8.0 ALTERNATIVES SCREENING

The first step in the screening process used the travel demand model to assess existing and projected 2025 volumes along the corridor to determine which segments were over capacity and thus had demand for express lanes. Step 2 evaluated the existing and projected volumes at existing and proposed interchange locations to determine which locations had high enough demand to warrant express lane access. The general impetus behind screening out access locations was to provide limited access to ensure operations are maintained and that the facility is used for longer trips. Generally, access points should be separated by approximately 2 miles to minimize turbulence typically found surrounding access points. The screening approach consisted of the following steps:

Step 1. Performing a corridor capacity analysis.
Step 2. Conducting a preliminary screening of access locations.
Step 3. Conducting a qualitative screening of access locations.
Step 4. Conducting a detailed quantitative screening of access locations and ramp types.

After the final access configuration was selected, the recommended alternative was refined with respect to design, traffic operations, toll pricing, traffic volume, and revenue optimization. This final step was termed optimization of the final alternative.

8.1 STEP 1. CORRIDOR CAPACITY ANALYSIS

Step 1 reviewed projected capacity levels along the general purpose lanes. This review was to determine which segments of C-470 had existing and projected volumes that exceeded roadway capacity. If volumes were reached or were under the capacity of the facility, there would not be sufficient demand for tolled express lanes. Because no significant time savings would be realized, motorists would be reluctant to choose to pay to use express lanes. Based on this supposition, the existing and projected volumes along C-470 were compared to the capacity.

Using HCS capacity analysis along C-470 was prepared to determine which sections might be candidates for tolling. This analysis began with several assumptions:

Capacity of a single mainline freeway lane is 2,200 vehicles per hour per lane (vphpl)
Capacity of 2-lane segments in each direction is 4,400 vphpl.
Capacity of 3-lane segments in each direction is 6,600 vphpl.

Volumes used in the analysis for PM peak hour existing and 2025 traffic volumes were taken from the existing traffic counts and the travel demand model projections. These volumes represent the highest directional peak hour on the mainline freeway segments.

The capacity between I-70 and I-25 was plotted on a graph for 2003 and 2025 conditions, assuming no improvements to the existing geometry. The existing geometry consists of three lanes in each direction between I-70 and Morrison Road, and between Quebec Street and I-25. The remaining segments of C-470 consist of two lanes in each direction. The 2025 analysis did include the proposed interchanges at Alameda Avenue and Yale Avenue. Figure 8.1 shows existing and proposed interchanges along the C-470 corridor. Figures 8.2 and 8.3 show the 2003 and 2025 V/C comparisons along the corridor.

