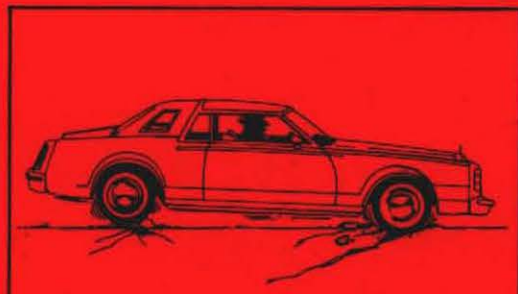
Highway Performance Monitoring System

FIELD MANUAL For The Continuing Analytical And Statistical Data Base



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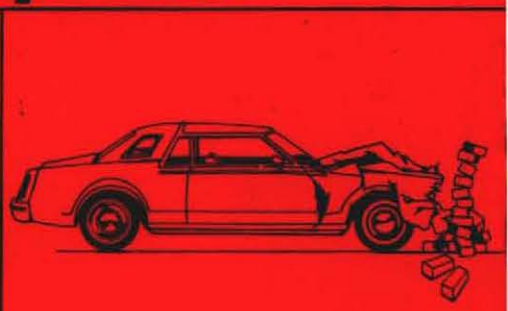


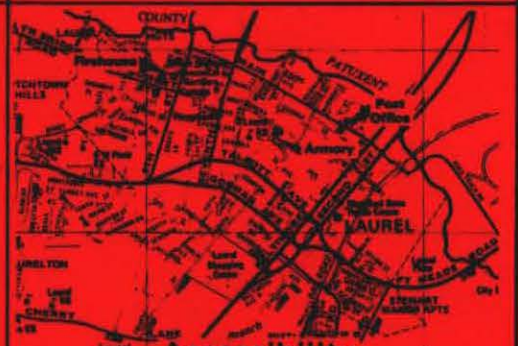
Safety

System Usage

Vehicle Operating Cost

Air Pollution

Comfort and Convenience



Accessibility

U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration
Office of Highway Planning
September 1980

Highway Performance Monitoring System

FIELD MANUAL For The Continuing Analytical And Statistical Data Base

OMB Approval of Initial HPMS Expires January 1984
OMB Approval of MFRS Expires January 1985

OMB Approval of the Merged System
Described in this Manual is Pending

U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration

SEPTEMBER 1980

PREFACE

In recent years, there has been a growing recognition of the need to assess the highway systems periodically with respect to extent and physical condition; the safety, efficiency, and economy of the systems in serving the movement of goods and people; and the impacts of existing national programs and policies. In addition, there is a need to assess the potential impacts of proposed programs, policies, and alternatives. The Highway Performance Monitoring System (HPMS) has been implemented to meet these needs. The HPMS is a program management tool considered to be prerequisite to sound Federal Highway Administration (FHWA) and State highway programs through the continuous monitoring of highway performance. Through prudent analyses and application, it should ensure the efficient use of dwindling financial resources and provide invaluable information to decisionmakers.

This Manual reflects the FHWA headquarters efforts to reduce total data reporting, to eliminate duplication, and to coordinate all planning data reporting requirements. This was achieved by merging the Mileage Facilities Reporting System (MFRS) with the HPMS resulting in an overall integrated data system which should ultimately be of less burden to the States. The objectives of the revised (merged) HPMS are as follows:

1) To provide current data necessary to meet legislative requirements and agency needs in a timely fashion;

2) To provide current statistics on the mileage and extent of the various systems;

3) To evaluate highway programs by monitoring changes in highway characteristics and performance based on detailed section specific data obtained on a sample basis;

4) To minimize the State reporting burden, the need for special data requests, and special national studies; and

5) To be compatible with other data systems to permit meaningful comparisons.

The resultant data system will provide indispensible information to highway administrators, legislative bodies, and others. The HPMS also consists of models and other analytical tools that will provide measures of resources, program accomplishments, trends, and will serve highway planning, programming, budgeting, forecasting, and fiscal management.

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CHAPTER I

INTRODUCTION

BACKGROUND

In a cooperative effort to develop the HPMS integrated data base, various organizations within the Office of Highway Planning have merged independent data collection efforts into a single data reporting system. The initial implementation of the merged system will be for 1980 data to be submitted by May 1, 1981 with all subsequent years' data to be reported by May 1 of the following year.

With few exceptions the data to be reported under the HPMS have been previously included in other data reporting systems. The merging of the previously separate data collection efforts will reduce the States' overall data collection effort while enhancing the usefulness of available data on a continuing basis. Inherent in the HPMS is the capability of reporting universe, sample section, and areawide data. The term "universe" is used throughout this Manual when referring to data for all mileage for a given highway system. These data are in contrast to "sample" data which are reported for a small portion of the highway mileage and contain more extensive information regarding physical characteristics, condition, and operation of the sampled sections of highway. The sample data serve as a base for evaluating changes in data element values over time, thereby providing a basis for the analysis of the performance of the Nation's highways. The sampled sections form "fixed" panels of highway sections which are monitored from year to year. The panels of sections were established using a statistically designed sampling plan based on the random selection of road sections within predetermined average annual daily traffic (AADT) volume groups (strata) for each functional highway classification in the rural, small urban, and individual urbanized areas of a State. Data for 1978 were initially reported under this sampling procedure. This effort established the fixed panels of road sections to be used for comparisons with data for succeeding years and will serve as the base for an ongoing historical data source for day-to-day data needs and future Congressional reports. The total data reporting requirements also include limited areawide totals.

The universe portion of the merged data effort is derived from the MFRS, which began producing universe basic inventory data around 1976. Although the MFRS did include data on roads and streets functionally classified as local, data for this functional classification were not addressed in the initial HPMS effort. Therefore, in addition to obtaining universe data for mileage functionally classified as local roads and streets, a procedure for sampling local roads and streets to obtain a limited number of data items is included in the HPMS.

Accident data have been reported previously by means of annual TA-1 data submittals from each State and, for a few States, by segment-specific reporting under MFRS. Accident data collection to meet certain FHWA needs has been reevaluated, and the resultant reporting procedures are outlined later in this Manual.

The merged data reporting system presented in this Manual has been designed to accomplish the objectives outlined in the Preface, utilizing the most appropriate portions of each of the previous highway planning data reporting systems. The resultant system is envisioned to be economical and efficient. Computer software and technical assistance will be made available to the States to develop, implement, and utilize the data base.

PURPOSE AND SCOPE

The purpose of this Manual is to provide guidelines for reporting HPMS data and to establish update procedures for the annual submission. This Manual outlines procedures for reporting three major types of data. They are:

1) Universe Mileage Data - This includes a complete inventory of mileage classified by system, jurisdiction, and selected operational characteristics. These data will be reported for all mileage. Although grouped mileage reporting is acceptable for non-Interstate, non-sampled mileage, States may continue to provide section-by-section data.

2) Sample Data - This includes specific inventory, condition and operational data obtained for the sample panels of highway sections. These data will be expanded to represent the universe of highway mileage, permitting evaluation of the performance of the various highway systems. A detailed discussion of the HPMS sample panel selection design is presented in Chapter III of the "Field Implementation Manual, Highway Performance Monitoring System", U.S. Department of Transportation, January 1979. Local roads and streets will be included in the sampling process in the 1981 submission.

   Capital improvement data are also part of the sample section data requirements. This consists of all improvements made on the non-local sample panels of sections, including costs and type of improvement. Additionally, six categories of accident data are requested to be reported for non-local sample sections.

3) Areawide Data - This information will be reported annually for rural, total small urban and individual urbanized areas. These data will be used in conjunction with sample data, and therefore, it is important that it be kept current. Areawide data consists of totals for mileage, travel, accidents, bus usage, land area and population.

Data on capital expenditures by State and geographic area will be obtained through a financial reporting system presently being implemented. These data will be reported on PR-534. The instructions for preparing this report are included in "A Guide for Reporting Highway Statistics". Expenditure data for the functional systems, excluding locals, will be initially collected under the new financial reporting system for the data year 1980 (submitted in 1981). A preliminary report was requested for State data for calendar year 1979 in order to determine the extent to which the States had capability to report these data. Expenditure data for locals will be collected for 1980 (submitted in 1982). However, until this system is fully implemented, capital obligation areawide data by State and geographic jurisdictions (which were reported in the initial phase of the HPMS for 1976-78) should be reported for any State unable to report expenditure data on the PR-534 reports for 1979.

The time table for submittal of the above data items will vary for the different types of data. Update cycles for areawide and section data will vary anywhere from 1 to 5 years, depending on how much the items change with time and upon the importance of having the information current. Capital improvement and accident data for the individual sample sections will be reported on an annual basis. This Manual outlines procedures for the preparation of the various types of data, including forms, contains instructions for building and editing the dataset, and includes a timetable for coordinating various aspects of the HPMS.

It is important to note, however, that each State is expected to make an annual submittal of the areawide forms and the data tape in accordance with the procedures outlined in this Manual.

ROLES OF PARTICIPANTS

The HPMS is a joint effort of the Federal, State, and local governments. The HPMS organization, guidance, and analyses are the responsibility of the FHWA. Data reporting for the HPMS will be accomplished by the State highway agencies in cooperation with local governmental units, Metropolitan Planning Organizations (MPO's), and other organizations.

All State highway agencies (SHA's), including the District of Columbia and Puerto Rico, are responsible for the development of those mechanisms necessary for reporting the data prescribed under the guidelines of this Manual and for the editing and timely submittal of the dataset in the prescribed form. The SHA's are also responsible for maintaining the maximum practicable participation in the HPMS by city, county, and other local governments, including the MPO's.

Direct participation by the MPO's, in cooperation with the SHA's is especially important and necessary. This includes utilizing both technical staffs and existing committees of the MPO's to provide overall guidance. It will be the SHA's responsibility to ensure that all work performed by the local governments and MPO's conforms with the guidelines provided in this Manual and that the data are submitted in advance of the due dates to allow sufficient time to incorporate it in the statewide submission to the FHWA.

CHAPTER II

AREAWIDE DATA

SUBMISSION OF AREAWIDE SUMMARY TABLES

A series of three summary forms are provided for reporting of: 1) Mileage and Daily Travel, 2) Motor Vehicle Accidents, and 3) Bus Usage and Service Data. Each form is to be submitted annually to the FHWA division office in triplicate. State submissions with supporting documentation covering any problem (including any revisions to previous estimates) with the data should be forwarded to the Highway Statistics Division, HHP-40, Office of Highway Planning, Federal Highway Administration, Washington, D.C. 20590 on or before May 1 following the year for which data are being reported. For example, 1980 data are due by May 1, 1981.

A supply of blank forms will be furnished to each SHA. Although the forms have been designed for keypunching, the SHA's should not furnish punched cards as part of the areawide data submittal requirements.

GENERAL CODING INSTRUCTIONS AND DEFINITIONS

1) 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.

2) Subtotals and totals on the forms should be checked.

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

Mileage	Miles
Travel	Daily Vehicle-Miles of Travel (DVMT) in thousands
Accidents	Actual Numbers
Injuries	Actual Numbers
Population	Thousands
Land Area	Square Miles
Passenger-Miles of Travel	Ten Thousands
Seat-Miles of Travel	Ten Thousands

4) Year - The last two digits of the calendar year for which the data apply.

5) State Code - The Federal Information Processing Standard (FIPS) Code given in Appendix A.

6) Rural-Urban Code:

1 - Rural
2 - Small Urban (population of 5,000 to under 50,000)
3 - Urbanized (population of 50,000 and over)
4 - Total Urban (for accident data only)

In this effort small urban and urbanized areas are defined for the HPMS as Federal-aid urban areas or portions thereof within State boundaries. In either case, a Federal-aid urban area must be a census place with a population of 5,000 to 49,999 to be a small urban area or a designated urbanized area with a population of 50,000 or more. Federal-aid urban boundaries for these urban areas are fixed by responsible State and local officials but shall, at a minimum, encompass the entire urban place designated by the U.S. Bureau of the Census. (See Title 23 U.S.C., section 101.)

7) Urbanized Area Code - The 3-digit codes for designated areas are furnished in Appendix B.

8) Land Area - The Bureau of the Census definition of land area will be used: Land area includes dry land and land temporarily or partially covered by water, such as marshland, swamps and river flood plains; systems, 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 are substituted for these values.)

9) Population - Current population based on the latest official census estimates adjusted to current Federal-aid urban area boundaries.

10) Number of Small Urban Areas - This number will change over time as a result of Census actions and expansion of urban area boundaries.

11) Functional Systems - The functional systems required by Title 23 U.S.C. 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). They are as follows:

Rural	Code
Principal Arterial-Interstate	01
Other Principal Arterial	02
Minor Arterial	06
Major Collector	07
Minor Collector	08
Local	09

Urbanized and Small Urban Areas	Code
Principal Arterial-Interstate	11
Principal Arterial-Other Freeways and Expressways	12
Other Principal Arterial	14
Minor Arterial	16
Collector	17
Local	19

12) Federal-aid Systems - For reporting accidents, the Federal-aid Systems are ranked as follows:

Federal-aid Interstate/Arterial
Federal-aid Other Primary/Arterial
Federal-aid Urban/Arterial
Non-Federal-aid/Arterial
Federal-aid Urban/Collector
Federal-aid Secondary/Collector
Non-Federal-aid/Collector
Non-Federal-aid/Local

13) Percent Functional Class DVMT - This is reported on the Motor Vehicle Accident Summary (Figure II-2, Columns 8-10). Enter the percent of the functional class travel which occurs on a specified Federal-aid system. Report percents in whole numbers, right-justified with leading zeroes in the three digit field.

MILEAGE AND DAILY TRAVEL SUMMARY

Mileage, Daily Vehicle-Miles of Travel, Population, Land Area, and numbers of small urban and urbanized areas are reported on the summary form shown in Figure II-1 in two parts. Part 1 of the form provides for statewide summaries of the above data by functional system for rural and small urban areas and also statewide totals of these data for all areas. Summaries for each individual urbanized area are to be reported on Part 2 of the form. States with many individual urbanized areas may need additional Part 2 forms.

Mileage Data

Road mileage figures reported on the form(s) must agree with existing public road mileage "open to traffic" submitted on the tape file. Mileage by functional system will be reported for rural, small urban, and individual urbanized areas. If applicable, States are to report ferryboat mileage by Federal-aid system.

Reporting of areawide mileage data requested in this section is not to be construed as fulfilling the requirements for the annual certification of public road mileage.

FIGURE II-1

MILEAGE AND DAILY TRAVEL SUMMARY

PART I — STATEWIDE TOTALS, RURAL AND SMALL URBAN DATA

STATE: _____ PREPARED: _____ (DATE)

STATEWIDE TOTALS

YEAR	STATE										TOTAL PUBLIC ROAD MILEAGE	TOTAL DVMT (000)	TOTAL SMALL URBAN AREAS	PUBLIC FERRYBOAT MILEAGE			TOTAL POPULATION (000)	TOTAL LAND AREA SQ. MI.
														FEDERAL-AID PRIMARY		FEDERAL-AID URBAN	FEDERAL-AID SECONDARY	
														RURAL	URBAN			
1 2	3 4	5	6	7	8	9	10	11	12	13–36	37–52	53–68	69–72	73–80
								0	0					

RURAL DATA

PUBLIC ROAD MILEAGE/ DAILY VEHICLE – MILES OF TRAVEL	YEAR	STATE	R-U						FUNCTIONAL CLASSIFICATION										POPULATION (000)	LAND AREA SQ. MI.
									PRINCIPAL ARTERIALS		MINOR ARTERIALS	COLLECTORS		LOCALS	TOTAL					
									INTERSTATE	OTHER		MAJOR	MINOR							
	1 2	3 4	5	6	7	8	9	10	11 12	13–28	29–36	37–44	45–52	53–60	61–68	69–72	73–76	77–80
MILEAGE/DVMT (000)			1						1 0									
			1						2 0									

SMALL URBAN DATA

PUBLIC ROAD MILEAGE/ DAILY VEHICLE – MILES OF TRAVEL	YEAR	STATE	R-U						FUNCTIONAL CLASSIFICATION										POPULATION (000)	LAND AREA SQ. MI.
									PRINCIPAL ARTERIALS			MINOR ARTERIALS	COLLECTORS	LOCALS	TOTAL					
									INTERSTATE	OTHER FREE-WAYS & EXP'S	OTHER									
	1 2	3 4	5	6	7	8	9	10	11 12	13–20	21–28	29–36	37–44	45–52	53–60	61–68	69–72	73–76	77–80	
MILEAGE/DVMT (000)			2						1 0											
			2						2 0											

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

USE PART 2 FOR INDIVIDUAL URBANIZED AREA DATA.

FIGURE II-1

MILEAGE AND DAILY TRAVEL SUMMARY

PART 2 — INDIVIDUAL URBANIZED AREA DATA

STATE: ______________________ SHEET #: ________________ PREPARED: ______________________ (DATE)

PUBLIC ROAD MILEAGE/ DAILY VEHICLE – MILES OF TRAVEL	YEAR	STATE	R-U[1]		URBANIZED AREA[2]		FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIALS: INTERSTATE	PRINCIPAL ARTERIALS: OTHER FREEWAYS & EXPRESSWAYS	PRINCIPAL ARTERIALS: OTHER	MINOR ARTERIALS	COLLECTORS	LOCALS	TOTAL	POPULATION (000)	LAND AREA SQ. MI.
	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 48 49 50 51 52	53 54 55 56 57 58 59 60	61 62 63 64 65 66 67 68	69 70 71 72 73	74 75 76 77 78 79 80
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			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 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 59 60	61 62 63 64 65 66 67 68	69 70 71 72 73	74 75 76 77 78 79 80

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

[2]SEE APPENDIX B FOR CODE

USE SUPPLEMENTARY SHEETS FOR ADDITIONAL URBANIZED AREAS.

Travel Estimates

Estimates of daily vehicle-miles of travel (DVMT) by functional system are to be prepared for rural, small urban and individual urbanized areas of the State on an annual basis. These data will be reported on the mileage and travel summary forms. These DVMT estimates are important to the analyses of vehicle operating costs, traveltime, fuel consumption, emissions, people movement, freight movement, maintenance practices, urban transportation programs, and revenue projects. Selected Federal legislative programs include DVMT as references or as apportionment factors. The following program activities involve travel as a factor: 1) Interstate System Resurfacing, Restoring and Rehabilitating (3R), 2) Quarterly Speed Monitoring, 3) Highway Safety Incentive Grants (presently not funded), and 4) the Highway Cost Allocation Study. In summary, DVMT estimates reported by the States are an integral part of certain legislative requirements, are included in reports to Congress and are being used in day-to-day program and policy evaluation activities, monitoring trends, and responding to continuing inquiries and requests of the Administration, the Congress, and the public.

While it is realized that there are various methods for developing areawide estimates of DVMT such as those based on gasoline consumption, traffic counts, AADT expansion, etc., one goal of HPMS is to base areawide DVMT estimates on sample section AADT's. The HPMS panels of sections have been statistically designed for a high level of measurable accuracy, especially for the determination of travel, and allows for the continuous monitoring of AADT with minimum effort. Annual updating of sample section AADT's is strongly recommended. States are encouraged to modify their traffic counting programs to obtain counts on the HPMS sample sections.

DVMT estimates will be developed separately for rural, small urban and individual urbanized areas for each functional system. Each State should provide a narrative describing the procedure(s) employed in determining travel for each functional system as well as any assumptions made or unusual circumstances concerning the reported data.

Effective communication between State and FHWA field and Washington Headquarters staff is encouraged to resolve any problem arising during the preparation of the DVMT report. Support and cooperation within every State is needed to derive accurate DVMT estimates.

Evaluation of Travel Estimates

Implementation of a process to develop estimates of travel based on improved sample section AADT's would not be complete without an adequate verification process to see whether the procedures are operating satisfactorily and are accomplishing the intended goals. FHWA will periodically review the approach used by the various States to derive AADT's on the sample sections. Reviews will be concerned with the development of an adequate traffic counting schedule, including sampling on the roads and streets functionally classified as local as well as the procedures for applying seasonal corrections and expanding traffic counts to AADT's.

Population and Land Area

Periodic review and update of the land area and population data is necessary. Since population and land area estimates are for the most part based on Census estimates, updates of population should at a minimum be tied to changes in Census estimates. However, between Census periods, Federal-aid urban boundaries may be changed. At a minimum, States are expected to submit updates for population and land area at least every five years beginning with 1981 data reported in 1982.

For those years between major updates, States should submit revised figures when they find significant changes have occurred in either population or land area for any urban or rural area of a State.

MOTOR VEHICLE ACCIDENT SUMMARY

Motor vehicle accident data shall be reported for rural and urban areas by functional and Federal-aid Systems. This information will provide accident totals from which rates can be derived to establish the performance of the functional systems. The form used for reporting accident data is given in Figure II-2.

States use a variety of procedures for collecting and processing accident data. Therefore, SHA's should develop appropriate cooperative arrangements with responsible State and local agencies to obtain the necessary accident data. Data on accidents on Federal lands within the State should be obtained from the appropriate agencies. Detailed accident related definitions are given in the "Manual on Classification of Motor Vehicle Traffic Accidents" American National Standards Institute (ANSI) D16.1 - 1976, as amended. In general, a traffic accident is an accident which occurs 1) within the right-of-way of a street or highway or 2) within the boundaries of other ways used by the public for motor vehicle travel. All motor vehicle accidents involving injuries, both fatal and non-fatal, that occur within a State should be reported. Responsibility for roadway maintenance or traffic law enforcement are not critera for inclusion in this report; an accident is

reported if it occurred within the geographic boundaries of the State. A small percentage of accidents occur on private trafficways open for public use or on other trafficways for which no roadway data are reported. These accidents should be reported as though they had occurred on the roads and streets functionally classified as local.

Fatality accident statistics reported to FHWA shall conform to the 30-day rule, i.e., a fatality resulting from an accident occurring within 30 days is counted. This definition applies only to statistics used by the U.S. Department of Transportation agencies and should not be taken to imply that States should be required or urged to stop collecting and using, for their own purposes, information about fatalities that occur more than 30 days after an accident. The National Highway Traffic Safety Administration's Fatal Accident Reporting System (FARS) statistics are based on the 30-day definition and are available to the States. If the State uses some other fatality counting definition, appropriate adjustments shall be made.

Accident assignments are based on the "Manual on Classification of Motor Vehicle Traffic Accidents", ANSI D16.1 - 1976, as amended, using the hierarchy of the Federal-aid Systems within the functional class systems listed above. Accidents that occur at intersections should be assigned to the functional system that the involved vehicle(s) were using or, if more than one system was being used by vehicles involved in the accident, to the higher functional system. This rule applies to all intersections, including those within interchanges. An accident on an interchange ramp should be assigned to the higher functional system served by the ramp. Accidents on a frontage road should be assigned to the functional designation of the frontage road.

Coding instructions for the State's accident data follow. All entries are to be right justified, and complete reporting is essential.

Fatal Accidents - Enter the number of motor vehicle accidents involving one or more fatalities, including pedestrians.

Non-Fatal Injury Accidents - Enter the number of motor vehicle accidents resulting in non-fatal injuries to one or more persons, including pedestrians.

Fatalities - Enter the number of persons fatally injured in motor vehicle accidents. The fatalities to be included are those (1) which result from accidents that occurred during the relevant calendar year and (2) in which the fatally injured died within 30 days of the accident. Included are fatally injured pedestrians which are also reported separately.

Non-Fatally Injured Persons - Enter the number of persons who are non-fatally injured in motor vehicle accidents. Included are non-fatally injured pedestrians who are also reported separately.

Pedestrian Fatalities - Enter the number of pedestrians fatally injured in motor vehicle accidents. The number of pedestrians included here is also included in Fatalities.

Non-Fatally Injured Pedestrians - Enter the number of pedestrians non-fatally injured in motor vehicle accidents. The number of pedestrians included here is also included in Non-Fatally Injured Persons.

In addition to the areawide reporting of accident data, these data are also reported for the arterial and collector sample sections for the development of accident rates relating to highway characteristics. Sample accident data are further discussed in Chapters III and IV.

FIGURE II-2

MOTOR VEHICLE ACCIDENT SUMMARY

STATE: _____ PREPARED: _____ (DATE)

FUNCTIONAL CLASS/FEDERAL-AID SYSTEM		YEAR	STATE	R-U[1]	F.C.	PERCENT F.C. DVMT		INJURY ACCIDENTS		PERSONS INJURED		PEDESTRIANS INJURED	
								FATAL	NON-FATAL	FATAL	NON-FATAL	FATAL	NON-FATAL
		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 48 49 50 51 52	53 54 55 56 57 58 59 60
RURAL													
PRINCIPAL ARTERIAL – INTERSTATE				1	0 1		3 0						
PRINCIPAL ARTERIAL – OTHER:	FEDERAL-AID OTHER PRIMARY			1	0 2		3 2						
	NON-FEDERAL-AID			1	0 2		3 8						
	SUBTOTAL			1	0 2		3 0						
MINOR ARTERIAL:	FEDERAL-AID OTHER PRIMARY			1	0 6		3 2						
	NON-FEDERAL-AID			1	0 6		3 8						
	SUBTOTAL			1	0 6		3 0						
MAJOR COLLECTOR:	FEDERAL-AID SECONDARY			1	0 7		3 4						
	NON-FEDERAL-AID			1	0 7		3 8						
	SUBTOTAL			1	0 7		3 0						
MINOR COLLECTOR	NON-FEDERAL-AID			1	0 8		3 8						
LOCAL	NON-FEDERAL-AID			1	0 9		3 8						
TOTAL RURAL				1			3 0						
URBAN													
PRINCIPAL ARTERIAL – INTERSTATE				4	1 1		3 0						
PRINCIPAL ARTERIAL – OTHER FREEWAYS & EXPRESSWAYS	FEDERAL-AID OTHER PRIMARY			4	1 2		3 2						
	FEDERAL-AID URBAN			4	1 2		3 3						
	NON-FEDERAL-AID			4	1 2		3 8						
	SUBTOTAL			4	1 2		3 0						
PRINCIPAL ARTERIAL – OTHER:	FEDERAL-AID OTHER PRIMARY			4	1 4		3 2						
	FEDERAL-AID URBAN			4	1 4		3 3						
	NON-FEDERAL-AID			4	1 4		3 8						
	SUBTOTAL			4	1 4		3 0						
MINOR ARTERIAL:	FEDERAL-AID OTHER PRIMARY			4	1 6		3 2						
	FEDERAL-AID URBAN			4	1 6		3 3						
	NON-FEDERAL-AID			4	1 6		3 8						
	SUBTOTAL			4	1 6		3 0						
COLLECTOR:	FEDERAL-AID URBAN			4	1 7		3 3						
	NON-FEDERAL-AID			4	1 7		3 8						
	SUBTOTAL			4	1 7		3 0						
LOCAL:	NON-FEDERAL-AID			4	1 9		3 8						
TOTAL URBAN				4			3 0						
TOTAL – STATEWIDE							3 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 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 59 60

[1] R-U CODE: 1–RURAL, 4–URBAN (SMALL URBAN & URBANIZED AREAS COMBINED)

BUS USAGE AND SERVICE SUMMARY

The Bus Usage and Service Summary form (see Figure II-3) requires the reporting of estimates of passenger-miles of travel (PMT) and seat-miles of travel. The following definitions apply:

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.

Bus - 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 which are designed to transport up to 15 persons.

Intercity Bus Service - Regularly scheduled public transportation that, for direct compensation, transports persons among communities, inter- or intraregionally, inter- or intrastate, but not primarily within an urban area.

School Bus Service - Regularly scheduled public transportation that, for direct or indirect compensation, transports students to any regularly conducted public or private school or to school-related activities.

Transit Bus Service - 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 travel data 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, the rural portion of the travel should be reported in the rural category.

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. Overall quality of data should increase with each submission since lines of communication should have been established with the bus operators. Bus system operators are the most likely source for bus usage data. It is recommended that procedures be established to obtain the necessary data from them. Data reported under the Urban Mass Transportation Administration's Financial Accounting Reporting Element (FARE) system may be helpful in the preparation of these requested data. Where metropolitan transit authorities or urban planning commissions exist, they may be the best source of data, especially where there is more than one transit operator.

FIGURE II-3
BUS USAGE AND SERVICE SUMMARY

STATE: _____ PREPARED: _____ (DATE)

YEAR	STATE	R-U[1]		URBANIZED AREA[2]		INTERCITY BUS		SCHOOL BUS		TRANSIT BUS	
						PASSENGER-MILES OF TRAVEL X (10,000)	SEAT-MILES OF SERVICE X (10,000)	PASSENGER-MILES OF TRAVEL X (10,000)	SEAT-MILES OF SERVICE X (10,000)	PASSENGER-MILES OF TRAVEL X (10,000)	SEAT-MILES OF SERVICE X (10,000)
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 48 49 50 51 52	53 54 55 56 57 58 59 60
		1			4 0						
		2			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 0						
		3			4 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 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 59 60

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

[2]SEE APPENDIX B FOR CODE

CHAPTER III

UNIVERSE AND SAMPLE DATA REQUIREMENTS

The HPMS requires the annual reporting of comprehensive statewide public road mileage (universe data) classified by specific categories and selected roadway physical operational and usage characteristics for sample sections. The annual data submittal will include all required items, including those which remain unchanged. Sample sections are to be updated according to the established schedule for each data element. Capital improvements (type and cost) as well as accidents are also to be reported for arterial and collector sample sections. This Chapter outlines these requirements for universe and sample data.

Preliminary to discussing the make up of the data tape, the following definitions apply throughout this Manual:

Section - A continuous length of roadway that is homogeneous with respect to the physical, operational, administrative, and jurisdictional characteristics being reported.

Grouped data - Universe data for a group of highway sections, not necessarily contiguous, with mileage aggregated with respect to the homogeneous administrative, physical, and jurisdictional characteristics being reported.

Universe data - Data representing the complete coverage of mileage for all road systems on either a section-by-section or grouped data basis. The universe data defines the extent of roadway mileage by system and jurisdiction.

Sample sections - Randomly selected sections from the universe of sections for which additional physical and operational data elements over and above the universe data are reported for the analyses of highway performance. The sections are homogeneous as to geometrics and cross section, and the termini are fixed as to location over time. There are two types of sample sections, each with a different sample design:

1) Arterial and collector samples that provide basic physical inventory and operational data for specific sections of highway for which the performance of the nation's highways will be evaluated. A discussion of the HPMS sample selection design for the arterial and collector systems is presented in Chapter III of the "Field Implementation Manual, Highway Performance Monitoring System", U.S. Department of Transportation, January 1979.

2) Local road and street samples provide limited physical inventory and operational data. The sample design for local roads and streets is presented in Chapter VI of this Manual.

UNIVERSE DATA

Records will be submitted on computer tape for all existing road mileage for all systems. Universe data are required to be reported on a section-by-section basis for the rural and urban Interstate systems and the sample sections. It is recognized that most States maintain data by individual section, especially for the higher functional systems, and that most States will report their data in this form. With the exception of sample sections and the Interstate system that are required to be reported on a section basis, States may group remaining highway sections, particularly collectors and local roads. It should be noted, however, that the aggregation of data into grouped records for reporting to the FHWA could have adverse implications regarding future potential use of the dataset by the SHA's. Analytical software under development by the FHWA that will be made available to the States for their use requires section-specific data. The States that elect to use the FHWA software may need to expand the sample to meet the needs within the State and, at the same time, may be limited in the reserve of future sample sections. Hence, deliberate grouping of data, when not necessary, could have an adverse effect on the future analytical options of the SHA.

The same record format will be used for both section-by-section and grouped data reporting; however, grouped sections, identified by a countywide (or equivalent) unique group number are not tied to a particular location.

The universe data, reported for all records (universe and sample sections) are shown below. Data items contained in each category are described in detail in Chapter IV. The universe data categories are:

Identification - contains State, county, and rural/small urban/urbanized codes and a unique identification or location reference.

System - provides for coding of functional classification, Federal-aid system, and public road mileage.

Jurisdiction - provides for coding of State or local highway system, domain, and special funding category.

Operation - includes type of facility, truck prohibition, high-occupancy vehicle facilities, and toll.

Travel/Special - contains length of highway section and a field for the coding of AADT and certain special data items.

SAMPLE SECTION DATA

In addition to the universe data items reported for all records, sample sections will contain additional inventory and operational data. As previously mentioned, there are two types of sample section data, each having a different sample design --- Arterial/Collector and Local roads and streets. A discussion of the two types follows.

Arterial and Collector Sample Sections

Sample sections, selected in the initial implementation of the HPMS plus any additional sections added as a result of change, constitute the panels of sampled sections for five functional systems in each of the rural, small urban and individual urbanized areas of a State. The functional systems represented are: Rural areas - Interstate, other principal arterial, minor arterial, major collector, and minor collector; small urban and individual urbanized areas - Interstate, other freeways and expressways, other principal arterial, minor arterial, and collector.

Except for the universe data portion of sample sections, sample section data requirements are essentially that required for the initial HPMS implementation with some rearrangement and augmentation. Sample section data reported in addition to the universe data are presented below by category. The data items within each category are discussed in detail in Chapter IV. The arterial and collector sample section data categories are:

Identification - contains unique identification for the sample section portion of the record.

Computational Elements - provides data items used to expand sample information to universe values.

Pavement Attributes - contains data items used to evaluate the physical characteristics of pavement, pavement performance, and the need for pavement overlays.

Geometrics/Configuration - describes the physical attributes used to evaluate the capacity and operating characteristics of the facility.

Traffic/Capacity - provides operational data items used to calculate the volume/capacity of a section and the need for improvements.

Environment - contains items that marginally affect the operation of a facility but are important to its structural integrity.

Supplemental Data - contains items used to evaluate safety, correlate capital investments to improvements, and provide linkage to existing structure and railroad crossing information systems.

It was noted above that the arterial and collector sample sections have been augmented. The following is a summary of the scope and requirements for two important additions to the HPMS sample base - accident and capital improvement data.

Accident Data

The relationships between accident information and physical and operational characteristics of roads and streets are fundamental to the evaluation of safety. We are requesting that accident data be reported for the sample sections. Using the sample data, accident rates by highway characteristics will be developed to evaluate safety implications and to determine how best to use limited highway funds with respect to highway safety.

A number of States presently have the capability to report accident data on a section-by-section basis, and several States have reported these data on that basis via the MFRS. It is expected that these States will report 1980 accident data for the sample sections by May 1, 1981 and that other States will follow in subsequent years as their capability develops. We encourage the States to expand their capabilities as soon as possible to fulfill the urgent need for these data.

Annual accident totals broken down by type of accident will be reported for each sample section as part of the section inventory record submitted each year. Detailed instructions for coding for these data are contained in Chapter IV.

