I-70 Traffic and Revenue Study Results

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COLORADO
Department of
Transportation

Outline

- T&R Study Goals
- Model description
- Overview of Forecasting Process and Assumptions
- Traffic and Revenue Results for Each Alternative

Goals of Level 1 Traffic and Revenue Forecast

- Estimation of future traffic conditions given anticipated growth in travel and a wide range of alternatives to expand capacity
    - 13 alternatives for capacity improvements with consideration of transit options and revenue generation through toll collection referenced against one future Base Condition.
    - Account for transit options (BRT and AGS)
- Estimation of revenue generation potential
    - Management of capacity through variable/congestion pricing
    - Account for traveler value of time and response to pricing
- Performance Metrics for Screening of Alternatives
    - Traffic, operational, financial, and environmental measures to support screening evaluation
- Integration with CSS process

Level 1 Forecast Development Process

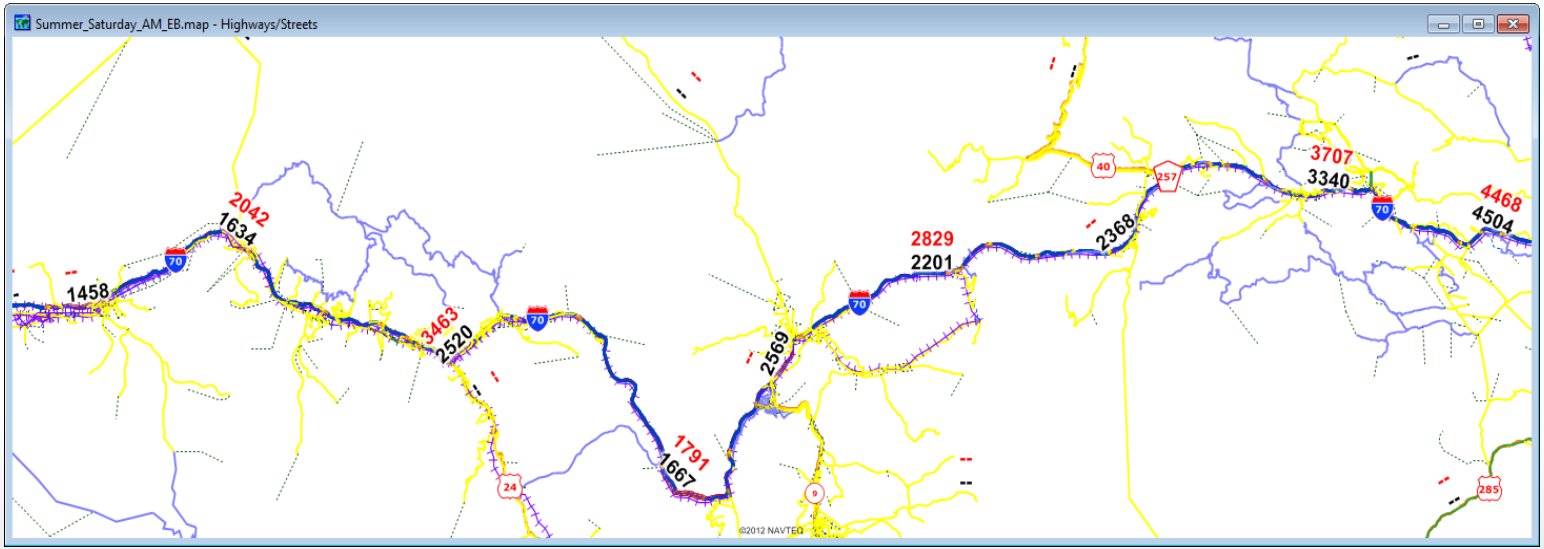
- Network travel demand model for 2025, based on the I-70 Mountain Corridor PEIS Model.
  - Full regional travel network with detailed representation of feeding and competing roadways.
  - Link level representation of capacity, speed, elevation, and geometry.
  - Comprehensive representation of origin and destination patterns and trip purposes (work, non-work, and recreation) with income stratification.
  - Representation of conditions by time of day, day of week and season.
  - Consistent with PEIS assumptions and findings.
- Detailed link-level tool for projection to 2075.
  - Corridor organized into 19 segments summarizing key links with representation of volumes, capacity, and speed on toll lanes and corresponding free lanes by time/day/season.
  - Forecast of managed lanes usage/pricing based on congestion and value of travel time savings.
  - Calculation of annual revenue and traffic performance measures.

Model Results Validation

Model outputs were compared for 2000 and 2010 data:

2000: Compared against PEIS period-specific counts by direction and day which were hard-coded within the GISDK code.

- Summer Saturday (counts in red; model flows in black)



Model Results Validation

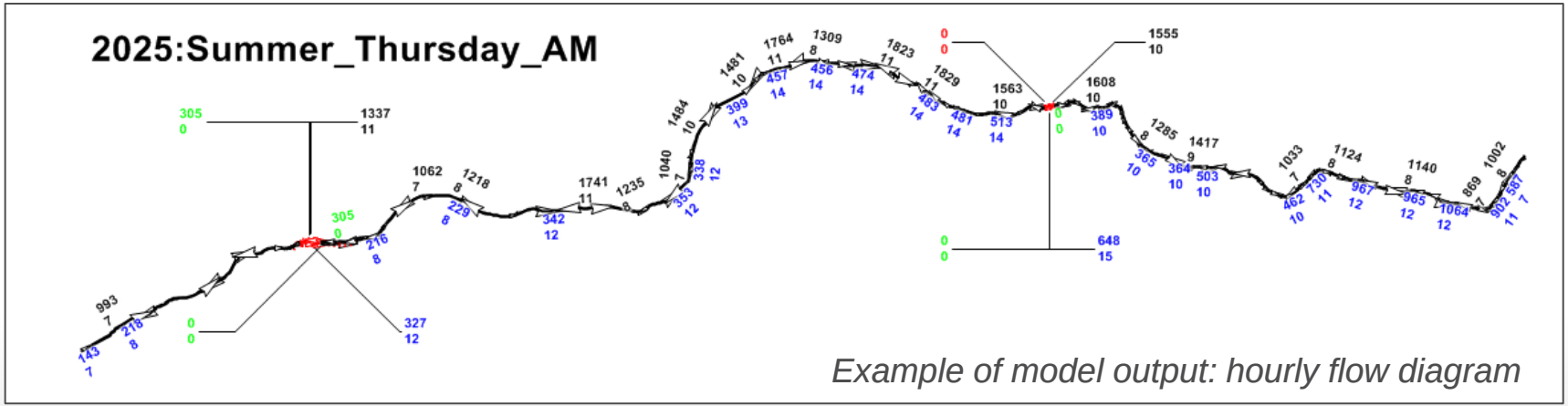
Model outputs were compared for 2000 and 2010 data:

2010: Compared against CDOT continuous hourly counters and a limited number of seasonal counts were aggregated to the 4 time periods; averaged by day and season (e.g. average of all counts for every AM Summer Sunday): 3 Continuous counters that cover all periods, all seasons, all days; 13 Special counters that mostly cover only Summer Thursday and Mud Thursday.