Figure 8.1
C-470 Corridor Map

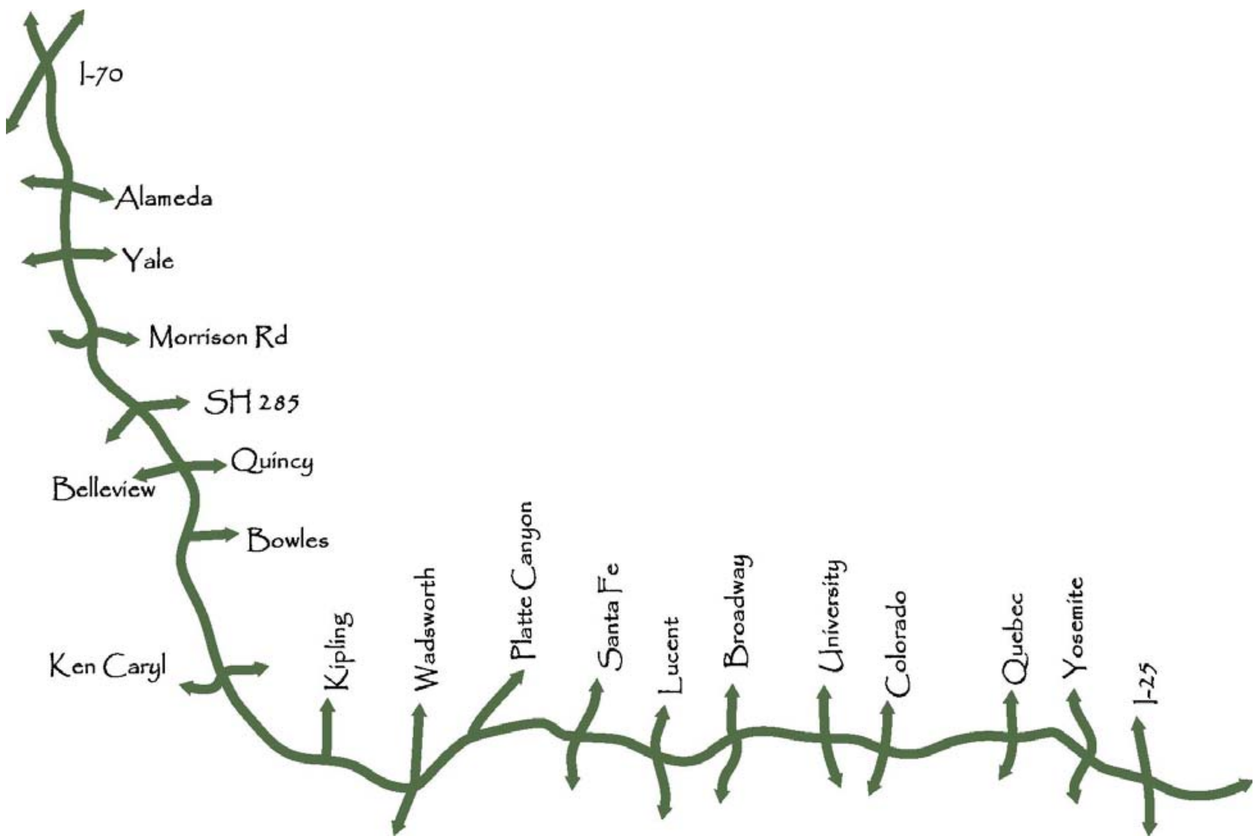


Figure 8.2
V/C Comparison – Existing (2003)

