Highway Performance Monitoring System

Field Implementation Manual

U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration
Program Management Division
January 1979

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter I

INTRODUCTION

Background

Over the past decade, biennial reports to the Congress have been prepared in response to Senate Joint Resolution 81 (SJR 81), Public Law 89-139, enacted in 1965. These reports were based on a variety of special national studies, the data bases for which ranged from already available data to varied and generally increasing levels of detail provided by the States that have become more demanding with each biennial study. Experience gained from these endeavors has produced a departure from the traditional means of estimating and reporting highway needs, to a new approach relating investment to highway performance. This performance-related investment concept was a result of the need to concentrate highway program investments in the areas of highest priority due to dwindling financial resources.

The Federal Highway Administration (FHWA) has been reevaluating its responsibilities with regard to maintaining up-to-date planning information and the parallel needs of national studies. It has been determined that appropriate improvements to the planning process must be made to make transportation planning as productive and cost-effective as possible. To accomplish this, changes must be made in the manner in which the data demands of future national studies are satisfied.

The Congress frequently includes in legislation requirements for various additional national studies concerning existing, new, or proposed programs. Many of these studies require the same basic information used for the biennial needs studies. To avoid the necessity of performing a separate national study for each of these requests for information at a specific point in time and to provide information for day-to-day planning activities, a system that allows for the continuous monitoring of a data base has been developed. This highway performance monitoring mechanism, when fully implemented, should drastically curtail special national study impacts on the State highway agencies (SHA's) by making available certain key highway elements on a continuing basis as part of the normal activities of the SHA. The concept of such a system is more fully described in the FHWA report titled "Highway Performance Monitoring System, Phase 1 Report," dated September 1978.

Purpose

The purpose of this Manual is twofold: To initiate the field work necessary to provide data for the HPMS and to provide data for the 1980 biennial report to the Congress. Inherent in the initiation of the HPMS is the establishment of a panel of sections that will comprise the base for future continuing performance monitoring. In addition, this panel of sections will be used to determine 1978 system condition

and performance that will then be compared with similar data presently available to the FHWA from the National Highway Inventory and Performance Study (NHIPS) conducted in 1976.

It is important to note that the gathering of data as outlined in this Manual constitutes the beginning of a continuing monitoring program in which all States are expected to actively participate. A merger of the Mileage Facilities Reporting System (MFRS) and the HPMS is expected to be the statistical data base for the FHWA's Office of Highway Planning. Current efforts reflected in this Manual represent initial coordination to accomplish this objective. A complete merger of these activities is expected to take place in the future.

Scope

The HPMS provides for the collection of rural, small urban area, and individual urbanized area data for each of the 50 States, the District of Columbia, and Puerto Rico. Three types of field data will be provided: Section specific data for a panel of sections, "typical" values from case studies, and areawide totals for control purposes (see Figure I-1). Section data (in the form of a panel of sections) will be obtained for sampled sections of the arterial and collector systems. While sampling has been used for several previous national studies, instructions in this Manual provide a statistically based framework that will result in documented precision levels at a smaller sample rate than previously required. When established, the panel of sections will be continually monitored over future years.

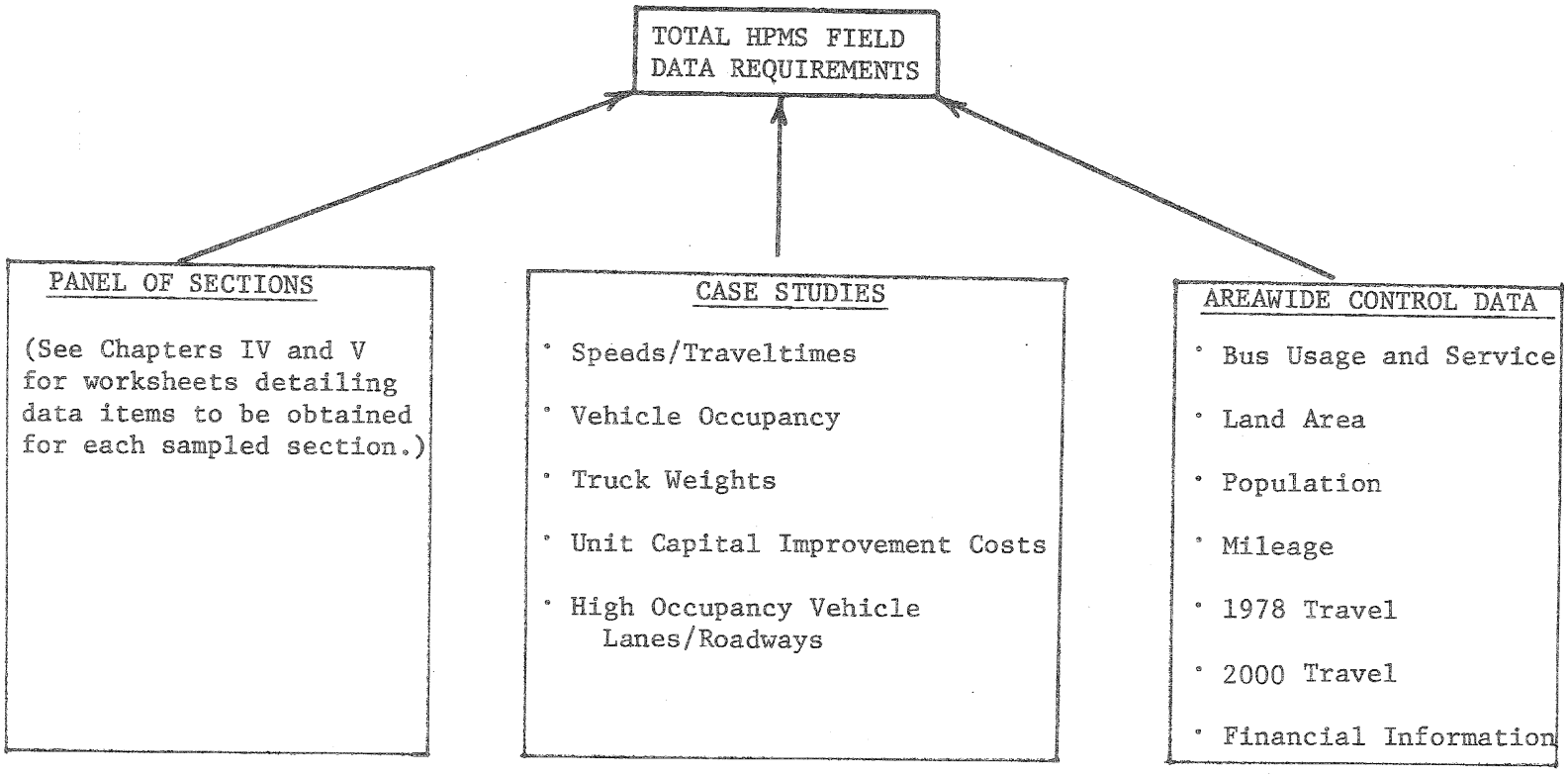
To supplement the data collected for the sampled sections, additional information will be obtained through case studies. (Case study instructions are not included in this Manual--some case studies will be initiated during 1979.) While the list of case studies is considered current, additional studies may become necessary as the HPMS is implemented. It is intended that the case studies will be distributed among the States in such a manner as to avoid a disproportionate workload by any State.

Areawide data will be reported for HPMS as general information for analytical purposes and as control total information for the expansion of sampled information. For example, mileage and travel by functional system will be reported. In addition, capital obligations data for 1976-78 will be collected and used in conjunction with data from the earlier studies to evaluate overall changes in the systems and to determine in general terms the systems and types of improvements on which the State and local governments are placing program emphasis.

Roles of Participants

The HPMS is intended to be a joint activity of the Federal, State, and local governments. The HPMS organization, guidance, and analyses

TYPES OF HPMS FIELD DATA[1/]



1/ A summary of HPMS data submittal requirements is contained in Appendix J.

Figure I-1

are the responsibility of the FHWA. Data preparation for the HPMS will be accomplished by the State highway agencies, together with the assistance and cooperation of local governmental units.

Federal Highway Administration Functions

The FHWA, Office of Highway Planning, is responsible for overall coordination of HPMS activities as well as for data synthesis, analysis modeling, and interpretation of results. In addition, Washington Office personnel will, to the extent possible, provide technical and field review assistance. The Office of Highway Planning will be responsible for the review of sampling plans when a State selects the Optional Theoretical Approach.

The major responsibility for guiding the States in the use and interpretation of this Manual is assigned to the Federal Highway Administration's region and division offices. Region office responsibilities shall include:

1. Interpretation of the guidelines to ensure maximum degree of consistency, coordination, and agreement among the States.

2. Periodic review of the data collection activities.

3. Supplying technical guidance when necessary.

4. Coordination and liaison with the Headquarters staff.

Division office responsibilities shall include:

1. Assisting in developing the data assembly design and schedule.

2. Early review and approval of methodologies such as sampling when the FHWA developed approach is used.

3. Continual review of the HPMS activities of the State and local governments to ensure conformity with this Manual.

4. Assuring that the schedule developed is maintained.

5. Advising the regional office when major problems occur or when significant departures from the schedule become evident.

The active participation of appropriate region and division office personnel is extremely important.

State Highway Agencies

The State highway agencies are responsible for the development of an adequate and consistent sample of highway sections under the guidelines

of this Manual and for the timely submittal of the required data in the prescribed form. They are also responsible for obtaining the maximum practicable participation by city, county, and other local governments and by the metropolitan planning organizations in HPMS activities. The general approach to HPMS implementation and the specific approach for developing effective intergovernmental participation must necessarily be worked out within each State.

Metropolitan Planning Organizations

Direct participation by the metropolitan planning organizations (MPO's), where applicable, is to be encouraged by the State highway agencies to the maximum extent feasible. This includes utilizing both technical staffs and existing committees to provide overall guidance. All work performed by such organizations shall conform with the guidelines provided in this Manual.

It is recognized that the size of the active staff of the MPO's differs among urbanized areas and that participation by these organizations will vary. Where full-scale involvement is not possible, it is highly desirable for such personnel to assist at least in the field inventory. All work performed by MPO's shall be coordinated with the efforts of the State highway agencies.

Geographic Detail

Problems vary considerably from State to State concerning revenues, ADT's, jurisdictional considerations, system extent, condition, performance, etc.; therefore, it is felt that certain base data must be collected in each State. This position is supported by the fact that many congressional and DOT/FHWA requests are related to individual State data. For these reasons, sample data will be required for rural, small urban, and urbanized areas within each State.

Urban and Rural Areas

Independent urban and rural analyses must be made so that programs that are unique to urban or rural areas can be properly assessed. In addition, travel and physical characteristics of the highway plant differ considerably in urban and rural areas and, perhaps, different performance measures will be applicable. The term "urban area" means an urbanized area (50,000 or greater population) or an urban place as designated by the Bureau of the Census having a population of 5,000 or more and not within any urbanized area.

Urbanized Areas

Independent appraisals of highway system performance for each urbanized area must be made because of the individuality that exists in urbanized areas. Experience with national studies has indicated a continual

demand for individual urbanized area transportation statistics. Accordingly, a basic data set will be gathered for each urbanized area.

Urban Boundaries

Federal-aid urban area boundaries (as defined in Section 101(a) of Title 23) were chosen for use in the HPMS because they are derived using a common definition, and should remain fixed for some extended period of time. Also, Federal-aid urban boundaries, by definition, are the termini of unique urban and rural Federal-aid highway programs.

Base Systems for Analyses

The functional systems required by Title 23 have been chosen as the most logical, stable base for the HPMS. The regulations for developing such systems are included in Volume 4, Chapter 6, Section 7 of the Federal-Aid Highway Program Manual (FHPM 4-6-7). The systems and their subclassifications are contained in Volume 20, Appendix 12 of the Highway Planning Program Manual. They are as follows:

Rural	Urbanized and Small Urban Areas
Principal Arterials	Principal Arterials
Interstate	Interstate
Other Principal Arterials	Other Freeways and Expressways
Minor Arterials	Other Principal Arterials
Collector Roads	Minor Arterials
Major Collectors	Collectors
Minor Collectors	Local Streets
Local Roads	

It is assumed that functional classification requirements related to Federal-aid system eligibility provide up-to-date functional systems. It is recognized, however, that spreading urbanization and changing traffic patterns resulting from urban growth and the construction of new facilities will require future revisions to these functionally classified systems and that the HPMS must accommodate and reflect such revisions.

Implementation Approach

At first glance, the data requirements for the HPMS appear to be rather large, requiring continuous high levels of effort. However, it should be noted that by sampling sections and monitoring them over time not many of the section data elements will change unless a capital improvement is made. Only ADT, future (2000) ADT, "K" factor, percent trucks, pavement condition, skid resistance, and drainage adequacy will change over time and will need to be updated on a cyclical basis. All other data elements will be updated only when improvements are made.

It is intended that HPMS data be collected for a statistical sample of sections and that updating be controlled by the frequency of statistically significant changes in the individual data elements and workload demands. Time-phasing of the data collection activities is a major concern, and efforts to avoid periodic, extraordinary heavy workloads have been incorporated in the overall HPMS implementation plan. Implementation of the HPMS will be spread over several years (a cycle), with various portions of the results being reported on an annual basis.

The premise of monitoring a panel of sections over time can raise the issue as to whether it can be expected to remain as a representative, unbiased sample of the functional systems. The selection of truly random samples in itself is insufficient assurance that representation can be preserved because capital investment and maintenance actions directed toward these sections could be biased toward self-serving extremes. Regardless how unlikely such deliberate actions may appear, measures will be taken to ensure that such situations are identified. This could include the comparative analysis of capital investments by type on panel sections and overall functional systems as well as other checking procedures.

If it is determined at some future date that bias exists in a particular panel of a State or in a particular State's data in general, remedial action will then be taken. Such action could take a number of forms, including the periodic substitution of a certain percentage of the panel. It is obviously beneficial to both the States and the FHWA from several points of view, including workload, to assure that panel sections receive attention that is consistent with normal practices.

HPMS/MFRS Coordination

A major goal of the FHWA is to merge the HPMS with the MFRS. Ultimately, this effort should produce a system that contains both detailed section specific data from the HPMS sample panel of sections and more limited data on the universe of mileage from MFRS. Efforts are also underway to update the financial reporting requirements so that financial information better fulfills current planning information requirements. These activities will result in one well-coordinated information system that will reduce the States' overall reporting burden and greatly increase the utility of the data available to serve various needs. Implementation of this "ultimate" system, however, will require several years. Consequently, information requirements for the upcoming 1980 report to Congress will require certain interim procedures. First, in order to provide a tie between HPMS and the present MFRS, the HPMS section identification number[1/] has been made large enough to allow a State to use either of the MFRS identification schemes--A-node, B-node, segment or route, milepoint--to generate the required unique section identification number. Secondly, the HPMS instructions in this Manual have been designed to provide two options as to how to furnish certain common MFRS/HPMS data for the sample panel of sections.

1/For further discussion of section identification schemes and the size of the field permitted, see Chapters IV and V.

Common Data Elements

The State may exercise the option of reporting certain data elements in the June 1979 MFRS submittal (1978 data) rather than in the HPMS submittal if the following conditions are met:

1. A unique HPMS section is established in the MFRS for every HPMS sample section.

2. The same A-node, B-node, segment or route-milepoint must be used in both systems to identify the HPMS sections.

3. All sections must be treated in the same manner, i.e., if a State elects to use the MFRS option, it must report the common data elements in MFRS for all HPMS sections on all systems.

4. Reporting a common data element as "unknown" or "not known" is not acceptable for HPMS sections.

5. The MFRS instructions allow certain codes that are incompatible with HPMS. These codes must not be reported.

The following data elements are common to both HPMS and MFRS. Unacceptable codes are noted.

Common Data Elements

	HPMS	MFRS	Unacceptable MFRS Codes
1.	County Code	County Code	None
2.	Jurisdictional Responsibility	Government Level of Control	None
3.	Federal-Aid System	Federal-Aid System-Designated Way	9-Non-Traveled
4.	Functional System	Functional Classification	None
5.	Access Control	Access Control, Public Roads	4-8
6.	ROW Width	ROW Width	None
7.	ADT	Average Daily Traffic (ADT)	None
8.	Surface Type	Pavement Type	All codes are acceptable except 50, must have 51, 52, or 53 to separate intermediate and low pavement types.

Data Submittal Options

1. Via MFRS - Assuming that the conditions established in the preceding section are met, the identified common data elements need only be submitted via MFRS. Remaining HPMS data elements will be submitted separately.

2. Via HPMS - In recognition of the fact that, in some States, it may not be possible to revise the MFRS submittal for 1978 as outlined above in a timely manner nor to select and include HPMS samples in the MFRS submittal, this second option is provided. Under this option, the common data items are coded in the HPMS record as outlined in Chapters IV and V. Some States may also wish to select this option so as to be able to generate certain data summaries (i.e., VMT) by using the software that will be furnished by the FHWA.

Chapter II

AREAWIDE DATA

A limited amount of areawide summary data must be obtained for control purposes for the entire analytical phase of the HPMS. These areawide data will also be used to calculate needed areawide parameters and to test how well the sampled section information represents a particular area (rural, small urban, or an urbanized area) of the State.

The following information has currently been identified as necessary HPMS areawide data:

- Mileage (Current)
- Vehicle Miles of Travel (Current)
- Vehicle Miles of Travel (Future)
- Land Area
- Population
- Bus Usage and Service
- Capital Obligations
- Special Urbanized Area Data

Mileage, Travel, Land Area, and Population Data

Current estimates of mileage and daily vehicle miles of travel are needed for HPMS as general information and as control totals for sampled information expansion. Likewise estimates of 2000 daily vehicle miles of travel are necessary to project future highway performance under various investment assumptions and to estimate future highway needs. The collection of land area and population data is necessary to the HPMS to provide input to the calculation of comparative parameters, such as miles of public roads per square mile, miles per capita, persons per square mile, dollars invested per capita, etc.

Land area and population totals for 1975 were submitted by the States for the 1976 NHIPS. It is necessary for the States to review and update these data using the most recent available estimates as part of the initial implementation of the HPMS. These estimates, in some cases, may be simply updated versions of Census values. If Census values are used as a basis for the land area and population estimates for urban areas, these estimates must be representative of complete Federal-aid urban areas. The land area and population reported should be for 1978.

The 1975 land area and population data are listed in Appendix A. Certain adjustments must be made to the data contained in this table because modifications were made to the original list of urbanized areas. The land area and population data for selected contiguous urbanized areas that were combined are indicated in the table . Since the HPMS requires that land area and population be available for each urbanized area, the combined areas will have to be separated before they can be updated for the HPMS. Also, there are several portions of urbanized areas for which no data were submitted. These areas are also indicated in Appendix A. Land area and population figures for these areas must be reported for the HPMS.

A series of four summary forms are provided for reporting the mileage, travel, land area and population data necessary for performance evaluation. All information will be reported for rural, small urban, and individual urbanized areas by functional system. The number of small urban areas will also be reported. The forms shown as Figures II-1 through II-4 are as follows:

1. Statewide Area, Population, Mileage, and Travel Summary

2. Rural Data Summary

3. Small Urban Area Data Summary

4. Individual Urbanized Area Data Summary

Only one each of the first three forms need be prepared by each State. The fourth form is to be prepared for each urbanized area (or portion) within the State. Each form is to be submitted to the FHWA division office in triplicate.

Although the forms have been designed for keypunching, the States are not requested to furnish any punched cards as part of the areawide data submittal requirements. A supply of blank forms will be furnished to each State.

Areawide Data Coding Instructions

The following instructions are applicable to all forms:

1. Urbanized area codes are furnished in Appendix B and State codes are furnished in Appendix C.

2. All data entered should be right justified, and a zero should be entered in the right column of any field where the value is zero. Leading zeros need not be entered.

3. The following units are applicable to all entries on the forms outlined in this chapter:

   Land area---Square miles
   Population---Thousands
   Mileage---Whole miles
   Travel---Daily vehicle miles in thousands

4. The sum of the mileage and travel entries reported by functional system should equal the respective values entered on the total line of each form and in sum on the Statewide Area, Population, Mileage, and Travel Summary.

5. The Bureau of the Census definition of land area will be used for this study. That definition is as follows: Land area includes dry land and land temporarily or partially covered

OMB No. 004-R-2457
Approval Expires January 1984

STATEWIDE AREA, POPULATION, MILEAGE, AND TRAVEL SUMMARY

I. YEAR [7][8] (1 2)

II. STATE NAME _____ STATE CODE: [ ][ ] (3 4)

III. LAND AREA (SQUARE MILES)

STATE TOTAL: [ ][ ][ ][ ][ ][ ] (5 10)

IV. ESTIMATED 1978 POPULATION (THOUSANDS)

STATE TOTAL: [ ][ ][ ][ ][ ][ ] (11 16)

V. STREET AND HIGHWAY MILEAGE

STATE TOTAL: 1978 [ ][ ][ ][ ][ ][ ] (17 22)

VI. DAILY VEHICLE MILES OF TRAVEL (THOUSANDS)

STATE TOTAL: 1978 [ ][ ][ ][ ][ ][ ][ ][ ] (23 30)

2000 [ ][ ][ ][ ][ ][ ][ ][ ] (31 38)

FHWA 1501

Figure II-1

RURAL DATA SUMMARY

OMB No. 004-R-2457
Approval Expires January 1984

STATE NAME _____

YEAR		STATE CODE		R-U CODE	FUNCT. CLASSIF. CODE		FUNCTIONAL CLASSIFICATION	1978 MILES						1978 DVMT (THOUSANDS)								2000 DVMT (THOUSANDS)							
1	2	3	4	5	6	7		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
							PRINCIPAL ARTERIAL SYSTEM																						
7	8			1	0	1	INTERSTATE																						
7	8			1	0	2	OTHER PRINCIPAL ARTERIALS																						
7	8			1	0	6	MINOR ARTERIAL SYSTEM																						
							COLLECTOR SYSTEM																						
7	8			1	0	7	MAJOR COLLECTORS																						
7	8			1	0	8	MINOR COLLECTORS																						
7	8			1	0	9	LOCAL ROADS																						
7	8			1	9	9	TOTAL																						
								1978 POPULATION (THOUSANDS)					1978 LAND AREA (SQ. MILES)																	
7	8			1	1	0																							
1	2	3	4	5	6	7		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

FHWA 1501 A

Figure II-2

SMALL URBAN AREA DATA SUMMARY
5,000 TO 49,999 POPULATION

OMB No. 004-R-2457
Approval Expires January 1984

STATE NAME _____

YEAR	STATE CODE	R-U CODE	FUNCT. CLASSIF. CODE	FUNCTIONAL CLASSIFICATION	1978 MILES	1978 DVMT (THOUSANDS)	2000 DVMT (THOUSANDS)
1 2	3 4	5	6 7		11 12 13 14 15 16	17 18 19 20 21 22 23 24	25 26 27 28 29 30 31 32
				PRINCIPAL ARTERIAL SYSTEM			
7 8		2	1 1	INTERSTATE			
7 8		2	1 2	OTHER FREEWAYS AND EXPRESSWAYS			
7 8		2	1 4	OTHER PRINCIPAL ARTERIALS			
7 8		2	1 6	MINOR ARTERIAL SYSTEM			
7 8		2	1 7	COLLECTOR SYSTEM			
7 8		2	1 9	LOCAL STREETS			
7 8		2	9 9	TOTAL			

					1978 POPULATION (THOUSANDS)	1978 LAND AREA (SQ. MILES)	NO. OF SMALL URBAN AREAS	
7 8		2	2 0					
1 2	3 4	5	6 7		11 12 13 14 15	16 17 18 19 20 21 22 23 '24	25	26 27 28 29 30 31 32

FHWA 1501B

Figure II-3

INDIVIDUAL URBANIZED AREA DATA SUMMARY

OMB No. 004-R-2457
Approval Expires January 1984

STATE NAME _____

URBANIZED AREA NAME _____

YEAR		STATE CODE		R-U CODE	FUNCT. CLASSIF. CODE		URBANIZED AREA CODE			FUNCTIONAL CLASSIFICATION	1978 MILES						1978 DVMT (THOUSANDS)								2000 DVMT (THOUSANDS)							
1	2	3	4	5	6	7	8	9	10		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
										PRINCIPAL ARTERIAL SYSTEM																					
7	8			3	1	1				INTERSTATE																					
7	8			3	1	2				OTHER FREEWAYS AND EXPRESSWAYS																					
7	8			3	1	4				OTHER PRINCIPAL ARTERIALS																					
7	8			3	1	6				MINOR ARTERIAL SYSTEM																					
7	8			3	1	7				COLLECTOR SYSTEM																					
7	8			3	1	9				LOCAL STREETS																					
7	8			3	9	9				TOTAL																					
											1978 POPULATION (THOUSANDS)					1978 LAND AREA (SQ. MILES)															
7	8			3	2	0																									
1	2	3	4	5	6	7	8	9	10		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

FHWA 1501C

Figure II-4

by water, such as marshland, swamps, and river flood plains; streams, sloughs, estuaries, and canals less than one-eighth of a statute mile in width; and lakes, reservoirs, and ponds less than 40 acres in area. (For Alaska, one-half mile and 640 acres were substituted for these values.)

6. The 1978 mileage and travel data reported in these forms shall be consistent with the mileage and travel information reported in the TA-1 Table, Statewide Mileage, Travel, and Nonfatal and Fatal Injury Accidents.

2000 Travel Forecasts

The 2000 travel forecasts must be consistent with State and national forecasts contained in the recently published report titled "Highway Travel Forecasts," January 1979. The 2000 State projections contained in this report are to be used as guidelines for statewide control purposes--the distribution within each State shall be based on available projections. While it is recognized that many uncertainties exist regarding future highway travel such as the cost and availability of fuel, potential fuel alternatives and overall vehicular fuel consumption rates, it is necessary to control State and national travel projections for the purpose of consistency when conducting various nationwide analyses. The FHWA's HPMS analyses, however, will explore various alternatives to these projections on a consistent nationwide basis.

Bus Usage and Service

It is recognized that the use of sample sections is not likely to provide a representative estimate of bus routes and/or bus usage. This is compounded by the fact that bus routes are periodically changed. Therefore, the HPMS requires 1978 estimates of total bus seat miles and passenger miles of travel (PMT) by geographic area for intercity, school, and transit bus service. This information will be used to generate estimates of total PMT via highways by State and area (i.e., rural, small urban, urbanized) and as a basis for coordinating with other agencies also concerned with mass transportation.

The form to be used in coding bus data is shown in Figure II-5 and requires estimates of passenger miles of travel and seat miles of travel using the following definitions:

- Passenger Miles of Travel - The sum of all the trip lengths (on vehicle portions) for all passenger trips by bus (annual).

- Seat Miles of Travel - The seating capacity of all buses in service times the bus miles traveled excluding miles traveled to and from storage facilities and other deadhead travel.

ANNUAL BUS USAGE AND SERVICE DATA

OMB No. 004-R-2457
Approval Expires January 1984

STATE: _____

YEAR	STATE CODE	R-U CODE 1/	URBANIZED AREA CODE 2/	INTERCITY BUS		SCHOOL BUS		TRANSIT BUS	
				PASSENGER MILES OF TRAVEL X (0,000)	SEAT MILES OF SERVICE X (0,000)	PASSENGER MILES OF TRAVEL X (0,000)	SEAT MILES OF SERVICE X (0,000)	PASSENGER MILES OF TRAVEL X (0,000)	SEAT MILES OF SERVICE X (0,000)
1 2	3 4	5	8 9 10	11 12 13 14 15 16 17 18	19 20 21 22 23 24 25 26	27 28 29 30 31 32 33 34	35 36 37 38 39 40 41 42	43 44 45 46 47 48 49 50	51 52 53 54 55 56 57 58
7 8		1	0 0 0						
7 8		2	9 9 9						
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
7 8		3							
1 2	3 4	5	8 9 10	11 12 13 14 15 16 17 18	19 20 21 22 23 24 25 26	27 28 29 30 31 32 33 34	35 36 37 38 39 40 41 42	43 44 45 46 47 48 49 50	51 52 53 54 55 56 57 58

1/ R-U CODE: 1– RURAL, 2–SMALL URBAN, 3–URBANIZED AREA

2/ SEE APPENDIX B FOR CODE

FHWA 1501D

Figure II-5

- Bus[1/] - A self-propelled rubber-tired vehicle that is not confined to a fixed guideway and that is designed to transport a large number of persons, specifically, to transport more persons than a limousine or van, i.e., designed to transport at least 11 to 15 persons.

- Intercity Bus Service - Public transportation on a nonexclusive basis that for direct compensation transports persons among communities, inter- or intraregionally, inter- or intrastate but not primarily within an urban area.

- School Bus Service[1/] - Public transportation on a nonexclusive basis that, for direct or indirect compensation, transports children to any regularly conducted public or private school or school-related activities.

- Transit Bus Service[1/] - Local public transportation available to any person who pays a prescribed fare and which operates on established schedules along designated routes with specific stops.

The bus types will be stratified by geographic area in the following manner:

- Intercity Bus - Estimate the passenger miles and seat miles of intercity bus travel by rural, small urban, and individual urbanized area. It is recognized that most intercity bus mileage will be in rural areas; however, the portion of passenger and seat miles of travel in small urban and each urbanized area should be estimated and coded in the appropriate column.

- School Bus - Estimate the passenger miles and seat miles of school bus travel for rural, small urban, and individual urbanized areas. Where school bus routes serve both rural and urban areas, the portion of passenger and seat miles of travel should be apportioned to the appropriate column.

- Transit Bus - Estimate the passenger miles and seat miles of transit bus travel for rural, small urban, and individual urbanized areas. It is recognized that most of the transit bus travel will be in urban areas; however, if bus routes extend beyond the urban boundaries, this travel should be reported in the rural category.

The passenger miles of travel and seat miles of travel must be expressed in ten thousands. All bus data must be right justified. The urbanized area codes are furnished in Appendix B and the State codes in Appendix C.

