

# **Simplified Highway Capacity Calculation Method for the Highway Performance Monitoring System**

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<p><b>16. Abstract</b></p> <p>The Federal Highway Administration's Highway Performance Monitoring System (HPMS) provides information on the extent, condition, performance, use, and operating characteristics of the Nation's highways. Each year State Transportation Agencies must submit HPMS data to the FHWA. The Sample Panel portion of HPMS provides detailed statistical data on a randomly selected sample of roadway sections on the State's public road system. One data item submitted for sample panels is capacity (Sample Panel Data Item 69). The HPMS Field Manual guidance for capacity is as follows: "The capacity of a roadway facility is the maximum reasonable hourly rate at which vehicles can be expected to transverse a point or a uniform section of lane or roadway during a given time period under prevailing road-way, traffic, and control conditions." Reasonable expectancy is that the stated capacity can be achieved repeatedly. The Highway Capacity Manual (HCM) provides procedures, formulas, graphics, and tables in assessing roadway capacity. This item should be estimated based on procedures consistent with the HCM.</p> <p>The results of the project are the development of:</p> <ol style="list-style-type: none"> <li>1. Capacity computation methods that use HPMS data items to the extent possible, and can be used to validate HPMS Sample Panel Item 69; and</li> <li>2. Simplified Methodologies to Create Generalized Level of Service (LOS) Lookup Tables. Both of these results use the most recent HCM methodologies. Specifically, it was found that the procedures in National Cooperative Research Program Report 825 ("Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual") could be easily adapted to the types of data present in HPMS.</li> </ol>			
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## CHAPTER 1. INTRODUCTION

The Federal Highway Administration's (FHWA) Highway Performance Monitoring System (HPMS) provides information on the extent, condition, performance, use, and operating characteristics of the Nation's highways. Each year State Transportation Agencies (STA) must submit HPMS data to the FHWA. Certain data items, including length, lane-miles, and travel are required for all public roads that are eligible for Federal-aid highway funds. The data items reported for all public roads are known as full extent data items. In addition to full extent data items, there are data items that are reported on a partial extent basis, which are known as sample panel data items. The sample panel provides more detailed statistical data on a randomly selected sample of roadway sections in the State's public road system. One data item submitted for sample panels is capacity (Sample Panel Data Item 69). The HPMS Field Manual guidance for capacity is as follows: "The capacity of a roadway facility is the maximum reasonable hourly rate at which vehicles can be expected to transverse a point or a uniform section of lane or roadway during a given time period under prevailing roadway, traffic, and control conditions. Reasonable expectancy is that the stated capacity can be achieved repeatedly. The *Highway Capacity Manual (HCM)* provides procedures, formulas, graphics, and tables in assessing roadway capacity. This item should be estimated based on procedures consistent with the HCM. All urban and rural capacity for freeways and other multilane facilities is for the peak direction. If a rural facility has two or three lanes with one-way operation, it is considered to be a multilane facility for determining capacity. The capacity for rural facilities with two or three lanes and two-way operation is for both directions."

The objectives of the project are to develop:

1. Capacity computation methods that: 1) use HPMS data items to the extent possible, and 2) can be used to validate HPMS Sample Panel Item 69.
2. Simplified methodologies to create generalized level of service (LOS) lookup tables.
3. These two objectives were covered by tasks 2 and 3 and are presented as separate sections below (figure 1).

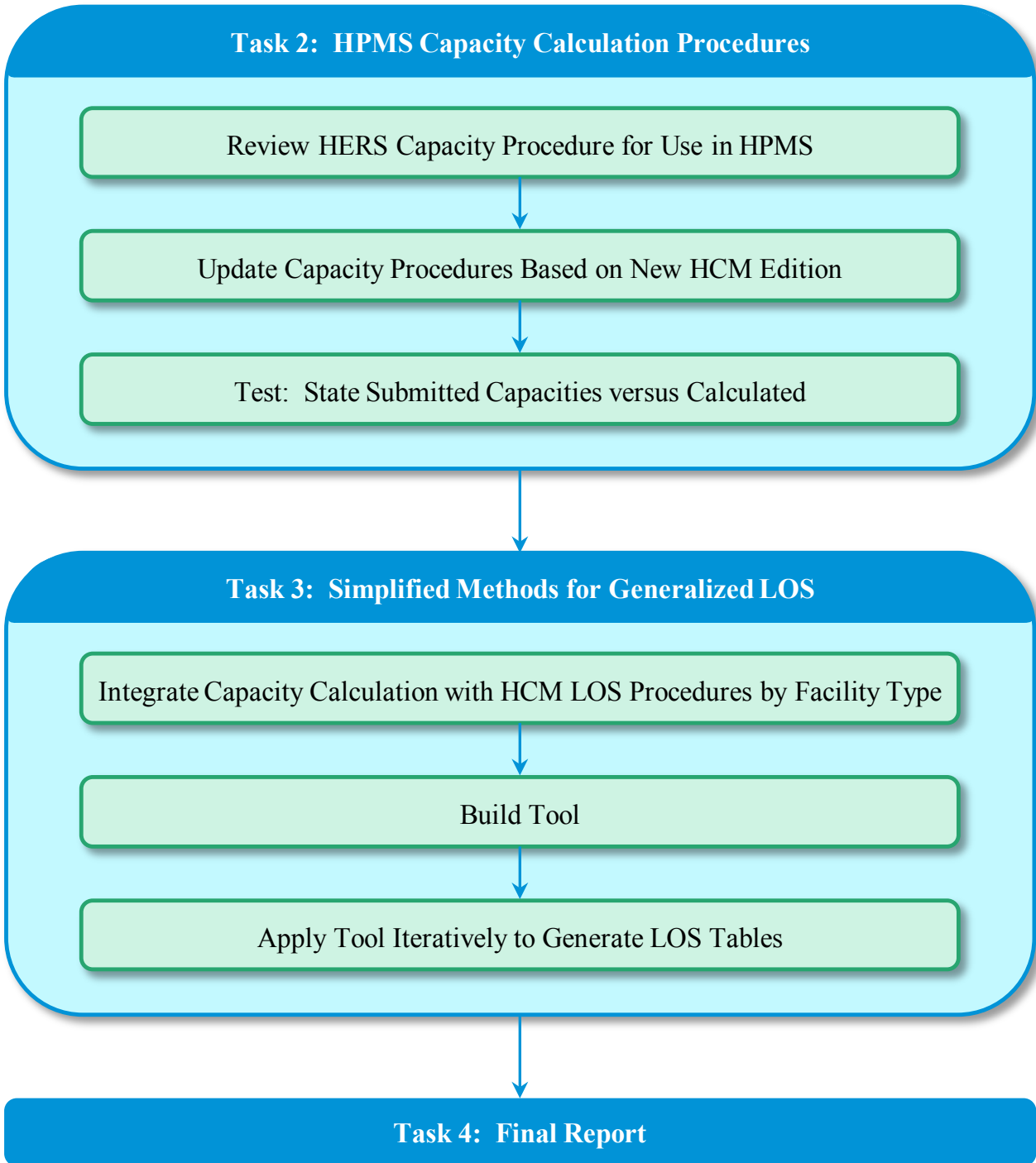


Figure 1. Flow chart. Overview of major task activities.