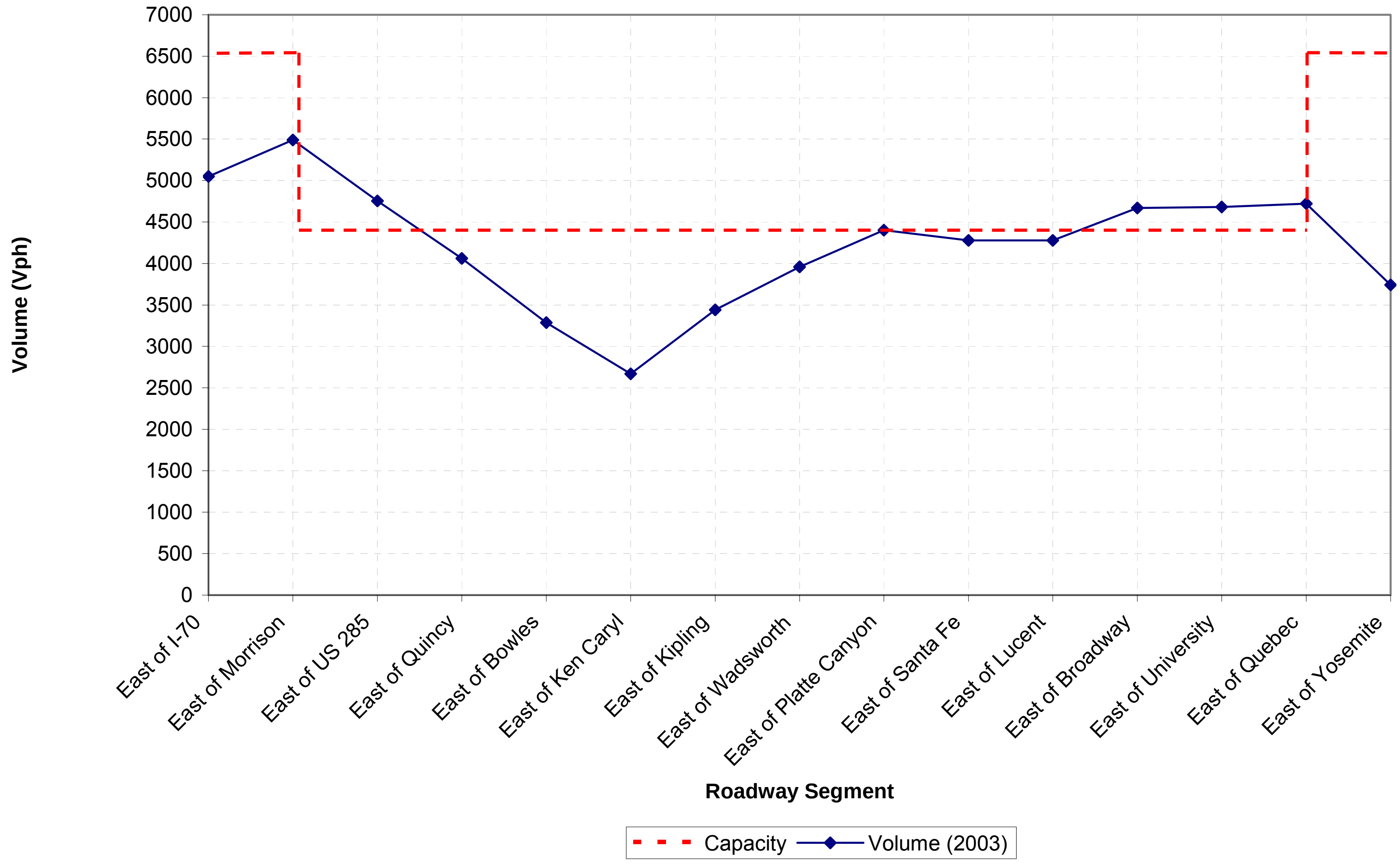
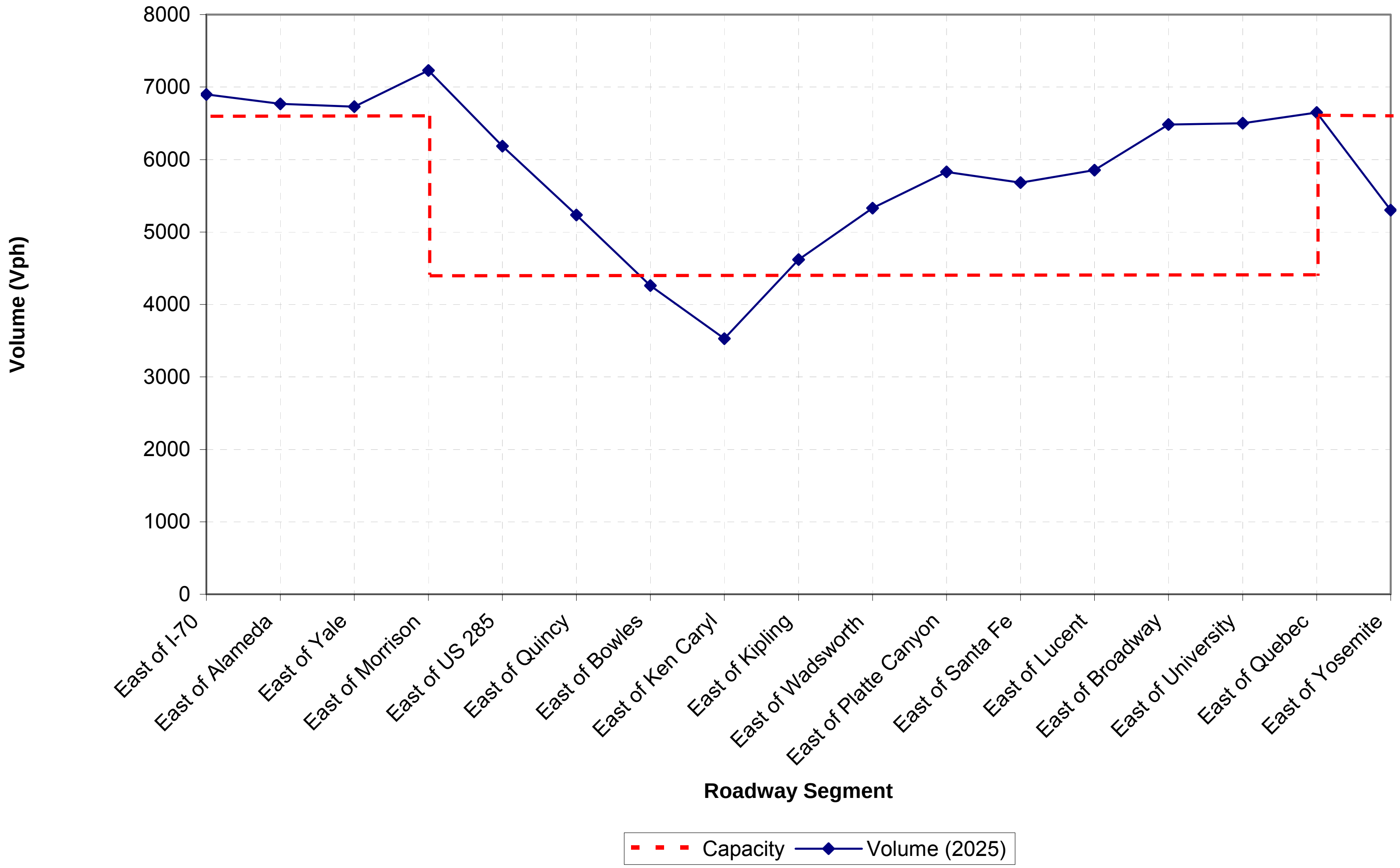


