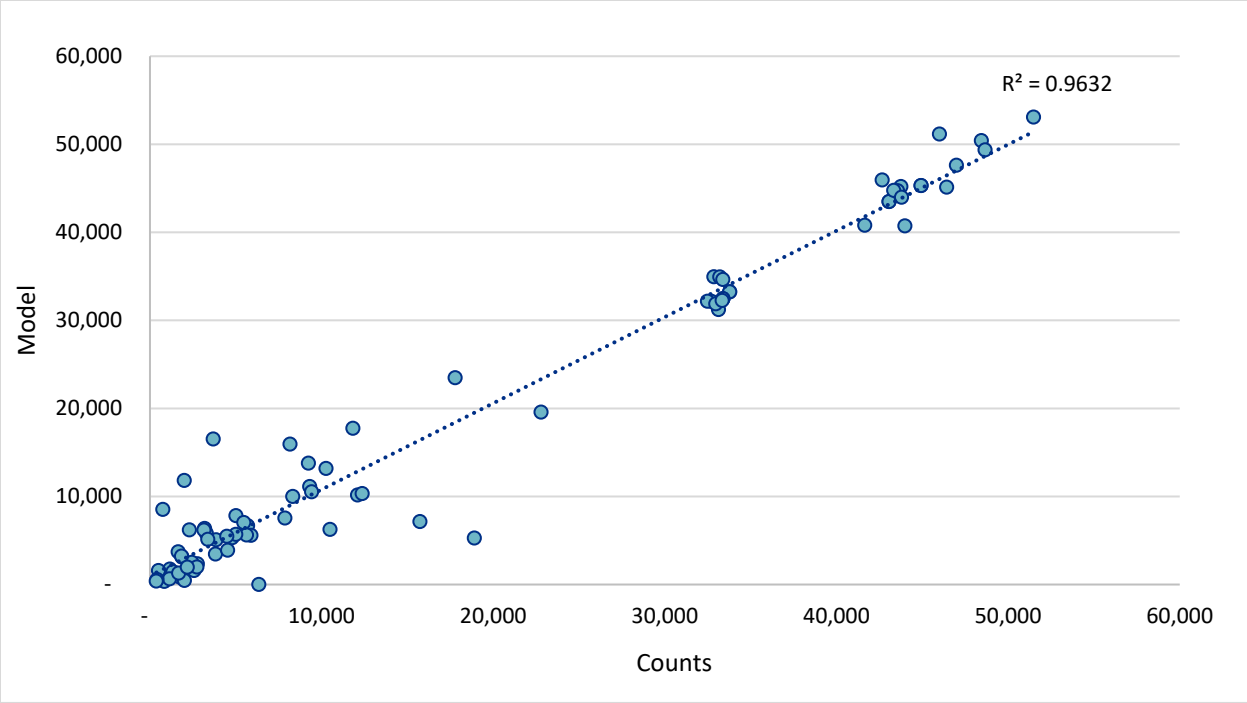


Figure 5-4 E-470 Mainline and Ramp Counts vs Model (2022)

5.3 Forecast Assumptions

Highway network improvements on E-470 and other regional facilities are described in Section 4, while regional and corridor growth assumptions were reviewed in Section 3 of this document. Other important assumptions underlying the T&R forecast are presented in this section, including toll rates, vehicle operating costs, values of time, method of payment, truck share, inflation and leakage loss.

5.3.1 Toll Rates

E-470 has a total of 22 toll locations including five mainline toll gantries and 17 ramp toll gantries located at E-470 interchanges. **Table 5-2** shows the 2022 toll rates on E-470 by payment type for passenger cars.

Table 5-2 E-470 Passenger Car Toll Rates (2022)

Toll Gantry	ETC	LPT
Gantry A	$2.60	$4.20
Gantry B	$2.90	$4.60
Gantry C	$2.65	$4.25
Gantry D	$2.90	$4.60
Gantry E	$2.90	$4.60
Ramps	$1.25	$2.05

ETC: Electronic Toll Collection (ExpressToll)
LPT: License Plate Tolling

Commercial vehicles are charged by the axle based on a modified “N-1” system. Beyond 2-axles, each additional axle is charged at roughly 90 percent of the 2-axle vehicle toll. For modeling purposes, the

average toll rate for commercial vehicles was used based on the average number of axles observed at mainline toll locations. This average commercial vehicle full toll rate was roughly 3.2 times the passenger car rate. A 20 percent discount is provided to 3-or-more axle ExpressToll vehicles between 9:00 AM and 12:00 PM. These discounted commercial vehicle toll rates were included in the traffic assignment process.

Based on direction from E-470 Staff, no toll rate increases were assumed. Thus, it was assumed that passenger cars and commercial vehicles will continue to pay the current toll 2022 rates at all mainline gantries and ramp toll locations throughout the forecast period.

5.3.2 Vehicle Operating Costs

Vehicle operating costs include fuel cost, as well as maintenance, oil, and tires. Factors such as depreciation and insurance are not included in the vehicle operating cost estimate. A vehicle operating cost of $0.268 per mile for passenger cars in 2022 was estimated. Future vehicle operating costs were then projected based on gas/diesel price forecasts from the Energy Information Administration (EIA), fuel efficiency improvements based on current national CAFÉ standards, and inflation assumptions derived from the latest economic outlook published by the Congressional Budget Office (CBO).

5.3.3 Values of Time

The prior study had estimated 2019 Values of Time (VOTs) by combining the VOTs developed from Stated Preference (SP) surveys conducted as part of the 2017 Investment-Grade Traffic and Revenue Study, county-level VOTs generated based on data obtained from the U.S. Census Bureau American Community Survey, information from initial model validation runs to estimate the current share of eligible trips using the toll road, and estimated shares by trip purpose from the regional travel demand model.

For this planning-level study, the 2019 VOT values at the county level were adjusted through 2022 based on actual hourly earnings increases derived from Census data: population, hours worked, and household income. Future VOT values were then estimated using inflation assumptions derived from the latest CBO economic outlook.

5.3.4 Method of Payment

Since July 4, 2009, E-470 has implemented a cashless toll collection system, providing two methods of toll payment: electronic toll collection through ExpressToll, and license plate tolling (LPT).

The analysis of recent transaction data indicated that the proportion of transactions paid through ExpressToll was about 76 percent. The share of ExpressToll traffic compared to LPT traffic has remained relatively stable before and after the COVID-19 Pandemic. As shown in **Table 5-3**, it is anticipated that the share of ExpressToll transactions will slightly increase to reach 78 percent in 2030 and remain stable thereafter.