## CHAPTER 2. DEVELOPMENT OF CAPACITY COMPUTATION METHODS

### REVIEW HIGHWAY ECONOMIC REQUIREMENTS SYSTEM CAPACITY PROCEDURES FOR USE IN HIGHWAY PERFORMANCE MONITORING SYSTEM

The Highway Economic Requirements System (HERS) capacity procedures, completed in 2014, adapted the Highway Capacity Manual (HCM) 2010 capacity calculation methods.<sup>1</sup> It utilized Highway Performance Monitoring System (HPMS) data items to the maximum extent but also had to make many assumptions about default values. The HPMS data items that were used are shown in table 1. HCM capacity input data that had to set to default values are as follows:

- **Freeways**—ramp density, peak-hour factor, and driver population factor.
- **Multilane highways**—driveway density, peak-hour factor, and driver population factor.
- **Signals**—lane group assignments (based on presence of right- and left-turning lanes), grade, number of parking maneuvers per hour, bus blockage, area type, lane utilization, left- and right-turn lanes.
- **Rural two-lane highways**—driveway density and peak-hour factor.
- **Stop signs**—conflicting flow rates, base critical gap, follow-up times, and assignment of turning movements to lanes.

The project team compared the HERS procedures with National Cooperative Highway Research Program (NCHRP) Project 07-22, Planning and Preliminary Engineering Applications Guide to the HCM. The report has recently been published as NCHRP Report 825.<sup>2</sup> Its midlevel analysis methods for capacity are very similar to the HERS procedures which preceded it. Where the two methods differ, we developed a test procedure using 2014 HPMS data to compare the capacity values obtained with each method. The results of the comparison are as follows.

Table 1. Highway performance monitoring system data items used in the highway economic requirements system capacity calculation procedures.

HPMS Data Item	Facility Type				
	Freeways	Multilane	Signals	Rural Two Lane	Stop Sign
Lane Width	●	●	●	●	—
Right Shoulder Width	●	●	—	●	—
Left Shoulder Width	—	●	—	—	—
Through Lanes	●	●	—	—	●
Peak Lanes	—	—	—	—	●
% SU Trucks	●	●	●	●	●

<sup>1</sup> Task 6 Technical Memo: Procedures for Estimating Highway Capacity, May 2014.

<sup>2</sup> Dowling, Richard et al., *Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual*, NCHRP Report 825, 2016, <http://www.trb.org/NCHRP/Blurbs/174958.aspx>.

Table 1. Highway performance monitoring system data items used in the highway economic requirements system capacity calculation procedures (continuation).

HPMS Data Item	Facility Type				
	Freeways	Multilane	Signals	Rural Two Lane	Stop Sign
% Comb. Trucks	●	●	●	●	●
Median Type	–	–	–	–	–
No. Other Intersections	–	●	–	●	–
Right-Turn Lanes	–	–	●	–	●
Left-Turn Lanes	–	–	●	–	●
K-factor	–	–	●	●	●
D-factor	–	–	●	●	●
Percent Green Lime	–	–	●	–	–
Terrain	●	●	–	●	–
Functional Class	–	–	–	–	●
Speed Limit <sup>a</sup>	–	–	–	●	–

<sup>a</sup> Speed limit is generally used in the computation of service measures but except for rural two-lane highways is not used in capacity calculation.

### Freeways

The HERS capacity procedure is very similar to that of NCHRP 825. The HERS procedure follows the HCM procedure verbatim, with adjustments for lane width, lateral clearance, interchange density, heavy trucks, and the peak-hour factor. The NCHRP method excludes the peak-hour factor. However, their formulations for the final capacity value are slightly different. When applied to 2014 Sample Panel data (21,940 freeway sections), HERS-developed capacity values are five percent lower than those of NCHRP 825. We consider this difference negligible, *so we recommend the NCHRP 825 method for capacity and (Level of Service) LOS calculations.*

$$Capacity = \frac{(2,200 + 10 \times (\min(70, FFS) - 50))}{1 + \%HV/100} \times Lanes$$

Where: FFS = free flow speed  
 %HV = percent of heavy vehicles (decimal), with heavy vehicles consisting of trucks with more than four tires, buses, and recreational vehicles Multilane Highways

Figure 2. Equation. Capacity calculation for freeway capacity.

$$FFS = 75.4 - f_{LW} - f_{RLC}$$

Where:  $f_{LW}$  = adjustment for lane width (HPMS data item 34)  
 $f_{RLC}$  = adjustment for right side lateral clearance (HPMS data item 38)  
 Lanes = HPMS data item 10

Figure 3. Equation. Calculation of free flow speed for freeways.

The HERS method follows the HCM faithfully. NCHRP 825 recommends using the HCM method, so the two methods are the same. ***Therefore, the HCM method (which also is the HERS method) is recommended for capacity and LOS calculations.***

### Multilane Highways

The HERS method follows the HCM faithfully. NCHRP 825 recommends using the HCM method, so the two methods are the same. ***Therefore, the HCM method (which is also the HERS method) is recommended for capacity and LOS calculations.***

$$Capacity = BaseCapacity \times f_{HV} \times Lanes$$

Where:  $BaseCapacity = 1,000 + 20 \times FFS$ ; for  $FFS \leq 60$ ; 2,200 otherwise

$f_{HV}$  = adjustment for heavy vehicles

$$f_{HV} = \frac{1}{(1 + PT \times (ET - 1))}$$

PT = HPMS data item 23 + HPMS data item 25

ET = 1.5 if HPMS data item 2 indicates a former urban area; otherwise:

= 1.5 if HPMS data item 44 = 1

= 2.5 if HPMS data item 44 = 2

= 4.5 if HPMS data item 44 = 3

FFS = HPMS data item 14 + 5

Lanes = HPMS data item 10

Figure 4. Equation. Calculation of capacity for multilane highways.

### Signalized Highways

Different philosophies are taken between the HERS method and NCHRP 825 method. In the HERS method, the capacity of the entire approach is calculated. This done because in HERS' speed estimation, turning movement volumes are not available in HPMS and the volume on the entire segment is used. In the NCHRP 825 method, only the through movement is used. (It offers a solution if only total volume is available: if exclusive left-turn and right lanes exist, deduct 10 percent for each.) To be comparable, we used the HERS method to analyze just the through

movement. In the HERS method, saturation flow rate is adjusted downward for lane width, heavy vehicles, parking, and the peak-hour factor. In the NCHRP 825 method, saturation flow rate is unadjusted. As a result, when applied to the Sample Panel data (26,504 signalized sections), the HERS method produces capacities that are 14 percent lower than NCHRP 825. The main problem with the HERS method is that the turning lane and their volume assignments are based on many assumptions. ***Because of its simplicity in dealing with turning movements, we recommend the NCHRP 825 method for capacity and LOS calculations.***

$$\text{Capacity} = \frac{g}{C} \times \text{Lanes} \times 1,900$$

Where:  $g/C$  = HPMS data item 30

Lanes = HPMS data item 10

Figure 5. Equation. Calculation of capacity for signalized highways.