Figure 8.3
V/C Comparison – Projected (2025)



8.1.1 Existing Conditions Analysis

The volume and capacity graph for existing conditions (2003) shows that portions of the C-470 corridor are operating above capacity during peak hours in the peak direction. The volume exceeds the capacity between the Morrison Road and US 285 Interchanges. The volume between the Quincy Avenue and Wadsworth Boulevard Interchanges is well below capacity. The volume along C-470 then approaches capacity of the facility between the Wadsworth Boulevard and Lucent Boulevard Interchanges. The volumes along C-470 exceed the capacity between the Lucent Boulevard and Quebec Street Interchanges. At the Quebec Street Interchange, a third lane is introduced in each direction, increasing the capacity of C-470. The volumes along C-470 are therefore below the capacity again between the Quebec Street Interchange and the I-25 Interchange.

8.1.2 2025 Conditions Analysis

The volume and capacity graph of mainline C-470 for projected 2025 conditions follows the same trends as the existing conditions graph. The volumes along C-470 between the I-70 and Yale Avenue Interchanges are slightly above the capacity of the facility. The volumes between the Morrison Road and Bowles Avenue Interchanges are projected to be significantly higher than the capacity of C-470. Between the Bowles Avenue and Kipling Parkway Interchanges, volumes are projected to be under the capacity of C-470. Between the Kipling Parkway and Quebec Street Interchanges, 2025 volumes along C-470 are projected to be significantly higher than capacity up to the Quebec Street Interchange. East of the Quebec Street Interchange, the volume drops below capacity.

There does not appear to be adequate travel demand in 2025 between the Kipling Parkway and I-70 Interchanges to warrant express lanes in the western segment. With this segment not being significantly over capacity, demand would be insufficient to make the express lanes feasible.

The segment between the Morrison Road and Bowles Avenue Interchanges has volumes exceeding the mainline capacity. However, this segment is only 4 miles long and is not enough to provide enough time savings to entice drivers to pay a toll for using the express lanes. Further, it is in the middle of the corridor, and without an express lanes facility at either end to connect to, the facility would not be able to synergize with a longer, contiguous facility.

The segment between Bowles Avenue and Wadsworth Boulevard has the lowest volumes of any segment along the corridor. The projected 2025 volumes are shown to be well below capacity, resulting in little demand for express lanes.

The segment between the Wadsworth Boulevard and I-25 Interchanges shows volumes that are at or approaching capacity in 2003, and are projected to be significantly over the capacity of the mainline facility in 2025. This segment has the highest demand and highest potential for express lanes to be financially feasible. It was therefore recommended that this segment be studied further to evaluate the financial feasibility of the different express lane configurations during the 2003 to 2025 planning horizon.

8.1.3 Cursory Feasibility Assessment of I-70 to Morrison Road

Before the confident elimination of I-70 to Kipling Parkway segment, a cursory check of the potential financial feasibility was performed. The analysis provided the basis for developing a phased implementation plan, as discussed in Chapter 11.

In the cursory feasibility assessment, five alternatives were developed to determine whether varying the number of lanes on the general purpose or express lane facilities would produce results different from those for feasibility. The length of a potential western segment of express lanes was also varied to determine the impact of not including segments that are marginally above capacity. The intent of the analysis was to determine whether any alternatives warranted a more detailed analysis in the micro-simulation model.

8.1.4 Four-lane Barrier Separated Concept

To give the western segment express lanes concept the best chance to survive, a best-case scenario was developed in which the maximum conceivable number of users would divert into the express lanes. For this best-case scenario, it was assumed that 100 percent of all excess capacity on the general purpose lanes would use the express lanes. In cases where the forecasted general purpose lanes volume was below capacity, it is assumed that 10 percent of the total volume would use the express lanes. This estimate is based on the finding in the ELFS User Survey (see Appendix C) that 7 percent of all users would use the express lanes under any circumstance.

