

District: **TxDOT Houston**

PROJECT: **FM 1774 from Waller C/L to FM 1488**

|       |             |
|-------|-------------|
| EA:   | Arterial    |
| PPNO: | 1400-04-021 |

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## INVESTMENT ANALYSIS

### SUMMARY RESULTS

|                                      |         |
|--------------------------------------|---------|
| <b>Life-Cycle Costs (mil. \$)</b>    | \$37.3  |
| <b>Life-Cycle Benefits (mil. \$)</b> | \$242.8 |
| <b>Net Present Value (mil. \$)</b>   | \$205.6 |
| <b>Benefit / Cost Ratio:</b>         | 6.5     |
| <b>Rate of Return on Investment:</b> | 23.6%   |
| <b>Payback Period:</b>               | 5 years |

| <b>ITEMIZED BENEFITS (mil. \$)</b>              | Average Annual | Total Over 20 Years |
|---|----------------|---------------------|
| <b>Travel Time Savings</b>                      | \$7.2          | \$143.8             |
| <b>Veh. Op. Cost Savings</b>                    | \$0.5          | \$10.8              |
| <b>Accident Cost Savings</b>                    | \$4.3          | \$86.9              |
| <b>Emission Cost Savings</b>                    | \$0.1          | \$1.3               |
| <b>TOTAL BENEFITS</b>                           | \$12.1         | \$242.8             |
| <b>Person-Hours of Time Saved</b>               | 600,749        | 12,014,971          |
| <b>CO<sub>2</sub> Emissions Saved (tons)</b>    | 2,783          | 55,665              |
| <b>CO<sub>2</sub> Emissions Saved (mil. \$)</b> | \$0.1          | \$1.1               |

**Should benefit-cost results include:**

- 1) Induced Travel? (y/n)**

Default = Y
- 2) Vehicle Operating Costs? (y/n)**

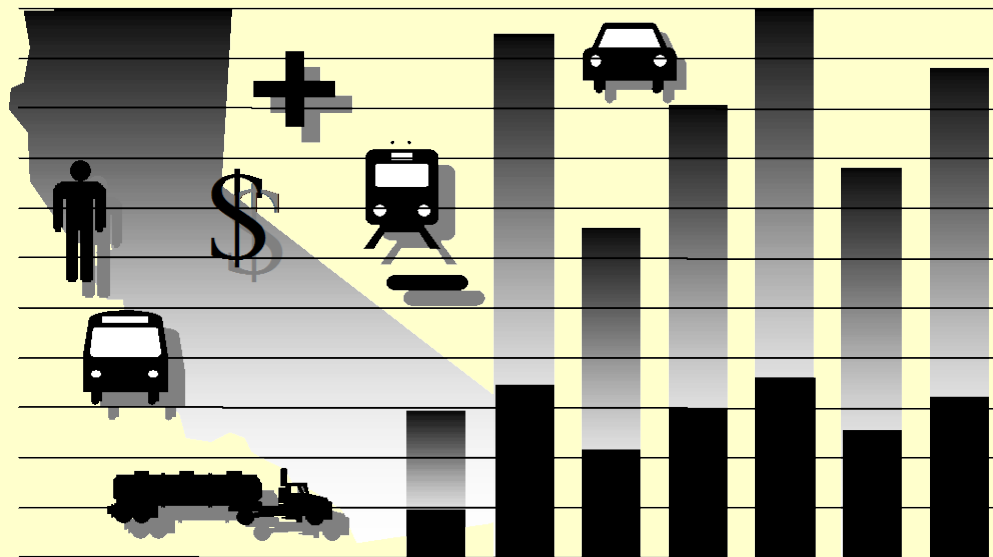
Default = Y
- 3) Accident Costs? (y/n)**

Default = Y
- 4) Vehicle Emissions? (y/n)**  
includes value for CO<sub>2</sub>e

Default = Y



# California Life-Cycle Benefit/Cost Analysis Model (Version 5.0) TIGER Benefit-Cost Analysis



Office of Transportation Economics  
Division of Transportation Planning  
2014 TIGER Grant Applications

For questions and comments, please contact:

Barry Padilla

(916) 653-9248 [barry\\_padilla@dot.ca.gov](mailto:barry_padilla@dot.ca.gov)

District: **TxDOT Houston**

PROJECT: **FM 1774 from Waller C/L to FM 1488**

Facility Type: **Arterial T**  
 CSJ #: **1400-04-021**

**1A PROJECT DATA**

**Type of Project**  
 Select project type from list: **General Highway**

**Project Location** (enter 1 for So. Cal., 2 for No. Cal., or 3 for rural): **1**

Length of Construction Period: **2** years  
 One- or Two-Way Data: **2** enter 1 or 2

Length of Peak Period(s) (up to 24 hrs): **7** hours (Current)

**1C HIGHWAY ACCIDENT DATA**

**Actual 3-Year Accident Data (from Table B)**

|                                      | Count (No.) | Rate  |
|--------------------------------------|-------------|-------|
| Total Accidents (Tot)                | 36          | 1.00  |
| Fatal Accidents (Fat)                | 1           | 0.028 |
| Injury Accidents (Inj)               | 15          | 0.41  |
| Property Damage Only (PDO) Accidents | 20          | 0.55  |

**Statewide Basic Average Accident Rate**

|   | No Build | Build |
|---|----------|-------|
| Rate Group                                |          |       |
| Accident Rate (per million vehicle-miles) | 0.46     | 0.29  |
| Percent Fatal Accidents (Pct Fat)         | 1.0%     | 0.2%  |
| Percent Injury Accidents (Pct Inj)        | 49.2%    | 9.8%  |

**1B HIGHWAY DESIGN AND TRAFFIC DATA**

**Highway Design**

|   | No Build | Build |
|---|----------|-------|
| Roadway Type (Fwy, Exp, Conv Hwy)               | C        | C     |
| Number of General Traffic Lanes                 | 2        | 4     |
| Number of HOV/HOT Lanes                         |          |       |
| HOV Restriction (2 or 3)                        |          |       |
| Exclusive ROW for Buses (y/n)                   | N        |       |
| Highway Free-Flow Speed                         | 40       | 60    |
| Ramp Design Speed (if aux. lane/off-ramp proj.) | 35       | 35    |
| Length (in miles) Highway Segment               | 2.3      | 2.3   |
| Impacted Length                                 | 2.3      | 2.3   |

**Average Daily Traffic**

|                    | No Build | Build  |
|--------------------|----------|--------|
| Current            | 20,157   |        |
| Base (Year 1)      | 21,916   | 21,916 |
| Forecast (Year 20) | 38,623   | 38,623 |

**Average Hourly HOV/HOT Lane Traffic**

|  | No Build | Build |
|--|----------|-------|
| Percent of Induced Trips in HOV (if HOT or 2-to-3 conv.) |          | 100%  |

**Percent Traffic in Weave**: 0.0%

**Percent Trucks** (include RVs, if applicable): 6%

**Truck Speed**

**On-Ramp Volume**

|   | Peak | Non-Peak |
|---|------|----------|
| Hourly Ramp Volume (if aux. lane/on-ramp proj.)     | 0    | 0        |
| Metering Strategy (1, 2, 3, or D, if on-ramp proj.) |      |          |

**Queue Formation** (if queuing or grade crossing project)

|                                       | Year 1 | Year 20 |
|---------------------------------------|--------|---------|
| Arrival Rate (in vehicles per hour)   | 0      | 0       |
| Departure Rate (in vehicles per hour) | 0      | 0       |

**Pavement Condition** (if pavement project)

|                                 | No Build | Build |
|---------------------------------|----------|-------|
| IRI (inches/mile) Base (Year 1) |          |       |
| Forecast (Year 20)              |          |       |

**Average Vehicle Occupancy (AVO)**

|   | No Build | Build |
|---|----------|-------|
| General Traffic Non-Peak                  | 1.32     | 1.32  |
| Peak                                      | 1.25     | 1.25  |
| High Occupancy Vehicle (if HOV/HOT lanes) | 2.15     | 2.15  |

**1D RAIL AND TRANSIT DATA**

**Annual Person-Trips**

|                    | No Build | Build |
|--------------------|----------|-------|
| Base (Year 1)      |          |       |
| Forecast (Year 20) |          |       |

**Percent Trips during Peak Period**: 54%

**Percent New Trips from Parallel Highway**: 100%

**Annual Vehicle-Miles**

|                    | No Build | Build |
|--------------------|----------|-------|
| Base (Year 1)      |          |       |
| Forecast (Year 20) |          |       |

**Average Vehicles/Train** (if rail project)

**Reduction in Transit Accidents**

Percent Reduction (if safety project)

**Average Transit Travel Time**

|                                      | No Build | Build |
|--------------------------------------|----------|-------|
| In-Vehicle Non-Peak (in minutes)     |          | 0.0   |
| Peak (in minutes)                    |          | 0.0   |
| Out-of-Vehicle Non-Peak (in minutes) | 0.0      | 0.0   |
| Peak (in minutes)                    | 0.0      | 0.0   |

**Highway Grade Crossing**

|                               | Current | Year 1 | Year 20 |
|-------------------------------|---------|--------|---------|
| Annual Number of Trains       |         | 0      |         |
| Avg. Gate Down Time (in min.) |         | 0.0    |         |

**Transit Agency Costs** (if TMS project)

|   | No Build | Build |
|---|----------|-------|
| Annual Capital Expenditure              |          | \$0   |
| Annual Ops. and Maintenance Expenditure |          | \$0   |

Model should be run for both roads for intersection or bypass highway projects, and may be run twice for connectors. Press button below to prepare model to enter data for second road. After data are entered, results reflect total project benefits.

Prepare Model for Second Road

Enter all project costs (in today's dollars) in columns 1 to 7. Costs during construction should be entered in the first eight rows. Project costs (including maintenance and operating costs) should be net of costs without project.

| 1E PROJECT COSTS (enter costs in thousands of dollars) |                      |       |              |                  |        |            |                             |                          |               |
|--|----------------------|-------|--------------|------------------|--------|------------|-----------------------------|--------------------------|---------------|
| Col. no.   | (1)                  | (2)   | (3)          | (4)              | (5)    | (6)        | (7)                         |                          |               |
| Year   | DIRECT PROJECT COSTS |       |              | SUBSEQUENT COSTS |        | Mitigation | Transit Agency Cost Savings | TOTAL COSTS (in dollars) |               |
|  | Project Support      | R / W | Construction | Maint./ Op.      | Rehab. |            |                             | Constant Dollars         | Present Value |
| <b>Construction Period</b>                             |                      |       |              |                  |        |            |                             |                          |               |
| 1  |                      |       | \$18,908     |                  |        |            |                             | \$18,908,000             | \$18,908,000  |
| 2  |                      |       | 18,908       |                  |        |            |                             | 18,908,000               | 18,357,282    |
| 3  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 4  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 5  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 6  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 7  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 8  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| <b>Project Open</b>                                    |                      |       |              |                  |        |            |                             |                          |               |
| 1  |                      |       |              |                  |        |            |                             | \$0                      | \$0           |
| 2  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 3  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 4  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 5  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 6  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 7  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 8  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 9  |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 10   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 11   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 12   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 13   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 14   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 15   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 16   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 17   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 18   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 19   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| 20   |                      |       |              |                  |        |            |                             | 0                        | 0             |
| <b>Total</b>   | \$0                  | \$0   | \$37,816     | \$0              | \$0    | \$0        | \$0                         | \$37,816,000             | \$37,265,282  |

$$\text{Present Value} = \frac{\text{Future Value (in Constant Dollars)}}{(1 + \text{Real Discount Rate})^{\text{Year}}}$$

## HIGHWAY SPEED AND VOLUME INPUTS

|                        | Calculated by<br>Model | Changed<br>by User | Used for Proj.<br>Eval. | Reason for Change |
|------------------------|------------------------|--------------------|-------------------------|-------------------|
| <b>No Build</b>        |                        |                    |                         |                   |
| <b>Year 1</b>          |                        |                    |                         |                   |
| <u>Peak Period</u>     |                        |                    |                         |                   |
| HOV Volume             | 0                      |                    | 0                       |                   |
| Non-HOV Volume         | 11,021                 |                    | 11,021                  |                   |
| Weaving Volume         | 0                      |                    | 0                       |                   |
| Truck Volume           | 703                    |                    | 703                     |                   |
| HOV Speed              | 55.0                   |                    | 55.0                    |                   |
| Non-HOV Speed          | 37.1                   |                    | 37.1                    |                   |
| Weaving Speed          | 55.0                   |                    | 55.0                    |                   |
| Truck Speed            | 37.1                   |                    | 37.1                    |                   |
| <u>Non-Peak Period</u> |                        |                    |                         |                   |
| Non-HOV Volume         | 9,579                  |                    | 9,579                   |                   |
| Weaving Volume         | 0                      |                    | 0                       |                   |
| Truck Volume           | 611                    |                    | 611                     |                   |
| Non-HOV Speed          | 40.0                   |                    | 40.0                    |                   |
| Weaving Speed          | 55.0                   |                    | 55.0                    |                   |
| Truck Speed            | 40.0                   |                    | 40.0                    |                   |
| <b>Year 20</b>         |                        |                    |                         |                   |
| <u>Peak Period</u>     |                        |                    |                         |                   |
| HOV Volume             | 0                      |                    | 0                       |                   |
| Non-HOV Volume         | 19,424                 |                    | 19,424                  |                   |
| Weaving Volume         | 0                      |                    | 0                       |                   |
| Truck Volume           | 1,240                  |                    | 1,240                   |                   |
| HOV Speed              | 55.0                   |                    | 55.0                    |                   |
| Non-HOV Speed          | 7.6                    |                    | 7.6                     |                   |
| Weaving Speed          | 55.0                   |                    | 55.0                    |                   |
| Truck Speed            | 7.6                    |                    | 7.6                     |                   |
| <u>Non-Peak Period</u> |                        |                    |                         |                   |
| Non-HOV Volume         | 16,882                 |                    | 16,882                  |                   |
| Weaving Volume         | 0                      |                    | 0                       |                   |
| Truck Volume           | 1,078                  |                    | 1,078                   |                   |
| Non-HOV Speed          | 40.0                   |                    | 40.0                    |                   |
| Weaving Speed          | 55.0                   |                    | 55.0                    |                   |
| Truck Speed            | 40.0                   |                    | 40.0                    |                   |
| <b>Build</b>           |                        |                    |                         |                   |
| <b>Year 1</b>          |                        |                    |                         |                   |
| <u>Peak Period</u>     |                        |                    |                         |                   |
| HOV Volume             | 0                      |                    | 0                       |                   |
| Non-HOV Volume         | 11,021                 |                    | 11,021                  |                   |
| Weaving Volume         | 0                      |                    | 0                       |                   |
| Truck Volume           | 703                    |                    | 703                     |                   |
| HOV Speed              | 55.0                   |                    | 55.0                    |                   |
| Non-HOV Speed          | 60.0                   |                    | 60.0                    |                   |
| Weaving Speed          | 55.0                   |                    | 55.0                    |                   |
| Truck Speed            | 60.0                   |                    | 60.0                    |                   |
| <u>Non-Peak Period</u> |                        |                    |                         |                   |
| Non-HOV Volume         | 9,579                  |                    | 9,579                   |                   |
| Weaving Volume         | 0                      |                    | 0                       |                   |
| Truck Volume           | 611                    |                    | 611                     |                   |
| Non-HOV Speed          | 60.0                   |                    | 60.0                    |                   |
| Weaving Speed          | 55.0                   |                    | 55.0                    |                   |
| Truck Speed            | 60.0                   |                    | 60.0                    |                   |
| <b>Year 20</b>         |                        |                    |                         |                   |
| <u>Peak Period</u>     |                        |                    |                         |                   |
| HOV Volume             | 0                      |                    | 0                       |                   |
| Non-HOV Volume         | 19,424                 |                    | 19,424                  |                   |
| Weaving Volume         | 0                      |                    | 0                       |                   |
| Truck Volume           | 1,240                  |                    | 1,240                   |                   |
| HOV Speed              | 55.0                   |                    | 55.0                    |                   |
| Non-HOV Speed          | 58.7                   |                    | 58.7                    |                   |
| Weaving Speed          | 55.0                   |                    | 55.0                    |                   |
| Truck Speed            | 58.7                   |                    | 58.7                    |                   |
| <u>Non-Peak Period</u> |                        |                    |                         |                   |
| Non-HOV Volume         | 16,882                 |                    | 16,882                  |                   |
| Weaving Volume         | 0                      |                    | 0                       |                   |
| Truck Volume           | 1,078                  |                    | 1,078                   |                   |
| Non-HOV Speed          | 60.0                   |                    | 60.0                    |                   |
| Weaving Speed          | 55.0                   |                    | 55.0                    |                   |
| Truck Speed            | 60.0                   |                    | 60.0                    |                   |

Model speed estimates based on Highway Capacity Manual, pavement research, and research on weaving impacts

2B

### HIGHWAY ACCIDENT RATES

|   | Calculated by Model | Changed by User | Used for Proj. Eval. | Reason for Change |
|---|---------------------|-----------------|----------------------|-------------------|
| <b>No Build</b>   |                     |                 |                      |                   |
| Fatal Accidents   | 0.028               |                 | 0.028                |                   |
| Injury Accidents  | 0.41                |                 | 0.41                 |                   |
| PDO Accidents   | 0.55                |                 | 0.55                 |                   |
| Total Accidents   | 0.988               |                 |                      |                   |
| <b>Hwy Safety or Weaving Improvement</b> <input type="text" value="0%"/> collision reduction factor (per HSIP Guidelines) |                     |                 |                      |                   |
| <b>Adjustment Factor (Actual/Statewide Avg. Existing)</b>   |                     |                 |                      |                   |
| Fatal Accidents   | 6.2648              |                 | 6.2648               |                   |
| Injury Accidents  | 1.8291              |                 | 1.8291               |                   |
| PDO Accidents   | 2.4183              |                 | 2.4183               |                   |
| <b>Build</b>  |                     |                 |                      |                   |
| Fatal Accidents   | 0.004               |                 | 0.004                |                   |
| Injury Accidents  | 0.05                |                 | 0.05                 |                   |
| PDO Accidents   | 0.62                |                 | 0.62                 |                   |
| Total Accidents   | 0.677               |                 |                      |                   |

2C

### RAMP AND ARTERIAL INPUTS

(if detailed information is available for a TMS or an arterial signal management project)

Detailed Information Available? (y/n)

Aggregate Segment Length (estimate as VMT/total volume)