Capital Improvement Data

Improvement cost data are essential to the evaluation of the effectiveness of existing highway programs. Additionally, these data are used to determine the relative effectiveness of various improvement types as the basis of simulation model cost matrices, and to determine the magnitude and make-up of future Federal-aid highway programs. The costs reported here are actual expenditures for improvements. The following must be reported for each sample section having an improvement completed during the data year.

Type of Improvement -- Improvement types are as follows:

1) New Route
2) Relocation
3) Reconstruction
4) Major Widening
5) Minor Widening
6) Restoration and Rehabilitation
7) Resurfacing
8) Bridge Replacement
9) Bridge Rehabilitation
10) Safety and Traffic Engineering
11) Other Highway Improvements

Only one improvement type can be reported for a particular section in a given year. While the determination of a single improvement type will not always be clear cut, the "primary purpose" of the improvement should be the determining factor. The above order of improvement types is a hierarchy of coding priorities, and should be followed when two or more types of improvements are involved in the same project. For example, if safety and engineering work (10) had been done in conjunction with a major widening project (4), the improvement type would be coded as a Major Widening Improvement (4).

If improvements are completed on a part or parts of a sample section during a specific year, thereby causing changes in a section, each dissimilar segment of the original section is treated as a separate and distinct record from that point on. Instructions explaining this situation are presented in Chapter IV along with coding instructions for capital improvements. Definitions for the above types of improvements are also presented in Chapter IV.

Improvement Costs -- The total improvement costs and its components are to be reported for each improvement. Where two or more improvements were completed on a section for a particular year, the costs are added and the total for each cost element is reported, with the major type of improvement determined by the abovementioned hierarchy. When improvements extend beyond the section ends being reported, only those costs adjusted to the section's length are reported. The cost element categories are:

1) Preliminary and Construction Engineering
2) Right-of-Way and Utility Adjustments
3) Grading and Drainage
4) Base and Surface
5) Structure
6) Other
7) Total Cost

Definitions for these cost elements are contained in the detailed instructions in Chapter IV. (See Table IV-5)

Section Data Changes Resulting from Capital Improvements -- When improvements are made, changes in data items as a result of the improvement are to be reported by updating the sample section's inventory record for the year the improvement was completed. States are encouraged to establish a system to document improvements as they are completed to avoid a peak workload. (See Chapter V.)

Local Sample Section Data

It has been previously mentioned that universe data includes information on roads and streets functionally classified as local (usually in the form of grouped data). Additionally, local samples shall be selected that supplement the universe data and will provide a base for estimating usage and certain pavement/surface attributes of local roads and streets. Limited data will be reported for the local samples consisting of universe data, surface width, pavement/surface type, and expansion factor. Thus, the contribution of local roads and streets to the sample portion of the data tape is limited to a minor role in the highway pavement category. Accident data and improvement costs are not to be reported for local sample sections.

Because of the lead time necessary in selecting and inventorying the local sample, only those States that feel they can provide data for 1980 (reported in 1981) are requested to do so. The remaining States are to select and inventory the local sample sections for the data year 1981 and to submit these data by May 1, 1982. Coding instructions for required local sample items are described in Chapter IV, and detailed sampling instructions are presented in Chapter VI, along with references to pertinent appendix material.

CHAPTER IV

RECORD FORMAT AND CODING INSTRUCTIONS

This Chapter presents the final record format and detailed coding instructions for the universe and sample section data. There are five types of varying length records that will be reported:

1) Universe Interstate Sections - These will contain Items 1-27. The record length is 73 positions. Where an Interstate is also a sample section, refer to (5), below for coding instructions.

2) Universe Sections excluding Interstate - These will contain Items 1-27, where applicable, with non-applicable items zero-filled. The record length is 73 positions. Where a section is a sample, refer to (4) or (5), below for appropriate instructions.

3) Universe Grouped Sections - These will contain Items 1-27, where applicable, with non-applicable items zero-filled. The record length is 73 positions. Interstate and sample sections cannot be grouped.

4) Local Sample Sections - These will contain Items 1-33, where applicable, with non-applicable items zero-filled. The record length is 97 positions.

5) Arterial and Collector Sample Sections - These will contain Items 1-75. Items 1-70, where non-applicable, will be zero-filled and Items 71-75 will be coded if applicable. The record length for Items 1-70 is 312 positions. Items 71-75 will add additional length to the record, depending on whether the items are coded.

There are instances where a sample road section will have independent alignments with regard to the geometrics of such data items as curvature and grade as well as others. Conflicting differences in dimension due to independent alignment are resolved by reporting average mileage in the case of section length and the lesser measurement or worse condition applicable to the data item(s) under consideration. The above rule for reporting the lesser or worse condition also applies to sections with uniform alignment but where staged construction results in unilateral differences in the quality and dimensions of the roadway.

RECORD FORMAT SUMMARY

Under the columns headed "Required Items", an asterisk (*) indicates that the item is required for the type of section being reported. The following abbreviations are used:

Universe Int - Report these items for all Interstate sections.
Universe Sec - Report these items for all universe sections.
Universe Grp - Report these items for grouped data ensuring that all data is homogeneous across all mileage being combined.
Sample Loc - Report these items for all local sample sections.
Sample Art - Report these items for all arterial (including Interstate samples) and collector sample sections.

Pos. - The "Pos." column indicates the position of the item in the final tape record. (See Chapter VII.)

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Universe Data

Item No.	Pos.	Length	Required Items: Universe Int	Universe Sec	Universe Grp	Sample Loc	Sample Art	Data Item
								Identification
1	1-2	2	*	*	*	*	*	Year
2	3-4	2	*	*	*	*	*	State code
3	5-7	3	*	*	*	*	*	County code
4	8	1	*	*	*	*	*	Rural/Urban Designation
5	9-13	5	*	*	*	*	*	Urban Area Code
6	14	1	*	*	*	*	*	Type of Section/Grouped Data ID
7	15-26	12	*	*	*	*	*	Section/Grouped Data Identification
								System
8	27-28	2	*	*	*	*	*	Functional Class
9	29	1	*	*	*	*	*	Federal-Aid System
10	30	1	*	*	*	*	*	Federal-Aid System Status
11	31	1	*				I	Route Signing
12	32-36	5	*				I	Route Number
13	37	1	*	*	*	*	*	Public Road
								Jurisdiction
14	38-39	2	*	*	*	*	*	Governmental Level of Control
15	40	1	*	*	*	*	*	Administrative Classification
16	41-42	2	*	*	*	*	*	Federal, State, and Local Domain
17	43-44	2	*	*	*	*	*	Special Systems
								Operation
18	45	1	*	*	*	*	*	Type of Facility
19	46	1	*	*	*	*	*	Reversible Lanes/Roadway
20	47	1	*	*	*	*	*	Trucks/Commercial Vehicles
21	48	1	*	*	*	*	*	Special HOV Lanes
22	49	1	*	*	*	*	*	Toll
								Travel/Special Data
23	50-55	6	*	*	*	*	*	Section/Group Length
24	56-61	6	*			*	*	AADT (Optional for all other sections)
25	62-63	2	*				I	Number of Interstate lanes open to traffic 5 or more years
26	64-65	2	*				*	Number of lanes
27	66-73	8	*	*	*	*	*	Record Continuation Code

The "I" in the "Sample-Art" column under "Required Items" indicates that these items are required only for Interstate Sample Sections.

Sample Data

Item No.	Pos.	Length	Required Items: Universe: Int	Sec	Grp	Sample: Loc	Art	Data Item
								Identification
28	74-85	12				*	*	Sample Number
29	86	1				*	*	Sample Subdivision
								Computational Elements
30	87-88	2					*	AADT Volume Group Identifier
31	89-93	5				*	*	Expansion Factor
								Pavement
32	94-95	2				*	*	Surface/Pavement Type
33	96-97	2				*		Surface/Pavement Width
34	98	1					*	Pavement Section
35	99-100	2					*	SN or Slab Thickness
36	101-102	2					*	Pavement Condition
37	103-104	2					*	Skid Resistance (Rural Arterials and Urban Freeways and Expressways including Interstate)
								Geometrics/Configuration
38	105	1					*	Access Control
39	106-107	2					*	Lane Width
40	108-110	3					*	Approach Width (Urban only)
41	111	1					*	Shoulder Type
42	112-115	4					*	Shoulder Width
43	116	1					*	Median Type
44	117-118	2					*	Median Width
45	119-121	3					*	ROW Width
46	122	1					*	Widening Feasibility
47	123	1					*	Horizontal Alignment Adequacy
48	124-214	91					*	Curves by Class
49	215	1					*	Vertical Alignment Adequacy
50	216-257	42					*	Grades by Class
51	258-260	3					*	% Passing Sight Distance (Rural Only)
52	261-262	2					*	Speed Limit
53	263-264	2					*	Average Highway Speed

Sample Data (Cont.)

Item No.	Pos.	Length	Required Items: Universe: Int	Sec	Grp	Loc	Sample: Art	Data Item
								Traffic/Capacity
54	265-268	4					*	Percent Trucks (Peak and Off-Peak)
55	269-270	2					*	K-Factor
56	271-273	3					*	Directional Factor
57	274-283	10					*	Capacity (Peak and Off-Peak)
58	284	1					*	Prevailing Signalization (Urban Only)
59	285-286	2					*	Typical Percent Green time (Urban Only)
60	287-288	2					*	Parking (Urban Only) (Peak and Off-Peak)
61	289-294	6					*	Future AADT
								Environment
62	295	1					*	Drainage Adequacy
63	296	1					*	Type of Terrain (Rural only)
64	297	1					*	Type of Development
65	298	1					*	Urban Location
66	299-300	2					*	No. of Grade Separated Interchanges
67	301-306	6					*	No. of At-Grade Intersections
68	307-308	2					*	No. of Major Commercial/ Recreational/Industrial Access Points
69	309-310	2					*	No. of Structures
70	311-312	2					*	No. of At-Grade Railroad Crossings
								Supplemental Data
71	Variable	15 x Item 69					*	Structure Identification Numbers
72	Variable	7 x Item 70					*	At-grade Railroad Crossing Identification Numbers
73	Variable	2					*	Type of Improvement
74	Variable	35					*	Capital Improvement Costs
75	Variable	23					*	Accident Data

UNIVERSE MILEAGE CODING INSTRUCTIONS

Identification

Item 1 - Year (Length = 2)

Enter the last two digits of the calendar year for which the data apply. For example, the 1980 data reported in 1981 would be coded "80".

Item 2 - State Code (Length = 2)

The Federal Information Processing Standards (FIPS) codes, listed in Appendix A, are used. (See Federal Information Processing Standards Publication 5, "States of the United States".)

Item 3 - County Code (Length = 3)

Use the three-digit FIPS county code (see Federal Information Processing Standards Publication 6, "Counties of the States of the United States"). In New England, the County Equivalents are the Townships.

Item 4 - Rural/Urban Designation (Length = 1)

Federal-aid urban area boundaries apply. (See Chapter II under General Coding Instructions for definitions of urban areas.)

Code	Description
1	Rural
2	Small Urban
3	Urbanized

Item 5 - Urban Area Code (Length = 5)

Area	Code
Rural	00000
Small Urban	5-digit FIPS code (one code per Small Urban Area)
Urbanized	3-digit code, right-justified (See Appendix B)

The States shall select small urban codes based on the FIPS Place Codes (see Federal Information Processing Standards Publication 55, "Codes for Named Populated Places and Related Entities of the States of the United States"). For small urban areas which encompass more than one place, the State shall select the code for the major place within the area (i.e., from which it gets its name or the largest place). This code shall remain unchanged.

Item 6 - Type of Section/Grouped Data Identification (Length = 1)

Enter the code that indicates the type of section identification used.

Code	Description
1	Route, Milepoint
2	A-Node, B-Node, Segment
3	Grouped Data - a countywide unique number
4	Local Section Data - a countywide unique number

See examples in Item 7.

Item 7 - Section/Grouped Data Identification (Length = 12)

This field is used as a location identifier or for unique identification. It provides a State with flexibility for identifying sections in accordance with their needs independent of the unique identification maintained for HPMS sample sections (see Item 28, Sample Number). The appropriate ID is as follows:

1) For all Interstate, use route-milepoint identification compatible with that used for the Interstate cost estimates.

2) For non-Interstate arterial and collector sections, including samples, use either route-milepoint or A-node, B-node identification.

3) For grouped data, use a unique identification number.

4) For sections, including samples, functionally classified as local, use a unique identification number.

Examples for each method follow:

1) Route, Milepoint (Item 6 = 1)

Inventory route number is coded in positions 15-20, right justified. Except for Interstate, the inventory route number is not necessarily the same as that posted along the roadway, but is a number used to uniquely identify a route within the State.

Milepoint is coded in positions 21-26, right justified, with an implied decimal point between positions 23-24. The milepoint represents the distance in miles from a set reference point to the beginning of this highway segment. The reference point could be a State or county line or the point where the particular route originates. The milepoint is the position along a route where one of the values in the segment

Item 7 (Cont.)
record changes. The milepoint numbering format should be such that the combination of county, inventory route number, and milepoint will define a unique location.

Example: Inventory Route 50 with milepoint 79.20

Pos.:	14	15	16	17	18	19	20	21	22	23	24	25	26
Code:	1	0	0	0	0	5	0	0	7	9	2	0	0

2) A-Node, B-Node - Segment (Item 6 = 2)

A-Node is coded in Positions 15-19, right justified
B-Node is coded in Positions 20-24, right justified
Segment is coded in Positions 25-26, right justified

The node numbers are unique within the State. They are usually located at major intersections, political boundaries, etc.

The segment number provides the position of the roadway segment being coded on the link between the same A-node and B-node pair. The segment is the position along the roadway where one of the data items changes. The number in this field should be low for the segment that begins at the A-node, and must increase for each segment progressing toward the B-node. While sequential numbers may be used, it is advantageous to leave gaps in the numbering to provide for expansion of the number of coded segments over time. For instance, if a section now contains only one segment, a "50" could be coded in this field to allow for changes over time on either end. The maximum number of segments between any A-node, B-node pair is 99.

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

Pos.:	14	15	16	17	18	19	20	21	22	23	24	25	26
Code:	2	0	0	5	7	2	0	0	6	9	1	0	4

3) Grouped Data (Item 6 = 3)

Any countywide unique number with no more than 12 digits is coded, right justified.

Grouped data is an aggregation of roadway mileage, where the following data items are homogeneous across all mileage being combined: Items 1-10, and 13-23.

NOTE: Interstate and sample sections cannot be grouped. All other arterials, collectors and locals can be grouped.

Example: 98365

Pos.:	14	15	16	17	18	19	20	21	22	23	24	25	26
Code:	3	0	0	0	0	0	0	0	9	8	3	6	5

Item 7 (Cont.)

4) Local Section Data (Item 6 = 4)

Any countywide unique number with no more than 12 digits is coded, right justified.

The data items to be coded for local sample sections are: 1-24 (Universe Data), 27 (Record Continuation Code), 28 (Sample Number), 29 (Sample Subdivision), 31 (Expansion Factor), 32 (Surface/Pavement Type), and 33 (Surface/Pavement Width).

Example: 4321

Pos.:	14	15	16	17	18	19	20	21	22	23	24	25	26
Code:	4	0	0	0	0	0	0	0	0	4	3	2	1

NOTE: Items 1-7 contain the identification portion of the section records.

System

Item 8 - Functional Class (Length = 2)

Code	Description
Rural	
01	Principal Arterial - Interstate
02	Principal Arterial - Other
06	Minor Arterial
07	Major Collector
08	Minor Collector
09	Local
Urban	
11	Principal Arterial - Interstate
12	Principal Arterial - Other Freeways or Expressways
14	Other Principal Arterial
16	Minor Arterial
17	Collector
19	Local

Codes 12 & 13 and 14 & 15 have been used in the past to identify non-connecting/connecting link portions of the urban Other Freeway and Expressway and Other Principal Arterial functional classes. Although codes 13 and 15 may still be used, if desired, codes 12 and 13 will be treated as code 12, and codes 14 and 15 will be treated as code 14.

Item 9 - Federal-Aid System (Length = 1)

Code	Description
1	Interstate
2	Federal-Aid Primary (Other than Interstate)
3	Federal-Aid Urban
4	Federal-Aid Secondary (rural only)
8	Non-Federal-Aid

Item 10 - Federal-Aid System Status (Length = 1)

Code	Description
1	Federal-Aid System open to traffic
2	Federal-Aid System not yet built or not open to traffic
8	Non-Federal-Aid

Item 11 - Route Signing (Length = 1)

Only Interstate is required to be reported under this item. The reporting of routes other than Interstate is optional. These codes specify the manner in which the highway segment is or will be signed and do not necessarily bear any relationship to the Federal-aid system category. If not coded, this field should be coded "0".

Code	Description
1	Interstate
2	U.S.
3	State
4	County
5	Township
6	Municipal
7	None of the above

When a route is signed with two or more identifiers (for example, Interstate Route 83 and U.S. Route 32), the code for the highest class of route should be used (Interstate in the above example). The hierarchy is in the order listed above.

Item 12 - Route Number (Length = 5)

Enter the Interstate route number, right justified. This item is optional for non-Interstate routes. If two or more routes of the same hierarchy (see Item 11) are signed along a roadway section, the lowest route number should be entered in this field. If Item 11 is coded "0", zero fill this field.

Item 13 - Public Road (Length = 1)

Code	Description
1	Public Road
2	Non-Public Road

Applicable definitions follow:

a. "A public road means any road under the jurisdiction of and maintained by a public authority and open to public travel." (23 U.S.C. 402(c)).

b. "The term 'maintenance' means the preservation of the entire highway, including surface, shoulders, roadsides, structures, and such traffic-control devices as are necessary for its safe and efficient utilization." (23 U.S.C. 101)

c. To be open to public travel a road must be available, except during scheduled periods, extreme weather or other emergency conditions, and open to the general public for use by 4-wheel passenger cars without restrictive gates, prohibitive signs, or regulation other than restrictions based on size, weight, or class of registration. Toll plazas of public toll facilities are not considered as restrictive gates. (FHPM, 4, 5, 3)

d. Primitive roads do not meet the criteria for "public roads" since they are defined as routes "on which there is no public maintenance."

e. A public authority is defined as a Federal, State, county, township, municipal or other local government or instrumentality thereof, with authority to finance, build, operate, or maintain highway facilities, either as toll or toll free. (FHPM 4, 5, 3)

If a roadway does not meet the above criteria, it is coded as non-public.

Jurisdiction

Item 14 - Governmental Level of Control (Length = 2)

This data element is used to identify the level of government that has responsibility for the facility. In the case of toll authorities, this code is not dependent upon a toll being charged.

Code	Description
01	State Highway Agency
02	County Highway Agency
03	Town or Township Highway Agency
04	Municipal Highway Agency
11	State Park, Forest, or Reservation Agency
12	Local Park, Forest, or Reservation Agency
21	Other State Agencies
25	Other Local Agencies
26	Private
31	State Toll Authority
32	Local Toll Authority
60	Other Federal Agencies (not listed below)
62	Bureau of Indian Affairs
64	U.S. Forest Service
66	National Park Service
68	Bureau of Land Management
70	Military Reservation/Corps of Engineers

Item 15 - Administrative Classification (Length = 1)

The code in this field indicates the administrative highway classification based on State or local regulations or procedures to which the highway facility is assigned.

Code	Description
1	Primary
2	Secondary
3	Local
4	Other

The codes in Item 14, Governmental Level of Control, indicate the level of control over the highway segment. This item supplements Item 14 by detailing particular administrative classifications. If a system of highway is subdivided into roads of primary and secondary importance then they should be shown as such by appropriately coding this position.

Item 15 (Cont.)

When there is no breakdown, the system as a whole should be considered as primary. In those States where all or part of county roads are under State control, then these are coded as "local" in this field and "State" in Item 14.

If a county controlled system is broken into a primary and secondary classification, then the level of control code, Item 14 would be "02" with the appropriate administrative classification coded.

This item should always be coded, either with the appropriate classification code for the State administered systems (primary, secondary, local), or, if known, the appropriate classification for a non-State administered system. If the classification is not known, use the primary code of "1".

Item 16 - Federal, State, and Local Domain (Length = 2)

The code in these positions identifies the Federal, State, or local agency, if any, having control over the land through which the highway segment passes. Where the highway falls between two domains, a judgement must be made as to the most appropriate domain to be coded. For example, if a State highway is the boundary for a National Forest, then it would not be considered to be within the National Forest, but if it were a Forest highway forming the boundary, then it would be considered to be within the National Forest.

Code	Description
01	Private Land (Non-Public agency)
10	Local Agencies
30	State Agencies
60	Other Federal Agencies (not listed below)
62	Bureau of Indian Affairs
64	U.S. Forest Service
66	National Park Service
68	Bureau of Land Management
70	Military reservation/Corps of Engineers

Item 17 - Special Systems (Length = 2)

This field is used to code the special funding categories in which some highway segments fall. These special systems are separate and distinct from those outlined in previously defined fields. While a limited number of codes are defined below, two positions are provided so that codes can be added as their need becomes apparent.

Code	Description
01	Not on a Special System
02	National Forest Highway System 1/
03	National Forest Development Roads and Trails
04	National Park Service Parkway 1/
05	National Park Roads and Trails
06	Indian Reservation Roads and Bridges 1/
07	Economic Growth Center Development Highway (23 U.S.C. 143)
10	Appalachian Development Highway 2/
15	Appalachian Highway Access Road
20	Priority Primary Route (23 U.S.C. 147)
25	Great River Road (23 U.S.C. 148)
30	Defense Access Road (23 U.S.C. 210)
40	Addition to the Interstate System (23 U.S.C. 139(a))

1/ These definitions are intended to be consistent with 23 U.S.C. 101(a), Definitions and Declaration of Policy.

2/ This definition is intended to be consistent with 23 U.S.C. 143(f) (2) and 23 U.S.C. 101(a).

These special systems may overlap previously defined systems. For example, the National Forest Highway System may include mileage under jurisdiction of a State or local government. However, if the mileage is part of the National Forest Highway System, it should be coded as such in this field.

Operation

Item 18 - Type of Facility (Length = 1)

Code	Description
1	One-Way
2	Two-Way
3	One-Way, Part of a One Way Couplet

Definitions:

One-Way - A one-way is a roadway with traffic moving in one direction, only.

Two-Way - A road with two-way traffic during non-rush hours.

One-Way Couplet - A pair of one-way streets serving the same traffic corridor and performing as a divided facility This code provides a method of determining chargeable Federal-aid system mileage. States report the one-way mileage for each leg of the couplet with a code 3 indicating that they are parts of a couplet. Then, in the analysis of chargeable Federal-aid mileage, only one-half of the total one-way mileage will be used.

Item 19 - Reversible Lanes/Roadway (Length = 1)

Code	Description
1	None
2	Reversible Lanes
3	Reversible Roadway

Reversible refers to flow in the peak direction.

Item 20 - Trucks/Commercial Vehicles (Length = 1)

Code	Description
1	Not a Parkway - Trucks/Commercial Vehicles Allowed
2	Parkway - Trucks/Commercial Vehicles Prohibited
3	Not a Parkway - Trucks/Commercial Vehicles Prohibited - All Day
4	Not a Parkway - Trucks/Commercial Vehicles Prohibited - During Specific Periods

For purposes of this data element, a Parkway is a highway with full or partial access control usually located within a park or a ribbon of parklike developments that prohibits commercial vehicles.

In this instance, buses are not considered commercial vehicles.

"Through Trucks Prohibited" regulations will be ignored when coding this item. The intent is to identify facilities such as parkways or others which prohibit truck usage.

Item 21 - Special High Occupancy Vehicle (HOV) Lanes (Length = 1)

Code	Description
1	None
2	HOV With-Flow - All day
3	HOV With-Flow - Specific periods
4	HOV Contra-Flow - All day
5	HOV Contra-Flow - Specific periods
6	Buses Only With-Flow - All day
7	Buses Only With-Flow - Specific periods
8	Buses Only Contra-Flow - All day
9	Buses Only Contra-Flow - Specific periods

HOV - High Occupancy Vehicles include buses, carpools, and vanpools.

With-Flow - A reserved lane(s), whereby a portion of the roadway normally used for the same direction of flow is designated solely for the use of high occupancy vehicles.

Contra-Flow - A reserved lane(s), whereby a portion of the roadway that normally serves opposing traffic flow is used to supplement peak-direction capacity and one or more of these lanes is designated for the exclusive use of high occupancy vehicles.

Item 22 - Toll (Length = 1)

Code	Description
1	Non-Toll
2	Toll

If portions of a roadway can be traversed without the payment of a toll, but a toll is charged on other portions, the segment is considered to be toll. This applies if a vehicle can enter and exit from the main through route without payment of a toll. If a toll is charged in only one direction, the "free" direction is also considered to be toll.

Travel

Item 23 - Section/Group Length (0.001 mile) (Length = 6)

The section length is coded XXX.XXX with an assumed decimal point between positions 52 and 53. For lower type highways where records by category of mileage are grouped, the total mileage in the category is coded. Should it be necessary to code a number larger than 999.999, two or more records should be included so as to produce the required sum. Care should be taken to avoid splitting the mileage equally between records so that the possibility of mistaking these for duplicate records can be avoided.

While provision has been made for coding to a maximum precision of 0.001 miles, the various submitted records should reflect the precision normally utilized by the State. This not only provides maximum precision, but alleviates rounding, programming, and checking problems. A minimum precision to the nearest tenth of a mile should be provided.

The field should be coded with trailing and leading zeros, depending on the precision obtained, i.e., 56.2 miles would be coded "056200".

Item 24 - AADT (Required for all Interstate sections, and all sample sections; optional for remaining non-sample sections.) (Length = 6)

Enter the section's annual average daily traffic (total both directions) for the given year. Since many applications, including VMT estimates will be based on sample section AADT's, the States are encouraged to concentrate on counts for sample sections of the highway system to provide "actual counts" adjusted to represent AADT rather than "estimates" as previously reported. The field is zero filled when not used.

For example, an AADT of 25,300 vehicles per day is coded "025300".

Item 25 - Number of Interstate Lanes Open to Traffic 5 Years or More (Interstate only) (Length = 2)

This item will be used to apportion Interstate 3R funds. A lane on a section is considered "open to traffic" when it is available to normal traffic and provides reasonable service for local and interstate traffic volumes. Only Interstate lanes on final location, designated as Interstate for 5 or more years are to be reported here. Total number of lanes will be reported in Item 26. For Interstate toll sections without the prescribed agreement to make the section a free section as outlined under section 105 of the 1978 Highway Act, code "99" to indicate the lanes are not counted. For those toll road sections with proper agreement, report the number of lanes open to traffic for 5 or more years, and designated for 5 or more years.

The information reported here for open to traffic lanes must be consistent with status groups 1, 2 and 6b(1) as defined in Volume 6, Chapter 1, Section 1, Subsection 5 (PR511 Reports) of the Federal-Aid Highway Program Manual. This entry shall include Interstate segments designated under Sections 103(e) and 139(a), Title 23, U.S.C.

Enter "00" for all non-Interstate sections.

Item 26 - Number of Through Lanes (For all Interstate and for all arterial/collector sample sections only) (Length = 2)

Enter the prevailing number of lanes in both directions (excluding parking and turning lanes) carrying through traffic in the off-peak period. Exclude truck climbing lanes unless the length and importance is sufficient to warrant inclusion.

Enter "00" for all non-Interstate, non-sample sections.

Item 27 - Record Continuation Code (Length = 8)

This field must be present in all records. It indicates what type of section record is being coded, consists of six elements, and is normally encoded by software. See Chapter VII for details.

NOTE: This is the end of the record for all non-sample sections.

SAMPLE SECTION CODING INSTRUCTIONS

Samples are obtained from public road mileage under the jurisdiction of and maintained by a public authority.

Identification

Item 28 - Sample Number (Length = 12)

Code the sample section identifier used for this section in the original HPMS submission or a unique number for a new sample section. This number may be route-milepoint or A-node, B-node, Segment, but will be considered as a unique number that may not change in the future. It will be assigned to all subdivided portions of the sample sections. Local samples may be assigned any unique number.

Item 29 - Section Subdivision (Length = 1)

This field will be used if it becomes necessary to subdivide a section due to operational or capital improvements on part of the section's length. Initially, this field is coded "0". If the section is subdivided over time, the code "0" is changed to 1, 2, 3, etc, depending upon the number of subdivisions (sections) created from the original section. Item 28, Sample Number, always remains unchanged.

Computational Elements

Item 30 - AADT Volume Group Identifier (Length = 2)

Enter the code representing the AADT volume group from which this sample section was selected. These codes are presented in Appendix F, Tables 1-3, or Appendix F, Figure 1, if the volume grouping is other than that prescribed by the FHWA. This item is not required for local sample sections.

Item 31 - Expansion Factor (Length = 5)

Enter the factor to the nearest one hundredth (decimal point is implied between the third and fourth digits).

The calculation of the expansion factor varies according to whether the sample section is for the arterial and collector systems or functionally classified as local.

(a) Arterial and Collector Sample Sections

By definition, the expansion factor is the ratio of the total mileage in a volume group to the total sampled volume group mileage.

Item 31 (Cont.)

Expansion Factor = Total miles in Volume Group / Sampled miles in Volume Group

For small urban and rural areas, code the expansion factor for the volume group within the functional system to which the section belongs to the nearest hundredth. For urbanized areas, code the expansion factor for the volume group within the functional system and urbanized area to which the section belongs.

If, for any reason, the expansion factor for a given group exceeds 100.00, additional sections in the volume group should be selected for sampling until the expansion factor is reduced to a maximum of 100.00.

It should be stressed that the same expansion factor is used for all sample sections in the same volume group and functional system. Experience has shown that more than one expansion factor has been erroneously reported for sample sections in the same volume group. A tabular summary of expansion factors by volume group within functional system and geographic area will be prepared by the State and submitted along with the required data. The table would contain the following:

Table IV-1

Expansion Factor Computation

Area, System, and Volume Group	(A) Total Mileage of Sample Sections	(B) Total Mileage in Volume Group	(C) Expansion Factor Col B / Col A
Rural, Interstate			
Group 1			
Group 2			
Group 3			
etc.			
Rural, Other Principal Arterial			
Group 1			
Group 2			
Group 3			
etc.			
etc.			

Item 31 (Cont.)

(b) Local Sample Sections

All sample sections in a given State geographic area - rural, small urban (5-25 thousand population group), small urban (25-50 thousand population group), and individual urbanized - will have the same expansion factor, expressed to the nearest hundredth. The maximum expansion factor for locals is 999.99. These are calculated from the following ratios:

Rural - Statewide rural local road and street mileage / Total sampled rural local mileage in State

Small Urban (5-25 thousand population) - Statewide small urban local road and street mileage / Total sampled local mileage in the small urban group

Small Urban (25-50 thousand population) - Statewide small urban local road and street mileage/ Total sampled local mileage in the small urban group

Individual Urbanized - Total local road and street mileage in a given urbanized area / Total sampled local mileage in a given urbanized area

Pavement Attributes

Item 32 - Surface/Pavement Type (Length = 2)

Enter the code that represents the type of surface on the section.

Code	Description
20	Unimproved Road - A road using the natural surface and maintained to permit bare passability for motor vehicles, but not conforming to the requirements for a graded and drained earth road. The road may have been bladed and minor improvements may have been made locally. (Road Type B 1/)
30	Graded and Drained - A road of natural earth aligned and graded to permit reasonably convenient use by motor vehicles and with drainage systems (natural and artificial) sufficient to prevent serious impairment of the road by normal surface water, and 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 C 1/)
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 D, E 1/)
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, plant-mix seals, and rock asphalt seals. (Road Type F 1/)
52	Mixed Bituminous - Low type (less than 7-inches combined thickness surface and base)- 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. (Road type G-1 1/)

Item 32 (Cont.)

Code	Description
53	Bituminous Penetration - Low type (less than 7-inches combined thickness surface and base)- 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. (Road type H-1 1/)
60	High Flexible - Mixed bituminous or bituminous penetration road on a rigid or flexible base with a combined (surface and base) thickness or 7-inches or more. Includes any bituminous concrete, sheet asphalt, or rock asphalt. (Road Types G-2, G-3, G-4, H-2, H-3, H-4, I 1/)
70	High Rigid - Portland cement concrete pavements with or without bituminous surfaces of less than 1-inch. (Road Types J, J-3, J-4 1/)
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 combination of wearing surfaces. (Road Types K, L, M 1/)

1/ As defined in the Federal Highway Program Manual.

Item 33 - Surface/Pavement Width (Local sample sections only) (Length = 2)

For local surfaced facilities the paved width from edge-to-edge of surface, including paved shoulders, or curb-to-curb is reported. For unpaved facilities, the width of the highway, including shoulders, available for use by vehicles is reported. Code "99" where the roadway is 100 feet or greater. Code "00" for non-local sample sections.

NOTE: This is the end of the record for all local sample sections. The following items are reported only for the arterial and collector sample sections.

Item 34 - Pavement Section (Length = 1)

Enter the appropriate code 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. Unpaved facilities are those designated as graded and drained earth and soil, gravel, or stone roads (codes 30/40 in Item 32).

Code	Description
0	Unpaved
1	"SN" Known
2	"D" Known
3	Heavy
4	Medium
5	Light

Table IV-2

Pavement Section Coding

	Flexible Pavement					Rigid Pavement
Code	Type of Section	"SN" Range	Surface Type & Thick.	Base Type & Thick.	Subbase Type & Thick.	Combined Depth 1/	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/ Used as a guide when the total depth is known or estimated.
2/ Subbase course not necessary under portland cement concrete base.

Item 35 - Structural Number (SN) or Slab Thickness (D) (Length = 2)

Enter the structural number (to the nearest 0.1 - decimal point is implied) for those sections coded "1" in Item 34. Enter the slab thickness (in whole inches) for those sections coded "2" in Item 34. Otherwise code "00".

Item 36 - Pavement Condition (Length = 2)

Enter the pavement condition, actual Present Serviceability Rating (PSR) or equivalent, to the nearest tenth, for all paved sections. A decimal point is implied between the two positions. For unpaved sections (defined in Item 34), code "00". The ratings are equivalent to those used in making a 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 from the following table. In view of the growing national concern regarding pavement deterioration, careful attention to realistic pavement condition ratings is strongly suggested. Estimates to the nearest tenth within the applicable range should be made, e.g. - 2.3. This is most important for comparisons to prior years.

Item 36 (Cont.)

Table IV-3

Pavement Condition Rating

(Use full range of values)

PSR	Verbal Rating	Description
5.0		
	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 the data year would normally be rated very good.
4.0		
	Good	Pavements in this category, although not quite as smooth as those described above, give a first class ride and exibit 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.
3.0		
	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.
2.0		
	Poor	Pavements that have deteriorated to such an extent that they are in need of resurfacing.
1.0		
	Very Poor	Pavements that are in an extremely deteriorated condition and may even need complete reconstruction.
0.0		

Item 37 - Skid Resistance (Length = 2)

For all paved rural arterial (Interstate, other principal arterial and minor arterial) sections and for urban freeways or expressways, as defined in the "Highway Capacity Manual" - 1965, which are functionally classified as Interstate or Other Freeways and Expressways, 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".

