APPENDIX 5: TRAFFIC INPUTS ESTIMATION

A. Free Flow Capacity

The alternate procedure for estimating the "Free Flow Capacity (vphpl)" is as follows:
(Assume standard lane and shoulder widths)

Select a passenger car equivalent factor, E (passenger cars/heavy vehicle), corresponding to the project terrain from Table A5-1

Table A5-1. Passenger Car Equivalent Factors

	Type of Terrain		
	Level	**Rolling**	**Mountainous**
E	1.5	2.5	4.5

Use Equation A5-1 to convert "Free Flow Capacity" in terms of pcphpl to vphpl (vehicles per hour per lane):

$$FC = \frac{F \times 100}{[(100 + P \times (E-1)]} \qquad \text{(Equation A5-1)}$$

Where:

FC = Free Flow Capacity (vphpl)

F = roadway capacity (passenger car per hour per lane)

= 1,700 pcphpl for two-lane highways

= 2,300 pcphpl for multi-lane highways

P = percentage of heavy vehicles (i.e., "Total Trucks %" at the project location. Input as percentage.)

E = passenger car equivalent (passenger cars/heavy vehicle)

B. Queue Dissipation Capacity

The procedure for estimating the "Queue Dissipation Capacity (vphpl)" is as follows:
(Assume standard lane and shoulder widths)

Select a passenger car equivalent factor, E (passenger cars/heavy vehicle), corresponding to the project terrain from Table 15;

Use Equation A5-2 to convert "Queue Dissipation Capacity" in terms of pcphpl to vphpl (vehicles per hour per lane):

$$QC = \frac{Q \times 100}{[(100 + P \times (E - 1)]} \qquad \text{(Equation A5-2)}$$

Where:

QC = Queue Dissipation Capacity (vphpl)

Q = base capacity (passenger cars per hour per lane)

= 1,800 pcphpl for both single-lane and multi-lane highways

P = percentage of heavy vehicles (i.e., "Total Trucks %" at the project location. Input as percentage.)

E = passenger car equivalent (passenger cars/heavy vehicle)

C. Maximum AADT (total for both directions)

The procedure for estimating the "Maximum AADT (total for both directions)" is as follows:

Select a passenger car equivalent factor, E (passenger cars/heavy vehicle), corresponding to the project terrain from Table A5-1;

Use Equation A5-3 to calculate "Maximum AADT (total for both directions)":

$$AADT_{\max} = \frac{M \times N \times 100}{[(100 + P \times (E - 1)]} \qquad \text{(Equation A5-3)}$$

Where:

$AADT_{max}$ = Maximum AADT (total for both directions)

M = 43,000 for two-lane highways or 57,000 for multi-lane highways

N = number of lanes (total for both directions)

P = percentage of heavy vehicles (i.e., "Total Trucks %" at the project location. Input as percentage.)

E = passenger car equivalent (passenger cars/heavy vehicle)

D. Work Zone Capacity

The procedure for estimating the "Work Zone Capacity (vphpl)" is as follows: (Assume standard lane and shoulder widths)

Select a passenger car equivalent factor, E (passenger cars/heavy vehicle), corresponding to the project terrain from Table A5-1.

Use Equation A5-4 to convert "Work Zone Capacity" in terms of pcphpl to vphpl (vehicles per hour per lane):

$$WC = \frac{W \times 100}{[100 + P \times (E - 1)]} \qquad \text{(Equation A5-4)}$$

Where:

WC = Work Zone Capacity (vphpl)

W = base work zone capacity (passenger cars per hour per lane)

W = 1,100 pcphpl for two-lane highways

= 1,600 pcphpl for multi-lane highways

P = percentage of heavy vehicles (i.e., "Total Trucks %" at the project location. Input as percentage.)

E = passenger car equivalent (passenger cars/heavy vehicle)

E. Maximum Queue Length Estimation
The maximum number of queued vehicles during the time the work zone is in effect is estimated by using the traffic demand-capacity model, as shown in Figure A5-1. When demand exceeds capacity, the queue starts to build up. The maximum number of queued vehicles is measured where the difference between the demand curve and the capacity curve is the greatest. Then the maximum queue length can be obtained by multiplying the maximum number of queued vehicles by the average vehicle length (i.e., 40 feet).