All Ramps  miles

Arterials  miles

|                                    | Entered by User | Used for Proj. Eval. | Source/Notes |
|------------------------------------|-----------------|----------------------|--------------|
| <b>No Build (Peak Period Only)</b> |                 |                      |              |
| <b>Year 1</b>                      |                 |                      |              |
| Aggregate Ramp Volume              |                 | 0                    |              |
| Aggregate Arterial Volume          |                 | 0                    |              |
| Average Ramp Speed                 |                 | 5.0                  |              |
| Average Arterial Speed             |                 | 5.0                  |              |
| <b>Year 20</b>                     |                 |                      |              |
| Aggregate Ramp Volume              |                 | 0                    |              |
| Aggregate Arterial Volume          |                 | 0                    |              |
| Average Ramp Speed                 |                 | 5.0                  |              |
| Average Arterial Speed             |                 | 5.0                  |              |
| <b>Build (Peak Period Only)</b>    |                 |                      |              |
| <b>Year 1</b>                      |                 |                      |              |
| Aggregate Ramp Volume              |                 | 0                    |              |
| Aggregate Arterial Volume          |                 | 0                    |              |
| Average Ramp Speed                 |                 | 5.0                  |              |
| Average Arterial Speed             |                 | 5.0                  |              |
| <b>Year 20</b>                     |                 |                      |              |
| Aggregate Ramp Volume              |                 | 0                    |              |
| Aggregate Arterial Volume          |                 | 0                    |              |
| Average Ramp Speed                 |                 | 5.0                  |              |
| Average Arterial Speed             |                 | 5.0                  |              |

2D

### ANNUAL PERSON-TRIPS

(for HOV and HOT lane projects that affect average vehicle occupancy)

|                        | No Build         | Build            | Induced  |
|------------------------|------------------|------------------|----------|
| <b>Year 1</b>          |                  |                  |          |
| <b>Peak Period</b>     |                  |                  |          |
| HOV Trips              | 0                | 0                |          |
| Non-HOV Trips          | 3,581,951        | 3,581,951        | 0        |
| Truck Trips            | 182,908          | 182,908          | 0        |
| <b>Non-Peak Period</b> |                  |                  |          |
| Non-HOV Trips          | 3,287,629        | 3,287,629        | 0        |
| Truck Trips            | 158,976          | 158,976          | 0        |
| <b>Total Trips</b>     | <b>7,211,465</b> | <b>7,211,465</b> | <b>0</b> |

|                        |                   |                   |          |
|------------------------|-------------------|-------------------|----------|
| <b>Year 20</b>         |                   |                   |          |
| <b>Peak Period</b>     |                   |                   |          |
| HOV Trips              | 0                 | 0                 |          |
| Non-HOV Trips          | 6,312,640         | 6,312,640         | 0        |
| Truck Trips            | 322,348           | 322,348           | 0        |
| <b>Non-Peak Period</b> |                   |                   |          |
| Non-HOV Trips          | 5,793,941         | 5,793,941         | 0        |
| Truck Trips            | 280,171           | 280,171           | 0        |
| <b>Total Trips</b>     | <b>12,709,100</b> | <b>12,709,100</b> | <b>0</b> |

C

**SUMMARY OF TRAVEL TIME BENEFITS**

| Year         | HIGHWAY    |                      |              |                    |            |               |                     |                  |                    |
|--------------|------------|----------------------|--------------|--------------------|------------|---------------|---------------------|------------------|--------------------|
|              | Peak HOV   | Peak Non-HOV         | Peak Weaving | Peak Truck         | Peak Ramp  | Peak Arterial | Non-Peak Non-HOV    | Non-Peak Weaving | Non-Peak Truck     |
| 1            | \$0        | \$1,237,894          | \$0          | \$110,171          | \$0        | \$0           | \$920,354           | \$0              | \$77,567           |
| 20           | \$0        | \$17,376,248         | \$0          | \$1,546,467        | \$0        | \$0           | \$1,160,296         | \$0              | \$97,789           |
| 2            | \$0        | \$1,407,495          | \$0          | \$125,265          | \$0        | \$0           | \$940,553           | \$0              | \$79,269           |
| 3            | \$0        | \$1,595,076          | \$0          | \$141,960          | \$0        | \$0           | \$959,764           | \$0              | \$80,888           |
| 4            | \$0        | \$1,802,983          | \$0          | \$160,464          | \$0        | \$0           | \$978,017           | \$0              | \$82,427           |
| 5            | \$0        | \$2,034,045          | \$0          | \$181,028          | \$0        | \$0           | \$995,339           | \$0              | \$83,886           |
| 6            | \$0        | \$2,291,697          | \$0          | \$203,958          | \$0        | \$0           | \$1,011,756         | \$0              | \$85,270           |
| 7            | \$0        | \$2,580,152          | \$0          | \$229,631          | \$0        | \$0           | \$1,027,296         | \$0              | \$86,580           |
| 8            | \$0        | \$2,904,632          | \$0          | \$258,509          | \$0        | \$0           | \$1,041,984         | \$0              | \$87,818           |
| 9            | \$0        | \$3,271,683          | \$0          | \$291,176          | \$0        | \$0           | \$1,055,845         | \$0              | \$88,986           |
| 10           | \$0        | \$3,689,619          | \$0          | \$328,372          | \$0        | \$0           | \$1,068,903         | \$0              | \$90,086           |
| 11           | \$0        | \$4,169,158          | \$0          | \$371,050          | \$0        | \$0           | \$1,081,182         | \$0              | \$91,121           |
| 12           | \$0        | \$4,724,358          | \$0          | \$420,463          | \$0        | \$0           | \$1,092,705         | \$0              | \$92,092           |
| 13           | \$0        | \$5,374,011          | \$0          | \$478,281          | \$0        | \$0           | \$1,103,496         | \$0              | \$93,002           |
| 14           | \$0        | \$6,143,828          | \$0          | \$546,794          | \$0        | \$0           | \$1,113,576         | \$0              | \$93,851           |
| 15           | \$0        | \$7,069,921          | \$0          | \$629,215          | \$0        | \$0           | \$1,122,966         | \$0              | \$94,643           |
| 16           | \$0        | \$8,204,662          | \$0          | \$730,206          | \$0        | \$0           | \$1,131,688         | \$0              | \$95,378           |
| 17           | \$0        | \$9,626,970          | \$0          | \$856,790          | \$0        | \$0           | \$1,139,762         | \$0              | \$96,058           |
| 18           | \$0        | \$11,461,568         | \$0          | \$1,020,067        | \$0        | \$0           | \$1,147,209         | \$0              | \$96,686           |
| 19           | \$0        | \$13,917,829         | \$0          | \$1,238,671        | \$0        | \$0           | \$1,154,047         | \$0              | \$97,262           |
| <b>Total</b> | <b>\$0</b> | <b>\$110,883,827</b> | <b>\$0</b>   | <b>\$9,868,537</b> | <b>\$0</b> | <b>\$0</b>    | <b>\$21,246,737</b> | <b>\$0</b>       | <b>\$1,790,659</b> |



C

**SUMMARY OF TRAVEL TIME BENEFITS (continued)**

| Year         | TRANSIT         |                 |                     |                     | Present Value of Travel Time Benefits | Constant Dollars     | Total Per-Hrs of Time Saved |
|--------------|-----------------|-----------------|---------------------|---------------------|---------------------------------------|----------------------|-----------------------------|
|              | Peak In-Vehicle | Peak Out-of-Veh | Non-Peak In-Vehicle | Non-Peak Out-of-Veh |                                       |                      |                             |
| 1            | \$0             | \$0             | \$0                 | \$0                 | \$2,345,985                           | \$2,488,856          | 155,141                     |
| 20           | \$0             | \$0             | \$0                 | \$0                 | \$20,180,800                          | \$37,542,232         | 1,864,403                   |
| 2            | \$0             | \$0             | \$0                 | \$0                 | \$2,552,582                           | \$2,789,275          | 171,798                     |
| 3            | \$0             | \$0             | \$0                 | \$0                 | \$2,777,688                           | \$3,126,312          | 190,266                     |
| 4            | \$0             | \$0             | \$0                 | \$0                 | \$3,023,890                           | \$3,505,518          | 210,805                     |
| 5            | \$0             | \$0             | \$0                 | \$0                 | \$3,294,298                           | \$3,933,564          | 233,731                     |
| 6            | \$0             | \$0             | \$0                 | \$0                 | \$3,592,682                           | \$4,418,545          | 259,425                     |
| 7            | \$0             | \$0             | \$0                 | \$0                 | \$3,923,659                           | \$4,970,373          | 288,353                     |
| 8            | \$0             | \$0             | \$0                 | \$0                 | \$4,292,943                           | \$5,601,317          | 321,092                     |
| 9            | \$0             | \$0             | \$0                 | \$0                 | \$4,707,690                           | \$6,326,741          | 358,364                     |
| 10           | \$0             | \$0             | \$0                 | \$0                 | \$5,176,980                           | \$7,166,150          | 401,083                     |
| 11           | \$0             | \$0             | \$0                 | \$0                 | \$5,712,512                           | \$8,144,676          | 450,430                     |
| 12           | \$0             | \$0             | \$0                 | \$0                 | \$6,329,618                           | \$9,295,257          | 507,950                     |
| 13           | \$0             | \$0             | \$0                 | \$0                 | \$7,048,790                           | \$10,661,927         | 575,707                     |
| 14           | \$0             | \$0             | \$0                 | \$0                 | \$7,898,048                           | \$12,304,902         | 656,524                     |
| 15           | \$0             | \$0             | \$0                 | \$0                 | \$8,916,745                           | \$14,308,758         | 754,364                     |
| 16           | \$0             | \$0             | \$0                 | \$0                 | \$10,161,934                          | \$16,796,128         | 874,975                     |
| 17           | \$0             | \$0             | \$0                 | \$0                 | \$11,719,580                          | \$19,951,800         | 1,027,014                   |
| 18           | \$0             | \$0             | \$0                 | \$0                 | \$13,725,529                          | \$24,067,798         | 1,224,162                   |
| 19           | \$0             | \$0             | \$0                 | \$0                 | \$16,407,810                          | \$29,634,330         | 1,489,382                   |
| <b>Total</b> | <b>\$0</b>      | <b>\$0</b>      | <b>\$0</b>          | <b>\$0</b>          | <b>\$143,789,760</b>                  | <b>\$227,034,460</b> | <b>12,014,971</b>           |

**SUMMARY OF VEHICLE OPERATING COST BENEFITS**

| Year         | HIGHWAY    |                     |              |                    |               |                    |                  |                    |             | TRANSIT         |                     | Present Value of Veh Op Cost Benefits | Constant Dollars |
|--------------|------------|---------------------|--------------|--------------------|---------------|--------------------|------------------|--------------------|-------------|-----------------|---------------------|---------------------------------------|------------------|
|              | Peak HOV   | Peak Non-HOV        | Peak Weaving | Peak Truck         | Peak Arterial | Non-Peak Non-HOV   | Non-Peak Weaving | Non-Peak Truck     | Peak Period | Non-Peak Period |                     |                                       |                  |
| 1            | \$0        | (\$18,637)          | \$0          | (\$2,225)          | \$0           | (\$45,357)         | \$0              | (\$5,118)          | -           | -               | (\$71,337)          | (\$75,681)                            |                  |
| 20           | \$0        | \$1,631,498         | \$0          | \$181,758          | \$0           | (\$45,585)         | \$0              | (\$5,144)          | -           | -               | \$1,762,526         | \$3,278,818                           |                  |
| 2            | \$0        | \$13,174            | \$0          | \$1,321            | \$0           | (\$45,803)         | \$0              | (\$5,168)          | -           | -               | (\$36,475)          | (\$39,857)                            |                  |
| 3            | \$0        | \$51,239            | \$0          | \$5,330            | \$0           | (\$46,184)         | \$0              | (\$5,211)          | -           | -               | \$5,173             | \$5,822                               |                  |
| 4            | \$0        | \$70,703            | \$0          | \$7,379            | \$0           | (\$46,504)         | \$0              | (\$5,248)          | -           | -               | \$26,330            | \$30,524                              |                  |
| 5            | \$0        | \$109,535           | \$0          | \$11,469           | \$0           | (\$46,767)         | \$0              | (\$5,277)          | -           | -               | \$68,960            | \$82,342                              |                  |
| 6            | \$0        | \$138,975           | \$0          | \$14,772           | \$0           | (\$46,974)         | \$0              | (\$5,301)          | -           | -               | \$101,472           | \$124,798                             |                  |
| 7            | \$0        | \$195,598           | \$0          | \$21,212           | \$0           | (\$47,130)         | \$0              | (\$5,318)          | -           | -               | \$164,361           | \$208,208                             |                  |
| 8            | \$0        | \$225,157           | \$0          | \$24,395           | \$0           | (\$47,237)         | \$0              | (\$5,330)          | -           | -               | \$196,984           | \$257,019                             |                  |
| 9            | \$0        | \$297,356           | \$0          | \$32,477           | \$0           | (\$47,298)         | \$0              | (\$5,337)          | -           | -               | \$277,198           | \$372,531                             |                  |
| 10           | \$0        | \$340,237           | \$0          | \$37,267           | \$0           | (\$47,315)         | \$0              | (\$5,339)          | -           | -               | \$324,849           | \$449,667                             |                  |
| 11           | \$0        | \$427,509           | \$0          | \$46,935           | \$0           | (\$47,291)         | \$0              | (\$5,336)          | -           | -               | \$421,817           | \$601,410                             |                  |
| 12           | \$0        | \$469,637           | \$0          | \$51,642           | \$0           | (\$47,228)         | \$0              | (\$5,329)          | -           | -               | \$468,721           | \$688,333                             |                  |
| 13           | \$0        | \$594,528           | \$0          | \$66,082           | \$0           | (\$47,129)         | \$0              | (\$5,318)          | -           | -               | \$608,163           | \$919,901                             |                  |
| 14           | \$0        | \$718,365           | \$0          | \$80,539           | \$0           | (\$46,996)         | \$0              | (\$5,303)          | -           | -               | \$746,605           | \$1,163,187                           |                  |
| 15           | \$0        | \$777,410           | \$0          | \$87,416           | \$0           | (\$46,830)         | \$0              | (\$5,284)          | -           | -               | \$812,711           | \$1,304,163                           |                  |
| 16           | \$0        | \$971,530           | \$0          | \$110,595          | \$0           | (\$46,634)         | \$0              | (\$5,262)          | -           | -               | \$1,030,229         | \$1,702,812                           |                  |
| 17           | \$0        | \$1,058,397         | \$0          | \$121,043          | \$0           | (\$46,410)         | \$0              | (\$5,237)          | -           | -               | \$1,127,793         | \$1,919,992                           |                  |
| 18           | \$0        | \$1,236,661         | \$0          | \$142,496          | \$0           | (\$46,159)         | \$0              | (\$5,209)          | -           | -               | \$1,327,789         | \$2,328,287                           |                  |
| 19           | \$0        | \$1,366,916         | \$0          | \$155,413          | \$0           | (\$45,884)         | \$0              | (\$5,178)          | -           | -               | \$1,471,267         | \$2,657,272                           |                  |
| <b>Total</b> | <b>\$0</b> | <b>\$10,675,787</b> | <b>\$0</b>   | <b>\$1,197,317</b> | <b>\$0</b>    | <b>(\$932,717)</b> | <b>\$0</b>       | <b>(\$105,250)</b> | <b>-</b>    | <b>-</b>        | <b>\$10,835,137</b> | <b>\$17,979,546</b>                   |                  |

## SUMMARY OF ACCIDENT REDUCTION BENEFITS

| Year         | HIGHWAY    |                     |              |                    |               |                     |                  |                    |             | TRANSIT             | Present Value of Accident Benefits | Constant Dollars |
|--------------|------------|---------------------|--------------|--------------------|---------------|---------------------|------------------|--------------------|-------------|---------------------|------------------------------------|------------------|
|              | Peak HOV   | Peak Non-HOV        | Peak Weaving | Peak Truck         | Peak Arterial | Non-Peak Non-HOV    | Non-Peak Weaving | Non-Peak Truck     | All Periods |                     |                                    |                  |
| 1            | \$0        | \$2,124,234         | \$0          | \$135,589          | \$0           | \$1,846,297         | \$0              | \$117,849          | \$0         | \$4,223,969         | \$4,481,208                        |                  |
| 20           | \$0        | \$2,134,943         | \$0          | \$136,273          | \$0           | \$1,855,605         | \$0              | \$118,443          | \$0         | \$4,245,264         | \$7,897,442                        |                  |
| 2            | \$0        | \$2,145,112         | \$0          | \$136,922          | \$0           | \$1,864,443         | \$0              | \$119,007          | \$0         | \$4,265,484         | \$4,661,010                        |                  |
| 3            | \$0        | \$2,162,972         | \$0          | \$138,062          | \$0           | \$1,879,966         | \$0              | \$119,998          | \$0         | \$4,300,999         | \$4,840,812                        |                  |
| 4            | \$0        | \$2,177,972         | \$0          | \$139,019          | \$0           | \$1,893,004         | \$0              | \$120,830          | \$0         | \$4,330,825         | \$5,020,614                        |                  |
| 5            | \$0        | \$2,190,263         | \$0          | \$139,804          | \$0           | \$1,903,687         | \$0              | \$121,512          | \$0         | \$4,355,266         | \$5,200,415                        |                  |
| 6            | \$0        | \$2,199,991         | \$0          | \$140,425          | \$0           | \$1,912,142         | \$0              | \$122,052          | \$0         | \$4,374,609         | \$5,380,217                        |                  |
| 7            | \$0        | \$2,207,294         | \$0          | \$140,891          | \$0           | \$1,918,489         | \$0              | \$122,457          | \$0         | \$4,389,130         | \$5,560,019                        |                  |
| 8            | \$0        | \$2,212,305         | \$0          | \$141,211          | \$0           | \$1,922,844         | \$0              | \$122,735          | \$0         | \$4,399,095         | \$5,739,821                        |                  |
| 9            | \$0        | \$2,215,151         | \$0          | \$141,393          | \$0           | \$1,925,318         | \$0              | \$122,893          | \$0         | \$4,404,755         | \$5,919,622                        |                  |
| 10           | \$0        | \$2,215,955         | \$0          | \$141,444          | \$0           | \$1,926,017         | \$0              | \$122,937          | \$0         | \$4,406,354         | \$6,099,424                        |                  |
| 11           | \$0        | \$2,214,833         | \$0          | \$141,372          | \$0           | \$1,925,042         | \$0              | \$122,875          | \$0         | \$4,404,123         | \$6,279,226                        |                  |
| 12           | \$0        | \$2,211,897         | \$0          | \$141,185          | \$0           | \$1,922,490         | \$0              | \$122,712          | \$0         | \$4,398,284         | \$6,459,028                        |                  |
| 13           | \$0        | \$2,207,252         | \$0          | \$140,888          | \$0           | \$1,918,453         | \$0              | \$122,454          | \$0         | \$4,389,048         | \$6,638,830                        |                  |
| 14           | \$0        | \$2,201,002         | \$0          | \$140,490          | \$0           | \$1,913,021         | \$0              | \$122,108          | \$0         | \$4,376,620         | \$6,818,631                        |                  |
| 15           | \$0        | \$2,193,244         | \$0          | \$139,994          | \$0           | \$1,906,277         | \$0              | \$121,677          | \$0         | \$4,361,192         | \$6,998,433                        |                  |
| 16           | \$0        | \$2,184,070         | \$0          | \$139,409          | \$0           | \$1,898,304         | \$0              | \$121,168          | \$0         | \$4,342,950         | \$7,178,235                        |                  |
| 17           | \$0        | \$2,173,570         | \$0          | \$138,738          | \$0           | \$1,889,177         | \$0              | \$120,586          | \$0         | \$4,322,071         | \$7,358,037                        |                  |
| 18           | \$0        | \$2,161,828         | \$0          | \$137,989          | \$0           | \$1,878,972         | \$0              | \$119,934          | \$0         | \$4,298,724         | \$7,537,838                        |                  |
| 19           | \$0        | \$2,148,927         | \$0          | \$137,166          | \$0           | \$1,867,759         | \$0              | \$119,219          | \$0         | \$4,273,070         | \$7,717,640                        |                  |
| <b>Total</b> | <b>\$0</b> | <b>\$43,682,815</b> | <b>\$0</b>   | <b>\$2,788,265</b> | <b>\$0</b>    | <b>\$37,967,307</b> | <b>\$0</b>       | <b>\$2,423,445</b> | <b>\$0</b>  | <b>\$86,861,832</b> | <b>\$123,786,502</b>               |                  |