Season	Day	AM Counts	AM Flows	% difference	PM Counts	PM Flows	% difference	Noon Counts	Noon Flows	% difference
Summer	Thursday	49420	59386	20.17%	84189	84569	0.45%	94114	94040	-0.08%
Summer	Friday	37964	41439	9.15%	84729	74859	-11.65%	99494	111229	11.79%
Summer	Saturday	42653	45565	6.83%	63461	86034	35.57%	87159	72214	-17.15%
Summer	Sunday	32316	36063	11.59%	64584	81743	26.57%	96565	102607	6.26%
Winter	Thursday	27656	29606	7.05%	34909	35291	1.09%	36819	35000	-4.94%
Winter	Friday	33247	20027	-39.76%	39770	46852	17.81%	61822	43206	-30.11%
Winter	Saturday	40838	40674	-0.40%	53187	26846	-49.53%	47991	25740	-46.36%
Winter	Sunday	33437	33683	0.74%	44937	55328	23.12%	58353	50030	-14.26%
Mud	Thursday	28141	24411	-13.25%	37438	47508	26.90%	40606	50752	24.99%

2025 Model Development

- Original PEIS TransCAD travel demand model with enhancements:
  - Updated to 2010 Census demographics.
  - Updated value of time by trip purpose consistent with AGS/ICS study and survey.
  - Conflated the I-70 corridor links to aerial photography to reflect true geography and geometry.
  - Added network links to represent features of Base Condition and Alternatives



Example of model output: hourly flow diagram

Forecast Model Description

Measures of the model:

- 4 day types (Weekday, Friday-Sunday)
- 4 times of day (AM, PM, Midday, Night)
- 3 seasons (Summer, Winter, Remainder)
- 80 distinct EB and WB links in TransCAD
- 19 distinct segments in forecast tool

Parameters Considered:

- Value of Time by trip purpose
- Growth rate of corridor and tolled capacity
- Toll values for peak and off-peak times

Structure of the Forecast Model

- **Trip Generation and distribution**: Trip generation and distribution is based on productions and attractions represented in the PEIS model (as updated with 2010 demographics). Volume in each segment of the corridor determined by origins and destinations and the assignment process in the regional network model which accounts for both time and cost of travel. Volumes tend to be higher in eastern segments.

- **Truck routing**: Regional and through trips for trucks are assigned to routes based on the time and cost of travel. Alternative routes like Loveland Pass are represented in the model.

Structure of the Forecast Model - Peak Period Travel Days

- In total, model includes 165 Fridays, Saturdays, Sundays, and Holidays per year.

	Summer	Winter	Spring/Fall (Off peak)
Friday	16	23	13
Saturday	16	23	13
Sunday/Holiday	21	25	15
Weekdays	59	90	51

- Peak periods within the day-types are defined as AM and PM periods.
- The designation of “peak period” is only relevant to define the base (starting) toll rate. ML utilization and the applicable toll rate is exclusively driven by demand regardless of day type, season, or time period.

2025 Baseline - Congested Conditions

The charts below illustrate that flows between the PEIS and our T&R Base Condition are within ± 5% to 10% at Key Locations. Possible reasons for differences include:

1. Revised and updated the model including using 2010 socioeconomic data
2. Addition of tolling and multiple user classes
3. T&R study assignment based on time and cost with VOT. The original PEIS had no tolling, facility assignment purely based on time.
4. Some congestion data presented in PEIS based on hourly results developed in simulation model

Winter Saturday		
Focal Point	PEIS	T&R Study
EJMT	51,000	49,686
East of Empire Junction	77,000	71,529
Genesee	136,300	128,000

Summer Sunday		
Focal Point	PEIS	T&R Study
EJMT	67,000	68,036
East of Empire Junction	88,000	83,177
Genesee	151,300	137,000

Model Parameters - Value of Time

- Forecasts for all alternatives incorporated assumptions for value of time equivalent to those estimated from findings of the Stated-Preference survey implemented for AGS study.
- I-70 Mountain Corridor travel model value of time assumptions were replaced with values from AGS study appropriate for the discrete market segments in the travel model.
- **Value of Time by Trip Purpose / Income Market Segment Used in T&R Study**

Home-Based Work High income	$16/hr
Home-Based Work Upper Income	$15/hr
Home-Based Work Middle Income	$13/hr
Home-Based Work Low Income	$11/hr
Non-work	$9/hr
High VOT Recreation	$18/hr
Low VOT Recreation	$12/hr

HBW: Home Based Work Trips

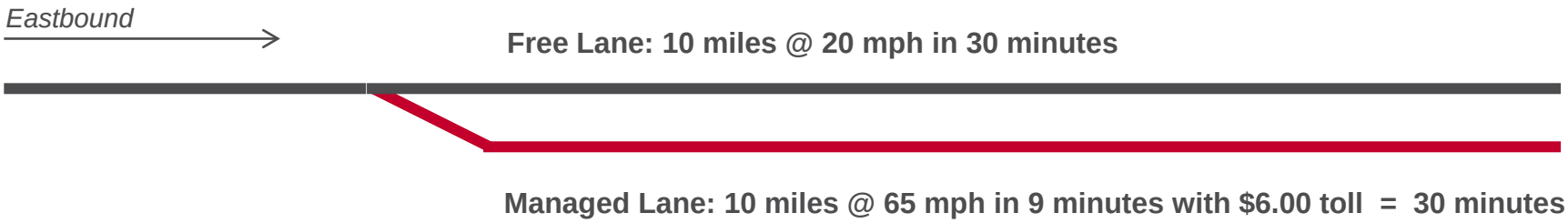
- Combo Truck VOT was derived from DRCOG: $55.02

Example: Traveler Value of Time and Managed Lane Choice

Median Value of Time:

$17.50 = 1 hour of travel *or*
$ 0.29 = 1 minute of travel

$6.00 toll ($0.60/mile) = 21 minutes of travel



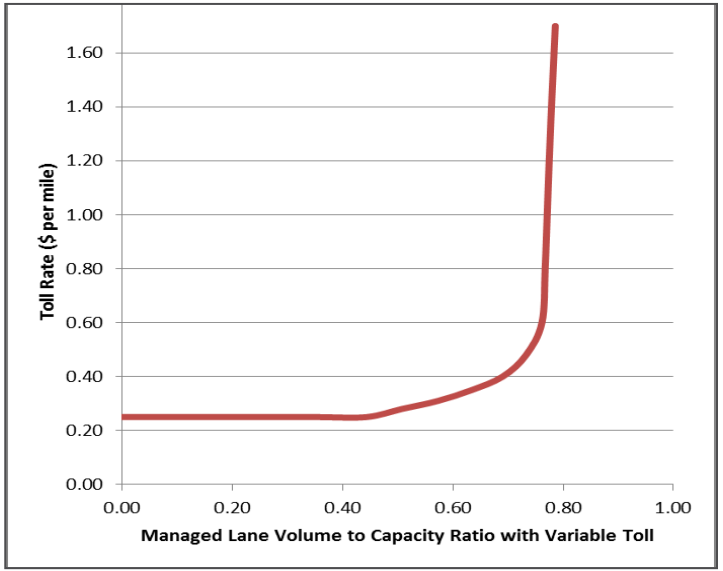
Other Equilibrium Conditions:

Free Lane: 10 miles @ 40 mph in 15 minutes = Managed Lane @ 65mph in 9 min with $1.68 toll ($0.17/mile)

Free Lane: 10 miles @ 50 mph in 12 minutes = Managed Lane @ 65mph in 9 min with $0.80 toll ($0.08/mile)

Managed Lanes Forecasting

- Pricing on managed lanes (single/multi-lane reversible or variable-priced shoulder lanes) is highly sensitive to congestion.
- Forecasts need to consider variations in level of congestion by time of day, day of week and season.
- Detailed examination of value of time, future rate of growth in travel; and lane performance through micro-simulation are appropriate for Level 2 and 3 studies.



Lanes Not Managed - Fixed Toll			*Lanes Managed – Variable Toll*		
V/C	Speed	Toll Rate	Managed V/C	Speed	Toll Rate
0.40	65	$0.25	0.40	65	$0.25
0.70	53	$0.25	0.58	60	$0.40
1.00	35	$0.25	0.75	50	$0.75

Example of increase in toll rate necessary to maintain ML speed and performance.

Model Parameters - Base Tolls and Toll Setting

- The analysis has a peak and off-peak base per mile toll rate, which indicates the lowest toll rate/ mi. charged at that given time regardless of congestion.

	Car	Truck
Peak (AM, PM)	$0.25	$0.75
Off-Peak (Noon, Night)	$0.10	$0.30

- The per mile toll rate is then adjusted based on congestion levels.

Alt 1 Opt 1 - Highest Estimated Toll Values		
	Car	Truck
2035	$0.61	$1.85
2045	$0.57	$1.72
2055	$0.80	$2.40
2065	$0.97	$2.90
2075	$1.15	$3.45

- Tunnel tolls were fixed at $5 for cars and $24 for trucks for all time periods.