Table 5-3 Method of Payment

Year	ETC	LPT
2022	76.4%	23.6%
2023	76.3%	23.7%
2024	76.0%	24.0%
2030	78.0%	22.0%
2040	78.0%	22.0%
2050	78.0%	22.0%

ETC: Electronic Toll Collection (ExpressToll)
LPT: License Plate Tolling

5.3.5 Truck Share of Transactions

Truck transactions represented 5.3 percent of all transactions in 2022 and decreased to about 4.6% in 2023 based on data available at the time of this study. Future truck shares are anticipated to remain below 5% as shown in **Table 5-4**.

Table 5-4 Share of Truck Transactions

Year	Truck %
2022	5.3%
2023	4.6%
2030	4.3%
2040	4.6%
2050	4.6%

5.3.6 Inflation

Historical inflation rates for the Denver area are based on the Consumer Price Index (CPI) from Bureau of Labor Statistics. Future inflation rates derived from the latest economic outlook published by the Congressional Budget Office (CBO). The resulting inflation assumptions used in this study are shown in **Table 5-5**.

Table 5-5 Annual Inflation Rates

Year	Inflation
2023	4.2%
2024	2.9%
2025	2.3%
2026	2.1%
2027	2.1%
2028-2050	2.0%

5.3.7 Annualization Factor

To estimate annual transactions, the average weekday transaction estimates developed from the weekday traffic assignments are annualized by method of payment. Based on actual daily-level 2022 data provided by the Authority, annualization factors of 328.5 and 337.7 were calculated for ExpressToll and LPT transactions, respectively. Combining all payment types, the overall annualization factor in 2022 was 331.0. This reflects the relationship between an average weekday and the annual totals. Weekday

traffic is slightly higher than the 7-day average traffic hence the annualization factor of less than 365 is used.

An annualization factor of 330.5 was assumed for future years in the forecast.

5.3.8 Leakage Loss

Revenue forecasts presented in this study include gross toll revenue and net toll revenue. Net toll revenue reflects leakage loss typically due to unreadable plates or uncollectable ExpressToll or LPT transactions. More generally, leakage includes any transactions that cannot be processed, and payment collected. Leakage estimates have been developed using actual historical data provided by the Authority. In 2022, the observed leakage rate was 15.6% and it is expected to be 15.1% in 2023 based on data available through September 2023. Moving forward, leakage rates are anticipated to be slightly lower based on additional improvements in technology and collections. In this study, it was assumed that starting in 2030, the leakage loss would remain stable at 14.5% of gross toll revenue as shown in **Table 5-6**.

Table 5-6 Leakage Loss

Year	Leakage
2022	15.6%
2023	15.1%
2030	14.5%
2040	14.5%
2050	14.5%

6.0 Traffic and Revenue Forecasts

The final products of this analysis are the estimates of annual toll transactions and toll revenue under the Base Case assumptions, a comparison of these forecasts with the last CDM Smith forecasts (December 2021 update letter) and select sensitivity tests dealing with varying toll rates and potential recession impacts.

6.1 Estimated Base Case Traffic and Revenue

Updated traffic and revenue forecasts over a 30-year projection period (2024-2053) are provided in this section. These forecasts were based on traffic assignments for years 2022, 2030, 2040, and 2050, incorporating all assumptions previously described in this report. Interim years were estimated through interpolation between model years, while forecast years beyond 2050 were extrapolated based on the model year forecasts.

6.1.1 Base Case Traffic and Revenue Stream

The annual toll transaction and revenue estimates through 2053 resulting from the updates and assumptions described in this study are provided for the total E-470 system in **Table 6-1**. These reflect the Base Case conditions.

E-470 annual performance in 2022 is based on actual reported toll transactions and revenue. At the time of this study, 2023 data were available through the end of the year, with the revenue data still being unaudited. As described in Section 2 analyzing recent traffic trends, annual transactions in 2023 exceeded 2019 (pre-COVID 19) levels by approximately 5.8 percent. This effectively represents a four-year lag in growth as a result of the Pandemic and its impact on E-470 traffic.

With the combined effects of socioeconomic regional trends, major development projects in the E-470 corridor and highway network improvements on E-470 and other regional facilities, transactions on E-470 are estimated to increase to 114.6 million in 2030, 143.9 million in 2040, and 176.4 million in 2050. This trend represents annual traffic growth rates of 3.6% between 2022 and 2030, 2.3% between 2030 and 2040, and 2.1% between 2040 and 2050.

Annual toll revenue estimates are also provided in **Table 6-1**. Gross toll revenues, excluding revenue adjustments to account for non-revenue vehicles, unbillable license plate toll images and unpaid license plate toll transactions, were calculated by multiplying the estimated transactions by the nominal toll rates, as previously mentioned. Gross toll revenues are estimated to increase from an actual of $274.0 million in 2022 to $353.1 million in 2030, $442.7 million in 2040, and $543.2 million in 2050. This represents an average systemwide growth rate in gross revenue of 3.2 percent between 2022 and 2030, 2.3 percent between 2030 and 2040, and 2.1 percent between 2040 and 2050.

Adjustments for uncollectible and unpaid revenue were developed to estimate net toll revenues, which include revenue adjustments to account for non-revenue vehicles, unbillable license plate toll images and unpaid license plate toll transactions. Leakage assumptions were described in section 5.3.8. As a result, net toll revenues are estimated to be $258.5 million in 2024, $301.7 million in 2030, $378.3 million in 2040, and $464.2 million in 2050.

