APPENDIX 3: PROCEDURES FOR ESTIMATING RAMP ALTERNATIVES

Procedures for Analyzing Ramps

The following procedures are provided to clarify ramp analysis and aid engineers in analyzing ramps as well as providing allowances to simplify the process. These procedures should be considered as the minimum allowable analysis for LCCA for state highways. Districts always have the discretion to analyze or require more locations and options than what is presented in this manual.

Omit Ramp Analysis

- Ramps as Part of a Larger Project
  When ramps are included as part of a larger project to widen, rehabilitate, or build a state highway, the district may omit the analysis of the ramps in the LCCA. When omitting, it is assumed that the results for the ramps will be the same as the result for the mainline. It is also assumed that the pavement design criteria and design life used for the mainline will be used for the ramps.
- When it is for minor ramp maintenance, such as remove and replace open grade friction course. This is often done when a major project is being done on mainline.
- When the ramp project is a CAPM.

> ***Example:***
> *Suppose a project proposes to add one mainline lane and completely reconstruct an existing interchange. If the ramp pavement structure proposes to be the same as the mainline, a ramp LCCA is not required. However, if the ramp pavement structure is not anticipated to match the mainline pavement structure, then a ramp LCCA is required.*

- Include Ramp analysis:

  See the process below for Ramps as Part of a Separate Project. The user cost associated with ramp construction assumes additional traffic delay on the mainline. **Therefore, only off-ramps are analyzed for LCCA since off-ramps affect mainline traffic.** For example, if motorists do not take an off-ramp exit from the mainline, then it is assumed that there will be an additional traffic delay on the mainline which will increase user costs. On-ramps are mainly associated with local road traffic and are not used for LCCA.

Ramps as Part of a Separate Project

For projects that propose pavement work only on ramps (such as interchange modification projects), it is not necessary to perform an LCCA for each individual ramp. Instead, the engineer should select one off-ramp which has the highest traffic volume that best represents all the off ramps for the project.

If the project proposes auxiliary lanes, a separate analysis is not required provided the following conditions are met.

- Auxiliary-lanes are short (typically around 1000-feet in length or less) and serve only to aid with traffic handling for the ramp and do not extend to the next interchange.
- There are no plans to extend the auxiliary lanes to the next interchange or convert the lane into a through traffic lane within the life span of the pavement.

The District is responsible for making the determination as to whether the above conditions have been met.

<u>Agency Construction Cost Considerations for Ramp Analysis</u>

Ramps have three basic segments, the gore, middle, and the terminus at the intersection with the local road. (Note: not all ramps have an end treatment.)

When analyzing the middle segment, the designer should take into account the constructability of the entire ramp when estimating costs and making final decisions. For example, when the gore area is concrete and the ramp terminus is also concrete, it may be more cost effective in initial costs to pave the entire ramp with concrete because of the lower labor and mobilization costs.

<u>Estimating User Cost</u>

When estimating the user cost for ramps, the following assumptions can be made unless District Traffic Operations provides specific data for the ramp.

For the Project-Level and Traffic Data Inputs, enter the following:

- It is assumed that motorists will detour and exit at the downstream interchange.
- Traffic Direction
  If the ramp peaks in the AM hours, then select "Inbound" as the Traffic Direction. If the ramp peaks in the PM hours, then select "Outbound" as the Traffic Direction. When either "Inbound" or "Outbound" is selected, *RealCost Version 2.5CA* analyzes user costs in one direction, the peak direction.
- AADT Construction Year (total for both directions)

  Add mainline traffic volume in both directions to twice the off-ramp ramp traffic volume. Ramp LCCA analyze users cost in one traffic direction. However, the traffic volume input in *RealCost Version 2.5CA* must be for both directions. The off-ramp AADT is doubled to simulate traffic conditions in both directions, but *RealCost Version 2.5CA* will analyze just the selected peak traffic hourly distribution in one traffic direction.