Model Parameters - Long-Term Growth Rate

- LBG based long-term growth rate on PEIS assumption to provide consistency in comparison of results
- Sensitivity test were run for range in growth rates reflected in PEIS - 1.4%-3.0% annual growth
- Most recent study in corridor (ICS/AGS) reflects 0.7% overall growth in total travel in I-70 Corridor through 2035
- In general previous studies in the corridor (PEIS and ICS/AGS) indicate that growth in travel in the I-70 Corridor is somewhat lower than overall growth in population and employment.

Growth Rate Benchmarks *(compound annual average growth rates)*

I-70 Mountain Corridor PEIS – Basis for Level 1 T&R Study

2000-2025	Corridor Counties	Denver Metro
Population	2.8%	1.4%
Employment	3.0%	1.5%
Corridor Auto Trips: 1.1% (2010-2025)		

2025-2035	Corridor Counties	Denver Metro
Population	1.9%	1.4%
Employment	0.4%	1.8%
Corridor Auto Trips: 1.4%		

2035-2050
Corridor Auto Trips: 0.5% to 3.0%

ICS-AGS Demand Forecasting Study

2010-2035	Population	Employment
Study Region	1.6%	1.5%
Study Region Auto Trips: 0.71% (Local Non-Work: 0.74%; Work: 0.70%; Visitor: 0.82%)		

Growth Rate Benchmarks *(compound annual average growth rates)*

DRCOG (2010)

2010-2035	Population	Employment
Metro Region	2.0%	2.0%
Clear Creek	1.5%	1.7%
Jefferson	1.2%	1.6%
Denver	1.1%	1.5%

Vehicle Miles Traveled 2010-2035: 1.9%

Number of Visitors 2010-2035: 3.5%

State Demographer / Labor Dept. (2013)

2010-2040	Population	Employment
State	1.4%	2.0%
Clear Creek	1.5%	1.8%
Jefferson	0.6%	N/A
Denver	1.2%	1.5%
Summit	2.0%	2.4%
Eagle	2.2%	2.1%

Other Measures

Denver International Airport Enplanements (2012-2035): 2.5% (Denver Dept. of Aviation, 2011)

Colorado Ski Resort Visitation (2001-2011): 0.6% (HVS Market Intelligence Report Colo. Mountains, 2013)

Managed Lanes - Estimated Capture Rates

- Capture rate of Managed Lanes is defined as vehicle miles traveled (VMT) on managed lanes as a proportion of total VMT on free lanes/managed lanes by direction. Capture rates are calculated in the model considering volumes and VoT.
- Capture rates during high-volume demand periods in the forecast range from 20% to 45%. In low-volume periods, capture rates range from 5% to 20%.
- LBG assumed a minimum capture rate of 5% during low-volume periods where managed lanes offer no demonstrable travel time savings
- Overall Capture Rates in 2025 reflective of an all-day mix of high-volume and low volume periods.

	# of Days	ML Utilization (%)
Overall ML Utilization	365	15%
Summer	112	18%
Winter	161	15%
Spring/Fall (Mud)	92	9%

Capture Rates

2025 Winter (Alt 1 Opt 1)

Overall ML Utilization: 19%

90 Weekdays	6%
23 Fri	5%
23 Sat	37%
25 Sun/Hol	11%

Season	Day	Time	Toll VMT	Free VMT in Toll Direction	Toll Utilzation	Toll Speed	Free Speed	Dir
Winter	Weekday	AM	24,055	457,042	5%	65	46	WB
Winter	Weekday	Midday	40,066	413,175	9%	65	52	WB
Winter	Weekday	PM	20,125	382,367	5%	65	52	WB
Winter	Weekday	Night	18,042	342,796	5%	65	55	WB
Winter	Friday	AM	17,768	337,591	5%	65	51	WB
Winter	Friday	Midday	16,718	317,637	5%	65	54	WB
Winter	Friday	PM	17,683	335,982	5%	65	53	WB
Winter	Friday	Night	13,111	249,117	5%	65	55	WB
Winter	Saturday	AM	459,354	567,316	45%	49	41	WB
Winter	Saturday	Midday	182,482	719,466	20%	63	41	EB
Winter	Saturday	PM	401,705	501,876	44%	56	47	WB
Winter	Saturday	Night	207,574	321,933	39%	64	54	EB
Winter	Sunday	AM	136,523	635,609	18%	64	35	WB
Winter	Sunday	Midday	29,951	550,835	5%	65	49	EB
Winter	Sunday	PM	128,293	780,149	14%	65	33	EB
Winter	Sunday	Night	35,734	680,010	5%	65	51	EB

Treatment of Unmet Demand

- Model uses the unmet demand procedure contained in the I-70 Mountain Corridor PEIS model. Two options:
  - Suppressed trip generation to produce overall volumes in I-70 corridor constrained with respect to capacity (suppressed trips to achieve overall speeds of 30mph or higher)
  - No suppression of trip generation (unconstrained – no minimum speed on corridor)
- Results are presented with no suppression of trip generation to show the full potential of capacity improvements to accommodate demand.
- Most accurate way to look at effect of Unmet Demand is comparison of Build Alternative to Baseline. In general Build Alternatives see higher level of overall VMT than baseline only during high-volume periods of travel when capacity improvement makes a difference.
- Unmet demand is a near-term factor reflected in early year performance – not an element of the growth rate.

Treatment of Unmet Demand – Example

- Table below illustrates how unmet demand is reflected in the model for 2025, based on a comparison of free and toll lane VMT (in the tolled direction) between the Alternative with two reversible lanes (1) and the Base Condition:

Season	Day	Period	Base Case VMT	Alt1 VMT	% Difference
Summer	Weekday	AM	39,091,320	54,958,835	29%
Summer	Friday	PM	8,838,514	9,842,532	10%
Winter	Saturday	AM	14,515,764	23,613,402	39%
Summer	Sunday	Night	11,436,365	15,270,539	34%
Spring/Fall	Sunday	Night	10,175,890	10,184,852	<1%
Spring/Fall	Saturday	PM	5,073,106	5,696,290	11%

2025-2075 Forecast: Transit Assumptions

- BRT deducted from auto travel based on anticipated service provision and capture rate. AGS deducted from auto travel based on published forecast for 2035 extrapolated to 2075 at pace with corridor growth.
- BRT farebox revenue for Alt 1,2 is included as it contributes to the 50 year concession arrangement. Alternatives with an AGS component do not consider AGS revenues or costs since its operations are separate from the highway capacity improvements.
- Average Vehicle Occupancy Rate:
  - Weekdays: 1.68
  - Weekend: 1.75

Number of Transit Trips Deducted in First Year of Operation	
AGS	2.35 M
BRT	0.83 M

Revenue Calculation - Treatment of Inflation

- All numbers presented are in 2014 dollars. The analysis includes no escalation for inflation.
- The Present Value (PV) for the revenue cash flow was discounted at 5% to the first year of revenue service. The 5% rate is a standard rate reflecting a weighted average cost of capital (WAAC) in real dollar terms.
- Toll rates are fixed in current dollars (assume nominal charges keep pace with inflation).

Detailed Evaluation Results of Each Alternative

Alternatives Descriptions

Alternative	Description
Base Condition	Existing roadway including EB Temporary PPSL improvements
1	Two reversible, tolled, managed lanes at 65MPH
2	Three reversible, tolled, managed lanes at 65MPH
3	PEIS Minimum Program – toll at 3rd bore EJMT
4	PEIS Maximum Program – one non-reversible tolled lane EB,WB
5	Permanent PPSL: left side tolled, managed side lane for peak time use
6	Temporary PPSL: Narrower WB tolled, managed lane for peak time use

PPSL: Peak Period Shoulder Lane EB: Eastbound WB: Westbound

Traffic and Revenue Forecast Results - 2025

Alternative	Corridor Vehicle Trips (M)	Tolled Vehicle Trips (M)	Toll Revenue (2014 $M)	Transit Person Trips (M)	Transit Revenue (2014 $M)
Base Condition	25.7	0.37	0.4	-	-
1	26.7	2.10	36.0	0.83	7.8
2	26.8	2.20	37.2	0.83	7.8
3	25.9	0.02	0.9	-	-
4	26.7	0.56	8.2	-	-
5	26.0	0.50	8.0	-	-
5.1	25.7	0.62	4.1	-	-
6	25.7	0.60	4.0	-	-

Base Condition

Existing I-70 with EB Peak Period Shoulder Lane

Base Condition includes the existing highway infrastructure including the planned improvement of the EB peak period shoulder lane from Empire to Floyd Hill. The recently completed widening of the EB Twin Tunnel is part of the peak period shoulder lane project.