Table 6-1 Estimated Base Case Annual Transactions and Revenue (in thousands)

Year	Transactions (000s)	Gross Revenue[1] ($000s)	Net Revenue[2] ($000s)
2022[3]	86,184	$273,970	$231,326
2023[3]	95,532	$277,116	$259,872
2024[4,5]	96,963	$304,461	$258,472
2025[6]	99,575	$311,347	$264,422
2026[5]	102,378	$319,081	$271,182
2027	104,852	$326,492	$277,765
2028[4,6]	108,432	$337,442	$287,450
2029[5]	110,740	$341,653	$291,431
2030[5,6]	114,629	$353,105	$301,744
2031	117,083	$360,674	$308,205
2032[4]	119,938	$369,452	$315,701
2033[6]	122,527	$376,726	$321,914
2034	125,157	$384,738	$328,758
2035[5,6]	128,127	$394,702	$337,278
2036[4,5]	130,155	$400,482	$342,220
2037[6]	133,354	$409,220	$349,687
2038[6]	137,565	$422,230	$360,809
2039[5]	140,572	$431,367	$368,633
2040[4,5,6]	143,891	$442,741	$378,341
2041	146,463	$450,727	$385,163
2042	149,497	$460,125	$393,190
2043	152,599	$469,729	$401,396
2044[4]	156,199	$480,858	$410,904
2045	159,017	$489,577	$418,354
2046	162,336	$499,830	$427,116
2047	165,732	$510,311	$436,073
2048[4]	169,670	$522,451	$446,450
2049	172,760	$531,973	$454,590
2050	176,396	$543,167	$464,160
2051	179,372	$552,320	$471,987
2052[4]	182,903	$563,176	$481,269
2053	185,492	$571,121	$488,063

Notes:
(1) Gross revenue does not include adjustments for unbillable or uncollectable toll revenue.
(2) Net revenue includes adjustments for unbillable or uncollectable toll revenue.
(3) Includes actual data through December 2023 (unaudited figures).
(4) Leap year.
(5) Assumed new interchange or interchange improvement for E-470.
(6) Assumed widening of various segments of the E-470 mainline.

6.1.2 Comparison with Prior Forecast (2021)

Figure 6-1 and **Figure 6-2** present a comparison of the estimated annual transactions and revenue for both the current study Base Case and the prior 2021 forecast documented in the December 2021 update letter.[2] In addition to updated socioeconomic projections, highway improvements, ExpressToll participation rate, VOT, VOC, and toll revenue leakage assumptions, the major difference in the current study over the 2021 study is revised toll rate assumptions.

In the current study Base Case scenario, toll rates are assumed to be held constant at 2022 levels throughout the forecast horizon. Under the 2021 forecast, toll rates were assumed to decrease in 2022 by $0.10 at Gantry A and $0.05 at Gantries B, C, D, and E for both the ExpressToll and LicensePlateToll toll rates. Toll rates were then assumed to be further reduced by the same amounts in 2023 and again in 2024. The analysis then assumed that toll rates would be held constant for all forecast years after 2024.

Between 2023 and 2030, annual systemwide transactions under the current study Base Case are estimated to track closely with the 2021 forecast, with differences varying between -1.7% and 1.5%. However, with higher toll rates in the current study, the resulting net revenue is higher by a margin of 2.0% to 4.6% in the period 2023-2030. By 2034, the new transaction forecast is 7.1% lower than the prior forecast, which produces a net revenue of 3.2% lower than the prior forecast.

From 2035 to 2050, the new forecasted annual transactions are consistently lower than in the prior forecast by a margin varying between -11.0% and -7.6%. This reduced number of transactions leads to new forecasted net revenue lower than in the prior forecast by a margin varying between -6.9% and -2.1%.

[2] 2021 Transaction and Revenue Forecast Update Letter Assuming Toll Rates Approved November 2021. Prepared by CDM Smith for E-470 Public Highway Authority. December 15, 2021.

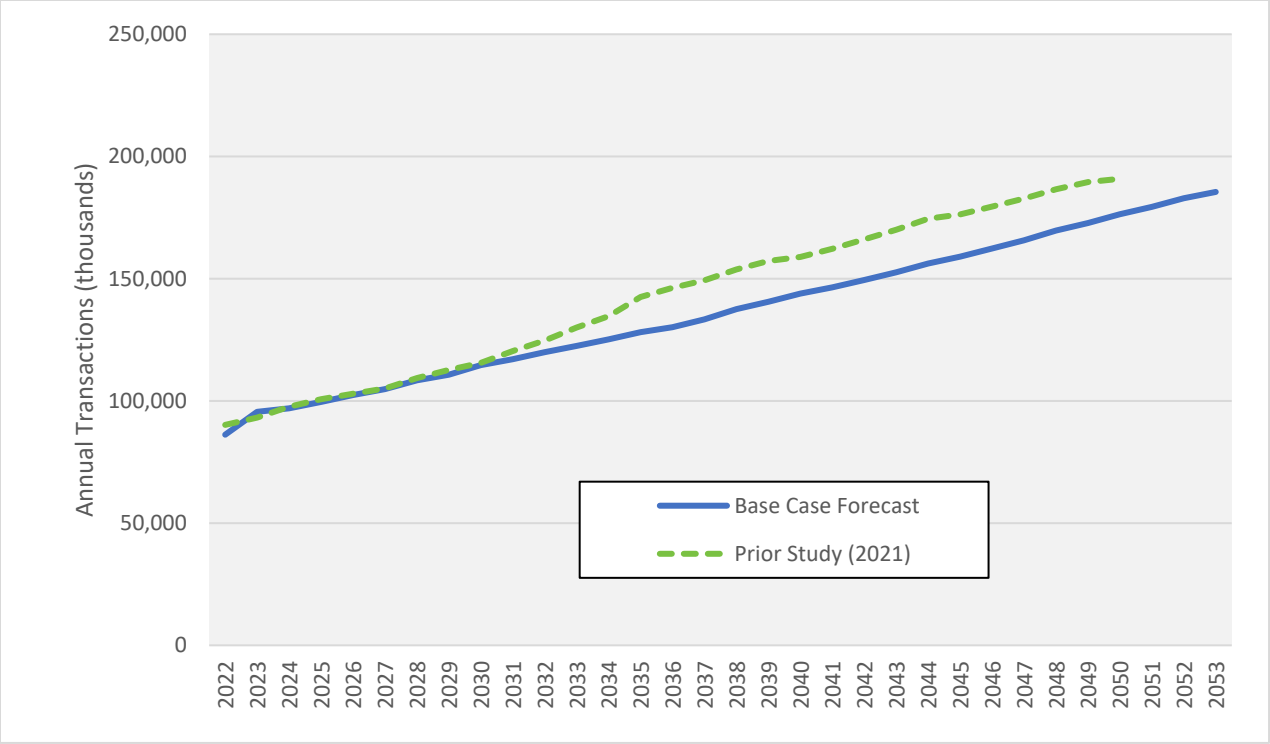


Figure 6-1 Annual Transactions (in thousands)