1/TRB Special Report 179.

Areawide totals of bus passenger miles and seat miles of travel will probably be most easily obtainable from bus system operators. Where metropolitan transit authorities exist and urban planning commissions exist, they may have the necessary data. (Recent emergency regulations issued by UMTA require the collection and reporting of a portion of these data.) Although the difficulties in obtaining this information are well recognized, the intent is for the State to obtain as good an estimate as possible based on the local situation.

Capital Obligations

Capital obligation reports will provide investment level information concerning the highway systems. The 1979 submittals shall contain the sum of capital obligation information for calendar years 1976 through 1978. As part of the 1974 National Highway Needs Study, the States furnished data on the 1970-72 nonlocal highway capital obligations. Similar data were furnished for 1973-75 as part of the NHIPS in 1976. The 1976-78 data will be used in conjunction with data from the earlier studies to examine overall changes in the condition and performance of the systems and to determine, in general terms, the types of systems improvements which the State and local governments have made as well as emphasis areas.

It is understood that there are significant differences among States as to the availability of such data. Some States have jurisdiction over most roads and streets and may have complete records on obligations. Others may have State highway systems closely corresponding to the arterial and collector systems and would also have good records for such facilities. Other States may not have up-to-date records of contracts let on the lower functional systems. In these instances, it is desirable to have appropriate local units of government (county, township, municipality, toll authority, etc.) assist in providing the necessary data. Although a statewide estimate of obligations on the local functional system is requested, it is recognized that local road data will be difficult to obtain in some States, especially data on non-State obligations. A "best estimate" will suffice in reporting these data.

Unique, isolated situations may arise that are not covered in these instructions. It should be remembered that the objective of this effort is to determine the rate at which different improvements are being made to the various functional systems.

For HPMS, an obligation is defined as "plans, specifications, and estimates (PS&E) approval" or "authorized to advertise for bids" on Federal-aid construction work, "authorized" for other Federal-aid work, work "advertised for bids" on non-Federal-aid projects, and "work underway" when force account is involved. The obligations reported should include the total cost of all road improvement work thus undertaken during any of the three calendar years 1976, 1977, and 1978. Arterial and collector costs will be reported by subsystem, stratified by projects that involve Federal funds and those that did not, with an

additional stratification by jurisdiction (State, toll, and other). Functional system obligations are to be broken down by improvement type. Local road and street obligations are reported on a gross basis.

Identification information must be provided on each individual form (Figure II-6) for each arterial and collector. The State codes to be used are shown in Appendix C. Rural, small urban, and urbanized areas will be distinguished by placing under "R-U code" the appropriate code as indicated on the form. (The Federal-aid boundaries approved as of December 31, 1978, will be used to determine rural, small urban, and urbanized areas.) Note that obligation data for urbanized areas should be reported in aggregate as a statewide urbanized total.

On the local road form (see Figure II-7), all small urban and urbanized areas will be combined for reporting. Since only one form is necessary for each State, only the State code is required as identification.

The functional classes and codes to be used for reporting obligations data will be the same as those that apply to the sampled section data (see Chapter III). The functional classes and codes are as follows:

Code	Description
RURAL	
01	Principal Arterial - Interstate
02	Principal Arterial - Other
06	Minor Arterial
07	Major Collector
08	Minor Collector
09	Local Roads
URBAN	
11	Principal Arterial - Interstate
12	Principal Arterial - Other Freeways and Expressways - Connecting Link
13	Principal Arterial - Other Freeways and Expressways - Nonconnecting Link
14	Principal Arterial - Other-Connecting Link
15	Principal Arterial - Other-Nonconnecting Link
16	Minor Arterial
17	Collector
19	Local Streets

Note: Since connecting link information is not applicable to HPMS and obligation data, the references to connecting links in the coding scheme may be ignored. For urban areas to indicate "Principal Arterial - Other Freeways and Expressways," the code "12" will be used and to indicate "Principal Arterial - Other," the code "14" will be used.

Obligations shall be reported under the governmental level actually having jurisdiction over the highway regardless of funding or contracting arrangements. The jurisdictional designations are defined as follows:

OMB No. 004-R-2457
Approval Expires January 1984

ARTERIAL AND COLLECTOR CAPITAL OBLIGATIONS (IN $000)
(1976-1978)

STATE: _____

R-U CLASS: _____

FUNCTIONAL CLASS: _____

YEAR	STATE CODE	R-U CODE 1/	FUNCT. CLASSIF. CODE	IMPROVEMENT TYPE CODE	IMPROVEMENT TYPE DESCRIPTION	FEDERAL-AID PROJECTS: STATE	FEDERAL-AID PROJECTS: OTHER	NON-FEDERAL-AID PROJECTS: STATE	NON-FEDERAL-AID PROJECTS: OTHER	NON-FEDERAL-AID PROJECTS: TOLL
1 2	3 4	5	6 7	8 9 10 11 12		13 14 15 16 17 18 19	20 21 22 23 24 25 26	27 28 29 30 31 32 33	34 35 36 37 38 39 40	41 42 43 44 45 46 47
				0 1	NEW ROUTE					
				0 2	RELOCATION					
				0 3	RECONSTRUCTION					
				0 4	MAJOR WIDENING					
				0 5	MINOR WIDENING					
				0 6	RESTORATION AND REHABILITATION					
				0 7	RESURFACING					
				0 8	BRIDGE REPLACEMENT					
				0 9	BRIDGE REHABILITATION					
				1 0	SAFETY-RELATED IMPROVEMENTS					
				1 1	OTHER HIGHWAY-RELATED IMPROVEMENTS					
				1 2	TOTAL					

1/ R-U CODE
1—RURAL, 2—SMAL URBAN, 3—URBANIZED AREA

FHWA 1501E

Figure II-6

OMB No. 004-R-2457
Approval Expires January 1984

CAPITAL OBLIGATION SUMMARY AND CAPITAL OBLIGATIONS ON LOCAL ROADS AND STREETS 1976-1978

YEAR [7][8] (1 2)

STATE NAME _____ STATE CODE: [ ][ ] (3 4)

[0][0][9][0][0][0] (5 10)

RURAL LOCAL OBLIGATIONS ($000)

STATE [ ][ ][ ][ ][ ][ ][ ] (11 17)

OTHER [ ][ ][ ][ ][ ][ ][ ] (18 24)

TOTAL RURAL [ ][ ][ ][ ][ ][ ][ ] (25 31)

URBAN LOCAL OBLIGATIONS ($000)

STATE [ ][ ][ ][ ][ ][ ][ ] (32 38)

OTHER [ ][ ][ ][ ][ ][ ][ ] (39 45)

TOTAL URBAN [ ][ ][ ][ ][ ][ ][ ] (46 52)

CONTROL TOTALS ($000)

TOTAL ARTERIAL – COLLECTOR OBLIGATIONS FROM OTHER FORMS [ ][ ][ ][ ][ ][ ][ ][ ] (53 60)

TOTAL OBLIGATIONS 1976-1978 [ ][ ][ ][ ][ ][ ][ ][ ] (61 68)

FHWA 1501F

Figure II-7

State--includes all routes, excluding toll facilities under a State agency, for which a State or multi-State or quasi-State agency has responsibility.

Toll--includes road and crossing facilities for which a public or quasi-public agency is principally responsibile even if no specific charge is made.

Other--includes all routes that do not fall in the above two categories, such as routes under the jurisdiction of a Federal, county or city agency.

Definitions for the types of improvement specified on the form are contained in Appendix D. The types of improvement are precoded on the forms.

Obligations are to be reported in thousands of dollars. These should be reported according to the total cost (Federal plus matching funds) of projects involving Federal funds and the total cost of projects that include only State and/or local funds. Included in the costs should be the cost of all engineering, right-of-way, grading and drainage, surface and base, structures, and other costs of construction, such as guardrails, lighting, traffic control devices, median barriers, railroad crossing warning devices, roadside improvements, noise barriers, etc. Maintenance and administration costs should not be included.

The following procedures should be used when funds for advance acquisition of right-of-way are involved:

1. Obligations associated with construction projects for which the right-of-way has previously been purchased should be reported normally. If the funds for the right-of-way were obligated prior to January 1, 1976, they should not be reported.

2. Obligations for advance acquisition of right-of-way only (i.e., money was obligated for right-of-way, but no money was obligated for construction during the study period) should be reported under the type of improvement contemplated.

Projects financed with Interstate funds should not be reported.

Blank copies of all needed forms will be furnished to the States. Only the coded forms (not punch cards) need be submitted by the States.

Special Urbanized Area Data

Two types of special data are requested from each urbanized area--vehicle occupancy and traveltime. These measures are of particular significance in assessing highway performance. Vehicle occupancy data are needed to

estimate person miles of travel and to assess the effectiveness of ride-sharing programs over time. Traveltime information is needed to assess trends in intraurban accessibility. Because of the difficulty and cost in collecting occupancy data, this request can be fulfilled utilizing currently available data. Limited new data will be requested by the FHWA in the near future as part of case studies to meet critical performance assessment voids.

Vehicle Occupancy Data

Each urbanized area transportation study group or MPO shall provide the FHWA existing vehicle occupancy data (in its present form) for the year(s) and/or coverage available. Existing vehicle occupancy data of interest is any available peak and off-peak information since 1975 plus summary data for previous points in time. In addition to the data please provide a brief summary of the methodology used as well as any significant qualifications on interpretation of the data.

Traveltime Data

Each urbanized area transportation study group or MPO shall provide the FHWA, as part of the HPMS, traveltime data that has been obtained since 1975. These data could be in a variety of forms, including the following:

- Traveltime contour maps
- Traveltime or speed maps
- Lists of point-to-point traveltime
- Narrative form that includes discussions of point-to-point traveltimes to the CBD, airport, major employment center(s), etc.

In addition to the data, please provide a brief summary of the methodology used as well as any significant qualifications on interpretation of the data. In the future, information on traveltime and vehicle occupancy will have increasing importance.

Chapter III

SELECTING THE SAMPLE OF HIGHWAY SECTIONS

Background

The sample of sections selected for the HPMS will be the basis of the continuing monitoring effort. The data reported for the sampled sections will serve as the source of system condition, usage, and operational characteristics and will be used in the calculation of performance measures. Impacts--the changes in performance over time--will be determined by using these data as reference points. These data will also serve as the data base for various analytical models.

While it is assumed that there is a "technically best" way to collect sample data, it was necessary that the sample design be simple and cost efficient because of manpower and cost considerations. The choice of an empirical method not involving preliminary pilot surveys in the field has the advantage of simplicity and general applicability. The required number of samples can be derived empirically by formula from the normal dispersion characteristics of ADT values within the framework of pre-selected ADT groups (strata). The sample size requirements obtained by this method relate to the critical data element, ADT, whose values can be conveniently stratified.

In order to obtain cost-effective, valid comparisons of system performance over time, the sample must be designed to minimize both sampling error and sample size. This can be accomplished by stratifying the sample and keeping it fixed over time. Hence, the same sections that are inventoried now will be updated in future years on a cyclical basis. (As noted earlier in this Manual, a procedure will be established to determine the continuing representation by the sample panel.) This means of obtaining data is efficient because: (1) The need for the periodic drawing of a new sample is eliminated; (2) the need to update or re-inventory all data elements every cycle is eliminated; and (3) only those data elements that change over time need be updated on a cyclical basis, the length of the cycle being determined by the known statistical characteristics of individual elements, the intended use and accuracy needed, and the time and cost required to collect and report such data.

It is emphasized that the sample sections be selected in full accordance with the instructions in this Manual in order to achieve the predetermined levels of desired precision. The sampling procedures described in this chapter are both simple and efficient and, if applied properly, will yield an adequate sample for performance monitoring.

Scope

Data needs will vary for the rural, small urban, and individual urbanized areas. This variation is reflected in the sample design. The design is capable of producing valid estimates of the condition of the highway plant

and its operating and performance characteristics on a State-by-State basis. It is also adequate for measuring the impacts of given policy proposals on individual States and urbanized areas. Rural and small urban functional systems will be sampled on a statewide basis--functional systems in each urbanized area will be sampled individually.

Roads and streets functionally classified as local will not be sampled since they serve a relatively minor mobility role and, therefore, are not as sensitive to changes in highway performance as are the higher functional systems.

Stratification and Precision Levels

The sampling plan consists of the random selection of a panel of road sections within predetermined 1978 average daily traffic (ADT) volume groups (strata) for each functional highway system in the rural and small urban subdivisions of the State and for individual urbanized areas. The stratification of sections (sampling units) into relatively homogeneous ADT groups produces estimates of greater accuracy with respect to VMT for a smaller number of samples at the functional class (summation) levels. Although stratification for sample selection is based on the critical data element, ADT, tests have shown that ADT stratification is compatible with the sampling of nonvolume-related data elements.

> Note: Stratification by ADT also has other advantages: (1) Most of the impacts discussed are very sensitive to VMT; (2) it serves as a weighting device for quantitative data element values sampled from sections of nonuniform length; (3) the effect of volume on volume-sensitive data element values may be measured; and (4) it is useful in the application of specific formulas for data element estimates.

Sample size requirements per functional class will vary by State according to the total number of road sections, the number of predetermined volume groups, and the design precision level. The term "precision level" in this Manual is defined as the degree of confidence that the sampling error of a produced estimate will fall within a desired fixed range. Thus, for a precision level of 80 percent confidence with 10 percent allowable error (80-10), there is a probability that 80 times out of 100 the error of a data element estimate will be no greater than 10 percent of its true value. The precision levels determined for this sample design apply specifically to the individual volume strata. Aggregation of the estimated stratum values of volume-related data elements will result in an upgrading of the precision level for functional system estimates. Some States may wish to initiate concurrently a highway performance monitoring system that produces the State's desired precision level at the highway district, county, or other level. When such is the case, either the FHWA developed approach or the optional theoretical approach should be applied to the area based

on the State's desires. If finer geographic breakdown than specified in this Manual is undertaken and the FHWA-specified precision levels are followed, the resultant sample panel precision levels should meet or exceed those specified in this Manual. To that end, the precision levels specified in this Manual represent minimum requirements for rural, small urban, and individual urbanized area functional class volume groups.

The HPMS sample size requirements are more stringent for the arterials, where a higher level of precision is needed because of the high level of Federal interest in them. In rural and small urban areas, the sample sizes are based on a 90-5 precision level for the volume groups of the principal arterial system, 90-10 for the minor arterial system, and on an 80-10 precision level for the collector system(s). For individual urbanized areas, the design precision levels for individual volume strata are 80-10 or 70-15, depending upon the number of individual urbanized areas in a given State. Those States with less than three individual urbanized areas will use a precision level of 80-10 for all functional systems, while those with three or more will use the lower precision level of 70-15 for minor arterials and collectors and 80-10 for principal arterials thereby requiring a smaller number of samples. The statewide summation of individual urbanized functional system data element estimates will result in an overall precision level of at least 80-10 at the State level and will, in a number of instances, have precision levels approaching 90-5. These higher precision levels at the State level are necessary for two important reasons--to obtain comparable urban and rural precision levels and to obtain precision levels that can adequately accommodate desired levels of accuracy for estimates of proportionate values.

The precision levels established above and the associated sample sizes relate solely to the measurement of data such as ADT. The same samples will be used to estimate the proportionate values of data such as pavement condition. Given the same desired precision levels, larger sample sizes are required for estimates of proportionate values. Since the level of accuracy for estimated proportions is closely related to sample size, care was taken to set the above precision levels sufficiently high to produce reasonable proportionate estimates at the functional class level.

Preparation for Sample Selection

Before a sample can be drawn, the universe from which it will be selected must be defined. The first step is to delimit the boundaries between rural, small urban, and individual urbanized areas using Federal-aid boundaries. Next, identify the functional classification of all arterial and collector routes within each of these areas. These steps, presumably, have already been accomplished. Then, all road sections in each functional class must be assigned to predetermined ADT groups (see Tables III-1, III-2, and III-3). Either uniform or nonuniform section lengths can be used. The

sections should be relatively homogeneous as to geometrics, traffic volume and cross section, and should be long enough to constitute a logical section for various analyses such as needs appraisal. In general, rural section lengths should range from 0.30 to 10.00 miles--urban access controlled facility section lengths should not exceed 5.00 miles. All other urban section lengths should range from 0.10 to 3.00 miles.

The total number of road sections and total mileage in each volume group are also needed to determine the proper sample size necessary for each functional class. In addition, if volume groups other than the predetermined volume groups used in the FHWA-developed approach (discussed below) are selected, the limits of these volume groups shall be reported on the volume group form, Figure III-1.

Section Documentation

The sampled sections described in this Manual and the resultant data will be used to monitor highway performance over an extended period of time. Consequently, it is extremely important that precise documentation of the exact location of each sampled section be made at the outset to assure that periodic updates are provided for the appropriate roadway sections. The documentation should logically consist of appropriate maps and narratives to facilitate continuing use and availability whenever needed.

Calculation of Expansion Factors

The purpose of the HPMS panel of sections is to provide an expandable base for each rural system, each small urban system, and each system in each urbanized area, all stratified by traffic volume. An expansion factor must be calculated for each volume stratum within each functional class. This is accomplished by dividing the total mileage in the stratum by the mileage included in that stratum's sample. This expansion factor will be entered on the worksheets and will allow the samples to be expanded to represent the entire functional subsystem for rural and small urban and for entire urbanized areas.

Example Factor Calculation
Rural Interstate

Volume Group	Number of Sample Sections	(A) Total Mileage of Sample Sections	(B) Total Mileage in Volume Group	(C) Expansion Factor Column B ÷ Column A
1	9	38.4	1132.6	29.49
2	8	41.6	924.0	22.21
3	6	23.7	362.1	15.28
4	3	10.6	133.9	12.63
5	2	7.4	36.0	4.85
6	2	6.9	18.1	2.62

OMB No. 004-R-2457
Approval Expires January 1984

NUMBER AND RANGES OF VOLUME GROUPS BY FUNCTIONAL SYSTEM[1]

STATE: _____

RURAL:

VOLUME GROUP:	RANGES				
	INTERSTATE	OTHER PRINCIPAL ARTERIALS	MINOR ARTERIALS	MAJOR COLLECTORS	MINOR COLLECTORS
1	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
2	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
3	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
4	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
5	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
6	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
7	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
8	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
9	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
10	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____

URBAN:

SMALL URBAN AREAS: VOLUME GROUP:	INTERSTATE	OTHER FREEWAYS AND EXPRESSWAYS	OTHER PRINCIPAL ARTERIALS	MINOR ARTERIALS	COLLECTORS
1	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
2	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
3	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
4	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
5	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
6	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
7	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
8	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
9	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
10	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____

URBANIZED AREAS: VOLUME GROUP: URBANIZED AREA NAME: _____ [2]

1	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
2	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
3	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
4	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
5	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
6	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
7	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
8	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
9	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____
10	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____	_____ TO _____

[1] TO BE SUBMITTED BY STATES USING OPTIONAL THEORETICAL APPROACH OR STATES ADDING VOLUME GROUPS TO THE FHWA SAMPLE APPROACH.
[2] IF THE VOLUME GROUPS DIFFER BY URBANIZED AREA, USE MULTIPLE COPIES OF THIS FORM AND INDICATE THE URBANIZED AREA(S) NAME(S) ON EACH FORM.

FHWA 1501G

Figure III-1

FHWA-Developed Approach

Rural and Small Urban Areas

Both rural and small urban area data will be sampled on a statewide basis, stratified only by functional class and volume group. The volume group for each section must be identified using Tables III-1 and III-2 before sample selection can begin. Then the number of sections to be included in the sample is determined from Tables III-4 and III-5. The values in these tables indicate the number of sections in each functional class that each State must sample. These tables were developed from analyses of data collected for previous national studies such as the NHIPS. The number of sample sections per volume group, in general, were determined based on: (1) Mileage by State functional class volume groups, (2) the variances of the ADT's as stratified in (1), (3) grouping of States with similar characteristics, and (4) normalizing sample sizes.

Next, the sample sizes drawn from Tables III-4 and III-5 must be distributed over the volume groups. Tables III-6 and III-7 specify the distribution to be used. If any value in these tables exceeds the number of sections available in a given State's volume group universe, the excess samples must be added to the number of samples for the first volume group. Sections will be selected for each functional class and volume group using a random number table or random number generation computer software until the required sample size is reached. Sampling procedures shall be reviewed by the FHWA division office.

Individual Urbanized Areas

Each urbanized area will be sampled, with the sample stratified by functional class and volume group. The ADT volume groups to be used for each urbanized area functional class are shown in Table III-3. In situations where ADT's higher than those contained in this table are encountered, it is suggested that higher volume groups be added that contain a range similar to that for the highest volume group shown in the table for the appropriate functional class. All portions of bi-State and tri-State areas must be sampled--the sample in each State should not be less than its pro rata share for the entire urbanized area by functional class volume group nor in any case less than one section per applicable volume group. In such areas, expansion factors must be calculated separately for each State's portion.

The required number of samples for the volume groups in each functional system is determined from the graphs in Figures III-2 through III-7. Each graph is based on an empirically derived sample size corrected for the given volume group finite population--the number of sections available for sampling. The empirical method for sample size selection is discussed in the Optional Theoretical Approach section of this chapter.

TABLE III-1
Rural Area Volume Groups

Volume Group (Code)	Interstate	Other Principal Arterials	Minor Arterials	Major Collectors	Minor Collectors
1	0- 9,999	0- 4,999	0- 2,499	0- 2,499	0- 999
2	10,000-19,999	5,000- 9,999	2,500- 4,999	2,500- 4,999	1,000- 1,999
3	20,000-29,999	10,000-14,999	5,000- 9,999	5,000- 9,999	2,000- 2,999
4	30,000-39,999	15,000-19,999	10,000-19,999	10,000-19,999	3,000- 4,999
5	40,000-49,999	20,000-29,999	20,000-29,999	20,000-29,999	5,000- 9,999
6	50,000-60,000	30,000-39,999	30,000-40,000		10,000-20,000
7		40,000-49,999			
8		50,000-60,000			

TABLE III-2
Small Urban Area Volume Groups

Volume Group (Code)	Interstate	Other Freeways and Expressways	Other Principal Arterials	Minor Arterials	Collectors
1	0- 9,999	0- 9,999	0- 4,999	0- 2,499	0- 999
2	10,000-19,999	10,000-19,999	5,000- 9,999	2,500- 4,999	1,000- 1,999
3	20,000-29,999	20,000-29,999	10,000-14,999	5,000- 9,999	2,000- 4,999
4	30,000-40,000	30,000-40,000	15,000-19,999	10,000-14,999	5,000- 9,999
5			20,000-24,999	15,000-19,999	10,000-14,999
6			25,000-29,999	20,000-25,000	15,000-19,999
7			30,000-35,000		20,000-25,000

TABLE III-3
Individual Urbanized Area Volume Groups

Volume Group (Code)	Interstate	Other Freeways and Expressways	Other Principal Arterials	Minor Arterials	Collectors
1	0- 24,999	0- 24,999	0- 2,499	0- 2,499	0- 999
2	25,000- 49,999	25,000- 49,999	2,500- 4,999	2,500- 4,999	1,000- 1,999
3	50,000- 74,999	50,000- 74,999	5,000- 9,999	5,000- 9,999	2,000- 4,999
4	75,000- 99,999	75,000- 99,999	10,000-14,999	10,000-14,999	5,000- 9,999
5	100,000-124,999	100,000-124,999	15,000-19,999	15,000-19,999	10,000-14,999
6	125,000-149,999	125,000-149,999	20,000-24,999	20,000-24,999	15,000-24,999
7	150,000-174,999	150,000-174,999	25,000-34,999	25,000-34,999	25,000-35,000
8	175,000-200,000	175,000-200,000	35,000-44,999	35,000-44,999	
9			45,000-55,000	45,000-55,000	

TABLE III-4
Rural Areas - Required Sample Sizes by Functional System

State	Interstate	Other Principal Arterials	Minor Arterials	Major Collectors	Minor Collectors
Alabama	B	E	F	D	D
Alaska	-	A	B	A	A
Arizona	E	B	C	D	C
Arkansas	A	B	C	C	C
California	F	D	F	E	F
Colorado	F	E	E	D	F
Connecticut	A	A	A	B	B
Delaware	A	A	A	A	A
District of Columbia	-	-	-	-	-
Florida	E	D	F	D	E
Georgia	D	E	F	E	F
Hawaii	A	A	A	A	A
Idaho	E	C	B	C	C
Illinois	D	C	F	E	D
Indiana	C	C	B	C	D
Iowa	C	F	E	C	D
Kansas	C	F	E	E	F
Kentucky	C	D	F	D	F
Louisiana	C	B	D	D	E
Maine	B	C	D	C	E
Maryland	A	A	D	D	F
Massachusetts	B	B	B	D	E
Michigan	F	E	E	E	F
Minnesota	B	E	E	C	E
Mississippi	B	D	F	D	D
Missouri	C	C	E	D	F
Montana	F	C	D	C	D
Nebraska	A	D	E	C	E
Nevada	D	B	B	A	B
New Hampshire	A	B	C	D	D
New Jersey	A	A	A	D	C
New Mexico	D	C	B	B	B
New York	D	C	F	E	F
North Carolina	C	C	C	E	F
North Dakota	C	B	D	B	C
Ohio	E	F	F	E	F
Oklahoma	D	E	E	D	C
Oregon	E	D	E	D	D
Pennsylvania	E	D	F	E	F
Rhode Island	A	A	A	A	A
South Carolina	B	D	F	D	F
South Dakota	C	C	D	B	C
Tennessee	D	B	F	D	E
Texas	F	E	D	C	D
Utah	E	B	D	C	D
Vermont	C	A	B	C	C
Virginia	D	C	E	E	C
Washington	C	C	E	C	E
West Virginia	D	B	E	D	D
Wisconsin	D	F	F	D	E
Wyoming	B	B	B	A	C
Puerto Rico	-	A	A	C	A
KEY:	A - 32 B - 62 C - 79 D - 91 E - 113 F - 160	A - 83 B - 146 C - 231 D - 288 E - 328 F - 376	A - 70 B - 99 C - 109 D - 122 E - 144 F - 155	A - 67 B - 80 C - 92 D - 97 E - 105	A - 82 B - 124 C - 141 D - 161 E - 167 F - 190

TABLE III-5
Small Urban Areas - Required Sample Sizes by Functional System

State	Interstate	Other Freeways and Expressways	Other Principal Arterials	Minor Arterials	Collectors
Alabama	B	A	F	E	D
Alaska	-	A	A	A	A
Arizona	C	A	B	B	D
Arkansas	B	C	D	D	E
California	E	E	D	E	E
Colorado	A	C	C	D	D
Connecticut	A	A	A	A	A
Delaware	A	A	A	A	A
District of Columbia	-	-	-	-	-
Florida	A	A	D	D	E
Georgia	D	D	F	E	E
Hawaii	A	C	A	A	A
Idaho	E	A	A	A	B
Illinois	D	A	E	E	E
Indiana	B	B	E	C	C
Iowa	B	A	F	E	E
Kansas	D	C	E	E	E
Kentucky	C	A	E	C	D
Louisiana	A	A	D	C	C
Maine	A	A	B	B	B
Maryland	A	B	C	B	C
Massachusetts	B	A	A	B	B
Michigan	E	C	D	E	E
Minnesota	A	A	E	D	D
Mississippi	C	C	E	D	D
Missouri	B	B	D	D	D
Montana	C	A	C	C	B
Nebraska	A	A	E	D	D
Nevada	A	A	A	B	A
New Hampshire	D	B	A	B	B
New Jersey	A	A	A	A	A
New Mexico	C	A	D	D	C
New York	D	B	F	D	D
North Carolina	C	E	F	E	E
North Dakota	D	A	B	B	C
Ohio	F	F	F	E	E
Oklahoma	D	E	E	E	E
Oregon	E	A	C	C	D
Pennsylvania	C	D	E	D	D
Rhode Island	A	A	A	A	A
South Carolina	A	A	F	E	D
South Dakota	A	A	C	D	C
Tennessee	C	A	E	C	D
Texas	F	B	F	E	E
Utah	A	A	A	B	A
Vermont	A	A	A	B	C
Virginia	B	A	B	C	B
Washington	C	B	D	D	E
West Virginia	B	A	B	B	C
Wisconsin	B	D	F	E	E
Wyoming	B	A	A	A	B
Puerto Rico	-	A	B	B	B
KEY:	A - 12 B - 13 C - 17 D - 20 E - 27 F - 45	A - 18 B - 26 C - 36 D - 51 E - 90 F - 117	A - 83 B - 116 C - 154 D - 201 E - 252 F - 301	A - 41 B - 55 C - 77 D - 85 E - 95	A - 51 B - 86 C - 114 D - 142 E - 172

TABLE III-6
Rural Sample Size by Volume Group

Sample Size Class	Volume Group[1/]								
	1	2	3	4	5	6	7	8	Total
Interstate									
A	9	8	6	3	3	3			32
B	39	11	3	3	3	3			62
C	46	19	5	3	3	3			79
D	51	23	6	5	3	3			91
E	70	25	8	4	3	3			113
F	117	24	7	6	3	3			160
Other Principal Arterials									
A	23	22	14	7	8	3	3	3	83
B	102	22	7	3	3	3	3	3	146
C	175	29	7	5	6	3	3	3	231
D	193	44	14	7	16	8	3	3	288
E	252	45	14	3	5	3	3	3	328
F	293	50	13	4	7	3	3	3	376
Minor Arterials									
A	29	13	12	8	5	3			70
B	67	13	7	6	3	3			99
C	66	16	12	9	3	3			109
D	86	14	7	7	5	3			122
E	101	18	13	6	3	3			144
F	105	18	15	11	3	3			155
Major Collectors									
A	53	5	3	3	3				67
B	65	6	3	3	3				80
C	68	10	6	5	3				92
D	69	11	9	5	3				97
E	72	12	10	8	3				105
Minor Collectors									
A	55	11	4	5	4	3			82
B	98	9	3	8	3	3			124
C	115	7	3	6	7	3			141
D	134	12	3	6	3	3			161
E	135	13	6	6	4	3			167
F	144	17	9	8	8	4			190

1/ See Table III-1.