Roadway Information

Extent of Roadway Improvements	Empire to Floyd Hill
General Purpose (GP) Lane Information	Additional capacity by restriping existing pavement
Direction of Improvements	EB Only Direction
Design Speed	Match Existing
Trucks, Private Buses, BRT	Allowed in Peak Period Shoulder Lane (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for EB Peak Period Shoulder Lane
Tunnels	Dynamic priced toll as part of the EB Peak Period Shoulder Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2014 (Assumes NEPA Cat-Ex)
Construction Duration	1 year
First Year Operation	2014 - WB Tunnel / 2015 - EB PPSL
Financial Period	50 years

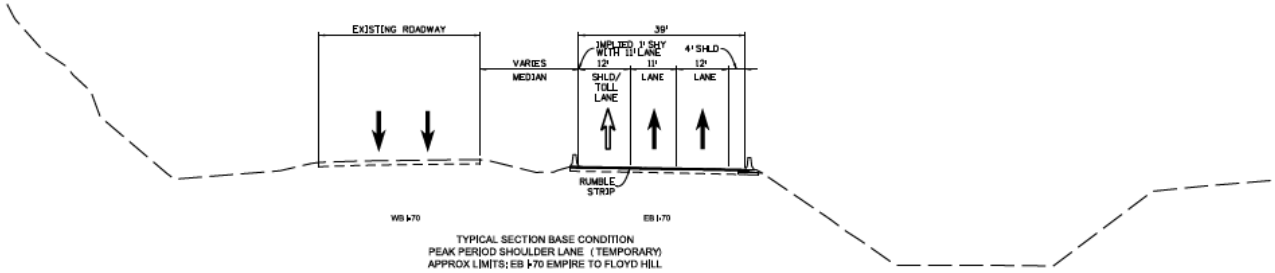
Transit Information

Termini	Glenwood Springs to Denver (CDOT Bus)
Special Infrastructure	N/A
Schedule	Fall 2014
Stations	6 CDOT Bus Stations - Glenwood Springs, Eagle, Vail, Frisco, Denver (2)
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	N/A

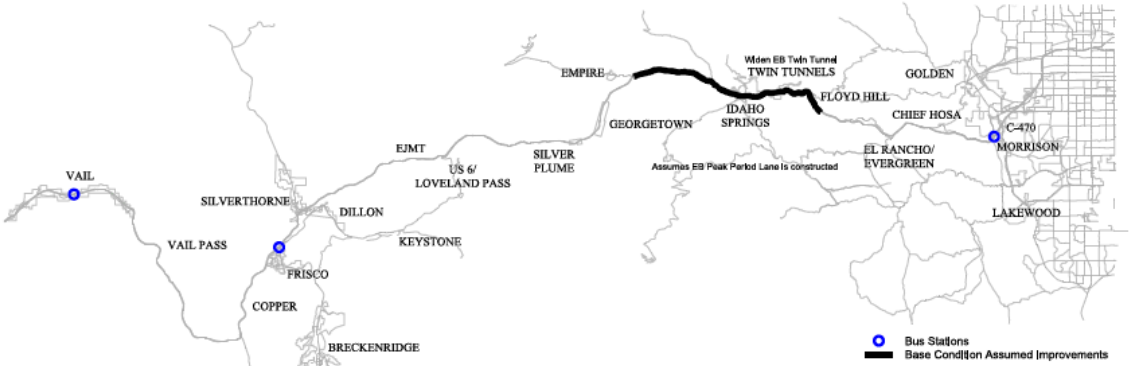
Special Structures

Special Structures	Existing EB Twin Tunnel Widening

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels



TYPICAL SECTION BASE CONDITION
PEAK PERIOD SHOULDER LANE (TEMPORARY)
APPROX LIMITS: EB I-70 EMPIRE TO FLOYD HILL



Forecast Traffic and Revenue Results - Base Condition

	Corridor Vehicle Trips (M)	Toll Vehicle Trips (M)	Toll Revenues (2014 $M)
2025	25.7	0.37	0.44
2035	29.3	0.45	4.1
2045	33.0	0.75	9.0
2055	36.7	0.95	14.0
2065	40.1	1.2	17.7
2075	43.4	1.5	21.5

Toll Revenue PV (at 5% DR, $2014M): $109.7

Alt01_Opt01

2 Tolled Reversible Managed Lanes

Reversible managed lanes designed at 65 mph. The reversible managed lanes are on a separate viaduct structure from East Idaho Springs to Floyd Hill in order to maintain 65 mph design speed. General purpose (GP) lanes designed at 55 mph except from East Idaho Springs to Floyd Hill, where existing design speeds & lanes will remain.

Roadway Information

Extent of Roadway Improvements	Silverthorne to C-470
General Purpose (GP) Lane Information	Align managed lanes with GP lanes except from E Idaho Springs to Floyd Hill
Direction of Improvements	Both directions (EB and WB)
Design Speed	65 mph Managed Lanes, 55 mph GP lanes
Trucks, Private Buses, BRT	Allowed in Managed Lanes (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for Reversible Managed Lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd bore
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2019 (Assumes 4 years NEPA & Procurement)
Construction Duration	4 years
First Year Operation	2023
Financial Period	50 years

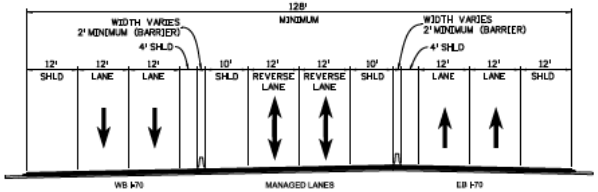
Transit Information

Termini	Vail to Denver
Special Infrastructure	Stations
Schedule	2019 – Limited Startup / 2023 – Full BRT Service
Stations	12 Total
Type	
CDOT Bus	N/A
BRT	Transit option for full 50 year concession
AGS	N/A

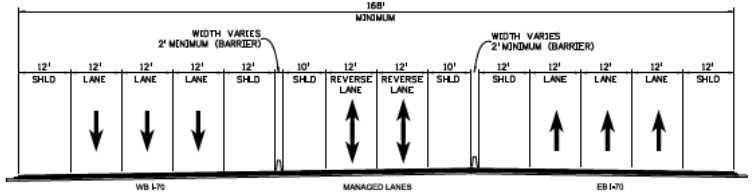
Special Structures

Special Structures	EJMT and Twin Tunnel 3rd Bores
	Managed Lanes on Viaduct from East Idaho Springs to Floyd Hill

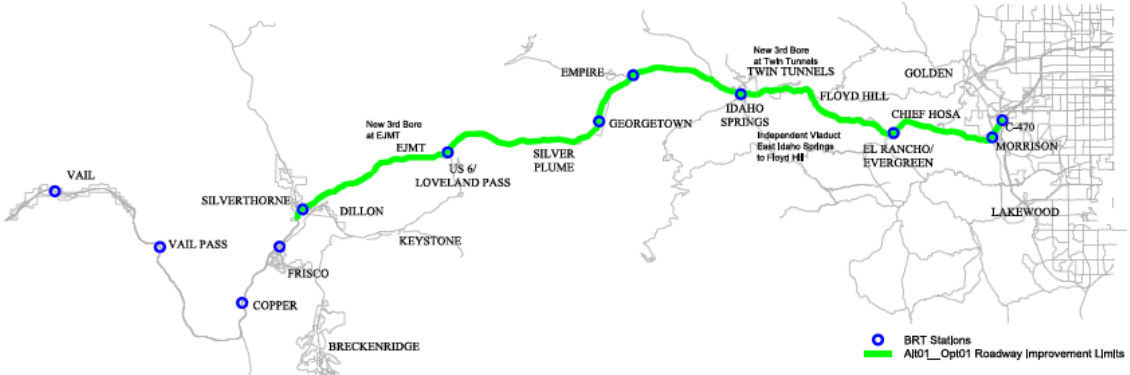
GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels



TYPICAL SECTION ALT01
2 TOLLED REVERSIBLE MANAGED LANES
EXISTING 2 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: EJMT TO FLOYD HILL



TYPICAL SECTION ALT01
2 TOLLED REVERSIBLE MANAGED LANES
EXISTING 3 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: SILVERTHORNE TO EJMT, FLOYD HILL TO C-470



Forecast Traffic and Revenue Results - Alternative 1

	Corridor Vehicle Trips (M)	Toll Vehicle Trips (M)	Toll Revenues (2014 $M)	BRT Person Trips (M)	BRT Revenue (2014 $M)
2025	26.7	2.1	36.0	0.83	7.8
2035	30.6	2.7	63.6	0.95	8.9
2045	34.9	3.6	87.7	1.1	10.2
2055	39.3	4.7	124.2	1.3	11.8
2065	43.8	5.9	167.8	1.4	13.5
2075	48.3	7.0	218.9	1.7	15.5

Alternative 1 Remarks

- Alt1Opt1 has more than 10 times the toll lane mileage as the Base Condition and begins with a higher level of utilization and revenue.
- Utilization increases over 300% during the 50-year life and revenue increases more than 600%.
- Toll rates rise to manage flow during peak periods and utilization increases throughout the day.