Example:
The construction year AADT of the mainline road in both directions before the off-ramp is 17,000, as shown in Figure A3-1. The construction year AADT of the auxiliary lane or off-ramp is 3,000.The AADT Construction Year (total for both directions) ***RealCost Version 2.5CA*** *input is 17,000 + 2 x 3,000 or 23,000 at the overcrossing during construction. This is because the traffic that would have normally travelled on the off-ramp is forced into the mainline. See AADT details in Figure A3-2 and Figure A3- 3.*

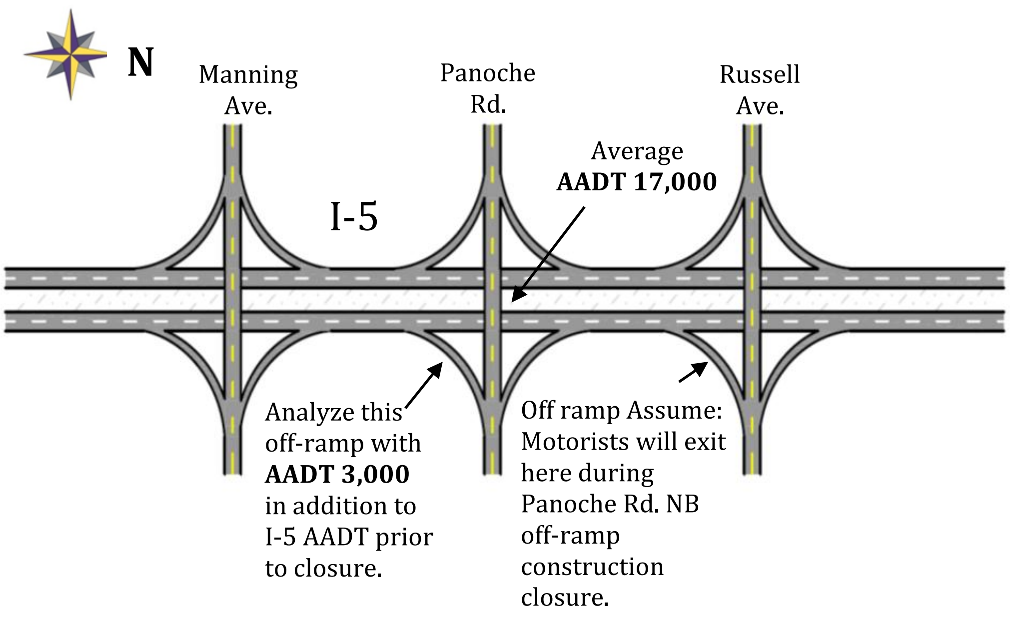

Figure A3-1 Layout showing AADT for I-5 and for off-ramp (pre-construction)

Figures A3-2 and Figure A3-3 show the AADT's at the ramp location prior to construction and during construction. It is assumed that the traffic that normally exits at Panoche Road (NB) is going to exit on the next exit, which is Russell Avenue. This causes a potential queue and traffic delay south of Panoche Road, and a user cost delay for up to 20,000 vehicles in a day.