C

### SUMMARY OF EMISSION REDUCTION BENEFITS

| Year         | HIGHWAY    |                    |              |                  |            |               |                   |                  |                   |
|--------------|------------|--------------------|--------------|------------------|------------|---------------|-------------------|------------------|-------------------|
|              | Peak HOV   | Peak Non-HOV       | Peak Weaving | Peak Truck       | Peak Ramp  | Peak Arterial | Non-Peak Non-HOV  | Non-Peak Weaving | Non-Peak Truck    |
| 1            | \$0        | (\$1,537)          | \$0          | (\$759)          | \$0        | \$0           | (\$4,333)         | \$0              | (\$961)           |
| 20           | \$0        | \$216,753          | \$0          | \$21,306         | \$0        | \$0           | (\$5,290)         | \$0              | (\$655)           |
| 2            | \$0        | \$1,975            | \$0          | (\$371)          | \$0        | \$0           | (\$4,446)         | \$0              | (\$978)           |
| 3            | \$0        | \$5,938            | \$0          | \$53             | \$0        | \$0           | (\$4,556)         | \$0              | (\$993)           |
| 4            | \$0        | \$8,322            | \$0          | \$269            | \$0        | \$0           | (\$4,662)         | \$0              | (\$1,008)         |
| 5            | \$0        | \$12,543           | \$0          | \$708            | \$0        | \$0           | (\$4,765)         | \$0              | (\$1,022)         |
| 6            | \$0        | \$16,094           | \$0          | \$1,071          | \$0        | \$0           | (\$4,865)         | \$0              | (\$1,034)         |
| 7            | \$0        | \$23,069           | \$0          | \$1,810          | \$0        | \$0           | (\$4,961)         | \$0              | (\$1,046)         |
| 8            | \$0        | \$24,536           | \$0          | \$2,271          | \$0        | \$0           | (\$4,330)         | \$0              | (\$560)           |
| 9            | \$0        | \$32,618           | \$0          | \$3,105          | \$0        | \$0           | (\$4,421)         | \$0              | (\$569)           |
| 10           | \$0        | \$37,875           | \$0          | \$3,627          | \$0        | \$0           | (\$4,511)         | \$0              | (\$579)           |
| 11           | \$0        | \$48,045           | \$0          | \$4,655          | \$0        | \$0           | (\$4,598)         | \$0              | (\$588)           |
| 12           | \$0        | \$53,645           | \$0          | \$5,229          | \$0        | \$0           | (\$4,683)         | \$0              | (\$596)           |
| 13           | \$0        | \$69,188           | \$0          | \$6,826          | \$0        | \$0           | (\$4,766)         | \$0              | (\$604)           |
| 14           | \$0        | \$85,154           | \$0          | \$8,465          | \$0        | \$0           | (\$4,847)         | \$0              | (\$613)           |
| 15           | \$0        | \$93,762           | \$0          | \$9,362          | \$0        | \$0           | (\$4,926)         | \$0              | (\$620)           |
| 16           | \$0        | \$119,406          | \$0          | \$12,073         | \$0        | \$0           | (\$5,002)         | \$0              | (\$628)           |
| 17           | \$0        | \$132,610          | \$0          | \$13,455         | \$0        | \$0           | (\$5,077)         | \$0              | (\$635)           |
| 18           | \$0        | \$157,668          | \$0          | \$16,123         | \$0        | \$0           | (\$5,150)         | \$0              | (\$642)           |
| 19           | \$0        | \$177,770          | \$0          | \$17,893         | \$0        | \$0           | (\$5,221)         | \$0              | (\$648)           |
| <b>Total</b> | <b>\$0</b> | <b>\$1,315,432</b> | <b>\$0</b>   | <b>\$127,172</b> | <b>\$0</b> | <b>\$0</b>    | <b>(\$95,411)</b> | <b>\$0</b>       | <b>(\$14,979)</b> |

C

**SUMMARY OF EMISSION REDUCTION BENEFITS (continued)**

| Year         | TRANSIT    |              |                |            | Present Value of Emission Benefits | Constant Dollars   | CO <sub>2</sub> EMISSIONS SAVED |                    |
|--------------|------------|--------------|----------------|------------|------------------------------------|--------------------|---------------------------------|--------------------|
|              | Peak Bus   | Non-Peak Bus | Passenger Rail | Light Rail |                                    |                    | tons/yr                         | PV \$/yr           |
| 1            | \$0        | \$0          | \$0            | \$0        | (\$7,590)                          | (\$8,052)          | (232)                           | (\$5,460)          |
| 20           | \$0        | \$0          | \$0            | \$0        | \$232,114                          | \$431,800          | 10,156                          | \$198,597          |
| 2            | \$0        | \$0          | \$0            | \$0        | (\$3,821)                          | (\$4,175)          | (116)                           | (\$2,714)          |
| 3            | \$0        | \$0          | \$0            | \$0        | \$441                              | \$497              | 22                              | \$516              |
| 4            | \$0        | \$0          | \$0            | \$0        | \$2,921                            | \$3,386            | 98                              | \$2,229            |
| 5            | \$0        | \$0          | \$0            | \$0        | \$7,464                            | \$8,913            | 255                             | \$5,771            |
| 6            | \$0        | \$0          | \$0            | \$0        | \$11,266                           | \$13,856           | 385                             | \$8,626            |
| 7            | \$0        | \$0          | \$0            | \$0        | \$18,872                           | \$23,906           | 648                             | \$14,381           |
| 8            | \$0        | \$0          | \$0            | \$0        | \$21,917                           | \$28,597           | 796                             | \$17,489           |
| 9            | \$0        | \$0          | \$0            | \$0        | \$30,732                           | \$41,301           | 1,153                           | \$25,107           |
| 10           | \$0        | \$0          | \$0            | \$0        | \$36,412                           | \$50,403           | 1,393                           | \$30,031           |
| 11           | \$0        | \$0          | \$0            | \$0        | \$47,514                           | \$67,744           | 1,856                           | \$39,614           |
| 12           | \$0        | \$0          | \$0            | \$0        | \$53,595                           | \$78,705           | 2,125                           | \$44,935           |
| 13           | \$0        | \$0          | \$0            | \$0        | \$70,644                           | \$106,856          | 2,843                           | \$59,525           |
| 14           | \$0        | \$0          | \$0            | \$0        | \$88,160                           | \$137,351          | 3,597                           | \$74,567           |
| 15           | \$0        | \$0          | \$0            | \$0        | \$97,579                           | \$156,585          | 4,039                           | \$82,917           |
| 16           | \$0        | \$0          | \$0            | \$0        | \$125,849                          | \$208,009          | 5,269                           | \$107,125          |
| 17           | \$0        | \$0          | \$0            | \$0        | \$140,353                          | \$238,942          | 5,945                           | \$119,709          |
| 18           | \$0        | \$0          | \$0            | \$0        | \$167,999                          | \$294,587          | 7,207                           | \$143,695          |
| 19           | \$0        | \$0          | \$0            | \$0        | \$189,793                          | \$342,787          | 8,227                           | \$162,456          |
| <b>Total</b> | <b>\$0</b> | <b>\$0</b>   | <b>\$0</b>     | <b>\$0</b> | <b>\$1,332,215</b>                 | <b>\$2,221,998</b> | <b>55,665</b>                   | <b>\$1,129,115</b> |

A

## NET PRESENT VALUE CALCULATION

| Year                       | PRESENT VALUE OF USER BENEFITS |                          |                     |                             | PRESENT VALUE OF USER BENEFITS<br>(road 2) |                          |                     |                             |
|----------------------------|--------------------------------|--------------------------|---------------------|-----------------------------|--|--------------------------|---------------------|-----------------------------|
|                            | Travel Time Savings            | Vehicle Op. Cost Savings | Accident Reductions | Vehicle Emission Reductions | Travel Time Savings                        | Vehicle Op. Cost Savings | Accident Reductions | Vehicle Emission Reductions |
| <b>Construction Period</b> |                                |                          |                     |                             |  |                          |                     |                             |
| 1                          |                                |                          |                     |                             |  |                          |                     |                             |
| 2                          |                                |                          |                     |                             |  |                          |                     |                             |
| 3                          |                                |                          |                     |                             |  |                          |                     |                             |
| 4                          |                                |                          |                     |                             |  |                          |                     |                             |
| 5                          |                                |                          |                     |                             |  |                          |                     |                             |
| 6                          |                                |                          |                     |                             |  |                          |                     |                             |
| 7                          |                                |                          |                     |                             |  |                          |                     |                             |
| 8                          |                                |                          |                     |                             |  |                          |                     |                             |
| <b>Project Open</b>        |                                |                          |                     |                             |  |                          |                     |                             |
| 1                          | \$2,345,985                    | (\$71,337)               | \$4,223,969         | (\$7,590)                   |  |                          |                     |                             |
| 2                          | \$2,552,582                    | (\$36,475)               | \$4,265,484         | (\$3,821)                   |  |                          |                     |                             |
| 3                          | \$2,777,688                    | \$5,173                  | \$4,300,999         | \$441                       |  |                          |                     |                             |
| 4                          | \$3,023,890                    | \$26,330                 | \$4,330,825         | \$2,921                     |  |                          |                     |                             |
| 5                          | \$3,294,298                    | \$68,960                 | \$4,355,266         | \$7,464                     |  |                          |                     |                             |
| 6                          | \$3,592,682                    | \$101,472                | \$4,374,609         | \$11,266                    |  |                          |                     |                             |
| 7                          | \$3,923,659                    | \$164,361                | \$4,389,130         | \$18,872                    |  |                          |                     |                             |
| 8                          | \$4,292,943                    | \$196,984                | \$4,399,095         | \$21,917                    |  |                          |                     |                             |
| 9                          | \$4,707,690                    | \$277,198                | \$4,404,755         | \$30,732                    |  |                          |                     |                             |
| 10                         | \$5,176,980                    | \$324,849                | \$4,406,354         | \$36,412                    |  |                          |                     |                             |
| 11                         | \$5,712,512                    | \$421,817                | \$4,404,123         | \$47,514                    |  |                          |                     |                             |
| 12                         | \$6,329,618                    | \$468,721                | \$4,398,284         | \$53,595                    |  |                          |                     |                             |
| 13                         | \$7,048,790                    | \$608,163                | \$4,389,048         | \$70,644                    |  |                          |                     |                             |
| 14                         | \$7,898,048                    | \$746,605                | \$4,376,620         | \$88,160                    |  |                          |                     |                             |
| 15                         | \$8,916,745                    | \$812,711                | \$4,361,192         | \$97,579                    |  |                          |                     |                             |
| 16                         | \$10,161,934                   | \$1,030,229              | \$4,342,950         | \$125,849                   |  |                          |                     |                             |
| 17                         | \$11,719,580                   | \$1,127,793              | \$4,322,071         | \$140,353                   |  |                          |                     |                             |
| 18                         | \$13,725,529                   | \$1,327,789              | \$4,298,724         | \$167,999                   |  |                          |                     |                             |
| 19                         | \$16,407,810                   | \$1,471,267              | \$4,273,070         | \$189,793                   |  |                          |                     |                             |
| 20                         | \$20,180,800                   | \$1,762,526              | \$4,245,264         | \$232,114                   |  |                          |                     |                             |
| <b>Total</b>               | \$143,789,760                  | \$10,835,137             | \$86,861,832        | \$1,332,215                 | \$0  | \$0                      | \$0                 | \$0                         |

|             |   |
|-------------|---|
| 12,014,971  | Person-Hours of Time Saved              |
| 55,665      | CO <sub>2</sub> Emissions Saved (tons)  |
| \$1,129,115 | CO <sub>2</sub> Emissions Saved (\$ PV) |

|  |   |
|--|---|
|  | Person-Hours of Time Saved              |
|  | CO <sub>2</sub> Emissions Saved (tons)  |
|  | CO <sub>2</sub> Emissions Saved (\$ PV) |

| PRESENT VALUE OF USER BENEFITS<br>(road 3) |                          |                     |                             | Present Value of Total User Benefits | Present Value of Total Project Costs | NET PRESENT VALUE    |
|--|--------------------------|---------------------|-----------------------------|--------------------------------------|--------------------------------------|----------------------|
| Travel Time Savings                        | Vehicle Op. Cost Savings | Accident Reductions | Vehicle Emission Reductions |                                      |                                      |                      |
|  |                          |                     |                             | \$0                                  | \$18,908,000                         | (\$18,908,000)       |
|  |                          |                     |                             | \$0                                  | \$18,357,282                         | (\$18,357,282)       |
|  |                          |                     |                             | \$0                                  | \$0                                  | \$0                  |
|  |                          |                     |                             | \$0                                  | \$0                                  | \$0                  |
|  |                          |                     |                             | \$0                                  | \$0                                  | \$0                  |
|  |                          |                     |                             | \$0                                  | \$0                                  | \$0                  |
|  |                          |                     |                             | \$0                                  | \$0                                  | \$0                  |
|  |                          |                     |                             | \$0                                  | \$0                                  | \$0                  |
|  |                          |                     |                             | \$6,491,027                          | \$0                                  | \$6,491,027          |
|  |                          |                     |                             | \$6,777,770                          | \$0                                  | \$6,777,770          |
|  |                          |                     |                             | \$7,084,301                          | \$0                                  | \$7,084,301          |
|  |                          |                     |                             | \$7,383,967                          | \$0                                  | \$7,383,967          |
|  |                          |                     |                             | \$7,725,988                          | \$0                                  | \$7,725,988          |
|  |                          |                     |                             | \$8,080,028                          | \$0                                  | \$8,080,028          |
|  |                          |                     |                             | \$8,496,022                          | \$0                                  | \$8,496,022          |
|  |                          |                     |                             | \$8,910,938                          | \$0                                  | \$8,910,938          |
|  |                          |                     |                             | \$9,420,375                          | \$0                                  | \$9,420,375          |
|  |                          |                     |                             | \$9,944,595                          | \$0                                  | \$9,944,595          |
|  |                          |                     |                             | \$10,585,966                         | \$0                                  | \$10,585,966         |
|  |                          |                     |                             | \$11,250,217                         | \$0                                  | \$11,250,217         |
|  |                          |                     |                             | \$12,116,646                         | \$0                                  | \$12,116,646         |
|  |                          |                     |                             | \$13,109,434                         | \$0                                  | \$13,109,434         |
|  |                          |                     |                             | \$14,188,227                         | \$0                                  | \$14,188,227         |
|  |                          |                     |                             | \$15,660,962                         | \$0                                  | \$15,660,962         |
|  |                          |                     |                             | \$17,309,797                         | \$0                                  | \$17,309,797         |
|  |                          |                     |                             | \$19,520,041                         | \$0                                  | \$19,520,041         |
|  |                          |                     |                             | \$22,341,940                         | \$0                                  | \$22,341,940         |
|  |                          |                     |                             | \$26,420,704                         | \$0                                  | \$26,420,704         |
| \$0  | \$0                      | \$0                 | \$0                         | <b>\$242,818,944</b>                 | <b>\$37,265,282</b>                  | <b>\$205,553,662</b> |

|  |   |
|--|---|
|  | Person-Hours of Time Saved              |
|  | CO <sub>2</sub> Emissions Saved (tons)  |
|  | CO <sub>2</sub> Emissions Saved (\$ PV) |

**INTERNAL RATE OF RETURN ON INVESTMENT AND PAYBACK PERIOD**

| Year                       | USER BENEFITS IN CONSTANT DOLLARS |                          |                     |                             | USER BENEFITS IN CONSTANT DOLLARS<br>(road 2) |                          |                     |                             |
|----------------------------|-----------------------------------|--------------------------|---------------------|-----------------------------|---|--------------------------|---------------------|-----------------------------|
|                            | Travel Time Savings               | Vehicle Op. Cost Savings | Accident Reductions | Vehicle Emission Reductions | Travel Time Savings                           | Vehicle Op. Cost Savings | Accident Reductions | Vehicle Emission Reductions |
| <b>Construction Period</b> |                                   |                          |                     |                             |   |                          |                     |                             |
| 1                          |                                   |                          |                     |                             |   |                          |                     |                             |
| 2                          |                                   |                          |                     |                             |   |                          |                     |                             |
| 3                          |                                   |                          |                     |                             |   |                          |                     |                             |
| 4                          |                                   |                          |                     |                             |   |                          |                     |                             |
| 5                          |                                   |                          |                     |                             |   |                          |                     |                             |
| 6                          |                                   |                          |                     |                             |   |                          |                     |                             |
| 7                          |                                   |                          |                     |                             |   |                          |                     |                             |
| 8                          |                                   |                          |                     |                             |   |                          |                     |                             |
| <b>Project Open</b>        |                                   |                          |                     |                             |   |                          |                     |                             |
| 1                          | \$2,488,856                       | (\$75,681)               | \$4,481,208         | (\$8,052)                   |   |                          |                     |                             |
| 2                          | \$2,789,275                       | (\$39,857)               | \$4,661,010         | (\$4,175)                   |   |                          |                     |                             |
| 3                          | \$3,126,312                       | \$5,822                  | \$4,840,812         | \$497                       |   |                          |                     |                             |
| 4                          | \$3,505,518                       | \$30,524                 | \$5,020,614         | \$3,386                     |   |                          |                     |                             |
| 5                          | \$3,933,564                       | \$82,342                 | \$5,200,415         | \$8,913                     |   |                          |                     |                             |
| 6                          | \$4,418,545                       | \$124,798                | \$5,380,217         | \$13,856                    |   |                          |                     |                             |
| 7                          | \$4,970,373                       | \$208,208                | \$5,560,019         | \$23,906                    |   |                          |                     |                             |
| 8                          | \$5,601,317                       | \$257,019                | \$5,739,821         | \$28,597                    |   |                          |                     |                             |
| 9                          | \$6,326,741                       | \$372,531                | \$5,919,622         | \$41,301                    |   |                          |                     |                             |
| 10                         | \$7,166,150                       | \$449,667                | \$6,099,424         | \$50,403                    |   |                          |                     |                             |
| 11                         | \$8,144,676                       | \$601,410                | \$6,279,226         | \$67,744                    |   |                          |                     |                             |
| 12                         | \$9,295,257                       | \$688,333                | \$6,459,028         | \$78,705                    |   |                          |                     |                             |
| 13                         | \$10,661,927                      | \$919,901                | \$6,638,830         | \$106,856                   |   |                          |                     |                             |
| 14                         | \$12,304,902                      | \$1,163,187              | \$6,818,631         | \$137,351                   |   |                          |                     |                             |
| 15                         | \$14,308,758                      | \$1,304,163              | \$6,998,433         | \$156,585                   |   |                          |                     |                             |
| 16                         | \$16,796,128                      | \$1,702,812              | \$7,178,235         | \$208,009                   |   |                          |                     |                             |
| 17                         | \$19,951,800                      | \$1,919,992              | \$7,358,037         | \$238,942                   |   |                          |                     |                             |
| 18                         | \$24,067,798                      | \$2,328,287              | \$7,537,838         | \$294,587                   |   |                          |                     |                             |
| 19                         | \$29,634,330                      | \$2,657,272              | \$7,717,640         | \$342,787                   |   |                          |                     |                             |
| 20                         | \$37,542,232                      | \$3,278,818              | \$7,897,442         | \$431,800                   |   |                          |                     |                             |
| <b>Total</b>               | \$227,034,460                     | \$17,979,546             | \$123,786,502       | \$2,221,998                 | \$0   | \$0                      | \$0                 | \$0                         |