Geometrics/Configuration

Item 38 - Access Control (Length = 1)

Enter the code for the type of access control, as defined below:

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 crossing at grades or by prohibiting direct driveway connections.
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 39 - Lane Width (Length = 2)

Enter the prevailing traffic lane width (through lanes) to the nearest whole foot.

Item 40 - Approach Width (Urban only) (Length = 3)

For sections which are not freeways or expressways, as defined in the Highway Capacity Manual, 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 whole foot. Code "000" for freeways and expressways.

Item 41 - Shoulder Type (Length = 1)

Enter the code 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 (i.e., a shoulder bounded by a curb or a mountable curb and then a shoulder), code the shoulders.

Code	Description
1	Surfaced - A portland cement concrete 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 42 - Shoulder Width (Length = 4)

42a - Right Shoulder - Enter the width to the nearest whole foot. Enter "00" if no right shoulder exists. (Length =2)

42b - Left Shoulder - On divided highways, enter the width of the left (median) shoulder to the nearest whole foot. Enter "00" where no left shoulder exists and for undivided or 2- or 3-lane facilities. (Length = 2)

Item 43 - Median Type (Length = 1)

Enter one of the following codes:

Code	Description
1	Curbed
2	Positive Barrier
3	Unprotected
4	None

Item 44 - Median Width (Length = 2)

Enter the predominant median width (including shoulders, if any), measured between the inside edges of the through roadways, to the nearest whole foot. Enter "00" for undivided roadways. Enter "99" where the median width is 100 feet or greater.

Item 45 - Existing Right-of-Way Width (Length = 3)

Enter the prevailing right-of-way width in whole 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. Code "999" where the right-of-way is 1000 feet or greater.

Item 46 - Is Widening Feasible? (Length = 1)

Enter the appropriate code 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, State practices concerning widening, or projected traffic.

Code	Description
1	No
2	Yes, less than one lane
3	Yes, one lane
4	Yes, two lanes
5	Yes, more than two lanes

Table IV-4

Coding Guide for Vertical and Horizontal Alignment
(For Coding Items 47 to 50)

	Item 47- Horizontal Alignment Adequacy	Item 48- Curves by Class	Item 49- Vertical Alignment Adequacy	Item 50- Grades by Class
Paved - Rural				
Principal Arterial	Code "0"	Required	Code "0"	Required
Minor Arterial	Code "0"	Required	Code "0"	Required
Major Collector	Required	Not Req'd	Required	Not Req'd
Minor Collector	Required	Not Req'd	Required	Not Req'd
Paved - Urban				
Principal Arterial	Code "0"	Required	Code "0"	Required
Minor Arterial	Not Req'd	Not Req'd	Not Req'd	Not Req'd
Collector	Not Req'd	Not Req'd	Not Req'd	Not Req'd

Item 47 - Horizontal Alignment Adequacy (Rural only) (Length = 1)

This item is required for paved Rural Collectors. (See Table IV-4, above.) Code "0" when Item 48 - Curves by Class - is reported or when this item is not required. The following codes will be used:

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.
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 traveled 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 48 - Curves by Class (Length = 91)

This item is required for paved Rural Arterials and Urban Principal Arterials. (See Table IV-4, above.) Zero-fill this item when it is not required. The following data will be reported:

Degree of Curvature	No. of Curves (right-justified)	Positions	Total Length of Curves in Class (implied decimal) (00.000 miles)	Positions
a. 0.0-0.4	--	124-125	-----	126-130
b. 0.5-1.4	--	131-132	-----	133-137
c. 1.5-2.4	--	138-139	-----	140-144
d. 2.5-3.4	--	145-146	-----	147-151
e. 3.5-4.4	--	152-153	-----	154-158
f. 4.5-5.4	--	159-160	-----	161-165
g. 5.5-6.9	--	166-167	-----	168-172
h. 7.0-8.4	--	173-174	-----	175-179
i. 8.5-10.9	--	180-181	-----	182-186
j. 11.0-13.9	--	187-188	-----	189-193
k. 14.0-19.4	--	194-195	-----	196-200
l. 19.5-27.9	--	201-202	-----	203-207
m. 28+	--	208-209	-----	210-214

The format is a (13 x 7 =) 91-position field with thirteen classes of curves reported. For each of the thirteen curve classes, the number of curves (2 positions) and class length (5 positions, with implied decimal 00.000 mile) are reported. The sum of the lengths of curves must equal the section length.

Item 49 - Vertical Alignment Adequacy (Rural only) (Length = 1)

This item is required for paved Rural Collectors. (See Table IV-4, above.) Code "0" when Item 50 - Grades by Class - is reported or when this item is not required. The following codes will be used:

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.

Item 50 - Grades by Class (Length = 42)

This item is required for paved Rural Arterials and Urban Principal Arterials. (See Table IV-4, above.) Zero-fill this item when it is not required. The following data will be reported:

	Gradient (%)	No. of Grades (Right-Justified)	Positions	Total Length of Grades in Class (implied decimal) (00.000 miles)	Positions
a.	0.0-0.4	--	216-217	-----	218-222
b.	0.5-2.4	--	223-224	-----	225-229
c.	2.5-4.4	--	230-231	-----	232-236
d.	4.5-6.4	--	237-238	-----	239-243
e.	6.5-8.4	--	244-245	-----	246-250
f.	8.5 +	--	251-252	-----	253-257

The format is a (6 x 7 =) 42 position field with six classes of grades reported. For each of the six grade classes, the numbers of grades (2 positions) and the grade length (5 positions, with implied decimal 00.000 miles) are reported. The sum of the lengths of grades must equal the section length.

Item 51 - Percent of Length with Sight Distance of 1500 Feet (Rural 2-lane facilities only) (Length = 3)

For all paved rural two-lane facilities, excluding dense rural sections, 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 C for optional estimating procedures. Code "000" for nonapplicable sections including dense rural.

Item 52 - Speed Limit (Length = 2)

Enter the daytime speed limit for automobiles posted or legally mandated on the greater part of the section.

Item 53 - Average Highway Speed (Rural only) (Length = 2)

This item is required for all paved rural collectors with type of development - rural (Item 64 = 1). 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. 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 D.

Traffic/Capacity

Item 54 - Percent Trucks (Peak and Off-Peak) (Length = 4)

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 on the calculation of capacity. In these cases, separate values are urged even if they must be estimated.

54a - Peak Percent Trucks (Length = 2)

Enter the percentage of commercial vehicles to the nearest whole percent, excluding pickups, panels, and light (two-axle, four-tired) trucks for the peak period. In this instance, buses are considered commercial vehicles.

54b - Off-Peak Percent Trucks (Length = 2)

Enter the percentage of commercial vehicles to the nearest whole percent, excluding pickups, panels, and light (two-axle, four-tired) trucks for the off-peak period. In this instance, buses are considered commercial vehicles.

Item 55 - K Factor (Length = 2)

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

Item 56 - Directional Factor (Length = 3)

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.

Item 57 - Capacity (Peak and Off-Peak) (Length = 10)

57a- Peak Capacity (Length = 5)

1) Urban

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". For purposes of this data element, 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. See Appendix E.

Item 57 (Cont.)

2) Rural (Optional)

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. See Appendix E.

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.

This field should be zero filled when not reported.

57b- Off-Peak Capacity (Urban only) (Length = 5)

1) Urban

Enter the present hourly capacity (in one direction) reflecting the off-peak situation. For further information, see the instructions for peak-period capacity. See Appendix E.

2) Rural

This field should be zero filled for "rural" sample sections.

Item 58 - Prevailing Type of Signalization (Urban only) (Length = 1)

Enter the appropriate code that best describes the signal system on the section.

Code	Description
1	Uncoordinated Fixed Time
2	Traffic Actuated
3	Progressive
4	No Signal System

Item 59 - Typical Percent Green Time (Urban only) (Length = 2)

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.

Item 60 - Parking (Peak and Off-Peak) (Length = 2)

60a- Peak Parking (Urban only) (Length = 1)

Enter the appropriate code reflecting the type of parking in the peak-hour situation, 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.

Code	Description
1	One Side
2	Both Sides
3	None

60b- Off-Peak Parking (Urban only) (Length = 1)

Enter the appropriate code reflecting the type of parking in the off-peak situation, 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.

Code	Description
1	One Side
2	Both Sides
3	None

Item 61 - Future AADT (Year-2000) (Length = 6)

Enter the forecasted annual average daily traffic (total both directions) for the year 2000. Ideally, travel forecasts are to be for an appropriate 20-year period but should not be for less than 17 years. Beginning with data year 1983, the travel forecast will be updated from 2000 to 2005, and thereafter the time projection will be incremented 5 years for every 5-year period.

Environment

Item 62 - Drainage Adequacy (Length = 1)

Enter the code 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.

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 comply with standards if rebuilt. Drainage structures are structurally sound. Some added maintenance effort required due to drainage and sedimentation 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 and sedimentation problems.

Item 63 - Type of Terrain (Rural only) (Length = 1)

Enter the code for the predominant terrain type through which the section passes.

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 64 - Type of Development (Rural only) (Length = 1)

Enter the code for the predominant type of development.

Code	Description
1	Rural - All areas outside of Federal-aid urban boundaries (cities of 5,000 or more population) excluding those described as "dense".
2	Dense - Those areas outside of Federal-aid 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.

Item 65 - Urban Location (Urban only) (Length = 1)

Enter the appropriate code 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 two of these categories, the code for the higher density of development should be used.

Code	Description
1	CBD
2	Fringe
3	Outlying Business District
4	Residential
5	Rural in character

Item 66 - Number of Grade-Separated Interchanges (Length = 2)

For all freeway and expressway facilities as defined in the "Highway Capacity Manual" - 1965, enter the number of grade - separated interchanges. Enter "00" if none exist or if the facility being sampled is not a freeway or an expressway.

Item 67 - Number of At-Grade Intersections with Public Roads (Length = 6)

This data item pertains to the type of traffic controls on the route being inventoried and not those of the intersecting route. It consists of three elements. Only those controls facing (controlling) the route being inventoried are counted. If a section begins and ends with an intersection, only one intersection is counted.

67a- Signals - Enter the number of signalized intersections. If none, enter "00". A signal that cycles through red, yellow, and green for all or a portion of the day shall be counted as a signalized intersection. (Length = 2)

67b- Stop Signs - Enter the number of intersections controlled by stop signs. A continuously operating flashing red ball shall be counted as a stop sign control. If none, code "00". (Length = 2)

67c- Other or No Controls - Enter the number of intersections controlled by other types of signing or having no controls. A continuously operating flashing yellow signal ball shall be considered as "other or no control". If none, code "00". (Length = 2)

Item 68 - Number of Major Commercial/Industrial/Recreational Access Points (Length = 2)

Enter the number of such entrances/exits that are estimated to have at least 500 vehicle movements (access plus egress) per week for all arterials not having full control of access. This count does not include intersections with public highways or access points controlled by traffic signals. Adjacent entrances or exits should be counted as one. If none or for other functional systems, code "00".

An option is available to report the number of access connections by ranges. Coding one of the following instead of an actual number indicates an average over the whole section. The ranges are:

Code	Range
R0	0/mile
R1	1-4/mile
R2	5-9/mile
R3	10-14/mile
R4	15-19/mile
R5	20-24/mile
R6	> 24/mile

Item 69 - Number of Structures (Length = 2)

Enter the number of structures located within the section. Include structures built 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 20 or more feet. Twin (side by side) structures are to be reported as two separate structures. All highway grade separated 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 two sections intersect by means of a structure and both roadways are on the same functional system, report the structure data with the roadway on which the deck is located, the "over" facility. For any structure included in this field, the corresponding structure identification number will be recorded in Item 71. Code "00" if no structures exist.

A maximum of "50" may be coded in this field. If more than that number of structures exist on the section, the section should be subdivided.

Item 70 - Number of At-Grade Railroad Crossings (Length = 2)

Enter the number of at-grade railroad crossings on the section. Multiple tracks should be reported as a single crossing. For any grade crossing in this field, the corresponding grade crossing identification number will be recorded in Item 72. Code "00" if no at-grade crossings exist.

A maximum of "15" may be coded in this field. If more than that number of railroad crossings exist on the section, the section should be subdivided.

Supplemental Data

NOTE: The following items constitute the variable portion of the sample record. The items are not reported if the data do not exist on the section.

Item 71 - Structure Identification Numbers (Variable - Length = 15 x Item 69)

For each structure reported in Item 69, the appropriate 15-digit unique structure identification number is coded from the bridge inventory and appraisal of the nation's bridges. For example, if Item 69 = 3, this item will contain three structure ID fields, each 15-digits long for a total of 45 digits. A maximum of 50 structure ID's may be coded in this field. If there are more than 50 structures on this section, it must be split into two or more segments. If there are no structures on the section, this item is not coded.

Item 72 - At-Grade Railroad Crossing Identification Numbers (Variable - Length = 7 x Item 70)

For each at-grade railroad crossing reported in Item 70, the appropriate seven-digit railroad grade crossing ID is coded from the "National Railroad Highway Crossing Inventory". For example, if Item 70 = 3, this item will contain three railroad crossing ID fields, each 7 digits long for a total of 21 digits. A maximum of 15 railroad crossing ID's may be coded in this field. If more than 15 railroad crossings exist on this section, it must be split into two or more segments. If there are no railroad crossings on this section, this item is not coded.

Item 73 - Type of Improvement (Length = 2)

This item is coded, right-justified, as defined below for all improvements completed during the reporting year. If completed improvements overlap, use the one with the highest priority (lowest code). If no improvements were completed during the reporting year, this item is not coded.

If only a portion of the section was improved and completed during the reporting year, the section should be split into two or more segments. Use one of the following codes:

Code 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 of the through traffic with the previous facility closed or retained as a land-service road only.

3 RECONSTRUCTION - Construction on approximate alignment of an 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 or more feet of width per lane to an existing facility without adding lanes. In many cases, the improvement will include resurfacing of the existing pavement and other incidental improvements such as shoulder and drainage improvements.

Item 73 (Cont.)

Code Improvement Type Definitions

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. (See Code 6.)

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 that 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.

Item 74 - Improvement Cost Data (Length = 35)

Costs (in thousands of dollars) are reported for each improvement for the year in which they occur, as defined in Table IV-5, below. All six elements plus the total are to be reported. If there were no costs for a particular element, zeros will be entered.

If no capital improvements were made during the year, this item is not coded. If only a portion of the section was improved and completed during the reporting year, the section should be split into two or more segments.

74a - Preliminary and Construction Engineering (Length = 5)
74b - Right-of-Way and Utility Adjustments (Length = 5)
74c - Grading and Drainage (Length = 5)
74d - Base and Surfacing (Length = 5)
74e - Other Improvements (Length = 5)
74f - Structure Improvements (Length = 5)
74g - Total Capital Improvement Cost (Length = 5)

Table IV-5

Cost Element Definitions

Costs are to be reported for the following categories:

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

b. 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.)

c. Grading and Drainage - Includes all earthwork preparatory to surface channels, flumes, dikes, underdrains, outfalls, and minor drainage structures, culvert (as usually defined) and special fill treatment. Also include the same items for interchange and frontage roads. Include cost 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.

Item 74 (Cont.)

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

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

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

g. Total - Includes all costs for all improvements.

Item 75 - Accident Data (Length = 23)

The reference for this item indicating assignment of accidents to systems may be found in the "Manual on Classification of Motor Vehicle Accidents" (ANSI D16.1, November - 1976, as amended). This item consists of six elements. If accidents are not reported, this item is not coded.

For assignment of accidents at intersections and on interchange ramps, the highway systems are ranked as follows:

Federal-aid Interstate/Arterial
Federal-aid Other Primary/Arterial
Federal-aid Urban/Arterial
Non-Federal-aid/Arterial
Federal-aid Urban/Collector
Federal-aid Secondary/Collector
Non-Federal-aid/Collector
Non-Federal-aid/Local

At intersections, accidents should be assigned to the highway system that the involved vehicle(s) was using or, if more than one system was being used by vehicles involved in the accident, to the higher ranking system. This rule applies to all intersections, including those within interchanges. An accident on an interchange ramp should be assigned to the higher ranking system served by the ramp.

Accidents on a frontage road should be assigned to the same system as the travel for that frontage road.

Item 75 (Cont.)

75a- Fatal Accidents (Length = 3)

Enter the number of motor vehicle accidents involving one or more fatalities including pedestrians.

75b- Non-Fatal Injury Accidents (Length = 5)

Enter the number of motor vehicle accidents resulting in non-fatal injuries to one or more persons, including pedestrians.

75c- Fatalities (Length = 3)

Enter the number of persons fatally injured in motor vehicle accidents. The fatalities that were included for previous years are those (1) which resulted from accidents that occurred during the relevant calendar year and (2) in which the fatally injured person died died within 30 days of the accident. Included are pedestrians who are also reported separately in Item 75e.

75d- Non-fatally Injured Persons (Length = 5)

Enter the number of injured persons who are not injured fatally in motor vehicle accidents. Included are pedestrians who are also reported separately in Item 75f.

75e- Pedestrian Fatalities (Length = 3)

Enter the number of pedestrians injured fatally in motor vehicle accidents. The number of pedestrians included here is also included in Item 75c.

75f- Non-Fatally Injured Pedestrians (Length = 4)

Enter the number of pedestrians injured non-fatally in motor vehicle accidents. The number of pedestrians included here is also included in Item 75d. This definition does not include pedal cyclists as pedestrians, which is different from past practices in several States.

CHAPTER V

UPDATE PROCEDURES FOR UNIVERSE AND SAMPLE DATA

The two previous chapters discussed the basic requirements for the HPMS data and gave guidelines, formats, and procedures for reporting data. These data are to be updated on a regularly scheduled basis. The continuous monitoring (updating) aspects of HPMS are the key to its success. It not only provides current mileage information but also provides a basis for evaluating highway performance. While absolute measures of performance, i.e.- condition, congestion, etc., are significant and useful in some very important analyses, the changes and trends in the performance of highway systems over time provide extremely valuable information to highway planners and administrators. Using this information to develop performance-investment relationships, planners can assess the effectiveness of various highway programs and investments.

The HPMS has been designed to permit updating to be accomplished with a minimum of effort. For the sample sections, special care must be taken to establish a process for monitoring and reporting changes. States are encouraged to set up those ongoing mechanisms necessary to update so as to minimize periodic disruptions to other ongoing activities. By setting up a system for reporting and documenting changes as they occur, the data will not only be accurate and current but States will also avoid periodic or sporadic workload requirements which sometimes are very inefficient and disruptive to a State's ongoing activities.

With a current nationwide data base containing mileage and performance information, the need for periodic national studies like those of the past will be greatly reduced or eliminated. The HPMS has been designed to serve a variety of purposes and, with little additional effort, can be used as input to future studies that may become necessary.

Data is submitted annually in the record format outlined in Chapters IV and VII. The following presents the types of updates, if any, that will be necessary. As can be expected, errors or needed improvement in quality of the data may become apparent as the data are used. These items should be examined and corrective action taken whenever necessary.

GENERAL UPDATING INSTRUCTIONS

The "Update Cycle" column in the listing below contains initials in some cases to indicate the following:

- N.C.P. - "No Change Permitted" refers to an item that by its very nature cannot change except in extraordinary circumstances. (i.e., county code)
- C.A.N. - "Change As Necessary" refers to items that may change as a result of administrative actions, changes in usage or operation, and capital improvements. (i.e., functional system)
- I.C. - "Improvement Change" refers to those items that can only change as a result of a capital improvement. (i.e., shoulder width)

Where 2 or 4 year update cycle periods are indicated, updated data will be reported in the odd-years for the even years, i.e.-1980 data in 1981, etc.

Universe Data

The updating of universe data is a straightforward process, with any change in system, jurisdiction, or operation reported for the year in which it occurs. Also any change in section identification or length should likewise be reported for whatever reason.

Data Item	Update Cycle
Identification	
1. Year	Code the calendar year for which data applies i.e., 1980 data submitted in 1981 is coded "80".
2. State Code	N.C.P.
3. County Code	N.C.P.

Data Item	Update Cycle
Identification (Cont.)	
4. Rural/Urban (R/U) Designation	C.A.N. - Changes in small urban and urbanized area designations are expected as a result of the decennial Censuses. New or revised urban area boundaries may necessitate rural/urban (R/U) code revisions for some sections. The appropriate code is dictated by Item 5, Urban Area Code.
5. Urban Area Code	C.A.N. - When a rural or small urban section is redesignated as an urbanized section the appropriate urbanized area code from Appendix B is used. (Appendix B will be revised as necessary to reflect Census changes plus any changes caused by Federal-aid boundary revisions.) Codes for small urban areas must be the codes for urban places contained in FIPS Publication 55. In cases where a small urban area encompasses more than one urban place, the State will choose the place code to represent the small urban area. These codes will remain unchanged. When a rural section is redesignated as a small urban section, or when small urban areas are combined, the appropriate small urban code shall be assigned.
6. Type of Section/Grouped Data ID	C.A.N.
7. Section/Grouped Data ID	C.A.N.

Data Item	Update Cycle
System	
8. Functional Class	C.A.N.
9. Federal-aid System	C.A.N.
10. Federal-Aid System Status	C.A.N.
11. Route Signing	C.A.N.
12. Route Number	C.A.N.
13. Public Road	C.A.N.
Jurisdiction	
14. Governmental Level of Control	C.A.N.
15. Administrative Classification	C.A.N.
16. Federal, State and Local Domain	C.A.N.
17. Special Systems	C.A.N.
Operation	
18. Type of Facility	C.A.N.
19. Reversible Lanes/Roadway	C.A.N.
20. Truck/Commercial Vehicles	C.A.N.
21. Special HOV Lanes	C.A.N.
22. Toll	C.A.N.

Data Item	Update Cycle
Travel/Special Data	
23. Section/Group Length	C.A.N. - Changes in length may occur because of construction or section subdivision or due to events such as jurisdictional changes.
24. AADT	AADT's on all Interstate sections and on all sample sections will be revised annually. It is imperative that the States begin making counts on the sample sections and make appropriate adjustments to them to yield count-based AADT's estimates as soon as possible.
25. Interstate Lanes Open to Traffic 5 or more Years	C.A.N.
26. No. of Through Lanes	I.C.
27. Record Continuation Code	C.A.N.

Sample Section Data

The sections sampled and inventoried for the initial implementation of HPMS in 1979 plus new sample sections added to the panels must be maintained. As part of the updating process, data elements reported for the sample sections must be kept current and correct. Data elements that are traffic related or that indicate changes in physical condition must be verified on a periodic basis. AADT and pavement condition are the two most critical data elements in this regard. Other data, such as lane width, number of lanes, etc., will change only as a result of physical improvement to the section.

The remainder of this chapter provides guidelines for keeping sample section data current with detailed instructions and update schedules for the collection and submittal of the data. The instructions given in this section are concerned with data item updates and not with changes in the panels of sample sections. The updated data is to be included in the annual data submission. Statistical procedures for verifying or revising the panels will be discussed in the following section of this chapter.

Data Item	Update Cycle
Identification	
28. Sample Number	N.C.P. - This number is used for all subdivisions of the section.
29. Sample Subdivision	C.A.N. - This item is provided for those cases where the original sample section is no longer uniform. For example, if part of a section is widened while the other is not, two segments numbered 1 and 2 will replace the original segment "0" with two updated section records submitted, both having the original sample number. Consecutive numbers will be assigned without replacement as any additional sample subdivisions are established. For example, if segment 2 is later subdivided into two parts the segment numbers would be 1, 3 and 4.
Computational Elements	
30. AADT Volume Group Identifier	C.A.N. - As AADT for a section changes, it may exceed the limits of its present assigned volume group.
31. Expansion Factor	C.A.N. - As sample or total mileage within volume groups change, the expansion factor must be recalculated.

Data Item	Update Cycle
Pavement Attributes	
32. Surface/Pavement Type	I.C.
33. Surface/Pavement Width	I.C.
34. Pavement Section	I.C.
35. SN or Slab Thickness	I.C.
36. Pavement Condition	I.C. or 2 Year
37. Skid Resistance (Rural Arterials and Urban Interstate, and Other Freeways and Expressways)	Should coincide with the State's Program or a minimum of 4 Years.
Geometrics/Configuration	
38. Access Control	I.C.
39. Lane Width	I.C.
40. Approach Width (Urban Only)	I.C.
41. Shoulder Type	I.C.
42. Shoulder Width	I.C.
43. Median Type	I.C.
44. Median Width	I.C.
45. ROW Width	I.C.
46. Widening Feasibility	C.A.N.
47. Horizontal Alignment Adequacy	I.C.
48. Curves by Class	I.C.
49. Vertical Alignment Adequacy	I.C.
50. Grades by Class	I.C.
51. Percent Passing Sight Distance (Rural Only)	I.C.
52. Speed Limit	C.A.N.
53. Average Highway Speed	I.C.

Data Item	Update Cycle
Traffic/Capacity	
54. Percent Trucks (Peak and Off-Peak)	2 Year
55. K-Factor	2 Year
56. Directional Factor	2 Year
57. Capacity (Peak and Off-Peak)	C.A.N.
58. Prevailing Type Signalization	C.A.N.
59. Typical Percent Green Time (Urban Only)	C.A.N.
60. Parking (Peak and Off-Peak) (Urban Only)	C.A.N.
61. Future AADT	Revise Target Year every 5 years beginning with 1983 data when the future AADT is to be updated to the year 2005.
Environment	
62. Drainage Adequacy	4 Year or I.C.
63. Type of Terrain (Rural Only)	N.C.P.
64. Type of Development	C.A.N.
65. Urban Location	C.A.N.
66. No. of Grade Separated Interchanges	I.C.
67. No. of At-Grade Intersections	I.C.
68. No. of Major Commercial/Industrial/ Recreational Access Points	C.A.N.
69. No. of Structures	I.C.
70. No. of At-Grade RR Crossings	I.C.

Data Item	Update Cycle
Supplemental Data	
71. Structure Identification Numbers	C.A.N.
72. At-Grade Railroad Crossing ID Numbers	C.A.N.
73. Type of Improvement	Annual
74. Capital Improvement Costs	Annual
75. Accident Data	Annual

SAMPLE PANEL UPDATES ON ARTERIALS AND COLLECTORS

Although the panels of sampled sections are to remain as fixed as possible, there are various causes for changes, deletions and additions in the size of the panels over time. The causes and corrective actions needed to maintain a valid sample are discussed below.

Type of Sample Updates

Census Designations

The decennial censuses of population are likely to be the major causes of changes in the panels of sample sections. As a result, the sampling bases of most States will change, in varying degrees, because the numbers of small urban areas (5,000 - 49,999 population), individual urbanized areas (50,000 population and over) and the Federal-aid urban boundaries of existing urban areas may be altered. The addition of new urban areas and the expansion of current Federal-aid urban boundaries will require the functional reclassification of additional mileage within the new boundaries. This will likely require transfers of sample sections from one panel to another and the drawing of additional samples to satisfy urban area requirements. The suggested procedures for adjusting to areal sample assimilations, newly designated small urban and individual urbanized areas, and functional system revisions follow:

(a) All mileage falling within new or expanded urban areas must be functionally classified in accordance with urban classification criteria. In the cases of small urban areas becoming an urbanized area and expansions of existing boundaries, a judgment will have to be made as to whether only the newly taken over mileage will have to be reclassified or whether all mileage within the area will need to be reclassified.

(b) Functional System mileage within the new or expanded urban areas will be stratified into traffic volume groups consistent with those groups established for the initial HPMS sample.

(c) Transfer rural sample sections taken over by small urban or urbanized areas into the appropriate functional classes and volume groups.

(d) Transfer small urban sample sections taken over by urbanized areas into the appropriate functional classes and volume groups.

(e) Establish the required sample sizes for the revised rural, small urban, and individual urbanized area panels and draw additional samples where necessary.

(f) Although changes in census designation of small urban to rural and individual urbanized to small urban could possibly occur, such changes will be uncommon, and will not require sample base verification.

Functional Reclassification of Sections

Changes in the mileage of functional systems, other than those dictated by census changes, will result from:

(a) Reclassification of mileage within panels as a result of functional system changes;

(b) Areal reassignment of existing road sections to adjust for expanding urban boundaries between decennial censuses; and

(c) New road construction which does not replace existing mileage.

In the case of areal reassignment, the adequacy of the gaining or losing sample base(s) should be checked. As for additional mileage resulting from functional reclassification or new road construction, a general "rule of thumb" may be applied; namely, if the current overall mileage for a given functional system has increased from the base period mileage by 20 percent or more, additional randomly selected sections will have to be added to the functional system requirements. The base period is defined as the latest year of complete assessment of sample size requirements by volume group for a given functional system.

Volume Group Reassignments within Functional System

Each volume group contained in a functional system is a separate sampling universe. (See Appendix F.) Normally, over the short term - less than 5 years - there should be only minor changes in sample section assignments to specific volume groups as a result of traffic increases (or decreases). Traffic increases can result from normal growth and/or capital improvements. Also, some volume group missassignments are inevitable and may be corrected by better AADT's over time.

If for some reason, other than for census period readjustments, a specific volume group loses sample sections to other volume groups, the following criteria can be used in determining whether sample additions within a specific volume group are necessary:

> Acceptable numbers of sample section losses from the base year are: 10 or less from Volume Group 1; 5 or less from Volume Group 2; 3 or less from each of the remaining volume groups. The minimum requirement of 3 sample sections per volume group must be maintained. Of course, where there are only one or two sections available for sampling within a volume group, all available sections should be sampled. If volume group losses exceed the above limitations, new randomly selected sections are to be added to the affected volume groups to maintain the required precision level.

Sample Selection for Updates

In the selection of the original panels of sample sections, the individual States have had the option of either using the FHWA prepared package of sample size requirements for the functional systems in rural, small urban, and individual urbanized areas, or taking an alternative theoretical approach because of special needs. Both choices conform to the prescribed sample design and the required precision levels of accuracy.

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 in an allowable error of 10 percent (80-10), there is a probability of 80 times out of 100 that the error of a data element estimate will be no greater or less than 10 percent of its true value. The prescribed precision levels for volume groups by functional system and geographic area are indicated in Appendix F, Tables 1-3.

A series of curve sets (Appendix G, Figures 1-17) is provided for the updating needs of those States using the FHWA predetermined volume group approach. Each curve is based on an empirically derived sample size for a given volume group corrected for volume group size - the number of sections available for sampling. The curve sets are a quick method for determining sampling size requirements per volume group, corrected for finiteness but not verified for proper proportional estimating as discussed later in this section. In reading the appropriate graph, the number of road sections available in a given volume group universe is on the horizontal x-axis, and the required number of sections to be sampled is on the vertical y-axis. The required precision level is indicated on each graph. Note that there are three specific precision levels for the rural and small urban areas and two precision levels for the individual urbanized areas. 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.

As an example in the use of the curve sets, to find the required sample size for Volume Group 2 in a Rural Principal Arterial System having a total of 150 road sections, reference is made to Appendix G, Figure 4. Here the number 150 on the x-axis intercepts the curve for group 2 at the y-axis value of 45, the number of samples required.

If the total number of sections available for sampling is not known, an estimate of this total for curve set application may be obtained by dividing the total volume group mileage by a "judgment" estimate of the average section length.

It must be stressed that the use of the sample size curve sets is valid only if the FHWA predetermined volume group ranges cited in Appendix F, Tables 1-3 of this Manual were used in a State's sample design. These curves are not appropriate for those States using the optional alternative or different volume group ranges. If volume groups other than the predetermined volume groups used in the FHWA-developed approach are selected, the limits of these volume groups shall be reported on the volume group form in Appendix F, Figure 1. In this situation, sample size should be determined from the reference, Appendix H, Empirical Method for Computing Sample Size. However, partial use of curve sets may be made if a designated volume group is matched by the one shown in Appendix F, Tables 1-3 for the applicable functional system and area.

Another graph to be used in the updating process is shown in Appendix I, Figure 1, "Functional System Sample Size Needed to Detect a 10 percent Change in Proportions". Just as statewide precision level requirements are to be maintained for functional class volume group estimates of data element averages and aggregates, there is also a minimum sample size level needed to satisfy the statistical design requirements for estimating changes in the proportions of data item attributes (i.e., percentage of poor pavement) at the statewide functional class level. It is required that the design sample size at the statewide functional system level for all three geographic areas be such that the smallest detectable change in proportions is no greater than 10 percent, and preferably less, at the 80 percent confidence level. Normally, the same volume group sample sizes for average and aggregates as determined by curve sets or by the empirical method exceed the minimum functional class sample size requirements for the measurement of proportions, especially for rural and small urban areas. However, it is possible that the sample requirements for individual urbanized areas aggregated to statewide functional class levels may not satisfy the minimum criterion for proportions. The curve in Appendix I, Figure 1 is used to ensure minimum sample compliance in all areas. Sample size deficiencies are to be prorated according to the initial sample sizes obtained from the curves or the empirical method. Further discussion of proportions is given in Appendix I.

Expansion Factor

In the updating process, any change in sample mileage and/or the mileage from which samples are being taken requires an updating of expansion factors relating to affected volume groups. Any of the following may require expansion factor updates:

(a) Census Redesignations
(b) Expansions of Federal-aid Boundaries and/or Census Boundaries
(c) Functional Class Redesignations
(d) Sample section additions or losses in a volume group
(e) New Mileage

The calculation of expansion factors is discussed in Chapter IV.

Summary of Causes for Updates and Corrective Procedures

The following overview of the causes for sample panel updates is in two parts: (a) point in time causes resulting directly or indirectly from Census releases; and, (b) causes generally occurring gradually over time during intercensus periods.

	Cause	Corrective Procedure
Census Period		
(a)	New small urban areas (rural to small urban)	Adjust all rural sample section records within the new area to urban requirements. Verify statewide rural and small urban sample bases and select additional samples as necessary.
(b)	New individual urbanized areas (small urban and/or rural to individual urbanized)	Adjust all rural sample section records within the new area to urbanized area requirements. Develop a new random sample base for the new area from the aforementioned curve sets or the empirical method, and include the original rural/small urban sample sections. Verify rural and small urban sample bases.
(c)	Expansion of the Federal-Aid boundaries of small urban or individual urbanized areas (rural to small urban and rural and/or small urban to individual urbanized)	Adjust all affected rural sample section records to urban requirements. Verify all affected sample bases and select additional samples as necessary.
(d)	Functional System reclassification--any area	Reassign reclassified sections to new volume groups. Sample new sections as necessary to maintain required volume group precision levels.
(e)	Losses in urban population	No action.