TABLE III-7
Small Urban Sample Size by Volume Group

Sample Size Class	Volume Group[1/]							
	1	2	3	4	5	6	7	Total
Interstate								
A	3	3	3	3				12
B	3	3	3	3				13
C	4	5	5	3				17
D	7	5	4	4				20
E	9	8	6	4				27
F	13	20	8	4				45
Other Freeways and Expressways								
A	7	5	3	3				18
B	14	6	3	3				26
C	19	10	4	3				36
D	27	16	5	3				51
E	51	27	8	4				90
F	75	34	5	3				117
Other Principal Arterials								
A	17	30	21	6	3	3	3	83
B	38	38	17	10	5	5	3	116
C	69	44	20	11	4	3	3	154
D	106	49	23	11	5	4	3	201
E	147	55	26	12	6	3	3	252
F	188	57	26	15	7	5	3	301
Minor Arterials								
A	11	10	9	5	3	3		41
B	28	9	7	5	3	3		55
C	47	11	9	4	3	3		77
D	55	11	9	4	3	3		85
E	63	12	9	5	3	3		95
Collectors								
A	15	10	14	3	3	3	3	51
B	40	15	15	7	3	3	3	86
C	69	16	14	6	3	3	3	114
D	95	16	14	7	4	3	3	142
E	121	17	16	8	4	3	3	172

1/ See Table III-2.

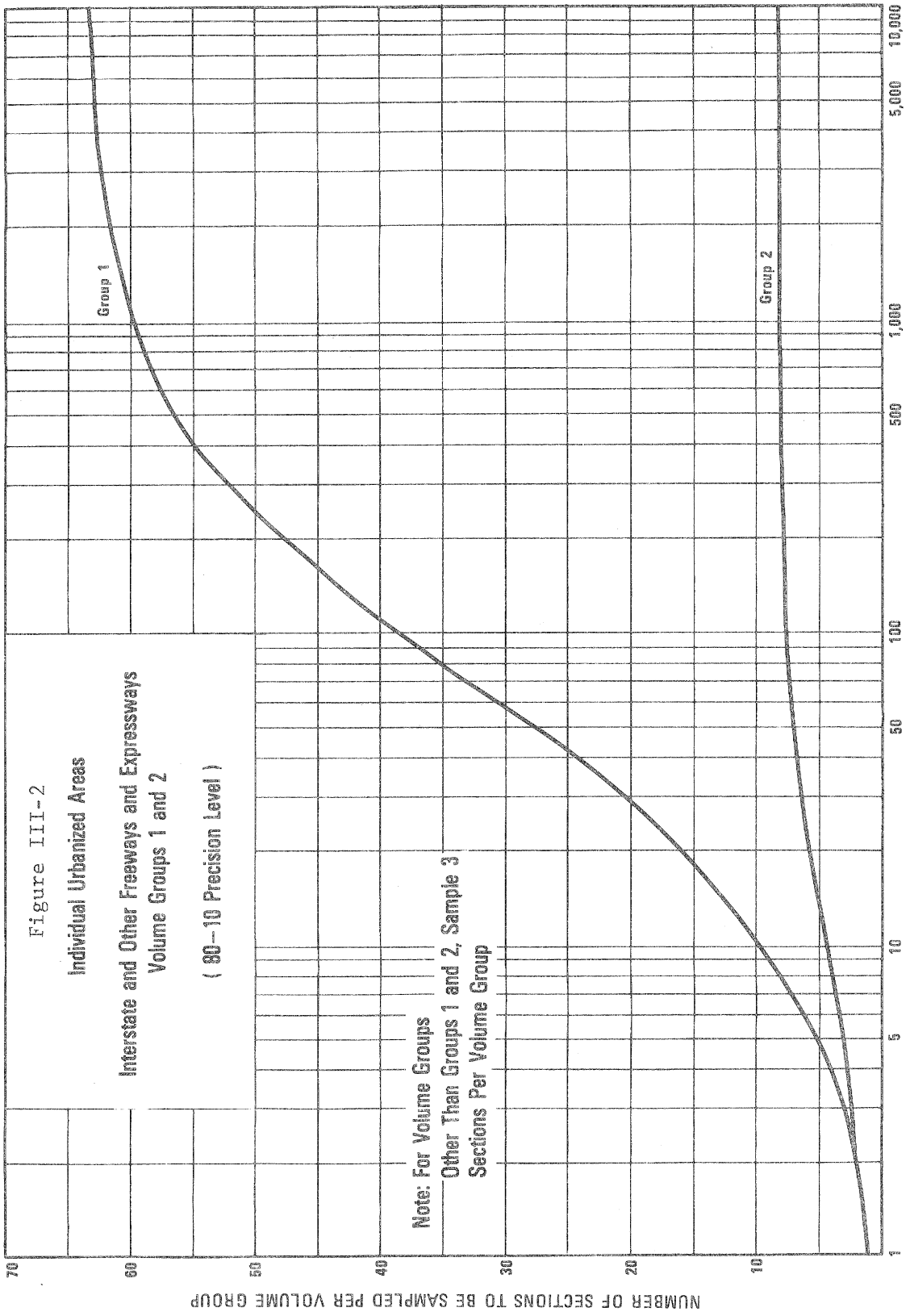


Figure III-2
Individual Urbanized Areas
Interstate and Other Freeways and Expressways
Volume Groups 1 and 2
(90-10 Precision Level)
Note: For Volume Groups Other Than Groups 1 and 2, Sample 3 Sections Per Volume Group
Group 1
Group 2
NUMBER OF SECTIONS TO BE SAMPLED PER VOLUME GROUP
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING PER VOLUME GROUP
70
60
50
40
30
20
10
1
5
10
50
100
500
1,000
5,000
10,000

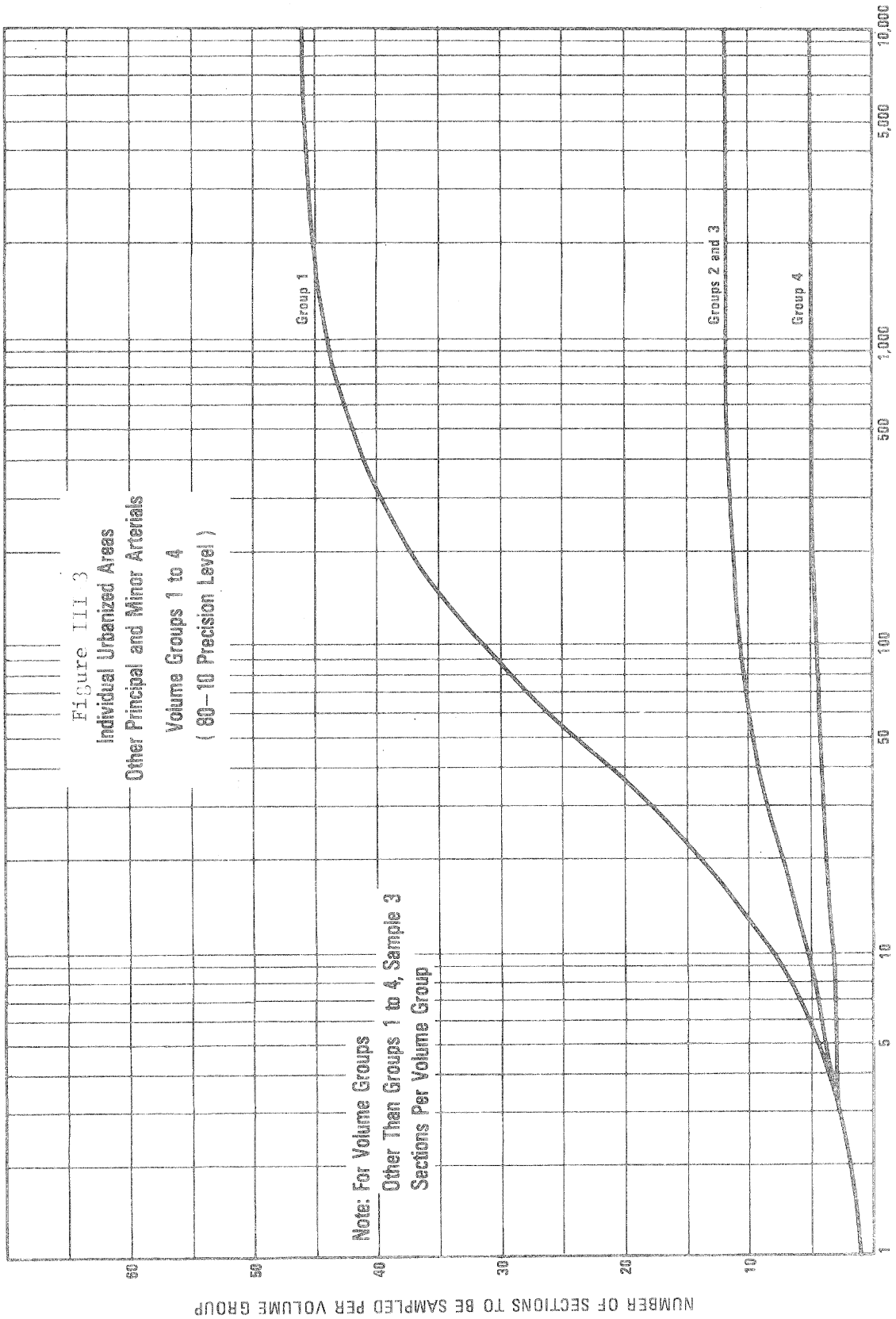


Figure III 3
Individual Urbanized Areas
Other Principal and Minor Arterials
Volume Groups 1 to 4
(90-10 Precision Level)
Note: For Volume Groups Other Than Groups 1 to 4, Sample 3 Sections Per Volume Group
Group 1
Groups 2 and 3
Group 4
NUMBER OF SECTIONS TO BE SAMPLED PER VOLUME GROUP
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING PER VOLUME GROUP
60
50
40
30
20
10
1
5
10
50
100
500
1,000
5,000
10,000

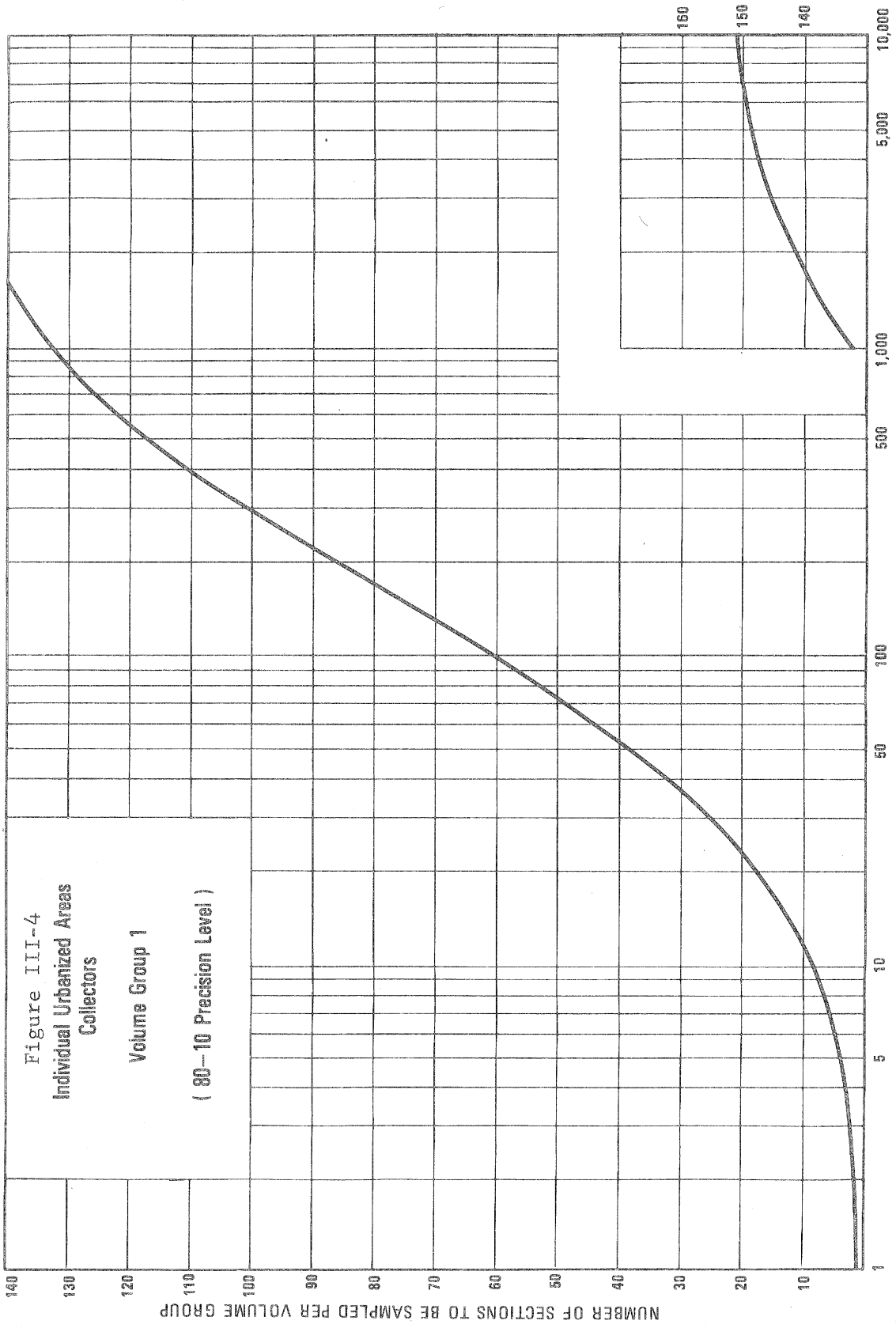


Figure III-4
Individual Urbanized Areas
Collectors
Volume Group 1
(80-10 Precision Level)
NUMBER OF SECTIONS TO BE SAMPLED PER VOLUME GROUP
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING PER VOLUME GROUP
140
130
120
110
100
90
80
70
60
50
40
30
20
10
1
5
10
50
100
500
1,000
5,000
10,000
160
150
140

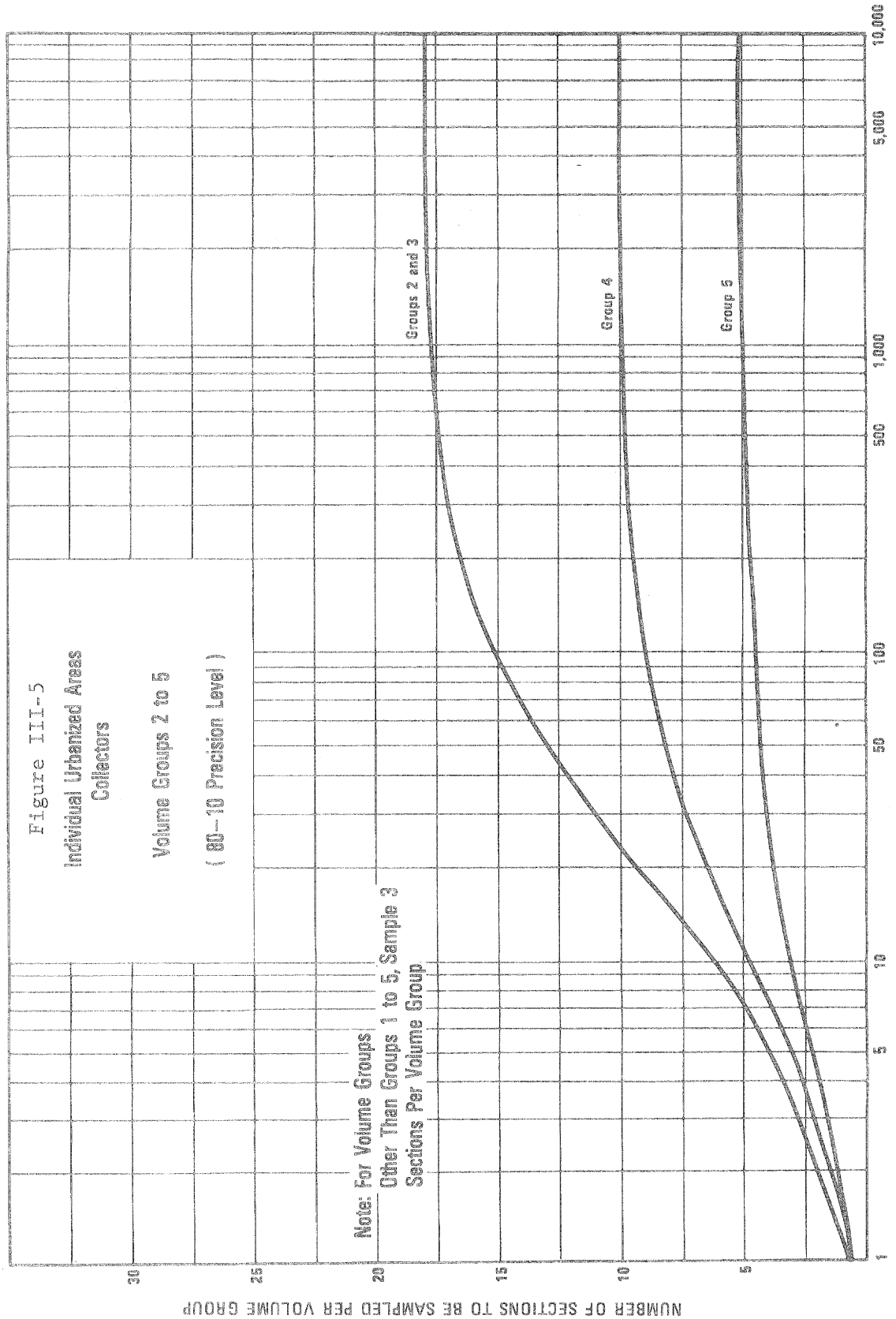


Figure III-5
Individual Urbanized Areas
Collectors
Volume Groups 2 to 5
(80-10 Precision Level)
Note: For Volume Groups
Other Than Groups 1 to 5, Sample 3
Sections Per Volume Group
Groups 2 and 3
Group 4
Group 5
NUMBER OF SECTIONS TO BE SAMPLED PER VOLUME GROUP
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING PER VOLUME GROUP
30
25
20
15
10
5
1
5
10
50
100
500
1,000
5,000
10,000

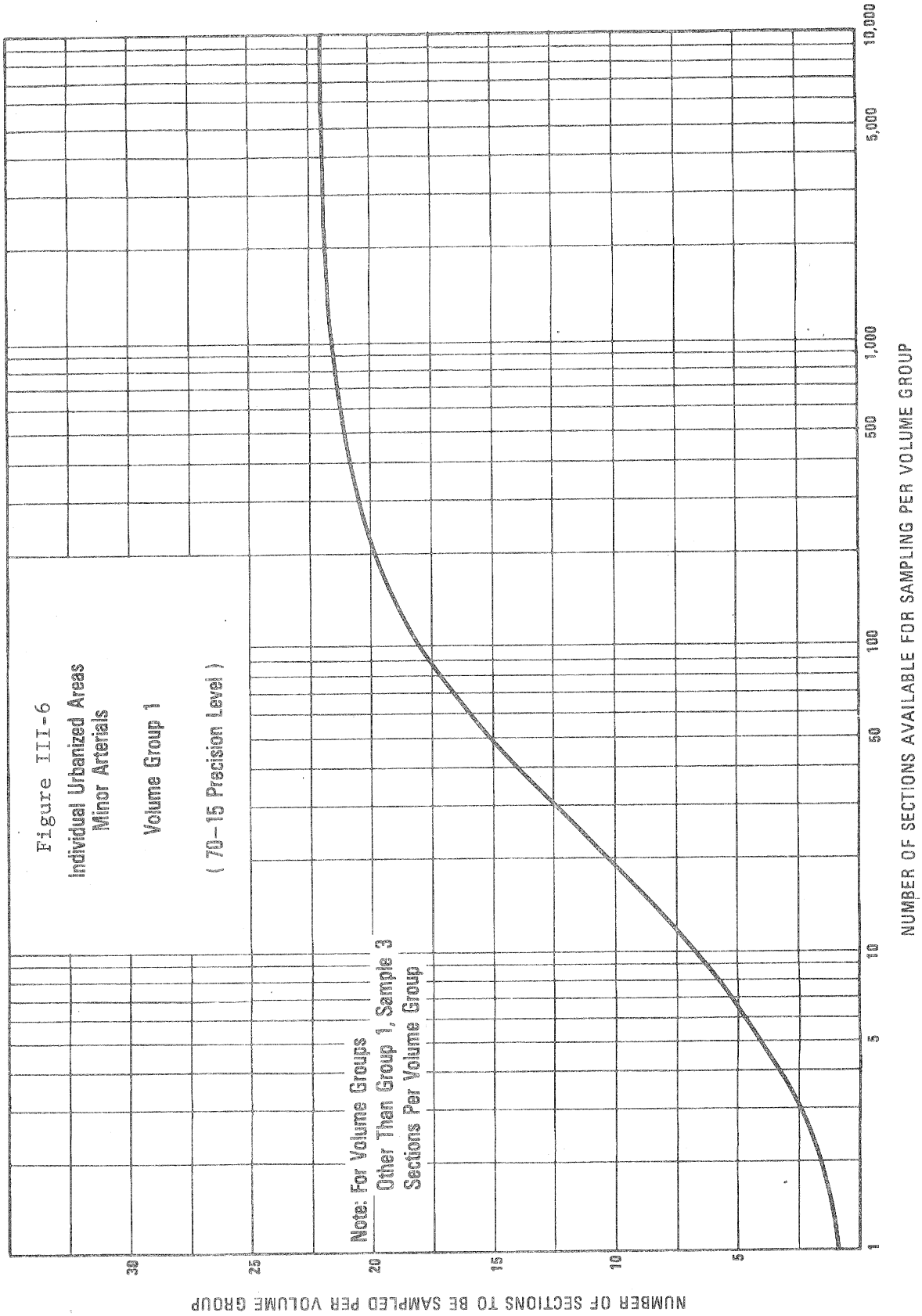


Figure III-6
Individual Urbanized Areas
Minor Arterials
Volume Group 1
(70-15 Precision Level)
Note: For Volume Groups Other Than Group 1, Sample 3 Sections Per Volume Group
NUMBER OF SECTIONS TO BE SAMPLED PER VOLUME GROUP
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING PER VOLUME GROUP
30
25
20
15
10
5
1
5
10
50
100
500
1,000
5,000
10,000

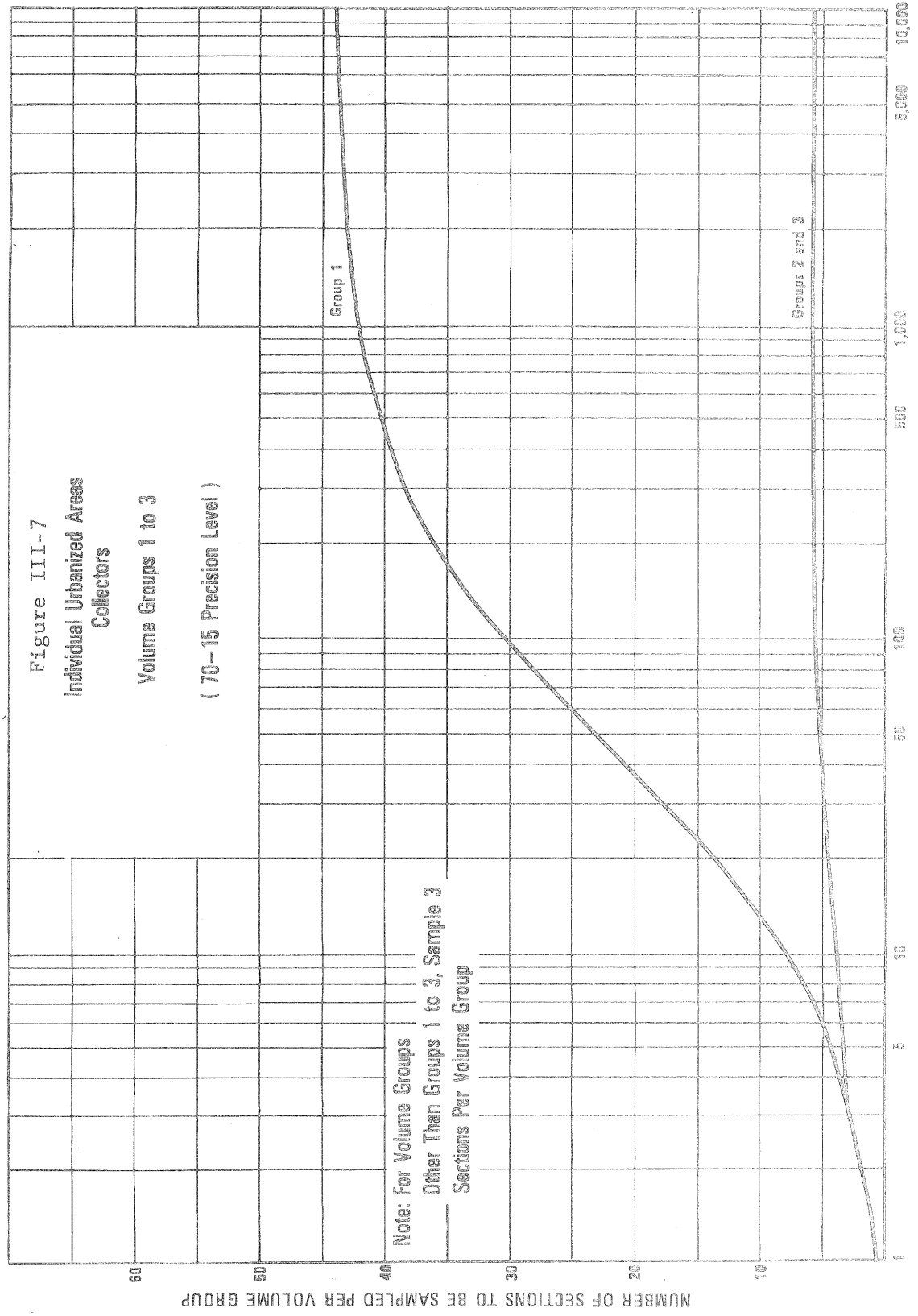


Figure III-7
Individual Urbanized Areas
Collectors
Volume Groups 1 to 3
(.75-.15 Precision Level)
Group 1
Groups 2 and 3
Note: For Volume Groups Other Than Groups 1 to 3, Sample 3 Sections Per Volume Group
NUMBER OF SECTIONS TO BE SAMPLED PER VOLUME GROUP
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING PER VOLUME GROUP
60
50
40
30
20
10
1
5
10
50
100
500
1,000
5,000
10,000

In the process of sample size selection, those States with less than three individual urbanized areas are to use the graphs for the 80-10 precision level in Figures III-2 through III-5; States having three or more individual urbanized areas may use the graphs in Figures III-2 and III-3 (80-10 precision level) and also the graphs in Figures III-6 and III-7 (70-15 precision level). In reading the appropriate graph, the number of sections in the given volume group universe is on the horizontal (x) axis and the applicable sections to be sampled are on the vertical (y) axis. A sample of three sections is required as applicable for those volume groups not specifically designated with a curve. Obviously, if there are only one or two sections in a volume group, they must all be sampled.

As with rural and small urban areas, the designated number of sections must be randomly selected from each volume group universe.

Optional Theoretical Approach

The preceding instructions in the FHWA-developed approach for the stratification and selection of sample size were developed for the convenience of the user. However, an individual State may wish to modify the FHWA approach because of special considerations or unusual characteristics in its highway system. The rationale for the FHWA sample design, which follows, should serve as a guide for possible modifications.

Sample Design Approval

Each State electing to use the optional theoretical approach shall submit a detailed plan of the sample design for review and approval by the FHWA Office of Highway Planning. Once an alternative sample design is submitted and accepted, the State may proceed with sampling sections. Some States may wish to make an initial or intermediate stratification by county, highway district, or terrain (for in-State use of the HPMS) which is totally acceptable providing that the final stratification is by volume group, systems, and areas as specified in this Manual. Each sample plan shall contain the following information:

1. A brief narrative description of the sample design.

2. The numbers and ranges of the volume group strata by functional class within each of the areas--rural, small urban, and individual urbanized (see Figure III-1).

3. The number of road sections to be sampled in each volume group by functional class within each area.

4. The total number of road sections available for sampling by volume group within each functional class and area.

5. The design precision level of accuracy at the volume group level for each functional class within each area. The minimum functional class volume group levels[1/] discussed earlier under this chapter must be met.

6. The method by which random samples will be drawn for each volume group.

Stratification

The allocation of sampling units into relatively homogeneous volume groups reduces overall sampling error and sample size requirements. Important considerations in the stratification process are the required number of strata for a functional class and the range of ADT values within each of the strata. A reasonable balance between the numbers and ranges of the strata must be obtained, with range as the controlling factor. If the strata ranges are too narrow, the assignment of road sections to the correct ADT group strata becomes difficult or questionable; if the ranges are too wide, the homogeneity of the strata is reduced--a judgment situation. A useful formula for approximating a suitable stratum range i for the two lowest volume strata is:

$$i = \frac{\text{Range}}{1 + 3.322 \log N}$$

where,

Range = the difference between the highest and lowest ADT in a given functional system.

N = the total number of road sections available for sampling in a given functional system.

The obtained value for i may be rounded to the nearest value of 500 or 1,000, as preferred. The ranges for higher volume groups may be considerably larger than the value of i, depending on the ADT frequency distribution of the road sections or individual State judgment.

In the FHWA approach, the above formula was used to a limited extent and the predetermined number of strata restricted to no more than nine for national coverage.