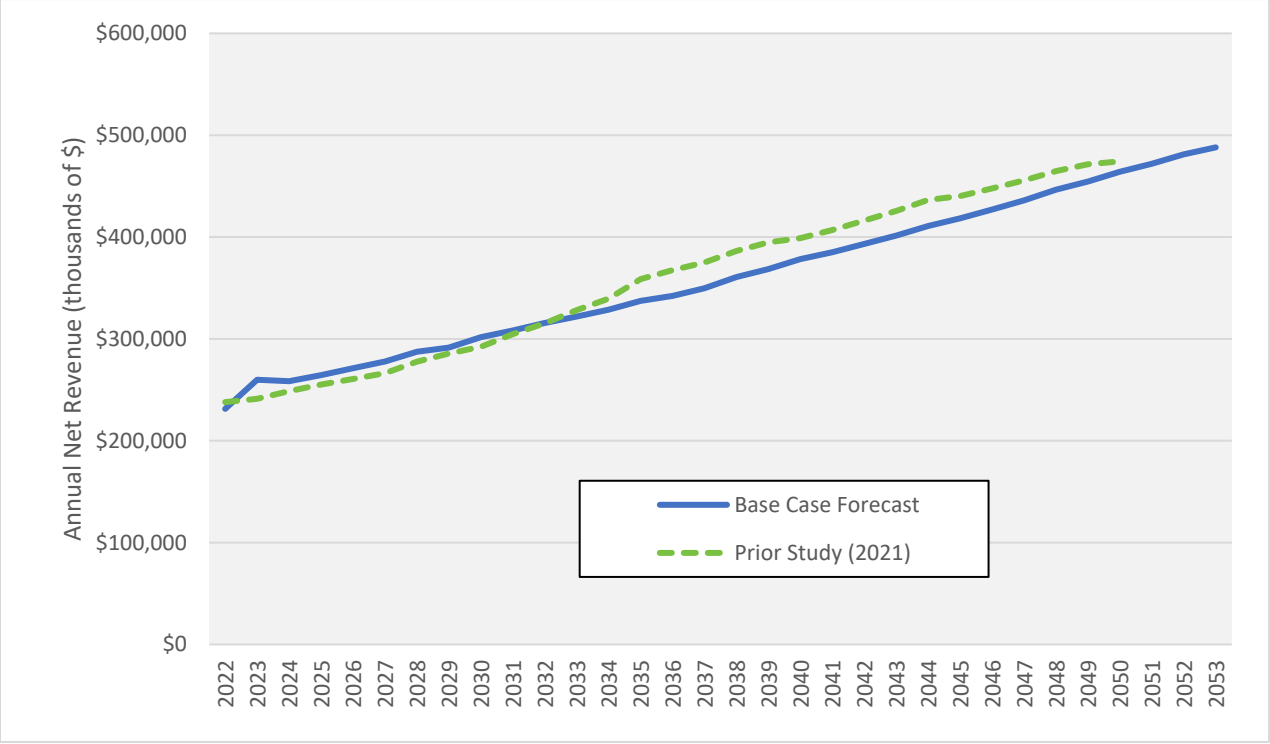


Figure 6-2 Annual Net Toll Revenue (in thousands of $)

6.2 Sensitivity Tests

Two types of sensitivity tests were conducted as part of this study to evaluate the potential impact of deviating from some of the assumptions included in the Base Case scenarios.

The first sensitivity test relates to toll rates and evaluates how transactions and revenue would vary under a range of toll rates, either below or above the toll rates assumed in the Base Case scenarios.

In the second sensitivity test, changes in short-term economic conditions were studied to account for a possible recession in the United States.

6.2.1 Toll Rate Sensitivity

The toll rate sensitivity test evaluates the impacts on transactions and revenue resulting from increases or decreases in toll rates. The resulting transaction and toll revenue estimates can be plotted on a graph as a toll sensitivity curve, illustrating the diversion effects.

The toll sensitivity analysis was performed at each mainline gantry for the years 2022 and 2040. This toll sensitivity analysis provides an indication of the revenue-optimizing toll rate for each mainline gantry and shows where currently approved schedule toll rates lie with respect to revenue maximization.

Toll sensitivity traffic assignments were run at 2022 and 2040 levels, assuming mainline toll rates above or below the current toll rates in increments of $0.50. Toll sensitivity was considered on a gantry-by-gantry basis in order to understand the relative toll sensitivity of each segment of the E-470 system.

The resulting toll sensitivity curves are presented by mainline toll gantry in **Figure 6-3** and **Figure 6-4**, respectively, for the years 2022 and 2040. Curves are also shown for the total E-470 system. The points on each curve show the assumed passenger car ExpressToll rates in each of the future years used in the traffic and revenue analysis, as well as the revenue-maximizing toll rates.

In 2022, it is estimated that ExpressToll rates for mainline toll gantries are $0.55 to $1.10 below the top of the toll revenue curve, meaning that, in theory, revenues could be increased by increasing the toll rates.

By 2040, the top of the toll revenue curves has shifted slightly to the right, indicating that the theoretical optimum toll rate has increased. This increase is due primarily to assumed inflationary increases in the VOT as well as increased congestion levels on parallel toll-free facilities. At 2040 levels, the assumed ExpressToll rates continue to fall below the theoretical revenue-maximizing toll rates by $1.00 to $1.60 (in 2040 dollars).