### Two-Lane Highways with No Traffic Control

Completely different approaches are taken by the two methods. The HERS method assumes that no traffic control is present while the NCHRP 825 method includes delay at intersections if they are present. The HERS procedure calculates two-way capacity while the NCHRP method uses one-way capacity and assigns a fixed value, either 1,450 or 1,490 vehicles per hour, but capacity is not used in the calculation of LOS—it is only used to create a  $v/c$  ratio for screening. Because of this difference, no tests were made. The HERS method is quite complex, accounting for grades, heavy vehicles, peak-hour factor, and percent no passing zones. The NCHRP 825 approach is simpler for capacity, but the calculation of speed and associated LOS basically follows the same method as for the capacity calculation in HERS. This is because capacity is “backcalculated” in the HERS method so that the HERS speed equations, which are based on the AADT-to-capacity ratio, can be used. In the NCHRP 825 method, capacity is largely irrelevant for two-lane highway LOS as it is based on average travel speed or percent of time following. ***Because it is more closely tied to HCM methods for the calculation of average travel speed (the basis for LOS), we recommend the NCHRP 825 method for capacity (one-way) and LOS calculations. That is, the one-way capacity is set at 1,490 vehicles per hour.***

### Stop-Controlled Highways

Very different capacity calculations are used in the HCM 2010 depending on whether an intersection has two-way stop control or all-way stop control. Unfortunately, it is impossible to distinguish the two conditions with HPMS data. Both HERS and NCHRP 825 procedures are complex and highly dependent on turning movements on all the approaches. The HERS procedure is based on the HCM 2000 procedure for two-way stop-controlled intersections. It is data intensive and makes many assumptions about turning movements based on the presence of turning lanes. In contrast, the NCHRP 825 procedure uses the highly simplified adaptation of the HCM procedure for all-way stop control and a more complex procedure for two-way stop control which is based on the update to the HCM 2010. For this reason, we did not run any comparisons between the two methods. ***Because, the two-way stop control procedures in NCHRP 825 is***



***based on the recently updated version of the HCM 2010, we recommend that the NCHRP 825 procedure be used for capacity and LOS calculations. In doing so, it is assumed that all stop control is two-way.***

$$\begin{aligned} \text{Capacity} &= 1,200 \text{ vehicles/hour; where HPMS data item } 10 = 1 \\ &= 1,500 \text{ vehicles/hour otherwise} \end{aligned}$$

Figure 6. Equation. Calculation of capacity for stop-controlled highways.

## **UPDATE CAPACITY PROCEDURES BASED ON NEW HIGHWAY CAPACITY MANUAL EDITION**

The Major Update to the HCM 2010 has been released. We reviewed the new procedures against the HERS capacity procedures and found no changes in the way capacity is calculated except for two-way stop-controlled intersections. The NCHRP 825 method is consistent with the new HCM as the researchers had access to the draft chapters. Therefore, the recommendations made above are not changed.



## **CHAPTER 3. BACKGROUND DEVELOP SIMPLIFIED METHODOLOGIES TO CREATE GENERALIZED LEVEL OF SERVICE (LOS) LOOKUP TABLES**

### **BACKGROUND**

This report documents the work performed on Task 3: Develop Simplified Methodologies to Create Generalized Level of Service (LOS) Lookup Tables. At the kickoff meeting it was decided that a stand-alone tool would be built that can interface directly with Highway Performance Monitoring System (HPMS) data. Based on the task 2 assessment, the **National Cooperative Highway Research Program (NCHRP) Report 825** version of the Highway Capacity Manual (HCM) procedures for calculating LOS has been programmed into this tool.<sup>3</sup> The advantage is that all relevant HPMS data elements could be used. Also, updating would be much easier—all that is required is to change the procedure rather than regenerate the massive lookup table that otherwise would have been created. In addition to the LOS designation for an HPMS section, the actual value of the service measure on which LOS is based will also be reported. It also was decided that generalized service volume tables for each facility would be produced, accounting for all of the nondefault factors that are covered by the NCHRP 825 methodology.

The types of facilities that are included in the analysis are as follows. These follow the facility types covered by the HCM:

- Freeways.
- Multilane highways.
- Rural two-lane highways.
- Signalized highways.
- Stop-controlled highways.

HPMS sections can be grouped into these categories based on their data elements. A hierarchy is used to make these assignments:

- If functional system is one or two, and full access control exists, then the section is a freeway.
- If stop signs exist, then the section is stop controlled.
- If signals exist, then the section is signalized.
- If through lanes are greater than or equal to four, the section is multilane.
- If through lanes are equal to two or three and the urban code indicates rural, the section is rural two lane.

However, a significant number of HPMS Sample Panel sections (about 30,000) cannot be classified using the above scheme. These tend to be two-, three-lane urban highways with no traffic control device on the actual section. Level of Service was not calculated for these

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<sup>3</sup> Dowling, Richard et al., *Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual*, NCHRP Report 825, 2016, <http://www.trb.org/NCHRP/Blurbs/174958.aspx>.

sections. One option for these sections is to treat them as signalized highways with 100 percent green time, but this results in a vast majority in LOS A, which is most likely misleading. Therefore, Level of Service was not calculated for these sections.

## **DEFAULT VALUES**

For freeways and multilane highways, the NCHRP 825 method is followed directly and all of the required data elements are present in the HPMS Sample Panel. For signalized highways, the only data element not present in HPMS is cycle length. The following cycle lengths are assumed:

- **Principal arterials**—120 seconds.
- **Minor arterials**—90 seconds.
- **Collectors**—60 seconds.

For rural two-lane highways, LOS is based on average travel speed (ATS). A greatly simplified method was used for stop-controlled highways because so much of the required data on turning movements and cross-street volumes do not exist in HPMS:

- It is assumed that the section is two-way stop controlled.
- Conflicting flow rates are based on the values in table 2.

Table 2. Conflicting flow rates for two-way stop-controlled highways—vehicles per hour.

<b>Land Use</b>	<b>Functional System</b>		
	<b>Principal Arterial</b>	<b>Minor Arterial</b>	<b>Collector</b>
Rural	100	150	200
Urban	250	500	750

Preliminary analysis of the 2014 HPMS Sample Panel revealed that many data items used to undertake the LOS calculations were missing. As a result, the project team developed default values for the required data items. These were calculated as the median value for records where the data items were present (table 3).

## **RESULTS**

Tables 4 and 5 present the results of applying the HCM-based LOS calculation procedures to the 2014 HPMS Sample Panel data. Tables 6 through 10 show the individual HPMS sections with LOS and service measure attached for each highway type; a separate spreadsheet contains the entire dataset. Tables 11 and 12 provide the LOS ranges for each highway type from the HCM.

Generalized service volume tables are provided in the appendix.

Table 3. Default values for level of service calculation.

HPMS Data Item	Freeways		Multilane		Signalized	Rural Two Lane
	Urban	Rural	Urban	Rural		
LANE_WIDTH	12	12	12	12	11	12
SHOULDER_WIDTH_R	10	10	10	10		5
AADT_SINGLE_UNIT	=AADT*0.034	=AADT*0.043	=AADT*0.038	=AADT*0.043		=AADT*0.051
AADT_COMBINATION	=AADT*0.060	=AADT*0.193	=AADT*0.035	=AADT*0.082		=AADT*0.048
K_FACTOR	10	9	10	10	10	11
D_FACTOR	55	55	59	57	57	57
MEDIAN_TYPE			3	2		
SPEED_LIMIT			55	65	40	55
PCT_GREEN_TIME					50	
SIGNAL_TYPE					2	
TERRAIN_TYPE	1	2	1	2		2

Table 4. Level of service for 2014 highway performance monitoring system sample panel—rural sections.