Toll Revenue PV (at 5% DR, $2014M): $1,575.38
Capital Cost (M): $4,116
O&M Cost (M): $49.6

Alt02_Opt01

3 Tolled Reversible Managed Lanes

Reversible managed lanes designed at 65 mph. The reversible managed lanes are on a separate viaduct structure from East Idaho Springs to Floyd Hill in order to maintain 65 mph design speed. General purpose (GP) lanes designed at 55 mph except from East Idaho Springs to Floyd Hill, where existing design speeds & lanes will remain.

Roadway Information

Extent of Roadway Improvements	Silverthorne to C-470
General Purpose (GP) Lane Information	Align managed lanes with GP lanes except from E Idaho Springs to Floyd Hill
Direction of Improvements	Both directions (EB and WB)
Design Speed	65 mph Managed Lanes, 55 mph GP lanes
Trucks, Private Buses, BRT	Allowed in Managed Lanes (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for Reversible Managed Lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd bore
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2019 (Assumes 4 years NEPA & Procurement)
Construction Duration	4 years
First Year Operation	2023
Financial Period	50 years

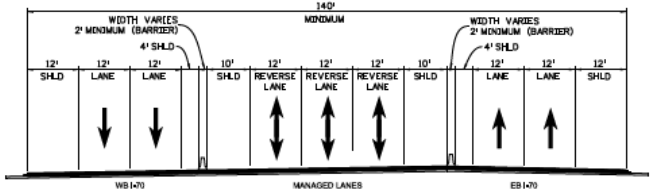
Transit Information

Termini	Vail to Denver
Special Infrastructure	Stations
Schedule	2019 – Limited Startup / 2023 – Full BRT Service
Stations	12 Total
Type	
CDOT Bus	N/A
BRT	Transit option for full 50 year concession
AGS	N/A

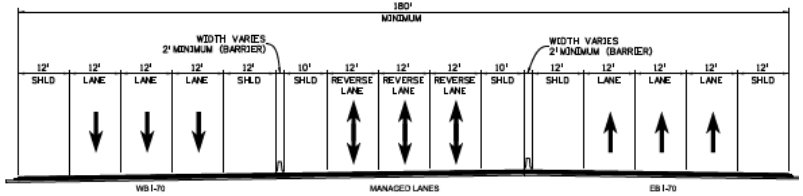
Special Structures

Special Structures	EJMT and Twin Tunnel 3rd Bores
	Managed Lanes on Viaduct from East Idaho Springs to Floyd Hill

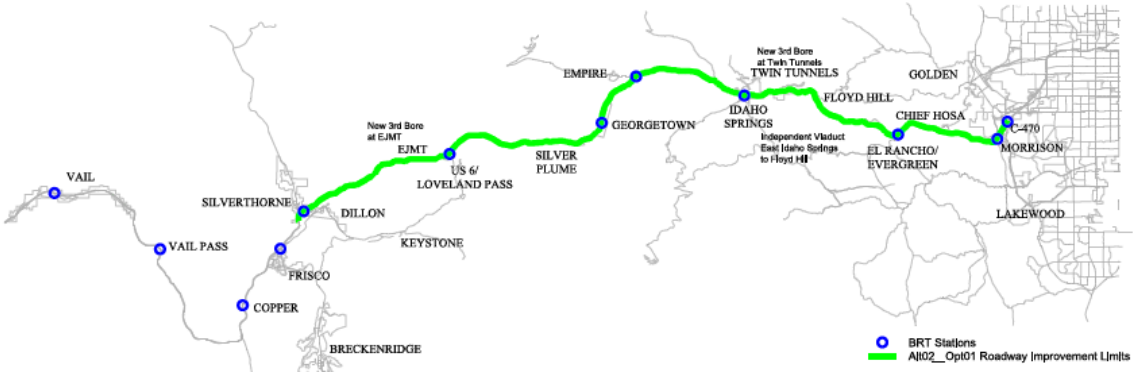
GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels



TYPICAL SECTION ALT02
3 TOLLED REVERSIBLE MANAGED LANES
EXISTING 2 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: EJMT TO FLOYD HILL



TYPICAL SECTION ALT02
3 TOLLED REVERSIBLE MANAGED LANES
EXISTING 3 GENERAL PURPOSE LANES EB & WB I-70
APPROX LIMITS: SILVERTHORNE TO EJMT, FLOYD HILL TO C-470



Forecast Traffic and Revenue Results - Alternative 2

	Corridor Vehicle Trips (M)	Toll Vehicle Trips (M)	Toll Revenues (2014 $M)	BRT Person Trips (M)	BRT Revenue (2014 $M)
2025	26.8	2.2	37.2	0.83	7.8
2035	30.7	3.0	56.9	0.95	8.9
2045	35.1	4.1	83.7	1.1	10.2
2055	39.6	5.4	119.1	1.3	11.8
2065	44.4	6.9	162.8	1.4	13.5
2075	49.2	8.5	214.4	1.7	15.5

Alternative 2 Remarks

- Alternative 2 has greater capacity than Alt1 and therefore can accommodate more traffic on the managed lanes. This improves the overall level of volume moving through the corridor on toll and free lanes.

- Given the additional capacity, however, toll lanes not as congested (nor are free lanes) and toll rates do not need to rise as high as Opt1Alt1 to manage volume. Although the lanes see a greater volume of traffic, toll rates are somewhat lower leading to marginally lower revenue than Opt1 Alt1 overall.

Toll Revenue PV (at 5% DR, $2014M): $1,517.97
Capital Cost (M): $5,092.36
O&M Cost (M): $53.86

Alt03_Opt01

MInImum Program per PEIS

Minimum program per PEIS with 55 mph design speed including a 3rd bore at EJMT. Minimum program is generally localized auxiliary lane improvements.

Roadway Information

Extent of Roadway Improvements	EJMT to Floyd Hill
General Purpose (GP) Lane Information	Auxiliary lanes added at localized areas between interchanges
Direction of Improvements	Both directions (EB and WB)
Design Speed	55 mph
Trucks, Private Buses, BRT	Allowed in GP Lanes and auxiliary lanes
Tolling	
Capacity Improvements	No toll for auxiliary lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2018 (Assumes 3 years NEPA)
Construction Duration	3 years
First Year Operation	2021
Financial Period	50 years

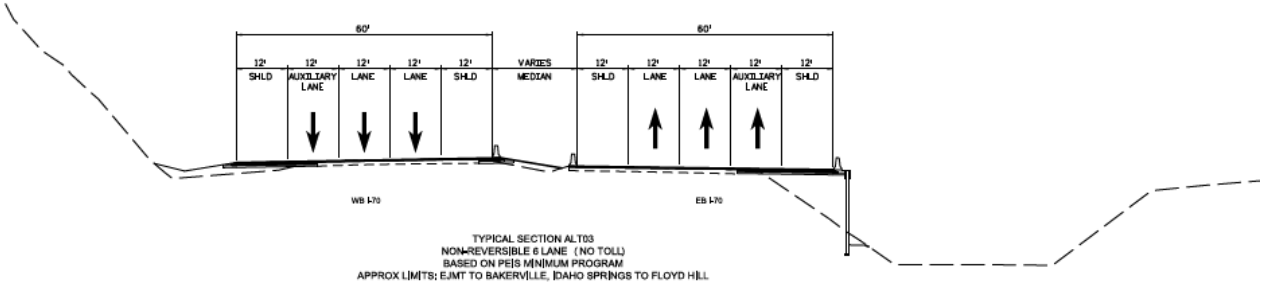
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System: None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