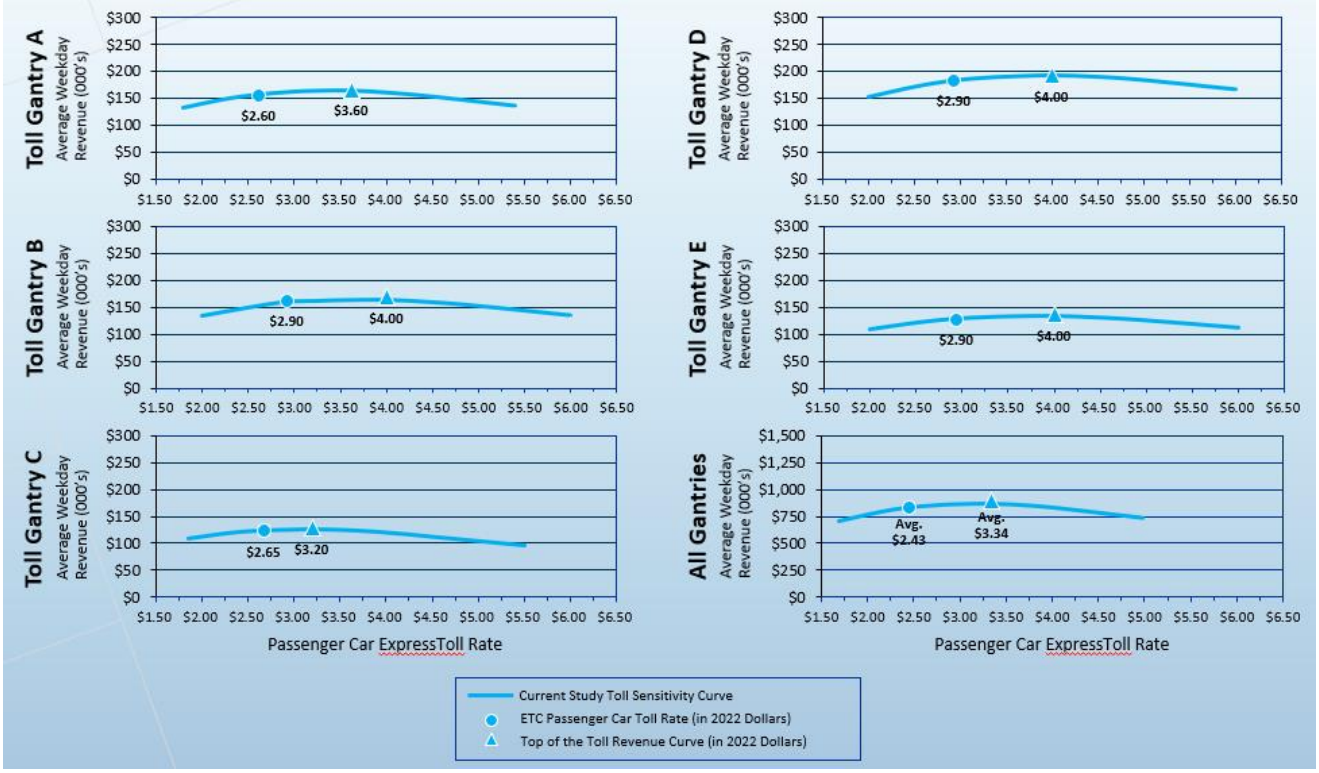


Figure 6-3 2022 Gross Toll Revenue Toll Sensitivity Curves

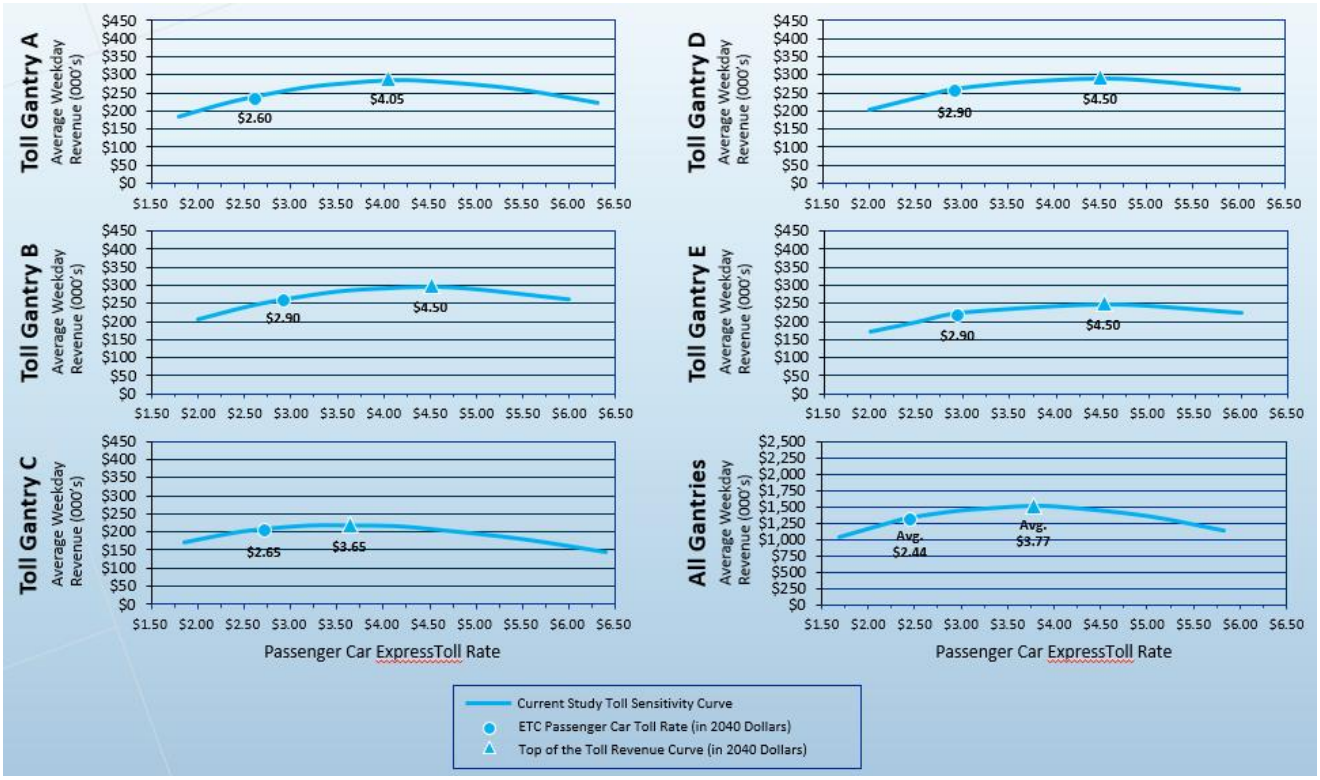


Figure 6-4 2040 Gross Toll Revenue Toll Sensitivity Curves

6.2.2 Recession Impacts

Changes in short-term economic conditions were studied to account for a possible recession in the United States in 2024. The impacts on E-470 traffic and revenue were evaluated based on a review of the facility's toll performance during the Great Recession (2008-2009) and the following recovery year (2010). For these three years, the effective recession impacts on systemwide transactions were identified by comparing actual year-over-year changes in 2008, 2009, and 2010 against normal growth trends observed over the 2006-2023 period.

For this analysis, it was assumed that the recession conditions would follow a similar three-year cycle, with an economic downturn affecting traffic in 2024/2025, followed by a recovery in 2026. The effective recession impacts were assumed to be less severe than in the case of the Great Recession. Two scenarios were considered: 30% of Great Recession impacts in Recession Scenario A, and 50% of Great Recession impacts in Recession Scenario B.

The resulting estimated annual transactions and net revenue for the period 2022 through 2028 are shown in **Table 6-2** for Recession Scenario A and **Table 6-3** for Recession Scenario B. The tables also present a comparison of annual transactions and revenue against the Base Case forecast.