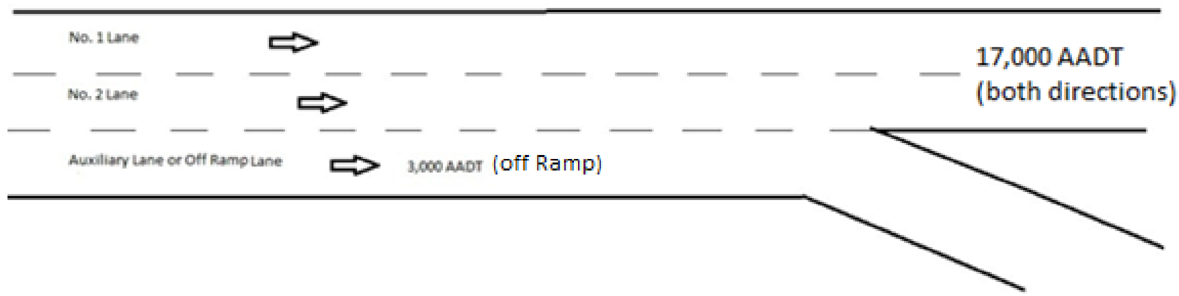

Figure A3-2 Pre-Construction AADT for Off-Ramp Scenario

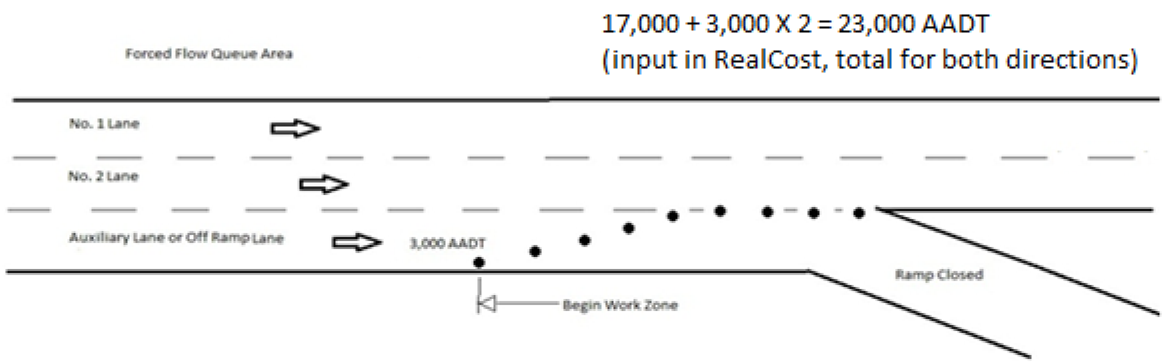

Figure A3-3 Construction AADT during Off-Ramp Closure

In Figure A8-3, a forced flow queue area is shown. This may cause a reduced speed delay, or a stopping delay for motorists, depending on the peak traffic, and if there is a lane reduction.

- Speed Limit Under Normal Operating Conditions

  Use posted speed limit of the mainline in that direction (mph)

- Lanes Open in Each Direction Under Normal Conditions

  Use number of through lanes on the mainline in that direction
  + 1 lane (to represent the off-ramp)

Example:
If the number of through lanes in the direction of the mainline highway that is feeding the off-ramp is 3, then the ***RealCost Version 2.5CA*** *input for number of lanes open in each direction is 4 lanes (3 through mainline highway lane + 1 ramp lane).*

- Maximum AADT (total for both directions)

  Calculate the value by using the total number of through lanes on the mainline.

Example:
If the number of thru lanes in the direction of the mainline highway that is feeding the off-ramp is 3, then the ***RealCost Version 2.5CA*** *input for Maximum AADT (total for both directions) is*

$$3\, lanes\ \times\ 2\, direction\ \times\ value\ from\, Table\ 3-1$$

- All other values are entered as per the manual based on data and information of the mainline.

Once the Project Level Inputs, and the M & R Sequence is complete, the Alternative section of *RealCost Version 2.5CA* needs to be completed by entering the following:

- Agency Construction Cost, and Activity Service Life.
- Based on the information of the ramp you are analyzing.
- Work Zone Length:
  Enter a length of no less than 1 mile.
- Number of Lanes Open in Each Direction During Work Zone:
  Enter the number of thru lanes of the mainline.
- Work Zone Duration:
  Based on the information of the ramp you are analyzing and the construction window prescribed under Work Zone Hours in Section 3.5.2.
- Work Zone Speed Limit:
  Enter a speed that is 5 mph less than the posted speed limit unless there is an approved reduced speed limit for the project as determined by District Traffic Operations.
- Work Zone Hours:
  Enter the time frame the ramp is closed from the Traffic Management Plan. If no traffic closure data is available, enter 0 to 6 as the First period of closure and enter 21 to 24 as the Second period of closure.