The five alternatives shown below were developed for the western segment express lanes concept using the assumptions listed above.

Alternative 1	Four general purpose lanes and 4 express lanes from Kipling Parkway to Morrison Road, and 6 general purpose lanes and four express lanes from Morrison Road to I-70.
Alternative 2	Four general purpose lanes and 4 express lanes from Bowles Avenue to Morrison Road, and six general purpose lanes and four express lanes from Morrison to I-70.
Alternative 3	Four general purpose lanes and four express lanes from Kipling Parkway to I-70.
Alternative 4	Four general purpose lanes and four express lanes from Bowles Avenue to I-70.

Alternative 5 Four general purpose lanes and four express lanes from Bowles Avenue to Morrison Road.

Although six lanes are currently in the segment from I-70 to Morrison Road, it was necessary to determine how sensitive the feasibility of this western segment was to the capacity. To determine this, Alternatives 3 and 4 were developed to represent a hypothetical situation in which only four free lanes were present.

The construction cost estimate for each alternative was based on the preliminary cost estimate for the eastern segment from Kipling Parkway to I-25. Based on a cost estimate of $23 million per mile for four express lanes and four general purpose lanes, a per lane mile cost of $2.875 million was used in the analysis below.

The express lane volume and corresponding vehicle miles traveled (VMT) input was used with projected toll rates to compute an overall financial feasibility of each alternative. The feasibility factor then gave an indication of the financial feasibility of the alternative.

Using these best case assumptions as input, traffic volumes in the express lanes were estimated, revenue was computed, and financial feasibility factors were calculated. These results show that the four-lane barrier-separated section under all five alternatives has nearly no potential for being financially feasible; the results also verify that the initial hypothesis that the western segment is not feasible for a toll lane facility.

It should be noted that the analysis above was performed assuming a four-lane barrier-separated section. To determine whether another typical section configuration could result in a more feasible rating, the sections below discuss reversible- and single-lane concepts.

8.1.5 Reversible Express Lane Concept

As a means of reducing the associated construction and O&M costs, another express lane alternative was analyzed. The volume trends observed on the western segment of C-470 showed a distinct directional split between the AM and PM peak hours. Typically, the AM peak hour direction is northbound, while the PM peak hour direction is southbound. Hence, a reversible two-lane express lane option was evaluated with the previously identified five alternatives. During the AM peak hour, the two express lanes would be open to northbound traffic, while during the PM peak hour, the southbound direction would be open. This would result in approximately half the original construction cost for the four-lane alternative. The O&M costs would also be reduced by half. With the reversible express lane concept, a corresponding reduction in the revenue generation occurred, because vehicles in the off peak direction did not have access to the express lanes.

As in the case of the four-lane barrier-separated segment, the reversible express lane concept was found to not be financially feasible.

8.1.6 Single Express Lane Concept

A final cost-saving scenario was evaluated using a single-lane concept (one lane in each direction). Similar to the reversible express lane concept, the construction and O&M costs would be reduced by approximately half.

As in the case with previous two alternatives, the single express lane concept was also found to not be financially feasible.

8.1.7 Conclusions of the I-70 to Kipling Parkway Analysis

The above analyses demonstrate that the western segment has no potential to be feasible in the planning horizon of this study. However, in the interest of identifying a long-term plan for implementation, discusses a potential phasing plan and associated timeframe for planning purposes only. Potentially, sometime after 2025, traffic volumes may continue to increase to the extent that express lanes could be considered a viable alternative.

8.1.8 Phasing Plan for Kipling Parkway to I-70

A potential phasing plan for constructing express lanes in the western segment could consider constructing two express lanes in each direction from Bowles Avenue to I-70 as an initial phase. The second phase would provide the connection between Bowles Avenue and Kipling Parkway. Based on a continued 1.5 percent annual growth rate beyond 2025, the first phase could be warranted around 2030, with the second phase potentially being needed around 2050. This more aggressive growth scenario represents the earliest tolls would be warranted. Using a less conservative growth rate of 1 percent, the segments between I-70 and Bowles Avenue, and between Bowles Avenue and Kipling Parkway, would not be worth considering until around 2040 and 2070, respectively. These estimates assume existing laneage and capacity. With the corridor approaching full build out at 2010, the anticipated growth rate beyond 2025 is expected to be more consistent with the conservative 1 percent rate. This analysis assumes a preferred four-lane barrier-separated facility due to the reliability and safety benefits mentioned in Sections.