Recession Scenario A results in transactions and revenue down by 2.4% in 2024, 5.0% in 2025, and 3.8% in 2026 and beyond, compared to the Base Case scenario. By the end of year 2026 (assumed recovery year), revenues are 3.4% higher than in 2023 (before the assumed recession).

Recession Scenario B results in transactions and revenue down by 3.9% in 2024, 8.3% in 2025, and 6.4% in 2026 and beyond, compared to the Base Case scenario. By the end of year 2026 (assumed recovery year), revenues are 0.6% higher than in 2023 (before the assumed recession).

The results are also shown graphically in **Figure 6-5** and **Figure 6-6**.

Table 6-2 Estimated Annual Transactions and Revenue for Recession Scenario A

Year	Transactions (000s; *% change*)		Net Revenue ($000s; *% change*)	
2022	86,184	*0.0%*	$231,326	*0.0%*
2023	95,532	*0.0%*	$259,872	*0.0%*
2024	94,669	*-2.4%*	$252,356	*-2.4%*
2025	94,550	*-5.0%*	$251,078	*-5.0%*
2026	98,465	*-3.8%*	$260,817	*-3.8%*
2027	100,844	*-3.8%*	$267,148	*-3.8%*
2028	104,288	*-3.8%*	$276,463	*-3.8%*

Note: % change represents the difference with the Base Case forecast

Table 6-3 Estimated Annual Transactions and Revenue for Recession Scenario B

Year	Transactions (000s; *% change*)		Net Revenue ($000s; *% change*)	
2022	86,184	*0.0%*	$231,326	*0.0%*
2023	95,532	*0.0%*	$259,872	*0.0%*
2024	93,139	*-3.9%*	$248,279	*-3.9%*
2025	91,272	*-8.3%*	$242,373	*-8.3%*
2026	95,858	*-6.4%*	$253,911	*-6.4%*
2027	98,174	*-6.4%*	$260,074	*-6.4%*
2028	101,526	*-6.4%*	$269,143	*-6.4%*