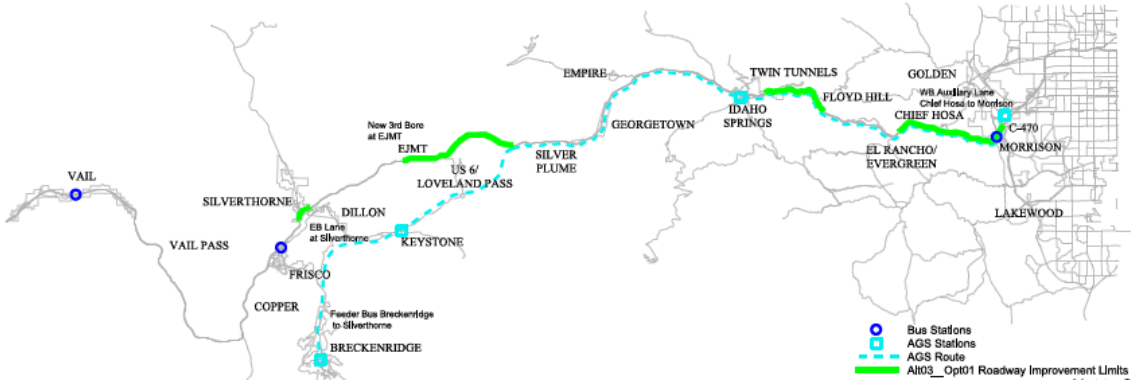
Special Structures

Special Structures	EJMT 3rd Bore

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT03
NON-REVERSIBLE 6 LANE (NO TOLL)
BASED ON PEIS MINIMUM PROGRAM
APPROX LIMITS: EJMT TO BAKERVILLE, IDAHO SPRINGS TO FLOYD HILL



Forecast Traffic and Revenue Results - Alternative 3

	Corridor Vehicle Trips (M)	Toll Vehicle Trips (M)	Toll Revenues (2014 $M)	AGS Person Trips (M)
2025	25.9	0.02	0.94	-
2035	27.9	0.04	2.1	3.3
2045	31.8	0.06	3.8	3.7
2055	35.7	0.08	5.8	4.3
2065	39.4	0.11	7.8	4.9
2075	43.1	0.14	9.7	5.7

Alternative 3 Remarks

- This alternative applies tolls to traffic only at the tunnels. As the tunnel segments are relatively short, the time savings offered is lower than the longer managed lane segments represented in the other Alternatives. The model shows that travelers are reluctant to utilize the tolled segments.

- Given the response in initial testing, tolls in this scenario were decreased to $1 for cars and $3 for trucks to maximize revenues and promote utilization of the new capacity.

Toll Revenue PV (at 5% DR, $2014M): $50.98
Capital Cost (M): $2012.52
O&M Cost (M): $10.72

Alt04_Opt01

Maximum Program per PEIS

Maximum program per PEIS with 55 mph design speed including a 3rd bore at EJMT. Maximum program includes one additional non-reversible tolled lane (EB & WB) between EJMT and Floyd Hill.

Roadway Information

Extent of Roadway Improvements	EJMT to Floyd Hill
General Purpose (GP) Lane Information	Additional capacity by widening existing (Non-reversible)
Direction of Improvements	Both directions (EB and WB)
Design Speed	55 mph
Trucks, Private Buses, BRT	Allowed in Toll Lane (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for 3rd toll lane
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2018 (Assumes 3 years NEPA)
Construction Duration	4 years
First Year Operation	2022
Financial Period	50 years

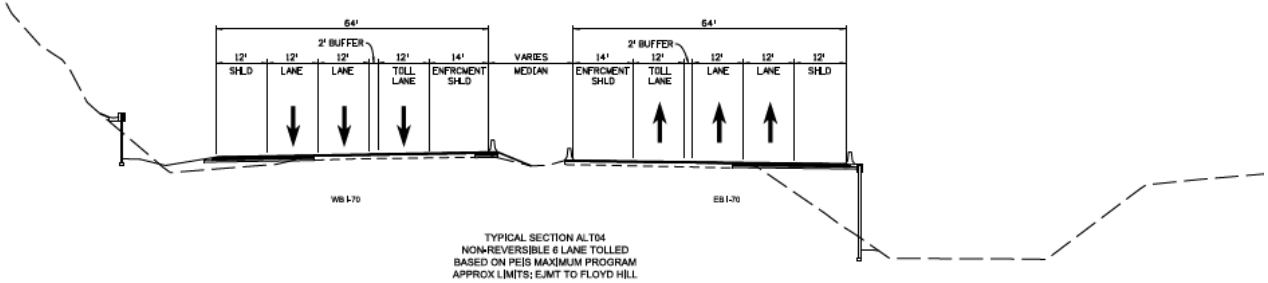
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System: None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

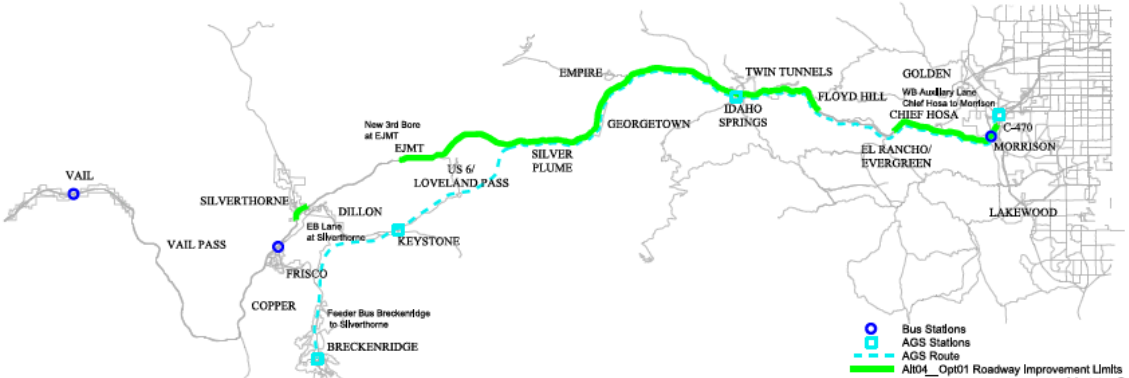
Special Structures

Special Structures	EJMT 3rd Bore

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT04
NON-REVERSIBLE 6 LANE TOLLED
BASED ON PEIS MAXIMUM PROGRAM
APPROX LIMITS: EJMT TO FLOYD HILL



Forecast Traffic and Revenue Results - Alternative 4

	Corridor Vehicle Trips (M)	Toll Vehicle Trips (M)	Toll Revenues (2014 $M)	AGS Person Trips (M)
2025	26.7	0.56	8.2	-
2035	28.7	0.97	21.7	3.3
2045	32.7	1.65	32.5	3.7
2055	36.8	2.46	50.7	4.3
2065	41.0	3.35	73.6	4.9
2075	45.0	4.34	102.5	5.7

Alternative 4 Remarks

- Alternative 4 generates substantial revenues in the later years as the capacity improvements are utilized and free-lane congestion increases.

- Overall, the revenues for this alternative are high relative to other Alternatives because the additional tolled lanes are open at all times in both directions. This is particularly advantageous at those periods where volumes are heavy in each direction.

Toll Revenue PV (at 5% DR, $2014M): $486.60
Capital Cost (M): $2,715.6
O&M Cost (M): $ 14.24

Alt05_Opt01

Permanent Peak Period Shoulder Lane

Widen the existing roadway to accommodate one additional left side managed lane (EB & WB) for use during peak times, during non-peak times operates as a standard shoulder. Provide full width shoulder on right side.