Empirical Method for Computing Sample Size

The ADT volume group strata are assigned areawide (rural, small urban, and individual urbanized) to each of the five functional systems in each area. The formulas for calculating the sample size, n_h, for each volume stratum for a given precision level of accuracy by simple random sampling are:

1/ If the sampling is by area subdivisions, e.g. highway districts, the precision level of estimates for combined subdivisions must conform to the rural, small urban, and urbanized area requirements as specified in this Manual--aggregates for these areas must also be possible.

$$n_h = \frac{n_o}{1 + n_o/N} \; ; \; n_o = \frac{Z^2(s_1^2 + s_2^2)}{d^2}$$

where,

n_h = the required sample size for a given volume group and for a given precision level, corrected for finiteness.

n_o = the required sample size without finite adjustment.

N = the total number of road sections available for sampling in a given volume group for a specific functional highway system in the State.

Z = the value of the normal variate as applied to a specific confidence level and the total number of road sections in a given volume group.1/

d = the allowable range of error from the midpoint value of a given ADT volume group. It is expressed as an absolute value and represents the allowable percentage deviation from the midpoint value of the volume group.

s_1^2 = the spatial variance. This refers to the variation of ADT values among road section locations for a given volume group. The square root of this value, s_1, is the spatial standard deviation. The simplest estimator of the standard deviation and its square, the variance, is based on the range of values contained in a volume group stratum. Analyses show that the normal distribution of ADT values within defined strata (volume groups) can be approximated. Thus, the spatial variance for a volume group can be estimated by the following formula, based on research by L. H. C. Tippett in Biometrika:

$$s_1^2 = \frac{(\text{Range})^2}{12} \cong (0.3 \text{ Range})^2$$

s_2^2 = the temporal variance. This is the variation of ADT over time at a given road section in a given ADT volume group. The square root of this value, s_2, is the temporal standard deviation. The formula for s_2 is:

$$s_2 = (CV)(\bar{X}_h) \text{ and } s_2^2 = [(CV)(\bar{X}_h)]^2$$

where,

CV = the coefficient of variation, a measure of the relative dispersion of individual road section

---

1/The Z values for confidence levels of 70, 80, 90, and 95 percent are 1.04, 1.29, 1.65, and 1.96, respectively.

ADT values over time with reference to the midpoint ADT value for a given volume group. Studies based on traffic counting programs have shown that the size of CV varies inversely with traffic volume.[1/] Figure III-8 shows a relationship between CV and two-way traffic volumes.

$\bar{X}_h$ = the midpoint of the predetermined volume group. In the computation of temporal variance the value of CV in Figure III-8 is referenced to this midpoint value.

Example Calculation--An illustration for the computation of sample size for a functional system follows.

To obtain the sample size needed to estimate the quantitative values of selected data elements in a functional system, e.g., rural, major collectors, at a precision level of 80 percent confidence in an allowable error of 10 percent, the following information is available:

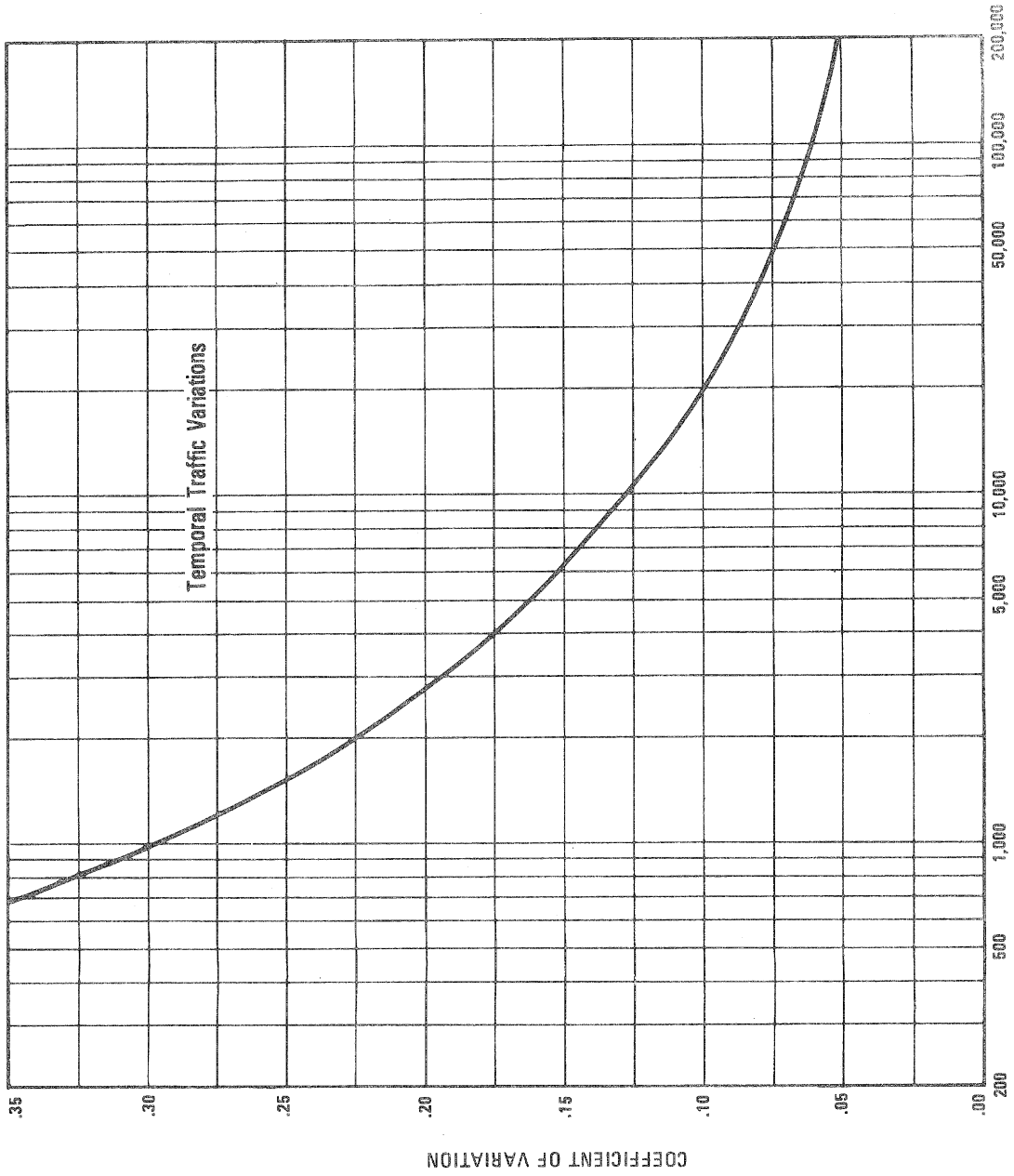
Stratum	Predetermined ADT Volume Group	Total Road Sections in Volume Group (N)	Midpoint Value of Volume Group ($\bar{X}$)	Value of $d^2 = (.10\bar{X})^2$	Range of Volume Group (R)
1	0-2,499	2,326	1,250	15,625	2,500
2	2,500-4,999	582	3,750	140,625	2,500
3	5,000-9,999	317	7,500	562,500	5,000
4	10,000-19,999	107	15,000	2,250,000	10,000
5	20,000-29,999	6	25,000	6,250,000	10,000
		3,338			

Computation, columns (1) through (6):

Stratum	(1) $s_1^2 = (.30R)^2$	(2) CV from Figure III-8	(3) $s_2^2 = [(CV)(\bar{X}_h)]^2$	(4) $s_1^2 + s_2^2$
1	562,500	0.27	113,906	676,406
2	562,500	0.18	455,625	1,018,125
3	2,250,000	0.14	1,102,500	3,352,500
4	9,000,000	0.11	2,722,500	11,722,500
5	9,000,000	0.0925	5,347,656	14,347,656

1/"Guide to Urban Traffic Volume Counting," U.S. Department of Transportation, FHWA, October 1975.

Figure III-8



SOURCE: "Guide to Urban Traffic Volume Counting," U.S. Department of Transportation, FHWA, October 1975.

Stratum	(5) $n_o = \frac{Z^2(s_1^2 + s_2^2)}{d^2}$; Z = 1.29	(6) $n_h = \frac{n_o}{1 + n_o/N}$
1	72.04	70
2	12.05	12
3	9.92	10
4	8.67	8
5	3.82	* 3
	Total sample for functional system	= 103

*No less than three road sections will be sampled for a volume group.

Sample Size Adjustments for Estimating Proportions

The sample size determined by the empirical method is based on the measurement of ADT and ADT sensitive variables. The empirical method sample size is appropriate for determining mean values of data elements, such as the average pavement condition of rural minor arterials. However, the same sample must be used to estimate proportions of mileage with certain characteristics, e.g., the rural minor arterial mileage with a pavement condition of less than 2.0. Therefore, steps must be taken to ensure that sample size requirements for quantitative data allow for sufficient sample size to produce proportionate estimates at desired accuracy levels at the functional class level. A method for determining an acceptable precision level for proportionate values is to find the functional system sample size required to detect a given percent change in proportions. The ability to detect change is a function of sample size and sampling error, the true values of estimated proportions being unknown. The relation between the smallest detectable percent change in proportions and sample size is shown in the formulas below.

Given, the formula:

$$(p_2 - p_1)^2 = Z^2[\bar{p}\bar{q}\ (\frac{1}{n_1} + \frac{1}{n_2})]$$

where,

p_1 = the estimated proportion for a given data element attribute for a functional system at time period #1.

p_2 = the same as above for time period #2.

Z = the normal variate for a given level of confidence.

$\bar{p} = (p_1 + p_2)/2$

$\bar{q} = 1 - \bar{p}$

n_1 = the total number of road sections in the sample panel for time period #1.

n_2 = the same as above for time period #2.

Assuming a "worst case" situation where $\bar{p} = \bar{q} = 0.50$, and $n_1 = n_2$ in the fixed sample, then let $2/n_o = \frac{1}{n_1} + \frac{1}{n_2}$.

Substituting, the formula reduces to

$$(p_2 - p_1)^2 = \frac{0.5Z^2}{n_o} \quad \text{or} \quad n_o = \frac{0.5Z^2}{(p_1 - p_2)^2}$$

and

$$n = \frac{n_o}{1 + n_o/N}$$ the number of samples required in a functional system to detect a given change in proportions

where,

N = the total number of road sections available for sampling in a functional system.

If the above formulas are applied to the base data in the illustration on page III-22 for example, the required number of sections (n) to detect with 80 percent confidence a 10 percent change in proportions in a system with 3338 road sections is:

$$n_o = \frac{0.5(1.29)^2}{(0.10)^2} = \frac{0.832}{0.01} = 83$$

$$n = \frac{83}{1 + 83/3338} = 81$$

The above value of 81 for the functional system is compared with the strata total of 103 sections in the illustration, where the desired precision level is directed to the individual strata. If the above formulas for minimum detectable change in proportions were applied to each stratum, the required functional system total sample size for detecting a 10 percent change by stratum with 80 percent confidence would be 272 sections, an inordinately large sample size for national purposes. Therefore, in this example, the calculated sample size of 81 is adequate for proportions at the functional system level, but will not achieve the desired accuracy standard for each stratum. A larger overall sample size is needed to achieve the desired accuracy for proportions at the stratum level. This, however, is not a requirement for HPMS.

The minimum detectable change in proportions $(p_2 - p_1)$ for any given number of sample road sections at stratum or functional system level is obtainable from the formula given below. Thus, for a functional system sample of 103 road sections out of a total of 3338, the minimum detectable percent change at 80 percent confidence is:

$$(p_2 - p_1)^2 = \frac{N - n}{N} \cdot Z^2(\bar{p}\,\bar{q} \cdot 2/n)$$

where,

$\frac{N - n}{N}$ = the finite correction factor

and, substituting values

$$(p_2 - p_1)^2 = \frac{3338 - 103}{3338} \cdot (1.29)^2(0.25)(2/103) = 0.007829$$

$$(p_2 - p_1) = 0.0885 = 8.9 \text{ percent}$$

Once a functional system sample size is calculated for the desired minimum detectable change $(p_2 - p_1)$ at the desired confidence level, this size can be compared to the volume strata sample size and, if larger, can be proportionately distributed among the stratum.

It is required that the design sample size at the functional system level be such that the smallest detectable change in proportions is no greater than 10 percent,and preferably less at the 80 percent confidence level.

It also should be noted that the values for n in the above formulas refer to the total number of sampled sections in a functional system whereas the values for p are the proportions for specific data element attributes obtained by the ratio of sampled attribute mileage to total sampled mileage in a functional system. In rural areas where the lengths of road sections are, as a rule, greater than those in urban areas, the computed value for the smallest detectable change is somewhat overestimated. This overestimate is reduced or nonexistent in urban areas as road section lengths approach 1 mile or less.

Alternative Random Sample Selection Method

In some instances, a State may not have its system mileage, e.g., collector mileage, subdivided into sections with assigned ADT's for sample selection. One of the following approaches can be used in such a case.

The first step is to determine the distribution of functional class mileage by ADT group. Using existing records and traffic flow maps, the ADT volume group(s) of each arterial and collector should be identified and marked on a map. It is suggested that the identification of mileage to volume groups start with the highest volume group and work downwards. When all mileage associated with the volume groups other than the lowest volume group has been identified, the total mileage for each completed volume group can be determined by scaling mileages from the maps. The sum of these mileages subtracted from the total functional class mileage yields the mileage in the lowest volume group. This approach will prove quite useful for functional classes with relatively high mileage in the lowest volume group.

After the mileage in each volume group has been established, the next step is to randomly select sample sections. The basic requirement is that each section has an equal probability of being selected. Without having specific sections identified, a sample location must be randomly selected and then a section containing the selected location must be established. Two alternative approaches for randomly sampling locations are presented below:

Sample Location Approach No. 1

1. Establish the following table for each volume group within each functional class and area.

Volume Group Mileage (Whole Miles)

Route	Miles	Cumulative Miles

2. Using a random number table (a computerized random number generating program could also be used), select an area in the table containing numbers with the same number of digits as are contained in the total volume group mileage (to the nearest mile). Choosing a number from this area of the table, compare this number to the cumulated miles column of the step 1 table and if the random number identifies a mile contained in a given subtotal line of the table, this location within the route is sampled. As an illustration, working with the following example and a two digit random number table, the first two digit random number selected is 12.

Route	Miles	Cumulative Miles
50	10	10
100	15	25
212	10	35

Looking at the cumulative miles column, this places the selected milepoint (12) 2 miles into the Route 100 mileage; therefore, the first location selected is mile 2 of Route 100. Additional random numbers are drawn and the process is repeated until the required sample size is obtained. Repeated random numbers and numbers larger than the total volume group mileage are ignored. Before the exact location to be sampled on a route can be established, a statewide convention must be established as to which end of a route will be the zero end. Using this convention and accumulating volume group miles from the maps, the sampled milepoints can be located.

Sample Location Approach No. 2

The second approach is much like the first approach except that only one random number is drawn and all other sample locations are chosen

at fixed mileage intervals from the random start milepoint. The required fixed interval is calculated by dividing the total volume group mileage by the required number of samples for the volume group. For example, using information from step 2 above and assuming five samples are needed, the fixed interval will be $\frac{35}{5}$ = 7 miles. Therefore with a random number of 12, as before, the locations sampled from the accumulative mileage column would be 12, 19, 26, 33, and 5 which translate to the following route locations:

Route 50 milepoint 5
Route 100 milepoints 2, 9, 16, and 23

Given the locations to be sampled, the States must establish homogeneous sections containing these locations and conforming to section requirements defined in other parts of this Manual.

Chapter IV

INSTRUCTIONS FOR COMPLETING THE URBAN INVENTORY WORKSHEET

General Instructions

This chapter contains detailed instructions for completing the urban inventory worksheet (Figure IV-1). In order to facilitate compilation of the total nationwide data base by the FHWA Washington Office, the information recorded on the worksheets must be coded and placed on data cards in a consistent format. To aid in this effort, the worksheets are suitable for direct use as coding sheets. The specifications for editing these data are given in Appendix E. Computer software to convert the data to a uniform tape format and to edit it will be provided at a later date. Sufficient copies of the worksheets will be supplied to each State.

Items 1 through 5 on the worksheet must be coded in columns 1 through 18 on each data card. All entries must be right justified. For example, a future ADT of 2175 would be entered in the six-digit field as _ _ 2 1 7 5.

Optional Data

Deferred Data

Certain data items that will be required for future submittals are optional for this initial submittal. For example, detailed curve data for principal arterials may be omitted if average highway speed is provided. (Average highway speed is applicable only to Interstate and other freeways and expressways.) If all the data items on a card are being omitted, that card may be completely omitted. For example, optional card 5 for bridge identification numbers could be deleted for the 1978 submittal. Although detailed curve and grade data are not required for minor arterials and collectors, the State may choose to provide them.

Optional MFRS Data

As discussed in the HPMS/MFRS Coordination Section in Chapter I, the following data elements may be reported as a part of the 1978 MFRS submittal rather than as a part of this submittal: County Code, Jurisdictional Responsibility, Federal-Aid System, Functional System, Access Control, Right-of-Way Width, 1978 ADT, and Surface Type. If these items are not reported as a part of this submittal, code zeros in these items.

Detailed Instructions

Card No. 1 (Required)	Columns
Item 1 - Year. Precoded as "78".	1-2

Figure IV-1

Urban Inventory Worksheet

CARD 1 (Required)

1. Year — 7 8 — 1-2
2. State Code — 3-4
3. Type of Section ID — 5
4. Section ID — 6-17
5. Segment — 0 — 18
*6. County Code — 19-21
7. Urban Area Code — 22-24
*8. Functional Class — 25-26

Code	Functional System
11	Principal Arterial-Interstate
12	Principal Arterial-Other Freeway or Expressways-Connecting Link
13	Principal Arterial-Other Freeways or Expressways-Non-Connecting Link
14	Principal Arterial-Other-Connecting Link
15	Principal Arterial-Other-Non-Connecting Link
16	Minor Arterial
17	Collector

*9. Federal-Aid System — 27

Code	Federal-Aid System
1	Interstate
2	Federal-Aid Primary
3	Federal-Aid Urban
8	Non-Federal-Aid

*10. Jurisdictional Responsibility — 28

Code	Jurisdiction
1	State
2	Federal Domain
3	Toll
4	Other

11. Section Length (0.01 Mile) — . — 29-32
*12. Access Control — 33

Full	Partial	None
1	2	3

13. Number of Through Lanes — 34-35
14. Lane Width (feet) — 36-37
15. Approach Width (feet) — 38-40
16. Median Width (feet) — 41-42
17. Median Type — 43

Curbed	Positive Barrier	Unprotected	None
1	2	3	4

18. Shoulder Width (feet)
    a. Right — 44-45
    b. Left — 46-47
19. Shoulder Type — 48

Surfaced	Stabilized	Earth	Curbed	None
1	2	3	4	5

20. Drainage Adequacy — 49

Good	Fair	Poor
1	2	3

*21. Surface Type — 50-51
22. Pavement Section — 52

'SN' Known	'D' Known	Heavy	Medium	Light
1	2	3	4	5

23. Structural Number (SN) or Slab Thickness (D) — 53-54
24. Pavement Condition (0.0) — . — 55-56
25. Skid Resistance (Fwys & Expwys Only--Optional) — 57-58
26. Number of Grade-Separated Interchanges (Fwys & Expwys Only) — 59-60
27. Number of At-Grade Intersections with Public Roads with:
    a. Signals — 61-62
    b. Stop Signs — 63-64
    c. Other or No Controls — 65-66
28. Prevailing Type of Signalization — 67
    1. Uncoordinated Fixed Time, 2. Traffic Actuated, 3. Progressive, 4. None
29. Typical Percent Green Time — 68-69
30. Number of Major Commercial/Industrial/Recreational Access Points — 70-71
32. Urban Location — 72

Code	Location
1	CBD
2	Fringe
3	Outlying Business District
4	Residential
5	Rural

*34. Existing Right-of-Way Width (feet) — 73-75
35. Is Widening Feasible? — 76
    1. No, 2. Yes, less than one lane, 3. Yes, one lane, 4. Yes, two lanes, 5. Yes, more than two lanes.
    Card Number — 1 — 80

CARD 2 (Required)

1-5 Identification (Repeat Card 1) — 1-18
*36. 1978 ADT — 19-24
37. Percent Trucks
    a. Peak Period — 25-26
    b. Off Peak — 27-28
38. K Factor — 29-30
39. Directional Factor — 31-33
40. Type of Operation — 34

Code	Type
1	One Way
2	Two Way
3	One Way, Reversible
4	Two Way, Reversible
5	One Way with HOV Lane
6	Two Way, with HOV Lane
7	One Way with Exclusive Bus Lane(s)
8	Two Way with Exclusive Bus Lane(s)
9	Two Way with Exclusive Bus Roadway
0	Two Way with Exclusive HOV Roadway

41. Parking
    a. Peak Period — 35

One Side	Both Sides	None
1	2	3

    b. Off Peak — 36

One Side	Both Sides	None
1	2	3

42. Capacity
    a. Peak Period — 37-41
    b. Off Peak — 42-46
43. 2000 ADT — 47-52
44. Number of Structures — 53-54
45. Number of At-Grade Railroad Crossings — 55-56
46. ADT Volume Group Identification — 57-58
47. Expansion Factor (00.00) — . — 59-62

FHWA 1501H

*Reporting via MFRS permissible.

Figure IV-1 Continued

48. Speed Limit (m.p.h.) 63-64
52. Average Highway Speed (m.p.h.) 65-66
Card Number 2 80

CARD 3 (Optional)
1-5 Identification (Repeat Card 2) 1-18
53. Curves by Class

Degree of Curvature	No. of Curves	Length (0.1 miles)	
a. 0.5-1.4			19-23
b. 1.5-2.4			24-28
c. 2.5-3.4			29-33
d. 3.5-4.4			34-38
e. 4.5-5.4			39-43
f. 5.5-6.9			44-48
g. 7.0-8.4			49-53
h. 8.5-10.9			54-58
i. 11.0-13.9			59-63
j. 14.0-19.4			64-68
k. 19.5-27.9			69-73
l. 28+			74-78
Card Number		3	80

CARD 4 (Optional)
1-5 Identification (Repeat Card 3) 1-18
54. Grades by Class

Gradient (%)	No. of Grades	Length (0.1 miles)	
a. 0.0-0.4			19-23
b. 0.5-2.4			24-28
c. 2.5-4.4			29-33
d. 4.5-6.4			34-38
e. 6.5-8.4			39-43
f. 8.5+			44-48
Card Number		4	80

CARD 5 (Optional)
1-5 Identification (Repeat Card 4) 1-18
55. Bridge Identification Numbers (four per card)
19-33
34-48
49-63
64-78
Card Number 5 80

CARD 5 (Optional)
1-5 Identification (Repeat Card 4) 1-18
55. Bridge Identification Numbers (four per card)
19-33
34-48
49-63
64-78
Card Number 5 80

CARD 6 (Optional)
1-5 Identification (Repeat Card 5) 1-18
56. At-Grade Railroad Crossing Identification Numbers (eight per card)
19-25
26-32
33-39
40-46
47-53
54-60
61-67
68-74
Card Number 6 80

WORKSHEET FOR CALCULATING AVERAGE HIGHWAY SPEED (AHS)

Degree of curvature 1/	Approximate Design Speed (mph)	Number of curves	Total travel time (min.) (from Table F-1)
28.0 – 43.0	25		
19.5 – 27.9	30		
14.0 – 19.4	35		
11.0 – 13.9	40		
8.5 – 10.9	45		
7.0 – 8.4	50		
5.5 – 6.9	55		
4.5 – 5.4	60		
3.5 – 4.4	65		
	Totals =		
	Tangent travel time =		
	Total travel time =		

Section length _____ mi.
Total curve length _____ mi. (from Table F-2)
Tangent length _____ mi.
x 0.86 min./mi.
Tangent travel time _____ min.
Section length _____ mi.
Average Highway Speed = _____ x 60 = _____ mph
Total travel time _____ min.
Rounded AHS = _____ mph

1/ For maximum superelevation rate of 0.08 ft./ft.

PEAK

WORKSHEET FOR CALCULATING CAPACITY OF URBAN HIGHWAYS

Capacity of Freeway and Expressway Facilities (Uninterrupted Flow)

$C = 2000\ N\ W\ T_c$

C = Capacity (total in one direction)

N = Number of lanes (in one direction)

W = Adjustment for lane width and lateral clearance (from Table 9.2 in the 1965 Highway Capacity Manual)

T_c = Truck factor for overall highway section (from Table 9.3b in the 1965 Highway Capacity Manual)

C = 2000 x _____ x _____ x _____ = _____

Capacity of Urban Arterial Streets (Interrupted Flow)

Capacity of urban arterial streets may be determined using Figures 6.5 – 6.10 and Tables 6.4 – 6.6 in 1965 Highway Capacity Manual 1/.

C = _____ (Approach vol. per hr. of green) x _____ (% green time) x _____ (Adjustment for PHF and metro. area size)

x _____ (Adjustment for location within metro. area) x _____ (Adjustment for trucks and busses) x _____ (Adjustment for turns (if available))

= _____ . (total in one direction)

1/ Capacity charts developed by Jack E. Leisch may also be used.

OFF PEAK

WORKSHEET FOR CALCULATING CAPACITY OF URBAN HIGHWAYS

Capacity of Freeway and Expressway Facilities (Uninterrupted Flow)

$C = 2000\ N\ W\ T_c$

C = Capacity (total in one direction)

N = Number of lanes (in one direction)

W = Adjustment for lane width and lateral clearance (from Table 9.2 in the 1965 Highway Capacity Manual)

T_c = Truck factor for overall highway section (from Table 9.3b in the 1965 Highway Capacity Manual)

C = 2000 x _____ x _____ x _____ = _____

Capacity of Urban Arterial Streets (Interrupted Flow)

Capacity of urban arterial streets may be determined using Figures 6.5 – 6.10 and Tables 6.4 – 6.6 in 1965 Highway Capacity Manual 1/.

C = _____ (Approach vol. per hr. of green) x _____ (% green time) x _____ (Adjustment for PHF and metro. area size)

x _____ (Adjustment for location within metro. area) x _____ (Adjustment for trucks and busses) x _____ (Adjustment for turns (if available))

= _____ . (total in one direction)

1/ Capacity charts developed by Jack E. Leisch may also be used.

Columns

Item 2 - State Code. Enter the State code as listed in Appendix C. — 3-4

Item 3 - Type of Section Identification. Enter the code shown below which indicates the type of section identification used: — 5

Code	Type
1	Route, Milepoint
2	A-Node, B-Node, Segment
3	Any Unique Number

Item 4 - Section ID. Enter a unique section identifier using any of the following: The A-Node, B-Node, and Segment as coded for the MFRS; the Route and Milepoint as coded for the MFRS; or any other number. The Section ID must be unique on a statewide basis. (See page IV-20 for detailed instructions.) — 6-17

Item 5 - Segment. This item is for future use only. It will be used if it becomes necessary to subdivide a section due to operational or capital improvements on part of the section's length. Precoded as "0". — 18

Item 6 - County Code. Enter the three-digit county code as shown in the "Federal Information Processing Standards Publication 6". — 19-21

Item 7 - Urban Area Code. For urban areas of at least 50,000 in population, enter the code shown in Appendix B. For small urban areas, enter "999". — 22-24

Item 8 - Functional Class. Enter the code shown on the worksheet that represents the functional class of the section. — 25-26

Item 9 - Federal-Aid System. Enter the code shown on the worksheet which represents the Federal-aid system of which this section is a part. — 27

Item 10- Jurisdictional Responsibility. Enter the code shown on the worksheet which represents the jurisdiction having present responsibility for the section. The codes are defined as follows: — 28

Columns

Code	Jurisdiction
1	State. Includes all routes under a State agency, excluding those under toll authorities, for which a State, multi-State, or quasi-State agency has responsibility.
2	Federal Domain. Includes routes for which a Federal agency, such as the National Park Service, Forest Service, Bureau of Indian Affairs, etc., has principal responsibility for capital improvements and maintenance and which are not included in the State or local road systems.
3	Toll. Includes road and crossing facilities for which a public or quasi-public toll authority is principally responsible even if no toll is charged on the highway section being classified.
4	Other. Includes all routes that do not fall in the above three categories, such as county, city, etc.

While it is important that HPMS and MFRS jurisdictional responsibility codes correlate well, HPMS does not require the level of detail of MFRS. To provide correlation between HPMS and MFRS codes, the following table is provided.

Jurisdictional Responsibility Codes

HPMS	MFRS
1	1, 11, 21
2	60-99
3	31-36
4	2-4, 12-14, 22-26

Item 11- Section Length. Enter the section length to the nearest 0.01 mile. 29-32

Item 12- Access Control. Enter the code for the type of access control, as defined below: 33

Code	Type of Access Control
1	Full Access Control. Preference has been given to through traffic movements by providing interchanges with selected public roads and by prohibiting crossings at grade or direct private driveway connections.

Columns

2 Partial Access Control. Preference has been given to through traffic movement. In addition to interchanges, there may be some crossings at grade with public roads, but direct private driveway connections have been minimized.

3 No Access Control.

Item 13- Number of Through Lanes. Enter the number of lanes, in both directions (excluding parking lanes), carrying through traffic in the off-peak period. Exclude short sections of truck climbing lanes. 34-35

Item 14- Lane Width. Enter the traffic lane width (through lanes) to the nearest foot. 36-37

Item 15- Approach Width. For sections which are not freeways or expressways, enter the approach width (curb to curb for one-way streets or curb to division line for two-way streets), including parking lanes but excluding separate turn lanes, for a typical intersection. Entries should be to the nearest foot. Code "000" for freeways and expressways. 38-40

Item 16- Median Width. Enter the predominant median width (including shoulders, if any), measured between the inside edges of the through roadways, to the nearest foot. Enter "00" for undivided or 2-lane roadways. Enter "99" where the median width is 100 feet or greater. 41-42

Item 17- Median Type. Enter the appropriate code shown on the worksheet. 43

Item 18- Shoulder Width.

a. Right Shoulder - Enter the width to the nearest foot. Enter "00" if no right shoulder exists. 44-45

b. Left Shoulder - On divided highways, enter the width of the left (median) shoulder to the nearest foot. Enter "00" where no left shoulder exists and for undivided or 2-lane facilities. 46-47

Item 19- Shoulder Type. Enter the code shown below for the predominant type of shoulder on the section. If shoulder types differ, the right shoulder type should normally be considered to be the predominant type. If the section has both shoulders and curbs, code the shoulders. 48

Columns

Code	Shoulder Type
1	Surfaced. A portland cement or bituminous surface course on a granular or stabilized base.
2	Stabilized. Gravel or other granular material, with or without admixture, capable of supporting most loads even in wet weather.
3	Earth. Natural earth, with or without turf.
4	Curbed. No shoulders exist. Section is curbed.
5	None. No shoulders or curbs.