Area Type	Highway Type	Level of Service	No. Sections	Mileage	% of Mileage
Rural	Freeway	A	3,561	18,209	56.3%
Rural	Freeway	B	2,148	8,711	26.9%
Rural	Freeway	C	687	3,402	10.5%
Rural	Freeway	D	270	1,407	4.4%
Rural	Freeway	E	78	343	1.1%
Rural	Freeway	F	88	265	0.8%
<b>Rural</b>	<b>Freeway</b>	<b>A-F Total</b>	<b>6,832</b>	<b>32,336</b>	<b>100.0%</b>
Rural	Multilane	A	2,624	30,015	89.7%
Rural	Multilane	B	478	2,647	7.9%
Rural	Multilane	C	131	616	1.8%
Rural	Multilane	D	43	91	0.3%
Rural	Multilane	E	13	42	0.1%
Rural	Multilane	F	12	47	0.1%
<b>Rural</b>	<b>Multilane</b>	<b>A-F Total</b>	<b>3,301</b>	<b>33,459</b>	<b>100.0%</b>
Rural	Rural Two Lane	A	9,559	374,043	77.9%
Rural	Rural Two Lane	B	1,679	33,692	7.0%
Rural	Rural Two Lane	C	1,323	28,683	6.0%
Rural	Rural Two Lane	D	888	18,033	3.8%
Rural	Rural Two Lane	E	1,808	23,353	4.9%
Rural	Rural Two Lane	F	182	2,333	0.5%
<b>Rural</b>	<b>Rural Two Lane</b>	<b>A-F Total</b>	<b>15,439</b>	<b>480,137</b>	<b>100.0%</b>
Rural	Signalized	A	442	6,921	87.7%
Rural	Signalized	B	101	566	7.2%
Rural	Signalized	C	81	277	3.5%
Rural	Signalized	D	23	30	0.4%
Rural	Signalized	E	15	24	0.3%
Rural	Signalized	F	40	76	1.0%
<b>Rural</b>	<b>Signalized</b>	<b>A-F Total</b>	<b>702</b>	<b>7,894</b>	<b>100.0%</b>
Rural	Stop Controlled	A	100	1,334	1.0%
Rural	Stop Controlled	B	2,022	127,671	97.6%
Rural	Stop Controlled	C	62	1,359	1.0%
Rural	Stop Controlled	D	10	138	0.1%
Rural	Stop Controlled	E	6	177	0.1%
Rural	Stop Controlled	F	15	74	0.1%
<b>Rural</b>	<b>Stop Controlled</b>	<b>A-F Total</b>	<b>2,215</b>	<b>130,754</b>	<b>100.0%</b>

Note: Mileage is the expanded mileage—section length times the HPMS expansion factor.

Table 5. Level of service for 2014 highway performance monitoring system sample panel—urban sections.

Area Type	Highway Type	Level of Service	No. Sections	Mileage	% of Mileage
Urban	Freeway	A	3,507	6,338	21.7%
Urban	Freeway	B	3,631	6,465	22.2%
Urban	Freeway	C	3,170	6,445	22.1%
Urban	Freeway	D	2,130	4,397	15.1%
Urban	Freeway	E	975	2,107	7.2%
Urban	Freeway	F	1,695	3,414	11.7%
<b>Urban</b>	<b>Freeway</b>	<b>A-F Total</b>	<b>15,108</b>	<b>29,166</b>	<b>100.0%</b>
Urban	Multilane	A	5,774	18,605	56.9%
Urban	Multilane	B	2,875	8,616	26.4%
Urban	Multilane	C	1,393	3,632	11.1%
Urban	Multilane	D	508	1,264	3.9%
Urban	Multilane	E	195	304	0.9%
Urban	Multilane	F	147	273	0.8%
<b>Urban</b>	<b>Multilane</b>	<b>A-F Total</b>	<b>10,892</b>	<b>32,695</b>	<b>100.0%</b>
Urban	Signalized	A	8,759	57,615	56.3%
Urban	Signalized	B	5,495	20,887	20.4%
Urban	Signalized	C	4,558	11,602	11.3%
Urban	Signalized	D	2,061	4,083	4.0%
Urban	Signalized	E	1,336	2,525	2.5%
Urban	Signalized	F	2,918	5,571	5.4%
<b>Urban</b>	<b>Signalized</b>	<b>A-F Total</b>	<b>25,127</b>	<b>102,284</b>	<b>100.0%</b>
Urban	Stop Controlled	B	1,643	3,358	5.5%
Urban	Stop Controlled	C	7,525	34,253	55.6%
Urban	Stop Controlled	D	1,234	8,657	14.1%
Urban	Stop Controlled	E	559	3,682	6.0%
Urban	Stop Controlled	F	1,839	11,611	18.9%
<b>Urban</b>	<b>Stop Controlled</b>	<b>A-F Total</b>	<b>12,800</b>	<b>61,560</b>	<b>100.0%</b>

Table 6. Selected highway performance monitoring system freeway sections with level of service and service measures attached.

Highway Type	State Code	Functional System	Route Signing	Route Number	Begin Point	End Point	County Code	Level of Service	Service Measure	Service Measure Value	Expanded Mileage
Freeway	1	1	2	65	182.47	183.53	1	C	Density	21.8	3.61
Freeway	1	1	2	10	29.07	29.073	3	E	Density	44.4	0.00
Freeway	1	1	2	10	29.073	30.258	3	F	Density	51.1	1.26
Freeway	1	1	2	10	30.258	32.77	3	F	Density	58.1	2.68
Freeway	1	1	2	10	32.77	34.5	3	F	Density	58.1	1.84
Freeway	1	1	2	10	34.5	34.98	3	F	Density	58.1	0.51
Freeway	1	1	2	10	34.984	35.181	3	F	Density	49.8	0.20
Freeway	1	1	2	10	35.181	38.775	3	E	Density	38.6	3.60
Freeway	1	1	2	10	38.775	41.3	3	C	Density	18.5	2.53
Freeway	1	1	2	10	41.3	44.31	3	C	Density	18.5	3.01
Freeway	1	1	2	10	44.32	44.89	3	B	Density	13.8	0.57
Freeway	1	1	2	10	44.89	44.899	3	B	Density	13.8	0.01
Freeway	1	1	2	10	58.56	66.29	3	C	Density	19.9	36.99
Freeway	1	1	2	65	32.21	34.07	3	C	Density	21.4	8.90
Freeway	1	1	2	65	34.092	37.77	3	A	Density	9.8	4.70
Freeway	1	1	2	65	37.77	37.88	3	A	Density	7.8	0.14
Freeway	1	1	2	65	107.5	111.81	13	B	Density	12.5	20.62
Freeway	1	1	2	65	120.25	123.87	13	B	Density	13.6	17.32
Freeway	1	1	2	65	126.09	126.44	13	B	Density	13.3	0.52
Freeway	1	1	2	65	128.12	129.66	13	B	Density	12.7	2.29
Freeway	1	1	2	65	130.2	131.11	13	B	Density	15.1	1.36
Freeway	1	1	2	65	131.81	133.93	13	B	Density	15.5	10.14
Freeway	1	1	2	65	135.21	139.6	13	B	Density	15.5	21.01



Table 7. Selected highway performance monitoring system multilane sections with level of service and service measures attached.

Highway Type	State Code	Functional System	Route Signing	Route Number	Begin Point	End Point	County Code	Level of Service	Service Measure	Service Measure Value	Expanded Mileage
Multilane	6	2		20	14.869	15.231	13	B	Density	17.1	4.34
Multilane	6	2		20	14.869	15.231	13	B	Density	17.1	0.94
Multilane	6	2		20	144.831	144.962	13	B	Density	17.1	0.18
Multilane	6	2		20	144.831	144.962	13	B	Density	17.1	1.57
Multilane	6	2		20	144.831	144.962	13	B	Density	17.1	0.34
Multilane	6	2		20	14.958	15.14	13	B	Density	17.1	0.25
Multilane	6	2		20	14.958	15.14	13	B	Density	17.1	2.18
Multilane	6	2		20	14.958	15.14	13	B	Density	17.1	0.47
Multilane	6	2		50	16.374	16.49	17	C	Density	24.0	0.31
Multilane	6	2		50	16.374	16.49	17	C	Density	24.0	0.13
Multilane	6	2		50	45.959	46.059	17	D	Density	32.7	0.25
Multilane	6	2		50	49.066	49.31	17	C	Density	24.0	0.65
Multilane	6	2		50	49.066	49.31	17	C	Density	24.0	0.28
Multilane	6	2		101	706.865	707.463	23	C	Density	21.9	1.51
Multilane	6	2		111	1.04	1.048	25	B	Density	17.7	0.01
Multilane	6	2		111	1.048	2.076	25	C	Density	19.5	1.03
Multilane	6	2		111	2.076	2.56	25	C	Density	19.0	0.51
Multilane	6	2		111	2.076	2.56	25	C	Density	19.0	0.48
Multilane	6	2		111	11.7	11.708	25	C	Density	19.0	0.01
Multilane	6	2		111	11.7	11.708	25	C	Density	19.0	0.01
Multilane	6	2		33	89.04	89.491	29	A	Density	5.5	1.75

Table 8. Selected highway performance monitoring system rural two-lane sections with level of service and service measures attached.