Intercensus Period

(a)	New mileage by functional system	Verify sample base if change in functional system mileage is 20% or more and sample new sections, if necessary.
(b)	Functional system reclassification--any area	Possible volume group reallocation of sample sections, precision level upgrading, and additional samples.
(c)	Volume group reassignment of sample sections	Reassign sample sections but no further action needed if changes are minor (see the section on volume group reassignments, above); if changes are major, expand volume group sample bases for those volume groups where insufficient sections are sampled.
(d)	Expansion factor	Adjust expansion factor values for sample section records in the affected volume group.

Permanence of Sample Selections

Once a road section has been selected for a sample panel, its existence must be maintained regardless of changes in volume group assignment, functional system, geographic area or section segmentation. Sample sections transferred to other geographic areas become part of the sample base for those areas. It is recognized that in a few cases existing road sections are abandoned, but generally they are replaced by construction on new location. In cases where a road is truly abandoned, i.e., not open to traffic, the section may be dropped.

Sample Conformity

The changes in sample panels during the periods between Censuses are generally not expected to be frequent or extensive. It is suggested that the overall mileage for each functional system be verified whenever major functional reclassifications or urban boundary changes are made or at least every 5 years for conformity with sample size requirements (see the previously discussed subsection on functional reclassification, the "rule of thumb" criterion). Such changes that occur would be included with other changes in the annual submittals.

LOCAL SAMPLE UPDATES

Local road sample data reporting will be initiated for the 1981 data year, with data submittal scheduled no later than May 1, 1982. This reporting should be concurrent with the 1980 Census of Population releases which will update the extent of rural and urban areas by designating new small urban and individual urbanized areas and by expanding existing areas. If the Census data are not available when the samples are to be selected, it would be advisable for a State to anticipate, if possible, which areas will be affected by the new Census designations. Thus, a State may avoid the possible updating of selected road samples within a short time span.

As with the arterial and collector system sample sections, it is intended that the local samples be fixed over time. If local sample sections are affected by areal redesignations (rural to small urban to individual urbanized), they become an integral part of the new areal sample bases. All areas affected by areal redesignations must be evaluated as to sample size adequacy and new sample sections selected as necessary.

Functional system reclassification will require adjustments in the local sample bases. Samples previously classified as local and reclassified as collectors will be replaced by randomly selecting new local sample sections.

Other than point in time occurences such as Census redesignations and functional system reclassfications, it is not expected that sample size updates for local roads will be frequent or extensive. Another feature of the local roads and streets sample design, contrasted with that for the arterial and collector samples, is the absence of volume group stratification, thus eliminating the necessity for AADT volume group reassignments. New mileage growth resulting from new land development can occasionally require the expansion of a sample base in some areas because the sample size for locals is calculated from a fixed sampling rate applied to the overall local mileage of the county, small urban area, or urbanized area being sampled. Sample section segmentation due to new construction may also occur, the treatment of which having been previously discussed in Chapter IV, Item 29.

Verification of the adequacy of the local road sample bases every five years at a minimum is suggested. Obviously, this does not preclude more frequent surveillance or efforts by the State to improve the accuracy of the sample base by expanding sample coverage.

A detailed discussion of the sample design, sample size determination, and sample selection procedures for local roads by geographic area is presented in the following Chapter.

CHAPTER VI

LOCAL SAMPLE DESIGN AND SELECTION

Reliable estimates of selected highway data elements on the local roads and streets are often difficult to achieve without extensive recording procedures. Even the use of probability sampling from the complete universe of local sections requires large sample sizes beyond cost/benefit considerations because of the relatively large local mileages involved as compared with the higher functional systems. This chapter presents a relatively simple method for sampling local roadway data, especially DVMT, along with a measureable error of estimate. The term "local" as used throughout this Chapter refers to roads and streets functionally classified as local.

The following sample section data items, in addition to universe mileage data categories, are to be reported for the HPMS: AADT, surface width, pavement/surface type, and expansion factor. Coding instructions for these selected items are detailed in Chapter IV.

SAMPLE DESIGN

Cluster type sampling will be applied to local road sections for the estimation of data item averages, aggregates, and proportions. By definition, in this Manual, a cluster is a county, small urban area, or urbanized area that has been selected for the sampling of data and which contains subareas (subclusters) having randomly selected sample sections. The sample design is therefore based on a random selection of a fixed number of sections or milepoints within randomly selected geographic subareas contained in randomly selected county or urban subdivisions (clusters) of a State. Given selected milepoints, homogeneous sections containing the milepoints are defined and established in accordance with engineering judgment. The random assignment of subareas containing a fixed number of sampling locations on public roads in relative close proximity is compatible with the concept of probability sampling and is also convenient for field observations. The randomly selected locations will remain fixed over time and will serve as reference points in the monitoring process. In order to apply the sample design, it is necessary to have a reasonable estimate of statewide local rural and urban area road mileages as well as the local mileages for the randomly selected counties and urban areas.

The cluster sample design, once established, may be expanded to meet greater precision levels. Methods are presented in Appendix J for the determination of the required number of cluster areas for desired precision levels not only for estimates in individual areas per se, but also for statewide estimates using counties and urban areas as sample clusters. It should be noted that the values in the examples in Appendix J may not represent actual conditions, they merely illustrate the application of the methods for the desired purposes.

SAMPLING FRACTION

Unlike simple random sampling, it is initially difficult to fix required sample sizes at predetermined precision levels for the proposed cluster sampling method because the determining factors for sample size are subject to a variety of uncertainties. Among these uncertainties are the number and sizes of the clusters (county and urban units).

The method presented in this section has been devised to maintain some stability in the numbers of subclusters (cells) to be initially sampled within a randomly selected cluster, based on the average local road or street mileage of the county or urban population group under consideration. It is also felt that the random selection of a fixed number of five locations within each selected subcluster or subarea will produce reasonable and reliable estimates of DVMT. However, the number of clusters and subclusters sampled, and the fixed number of five locations within subclusters is at the option of the user. Should a State's cluster sample plan prove to have too high a sampling error, Appendix J presents a method by which the number of subclusters or clusters required for desired design precision levels can be calculated, based on the already known base data.

Table VI-1 shows suggested sampling rates (f) to be applied to the total local road or street mileage of each sampled county or urban area. These are based on the following relationship:

f=[Number of sampling locations per subcluster (grid cell)] times [average number of subclusters] times [the constant, k] divided by [N]

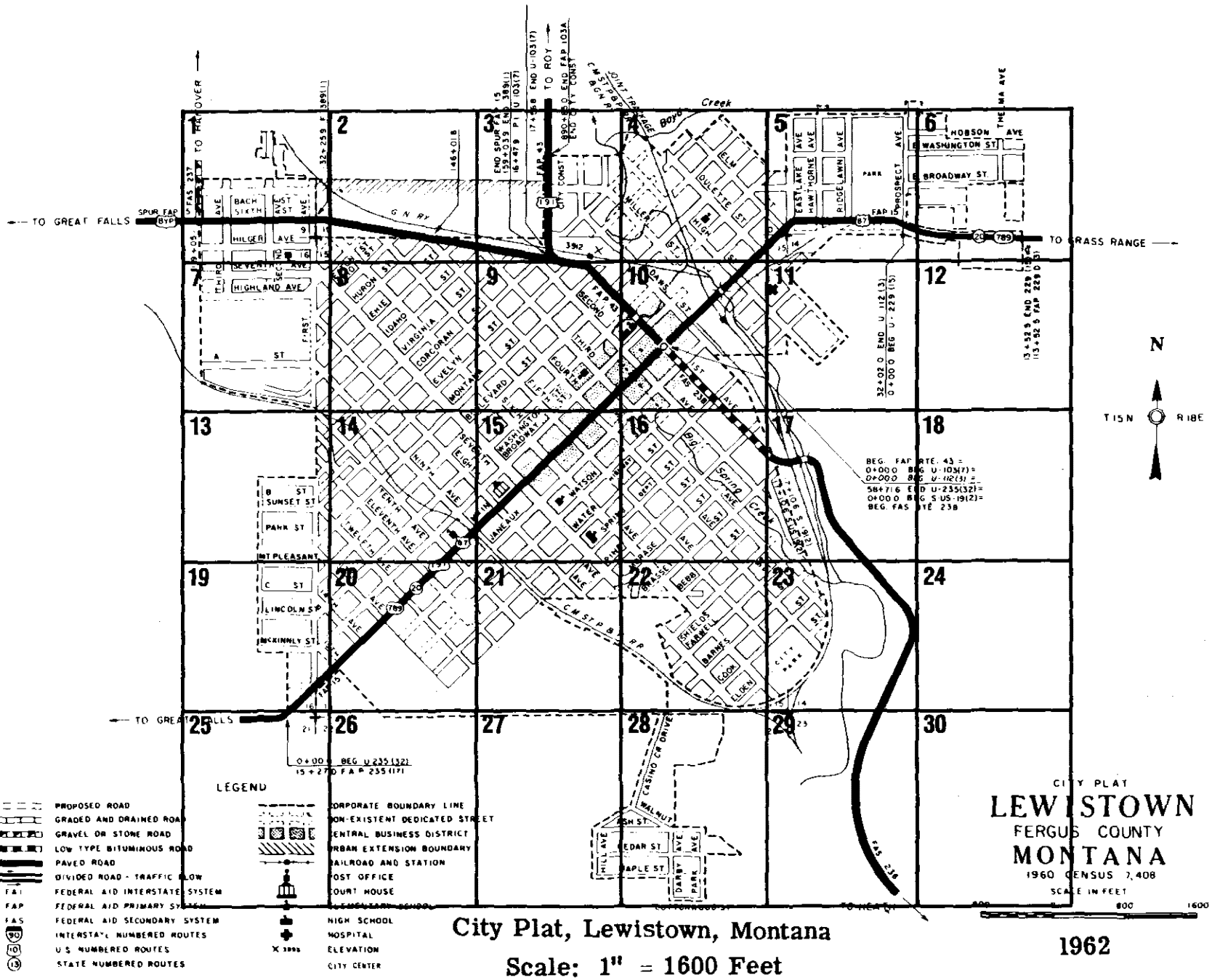
where,

The number of sampled locations per subcluster has been arbitrarily fixed at 5.

The average number of subclusters per county or urban unit has been arbitrarily set at 12. This will give an "average" of 60 sample locations (5 locations per subcluster) for each sampled county or urban area.

k = The constant, 0.25, is based on the average section length in urban areas. This is later discussed in the Local Streets in Small Urban Areas section of this Chapter. It is omitted from the formula for rural area sampling.

N = The "average" nationwide total local road or street mileage per county or urban population group unit (see Table VI-1).



City Plat, Lewistown, Montana

Scale: 1" = 1600 Feet

1962

Figure VI-1

Table VI-1

Suggested Sampling Rates (f) by Type of Sampling Unit and Population Group

Type of Unit	Average Local Mileage (N) per Unit	Suggested Sampling Rate (f) per Individual Unit
County, Rural	725	10%
Small Urban Area Groups:		
5-25 thousand population	65	20%
25-50 thousand population	125	10%
Individual Urbanized Areas:		
50-100 thousand population	300	5%
100-200 thousand population	525	3%
200-500 thousand population	900	1.5%
500- 1 million population	1750	1%
1- 2 million population	3850	0.5%
over 2 million population	7200	0.25%

It is realized that the local mileage of a given area may differ significantly from the above table. In such instances, the sampling rate is obtained from the above equation for (f), using the actual value of N.

Procedures for sample selection and the calculation of local road and street DVMT estimates in the rural, small urban, and individual urbanized State subdivisions follow.

LOCAL ROADS IN RURAL AREAS

(1) Select randomly 10% (rounded upwards) of the counties in the State, but no less than 3 counties. The 10 percent is the suggested statewide percentage (r) of counties to be sampled. It is advisable to exclude from the random selection process those counties whose major portions are urbanized.

For example, the number of counties in Alabama = 67, Arizona = 14, and Georgia = 159. Number of counties selected: Alabama = 7, Arizona = 3, and Georgia = 16. The counties so selected are statistically designated as "clusters".

(2) Predetermine the sampling rate (f) to be applied to the total local rural mileage in each selected county for obtaining the number of milepoints or sampling locations. A minimum sampling rate of 10% is suggested for locals. (Table VI-1)

The application of a sampling rate (f) of 10% within each selected county and a 10% sample (r) of all counties produces a statewide sampling rate on all local rural road mileage of approximately 1% = (.10 x .10) = fr

(3) Calculate county sample size, the number of sampling locations (n), to the nearest 5, where n = fm, and m = total local rural mileage in a county.

Example: Appling County in Georgia has 355 total miles of local roads
n = (0.10)(355) = 35.5
= 35 (nearest 5) = number of sampling locations or milepoints.

(4) For each selected county, prepare a grid containing at least 25 cells and which overlaps a county map showing local rural roads. This grid may be in the form of a square, rectangle, or rhomboid, roughly conforming with the outline of the county boundaries. The grid shown in Figure VI-1 is for an urban area, but the same can apply to a county.

(5) Number the cells within the grid in some sequence from 01, 02, 03, to---completion.

(6) Using a table of random numbers, select n/5 cells in the grid. This is the number of "subclusters" (grid cells), each containing 5 potential sampling locations, selected for random sampling in a county. Thus if the county sample size (n) is 35, the number of grid cells to be randomly selected is 35/5 = 7. No cell should be selected more than once.

(7) Within each of the selected cells, randomly choose five sections or milepoints according to any conventional system of numbering. If a cell does not contain any rural local roads, or contains less than five sections or milepoints for rural local roads, randomly select other cells until the criteria for the required number of grid cells are met.

(8) If milepoints are sampled as point locations, define the limits of each section containing a selected milepoint. Document the location and record the section length, AADT, surface width, pavement/surface type, and expansion factor for each of the five selected locations in each sampled grid cell. <u>All rural local road samples will have the identical expansion factor</u>. For rural areas, the expansion factor is the total statewide local rural road mileage divided by the total sampled local road mileage for all sampled counties. In addition to the above sample section data items, report the remaining required universe data items. Coding instructions for all of these items are given in Chapter IV.

This step (8) concludes the procedures for the sample selection and reporting of rural local data. The following procedures, steps (9)-(12), are concerned with the calculation of AADT and statewide DVMT. Applicable formulas and examples are given in Appendix J as an aid in evaluating and improving the accuracy of local samples.

(9) For each sampled location, calculate the product of the AADT and the section length. Sum these products for a county sample total. Let this total = sum ya, for subsequent computation.

(10) Sum the lengths of each sampled section for a county sample total. Let this total = sum xa, for subsequent computation.

(11) Calculate the estimated weighted AADT for local rural roads in the State. This is the ratio of the sampled counties' sums for item (9) to item (10) above or, sum y/sum x where,

[sum y = (sum ya for sampled county 1) + (sum ya for sample county 2) + (----etc.)]

[sum x = (sum xa for sampled county 1) + (sum xa for sample county 2) + (----etc.)]

(12) Calculate the estimated statewide DVMT for local rural roads. This is the product of the total statewide mileage for local rural roads (M) times the weighted AADT for the above item (11).

Statewide DVMT = My or F(sum y)
where, y = sum y/sum x, and F is the expansion factor. (See Chapter IV, Item 31 for the calculation of expansion factors for local roads and streets.)

LOCAL STREETS IN SMALL URBAN AREAS

The procedure for sampling local streets in small urban areas is similar to that for rural areas (counties) except that the method for determining the number of sampling locations differs.

In rural areas, the number of sampling locations is the number of miles (rounded to the nearest five) calculated from the application of a predetermined sampling rate (f) to total county mileage. The assumption is that the section lengths in rural areas are of sufficient length, usually greater than one mile, to provide reasonable accurate DVMT/unit mile values for estimating State or countywide DVMT's. Based on experience, the random selection of sections having a length of less than one mile is unavoidable but acceptable, as long as the number of such sections is minor.

Local urban street section lengths are mostly a fraction of a mile. Therefore, in addition to the application of a predetermined sampling rate for obtaining mileage to be sampled, this sample mileage is divided by a constant in order to obtain the number of sampling locations. This constant, 0.25, is the estimated median section length for local city streets and is based on data from the 1976 National Highway Inventory and Performance Study (NHIPS). The use of the constant does not directly affect the accuracy of the estimate other than being a determinant of sample size in conjunction with the sampling rate.

Procedures for Small Urban Areas are as follows:

This approach divides the small urban units into two population groups: 5-25 thousand and 25-50 thousand. Because of differences in the two groups with respect to average local street mileage (Table VI-1) and number of areas in each population group per State, both groups will be sampled independently. Each group is a separate and distinct subarea in the sample selection and updating processes. The estimates for both groups can be combined later for statewide totals.

(1) (a) 5-25 Thousand Population Group

Select randomly 20% (rounded upwards) of the small urban units in this group in a State, but no less than 3 small urban units. This is the suggested statewide sampling percentage (r) of small urban units in this population group.

Examples:

Total number small urban units: Alabama = 35; Connecticut = 6; Georgia = 44
Number of small urban units (clusters) selected: Alabama = 7; Connecticut = 3; Georgia = 9

(b) 25-50 Thousand Population Group

(i) If a State has just one or two small urban units in this group, all are to be sampled.

(ii) If a State has three or more small urban units in this group, randomly select the greater of 10% of the total number of small urban units or 3. This is the suggested statewide sampling percentage (r) of small urban units in this population group.

Example:

Total number small urban units: Alabama = 4; Texas = 60; Louisiana = 2
Number of small urban units (clusters) selected: Alabama= 3; Texas = 6; Louisiana =2

(2) The suggested sampling rate (f) for the 5-25 thousand population group is 20%; that for the 25-50 thousand population group is 10% (Table VI-1).

For the 5-25 thousand population group, the application of a sampling rate (f) of 20% within each selected small urban area and a 20% sample of all small urban areas in this group produces a statewide sampling rate on all small urban street mileage of approximately 4% = (.20 x.20) = fr.

Similarly, for the 25-50 thousand population group, the statewide sampling rate on all small urban street mileage will range from approximately 1% = (.10 x .10) = fr to a maximum of 10% = (.10 x 1) = fr, depending on the number of small urban units in this group in the State.

(3) Calculate the number (rounded to the nearest 5) of sampling locations or milepoints (n) for <u>each selected small urban unit</u> where n = f x (total local street mileage / k = 0.25)

Note: This is similar to the calculation of (n) for local rural roads, except for the application of the the divisor, k.

Example: The total local street mileage in a small urban area of 10,000 population (5-25 thousand population group) = 65

then,

n = 0.20 x 65 / .25 = 52 or 50 (rounded to the nearest 5)

The above procedure also applies to each selected small urban unit in the larger population group, 25-50 thousand, except that the sampling rate (f) is 10%.

(4) For each selected small urban area, prepare a grid containing at least 25 cells which overlaps an urban map showing local streets. The outline of the grid should conform roughly with the urban area boundaries. In some small areas, the number of cells available for sampling may have to be reduced for greater coverage to allow at least 5 street sections in most of the grid cells.

(5) Continue with the procedures already discussed in the preceding section on Local Roads in Rural Areas, items (5) through (8) except that reference is to be made to small urban units and their associated individual and statewide mileages. For instance, after the value of (n), the number of sampling locations, has been calculated for each of the small urban units in each population group, the value n/5 represents the number of grid cells to be randomly sampled in each selected small urban area. Each grid cell is a package of 5 sampling locations. The expansion factor is calculated separately for each of the two small urban population groups. All local street sample sections in the same population group will have the same expansion factor - the ratio of the total statewide local street mileage for a given population group to the sample local street mileage of that population group.

The procedural steps (9) - (12), described in the preceding section on local rural roads, may be used for the calculation of statewide weighted AADT and DVMT estimates for each small urban population group. The estimated DVMT's for each population group are aggregated to produce a statewide total for all small urban areas.

The statistical determination of the error of the above estimate is presented in Appendix J, along with example calculations.

LOCAL STREETS IN INDIVIDUAL URBANIZED AREAS

In the individual urbanized areas, the procedures are the same as those for small urban areas except that the suggested sampling rate (f) - see Table VI-1 - varies according to the population group. Also, the number of cells in the prepared map grid must be extensive enough to cover the specified urban area for the desired detail, namely, the inclusion of a minimum of 5 local street sections in a major portion of the total number of grid cells covering the urbanized area.

In the HPMS procedure, each individual urbanized area in a State is sampled. A prerequisite is that the total local street mileage, or a reasonable estimate thereof, for each urbanized area must be known. Those areas which are a State's portion of a bi- or tri-state individual urbanized area are treated as individual urbanized areas within the State. All portions of bi-State or tri-State areas must be sampled -- the sample in each State should be its pro rata share of local street mileage or in any case at least two subclusters of 5 sampling locations per subcluster. For example, a tri-state urbanized area of 75 thousand population has an overall total of 300 miles of local streets, requiring a total sample size of 12 subclusters or 60 sample section locations. If the pro-rata shares of local street mileage for the three states are 0.50, 0.35, and 0.15, then the number of required sample subclusters

in each State are 6, 4, and 2, respectively, with 5 sampling locations per subcluster. In such areas, expansion factors must be calculated for each State's portion; namely, the ratio of the total local street mileage in the State's portion of the multi-State urbanized area to the sampled local street mileage of that State's portion of the entire urbanized area.

The following summarizes the sampling procedures applied to each individual urbanized area:

(1) Determine the sampling rate (f) to be applied based on urbanized area population or local street mileage. (Refer to Table VI-1 for the applicable population group.)

(2) Calculate the required sample size, n, to the nearest 5, where n = fm / 0.25, and m = total local street mileage in the urbanized area.

(3) For each individual urbanized area, prepare a grid containing at least 25 cells which overlaps the urbanized area map showing local streets. The outline of the grid should conform roughly with the urbanized area boundaries.

(4) Number the cells within the grid in some sequence from 01, 02, 03, to---completion. (See Figure VI-1.)

(5) Using a table of random numbers, or a random number generator select n/5 cells in the grid. Thus, if the urbanized area sample size is 50, the value of (n), the total number of sample cells for random selection is 50/5 = 10, each containing 5 potential sampling locations. No cell should be selected more than once.

(6) Within each of the selected cells, randomly choose five local street sections according to any conventional system of numbering. If a cell does not contain any local streets or contains less than five local street sections, randomly select other cells until the criteria for the required number of grid cells are met.

(7) Record the location, section length, AADT, surface width, pavement/surface type, and the expansion factor for each of the five selected local street sections in each of the sampled grid cells. If milepoints are used as spot locations, determine section lengths by defining the limits of each section containing a selected milepoint. <u>All local street samples in the same individual urbanized area will have the same expansion factor</u>. For each urbanized area, the expansion factor is the total individual urbanized area street mileage divided by the total sampled street mileage in that urbanized area. In addition to the above sample section data items, report the remaining required universe data items. Coding instructions for the above data items are given in Chapter IV.

If a State opts to calculate the weighted AADT and the DVMT of the sample base, procedures (8) - (11) are to be followed.

(8) For each grid cell package of five sample sections, calculate the product of the AADT and the section length of each section. Sum these five products and let this total = sum ya for subsequent use.

(9) Sum the section lengths of the five sections in each sampled grid cell. Let this total = sum xa for subsequent use.

(10) Let sum y = the sum of all sum ya values, and sum x = the sum of all sum xa values, then the ratio sum y / sum x is the estimated AADT for all sampled local streets in a given individual urbanized area. The estimated DVMT is obtained by multiplying this ratio by the total local street mileage in the individual urbanized area or by multiplying the expansion factor by the value "sum y".

(11) Statewide urbanized area DVMT is the sum of the estimated DVMT's for all of the individual urbanized areas.

Applicable formulas with examples are given in Appendix J for the evaluation of the accuracy of urbanized area sample bases. Appendix J also presents methods for determining the number of grid cells required to achieve a predetermined design precision level of accuracy, once a preliminary data base has been established.

CHAPTER VII

SOFTWARE FOR BUILDING AND USING THE DATA TAPE

DATA TAPE CONTENTS

As indicated in Chapters III and IV, the final dataset will consist of variable length records. The length of each data record depends on the type of section being coded and the required number of data items associated with the section. The following summarizes the contents of the different types of records. The rest of the Chapter describes software for building, updating, and editing the dataset in its final format.

Dataset Record Layout

Complete Section Record	Minimum- 73 digits Maximum-1227 digits

---

Part 1: Fixed

Universe portion of all records (including samples)	65 digits
Continuation Code (see below)	8 digits
Total fixed portion	73 digits

Part 2: Variable

Local Sample Section:
Consists of the 73 fixed digits plus 24 digits = 97 digits

Arterial/Collector Sample Section:
Consists of the 73 fixed digits plus 239 digits = 312 digits

Plus, if applicable, the following additional variable data:

Structures	an additional	15-750 digits
Railroad Crossings	an additional	7-105 digits
Type and Cost of Improvements	an additional	37 digits
Accidents	an additional	23 digits

Continuation Code

The continuation code in Part 1, above, consists of the following:

Description	Position	Code
Indicates Universe Section Only	66-73	00000000
Indicates Local Sample Section	66	0=no; 1=yes
Indicates Arterial/Collector Sample Section	67	0=no; 1=yes
Indicates Number of Structure ID's Provided	68-69	xx=# ID's for section 00 = no ID's
Indicates Number of Railroad Crossing ID's Provided	70-71	xx=# ID's for section 00 = no ID's
Indicates Capital Improvements Data Provided	72	0=no; 1=yes
Indicates Accident Data Provided	73	0=no; 1=yes

For example, a record for an arterial/collector sample section that contains three structures, has no railroad crossings, accidents are not reported, and has an improvement that was completed during the calendar year being reported would contain the following:

Universe portion	65 digits
Continuation Code (01030010)	8 digits
Sample portion	239 digits
Structure ID's (3 x 15 digits)	45 digits
Improvement Type and Costs	37 digits

For a record length of 394 digits.

BUILDING THE DATA TAPE

There are several possible methods of building the dataset preliminary to editing or updating:

1) Merging the "old-format" (pre-1980) HPMS and MFRS datasets using FHWA-provided software;

2) Creating a card-image file as outlined below and in Appendix K, and using FHWA-provided software to create the dataset in its final form;

3) Extracting the data from the State's database, if applicable, using utility software to directly create the dataset in its final form or to produce a card-image file as outlined below; or

4) Using some combination of the above and/or other software or methods available to the State.

Merging From HPMS/MFRS

The FHWA will provide software to merge the edited (pre-1980) HPMS and the Mileage Facility Reporting System (MFRS) dataset formats into the format described above and in Chapter IV. This will include shifting fields, eliminating (after checking) one of the data fields where there is duplication (i.e., functional class), recoding, etc. In order to use this software, the Identification (ID) fields, Items 1-6 of the pre-1980 HPMS and Items 1-9 (or 1-7 and 10-12 if A-node, B-node, Segment is used) of the MFRS will have to match. If a State is using different ID's for the two systems, then a prerequisite for using this software would be to change one of the ID's to match the other (i.e., Route-Milepoint or A-node, B-node, Segment).

In the case of Route-Milepoint, it would not be necessary to match the milepoints exactly. The software will split sections appropriately, according to the milepoints and section lengths, using the pre-1980 HPMS sections as a base. Universe sections will be created out of remaining portions of the MFRS sections where overlaps occur, if any. Under the A-node, B-node method, matches would have to be exact.

Since there are a few items that were not a part of the pre-1980 datasets, and would therfore be missing from the merged dataset, the State would then proceed with updating the merged dataset using the software described under "Updating The Data Tape", below, or some other method, to fill in the missing data items.

Creating a Card-Image File

Another alternative for developing the HPMS dataset is to code the information described in Chapter IV onto 80-column cards or into a card-image file, and to use the FHWA-provided software to build the final dataset. This method, to be used when the other, more efficient, methods cannot serve the State's needs, would require anywhere from one to twenty-nine cards per section record depending on the type of section record being coded (universe, sample). The details of the card layout are given in Appendix K.

Other Methods

Where a State has its inventory on a computerized database or in some other form not applicable to the methods mentioned above, utility software will have to be utilized to create either the dataset in its final format or a card-image file. Once the dataset is in the final format, it must be edited. The update software may be used to insert missing data items or to make corrections to other fields.

Final Format

The final dataset will contain a mixture of universe and sample section records varying in length from the minimum of 73-digits to the maximum of 1227-digits, although it is unlikely that the latter figure will ever occur. The following are the attributes of the file:

LRECL (Logical Record Length);	1231 (1227 + 4) bytes
BLKSIZE (Physical Record Length);	6159 (5 x 1231 = 6155 + 4) bytes
RECFM (Record Format);	VB (Variable-Blocked)

The dataset will be written in Extended Binary Coded Decimal Interchangeability Code (EBCDIC) character representation. Other characteristics pertaining to the final submittal tape are outlined in Chapter VIII.

UPDATING THE DATA TAPE

The FHWA is providing software to update the dataset subsequent to building where data items may be missing, or after an edit run where data items are found to be in error. The dataset must be in the final format before this software can be utilized.

It is recommended that each State maintain a current data file making updates as they occur, rather than rebuilding the file each year, especially where a State opts to build the file from merging pre-1980 HPMS and MFRS formats. It is further recommended that each State store a copy of each year's submittal for historical purposes. A complete new file will be submitted each year that incorporates all changes (individual item updates, additions, deletions, etc.) as discussed in Chapter V. Special attention will be needed for Items 73 and 74, Type and Cost of Improvements and Item 75, Accident Data. These are reported only for the year in which they occur, and are then deleted from the file or updated with new values, if applicable. Once coded, all other data items and records will remain as is unless changed due to update cycles, improvements, or errors.

EDITING THE DATA TAPE

Since it is extremely important for a clean, edited data tape to be submitted by a State, software for editing the dataset is being provided by the FHWA. The software is comprehensive in that it not only will check for missing fields, numerics, and out-of-range codes, but will also perform numerous cross-checks between related items to further insure against improper coding. As with other FHWA-provided software, the dataset must be in its final format before it can be utilized.

OTHER SOFTWARE

The FHWA will provide other summary and analysis software that will be described in detail as it becomes available. It will include standard table-producing computer programs as in the pre-1980 HPMS and MFRS as well as new analysis software.

As indicated in Chapter III, some of the new software will be keyed to section-specific data. States planning to use the summary/analysis software, therefore, should refrain from grouping data unnecessarily.

CHAPTER VIII

DATA SUBMITTAL

This Chapter is a synopsis of the annual submittal requirements as discussed in the preceding Chapters of this Manual.

THE DATA TAPE

Software will be provided by the FHWA for the edit process. It should be emphasized that a clean, edited tape is of the utmost importance. Data records in the format discussed in Chapters IV and VII must be submitted on magnetic tape by May 1 of each year reflecting the status of the State's roadway inventory as of December 31 of the preceding (data) year. The magnetic tape will be returned as soon as the data has been copied and verified. It is advisable for the State to retain a copy of the data tape for reference.

The tape should be written in 1600 bpi density, nine-channel (9-track), and should contain standard internal tape labels compatible with the IBM operating system. The dataset name (DSNAME) should be HPXXZZ, where XX is the last two-digits of the data year and ZZ is the FIPS State code listed in Appendix A. The tape should have a volume serial number (VOL=SER) of HPMSZZ, where ZZ is the same as above. If the above specifications or any of those discussed in Chapter VII cannot be met, the transmittal correspondence and an external physical label on the tape reel should contain the following information at a minimum:

Name and model of computer on which the tape was produced
Number of channels (tracks)
Whether or not the tape has standard labels and what they are
Density
Character Representation Code
Blocking factor
Other pertinent information

An external physical label should be attached to both the tape reel and shipping carton containing the State name and the words "Highway Performance Monitoring System Data File" and "Deliver to the Office of Planning, HHP-42 FHWA." The same or another external label should contain a return address.

STATISTICAL INFORMATION

Expansion Factor Table

An expansion factor table stratified by area type (rural, small urban and individual urbanized) by functional classification, and by volume group should be established for the sample sections by the State as outlined under Item 31 - Expansion Factor in Chapter IV. A copy of the table will be submitted at the same time as the other items being discussed in this Chapter.

Volume Group Table

For those States that use volume groups other than those prescribed by the FHWA, a table of the number and ranges of the volume groups stratified by functional classification and the required precision level should be submitted by the State. The format for this table is in Appendix F, Figure 1. A copy of the table will be submitted along with the other required annual data.

For both tables the letter of transmittal (or the tables themselves) should alert the FHWA of any unusual or large variations from previous years' submittals and include any other information deemed pertinent by the State.

AREAWIDE DATA

Areawide (rural, small urban, and individual urbanized) and statewide totals of the data discussed in Chapter II are to be reported on the forms shown in Figures II-1, Parts 1 and 2, (Mileage and Daily Travel Summary), II-2 (Motor Vehicle Accident Summary), and II-3 (Bus Usage and Service Summary). The forms are distributed to all States via the FHWA Division Offices and extra copies are available. The forms are to be sumbitted in triplicate to the appropriate FHWA Division Office for forwarding to the address shown ahead to arrive in the Washington D.C. headquarters by May 1 of the year following the data year.

SUMMARY

The following items are to be submitted annually by May 1 of the year following the calendar data year:

1) Data tape, as discussed in Chapters IV and VII.

2) Statistical Information:

   a) Expansion Factor Table as discussed in Chapter IV, Item 31.

   b) Number and Ranges of Volume Groups by Functional Class and Required Precision Level (see Appendix F, Figure 1). This is to be submitted by States using volume grouping other than that prescribed by FHWA.

3) Areawide Data Forms, as discussed in Chapter II:

   a) Mileage and Daily Travel Summary (Figure II-1, Parts 1 & 2).

   b) Motor Vehicle Accident Summary (Figure II-2).

   c) Bus Usage and Service Summary (Figure II-3).

The magnetic tape, the statistical information, and a letter of transmittal should be sent to:

Chief, Highway Statistics Division
Office of Highway Planning, HHP-42
Federal Highway Administration
Washington, D.C. 20590

The letter of transmittal should contain documentation describing the contents of the submittal. A summary of unusual changes in the contents from previous years, a discussion of any large variations in mileage or number of sections, and other information pertinent to the submittal should also be included.

The Areawide Data Forms should be submitted in triplicate to the appropriate FHWA Division Office.

APPENDIX A

Table of Standard Codes for States, District of Columbia and Puerto Rico

State	Code	State	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		

Other Standard Codes

Name	Code
American Samoa	60
Guam	66
Virgin Islands	78

APPENDIX B

Urbanized Area Codes

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
	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

Urbanized Area Codes

State	Urbanized Area	Code
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

*All combined under Bridgeport, Conn - 051 as one large sample.
**Combined under Hartford, Conn - 047.

