

**APPENDIX F:
RURAL TWO-LANE
HIGHWAY (55 MPH)
INPUTS**

Appendix F1: HCM 2000 Two-Lane Highway Equations

The two-lane highways in systems level planning are assumed to be in the Class I category. These are two-lane highways on which motorists expect to travel at relatively high speeds. They are major intercity routes, primary arterials connecting major traffic generators, daily commuter routes, or primary links in the state or national highway networks. They most often serve long-distance trips or provide connecting links between facilities that serve long-distance trips.

The equation below calculates the one-way “ultimate capacity” (LOS E) of a two-lane highway. As is the case for Urban Streets, HCM 2000 does not provide a simplified equation to estimate capacity for two-lane highways at Levels of Service other than LOS E. To determine two-lane highway capacity for LOS A through LOS D, refer to the procedures in HCM 2000 Chapter 20. A copy of the HCM Two-Way Two-Lane Highway Segment Worksheet is included for reference as **Exhibit 4**.

$$c = Q \cdot f_{HV}$$

Where:

c = Capacity (vehicles/hour)

Q = PCE (passenger-car equivalents) capacity of 1700 pc/hr/ln. Note the additional capacity constraint that two-way flow may not exceed 3200 pc/hr/ln.

f_{HV} = Heavy-vehicle adjustment factor (See *HCM 2000 Exhibits 20-9 – 20-10* for truck and RV equivalent values)

$$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad (\text{HCM Eqn. 20-4})$$

E_T = Passenger-car equivalents for trucks/buses

E_R = Passenger-car equivalents for RVs

P_T = Proportion of trucks/buses in traffic stream, expressed as a decimal fraction

P_R = Proportion of RVs in traffic stream, expressed as a decimal fraction

For NCDOT – TPB Level of Service D for Systems Level Planning, the 2000 Highway Capacity Manual Software was used in developing the two-lane highway capacities. NCLOS 2.1 was NOT used in developing the two-lane highway capacities due to an error in the program.

See HCM 2000, Exhibit 20-28 (Figure 4) for Two-Lane Highway Segment Worksheet for data input needed in analyzing two-lane highways

Appendix F1: HCM 2000 Two-Lane Highway Equations

Exhibit 4: HCM 2000 Two-Way Two-Lane Highway Segment Worksheet

EXHIBIT 20-28. TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET	
General Information	
Analyst _____	Highway _____
Agency or Company _____	From/To _____
Date Performed _____	Jurisdiction _____
Analysis Time Period _____	Analysis Year _____
<input type="checkbox"/> Operational (LOS)	<input type="checkbox"/> Design (v_p)
<input type="checkbox"/> Planning (LOS)	<input type="checkbox"/> Planning (v_p)
Input Data	
<p>Shoulder width _____ ft</p> <p>Lane width _____ ft</p> <p>Lane width _____ ft</p> <p>Shoulder width _____ ft</p> <p>Segment length, L_1 _____ mi</p>	<input type="checkbox"/> Class I highway <input type="checkbox"/> Class II highway Terrain <input type="checkbox"/> Level <input type="checkbox"/> Rolling Two-way hourly volume _____ veh/h Directional split _____ / _____ Peak-hour factor, PHF _____ % Trucks and buses, P_T _____ % % Recreational vehicles, P_R _____ % % No-passing zone _____ % Access points/mi _____ /mi
Average Travel Speed	
Grade adjustment factor, f_G (Exhibit 20-7)	
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	
Two-way flow rate, $^1 v_p$ (pc/h) $v_p = \frac{V}{PHF \cdot f_G \cdot f_{HV}}$	
v_p * highest directional split proportion ² (pc/h)	
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} _____ mi/h	Base free-flow speed, BFFS _____ mi/h
Observed volume, V_f _____ veh/h	Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) _____ mi/h
Free-flow speed, FFS _____ mi/h	Adj. for access points, f_A (Exhibit 20-6) _____ mi/h
$FFS = S_{FM} + 0.00776 \left(\frac{V_f}{f_{HV}} \right)$	Free-flow speed, FFS _____ mi/h
	$FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776 v_p - f_{np}$	
Percent Time-Spent-Following	
Grade adjustment factor, f_G (Exhibit 20-8)	
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	
Two-way flow rate, $^1 v_p$ (pc/h) $v_p = \frac{V}{PHF \cdot f_G \cdot f_{HV}}$	
v_p * highest directional split proportion ² (pc/h)	
Base percent time-spent-following, BPTSF (%)	
$BPTSF = 100(1 - e^{-0.000879 v_p})$	
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	
Level of Service and Other Performance Measures	
Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3,200}$	
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi)	
$VMT_{15} = 0.25 L_1 \left(\frac{V}{PHF} \right)$	
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V \cdot L_1$	
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	
Notes	
1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F	
2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F	

Appendix F2: Coastal Rural 2-Lane Highway Inputs

12-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	60	40	20
Lane Width	12	12	12
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	15	10
Maximum AADT	10500	12700	14700

11-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	60	40	20
Lane Width	11	11	11
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	15	10
Maximum AADT	10000	12700	14700

10-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	60	40	20
Lane Width	10	10	10
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	20	10
Maximum AADT	9200	12000	14700

9-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	60	40	20
Lane Width	9	9	9
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	20	10
Maximum AADT	7700	10700	14700

Appendix F3: Piedmont Rural 2-Lane Highway Inputs

12-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	70	50	30
Lane Width	12	12	12
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	15	10
Maximum AADT	10300	12400	14300

11-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	70	50	30
Lane Width	11	11	11
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	15	10
Maximum AADT	9900	12400	14300

10-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	70	50	30
Lane Width	10	10	10
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	20	10
Maximum AADT	9000	11800	14300

9-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	70	50	30
Lane Width	9	9	9
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	20	10
Maximum AADT	7500	10500	14300

Appendix F4: Mountain (Level) Rural 2-Lane Highway Inputs

12-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	80	60	40
Lane Width	12	12	12
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	15	10
Maximum AADT	10200	12100	14000

11-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	80	60	40
Lane Width	11	11	11
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	15	10
Maximum AADT	9800	12100	14000

10-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	12
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	80	60	40
Lane Width	10	10	10
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	20	10
Maximum AADT	8800	11700	14000

9-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	80	60	40
Lane Width	9	9	9
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	20	10
Maximum AADT	7400	10300	14000

Appendix F5: Mountain (Rolling) Rural 2-Lane Highway Inputs

12-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	80	60	40
Lane Width	12	12	12
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	15	10
Maximum AADT	9600	12100	14000

11-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	80	60	40
Lane Width	11	11	11
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	15	10
Maximum AADT	9100	12100	14000

10-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	80	60	40
Lane Width	10	10	10
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	20	10
Maximum AADT	8200	11100	14000

9-foot lanes	MINIMUM	STANDARD	MAXIMUM
LOS	D	D	D
Street Class	I	I	I
PHF	0.88	0.88	0.88
K Factor	12	11	10
D Factor	60	60	60
Truck %	15	10	5
RV	0	0	0
No Passing Zone	80	60	40
Lane Width	9	9	9
BFFS	60	60	60
Shoulder Width	2-3	4-5	6+
Access Points/Mile	20	20	10
Maximum AADT	6200	9800	14000