Highway Type	State Code	Functional System	Route Signing	Route Number	Begin Point	End Point	County Code	Level of Service	Service Measure	Service Measure Value	Expanded Mileage
Rural two lane	29	3	3	59	90.64	96.586	21	A	ATS	66.0	28.53
Rural two lane	29	3	3	59	96.586	99.204	21	A	ATS	66.0	12.56
Rural two lane	29	3	3	59	99.204	101.211	21	A	ATS	66.0	9.63
Rural two lane	29	3	4	53	3.078	9.02	23	A	ATS	59.0	18.99
Rural two lane	29	3	3	54	88.448	93.976	29	A	ATS	66.0	17.67
Rural two lane	29	3	3	54	93.976	97.224	29	A	ATS	64.0	15.58
Rural two lane	29	3	3	54	104.956	107.78	29	A	ATS	67.0	9.84
Rural two lane	29	3	4	72	157.529	161.565	31	A	ATS	61.0	12.90
Rural two lane	29	3	3	24	85.633	87.797	33	A	ATS	61.0	3.88
Rural two lane	29	3	4	21	147.476	148.761	35	A	ATS	61.0	2.31
Rural two lane	29	3	4	291	40.983	43.001	37	B	ATS	54.0	9.68
Rural two lane	29	3	3	54	40.832	44.162	39	A	ATS	67.0	5.97
Rural two lane	29	3	3	24	107.134	109.726	41	A	ATS	67.0	8.28

Table 8. Selected highway performance monitoring system rural two-lane sections with level of service and service measures attached (continuation).

Highway Type	State Code	Functional System	Route Signing	Route Number	Begin Point	End Point	County Code	Level of Service	Service Measure	Service Measure Value	Expanded Mileage
Rural two lane	29	3	3	60	65.175	66.136	43	A	ATS	63.0	3.35
Rural two lane	29	3	3	61	0	2.413	45	A	ATS	62.0	7.71
Rural two lane	29	3	4	92	22.623	26.498	47	B	ATS	55.0	12.38
Rural two lane	29	3	4	8	4.782	14.947	55	A	ATS	61.0	18.24
Rural two lane	29	3	4	8	19.762	22.989	55	A	ATS	59.0	10.31
Rural two lane	29	3	4	8	23.454	33.377	55	A	ATS	61.0	31.71
Rural two lane	29	3	3	65	213.933	215.239	59	A	ATS	66.0	4.17
Rural two lane	29	3	4	6	47.655	51.941	61	A	ATS	66.0	13.70

Table 9. Selected highway performance monitoring system signalized sections with level of service and service measures attached.

Highway Type	State Code	Functional System	Route Signing	Route Number	Begin Point	End Point	County Code	Level of Service	Service Measure	Service Measure Value	Expanded Mileage
Signalized	5	3	4	22	2.56	3.2	131	C	ATS	25.6	4.88
Signalized	5	3	4	22	3.2	3.58	131	A	ATS	35.7	2.90
Signalized	5	3	4	22	8.91	10.64	131	A	ATS	45.9	10.63
Signalized	5	3	3	71	3.91	4.92	131	A	ATS	41.2	7.70
Signalized	5	3	6		0	1.88	131	A	ATS	36.7	11.55
Signalized	5	3	6		0	1.88	131	A	ATS	36.7	11.55
Signalized	5	3	6		0	1.88	131	A	ATS	36.7	11.55
Signalized	5	3	6		0	1.88	131	A	ATS	36.7	11.55
Signalized	5	3	3	71	12.47	13.34	133	A	ATS	44.3	3.62
Signalized	8	3	10		1.009	1.989	1	B	ATS	39.0	7.14
Signalized	8	3	10		0	0.48	1	D	ATS	18.0	3.50
Signalized	8	3	10		1.06	2.08	1	A	ATS	43.6	7.43
Signalized	8	3	10		2.08	4.19	1	B	ATS	39.2	6.30
Signalized	8	3	4	2	3.039	4.401	1	B	ATS	43.5	9.92
Signalized	8	3	10		2.32	3.38	1	A	ATS	42.5	16.90
Signalized	8	3	4	44	0.435	1.807	1	F	ATS	13.8	10.00
Signalized	8	3	4	44	0.435	1.807	1	F	ATS	13.8	10.00
Signalized	8	3	3	160	229.351	230.428	3	C	ATS	36.7	7.62
Signalized	8	3	10		7.82	8.83	5	B	ATS	32.9	16.11
Signalized	8	3	10		0	1.11	5	D	ATS	22.5	17.70
Signalized	8	3	10		2.1	3.1	5	B	ATS	32.2	15.95

Table 10. Selected highway performance monitoring system stop-controlled sections with level of service and service measures attached.

Highway Type	State Code	Functional System	Route Signing	Route Number	Begin Point	End Point	County Code	Level of Service	Service Measure	Service Measure Value	Expanded Mileage
Stop Control	1	5	1	1046	0.12	0.83	33	C	Delay	16.0	1.22
Stop Control	1	5	1	1386	0.294	1.12	33	C	Delay	16.0	1.41
Stop Control	1	5	6	30	5.335	7.2	35	B	Delay	10.2	75.01
Stop Control	1	5	6	85	1.368	6.63	37	B	Delay	10.3	211.63
Stop Control	1	5	6	101	0	1.55	39	C	Delay	16.0	9.61
Stop Control	1	5	6	687	0.07	0.71	39	C	Delay	15.9	3.97
Stop Control	1	5	6	19	0	1.52	39	C	Delay	16.1	9.42
Stop Control	1	5	6	36	7.41	8.17	43	C	Delay	17.3	15.85
Stop Control	1	5	6	11	1.84	6.67	45	B	Delay	10.3	194.25
Stop Control	1	5	6	50	1.534	3.38	45	C	Delay	17.9	38.50
Stop Control	1	5	6	375	0.104	0.69	45	C	Delay	16.3	0.96
Stop Control	1	5	6	377	0	0.31	45	C	Delay	15.7	0.51
Stop Control	1	5	6	23	4.5	7.24	51	C	Delay	17.2	10.80
Stop Control	1	5	6	1	10.858	17	53	B	Delay	10.3	247.02

Table 10. Selected highway performance monitoring system stop-controlled sections with level of service and service measures attached (continuation).

Highway Type	State Code	Functional System	Route Signing	Route Number	Begin Point	End Point	County Code	Level of Service	Service Measure	Service Measure Value	Expanded Mileage
Stop Control	1	5	6	49	1.132	1.46	53	D	Delay	25.8	20.19
Stop Control	1	5	6	5039	0.9	1.5	53	C	Delay	20.1	12.51
Stop Control	1	5	6	15	0	1.43	55	C	Delay	20.2	9.01
Stop Control	1	5	6	185	0	1.86	55	C	Delay	18.2	11.72
Stop Control	1	5	6	185	1.869	2.65	55	C	Delay	18.6	4.92
Stop Control	1	5	1	419	4.238	4.97	55	C	Delay	18.7	4.61
Stop Control	1	5	1	810	0	0.88	55	C	Delay	16.3	1.20

Table 11. Level of service ranges by highway type.