| USER BENEFITS IN CONSTANT DOLLARS<br>(road 3) |                          |                     |                             | Total User Benefits in Constant Dollars | Total Project Costs in Constant Dollars | ANNUAL RETURNS ON INVESTMENT | CUMULATIVE RETURNS AFTER PROJ OPENS |
|---|--------------------------|---------------------|-----------------------------|---|---|------------------------------|-------------------------------------|
| Travel Time Savings                           | Vehicle Op. Cost Savings | Accident Reductions | Vehicle Emission Reductions |   |   |                              |                                     |
|   |                          |                     |                             | \$0                                     | \$18,908,000                            | (\$18,908,000)               |                                     |
|   |                          |                     |                             | \$0                                     | \$18,908,000                            | (\$18,908,000)               |                                     |
|   |                          |                     |                             | \$0                                     | \$0                                     | \$0                          |                                     |
|   |                          |                     |                             | \$0                                     | \$0                                     | \$0                          |                                     |
|   |                          |                     |                             | \$0                                     | \$0                                     | \$0                          |                                     |
|   |                          |                     |                             | \$0                                     | \$0                                     | \$0                          |                                     |
|   |                          |                     |                             | \$0                                     | \$0                                     | \$0                          |                                     |
|   |                          |                     |                             | \$0                                     | \$0                                     | \$0                          |                                     |
|   |                          |                     |                             | \$0                                     | \$0                                     | \$0                          |                                     |
|   |                          |                     |                             | \$6,886,331                             | \$0                                     | \$6,886,331                  | \$6,886,331                         |
|   |                          |                     |                             | \$7,406,253                             | \$0                                     | \$7,406,253                  | \$14,292,583                        |
|   |                          |                     |                             | \$7,973,443                             | \$0                                     | \$7,973,443                  | \$22,266,027                        |
|   |                          |                     |                             | \$8,560,041                             | \$0                                     | \$8,560,041                  | \$30,826,068                        |
|   |                          |                     |                             | \$9,225,234                             | \$0                                     | \$9,225,234                  | \$40,051,301                        |
|   |                          |                     |                             | \$9,937,415                             | \$0                                     | \$9,937,415                  | \$49,988,717                        |
|   |                          |                     |                             | \$10,762,506                            | \$0                                     | \$10,762,506                 | \$60,751,223                        |
|   |                          |                     |                             | \$11,626,753                            | \$0                                     | \$11,626,753                 | \$72,377,976                        |
|   |                          |                     |                             | \$12,660,196                            | \$0                                     | \$12,660,196                 | \$85,038,172                        |
|   |                          |                     |                             | \$13,765,645                            | \$0                                     | \$13,765,645                 | \$98,803,817                        |
|   |                          |                     |                             | \$15,093,056                            | \$0                                     | \$15,093,056                 | \$113,896,873                       |
|   |                          |                     |                             | \$16,521,323                            | \$0                                     | \$16,521,323                 | \$130,418,196                       |
|   |                          |                     |                             | \$18,327,514                            | \$0                                     | \$18,327,514                 | \$148,745,710                       |
|   |                          |                     |                             | \$20,424,071                            | \$0                                     | \$20,424,071                 | \$169,169,781                       |
|   |                          |                     |                             | \$22,767,939                            | \$0                                     | \$22,767,939                 | \$191,937,720                       |
|   |                          |                     |                             | \$25,885,183                            | \$0                                     | \$25,885,183                 | \$217,822,903                       |
|   |                          |                     |                             | \$29,468,771                            | \$0                                     | \$29,468,771                 | \$247,291,674                       |
|   |                          |                     |                             | \$34,228,511                            | \$0                                     | \$34,228,511                 | \$281,520,185                       |
|   |                          |                     |                             | \$40,352,029                            | \$0                                     | \$40,352,029                 | \$321,872,214                       |
|   |                          |                     |                             | \$49,150,291                            | \$0                                     | \$49,150,291                 | \$371,022,505                       |
| \$0   | \$0                      | \$0                 | \$0                         | <b>\$371,022,505</b>                    | <b>\$37,816,000</b>                     | <b>\$333,206,505</b>         |                                     |

Total Construction Costs

**\$37,816,000**

| Years After Construction Begins | ANNUAL RETURNS ON INVESTMENT |
|---------------------------------|------------------------------|
| 1                               | (\$18,908,000)               |
| 2                               | (\$18,908,000)               |
| 3                               | \$6,886,331                  |
| 4                               | \$7,406,253                  |
| 5                               | \$7,973,443                  |
| 6                               | \$8,560,041                  |
| 7                               | \$9,225,234                  |
| 8                               | \$9,937,415                  |
| 9                               | \$10,762,506                 |
| 10                              | \$11,626,753                 |
| 11                              | \$12,660,196                 |
| 12                              | \$13,765,645                 |
| 13                              | \$15,093,056                 |
| 14                              | \$16,521,323                 |
| 15                              | \$18,327,514                 |
| 16                              | \$20,424,071                 |
| 17                              | \$22,767,939                 |
| 18                              | \$25,885,183                 |
| 19                              | \$29,468,771                 |
| 20                              | \$34,228,511                 |
| 21                              | \$40,352,029                 |
| 22                              | \$49,150,291                 |
| 23                              | \$0                          |
| 24                              | \$0                          |
| 25                              | \$0                          |
| 26                              | \$0                          |
| 27                              | \$0                          |
| 28                              | \$0                          |

**Internal Rate of Return**

**23.57%**

**Payback Period**

**5 years**

The INTERNAL RATE OF RETURN (IRR) is the discount rate at which benefits and costs break even (are equal). For a project with an IRR greater than the Discount Rate, benefits are greater than costs, and the project has a positive economic value. The IRR allows projects with different costs, different benefit flows, and different time periods to be compared.

The PAYBACK PERIOD is the number of years it takes for the net benefits (benefits minus costs) to equal, or payback, the initial construction costs. For a project with a Payback Period longer than the life-cycle of the project, initial construction costs are not recovered. The Payback Period varies inversely with the Benefit-Cost Ratio: shorter Payback Period yields higher Benefit-Cost.

## Parameters

This page contains all economic values and rate tables.

To update economic values automatically, change "Economic Update Factor."

| General Economic Parameters                 |      |
|---|------|
| Year of Current Dollars for Model           | 2015 |
| Economic Update Factor (Using GDP Deflator) | 1.02 |
| Real Discount Rate                          | 3.0% |

| Travel Time Parameters                      |    | Value      | Units          |    |
|---|----|------------|----------------|----|
| Statewide Average Hourly Wage               | \$ | 30.26      | \$/hr          | 3  |
| <b>Heavy and Light Truck Drivers</b>        |    |            |                |    |
| Average Hourly Wage                         | \$ | 17.69      | \$/hr          | 3  |
| Benefits and Costs                          | \$ | 8.68       | \$/hr          | 4  |
| <b>Value of Time</b>                        |    |            |                |    |
| Automobile                                  | \$ | 15.13      | \$/hr/per      | 5  |
| Truck                                       | \$ | 26.37      | \$/hr/veh      | 5  |
| Auto & Truck Composite                      | \$ | 20.27      | \$/hr/veh      | 6  |
| Transit                                     | \$ | 15.13      | \$/hr/per      | 5  |
| Out-of-Vehicle Travel                       |    | 2          | times          | 5  |
| Incident-Related Travel                     |    | 3          | times          | 7  |
| Travel Time Updater                         |    | 1.2%       | annual incr    |    |
| <b>Vehicle Operating Cost Parameters</b>    |    |            |                |    |
| <b>Average Fuel Price</b>                   |    |            |                |    |
| Automobile (regular unleaded)               | \$ | 3.37       | \$/gal         | 8  |
| Truck (diesel)                              | \$ | 3.74       | \$/gal         | 8  |
| <b>Sales and Fuel Taxes</b>                 |    |            |                |    |
| State Sales Tax (gasoline)                  |    | 0.00%      | %              | 9  |
| State Sales Tax (diesel)                    |    | 0.00%      | %              | 9  |
| Average Local Sales Tax                     |    | 0.00%      | %              | 9  |
| Federal Fuel Excise Tax (gasoline)          | \$ | 0.184      | \$/gal         | 9  |
| Federal Fuel Excise Tax (diesel)            | \$ | 0.244      | \$/gal         | 9  |
| State Fuel Excise Tax (gasoline)            | \$ | 0.200      | \$/gal         | 9  |
| State Fuel Excise Tax (diesel)              | \$ | 0.200      | \$/gal         | 9  |
| <b>Fuel Cost Per Gallon (Exclude Taxes)</b> |    |            |                |    |
| Automobile                                  | \$ | 3.00       | \$/gal         |    |
| Truck                                       | \$ | 3.30       | \$/gal         |    |
| <b>Non-Fuel Cost Per Mile</b>               |    |            |                |    |
| Automobile                                  | \$ | 0.324      | \$/mi          | 10 |
| Truck                                       | \$ | 0.447      | \$/mi          | 11 |
| Idling Speed for Op. Costs and Emissions    |    | 5          | mph            |    |
| <b>Accident Cost Parameters</b>             |    |            |                |    |
| Cost of a Fatality                          | \$ | 9,200,000  | \$/event       | 12 |
| <b>Cost of an Injury</b>                    |    |            |                |    |
| Level A (Severe)                            | \$ | 966,000    | \$/event       | 12 |
| Level B (Moderate)                          | \$ | 432,400    | \$/event       | 12 |
| Level C (Minor)                             | \$ | 27,600     | \$/event       | 12 |
| Cost of Property Damage                     | \$ | 3,927      | \$/event       | 12 |
| <b>Cost of Highway Accident</b>             |    |            |                |    |
| Fatal Accident                              | \$ | 10,200,000 | \$/accident    |    |
| Injury Accident                             | \$ | 261,100    | \$/accident    |    |
| PDO Accident                                | \$ | 15,900     | \$/accident    |    |
| Average Cost                                | \$ | 145,400    | \$/accident    |    |
| <b>Statewide Highway Accident Rates</b>     |    |            |                |    |
| Fatal Accident                              |    | 0.007      | per mil veh-mi | 13 |
| Injury Accident                             |    | 0.27       | per mil veh-mi | 13 |
| PDO Accident                                |    | 0.53       | per mil veh-mi | 13 |
| Non-Freeway                                 |    | 1.05       | per mil veh-mi | 13 |

| Highway Operations Parameters    |       | Value | Units            |                   |
|----------------------------------|-------|-------|------------------|-------------------|
| Maximum V/C Ratio                |       | 1.56  | -                | 15                |
| Percent ADT in Peak Period       |       | 53.5% | %                |                   |
| Percent ADT in Average Peak Hour |       | 7.6%  | %                |                   |
| Annualization Factor             |       | 260   | days/yr          |                   |
| <b>Freeway</b>                   |       |       |                  |                   |
|                                  | Alpha | Beta  | Capacity (vphpl) | Dep. Rate (vphpl) |
| Freeway                          | 0.20  | 10    | 2,000            | 1,800             |
| Expressway                       | 0.20  | 10    | 2,000            | 1,800             |
| Conventional Highway             | 0.05  | 10    | 800              | 1,400             |
| HOV Lanes                        | 0.55  | 8     | 1,600            |                   |
| <b>Non-HOV Lanes</b>             |       |       |                  |                   |
|                                  | Alpha | Beta  | Capacity (vphpl) |                   |
| No Build                         | 0.05  | 10    | 800              |                   |
| Build                            | 0.05  | 10    | 800              |                   |

Sources: 15) Highway Capacity Manual, 16) NCHRP 387, 17) PeMS data

Sources: 1) Office of Management and Budget (OMB), 2) Review of OMB and State Treasurer's Office data, 3) Bureau of Labor Statistics (BLS) OES, 4) BLS Employment Cost Index, 5) USDOT Department Guidance, 6) California Department of Transportation TSI and Traffic Operations, 7) IDAS model, 8) AAA Daily Fuel Gauge Report, 9) California Board of Equalization, 10) AAA Your Driving Costs, 11) American Transportation Research Institute, 12) National Safety Council, 13) TASAS summary 2009

TIGER Sources: 1) OMB GDP and Deflators Used in Historical Tables 1940-2019 (Table 10.1), 2) TIG

**Travel Demand Tables**

| <b>Project Types</b>                                |       |               |
|---|-------|---------------|
| <b>Highway Capacity Expansion</b>                   |       |               |
| General Highway                                     | TRUE  | GenHwy        |
| HOV Lane Addition                                   | FALSE | HOV           |
| HOT Lane Addition                                   | FALSE | HOT           |
| Passing Lane  | FALSE | Passing       |
| Intersection  | FALSE | Intersect     |
| Bypass  | FALSE | Bypass        |
| Queueing  | FALSE | Queueing      |
| Pavement  | FALSE | Pavement      |
| Please select a type of highway project             |       |               |
| Enter HOV restriction in section 1B                 |       |               |
| Include toll payers as HOVs & check AVOs            |       |               |
| Enter a truck speed in section 1B                   |       |               |
| Remember to run model for both roads                |       |               |
| Remember to run model for both roads                |       |               |
| Add arrival rate & check departure rate in 1B       |       |               |
| Enter pavement condition in section 1B              |       |               |
| <b>Rail or Transit Cap Expansion</b>                |       |               |
| Passenger Rail                                      | FALSE | PassRail      |
| Light-Rail (LRT)                                    | FALSE | LRT           |
| Bus   | FALSE | Bus           |
| Hwy-Rail Grade Crossing                             | FALSE | HwyRail       |
| Please select a type of rail or transit project     |       |               |
| Enter data in both sections 1B & 1E                 |       |               |
| Enter data in both sections 1B & 1E                 |       |               |
| Enter data in both sections 1B & 1E                 |       |               |
| Put hwy design in 1B, safety in 1C & crossing in 1D |       |               |
| <b>Hwy Operational Improvement</b>                  |       |               |
| Auxiliary Lane                                      | FALSE | AuxLane       |
| Freeway Connector                                   | FALSE | FreeConn      |
| HOV Connector                                       | FALSE | HOVConn       |
| HOV Drop Ramp                                       | FALSE | HOVDrop       |
| Off-Ramp Widening                                   | FALSE | OffRamp       |
| On-Ramp Widening                                    | FALSE | OnRamp        |
| HOV-2 to HOV-3 Conv                                 | FALSE | HOV2to3       |
| HOT Lane Conversion                                 | FALSE | HOTConv       |
| Please select a type of op. improvement             |       |               |
| Enter ramp design speed & on-ramp volume            |       |               |
| Check percent traffic in weave in section 1B        |       |               |
| Check percent traffic in weave in section 1B        |       |               |
| Check percent traffic in weave in section 1B        |       |               |
| Check percent traffic in weave in section 1B        |       |               |
| Enter on-ramp volume & metering strategy            |       |               |
| Check AVOs & trips in sections 1B & 2D              |       |               |
| Check AVOs & trips in sections 1B & 2D              |       |               |
| <b>Transp Mgmt Systems (TMS)</b>                    |       |               |
| Ramp Metering                                       | FALSE | RM            |
| Ramp Metering Signal Coord                          | FALSE | AM            |
| Incident Management                                 | FALSE | IM            |
| Traveler Information                                | FALSE | TI            |
| Arterial Signal Management                          | FALSE | ASM           |
| Transit Vehicle Location (AVL)                      | FALSE | AVL           |
| Transit Vehicle Signal Priority                     | FALSE | SigPriority   |
| Bus Rapid Transit (BRT)                             | FALSE | BRT           |
| Please select a type of TMS project                 |       |               |
| Enter model data, if avail, in sections 2A & 2C     |       |               |
| Enter model data, if avail, in sections 2A & 2C     |       |               |
| Enter model data, if avail, in sections 2A & 2C     |       |               |
| Enter model data, if avail, in sections 2A & 2C     |       |               |
| Complete only sections 1A, 1E & 2C                  |       |               |
| Enter transit agency costs in section 1D            |       |               |
| Check travel time in section 1D                     |       |               |
| Enter free-flow bus lane speed in section 1B        |       |               |
| TMS Lookup Code                                     | NoAdj | TMSLookup     |
| User Modified Inputs                                | FALSE | UserAdjInputs |

| <b>DEMAND FOR TRAVEL IN PEAK PERIOD</b><br>(percent of total daily travel) |                |        |                |        |         |        |
|--|----------------|--------|----------------|--------|---------|--------|
| Number of Hours in Peak Period   | Urban          |        |                |        | Rural   |        |
|  | So. California |        | No. California |        | Fwy/Exp | Other  |
|  | Fwy/Exp        | Other  | Fwy/Exp        | Other  | Fwy/Exp | Other  |
| 1  | 8.6%           | 8.6%   | 8.6%           | 8.6%   | 8.6%    | 8.6%   |
| 2  | 17.2%          | 17.2%  | 17.2%          | 17.2%  | 17.2%   | 17.2%  |
| 3  | 25.8%          | 25.8%  | 25.8%          | 25.8%  | 25.8%   | 25.8%  |
| 4  | 34.1%          | 34.1%  | 34.1%          | 34.1%  | 34.1%   | 34.1%  |
| 5  | 41.0%          | 41.0%  | 41.0%          | 41.0%  | 41.0%   | 41.0%  |
| 6  | 47.3%          | 47.3%  | 47.3%          | 47.3%  | 47.3%   | 47.3%  |
| 7  | 53.5%          | 53.5%  | 53.5%          | 53.5%  | 53.5%   | 53.5%  |
| 8  | 59.6%          | 59.6%  | 59.6%          | 59.6%  | 59.6%   | 59.6%  |
| 9  | 65.6%          | 65.6%  | 65.6%          | 65.6%  | 65.6%   | 65.6%  |
| 10   | 71.1%          | 71.1%  | 71.1%          | 71.1%  | 71.1%   | 71.1%  |
| 11   | 76.5%          | 76.5%  | 76.5%          | 76.5%  | 76.5%   | 76.5%  |
| 12   | 81.7%          | 81.7%  | 81.7%          | 81.7%  | 81.7%   | 81.7%  |
| 13   | 86.9%          | 86.9%  | 86.9%          | 86.9%  | 86.9%   | 86.9%  |
| 14   | 89.9%          | 89.9%  | 89.9%          | 89.9%  | 89.9%   | 89.9%  |
| 15   | 92.7%          | 92.7%  | 92.7%          | 92.7%  | 92.7%   | 92.7%  |
| 16   | 95.0%          | 95.0%  | 95.0%          | 95.0%  | 95.0%   | 95.0%  |
| 17   | 96.7%          | 96.7%  | 96.7%          | 96.7%  | 96.7%   | 96.7%  |
| 18   | 97.9%          | 97.9%  | 97.9%          | 97.9%  | 97.9%   | 97.9%  |
| 19   | 98.9%          | 98.9%  | 98.9%          | 98.9%  | 98.9%   | 98.9%  |
| 20   | 99.5%          | 99.5%  | 99.5%          | 99.5%  | 99.5%   | 99.5%  |
| 21   | 99.7%          | 99.7%  | 99.7%          | 99.7%  | 99.7%   | 99.7%  |
| 22   | 99.8%          | 99.8%  | 99.8%          | 99.8%  | 99.8%   | 99.8%  |
| 23   | 99.9%          | 99.9%  | 99.9%          | 99.9%  | 99.9%   | 99.9%  |
| 24   | 100.0%         | 100.0% | 100.0%         | 100.0% | 100.0%  | 100.0% |