8.2 STEP 2. PRELIMINARY SCREENING OF ACCESS LOCATIONS

With only the eastern segment of C-470 from I-25 to Kipling Parkway showing potential demand for express lanes, it was carried to the next phase of screening. Step 2 sought to evaluate all existing and proposed interchange locations to determine which had enough demand to warrant access to the express lanes. The first step was to determine which interchanges currently carry the most volume. As a representative measure of demand, the interchange locations that comprise 75 percent or more of the total corridor volume were carried forward for further consideration. Using this methodology, Platte Canyon Road was the only interchange eliminated from further consideration. Table 8.4 summarizes the projected 2025 combined AM and PM peak hour ramp volumes.

Table 8.1
Preliminary Access Location Screening
Based on Interchange Volumes

Interchange	Project 2025 AM and PM Peak Hour General Purpose Lane Ramp Combined Totals	Disposition
I-25	16,830	Carried Forward
Yosemite	4,375	Carried Forward
Quebec	11,135	Carried Forward
Colorado*	N/A	Carried Forward
University	7,110	Carried Forward
Broadway	9,165	Carried Forward
Lucent	8,650	Carried Forward
Santa Fe	9,290	Carried Forward
Platte Canyon	1,125	Eliminated
Wadsworth	8,695	Carried Forward
Kipling	5,640	Carried Forward
* No data for Colorado Interchange; ramps do not currently exist		

8.3 STEP 3. QUALITATIVE SCREENING OF ACCESS LOCATIONS

In Step 3, output from TP+ model runs was used to determine which locations had the highest average combined 2025 AM and PM peak hour ramp volumes. The locations with the lowest ramp volumes - Ken Caryl Avenue, Kipling Parkway, and Lucent Boulevard - were eliminated. Despite having the lowest volume of the remaining access locations, Colorado Boulevard was carried forward for further evaluation. This decision was made solely on its inclusion in the Public Private Initiative alternative. It should be noted that the locations of Lucent Boulevard and Kipling Parkway were later reintroduced into the screening process to alleviate some operational issues on the corridor. Table 8.5 summarizes the access locations that were carried forward or eliminated at this level of screening.

Table 8.2
Qualitative Access Location Screening
Based on TP+ Model

Access Locations	Average Combined AM and PM Peak Hour Express Lanes Ramp Volumes	Description	Disposition
Colorado	2,065	Carried forward for comparison to public private initiative alternative	Carried forward
Lucent	3,640	Low volume	Eliminated
Kipling	4,540	Lower volume on EL ramps and general purpose lane ramps and close proximity to Wadsworth	Eliminated
I-25/Yosemite	5,026	Medium volume and logical terminus of eastern segment	Carried forward
Santa Fe	5,104	Medium volume and connection to US Highway	Carried forward
Wadsworth	6,983	High volume	Carried forward
Broad/University	7,023	High volume	Carried forward
Quebec	7,304	High volume	Carried forward

During this third level of screening, only interchange nodes were considered; specific ramp configurations at access points were not considered. The travel demand model was not sensitive enough to distinguish between different access types. The exact locations, types, and directions that will be afforded access at each location were evaluated in the final level of screening for the short-listed alternatives only.

8.4 STEP 4. QUANTITATIVE SCREENING OF ACCESS LOCATIONS

Step 4 involved a detailed analysis of access locations, operations, design considerations, and projected construction costs. An accurate estimate of express lane users was developed using the AIMSUN micro-simulation model and results of the Stated Preference Survey. These tools considered the toll rate and time savings with which drivers would be willing to divert into the express lanes.

8.4.1 Access Alternatives

The remaining access points from Steps 2 and 3 of the screening process were analyzed in the AIMSUN micro-simulation model to determine specific access locations and types. From Steps 2 and 3, four locations were identified as having the highest traffic demand: Wadsworth Boulevard, Santa Fe Drive, Quebec Street, and I-25. These were logical locations for providing access based strictly on projected volumes. Direct access was provided at these high-volume locations in several alternatives to determine its overall benefit. The remaining locations of Lucent Boulevard, Broadway, and University Boulevard all experienced similar volumes and thus were combined into several alternatives to determine which combination of these access points provided the highest express lane ridership and best overall operations. Due to slightly lower volumes, these locations were analyzed only with slip ramp access. The access locations were then grouped into 10 distinct alternatives, as shown in Figure 8.4.

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