Service Measure	Freeway	Multilane	Rural Two Lane	Stop Controlled
	Density	Density	Average Travel Speed (ATS)	Delay
Level of Service A	<= 11	<= 11	> 55	<= 10
Level of Service B	> 11-18	> 11-18	> 50-55	> 10-15
Level of Service C	> 18-26	> 18-26	> 45-50	> 15-25
Level of Service D	> 26-35	> 26-35	> 40-45	> 25-35
Level of Service E	> 35-45	> 35-45	<= 40	> 35-50
Level of Service F	> 45 or where demand > capacity	> 45 or where demand > capacity	Demand > capacity	> 50

Notes: Density is measured as passenger cars per mile, per lane. ATS is measured as miles per hour. Delay is measured in seconds per vehicle.

Table 12. Level of service ranges for signalized highways.

Base-Free Flow Speed	Average Travel Speed					
	Level of Service A	Level of Service B	Level of Service C	Level of Service D	Level of Service E	Level of Service F
>= 55	> 44	> 37	> 28	> 22	> 17	<= 17
50	> 40	> 34	> 25	> 20	> 15	<= 15
45	> 36	> 30	> 23	> 18	> 14	<= 14
40	> 32	> 27	> 20	> 16	> 12	<= 12
35	> 28	> 23	> 18	> 14	> 11	<= 11
30	> 24	> 20	> 15	> 12	> 9	<= 9
<= 25	>20	> 17	> 13	> 10	> 8	<= 8





## APPENDIX A. GENERALIZED SERVICE VOLUME TABLES

The service volumes in the tables are the maximum values that can be maintained and still be within the Level of Service (LOS) range. For example in the first row of the freeway table, if the actual volume is less than or equal to 46,100, then it is LOS B. Therefore, the service volumes in the tables are the **maximum** volumes that can be achieved for that LOS category.

For roadways that are dual carriageways, AADT should be divided by two before entering the tables.

Table 13. Freeway generalized service volume table.

Area Type	Number Lanes	Truck Percent	Level of Service			
			B Service Volume	C Service Volume	D Service Volume	E Service Volume
Rural						
	4	0	46,100	62,000	74,800	84,700
		10	43,900	59,000	71,200	80,700
		20	41,900	56,300	68,000	77,000
		30	40,100	53,900	65,000	73,700
	6	0	69,200	93,000	112,200	127,100
		10	65,900	88,500	106,900	121,100
		20	62,900	84,500	102,000	115,600
		30	60,100	80,800	97,600	110,500
	8	0	92,200	124,000	149,600	169,500
		10	87,800	118,100	142,500	161,400
		20	83,800	112,700	136,000	154,100
		30	80,200	107,800	130,100	147,400
	10	0	115,300	155,000	187,100	211,900
		10	109,800	147,600	178,100	201,800
		20	104,800	140,900	170,000	192,600
		30	100,300	134,800	162,600	184,200
	12	0	138,400	186,000	224,500	254,300
		10	131,800	177,100	213,800	242,200
		20	125,800	169,100	204,100	231,200
		30	120,300	161,700	195,200	221,100

Table 13. Freeway generalized service volume table (continuation).

Area Type	Number Lanes	Truck Percent	Level of Service			
			B Service Volume	C Service Volume	D Service Volume	E Service Volume
<b>Urban</b>						
	4	0	43,700	60,100	73,100	83,000
		10	41,600	57,200	69,600	79,100
		20	39,700	54,600	66,400	75,500
		30	38,000	52,200	63,600	72,200
	6	0	65,600	90,100	109,700	124,600
		10	62,500	85,800	104,400	118,600
		20	59,600	81,900	99,700	113,200
		30	57,000	78,300	95,400	108,300
	8	0	87,500	120,200	146,200	166,100
		10	83,300	114,400	139,300	158,200
		20	79,500	109,200	132,900	151,000
		30	76,100	104,500	127,200	144,400
	10	0	109,400	150,200	182,800	207,600
		10	104,200	143,100	174,100	197,700
		20	99,400	136,600	166,200	188,700
		30	95,100	130,600	159,000	180,500
	12	0	131,300	180,300	219,400	249,200
		10	125,000	171,700	208,900	237,300
		20	119,300	163,900	199,400	226,500
		30	114,100	156,700	190,800	216,700

Table 14. Multilane highway generalized service volume table.

Area Type	Number Lanes	Truck Percent	Level of Service			
			B Service Volume	C Service Volume	D Service Volume	E Service Volume
<b>Rural</b>						
	4	0	42,000	57,300	69,600	80,000
		10	39,900	54,600	66,300	76,100
		20	38,100	52,100	63,300	72,700
		30	36,500	49,900	60,600	69,500
	6	0	63,000	86,000	104,500	120,000
		10	59,900	81,900	99,500	114,200
		20	57,200	78,200	95,000	109,000
		30	54,700	74,800	90,900	104,300
	8	0	84,000	114,700	139,300	160,000
		10	79,900	109,300	132,700	152,300
		20	76,300	104,300	126,700	145,400
		30	73,000	99,800	121,200	139,100
	10	0	105,000	143,400	174,200	200,000
		10	99,900	136,600	165,900	190,400
		20	95,400	130,400	158,300	181,800
		30	91,300	124,700	151,500	173,900
<b>Urban</b>						
	4	0	34,500	49,300	61,400	71,600
		10	32,800	47,000	58,400	68,200
		20	31,300	44,800	55,800	65,100
		30	30,000	42,900	53,300	62,300
	6	0	51,700	74,000	92,100	107,500
		10	49,200	70,500	87,700	102,300
		20	47,000	67,300	83,700	97,700
		30	45,000	64,400	80,000	93,400
	8	0	69,000	98,700	122,800	143,300
		10	65,700	94,000	116,900	136,500
		20	62,700	89,700	111,600	130,300
		30	60,000	85,800	106,700	124,600
	10	0	86,200	123,400	153,500	179,100
		10	82,100	117,500	146,200	170,600
		20	78,400	112,200	139,500	162,800
		30	75,000	107,300	133,400	155,700

Table 15. Signalized highway generalized service volume table.

Number Lanes	% Green Time	Speed Limit	Level of Service			
			B Service Volume	C Service Volume	D Service Volume	E Service Volume
2	40	35	12,800	14,900	16,400	18,700
		40	12,600	14,400	15,900	17,700
		45	12,000	14,200	15,500	17,400
		50	11,800	13,800	15,200	16,700
		55	12,300	14,100	15,400	16,900
		60	12,700	14,300	15,500	17,100
	45	35	14,600	16,900	18,500	21,100
		40	14,400	16,300	18,000	20,000
		45	13,900	16,100	17,600	19,700
		50	13,600	15,700	17,200	18,900
		55	14,200	16,000	17,400	19,100
		60	14,600	16,200	17,600	19,300
	50	35	16,500	18,900	20,700	23,600
		40	16,300	18,300	20,100	22,300
		45	15,700	18,100	19,600	22,000
		50	15,500	17,700	19,200	21,100
		55	16,100	17,900	19,500	21,400
		60	16,400	18,100	19,600	21,500
	55	35	18,400	20,900	22,900	26,000
		40	18,100	20,300	22,200	24,700
		45	17,600	20,000	21,700	24,300
		50	17,400	19,600	21,300	23,400
		55	17,900	19,900	21,500	23,600
		60	18,300	20,100	21,700	23,800
60	35	20,300	22,900	25,100	28,500	
	40	20,000	22,200	24,400	27,000	
	45	19,500	22,000	23,800	26,600	
	50	19,300	21,500	23,300	25,600	
	55	19,800	21,800	23,600	25,800	
	60	20,200	22,100	23,800	26,100	

Table 15. Signalized highway generalized service volume table (continuation).