Item 20- Drainage Adequacy. Enter the code, as shown below, for the drainage adequacy of the section. Adequacy is based on the height of the grade line, the design of the cross section, and the capability, both in condition and capacity, of the cross drains to maintain a well-drained surface on a stable subgrade. 49

Code	Rating
1	Good. Fully adequate drainage and cross section design. No evidence of flooding, erosion, ponding, or other water damage.
2	Fair. Height of grade line, crossing section, or culvert capacity somewhat below the standard that would apply if rebuilt. Drainage structures are sound. Some added maintenance effort required due to drainage problems.
3	Poor. Evidence of severe flooding, ponding, erosion, or other drainage problems. Drainage structures may be in poor condition. Considerable excess maintenance effort required due to drainage problems.

Item 21- Surface Type. Enter the code shown below that represents the type of surface on the section 50-51

Columns

Code	Description
30	Graded and Drained. A road of natural earth aligned and graded to permit reasonably convenient use by motor vehicles and drained by longitudinal and transverse drainage systems (natural and artificial) sufficient to prevent serious impairment of the road by normal surface water, with or without dust palliative treatment or a continuous course of special borrow material to protect the new roadbed temporarily and to facilitate immediate traffic service. (Road Type[1/] C)
40	Soil, Gravel, or Stone. A road, the surface of which consists of mixed soil, stablized soil, gravel, or stone. Gravel or stone surfaces may be stablized. (Road Types[1/] D, E)
51	Bituminous Surface Treated. An earth road, a soil-surfaced road, or a gravel or stone road to which has been added by any process a bituminous surface course with or without a seal coat, the total compacted thickness of which is less than 1 inch. Seal coats include those known as chip seals, drag seals, plantmix seals, and rock asphalt seals. (Road Type[1/] F)
52	Mixed Bituminous. (See definition below.) Low type (less than 7 inches combined thickness surface and base). (Road Type[1/] G-1)
53	Bituminous Penetration. (See definition below.) Low type (less than 7 inches combined thickness surface and base). (Road Type[1/] H-1)
60	High Flexible. Mixed bituminous or bituminous penetration road on a rigid or flexible base with a combined (surface and base) thickness of 7 inches or more. Includes any bituminous concrete, sheet asphalt, and rock asphalt. (Road Types[1/] G-2, G-3, G-4, H-2, H-3, H-4, I)
70	High Rigid. Portland cement concrete pavements with or without bituminous surfaces of less than 1 inch. (Road Types [1/] J, J-3, J-4)

1/ As defined in the "Guide for Reporting Roadway, Travel, and Accident Data," Federal Highway Administration, September 1976.

80 Brick, Block, Other, or Combination. A road consisting of paving brick; stone, asphalt, wood, and other block; steel or wood with or without a bituminous wearing surface less than 1 inch in compacted thickness. Includes roads with combinations of wearing surfaces. (Road Types[1/] K, L, M)

DEFINITIONS:

Mixed Bituminous Pavement - A road, the surface course of which is 1 inch or more in compacted thickness composed of gravel, stone, sand, or similar material, mixed with bituminous material under partial control as to grading and proportions.

Bituminous Penetration Road - A road, the surface course of which is 1 inch or more in compacted thickness composed of gravel, stone, sand, or similar material bound with bituminous material introduced by downward or upward penetration.

Item 22- Pavement Section. Enter the code shown on the worksheet to indicate that the structural number ("SN" - for flexible pavements) or the slab thickness ("D" - for rigid pavements) is known or the code for the type of pavement section (heavy, medium, light) where detailed data are not known. To assist in determining the type of pavement section, the following table has been prepared showing three typical pavement sections. This guide includes typical thicknesses of surface, base and subbase, and the minimum combined depth of pavement structure. For unpaved facilities, enter "0". Unpaved facilities are those designated as graded and drained earth, soil surfaced, or gravel or stone roads (Codes 30 and 40 in Item 21). 52

1/ Ibid.

Code	Type of Section	Flexible Pavement "SN" Range	Surface Type & Thickness	Base Type & Thickness	Subbase Type & Thickness	Combined Depth[1]	Rigid Pavement Range in Pavement Thickness "D"
3	Heavy	4.6-6.0	4" asphaltic concrete	9" crushed stone to PC concrete	4" gravel[2]	> 12"	9.1 - 11.0" (8" if continuously reinforced)
4	Medium	3.1-4.5	3" asphaltic concrete	8" gravel to penetration macadam	4" gravel	11-12"	7.1 - 9.0" (6" if continuously reinforced)
5	Light	1.0-3.0	Surface treatment to 2" asphaltic concrete	6" gravel or crushed stone	2" gravel or sand	10"	6.0 - 7.0"

1/To be used as a guide where only the total depth is known or estimated.

2/Subbase course not necessary under portland cement concrete base.

Item 23- Structural Number (SN) or Slab Thickness (D). Enter the structural number (to the nearest 0.1) for those sections coded "1" in Item 22. Enter the slab thickness (in whole inches) for those sections coded "2" in Item 22. Otherwise, enter "00". 53-54

Item 24- Pavement Condition. Enter the pavement condition (actual PSR or equivalent), to the nearest tenth, for all paved sections. For unpaved sections (defined in Item 22), code "00". The ratings are equivalent to those used in making a Present Serviceability Rating (PSR), so recent PSR and Present Serviceability Index (PSI) ratings may be used where available. Also, if current sufficiency ratings of pavement condition (but excluding geometrics) are available, a correlation between the sufficiency rating scale and the PSR scale or rating factors may be developed so that such existing ratings may be used. If there are no recent PSR, PSI, or sufficiency ratings that can be adapted, the section should be rated as shown in Figure IV-2. In view of the growing national concern regarding pavement deterioration, careful attention to realistic pavement condition ratings is strongly suggested. 55-56

Figure IV-2

Pavement Condition Rating

PSR	Verbal Rating	Description
5	Very good	Only new (or nearly new) pavements are likely to be smooth enough and sufficiently free of cracks and patches to qualify for this category. All pavements constructed or resurfaced during 1978 should be rated very good.
4	Good	Pavements in this category, although not quite as smooth as those described above, give a first-class ride and exhibit few, if any visible signs of surface deterioration. Flexible pavements may be beginning to show evidence of rutting and fine random cracks. Rigid pavements may be beginning to show evidence of slight surface deterioration, such as minor cracks and spalling.
3	Fair	The riding qualities of pavements in this category are noticeably inferior to those of new pavements, and may be barely tolerable for high-speed traffic. Surface defects of flexible pavements may include rutting, map cracking, and more or less extensive patching. Rigid pavements in this group may have a few joint failures, faulting and cracking, and some pumping.
2	Poor	Pavements that have deteriorated to such an extent that they are in need of resurfacing.
1	Very Poor	Pavements which are in an extremely deteriorated condition and may even need complete reconstruction.
0		

Columns

Item 25- Skid Resistance. This item is optional for 1978. For all freeways and expressways, including Interstate, enter the skid number to the nearest whole number as measured by a locked wheel skid trailer per ASTM E274. For all other facilities, enter "00". If omitted for 1978, enter "00". 57-58

Item 26- Number of Grade-Separated Interchanges. For freeway and expressway facilities only, enter the number of grade-separated interchanges. Enter "00" if none exist or if the facility is not a freeway or expressway. 59-60

Item 27- Number of At-Grade Intersections with Public Roads with:

a. Signals - Enter the number of signalized intersections. If none, enter "00". 61-62

b. Stop Signs - Enter the number of intersections controlled by stop signs. If none, enter "00". 63-64

c. Other or No Controls - Enter the number of intersections controlled by other types of signing or having no controls. If none, enter "00". 65-66

Item 28- Prevailing Type of Signalization. Enter the appropriate code as shown on the worksheet which best describes the signal system on the section. 67

Item 29- Typical Percent Green Time. Enter the typical percent green time in effect during peak hours at the signalized intersections in this section. Enter "00" if no signalized intersections exist. 68-69

Item 30- Number of Major Commercial/Industrial/Recreational Access Points. Enter the number of entrances/exits that are estimated to have at least 500 vehicle movements (access plus egress) per week for other principal and minor arterials. Adjacent entrances or exits should be counted as one. If none or for other functional systems, enter "00". 70-71

Columns

Item 32- Urban Location. Enter the appropriate code shown on the worksheet that best reflects present land use in the area adjacent to the section. The definitions for CBD, fringe, outlying business district, and residential are discussed in the 1965 "Highway Capacity Manual." If an area appears to fit in two of these categories, the code for the higher density of development should be used. 72

Item 34- Existing Right-of-Way Width. Enter the existing prevailing right-of-way width in feet for the section. Where data are unavailable, estimates are sufficient. In heavily built up areas such as the CBD where the only space between the curbs and buildings is the sidewalk area, enter the curb-to-curb width. 73-75

Item 35- Is Widening Feasible? Enter the appropriate code shown on the worksheet to indicate the extent to which it is feasible to widen the existing road. Consider only the physical features along the roadway section, such as buildings, severe terrain, cemeteries and park land; do not consider restrictions because of current right-of-way width. 76

Card Number - Precoded 1. 80

Card No. 2 (Required)

Identification - See instructions for Card No. 1. 1-18

Item 36- 1978 ADT. Enter the estimated present (1978) average daily traffic (total both directions). Although traffic counts on the sample sections are not anticipated for the 1978 estimates, steps should be taken to prepare reasonable estimates since these data will be used to estimate VMT.

Item 37- Percent Trucks. Enter the percentage of commercial vehicles to the nearest percent, excluding pickups, panels, and light (two-axle, four-tired) trucks for the following:

a. Peak Period 25-26
b. Off Peak 27-28

It is recognized that this item will likely not be available separately for peak and off-peak periods on many facilities. Where this is the case, the same value may be coded for both periods. On certain routes, e.g., recreational and heavy

Columns

commuter routes, the differences are significant and will have a major impact in calculating capacity. In these cases, separate values are urged even if they must be estimated.

Item 38- K Factor. Enter the K factor - the design hour volume (30th highest hour) as a percentage of the average daily traffic - to the nearest percent. 29-30

Item 39- Directional Factor. Enter the percentage of the design hour volume (30th highest hour) flowing in the peak direction, to the nearest 5 percent. Code "100" for one-way facilities. 31-33

Item 40- Type of Operation. Enter the appropriate code as indicated which reflects the type of operation during the peak hour. 34

Code	Operation
1	One Way. All lanes are always in the same direction.
2	Two Way. Traffic in both directions is present at all times.
3	One-Way Reversible. All lanes are in one direction with the direction reversing from the a.m. to the p.m. peak hours.
4	Two-Way Reversible. One or more, but not all, lanes are reversed from the a.m. to the p.m. peak hours.
5	One Way with High Occupancy Vehicle (HOV) Lanes(s).
6	Two Way with HOV Lane(s).
7	One Way with Exclusive Bus Lane(s).
8	Two Way with Exclusive Bus Lane(s).
9	Two Way with Exclusive Bus Roadway.
0	Two Way with Exclusive HOV Roadway.

Columns

Item 41- Parking. Enter the appropriate code provided on the worksheet reflecting the type of parking, if any, that is allowed or exists on the section. If parking regulations are routinely ignored, use the code reflecting the actual situation rather than the regulations.

a. Peak Period 35

b. Off Peak 36

Item 42- Capacity.

a. Peak Period - Enter the present hourly capacity (in one direction) reflecting the peak-period situation taking into consideration the peak-period parking regulations, signalization, local bus movements, etc. The procedures described in the 1965 "Highway Capacity Manual" should be used for these calculations. For a recommended aid in simplifying the calculation of capacity, see "Capacity Analysis Techniques for Design of Signalized Intersections" by Jack E. Leisch, August 1967 and October 1967 issues of "Public Roads" and also reprinted as a special issue. For purposes of this study, a capacity consistent with Level of Service "E" as defined in the 1965 "Highway Capacity Manual" should be calculated and entered on the inventory worksheet. This corresponds to "possible capacity" as used in the AASHTO "Blue Book." Thus, when using the Leisch charts, the value obtained directly from the chart must be multiplied by an appropriate factor to get Level of Service "E" or "possible capacity." Often urban street capacity is governed by a critical intersection in the section under study. When this is the case, code the capacity for the critical intersection. Otherwise, code the capacity of a typical intersection. Where detailed information is not known, assumptions will necessarily have to be made regarding such items as percent right and left turns in order to calculate capacity by section.[1/] 37-41

b. Off Peak - Enter the present hourly capacity (in one direction) reflecting the off-peak situation. For further information, see the instructions for peak-period capacity.[1/] 42-46

1/Capacity calculation forms are provided on the worksheets.

Columns

Item 43- 2000 ADT. Enter the forecast average daily traffic (total both directions) for 2000. See Chapter II, 2000 Travel Forecasts, for the basis of these projections. 47-52

Item 44- Number of Structures. Enter the number of existing bridges located within the section. A bridge is a structure erected over a depression or an obstruction, such as water, highway, or railway, and having a passageway for carrying traffic or other moving loads and having a length measured along the center of the overcrossing of more than 20 feet. Twin (side by side) structures are to be reported as two separate structures. All highway grade separation structures are to be reported only once, generally as part of the facility of highest functional class. (What is intended is that the structure be reported in conjunction with the highway system which would logically finance its improvement.) If the higher type facility were not part of the sample, then the structure would not be reported. This would not result in an underestimate of structures as might first be thought, because these unreported structures are accounted for through the expansion of the sample. If both roadways are on the same functional system, report the structure data with the roadway on which the deck is located, the "over" facility. Enter "00", if no structures exist. 53-54

Item 45- Number of At-Grade Railroad Crossings. Enter the number of at-grade railroad crossings on the section. Multiple tracks should be reported as a single crossing. Enter "00" if no at-grade crossings exist. 55-56

Item 46- ADT Volume Group Identifier. Enter the code representing the ADT volume group from which this sample section was selected (See Tables III-2 and III-3 and Figure III-1). 57-58

Item 47- Expansion Factor. For small urban areas, enter the expansion factor for the functional system and volume group to which the section belongs to the nearest hundredth. For urbanized areas, code the expansion factor for the functional system, volume group and urbanized area to which the section belongs. Instructions for calculation are given in Chapter III. 59-62

Columns

Item 48- Speed Limit. Enter the speed limit for the section. The daytime speed limit for automobiles posted on the greater part of the section should be used. On highways where the maximum allowable speed is 55 m.p.h. and where the speed limit is periodically physically posted (i.e., every 1 to 5 miles), enter "55". On other highways where the speed limit is 55 m.p.h. by statute but on which the speed limit is not posted (e.g., gravel roads in some States), enter "56". 63-64

Item 52- Average Highway Speed. This item is required only for freeways and expressways, including Interstate, and only when Item 53, Curves by Class, is not provided. Code "00" for all sections for which average highway speed is not supplied. Enter the average highway speed, to the nearest 5 m.p.h. 65-66

The average highway speed is determined by weighting the design speed of the individual horizontal curves and tangents in the section by the length of each. A recommended procedure for calculating average highway speed is included in Appendix F.

Card Number - Precoded 2. 80

Card No. 3 (Optional)

Identification - See instructions for Card No. 1. 1-18

Item 53- Curves by Class. This item is not required for minor arterials or collectors. States may choose to provide it. Detailed curvature data are optional for principal arterials for this submittal only, if Item 52, Average Highway Speed, is coded for freeway and expressway sections. They will be required for future submittals. Omit this card if curve data are not being supplied. 19-78

Enter the number of curves in each class shown on the worksheet and the sum of the lengths of the curves in each class. Enter zeros in the number of curves and curve length fields for those classes in which there are no curves. If the section is tangent, supply this card with zeros in all curve data.

Card Number - Precoded 3. 80

Card No. 4 (Optional)

	Columns
Identification - See instructions for Card No. 1.	1-18
Item 54- Grades by Class. This item is not required for minor arterials or collectors. States may choose to provide it. Detailed grade data are optional for principal arterials for this submittal only, and will be required for future submittals. Omit this card if grade data are not being supplied. Enter the number of grades in each class shown on the worksheet and the sum of the lengths of the grades in each class. Enter zeros in the number of grades and grade length fields for those classes in which there are no grades.	19-48
Card Number - Precoded 4.	80

Card No. 5 (Optional)

Identification - See instructions for Card No. 1.	1-18
Item 55- Bridge Identification Numbers. This information is optional for this submittal but will be required for future submittals. For the most part, only bridges on Federal-aid systems are inventoried at present. The Federal-Aid Highway Act of 1978 now requires preparation of an inventory of off-system bridges. Enter the 15-digit bridge identification numbers as coded for the Structure Inventory and Appraisal of the Nation's Bridges (Item 8 on the S.I. and A. record). Use as many of these cards as necessary to identify all bridges counted in Item 44. Omit this card if not supplying bridge numbers for this submittal.	19-78
Card Number - Precoded 5.	80

Card No. 6 (Optional)

Identification - See instructions for Card No. 1.	1-18
Item 56- At-Grade Railroad Crossing Identification Numbers. This information is optional for this submittal but will be required for future submittals. Enter the seven-digit railroad grade crossing identification used in the National Railroad-Highway Crossing Inventory. Use as many of these cards as necessary to identify all grade crossings counted in Item 45. Omit this card if not supplying crossing numbers for this submittal.	19-74
Card Number - Precoded 6.	80

ADDITONAL INSTRUCTIONS APPLICABLE TO OPTIONAL DATA CARDS (NUMBERS 3-6)

Card 3, Curves by Class and Card 4, Grades by Class:

If a State chooses to report optional curve and grade data, these data must be reported for all applicable HPMS sections.

Card 5, Bridge Identification Numbers and/or Card 6, At-Grade Railroad Crossing Identification Numbers:

If a State provides these optional identification numbers, each item must be complete on an individual HPMS section basis.

Detailed Instructions for Section ID

There are three permissible ways for establishing Section ID's. Outlined below are specific instructions for coding Items 3 and 4 depending on the option selected. The first two options are required only if the States are reporting HPMS data through the MFRS as outlined on page I-8.

Route - Milepoint - (Coordinated with MFRS)

Item 3 - Type of Section Identification, Column 5
Code 1 - Route, Milepoint.

Item 4 - Section ID, Columns 6-17
Route number, coded in Columns 6-11, right justified.
Milepoint, coded in Columns 12-17, right justified, coded to the nearest thousandth.

Example: Route 50 with milepoint 79.20

Node - Segment - (Coordinate with MFRS)

Item 3 - Type of Section Identification, Column 5
Code 2 - A-Node, B-Node, Segment.

Item 4 - Section ID, Columns 6-17
A-Node, Columns 6-10, right justified.
B-Node, Columns 11-15, right justified.
Segment, Columns 16-17, right justified.

Example: A-Node - 572 B-Node - 691 Segment - 4

Any Unique Number - (State's Existing Numbering System or Newly Assigned Numbers)

Item 3 - Type of Section Identification, Column 5
Code 3 - Any unique number.

Item 4 - Section ID, Columns 6-17
Code any statewide unique number with no more than 12 digits in Columns 6-17, right justified.

Example: Number assigned by State - 4321

Chapter V

INSTRUCTIONS FOR COMPLETING THE RURAL INVENTORY WORKSHEET

General Instructions

This chapter contains detailed instructions for completing the rural worksheet (Figure V-1). In order to facilitate compilation of the total nationwide data base by the FHWA Washington Office, the information recorded on the worksheets must be coded and placed on data cards in a consistent format. To aid in this effort, the worksheets are suitable for direct use as coding sheets. The specifications for editing these data are found in Appendix H. Computer software to convert the data to a uniform tape format and to edit it will be provided at a later date. Sufficient copies of the worksheets will be provided to each State.

Items 1 through 5 on the worksheet must be coded in columns 1 through 18 on each data card. All entries must be right justified. For example, a future ADT of 2175 would be entered in the six-digit field as _ _ 2 1 7 5.

Optional Data

Deferred Data

Certain data items that will be required for future submittals are optional for this initial submittal. For example, detailed curve and grade data for paved arterials may be omitted if average highway speed and horizontal and vertical alignment adequacy data are provided. Although detailed curve and grade data are not required for collectors, the State may choose to provide them in lieu of average highway speed, horizontal alignment adequacy, and vertical alignment adequacy, when these detailed data are readily available. If all the data items on a card are being omitted, that card may be completely omitted. For example, optional card 5 for bridge identification numbers could be deleted for the 1978 submittal.

Optional MFRS Data

As discussed in the HPMS/MFRS Coordination Section in Chapter I, the following data elements may be reported as a part of the 1978 MFRS submittal rather than as a part of this submittal: County Code, Jurisdictional Responsibility, Federal-Aid System, Functional System, Access Control, Right-of-Way Width, 1978 ADT, and Surface Type. If these items are not reported as a part of this submittal, code zeros in these items.

Detailed Instructions

Card No. 1 (Required)	Columns
Item 1 - Year. Precoded as "78".	1-2

Figure V-1

Rural Inventory Worksheet

CARD 1 (Required)

1.	Year	7 8	1-2
2.	State Code		3-4
3.	Type of Section ID		5
4.	Section ID		6-17
5.	Segment	0	18
*6.	County Code		19-21
*8.	Functional Class		22-23
*9.	Federal-Aid System		24
*10.	Jurisdictional Responsibility		25
11.	Section Length (0.01 mile)	.	26-29
*12.	Access Control		30
13.	Number of Through Lanes		31-32
14.	Lane Width (feet)		33-34
16.	Median Width (feet)		35-36
17.	Median Type		37
18.	Shoulder Width (feet) a. Right		38-39
	b. Left		40-41
19.	Shoulder Type		42
20.	Drainage Adequacy		43
*21.	Surface Type		44-45
22.	Pavement Section		46
23.	Structural Number (SN) or Slab Thickness (D)		47-48
24.	Pavement Condition (0.0)	.	49-50
25.	Skid Resistance (Paved Arterials Only—Optional)	.	51-52
26.	Number of Grade-Separated Interchanges (Fwys & Expwys Only)		53-54
27.	Number of At-Grade Intersections with Public Roads with: a. Signals		55-56
	b. Stop Signs		57-58
	c. Other or No Controls		59-60
30.	Number of Major Commercial/Industrial/ Recreational Access Points		61-62
31.	Type of Developement		63
33.	Terrain		64
*34.	Existing Right-of-way Width (feet)		65-67
35.	Is Widening Feasible?		68
*36.	1978 ADT		69-74
37.	Percent Trucks a. Peak Period		75-76
	b. Off Peak		77-78
	Card Number	1	80

Code | Functional System

Code	Functional System
01	Principal Arterial-Interstate
02	Principal Arterial-Other
06	Minor Arterial
07	Major Collector
08	Minor Collector

Code | Federal-Aid System

Code	Federal-Aid System
1	Interstate
2	Federal-Aid Primary
4	Federal-Aid Secondary
8	Non-Federal-Aid

Code | Jurisdiction

Code	Jurisdiction
1	State
2	Federal Domain
3	Toll
4	Other

Full | Partial | None

Full	Partial	None
1	2	3

Curbed | Positive Barrier | Unprotected | None

Curbed	Positive Barrier	Unprotected	None
1	2	3	4

Surfaced | Stabilized | Earth | Curbed | None

Surfaced	Stabilized	Earth	Curbed	None
1	2	3	4	5

Good | Fair | Poor

Good	Fair	Poor
1	2	3

'SN' Known | 'D' Known | Heavy | Medium | Light

'SN' Known	'D' Known	Heavy	Medium	Light
1	2	3	4	5

Rural | Dense

Rural	Dense
1	2

Flat | Rolling | Mountainous

Flat	Rolling	Mountainous
1	2	3

1. No; 2. Yes, less than one lane; 3. Yes, one lane; 4. Yes, two lanes; 5. Yes, more than two lanes

CARD 2 (Required)

1-5	Identification (Repeat Card 1)	1-18
38.	K Factor	19-20
39.	Directional Factor	21-23
42.	Peak-Period Capacity (Optional)	24-28
43.	2000 ADT	29-34
44.	Number of Structures	35-36
45.	Number of At-Grade Railroad Crossings	37-38
46.	ADT Volume Group Identifier	39-40
47.	Expansion Factor (00.00)	. 41-44
48.	Speed Limit (m.p.h.)	45-46
49.	Percent of Length with Sight Distance≥1500 Feet	47-49
50.	Horizontal Alignment Adequacy	50
51.	Vertical Alignment Adequacy	51
52.	Average Highway Speed (m.p.h.)	52-53
	Card Number	2 80

CARD 3 (Optional)

1-5.	Identification (Repeat Card 2)	1-18
53.	Curves by Class	

Degree of Curvature	No. of Curves	Length (0.1 miles)	
a. 0.5-1.4		.	19-23
b. 1.5-2.4		.	24-28
c. 2.5-3.4		.	29-33
d. 3.5-4.4		.	34-38
e. 4.5-5.4		.	39-43
f. 5.5-6.9		.	44-48
g. 7.0-8.4		.	49-53
h. 8.5-10.9		.	54-58
i. 11.0-13.9		.	59-63
j. 14.0-19.4		.	64-68
k. 19.5-27.9		.	69-73
l. 28+		.	74-78
Card Number		3	80

FHWA 1501 I

* Reporting via MFRS permissible.

Figure V-1 Continued

CARD 4 (Optional)

1-5 Identification (Repeat Card 3) 1-18

54. Grades by Class Gradient (%)

	No. of Grades	Length (0.1 miles)	
a. 0.0-0.4		.	19-23
b. 0.5-2.4		.	24-28
c. 2.5-4.4		.	29-33
d. 4.5-6.4		.	34-38
e. 6.5-8.4		.	39-43
f. 8.5+		.	44-48
Card Number		4	80

CARD 5 (Optional)

1-5 Identification (Repeat Card 4) 1-18

55. Bridge Identification Numbers (four per card)

	19-33
	34-48
	49-63
	64-78
Card Number 5	80

CARD 5 (Optional)

1-5 Identification (Repeat Card 4) 1-18

55. Bridge Identification Numbers (four per card)

	19-33
	34-48
	49-63
	64-78
Card Number 5	80

CARD 6 (Optional)

1-5 Identification (Repeat Card 5) 1-18

56. At-Grade Railroad Crossing Identification Numbers (eight per card)

	19-25
	26-32
	33-39
	40-46
	47-53
	54-60
	61-67
	68-74
Card Number 6	80

WORKSHEET FOR CALCULATING AVERAGE HIGHWAY SPEED (AHS)

Degree of curvature 1/	Approximate Design Speed (mph)	Number of curves	Total travel time (min.) (from Table F-1)
28.0 – 43.0	25		
19.5 – 27.9	30		
14.0 – 19.4	35		
11.0 –13.9	40		
8.5 – 10.9	45		
7.0 – 8.4	50		
5.5 – 6.9	55		
4.5 – 5.4	60		
3.5 – 4.4	65		
	Totals =		
		Tangent travel time =	
		Total travel time =	

Section length _____ mi.

– Total curve length _____ mi. (from Table F-2)

Tangent length _____ mi.

x 0.86 min./mi.

Tangent travel time _____ min.

Section length _____ mi.

Average Highway Speed = _____ x 60 = _____ mph

Total travel time _____ min.

Rounded AHS = _____ mph

1/ For maximum superelevation rate of 0.08 ft./ft.

Figure V-1 Continued

WORKSHEET FOR CALCULATING RURAL HIGHWAY CAPACITY

Capacity of 2-lane highways

$C = 2000\ W_c\ T_c$

C = Capacity, vph (total in both directions)

W_c = _____ (adjustment for lane width and lateral clearance, from Table 10.8 in the 1965 Highway Capacity Manual)

T_c = _____ (truck factor for overall highway sections, from Table 10.9b in the 1965 Highway Capacity Manual)

C = 2000 x _____ x _____ = _____

Capacity of multilane highways

$C = 2000\ N\ W\ T_c$

C = Capacity, vph (total for one direction)

N = _____ (number of lanes in one direction

W = _____ (adjustment for lane width and lateral clearance, from Tables 9.2 or 10.2 in the 1965 Highway Capacity Manual)

T_c = _____ (truck factor for overall highway section, from Tables 9.3b or 10.3b in the 1965 Highway Capacity Manual)

C = 2000 x _____ x _____ x _____ = _____

Columns

Item 2 - State Code. Enter the State code as listed in Appendix C. 3-4

Item 3 - Type of Section Identification. Enter the code shown below which indicates the type of section identification used: 5

Code	Type
1	Route, Milepoint
2	A-Node, B-Node, Segment
3	Any Unique Number

Item 4 - Section ID. Enter a unique section identifier using any of the following: The A-Node, B-Node, and Segment as coded for the MFRS; the Route and Milepoint as coded for the MFRS; or any other number. The Section ID must be unique on a state-wide basis. (See page V-21 for detailed instructions.) 6-17

Item 5 - Segment. This item is for future use only. It will be used if it becomes necessary to subdivide a section due to operational or capital improvement on part of the section's length. Precoded as "0". 18

Item 6 - County Code. Enter the three-digit county code as shown in the "Federal Information Processing Standards Publication 6." 19-21

Item 8 - Functional Class. Enter the code shown on the worksheet which represents the functional class of the section. 22-23

Item 9 - Federal-Aid System. Enter the code shown on the worksheet which represents the Federal-aid system of which this section is a part. 24

Item 10- Jurisdictional Responsibility. Enter the code as shown on the worksheet which represents the jurisdiction having present responsibility for the section. The codes are defined as follows: 25

Code	Jurisdiction
1	State. Includes all routes under a State agency, excluding those under toll authorities, for which a State, multi-State, or quasi-State agency has responsibility.