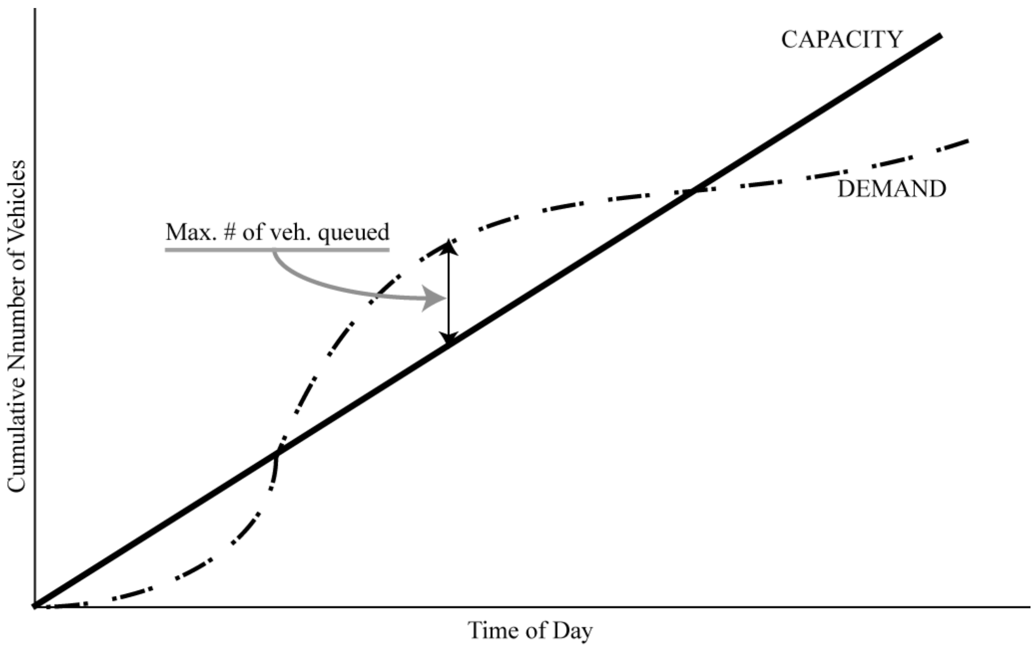

Figure A5-1: Traffic Demand-Capacity Model

Example:

Maximum Queue Length Estimation

During construction on a three-lane urban freeway section, one lane will be closed and two lanes will be open. The work zone capacity is assumed to be 1,600 passenger cars per hour per lane (pcphpl). The hourly traffic demands, expressed in vehicles per hour (vph), are assumed to be those shown in the second column in Table A5-2. Ten percent of the traffic volume is assumed to be occupied by single-unit and combination trucks. The procedure for estimating the maximum queue length is:

The hourly passenger car capacity of one lane (1,600 pcphpl) of the work zone is converted to the hourly vehicular capacity of one lane [1,524 vphpl (vehicles per hour per lane)] of the work zone using Equation A5-4.

Table A5-2 Maximum Queue Length Estimation

Hour	Volume (vph)	Capacity (pcphpl)	Capacity (vphpl)	No. of lanes open	Capacity (vph)	Cumulative Queued veh.
1	340	1,600	1,524	2	3,048	0
2	350	1,600	1,524	2	3,048	0
3	350	1,600	1,524	2	3,048	0
4	400	1,600	1,524	2	3,048	0
5	800	1,600	1,524	2	3,048	0
6	1,200	1,600	1,524	2	3,048	0
7	3,000	1,600	1,524	2	3,048	0
8	3,400	1,600	1,524	2	3,048	352
9	3,600	1,600	1,524	2	3,048	904
10	3,000	1,600	1,524	2	3,048	856
11	1,800	1,600	1,524	2	3,048	0
12	1,300	1,600	1,524	2	3,048	0
13	1,200	1,600	1,524	2	3,048	0
14	1,000	1,600	1,524	2	3,048	0
15	1,200	1,600	1,524	2	3,048	0
16	1,900	1,600	1,524	2	3,048	0
17	3,400	1,600	1,524	2	3,048	352
18	3,650	1,600	1,524	2	3,048	954
19	2,400	1,600	1,524	2	3,048	306
20	1,000	1,600	1,524	2	3,048	0
21	800	1,600	1,524	2	3,048	0
22	760	1,600	1,524	2	3,048	0
23	300	1,600	1,524	2	3,048	0
24	300	1,600	1,524	2	3,048	0
					Max. queued veh.	954
	Max. queued veh. on 3 lanes, at upstream of work zone					318
					Average vehicle length	40 ft
					Max. queue length	12,720 ft
						2.41 mi

As shown in Table A5-2, the queue starts at slightly after 7 AM when the traffic demand exceeds the work zone capacity (3,048 vph) and starts dissipating after 10 AM when the sum of the hourly demand becomes less than the work zone capacity. The queue is completely dissipated by 11 AM, and starts again at about 5 PM when the traffic demand exceeds the work zone capacity (3,048 vph).

The maximum number of queued vehicles is 954 at 6 PM when the cumulative number of the queued vehicles is the greatest. The maximum number of queued vehicles per lane upstream of the work zone is 318 (954 vehicles divided by 3 lanes). Thus, the maximum queue length from the work zone operation is estimated at 2.41 miles (318 vehicles multiplied by 40 ft. average vehicle length).