Number Lanes	% Green Time	Speed Limit	Level of Service			
			B Service Volume	C Service Volume	D Service Volume	E Service Volume
2	65	35	22,200	25,000	27,300	31,000
		40	21,900	24,200	26,500	29,400
		45	21,400	24,000	25,900	28,900
		50	21,200	23,500	25,400	27,800
		55	21,700	23,800	25,700	28,100
		60	22,100	24,000	25,900	28,300
	70	35	24,100	27,000	29,500	33,500
		40	23,800	26,200	28,700	31,700
		45	23,300	26,000	28,000	31,200
		50	23,100	25,400	27,500	30,100
		55	23,600	25,800	27,800	30,400
		60	24,000	26,000	28,000	30,600
	75	35	26,000	29,100	31,700	36,000
		40	25,700	28,200	30,800	34,100
		45	25,200	28,000	30,100	33,600
		50	25,000	27,400	29,600	32,300
		55	25,500	27,700	29,900	32,700
		60	25,900	28,000	30,100	32,900
	80	35	27,900	31,100	33,900	38,500
		40	27,600	30,300	33,000	36,500
		45	27,100	30,000	32,300	35,900
		50	26,900	29,400	31,700	34,600
		55	27,400	29,700	32,000	35,000
		60	27,800	30,000	32,300	35,200
4	40	35	27,400	30,600	33,300	37,800
		40	27,100	29,700	32,400	35,900
		45	26,500	29,400	31,700	35,300
		50	26,200	28,800	31,100	34,000
		55	26,800	29,200	31,400	34,300
		60	27,300	29,500	31,700	34,600

Table 15. Signalized highway generalized service volume table (continuation).

Number Lanes	% Green Time	Speed Limit	Level of Service			
			B Service Volume	C Service Volume	D Service Volume	E Service Volume
4	45	35	31,100	34,500	37,600	42,700
		40	30,700	33,600	36,600	40,500
		45	30,100	33,300	35,800	39,900
		50	29,800	32,600	35,100	38,400
		55	30,500	33,000	35,500	38,800
		60	30,900	33,400	35,800	39,100
	50	35	34,700	38,500	41,900	47,600
		40	34,400	37,500	40,800	45,100
		45	33,700	37,100	39,900	44,400
		50	33,500	36,400	39,200	42,800
		55	34,100	36,900	39,600	43,200
		60	34,600	37,200	39,900	43,600
	55	35	38,400	42,600	46,300	52,500
		40	38,100	41,400	45,100	49,800
		45	37,400	41,000	44,100	49,000
		50	37,100	40,200	43,200	47,200
		55	37,800	40,700	43,700	47,700
		60	38,300	41,100	44,100	48,100
	60	35	42,100	46,600	50,700	57,400
		40	41,800	45,400	49,300	54,400
		45	41,100	44,900	48,200	53,600
		50	40,800	44,100	47,300	51,700
		55	41,500	44,600	47,800	52,200
		60	42,000	45,000	48,300	52,600
65	35	45,900	50,700	55,100	62,300	
	40	45,500	49,300	53,600	59,200	
	45	44,800	48,900	52,400	58,300	
	50	44,500	48,000	51,500	56,200	
	55	45,200	48,500	52,000	56,700	
	60	45,700	49,000	52,400	57,100	

Table 15. Signalized highway generalized service volume table (continuation).

Number Lanes	% Green Time	Speed Limit	Level of Service			
			B Service Volume	C Service Volume	D Service Volume	E Service Volume
4	70	35	49,600	54,700	59,500	67,300
		40	49,200	53,300	57,900	63,900
		45	48,500	52,800	56,600	62,900
		50	48,200	51,900	55,600	60,700
		55	48,900	52,400	56,200	61,200
		60	49,500	52,900	56,700	61,700
	75	35	53,400	58,800	63,900	72,300
		40	53,000	57,300	62,200	68,600
		45	52,200	56,800	60,900	67,600
		50	51,900	55,800	59,800	65,200
		55	52,700	56,400	60,400	65,800
		60	53,200	56,900	60,900	66,300
	80	35	57,200	63,000	68,400	77,300
		40	56,800	61,300	66,600	73,400
		45	56,000	60,800	65,100	72,300
		50	55,700	59,700	64,000	69,700
		55	56,400	60,400	64,600	70,400
		60	57,000	60,900	65,200	70,900
6	40	35	41,700	46,100	50,200	56,900
		40	41,300	44,900	48,800	53,900
		45	40,600	44,400	47,700	53,100
		50	40,300	43,600	46,800	51,200
		55	41,000	44,100	47,300	51,700
		60	41,500	44,600	47,800	52,100
	45	35	47,100	52,000	56,600	64,100
		40	46,700	50,700	55,100	60,800
		45	46,000	50,200	53,900	59,900
		50	45,700	49,300	52,900	57,700
		55	46,400	49,800	53,400	58,300
		60	47,000	50,300	53,900	58,800

Table 15. Signalized highway generalized service volume table (continuation).

Number Lanes	% Green Time	Speed Limit	Level of Service			
			B Service Volume	C Service Volume	D Service Volume	E Service Volume
6	50	35	52,600	58,000	63,100	71,500
		40	52,200	56,500	61,400	67,800
		45	51,400	56,000	60,100	66,800
		50	51,100	55,000	59,000	64,400
		55	51,800	55,600	59,600	65,000
		60	52,400	56,100	60,100	65,500
	55	35	58,100	64,100	69,600	78,800
		40	57,700	62,400	67,800	74,800
		45	56,800	61,800	66,300	73,700
		50	56,500	60,700	65,100	71,000
		55	57,300	61,400	65,700	71,700
		60	57,900	62,000	66,300	72,200
	60	35	63,700	70,100	76,200	86,200
		40	63,200	68,300	74,100	81,800
		45	62,300	67,700	72,500	80,600
		50	62,000	66,500	71,200	77,700
		55	62,800	67,200	71,900	78,400
		60	63,500	67,800	72,600	79,000
	65	35	69,300	76,200	82,700	93,600
		40	68,800	74,200	80,600	88,900
		45	67,800	73,600	78,800	87,500
		50	67,400	72,200	77,400	84,400
		55	68,300	73,100	78,200	85,200
		60	69,000	73,700	78,900	85,900
70	35	74,900	82,300	89,400	101,100	
	40	74,300	80,200	87,000	95,900	
	45	73,300	79,500	85,100	94,500	
	50	72,900	78,100	83,600	91,100	
	55	73,900	78,900	84,500	92,000	
	60	74,700	79,700	85,200	92,700	



Table 15. Signalized highway generalized service volume table (continuation).