Source: California Department of Transportation, 2000-2001 California Statewide Travel Survey  
Weekday Travel Report, June 2003

## Operating Cost Tables

| <b>FUEL CONSUMPTION RATES</b> |              |              |
|-------------------------------|--------------|--------------|
| <small>(gal/veh-mi)</small>   |              |              |
| <b>Speed</b>                  | <b>Auto*</b> | <b>Truck</b> |
| 5                             | 0.1439       | 0.2234       |
| 6                             | 0.1366       | 0.2130       |
| 7                             | 0.1293       | 0.2026       |
| 8                             | 0.1220       | 0.1922       |
| 9                             | 0.1147       | 0.1818       |
| 10                            | 0.1074       | 0.1714       |
| 11                            | 0.1025       | 0.1631       |
| 12                            | 0.0977       | 0.1548       |
| 13                            | 0.0929       | 0.1466       |
| 14                            | 0.0880       | 0.1383       |
| 15                            | 0.0832       | 0.1300       |
| 16                            | 0.0800       | 0.1247       |
| 17                            | 0.0767       | 0.1193       |
| 18                            | 0.0735       | 0.1139       |
| 19                            | 0.0702       | 0.1086       |
| 20                            | 0.0670       | 0.1032       |
| 21                            | 0.0648       | 0.0997       |
| 22                            | 0.0626       | 0.0962       |
| 23                            | 0.0603       | 0.0926       |
| 24                            | 0.0581       | 0.0891       |
| 25                            | 0.0559       | 0.0856       |
| 26                            | 0.0544       | 0.0832       |
| 27                            | 0.0529       | 0.0809       |
| 28                            | 0.0515       | 0.0785       |
| 29                            | 0.0500       | 0.0762       |
| 30                            | 0.0485       | 0.0738       |
| 31                            | 0.0475       | 0.0723       |
| 32                            | 0.0465       | 0.0708       |
| 33                            | 0.0455       | 0.0693       |
| 34                            | 0.0445       | 0.0678       |
| 35                            | 0.0435       | 0.0663       |
| 36                            | 0.0429       | 0.0654       |
| 37                            | 0.0423       | 0.0645       |
| 38                            | 0.0417       | 0.0635       |
| 39                            | 0.0411       | 0.0626       |
| 40                            | 0.0405       | 0.0617       |
| 41                            | 0.0402       | 0.0613       |
| 42                            | 0.0400       | 0.0609       |
| 43                            | 0.0397       | 0.0604       |
| 44                            | 0.0394       | 0.0600       |
| 45                            | 0.0391       | 0.0596       |
| 46                            | 0.0391       | 0.0596       |
| 47                            | 0.0391       | 0.0596       |
| 48                            | 0.0391       | 0.0596       |
| 49                            | 0.0391       | 0.0596       |
| 50                            | 0.0390       | 0.0596       |
| 51                            | 0.0393       | 0.0600       |
| 52                            | 0.0396       | 0.0604       |
| 53                            | 0.0399       | 0.0608       |
| 54                            | 0.0401       | 0.0612       |
| 55                            | 0.0404       | 0.0617       |
| 56                            | 0.0410       | 0.0626       |
| 57                            | 0.0416       | 0.0635       |
| 58                            | 0.0422       | 0.0644       |
| 59                            | 0.0428       | 0.0653       |
| 60                            | 0.0433       | 0.0662       |
| 61                            | 0.0443       | 0.0677       |
| 62                            | 0.0453       | 0.0692       |
| 63                            | 0.0462       | 0.0708       |
| 64                            | 0.0472       | 0.0723       |
| 65                            | 0.0482       | 0.0738       |
| 66                            | 0.0488       | 0.0752       |
| 67                            | 0.0495       | 0.0767       |
| 68                            | 0.0502       | 0.0781       |
| 69                            | 0.0509       | 0.0796       |
| 70                            | 0.0515       | 0.0810       |
| 71                            | 0.0516       | 0.0821       |
| 72                            | 0.0516       | 0.0831       |
| 73                            | 0.0516       | 0.0842       |
| 74                            | 0.0517       | 0.0854       |
| 75                            | 0.0517       | 0.0865       |
| 76                            | 0.0518       | 0.0882       |
| 77                            | 0.0518       | 0.0900       |
| 78                            | 0.0519       | 0.0918       |
| 79                            | 0.0519       | 0.0936       |
| 80                            | 0.0520       | 0.0953       |

*\* Includes motorcycles & motorhomes  
Note: Five mph is best estimate for idling*

*Source: California Air Resources Board,  
EMFAC2011, 2011 & 2031 average*

## Accident Tables

| HIGHWAY INJURY SEVERITY FREQUENCY<br>(percent of injuries) |        |          |        |         |
|--|--------|----------|--------|---------|
| Event  | Urban  | Suburban | Rural  | Average |
| Severe Injury (A)  | 4.70%  | 4.70%    | 4.70%  | 4.70%   |
| Other Visible Injury (B)                                   | 26.28% | 26.28%   | 26.28% | 26.28%  |
| Complaint of Pain (C)                                      | 69.02% | 69.02%   | 69.02% | 69.02%  |

Source: 2009 SWITRS Annual Report, Table 8C

| RATES FOR TRANSIT ACCIDENT EVENTS<br>(events/million veh-mi) |            |            |        |
|--|------------|------------|--------|
| Event  | Pass Train | Light Rail | Bus    |
| Fatality   | 0.0428     | 0.1897     | 0.0351 |
| Injury   | 0.2517     | 3.6283     | 3.8909 |
| All Accidents  | 0.2519     | 7.4952     | 3.8924 |

Source: USDOT, Transportation Statistics Annual Report, Table 2-33, 2002 to 2008 average

| NUMBER OF FATALITIES<br>(events/accident) |       |          |       |         |
|---|-------|----------|-------|---------|
| Accident Type                             | Urban | Suburban | Rural | Average |
| Fatal Accident                            | 1.09  | 1.11     | 1.16  | 1.13    |

| NUMBER OF INJURIES<br>(events/accident) |       |          |       |         |
|---|-------|----------|-------|---------|
| Accident Type                           | Urban | Suburban | Rural | Average |
| Fatal Accident                          | 0.84  | 1.02     | 1.26  | 1.06    |
| Injury Accident                         | 1.42  | 1.43     | 1.51  | 1.44    |

| NUMBER OF VEHICLES INVOLVED<br>(events/accident) |       |          |       |         |
|--|-------|----------|-------|---------|
| Accident Type                                    | Urban | Suburban | Rural | Average |
| Fatal Accident                                   | 1.69  | 1.63     | 1.61  | 1.65    |
| Injury Accident                                  | 2.08  | 1.97     | 1.58  | 1.96    |
| PDO Accident                                     | 2.03  | 1.94     | 1.62  | 1.95    |

| DISTRIBUTION OF ACCIDENT TYPES<br>(percent of accidents) |        |          |        |         |
|--|--------|----------|--------|---------|
| Accident Type  | Urban  | Suburban | Rural  | Average |
| Fatal Accident   | 0.50%  | 0.74%    | 2.11%  | 0.83%   |
| Injury Accident  | 32.08% | 32.90%   | 37.91% | 33.27%  |
| PDO Accident   | 67.42% | 66.37%   | 59.98% | 65.90%  |

Source: California Department of Transportation, TASAS Unit, 2007 to 2009 average

| COST OF TRANSIT ACCIDENT EVENTS<br>(\$/event) |             |             |             |
|---|-------------|-------------|-------------|
| Event   | Pass Train  | Light Rail  | Bus         |
| Fatality                                      | \$9,200,000 | \$9,200,000 | \$9,200,000 |
| Injury  | \$513,400   | \$513,400   | \$513,400   |
| Prop Damage                                   | \$82,000    | \$5,800     | \$2,800     |

Source: FTA, Transit Safety & Security Statistics, 2002 to 2007 average

| COSTS OF TRANSIT ACCIDENTS<br>(\$/million veh-mi) |            |             |             |
|---|------------|-------------|-------------|
| Value   | Pass Train | Light Rail  | Bus         |
| Cost  | \$543,600  | \$3,651,500 | \$2,331,400 |

Source: Combination of above two tables

| HIGHWAY-RAIL GRADE CROSSING INCIDENTS<br>(units in table) |          |             |           |
|---|----------|-------------|-----------|
| Value   | Incident | Fatality    | Injury    |
| Total Events  | 1,500    | 332         | 608       |
| Avg per Incident  |          | 0.2213      | 0.4053    |
| Cost per Event  |          | \$9,200,000 | \$513,400 |

Source: FRA, Office of Safety Analysis, 5.11 - Hwy/Rail Incidents Summary Tables, California, Jan 2001 to Dec 2010

| COST OF HIGHWAY ACCIDENTS<br>(\$/accident) |              |              |              |              |
|--|--------------|--------------|--------------|--------------|
| Accident Type                              | Urban        | Suburban     | Rural        | Average      |
| Fatal Accident                             | \$10,200,000 | \$10,400,000 | \$10,900,000 | \$10,600,000 |
| Injury Accident                            | \$261,100    | \$262,400    | \$275,100    | \$264,100    |
| PDO Accident                               | \$15,900     | \$15,200     | \$12,700     | \$15,300     |
| All Types                                  | \$145,400    | \$172,900    | \$342,100    | \$185,700    |

Source: Combination of above four tables

| PASSING LANE ACCIDENT REDUCTION FACTORS<br>(rate with passing lane/rate without passing lane) |          |        |       |
|---|----------|--------|-------|
| Minimum ADT   | Fatality | Injury | PDO   |
| 0   | 25.0%    | 69.4%  | 92.6% |
| 5,000   | 19.2%    | 80.3%  | 96.5% |
| 10,000  | 84.0%    | 57.7%  | 97.8% |

Source: Taylor and Jain, 1991

Emissions Tables

HIGHWAY EMISSIONS FACTORS (g/mi)  
Model Year 2011

| Mode | Speed | CO     | CO <sub>2</sub> | NO <sub>x</sub> | PM <sub>10</sub> | SO <sub>x</sub> | VOC    |
|------|-------|--------|-----------------|-----------------|------------------|-----------------|--------|
| Auto | 0     | 5.2339 | 79.62           | 0.3731          | 0.0044           | 0.0000          | 0.7131 |
|      | 5     | 5.7109 | 1200.44         | 0.4530          | 0.0640           | 0.0122          | 0.6503 |
|      | 6     | 5.5208 | 1138.67         | 0.4412          | 0.0627           | 0.0116          | 0.6153 |
|      | 7     | 5.3308 | 1076.91         | 0.4294          | 0.0614           | 0.0110          | 0.5802 |
|      | 8     | 5.1407 | 1015.14         | 0.4176          | 0.0601           | 0.0104          | 0.5452 |
|      | 9     | 4.9507 | 953.38          | 0.4058          | 0.0588           | 0.0098          | 0.5102 |
|      | 10    | 4.7606 | 891.61          | 0.3940          | 0.0575           | 0.0091          | 0.4751 |
|      | 11    | 4.6222 | 850.74          | 0.3852          | 0.0567           | 0.0087          | 0.4539 |
|      | 12    | 4.4838 | 809.87          | 0.3764          | 0.0559           | 0.0083          | 0.4326 |
|      | 13    | 4.3453 | 769.00          | 0.3677          | 0.0551           | 0.0079          | 0.4114 |
|      | 14    | 4.2069 | 728.13          | 0.3589          | 0.0543           | 0.0075          | 0.3901 |
|      | 15    | 4.0685 | 687.26          | 0.3502          | 0.0535           | 0.0071          | 0.3689 |
|      | 16    | 3.9674 | 659.79          | 0.3438          | 0.0531           | 0.0068          | 0.3558 |
|      | 17    | 3.8664 | 632.31          | 0.3373          | 0.0526           | 0.0065          | 0.3428 |
|      | 18    | 3.7653 | 604.84          | 0.3309          | 0.0521           | 0.0063          | 0.3298 |
|      | 19    | 3.6643 | 577.36          | 0.3245          | 0.0516           | 0.0060          | 0.3168 |
|      | 20    | 3.5632 | 549.88          | 0.3181          | 0.0512           | 0.0057          | 0.3038 |
|      | 21    | 3.4877 | 531.23          | 0.3134          | 0.0509           | 0.0055          | 0.2958 |
|      | 22    | 3.4122 | 512.58          | 0.3087          | 0.0506           | 0.0053          | 0.2878 |
|      | 23    | 3.3367 | 493.93          | 0.3040          | 0.0503           | 0.0051          | 0.2798 |
|      | 24    | 3.2612 | 475.28          | 0.2993          | 0.0500           | 0.0050          | 0.2718 |
|      | 25    | 3.1857 | 456.63          | 0.2947          | 0.0497           | 0.0048          | 0.2638 |
|      | 26    | 3.1288 | 444.02          | 0.2914          | 0.0495           | 0.0046          | 0.2588 |
|      | 27    | 3.0718 | 431.40          | 0.2881          | 0.0493           | 0.0045          | 0.2538 |
|      | 28    | 3.0149 | 418.78          | 0.2847          | 0.0491           | 0.0044          | 0.2488 |
|      | 29    | 2.9579 | 406.16          | 0.2814          | 0.0489           | 0.0043          | 0.2437 |
|      | 30    | 2.9010 | 393.55          | 0.2781          | 0.0487           | 0.0041          | 0.2387 |
|      | 31    | 2.8584 | 385.23          | 0.2759          | 0.0486           | 0.0040          | 0.2356 |
|      | 32    | 2.8159 | 376.92          | 0.2738          | 0.0485           | 0.0040          | 0.2325 |
|      | 33    | 2.7734 | 368.60          | 0.2716          | 0.0483           | 0.0039          | 0.2294 |
|      | 34    | 2.7309 | 360.29          | 0.2694          | 0.0482           | 0.0038          | 0.2263 |
|      | 35    | 2.6883 | 351.97          | 0.2672          | 0.0481           | 0.0037          | 0.2231 |
|      | 36    | 2.6580 | 346.91          | 0.2659          | 0.0480           | 0.0037          | 0.2214 |
|      | 37    | 2.6277 | 341.84          | 0.2647          | 0.0479           | 0.0036          | 0.2196 |
|      | 38    | 2.5974 | 336.77          | 0.2634          | 0.0479           | 0.0036          | 0.2178 |
|      | 39    | 2.5671 | 331.70          | 0.2622          | 0.0478           | 0.0035          | 0.2160 |
|      | 40    | 2.5368 | 326.63          | 0.2609          | 0.0477           | 0.0034          | 0.2142 |
|      | 41    | 2.5180 | 324.21          | 0.2605          | 0.0477           | 0.0034          | 0.2134 |
|      | 42    | 2.4992 | 321.78          | 0.2601          | 0.0476           | 0.0034          | 0.2127 |
|      | 43    | 2.4804 | 319.36          | 0.2597          | 0.0476           | 0.0034          | 0.2119 |
|      | 44    | 2.4615 | 316.93          | 0.2593          | 0.0475           | 0.0034          | 0.2112 |
|      | 45    | 2.4427 | 314.51          | 0.2589          | 0.0475           | 0.0033          | 0.2104 |
|      | 46    | 2.4360 | 314.44          | 0.2593          | 0.0475           | 0.0033          | 0.2105 |
|      | 47    | 2.4293 | 314.37          | 0.2597          | 0.0475           | 0.0033          | 0.2107 |
|      | 48    | 2.4227 | 314.30          | 0.2601          | 0.0474           | 0.0033          | 0.2108 |
|      | 49    | 2.4160 | 314.23          | 0.2605          | 0.0474           | 0.0033          | 0.2109 |
|      | 50    | 2.4093 | 314.17          | 0.2609          | 0.0474           | 0.0033          | 0.2111 |
|      | 51    | 2.4171 | 316.46          | 0.2621          | 0.0474           | 0.0033          | 0.2121 |
|      | 52    | 2.4249 | 318.75          | 0.2633          | 0.0474           | 0.0034          | 0.2132 |
|      | 53    | 2.4328 | 321.05          | 0.2645          | 0.0474           | 0.0034          | 0.2142 |
|      | 54    | 2.4406 | 323.34          | 0.2657          | 0.0474           | 0.0034          | 0.2153 |
|      | 55    | 2.4485 | 325.64          | 0.2669          | 0.0474           | 0.0034          | 0.2163 |
|      | 56    | 2.4758 | 330.54          | 0.2690          | 0.0475           | 0.0035          | 0.2184 |
|      | 57    | 2.5031 | 335.45          | 0.2711          | 0.0475           | 0.0035          | 0.2206 |
|      | 58    | 2.5304 | 340.36          | 0.2732          | 0.0475           | 0.0036          | 0.2227 |
|      | 59    | 2.5577 | 345.27          | 0.2753          | 0.0476           | 0.0036          | 0.2248 |
|      | 60    | 2.5851 | 350.18          | 0.2774          | 0.0476           | 0.0037          | 0.2270 |
|      | 61    | 2.6411 | 358.30          | 0.2805          | 0.0476           | 0.0038          | 0.2305 |
|      | 62    | 2.6972 | 366.41          | 0.2836          | 0.0477           | 0.0039          | 0.2341 |
|      | 63    | 2.7533 | 374.53          | 0.2868          | 0.0478           | 0.0039          | 0.2377 |
|      | 64    | 2.8094 | 382.64          | 0.2899          | 0.0478           | 0.0040          | 0.2413 |
|      | 65    | 2.8654 | 390.76          | 0.2930          | 0.0479           | 0.0041          | 0.2449 |
|      | 66    | 2.9386 | 396.35          | 0.2952          | 0.0479           | 0.0042          | 0.2489 |
|      | 67    | 3.0117 | 401.95          | 0.2973          | 0.0480           | 0.0042          | 0.2528 |
|      | 68    | 3.0848 | 407.55          | 0.2995          | 0.0480           | 0.0043          | 0.2568 |
|      | 69    | 3.1580 | 413.15          | 0.3016          | 0.0481           | 0.0043          | 0.2608 |
|      | 70    | 3.2311 | 418.75          | 0.3038          | 0.0481           | 0.0044          | 0.2647 |
|      | 71    | 3.3211 | 418.85          | 0.3042          | 0.0481           | 0.0044          | 0.2688 |
|      | 72    | 3.4111 | 418.95          | 0.3045          | 0.0482           | 0.0044          | 0.2729 |
|      | 73    | 3.5012 | 419.04          | 0.3049          | 0.0482           | 0.0044          | 0.2770 |
|      | 74    | 3.5912 | 419.14          | 0.3052          | 0.0482           | 0.0044          | 0.2811 |
|      | 75    | 3.6812 | 419.24          | 0.3056          | 0.0482           | 0.0044          | 0.2852 |
|      | 76    | 3.8430 | 419.40          | 0.3060          | 0.0482           | 0.0044          | 0.2919 |
|      | 77    | 4.0048 | 419.55          | 0.3065          | 0.0482           | 0.0044          | 0.2986 |
|      | 78    | 4.1666 | 419.70          | 0.3070          | 0.0482           | 0.0044          | 0.3053 |
|      | 79    | 4.3284 | 419.86          | 0.3075          | 0.0482           | 0.0044          | 0.3119 |
|      | 80    | 4.4902 | 420.01          | 0.3079          | 0.0482           | 0.0044          | 0.3186 |