Columns

2 Federal Domain. Includes routes for which a Federal agency, such as the National Park Service, Forest Service, Bureau of Indian Affairs, etc., has principal responsibility for capital improvements and maintenance and which are not included in the State or local road systems.

3 Toll. Includes road and crossing facilities for which a public or quasi-public toll authority is principally responsible even if no toll is charged on the section being classified.

4 Other. Includes all routes that do not fall in the above three categories, such as county, city, etc.

While it is important that HPMS and MFRS jurisdictional responsibility codes correlate well, HPMS does not require the level of detail of MFRS. To provide correlation between HPMS and MFRS codes, the following table is provided:

Jurisdictional Responsibility Codes

HPMS	MFRS
1	1, 11, 21
2	60-99
3	31-36
4	2-4, 12-14, 22-26

Item 11- Section Length. Enter the section length to the nearest 0.01 mile. 26-29

Item 12- Access Control. Enter the code for the type of access control, as defined below: 30

Code Type of Access Control

1 Full Access Control. Preference has been given to through traffic movements by providing interchanges with selected public roads and by prohibiting crossings at grade or direct private driveway connections.

Columns

2 Partial Access Control. Preference has been given to through traffic movement. In addition to interchanges, there may be some crossings at grade with public roads, but direct private driveway connections have been minimized.

3 No Access Control.

Item 13- Number of Through Lanes. Enter the number of lanes, in both directions (excluding parking lanes), carrying through traffic in the off-peak period. Exclude short sections of truck climbing lanes. 31-32

Item 14- Lane Width. Enter the traffic lane width (through lanes) to the nearest foot. 33-34

Item 16- Median Width. Enter the predominant median width (including shoulders, if any), measured between the inside edge of the through roadways, to the nearest foot. Enter "00" for undivided or 2-lane roadways. Enter "99" where the median width is 100 feet or greater. 35-36

Item 17- Median Type. Enter the appropriate code shown on the worksheet. 37

Item 18- Shoulder Width.

a. Right Shoulder - Enter the width to the nearest foot. Enter "00" if no right shoulder exists. 38-39

b. Left Shoulder - On divided highways, enter the width of the left (median) shoulder to the nearest foot. Enter "00" where no left shoulder exists and for undivided or 2-lane facilities. 40-41

Item 19- Shoulder Type. Enter the code shown below for the predominant type of shoulder on the section. If shoulder types differ, the right shoulder type should normally be considered to be the predominant type. If the section has both shoulders and curbs, code the shoulders. 42

Columns

Code	Shoulder Type
1	Surfaced. A portland cement or bituminous surface course on a granular or stabilized base.
2	Stabilized. Gravel or other granular material, with or without admixture, capable of supporting most loads even in wet weather.
3	Earth. Natural earth, with or without turf.
4	Curbed. No shoulders exist. Section is curbed.
5	None. No shoulders or curb.

Item 20- Drainage Adequacy. Enter the code, as shown below, for the drainage adequacy of the section. Adequacy is based on the height of the grade line, the design of the cross section, and the capability of the cross drains, both in condition and capacity, to maintain a well-drained surface on a stable subgrade. 43

Code	Rating
1	Good. Fully adequate drainage and cross section design. No evidence of flooding, erosion, ponding, or other water damage.
2	Fair. Height of grade line, cross section, or culvert capacity somewhat below the standard that would apply if rebuilt. Drainage structures are sound. Some added maintenance effort required due to drainage problems.
3	Poor. Evidence of severe flooding, ponding, erosion, or other drainage problems. Drainage structures may be in poor condition. Considerable excess maintenance effort required due to drainage problems.

Item 21- Surface Type. Enter the code shown below that represents the type of surface on the section. 44-45

Columns

Code	Description
30	Grade and Drained. A road of natural earth aligned and graded to permit reasonably convenient use by motor vehicles and drained by longitudinal and transverse drainage systems (natural and artificial) sufficient to prevent serious impairment of the road by normal surface water, with or without dust palliative treatment or a continuous course of special borrow material to protect the new roadbed temporarily and to facilitate immediate traffic service. (Road Type[1/] C)
40	Soil, Gravel, or Stone. A road, the surface of which consists of mixed soil, stabilized soil, gravel, or stone. Gravel or stone surfaces may be stabilized. (Road Types[1/] D, E)
51	Bituminous Surface-Treated. An earth road, a soil-surfaced road, or a gravel or stone road to which has been added by any process a bituminous surface course with or without a seal coat, the total compacted thickness of which is less than 1 inch. Seal coats include those known as chip seals, drag seals, plantmix seals, and rock asphalt seals. (Road Type[1/] F)
52	Mixed Bituminous. (See definition below.) Low type (less than 7 inches combined thickness surface and base). (Road Type[1/] G-1)
53	Bituminous Penetration. (See definition below.) Low type (less than 7 inches combined thickness surface and base). (Road Type[1/] H-1)
60	High Flexible. Mixed bituminous or bituminous penetration road on a rigid or flexible base with a combined (surface and base) thickness of 7 inches or more. Includes any bituminous concrete, sheet asphalt, or rock asphalt. (Road Types[1/] G-2, G-3, G-4, H-2, H-3, H-4, I)
70	High Rigid. Portland cement concrete pavements with or without bituminous surfaces of less than 1 inch. (Road Types[1/] J, J-3, J-4)

1/ As defined in the "Guide for Reporting Roadway, Travel, and Accident Data," Federal Highway Administration, September 1976.

80 Brick, Block, Other, or Combination. A road consisting of paving brick; stone, asphalt, wood, or other block; steel or wood with or without a bituminous wearing surface less than 1 inch in compacted thickness. Includes roads with combinations of wearing surfaces. (Road Types[1] K, L, M)

DEFINITIONS:

Mixed Bituminous Pavement - A road, the surface course of which is 1 inch or more in compacted thickness composed of gravel, stone, sand, or similar material, mixed with bituminous material under partial control as to grading and proportions.

Bituminous Penetration Road - A road, the surface course of which is 1 inch or more in compacted thickness composed of gravel, stone, sand, or similar material bound with bituminous material introduced by downward or upward penetration.

Item 22- Pavement Section. Enter the code shown on the worksheet to indicate that the structural number ("SN" - for flexible pavements) or the slab thickness ("D" - for rigid pavements) is known or the code for the type of pavement section (heavy, medium, light) where detailed data are not known. To assist in determining the type of pavement section, the table below has been prepared showing three typical pavement sections. This guide includes typical thicknesses of surface, base and subbase, and the minimum combined depth of pavement structure. For unpaved facilities enter "0". Unpaved facilities are those designated as graded and drained earth and soil, gravel, or stone roads (Codes 30 and 40 in Item 21). 46

1/ Ibid.

Code	Type of Section	Flexible Pavement "SN" Range	Surface Type & Thickness	Base Type & Thickness	Subbase Type & Thickness	Combined Depth[1]	Rigid Pavement Range in Pavement Thickness "D"
3	Heavy	4.6-6.0	4" asphaltic concrete	9" crushed stone to PC concrete	4" gravel[2]	> 12"	9.1 - 11.0" (8" if continuously reinforced)
4	Medium	3.1-4.5	3" asphaltic concrete	8" gravel to penetration macadam	4" gravel	11-12"	7.1 - 9.0" (6" if continuously reinforced)
5	Light	1.0-3.0	Surface treatment to 2" asphaltic concrete	6" gravel or crushed stone	2" gravel or sand	10"	6.0 - 7.0"

1/To be used as a guide where only the total depth is known or estimated.

2/Subbase course not necessary under portland cement concrete base.

Columns

Item 23- Structural Number (SN) or Slab Thickness (D). 47-48
Enter the structural number (to the nearest 0.1) for those sections coded "1" in Item 22. Enter the slab thickness (in whole inches) for those sections coded "2" in Item 22. Otherwise enter "00".

Item 24- Pavement Condition. Enter the pavement condition 49-50
(actual PSR or equivalent) to the nearest tenth, for all paved sections. For unpaved sections, enter "00". See Item 22 for the definition of unpaved. The ratings are equivalent to those used in making a Present Serviceability Rating (PSR), so recent PSR and Present Serviceability Index (PSI) ratings may be used where available. Also, if current sufficiency ratings of pavement condition (but excluding geometrics) are available, a correlation between the sufficiency rating scale and the PSR scale or rating factors may be developed so that such existing ratings may be utilized. If there are no recent PSR, PSI, or sufficiency ratings that can be adapted, the section should be rated as shown in Figure V-2. In view of the growing national concern regarding pavement deterioration, careful attention to realistic pavement condition ratings is strongly suggested.

Figure V-2

Pavement Condition Rating

PSR	Verbal Rating	Description
5	Very good	Only new (or nearly new) pavements are likely to be smooth enough and sufficiently free of cracks and patches to qualify for this category. All pavements constructed or resurfaced during 1978 should be rated very good.
4	Good	Pavements in this category, although not quite as smooth as those described above, give a first-class ride and exhibit few, if any visible signs of surface deterioration. Flexible pavements may be beginning to show evidence of rutting and fine random cracks. Rigid pavements may be beginning to show evidence of slight surface deterioration, such as minor cracks and spalling.
3	Fair	The riding qualities of pavements in this category are noticeably inferior to those of new pavements, and may be barely tolerable for high-speed traffic. Surface defects of flexible pavements may include rutting, map cracking, and more or less extensive patching. Rigid pavements in this group may have a few joint failures, faulting and cracking, and some pumping.
2	Poor	Pavements that have deteriorated to such an extent that they are in need of resurfacing.
1	Very Poor	Pavements which are in an extremely deteriorated condition and may even need complete reconstruction.
0		

Columns

Item 25- Skid Resistance. This item is optional for 1978. For all paved arterials, enter the skid number to the nearest whole number as measured by a locked wheel skid trailer per ASTM E274. For all other facilities, enter "00". If omitted for 1978, code "00". 51-52

Item 26- Number of Grade-Separated Interchanges. For freeway and expressway facilities only, enter the number of grade-separated interchanges. Enter "00" if none exist or if the facility is not a freeway or expressway. 53-54

Item 27- Number of At-Grade Intersections with Public Roads with:

a. Signals - Enter the number of signalized intersections. If none, enter "00". 55-56

b. Stop Signs - Enter the number of intersections controlled by stop signs. If none, enter "00". 57-58

c. Other or No Controls - Enter the number of intersections controlled by other types of signing or having no controls. If none, enter "00". 59-60

Item 30- Number of Major Commercial/Industrial/Recreational Access Points. Enter the number of such entrances/exits that are estimated to have at least 500 vehicle movements (access plus egress) per week for other principal and minor arterials. Adjacent entrances or exits should be counted as one. If none or for other functional systems, enter "00". 61-62

Item 31- Type of Development. Enter the code shown below for the predominant type of development. 63

Code	Type of Development
1	Rural. All areas outside of urban boundaries (cities of 5,000 or more population) excluding those described as "dense."
2	Dense. Those areas outside of urban boundaries which have urban characteristics (i.e., small towns) or areas in which major recreational facilities, such as parks, ski resorts, scenic overlooks, and rest areas, have significant impact on traffic operation of the adjacent facility.

Columns

Item 33- Terrain. Enter the code as shown below for the predominant terrain type through which the section passes. — 64

Code	Terrain Type
1	Flat Terrain. That condition where highway sight distances, as governed by both horizontal and vertical restrictions, are generally long or could be made to be so without construction difficulty or major expenses.
2	Rolling Terrain. That condition where the natural slopes consistently rise above and fall below the highway grade line and where occasional steep slopes offer some restriction to normal highway horizontal and vertical alignment.
3	Mountainous Terrain. That condition where the longitudinal and transverse changes in the elevation of the ground with respect to the highway are abrupt and where the roadbed requires frequent benching or side hill excavation.

Item 34- Existing Right-of-Way Width. Enter the prevailing right-of-way width in feet for the section. Where data are unavailable, estimates are sufficient. — 65-67

Item 35- Is Widening Feasible? Enter the appropriate code shown on the worksheet to indicate the extent to which it is feasible to widen the existing road. Consider only the physical features along the roadway section such as buildings, severe terrain, cemeteries, and parkland; do not consider restrictions because of current right-of-way width. — 68

Item 36- 1978 ADT. Enter the estimated present (1978) average daily traffic (total both directions). Although traffic counts on the sample sections are not anticipated for the 1978 estimates, steps should be taken to prepare reasonable estimates since these data will be used to estimate VMT. — 69-74

Item 37- Percent Trucks. Enter the percentage of commercial vehicles to the nearest percent, excluding pickups, panels, and light (two-axle, four-tired) trucks for the following:

a. Peak Period — 75-76
b. Off Peak — 77-78

Columns

It is recognized that this item will likely not be available for peak and off-peak periods on many facilities. Where this is the case, the same value may be coded for both periods. On certain routes, e.g., recreational, the differences are significant and will have major impact in calculating capacity. In these cases, separate values are urged even if they must be estimated.

Card Number - Precoded 1. 80

Card No. 2 (Required)

Identification - See instructions for Card No. 1. 1-18

Item 38- K Factor. Enter the K factor - the design hour volume (30th highest hour) as a percentage of the average daily traffic - to the nearest percent. 19-20

Item 39- Directional Factor. Enter the percentage of the design hour volume (30th highest hour) flowing in the peak direction, to the nearest 5 percent. Code "100" for one-way facilities. 21-23

Item 42- Peak-Period Capacity. This item is optional. It should be entered if the facility has features affecting capacity but not reflected on this record. If capacity is not reported, code "00000". The off-peak percent trucks (Item 37b) will be used by FHWA to calculate off-peak capacity. 24-28

Enter the present hourly capacity (total of both directions for two-lane facilities and for one direction on multi-lane facilities). Capacity is the maximum service volume at Level of Service E, as described in the 1965 "Highway Capacity Manual" (HCM). (This corresponds to possible capacity as used in the 1965 AASHTO "Blue Book.") The procedures described in the HCM should be used for this calculation.1/

In built-up areas of small towns (population less than 5,000), it may be more reasonable to calculate capacity using the procedures described in Chapter VI of the HCM for urban areas, but the capacity should still be reported as a total of both directions for two-lane facilities and for one direction on multi-lane facilities.

1/A capacity calculation form is provided on the worksheet.

Columns

Example: The section is a rural 2-lane highway in rolling terrain with 11-foot lanes, 4-foot unpaved shoulders, lateral obstructions outside the shoulders, and carrying 10 percent trucks. From the HCM, we get a W_c of 0.83 (for 11-foot lanes with 4-foot lateral clearance) and a T_c of 0.71 (for 10 percent trucks in rolling terrain). Capacity is therefore 2,000 x 0.83 x 0.71 or 1,180 vph.

Item 43- 2000 ADT. Enter the forecast average daily traffic (total both directions) for 2000. See Chapter II, 2000 Travel Forecasts, for the basis of these projections. 29-34

Item 44- Number of Structures. Enter the number of existing bridges located within the section. A bridge is a structure erected over a depression or an obstruction such as water, highway, or railway, and having a passageway for carrying traffic or other moving loads and having a length measured along the center of the overcrossing of more than 20 feet. Twin (side by side) structures are to be reported as two separate structures. All highway grade separation structures are to be reported only once, generally as part of the facility of highest functional class. (What is intended is that the structure be reported in conjunction with the highway system which would logically finance its improvement.) If the higher type facility were not part of the sample, then the structure would not be reported. This would not result in an underestimate of structures as might first be thought, because these unreported structures are accounted for through the expansion of the sample. If both roadways are on the same functional system, report the structure data with the roadway on which the deck is located, the "over" facility. Enter "00" if no structures exist. 35-36

Item 45- Number of At-Grade Railroad Crossings. Enter the number of at-grade railroad crossings on the section. Multiple tracks should be reported as a single crossing. Enter "00" if no at-grade crossings exist. 37-38

Item 46- ADT Volume Group Identifier. Enter the code representing the ADT volume group from which this sample section was selected (See Table III-1 and Figure III-1). 39-40

Columns

Item 47- Expansion Factor. Enter the expansion factor for the functional class and traffic volume group to which the section belongs to the nearest hundredth. Instructions for calculation are given in Chapter III. 41-44

Item 48- Speed Limit. Enter the speed limit for the section. The daytime speed limit for automobiles posted on the greater part of the section should be used. On highways where the maximum allowable speed is 55 m.p.h. and where the speed limit is periodically physically posted (i.e., every 1 to 5 miles), enter "55". On other highways where the speed limit is 55 m.p.h. by statute, but on which the speed limit is not posted (e.g., gravel roads in some States), enter "56". 45-46

Item 49- Percent of Length with Sight Distance ≥ 1500 Feet. For all paved two-lane facilities except for dense rural sections where free-flow conditions do not exist, enter the percent of the section length (estimated to the nearest 10 percent) which has an available passing sight distance (as measured from the driver's eye to the road surface) of at least 1500 feet. See Appendix I for optional estimating procedures. This item will be used in the calculation of vehicle speeds. Code "000" for nonapplicable sections. 47-49

Item 50- Horizontal Alignment Adequacy. This item is required for all paved collectors unless the State prefers to supply Item 53, Curves by Class. For this submittal, it is required for all paved arterials when Item 53, Curves by Class, is not provided. Code "0" if horizontal alignment adequacy is not supplied. Enter the code, as shown below, for the horizontal alignment adequacy of the section. 50

Code	Description
1	All curves meet appropriate design standards. Reduction of curvature would be unnecessary even if reconstruction were required to meet other deficiencies, i.e., capacity, vertical alignment, etc.
2	Although some curves are below appropriate design standards for new construction, all curves can be safely and comfortably negotiated at the prevailing speed limit on the section. The speed limit was not established by the design speed of curves.

Columns

3 Infrequent curves with design speeds less than the prevailing speed limit on the section. Infrequent curves may have reduced speed limits for safety purposes.

4 Several curves uncomfortable and/or unsafe when travelled at the prevailing speed limit on the section, or the speed limit on section is severely restricted due to the design speed of curves.

Item 51- Vertical Alignment Adequacy. This item is required for all paved collectors unless the State prefers to provide Item 54, Grades by Class. For this submittal, it is required for all paved arterials when Item 54, Grades by Class, is not provided. Code "0" if vertical alignment adequacy is not supplied. Enter the code, as shown below, for the vertical alignment adequacy of the section. 51

Code	Description
1	All grades (rate and length) and vertical curves meet minimum design standards appropriate for the terrain. Reduction in rate or length of grade would be unnecessary even if reconstruction were required to meet other deficiencies, i.e., capacity, horizontal alignment, etc.
2	Although some grades (rate and/or length) and vertical curves are below appropriate design standards for new construction, all grades and vertical curves provide sufficient sight distance for safe travel and do not substantially affect the speed of trucks.
3	Infrequent grades and vertical curves that impair sight distance and/or affect the speed of trucks if truck climbing lanes are not provided.
4	Frequent grades and vertical curves that impair sight distance and/or severely affect the speed of trucks and truck climbing lanes are not provided.

Columns

Item 52- Average Highway Speed. This item is required for all paved collectors for which the type of development is rural (Item 31 coded as "1") unless the State prefers to provide Item 53, Curves by Class. It is optional for collectors in densely developed areas (Item 31 coded as "2"). For this submittal only, it is required for all paved arterials for which Item 53, Curves by Class, is not provided. Code "00" if the AHS is not supplied. Enter the AHS rounded to the nearest of the following values 70, 60, 50, 45, 40, 35. 52-53

The average highway speed is determined by weighting the design speed of the individual horizontal curves and tangents in the section by the length of each. A recommended procedure is contained in Appendix F.

Card Number - Precoded 2. 80

Card No. 3 (Optional)

Identification - See instructions for Card No. 1. 1-18

Item 53- Curves by Class. This item is not required for collectors or for any unpaved facilities. It may be supplied for paved collectors if the State prefers to provide it in lieu of Item 50, Horizontal Alignment Adequacy, and Item 52, Average Highway Speed. For this submittal, it is optional for paved arterials and may be omitted if Item 50, Horizontal Alignment Adequacy, and Item 52, Average Highway Speed, are supplied. For all future submittals, detailed curvature data are required for all paved arterial sections. Omit this card if this item is not supplied. 19-78

Enter the number of curves in each class shown on the worksheet and the sum of the lengths of the curves in each class. If the section is tangent, supply this card with zeros in all curve data.

Card Number - Precoded 3. 80

Card No. 4 (Optional)

Identification - See instructions for Card No. 1. 1-18

Columns

Item 54- Grades by Class. This item is not required for collectors or for any unpaved facilities. It may be supplied for paved collectors if the State prefers to provide it in lieu of Item 51, Vertical Alignment Adequacy. For this submittal, it is optional for paved arterials and may be omitted if Item 51, Vertical Alignment Adequacy, is supplied. For all future submittals, detailed grade data are required for all paved arterial sections. Omit this card if this item is not supplied. 19-48

Enter the number of grades in each class shown on the worksheet and the sum of the lengths of the grades in each class.

Card Number - Precoded 4. 80

Card No. 5 (Optional)

Identification - See instructions for Card No. 1. 1-18

Item 55- Bridge Identification Numbers. This information is optional for this submittal but will be required for future submittals. For the most part, only bridges on Federal-aid systems are inventoried at present. The Federal-Aid Highway Act of 1978 now requires preparation of an inventory of off-system bridges. Enter the 15-digit bridge identification numbers as coded for the Structure Inventory and Appraisal of the Nation's Bridges (Item 8 on the S.I. and A. record). Use as many of these cards as necessary to identify all bridges counted in Item 44. 19-78

Card Number - Precoded 5. 80

Card No. 6 (Optional)

Identification - See instructions for Card No. 1. 1-18

Item 56- At-Grade Railroad Crossing Identification Numbers. This information is optional for this submittal but will be required for future submittals. Enter the seven-digit railroad grade crossing identification used in the National Railroad-Highway Crossing Inventory. Use as many of these cards as necessary to identify all at-grade crossings counted in Item 45. 19-74

Card Number - Precoded 6. 80

ADDITONAL INSTRUCTIONS APPLICABLE TO OPTIONAL DATA CARDS (NUMBERS 3-6)

Card 3, Curves by Class and Card 4, Grades by Class:

If a State chooses to report optional curve and grade data, these data must be reported for all applicable HPMS sections.

Card 5, Bridge Identification Numbers and/or Card 6, At-Grade Railroad Crossing Identification Numbers:

If a State provides these optional identification numbers, each item must be complete on an individual HPMS section basis.

Detailed Instructions for Section ID.

There are three permissible ways for establishing Section ID's. Outlined below are specific instructions for coding Items 3 and 4 depending on the option selected. The first two options are required only if the States are reporting HPMS data through the MFRS as outlined on page I-8.

Route - Milepoint - (Coordinated with MFRS)

Item 3 - Type of Section Identification, Column 5
Code 1 - Route, Milepoint.

Item 4 - Section ID, Columns 6-17
Route number, coded in Columns 6-11, right justified.
Milepoint, coded in Columns 12-17, right justified, coded to the nearest thousandth.

Example: Route 50 with milepoint 79.20

				5	0		7	9	2	0	0
6					11	12					17

Node - Segment - (Coordinate with MFRS)

Item 3 - Type of Section Identification, Column 5
Code 2 - A-Node, B-Node, Segment.

Item 4 - Section ID, Columns 6-17
A-Node, Columns 6-10, right justified.
B-Node, Columns 11-15, right justified.
Segment, Columns 16-17, right justified.

Example: A-Node - 572 B-Node - 691 Segment - 4

		5	7	2			6	9	1		4
6				10	11				15	16	17

Any Unique Number - (State's Existing Numbering System or Newly Assigned Numbers)

Item 3 - Type of Section Identification, Column 5
Code 3 - Any unique number.

Item 4 - Section ID, Columns 6-17
Code any statewide unique number with no more than 12 digits in Columns 6-17, right justified.

Example: Number assigned by State - 4321

Chapter VI

FUTURE HPMS CONSIDERATIONS

Background

The HPMS is being established as part of an overall continuing FHWA planning information system designed to accommodate and integrate the following:

- Universe data,such as mileage and travel by system.
- Section specific data for sampled sections,such as pavement condition and number of intersections.
- Areawide control estimates for rural, small urban and individual urbanized areas, such as bus PMT, population and land area.
- Typical or representative information produced by case studies such as vehicle type distributions, vehicle occupancies, and tonnage carried by trucks.

As a part of the effort to build a comprehensive information system, financial data reporting requirements are being revised to provide total areawide financial control information compatible with anticipated FHWA needs. While there are planning data reporting requirements not mentioned above that may potentially be affected by HPMS (or the ultimate FHWA planning information system), decisions on how these requirements will be affected by the overall information system are yet to be made. After the continuing system is fully integrated, the future of these requirements can be determined.

Initial HPMS implementation plans were developed in concert with several important issues--namely, data necessary to fulfill the requirements for the 1980 report to the Congress, availability of the data elements in the States, State workloads, and short-term data deferral. Consequently, several data elements have been identified as optional on the coding forms for the initial implementation phase. A tentative schedule for reporting the deferred data elements is contained in this chapter. Similarly, certain case studies have been identified as essential and will be undertaken in 1979---others have been deferred to a later year.

Information updates,other than those necessitated by annual capital improvements,will be time phased (staggered) to smooth State workloads. With regard to case studies, several different studies will be underway concurrently with no State participating in more than one case study during a given year.

It is recognized that immediate implementation of necessary revisions to financial information reporting requirements cannot result in deliverable data in the near future. Therefore, the financial obligation information required for 1976-78 will be similar to that reported in the 1976 NHIPS. This information is available and will provide an interim means of reporting financial information until the necessary revisions can be implemented.

Panel of Sections

Deferred Data

The reporting of the following data elements for 1978 can be deferred 1 year if such reporting requires significant work on the part of individual States: Horizontal curves, grades, skid resistance, bridge identification numbers and at-grade railroad/highway crossing identification numbers. However, if any of these data elements are readily available and transferable from existing files, the elements should be reported in 1979. Note: When horizontal curves and grades are reported for a section, it then becomes optional whether AHS, horizontal alignment adequacy, and vertical alignment adequacy are reported for the sections.

At present, bridge identification numbers are generally available only for those bridges on the Federal-aid systems. As off-system bridges are inventoried, inspected and numbered, the assigned bridge identification numbers for bridges on HPMS sections shall be reported. Such new bridge identification numbers will be reported as updates to the HPMS in the same years as will be required for reporting the detailed data to the FHWA for the National Bridge Inventory and Inspection Program.

Section Data Updates

To maintain a current and updated HPMS data base, it will be necessary for each State to update all data elements that change on the sampled sections. These changes may be due to an improvement made during a given year or may be the result of a change in data elements over time, e.g., ADT.

The changes in the section data resulting from an improvement are to be updated the year in which the improvement is completed. The type of improvement made to the section and the capital costs of the improvement shall be reported. The updates for the changed data elements will probably be furnished to FHWA by coding the data element number along with the updated value(s). In essence, the update format could be as follows:

State Code
Section ID Number
Segment Number
Year

(1) Data Element Number to be Updated
(2) Value of Updated Data Element

Items (1) and (2) would be repeated for each data element that is to be updated.

This format could also be used to furnish capital improvement updates assuming the following improvement types, cost requirements, and item numbers:

Capital Improvement Type

Item Number 57

Code	Type	Code	Type
01	New Route	07	Resurfacing
02	Relocation	08	Bridge Replacement
03	Reconstruction	09	Bridge Rehabilitation
04	Major Widening	10	Safety and Traffic Engineering Improvements
05	Minor Widening		
06	Restoration and Rehabilitation	11	Other Highway Improvements

Improvement Costs ($000)

Item Number

58	Preliminary and Construction Engineering
59	Right-of-Way
60	Grading and Drainage
61	Surface and Base
62	Other
63	Structures

Then, for example, if a sample section is resurfaced at a cost of $500,000 and the new pavement condition rating is 4.8 and the skid number is not applicable for the functional class, the following data would be required:

State Code
Section Number
Year

(1)	57	(Item number for improvement type)
(2)	07	(Code)
(1)	61	(Item number for surface and base cost)
(2)	500	(Cost of surface)
(1)	24	(Item number for pavement condition)
(2)	48	(Pavement condition value)

Maintaining the Integrity of the Panel of Sections

While the HPMS is based on the concept of monitoring change on a panel of sections that will remain as fixed as possible, there are several possible reasons for augmenting the panel to maintain its integrity in terms of being representative of all arterial and collector highways:

- As urban areas grow, there will be a need to refine the panel to reflect both rural mileage becoming urban and significant growth in travel.
- Changes in the functional classification of roads and streets resulting from urban development could require adjustment to the panel.
- Significant new mileage resulting from urbanization may require expansion of the panel.

Occurence of situations requiring adjustment to the panel of sections is expected to be infrequent. Changes in urban boundaries and resultant functional classification, as well as reclassification, at the most, would require the redesignation of some sections and the drawing of a few additional samples. Significant new arterial and collector mileage would simply require the drawing of a few additional samples. Comparisons will be continually made between panel sections and universe data to assure that a representative share of travel and capital investments occurs on the sampled sections and that consistency between the universe and sampled distributions of improvement types exists. If it becomes obvious, however, that any individual panel is no longer representative of its universe, appropriate resampling must then take place.

Case Studies

Several case studies have been identified as necessary for the HPMS--it is possible that limited additional case studies may be identified in the future. Representative States of the various regions of the country will be selected to conduct individual case studies with no State conducting more than one case study in a given year unless on a voluntary basis. Initial case study assignments and instructions will be issued under separate cover in a few months.

Control Speeds/Traveltimes

Average running speeds and overall traveltime will be measured in rural, small urban, and urbanized areas for various design types (e.g., freeways, multilane divided highways without access control, two-lane facilities) with a range of operating characteristics and traffic volumes to develop

control values for HPMS speed/traveltime estimating relationships. Speed is the desired measurement on rural highways and urban freeways and expressways that typically operate under free-flow conditions. Traveltime is the preferred control measurement when restricted travel flow conditions exist.