Number Lanes	% Green Time	Speed Limit	Level of Service			
			B Service Volume	C Service Volume	D Service Volume	E Service Volume
6	75	35	80,500	88,500	96,000	108,600
		40	80,000	86,200	93,500	103,100
		45	78,900	85,500	91,500	101,500
		50	78,500	83,900	89,900	97,900
		55	79,500	84,900	90,800	98,800
		60	80,300	85,700	91,600	99,600
	80	35	86,200	94,700	102,700	116,100
		40	85,600	92,300	100,000	110,200
		45	84,500	91,400	97,900	108,600
		50	84,100	89,800	96,100	104,700
		55	85,100	90,800	97,100	105,700
		60	86,000	91,700	97,900	106,500
8	40	35	55,800	61,600	67,000	75,900
		40	55,400	60,000	65,200	72,000
		45	54,500	59,400	63,700	70,900
		50	54,200	58,300	62,600	68,300
		55	55,000	59,000	63,200	69,000
		60	55,700	59,600	63,800	69,500
	45	35	63,100	69,500	75,600	85,600
		40	62,600	67,700	73,500	81,200
		45	61,700	67,100	71,900	80,000
		50	61,300	65,900	70,600	77,100
		55	62,200	66,600	71,300	77,800
		60	62,900	67,200	72,000	78,400
	50	35	70,400	77,500	84,200	95,300
		40	69,900	75,500	82,000	90,500
		45	68,900	74,800	80,200	89,100
		50	68,500	73,500	78,700	85,900
		55	69,400	74,300	79,500	86,700
		60	70,200	75,000	80,200	87,400

Table 15. Signalized highway generalized service volume table (continuation).

Number Lanes	% Green Time	Speed Limit	Level of Service			
			B Service Volume	C Service Volume	D Service Volume	E Service Volume
8	55	35	77,700	85,500	92,900	105,100
		40	77,200	83,300	90,400	99,800
		45	76,100	82,600	88,500	98,300
		50	75,700	81,100	86,900	94,700
		55	76,700	82,000	87,800	95,600
		60	77,500	82,700	88,500	96,400
	60	35	85,100	93,600	101,600	115,000
		40	84,500	91,200	99,000	109,100
		45	83,300	90,400	96,800	107,500
		50	82,900	88,800	95,100	103,600
		55	84,000	89,700	96,000	104,600
		60	84,900	90,600	96,900	105,400
	65	35	92,600	101,700	110,400	124,900
		40	91,900	99,100	107,500	118,500
		45	90,700	98,200	105,200	116,800
		50	90,200	96,500	103,300	112,600
		55	91,400	97,500	104,400	113,600
		60	92,300	98,400	105,200	114,500
	70	35	100,100	109,900	119,200	134,800
		40	99,300	107,100	116,100	128,000
		45	98,000	106,100	113,600	126,100
		50	97,600	104,200	111,600	121,600
		55	98,800	105,400	112,700	122,700
		60	99,800	106,400	113,700	123,700
75	35	107,600	118,100	128,100	144,800	
	40	106,800	115,100	124,800	137,500	
	45	105,400	114,100	122,100	135,500	
	50	104,900	112,100	119,900	130,600	
	55	106,200	113,300	121,100	131,900	
	60	107,300	114,300	122,200	132,900	
80	35	115,200	126,300	137,000	–	
	40	114,400	123,100	133,500	297,000	
	45	112,900	122,100	130,600	144,900	
	50	112,300	119,900	128,300	139,700	
	55	113,700	121,200	129,600	141,000	
	60	114,800	122,300	130,700	142,100	

Table 16. Stop sign-controlled highways generalized service volume table.

Land Use	Functional System	Level of Service			
		B Service Volume	C Service Volume	D Service Volume	E Service Volume
Rural	Princ. Arterial	7,600	11,100	12,400	13,600
	Minor Arterial	6,800	10,200	11,500	12,600
	Collector	5,900	9,300	10,600	11,700
Urban	Princ. Arterial	5,200	8,500	9,800	10,900
	Minor Arterial	1,900	5,200	6,400	7,400
	Collector		2,800	4,000	4,800

Table 17. Rural two-lane highways generalized service volume table.

Speed Limit	Terrain	Truck Pct.	Level of Service		
			B Service Volume	C Service Volume	D Service Volume
45	Flat	0	3,600	8,700	13,900
		2	3,500	8,700	13,900
		4	3,500	8,700	13,900
		6	3,500	8,700	13,900
		8	3,400	8,600	13,900
		10	3,400	8,600	13,900
	Rolling	0	3,600	8,700	13,900
		2	3,500	8,600	13,900
		4	3,400	8,500	13,900
		6	3,300	8,400	13,900
		8	3,300	8,200	13,900
		10	3,200	8,100	13,900
	Mountainous	0	3,600	8,700	13,900
		2	3,200	7,700	12,300
		4	2,800	7,000	11,100
		6	2,600	6,300	10,100
		8	2,400	5,800	9,300
		10	2,200	5,400	8,500
50	Flat	0	8,700	13,900	19,000
		2	8,700	13,900	19,000
		4	8,700	13,900	19,000

Table 17. Rural two-lane highways generalized service volume table (continuation).

Speed Limit	Terrain	Truck Pct.	Level of Service		
			B Service Volume	C Service Volume	D Service Volume
50	Flat	6	8,700	13,900	19,000
		8	8,600	13,900	19,000
		10	8,600	13,900	19,000
	Rolling	0	8,700	13,900	19,000
		2	8,600	13,900	19,000
		4	8,500	13,900	19,000
		6	8,400	13,900	19,000
		8	8,200	13,900	19,000
		10	8,100	13,900	19,000
		Mountainous	0	8,700	13,900
	2		7,700	12,300	16,900
	4		7,000	11,100	15,200
	6		6,300	10,100	13,900
	8		5,800	9,300	12,700
	10		5,400	8,500	11,700
55	Flat	0	13,900	19,000	24,200
		2	13,900	19,000	24,200
		4	13,900	19,000	24,200
		6	13,900	19,000	24,200
		8	13,900	19,000	24,200
		10	13,900	19,000	24,200
	Rolling	0	13,900	19,000	24,200
		2	13,900	19,000	24,200
		4	13,900	19,000	24,200
		6	13,900	19,000	24,200
		8	13,900	19,000	24,200
		10	13,900	19,000	24,200
	Mountainous	0	13,900	19,000	24,200
		2	12,300	16,900	21,500
		4	11,100	15,200	19,400
		6	10,100	13,900	17,600
		8	9,300	12,700	16,100
		10	8,500	11,700	14,900

Table 17. Rural two-lane highways generalized service volume table (continuation).

Speed Limit	Terrain	Truck Pct.	Level of Service		
			B Service Volume	C Service Volume	D Service Volume
60	Flat	0	19,000	24,200	29,300
		2	19,000	24,200	29,300
		4	19,000	24,200	29,300
		6	19,000	24,200	29,300
		8	19,000	24,200	29,300
		10	19,000	24,200	29,300
	Rolling	0	19,000	24,200	29,300
		2	19,000	24,200	29,300
		4	19,000	24,200	29,300
		6	19,000	24,200	29,300
		8	19,000	24,200	29,300
		10	19,000	24,200	29,300
	Mountainous	0	19,000	24,200	29,300
		2	16,900	21,500	26,100
		4	15,200	19,400	23,500
		6	13,900	17,600	21,400
		8	12,700	16,100	19,600
		10	11,700	14,900	18,100
65	Flat	0	24,200	29,300	34,500
		2	24,200	29,300	34,500
		4	24,200	29,300	34,500
		6	24,200	29,300	34,500
		8	24,200	29,300	34,500
		10	24,200	29,300	34,500
	Rolling	0	24,200	29,300	34,500
		2	24,200	29,300	34,500
		4	24,200	29,300	34,500
		6	24,200	29,300	34,500
		8	24,200	29,300	34,500
		10	24,200	29,300	34,500
	Mountainous	0	24,200	29,300	34,500
		2	21,500	26,100	30,700
		4	19,400	23,500	27,600
		6	17,600	21,400	25,100
		8	16,100	19,600	23,000
		10	14,900	18,100	21,300

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