HIGHWAY EMISSIONS FACTORS (g/mi)  
Model Year 2031

| Mode | Speed | CO     | CO <sub>2</sub> | NO <sub>x</sub> | PM <sub>10</sub> | SO <sub>x</sub> | VOC    |
|------|-------|--------|-----------------|-----------------|------------------|-----------------|--------|
| Auto | 0     | 1.3628 | 80.38           | 0.0771          | 0.0049           | 0.0000          | 0.2019 |
|      | 5     | 1.3760 | 1208.90         | 0.1323          | 0.0584           | 0.0122          | 0.1693 |
|      | 6     | 1.3510 | 1146.73         | 0.1290          | 0.0574           | 0.0116          | 0.1612 |
|      | 7     | 1.3260 | 1084.55         | 0.1258          | 0.0564           | 0.0110          | 0.1530 |
|      | 8     | 1.3011 | 1022.37         | 0.1225          | 0.0554           | 0.0104          | 0.1449 |
|      | 9     | 1.2761 | 960.19          | 0.1193          | 0.0544           | 0.0097          | 0.1367 |
|      | 10    | 1.2511 | 898.02          | 0.1160          | 0.0534           | 0.0091          | 0.1286 |
|      | 11    | 1.2273 | 856.86          | 0.1135          | 0.0528           | 0.0087          | 0.1235 |
|      | 12    | 1.2034 | 815.71          | 0.1109          | 0.0523           | 0.0083          | 0.1185 |
|      | 13    | 1.1796 | 774.55          | 0.1084          | 0.0517           | 0.0079          | 0.1135 |
|      | 14    | 1.1558 | 733.40          | 0.1058          | 0.0511           | 0.0075          | 0.1085 |
|      | 15    | 1.1320 | 692.24          | 0.1033          | 0.0505           | 0.0071          | 0.1035 |
|      | 16    | 1.1120 | 664.57          | 0.1014          | 0.0502           | 0.0068          | 0.1005 |
|      | 17    | 1.0920 | 636.90          | 0.0994          | 0.0499           | 0.0065          | 0.0975 |
|      | 18    | 1.0721 | 609.23          | 0.0975          | 0.0495           | 0.0062          | 0.0944 |
|      | 19    | 1.0521 | 581.56          | 0.0955          | 0.0492           | 0.0060          | 0.0914 |
|      | 20    | 1.0322 | 553.89          | 0.0936          | 0.0488           | 0.0057          | 0.0884 |
|      | 21    | 1.0154 | 535.11          | 0.0921          | 0.0486           | 0.0055          | 0.0865 |
|      | 22    | 0.9985 | 516.34          | 0.0906          | 0.0484           | 0.0053          | 0.0847 |
|      | 23    | 0.9817 | 497.56          | 0.0891          | 0.0482           | 0.0051          | 0.0828 |
|      | 24    | 0.9649 | 478.79          | 0.0876          | 0.0480           | 0.0049          | 0.0809 |
|      | 25    | 0.9481 | 460.01          | 0.0862          | 0.0478           | 0.0048          | 0.0791 |
|      | 26    | 0.9340 | 447.31          | 0.0850          | 0.0477           | 0.0046          | 0.0779 |
|      | 27    | 0.9198 | 434.61          | 0.0839          | 0.0475           | 0.0045          | 0.0768 |
|      | 28    | 0.9057 | 421.90          | 0.0828          | 0.0474           | 0.0044          | 0.0757 |
|      | 29    | 0.8916 | 409.20          | 0.0817          | 0.0473           | 0.0042          | 0.0745 |
|      | 30    | 0.8774 | 396.50          | 0.0806          | 0.0472           | 0.0041          | 0.0734 |
|      | 31    | 0.8657 | 388.13          | 0.0798          | 0.0471           | 0.0040          | 0.0727 |
|      | 32    | 0.8540 | 379.77          | 0.0791          | 0.0470           | 0.0039          | 0.0721 |
|      | 33    | 0.8422 | 371.40          | 0.0783          | 0.0469           | 0.0039          | 0.0714 |
|      | 34    | 0.8305 | 363.04          | 0.0775          | 0.0468           | 0.0038          | 0.0708 |
|      | 35    | 0.8188 | 354.67          | 0.0767          | 0.0468           | 0.0037          | 0.0701 |
|      | 36    | 0.8093 | 349.58          | 0.0762          | 0.0467           | 0.0036          | 0.0698 |
|      | 37    | 0.7999 | 344.48          | 0.0756          | 0.0466           | 0.0036          | 0.0695 |
|      | 38    | 0.7904 | 339.39          | 0.0751          | 0.0466           | 0.0035          | 0.0692 |
|      | 39    | 0.7810 | 334.29          | 0.0746          | 0.0465           | 0.0035          | 0.0689 |
|      | 40    | 0.7716 | 329.19          | 0.0740          | 0.0465           | 0.0034          | 0.0686 |
|      | 41    | 0.7645 | 326.76          | 0.0738          | 0.0465           | 0.0034          | 0.0686 |
|      | 42    | 0.7574 | 324.33          | 0.0735          | 0.0464           | 0.0034          | 0.0685 |
|      | 43    | 0.7504 | 321.90          | 0.0732          | 0.0464           | 0.0034          | 0.0685 |
|      | 44    | 0.7433 | 319.47          | 0.0729          | 0.0464           | 0.0033          | 0.0685 |
|      | 45    | 0.7362 | 317.03          | 0.0726          | 0.0464           | 0.0033          | 0.0685 |
|      | 46    | 0.7319 | 316.98          | 0.0726          | 0.0463           | 0.0033          | 0.0688 |
|      | 47    | 0.7275 | 316.94          | 0.0725          | 0.0463           | 0.0033          | 0.0690 |
|      | 48    | 0.7232 | 316.89          | 0.0724          | 0.0463           | 0.0033          | 0.0693 |
|      | 49    | 0.7188 | 316.84          | 0.0724          | 0.0463           | 0.0033          | 0.0696 |
|      | 50    | 0.7144 | 316.79          | 0.0723          | 0.0463           | 0.0033          | 0.0699 |
|      | 51    | 0.7135 | 319.12          | 0.0725          | 0.0463           | 0.0033          | 0.0705 |
|      | 52    | 0.7126 | 321.45          | 0.0726          | 0.0463           | 0.0034          | 0.0711 |
|      | 53    | 0.7116 | 323.78          | 0.0728          | 0.0463           | 0.0034          | 0.0717 |
|      | 54    | 0.7107 | 326.11          | 0.0729          | 0.0463           | 0.0034          | 0.0723 |
|      | 55    | 0.7098 | 328.45          | 0.0731          | 0.0463           | 0.0034          | 0.0729 |
|      | 56    | 0.7137 | 333.43          | 0.0735          | 0.0464           | 0.0035          | 0.0739 |
|      | 57    | 0.7176 | 338.41          | 0.0738          | 0.0464           | 0.0035          | 0.0749 |
|      | 58    | 0.7215 | 343.39          | 0.0742          | 0.0464           | 0.0036          | 0.0760 |
|      | 59    | 0.7254 | 348.37          | 0.0746          | 0.0464           | 0.0036          | 0.0770 |
|      | 60    | 0.7293 | 353.35          | 0.0750          | 0.0464           | 0.0037          | 0.0780 |
|      | 61    | 0.7407 | 361.57          | 0.0756          | 0.0465           | 0.0038          | 0.0797 |
|      | 62    | 0.7520 | 369.78          | 0.0762          | 0.0465           | 0.0038          | 0.0813 |
|      | 63    | 0.7634 | 378.00          | 0.0769          | 0.0466           | 0.0039          | 0.0830 |
|      | 64    | 0.7747 | 386.22          | 0.0775          | 0.0466           | 0.0040          | 0.0847 |
|      | 65    | 0.7861 | 394.44          | 0.0781          | 0.0467           | 0.0041          | 0.0863 |
|      | 66    | 0.8123 | 400.15          | 0.0786          | 0.0467           | 0.0042          | 0.0888 |
|      | 67    | 0.8386 | 405.86          | 0.0791          | 0.0467           | 0.0042          | 0.0912 |
|      | 68    | 0.8648 | 411.57          | 0.0796          | 0.0468           | 0.0043          | 0.0936 |
|      | 69    | 0.8911 | 417.28          | 0.0801          | 0.0468           | 0.0043          | 0.0960 |
|      | 70    | 0.9173 | 422.99          | 0.0806          | 0.0468           | 0.0044          | 0.0984 |
|      | 71    | 0.9675 | 423.21          | 0.0808          | 0.0468           | 0.0044          | 0.1020 |
|      | 72    | 1.0177 | 423.43          | 0.0810          | 0.0468           | 0.0044          |        |

**Emissions Tables**

|       |    |        |         |        |        |        |        |
|-------|----|--------|---------|--------|--------|--------|--------|
| Truck | 0  | 7.7807 | 88.95   | 0.9968 | 0.0033 | 0.0000 | 0.8010 |
|       | 5  | 8.2113 | 1871.17 | 1.4852 | 0.0764 | 0.0190 | 0.8648 |
|       | 6  | 7.9348 | 1783.22 | 1.4539 | 0.0752 | 0.0181 | 0.8200 |
|       | 7  | 7.6582 | 1695.27 | 1.4225 | 0.0739 | 0.0172 | 0.7751 |
|       | 8  | 7.3817 | 1607.32 | 1.3912 | 0.0727 | 0.0164 | 0.7303 |
|       | 9  | 7.1052 | 1519.37 | 1.3599 | 0.0714 | 0.0155 | 0.6854 |
|       | 10 | 6.8287 | 1431.43 | 1.3286 | 0.0702 | 0.0146 | 0.6406 |
|       | 11 | 6.5519 | 1361.83 | 1.2955 | 0.0691 | 0.0139 | 0.6068 |
|       | 12 | 6.2751 | 1292.24 | 1.2625 | 0.0680 | 0.0132 | 0.5731 |
|       | 13 | 5.9984 | 1222.65 | 1.2294 | 0.0669 | 0.0125 | 0.5394 |
|       | 14 | 5.7216 | 1153.05 | 1.1964 | 0.0658 | 0.0118 | 0.5056 |
|       | 15 | 5.4448 | 1083.46 | 1.1633 | 0.0647 | 0.0111 | 0.4719 |
|       | 16 | 5.2607 | 1038.29 | 1.1404 | 0.0640 | 0.0106 | 0.4514 |
|       | 17 | 5.0765 | 993.12  | 1.1176 | 0.0633 | 0.0102 | 0.4310 |
|       | 18 | 4.8924 | 947.96  | 1.0947 | 0.0626 | 0.0097 | 0.4105 |
|       | 19 | 4.7082 | 902.79  | 1.0719 | 0.0619 | 0.0093 | 0.3901 |
|       | 20 | 4.5241 | 857.62  | 1.0490 | 0.0612 | 0.0088 | 0.3696 |
|       | 21 | 4.3967 | 827.81  | 1.0337 | 0.0607 | 0.0085 | 0.3568 |
|       | 22 | 4.2692 | 797.99  | 1.0184 | 0.0602 | 0.0082 | 0.3440 |
|       | 23 | 4.1418 | 768.18  | 1.0032 | 0.0597 | 0.0079 | 0.3311 |
|       | 24 | 4.0144 | 738.36  | 0.9879 | 0.0592 | 0.0076 | 0.3183 |
|       | 25 | 3.8870 | 708.54  | 0.9726 | 0.0588 | 0.0073 | 0.3055 |
|       | 26 | 3.7963 | 688.82  | 0.9631 | 0.0584 | 0.0071 | 0.2973 |
|       | 27 | 3.7057 | 669.09  | 0.9537 | 0.0581 | 0.0070 | 0.2890 |
|       | 28 | 3.6150 | 649.37  | 0.9442 | 0.0578 | 0.0068 | 0.2808 |
|       | 29 | 3.5243 | 629.64  | 0.9348 | 0.0574 | 0.0066 | 0.2725 |
|       | 30 | 3.4337 | 609.92  | 0.9253 | 0.0571 | 0.0064 | 0.2643 |
|       | 31 | 3.3683 | 597.14  | 0.9207 | 0.0569 | 0.0062 | 0.2589 |
|       | 32 | 3.3030 | 584.37  | 0.9162 | 0.0567 | 0.0061 | 0.2535 |
|       | 33 | 3.2377 | 571.59  | 0.9116 | 0.0565 | 0.0060 | 0.2481 |
|       | 34 | 3.1723 | 558.81  | 0.9070 | 0.0562 | 0.0058 | 0.2427 |
|       | 35 | 3.1070 | 546.04  | 0.9024 | 0.0560 | 0.0057 | 0.2373 |
|       | 36 | 3.0606 | 538.35  | 0.9022 | 0.0559 | 0.0056 | 0.2339 |
|       | 37 | 3.0141 | 530.65  | 0.9020 | 0.0557 | 0.0055 | 0.2304 |
|       | 38 | 2.9676 | 522.96  | 0.9018 | 0.0555 | 0.0054 | 0.2269 |
|       | 39 | 2.9212 | 515.26  | 0.9015 | 0.0553 | 0.0054 | 0.2235 |
|       | 40 | 2.8747 | 507.57  | 0.9013 | 0.0552 | 0.0053 | 0.2200 |
|       | 41 | 2.8437 | 503.97  | 0.9054 | 0.0551 | 0.0052 | 0.2180 |
|       | 42 | 2.8126 | 500.38  | 0.9094 | 0.0549 | 0.0052 | 0.2159 |
|       | 43 | 2.7815 | 496.79  | 0.9135 | 0.0548 | 0.0052 | 0.2139 |
|       | 44 | 2.7504 | 493.20  | 0.9175 | 0.0547 | 0.0051 | 0.2118 |
|       | 45 | 2.7193 | 489.60  | 0.9216 | 0.0546 | 0.0051 | 0.2098 |
|       | 46 | 2.7023 | 489.59  | 0.9303 | 0.0545 | 0.0051 | 0.2087 |
|       | 47 | 2.6853 | 489.58  | 0.9390 | 0.0545 | 0.0051 | 0.2076 |
|       | 48 | 2.6683 | 489.58  | 0.9477 | 0.0544 | 0.0051 | 0.2065 |
|       | 49 | 2.6513 | 489.57  | 0.9564 | 0.0543 | 0.0051 | 0.2055 |
|       | 50 | 2.6343 | 489.56  | 0.9651 | 0.0543 | 0.0051 | 0.2044 |
|       | 51 | 2.6320 | 493.15  | 0.9792 | 0.0542 | 0.0051 | 0.2041 |
|       | 52 | 2.6296 | 496.74  | 0.9934 | 0.0542 | 0.0052 | 0.2039 |
|       | 53 | 2.6273 | 500.34  | 1.0076 | 0.0542 | 0.0052 | 0.2037 |
|       | 54 | 2.6250 | 503.93  | 1.0218 | 0.0542 | 0.0052 | 0.2034 |
|       | 55 | 2.6226 | 507.52  | 1.0360 | 0.0541 | 0.0053 | 0.2032 |
|       | 56 | 2.6377 | 515.24  | 1.0571 | 0.0541 | 0.0053 | 0.2038 |
|       | 57 | 2.6528 | 522.95  | 1.0783 | 0.0541 | 0.0054 | 0.2043 |
|       | 58 | 2.6679 | 530.66  | 1.0995 | 0.0541 | 0.0055 | 0.2049 |
|       | 59 | 2.6830 | 538.37  | 1.1207 | 0.0541 | 0.0056 | 0.2054 |
|       | 60 | 2.6981 | 546.08  | 1.1418 | 0.0541 | 0.0057 | 0.2060 |
|       | 61 | 2.7365 | 558.91  | 1.1726 | 0.0541 | 0.0058 | 0.2075 |
|       | 62 | 2.7748 | 571.73  | 1.2033 | 0.0542 | 0.0059 | 0.2091 |
|       | 63 | 2.8132 | 584.55  | 1.2340 | 0.0542 | 0.0061 | 0.2107 |
|       | 64 | 2.8516 | 597.37  | 1.2647 | 0.0542 | 0.0062 | 0.2122 |
|       | 65 | 2.8899 | 610.19  | 1.2954 | 0.0543 | 0.0064 | 0.2138 |
|       | 66 | 2.9429 | 622.24  | 1.3362 | 0.0543 | 0.0065 | 0.2152 |
|       | 67 | 2.9958 | 634.29  | 1.3770 | 0.0543 | 0.0066 | 0.2167 |
|       | 68 | 3.0488 | 646.34  | 1.4178 | 0.0543 | 0.0067 | 0.2181 |
|       | 69 | 3.1017 | 658.39  | 1.4586 | 0.0544 | 0.0068 | 0.2195 |
|       | 70 | 3.1547 | 670.44  | 1.4994 | 0.0544 | 0.0069 | 0.2210 |
|       | 71 | 3.2177 | 679.52  | 1.5549 | 0.0544 | 0.0070 | 0.2215 |
|       | 72 | 3.2807 | 688.60  | 1.6103 | 0.0545 | 0.0071 | 0.2221 |
|       | 73 | 3.3436 | 697.68  | 1.6658 | 0.0545 | 0.0072 | 0.2226 |
|       | 74 | 3.4066 | 706.77  | 1.7213 | 0.0546 | 0.0073 | 0.2231 |
|       | 75 | 3.4696 | 715.85  | 1.7767 | 0.0546 | 0.0074 | 0.2237 |
|       | 76 | 3.5719 | 730.65  | 1.8592 | 0.0547 | 0.0076 | 0.2245 |
|       | 77 | 3.6741 | 745.45  | 1.9417 | 0.0547 | 0.0077 | 0.2253 |
|       | 78 | 3.7764 | 760.25  | 2.0243 | 0.0547 | 0.0079 | 0.2262 |
|       | 79 | 3.8787 | 775.04  | 2.1068 | 0.0548 | 0.0080 | 0.2270 |
|       | 80 | 3.9809 | 789.84  | 2.1893 | 0.0548 | 0.0082 | 0.2278 |