Note: % change represents the difference with the Base Case forecast

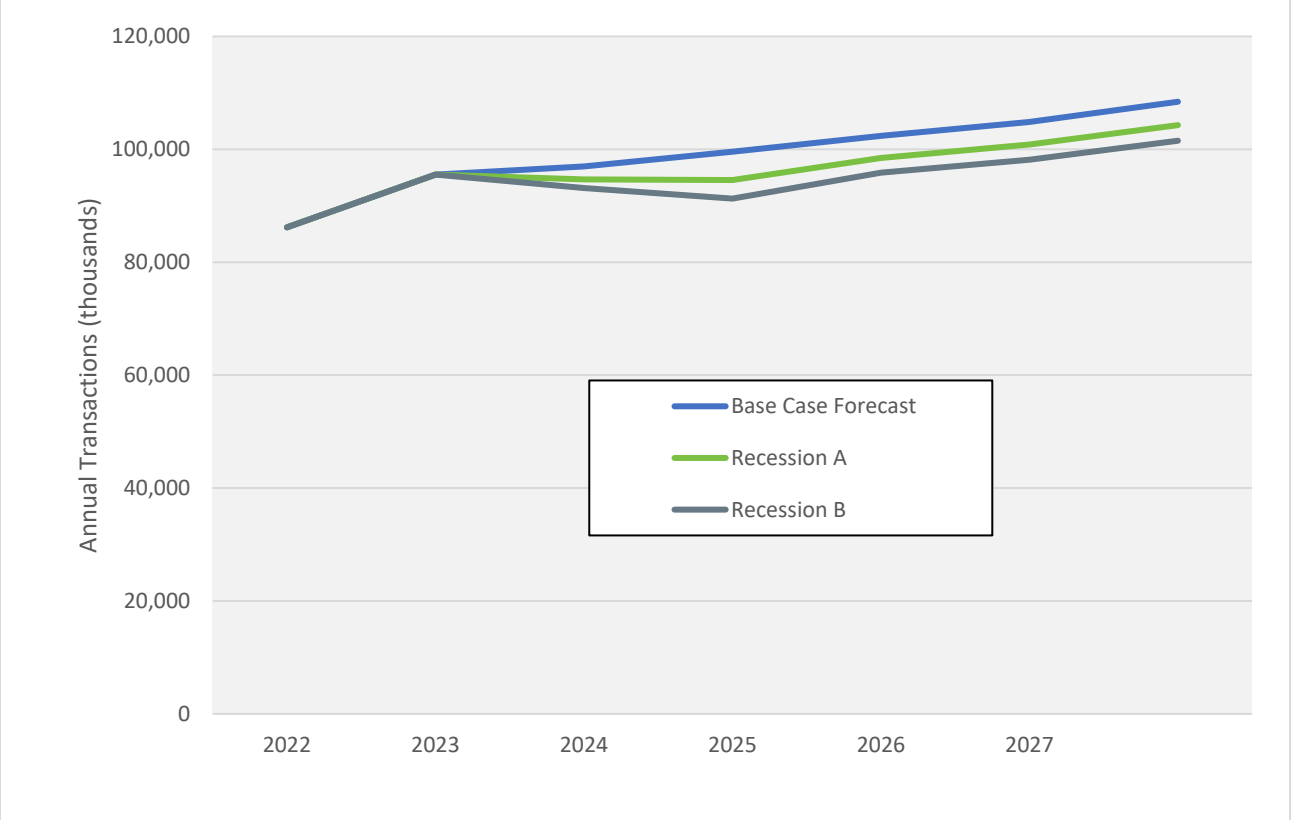


Figure 6-5 Recession Scenario Forecasts - Transactions

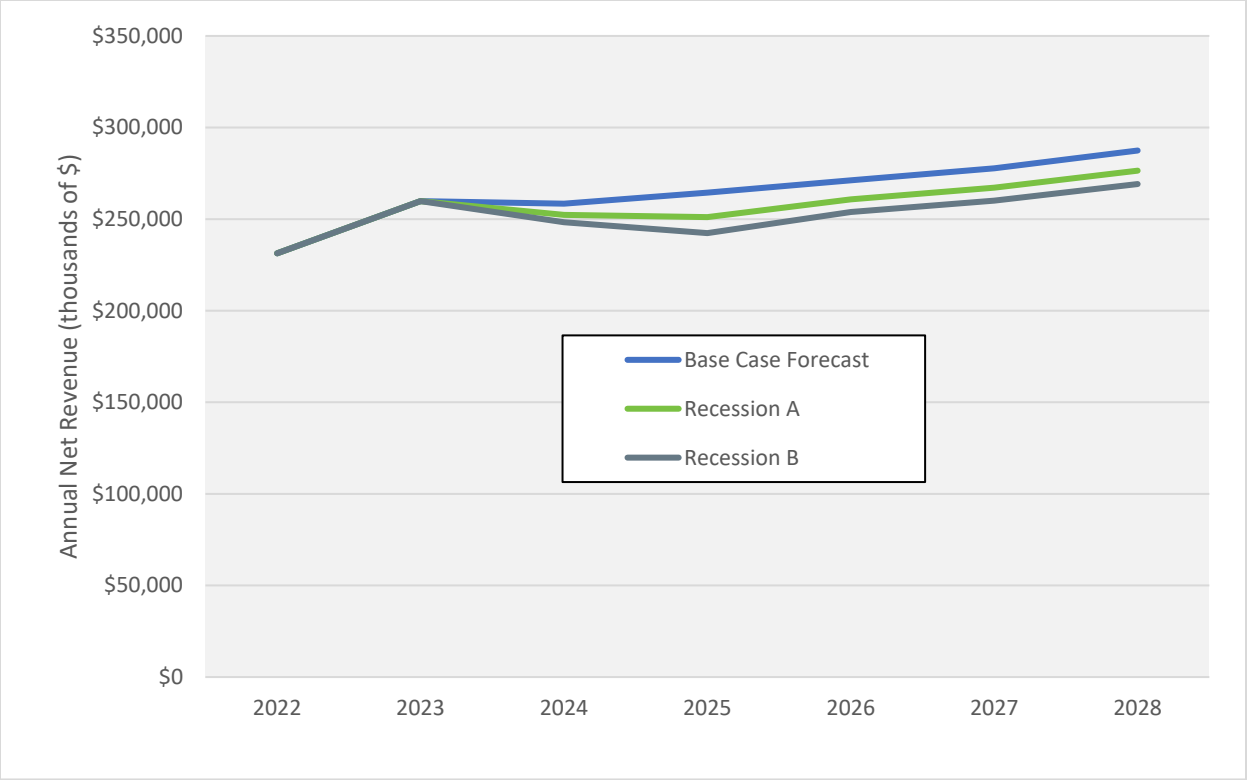


Figure 6-6 Recession Scenario Forecasts - Net Revenue

7.0 Disclaimer

Current accepted professional practices and procedures were used in the development of these traffic and revenue estimates. However, as with any forecast of the future, it should be understood that there may be differences between forecasted and actual results caused by events and circumstances beyond the control of the forecasters. In formulating its estimates, CDM Smith has reasonably relied upon the accuracy and completeness of information provided (both written and oral) by the E-470 Public Highway Authority and other local and state agencies. CDM Smith also has relied upon the reasonable assurances of some independent parties and is not aware of any facts that would make such information misleading.

CDM Smith has made qualitative judgments related to several key variables in the development and analysis of the traffic and revenue estimates that must be considered as a whole; therefore, selecting portions of any individual result without consideration of the intent of the whole may create a misleading or incomplete view of the results and the underling methodologies used to obtain the results. CDM Smith gives no opinion as to the value or merit to partial information extracted from this report.

All forecasts and projections reported herein are based on CDM Smith's experience and judgment and on a review of information obtained from multiple state and local agencies, including the E-470 Public Highway Authority, the Denver Regional Council of Governments, and by independent third parties. These estimates and projections may not be indicative of actual or future values, and are therefore subject to substantial uncertainty. Future developments, economic conditions cannot be predicted with certainty, and may affect the estimates or projections expressed in this report, such that CDM Smith does not specifically guarantee or warrant any estimate or projection contained within this report.

While CDM Smith believes that some of the projections or other forward-looking statements contained within the report are based on reasonable assumptions as of the date in the report, such forward looking statements involve risks and uncertainties that may cause actual results to differ materially from the results predicted.

Therefore, following the date of this report, CDM Smith will take no responsibility or assume any obligation to advise of changes that may affect its assumptions contained within the report, as they pertain to socioeconomic and demographic forecasts, proposed residential or commercial land use development projects and/or potential improvements to the regional transportation network.

The report and its contents are intended solely for use by the E-470 Public Highway Authority and designated parties approved by E-470 Public Highway Authority and CDM Smith. Any use by third-parties, other than as noted above, is expressly prohibited. In addition, any publication of the report for purposes of financing without the express written consent of CDM Smith is prohibited.

CDM Smith is not, and has not been, a municipal advisor as defined in Federal law (the Dodd Frank Bill) to the E-470 Public Highway Authority and does not owe a fiduciary duty pursuant to Section 15B of the Exchange Act to the E-470 Public Highway Authority with respect to the information and material

contained in this report. CDM Smith is not recommending and has not recommended any action to the E-470 Public Highway Authority. The E-470 Public Highway Authority should discuss the information and material contained in this report with any and all internal and external advisors that it deems appropriate before acting on this information.

Appendix A

E-470 Tolling and Revenue Study Operational Analysis

Felsburg, Holt and Ullevig, January 2024

FELSBURG HOLT & ULLEVIG
connecting & enhancing communities

MEMORANDUM

TO: Davd P. Aron, PTP

FROM: Philip J. Dunham PE, PTOE
Yory Moncada

DATE: January 18, 2024

SUBJECT: E-470 Tolling and Revenue Study Operational Analysis
FHU Project Number 122596-01

Felsburg Holt & Ullevig (FHU) has partnered with CDM Smith to provide operational analysis of the E-470 Tollway as part of the updated E-470 Tolling and Revenue Study. This memorandum details the methodology and results of the operational analysis of the E-470 Tollway for base and future year conditions. The purpose of this analysis is to provide insight to the E-470 Public Highway Authority (the Authority) of how the system is projected to operate over the future year planning horizons based on the current Capital Improvement Program (CIP).

Methodology

The CDM Smith team provided FHU with peak hour volume data. Volume data was derived from the Denver Regional Council of Governments (DRCOG) travel demand model, Focus. The team evaluated the Focus model for base and future year conditions with modifications to land use data, employment and housing statistics. These modifications were based on known development plans and analysis performed by Economic & Planning Systems (EPS) of the expected growth in the region through 2050. Additionally, the CDM Smith team made geometric modifications to future year model runs based on the current E-470 CIP.