Vehicle Classification

The distribution of vehicle types using various highway facilities must be known to facilitate calculation of several performance measures and impacts. For HPMS, 11 vehicle types have been selected to represent current and future highway usage:

1. Automobiles
   a. Small ($\leq$ 2600 lbs.)
   b. Middle sized (> 2600 lbs. $\leq$ 3700 lbs.)
   c. Heavy (> 3700 lbs.)
2. Buses
3. Motorcycles
4. Single unit trucks
   a. 2-axle, 4-wheel
   b. 2-axle, 6-wheel
   c. 3 or more axles
5. Combinations
   a. 3 or 4-axle
   b. 5 or more axles
   c. Tractor + semi + full trailers

Case studies will be conducted to determine necessary vehicle type distributions for the HPMS. It is recognized that classification studies may not be able to accommodate the three identified automobile classes--further subclassification may be possible using registration data. It is possible that initial vehicle classification case study needs could draw heavily on classification data presently available in the States or to be collected in 1979.

Vehicle Occupancy

The primary HPMS use to be made of typical vehicle occupancy information is to develop estimates of system person miles of travel that will be used to address the efficiency, economy and safety aspects of the movement of people via highways. Estimates of person miles of travel (occupancy x VMT) will also serve as a means of determining trends in carpooling and as a parameter for coordinating with agencies with an interest in mass transportation.

Although the FHWA is interested in addressing the relative change in rural and urban vehicle occupancy, measurement of such change will be delayed until procedures now being developed and tested have been fully evaluated. As a result, current HPMS interest in vehicle occupancy will be limited to calculating a mean vehicle occupancy for each HPMS vehicle type.

Vehicle Weights

Another area the HPMS will address is the performance of the Nation's highways in terms of goods movement. The system usage performance measure identified for this monitoring effort is ton miles of freight moved. In order to develop this performance measure for the functional systems, it is necessary to obtain data on the average empty weight, average loaded weight and proportion of empty trucks by truck type. In addition, to fully evaluate the potential for change in this performance measure, it is also necessary to obtain information on the average weight of vehicles fully loaded volume-wise and those fully loaded weight-wise and the relative proportions of each. To obtain this information, it will be necessary to conduct truck weight case studies. This case study will make maximum practical use of truck weight information available in the States.

Cost Effectiveness of High Occupancy Vehicle Lanes/Roadways

A study of the cost effectiveness of high-occupancy vehicle lanes/ roadways is part of the overall HPMS effort to evaluate the movement of people. This effort will include a complete inventory of such facilities and their usage since the number of these facilities is rather small.

Unit Capital Improvement Cost Update

Unit capital improvement costs currently available to FHWA were reported in 1970 by the States as a part of the National Highway Functional Classification and Needs Study (1970 to 1990). These costs periodically have been updated and used in various national needs and investment analyses. It is the intent that these costs be updated by the FHWA to 1978 values and be sent to selected States for review and adjustment. These modified values will then be used by the FHWA in various analytical models.

Areawide Information

Areawide information required by HPMS for general information and control total purposes have been discussed in detail in Chapter II. Proposed updating intervals and specific comments concerning each of these information areas are as follows:

Areawide Information Updates

Type of Areawide Information	Update Interval	Comments
1. Bus Usage and Service	2 Years	Limited to areawide estimates of intercity school and transit bus person miles of travel and seat miles of travel.
2. Land Area	5 Years	Updates will be done every 5 years starting with the year following the decennial census (i.e., 1981).
3. Population	5 Years	
4. Mileage (Current)	Annually	As MFRS is implemented and integrated into the proposed overall planning information system, this information will be obtained on an annual basis.
5. Vehicle Miles of Travel (Current)	Annually	
6. Vehicle Miles of Travel (Future)	5 Years	First update will be done in 1984 to provide a projected VMT for 2000.
7. Financial Information	Annually	Efforts are currently underway to modify the present financial reporting system, maintained by the Highway Statistics Division, to provide the financial information required by HPMS. Implementation of the required revisions will take several years. In the interim, the States will be required to provide financial obligation information on a periodic basis.

It would be advantageous for each State to develop and implement an internal reporting mechanism so that changes made to HPMS sections via capital improvements are reported directly to planning personnel responsible for maintaining the HPMS.

The majority of the sample sections will not be improved and only a few data elements such as ADT and pavement condition will change. Changes in such data elements will occur at varying rates. The following schedule lists the data elements that need to be periodically updated, the tentative initial update year, and the maximum time interval between updates. For example, after the initial gathering of 1978 data in 1979, pavement condition for each section should be updated in 1981 (1980 data) and every 2 years thereafter.

Tentative Data Element Update Schedule

Data Element	Initial Update Year	Update Interval
ADT	1981	2
% Trucks	1981	4
Type of Development	1982	4
Number of Access Points	1982	4
Pavement Condition	1981	2
Skid Resistance	1983	4
Drainage Adequacy	1983	4
Future ADT	1983	4

The tentative initial update years and update intervals have been established considering the variability of the data elements and the schedule for reports to the Congress.

APPENDICES

APPENDIX A

LAND AREA AND POPULATION FIGURES AS REPORTED
FOR THE 1976 NHIPS

	Population (ØØØ)	Land Area (Sq. Miles)
State: Alabama		
Rural	1,638	49,094
Small Urban	509	673
Urbanized		
Anniston	66	43
Birmingham	561	440
Columbus (Ga.)	25	23
Florence	65	41
Gadsden	86	115
Huntsville	146	176
Mobile	271	249
Montgomery	155	125
Tuscaloosa	92	81
State: Alaska		
Rural	241	566,349
Small Urban	48	13
Urbanized		
Anchorage	116	70
State: Arizona		
Rural	549	112,558
Small Urban	238	228
Urbanized		
Phoenix	1,093	495
Tucson	305	136
State: Arkansas		
Rural	1,172	52,451
Small Urban	549	473
Urbanized		
Ft. Smith (Oklahoma)	78	58
Little Rock-		
N. Little Rock	228	180
Pine Bluff	65	25
Texarkana (Texas)	24	19
State: California		
Rural	2,663	150,710
Small Urban	1,385	1,031
Urbanized		
Antioch-Pittsburg	56	33
Bakersfield	186	82
Fresno	285	96
Los Angeles - Long Beach		
Pomona-Ontario	8,601	1,724

	Population (ØØØ)	Land Area (Sq. Miles)
Modesto	117	39
Oxnard-Ventura-Thousand Oaks	289	177
Sacramento	702	318
Salinas	68	17
San Bernardino-Riverside	632	401
San Diego	1,388	614
San Francisco-Oakland	3,016	748
San Jose	1,168	321
Santa Barbara	139	46
Santa Cruz	80	36
Santa Rosa	92	52
Seaside-Monterey	101	46
Simi Valley	67	23
Stockton	171	59
State: Colorado		
Rural	484	103,019
Small Urban	327	170
Urbanized		
Boulder	77	22
Colorado Springs	191	137
Denver	1,237	373
Pueblo	108	45
State: Connecticut		
Rural	800	3,545
Small Urban	85	72
Urbanized		
Bridgeport	402	161
Bristol	58	34
Danbury	92	122
Hartford	559	316
Meriden	95	76
New Britain	117	46
New Haven	352	176
New London-Norwich	138	120
Norwalk	110	44
*Springfield-Chicopee-Holyoke (Mass.)		
Stamford	161	77
Waterbury	155	73
State: Delaware		
Rural	185	1,848
Small Urban	34	29
Urbanized		
Wilmington (New Jersey)	360	101

*Not Reported for the NHIPS

	Population (ØØØ)	Land Area (Sq. Miles)
State: District of Columbia		
Rural	0	0
Small Urban	0	0
Urbanized		
Washington, D.C. (Maryland, Virginia)	722	61
State: Florida		
Rural	1,902	54,230
Small Urban	828	769
Urbanized		
Daytona Beach	146	120
Ft. Lauderdale - Hollywood	823	290
Ft. Myers	128	186
Gainsville	90	63
Jacksonville	520	512
Lakeland	141	71
Melbourne-Cocoa	239	252
Miami	1,437	411
Orlando	382	344
Pensacola	143	130
St. Petersburg	500	392
Sarasota-Bradenton	231	220
Tallahassee	86	75
Tampa	458	317
West Palm Beach	431	178
State: Georgia		
Rural	2,204	55,827
Small Urban	698	709
Urbanized		
Albany	82	73
Atlanta	1,257	929
Augusta (S.C.)	136	132
Chattanooga (Tenn.)	31	51
Columbus (Ala.)	196	91
Macon	137	121
Savannah	176	140
State: Hawaii		
Rural	213	6,214
Small Urban	178	95
Urbanized		
Honolulu	474	137

	Population (ØØØ)	Land Area (Sq. Miles)
State: Idaho		
Rural	445	82,449
Small Urban	267	130
Urbanized		
Boise City	108	88
State: Illinois		
Rural	1,965	52,227
Small Urban	1,034	521
Urbanized		
Alton	108	65
Aurora-Elgin	(Included in Chicago urbanized area figures)	
Bloomington-Normal	78	27
Champaign-Urbana	105	30
Chicago-Northwestern	6,433	1,608
Indiana (Ind.)	(Includes Aurora-Elgin urbanized area)	
Davenport-Rock Island-Moline (Iowa)	153	83
Decatur	104	52
Dubuque (Iowa)	3	2
Joliet	177	82
Peoria	258	151
Rockford	216	80
St. Louis (Mo.)	325	190
Springfield	130	64
State: Indiana		
Rural	2,111	34,049
Small Urban	821	693
Urbanized		
Anderson	81	52
Chicago-Northwestern Indiana (Ill.)	536	291
Evansville	139	92
Fort Wayne	233	93
Indianapolis	824	420
Lafayette-West Lafayette	82	43
Louisville (Ky.)	87	49
Muncie	92	67
South Bend (Mich.)	267	187
Terre Haute	79	61
State: Iowa		
Rural	1,381	54,862
Small Urban	634	478
Urbanized		
Cedar Rapids	132	126
Davenport-Rock Island-Moline (Ill.)	129	86

	Population (ØØØ)	Land Area (Sq. Miles)
Des Moines	251	141
Dubuque (Ill.)	63	27
Omaha (Nebr.)	65	54
Sioux City (Nebr., S.D.)	88	66
Waterloo	112	101
State: Kansas		
Rural	862	81,118
Small Urban	613	385
Urbanized		
Kansas City (Mo.)	375	181
St. Joseph (Mo.)	2	3
Topeka	150	63
Wichita	265	141
State: Kentucky		
Rural	1,808	39,279
Small Urban	438	46
Urbanized		
Cincinnati (Ohio)	187	68
*Clarksville-Ft. Campbell (Tenn.)		
Huntington-Ashland (W. Va.-Ohio)	53	23
Lexington	163	40
Louisville (Ind.)	695	182
Owensboro	52	12
State: Louisiana		
Rural	1,286	43,786
Small Urban	466	213
Urbanized		
Alexandria	93	70
Baton Rouge	320	152
Lafayette	108	57
Lake Charles	99	47
Monroe	114	77
New Orleans	1,030	275
Shreveport	275	253
State: Maine		
Rural	522	30,075
Small Urban	352	178
Urbanized		
Lewiston-Auburn	73	126
Portland	113	112

*Not Reported for the NHIPS

	Population (ØØØ)	Land Area (Sq. Miles)
State: Maryland		
Rural	763	8,822
Small Urban	320	154
Urbanized		
Baltimore	1,839	487
Washington, D.C. (D.C.-Va.)	1,176	411
State: Massachusetts		
Rural	651	5,303
Small Urban	379	411
Urbanized		
Boston	2,879	909
Brockton	173	102
Fall River (R.I.)	132	61
Fitchburg-Leominster	81	65
Lawrence-Haverhill (N.H.)	203	123
Lowell	216	127
New Bedford	144	61
Pittsfield	66	51
Providence-Pawtucket-Warwick (R.I.)	96	145
Springfield-Chicopee-Holyoke (Conn.)	491	280
Worcester	317	201
State: Michigan		
Rural	2,805	54,113
Small Urban	615	608
Urbanized		
Ann Arbor	179	95
Battle Creek	78	54
Bay City	78	41
Detroit	3,971	1,086
Flint	330	200
Grand Rapids	353	186
Jackson	79	66
Kalamazoo	152	97
Lansing	229	109
Muskegon-Muskegon Hgts.	106	71
Saginaw	147	58
South Bend (Ind.)	23	19
Toledo (Ohio)	12	20

	Population (000)	Land Area (Sq. Miles)
State: Minnesota		
Rural	1,426	78,752
Small Urban	463	305
Urbanized		
Duluth-Superior (Wisc.)	107	78
Fargo-Moorhead (N.D.)	34	14
LaCrosse (Wisc.)	3	2
Minneapolis-St. Paul	1,780	803
Rochester	59	27
St. Cloud	54	28
State: Mississippi		
Rural	1,297	46,527
Small Urban	614	458
Urbanized		
Biloxi-Gulfport	211	99
Jackson	212	128
Memphis (Tenn.)	12	11
State: Missouri		
Rural	1,381	67,940
Small Urban	538	293
Urbanized		
Columbia	66	42
Kansas City (Kansas)	840	359
St. Joseph (Kansas)	80	32
St. Louis (Ill.)	1,750	266
Springfield	139	63
State: Montana		
Rural	384	145,380
Small Urban	210	125
Urbanized		
Billings	82	43
Great Falls	72	39
State: Nebraska		
Rural	621	76,258
Small Urban	289	123
Urbanized		
Lincoln	168	77
Omaha (Iowa)	455	150
Sioux City (Iowa, S.D.)	9	4
State: Nevada		
Rural	165	110,289
Small Urban	56	42
Urbanized		
Las Vegas	264	166
Reno	107	43

	Population (ØØØ)	Land Area (Sq. Miles)
State: New Hampshire		
Rural	401	8,765
Small Urban	223	155
Urbanized		
Lawrence-Haverhill (Mass.)	25	23
Manchester	101	41
Nashua	75	40
State: New Jersey		
Rural	804	5,251
Small Urban	140	135
Urbanized		
Allentown-Bethlehem-Easton (Pa.)	25	11
Atlantic City	132	62
New York-Northeastern N.J. (N.Y.)	5,126	1,474
Philadelphia (Pa.)	816	315
Trenton (Pa.)	286	112
Vineland-Millville	79	128
Wilmington (Del.)	26	20
State: New Mexico		
Rural	371	120,985
Small Urban	406	323
Urbanized		
Albuquerque	370	203
State: New York		
Rural	4,203	44,009
Small Urban	888	604
Urbanized		
Albany-Schenectady-Troy	519	364
Binghamton	142	79
Buffalo	1,134	374
Elmira	59	41
New York-Northeastern N.J. (N.J.)	9,955	1,634
Poughkeepsie	143	120
Rochester	643	292
Syracuse	383	216
Utica-Rome	178	98

	Population (ØØØ)	Land Area (Sq. Miles)
State: North Carolina		
Rural	3,167	47,305
Small Urban	931	631
Urbanized		
Asheville	66	51
Burlington	63	37
Charlotte	292	139
Durham	106	51
Fayetteville	114	96
Gastonia	97	47
Greensboro	157	101
High Point	87	93
Raleigh	172	93
Wilmington	53	36
Winston-Salem	146	118
State: North Dakota		
Rural	378	69,128
Small Urban	193	115
Urbanized		
Fargo-Moorhead (Minn.)	66	30
State: Ohio		
Rural	2,955	37,306
Small Urban	1,194	582
Urbanized		
Akron	519	316
Canton	263	124
Cincinnati (Ky.)	1,010	372
	(Includes Hamilton urbanized area)	
Cleveland	2,166	915
	(Includes Lorain-Elyria urbanized area)	
Columbus	856	379
Dayton	639	294
Hamilton	(Included in Cincinnati urbanized area figures)	
Huntington-Ashland (W. Va.-Ky.)	29	19
Lima	78	56
Lorain-Elyria	(Included in Cleveland urbanized area figures)	
Mansfield	81	56
Middletown	83	57
Parkersburg (W.Va.)	7	4
Springfield	91	34
Steubenville-Weirton (W.Va.)	47	31
Toledo (Mich.)	482	193
Wheeling (W.Va.)	32	14
Youngstown-Warren	439	230

	Population (ØØØ)	Land Area (Sq. Miles)
State: Oklahoma		
Rural	1,009	67,645
Small Urban	608	677
Urbanized		
Ft. Smith (Ark.)	2	4
Lawton	81	53
Oklahoma City	632	400
Tulsa	380	205
State: Oregon		
Rural	752	95,415
Small Urban	437	217
Urbanized		
Eugene	165	81
Portland (Wash.)	822	369
Salem	112	70
State: Pennsylvania		
Rural	3,649	42,131
Small Urban	1,232	513
Urbanized		
Allentown-Bethlehem-Easton (N.J.)	315	119
Altoona	78	29
Erie	172	62
Harrisburg	251	102
Johnstown	91	37
Lancaster	102	43
Philadelphia (N.J.)	3,281	620
Pittsburgh	1,917	977
Reading	160	47
Scranton	412	216
	(Includes Wilkes-Barre urbanized area)	
*Trenton (N.J.)		
Wilkes-Barre	(Included in Scranton urbanized area figures)	
Williamsport	59	22
York	108	53
State: Puerto Rico		
Rural	1,320	3,080
Small Urban	367	91
Urbanized		
Caguas	83	22
Mayaguez	75	29
Ponce	151	42
San Juan	974	157

*Not Reported for the NHIPS

	Population (ØØØ)	Land Area (Sq. Miles)
State: Rhode Island		
Rural	48	393
Small Urban	54	18
Urbanized		
Fall River (Mass.)	90	45
Providence-Pawtucket-Warwick (Mass.)	756	613
State: South Carolina		
Rural	1,598	29,541
Small Urban	430	257
Urbanized		
Augusta (Ga.)	25	16
Charleston	240	150
Columbia	275	128
Greenville	170	79
Spartanburg	80	54
State: South Dakota		
Rural	420	76,217
Small Urban	182	119
Urbanized		
Sioux City (Iowa, Nebr.)	1	1
Sioux Falls	80	41
State: Tennessee		
Rural	1,401	39,422
Small Urban	1,009	792
Urbanized		
Chattanooga (Ga.)	242	164
*Clarksville-Ft. Campbell (Ky.)		
Kingsport (Va.)	59	129
Knoxville	272	134
Memphis (Miss.)	691	324
Nashville-Davidson	514	363
State: Texas		
Rural	3,371	253,695
Small Urban	3,024	1,615
Urbanized		
Abilene	95	84
Amarillo	127	160
Austin	304	304
Beaumont	126	200
Brownsville	53	52
Bryan-College Station	65	62
Corpus Christi	205	103
Dallas	844	892
El Paso	360	366

*Not Reported for the NHIPS

	Population (ØØØ)	Land Area (Sq. Miles)
Ft. Worth	393	860
Galveston	62	117
Harlingen-San Benito	49	48
Houston	1,341	1,311
Killeen	51	50
Laredo	76	28
Lubbock	171	153
McAllen-Pharr-Edinburg	85	63
Midland	59	72
Odessa	80	72
Port Arthur	57	81
San Angelo	64	72
San Antonio	773	1,047
Sherman-Denison	54	70
Texarkana (Ark.)	55	200
Texas City-LaMarque	30	51
Tyler	63	58
Waco	102	143
Wichita Falls	98	105
State: Utah		
Rural	260	81,563
Small Urban	88	73
Urbanized		
Ogden	178	99
Provo-Orem	127	81
Salt Lake City	553	280
State: Vermont		
Rural	318	9,172
Small Urban	153	95
Urbanized	0	0
State: Virginia		
Rural	1,762	38,059
Small Urban	513	252
Urbanized		
Kingsport (Tenn.)	5	3
Lynchburg	88	78
Newport News-Hampton	304	145
Norfolk-Portsmouth	728	630
Petersburg-Colonial Heights	115	62
Richmond	461	200
Roanoke	181	83
Washington, D.C. (D.C.-Md.)	807	268

	Population (ØØØ)	Land Area (Sq. Miles)
State: Washington		
Rural	914	65,198
Small Urban	503	364
Urbanized		
Portland (Ore.)	99	62
Richland-Kennewick	84	87
Seattle-Everett	1,620	767
	(Includes Tacoma urbanized area)	
Spokane	250	150
Tacoma	(Included in Seattle-Everett urbanized area figures)	
Yakima	74	37
State: West Virginia		
Rural	1,180	23,696
Small Urban	240	138
Urbanized		
Charleston	140	105
Huntington-Ashland (Ky.-Ohio)	88	47
Parkersburg (Ohio)	59	25
Steubenville-Weirton (Ohio)	34	28
Wheeling (Ohio)	62	31
State: Wisconsin		
Rural	1,849	54,806
Small Urban	766	466
Urbanized		
Appleton	126	62
Duluth-Superior (Minn.)	31	38
Green Bay	140	94
Kenosha	84	24
LaCrosse (Minn.)	55	31
Madison	196	56
Milwaukee	1,206	521
Oshkosh	51	20
Racine	103	36
State: Wyoming		
Rural	137	97,082
Small Urban	237	124
Urbanized	0	0

URBANIZED AREA CODE

State	Urbanized Area	Code
Alabama	Anniston	254
	Birmingham	035
	Columbus (Ga.)	109
	Gadsden	192
	Florence	255
	Huntsville	184
	Mobile	067
	Montgomery	115
	Tuscaloosa	183
Alaska	Anchorage	256
Arizona	Phoenix	033
	Tucson	073
Arkansas	Ft. Smith (Okla.)	202
	Little Rock-North Little Rock	092
	Pine Bluff	219
	Texarkana (Texas)	211
California	Antioch-Pittsburg	257
	Bakersfield	117
	Fresno	080
	Los Angeles-Long Beach-Pomona-Ontario	002
	Modesto	234
	Oxnard-Ventura-Thousand Oaks	224
	Sacramento	042
	Salinas	229
California (cont.)	San Bernardino-Riverside	048
	San Diego	023
	San Francisco-Oakland	006
	San Jose	032
	Santa Barbara	187
	Santa Cruz	258
	Santa Rosa	235
	Seaside-Monterey	236
	Simi Valley	237
	Stockton	119
Colorado	Boulder	238
	Colorado Springs	153
	Denver	024
	Pueblo	149
Connecticut	Bridgeport	051
	Bristol	239
	Danbury	240
	Hartford	047
	Meriden	212
	New Britain	154
	New Haven	064
	New London-Norwich	259
	Norwalk	176
	Springfield-Chicopee-Holyoke (Mass.)	043
	Stamford	103
	Waterbury	118

URBANIZED AREA CODE

State	Urbanized Area	Code
Delaware	Wilmington (N.J.)	063
Dist. of Col.	Washington, D. C., (Maryland, Virginia)	008
Florida	Daytona Beach	260
	Ft. Lauderdale-Hollywood	058
	Ft. Myers	261
	Gainsville	241
	Jacksonville	050
	Lakeland	262
	Melbourne-Cocoa	263
	Miami	021
	Orlando	087
	Pensacola	125
	St. Petersburg	057
	Sarasota-Bradenton	264
	Tallahassee	220
	Tampa	059
	West Palm Beach	097
Georgia	Albany	209
	Atlanta	025
	Augusta (S.C.)	131
	Chattanooga (Tenn.)	086
	Columbus (Ala.)	109
	Macon	143
	Savannah	100
Hawaii	Honolulu	052
Idaho	Boise City	217
Illinois	Alton	265
	Aurora-Elgin	172
	Bloomington-Normal	227
	Champaign-Urbana	181
	Chicago-Northwestern Indiana (Ind.)	003
	Davenport-Rock Island-Moline (Iowa)	074
	Decatur	169
	Dubuque (Iowa)	206
	Joliet	138
	Peoria	093
	Rockford	099
	St. Louis (Mo.)	011
	Springfield	146
Indiana	Anderson	223
	Chicago-Northwestern Indiana (Ill.)	003
	Evansville	114
	Fort Wayne	094
	Indianapolis	029
	Louisville (Ky.)	031
	Lafayette-West Lafayette	222
	Muncie	182
	South Bend (Mich.)	077
	Terre Haute	178
Iowa	Cedar Rapids	148
	Davenport-Rock Island-Moline (Ill.)	074
	Des Moines	071

URBANIZED AREA CODE

State	Urbanized Area	Code
Iowa (cont.)	Dubuque (Ill.)	206
	Omaha (Nebr.)	046
	Sioux City (Nebr., S.D.)	156
	Waterloo	150
Kansas	Kansas City (Mo.)	019
	St. Joseph (Mo.)	179
	Topeka	134
	Wichita	062
Kentucky	Cincinnati (Ohio)	017
	Huntington-Ashland, (W.Va.-Ohio)	105
	Lexington	144
	Louisville (Ind.)	031
	Owensboro	242
	Clarksville-Hopkinsville (Tenn.)	280
Louisiana	Alexandria	266
	Baton Rouge	088
	Lafayette	218
	Lake Charles	171
	Monroe	180
	New Orleans	022
	Shreveport	085
Maine	Lewiston-Auburn	196
	Portland	145
Maryland	Wash., D.C., Md., Va.	008
	Baltimore	012
Massachusetts	Boston	007
	Brockton	147
	Fall River (R.I.)	130
	Fitchburg-Leominster	189
	Lawrence-Haverhill (N.H.)	104
	Lowell	136
	New Bedford	127
	Pittsfield	199
	Providence-Pawtucket-Warwick (R.I.)	026
	Springfield-Chicopee-Holyoke (Conn.)	043
	Worcester	076
Michigan	Ann Arbor	142
	Battle Creek	267
	Bay City	186
	Detroit	005
	Flint	065
	Grand Rapids	061
	Jackson	190
	Kalamazoo	141
	Lansing	102
	Muskegon-Muskegon Hgts.	162
	Saginaw	123
	South Bend (Ind.)	077
	Toledo (Ohio)	044
Minnesota	Duluth-Superior (Wisc.)	113
	Fargo-Moorhead (N.D.)	188
	LaCrosse (Wisc.)	243
	Minneapolis-St. Paul	013
	Rochester	244
	St. Cloud	268

URBANIZED AREA CODE

State	Urbanized Area	Code
Mississippi	Biloxi-Gulfport	231
	Jackson	112
	Memphis (Tenn.)	034
Missouri	Columbia	245
	Kansas City (Kansas)	019
	St. Joseph (Kansas)	179
	St. Louis (Ill.)	011
	Springfield	157
Montana	Billings	204
	Great Falls	210
Nebraska	Lincoln	121
	Omaha (Iowa)	046
	Sioux City (Iowa, S.D.)	156
Nevada	Las Vegas	170
	Reno	191
New Hampshire	Lawrence-Haverhill (Mass.)	104
	Manchester	165
	Nashua	246
New Jersey	Allentown-Bethlehem-Easton (Pa.)	068
	Atlantic City	128
	New York-Northeastern (N.J., N.Y.)	001
	Philadelphia (Pa.)	004
	Trenton (Pa.)	069
	Vineland-Millville	233
	Wilmington (Del.)	063
New Mexico	Albuquerque	070
New York	Albany-Schenectady-Troy	041
	Binghamton	110
	Buffalo	016
	Elmira	269
	New York-Northeastern N.J.	001
	Poughkeepsie	270
	Rochester	039
	Syracuse	056
	Utica-Rome	089
North Carolina	Asheville	193
	Burlington	271
	Charlotte	082
	Durham	173
	Fayetteville	221
	Gastonia	272
	Greensboro	132
	High Point	195
	Raleigh	163
	Wilmington	226
	Winston- Salem	124
North Dakota	Fargo-Moorhead (Minn.)	188
Ohio	Akron	040
	Canton	079
	Cincinnati (Ky.)	017
	Cleveland	010
	Columbus	030
	Dayton	038
	Hamilton	168
	Huntington-Ashland (W.Va.-Ky.)	105
	Lima	198
	Lorain-Elyria	116
	Mansfield	228

URBANIZED AREA CODE

State	Urbanized Area	Code
Ohio (cont.)	Parkersburg (W.Va.)	273
	Steubenville-Weirton (W.Va.)	177
	Springfield	167
	Toledo (Mich.)	044
	Wheeling (W.Va.)	155
	Youngstown-Warren	049
Oklahoma	Ft. Smith (Ark.)	202
	Lawton	200
	Oklahoma City	045
	Tulsa	060
Oregon	Eugene	161
	Portland (Wash.)	027
	Salem	225
Pennsylvania	Allentown-Bethlehem-Easton (N.J.)	068
	Altoona	175
	Erie	095
	Harrisburg	083
	Johnstown	159
	Lancaster	164
	Philadelphia (N.J.)	004
	Pittsburgh	009
	Reading	107
	Scranton	081
	Trenton (N.J)	069
	Wilkes-Barre	072
	Williamsport	274
	York	152
Puerto Rico	Caguas	247
	Mayaguez	216
	Ponce	215
	San Juan	214
Rhode Island	Fall River (Mass.)	130
	Providence-Pawtucket-Warwick (Mass.)	026
South Carolina	Augusta (Ga.)	131
	Charleston	108
	Columbia	106
	Greenville	126
	Spartanburg	275
South Dakota	Sioux City (Iowa, Nebr.)	156
	Sioux Falls	194
Tennessee	Chattanooga (Ga.)	086
	Kingsport (Va.)	276
	Knoxville	098
	Memphis (Miss.)	034
	Nashville-Davidson	054
	Clarksville-Hopkinsville (Ky.)	280
Texas	Abilene	166
	Amarillo	120
	Austin	090
	Beaumont	135
	Brownsville	248
	Bryan-College Station	249
	Corpus Christi	096
	Dallas	018
	El Paso	066
	Ft. Worth	037
	Galveston	137
	Harlingen-San Benito	201
	Houston	015
	Killeen	277
	Laredo	205
	Lubbock	122

URBANIZED AREA CODE

State	Urbanized Area	Code
Texas (cont.)	McAllen-Pharr-Edinburg	230
	Midland	197
	Odessa	174
	Port Arthur	139
	San Angelo	208
	San Antonio	028
	Sherman-Denison	232
	Texarkana (Ark.)	211
	Texas City-LaMarque	250
	Tyler	213
	Waco	140
	Wichita Falls	151
Utah	Ogden	133
	Provo-Orem	203
	Salt Lake City	053
Vermont	None	
Virginia	Kingsport (Tenn.)	276
	Lynchburg	207
	Newport News-Hampton	084
	Norfolk-Portsmouth	036
	Petersburg-Colonial Heights	251
	Richmond	055
	Roanoke	129
	Wash., D.C., Md., Va.	008
Washington	Portland (Ore.)	027
	Richland-Kennewick	278
	Seattle-Everett	020
	Spokane	075
	Tacoma	078
	Yakima	279
West Virginia	Charleston	101
	Huntington-Ashland, (Ky.-Ohio)	105
	Parkersburg (Ohio)	273
	Steubenville-Weirton (Ohio)	177
	Wheeling (Ohio)	155
Wisconsin	Appleton	252
	Duluth-Superior (Minn.)	113
	Green Bay	158
	Kenosha	185
	LaCrosse (Minn.)	243
	Madison	111
	Milwaukee	014
	Oshkosh	253
	Racine	160
Wyoming	None	

APPENDIX C

TABLE OF STANDARD CODES FOR STATES,
DISTRICT OF COLUMBIA AND PUERTO RICO

NAME	CODE	NAME	CODE
Alabama	01	Nevada	32
Alaska	02	New Hampshire	33
Arizona	04	New Jersey	34
Arkansas	05	New Mexico	35
California	06	New York	36
Colorado	08	North Carolina	37
Connecticut	09	North Dakota	38
Delaware	10	Ohio	39
District of Columbia	11	Oklahoma	40
Florida	12	Oregon	41
Georgia	13	Pennsylvania	42
Hawaii	15	Rhode Island	44
Idaho	16	South Carolina	45
Illinois	17	South Dakota	46
Indiana	18	Tennessee	47
Iowa	19	Texas	48
Kansas	20	Utah	49
Kentucky	21	Vermont	50
Louisiana	22	Virginia	51
Maine	23	Washington	53
Maryland	24	West Virginia	54
Massachusetts	25	Wisconsin	55
Michigan	26	Wyoming	56
Minnesota	27	Puerto Rico	72
Mississippi	28		
Missouri	29		
Montana	30		
Nebraska	31		

APPENDIX D

IMPROVEMENT TYPE DEFINITIONS

1 - NEW ROUTE - Construction of a new facility that will not replace or relocate an existing facility. A new facility will provide: (a) a facility where none existed or (b) an additional and alternate facility to an existing facility that will remain open and continue to serve through traffic.