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
	Gainesville	241
	Jacksonville	050
	Lakeland	262
	Melbourne-Cocoa Beach	263
	Miami	021
	Orlando	087
	Pensacola	125
	St. Peterburg	057
	Sarasota-Bradenton	264
	Tallahassee	220
	Tampa	059
	West Palm Beach	097

Urbanized Area Codes

State	Urbanized Area	Code
Georgia	Albany	209
	Atlanta	025
	Augusta (S.C)	131
	Chattanooga (Tenn.)	086
	Columbus (Ala.)	109
	Macon	143
	Savannah	100
Hawaii	Honolulu	052
Idaho	Boise	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 (Ind.)	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
	Dubuque (Ill.)	206
	Omaha (Nebr.)	046
	Sioux City (Nebr., S.D.)	156
	Waterloo	150

Urbanized Area Codes

State	Urbanized Area	Code
Kansas	Kansas City (Mo.)	019
	St. Joseph (Mo.)	179
	Topeka	134
	Wichita	062
Kentucky	Cincinnati (Ohio)	017
	Clarksville-Ft. Campbell (Tenn.)	280
	Huntington-Ashland, (W. Va. - Ohio)	105
	Lexington	144
	Louisville (Ind.)	031
	Owensboro	242
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

Urbanized Area Codes

State	Urbanized Area	Code
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
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

Urbanized Area Codes

State	Urbanized Area	Code
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
	Greenboro	132
	High Point	195
	Raleigh	163
	Wilmington	226
	Winston-Salem	124
North Dakota	Fargo-Moorhead (Minn.)	188

Urbanized Area Codes

State	Urbanized Area	Code
Ohio	Akron	040
	Canton	079
	*Cincinnati (Ky.)	017
	**Cleveland	010
	Columbus	030
	Dayton	038
	*Hamilton	168
	Huntington-Ashland (W. Va.-Ky.)	
	Lima	198
	**Lorain-Elyria	116
	Mansfield	228
	Middletown	291
	Parkersburg (W. Va.)	273
	Steubenville-Weirton (W.Va.)	177
	Springfield	167
	Toledo (Mich.)	044
	Wheeling (W.Va.)	155
	Youngstown-Warren	049

*Ohio - Hamilton is combined with Cincinnati, as 017
**Ohio - Lorain-Elyria is combined with Cleveland, as 010

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

Urbanized Area Codes

State	Urbanized Area	Code
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
	Clarksville-Ft. Campbell (Ky.)	280
	Kingsport (Va.)	276
	Knoxville	098
	Memphis (Miss.)	034
	Nashville-Davidson	054
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
	McAllen-Pharr-Edinburg	230
	Midland	197
	Odessa	174

Urbanized Area Codes

State	Urbanized Area	Code
Texas (Cont.)	Port Arthur	139
	San Angelo	208
	San Antonia	028
	Sherman-Denison	232
	Texarkana (Ark.)	211
	Texas City-LaMarque	250
	Tyler	213
	Waco	140
	Wichita Falls	151
Utah	Odgen	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

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 D

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 degrees) 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 D-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 D-1 the travel time in minutes corresponding to that number of curves. Enter this value in the column labeled "Total travel time".

3. Total the number of all curves and post this value in the total line for the "Number of curves" column.

4. Determine the total curve length by multiplying the total number of curves by the constant 0.15. Subtract this value from the section length to determine the tangent length.

5. Compute tangent travel time by multiplying the tangent length by 0.86 min./mile. Enter the resulting tangent travel time in the 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 D-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 multiplied by 0.15 gives a total curve length of 1.50 miles. 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 D-1

Worksheet for Calculating Average Highway Speed (AHS)

Degree of Curvature 1/	Approximate Design Speed (mph)	Number of curves	Total travel time (minutes) (from Table D-1)
28.0 - 43.0	25		
19.5 - 27.9	30		
14.0 - 19.4	35		
11.0 - 13.9	40		
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.

Less, Total Curve Length 1.50 mi.

=Tangent Length 2.70 mi. x 0.86 min./mi.

=Tangent Travel Time 2.32 min.

Average Highway Speed = (Section Length 4.20 mi. divided by Total Travel Time 4.26 min.) x 60

= 59 mph

Rounded AHS = 60 mph

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

Table D-1--Travel times for curves of various design speeds 2/

Design Speed	Travel time in minutes for number of curves indicated							
	Number of curves							
	1	2	3	4	5	6	7	8
25	0.36	0.72	1.08	1.44	1.80	2.16	2.52	2.88
30	0.30	0.60	0.90	1.20	1.50	1.80	2.10	2.40
35	0.26	0.51	0.77	1.03	1.29	1.54	1.80	2.06
40	0.23	0.45	0.68	0.90	1.13	1.35	1.58	1.80
45	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60
50	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44
55	0.16	0.33	0.49	0.65	0.82	0.98	1.15	1.31
60	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20
65	0.14	0.28	0.42	0.55	0.69	0.83	0.97	1.11

Design Speed	Travel time in minutes for number of curves indicated						
	Number of curves						
	9	10	11	12	13	14	15
25	3.24	3.60	3.96	4.32	4.68	5.04	5.40
30	2.70	3.00	3.30	3.60	3.90	4.20	4.50
35	2.31	2.57	2.83	3.09	3.34	3.60	3.86
40	2.03	2.25	2.48	2.70	2.93	3.15	3.38
45	1.80	2.00	2.20	2.40	2.60	2.80	3.00
50	1.62	1.80	1.98	2.16	2.34	2.52	2.70
55	1.47	1.64	1.80	1.96	2.13	2.29	2.45
60	1.35	1.50	1.65	1.80	1.95	2.10	2.25
65	1.25	1.38	1.52	1.66	1.80	1.94	2.18

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

APPENDIX E

Highway Capacity Calculation Instructions

Worksheet for Calculating Capacity of Urban Highways

PEAK

Capacity of Freeway and Expressway Facilities
(Uninterrupted Flow)

C = 2000 N W Tc

C = Capacity (total 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" (HCM))

Tc= Truck factor for overall highway section (from Table 9.3b in the HCM)

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 the HCM. 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 buses) x _____ (Adjustment for turns (if available))

= _____ (total in one direction)

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

Worksheet for Calculating Capacity of Urban Highways

OFF-PEAK

Capacity of Freeway and Expressway Facilities (Uninterrupted Flow)

C = 2000 N W Tc

C = Capacity (total 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" (HCM))

Tc= Truck factor for overall highway section (from Table 9.3b in the HCM)

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 the HCM. 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 buses) x _____ (Adjustment for turns (if available))

= _____ (total in one direction)

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

Worksheet for Calculating Rural Highway Capacity

Capacity of 2-Lane Highways

C = 2000 Wc Tc

C = Capacity, vph (total both directions)

Wc= Adjustment for lane width and lateral clearance (from Table 10.8 in the 1965 "Highway Capacity Manual" (HCM))

Tc= Truck factor for overall highway section (from Table 10.9b in the HCM)

C = 2000 x _____ x _____ = _____

Capacity of Multilane Highways

C = 2000 N W Tc

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 HCM)

Tc= Truck factor for overall highway section (from Tables 9.3b or 10.3b in the HCM)

C = 2000 x _____ x _____ x _____ = _____

APPENDIX F
Prescribed Volume Groups and Precision Levels

TABLE F-1
Rural Area Volume Groups and Precision Levels

Volume Group Code	Interstate (90-5)	Other Principal Arterials (90-5)	Minor Arterials (90-10)	Major Collectors (80-10)	Minor Collectors (80-10)
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 F-2
Small Urban Area Volume Groups and Precision Levels

Volume Group Code	Interstate (90-5)	Other Freeways and Expressways (90-5)	Other Principal Arterials (90-5)	Minor Arterials (80-10)	Collectors (80-10)
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 F-3
Individual Urbanized Area Volume Groups
and Precision Levels

Volume Group Code	Interstate (80-10)	Other Freeways and Expressways (80-10)	Other Principal Arterials (80-10)	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	

*Use (70-15) Precision Level for States with 3 or more individual urbanized areas. Use (80-10) Precision Level for States with less than 3 individual urbanized areas.

NUMBER AND RANGES OF VOLUME GROUPS BY FUNCTIONAL SYSTEM AND PRESCRIBED PRECISION LEVELS [1/]

RANGES

STATE: _____

RURAL:

VOLUME GROUP:	INTERSTATE (90 - 5)	OTHER PRINCIPAL ARTERIALS (90 - 5)	MINOR ARTERIALS (90 - 10)	MAJOR COLLECTORS (80 - 10)	MINOR COLLECTORS (80 - 10)
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 (90 - 5)	OTHER FREEWAYS AND EXPRESSWAYS (90 - 5)	OTHER PRINCIPAL ARTERIALS (90 - 5)	MINOR ARTERIALS (80 - 10)	COLLECTORS (80 - 10)
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/] [3/]

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 VOLUME GROUP RANGES OTHER THAN THOSE SHOWN IN APPENDIX F, TABLES 1-3 OR BY STATES ADDING VOLUME GROUPS TO THE FHWA PRESCRIBED GROUPINGS.

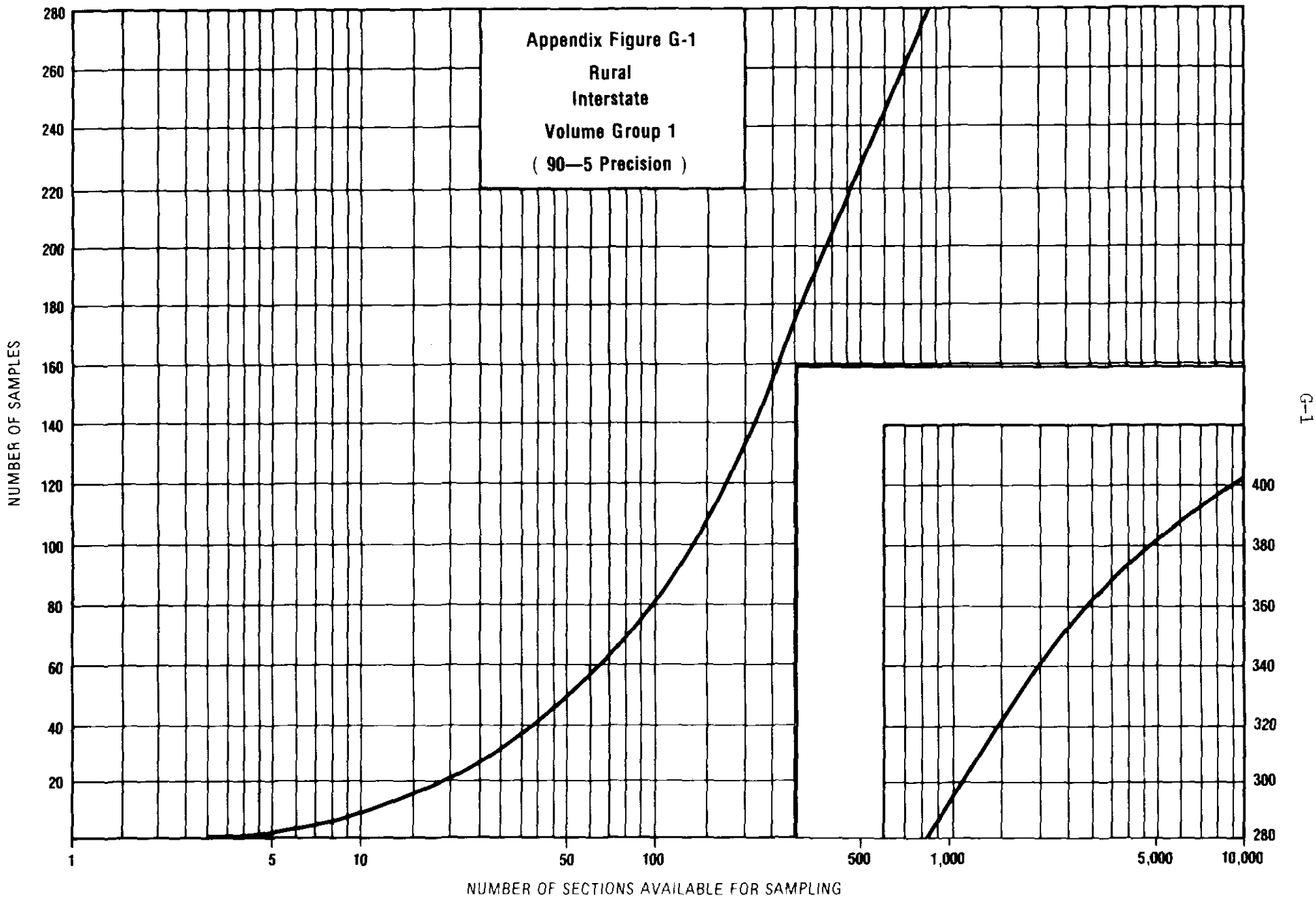
2/ IF THE VOLUME GROUPS DIFFER BY URBANIZED AREA, USE MULTIPLE COPIES OF THIS FORM AND INDICATE THE URBANIZED AREA(S) NAME(S) ON EACH FORM.

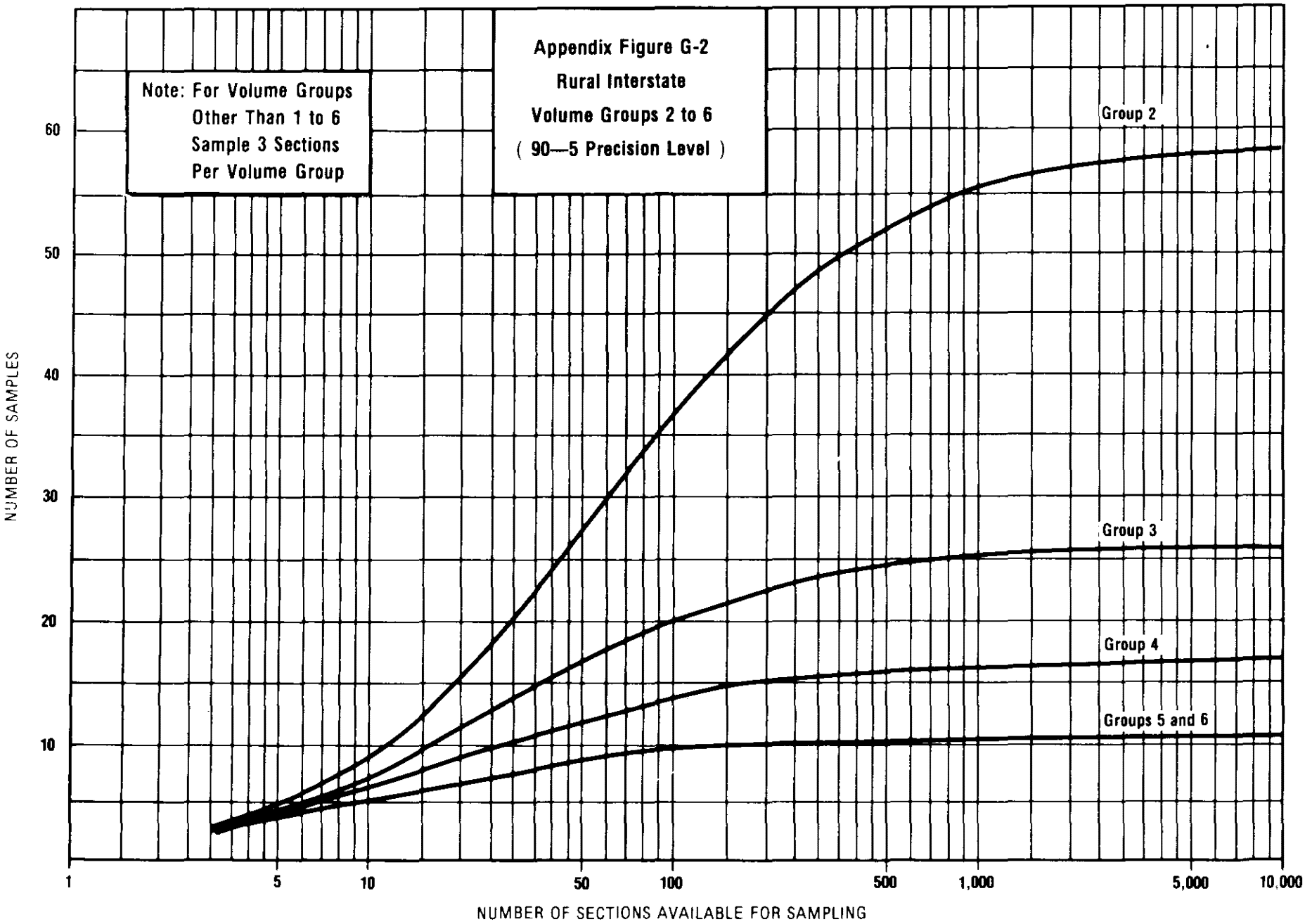
3/ SEE APPENDIX TABLE F-3 FOR PRESCRIBED PRECISION LEVEL REQUIREMENTS.

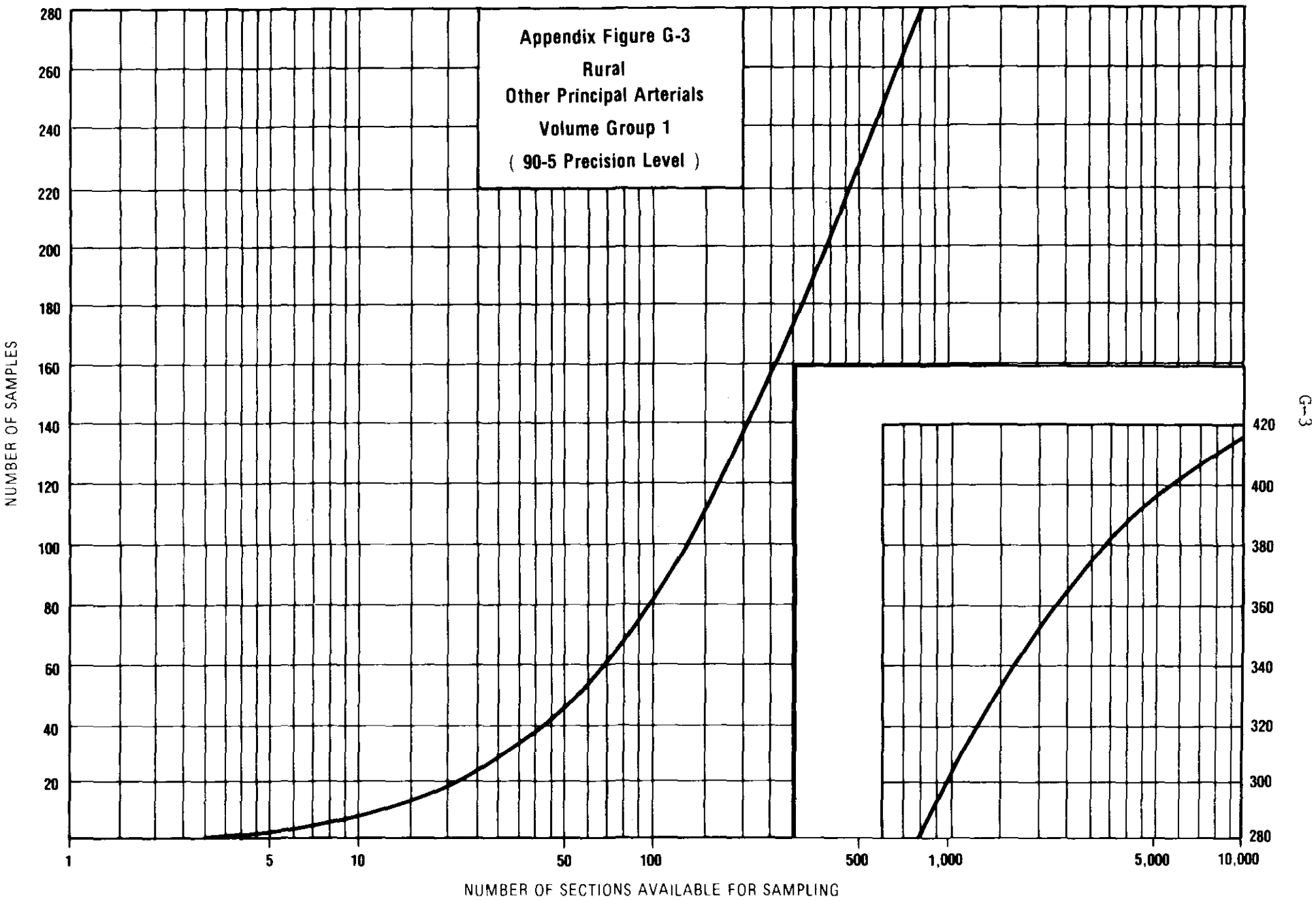
Figure F-1

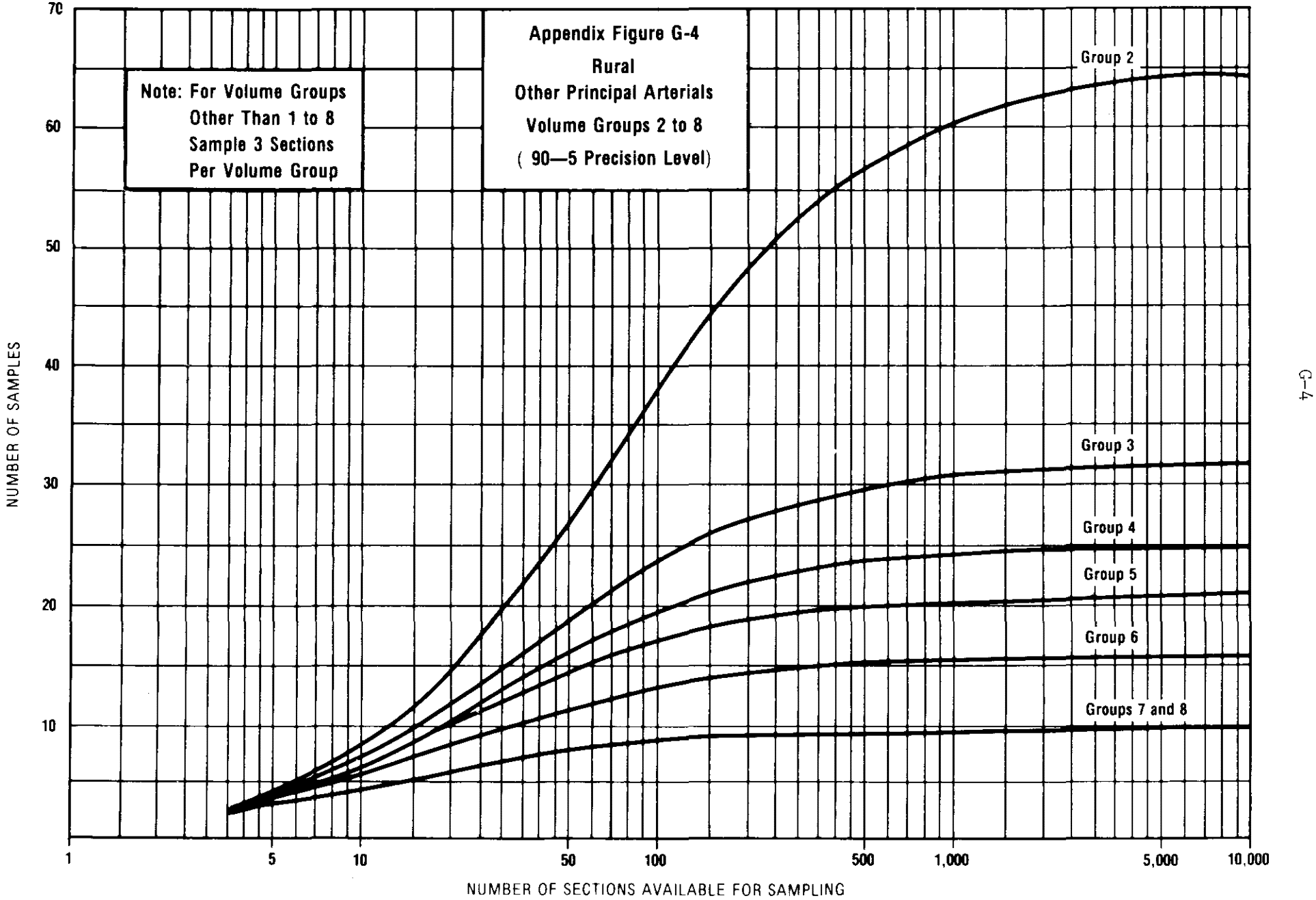
APPENDIX G

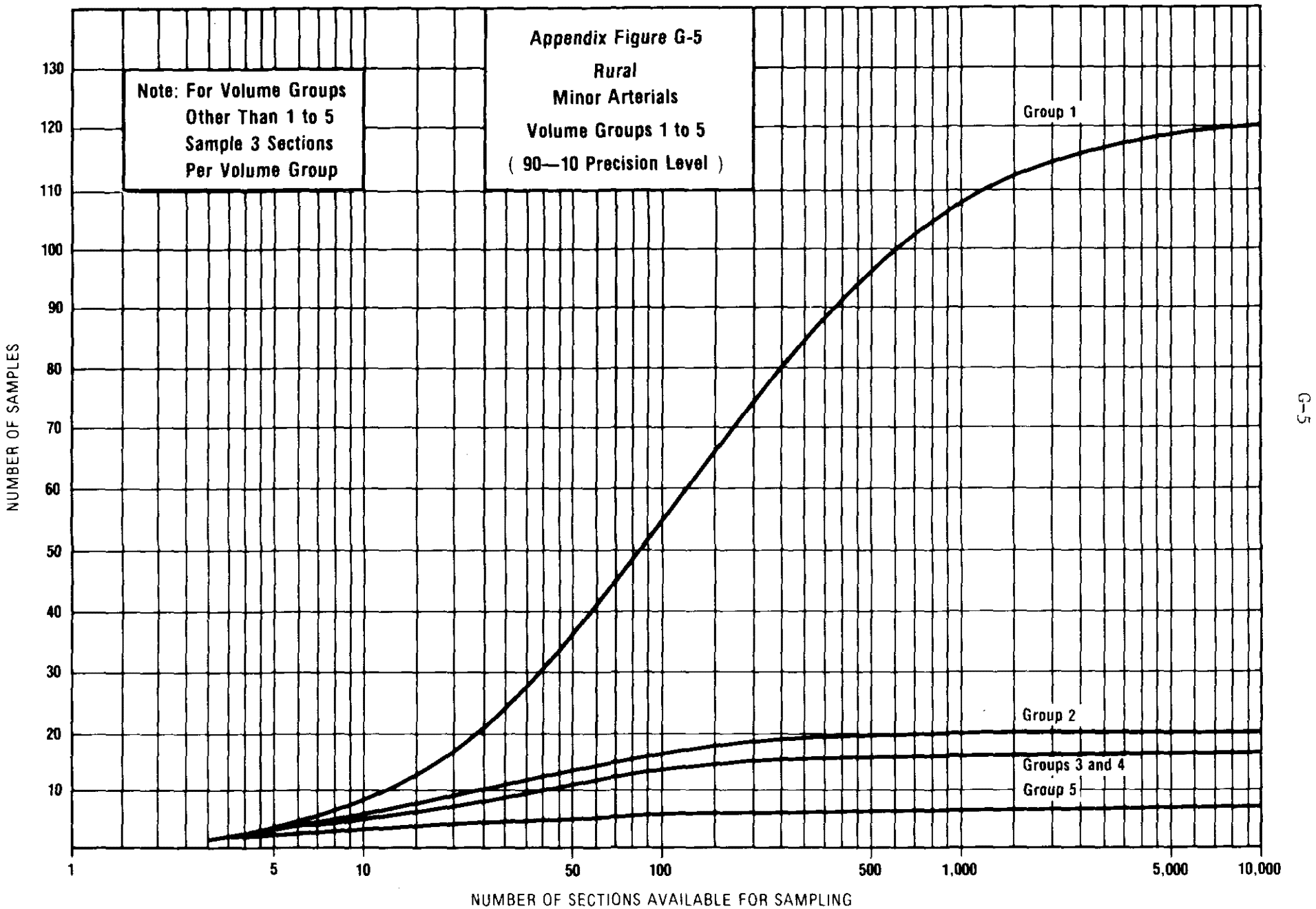
Graphic Determination of Sample Size Requirements on Arterials and Collectors

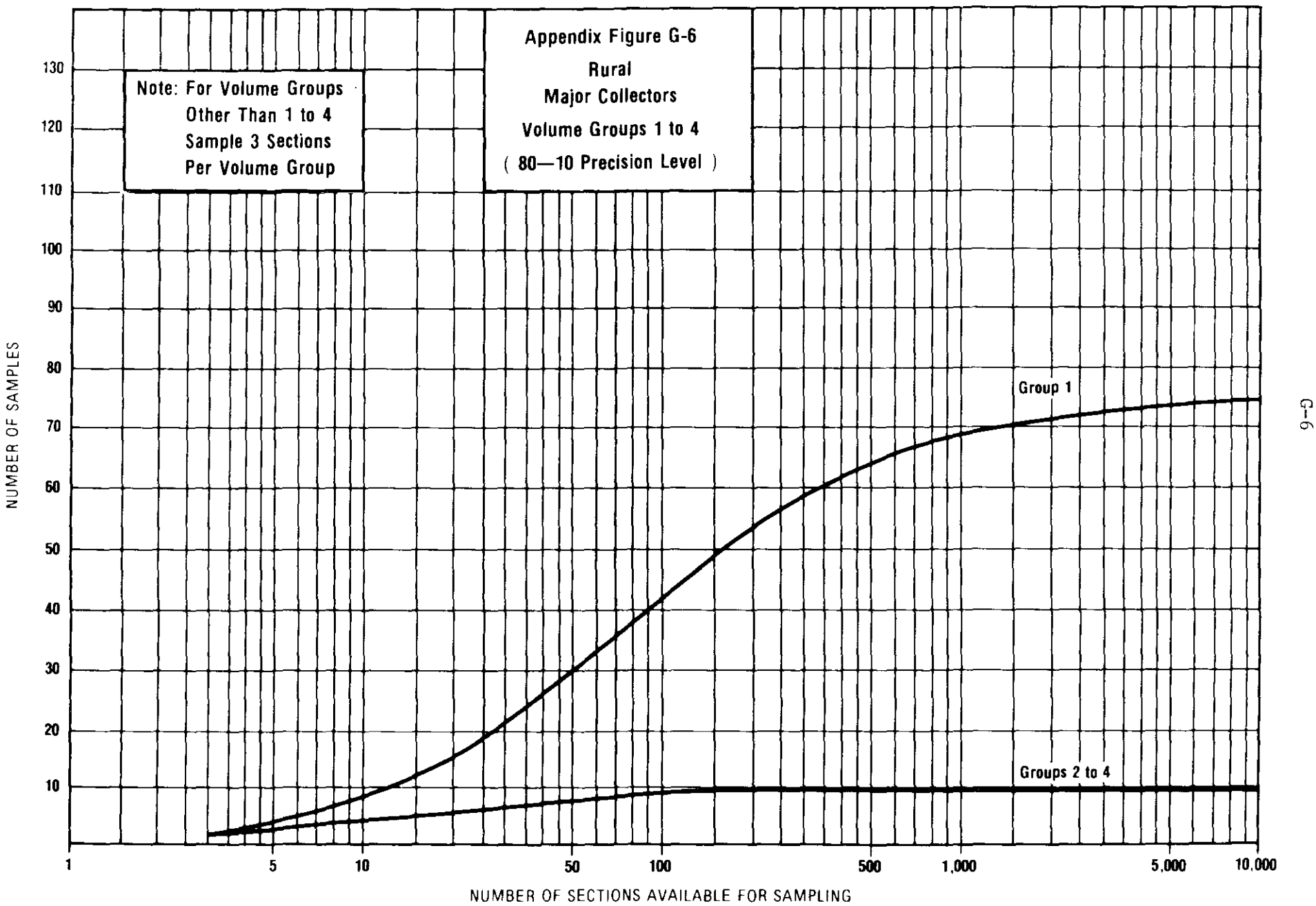

Appendix Figure G-1
Rural
Interstate
Volume Group 1
(90—5 Precision)
NUMBER OF SAMPLES
280
260
240
220
200
180
160
140
120
100
80
60
40
20
400
380
360
340
320
300
280
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING

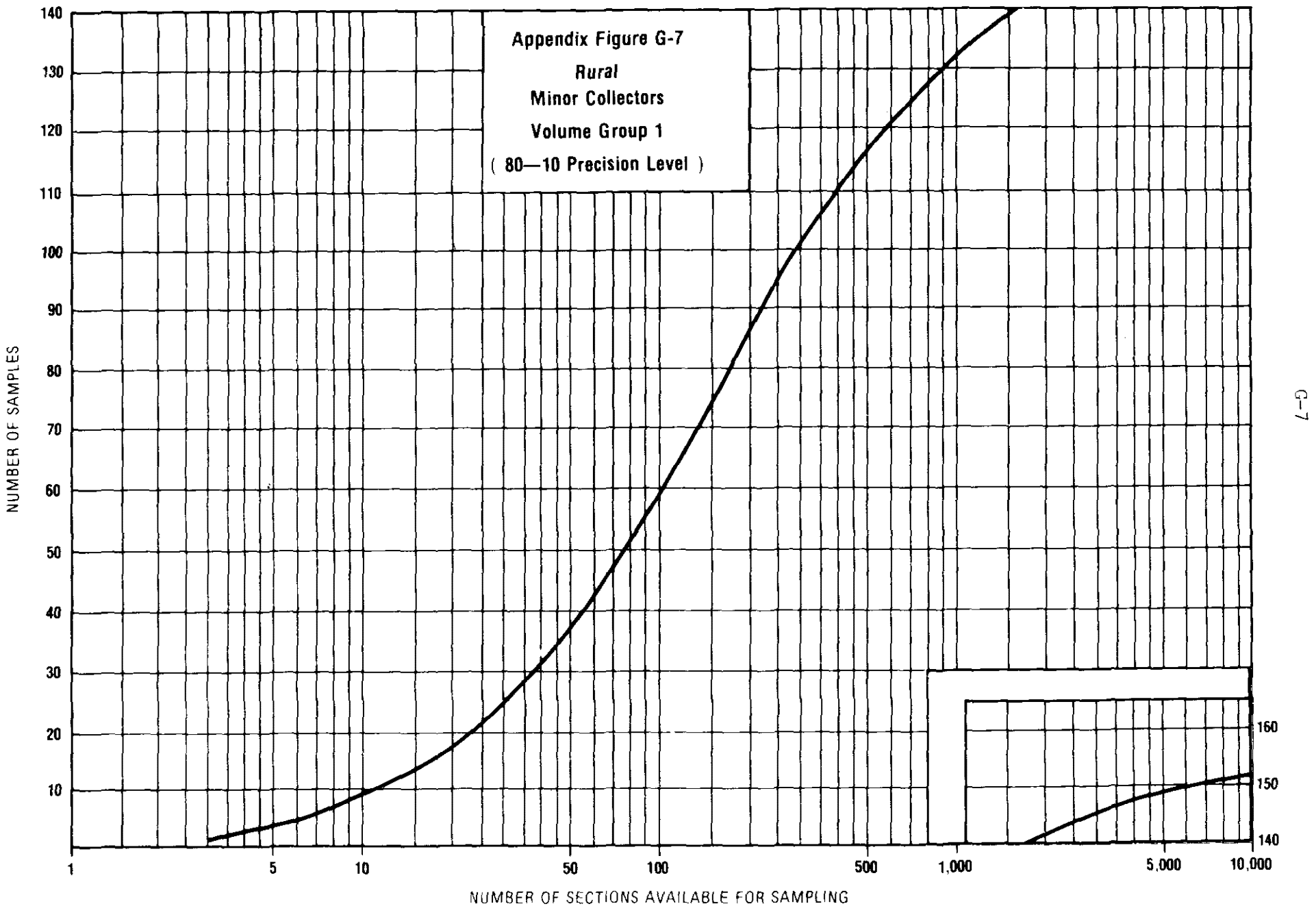

Appendix Figure G-2
Rural Interstate
Volume Groups 2 to 6
(90—5 Precision Level)
Note: For Volume Groups
Other Than 1 to 6
Sample 3 Sections
Per Volume Group
Group 2
Group 3
Group 4
Groups 5 and 6
NUMBER OF SAMPLES
60
50
40
30
20
10
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING

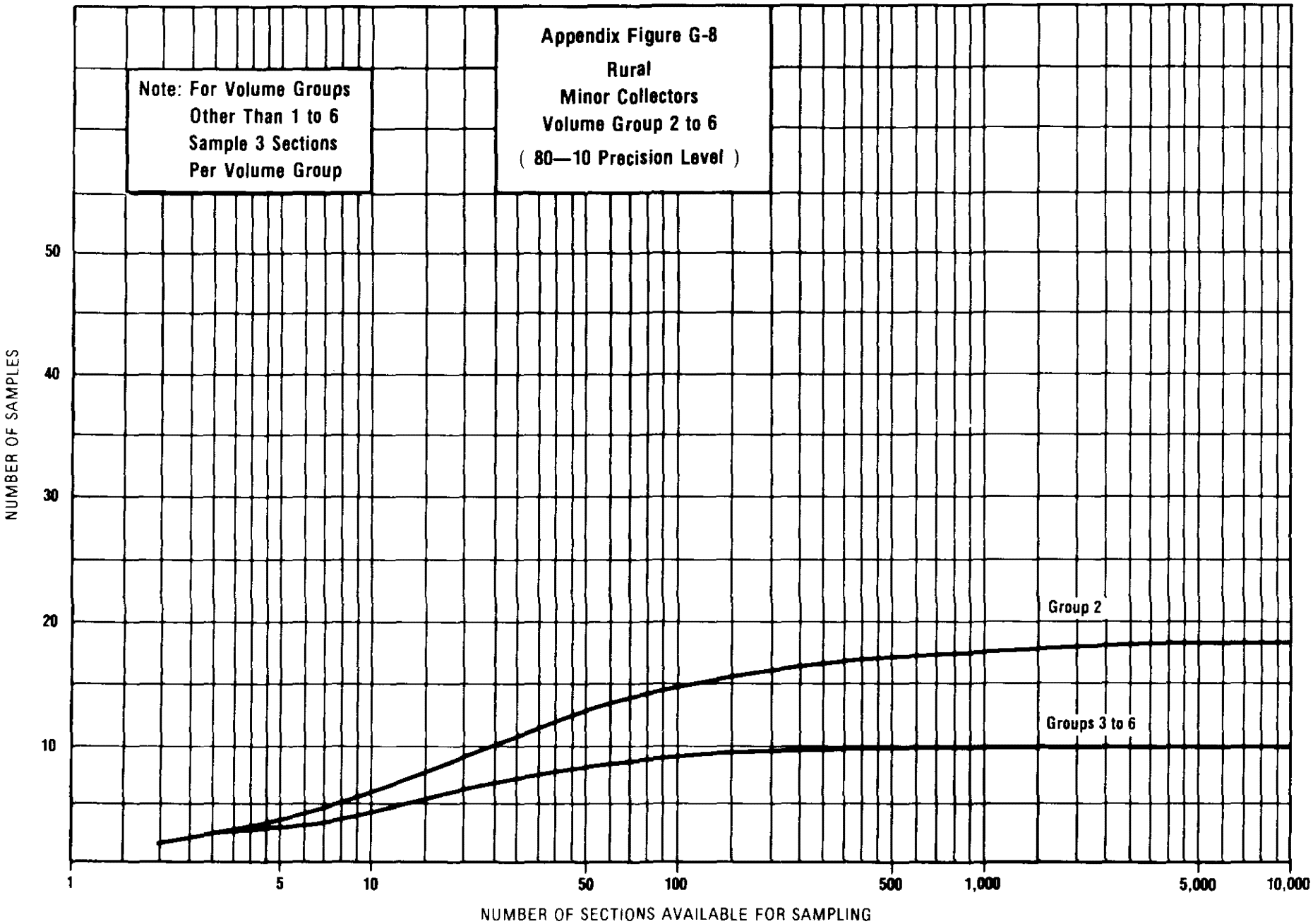

Appendix Figure G-3
Rural
Other Principal Arterials
Volume Group 1
(90-5 Precision Level)
NUMBER OF SAMPLES
280
260
240
220
200
180
160
140
120
100
80
60
40
20
420
400
380
360
340
320
300
280
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING


Appendix Figure G-4
Rural
Other Principal Arterials
Volume Groups 2 to 8
(90—5 Precision Level)
Note: For Volume Groups
Other Than 1 to 8
Sample 3 Sections
Per Volume Group
Group 2
Group 3
Group 4
Group 5
Group 6
Groups 7 and 8
NUMBER OF SAMPLES
70
60
50
40
30
20
10
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING


Appendix Figure G-5
Rural
Minor Arterials
Volume Groups 1 to 5
(90—10 Precision Level)
Note: For Volume Groups
Other Than 1 to 5
Sample 3 Sections
Per Volume Group
NUMBER OF SAMPLES
130
120
110
100
90
80
70
60
50
40
30
20
10
Group 1
Group 2
Groups 3 and 4
Group 5
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING


Appendix Figure G-6
Rural
Major Collectors
Volume Groups 1 to 4
(80—10 Precision Level)
Note: For Volume Groups
Other Than 1 to 4
Sample 3 Sections
Per Volume Group
NUMBER OF SAMPLES
130
120
110
100
90
80
70
60
50
40
30
20
10
Group 1
Groups 2 to 4
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING


Appendix Figure G-7
Rural
Minor Collectors
Volume Group 1
(80—10 Precision Level)
NUMBER OF SAMPLES
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING
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


Appendix Figure G-8
Rural
Minor Collectors
Volume Group 2 to 6
(80—10 Precision Level)
Note: For Volume Groups
Other Than 1 to 6
Sample 3 Sections
Per Volume Group
NUMBER OF SAMPLES
50
40
30
20
10
Group 2
Groups 3 to 6
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING

APPENDIX G

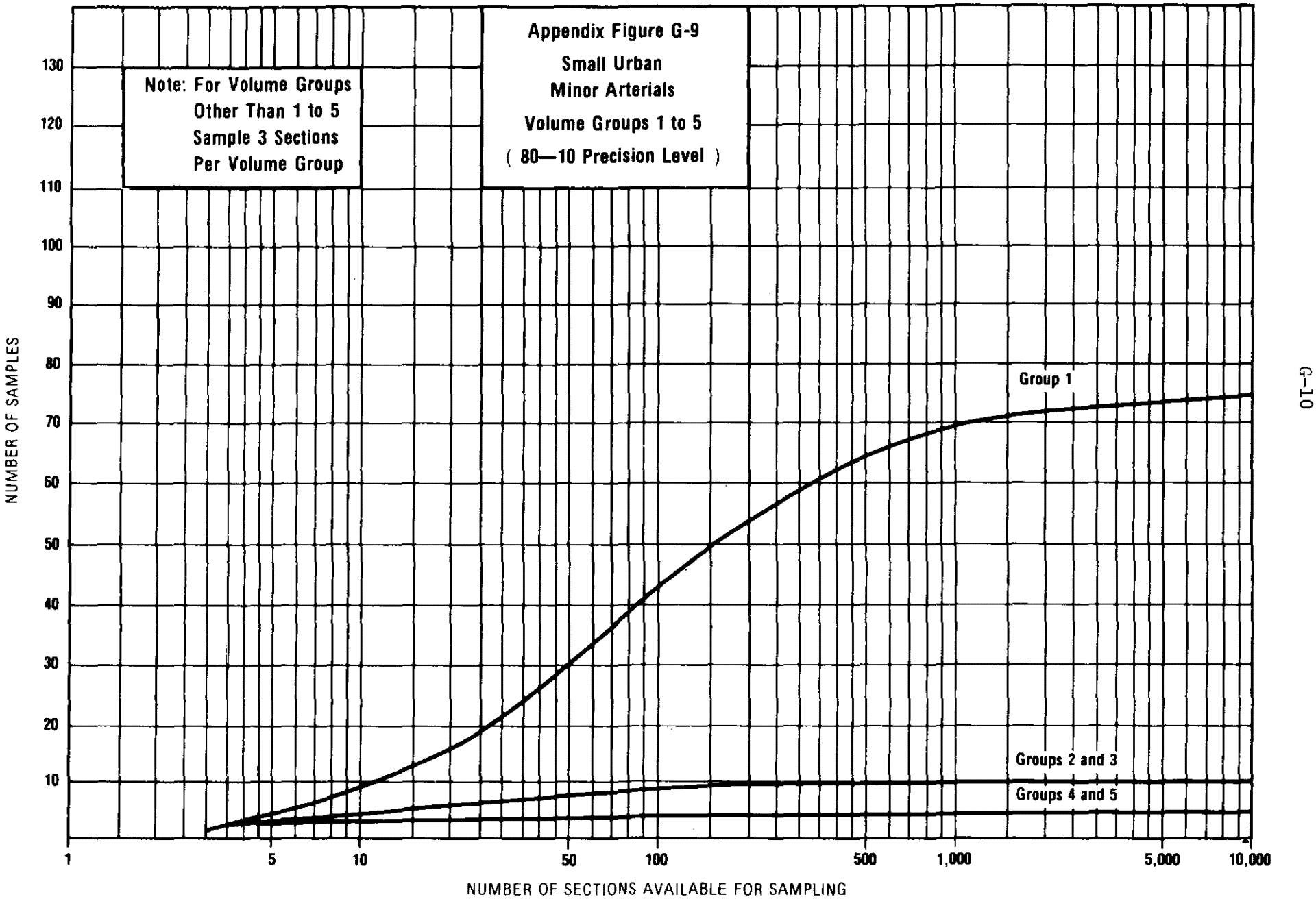
SMALL URBAN SAMPLES

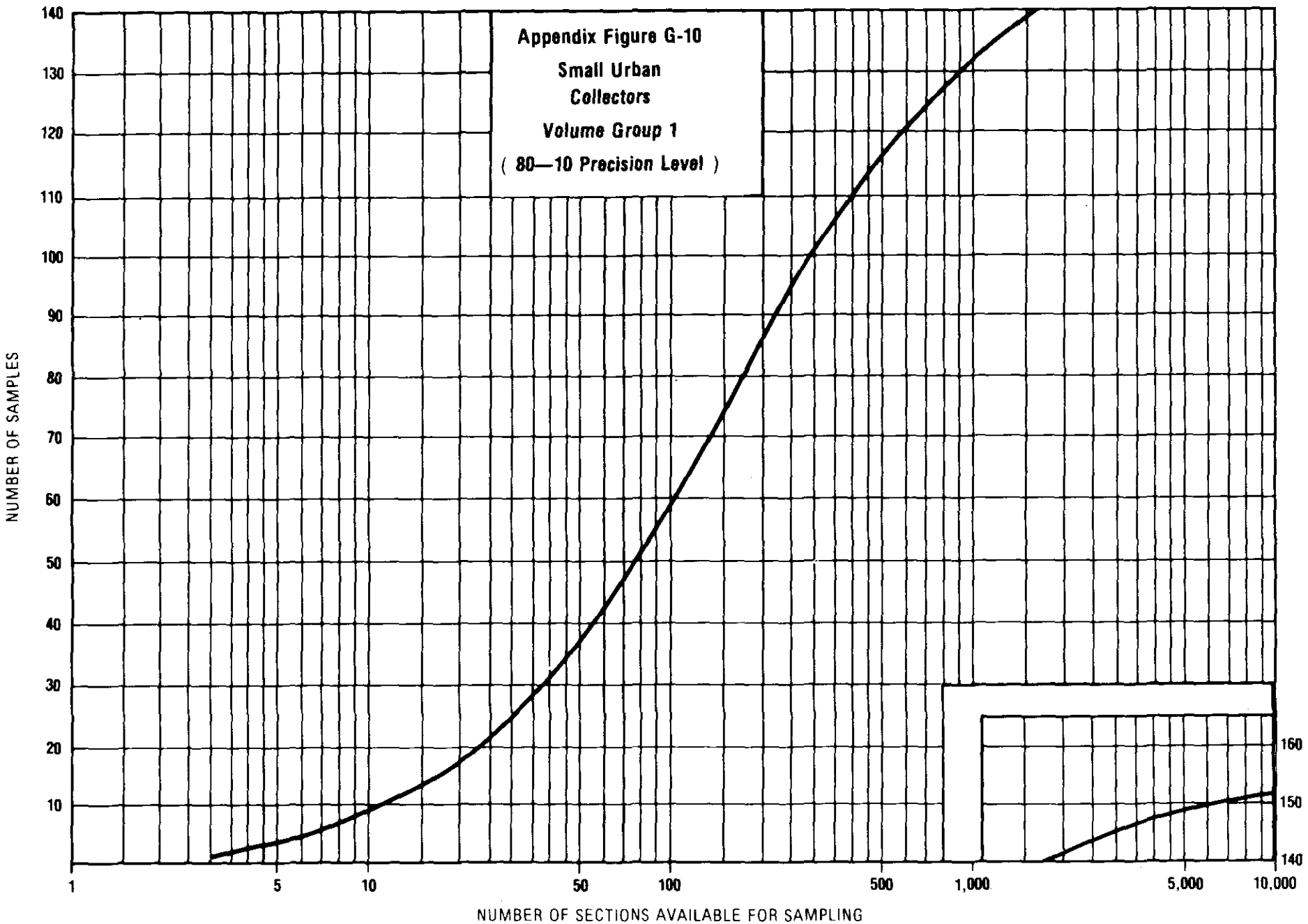
Interstate and Other Freeways and Expressways

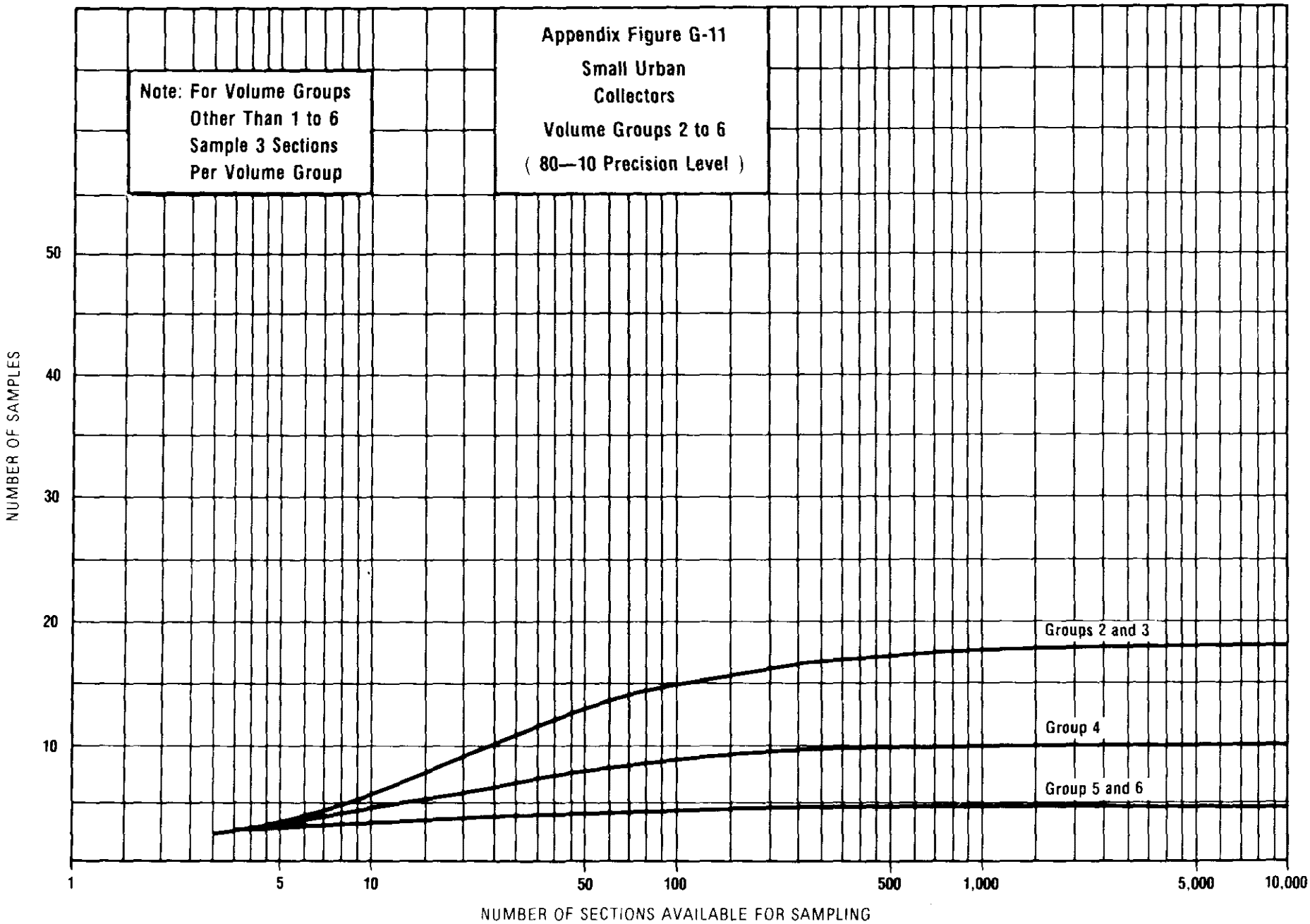
Use the same curves as for Rural Interstate (Figures G-1 and G-2) for the applicable volume group numbers.

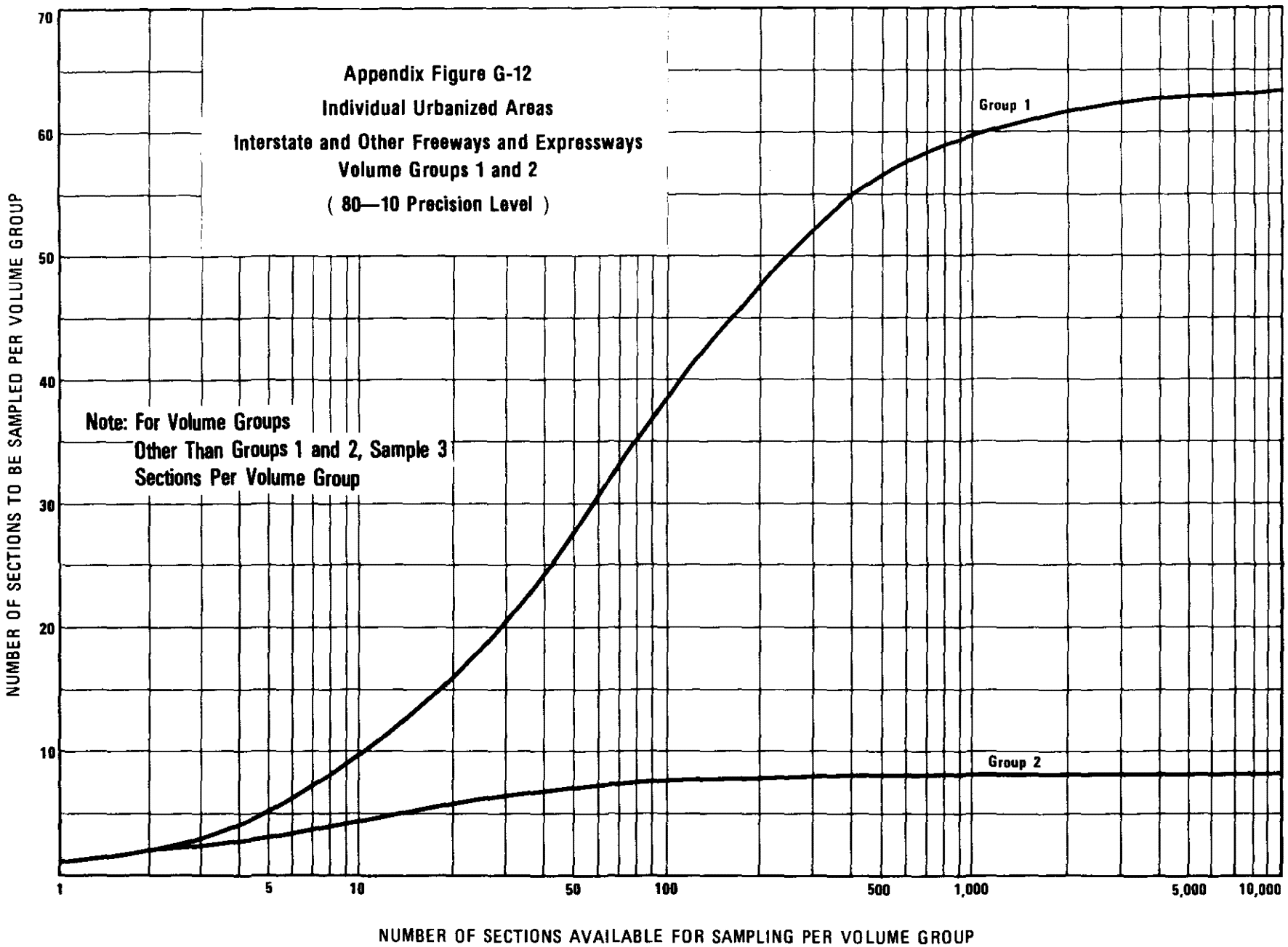
Other Principal Arterials

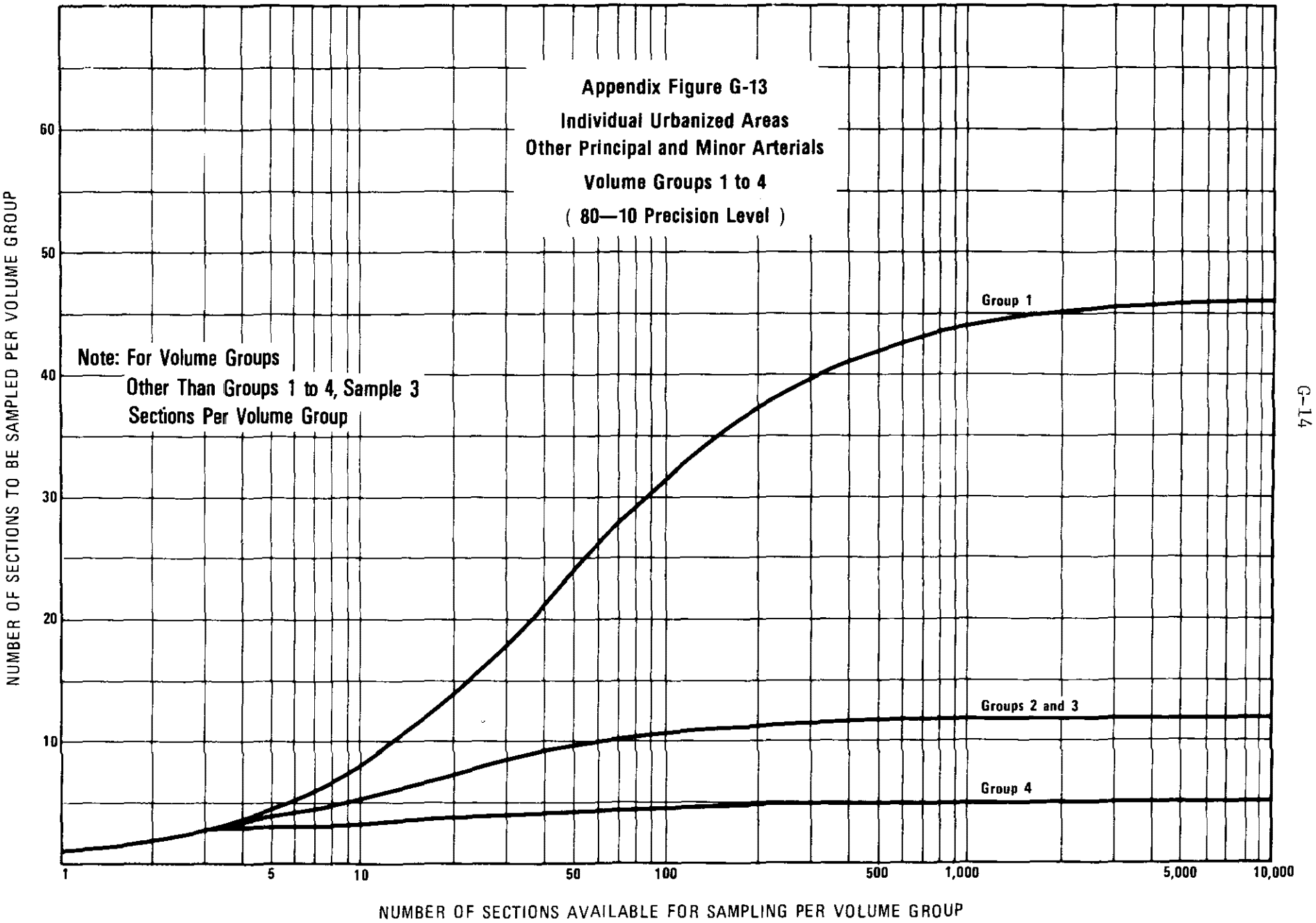
Use same curves as for Rural - other Principal Arterials (Figures G-3 and G-4) for the applicable volume group numbers.

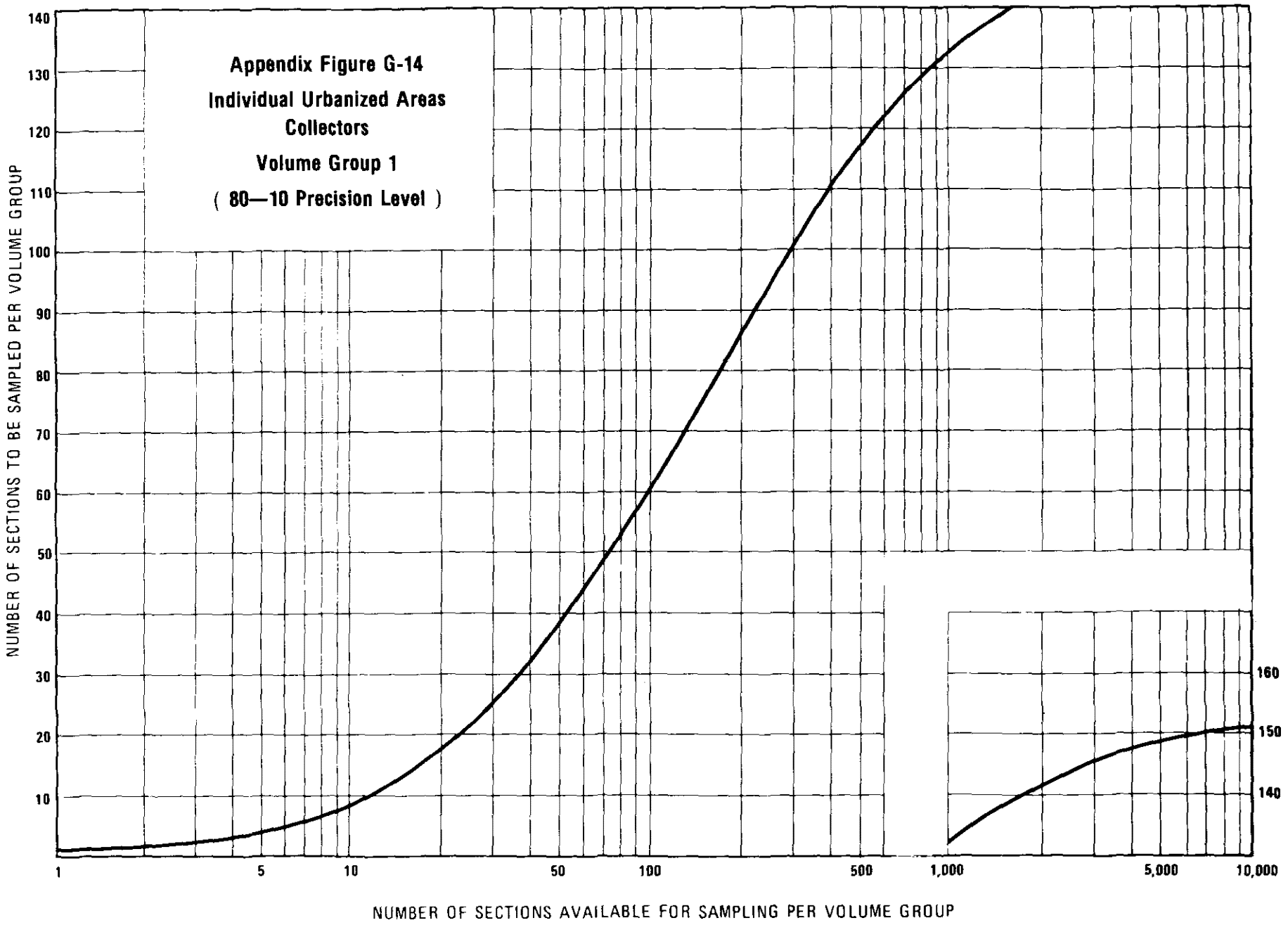

Appendix Figure G-9
Small Urban
Minor Arterials
Volume Groups 1 to 5
(80—10 Precision Level)
Note: For Volume Groups
Other Than 1 to 5
Sample 3 Sections
Per Volume Group
NUMBER OF SAMPLES
130
120
110
100
90
80
70
60
50
40
30
20
10
Group 1
Groups 2 and 3
Groups 4 and 5
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING

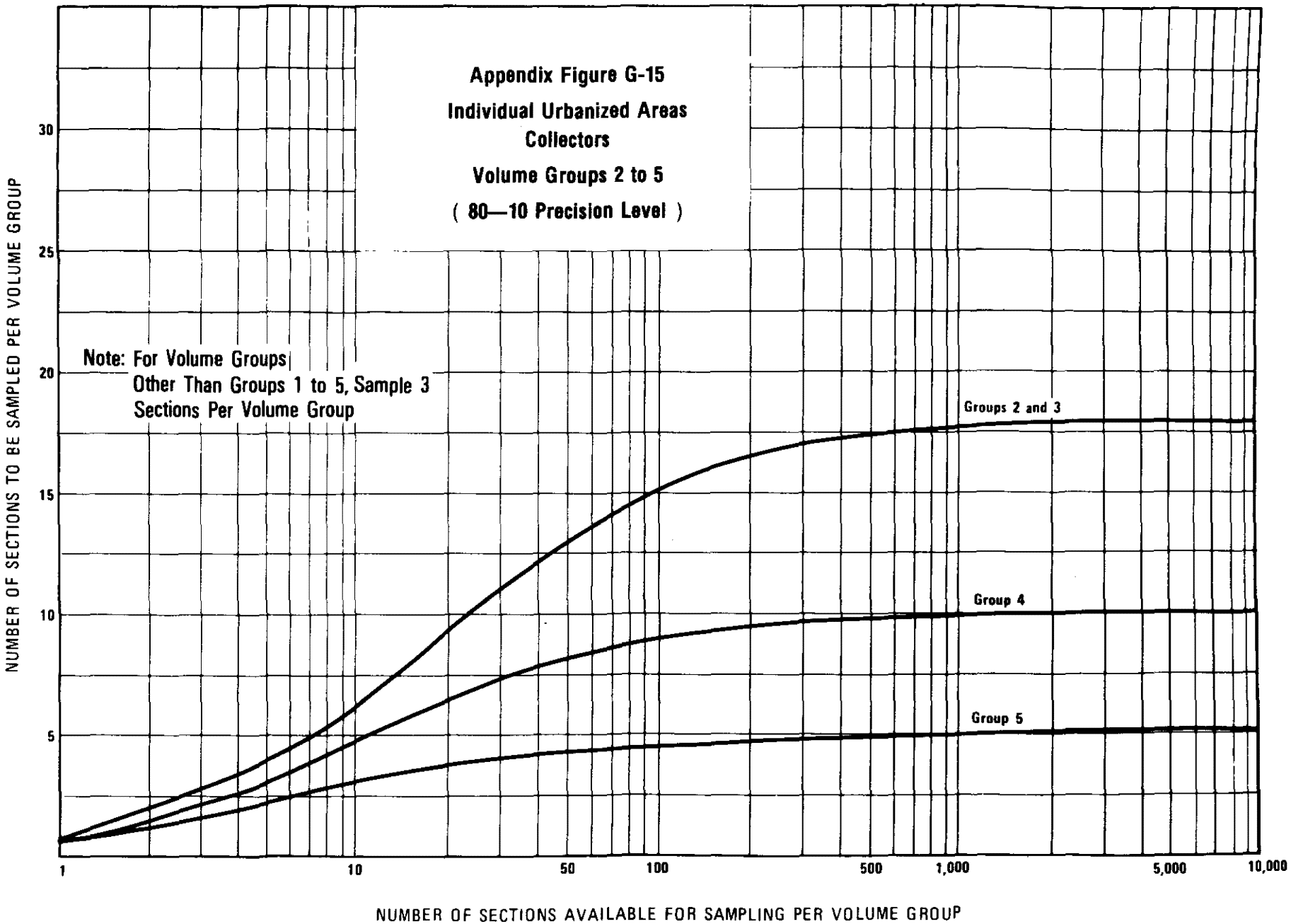

Appendix Figure G-10
Small Urban
Collectors
Volume Group 1
(80—10 Precision Level)
NUMBER OF SAMPLES
140
130
120
110
100
90
80
70
60
50
40
30
20
10
160
150
140
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING

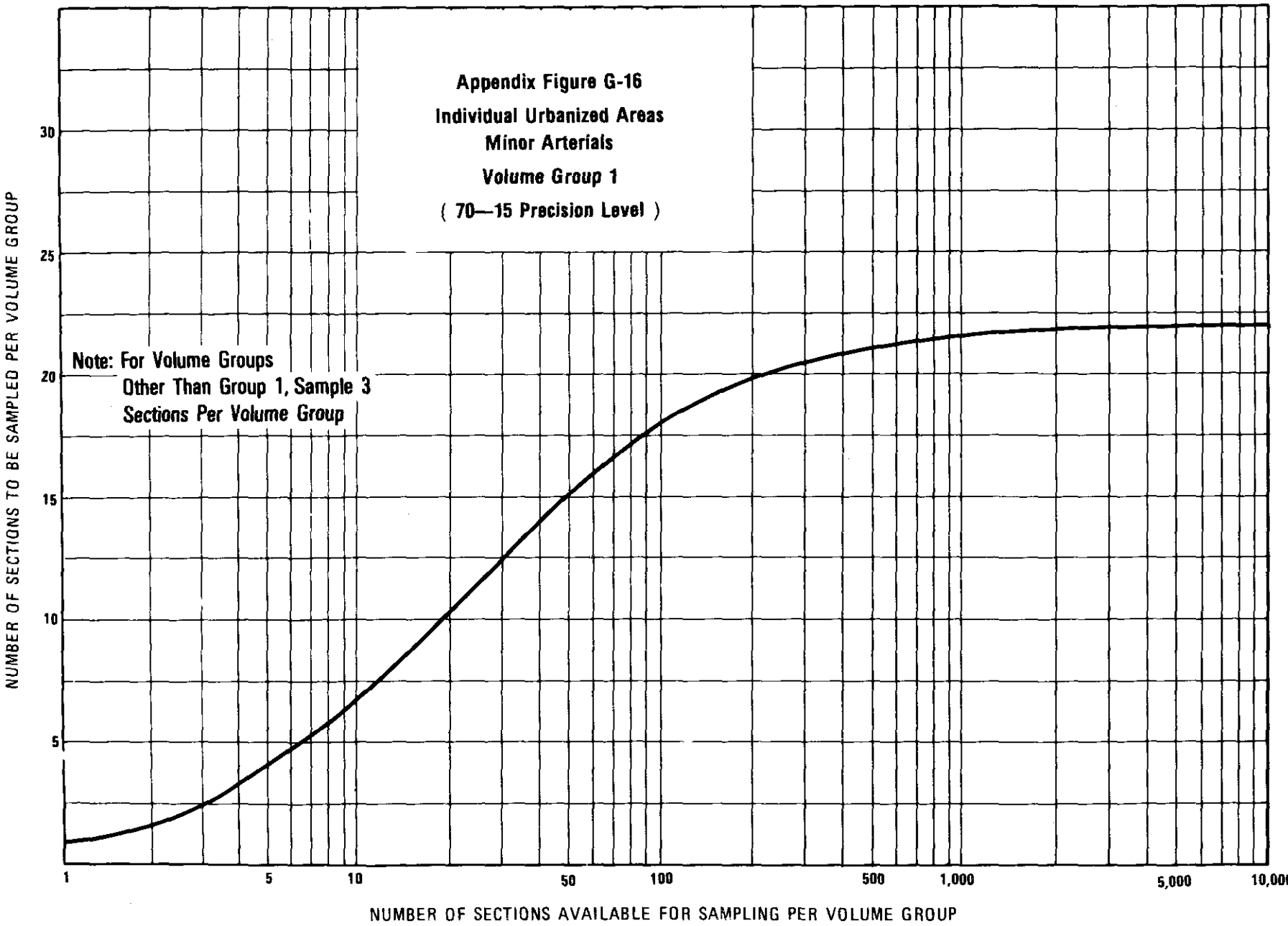

Appendix Figure G-11
Small Urban
Collectors
Volume Groups 2 to 6
(80—10 Precision Level)
Note: For Volume Groups
Other Than 1 to 6
Sample 3 Sections
Per Volume Group
NUMBER OF SAMPLES
50
40
30
20
10
Groups 2 and 3
Group 4
Group 5 and 6
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING

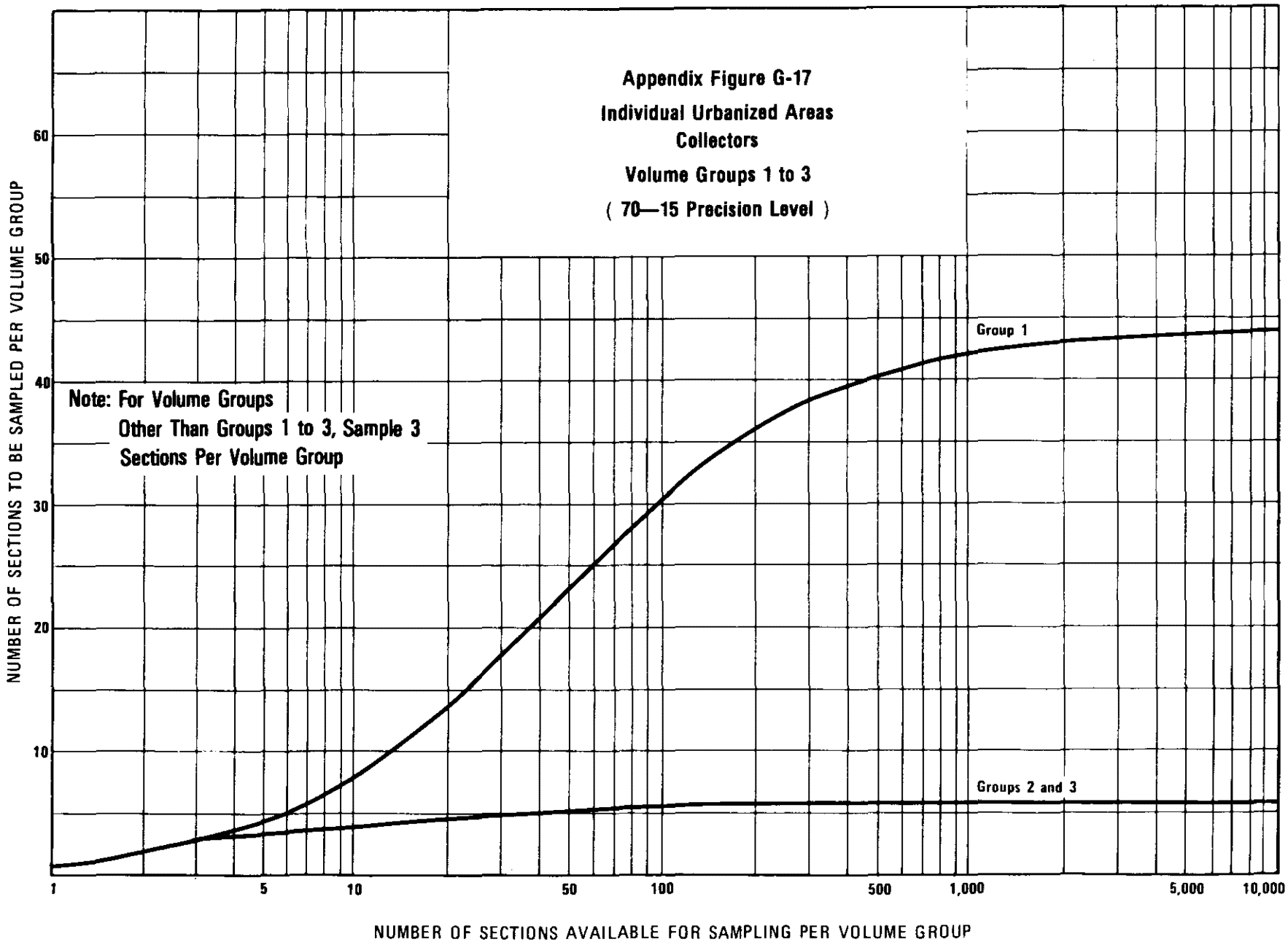

Appendix Figure G-12
Individual Urbanized Areas
Interstate and Other Freeways and Expressways
Volume Groups 1 and 2
(80—10 Precision Level)
Note: For Volume Groups
Other Than Groups 1 and 2, Sample 3
Sections Per Volume Group
Group 1
Group 2
NUMBER OF SECTIONS TO BE SAMPLED PER VOLUME GROUP
NUMBER OF 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


Appendix Figure G-13
Individual Urbanized Areas
Other Principal and Minor Arterials
Volume Groups 1 to 4
(80—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


Appendix Figure G-14
Individual Urbanized Areas
Collectors
Volume Group 1
(80—10 Precision Level)
NUMBER OF SECTIONS TO BE SAMPLED 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
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING PER VOLUME GROUP


Appendix Figure G-15
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
30
25
20
15
10
5
1
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING PER VOLUME GROUP


Appendix Figure G-16
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
30
25
20
15
10
5
1
5
10
50
100
500
1,000
5,000
10,000
NUMBER OF SECTIONS AVAILABLE FOR SAMPLING PER VOLUME GROUP


Appendix Figure G-17
Individual Urbanized Areas
Collectors
Volume Groups 1 to 3
(70—15 Precision Level)
Note: For Volume Groups Other Than Groups 1 to 3, Sample 3 Sections Per Volume Group
Group 1
Groups 2 and 3
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

APPENDIX H

Empirical Method for Computing Sample Size for Arterials and Collectors

The AADT 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:

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

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 AADT 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 AADT 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 AADT 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:

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

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

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

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.

where,

CV = the coefficient of variation, a measure of the relative dispersion of individual road section AADT values over time with reference to the midpoint AADT 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 H-1 shows a relationship between CV and two-way traffic volumes.

$\overline{X}_h$ = the midpoint of the predetermined volume group. In the computation of temporal variance, the value of CV in Figure H-1 is referenced to this midpoint value. It is noted that the CV values in Figure H-1 for midpoints below 700 ADT are off scale. Should there be need for CV values for lower AADT midpoints, estimates for CVs at selected volume group midpoint values are, respectively: .38-500, .42-400, .55-300, and .62-250. Intermediate values of CV may be interpolated.

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

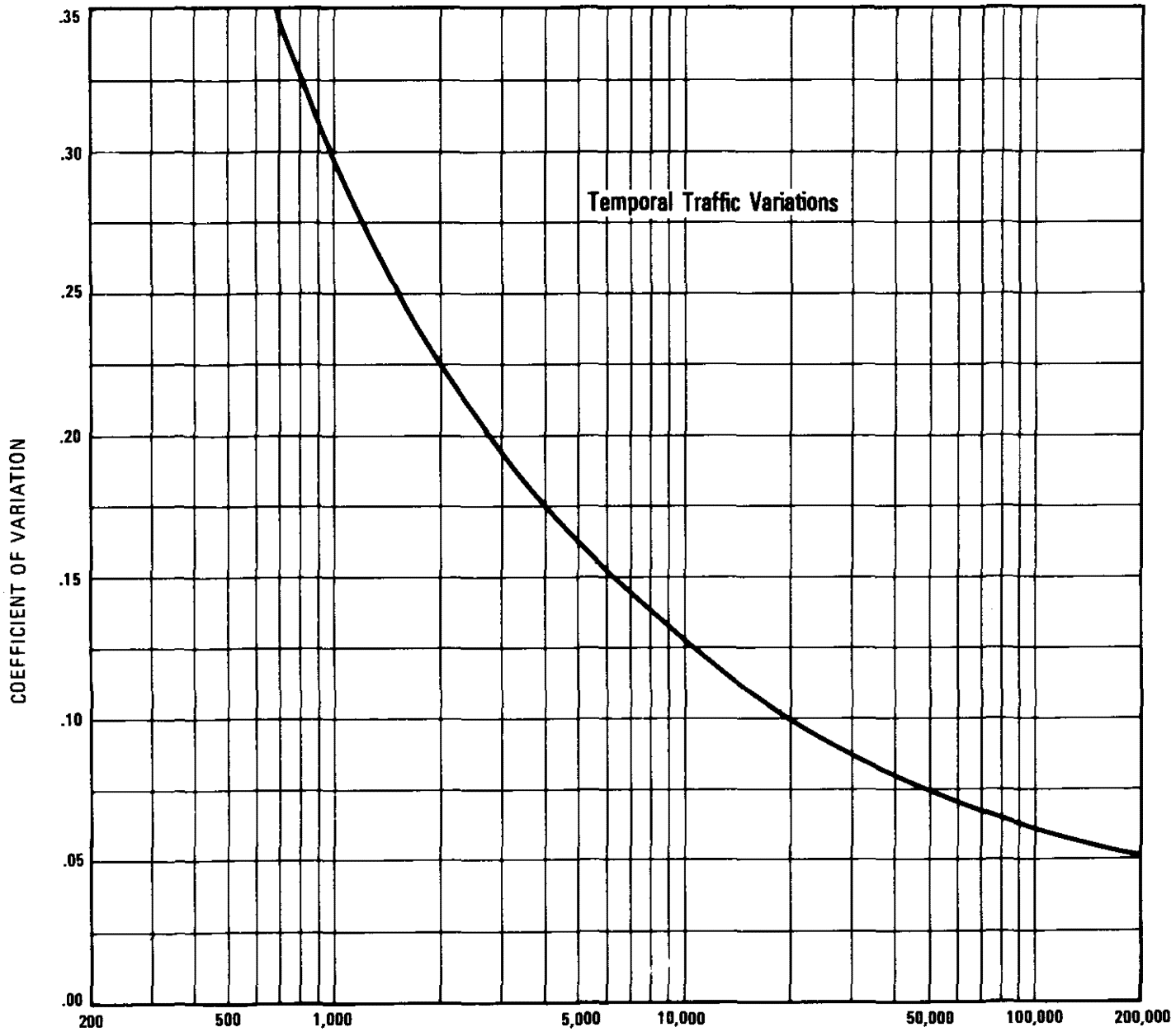


Figure H-1

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

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 H-1	(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

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.

APPENDIX I

Sample Size Requirements for Estimating Proportions

The sample size determined by the HPMS empirical method is based on the measurement of AADT and AADT sensitive variables. Although the sample size determined by the empirical method is appropriate for the obtaining mean values of data elements such as average pavement condition of arterials, the same sample must also be used to estimate the proportion of mileage having specific characteristics, e.g., rural arterial mileage with a PSR rating less than 2.0. Therefore, steps must be taken to ensure that the sample size requirements for averages and aggregates also allow for sufficient sample size to produce estimates of proportions at desired accuracy levels for each functional system.

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. This is essential to the monitoring process. 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 true percent change in proportions and sample size is shown in the formulas below.

Given, the formula:

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

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.

$(p_2 - p_1)$ = the smallest detectable true change, not concealed by sampling error.

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

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

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_o = the number of samples required, without finite correction.

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

As an example, if the above formulas are applied to a functional system having a Statewide total of 200 sections (N), the required number of sections (n) to detect with 80 percent confidence, a 10 percent change is:

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

$$n = \frac{83}{1 + 83/200} = 59$$

The graph shown in Appendix Figure I-1 is plotted for sample size (n), based on 80 percent confidence in the detection of a 10 percent change.

The minimum detectable true change in proportions $(p_2 - p_1)$ for any given number of sample road sections at stratum of 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

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

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

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.

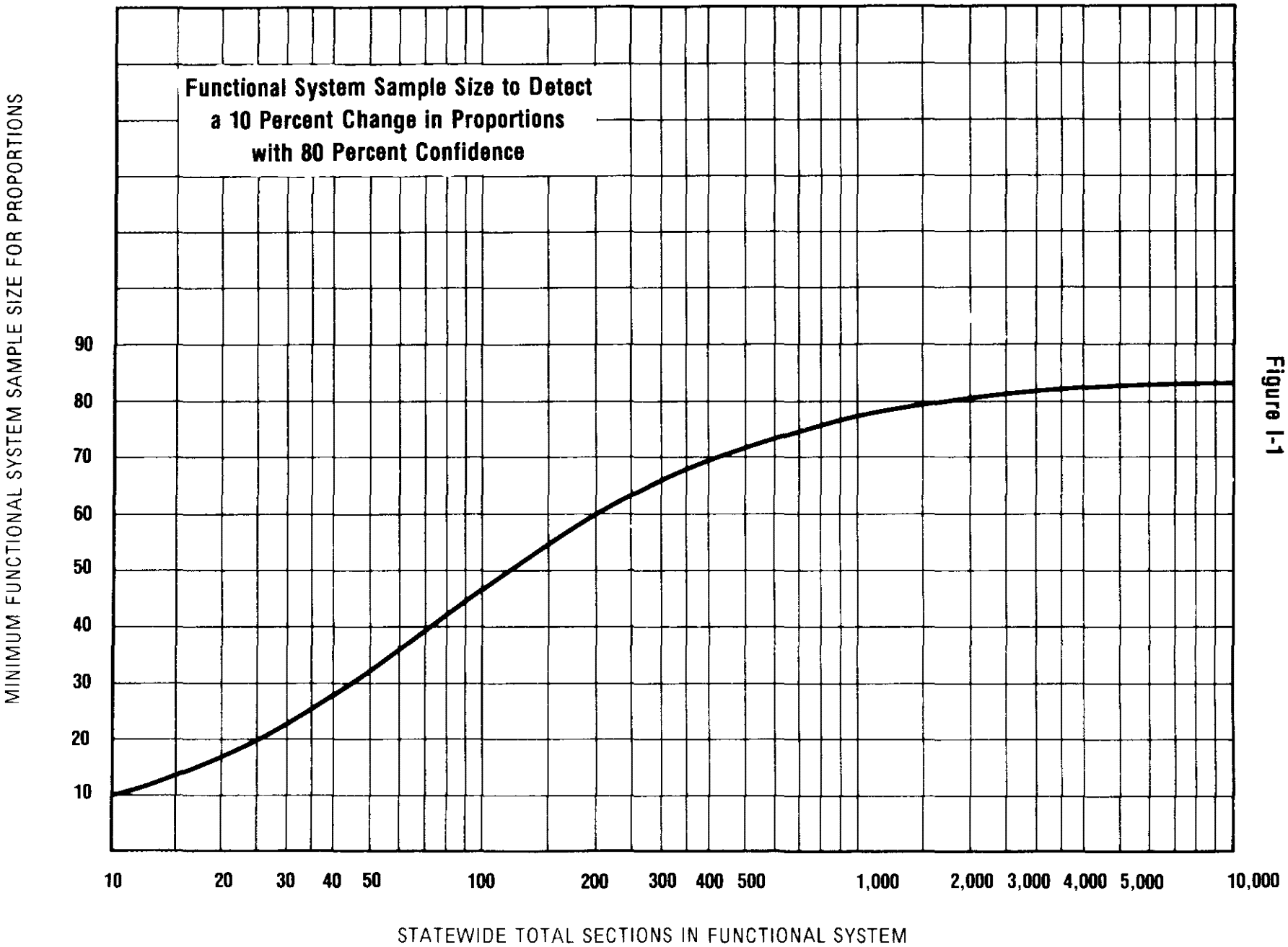

Functional System Sample Size to Detect
a 10 Percent Change in Proportions
with 80 Percent Confidence
MINIMUM FUNCTIONAL SYSTEM SAMPLE SIZE FOR PROPORTIONS
90
80
70
60
50
40
30
20
10
10
20
30
40
50
100
200
300
400
500
1,000
2,000
3,000
4,000
5,000
10,000
STATEWIDE TOTAL SECTIONS IN FUNCTIONAL SYSTEM

Figure I-1

APPENDIX J

Supplementary Instructions For Local Samples

(1) Local Rural Roads - Formulas and Examples

The following presents methods for calculating Statewide DVMT, the error of estimated DVMT and AADT, and the confidence level attained by sample estimates of randomly selected counties.

In the Chapter VI section on local rural roads, procedures are given for the calculation of Statewide estimated AADT and DVMT, wherein

(a) Σy = the sum of the DVMT's of all sampled sections in a State,

= (Σy a for sampled county 1) + (Σy a for sampled county 2) + ----- etc.,

(b) Σx = the sum of the mileage of all sampled sections of a State,

= (Σx a for sampled county 1) + (Σx a for sampled county 2) + ----- etc.,

(c) the ratio $\Sigma y / \Sigma x = \bar{y}$ = the estimated Statewide weighted AADT for local rural roads and

(d) the Statewide DVMT = $M \bar{y} = Y$
where, M = the total Statewide mileage for local rural roads.

In order to determine the extent to which the estimated DVMT and Statewide AADT are in error from the true values (100% sampling), the following variance formula is used:

$$\text{variance } (\bar{y}) = \frac{1 - f(sw)}{(\Sigma x)^2} \cdot \frac{a}{a-1} \left[\left(\Sigma y^2 a - \frac{(\Sigma y)^2}{a} \right) + (\bar{y})^2 \left(\Sigma x^2 a - \frac{(\Sigma x)^2}{a} \right) - 2 \bar{y} \left(\Sigma y a \, x \, a - \frac{(\Sigma y)(\Sigma x)}{a} \right) \right]$$

where,

f(sw) = f r,
f = sampling rate on Table V+1,
r = number counties sampled/total counties,
a = number of counties sampled,
$\Sigma y^2 a$ = sum of the squares of the sums, $\Sigma y a$, in each county sampled,
$\Sigma x^2 a$ = sum of the squares of the sums, $\Sigma x a$, in each county sampled, and
$\Sigma y a \, x \, a$ = sum of the products of the $\Sigma y a$ and $\Sigma x a$ sums in each sampled county.
The values Σy, Σx, and $\bar{y}$ have been previously defined.

The error of estimate of the Statewide AADT or $\bar{y}$ is the square root of the variance $(\bar{y})$.

Also, the error of estimate of the Statewide DVMT or Y is:

$$\text{Error } (Y) = \left[(M)^2 \text{ (Variance } \bar{y})\right]^{\frac{1}{2}}$$

where,

M is the total Statewide mileage for local rural roads.

Thus, $\bar{y} \pm$ error of $\bar{y}$ = 68% confidence range of the true value of the Statewide AADT,

and, Y $\pm$ error of Y = 68% confidence range of the true value of the Statewide DVMT.

The calculation of the confidence level for any given allowable error is as follows:

(a) Find either the relative error, CV(Y), of the estimated Statewide DVMT or the relative error, $CV(\bar{y})$, of the Statewide AADT. When calculated, $CV(Y) = CV(\bar{y})$.

$CV(Y) = \text{Error } (Y)/Y$ and $CV(\bar{y}) = \text{Error } (\bar{y})/\bar{y}$

(b) Find the value of Z, a value expressed in standard error units of area under the standard normal curve. Reference to a table of Z-values gives the level of confidence to be expected from the sample estimates for any given allowable error. See Appendix Table J-1.

$Z = \text{allowable error}/CV(Y)$ or $CV(\bar{y})$

EXAMPLE:

A State has 60 counties with a Statewide local rural road mileage of 42,000. 5% of the counties were randomly selected for sampling; (.05)(60) = 3 counties. The data shown below is obtained by following the procedures shown in Chapter VI.

County (a)	Sampling Fraction (f)	Total Local Rural Road Mileage (m)	Number Locations (n) To Sample 1/ (n = fm)	Number Grid Cells To Sample (n/5)
A	.05	360	18	4
B	.05	580	29	6
C	.05	1100	55	11

and,

County	Σ y a	Σ x a
A	64,000	64.0
B	93,240	126.0
C	100,100	143.0
	257,340 = Σ y	333.0 = Σ x

1/Since each cell contains 5 sampling locations, the actual total number of locations to be sampled is the number of cells times five.

The estimated Statewide AADT = $\bar{y} = \Sigma\, y/\Sigma\, x = 257,340/333 = 773$

The estimated Statewide DVMT = $M\,\bar{y} = (42,000)(773) = 32,466,000$

$$\text{Variance } (\bar{y}) = \frac{1 - (.05)(.05)}{(333)^2} \cdot \frac{3}{3-1} \cdot \left[22,809,707,600 - \frac{(257,340)^2}{3} + (773)^2 \left(40,421 - \frac{(333)^2}{3}\right) - 2(773)\left(30,158,540 - \frac{(257,340)(333)}{3}\right)\right]$$

$$= 4416$$

Error of $\bar{y}$ (AADT) = $(4416)^{\frac{1}{2}} = 66.453$

Error of Y (DVMT) = (M)(Error of $\bar{y}$) = (42,000)(66.453) = 2,791,026

Confidence Level (Z) = Allowable Error/CV(Y) or CV($\bar{y}$)

CV(Y) = 2,791,096/32,466,000 = .085
CV($\bar{y}$) = 66.453/773 = .085

Assuming a desired allowable error of 10%, then

$$Z = \frac{0.10}{0.085} = 1.18$$

Referring to the probability distribution table (Appendix Table J-1), when Z=1.18 the area under the normal curve is (.3810) x 2 = .7620, the confidence level, (76 - 10). (Note - the area under the normal curve in the table is multiplied by 2 because both tails of the normal curve are considered in this sample design.) Thus, there is confidence that 76 times out of 100 that the estimated AADT or DVMT is within 10% of the true value.

TABLE J-1

PROBABILITY DISTRIBUTIONS

AREA UNDER STANDARD NORMAL CURVE

$Z=\frac{x}{\sigma}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0159	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4430	.4441
1.6	.4452	.4463	.4474	.4485	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4762	.4767
2.0	.4773	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4865	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4980	.4980	.4981
2.9	.4981	.4982	.4983	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.49865	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.49903	.4991	.4991	.4991	.4992	.4992	.4992	.4993	.4993	.4993
3.2	.49931									
3.3	.49952									

(2) Local Streets in Small Urban Areas - Formulas and Examples

Methods are presented here for calculating Statewide DVMT, the error of the estimated DVMT and AADT, and the confidence level attained by sample estimates of randomly selected small urban areas.

In the Chapter VI section on small urban local streets, procedures are given for the calculation of Statewide estimated AADT and DVMT for each of the two small urban population groups, whereby

(a) $\Sigma\ y$ = the sum of the DVMT's of all sampled sections in a State,

= (Σ y a for small urban unit 1) + (Σ y a for small urban unit 2) + -----, etc.,

(b) $\Sigma\ x$ = the sum of the mileage of all sampled sections in a State,

= (Σ x a for small urban unit 1) + (Σ x a for small urban unit 2) + -----, etc.,

(c) the ratio $\Sigma\ y/\Sigma\ x = \bar{y}$ = the estimated Statewide weighted AADT for small urban local streets in a given population group, and

(d) the Statewide DVMT = $Y = M\ \bar{y} = F\ \Sigma\ y$

where, M = the total Statewide mileage for small urban local streets in a given population group, and $F = M/\Sigma\ x$ = the expansion factor.

Variance and confidence level calculations are similar to those presented in this Appendix, Local Rural Roads, except that these values are initially computed for each of the two small urban population groups.

The Statewide AADT for all small urban streets is a weighted value based on the total local street mileage for both small urban population groups, 5-25 thousand and 25-50 thousand. If the subscripts (1) and (2) represent estimated values for population groups, 5-25 thousand and 25-50 thousand, respectively, the following Statewide values may be calculated:

(a) $\bar{y}_{1+2} = \dfrac{M_1\ \bar{y}_1 + M_2\ \bar{y}_2}{M_1 + M_2}$ = weighted AADT

where, M_1 and M_2 are the total Statewide small urban local street mileages for the population groups (1) and (2), respectively.

(b) $Y_{1+2} = Y_1 + Y_2$ = total small urban local road DVMT

(c) Variance of $\bar{y}_{1+2} = \dfrac{(M_1)^2(\text{Variance of } \bar{y}_1) + (M_2)^2(\text{Variance of } \bar{y}_2)}{(M_1 + M_2)^2}$

(d) Error of $\bar{y}_{1+2}$ = square root of the variance of $\bar{y}_{1+2}$

(e) Error of $Y_{1+2} = (M_1 + M_2)(\text{Error of } \bar{y}_{1+2})$

(f) Confidence Level (Z) = Allowable Error/$CV(Y_{1+2})$ or $CV(\bar{y}_{1+2})$
(See Local Rural Roads in this Appendix for reference to Z- values.)

where, $CV(Y_{1+2})$ = error of Y_{1+2}/Y_{1+2}
$CV(\bar{y}_{1+2})$ = error of $\bar{y}_{1+2}/\bar{y}_{1+2}$

EXAMPLE:

A State has 14 small urban units in the 5-25 thousand population group and 3 small urban units in the 25-50 thousand population group, with Statewide local street mileages of 697 and 424, respectively.

According to the procedure in Chapter VI, 3 small urban units are randomly selected from the 5-25 thousand population group (.20 x 14) (Group 1) and all 3 in the 25-50 thousand population group (Group 2) are sampled. The following data are obtained:

Small Urban Area (a)	Sampling Fraction (f)	Total Local Street Mileage (m)	Number Locations to Sample (n)	Number Grid Cells to Sample (n/5)
		Group 1		
Unit A	0.20	40	30	6
Unit B	0.20	50	40	8
Unit C	0.20	65	50	10
		Group 2		
Unit D	0.10	158	65	13
Unit E	0.10	125	50	10
Unit F	0.10	141	55	11

and

	Σ x a	Σ y a
Group 1		
Unit A	10.0	14,140
Unit B	13.0	19,260
Unit C	14.0	15,750
Totals	$\Sigma x = 37.0$	$49,150 = \Sigma y$
Group 2		
Unit D	20.1	34,710
Unit E	16.5	15,750
Unit F	18.1	28,380
Totals	$\Sigma x = 54.7$	$78,840 = \Sigma y$

(a) 5-25 Thousand Population (Group 1)

Estimated Statewide AADT = $\bar{y} = \Sigma\, y/\Sigma\, x = 49{,}150/37.0 = 1328.38$

Estimated Statewide DVMT = $Y = F\,\Sigma\, y = \frac{M}{\Sigma\, x}\,\Sigma\, y = \frac{697}{37}(49{,}150) = 925{,}839$

$$\text{Variance}(\bar{y}) = \frac{1 - (.20 \times .20)}{(37)^2} \cdot \frac{3}{3-1}\left[(818{,}949{,}700 - \frac{(49{,}150)^2}{3}) + (1328.38)^2(465 - \frac{(37)^2}{3}) - 2(1328.38)(612{,}280 - \frac{(37)(49{,}150)}{3})\right]$$

$$= 13{,}469$$

Error of $\bar{y} = (13{,}469)^{\frac{1}{2}} = 116.056$

Error of $Y = (M)(\text{Error of } \bar{y}) = (697)(116.056) = 80{,}891$

(b) 25-50 Thousand Population (Group 2)

(Note: the Statewide sampling rate $f(sw) = f\,r = (.10)(1.00) = .10$)

Estimated Statewide AADT = $\bar{y} = \Sigma\, y/\Sigma\, x = 78{,}840/54.7 = 1{,}441.32$

Estimated Statewide DVMT = $Y = F\,\Sigma\, y = \frac{M}{\Sigma\, x}\,\Sigma\, y = \frac{424}{54.7}(78{,}840) = 611{,}089$

Variance of $\bar{y} = 46{,}340$

Error of $\bar{y} = (46{,}340)^{\frac{1}{2}} = 215.267$

Error of $Y = (M)(\text{Error of } \bar{y}) = (424)(215.267) = 91{,}273$

(c) Combining Population Groups (1) and (2)

Let the subscripts (1) and (2) define the 5-25 thousand and 25-50 thousand population groups, respectively.

Estimated DVMT $(Y_{1+2}) = Y_1 + Y_2 = 925{,}839 + 611{,}089 = 1{,}536{,}928$

Estimated Statewide AADT = $\bar{y}_{1+2} = \frac{(697)(1328.38) + (424)(1441.32)}{697 + 424}$

$$= 1371$$

Variance of $\bar{y}_{1+2} = \frac{(697)^2(13{,}469) + (424)^2(46{,}340)}{(697 + 424)^2}$

$$= 11{,}836$$

Error of $\bar{y}_{1+2} = (11{,}836)^{\frac{1}{2}} = 108.793$

Error of Y_{1+2} = (697 + 424)(108.793) = 121,956

Confidence Level (Z) = Allowable Error/CV(Y_{1+2}) or CV($\bar{y}_{1+2}$)

where, CV(Y_{1+2}) = 121,956/1,536,928 = .079

CV($\bar{y}_{1+2}$) = 108.793/1371 = .079

Assuming a desired allowable error of 10%, then

$Z = \frac{.10}{.079}$ = 1.27 or a confidence level of .80, (80-10)

(3) Local Streets in Individual Urbanized Areas - Formulas and Examples

According to Chapter VI, the local streets in each individual urbanized area in a State are sampled. The procedures for the calculation of urbanwide AADT, DVMT, and the confidence level of the estimates for an individual urbanized area are similar to those for rural and small urban areas, except that the formula reference is made to the randomly selected grid cells of the grid matrix for the urbanized area rather than to the selected counties or small urban units.

The following definitions, procedures, and formulas are used for computing the statistical parameters for an individual urbanized area:

(a) $\Sigma\ y\ a$ = the sum of the products of the AADT and the section length for each of the five sample locations contained in each sampled grid cell, per the procedure in Chapter VI.

(b) $\Sigma\ x\ a$ = the sum of the section lengths for each of the five sample locations contained in each sampled grid cell, per the procedure in Chapter VI.

(c) $\Sigma\ y$ = the sum of the $\Sigma\ y\ a$ values for the sampled grid cells in an individual urbanized area.

(d) $\Sigma\ x$ = the sum of the $\Sigma\ x\ a$ values for the sampled grid cells in an individual urbanized area.

(e) $\bar{y}_i = \Sigma\ y / \Sigma\ x$ = the weighted AADT for the local streets in an individual urbanized area.

(f) $Y_i = M_i \bar{y}_i = F\ \Sigma\ y$ = the estimated DVMT for an individual urbanized area, where M_i = the total local street mileage in the area, and $F = M_i / \Sigma\ x$ = the expansion factor.

(g) $$\text{Variance } (\bar{y}_i) = \frac{1 - f}{(\Sigma\ x)^2} \cdot \frac{a}{a - 1} \left[(\Sigma\ y^2\ a - \frac{(\Sigma\ y)^2}{a}) + (\bar{y}_i)^2 (\Sigma\ x^2\ a - \frac{(\Sigma\ x)^2}{a}) - 2\ \bar{y}_i\ (\Sigma\ y\ a\ x\ a - \frac{(\Sigma\ y)(\Sigma\ x)}{a}) \right]$$

where,

f = the sampling rate for the urbanized area according to population group (Table VI-1). (Note: Since each urbanized area in a State is sampled, a Statewide sampling rate "r" is not used.)

a = the number of grid cells sampled in an urbanized area grid matix

$\Sigma\ y\ a$, $\Sigma\ y$, $\Sigma\ x\ a$, $\Sigma\ x$, and $\bar{y}_i$ are previously defined.

(h) Error of $\bar{y}_i$ = Square root of the variance $(\bar{y}_i)$

(i) Error of $Y_i = (M_i)$(Error of $\bar{y}_i$)

(j) Confidence Level (Z) = Allowable Error/CV(Y_i) or CV($\bar{y}_i$)

where, CV(Y_i) = Error of Y_i/Y_i
and, CV($\bar{y}_i$) = Error of $\bar{y}_i/\bar{y}_i$

If a State has two or more individual urbanized areas, the samples for each area are combined for statewide urbanized area statistics as follows:

(a) Statewide weighted AADT = $\bar{y} = \frac{\Sigma M_i \bar{y}_i}{\Sigma M_i}$

where, the above numerator is the sum of the products of each individual area total local street mileage times its average AADT; and, the denominator is the total Statewide urbanized local street mileage.