|       |    |        |         |        |        |        |        |
|-------|----|--------|---------|--------|--------|--------|--------|
| Truck | 0  | 2.4976 | 90.05   | 0.4876 | 0.0028 | 0.0000 | 0.2977 |
|       | 5  | 2.1294 | 1891.53 | 0.3786 | 0.0651 | 0.0191 | 0.2464 |
|       | 6  | 2.0765 | 1802.78 | 0.3708 | 0.0642 | 0.0182 | 0.2360 |
|       | 7  | 2.0236 | 1714.03 | 0.3631 | 0.0633 | 0.0173 | 0.2256 |
|       | 8  | 1.9707 | 1625.28 | 0.3553 | 0.0625 | 0.0164 | 0.2151 |
|       | 9  | 1.9178 | 1536.53 | 0.3475 | 0.0616 | 0.0156 | 0.2047 |
|       | 10 | 1.8650 | 1447.78 | 0.3397 | 0.0608 | 0.0147 | 0.1942 |
|       | 11 | 1.8056 | 1377.21 | 0.3314 | 0.0601 | 0.0140 | 0.1876 |
|       | 12 | 1.7462 | 1306.63 | 0.3231 | 0.0595 | 0.0133 | 0.1810 |
|       | 13 | 1.6868 | 1236.06 | 0.3148 | 0.0589 | 0.0126 | 0.1745 |
|       | 14 | 1.6275 | 1165.48 | 0.3065 | 0.0582 | 0.0118 | 0.1679 |
|       | 15 | 1.5681 | 1094.91 | 0.2981 | 0.0576 | 0.0111 | 0.1613 |
|       | 16 | 1.5259 | 1049.14 | 0.2923 | 0.0572 | 0.0107 | 0.1573 |
|       | 17 | 1.4836 | 1003.38 | 0.2865 | 0.0568 | 0.0102 | 0.1534 |
|       | 18 | 1.4414 | 957.61  | 0.2806 | 0.0564 | 0.0098 | 0.1494 |
|       | 19 | 1.3992 | 911.84  | 0.2748 | 0.0560 | 0.0093 | 0.1455 |
|       | 20 | 1.3570 | 866.08  | 0.2690 | 0.0556 | 0.0089 | 0.1415 |
|       | 21 | 1.3255 | 835.90  | 0.2650 | 0.0553 | 0.0086 | 0.1391 |
|       | 22 | 1.2941 | 805.73  | 0.2611 | 0.0551 | 0.0083 | 0.1366 |
|       | 23 | 1.2627 | 775.56  | 0.2571 | 0.0548 | 0.0080 | 0.1341 |
|       | 24 | 1.2312 | 745.39  | 0.2531 | 0.0546 | 0.0077 | 0.1317 |
|       | 25 | 1.1998 | 715.21  | 0.2492 | 0.0543 | 0.0074 | 0.1292 |
|       | 26 | 1.1756 | 695.24  | 0.2467 | 0.0541 | 0.0071 | 0.1276 |
|       | 27 | 1.1513 | 675.26  | 0.2442 | 0.0539 | 0.0069 | 0.1260 |
|       | 28 | 1.1271 | 655.29  | 0.2416 | 0.0537 | 0.0067 | 0.1244 |
|       | 29 | 1.1029 | 635.31  | 0.2391 | 0.0536 | 0.0065 | 0.1229 |
|       | 30 | 1.0786 | 615.34  | 0.2366 | 0.0534 | 0.0063 | 0.1213 |
|       | 31 | 1.0595 | 602.42  | 0.2353 | 0.0532 | 0.0062 | 0.1202 |
|       | 32 | 1.0403 | 589.49  | 0.2340 | 0.0531 | 0.0060 | 0.1192 |
|       | 33 | 1.0211 | 576.57  | 0.2327 | 0.0530 | 0.0059 | 0.1181 |
|       | 34 | 1.0019 | 563.65  | 0.2314 | 0.0529 | 0.0058 | 0.1171 |
|       | 35 | 0.9828 | 550.73  | 0.2301 | 0.0528 | 0.0057 | 0.1160 |
|       | 36 | 0.9674 | 542.95  | 0.2299 | 0.0527 | 0.0056 | 0.1153 |
|       | 37 | 0.9520 | 535.17  | 0.2297 | 0.0526 | 0.0055 | 0.1146 |
|       | 38 | 0.9367 | 527.39  | 0.2295 | 0.0525 | 0.0054 | 0.1140 |
|       | 39 | 0.9213 | 519.62  | 0.2292 | 0.0524 | 0.0054 | 0.1133 |
|       | 40 | 0.9060 | 511.84  | 0.2290 | 0.0524 | 0.0053 | 0.1126 |
|       | 41 | 0.8937 | 508.20  | 0.2299 | 0.0523 | 0.0053 | 0.1122 |
|       | 42 | 0.8814 | 504.57  | 0.2307 | 0.0523 | 0.0052 | 0.1118 |
|       | 43 | 0.8690 | 500.94  | 0.2315 | 0.0522 | 0.0052 | 0.1113 |
|       | 44 | 0.8567 | 497.30  | 0.2324 | 0.0522 | 0.0051 | 0.1109 |
|       | 45 | 0.8444 | 493.67  | 0.2332 | 0.0521 | 0.0051 | 0.1105 |
|       | 46 | 0.8347 | 493.67  | 0.2352 | 0.0521 | 0.0051 | 0.1103 |
|       | 47 | 0.8251 | 493.67  | 0.2372 | 0.0520 | 0.0051 | 0.1100 |
|       | 48 | 0.8154 | 493.67  | 0.2393 | 0.0520 | 0.0051 | 0.1098 |
|       | 49 | 0.8057 | 493.67  | 0.2413 | 0.0520 | 0.0051 | 0.1096 |
|       | 50 | 0.7960 | 493.67  | 0.2433 | 0.0520 | 0.0051 | 0.1094 |
|       | 51 | 0.7888 | 497.33  | 0.2466 | 0.0519 | 0.0051 | 0.1093 |
|       | 52 | 0.7816 | 501.00  | 0.2500 | 0.0519 | 0.0052 | 0.1093 |
|       | 53 | 0.7743 | 504.66  | 0.2533 | 0.0519 | 0.0052 | 0.1092 |
|       | 54 | 0.7671 | 508.32  | 0.2567 | 0.0519 | 0.0053 | 0.1091 |
|       | 55 | 0.7599 | 511.99  | 0.2600 | 0.0518 | 0.0053 | 0.1091 |
|       | 56 | 0.7552 | 519.76  | 0.2651 | 0.0518 | 0.0054 | 0.1092 |
|       | 57 | 0.7505 | 527.54  | 0.2702 | 0.0519 | 0.0054 | 0.1093 |
|       | 58 | 0.7459 | 535.32  | 0.2752 | 0.0519 | 0.0055 | 0.1094 |
|       | 59 | 0.7412 | 543.10  | 0.2803 | 0.0519 | 0.0056 | 0.1094 |
|       | 60 | 0.7365 | 550.88  | 0.2854 | 0.0519 | 0.0057 | 0.1095 |
|       | 61 | 0.7348 | 563.87  | 0.2928 | 0.0519 | 0.0058 | 0.1098 |
|       | 62 | 0.7331 | 576.87  | 0.3002 | 0.0519 | 0.0059 | 0.1101 |
|       | 63 | 0.7313 | 589.86  | 0.3076 | 0.0520 | 0.0061 | 0.1104 |
|       | 64 | 0.7296 | 602.86  | 0.3150 | 0.0520 | 0.0062 | 0.1107 |
|       | 65 | 0.7279 | 615.86  | 0.3224 | 0.0520 | 0.0063 | 0.1110 |
|       | 66 | 0.7328 | 628.14  | 0.3324 | 0.0520 | 0.0065 | 0.1112 |
|       | 67 | 0.7378 | 640.43  | 0.3424 | 0.0521 | 0.0066 | 0.1115 |
|       | 68 | 0.7427 | 652.71  | 0.3525 | 0.0521 | 0.0067 | 0.1118 |
|       | 69 | 0.7476 | 665.00  | 0.3625 | 0.0521 | 0.0069 | 0.1120 |
|       | 70 | 0.7526 | 677.28  | 0.3725 | 0.0521 | 0.0070 | 0.1123 |
|       | 71 | 0.7653 | 686.73  | 0.3863 | 0.0521 | 0.0071 | 0.1123 |
|       | 72 | 0.7779 | 696.18  | 0.4001 | 0.0522 | 0.0072 | 0.1124 |
|       | 73 | 0.7906 | 705.64  | 0.4140 | 0.0522 | 0.0073 | 0.1125 |
|       | 74 | 0.8033 | 715.09  | 0.4278 | 0.0522 | 0.0073 | 0.1126 |
|       | 75 | 0.8160 | 724.54  | 0.4416 | 0.0522 | 0.0074 | 0.1126 |
|       | 76 | 0.8364 | 73      |        |        |        |        |



**Emissions Tables**

|            |          |         |         |         |        |        |        |
|------------|----------|---------|---------|---------|--------|--------|--------|
| <b>Bus</b> | <b>0</b> | 16.2307 | 31.60   | 1.9169  | 0.0000 | 0.0000 | 1.1480 |
|            | 5        | 28.2802 | 2573.44 | 19.0484 | 0.9433 | 0.0248 | 3.0451 |
|            | 6        | 27.1830 | 2530.41 | 18.5778 | 0.9295 | 0.0243 | 2.9403 |
|            | 7        | 26.0858 | 2487.38 | 18.1073 | 0.9157 | 0.0237 | 2.8355 |
|            | 8        | 24.9885 | 2444.35 | 17.6367 | 0.9019 | 0.0232 | 2.7307 |
|            | 9        | 23.8913 | 2401.32 | 17.1662 | 0.8882 | 0.0226 | 2.6258 |
|            | 10       | 22.7941 | 2358.29 | 16.6956 | 0.8744 | 0.0221 | 2.5210 |
|            | 11       | 21.3267 | 2300.37 | 16.0232 | 0.8534 | 0.0215 | 2.3743 |
|            | 12       | 19.8593 | 2242.45 | 15.3507 | 0.8324 | 0.0210 | 2.2276 |
|            | 13       | 18.3919 | 2184.53 | 14.6782 | 0.8115 | 0.0204 | 2.0808 |
|            | 14       | 16.9246 | 2126.60 | 14.0058 | 0.7905 | 0.0199 | 1.9341 |
|            | 15       | 15.4572 | 2068.68 | 13.3333 | 0.7695 | 0.0193 | 1.7873 |
|            | 16       | 14.5867 | 2033.37 | 12.9075 | 0.7558 | 0.0188 | 1.6952 |
|            | 17       | 13.7162 | 1998.07 | 12.4816 | 0.7420 | 0.0182 | 1.6031 |
|            | 18       | 12.8457 | 1962.76 | 12.0557 | 0.7282 | 0.0177 | 1.5110 |
|            | 19       | 11.9752 | 1927.46 | 11.6298 | 0.7144 | 0.0171 | 1.4188 |
|            | 20       | 11.1047 | 1892.15 | 11.2040 | 0.7006 | 0.0165 | 1.3267 |
|            | 21       | 10.5723 | 1870.09 | 10.9408 | 0.6918 | 0.0165 | 1.2671 |
|            | 22       | 10.0400 | 1848.02 | 10.6777 | 0.6829 | 0.0165 | 1.2076 |
|            | 23       | 9.5076  | 1825.95 | 10.4146 | 0.6741 | 0.0165 | 1.1480 |
|            | 24       | 8.9753  | 1803.89 | 10.1514 | 0.6653 | 0.0165 | 1.0884 |
|            | 25       | 8.4430  | 1781.82 | 9.8883  | 0.6565 | 0.0165 | 1.0288 |
|            | 26       | 8.1131  | 1768.58 | 9.7399  | 0.6504 | 0.0165 | 0.9897 |
|            | 27       | 7.7832  | 1755.34 | 9.5915  | 0.6443 | 0.0165 | 0.9505 |
|            | 28       | 7.4533  | 1742.10 | 9.4431  | 0.6383 | 0.0165 | 0.9113 |
|            | 29       | 7.1234  | 1728.86 | 9.2947  | 0.6322 | 0.0165 | 0.8722 |
|            | 30       | 6.7935  | 1715.62 | 9.1463  | 0.6261 | 0.0165 | 0.8330 |
|            | 31       | 6.5905  | 1707.35 | 9.0884  | 0.6217 | 0.0165 | 0.8071 |
|            | 32       | 6.3875  | 1699.08 | 9.0305  | 0.6173 | 0.0165 | 0.7811 |
|            | 33       | 6.1845  | 1690.80 | 8.9726  | 0.6129 | 0.0165 | 0.7552 |
|            | 34       | 5.9815  | 1682.53 | 8.9146  | 0.6085 | 0.0165 | 0.7293 |
|            | 35       | 5.7785  | 1674.25 | 8.8567  | 0.6041 | 0.0165 | 0.7034 |
|            | 36       | 5.6621  | 1669.29 | 8.8760  | 0.6013 | 0.0165 | 0.6857 |
|            | 37       | 5.5457  | 1664.32 | 8.8953  | 0.5985 | 0.0165 | 0.6680 |
|            | 38       | 5.4293  | 1659.36 | 8.9146  | 0.5958 | 0.0165 | 0.6504 |
|            | 39       | 5.3129  | 1654.39 | 8.9339  | 0.5930 | 0.0165 | 0.6327 |
|            | 40       | 5.1965  | 1649.43 | 8.9532  | 0.5903 | 0.0165 | 0.6151 |
|            | 41       | 5.1430  | 1647.77 | 9.0531  | 0.5886 | 0.0160 | 0.6041 |
|            | 42       | 5.0895  | 1646.12 | 9.1529  | 0.5870 | 0.0154 | 0.5930 |
|            | 43       | 5.0360  | 1644.46 | 9.2528  | 0.5853 | 0.0149 | 0.5820 |
|            | 44       | 4.9825  | 1642.81 | 9.3526  | 0.5836 | 0.0143 | 0.5710 |
|            | 45       | 4.9290  | 1641.15 | 9.4525  | 0.5820 | 0.0138 | 0.5599 |
|            | 46       | 4.9306  | 1641.15 | 9.6478  | 0.5809 | 0.0143 | 0.5528 |
|            | 47       | 4.9323  | 1641.15 | 9.8431  | 0.5798 | 0.0149 | 0.5456 |
|            | 48       | 4.9339  | 1641.15 | 10.0383 | 0.5787 | 0.0154 | 0.5384 |
|            | 49       | 4.9356  | 1641.15 | 10.2336 | 0.5776 | 0.0160 | 0.5312 |
|            | 50       | 4.9372  | 1641.15 | 10.4289 | 0.5765 | 0.0165 | 0.5241 |
|            | 51       | 4.9395  | 1643.91 | 10.7489 | 0.5759 | 0.0165 | 0.5202 |
|            | 52       | 5.0498  | 1646.67 | 11.0688 | 0.5754 | 0.0165 | 0.5163 |
|            | 53       | 5.1061  | 1649.43 | 11.3888 | 0.5748 | 0.0165 | 0.5125 |
|            | 54       | 5.1623  | 1652.19 | 11.7087 | 0.5743 | 0.0165 | 0.5086 |
|            | 55       | 5.2186  | 1654.94 | 12.0287 | 0.5737 | 0.0165 | 0.5048 |
|            | 56       | 5.3400  | 1660.46 | 12.5312 | 0.5737 | 0.0165 | 0.5048 |
|            | 57       | 5.4613  | 1665.98 | 13.0338 | 0.5737 | 0.0165 | 0.5048 |
|            | 58       | 5.5827  | 1671.49 | 13.5363 | 0.5737 | 0.0165 | 0.5048 |
|            | 59       | 5.7040  | 1677.01 | 14.0389 | 0.5737 | 0.0165 | 0.5048 |
|            | 60       | 5.8254  | 1682.53 | 14.5414 | 0.5737 | 0.0165 | 0.5048 |
|            | 61       | 6.0334  | 1691.35 | 15.3237 | 0.5748 | 0.0165 | 0.5070 |
|            | 62       | 6.2413  | 1700.18 | 16.1059 | 0.5759 | 0.0165 | 0.5092 |
|            | 63       | 6.4493  | 1709.00 | 16.8881 | 0.5770 | 0.0165 | 0.5114 |
|            | 64       | 6.6573  | 1717.83 | 17.6704 | 0.5781 | 0.0165 | 0.5136 |
|            | 65       | 6.8653  | 1726.66 | 18.4526 | 0.5792 | 0.0165 | 0.5158 |
|            | 66       | 7.2029  | 1741.55 | 19.6861 | 0.5809 | 0.0165 | 0.5213 |
|            | 67       | 7.5405  | 1756.45 | 20.9196 | 0.5825 | 0.0165 | 0.5268 |
|            | 68       | 7.8781  | 1771.34 | 22.1531 | 0.5842 | 0.0165 | 0.5323 |
|            | 69       | 8.2157  | 1786.24 | 23.3866 | 0.5858 | 0.0165 | 0.5379 |
|            | 70       | 8.5533  | 1801.13 | 24.6200 | 0.5875 | 0.0165 | 0.5434 |
|            | 71       | 9.0967  | 1824.30 | 26.6181 | 0.5897 | 0.0165 | 0.5533 |
|            | 72       | 9.6400  | 1847.47 | 28.6162 | 0.5919 | 0.0165 | 0.5632 |
|            | 73       | 10.1834 | 1870.64 | 30.6142 | 0.5941 | 0.0165 | 0.5732 |
|            | 74       | 10.7268 | 1893.81 | 32.6123 | 0.5963 | 0.0165 | 0.5831 |
|            | 75       | 11.2702 | 1916.98 | 34.6104 | 0.5985 | 0.0165 | 0.5930 |
|            | 76       | 12.1600 | 1955.59 | 37.9467 | 0.6024 | 0.0171 | 0.6074 |
|            | 77       | 13.0498 | 1994.21 | 41.2831 | 0.6063 | 0.0177 | 0.6217 |
|            | 78       | 13.9396 | 2032.82 | 44.6195 | 0.6101 | 0.0182 | 0.6360 |
|            | 79       | 14.8294 | 2071.44 | 47.9558 | 0.6140 | 0.0188 | 0.6504 |
|            | 80       | 15.7192 | 2110.05 | 51.2922 | 0.6178 | 0.0193 | 0.6647 |