2 - RELOCATION - Construction of a facility on new location that replaces an existing route. The new facility carries all the through traffic with the previous facility closed or retained as a land-service road only.

3 - RECONSTRUCTION - Construction on approximate alignment of existing route where old pavement structure is removed and replaced. Such reconstruction may be to the existing number of lanes or may include widening to provide continuous additional lane(s) or dualizing, adding or revising interchanges or otherwise substantially changing the general character of the highway.

4 - MAJOR WIDENING - The addition of lanes or dualization of an existing facility where the existing pavement is salvaged. Also included, where necessary, is the resurfacing of existing pavement and other incidental improvements such as drainage and shoulder improvements.

5 - MINOR WIDENING - The addition of 2 feet or more of width per lane to an existing facility without adding lanes. In many cases, the improvement will include resurfacing the existing pavement and other incidental improvements such as shoulder and drainage improvements.

6 - RESTORATION AND REHABILITATION - Work required to return an existing pavement or bridge deck (including shoulders and expansion joint devices) to a condition of adequate structural support or to a condition adequate for placement of an additional stage of construction (i.e., bridge deck protective system or resurfacing). There may be some upgrading of unsafe features or other incidental work in conjunction with restoration and rehabilitation. Typical improvements would include replacing spalled or malfunctioning joints; substantial pavement undersealing when essential for pavement stabilization prior to resurfacing; grinding/grooving of rigid pavements; replacing deteriorated materials; reworking or strengthening bases or subbases; adding underdrains; and bridge deck repair.

7 - RESURFACING - Placement of additional surface material over the existing roadway or bridge deck to improve serviceability or to provide additional strength. There may be some minor widening, upgrading of unsafe features and other incidental work in conjunction with resurfacing. Where surfacing is constructed by separate project

as a final stage of construction, the type of improvement should be the same as that of the preceding stage--new route, relocation, reconstruction, minor widening, etc.

8 - BRIDGE REPLACEMENT - This is the replacement of a bridge due to structural inadequacy or functional obsolescence on an existing facility. Includes widening to standard and incidental roadway approach work.

9 - BRIDGE REHABILITATION - Work involving the substructure and superstructure of a bridge that has been determined structurally inadequate. This would include the necessary substructure and superstructure construction to conform to current geometric and structural standards. Work involving only the bridge deck slab or plate would not be included here.

10 - SAFETY AND TRAFFIC ENGINEERING IMPROVEMENTS - The following are typical projects that would be included: high hazard location improvements and elimination of roadside obstacles, traffic engineering improvements requiring lane configuration changes, traffic control devices and features, delineation, and railroad-highway grade crossing improvements.

11 - OTHER HIGHWAY IMPROVEMENTS - This category includes improvements that do not provide any increase in the level of service, the condition of the facility or safety. Typical improvements, which would fall in this category, would be noise barriers, beautification and other environmentally related features not built as part of the above identified improvement types.

Note: These improvement type definitions are different than those used in the 1976 NHIPS. The following table defines the relationship between the HPMS and NHIPS definitions.

HPMS		NHIPS	
1	New Route	1	New Location
2	Relocation		
3	Reconstruction	2	Reconstruction
4	Major Widening	4	Major Widening *
5	Minor Widening	5	Minor Widening *
6	Restoration & Rehabilitation	7	Resurfacing
7	Resurfacing	8	Resurfacing and Shoulder Improvement
8	Bridge Replacement	9	Structures Only
9	Bridge Rehabilitation		
10	Safety and Traffic Engineering Improvements	3	Isolated Reconstruction
11	Other Highway Improvements		

*These improvement types apply only to rural areas. In urban areas both types of widening were reported as widening. It will be necessary to combine the HPMS major and minor widening categories to compare to the NHIPS widening category.

APPENDIX E

EDIT SPECIFICATIONS FOR THE URBAN DATASET

The following specifications are to be met when editing the urban inventory data. Items marked with astericks are those which may optionally be reported through the MFRS as described in the HPMS/MFRS Coordination Section in Chapter I. If this option is selected, the indicated items must contain zeros on the HPMS inventory records rather than the values indicated below.

Worksheet Item	Data Card Location	Edit to be Performed
	Card 1	
1. Year	1-2	Must equal 78 for this submittal.
2. State Code	3-4	Must match State code on edit program control card.
3. Type of Section ID	5	Must contain a value from 1 to 3.
4. Section ID	6-17	Must be unique to this section on a statewide basis.
5. Segment	18	Must be zero for this submittal.
* 6. County Code	19-21	Must contain a nonzero numeric value.
7. Urbanized Area Code	22-24	Must contain a value from 001 to 291 or "999".
* 8. Functional Class	25-26	Must contain a value from 11 to 17.
* 9. Federal-Aid System	27	Must equal one of the following: "1", "2", "3", "8".
*10. Jurisdictional Responsibility	28	Must contain a value from 1 to 4.
11. Section Length	29-32	Must contain a nonzero numeric entry.
*12. Access Control	33	Must contain a value from 1 to 3.
13. Number of Through Lanes	34-35	Must contain a value from 01 to 15.
14. Lane Width	36-37	Must contain a value from 07 to 15.
15. Approach Width	38-40	If Item 8 > 13, this item must contain a value from 015 to 100. Otherwise, it must contain "000".

16.	Median Width	41-42	Must contain a numeric value. If Item 13 $\leq$ 2, this item must contain "00".
17.	Median Type	43	If Item 16 > 0, this item must contain a value from 1 to 3. Otherwise, it must contain "4".
18.	Shoulder Width		
	a. Right	44-45	Must contain a value from 00 to 12.
	b. Left	46-47	Must contain a value from 00 to 12.
19.	Shoulder Type	48	If Item 18a > 0, this item must contain a value from 1 to 3. Otherwise, it must contain "4" or "5".
20.	Drainage Adequacy	49	Must contain a value from 1 to 3.
*21.	Surface Type	50-51	Must contain one of the following: "30", "40", a value from 51 to 53, "60", "70", "80". If Item 8 is "11", this item must contain a value from 60 to 80.
22.	Pavement Section	52	If Item 21 > 40, this item must contain a value from 1 to 5. Otherwise, it must contain "0".
23.	Structural Number or Slab Thickness	53-54	a. If Item 22 contains "1", this item must contain a value from 10 to 60. b. If Item 22 contains "2", this item must contain a value from 06 to 12. c. If Item 22 does not contain "1" or "2", this item must contain "00".
24.	Pavement Condition	55-56	If Item 21 > 40, this item must contain a value from 01 to 50. Otherwise, it must contain "00".
25.	Skid Resistance	57-58	If Item 8 < 14, this item must contain a value from 20 to 80 or "00". Otherwise, it must contain "00".
26.	Number of Grade-Separated Interchanges	59-60	If Item 8 < 14, this item must contain a numeric value. Otherwise, it must contain "00".

27.	Number of At-Grade Intersections with Public Facilities with:		
	a. Signals	61-62	Must contain a numeric value.
	b. Stop Signs	63-64	Must contain a numeric value.
	c. Other or No Controls	65-66	Must contain a numeric value.
28.	Prevailing Type of Signalization	67	If Item 27a > 00, this item must contain a value from 1 to 3. Otherwise, it must contain "4".
29.	Typical Percent Green Time	68-69	If Item 27a > 00, this item must contain a nonzero numeric value < 86. Otherwise, it must contain "00".
30.	Number of Major Commercial/Industrial/ Recreational Access Points	70-71	Must contain a numeric value. If Item 8 contains 11-13 or "17", this item must contain "00".
32.	Urban Location	72	Must contain a value from 1 to 5.
*34.	Existing Right-of-Way Width	73-75	Must contain a value $\geq$ 20.
35.	Is Widening Feasible?	76	Must contain a value from 1 to 5.
		Card 2	
*36.	1978 ADT	19-24	Must contain a nonzero numeric value.
37.	Percent Trucks		
	a. Peak Period	25-26	Must contain a numeric value < 40.
	b. Off Peak	27-28	Must contain a numeric value < 40.
38.	K Factor	29-30	Must contain a value from 01 to 24.
39.	Directional Factor	31-33	a. If Item 40 contains "1", "3", "5", or "7", this item must contain "100". b. If Item 40 contains "2", "4", "6", "8", "9", or "10", this item must contain a value from 050 to 075.
40.	Type of Operation	34	Must contain a value from 1 to 4.

41.	Parking		
	a. Peak Period	35	Must contain a value from 1 to 3.
	b. Off Peak	36	Must contain a value from 1 to 3.
42.	Capacity		
	a. Peak Period	37-41	Must contain a nonzero numeric entry $\leq$ Item 13 x 1,000.
	b. Off Peak	42-46	Must contain a nonzero numeric entry $\leq$ Item 13 x 1,000.
43.	2000 ADT	47-52	Must contain a nonzero numeric entry.
44.	Number of Structures	53-54	Must contain a numeric value.
45.	Number of At-Grade Railroad Crossings	55-56	Must contain a numeric value.
46.	ADT Volume Group Identifier	57-58	Must contain a positive numeric value. The value must correspond to the value in Item 36 and either the default ADT volume groups or those input on parameter cards to the edit program.
47.	Expansion Factor	59-62	Must contain a value $\geq$ 0100.
48.	Speed Limit	63-64	Must contain a value from 15 to 56.
52.	Average Highway Speed	65-66	If Item 8 < 14 and Item 53 is omitted, this item must contain a value from 20 to 70. Otherwise, this item must contain "00".
		Card 3	
53.	Curves by Class	19-78	a. If Item 8 < 14, this item must be omitted or meet the following specifications: For each curvature class, the number of curves field must contain a numeric value. If the number of curves is > 0, the corresponding curve length field must contain a nonzero numeric value. If the number of curves equal "00", the corresponding curve length field must contain "000". b. Otherwise, this item must be omitted or meet the specifications shown in part a.

Card 4

54. Grades by Class	19-48	a. If Item 8 < 14, this item must be omitted or meet the following specifications: For each gradient class, the number of grades field must contain a numeric value. If the number of grades is > 0, the corresponding length of grade field must contain a nonzero numeric value. If the number of grades equals 0, the corresponding length of grade field must contain "000". The sum of the grade lengths must equal the section length. b. Otherwise, this item must be zero or the entire card must be omitted or it must meet the specifications shown in part a.

Card 5

55. Bridge Identification Numbers	19-78	This item (card) may be omitted. If supplied, it must contain positive numeric values.

Card 6

56. At-Grade Railroad Crossing Identification Numbers	19-74	This item (card) may be omitted. If supplied, the first six positions of each crossing number must be a positive numeric value. The seventh character must be alphabetic.

APPENDIX F

PROCEDURES FOR DETERMINING AVERAGE HIGHWAY SPEED

Average highway speed is defined in the 1965 "Highway Capacity Manual" as the weighted average of the design speeds within the section, when each subsection within the section is considered to have an individual design speed.

This appendix contains a recommended procedure for computing average highway speed where it is not already available. It utilizes the "Highway Capacity Manual" recommendation of approximately 800 feet (0.15 mile) for the effective length of each curve. Tangent sections and flat (less than 3.5^{o}) curves are assumed to have design speeds of 70 miles per hour. The maximum superelevation rate is assumed to be 0.08 ft./ft. (Where the superelevation rate varies appreciably from this, the curvature range shown for each design speed may be adjusted to fit the appropriate rate of superelevation.)

A worksheet for average highway speed calculation is shown in Figure F-1. The steps in its use are as follows:

1. For the section of highway being analyzed, tally the total number of curves in each design speed grouping, in the column headed "number of curves."

2. For each design speed grouping in which curves have been tallied, select from Table F-1 the travel time in minutes corresponding to that number of curves. Enter this value in the right hand column, labeled "total travel time."

3. Total the number of all curves and post this value at the foot of the "number of curves" column.

4. From the total number of curves, determine the total curve length, using Table F-2. Subtract this value from the section length to determine the tangent length.

5. Compute tangent travel time by multiplying tangent length by 0.86 min./mile. Enter the resulting tangent travel time in the right hand column, headed "total travel time."

6. Sum all entries in "total travel time" column. Divide the length of section of highway by the total travel time and then multiply by 60 min./hr. to obtain the average highway speed (AHS) in miles per hour.

7. Round to the nearest of the following values: 70, 60, 50, 45, 40, 35. These are the average highway speeds for the family of operating speed curves in the "Highway Capacity Manual.

A sample calculation is shown on the worksheet, Figure F-1. For a rural section, three 40 m.p.h. curves have been tallied, for a travel time of 0.68 minutes, and seven 50 m.p.h. curves for a travel time of 1.26 minutes. The total of ten curves gives a total curve length of 1.50 miles (lower table). This value is subtracted from the section length of 4.20 miles, giving a tangent length of 2.70 miles. The latter figure is multiplied by 0.86 minutes per mile (for 70 m.p.h. tangent speed), giving a tangent travel time of 2.32 minutes. This value is added to the previously posted curve travel times to obtain a total travel time of 4.26 minutes. The total section length divided by this value (4.26 min.) and multiplied by 60 (min./hr.) yields an average highway speed of 59 m.p.h. This is then rounded to 60 m.p.h.

Figure F-1

WORKSHEET FOR CALCULATING AVERAGE HIGHWAY SPEED (AHS)

Degree of curvature 1/	Approximate Design Speed (mph)	Number of curves	Total travel time (min.) (from Table F-1)
28.0 – 43.0	25		
19.5 – 27.9	30		
14.0 – 19.4	35		
11.0 – 13.9	40	3	0.68
8.5 – 10.9	45		
7.0 – 8.4	50	7	1.26
5.5 – 6.9	55		
4.5 – 5.4	60		
3.5 – 4.4	65		
	Totals =	10	1.94
		Tangent travel time =	2.32
		Total travel time =	4.26

Section length 4.20 mi.

⇨ Total curve length 1.50 mi. (from Table F-2)

Tangent length 2.70 mi.

x 0.86 min./mi.

Tangent travel time 2.32 min.

Section length 4.20 mi.

Average Highway Speed = ____ x 60 = 59 mph

Total travel time 4.26 min.

Rounded AHS = 60 mph

1/ For maximum superelevation rate of 0.08 ft./ft.

Table F-1--Travel times for curves of various design speeds 1/

Design Speed	Travel time in minutes for number of curves indicated														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
25	0.36	0.72	1.08	1.44	1.80	2.16	2.52	2.88	3.24	3.60	3.96	4.32	4.68	5.04	5.40
30	0.30	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.30	3.60	3.90	4.20	4.50
35	0.26	0.51	0.77	1.03	1.29	1.54	1.80	2.06	2.31	2.57	2.83	3.09	3.34	3.60	3.86
40	0.23	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.48	2.70	2.93	3.15	3.38
45	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00
50	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80	1.98	2.16	2.34	2.52	2.70
55	0.16	0.33	0.49	0.65	0.82	0.98	1.15	1.31	1.47	1.64	1.80	1.96	2.13	2.29	2.45
60	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.65	1.80	1.95	2.10	2.25
65	0.14	0.28	0.42	0.55	0.69	0.83	0.97	1.11	1.25	1.38	1.52	1.66	1.80	1.94	2.18

Table F-2--Total curve length 2/

Total curve length, in miles, for number of curves indicated																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.15	0.30	0.45	0.60	0.75	0.90	1.0	1.20	1.35	1.50	1.65	1.80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	3.00
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
3.15	3.30	3.45	3.60	3.75	3.90	4.05	4.20	4.35	4.50	4.65	4.80	4.95	5.10	5.25	5.40	5.55	5.70	5.85	6.00
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
6.15	6.30	6.45	6.60	6.75	6.90	7.05	7.20	7.35	7.50	7.65	7.80	7.95	8.10	8.25	8.40	8.55	8.70	8.85	9.00

1/ Table F-1 was derived by multiplying the inverse of the speed (in minutes per mile) by the effective length of curve (0.15 miles).

2/ Table F-2 is the effective curve length (0.15 mi.) multiplied by the number of curves.

APPENDIX G

COST ELEMENT DEFINITIONS

Costs are to be reported for the following categories:

1. Preliminary and Construction Engineering - Included are the costs for field engineering and inspection, consultant fees, aerial surveys, material testing, borings, etc. Also includes preparation of PS&E and other reports, traffic and related studies on specific projects and other engineering costs assignable to construction.

2. Right-of-Way and Utility Adjustments - Costs for acquisition of necessary rights of way and, where applicable, those for access control. Include costs for all lands acquired, including any developments thereon, easements including scenic, access rights and consequential damages, appraisals, legal fees, special engineering surveys, preparation of right-of-way plats, relocation payments, etc. Also includes costs for all types of utility adjustments (private and public) within (or to clear) the right of way. (Betterments are not included.)

3. Grading and Drainage - Includes all earthwork preparatory to roadside improvement, such as channel changes, inlets, surface channels, flumes, dikes, underdrains, outfalls, and minor drainage structures, culverts (as usually defined) and special fill treatment. Also include the same items for interchange and frontage roads. Include costs of storm sewer adjustment and all new major storm sewer lines and appurtenances such as pumping stations and equipment. Include all costs for demolishing buildings, moving fences, clearing and grubbing, etc.

4. Base and Surface - Includes costs of all base courses and surfacing, including shoulders, for the through roadway, interchanges, and frontage roads. Include all curbs and sidewalks.

5. Other - Include all roadway items not included in 2, 3, and 4 above. Includes traffic control devices, roadside improvements (such as sodding, planting, roadside rests, etc.), lighting, guardfence, median barriers, railroad crossing protection (excluding separations).

6. Structure Costs - Includes the costs for all new structures and all structural improvements. This includes railroad crossing grade separation structures.

APPENDIX H

EDIT SPECIFICATIONS FOR THE RURAL DATASET

The following specifications are to be met when editing the rural inventory data. Items marked with asterisks are those which may optionally be reported through the MFRS as described in the HPMS/MFRS Coordination Section in Chapter I. If this option is selected, the indicated items must contain zeros on the HPMS inventory records rather than the values indicated below.

Worksheet Item	Data Card Location	Edit to be Performed
	Card 1	
1. Year	1-2	Must equal 78 for this submittal.
2. State Code	3-4	Must match State code on the edit program control card.
3. Type of Section ID	5	Must contain a value from 1 to 3.
4. Section Number	6-17	Must be unique to this section on a statewide basis.
5. Segment	18	Must be zero for this submittal.
* 6. County Code	19-21	Must contain a nonzero numeric value.
* 8. Functional Class	22-23	Must equal one of the following: "01", "02", "06", "07", "08".
* 9. Federal-Aid System	24	Must equal one of the following: "1", "2", "4", "8".
*10. Jurisdictional Responsibility	25	Must contain a value from 1 to 4.
11. Section Length	26-29	Must contain a nonzero numeric entry.
*12. Access Control	30	Must contain a value from 1 to 3.
13. Number of Through Lanes	31-32	Must contain a value from 01 to 11.
14. Lane Width	33-34	Must contain a value from 07 to 15.
16. Median Width	35-36	Must contain a numeric value. If Item 13 $\leq$ 2, must contain "00".

17.	Median Type	37	If Item 16 > 0, this item must contain a value from 1 to 3. Otherwise, it must contain "4".
18.	Shoulder Width		
	a. Right	38-39	Must contain a value from 00 to 12.
	b. Left	40-41	Must contain a value from 00 to 12.
19.	Shoulder Type	42	If Item 18a > 0, this item must contain a value from 1 to 3. Otherwise, it must contain "4" or "5".
20.	Drainage Adequacy	43	Must contain a value from 1 to 3.
21.	Surface Type	44-45	Must contain one of the following: "30", "40", a value from 51 to 53, "60", "70", "80". If Item 8 is "01", this item must contain a value from 60 to 80.
22.	Pavement Section	46	If Item 21 > 40, this item must contain a value from 1 to 5. Otherwise, it must contain "0".
23.	Structural Number or Slab Thickness	47-48	a. If Item 22 contains "1", this item must contain a value from 10 to 60. b. If Item 22 contains "2", this item must contain a value from 06 to 12. c. If Item 22 does not contain "1" or "2", this item must contain "0".
24.	Pavement Condition	49-50	If Item 21 > 40, this item must contain a value from 01 to 50. Otherwise, it must contain "00".
25.	Skid Resistance	51-52	If Item 8 < 07 and Item 21 > 40, this item must contain a value from 20 to 80 or "00". Otherwise, it must contain "00".
26.	Number of Grade-Separated Interchanges	53-54	If Item 8 < 07, and Item 12 > 3 and Item 16 > 0, this item must contain a numeric value. Otherwise, it must contain "00".

27.	Number of At-Grade Intersections with Public Facilities with:		
	a. Signals	55-56	Must contain a numeric entry.
	b. Stop Signs	57-58	Must contain a numeric entry.
	c. Other or No Controls	59-60	Must contain a numeric entry.
30.	Number of Major Commercial/Industrial/ Recreational Access Points	61-62	If Item 8 contains "02" or "06", this item must contain a numeric entry.
31.	Type of Development	63	Must contain "1" or "2".
33.	Terrain	64	Must contain a value from 1 to 3.
*34.	Existing Right-of-Way Width	65-67	Must contain a value $\geq$ 20.
35.	Is Widening Feasible?	68	Must contain a value from 1 to 5.
*36.	1978 ADT	69-74	Must contain a nonzero numeric value.
37.	Percent Trucks		
	a. Peak Period	75-76	Must contain a numeric value < 40.
	b. Off Peak	77-78	Must contain a numeric value < 40.
		Card 2	
38.	K Factor	19-20	Must contain a value from 01 to 24.
39.	Directional Factor	21-23	Must contain a value from 050 to 075 or "100".
42.	Peak Period Capacity	24-28	Must contain "00000" or a numeric value less than or equal to: a. 2,000 if Item 13 is 2. b. 4,000 if Item 13 is 3. c. 1,000 x value in Item 13 if Item 13 is 4 or more.
43.	2000 ADT	29-34	Must contain a nonzero numeric entry.
44.	Number of Structures	35-36	Must contain a numeric value.
45.	Number of At-Grade Railroad Crossings	37-38	Must contain a numeric value.

46.	ADT Volume Group Identifier	39-40	Must contain a nonzero numeric value corresponding to Item 36 and either the default ADT volume groups or those specified on the edit program control card.
47.	Expansion Factor	41-44	Must contain a numeric value $\geq$ 0100.
48.	Speed Limit	45-46	Must contain a value from 15 to 56.
49.	Percent of Length with Sight Distance $\geq$ 1500 Feet	47-49	a. If Item 31 contains "1" and Item 21 > 40 and Item 13 = 2, this item must contain a numeric value $\leq$ 100. b. If Item 31 contains "2" and Item 21 > 40 and Item 13 = 2, this item must contain a numeric value $\leq$ 100 or "000". c. Otherwise, this item must contain "000".
50.	Horizontal Alignment Adequacy	50	If Item 21 > 40 and Item 53 is omitted, this item must contain a value from 1 to 4. Otherwise, it must contain "0".
51.	Vertical Alignment Adequacy	51	If Item 21 > 40 and Item 54 is omitted or zero, this item must contain a value from 1 to 4. Otherwise, it must contain "0".
52.	Average Highway Speed	52-53	a. If Item 8 > 6 and Item 21 > 40 and Item 31 = 1 and Item 53 is omitted, this item must contain a value from 35 to 70. b. If Item 8 > 6 and Item 21 > 40 and Item 31 = 2 and Item 53 is omitted, this item must contain a value from 35 to 70 or "00". c. If Item 8 < 7 and Item 21 > 40 and Item 53 is omitted, this item must contain a value from 35 to 70. d. Otherwise, it must be "00".
		Card 3	
53.	Curves by Class	19-78	If Item 21 > 40, this item must be omitted, zero, or meet the following specifications: For each curvature

			class, the number of curves field must contain a numeric value. If the number of curves > 0, the corresponding curve length field must contain a nonzero numeric value. If the number of curves = "00", the corresponding curve length field must contain "000".
		Card 4	
54.	Grades by Class	19-48	If Item 21 > 40, this item must be omitted, zero, or meet the following specifications: For each gradient class, the number of grades field must contain a numeric value. If the number of grades > 0, the corresponding length of grade field must contain a nonzero numeric value. If the number of grades = "00", the corresponding length of grade field must contain "000". The sum of the grade lengths must equal the section length.
		Card 5	
55.	Bridge Identification Numbers	19-78	This item (card) may be omitted. If supplied, it must contain nonzero numeric values.
		Card 6	
56.	At-Grade Railroad Crossing Identification Numbers	19-74	This item (card) may be omitted. If supplied, the first six positions of each crossing number must contain a nonzero numeric value and the seventh position must contain an alphabetic character.

APPENDIX I

DETERMINATION OF AVAILABLE SIGHT DISTANCE

In order to provide data for determining speed, it will be necessary to estimate for 2-lane highways the percentage of a section length having at least 1,500 feet of sight distance (as measured from the height of the driver's eye to the road surface) available. Any available data, such as construction plans, etc., can be used in this determination. The procedure described below is suggested as a method of determining available sight distance when this data is not available from existing files.

The suggested procedure for the field inventory crew is as follows: First, the observer (sitting beside the vehicle driver) estimates ahead 1,500 feet. If the pavement surface is visible over this entire distance, he records the starting odometer reading as "in". If the pavement surface is not visible, he records the reading as "out". The crew then drives over the section and the observer records the odometer as "out" any time the pavement surface passes from view in the 1,500 foot distance estimated ahead and as "in" when the pavement surface 1,500 feet ahead comes back into view.

This method for identifying the "in" and "out" values of available sight distance applies whether restrictions are caused by vertical curvature, horizontal curvature, other facts of design within the right of way, or trees and permanent type billboards. Sight restrictions such as those caused by tall grass or shrubs that could be removed by routine maintenance would not be considered.

Having completed the above, the length of available sight distance is obtained by subtracting each "in" mileage reading from the succeeding "out" mileage reading and summing these differences. The percent of available sight distance is then calculated by dividing the total available length by the section length and multiplying by 100. This value should then be rounded to the nearest 10 percent and recorded on the Rural Inventory Worksheet.

APPENDIX J

DATA SUBMITTAL SUMMARY

The following submittals are due by December 31, 1979.

Areawide Data Summaries

1. Statewide Area, Population, Mileage, and Travel Summary
2. Rural Data Summary
3. Small Urban Data Summary
4. Individual Urbanized Area Data Summary (One for Each Urbanized Area)
5. Annual Bus Usage and Service Data
6. Arterial and Collector Capital Obligations (in $000) (1976-1978)
7. Capital Obligations Summary and Capital Obligations on Local Roads and Streets 1976-1978
8. Special Urbanized Area Data (Vehicle Occupancy and Traveltime Data)(To be Reported by Urbanized Area Study Groups or MPO's)

Statistical Information (To be submitted by States using optional theoretical sampling approach or States adding volume groups to the FHWA sample approach.)

1. Number and Ranges of Volume Groups by Functional Class (Figure III-1)

Rural and Urban Section Data

States choosing to report some of the required section specific data in the MFRS submittal, as discussed in the HPMS/MFRS Coordination section, page I-7, must do so by June 1979, and must advise the FHWA by April 1, 1979.

*U.S. GOVERNMENT PRINTING OFFICE:1979 624-656/1104 1-3