Roadway Information

Extent of Roadway Improvements	EJMT to Floyd Hill
General Purpose (GP) Lane Information	Additional capacity by widening existing
Direction of Improvements	Both directions (EB and WB)
Design Speed	Match Existing
Trucks, Private Buses, BRT	Allowed in Peak Period Lane (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for EB & WB Peak Period Shoulder Lanes
Tunnels	Dynamic priced toll for EJMT 3rd Bore and Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2019 (Assumes 4 years NEPA)
Construction Duration	4 years
First Year Operation	2023
Financial Period	50 years

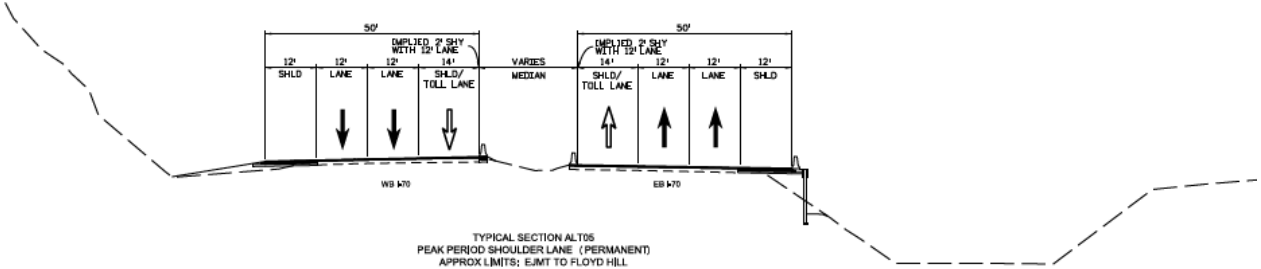
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System: None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

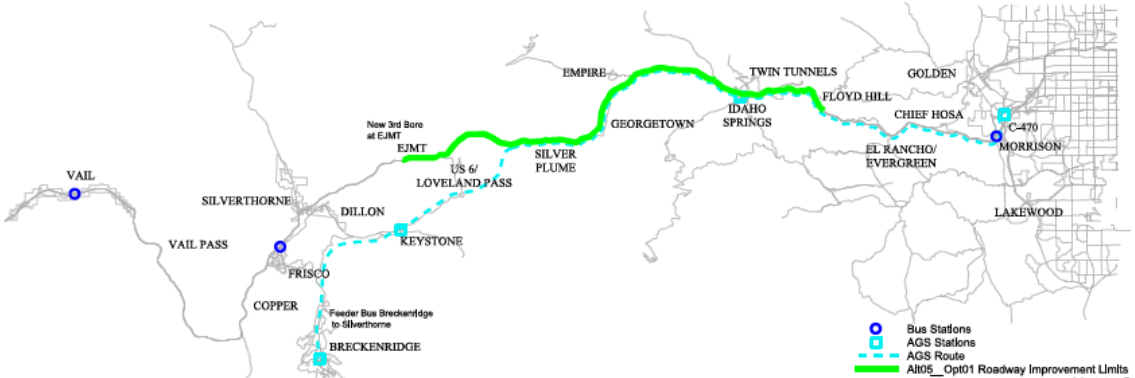
Special Structures

Special Structures	EJMT 3rd Bore

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT05
PEAK PERIOD SHOULDER LANE (PERMANENT)
APPROX LIMITS: EJMT TO FLOYD HILL



Forecast Traffic and Revenue Results - Alternative 5

	Corridor Vehicle Trips (M)	Toll Vehicle Trips (M)	Toll Revenues (2014 $M)	AGS Person Trips (M)
2025	26.0	0.50	8.0	-
2035	27.9	0.73	19.3	3.3
2045	31.6	1.1	28.4	3.7
2055	35.3	1.6	42.8	4.3
2065	39.0	2.1	61.3	4.9
2075	42.2	2.6	85.3	5.7

Alternative 5 Remarks

- Alternative 5 provides additional tolled capacity in both directions which allows it to generate substantial revenue.

- Growth in revenue substantially outpaces growth in volume as toll prices are raised in the out-years of the forecast to manage volumes in the toll lanes.

- In contrast to Alternative 4, Alternative 5 is only open during peak periods, which limits its revenue-generating potential in comparison to Alt4Opt1.

Toll Revenue PV (at 5% DR, $2014M): $440.49
Capital Cost (M): $1,959.17
O&M Cost (M): $13.81

Permanent Peak Period Shoulder Lane

Widen the existing roadway to accommodate one additional left side managed lane (EB & WB) for use during peak times, during non-peak times operates as a standard shoulder. Provide full width shoulder on right side.

Roadway Information

Extent of Roadway Improvements	Empire to top of Floyd Hill
General Purpose (GP) Lane Information	Additional capacity by widening existing
Direction of Improvements	Both directions (EB and WB)
Design Speed	Match Existing
Trucks, Private Buses, BRT	Allowed in Peak Period Lane (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for EB & WB Peak Period Shoulder Lanes
Tunnels	Dynamic priced toll for Twin Tunnels 3rd Lane
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2019 (Assumes 4 years NEPA)
Construction Duration	4 years
First Year Operation	2023
Financial Period	50 years

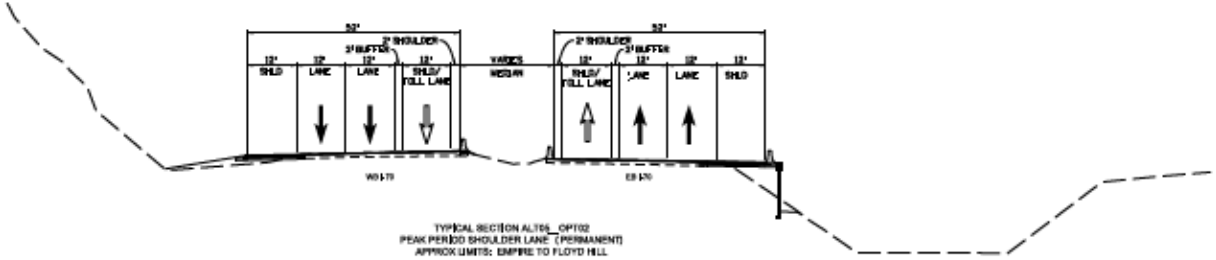
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System: None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2's 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

Special Structures

Special Structures	

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT05_OPT02
PEAK PERIOD SHOULDER LANE (PERMANENT)
APPROX LIMITS: EMPIRE TO FLOYD HILL

Not to Scale
Print Date: 5/2/2014

Forecast Traffic and Revenue Results - Alternative 5.1

	Corridor Vehicle Trips (M)	Toll Vehicle Trips (M)	Toll Revenues (2014 $M)	AGS Person Trips (M)
2025	25.7	0.62	4.1	-
2035	27.6	0.86	11.9	3.3
2045	31.3	1.2	16.8	3.7
2055	35.1	1.7	25.1	4.3
2065	38.7	2.1	36.0	4.9
2075	42.2	2.6	48.7	5.7

Alternative 5.1 Remarks

- Alt. 5.1 is the equivalent of Alternative 6 except that the PPSL is permanent rather than temporary. Alternative 5.1 does not include a 3rd bore at EJMT.

- The permanent nature of this Alternative makes it wider than the temporary lane in Alternative 6 and therefore provides it with higher capacity.

- Given that this alternative is half the distance of Alternative 5, Alternative 5.1 has lower revenue generation potential.

Toll Revenue PV (at 5% DR, $2014M): $256.65
Capital Cost (M): $99.77
O&M Cost (M): $3.46

Alt06_Opt01

Temporary Peak Period Shoulder Lane

Using the existing roadway, accommodate one additional WB left side managed lane for use during peak times; during non-peak times operates as a standard shoulder. No twelve foot wide shoulders are available during peak periods. During non-peak periods, twelve foot breakdown shoulder is on left side instead of right. Construction of WB peak period lane from Empire to Floyd Hill only. (This alternative assumes EB direction peak period lane from Empire to Floyd Hill is constructed.)