FHU used the peak hour volumes to conduct basic freeway and weave segment analysis using Highway Capacity Software (HCS) 2023. This software uses industry standard calculations from the Highway Capacity Manual (HCM) 7th Edition. The annual weekday average volumes provided by CDM Smith were modified to consider the peak month using seasonal factors. Seasonal factors ranging from 1.09 to 1.13 were utilized based on the peak month from 2019 volume data. Traditionally the previous calendar year is used in determining seasonal factors; however, the effects of the COVID-19 pandemic on travel demand in the region lingered into 2022. As a result, the team reverted to the data in the year prior to the pandemic to best represent future seasonality patterns post pandemic. Additionally, a heavy vehicle percentage of 5 percent was used based on tolling and count data provided by the Authority from January 2022 through June 2023.

In previous iterations of the E-470 Tolling and Revenue Study, only basic freeway segments were analyzed. However, in recent years, additional interchanges added to the E-470 Tollway have created a growing number of weave segments. A weave segment is defined as a segment that has a continuous acceleration/deceleration lane between on- and off-ramps that are spaced closer than 3,000' from gore point to gore point. We also evaluated these segments as basic freeway segments to compare previous versions of the analysis, along with the weave analysis to match industry standards.

All segments were analyzed as flat terrain with the exception of the segment between Parker Road and Gartrell Road, which was analyzed as a rolling section due to its grade of 2.4 percent along its length of 1.5 miles. While the HCM methodology does not provide definitive grade values for level or rolling terrain, level terrain is defined as short grades of no more than 2%, and rolling terrain is defined as grades causing

heavy vehicles to reduce their speeds substantially below those of passenger cars, but not causing heavy vehicles to operate at crawl speeds.

Base Year Freeway Analysis and Results

Due to significant fluctuations in traffic the last few years due to the COVID-19 pandemic, several base years were explored as part of the model validation process. Years 2019, 2022, and 2023 were evaluated. The Authority uses Level of Service (LOS) C or better as the standard that they want to be maintained along the Tollway.

Analysis indicated the following findings for the three base year scenarios:

2019

- AM peak hour analysis for both the basic and weave segments shows that all segments operated at LOS C or better.
- PM peak hour analysis found three basic segments that operated at LOS D, while all weave segments operated at LOS C or better. LOS D segments included:
  - Northbound from Peña Boulevard to 88th Avenue
  - Northbound from 88th Avenue to 96th Avenue
  - Southbound from Jewell Avenue to Quincy Avenue

2022

- AM peak hour analysis for both the basic and weave segments shows that all segments operated at LOS C or better.
- PM peak hour analysis for both the basic and weave segments shows that all segments operated at LOS C or better.

2023

- AM peak hour operations found two basic segments operated at LOS D, while all weave segments operated at LOS C or better. LOS D segments included:
  - Southbound from 88th Avenue to Peña Boulevard
  - Southbound from Peña Boulevard to 64th Avenue
- PM peak hour analysis for both the basic and weave segments shows that all segments operated at LOS C or better.

Widening efforts completed in 2020 from Quincy Avenue to I-70 expanding the cross-section from four- to six-lanes addressed the southbound segment from Jewell Avenue to Quincy Avenue that experienced LOS D in 2019. Additionally, the ongoing widening effort from I-70 to 104th Avenue expanding the cross-section from four- to six-lanes is anticipated to be completed in 2025. This widening effort will address the northbound segments from Peña Boulevard to 88th Avenue and 88th Avenue to 96th Avenue that experienced LOS D in 2019, as well as the southbound segments from 88th Avenue to Peña Boulevard and Peña Boulevard to 64th Avenue that experienced LOS D in 2023. With these segments addressed under the latest and current widening effort, all segments should be operating at the Authority's standard of LOS C or better in the near term. **Table 1** and **Table 2** provide a full evaluation of the base year conditions for the basic and weave segments, respectively.

Table 1. Base Years Basic Freeway Segment Level of Service

Mainline		2019				2022				2023			
		AM		PM		AM		PM		AM		PM	
Cross Street 1	Cross Street 2	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
Northwest Pkwy	I-25 (North End)	A	A	A	A	A	A	A	A	A	A	A	A
I-25 (North End)	York St.	B	B	B	B	A	A	B	B	B	B	B	B
York St.	Colorado Blvd.	B	B	B	B	A	B	B	B	B	B	B	B
Colorado Blvd.	Quebec St.	A	B	B	B	A	B	B	B	A	B	B	B
Quebec St.	U.S. Rte. 85	A	B	B	B	A	B	B	B	A	B	B	B
U.S. Rte. 85	Potomac St.	A	B	B	B	A	B	B	B	A	B	B	B
Potomac St.	I-76	A	B	B	B	A	B	B	B	A	B	B	B
I-76	E 120th Ave.	B	C	C	B	A	B	C	B	B	C	C	B
E 120th Ave.	E 112th Ave.	B	C	C	B	A	C	C	B	B	C	C	C
E 112th Ave.	E 104th Ave.	B	C	C	B	A	C	C	B	B	C	C	C
E 104th Ave.	E 96th Ave.	B	C	C	B	A	C	C	B	A	C	C	C
E 96th Ave.	E 88th Ave.	B	C	D	B	A	C	C	B	B	D	C	C
E 88th Ave.	Peña Blvd.	B	C	D	B	A	C	C	B	B	D	C	C
Peña Blvd.	E 64th Ave.	B	A	B	B	B	A	B	B	B	B	B	B
E 64th Ave.	E 56th Ave.	B	A	B	B	B	A	B	B	B	B	B	B
E 56th Ave.	E 48th Ave.	B	A	B	B	B	A	B	B	B	B	B	B
E 48th Ave.	E 38th Ave.	B	A	B	B	B	A	B	B	B	B	B	B
E 38th Ave.	I-70	B	A	B	B	B	A	B	B	B	B	B	B
I-70	E 6th Pkwy.	C	B	B	C	B	A	B	B	B	A	B	B
E 6th Pkwy.	Jewell Ave.	C	B	B	C	B	A	B	B	B	A	B	B
Jewell Ave.	Quincy Ave.	C	B	C	D	B	A	B	B	B	B	B	B
Quincy Ave.	Smoky Hill Rd.	B	B	B	B	B	B	B	B	B	B	B	B
Smoky Hill Rd.	Gartrell Rd.	B	B	B	B	A	B	B	B	B	B	B	B