|            |          |        |         |         |        |        |        |
|------------|----------|--------|---------|---------|--------|--------|--------|
| <b>Bus</b> | <b>0</b> | 6.7367 | 35.88   | 0.9329  | 0.0000 | 0.0000 | 0.4575 |
|            | 5        | 8.5199 | 2438.77 | 9.8329  | 0.7659 | 0.0243 | 1.0942 |
|            | 6        | 8.1853 | 2395.98 | 9.5863  | 0.7576 | 0.0238 | 1.0616 |
|            | 7        | 7.8508 | 2353.19 | 9.3398  | 0.7494 | 0.0233 | 1.0290 |
|            | 8        | 7.5162 | 2310.39 | 9.0932  | 0.7411 | 0.0229 | 0.9964 |
|            | 9        | 7.1816 | 2267.60 | 8.8467  | 0.7328 | 0.0224 | 0.9638 |
|            | 10       | 6.8470 | 2224.80 | 8.6001  | 0.7246 | 0.0219 | 0.9313 |
|            | 11       | 6.4035 | 2168.39 | 8.2490  | 0.7124 | 0.0209 | 0.8846 |
|            | 12       | 5.9600 | 2111.98 | 7.8979  | 0.7003 | 0.0199 | 0.8379 |
|            | 13       | 5.5165 | 2055.57 | 7.5468  | 0.6881 | 0.0190 | 0.7912 |
|            | 14       | 5.0730 | 1999.16 | 7.1957  | 0.6760 | 0.0180 | 0.7445 |
|            | 15       | 4.6295 | 1942.75 | 6.8446  | 0.6638 | 0.0170 | 0.6978 |
|            | 16       | 4.3689 | 1908.71 | 6.6219  | 0.6555 | 0.0170 | 0.6677 |
|            | 17       | 4.1082 | 1874.67 | 6.3992  | 0.6473 | 0.0170 | 0.6375 |
|            | 18       | 3.8476 | 1840.63 | 6.1764  | 0.6390 | 0.0170 | 0.6074 |
|            | 19       | 3.5869 | 1806.59 | 5.9537  | 0.6307 | 0.0170 | 0.5772 |
|            | 20       | 3.3263 | 1772.55 | 5.7310  | 0.6225 | 0.0170 | 0.5471 |
|            | 21       | 3.1687 | 1751.15 | 5.5929  | 0.6171 | 0.0170 | 0.5271 |
|            | 22       | 3.0111 | 1729.75 | 5.4548  | 0.6118 | 0.0170 | 0.5072 |
|            | 23       | 2.8536 | 1708.36 | 5.3167  | 0.6064 | 0.0170 | 0.4873 |
|            | 24       | 2.6960 | 1686.96 | 5.1786  | 0.6011 | 0.0170 | 0.4673 |
|            | 25       | 2.5385 | 1665.56 | 5.0405  | 0.5957 | 0.0170 | 0.4474 |
|            | 26       | 2.4412 | 1652.92 | 4.9617  | 0.5923 | 0.0170 | 0.4343 |
|            | 27       | 2.3439 | 1640.28 | 4.8829  | 0.5889 | 0.0170 | 0.4211 |
|            | 28       | 2.2467 | 1627.63 | 4.8041  | 0.5855 | 0.0170 | 0.4080 |
|            | 29       | 2.1494 | 1614.99 | 4.7253  | 0.5821 | 0.0170 | 0.3949 |
|            | 30       | 2.0522 | 1602.34 | 4.6466  | 0.5787 | 0.0170 | 0.3817 |
|            | 31       | 1.9919 | 1593.59 | 4.6149  | 0.5758 | 0.0170 | 0.3730 |
|            | 32       | 1.9316 | 1584.84 | 4.5833  | 0.5729 | 0.0170 | 0.3642 |
|            | 33       | 1.8713 | 1576.08 | 4.5517  | 0.5699 | 0.0170 | 0.3555 |
|            | 34       | 1.8110 | 1567.33 | 4.5201  | 0.5670 | 0.0170 | 0.3467 |
|            | 35       | 1.7507 | 1558.58 | 4.4885  | 0.5641 | 0.0170 | 0.3380 |
|            | 36       | 1.7166 | 1554.20 | 4.4977  | 0.5626 | 0.0165 | 0.3321 |
|            | 37       | 1.6826 | 1549.82 | 4.5070  | 0.5612 | 0.0160 | 0.3263 |
|            | 38       | 1.6485 | 1545.45 | 4.5162  | 0.5597 | 0.0156 | 0.3205 |
|            | 39       | 1.6145 | 1541.07 | 4.5255  | 0.5583 | 0.0151 | 0.3146 |
|            | 40       | 1.5805 | 1536.69 | 4.5347  | 0.5568 | 0.0146 | 0.3088 |
|            | 41       | 1.5639 | 1534.75 | 4.5863  | 0.5558 | 0.0141 | 0.3049 |
|            | 42       | 1.5474 | 1532.80 | 4.6378  | 0.5549 | 0.0136 | 0.3010 |
|            | 43       | 1.5309 | 1530.86 | 4.6894  | 0.5539 | 0.0131 | 0.2971 |
|            | 44       | 1.5143 | 1528.91 | 4.7409  | 0.5529 | 0.0126 | 0.2932 |
|            | 45       | 1.4978 | 1526.97 | 4.7924  | 0.5519 | 0.0122 | 0.2893 |
|            | 46       | 1.4973 | 1526.97 | 4.8926  | 0.5510 | 0.0122 | 0.2869 |
|            | 47       | 1.4968 | 1526.97 | 4.9928  | 0.5500 | 0.0122 | 0.2845 |
|            | 48       | 1.4963 | 1526.97 | 5.0930  | 0.5490 | 0.0122 | 0.2821 |
|            | 49       | 1.4958 | 1526.97 | 5.1932  | 0.5481 | 0.0122 | 0.2796 |
|            | 50       | 1.4954 | 1526.97 | 5.2933  | 0.5471 | 0.0122 | 0.2772 |
|            | 51       | 1.5099 | 1529.40 | 5.4592  | 0.5471 | 0.0126 | 0.2762 |
|            | 52       | 1.5245 | 1531.83 | 5.6250  | 0.5471 | 0.0131 | 0.2752 |
|            | 53       | 1.5391 | 1534.26 | 5.7908  | 0.5471 | 0.0136 | 0.2743 |
|            | 54       | 1.5537 | 1536.69 | 5.9566  | 0.5471 | 0.0141 | 0.2733 |
|            | 55       | 1.5683 | 1539.13 | 6.1225  | 0.5471 | 0.0146 | 0.2723 |
|            | 56       | 1.6019 | 1544.48 | 6.3836  | 0.5471 | 0.0151 | 0.2723 |
|            | 57       | 1.6354 | 1549.82 | 6.6447  | 0.5471 | 0.0156 | 0.2723 |
|            | 58       | 1.6690 | 1555.17 | 6.9059  | 0.5471 | 0.0160 | 0.2723 |
|            | 59       | 1.7025 | 1560.52 | 7.1670  | 0.5471 | 0.0165 | 0.2723 |
|            | 60       | 1.7361 | 1565.87 | 7.4282  | 0.5471 | 0.0170 | 0.2723 |
|            | 61       | 1.7930 | 1574.63 | 7.8347  | 0.5476 | 0.0170 | 0.2738 |
|            | 62       | 1.8499 | 1583.38 | 8.2413  | 0.5481 | 0.0170 | 0.2752 |
|            | 63       | 1.9068 | 1592.13 | 8.6478  | 0.5485 | 0.0170 | 0.2767 |
|            | 64       | 1.9637 | 1600.89 | 9.0543  | 0.5490 | 0.0170 | 0.2782 |
|            | 65       | 2.0206 | 1609.64 | 9.4609  | 0.5495 | 0.0170 | 0.2796 |
|            | 66       | 2.1144 | 1624.23 | 10.1038 | 0.5505 | 0.0170 | 0.2821 |
|            | 67       | 2.2083 | 1638.82 | 10.7467 | 0.5515 | 0.0170 | 0.2845 |
|            | 68       | 2.3021 | 1653.41 | 11.3895 | 0.5524 | 0.0170 | 0.2869 |
|            | 69       | 2.3960 | 1667.99 | 12.0324 | 0.5534 | 0.0170 | 0.2893 |
|            | 70       | 2.4898 | 1682.58 | 12.6753 | 0.5544 | 0.0170 | 0.2918 |
|            | 71       | 2.6401 | 1705.44 | 13.7155 | 0.5558 | 0.0170 | 0.2957 |
|            | 72       | 2.7904 | 1728.30 | 14.7557 | 0.5573 | 0.0170 | 0.2996 |
|            | 73       | 2.9406 | 1751.15 | 15.7959 | 0.55   |        |        |

**HEALTH COST OF TRANSPORTATION EMISSIONS**  
(\$/ton)

| Area           | Proj Loc | CO  | CO <sub>2</sub> e | NO <sub>x</sub> | PM <sub>10</sub> | SO <sub>x</sub> | VOC     |
|----------------|----------|-----|-------------------|-----------------|------------------|-----------------|---------|
| LA/South Coast | 1        | \$0 | \$24              | \$8,209         | \$360,383        | \$46,561        | \$2,083 |
| CA Urban Area  | 2        | \$0 | \$24              | \$7,877         | \$360,383        | \$46,561        | \$1,999 |
| CA Rural Area  | 3        | \$0 | \$24              | \$7,877         | \$360,383        | \$46,561        | \$1,999 |

CO<sub>2</sub>e Uprater  increase in value per year

Sources: McCubbin and Delucchi, 1996 for emissions other than CO<sub>2</sub>e  
Interagency Working Group on Social Cost of Carbon, United States Government, 2010 for CO<sub>2</sub>e

**PASSENGER TRAIN EMISSIONS FACTORS**  
(g/train-mile)

| Mode            | Year | CO    | CO <sub>2</sub> | NO <sub>x</sub> | PM <sub>10</sub> | SO <sub>x</sub> | VOC   |
|-----------------|------|-------|-----------------|-----------------|------------------|-----------------|-------|
| Passenger Train | 2002 | 45.67 |                 | 583.58          | 62.02            |                 | 19.73 |
|                 | 2022 | 45.67 |                 | 250.11          | 31.01            |                 | 19.73 |

**LIGHT RAIL EMISSIONS FACTORS**  
(g/veh-mile)

| Mode       | Year | CO   | CO <sub>2</sub> | NO <sub>x</sub> | PM <sub>10</sub> | SO <sub>x</sub> | VOC  |
|------------|------|------|-----------------|-----------------|------------------|-----------------|------|
| Light Rail | 2002 | 0.14 |                 | 1.13            | 0.17             |                 | 0.06 |
|            | 2022 | 0.14 |                 | 1.14            | 0.17             |                 | 0.06 |

Source: California Air Resources Board

**Pavement Adjustments** (used only for pavement projects)

| PAVEMENT DETERIORATION<br>(IRI in inches/mile) |                     |        |       |
|--|---------------------|--------|-------|
| Year 0   | Year 20, By Loading |        |       |
|  | Light               | Medium | Heavy |
| 0  | 125                 | 150    | 350   |
| 25   | 150                 | 200    | 500   |
| 50   | 175                 | 250    | 675   |
| 75   | 200                 | 300    | 750   |
| 100  | 275                 | 400    | 750   |
| 125  | 325                 | 475    | 750   |
| 150  | 400                 | 575    | 750   |
| 175  | 500                 | 700    | 750   |
| 200  | 575                 | 750    | 750   |
| 225  | 650                 | 750    | 750   |
| 250  | 750                 | 750    | 750   |
| 275  | 750                 | 750    | 750   |
| 300  | 750                 | 750    | 750   |
| 325  | 750                 | 750    | 750   |
| 350  | 750                 | 750    | 750   |
| 375  | 750                 | 750    | 750   |
| 400  | 750                 | 750    | 750   |
| 425  | 750                 | 750    | 750   |
| 450  | 750                 | 750    | 750   |

Source: Paterson, 1987

| VEHICLE OPERATING SPEED<br>(percent adjustment) |      |       |
|---|------|-------|
| IRI   | Auto | Truck |
| 0   | 1.00 | 1.02  |
| 25  | 1.00 | 1.02  |
| 50  | 1.00 | 1.02  |
| 75  | 1.00 | 1.02  |
| 100   | 1.00 | 1.02  |
| 125   | 1.00 | 1.02  |
| 150   | 1.00 | 1.01  |
| 175   | 1.00 | 1.00  |
| 200   | 1.00 | 0.98  |
| 225   | 1.00 | 0.95  |
| 250   | 1.00 | 0.92  |
| 275   | 0.99 | 0.89  |
| 300   | 0.98 | 0.86  |
| 325   | 0.97 | 0.83  |
| 350   | 0.96 | 0.81  |
| 375   | 0.95 | 0.78  |
| 400   | 0.94 | 0.76  |
| 425   | 0.93 | 0.73  |
| 450   | 0.92 | 0.71  |

Source: Botterill, 1996 and 1997

| FUEL CONSUMPTION<br>(percent adjustment) |      |       |
|--|------|-------|
| IRI                                      | Auto | Truck |
| 0  | 0.97 | 0.96  |
| 25                                       | 0.98 | 0.97  |
| 50                                       | 0.98 | 0.97  |
| 75                                       | 0.98 | 0.98  |
| 100                                      | 0.98 | 0.98  |
| 125                                      | 0.99 | 0.99  |
| 150                                      | 1.00 | 0.99  |
| 175                                      | 1.00 | 1.00  |
| 200                                      | 1.01 | 1.01  |
| 225                                      | 1.01 | 1.02  |
| 250                                      | 1.02 | 1.03  |
| 275                                      | 1.03 | 1.04  |
| 300                                      | 1.03 | 1.05  |
| 325                                      | 1.04 | 1.06  |
| 350                                      | 1.05 | 1.07  |
| 375                                      | 1.06 | 1.08  |
| 400                                      | 1.07 | 1.10  |
| 425                                      | 1.08 | 1.11  |
| 450                                      | 1.09 | 1.13  |

Source: Texas Transportation Institute, 1994

| NON-FUEL COSTS<br>(percent adjustment) |      |       |
|--|------|-------|
| IRI                                    | Auto | Truck |
| 0                                      | 1.00 | 1.00  |
| 25                                     | 1.00 | 1.00  |
| 50                                     | 1.00 | 1.00  |
| 75                                     | 1.00 | 1.00  |
| 100                                    | 1.00 | 1.00  |
| 125                                    | 1.00 | 1.00  |
| 150                                    | 1.02 | 1.02  |
| 175                                    | 1.03 | 1.04  |
| 200                                    | 1.05 | 1.06  |
| 225                                    | 1.07 | 1.08  |
| 250                                    | 1.09 | 1.10  |
| 275                                    | 1.11 | 1.12  |
| 300                                    | 1.12 | 1.14  |
| 325                                    | 1.14 | 1.16  |
| 350                                    | 1.16 | 1.18  |
| 375                                    | 1.18 | 1.20  |
| 400                                    | 1.19 | 1.22  |
| 425                                    | 1.21 | 1.24  |
| 450                                    | 1.23 | 1.26  |

Source: ARRB Research Board TR VOC Model

**Weaving Adjustments** (used only for freeway connector, HOV connector, and HOV drop ramp projects)

| VEHICLE OPERATING SPEED<br>(percent adjustment) |              |             |
|---|--------------|-------------|
| Percent Weaving                                 | Freeway Conn | HOV Project |
| 0.000   | 1.00         | 1.00        |
| 0.002   | 0.98         | 0.99        |
| 0.004   | 0.96         | 0.98        |
| 0.006   | 0.95         | 0.96        |
| 0.008   | 0.93         | 0.95        |
| 0.010   | 0.91         | 0.94        |
| 0.012   | 0.89         | 0.93        |
| 0.014   | 0.87         | 0.92        |
| 0.016   | 0.85         | 0.90        |
| 0.018   | 0.84         | 0.89        |
| 0.020   | 0.79         | 0.88        |
| 0.022   | 0.75         | 0.87        |
| 0.024   | 0.71         | 0.85        |
| 0.026   | 0.66         | 0.84        |
| 0.028   | 0.62         | 0.82        |
| 0.030   | 0.58         | 0.79        |
| 0.032   | 0.54         | 0.76        |
| 0.034   | 0.50         | 0.73        |
| 0.036   | 0.48         | 0.71        |
| 0.038   | 0.47         | 0.68        |
| 0.040   | 0.47         | 0.65        |
| 0.042   | 0.47         | 0.62        |
| 0.044   | 0.47         | 0.60        |
| 0.046   | 0.46         | 0.57        |
| 0.048   | 0.46         | 0.54        |
| 0.050   | 0.46         | 0.51        |
| 0.052   | 0.46         | 0.48        |
| 0.054   | 0.45         | 0.48        |
| 0.056   | 0.45         | 0.47        |
| 0.058   | 0.45         | 0.47        |
| 0.060   | 0.45         | 0.47        |
| 0.062   | 0.45         | 0.47        |
| 0.064   | 0.45         | 0.47        |
| 0.066   | 0.45         | 0.47        |
| 0.068   | 0.45         | 0.46        |
| 0.070   | 0.45         | 0.46        |
| 0.072   | 0.45         | 0.46        |
| 0.074   | 0.45         | 0.46        |
| 0.076   | 0.45         | 0.46        |
| 0.078   | 0.45         | 0.46        |
| 0.080   | 0.45         | 0.45        |

Source: Fitzpatrick, Brewer, and Venglar, 2003

**TMS Adjustments** (used only for ramp metering, ramp metering signal coordination, incident management, traveler information projects, AVL, transit priority, and BRT projects)

| PEAK PERIOD SPEED, VOLUME, AND NON-HIGHWAY BENEFITS<br>(percent adjustment) |         |        |       |        |                      |       |       |               |
|---|---------|--------|-------|--------|----------------------|-------|-------|---------------|
| TMS Strategy  | Without |        | With  |        | Non-Highway Benefits |       |       | Total Benefit |
|   | Speed   | Volume | Speed | Volume | TT                   | VOC   | Em    |               |
| AMoth   | 1.02    | 0.95   | 1.02  | 0.95   | -5.05                | 12.81 | 1.37  | 0.74          |
| AMsev   | 1.53    | 0.94   | 1.53  | 0.94   | 1.21                 | 1.38  | -0.37 | 1.00          |
| IMoth   | 0.88    | 1.18   | 0.98  | 0.96   | 0.51                 | 0.15  | 0.06  | 0.74          |
| IMsev   | 1.01    | 0.97   | 1.01  | 0.95   | 0.30                 | 0.31  | 0.30  | 1.00          |
| NoAdj   | 1.00    | 1.00   | 1.00  | 1.00   | 0.00                 | 0.00  | 0.00  | 1.00          |
| ORoth   | 0.98    | 1.03   | 1.00  | 1.00   | -0.07                | -0.03 | -0.07 | 0.00          |
| ORsev   | 0.95    | 1.03   | 1.00  | 1.00   | 0.00                 | 0.00  | 5.67  | 0.00          |
| RMoth   | 1.00    | 1.00   | 1.03  | 0.97   | -0.07                | -0.03 | -0.07 | 1.00          |
| RMsev   | 1.00    | 1.00   | 1.05  | 0.97   | 0.00                 | 0.00  | 5.67  | 1.00          |
| Tloth   | 1.00    | 1.00   | 1.02  | 0.97   | -0.11                | -0.12 | -0.35 | 1.00          |
| Tlsev   | 1.00    | 1.00   | 1.01  | 0.97   | -0.39                | -0.39 | -0.35 | 1.00          |

Source: California Department of Transportation TMS Master Plan, 2003  
18) Chaudhary and Messer, 2000

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| TRANSIT TRAVEL TIME AND AGENCY COST SAVINGS<br>(percent savings) |             |              |     |
|--|-------------|--------------|-----|
| TMS Strategy   | Travel Time | Agency Costs |     |
|  |             | Capital      | O&M |
| Transit Vehicle Location (AVL)                                   | 15%         | 2%           | 8%  |
| Transit Vehicle Signal Priority                                  | 10%         | -            | -   |
| Bus Rapid Transit (BRT)  | 29%         | -            | -   |

Sources: FHWA ITS Deployment Analysis System (IDAS), California PATH