Roadway Information

Extent of Roadway Improvements	Empire to Floyd Hill
General Purpose (GP) Lane Information	Additional capacity by restriping existing
Direction of Improvements	WB Only Direction
Design Speed	Match Existing
Trucks, Private Buses, BRT	Allowed in Peak Period Lane (Always in GP Lanes)
Tolling	
Capacity Improvements	Dynamic priced toll for EB & WB Peak Period Shoulder Lanes
Tunnels	Dynamic priced toll for Twin Tunnels 3rd Lanes
Technology	Transponder and license plate recognition
Schedule	
Construction Start	2016 (Assumes 1.5 years NEPA)
Construction Duration	3 years
First Year Operation	2019
Financial Period	50 years

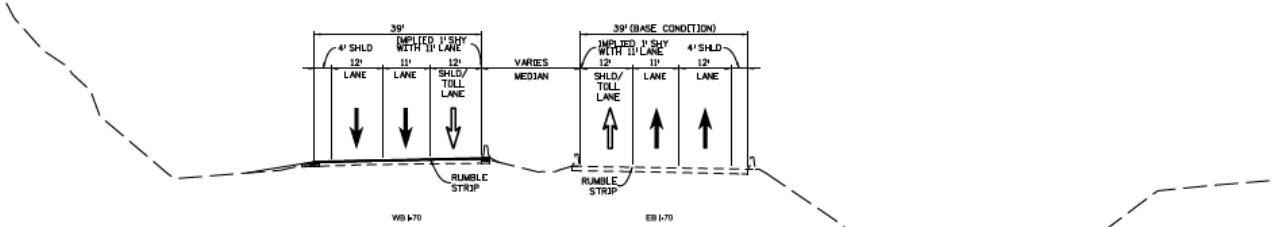
Transit Information

Termini	Silverthorne-Denver, Service to GWS (CDOT Bus), Breckenridge-Denver (AGS)
Special Infrastructure	AGS System: None for CDOT Bus
Schedule	Fall 2014 - CDOT Bus / After 2035 - AGS
Stations	6 CDOT Bus Stations - GWS, Eagle, Vail, Frisco, Denver (2); 5 AGS Stations
Type	
CDOT Bus	TBD by CDOT
BRT	N/A
AGS	In operation after 2035

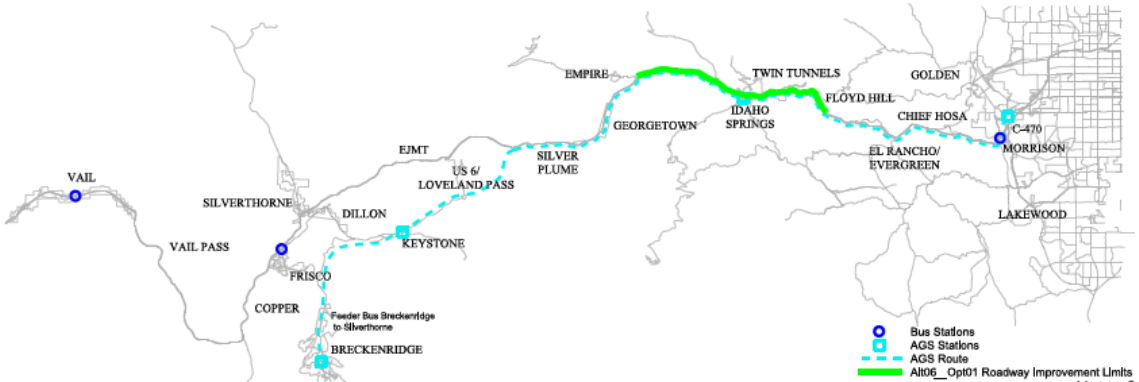
Special Structures

Special Structures	

GP = General Purpose Lane EJMT = Eisenhower Johnson Memorial Tunnels GWS = Glenwood Springs



TYPICAL SECTION ALT06_OPT01
PEAK PERIOD SHOULDER LANE (TEMPORARY)
APPROX LIMITS; WB I-70 EMPIRE TO FLOYD HILL



Forecast Traffic and Revenue Results - Alternative 6

	Corridor Vehicle Trips (M)	Toll Vehicle Trips (M)	Toll Revenues (2014 $M)	AGS Person Trips (M)
2025	25.7	0.60	4.0	-
2035	27.6	0.83	12.1	3.3
2045	31.4	1.2	17.1	3.7
2055	35.1	1.6	25.7	4.3
2065	38.8	2.1	37.1	4.9
2075	42.2	2.5	49.6	5.7

Alternative 6 Remarks

- Similar to the performance of Alternative 5, this alternative sees an increase in revenue that substantially outpaces the growth in traffic.

- This alternative has lower revenue generating potential in comparison with Alternative 5, as it covers half the distance and is a narrower, lower capacity lane, limiting the volumes it can carry overall.

Toll Revenue PV (at 5% DR, $2014M): $222.57
Capital Cost (M): $99.77
O&M Cost (M): $3.46

Comparison Across Alternatives – Reference Case

	Corridor Vehicle Trips		Toll Revenue		Revenue PV	Costs	
Alt.	2035 (M)	2050 (M)	2035 ($M)	2050 ($M)	(2014 $M)	Capital	O&M
Base Cond	29.3	34.8	4.1	11.3	$109.73	-	-
1	30.6	37.1	63.6	104.4	$1575.4	$4,116.4	$49.7
2	30.7	37.3	56.9	99.9	$1,518.0	$5,092.4	$53.9
3	27.9	33.7	2.1	4.7	$51.0	$2012.5	$10.7
4	28.7	34.7	21.7	40.6	$486.6	$2,715.6	$14.2
5	27.8	33.4	19.3	34.9	$440.5	$1,959.2	$13.8
5.1	27.6	33.2	11.9	20.5	$256.7	$99.8	$3.5
6	27.6	33.2	12.1	21.0	$222.6	$99.8	$3.5

Comparison Across Alternatives – Ranges (1.4%-3.0% Growth Rates)

Alt.	Corridor Vehicle Trips 2050 (M)		Tolled Vehicle Trips 2050 (M)		Toll Revenue 2050 (2014 $M)		Revenue PV (2014$M)	
Growth Rate	**1.4%**	**3.0%**	**1.4%**	**3.0%**	**1.4%**	**3.0%**	**1.4%**	**3.0%**
Base Cond	34.8	44.1	0.85	1.6	11.3	25.7	$109.7	$239.6
1	37.1	49.6	4.1	8.3	104.4	381.0	$1,575.4	$4,473.4
2	37.3	50.6	4.7	10.0	99.9	338.4	$1,518.0	$4,182.6
3	33.7	43.9	0.66	5.5	4.7	13.5	$51.0	$126.6
4	34.7	46.0	2.0	5.9	40.6	223.4	$486.6	$2,097.0
5	33.4	43.3	1.3	3.3	34.9	173.8	$440.5	$1680.1
5.1	33.2	43.0	1.4	3.2	20.5	86.6	$256.7	$847.1
6	33.2	43.0	1.4	3.0	21.0	82.3	$222.6	$668.4

Conclusions

Does the Expected Revenue Cover Expenses?							
	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. .5.1	Alt. 6
Capital + O&M	✗	✗	✗	✗	✗	✓	✓
O&M	✓	✓	✗	✓	✓	✓	✓

- Alternatives 1 and 2 show the greatest improvements in capacity. However, the revenues captured are not able to cover capital and O&M expenses.
- Alternative 3 provides minimal improvements in time savings and therefore minimal revenue.
- Alternatives 4 and 5 provide considerable improvements in capacity and significant revenues. Both can cover O&M but neither can cover capital expenses.
- Alternatives 5.1 and 6 provide limited improvements in capacity but generate an important amount of revenues; both cover all costs.

Level 1 Forecast Limitations

- A TransCAD-based travel demand model is not the most accurate means to model congestion. Weather, grades, and road curvature, among others have a strong impact on congestion and are not fully captured in the PEIS model.
- Level 1 T&R study uses existing data from recent studies, which limits the model's ability to include the most up to date or variable assumptions on Value of Time, vehicle occupancy rates, trip purposes, and other critical measures.
- The standard activities developed in a Level 2 study including the implementation of a micro-simulation tool and the development of a stated preference survey would address most of the limitations listed above and provide a more accurate evaluation of traffic and revenue for the proposed alternatives.

THANK YOU

COLORADO
Department of Transportation