(b) Statewide estimated DVMT = $Y = \Sigma Y_i$, which is the sum of the estimated DVMT for all individual urbanized areas.

(c) Statewide variance $(\bar{y}) = \frac{\left[\Sigma (M_i)^2 (\text{Variance } \bar{y}_i)\right]}{(\Sigma M_i)^2}$

where, the above numerator is the sum of the products of each individual area total local street mileage squared times its AADT variance; and, the denominator is the total Statewide urbanized local street mileage squared.

(d) Error of $\bar{y}$ = Square root of variance $(\bar{y})$

(e) Error of Statewide DVMT = Error of Y = (M)(Error of $\bar{y}$)

where, M is the Statewide mileage for urbanized area local streets.

(f) Confidence Level (Z) = Allowable Error/CV(Y) or CV($\bar{y}$)

where, CV(Y) = Error of Y/Y
and, CV($\bar{y}$) = Error of $\bar{y}/y$

EXAMPLES:

It is decided to sample the local streets in an individual urbanized area "A" with 75 thousand population at a sampling rate of 2.5%, instead of 5%. The total local street mileage for the area is 300 miles. The number of sampling locations (n), according to formula, is .025 x 300/.25 or 30. The number of grid cells to be randomly sampled from the urban grid matrix is 30/5 or 6. The exhibit, which follows, shows the sample data needed to compute estimated AADT, DVMT, and sampling error. The documentaiton of pavement type and width is intentionally omitted.

Individual Urbanized Area "A"

Random Cell Number (1)		Random Section Within Cell (2)	AADT (3)	Section Length (M_i) (4)	DVMT (3) x (4) (5)
1		a	500	0.3	150
		b	800	0.5	400
		c	400	0.3	120
		d	500	0.5	250
		e	1400	0.5	700
	Subtotals			Σ x a = 2.1	1620 = Σ y a
2		a	1800	0.3	540
		b	1300	0.5	650
		c	400	0.4	160
		d	900	0.1	90
		e	500	0.3	150
	Subtotals			Σ x a = 1.6	1590 = Σ y a
3		a	2500	0.5	1250
		b	2400	0.5	1200
		c	700	0.1	70
		d	700	0.4	280
		e	900	0.3	270
	Subtotals			Σ x a = 1.8	3070 = Σ y a
4		a	3300	0.4	1320
		b	4200	0.4	1680
		c	400	0.1	40
		d	300	0.3	90
		e	300	0.1	30
	Subtotals			Σ x a = 1.3	3160 = Σ y a
5		a	6500	0.5	3250
		b	600	0.5	300
		c	400	0.2	80
		d	300	0.4	120
		e	400	0.5	200
	Subtotals			Σ x a = 2.1	3950 = Σ y a
6		a	1100	0.2	220
		b	900	0.1	90
		c	500	0.4	200
		d	900	0.2	180
		e	300	0.2	60
	Subtotals			Σ x a = 1.1	750 = Σ y a
	Total			Σ x = 10.0	14,140 = Σ y

Referring to the aforementioned formulas,

Estimated AADT = $\bar{y}_i = \Sigma y / \Sigma x = 14,140/10.0 = 1,414$

Estimated DVMT = $Y_i = F \Sigma y = \frac{M_i}{\Sigma x} \cdot \Sigma y = \frac{300}{10} \cdot 14,140 = 424,200$

$$\text{Variance } (\bar{y}_i) = \frac{1 - .025}{(10)^2} \cdot \frac{6}{6-1} \left[(40,728,000 - \frac{(14,140)^2}{6}) + (1414)^2 (17.52 - \frac{(10)^2}{6}) - 2(1414)(24,700 - \frac{(10)(14,140)}{6}) \right]$$

$$= 69,114$$

where, in the formula,

$\Sigma y^2 a = (1620)^2 + (1590)^2 + - - - + (750)^2 = 40,728,000$

$\Sigma x^2 a = (2.1)^2 + (1.6)^2 + - - - + (1.1)^2 = 17.520$

$\Sigma y a x a = (1620)(2.1) + (1590)(1.6) + - - - + (750)(1.1) = 24,700$

Error of $\bar{y}_i$ = square root of 69,114 = 262.895

Error of $Y_i = (300)(262.895) = 78,869$

Confidence Level (Z):

$CV(\bar{y}_i) = 262.895/1414 = .185$

$CV(Y_i) = 78,869/424,200 = .185$

If the desired allowable error is 10%, then

$Z = .10/.185 = .540$ or a confidence level of .41, (41-10)

Combining Individual Urbanized Areas

Assuming that the given State has three individual urbanized areas - A, B, and C, the following data are obtained:

Urbanized Area	Total Local Street Mileage (M_i)	Estimated Urbanwide AADT ($\bar{y}_i$)	Variance of the AADT (Var $\bar{y}_i$)	Estimated Urbanwide DVMT (Y_i)
A	300	1414	69114	424,200
B	900	800	14400	720,000
C	500	900	8100	450,000
	1700 = M			1,594,200 = Y

The calculations for Statewide urbanized statistics are:

$$\text{Weighted AADT} = \bar{y} = \frac{(300)(1414) + (900)(800) + (500)(900)}{1700}$$

$$= 938$$

$$\text{Estimated DVMT} = Y = \Sigma Y_i = 1,594,200$$

$$\text{Variance } (\bar{y}) = \frac{(300)^2(69114) + (900)^2(14400) + (500)^2(8100)}{(1700)^2}$$

$$= 6889$$

Error of $\bar{y}$ = square root of 6889 = 83

Error of Y = (1700)(83) = 141,100

Confidence Level (Z)

$CV(\bar{y}) = 83/938 = .088$
$CV(Y) = 141,100/1,594,200 = .088$

If the desired allowable error is 10%, then

$Z = .10/.088 = 1.14$ or a confidence level of .75, (75-10)

(4) Local Roads and Streets - Sample Errors and Precision Levels for Proportions

The reporting of physical features on local road sample sections is limited to surface/pavement type and width in the sample section portion of the record format. Methods for calculating local road Statewide AADT and DVMT are presented in Chapter VI and in the preceding sections of this Appendix. The surface/pavement type and width data items can be expressed in the form of proportions -- e.g., the proportion (percentage) of graded road mileage to total mileage, or the proportion of roads under 16 feet in width. Since a proportion must be estimated from road section samples, its value ($\bar{p}$) is expressed as the ratio of the summed sample mileage having a given attribute (graded roads) to total sampled mileage.

Thus, let the proportion

$$\bar{p} = \Sigma\, y / \Sigma\, x$$

$$= y\,a\,(1) + y\,a\,(2) + \text{------}y\,a\,(n) / x\,a\,(1) + x\,a\,(2) + \text{------}x\,a\,(n)$$

where,

$\Sigma\, y$ = the summed sampled mileage having a specified attribute of a data item.

$y\,a$ = (1) For Statewide rural or small urban area estimates: the sampled mileage in an individual county or small urban area having the specified attribute of a data item.

or

(2) For an individual urbanized area estimate: the sampled mileage having the specified attribute of a data item as contained in an individual grid cell of the urbanized area and grid matrix.

$\Sigma\, x$ = the total sampled mileage.

$x\,a$ = (1) For Statewide rural or small urban area estimates: the total sampled mileage in an individual county or small urban area.

or

(2) For an individual urbanized area: the total sampled mileage contained in an individual grid cell of the urbanized area grid matrix.

The reliability of the estimated proportion ($\bar{p}$) is calculated as follows:

(a) Variance of $\bar{p}$

$$= \frac{1 - F}{(\Sigma\, x)^2} \cdot \frac{a}{a - 1} \left[\left(\Sigma\, y^2\, a - \frac{(\Sigma\, y)^2}{a} \right) + \bar{p}^2 \left(\Sigma\, x^2\, a - \frac{(\Sigma\, x)^2}{a} \right) - 2\,\bar{p} \left(\Sigma\, y\, a\, x\, a - \frac{(\Sigma\, y)(\Sigma\, x)}{a} \right) \right]$$

where,

F (for rural and small urban estimates) = f r and f is the sampling rate in Table VI-1 and r is the ratio of the number of counties sampled to the total number of counties in a State; or, r is the ratio of the number of small urban areas sampled to the total small urban areas in a State for a given small urban population group.

or

F (for an individual urbanized area) = f, the population sampling rate in Table VI-1 or any other desired sampling rate.

a (for rural and small urban estimates) = total number of counties or small urban units sampled.

or

a (for an individual urbanized area) = total number of grid cells sampled in an urbanized area matrix.

Σ y, Σ x, y a, x a, and $\bar{p}$ have been defined above.

(b) The error of $\bar{p}$ = square root of the variance of $\bar{p}$

(c) Find the value of Z, the normal variate and confidence level determinant, where

Z = desired allowable error/CV($\bar{p}$)
and CV($\bar{p}$) = Error of $\bar{p}/\bar{p}$

(d) Refer to Table J-1, Table of Probability Distributions, for the confidence level of Z. (See the example in the Local Rural Roads Section of this Appendix for confidence level determination from Z-values.)

When population groups must be combined for Statewide values, as in the case of small urban areas and individual urbanized areas, the Statewide value of $\bar{p}$ is determined by weighting with population group mileages. Thus,

(a) Statewide $\bar{p} = \Sigma M_i \bar{p}_i / \Sigma M_i$

where, $\Sigma M_i \bar{p}_i$ = Sum of the products of the total local road mileage of each population group times its respective value of $\bar{p}$;

and, ΣM_i = Total local road mileage for all applicable population groups in the State.

(b) Variance of the Statewide $\bar{p}$

$= \Sigma\ (M_i)^2(\text{Variance } \bar{p}_i)/\Sigma\ (M_i)^2$

where, the variance $\bar{p}_i$ refers to each individual population group and M_i is the total local road mileage for each applicable population group.

(c) Error of the Statewide $\bar{p}$ is the square root of variance of Statewide $\bar{p}$.

(d) Relative error of Statewide $\bar{p}$ = CV(Statewide $\bar{p}$)

= Error of Statewide $\bar{p}$/Statewide $\bar{p}$)

(e) Value of Z = Desired allowable Error/CV(Statewide $\bar{p}$)

(f) The estimated Statewide mileage for a specific attribute is the product of the value of $\bar{p}$ times the total Statewide mileage.

EXAMPLES:

Referring to the sample data in the example in the Appendix section, Local Streets in Small Urban Areas, estimate the proportion ($\bar{p}$) of small urban local gravel roads in a State, using the data shown below:

Small Urban Area (a)	Total Street Mileage (m)	Sampled Mileage (x a)	Gravel Street Mileage (y a)
	Group (1) - 5-25 thousand pop.		
Unit A	40	10	2
Unit B	50	12	3
Unit C	65	14	1
		36 = Σ x	6 = Σ y
	Σ y/Σ x = $\bar{p}_1$ = 6/36 = .167		
Unit D	158	20	2
Unit E	125	15	1
Unit F	141	16	4
		51 = Σ x	7 = Σ y
	Σ y/Σ x = $\bar{p}_2$ = 7/51 = .137		

An analysis of the reliability of these proportions follows:

$$\text{Variance of } \bar{p}_1 = \frac{1 - (.20)(.20)}{(36)^2} \cdot \frac{3}{3-1} \left[(2^2 + 3^2 + 1^2 - \frac{(6)^2}{3}) + (.167)^2(10^2 + 12^2 + 14^2 - \frac{36^2}{3}) - 2(.167)(2 \times 10 + 3 \times 12 + 1 \times 14 - \frac{3 \times 36}{3}) \right]$$

$$= 0.001111 \left[2 + 0.223112 + 0.668 \right]$$

$$= .003212$$

Similarly, variance of $\bar{p}_2 = 0.002558$

Error of $\bar{p}_1 = 0.056675$

Error of $\bar{p}_2 = 0.050577$

$CV(\bar{p}_1) = 0.056675/0.167 = 0.34$

$CV(\bar{p}_2) = 0.050577/0.137 = 0.37$

Z for $\bar{p}_1$ for 10% allowable error = 0.10/0.34 = .29
precision level = (23-10)

Z for $\bar{p}_2$ for 10% allowable error = 0.10/0.37 = .27
precision level = (21-10)

Combining the two small urban population groups:

Statewide $\bar{p} = (697)(.167) + (424)(.137)/1121$

$= .155$

Variance of Statewide $\bar{p} = (697)^2(.003212) + (424)^2(.002558)/(697 + 424)^2$

$= 0.001607$

Error of Statewide $\bar{p} = 0.040$

CV(Statewide $\bar{p}$) = 0.040/0.155 = 0.26 = relative error

Z for $\bar{p}$ for 10% allowable error = 0.10/0.26 = .38
precision level = (30-10)

Total Statewide mileage having gravel local roads = (.155)(697 + 424) = 174 miles

(Note: A similar procedure is applied when combining the proportionate values of individual urbanized areas to a Statewide level.)

(5) Local Roads - Number of Clusters Required for a Desired Design Precision Level

The term "Number of Clusters" in the above title refers to the number of counties, small urban areas, or grid cells in an urbanized area grid matrix to be randomly sampled. This section of Appendix J presents a method for determining the precision level of an existing cluster sample data base, and in addition, the number of sample clusters required to upgrade sampling accuracy to desired precision levels. The term "precision level" used here 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 70 percent confidence in an allowable error of 15 percent (70-15), there is a probability of 70 times out of 100 that the error of the estimate will be no greater or less than 15 percent of its true value. The determination of the number of sample clusters needed for a desired design precision level requires beforehand an existing sample data base to supply the necessary statistical parameters for further calculations.

The basic formula showing the number, (a), of required sample clusters as a function of cluster AADT variance and precision level determinants is:

$$a = Z^2(s\ g/\bar{y})^2/e^2$$

where,

a = the design number of clusters needed for a desired precision level of accuracy.

Z = the normal variate for the desired confidence level; e.g., Z = 1.29 for 80 percent and 1.04 for 70 percent confidence levels.

s g = the standard deviation of the individual cluster AADT's about the sample average AADT.

= the square root of (a_o)(variance of $\bar{y}$)

a_o = the number of sample clusters in the existing data base.

Variance of $\bar{y}$ = this is derived from the formulas shown in the preceding sections of this Appendix.

CVC = s $g/\bar{y}$ = the coefficient of variation of the clusters; also, the relative error of the clusters. The computation of $\bar{y}$, the weighted sample AADT, is given in Chapter VI and preceding sections of this Appendix.

e = the desired allowable error expressed as a percent. Thus, 10 percent = 0.10.

The computation for the required number of clusters, (a), is simplified by referencing the base data value of CVC, the relative error of the cluster AADT's, to the x-axis of the graph in Appendix Figure J-1. The graph is derived from the above formula and has curves for four levels of precision. As mentioned previously, the graph is also useful in approximating the accuracy level of an existing sample data base.

EXAMPLES:

Referring to the sample data in the example in the Appendix section, Local Streets in Small Urban Areas, the 5-25 thousand population group, find the number (a) of small urban areas required to achieve a design precision level of (80-10). The following data are available: $Z = 1.29$; $a_o = 3$; variance of $y = 13{,}469$; $\bar{y} = 1328.38$; and $e = 0.10$.

The cluster variance, $s^2 g = (a_o)$(variance of $\bar{y}$)
$= (3)(13{,}469)$
$= 40{,}407$

$s\ g$ = square root of $40{,}407 = 201.015$

Then, the required number of small urban area units,

$a = (1.29)^2(201.015/1328.38)^2/(.10)^2$
$= 3.8$ or 4

Reference to the graph (Figure J-1) requires the calculation of the clusters relative error, CVC. Here, CVC = $s\ g/\bar{y} = 201.015/1328.38 = .15$. Relating the value .15 to the x-axis of the graph shows that 4 sample clusters (small urban areas) are required to maintain a (80-10) precision level. This closely matches the above computation method with 3.8 clusters.

In the same example, the value of CVC for the 25-50 thousand population group sample of three small urban areas is .26. On the graph, this value on the x-axis closely intercepts the (70-15) curve at the 3 cluster level on the y-axis. Since the State has in the example just three small urban areas in this population group, any further improvement in accuracy better than the (70-15) precision level will have to be accomplished by increasing the sampling rate (f) in the three areas. This is accomplished by either increasing the number of sample grid cells in each of the small urban areas, or increasing the number of sample locations per sample grid cell to greater than 5.

In another example, reference is made to the example in the Appendix section, Local Streets in Individual Urbanized Areas, where the number of grid cells $(a_o) = 6$, variance of $y = 69{,}114$, and $\bar{y} = 1414$. By calculation, $s\ g = 643.96$ and CVC = .46. The number (a) of sampled grid cells required to achieve a design precision level of (80-10) is:

(1) by computation,

$a = (1.29)^2(643.96/1414)^2/(.10)^2 = 34.5$ or 35 grid cells

and (2) by the graphic method,

$$a = 35 \text{ grid cells when } CVC = s\, g/\bar{y} = .46$$

Referring again to the graph, the existing data base, when CVC = .46, has a precision level of about (70-20). This is equivalent to the (41-10) precision level cited in the example in the appendix section on individual urbanized areas.

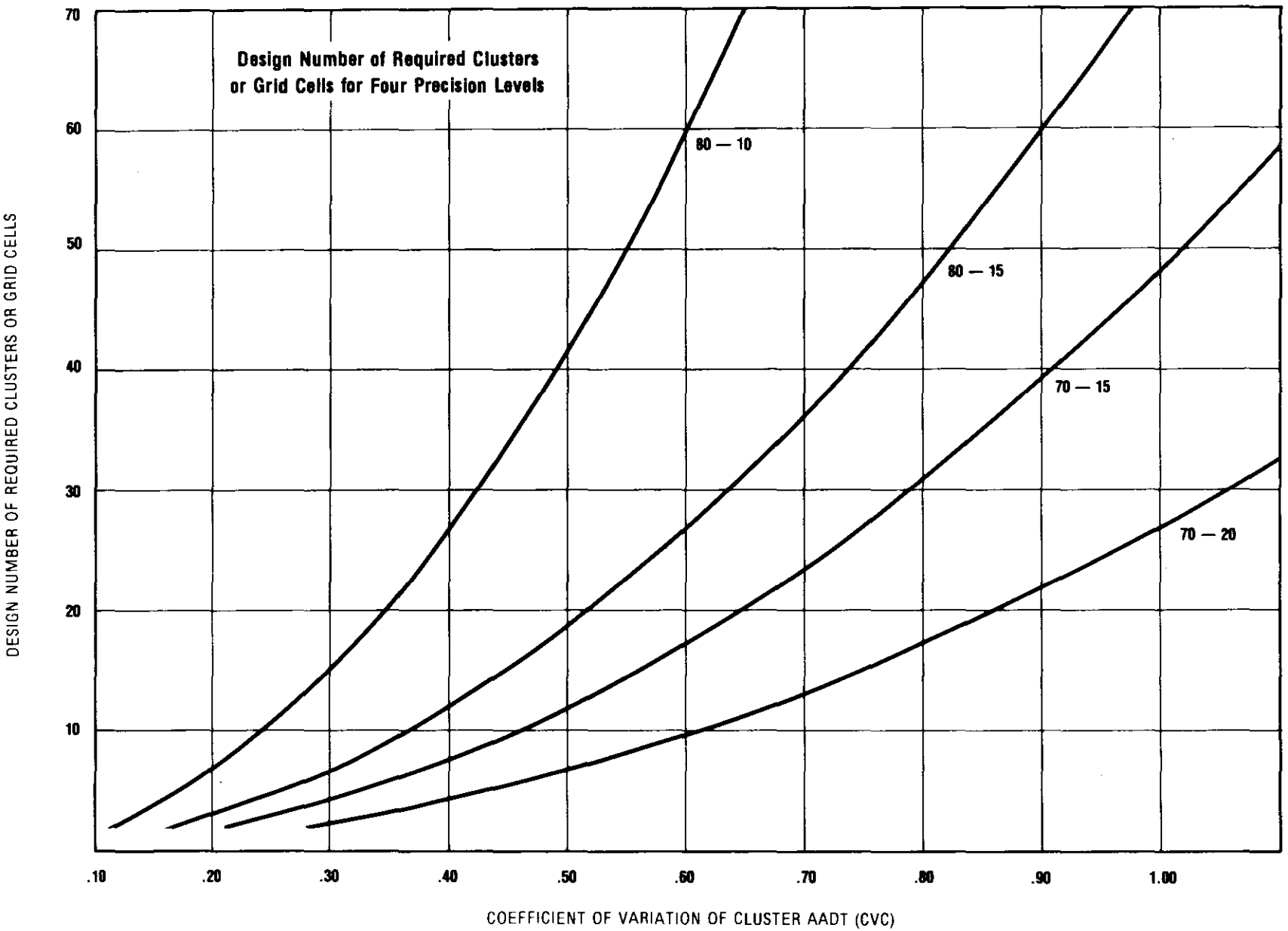

Design Number of Required Clusters
or Grid Cells for Four Precision Levels
80 — 10
80 — 15
70 — 15
70 — 20
70
60
50
40
30
20
10
.10
.20
.30
.40
.50
.60
.70
.80
.90
1.00
DESIGN NUMBER OF REQUIRED CLUSTERS OR GRID CELLS
COEFFICIENT OF VARIATION OF CLUSTER AADT (CVC)

Figure J-1

APPENDIX K

Creating a Card-Image File

As indicated in Chapter VII, an alternative to building the data tape directly into its final format is to code 80-column computer cards (or a card-image file), and utilize the FHWA-provided software to build the dataset in its final format.

There are from one to twenty-nine possible cards per section record depending on the type of section being coded. These consist of eleven card-types (Card #'s) as described below. Chapter IV and/or the Card Format Summary ahead should be referenced for the length of the Items to be coded on each card.

Card # Placed In Cols. 79-80 Right-Justified	Items Coded	Card Columns	Discussion
01	1-26	1-65	Coded for all sections (Universe and Sample)
02	28-33	27-50 where 1-26 are same as card #01	Coded in addition to card 01 for Local and Arterial/Collector Sample Sections
03	34-47 plus 48a-48c	27-73 where 1-26 are same as card #01	Coded in addition to cards 01-02 for Arterial/Collector Sample Sections
04	48d-48j	27-75 where 1-26 are same as card #01	Coded in addition to cards 01-03 for Arterial/Collector Sample Sections
05	48k-49	27-48 where 1-26 are same as card #01	Coded in addition to cards 01-04 for Arterial/Collector Sample Sections

Card # Placed In Cols. 79-80 Right-Justified	Items Coded	Card Columns	Discussion
06	50-53	27-75 where 1-26 are same as card #01	Coded in addition to cards 01-05 for Arterial/Collector Sample Sections
07	54-70	27-74 where 1-26 are same as card #01	Coded in addition to cards 01-06 for Arterial/Collector Sample Sections
08	71	27-71 where 1-26 are same as card #01	Coded in addition to cards 01-07 only when an Arterial/Collector Sample Section contains structure ID's. As many as 17 of cards # 08 may be coded, as needed, for up to the maximum of 50 structure ID's
09	72	27-75 where 1-26 are same as card #01	Coded in addition to cards 01-07 only when an Arterial/Collector Sample Section contains railroad crossing ID's. As many as 3 of cards # 09 may be coded, as needed, for up to the maximum of 15 railroad crossing ID's
10	73-74	27-63 where 1-26 are same as card #01	Coded in addition to cards 01-07 only when improvements take place on an Arterial/Collector Sample Section.
11	75	27-49 where 1-26 are same as card #01	Coded in addition to cards 01-07 only when accidents are included for an Arterial/Collector Sample Section.

CARD FORMAT SUMMARY

The following presents the card format for the universe and sample section data. There are eleven card types (each identified by a unique card number) that may be coded as indicated previously.

Under the columns headed "Required Items", an asterisk (*) indicates that the item is required for the type of section being reported. The card number is shown in the left column of the summary table, below, and is coded in columns 79-80, right-justified. Note that Items 1-7 (Columns 1-26) are identical for all card types pertaining to the same section. The following abbreviations are used:

Universe Int - Report these items for all Interstate sections.
Universe Sec - Report these items for all universe sections.
Universe Grp - Report these items for grouped data ensuring that all data is homogeneous across all mileage being combined.
Sample Loc - Report these items for all local sample sections.
Sample Art - Report these items for all arterial (including Interstate samples) and collector sample sections.

Universe Data

Card #	Item No.	Card Col.	Length	Required Items: Universe: Int	Universe: Sec	Universe: Grp	Sample: Loc	Sample: Art	Data Item
									Identification
1	1	1-2	2	*	*	*	*	*	Year
1	2	3-4	2	*	*	*	*	*	State code
1	3	5-7	3	*	*	*	*	*	County code
1	4	8	1	*	*	*	*	*	Rural/Urban Designation
1	5	9-13	5	*	*	*	*	*	Urban Area Code
1	6	14	1	*	*	*	*	*	Type of Section/Grouped
1	7	15-26	12	*	*	*	*	*	Section/Grouped Data Identification
									System
1	8	27-28	2	*	*	*	*	*	Functional Class
1	9	29	1	*	*	*	*	*	Federal-Aid System
1	10	30	1	*	*	*	*	*	Federal-Aid System Status
1	11	31	1	*	*		*	*	Route Signing
1	12	32-36	5	*	*		*	*	Route Number
1	13	37	1	*	*	*	*	*	Public Road
									Jurisdiction
1	14	38-39	2	*	*	*	*	*	Governmental Level of Control
1	15	40	1	*	*	*	*	*	Administrative Classification
1	16	41-42	2	*	*	*	*	*	Federal, State, and Local Domain
1	17	43-44	2	*	*	*	*	*	Special Systems
									Operation
1	18	45	1	*	*	*	*	*	Type of Facility
1	19	46	1	*	*	*	*	*	Reversible Lanes/ Roadway
1	20	47	1	*	*	*	*	*	Trucks/Commercial Vehicles
1	21	48	1	*	*	*	*	*	Special HOV Lanes
1	22	49	1	*	*	*	*	*	Toll
									Travel/Special Data
1	23	50-55	6	*	*	*	*	*	Section/Group Length
1	24	56-61	6	*				*	AADT (Optional for all other sections)
1	25	62-63	2	*				*	Number of Interstate lanes open to traffic 5 or more years
1	26	64-65	2	*				*	Number of lanes
1	--	79-80	2	*	*	*	*	*	Card Number = 01

Sample Data

Card #	Item No.	Card Col.	Length	Required Items: Universe Int	Universe Sec	Universe Grp	Sample Loc	Sample Art	Data Item
									Universe Identification
2	1	1-2	2				*	*	Year
2	2	3-4	2				*	*	State code
2	3	5-7	3				*	*	County code
2	4	8	1				*	*	Rural/Urban Designation
2	5	9-13	5				*	*	Urban Area Code
2	6	14	1				*	*	Type of Section/Grouped Data ID
2	7	15-26	12				*	*	Section/Grouped Data Identification
									Sample Identification
2	28	27-38	12				*	*	Sample Number
2	29	39	1				*	*	Sample Subdivision
									Computational Elements
2	30	40-41	2					*	AADT Volume Group Identifier
2	31	42-46	5				*	*	Expansion Factor
									Pavement
2	32	47-48	2				*	*	Surface/Pavement Type
2	33	49-50	2				*		Surface/Pavement Width
2	--	79-80	2				*	*	Card Number = 02
									Identification
3	1	1-2	2					*	Year
3	2	3-4	2					*	State code
3	3	5-7	3					*	County code
3	4	8	1					*	Rural/Urban Designation
3	5	9-13	5					*	Urban Area Code
3	6	14	1					*	Type of Section/Grouped Data ID
3	7	15-26	12					*	Section/Grouped Data Identification
									Pavement (Cont.)
3	34	27	1					*	Pavement Section
3	35	28-29	2					*	SN or Slab Thickness
3	36	30-31	2					*	Pavement Condition
3	37	32-33	2					*	Skid Resistance (Rural Arterials and Urban Freeways and Expressways including Interstate)

Sample Data (Cont.)

Card #	Item No.	Card Col.	Length	Required Items: Universe Int	Universe Sec	Universe Grp	Sample Loc	Sample Art	Data Item
									Geometrics/ Configuration
3	38	34	1					*	Access Control
3	39	35-36	2					*	Lane Width
3	40	37-39	3					*	Approach Width (Urban only)
3	41	40	1					*	Shoulder Type
3	42	41-44	4					*	Shoulder Width
3	43	45	1					*	Median Type
3	44	46-47	2					*	Median Width
3	45	48-50	3					*	ROW Width
3	46	51	1					*	Widening Feasibility
3	47	52	1					*	Horizontal Alignment Adequacy
3	48	53-73	21					*	Curves by Class (parts a thru c)
3	--	79-80	2					*	Card Number = 03
									Identification
4	1	1-2	2					*	Year
4	2	3-4	2					*	State code
4	3	5-7	3					*	County code
4	4	8	1					*	Rural/Urban Designation
4	5	9-13	5					*	Urban Area Code
4	6	14	1					*	Type of Section/Grouped Data ID
4	7	15-26	12					*	Section/Grouped Data Identification
									Geometrics/ Configuration (Cont.)
4	48	27-75	49					*	Curves by Class (parts d thru j)
4	--	79-80	2					*	Card Number = 04
									Identification
5	1	1-2	2					*	Year
5	2	3-4	2					*	State code
5	3	5-7	3					*	County code
5	4	8	1					*	Rural/Urban Designation
5	5	9-13	5					*	Urban Area Code
5	6	14	1					*	Type of Section/Grouped Data ID
5	7	15-26	12					*	Section/Grouped Data Identification
									Geometrics/ Configuration (Cont.)
5	48	27-47	21					*	Curves by Class (parts k thru m)
5	49	48	1					*	Vertical Alignment Adequacy
5	--	79-80	2					*	Card Number = 05

Sample Data (Cont.)

Card #	Item No.	Card Col.	Length	Required Items: Universe Int	Universe Sec	Universe Grp	Sample Loc	Sample Art	Data Item
									Identification
6	1	1-2	2					*	Year
6	2	3-4	2					*	State code
6	3	5-7	3					*	County code
6	4	8	1					*	Rural/Urban Designation
6	5	9-13	5					*	Urban Area Code
6	6	14	1					*	Type of Section/Grouped Data ID
6	7	15-26	12					*	Section/Grouped Data Identification
									Geometrics/ Configuration (Cont.)
6	50	27-68	42					*	Grades by Class
6	51	69-71	3					*	% Passing Sight Distance (Rural Only)
6	52	72-73	2					*	Speed Limit
6	53	74-75	2					*	Average Highway Speed
6	--	79-80	2					*	Card Number = 06
									Identification
7	1	1-2	2					*	Year
7	2	3-4	2					*	State code
7	3	5-7	3					*	County code
7	4	8	1					*	Rural/Urban Designation
7	5	9-13	5					*	Urban Area Code
7	6	14	1					*	Type of Section/Grouped Data ID
7	7	15-26	12					*	Section/Grouped Data Identification
									Traffic/Capacity
7	54	27-30	4					*	Percent Trucks (Peak and Off-Peak)
7	55	31-32	2					*	K-Factor
7	56	33-35	3					*	Directional Factor
7	57	36-45	10					*	Capacity (Peak and Off-Peak)
7	58	46	1					*	Prevailing Signalization (Urban Only)
7	59	47-48	2					*	Typical Percent Green time (Urban Only)
7	60	49-50	2					*	Parking (Urban Only) (Peak and Off-Peak)
7	61	51-56	6					*	Future AADT

Sample Data (Cont.)

Card #	Item No.	Card Col.	Length	Required Items: Universe Int	Universe Sec	Universe Grp	Sample Loc	Sample Art	Data Item
									Environment
7	62	57	1					*	Drainage Adequacy
7	63	58	1					*	Type of Terrain (Rural only)
7	64	59	1					*	Type of Development
7	65	60	1					*	Urban Location
7	66	61-62	2					*	No. of Grade Separated Interchanges
7	67	63-68	6					*	No. of At-Grade Intersections
7	68	69-70	2					*	No. of Major Commercial/ Recreational/ Industrial Access Points
7	69	71-72	2					*	No. of Structures
7	70	73-74	2					*	No. of At-Grade Railroad Crossings
7	--	79-80	2					*	Card Number = 07
									Identification
8	1	1-2	2					*	Year
8	2	3-4	2					*	State code
8	3	5-7	3					*	County code
8	4	8	1					*	Rural/Urban Designation
8	5	9-13	5					*	Urban Area Code
8	6	14	1					*	Type of Section/Grouped Data ID
8	7	15-26	12					*	Section/Grouped Data Identification
									Supplemental Data
8	71	27-71	15 x Item 69					*	Structure Identification Numbers (3 per card)
8	--	79-80	2					*	Card Number = 08

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Sample Data (Cont.)

Card #	Item No.	Card Col.	Length	Required Items: Universe Int	Universe Sec	Universe Grp	Sample Loc	Sample Art	Data Item
									Identification
9	1	1-2	2					*	Year
9	2	3-4	2					*	State code
9	3	5-7	3					*	County code
9	4	8	1					*	Rural/Urban Designation
9	5	9-13	5					*	Urban Area Code
9	6	14	1					*	Type of Section/Grouped Data ID
9	7	15-26	12					*	Section/Grouped Data Identification
									Supplemental Data (Cont.)
9	72	27-75	7 x Item 70					*	At-grade Railroad Crossing Identification Numbers (7 per card)
9	--	79-80	2					*	Card Number = 09
									Identification
10	1	1-2	2					*	Year
10	2	3-4	2					*	State code
10	3	5-7	3					*	County code
10	4	8	1					*	Rural/Urban Designation
10	5	9-13	5					*	Urban Area Code
10	6	14	1					*	Type of Section/Grouped Data ID
10	7	15-26	12					*	Section/Grouped Data Identification
									Supplemental Data (Cont.)
10	73	27-28	2					*	Type of Improvement
10	74	29-63	35					*	Capital Improvement Costs
10	--	79-80	2					*	Card Number = 10
									Identification
11	1	1-2	2					*	Year
11	2	3-4	2					*	State code
11	3	5-7	3					*	County code
11	4	8	1					*	Rural/Urban Designation
11	5	9-13	5					*	Urban Area Code
11	6	14	1					*	Type of Section/Grouped Data ID
11	7	15-26	12					*	Section/Grouped Data Identification
									Supplemental Data (Cont.)
11	75	27-49	23					*	Accident Data
11	--	79-80	2					*	Card Number = 11

HHP-12 / 8-80 (3M)